

MELFA

Industrial Robot

Standard Specifications Manual

RV-4A/5AJ/3AL/4AJL Series (CR2-532 Controller)

Safety Precautions

Always read the following precautions and the separate "Safety Manual" before starting use of the robot to learn the required measures to be taken.

CAUTION

All teaching work must be carried out by an operator who has received special training. (This also applies to maintenance work with the power source turned ON.)
→ Enforcement of safety training

CAUTION

For teaching work, prepare a work plan related to the methods and procedures of operating the robot, and to the measures to be taken when an error occurs or when restarting. Carry out work following this plan. (This also applies to maintenance work with the power source turned ON.)
→ Preparation of work plan

WARNING

Prepare a device that allows operation to be stopped immediately during teaching work. (This also applies to maintenance work with the power source turned ON.)
→ Setting of emergency stop switch

CAUTION

During teaching work, place a sign indicating that teaching work is in progress on the start switch, etc. (This also applies to maintenance work with the power source turned ON.)
→ Indication of teaching work in progress

WARNING

Provide a fence or enclosure during operation to prevent contact of the operator and robot.
→ Installation of safety fence

CAUTION

Establish a set signaling method to the related operators for starting work, and follow this method.
→ Signaling of operation start










CAUTION

As a principle turn the power OFF during maintenance work. Place a sign indicating that maintenance work is in progress on the start switch, etc.
→ Indication of maintenance work in progress

CAUTION

Before starting work, inspect the robot, emergency stop switch and other related devices, etc., and confirm that there are no errors.
→ Inspection before starting work

The points of the precautions given in the separate "Safety Manual" are given below.
Refer to the actual "Safety Manual" for details.

-  **CAUTION** Use the robot within the environment given in the specifications. Failure to do so could lead to a drop or reliability or faults. (Temperature, humidity, atmosphere, noise environment, etc.)
-  **CAUTION** Transport the robot with the designated transportation posture. Transporting the robot in a non-designated posture could lead to personal injuries or faults from dropping.
-  **CAUTION** Always use the robot installed on a secure table. Use in an instable posture could lead to positional deviation and vibration.
-  **CAUTION** Wire the cable as far away from noise sources as possible. If placed near a noise source, positional deviation or malfunction could occur.
-  **CAUTION** Do not apply excessive force on the connector or excessively bend the cable. Failure to observe this could lead to contact defects or wire breakage.
-  **CAUTION** Make sure that the workpiece weight, including the hand, does not exceed the rated load or tolerable torque. Exceeding these values could lead to alarms or faults.
-  **WARNING** Securely install the hand and tool, and securely grasp the workpiece. Failure to observe this could lead to personal injuries or damage if the object comes off or flies off during operation.
-  **WARNING** Securely ground the robot and controller. Failure to observe this could lead to malfunctioning by noise or to electric shock accidents.
-  **CAUTION** Indicate the operation state during robot operation. Failure to indicate the state could lead to operators approaching the robot or to incorrect operation.
-  **WARNING** When carrying out teaching work in the robot's movement range, always secure the priority right for the robot control. Failure to observe this could lead to personal injuries or damage if the robot is started with external commands.
-  **CAUTION** Keep the jog speed as low as possible, and always watch the robot. Failure to do so could lead to interference with the workpiece or peripheral devices.
-  **CAUTION** After editing the program, always confirm the operation with step operation before starting automatic operation. Failure to do so could lead to interference with peripheral devices because of programming mistakes, etc.
-  **CAUTION** Make sure that if the safety fence entrance door is opened during automatic operation, the door is locked or that the robot will automatically stop. Failure to do so could lead to personal injuries.
-  **CAUTION** Never carry out modifications based on personal judgments, or use non-designated maintenance parts.
Failure to observe this could lead to faults or failures.
-  **WARNING** When the robot arm has to be moved by hand from an external area, do not place hands or fingers in the openings. Failure to observe this could lead to hands or fingers catching depending on the posture.
-  **CAUTION** Do not stop the robot or apply emergency stop by turning the robot controller's main power OFF.
If the robot controller main power is turned OFF during automatic operation, the robot accuracy could be adversely affected.

■ Revision history

| Date of print | Specifications No. | Details of revisions |
|---------------|--------------------|---|
| 1999-10-05 | BFP-A8026Z | · First print |
| 1999-11-15 | BFP-A8026 | · Error in writing correction. |
| 1999-11-25 | BFP-A8026-A | · The source I/O was added. · Error in writing correction. |
| 2000-04-27 | BFP-A8026-B | · Error in writing correction. |
| 2001-03-21 | BFP-A8026-C | · Error in writing correction. |
| | | |

■ Introduction

This series is a vertical articulated compact robot, based on the <EN Series> that has been greatly upgraded in terms of performance, functions and reliability on the principle of "replacement for people" to answer to personal needs.

Various variations including mass capacities between 3kg and 5kg, 5-axis type, 6-axis type, and clean specifications are available.

However, to comply with the target application, a work system having a well-balanced robot arm, peripheral devices or robot and hand section must be structured.

When creating these standard specifications, we have edited them so that the Mitsubishi robot's characteristics and specifications can be easily understood by users considering the implementation of robots. However, if there are any unclear points, please contact your nearest Mitsubishi branch or dealer.

Mitsubishi hopes that you will consider these standard specifications and use our robots.

In this manual, the specifications regarding the robot arm are given in [Page 5, "2 Robot arm"](#) and following, and the specifications regarding the controller are given in [Page 47, "3 Controller"](#) and following. Refer to the corresponding sections for details on the specifications, options and maintenance parts, etc.

The contents of this manual correspond to the following robot models.

- | | |
|---------|--------------|
| <Model> | • RV-4A |
| | • RV-4AC-SA |
| | • RV-4AC-SB |
| | • RV-5AJ |
| | • RV-5AJ-SA |
| | • RV-5AJ-SB |
| | • RV-3AL |
| | • RV-3AL-SA |
| | • RV-3AL-SB |
| | • RV-4AJL |
| | • RV-4AJL-SA |
| | • RV-4AJL-SB |

Note:

- No part of this manual may be reproduced by any means or in any form, without prior consent from Mitsubishi.
 - The contents of this manual are subject to change without notice.
 - The specifications values are based on Mitsubishi standard testing methods.
 - The information contained in this document has been written to be accurate as much as possible. Please interpret that items not described in this document "cannot be performed."
- Please contact your nearest dealer if you find any doubtful, wrong or skipped point.

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1 General configuration

1.1 Structural equipment

Structural equipment consists of the following types.

1.1.1 Standard structural equipment

The following items are enclosed as a standard.

- (1) Robot arm
- (2) Controller
- (3) Machine cable
- (4) Robot arm installation bolts
- (5) Instruction manual, Safety manual
- (6) Guarantee card

1.1.2 Shipping special specifications

Part of the standard structural equipment is changed at the time of factory shipment. Consequently, kindly confirm the delivery date.

To make changes to the specifications after shipment, service work must be performed at the work site or the robot must be returned for service.

1.1.3 Options

Installation is possible after shipment. Customer needs to perform the installation work.

1.1.4 Maintenance parts

Consumable parts and spare parts for maintenance use.

For items not listed, contact the dealer where you made your purchase.

1.2 Contents of the structural equipment

1.2.1 Robot arm

The list of structural equipment is shown in Fig. 1-1

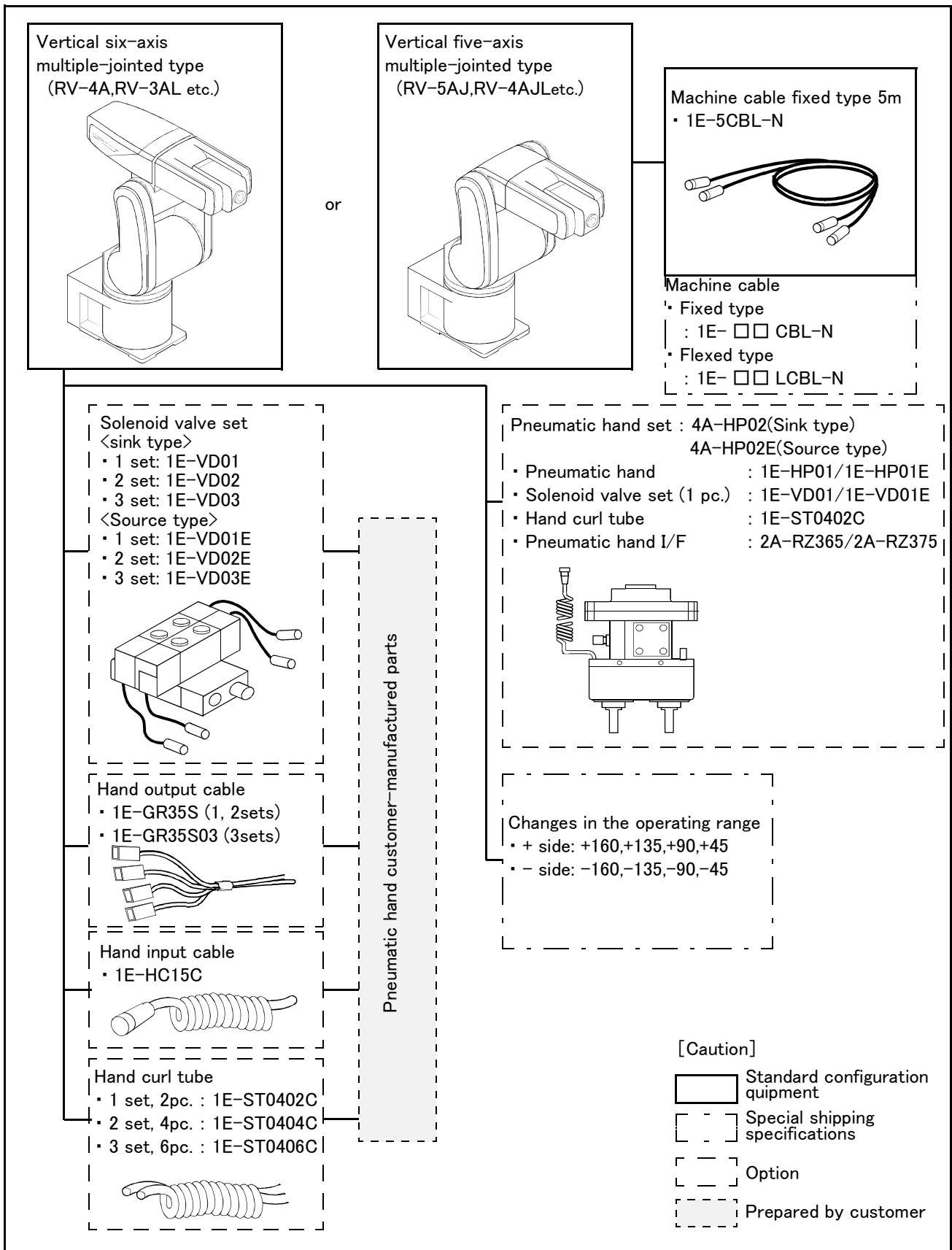
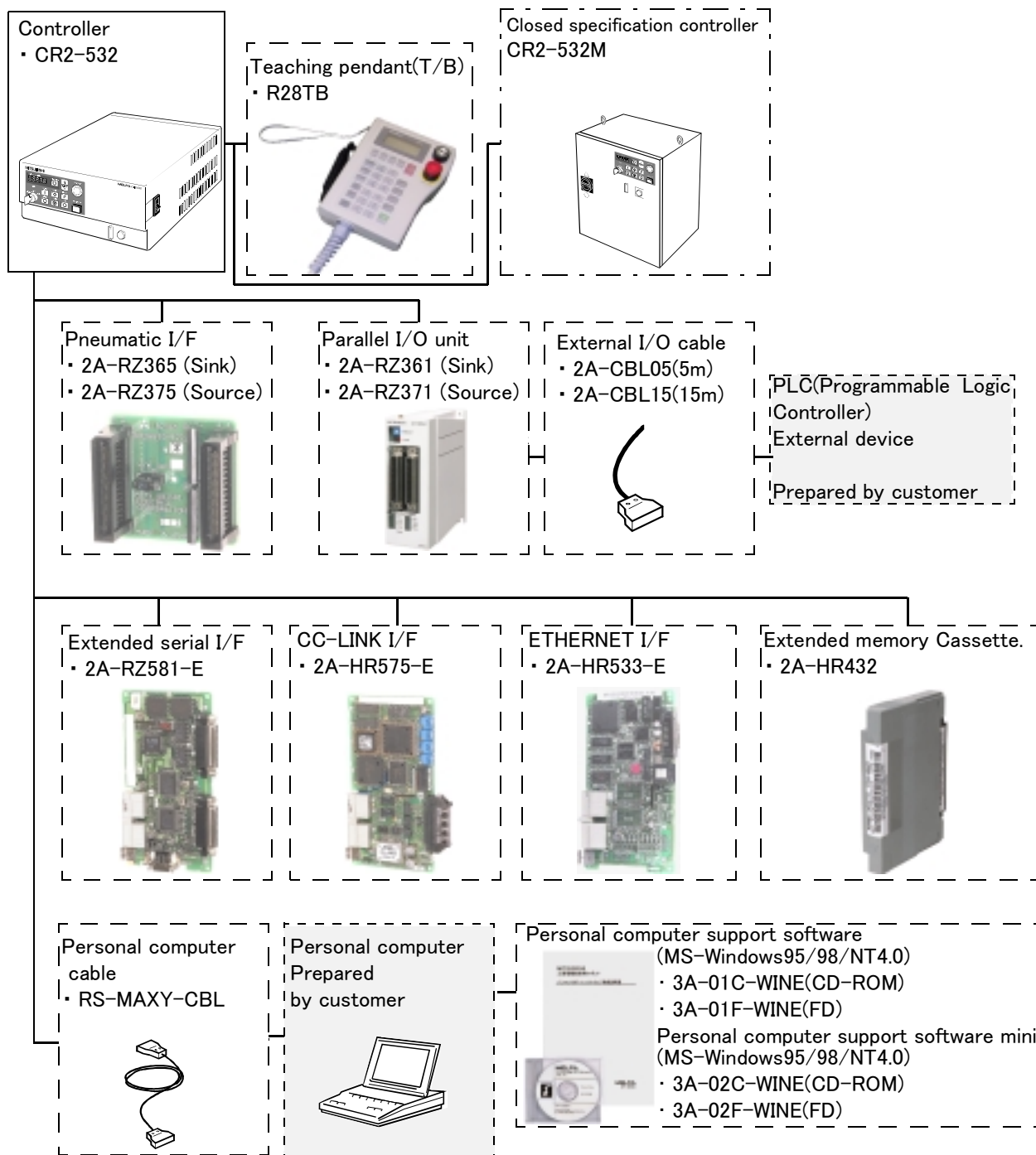


Fig.1-1 : Structural equipment (Robot arm)

1.3 Controller

The devices shown below can be installed on the controller.



[Caution]

- Standard configuration equipment
- Special shipping specifications
- Option
- Prepared by customer

Fig.1-2 : Structural equipment(Controller)

1.4 Contents of the Option equipment and special specification

A list of all Optional equipments and special specifications are shown below.

Table 1-1 : The list of Option equipment and special specification

| Item | Type | Specifications | Classification | Description |
|---|---------------|--|----------------|---|
| Pneumatic hand set | 4A-HP02 | Pneumatic hand, Solenoid valve set (1 pc.), Curl cable, Hand curl tube, Pneumatic hand I/F, Hand adapter, Installation bolts | ○ | The pneumatic hand and required parts are prepared in a set.(sink type) |
| | 4A-HP02E | | ○ | The pneumatic hand and required parts are prepared in a set.(source type) |
| J1-axis operating range change | 1E-DH**-** | + side : +160、+135、+90、+45 ° - side : -160、-135、-90、-45 ° | ○ · □ | The J1 axis operating range is changed. The angle is inserted in ** in the order of (+ side) (- side). The standard specification is 160 degrees. |
| Solenoid valve set | 1E-VD01 | 1 set(Sink type) | ○ | A solenoid valve set for the pneumatic hand. |
| | 1E-VD02 | 2 set(Sink type) | ○ | |
| | 1E-VD03 | 3 set(Sink type) | ○ | |
| | 1E-VD01E | 1 set(Source type) | ○ | |
| | 1E-VD02E | 2 set(Source type) | ○ | |
| | 1E-VD03E | 3 set(Source type) | ○ | |
| Hand output cable | 1E-GR35S | 1 or 2 sets | ○ | The cable is connected to the hand output connector by the customer. |
| | 1E-GR35S03 | 3 sets | ○ | |
| Hand input cable | 1E-HC15C | IP65 connector with one end not processed | ○ | The cable is connected to the sensor by the customer. |
| Hand curl tube | 1E-ST0402C | For solenoid valve 1set.:Φ 4x2 | ○ | Curl type air tube |
| | 1E-ST0404C | For solenoid valve 2set.:Φ 4x4 | ○ | |
| | 1E-ST0406C | For solenoid valve 3set.:Φ 4x6 | ○ | |
| Extended machine cable | 1E- □□ CBL-N | For fixing (Two sets for power and signal) | □ | The boxes □□ indicates the cable length. 10 or 15m |
| | 1E- □□ LCBL-N | For bending (Two sets for power and signal) | □ | The boxes □□ indicates the cable length. 5, 10 or 15m |
| Teaching pendant | R28TB | Cable length 7m | ○ | With 3-position deadman switch/ IP 65 |
| | R28TB-15 | Cable length 15m | ○ | |
| Pneumatic hand interface | 2A-RZ365 | DO: 8 point (Sink type) | ○ | It is necessary when the hand output signal of the robot arm is used. (Integrated in the controller.) |
| | 2A-RZ375 | DO: 8 point (Source type) | ○ | |
| Parallel I/O interface | 2A-RZ361 | DO: 32 point (Sink type)/ DI: 32 point (Sink type) | ○ | Electrical isolated Type (100mA/Point) |
| | 2A-RZ371 | DO: 32 point (Source type)/ DI: 32 point (Source type) | ○ | |
| External I/O cable | 2A-CBL05 | 5m | ○ | |
| | 2A-CBL15 | 15m | ○ | |
| Personal computer cable | RS-MAXY-CBL | 3m for PC-AT compatible model | ○ | |
| Personal computer Support software | 3A-01C-WINE | CD-ROM | ○ | MS-Windows95/98/NT4.0 (With the simulation function) |
| | 3A-01F-WINE | FD | ○ | |
| Personal computer Support software mini | 3A-02C-WINE | CD-ROM | ○ | MS-Windows95/98/NT4.0 (Without the simulation function) |
| | 3A-02F-WINE | FD | ○ | |
| Extended serial interface | 2A-RZ581-E | RS-232C x 2 RS-422 x 1 | ○ | |
| CC-Link interface | 2A-HR575-E | Local station (The local station alone is supported.) | ○ | for MELSEC PLC with CC-Link connection. |
| ETHERNET interface | 2A-HR533-E | ETHERNET x 1 | ○ | |
| Extended memory cassette | 2A-HR432 | Teaching point is 25,400 points. | ○ | Expand the teaching point up to 27,900 points, including 2,500 points of standard |
| Closed specification controller | CR2-532M | | □ | |

Note) In the classification column, ○ refers to an option, and □ to a Sipping special specifications.

2 Robot arm

2.1 Standard specifications

2.1.1 Standard specifications

Table 2-1 : Tab Standard specifications of robot

| Item | | Unit | Specifications | | | | | | |
|--|------------------------------|-------------------|---|-------------------------------|------------|---------------------------------|-------------------------------|------------|------------|
| Type | | | RV-5AJ | RV-5AJC-SB | RV-5AJC-SA | RV-4A | RV-4AC-SB | RV-4AC-SA | |
| Type of robot | | | 5-axis standard arm | | | 6-axis standard arm | | | |
| | | | Standard | Clean(Special Specifications) | | Standard | Clean(Special Specifications) | | |
| Degree of freedom | | | 5 | | | 6 | | | |
| Installation posture | | | On floor, hanging, against wall | On floor | | On floor, hanging, against wall | On floor | | |
| Structure | | | Vertical, multiple-joint type | | | | | | |
| Drive system | | | AC servo motor (J1,J2 axis :400W , J3 axis :200W , J4,J5,J6 axis :100W , With all axes brakes) | | | | | | |
| Position detection method | | | Absolute encoder | | | | | | |
| Arm length | Shoulder shift | mm | 100 | | | 100 | | | |
| | Upper arm | | 250 | | | 250 | | | |
| | Fore arm | | 280 | | | 250 | | | |
| | Elbow shift | | 20 | | | 135 | | | |
| | Wrist length | | 90 | 100 | | 90 | 100 | | |
| Operating range | Waist (J1) ^{Note1)} | Degree | 320 (-160 to +160) | | | 320 (-160 to +160) | | | |
| | Shoulder (J2) | | 230 (-90 to +140) | | | 230 (-90 to +140) | | | |
| | Elbow (J3) | | 270 (-130 to +140) | | | 154 (+15 to +169) | | | |
| | Wrist twist (J4) | | - | | | 320 (-160 to +160) | | | |
| | Wrist pitch (J5) | | 240 (-120 to +120) | | | 240 (-120 to +120) | | | |
| | Wrist roll (J6) | | 400 (-200 to +200) | | | 400 (-200 to +200) | | | |
| Speed of motion | Waist (J1) | Degree/s | 216 | | | 216 | | | |
| | Shoulder (J2) | | 270 | | | 270 | | | |
| | Elbow (J3) | | 270 | | | 270 | | | |
| | Wrist twist (J4) | | - | | | 270 | | | |
| | Wrist pitch (J5) | | 270 | | | 270 | | | |
| | Wrist roll (J6) | | 432 | | | 432 | | | |
| Maximum resultant velocity | | mm/sec | Approx. 5700 | | | Approx. 5800 | | | |
| Load | Maximum ^{Note2)} | kg | 5 | | | 4 | | | |
| | Rating | | 4 | | | 3 | | | |
| Pose repeatability | | mm | ± 0.03 | | | | | | |
| Ambient temperature | | °C | 0 to 40 | | | | | | |
| mass ^{Note3)} | | kg | Approx. 46 | | Approx. 49 | | Approx. 50 | | Approx. 53 |
| Allowable moment load | Wrist twist (J4) | N·m | - | | | 5.58 | | | |
| | Wrist pitch (J5) | | 7.44 | | | 5.58 | | | |
| | Wrist roll (J6) | | 3.92 | | | 2.94 | | | |
| Allowable inertia | Wrist twist (J4) | kg·m ² | - | | | 1.08 × 10 ⁻¹ | | | |
| | Wrist pitch (J5) | | 1.44 × 10 ⁻¹ | | | 1.08 × 10 ⁻¹ | | | |
| | Wrist roll (J6) | | 4.00 × 10 ⁻² | | | 3.00 × 10 ⁻² | | | |
| Arm reachable radius front p-axis center point | | mm | 630 | | | 634 | | | |
| Tool wiring | | | Eight wires for checking the hand (Two for power source and six for signal input) Four spare wires (stored between the base to the tip of the fore arm : size 0.3mm ²) | | | | | | |
| Tool pneumatic pipes | | | Primary side : Φ6 × 2 , Secondary side : Φ4 × 6 | | | | | | |
| Supply pressure | | MPa | 0.49 ± 10% | | | | | | |
| Protection specification ^{Note4)} | | | IP54F | - | | IP54F | - | | |
| Degree of cleanliness ^{Note5)} | | | - | 100(0.3 μm) | 10(0.3 μm) | - | 100(0.3 μm) | 10(0.3 μm) | |
| | | | | Internal suction requirement | | | Internal suction requirement | | |

Note1)For the wall hanging type, the W axis(J1) operating range must be set within ± 45°. Use a J1 axis operating range change option (1E-DH45-45). The movement range limit is set with mecha stopper and parameters.

The movement range limit is set with mecha stopper and parameters

Note2)The maximum load capacity is the mass with the flange posture facing downward at the ± 10° limit.

Note3)The robot arm mass for the SA type includes the suction blower base.

Note4)The protection specification details are given in [Page 29, "2.5.6 Protection specifications and working environment"](#).

Note5)The clean specification details are given in [Page 30, "2.5.7 Clean specifications"](#). A down flow (0.3m/s or more) in the clean room is the necessary conditions for the cleanliness.

Table 2-1: Tab Standard specifications of robot (Continued)

| Item | | Unit | Specifications | | | | | |
|---|------------------------------|---|--|-------------------------------|--------------|--|-------------------------------|------------|
| Type | | | RV-4AJL | RV-4AJLC-SB | RV-4AJLC-SA | RV-3AL | RV-3ALC-SB | RV-3ALC-SA |
| Type of robot | | | 5-axis long arm | | | 6-axis long arm | | |
| | | | Standard | Clean(Special Specifications) | | Standard | Clean(Special Specifications) | |
| Degree of freedom | | | 5 | | | 6 | | |
| Installation posture | | | On floor,hanging,against wall Note 3) | On floor | | On floor,hanging,against wall Note 3) | On floor | |
| Structure | | | Vertical, multiple-joint type | | | | | |
| Drive system | | | AC servo motor (J1,J2 axis :400W、J3 axis :200W、J4,J5,J6 axis :100W、With all axes brakes) | | | | | |
| Position detection method | | | Absolute encoder | | | | | |
| Arm length | Shoulder shift | mm | 100 | | | 100 | | |
| | Upper arm | | 350 | | | 350 | | |
| | Fore arm | | 400 | | | 370 | | |
| | Elbow shift | | 20 | | | 135 | | |
| | Wrist length | | 90 | 100 | | 90 | 100 | |
| Operating range | Waist (J1) ^{Note1)} | Degree | 320 (-160 to +160) | | | 320 (-160 to +160) | | |
| | Shoulder (J2) | | 230 (-90 to +140) | | | 230 (-90 to +140) | | |
| | Elbow (J3) | | 270 (-130 to +140) | | | 154 (+15 to +169) | | |
| | Wrist twist (J4) | | - | | | 320 (-160 to +160) | | |
| | Wrist pitch (J5) | | 240 (-120 to +120) | | | 240 (-120 to +120) | | |
| | Wrist roll (J6) | | 400 (-200 to +200) | | | 400 (-200 to +200) | | |
| Speed of motion | Waist (J1) | Degree/s | 216 | | | 216 | | |
| | Shoulder (J2) | | 180 | | | 180 | | |
| | Elbow (J3) | | 216 | | | 216 | | |
| | Wrist twist (J4) | | - | | | 270 | | |
| | Wrist pitch (J5) | | 270 | | | 270 | | |
| | Wrist roll (J6) | | 432 | | | 432 | | |
| Maximum resultant velocity | mm/sec | Approx. 6000 | Approx. 6100 | | Approx. 6000 | Approx. 6100 | | |
| Load | Rating ^{Note2)} | kg | 4 | | | 3 | | |
| | Maximum | | 3 | | | 2 | | |
| Pose repeatability | mm | ± 0.04 | | | | | | |
| Ambient temperature | °C | 0 to 40 | | | | | | |
| mass ^{Note3)} | kg | Approx. 53 | | Approx. 56 | Approx. 58 | | Approx. 61 | |
| Allowable moment load | Wrist twist (J4) | N·m | - | | | 3.72 | | |
| | Wrist pitch (J5) | | 5.59 | | | 3.72 | | |
| | Wrist roll (J6) | | 2.94 | | | 1.96 | | |
| Allowable inertia | Wrist twist (J4) | kg·m ² | - | | | 7.22 × 10 ⁻² | | |
| | Wrist pitch (J5) | | 1.08 × 10 ⁻¹ | | | 7.22 × 10 ⁻² | | |
| | Wrist roll (J6) | | 3.00 × 10 ⁻² | | | 2.00 × 10 ⁻² | | |
| Arm reachable radius from p-axis center point | mm | 850 | | | 843 | | | |
| Tool wiring | | Eight wires for checking the hand (Two for power source and six for signal input) Four spare wires (stored between the base to the tip of the fore arm : size 0.3mm ²) | | | | | | |
| Tool pneumatic pipes | | Primary side : Φ6 × 2 , Secondary side : Φ4 × 6 | | | | | | |
| Supply pressure | MPa | 0.49 ± 10% | | | | | | |
| Protection specification ^{Note4)} | | IP54F | - | | IP54F | - | | |
| Degree of cleanliness ^{Note5)} | | - | 100(0.3 μm) | 10(0.3 μm) | - | 100(0.3 μm) | 10(0.3 μm) | |
| | | | Internal suction requirement | | | | | |

Note1)For the wall hanging type, the W axis(J1) motion operating range must be set within ± 45°. Use a J1 axis operating range change option (1E-DH45-45).

The movement range limit is set with mecha stopper and parameters.

Note2)The maximum load capacity is the mass with the flange posture facing downward at the ± 10° limit.

Note3)The robot arm mass for the SA type includes the suction blower base.

Note4)The protection specification details are given in Page 29, "2.5.6 Protection specifications and working environment".

Note5)The clean specification details are given in Page 30, "2.5.7 Clean specifications". A down flow(0.3m/s or more) in the clean room is the necessary conditions for the cleanliness.

2.2 Definition of specifications

The accuracy of pose repeatability mentioned in catalogs and in the specification manual is defined as follows.

- (1) The pose accuracy in terms of coordinates (XYZ) for the standard point which is obtained repeatedly under the same conditions and motions when the robot is on an operating course.
- (2) The standard point is the intersection between the J6 axis and the flange surface for tooling installation.

2.2.1 Pose repeatability and distance accuracy

This robot, the pose repeatability and distance accuracy are defined and calculated in [Table 2-2](#).

Table 2-2 : Specified accuracy

| Item | Specified conditions |
|--------------------|---|
| pose repeatability | The value equal to the average of the maximum value and the minimum value of the group of attained poses, with (+) or (-) added. |
| Distance accuracy | The distance from the teaching point to the point that is equal to the average of the maximum value and the minimum value of the group of attained poses. |

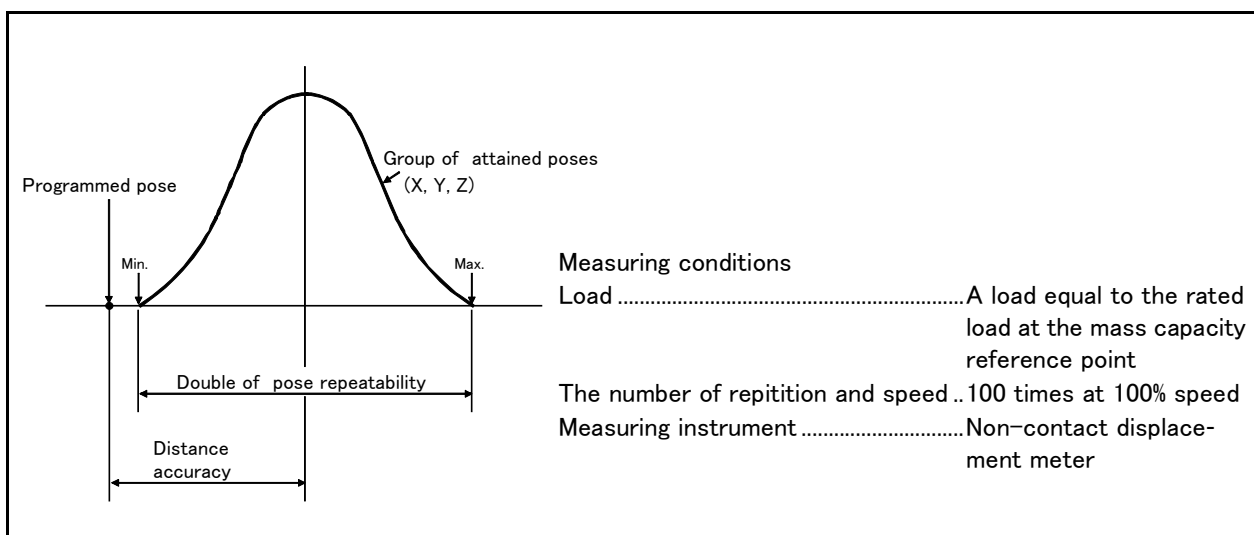


Fig.2-1 : Specified accuracy

[Caution] The pose accuracy given in the specifications is the accuracy measured under the same conditions. It does not include the effect of the robot working environment or conditions. Thus, even when used on the same path, the repeatability according to the presence of a workpiece, or the repeatability when the temperature changes will cause arm slack or expansion, so the accuracy will drop slightly. This also applies to when the teaching speed and actual speed are different or when the coordinates set with values.

2.3 Names of each part of the robot

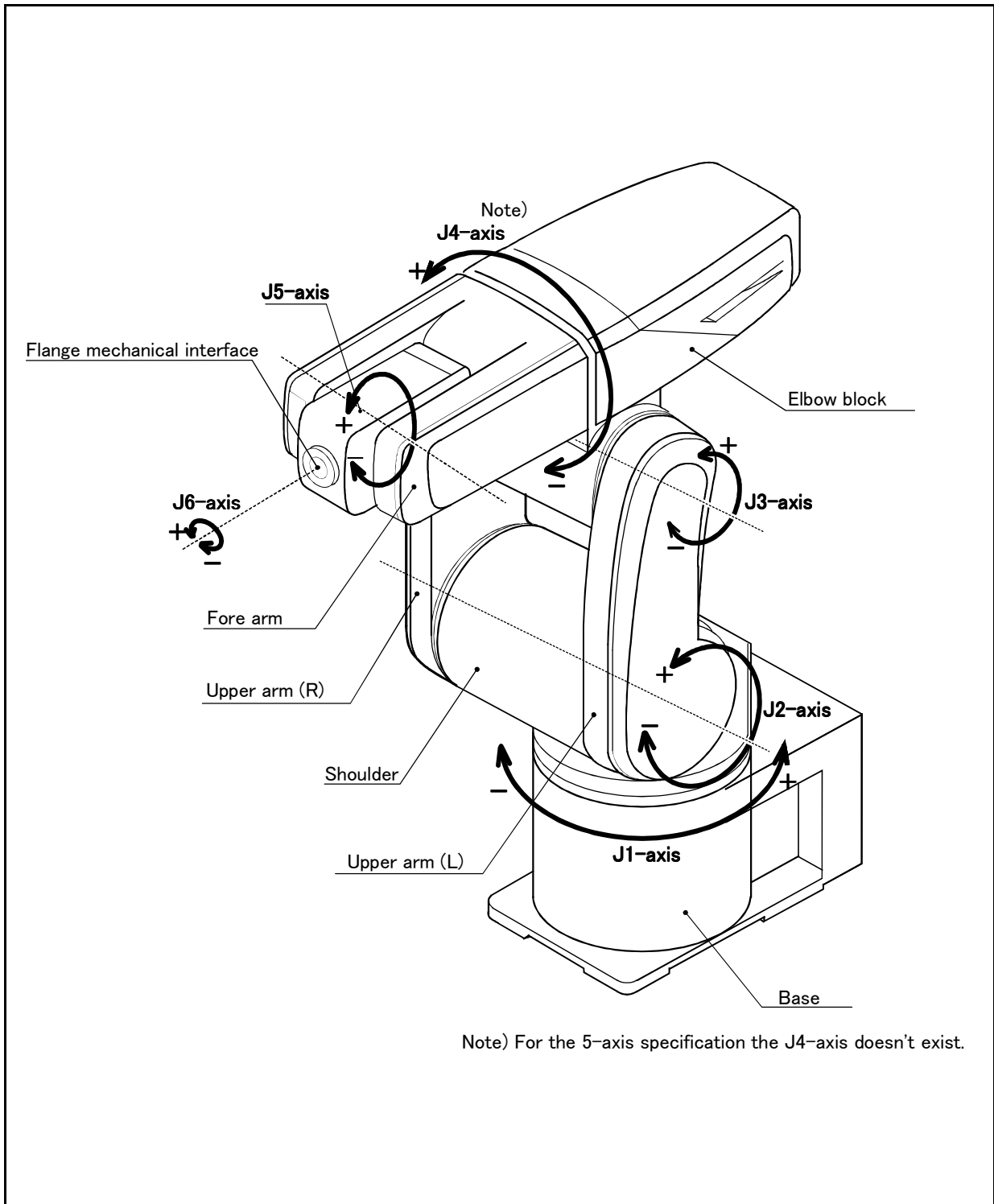


Fig.2-2 : Names of each part of the robot

2.4 Outside dimensions • Operating range diagram

(1) RV-4A/4AC-SB/4AC-SA

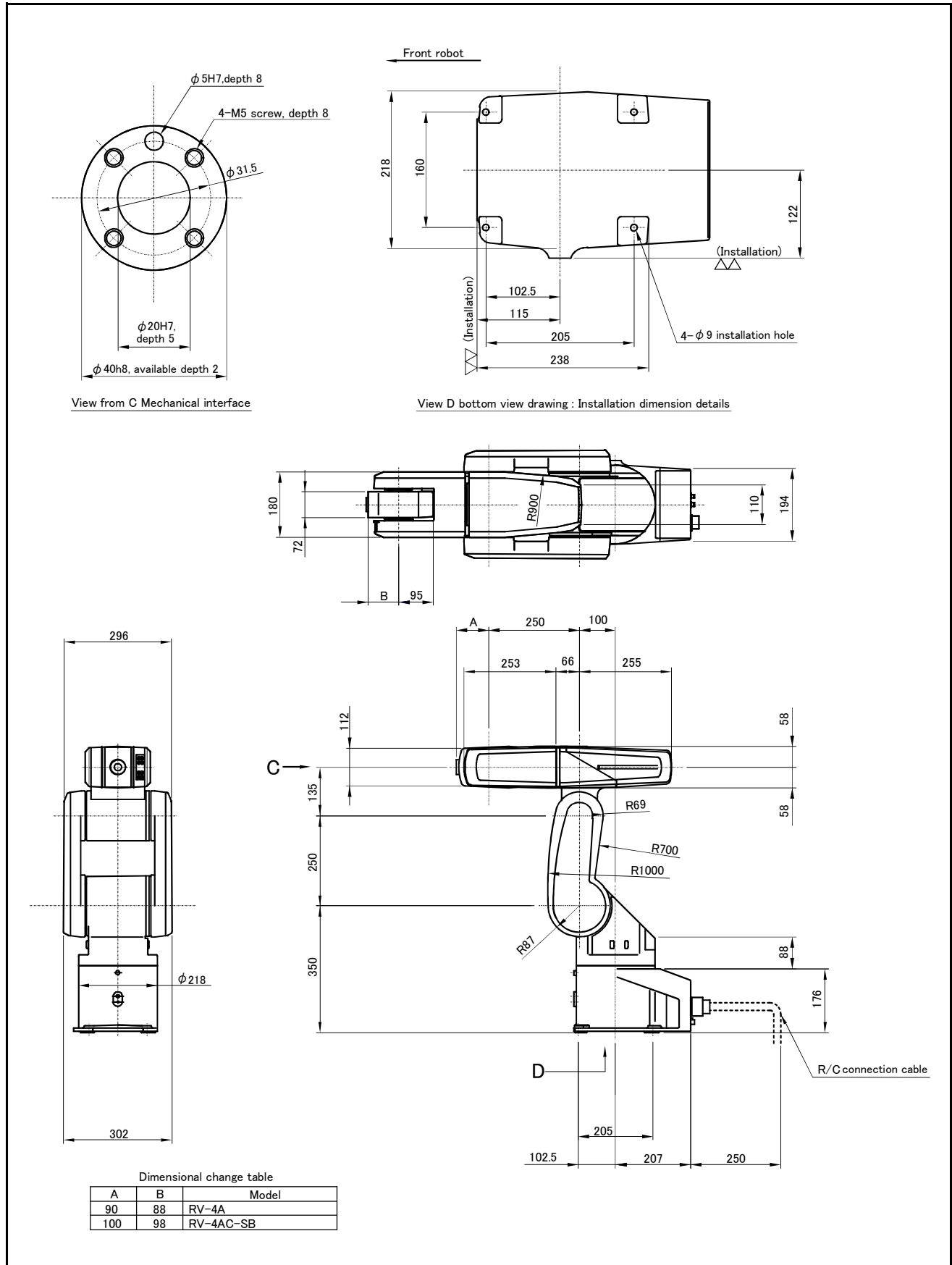


Fig.2-3 : Outside dimensions for RV-4A/4AC-SB

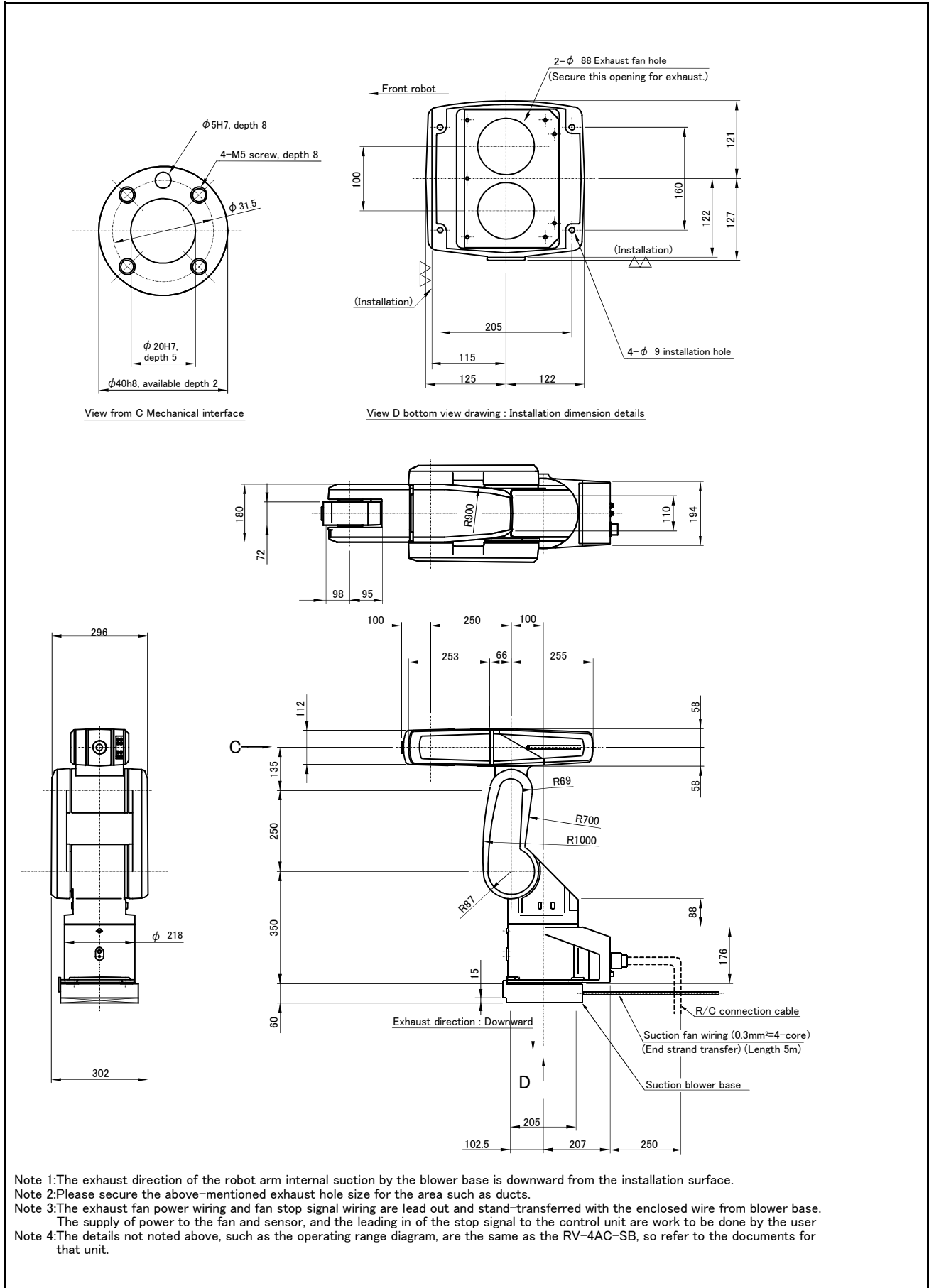


Fig.2-4 : Outside dimensions for RV-4AC-SA

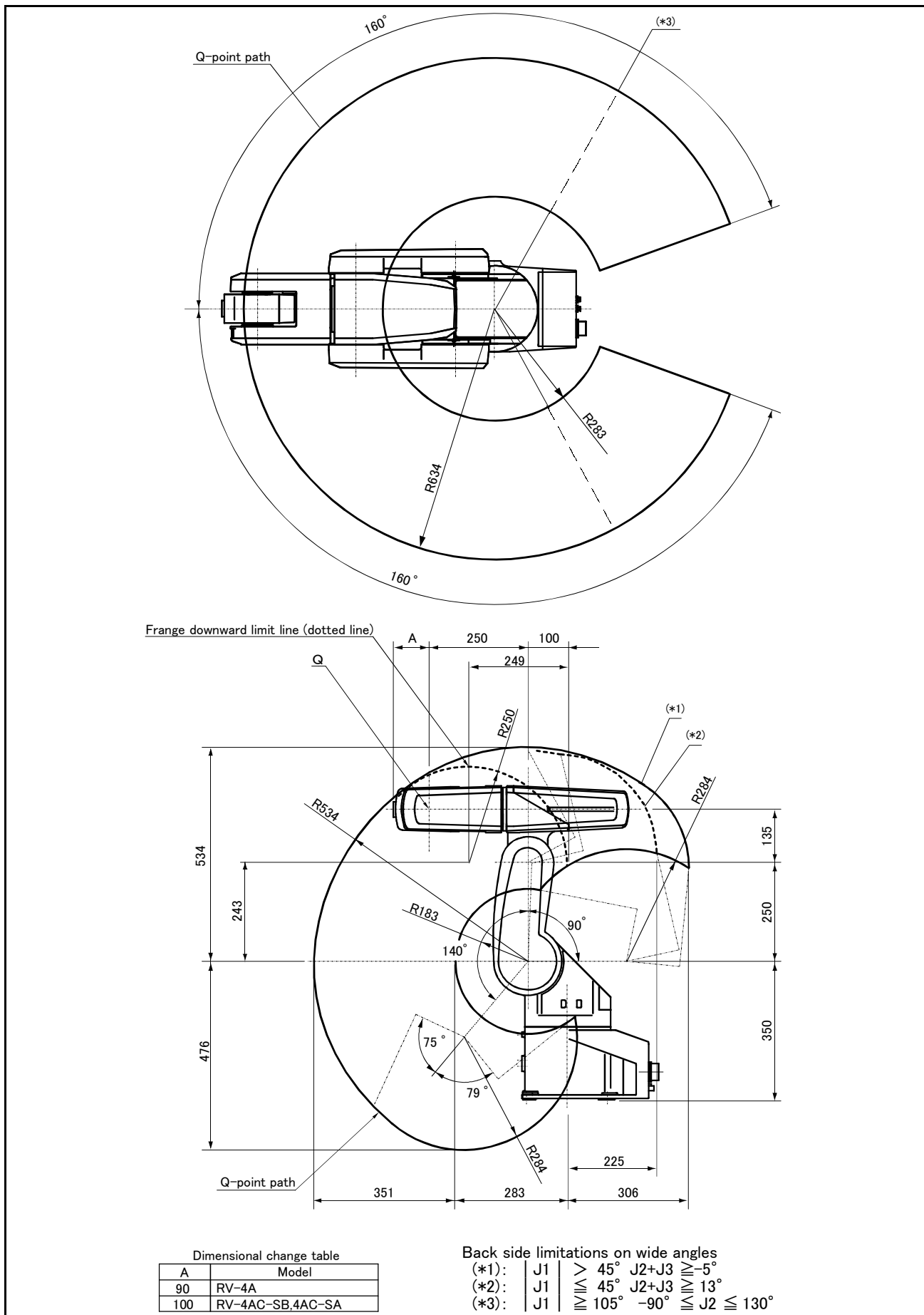


Fig.2-5 : Operating range diagram : RV-4A/4AC-SB/4AC-SA

(2) RV-5AJ/5AJC-SB/5AJC-SA

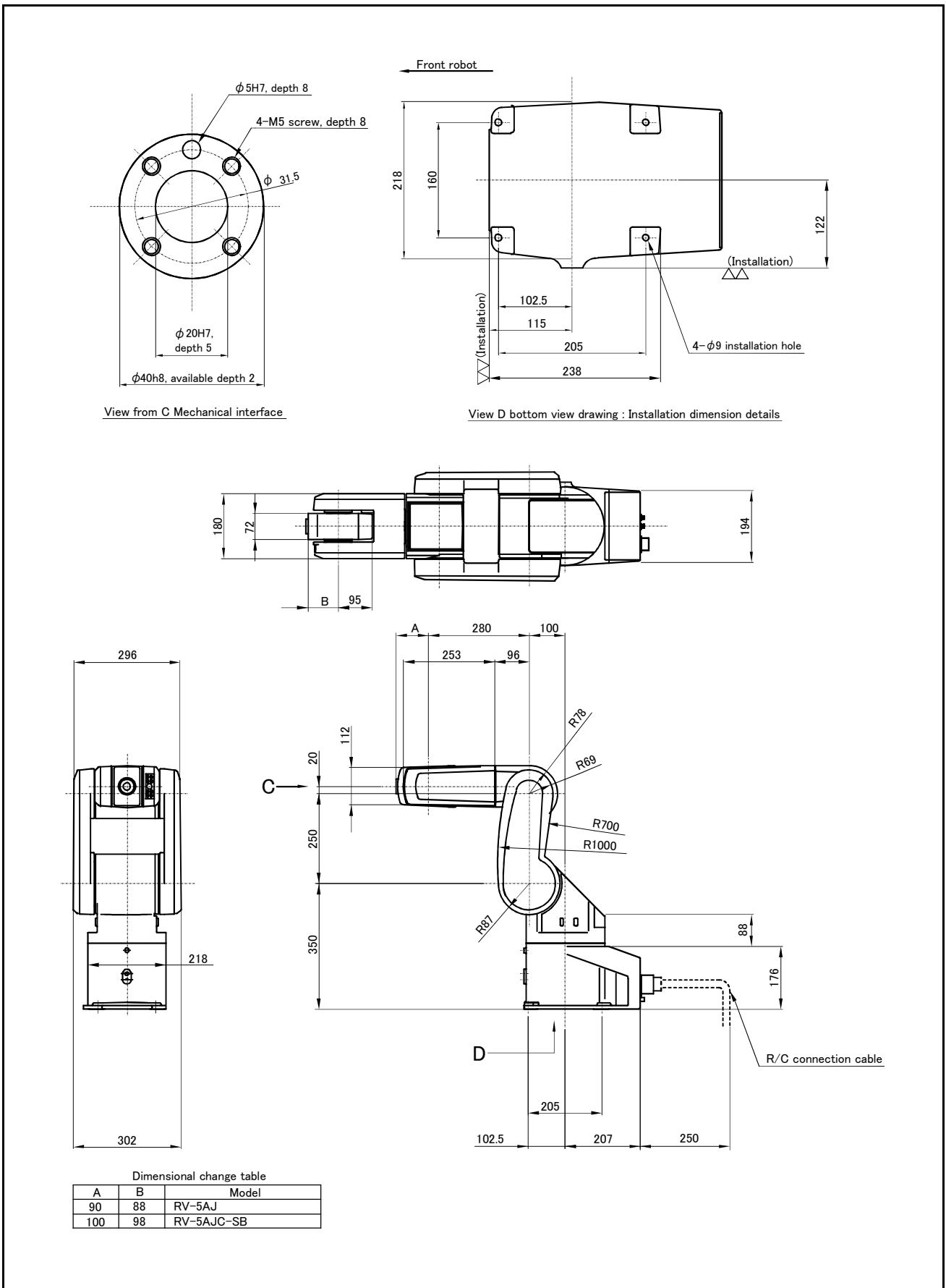


Fig.2-6 : Outside dimensions for RV-5AJ/5AJC-SB

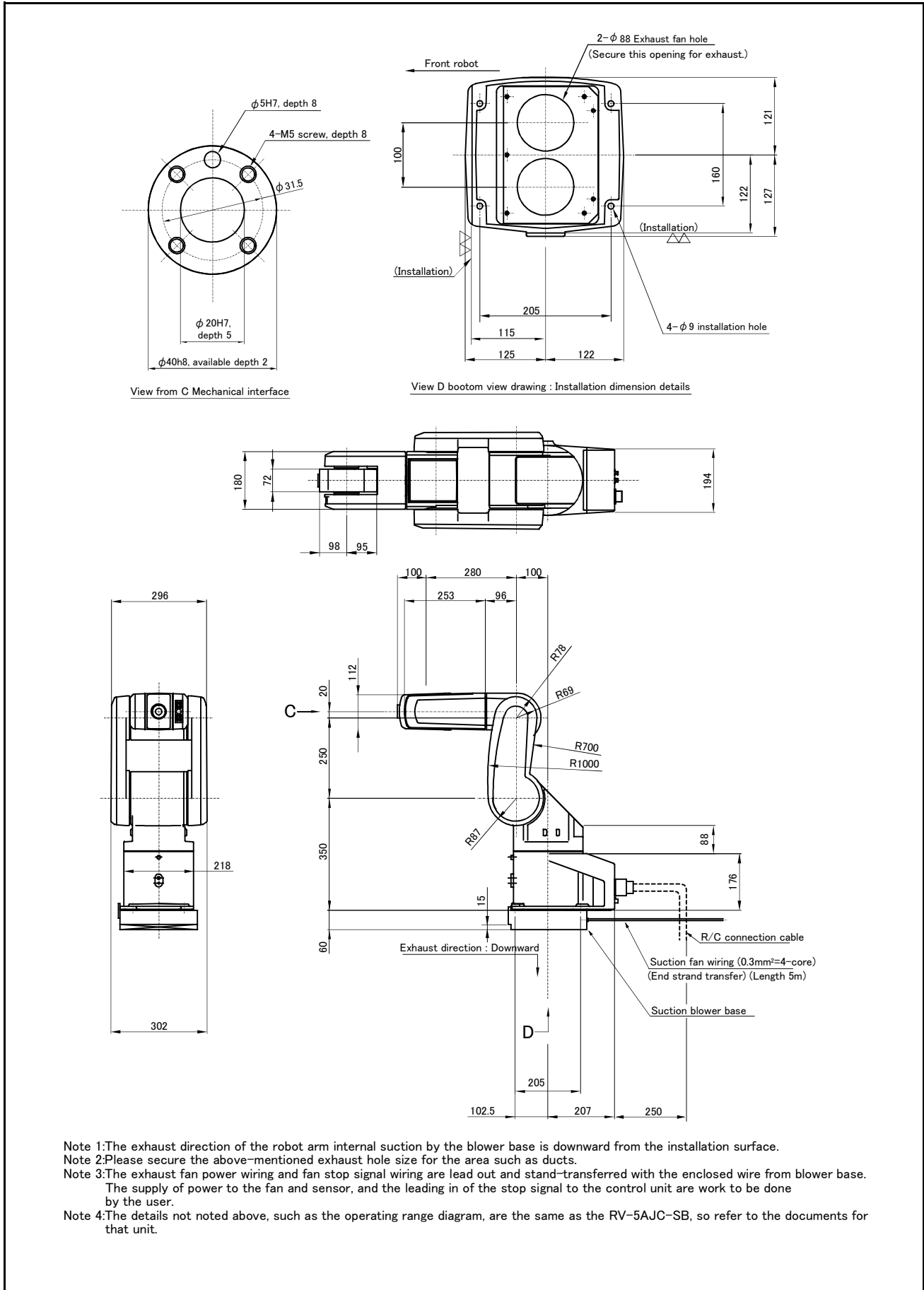


Fig.2-7 : Outside dimensions for RV-5AJC-SA

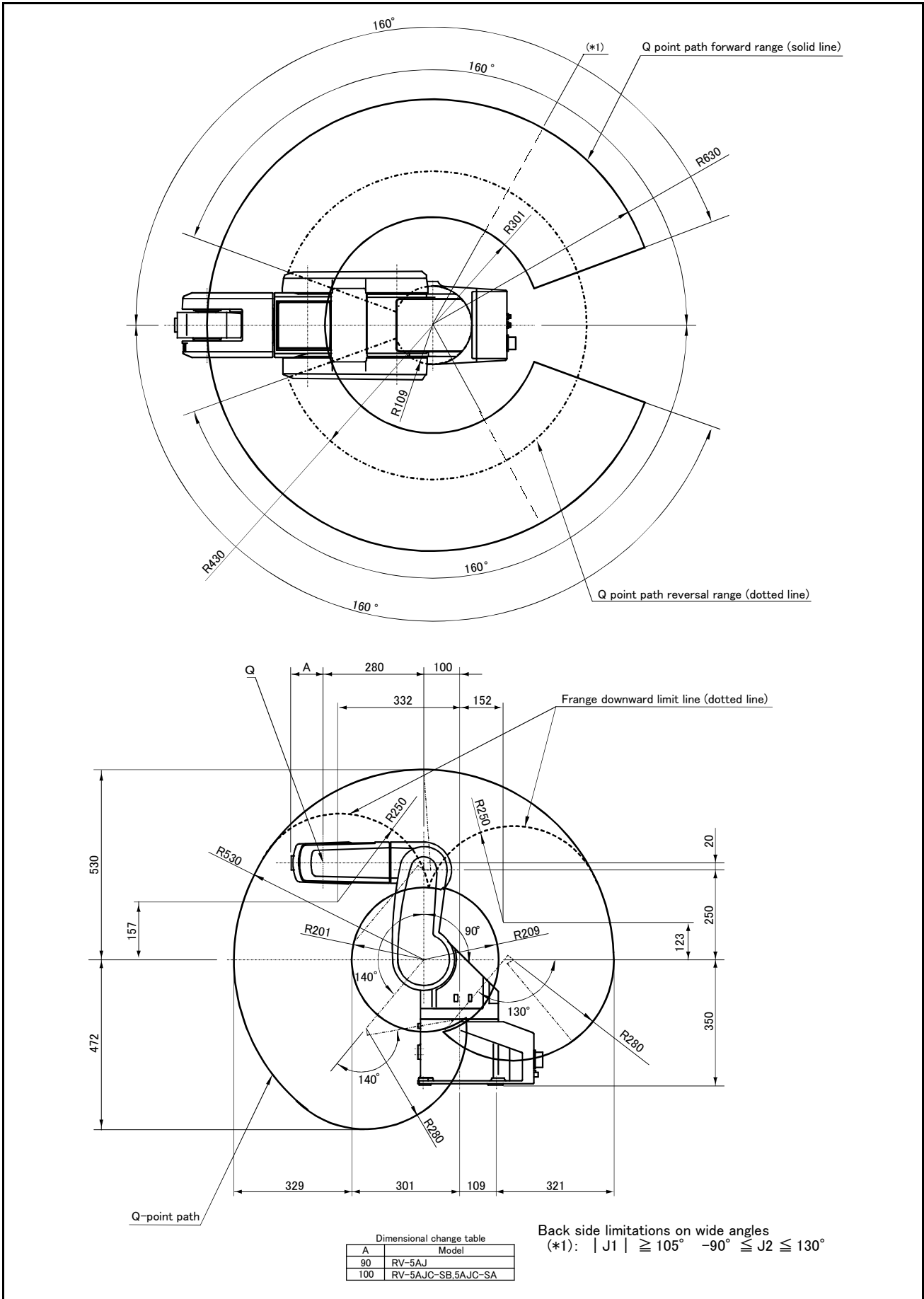


Fig.2-8 : Operating range diagram : RV-5AJ/5AJC-SB/5AJC-SA

(3) RV-3AL/3ALC-SB/3ALC-SA

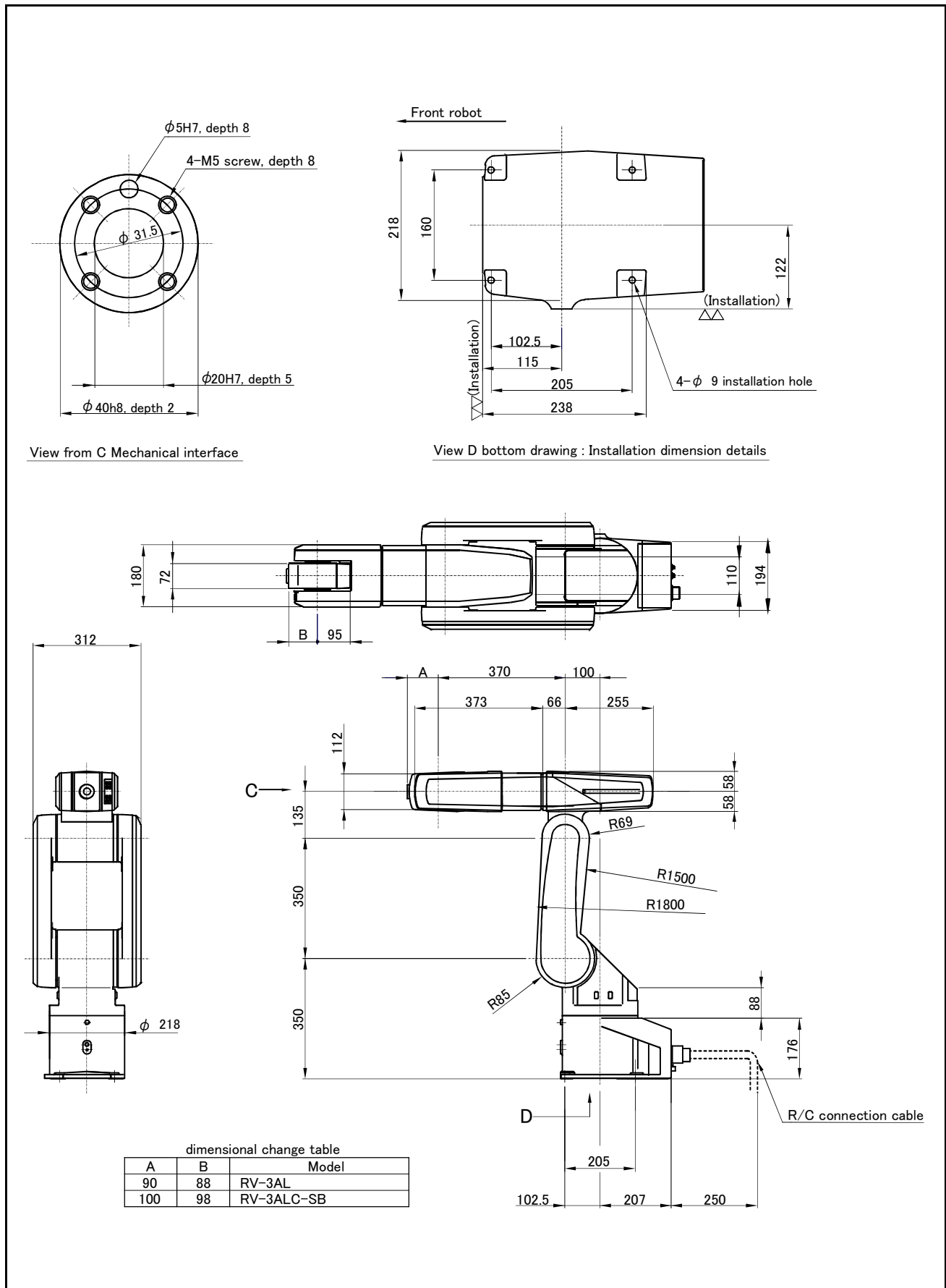
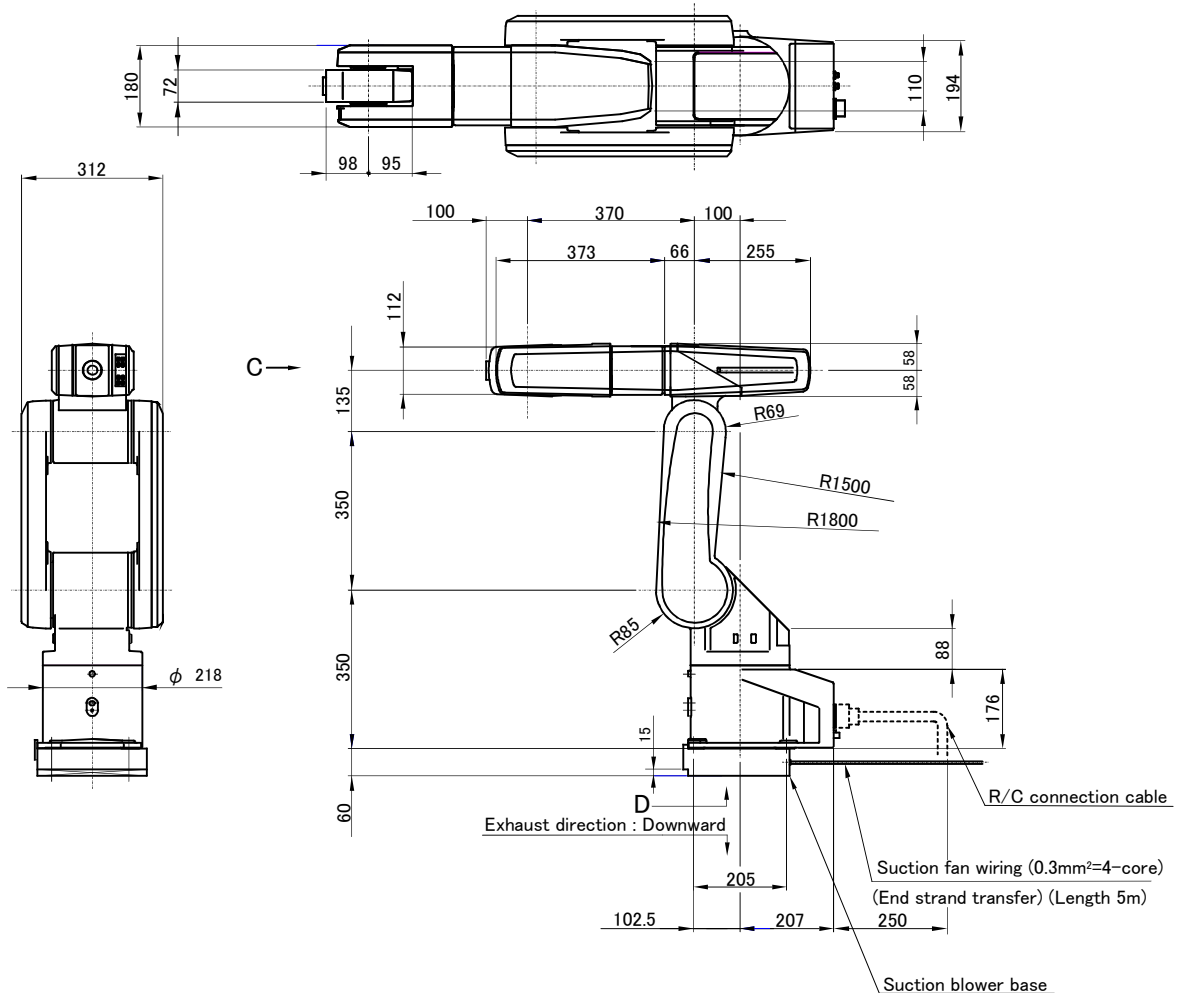
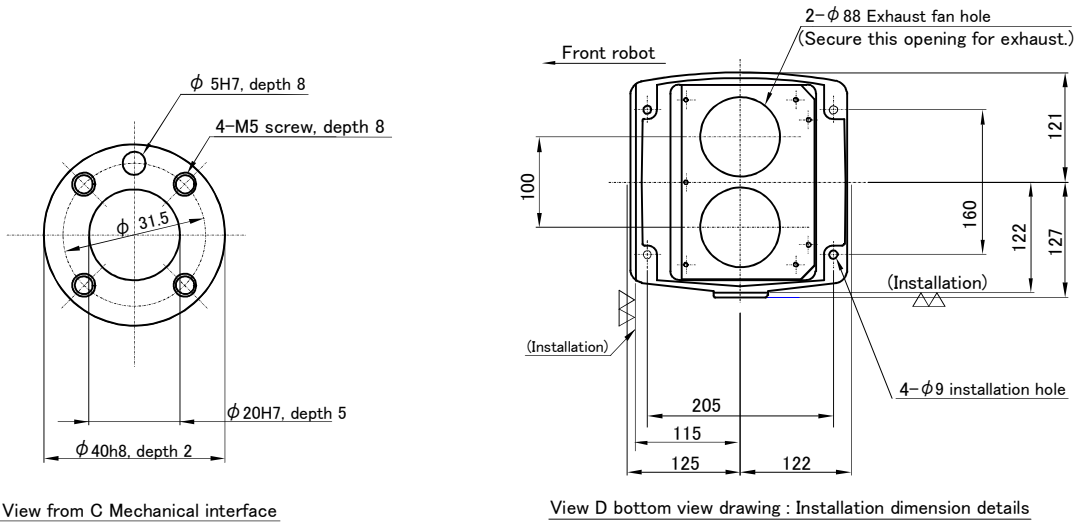


Fig.2-9 : Outside dimensions for RV-3AL/3ALC-SB



- Note 1: The exhaust direction of the robot arm internal suction by the blower base is downward from the installation surface.
- Note 2: Please secure the above-mentioned exhaust hole size for the area such as ducts.
- Note 3: The exhaust fan power wiring and fan stop signal wiring are lead out and stand-transferred with the enclosed wire from blower base. The supply of power to the fan and sensor, and the leading in of the stop signal to the control unit are work to be done by the user.
- Note 4: The details not noted above, such as the operating range diagram, are the same as the RV-3ALC-SB, so refer to the documents for that unit.

Fig.2-10 : Outside dimensions for RV-3ALC-SA

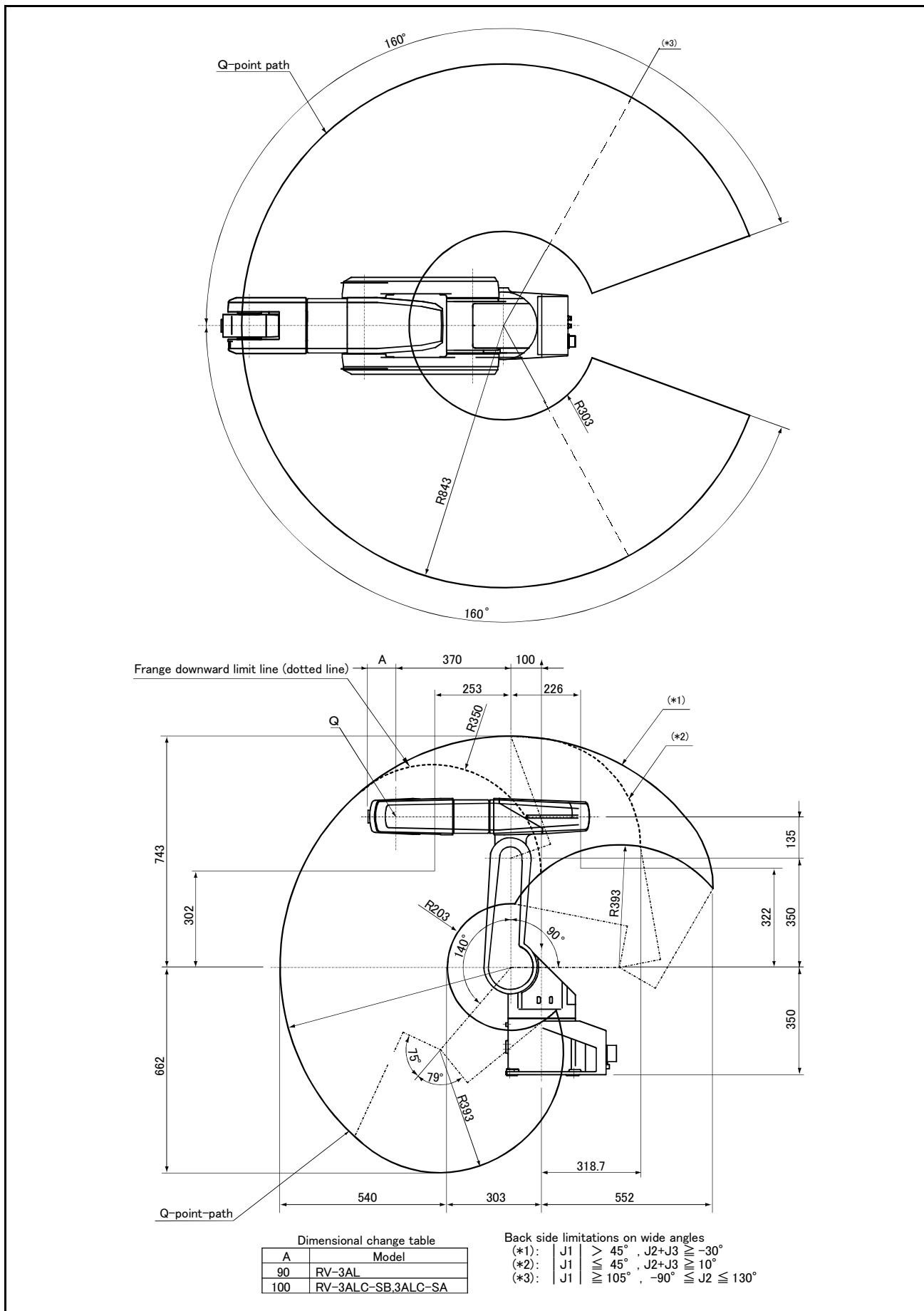


Fig.2-11 : Operating range diagram : RV-3AL/3ALC-SA/3ALC-SB

(4) RV-4AJL/4AJLC-SB/4AJLC-SA

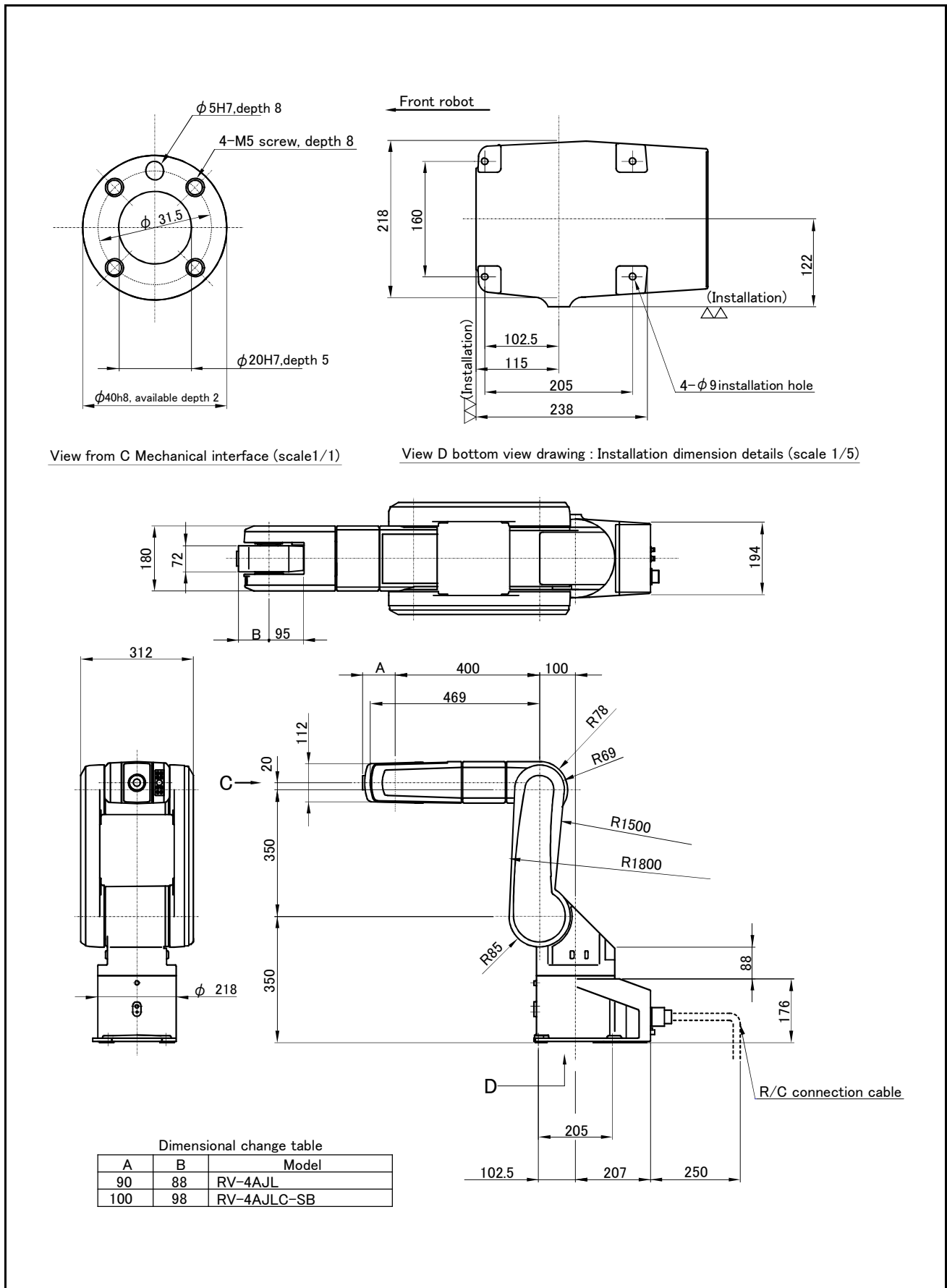
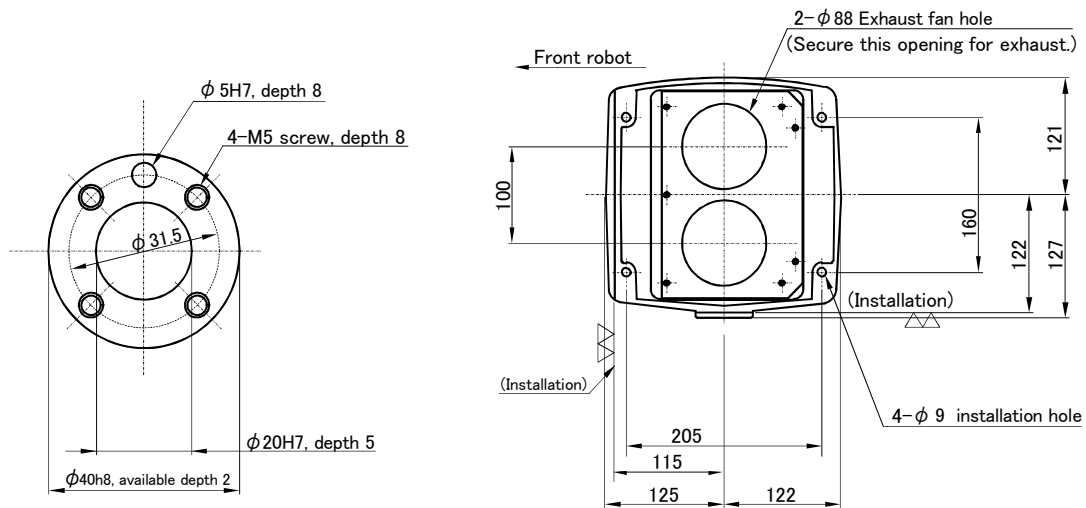
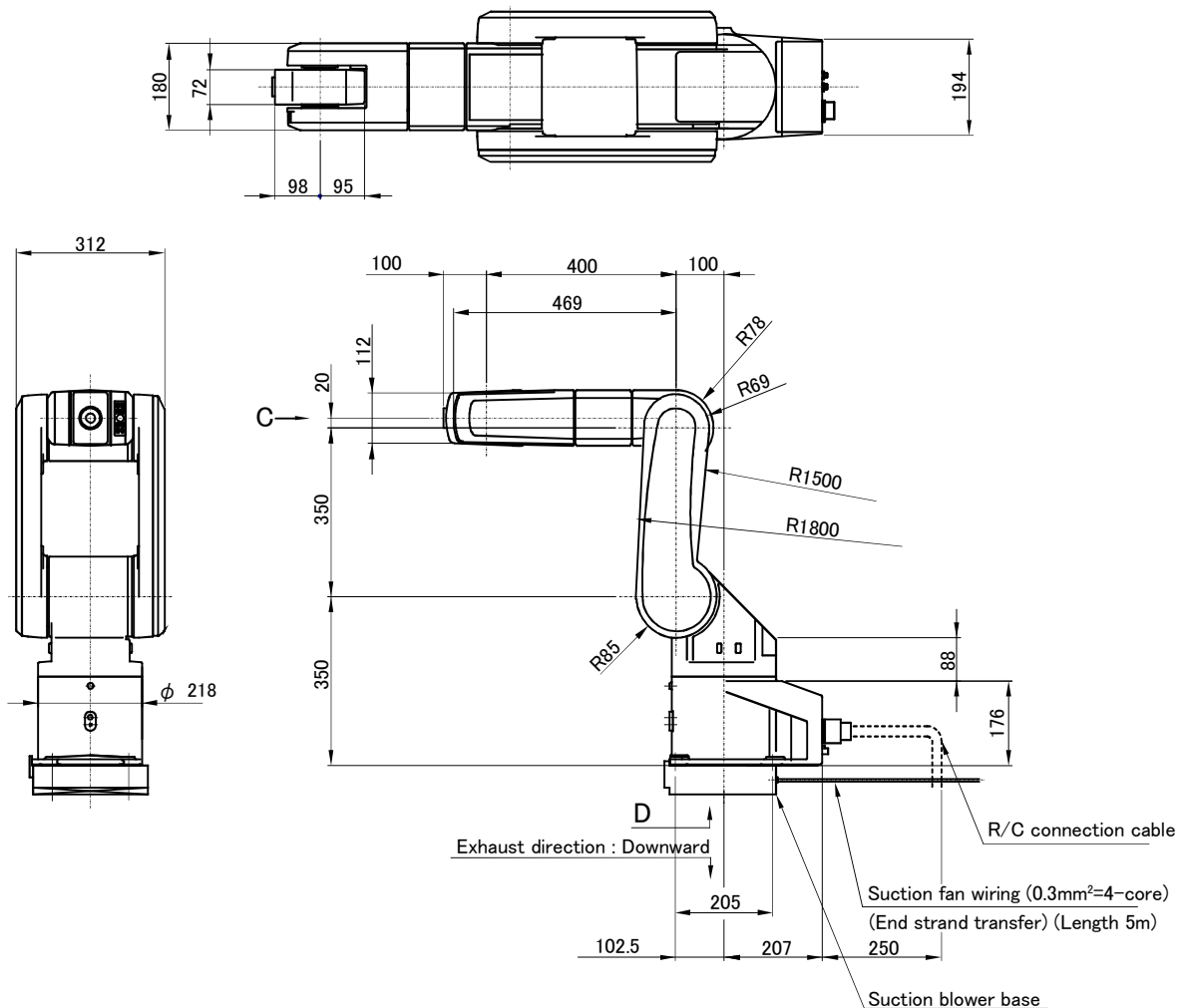


Fig.2-12 : Outside dimensions for RV-4AJL/4AJLC-SB



View from C Mechanical interface (scale 1/1)

View D bottom view drawing : Installation dimension details (scale 1/5)



- Note 1: The exhaust direction of the robot arm internal suction by the blower base is downward from the installation surface.
- Note 2: Please secure the above-mentioned exhaust hole size for the area such as ducts.
- Note 3: The exhaust fan power wiring and fan stop signal wiring are lead out and stand-transferred with the enclosed wire from blower base.
The supply of power to the fan and sensor, and the leading in of the stop signal to the control unit are work to be done by the user.
- Note 4: The details not noted above, such as the operating range diagram, are the same as the RV-4AJLC-SB, so refer to the documents for that unit.

Fig.2-13 : Outside dimensions for RV-4AJLC-SA

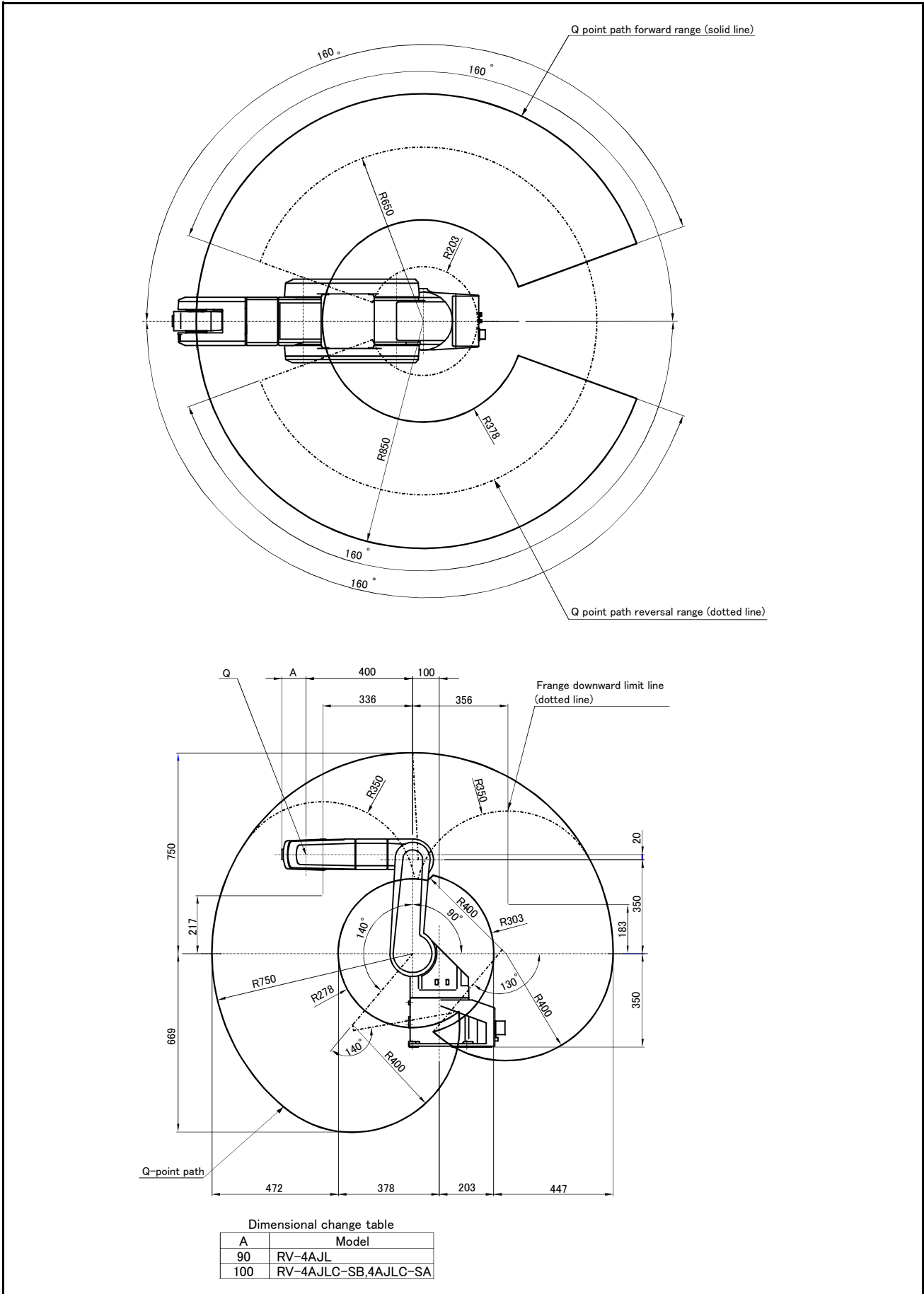


Fig.2-14 : Operating range diagram : RV-4AJL/4AJLC-SA/4AJLC-SB

2.5 Tooling

2.5.1 Wiring and piping for hand

Shows the wiring and piping configuration for a standard-equipped hand.

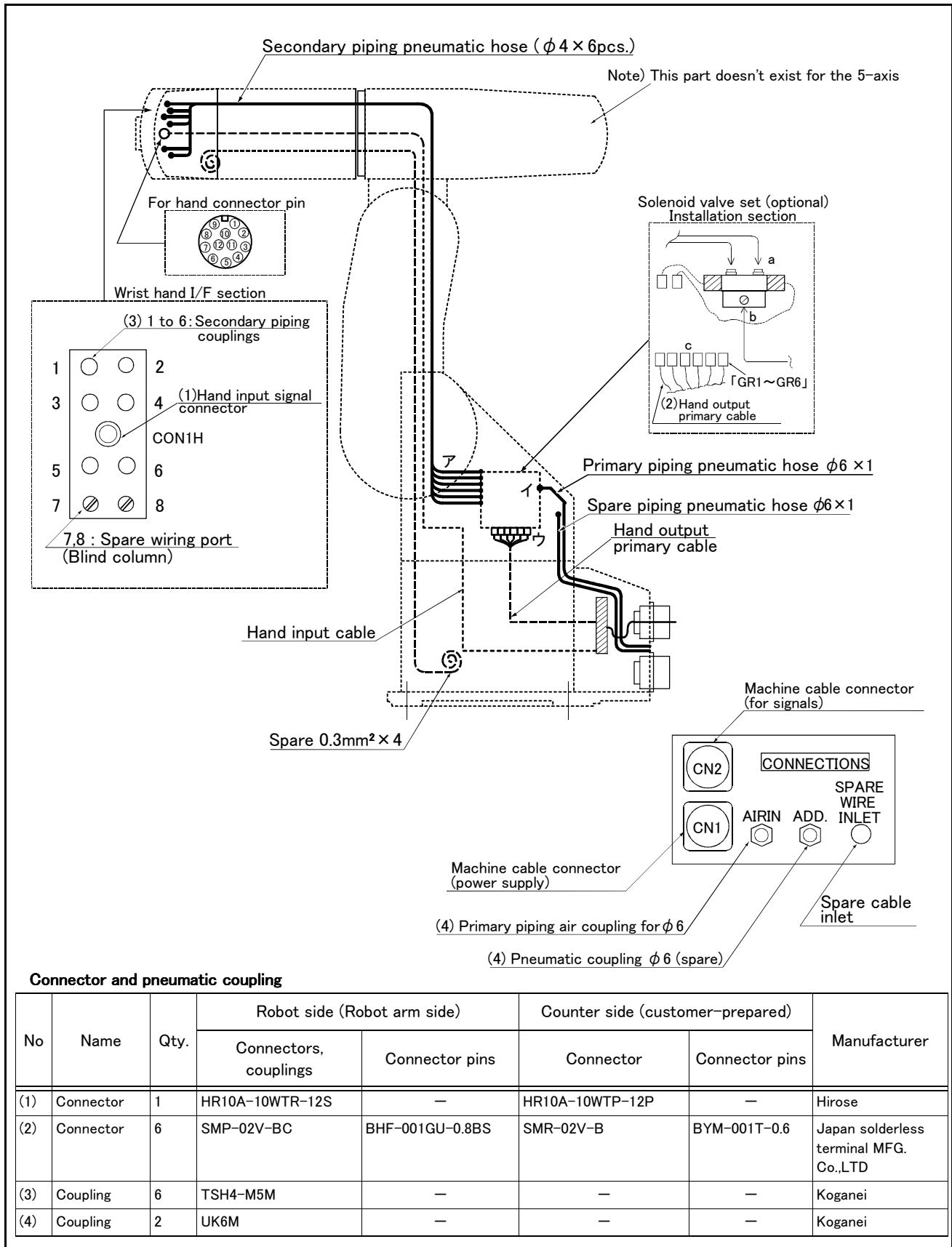


Fig.2-15 : Wiring and piping for hand(Standard type)

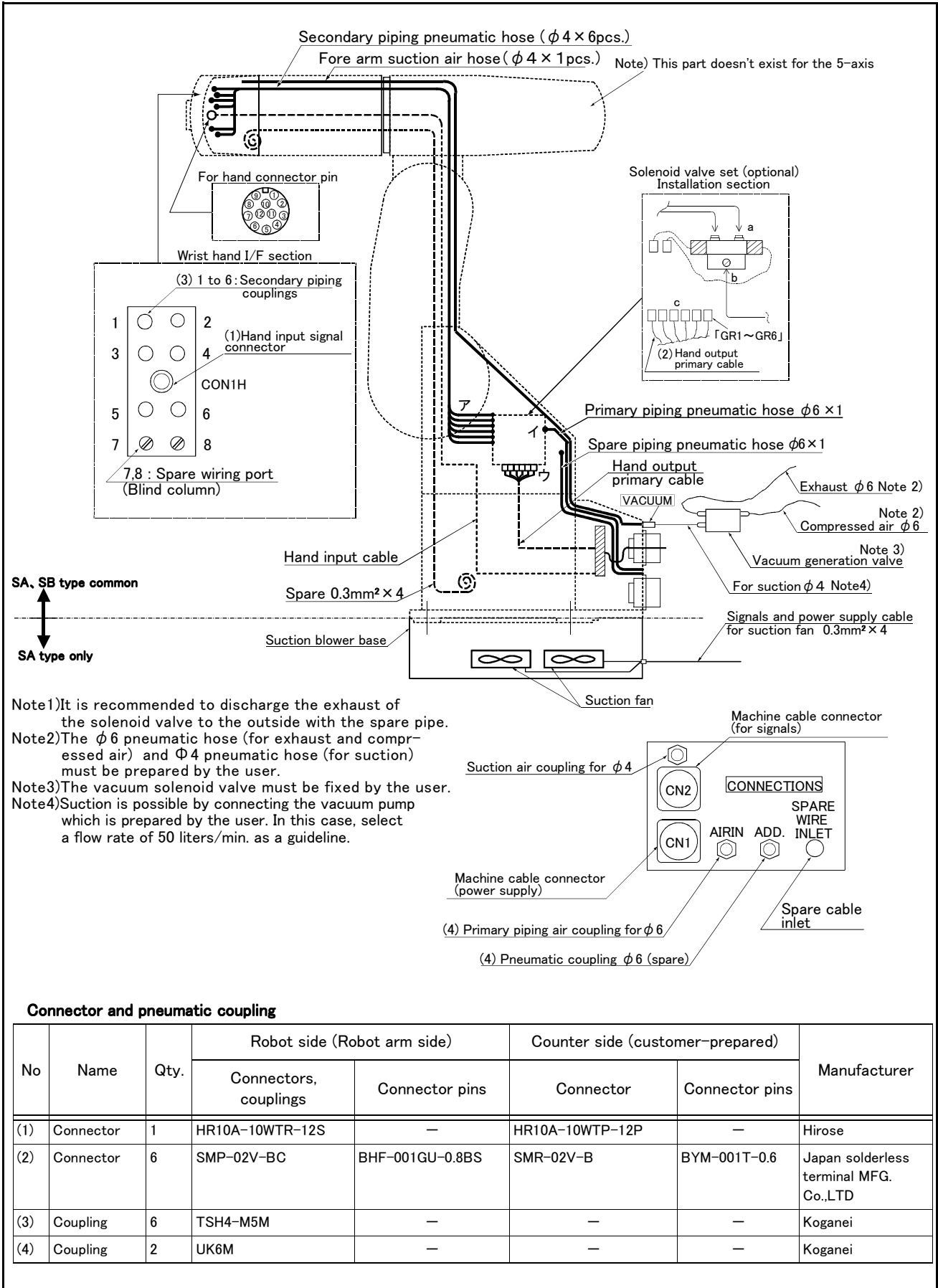


Fig.2-16 : Wiring and piping for hand(Clean type)

2.5.2 Internal air piping

(1) Standard type

- 1) The robot has two $\phi 6 \times 4$ urethane hoses from the pneumatic entrance on the base section to the shoulder cover.
- 2) One hose is the primary piping for the pneumatic equipment. The other is a spare piping for pneumatic blow, compulsion exhaust, or for the suction hand.
- 3) The robot has for a $\phi 4 \times 2.5$ urethane hose from the shoulder cover to the side of the fore arm. There are a total of 6 internal hoses.
- 4) All hose terminals have a hose bridge in the shoulder base. In the fore arm there are six pneumatic coupling bridges for the $\phi 4$ hoses.
- 5) The pneumatic inlet in the base section has a $\phi 6$ pneumatic coupling bridge.
- 6) The robot can have up to three pneumatic valve sets in the shoulder base (optional).
- 7) Refer to [Page 40](#), "(2) Solenoid valve set" for details on the electronic valve set (optional).

(2) Clean type

- 1) The clean type basically includes the same piping as the standard type.
- 2) In the clean type, the hose of $\Phi 4 \times 2.5$ is connected from the base section to inside the fore arm for suction. This hose is connected to the suction coupling ($\Phi 4$ size) of the base section. For use, connect it to the suction port of the vacuum pump or the coupling on the "VACUUM" side of the vacuum generating valve. Moreover, to clean the exhaust from the vacuum pump or vacuum generator, use the exhaust filter (prepared by the customer). [Table 2-3](#) shows the specifications of the vacuum generating valve.
- 3) To use the vacuum pump, assure a flow rate of 50 liters/min. or more.
- 4) Use clean air as the air supplied to the vacuum generator.
- 5) On SA type, the suction fan is provided at the bottom of the robot. To smoothen the internal suction of the suction fan, prepare the exhaust port on the installation surface of the customer.

Table 2-3 : Vacuum generating valve specifications

| Type | Maker | Air pressure |
|---------|---------|----------------|
| MEDT 10 | Koganei | 0.2 to 0.6 MPa |

2.5.3 Internal wiring for the pneumatic hand output cable(Standard type/Clean type)

- (1) When the controller uses the optional pneumatic hand interface (2A-RZ365), the hand output primary cable works as the pneumatic hand cable.
- (2) The hand output primary cable extends from the connector PCB of the base section to the inside of the shoulder. ($0.2\text{mm}^2 \times 2 : 6$ cables) The cable terminals have connector bridges for six hand outputs. The connector names are GR1 to GR6.

2.5.4 Internal wiring for the hand check input cable(Standard type/Clean type)

- (1) The hand check input cable is wired directly from the base. The terminal connects to the 1st to 6th pins and to the 9th and 10th pins of the connector in the fore arm section.
- (2) The hand check signal of the pneumatic hand is input by connecting this connector.
- (3) There is interior spare wiring ($0.3\text{mm}^2 \times 4$ cables) that extends from the base section to the side of the forearm. Both ends of the wire terminals are unprocessed. Use them under the following circumstances:
 - For folding as the hand output cable when installing the solenoid valve in outside the robot.
 - For when installing six or more hand I/O points for the sensor in the hand section (Connects to the parallel I/O general purpose input.)

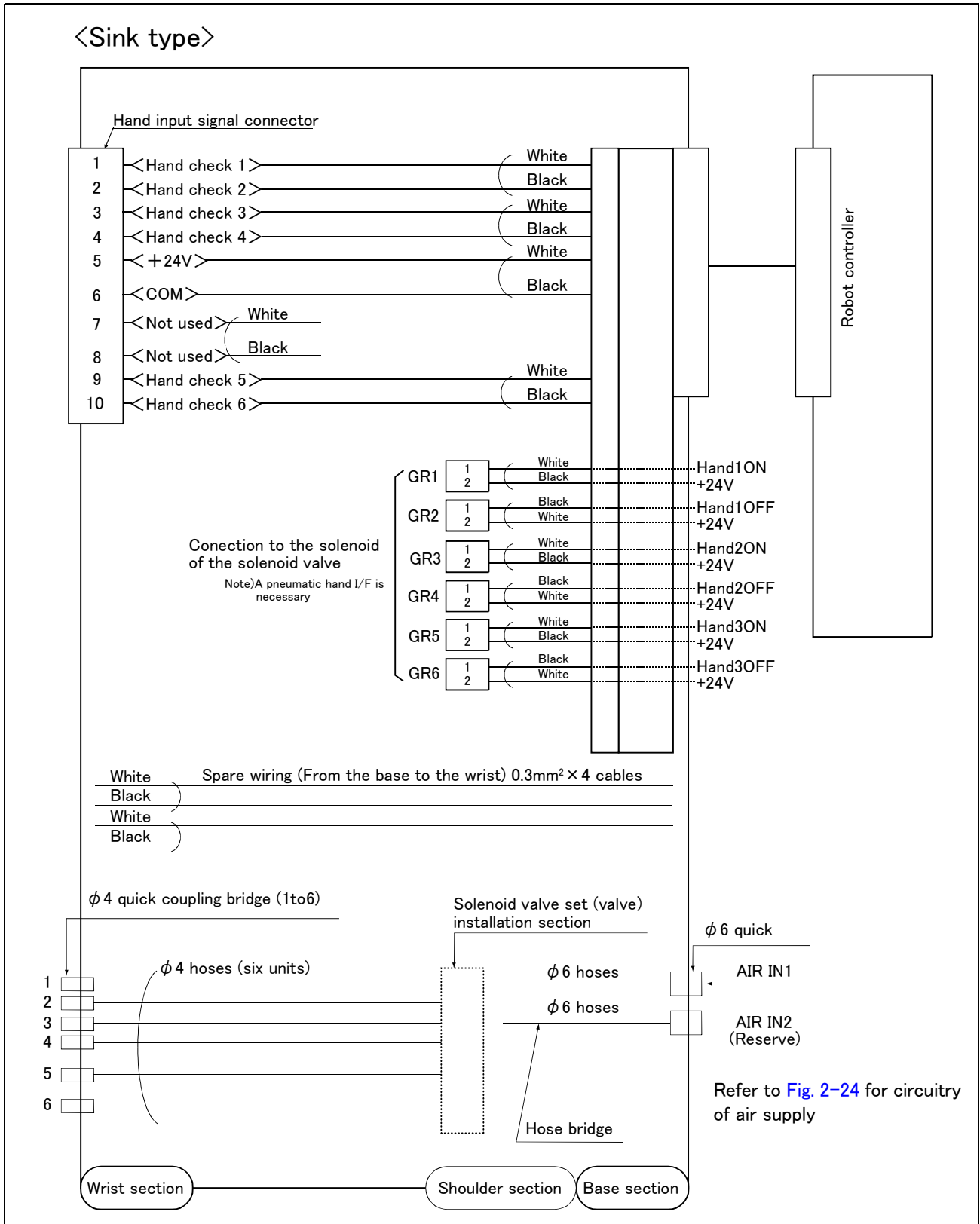


Fig.2-17 : Wiring and piping system diagram for hand and example the solenoid valve installation(Sink type)

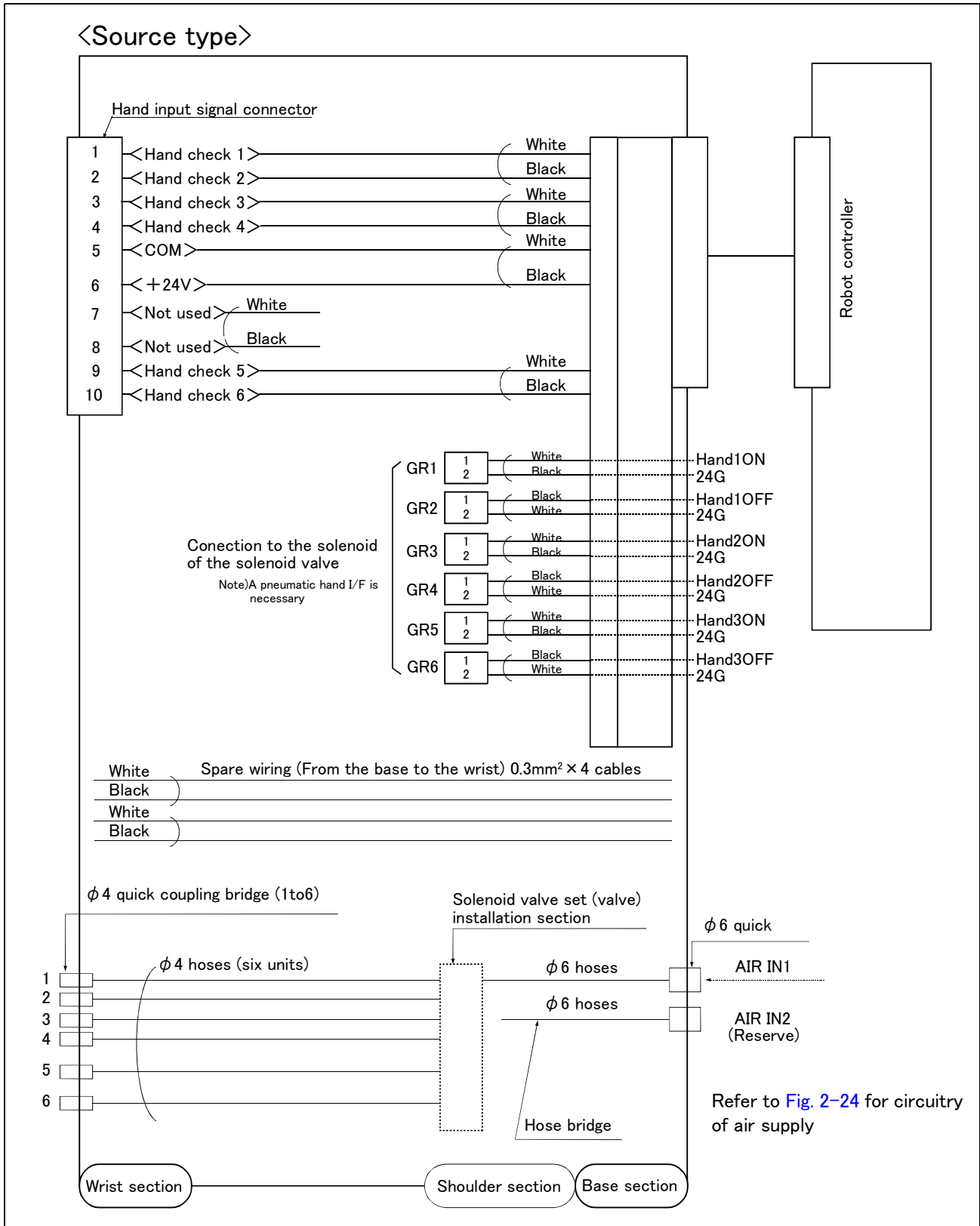


Fig.2-18 : Wiring and piping system diagram for hand and example the solenoid valve installation(Source type)
 Note) An optional air hand interface (2A-RZ365) is required to use hand output.

2.5.5 Rated load (mass capacity)

The robot's mass capacity is expressed solely in terms of mass, but even for tools and works of similar mass, eccentric loads will have some restrictions. When designing the tooling or when selecting a robot, consider the following issues.

- (1) The tooling should have the value less or equal than the smaller of the tolerable inertia and the tolerable moment found in [Page 5, "Table 2-1 : Tab Standard specifications of robot"](#).
- (2) [Fig. 2-19](#), [Fig. 2-20](#), [Fig. 2-21](#), and [Fig. 2-22](#) shows the distribution dimensions for the center of gravity in the case where the volume of the load is relatively small. Use this figure as a reference when designing the tooling.
- (3) When the load is not mass, but force, you should design the tooling so that it does not exceed the value for allowable moment described in [Page 5, "Table 2-1 : Tab Standard specifications of robot"](#).

[Caution] The mass capacity is greatly influenced by the operating speed of the robot and the motion posture. Even if you are within the allowable range mentioned previously, an overload or generate an overcurrnt alarm could occur. In such cases, it will be necessary to change the time setting for acceleration/deceleration, the operating speed, and the motion posture.

[Caution] The overhang amount of the load for the specified moment and inertia in this section is the dynamic limit value determined by the motor driving each axis and by the capacity of the reduction gears. Consequently, accuracy cannot be guaranteed for the entire tooling area. Since accuracy is based on the center point of the mechanical interface surface, position accuracy can diminish as you go away from the flange surface, or vibration can result, with tooling that is not rigid or that is long.

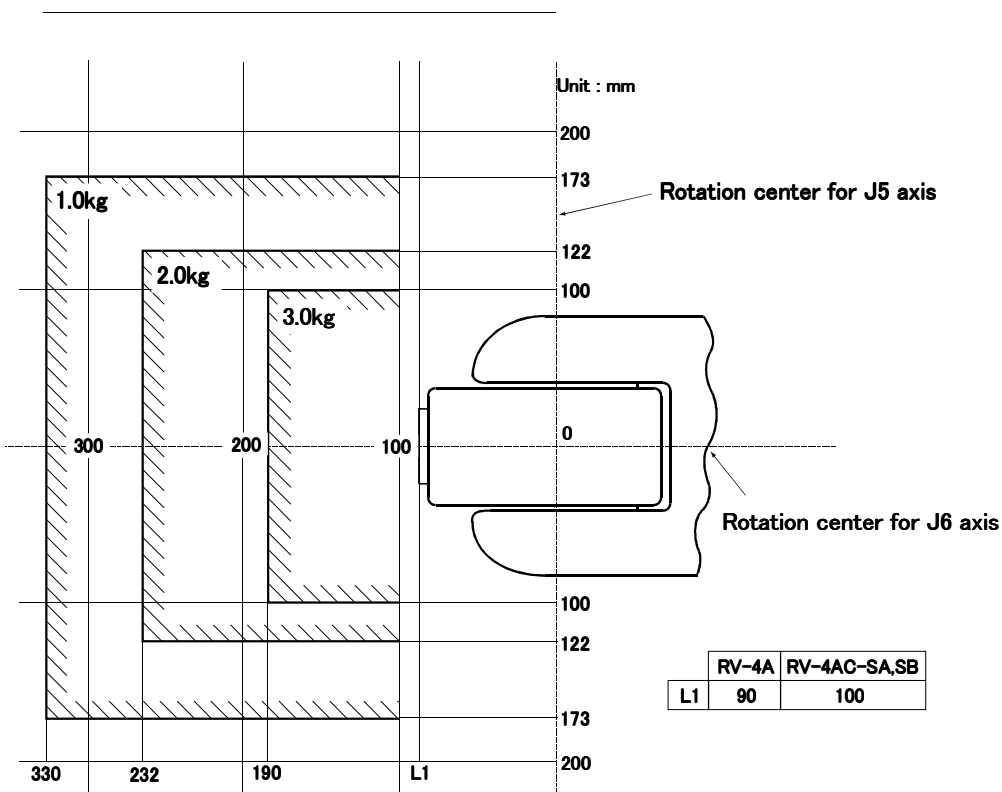


Fig.2-19 : Position of center of gravity for loads (for loads with comparatively small volume):RV-4A/4AC-SA,SB

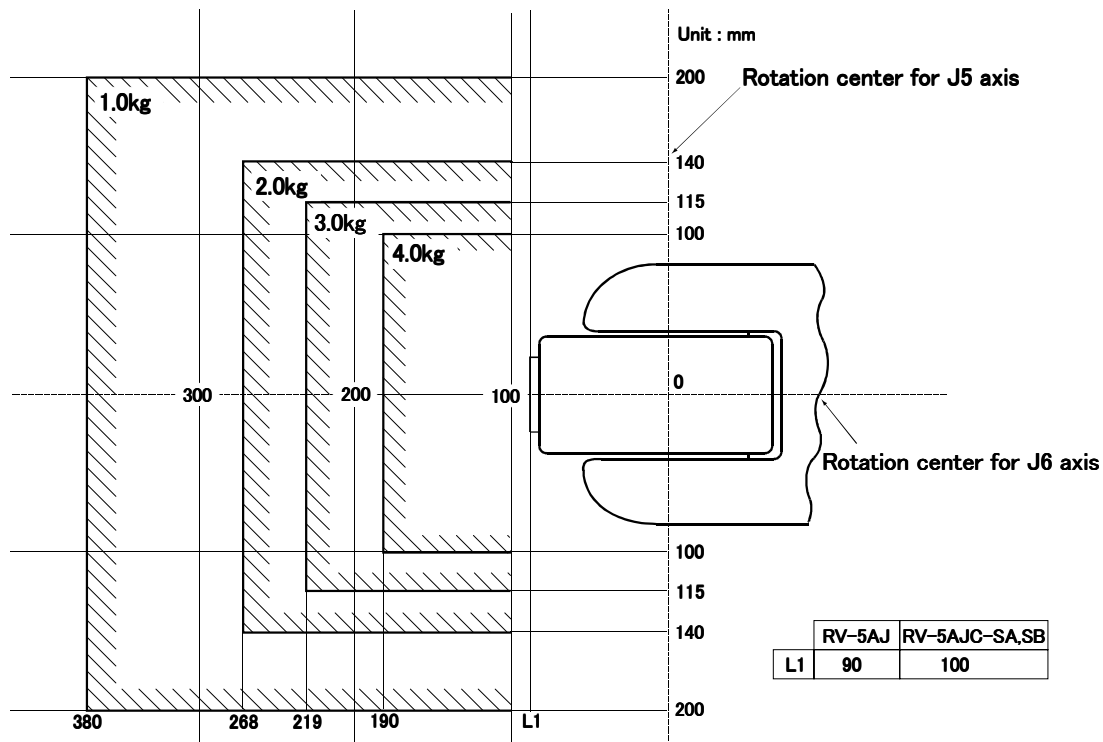


Fig.2-20 : Position of center of gravity for loads (for loads with comparatively small volume):RV-5AJ/5AJC-SA,SB

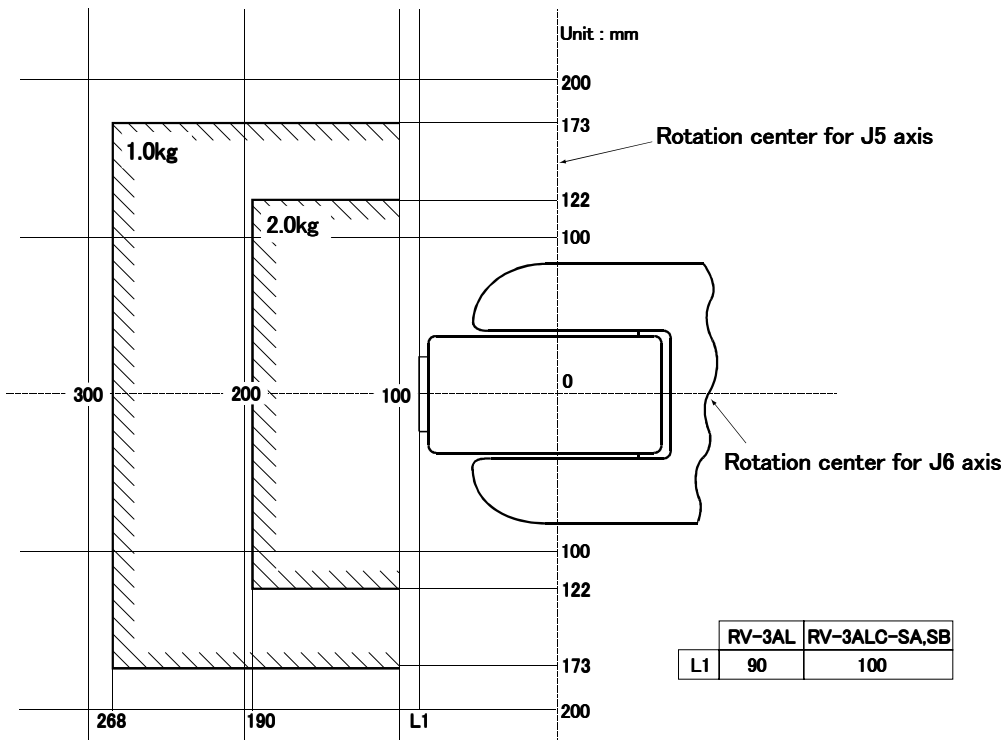


Fig.2-21 : Position of center of gravity for loads (for loads with comparatively small volume):RV-3AL/3ALC-SA,SB

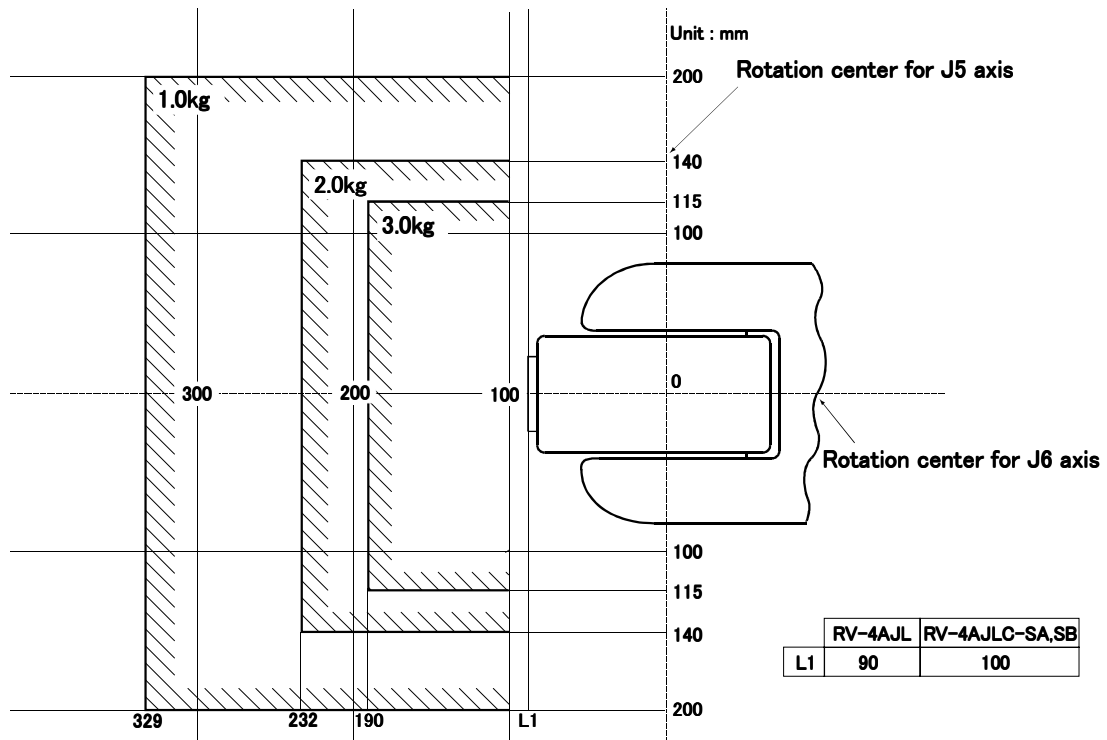


Fig.2-22 : Position of center of gravity for loads (for loads with comparatively small volume):RV-4AJL/4AJLC-SA,SB

2.5.6 Protection specifications and working environment

(1) Types of protection specifications

The robot arm has protection specifications that comply with the IEC Standards. The protection specifications and applicable fields are shown in [Table 2-4](#).

Table 2-4 : Protection specifications and applicable fields

| Type | Protection specifications (IEC Standards value) | Classification | Applicable field | Remarks |
|--------------------------------------|---|--|---|---|
| RV-4A RV-5AJ RV-3AL RV-4AJL | IP54F (drip-proof type) | General-purpose environment specifications | General assembly Slightly dusty environment | |
| | | Oil mist specifications | Machine tool (cutting) Machine shop with heavy oil mist Dusty work shop | Note that if the cutting machine contains abrasive materials, the machine line will be shortened. |

Note) Both the fixed and flexible machine cables are compatible with IP54F (drip-proof type).

The IEC IP symbols define the degree of protection against solids and fluids, and do not indicate a protective structure against the entry of oil or water.

The evaluation regarding oil mist specifications has been confirmed with Mitsubishi's standard testing methods using the cutting oils shown in [Table 2-5](#).

Table 2-5 : Tested cutting oil for oil mist specifications

| Name | Maker | Relevant JIS | Main characteristics | Application |
|--------------------|-----------------------------------|---------------|---|--|
| Yushiron oil No. 2 | Yushiron Chemical Co., (Japan) | Class 2 No. 2 | Fat oil: 5.0% Chlorine content: 2.0% | Cutting of nonferrous metal such as aluminum alloys, etc. Wide range of machining such as cutting of FC material. |

【Information】

• The IEC IP54

The IEC IP54 standard refers to protection structure designed to prevent any harmful effects by fresh water scattering vertically onto the testing equipment in a radius of 180 degrees from a distance of 300 to 500 mm, with 10 ± 0.5 liters of water every minute, at a water pressure of 80 to 100kPa, covering the entire area of the robot with the exception of the installation section at 1 m^2 per minute, for a total of 5 minutes or more.

(2) About the use with the bad environment

This robot has protection methods that conform to IEC's IP54 standards (splashproof type). It has protection structure designed to prevent harmful effects caused by splashing water coming from various directions, as the robot is operating.

Recommended usage conditions

- 1) The robot is designed for use in combination with machining device.
- 2) Please examine cutting oil referring to [Table 2-5](#) used by a standard examination of our company.
- 3) Take measures so that water, oil, and chips do not directly fall on the robot.

The warranty is invalid for any faults that occur when the robot is used under the following conditions.

- 1) In surroundings that generate inflammable gases or corrosive gasses.
- 2) Robot is used for cutting.
- 3) Atmosphere used excluding cutting oil shown in [Table 2-5](#).
- 4) In surroundings where water, oil, and chips fall directly on the robot.
- 5) In surroundings where chips fall directly on the robot. In surroundings where the minimum diameter of chips is less than 0.5mm.
- 6) In surroundings that generate a large amount of dust or oil mist.

2.5.7 Clean specifications

(1) Types of clean specifications

The robot arm clean specifications include the SA type and SB type shown in [Table 2-6](#).

Please confirm the delivery date, because both are special specifications.

Table 2-6 : Clean specifications

| Clean specifications | Type | Degree of cleanliness | Internal suction | Remarks |
|----------------------|--|-----------------------|---|---|
| Type SA | RV-4AC-SA RV-5AJC-SA RV-3ALC-SA RV-4AJLC-SA | 10(0.3 μ m) | Combination of internal suction with fan blower (installed in fan blower base), and concentrated suction with vacuum generating valve. (The concentrated suction is provided only for the 2nd arm section.) | A fan and vacuum generating valve (refer to Table 2-7) are enclosed. |
| Type SB | RV-4AC-SB RV-5AJC-SB RV-3ALC-SB RV-4AJLC-SB | 100(0.3 μ m) | Concentrated suction with vacuum generating valve. (The concentrated suction is provided only for the 2nd arm section.) | A vacuum generating valve (refer to Table 2-7) is enclosed. |

Table 2-7 : Specifications of vacuum generation valve

| Type | Maker | Air pressure |
|---------|---------|----------------|
| MEDT 10 | Koganei | 0.2 to 0.6 MPa |

■ Precautions for use

- 1) For the SA type, provide an exhaust hole on the robot installation surface.
The robot arm outline drawings are shown in [Table 2-4](#), [Table 2-7](#), [Table 2-10](#), and [Table 2-13](#) according to type for reference.
- 2) When using a device that moves or rotates the robot arm, the down flow may not be secured because of the air flow. In this case, the degree of cleanliness cannot be ensured.
- 3) For suction in the robot main unit, one hose of $\Phi 4 \times 2.5$ is routed from the inside of the fore arm to the joint at the rear of the base section. Prepare the hose of $\Phi 4 \times 2.5$ and connect this joint to the appended vacuum generating valve or the vacuum pump prepared by the customer.
 - * If the appended vacuum generating valve is used, connect the rear joint of the robot to the joint on the "VACUUM" side of the vacuum generating valve. Moreover, in order to prevent the exhaust of the vacuum generating valve from impairing the cleanliness, install the vacuum generating valve on the downstream side of the down flow or attach the filter to the exhaust section as possible.
Recommended filter: Exhaust filter EF300-02, Koganei Corporation
 - * If any vacuum pump is prepared by the customer, assure the flow rate of 50 liters/min. or more.
- 4) When using the Mitsubishi standard option solenoid valve set, use the spare piping ($\Phi 6$ pneumatic hose) of the primary piping to exhaust the air.
If the exhaust leaks into the robot arm, the degree of cleanliness could be affected.

(2) SA type suction fan wiring

The suction fan specifications are shown in Table 2-8, the suction fan signal wire specifications in Table 2-9, and the lock sensor output signal specifications in Fig. 2-23.

Table 2-8 : Suction fan specifications

| Item | Specification | Remarks |
|-----------------------------|--------------------|------------------------|
| Voltage used by fan (range) | 24V (20.4 ~ 27.6V) | |
| Rated current for fans | 0.14A x 2 | |
| Fan attachment function | Motion detection | |
| Cable Finished outline | φ 4.6mm | Flexible specification |

Table 2-9 : Signal cable specifications

| Wire color | Signal name | Function | Remarks |
|------------|--------------------------------|---------------------------------------|--|
| Black | Lock sensor output (Fan no. 1) | Rotary state of fan No. 1 is checked. | The specifications are shown in Fig. 2-23. |
| White | Lock sensor output (Fan no. 2) | Rotary state of fan No. 2 is checked. | |
| Red | +24V | Power is supplied for operation. | |
| Blue | GND | | |

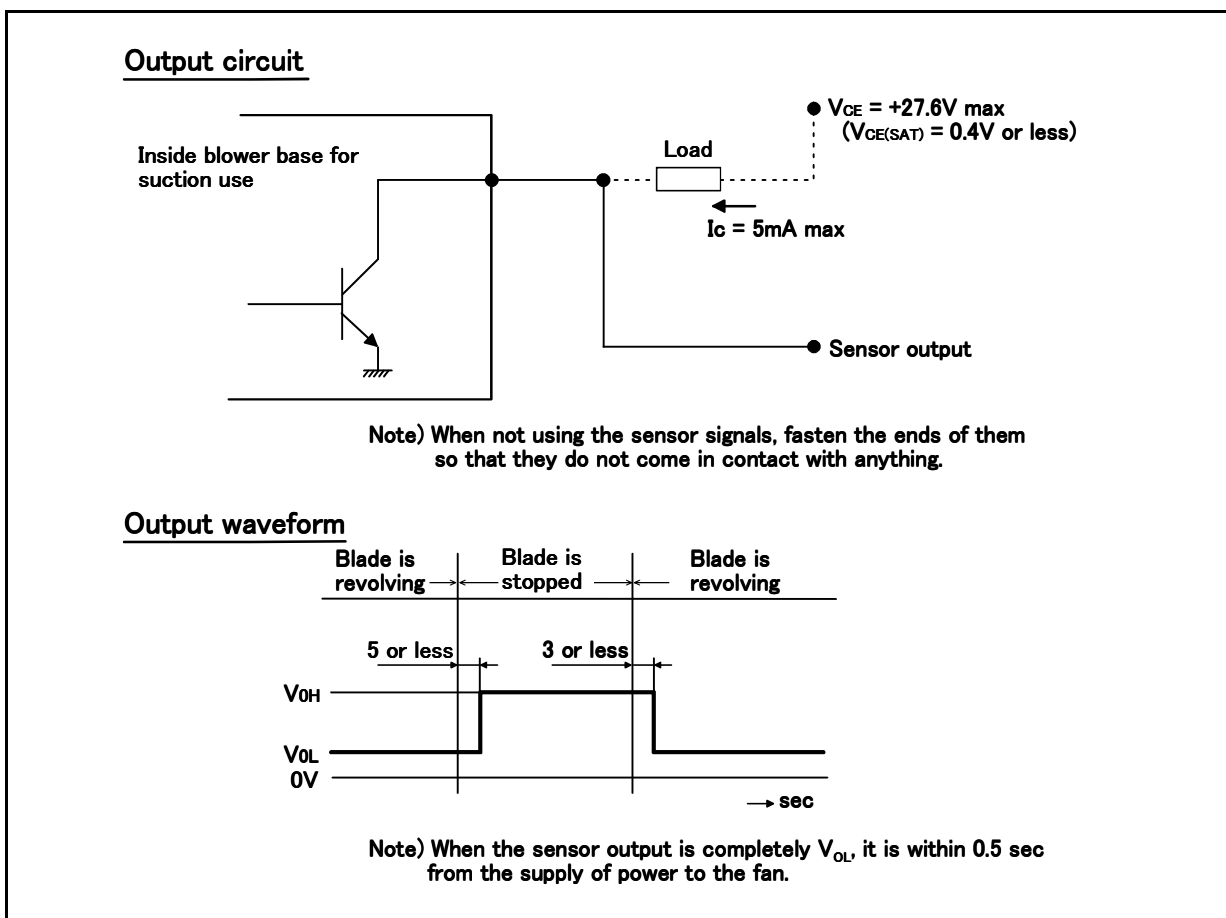


Fig.2-23 : Specifications for lock sensor signal

2.5.8 Air supply circuit example for the hand

Fig. 2-24 shows an example of pneumatic supply circuitry for the hand.

- (1) Place diodes parallel to the solenoid coil.
- (2) When the factory pneumatic pressure drops, as a result of the hand clamp strength weakening, there can be damage to the work. To prevent it, install a pressure switch to the source of the air as shown in Fig. 2-24 and use the circuit described so that the robot stops when pressure drops. Use a hand with a spring-pressure clamp, or a mechanical lock-type hand, that can be used in cases where the pressure switch becomes damaged.
- (3) The optional hand and solenoid valve are of an oilless type. If they are used, don't use any lubricator.
- (4) Supply clean air to the vacuum generation valve when you use clean type robot.

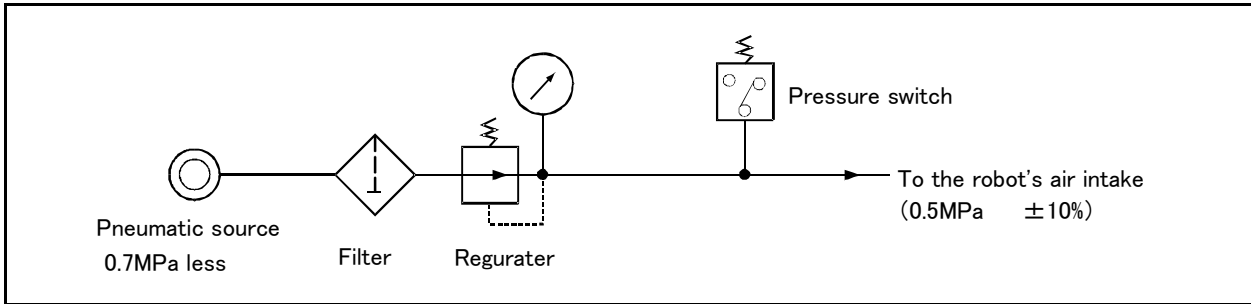


Fig.2-24 : Air supply circuit example for the hand

2.6 Shipping special specifications, options, and maintenance parts

2.6.1 Shipping special specifications

■ What are Shipping special specifications?

Shipping special specifications are changed at the time of shipment from the factory. Consequently, customer need to confirm the delivery date.

To make changes to the specifications after shipment, service work must be performed at the work site or the robot must be returned for service.

■ How to order

- (1) Confirm beforehand when the Factory special specifications can be shipped, because they may not be immediately available.
- (2) Order before the factory shipping date.
- (3) Specified method ····· Specify the part name, model, and robot model type.

(1) Machine cable extension

- Order model : ● Fixed type(10m) 1E-10CBL-N
- Fixed type(15m) 1E-15CBL-N
- Flexed type 1E-05LCBL-N
- Flexed type 1E-10LCBL-N
- Flexed type 1E-15LCBL-N

■ Outline



This cable is exchanged with the standard machine cable (5m) accessory to extend the distance between the controller and the robot arm.
 A fixed type and flexible type are available.
 Exchanges after shipment will be charged for (packaging, shipping costs).
 The fixing and flexible types are both configured of the motor signal cable and motor power cable .

■ Configuration

Table 2-10 : Configuration equipments and types

| Part name | Model | Qty. | | Remarks |
|--------------------------------------|------------------|---------|---------|----------------------|
| | | Fixed | Flexed | |
| Motor signal cable (for fixed type) | 1E- □□ CBL(S)-N | 1 cable | — | 10m, or 15m each |
| Motor power cable (for fixed type) | 1E- □□ CBL(P)-N | 1 cable | — | 10m, or 15m each |
| Motor signal cable (for flexed type) | 1E- □□ LCBL(S)-N | — | 1 cable | 5m, 10m, or 15m each |
| Motor power cable (for flexed type) | 1E- □□ LCBL(P)-N | — | 1 cable | 5m, 10m, or 15m each |
| Nylon clamp | NK-24N | — | 2 pcs. | |
| Nylon clamp | NK-16N | — | 2 pcs. | |
| Silicon rubber | | — | 4 pcs. | |

Note) The numbers in the boxes □□ refer the length.

■ Specifications

The specifications for the fixed type cables are the same as those for standard cables.
 Shows usage conditions for flexed type cables in [Table 2-11](#).

Table 2-11 : Conditions for the flexed type cables

| Item | Specifications | |
|---------------------------------|--|-------------------------|
| Minimum bending radius | 100R or more | |
| Cable bear isovolumetric ration | 50% or less | |
| Maximum movement speed | 2000mm/s or less | |
| Warranty life (no.) | 7.5 million times | |
| Environmental proof | Oil-proof specification sheath (for silicon grease, cable sliding lubricant type) | |
| Cable configuration | Motor power cable | φ 8.9 x 3 and φ 6.5 x 6 |
| | Motor signal cable | φ 7 x 6 and φ 1.7 x 1 |

[Caution] The warranty life may greatly differ according to the usage state (items related to [Table 2-11](#) and to the amount of silicon grease applied in the cable conduit.

■ Cable configuration

The configuration of the flexible cable is shown in Table 2-12. Refer to this table when selecting the cable bare.

Table 2-12 : Cable configuration

| Item | Motor signal cable 1E- □ □ LCBL(S)-N | | Motor power cable 1E- □ □ LCBL(P)-N | |
|-------------------|---|------------------------|--|-------------------------|
| | No.of cores | 0.2mm ² -4P | 0.75mm ² | 1.25mm ² -4C |
| Finish dimensions | Approx. φ 7mm | Approx. φ 1.7mm | Approx. φ 8.9mm | Approx. φ 6.5mm |
| No.of cables used | 6 cables | 1 cables | 3 cables | 6 cables |
| No. in total | 7 cables | | 9 cables | |

Note. The square in the cable name indicates the cable length.

■ Fixing the flexible cable

- (1) Connect the connector to the robot arm and controller.
- (2) Wind the silicon rubber around the cable at a position 300 to 400 mm from the robot arm and controller as shown in Fig. 2-25, and fix with the nylon clamp to protect the cable from external stress.

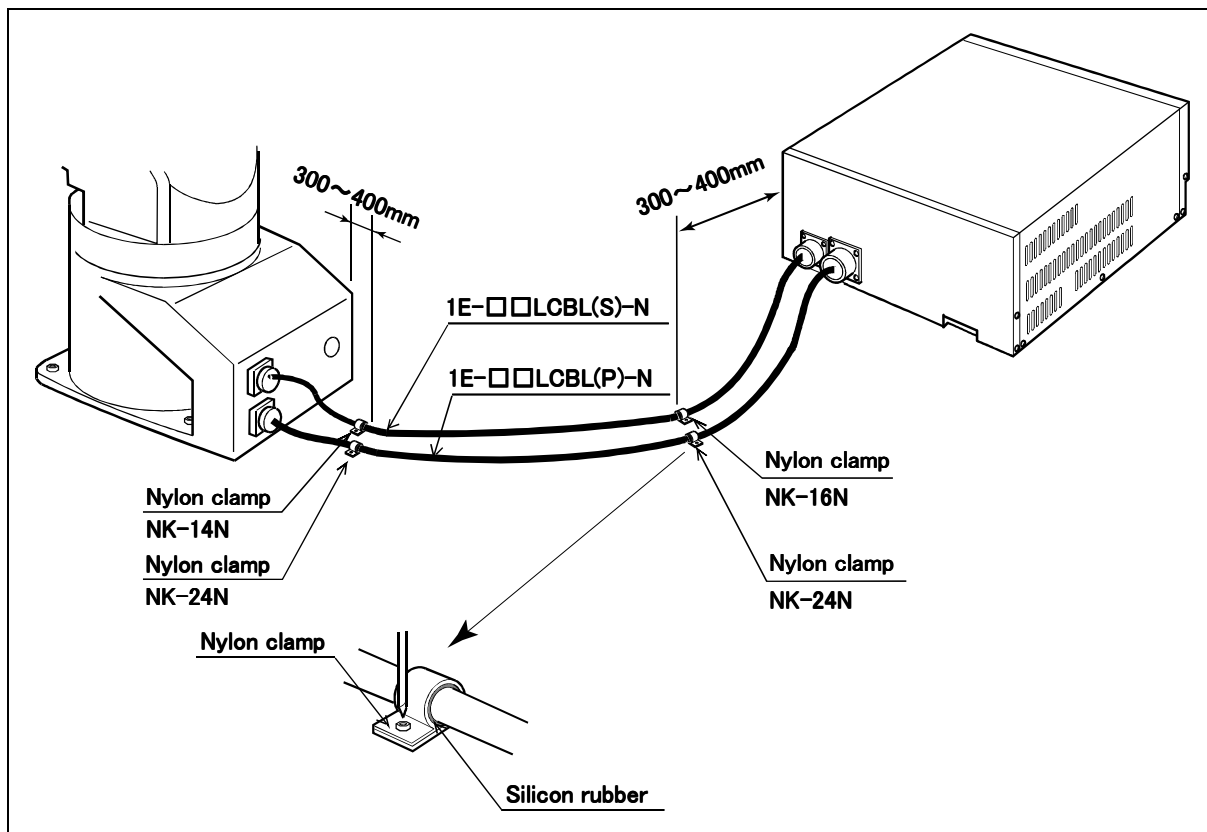


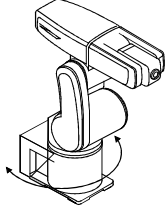
Fig.2-25 : Fixing the flexible cable

(2) Changing the operating range

■ Order type: 1E-DH □□□ - □□□

Note) □□□ indicates the [+ side angle]- [- side angle].
 Example) 1E-DH135-90: + angle is +135 degrees, - side is -90 degrees.

■ Outline



The J1 axis operating range is limited by the robot arm's mechanical stopper and the controller parameters.
 If the axis could interfere with the peripheral devices, etc., and the operating range need to be limited, use this.

■ Configuration

Table 2-13 : Configuration devices

| Part name | Type | Qty. | Remarks |
|------------------------|-----------------|-------|--|
| Operating range change | 1E-DH □□□ - □□□ | 1 pc. | The following work is done in our company. • The installation of the mecha stopper. • The change of the S/W parameter. |

■ Specifications

Table 2-14 : Robot arm operating range changeable angle

| Axis | | Standard | Changeable angle |
|------|--------|----------|------------------------------------|
| J1 | + side | +160° | One point from +135° , +90° , +45° |
| | - side | -160° | One point from -135° , -90° , -45° |

- (1) The changeable angle shown in [Table 2-14](#) indicates the operation range by the software.
 The limit by the mechanical stopper is positioned five degrees outward from that angle, so take care when designing the layout.
- (2) The changeable angle can be set independently on the + side and - side.
- (3) The movement range can be changed after shipment.
 Confer to dealer.

2.7 Options

■ What are options?

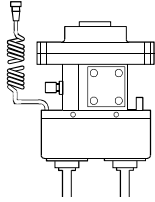
There are a variety of options for the robot designed to make the setting up process easier for customer needs. customer installation is required for the options. Options come in two types: "set options" and "single options".

1. Set optionsA combination of single options and parts that together, from a set for serving some purpose.
2. Single optionsThat are configured from the fewest number of required units of a part.
Please choose customer's purpose additionally.

(1) Pneumatic hand set

- Order type: 4E-HP02 (Sink type)
4E-HP02E (Source type)

■ Outline



Pneumatic hand and the required parts come in a set.
The hand has a life of 10 million cycles.
There is a sensor at the open/close end.

■ Configuration

Table 2-15 : Configuration equipment

| Part name | Type | Qty. | | Remarks |
|-------------------------------|--------------|---------|----------|--|
| | | 4E-HP02 | 4E-HP02E | |
| Pneumatic hand | 1E-HP01 | 1 pc. | - | Pneumatic hand body. |
| | 1E-HP01E | - | 1 pc. | |
| Hand curl tube (1 set: 2pc.) | 1A-ST0402C | 1 pc. | 1 pc. | Refer to the section on Page 45, "(5) Hand curl tube". |
| Curl cable | 1A-GHCD | 1 pc. | 1 pc. | |
| Pneumatic hand interface | 2A-RZ365 | 1 pc. | - | Refer to the section on Page 65, "(2) Pneumatic hand interface" |
| | 2A-RZ375 | - | 1 pc. | |
| Solenoid valve set (1 set) | 1E-VD01 | 1 pc. | - | Refer to the section on Page 40, "(2) Solenoid valve set". |
| | 1E-VD01E | - | 1 pc. | |
| Installation bolt (with hole) | M5 x 16 | 4 bolts | 4 bolts | |
| | M3 x 12 | 4 bolts | 4 bolts | |
| Adapter | BU144D697H01 | 1 pc. | 1 pc. | The adapter for installing the pneumatic hand to the robot's mechanical interface. |

■ Specifications

Table 2-16 : Pneumatic hand specifications

| Item | Specifications | Remarks | |
|--------------------------------|----------------------------------|------------------------------|---|
| Operating fluid | Clean air | | |
| Operating pressure range | 0.04 to 0.7MPa | | |
| Operating temperature range | 0 to 40 °C | | |
| Open/close stroke | 12 ₀ ⁺² mm | | |
| Life | 10 million cycles or more | | |
| Operating method | Double action | | |
| Mass | 0.45kg | Includes the adapter | |
| Open/close confirmation sensor | Open edge and close edge | | |
| Pneumatic coupling size | Φ4 (quick coupling) | Connection hose diameter: Φ4 | |
| Maximum load per finger | Radial | 686N | When installing the finger attachment, avoid shock or excessive moment to the tips. |
| | M _{po} moment | 6.07N · m | |
| | M _{ro} moment | 10.6N · m | |
| | M _{yo} moment | 5.88N · m | |

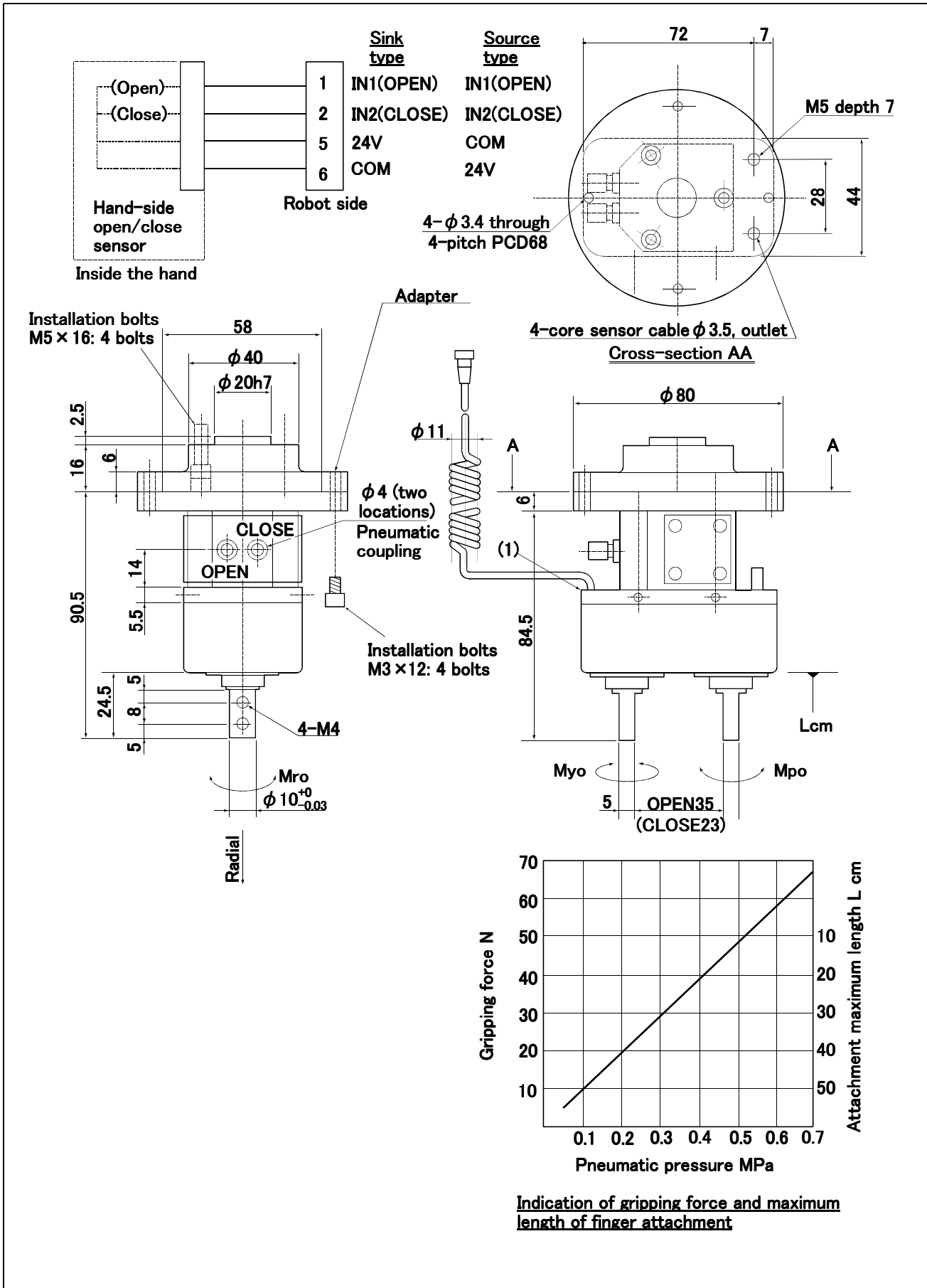
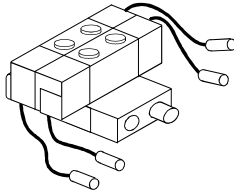


Fig.2-26 : Pneumatic hand outside dimensional drawing

(2) Solenoid valve set

- Order type: One set: 1E-VD01(Sink type)/1E-VD01E(Source type)
Two sets: 1E-VD02(Sink type)/1E-VD02E(Source type)
Three sets: 1E-VD03(Sink type)/1E-VD03E(Source type)

■ Outline



The solenoid valve set is an option that is used for controlling toolings when various toolings, such as the hand, are installed at the end of the arm. All have double solenoid specification, and either one or two or three sets can be selected. This solenoid valve set has a hand output cable attached to the solenoid valve. Also, for easy installation of this electromaagnetic set onto the robot, it comes equipped with a manifold, couplings, silencers, among other things.

When using the robot arm's hand output signal, the pneumatic hand interface option must be installed on the separate controller.

■ Configuration

Table 2-17 : Configuration equipment

| Part name | Type | Q'ty | | | Remark |
|-----------------------------|----------------------|---------|----------|------------|---|
| | | One set | Two sets | Three sets | |
| Solenoid valve set (1 set) | 1E-VD01/ 1E-VD01E | 1 pc. | — | — | Connecting the Page 43, "(4) Hand output cable". M3 x 25 Two screws (Installation screws) 1E-VD01/VD02/VD03 are the sink type. 1E-VD01E/VD02E/VD03E are the source type. |
| Solenoid valve set (2 sets) | 1E-VD02/ 1E-VD02E | — | 1 pc. | — | |
| Solenoid valve set (3 sets) | 1E-VD03/ 1E-VD03E | — | — | 1 pc. | |

■ Specifications

Table 2-18 : Valve specifications

| Item | Specifications |
|-------------------------------------|-----------------|
| Number of positions | 2 |
| Port | 5 |
| Valve function | Double solenoid |
| Operating fluid | Clean air |
| Operating method | Pilot type |
| Effective sectional area (CV value) | 1.5mm(0.08) |
| Oiling | Unnecessary |
| Operating pressure range | 0.2 to 0.7MPa |
| Guaranteed proof of pressure | 1.0MPa or more |
| Response time | 12msec or less |
| Max. operating frequency | 5c/s |
| Ambient temperature | -5 to 50 °C |

Table 2-19 : Solenoid specifications

| Item | Specifications |
|-----------------------|---|
| Method | Built-in fly-wheel diodes with surge protection |
| Operation voltage | DC24V ± 10% |
| Current value | 40mA |
| Insulation | B type |
| Insulation resistance | 100M Ω or more |
| Surge protection | Fly-wheel diode |

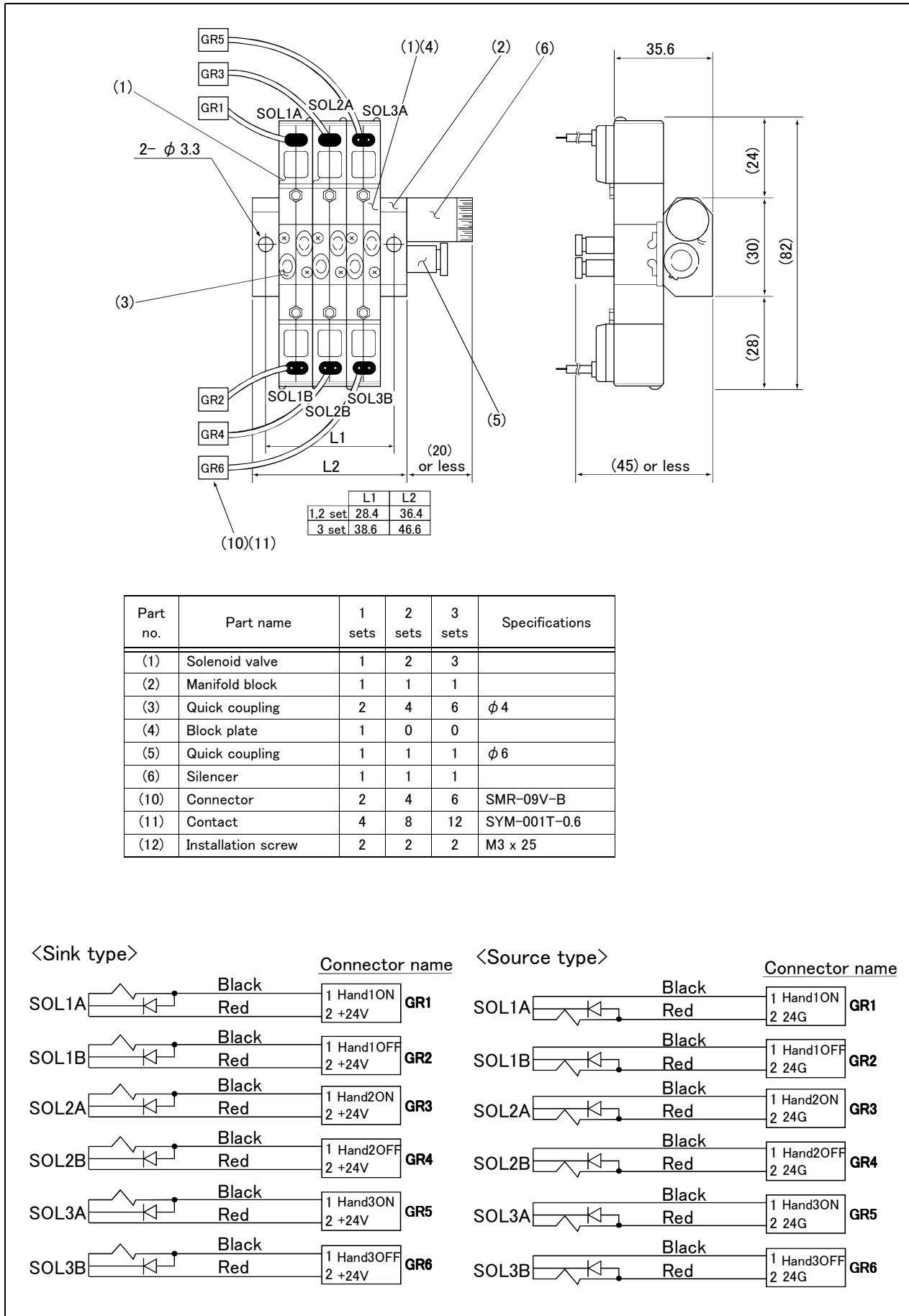


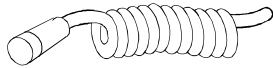
Fig.2-27 : Outline dimensional drawing

(3) Hand input cable

■ Order type: 1E-HC15C

■ Outline

The hand input cable is used for customer-designed pneumatic hands. It is necessary to use this to receive the hand's open/close confirmation signals and grasping confirmation signals, at the controller.



One end of the cable connects to the connector for hand input signals, which is in the wrist section of the hand. The other end of the cable connects to the sensor inside the hand customer designed.

■ Configuration

Table 2-20 : Configuration equipment

| Part name | Type | Qty. | Remarks |
|------------------|----------|---------|---------|
| Hand input cable | 1E-HC15C | 1 cable | |

■ Specifications

Table 2-21 : Specifications

| Item | Specifications | Remarks |
|-------------------|---|---------|
| Size x cable core | 0.2mm ² x 8 cores | |
| Total length | 370mm (Including the curl section, which is 150mm long) | |

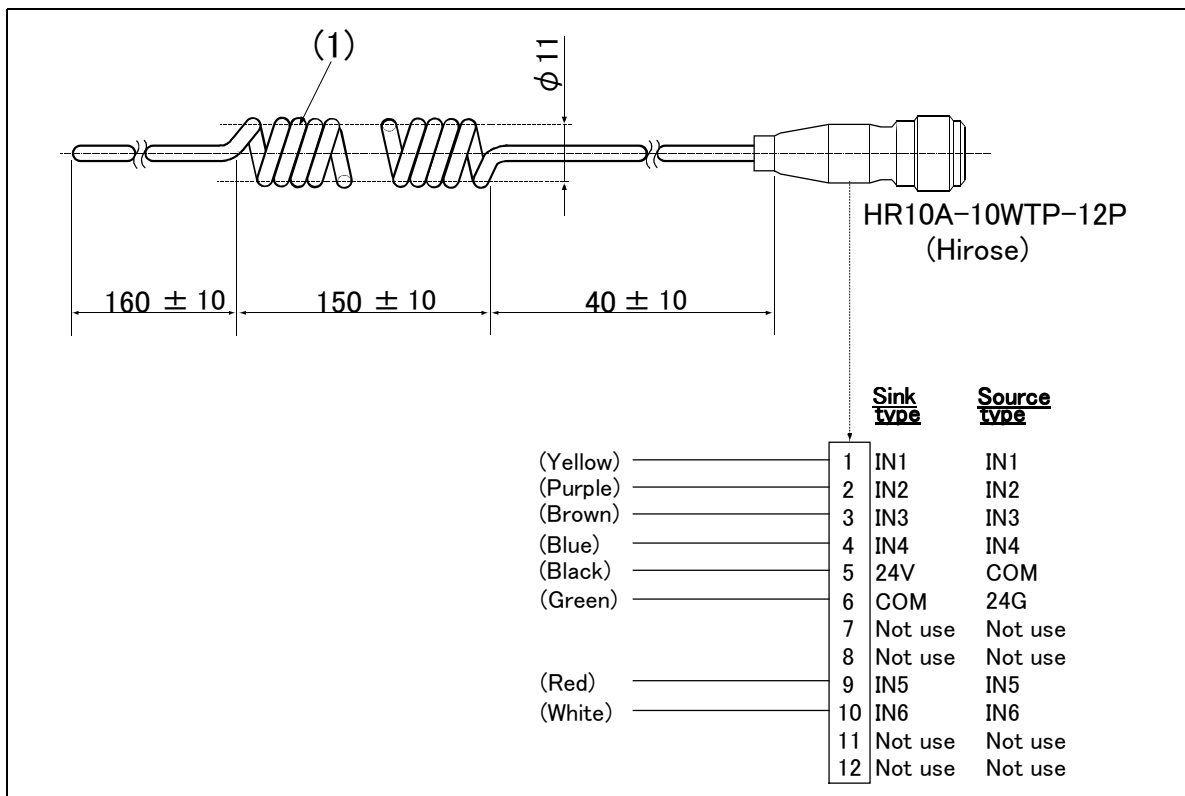
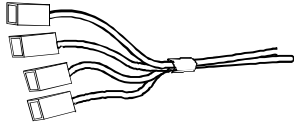


Fig.2-28 : Outside dimensional drawing and pin assignment

(4) Hand output cable

- Order type: One set and tow sets:1E-GR35S
 Three sets :1E-GR35S03

■ Outline



The hand output cable (solenoid valve connection cable) is an option that is used when an solenoid valve other than one of the solenoid valve set options, is used. One end of the cable has a connector that connects to the input terminal inside the robot. The other end of the cable is connected.

■ Configuration

Table 2-22 : Configuration equipment

| Part name | Type | Q'ty | | Remarks |
|-------------------|------------|---------------------|------------|--------------------------|
| | | One set Tow sets | Three sets | |
| Hand output cable | 1E-GR35S | 1 cable | | For one set and tow sets |
| | 1E-GR35S03 | | 1 cable | For tree sets |

■ Specifications

Table 2-23 : Specifications

| Item | Specifications | | Remarks |
|-------------------|--------------------------------|-------------------------------|--|
| | 1E-GR35S | 1E-GR35S03 | |
| Size x Cable core | 0.3mm ² x 2 cores | | One side connector and one side cable connection |
| Total length | 350mm | | |
| No. of set | Three sets(Six cores in total) | Tow sets(Four cores in total) | |

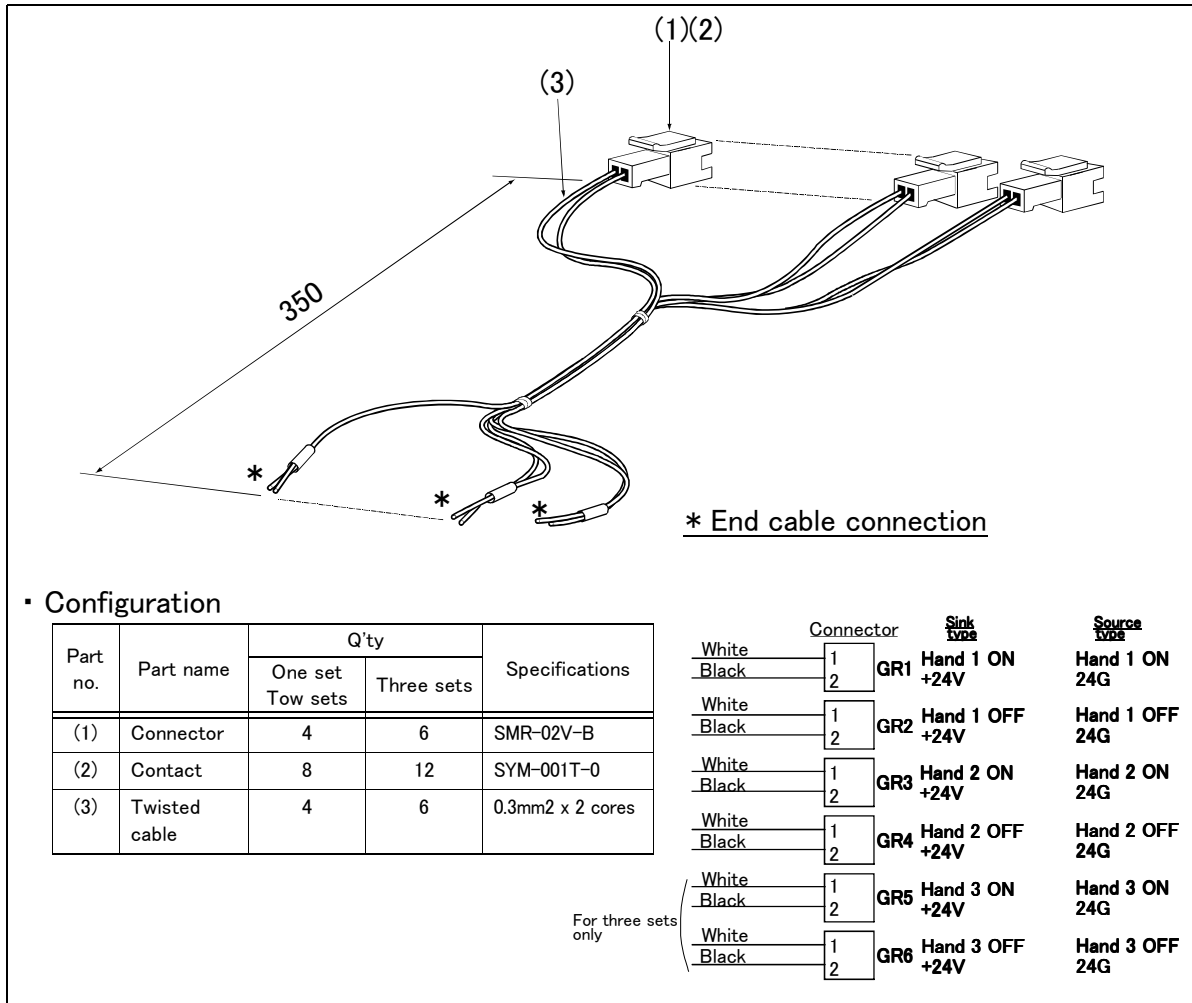


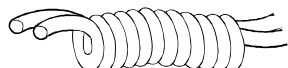
Fig.2-29 : Outline dimensional drawing and pin assignment

(5) Hand curl tube

- Order type: One set (2 pcs.) : 1E-ST0402C
- Two sets (4 pcs.) : 1E-ST0404C
- Three sets (6 pcs.) : 1E-ST0406C

■ Outline

The hand curl tube is a curl tube for the pneumatic hand.



■ Configuration

Table 2-24 : Configuration equipment

| Part name | Type | Qty. | Remarks |
|------------------------------------|------------|-------|---------------------------------|
| Hans curl tube (One set: 2 pcs.) | 1E-ST0402C | 1 pc. | For single-hand: Φ4 tube, 2pcs. |
| Hans curl tube (Two set: 4 pcs.) | 1E-ST0404C | 1 pc. | For double hand: Φ4 tube, 4pcs. |
| Hans curl tube (Three set: 6 pcs.) | 1E-ST0406C | 1 pc | For triple hand: Φ4 tube, 6pcs. |

■ Specifications

This option can be installed on clean-type, but its cleanliness is not under warranty.

Table 2-25 : Specifications

| Item | Specifications |
|----------|---|
| Material | Urethane |
| Size | Outside diameter: Φ4 x Inside diameter Φ2.5 |

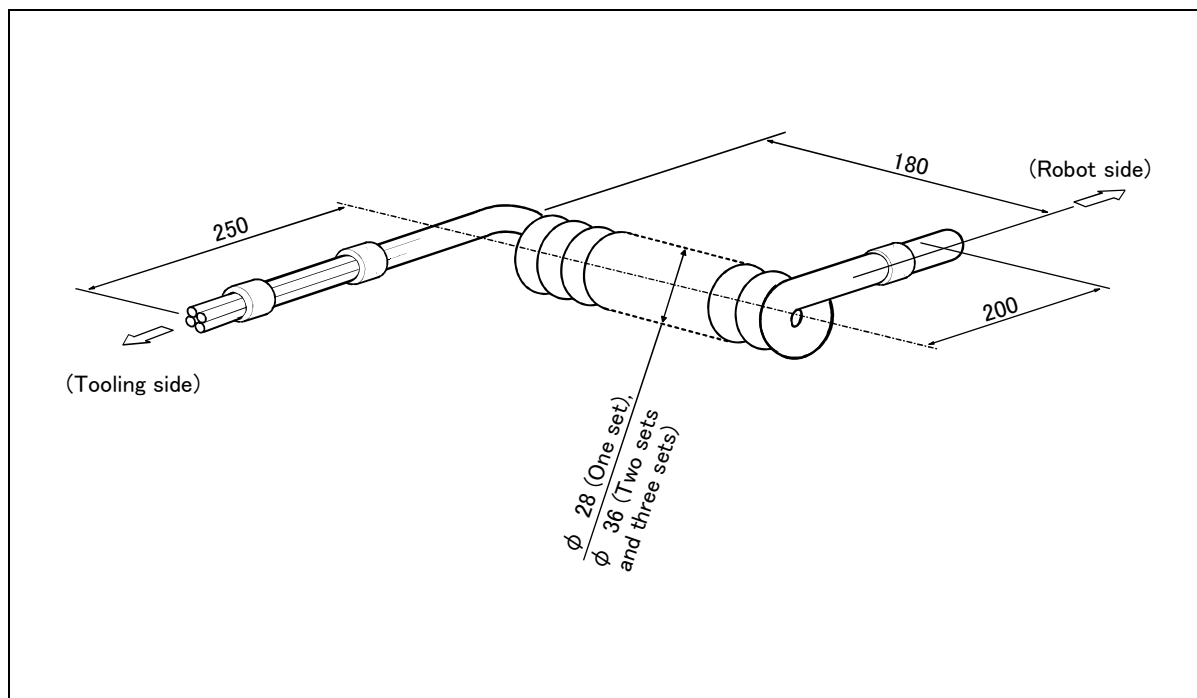


Fig.2-30 : Outline dimensional drawing

2.8 Maintenance parts

The consumable parts used in the robot arm are shown in [Table 2-26](#). Purchase these parts from the designated maker or dealer when required. Some Mitsubishi-designated parts differ from the maker's standard parts. Thus, confirm the part name, robot arm and controller serial No. and purchase the parts from the dealer.

Table 2-26 : Consumable part list

| No. | Part name | Type | Qty. | Usage place | Supplier |
|-----|-----------------|-------|-----------|----------------------------------|---------------------|
| 1 | Lithium battery | A6BAT | 4 | In the battery cover:5-axis type | Mitsubishi Electric |
| | | | 5 | In the battery cover:6-axis type | |
| 2 | Grrase | SK-1A | As needed | Reduction gears of each axis | |

3 Controller

3.1 Standard specifications

3.1.1 Standard specifications

Table 3-1 : Standard specifications of controller

| Item | | Unit | Specification | Remarks |
|-----------------------------|---------------------------------------|------------|--|---|
| Type | | | CR2-532 | |
| Number of control axis | | | Simultaneously 6(Maximum) | |
| CPU | | | 64 bit RISC, and DSP | |
| Memory capacity | Programmed positions and No. of steps | point step | 2,500 5,000 | |
| | Number of programs | | 88 | |
| Robot language | | | MELFA-BASIC IV | |
| Teaching method | | | Pose teaching method ,MDI method | |
| External input and output | input and output | point | 32/32 | Max. 256/256 ^{Note1)} |
| | Dedicated input/output | point | Assigned with general-purpose input/output | "STOP" 1 point is fixed |
| | Hand open/close input/output | point | Input 8 point/Output 0 point | Up to 8 output points can be added as an option ^{Note2)} |
| | Emergency stop input | point | 1 | Dual emergency line |
| Interface | RS-232C | port | 1 | |
| | RS-422 | port | 1 | Dedicated for T/B |
| | Hand dedicated slot | slot | 1 | Dedicated for pneumatic hand interface |
| | Expansion slot | slot | 2 | Extended option |
| | Memory expand slot | slot | 1 | Memory option |
| | Robot input/output link | channel | 1 | used for general-purpose input/output |
| Power source | Input voltage range | V | 3-phase, AC180 to 253 | ^{Note3)} |
| | Power capacity | KVA | 3.5 | Does not include rush current ^{Note4)} |
| Outline dimensions | | mm | 420(W)x510(D)x220(H) | |
| Mass | | kg | Approx.28 | |
| Construction | | | Self-contained floor type, Opened type | IP20 |
| Operating temperature range | | °C | 0 to 40 | |
| Ambient humidity | | %RH | 45 to 85 | Without dew drops |
| Grounding | | Ω | 100 or less | D class grounding earth ^{Note5)} |
| Paint color | | | Light gray | Munsell7.65Y7.64/0.73 |

Note1) It is the value when seven maximums expand (224/224) the Parallel I/O unit.

(2A-RZ361 or 2A-RZ371:Input 32 points / Output 32 points.)

Note2) It is when an pneumatic hand interface (2A-RZ365 or 2A-RZ375) is installed.

Note3) 1-phase, AC180 to 253. This specification is changed for CE-Marking model.

Note4) The power capacity (3.5kVA) is the maximum rating value for normal operation. The power capacity does not include the rush current when the power is turned ON. The power capacity is a guideline and the actual operation is affected by the input power voltage. The power consumption in the specific operation pattern with the RV-4A/5AJ is approx. 1kW.

Note5) The robot must be grounded by the customer.

3.1.2 Protection specifications and operating supply

A protection method complying with the IEC Standard IP20 (Opened type) is adopted for the controller.

IEC's IP symbols refer only to the degree of protection between the solid and the fluids, and don't indicated that any special protection has been constructed for the prevention against oil and water.

Refer to the section [Page 92, "5.2 Working environment"](#) for details on the working environment.

3.2 Names of each part

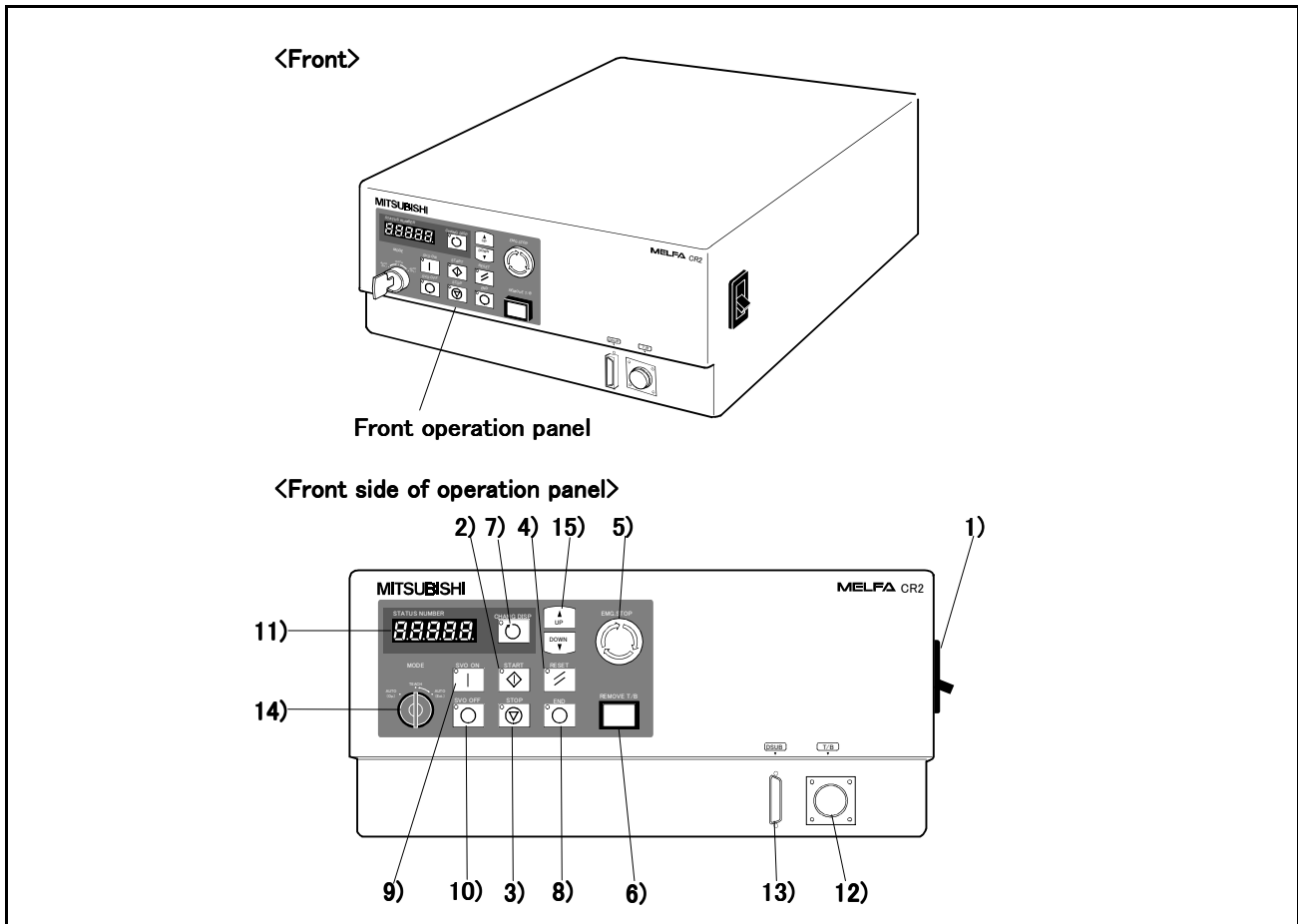


Fig.3-1 : Names of controller parts

- 1) POWER switch..... This turns the control power ON/OFF. (With earth leakage breaker function)
- 2) START button..... This executes the program and operates the robot. The program is run continuously.
- 3) STOP button..... This stops the robot immediately. The servo does not turn OFF.
- 4) RESET button..... This resets the error. This also resets the program's halted state and resets the program.
- 5) Emergency stop switch..... This stops the robot in an emergency state. The servo turns OFF.
- 6) T/B remove switch..... This is used to connect/disconnect the T/B without turning OFF the controller's control power.
- 7) CHNGDISP button..... This changes the details displayed on the display panel in the order of "Override" → "Program No." → "Line No.".
- 8) END button..... This stops the program being executed at the last line or END statement.
- 9) SVO.ON button..... This turns ON the servo power. (The servo turns ON.)
- 10) SVO.OFF button..... This turns OFF the servo power. (The servo turns OFF.)
- 11) STATUS NUMBER
(display panel)..... The alarm No., program No., override value (%), etc., are displayed.
- 12) T/B connection connector This is a dedicated connector for connecting the T/B.
- 13) Personal computer
connection connector..... This is an RS-232C specification connector for connecting the personal computer.
- 14) MODE key switch..... This changes the robot's operation mode.
- AUTO (Op.)..... Only operations from the controller are valid. Operations for which the operation mode must be at the external device or T/B are not possible.
- TEACH..... When the T/B is valid, only operations from the T/B are valid. Operations for which the operation mode must be at the external device or controller are not possible.
- AUTO (Ext.)..... Only operations from the external device are valid. Operations for which the operation mode must be at the T/B or controller are not possible.
- 15) UP/DOWN button..... This scrolls up or down the details displayed on the "STATUS. NUMBER" display panel.

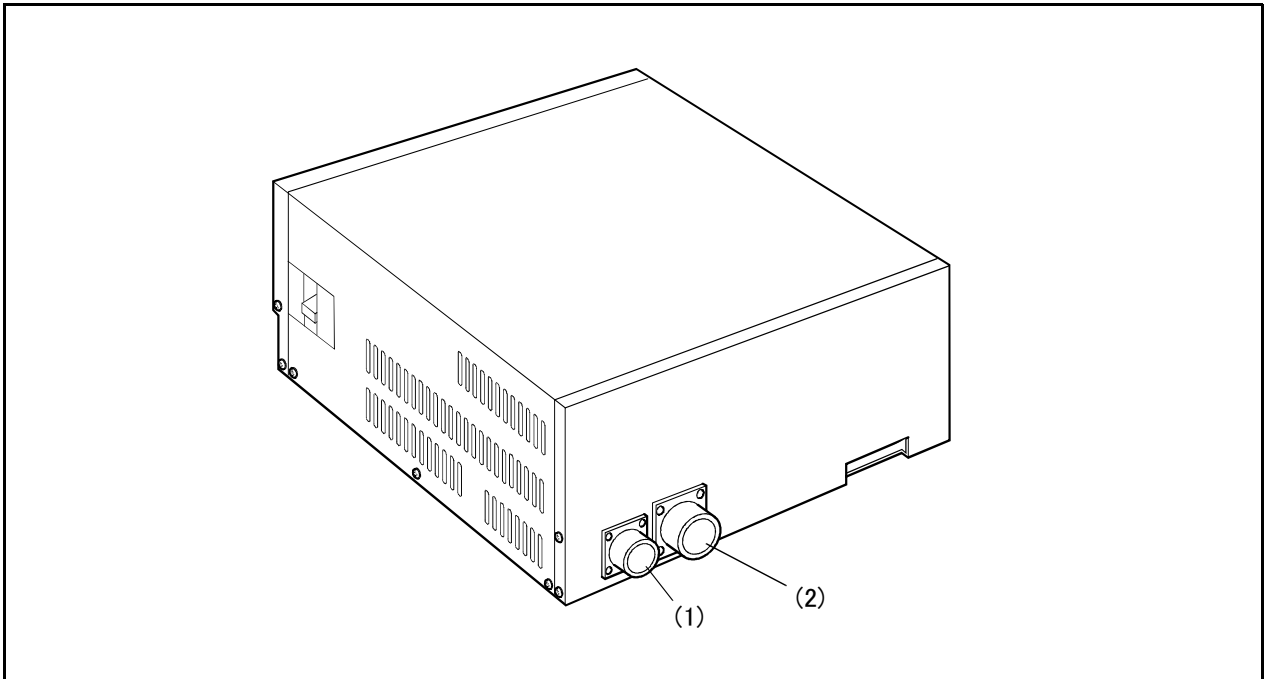


Fig.3-2 : Names of each controller part (Rear side)

- (1) Machine cable connector (for motor power) Connects to the robot arm base. (CN1 connector)
- (2) Machine cable connector (for motor signals)..... Connects to the robot arm base. (CN2 connector)

3.3 Outside dimensions/Installation dimensions

3.3.1 Outside dimensions

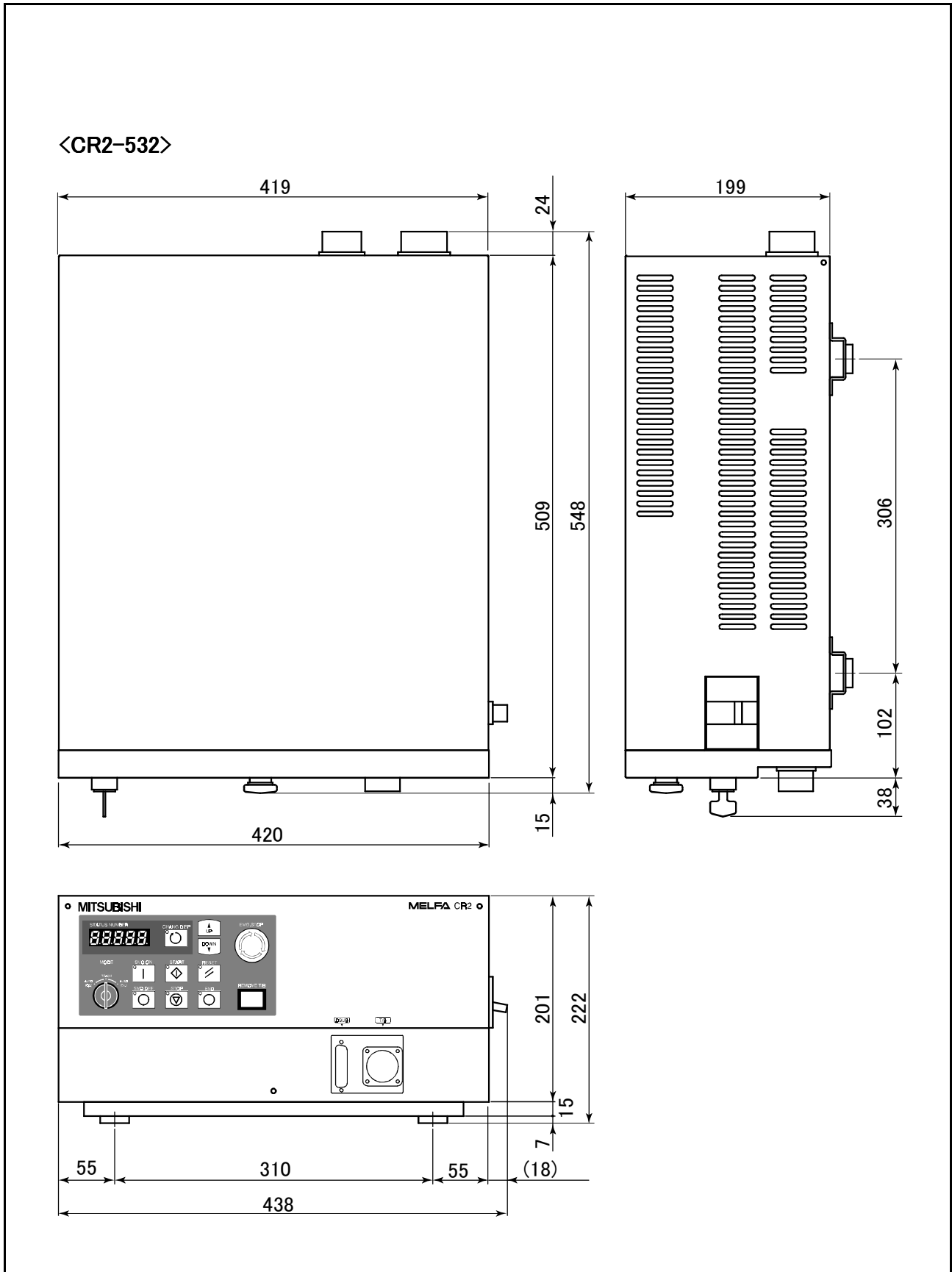


Fig.3-3 : Outside dimensions of controller

3.3.2 Installation dimensions

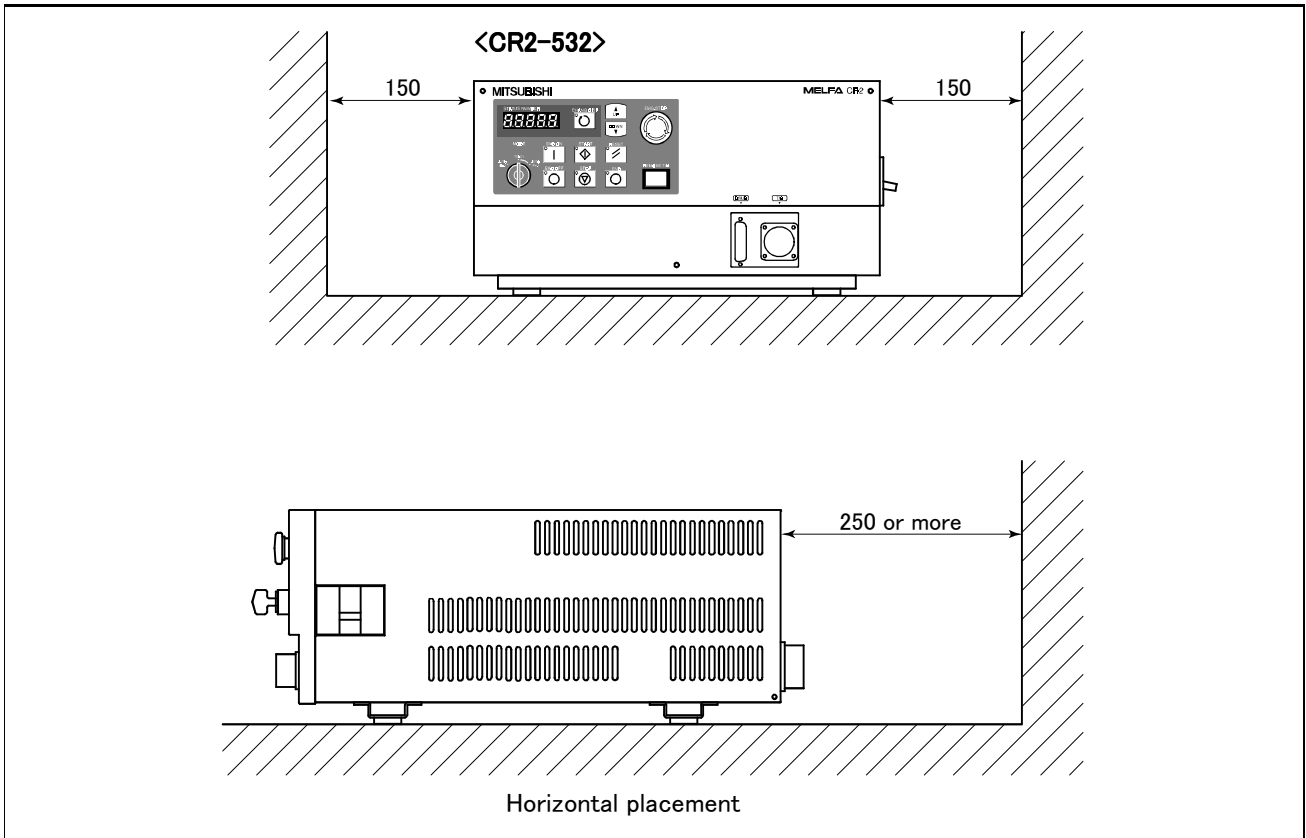


Fig.3-4 : Installation of controller

The controller can be installed vertically.
Contact your nearest dealer.

3.4 External input/output

3.4.1 Types

- (1) Dedicated input/output.....These inputs and outputs carry out the robot remote operation and status display.
- (2) General-purpose input/output.....These are inputs and outputs that the customer can program for peripheral device control.
- (3) Hand input/output.....These are inputs and outputs related to the hand that the customer can program. (The hand output is an option. The [Page 65, "\(2\) Pneumatic hand interface"](#) is required.)

| Class | Name | No. of input/output points | | Connection format |
|----------|-----------------------|--|--|-------------------|
| | | Input | Output | |
| Standard | Emergency stop | 1 | 0 | Terminal block |
| Standard | Parallel input/output | Occupies 32 general-purpose points/(6) dedicated points in general-purpose | Occupies 32 general-purpose points/(4) dedicated points in general-purpose | Connector |

3.4.2 Explanation

The parallel input/output unit uses connector bridging. Purchase the "External I/O cable" for connection with external devices.

The hand output is an option. Refer to [Page 65, "\(2\) Pneumatic hand interface"](#) for details

The parallel input/output unit can be expanded outside of the controller.

The expansion parallel input/output unit is connected with the control unit in the controller using a robot I/O link cable. Parallel input and output units can be expand as an option to seven maximums. With allows up to input 256 points and output 256 points of maximums can be used including 32 points input and 32 points output of standard.

Refer to [Page 68, "\(3\) Parallel I/O unit"](#) for details on the parallel input/output unit.

3.5 Dedicated input/output

The functions shown in Table 3-2 are provided for the dedicated input/output functions.

Each parameter indicated with the parameter name is used by designated the signal No., assigned in the order of input signal No. and output signal No. If the number of dedicated inputs and general-purpose input points used exceeds the standard No. of input/output points, install the parallel input /output unit (1st to 7th station: option).

Table 3-2 : Dedicated input/output list

| Parameter name | Input Note1) | | | Output | |
|--------------------------|---|--|-------|---|---|
| | Name | Function | Level | Name | Function |
| TEACHMD | None | | | Teaching mode output signal | Outputs that the teaching mode is entered. |
| ATTOPMD | None | | | Automatic mode output signal | Outputs that the automatic mode is entered. |
| ATEXTMD | None | | | Remote mode output signal | Outputs that the remote mode is entered. |
| AUTOENA | Automatic operation enabled input signal | Disables automatic operation when inactive, and enables automatic operation when active. | L | Automatic operation enabled output signal | Outputs the automatic operation enabled state. |
| START | Start input signal | Starts all slots. | E | Operating output signal | Outputs that the slot is operating. |
| STOP | Stop input signal | Stops all slots. The input signal No. is fixed to 0. Note) Use the emergency stop input for stop inputs related to safety. | L | Wait output signal | Outputs that the slot is temporarily stopped. |
| SLOTINIT | Slot initialization input signal | Resets the wait state, and initializes all slots. | E | Program selection enabled output signal | Outputs that the slot is in the program selection enabled state. |
| ERRRESET | Error reset input signal | Resets the error state. | E | Error occurring output signal | Outputs that an error has occurred. |
| CYCLE | Cycle stop input signal | Carries out cycle stop. | L | In cycle stop operation output signal | Outputs that the cycle stop is operating. |
| SRVOFF | Servo ON enabled input signal | Sets all mechanisms to servo ON enabled. | L | Servo ON enabled output signal | Outputs the servo ON enabled state. (Echo back) |
| SRVON | Servo ON input signal | Turns the servo ON for all mechanisms. | E | In servo ON output signal | Outputs the servo ON state. |
| IOENA | Operation rights input signal | Requests the operation rights for the external signal control. | E | Operation rights output signal | Outputs the operation rights valid state for the external signal control. |
| MELOCK | Machine lock input signal | Sets/resets the machine lock state for all mechanisms. | E | In machine lock output signal | Outputs the machine lock state. |
| SAFEPOS | Evasion point return input signal | Requests the evasion point return operation. | E | In evasion point return output signal | Outputs that the evasion point return is taking place. |
| OUTRESET | General-purpose output signal reset | Resets the general-purpose output signal. | E | None | |
| EMGERR | None | | | Emergency stop output signal | Outputs that an emergency stop has occurred. |
| S1START : S32START | Start input | Starts each slot. | E | In operation output | Outputs the operating state for each slot. |
| S1STOP : S32STOP | Stop input | Stops each slot. | L | In wait output | Outputs that each slot is temporarily stopped. |
| PRGSEL | Program selection input signal | esignates the setting value for the program No. with numeric value input signals. | E | None | |
| OVRDSEL | Override selection input signal | esignates the setting value for the override with the numeric value input signals. | E | None | |

| Parameter name | Input <small>Note1)</small> | | | Output | |
|---------------------------------|---|--|-------|---|---|
| | Name | Function | Level | Name | Function |
| IODATA <small>Note2)</small> | Numeric value input (start No., end No.) | Used to designate the program No., override value., mechanism value. | L | Numeric value output (start No., end No.) | Used to output the program No., override value., mechanism No. |
| PRGOUT | Program No. output request | Requests output of the program No. | E | Program No. output signal | Outputs that the program No. is being output to the numeric value output signal. |
| LINEOUT | Line No. output request | Requests output of the line No. | E | Line No. output signal | Outputs that the line No. is being output to the numeric value output signal. |
| OVRDOUT | Override value output request | Requests the override output. | E | Override value output signal | Outputs that the override value is being output to the numeric value output signal. |
| ERROUT | Error No. output request | Requests the error No. output. | E | Error No. output signal | Outputs that the error No. is being output to the numeric value output signal. |
| JOGENA | Jog valid input signal | Validates jog operation with the external signals | E | Jog valid output signal | Outputs that the jog operation with external signals is valid. |
| JOGM | Jog mode input 2-bit | Designates the jog mode. | L | Jog mode output 2-bit | Outputs the current jog mode. |
| JOG+ | Jog feed + side for 8-axes | Requests the + side jog operation. | L | None | |
| JOG- | Jog feed - side for 8-axes | Requests the - side jog operation. | L | None | |
| HNDERR1 : HNDERR5 | Mechanism 1 hand error input signal : Mechanism 5 hand error input signal | Requests the hand error occurrence. | L | Mechanism 1 hand error output signal : Mechanism 5 hand error output signal | Outputs that a hand error is occurring. |
| AIRERR1 : AIRERR5 | Mechanism 1 pneumatic pressure error input signal : Mechanism 5 pneumatic pressure error input signal | Request the pneumatic pressure error occurrence. | L | Mechanism 1 pneumatic pressure error output signal. : Mechanism 5 pneumatic pressure error output signal. | Outputs that a pneumatic pressure error is occurring. |
| USER-AREA ^{Note3)} | None | | | User-designated area 8-points | Outputs that the robot is in the user-designated area. |

Note1) The level indicates the signal level.

L: Level signal → The designated function is validated when the signal is ON, and is invalidated when the signal is OFF.

E: Edge signal → The designated function is validated when the signal changes from the OFF to ON state, and the function maintains the original state even when the signal then turns OFF.

Note2) Four elements are set in the order of input signal start No., end No., output signal start No. and end No.

Note3) Up to eight points can be set successively in order of start output signal No. and end output signal No.

3.6 Emergency stop input

This signal is input from the "emergency stop input" terminal in the controller.

Table 3-3 : Dedicated input terminals in controller

| Class | Name | Terminal size | Details |
|-------|----------------|---------------|--|
| Input | Emergency stop | M4 | Applies the emergency stop (2b contact). |

3.6.1 Connection of the external emergency stop

The external emergency stop input terminal block is short-circuited with a short piece at shipment as shown in Fig. 3-5.

Connect the external emergency stop switch with the following procedure. The emergency stop circuit in the controller is redundant (duplex), so use a 2-contact type switch for the emergency stop switch.

- 1) Prepare the "emergency stop switch" (2b contact).
- 2) Remove the plastic cover from the terminal block.
- 3) Remove the two short pieces 1 and 2.
- 4) Securely connect the external emergency stop's two contacts across "1-2 and 3-4" on the terminal block with an M4 screw.
- 5) Return the plastic cover to the original position.

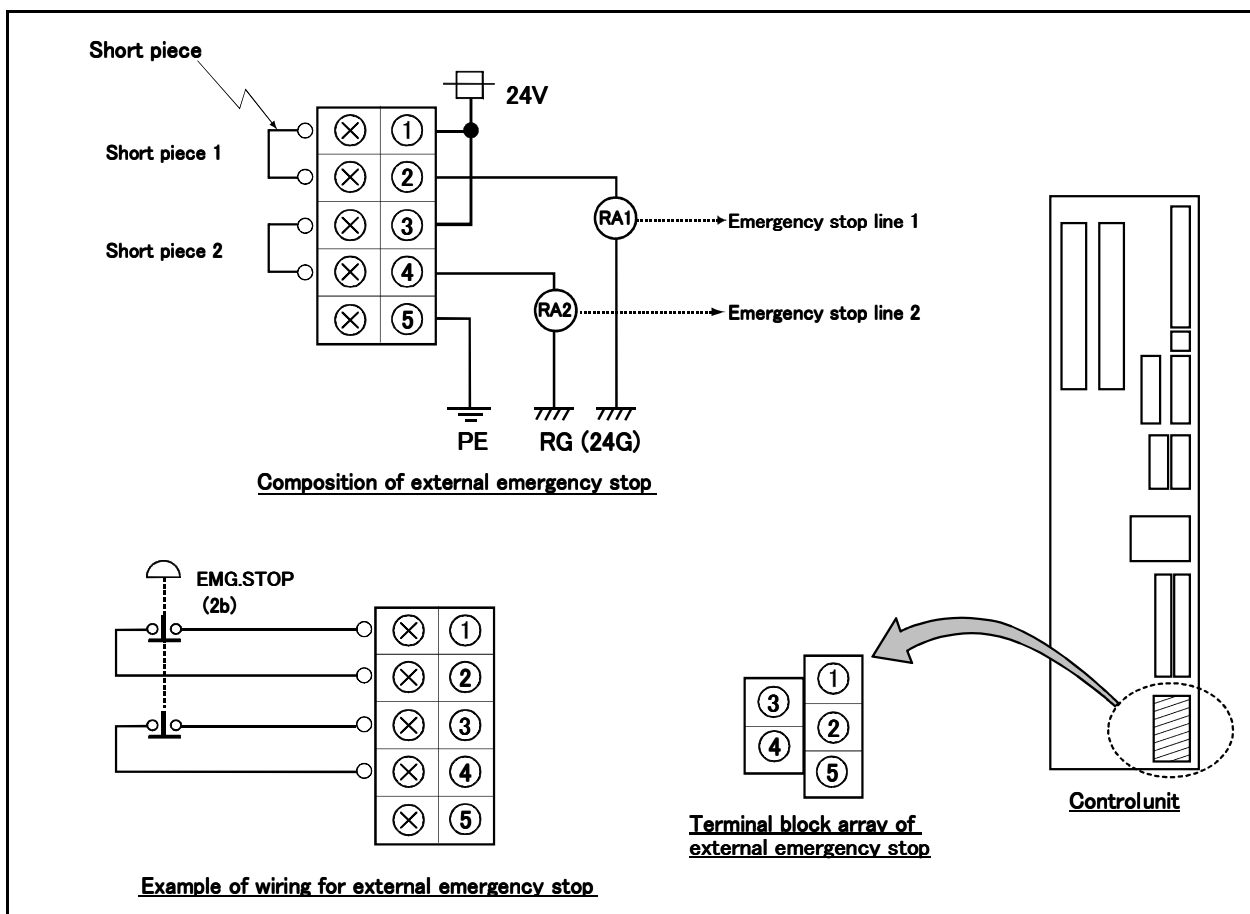


Fig.3-5 : Connection of the external emergency stop

[Note] Refer to Page 90, "5.1.7 Examples of safety measures" together, and carry out wiring to the emergency stop.

3.7 Parallel input/output unit

- A parallel input/output card is mounted as a standard in the controller's control unit.
- The external input/output circuit specifications are shown in [Table 3-4](#) and [Table 3-5](#).
- The correspondence of the external input/output connector pin No. and the colors of the connected "external input/output cable" wires (separate option) is as shown in [Page 59, "Table 3-6"](#) and [Table 3-7](#). Refer to [Page 76, "\(4\) External I/O cable"](#) for details of external I/O cable.
- Pin Nos. described as both general-purpose signal and dedicated signal can be shared.
- The other dedicated input/output signals that are not assigned can be assigned to required general-purpose input/output pins when creating the program.
- If the standard inputs and outputs are insufficient, install the parallel input/output unit connection option outside the controller.

Table 3-4 : Electrical specifications of input circuit

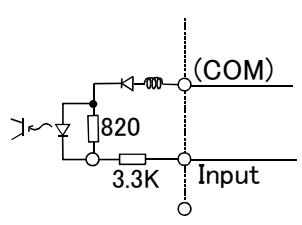
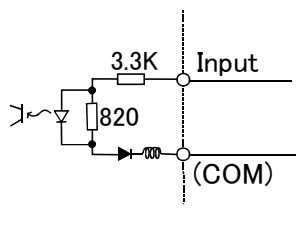
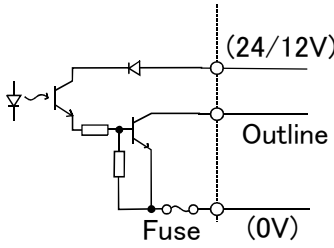
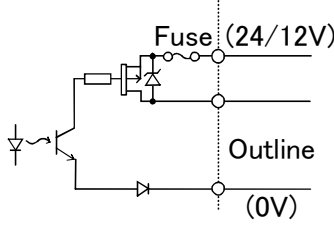
| Item | Specifications | | Internal circuit |
|---------------------------------|---|---------------------|---|
| Type | DC input | | <p><Sink type></p>  <p><Source type></p>  |
| No. of input points | 32 | | |
| Insulation method | Photo-coupler insulation | | |
| Rated input voltage | 12VDC/24VDC | | |
| Rated input current | Approx. 3mA/approx. 7mA | | |
| Working voltage range | 10.2VDC to 26.4VDC(ripple rate within 5%) | | |
| ON voltage/ON current | 8VDC or more/2mA or more | | |
| OFF voltage/OFF current | 4VDC or more/1mA or more | | |
| Input resistance | Approx. 3.3kΩ | | |
| Response time | OFF-ON | 10ms or less(DC24V) | |
| | ON-OFF | 10ms or less(DC24V) | |
| Common method | 8 points per common | | |
| External wire connection method | Connector | | |
| | | | |

Table 3-5 : Electrical specifications of output circuit

| Item | Specifications | | Internal circuit |
|---------------------------------|---|--|---|
| Type | Transistor output | | <p><Sink type></p>  <p><Source type></p>  |
| No. of output points | 32 | | |
| Insulation method | Photo-coupler insulation | | |
| Rated load voltage | DC12V/DC24V | | |
| Rated load voltage range | DC10.2 ~ 30V(peak voltage 30VDC) | | |
| Max. load current | 0.1A/point (100%) | | |
| Leakage current at OFF | 0.1mA or less | | |
| Max. voltage drop at ON | DC0.9V(TYP.) | | |
| Response time | OFF-ON | 2ms or less (hardware response time) | |
| | ON-OFF | 2ms or less (Resistance load) (hardware response time) | |
| Fuse rating | Fuse 3.2A (one per common) Replacement not possible | | |
| Common method | 4 points per common (common terminal: 4 points) | | |
| External wire connection method | Connector | | |
| External power supply | Voltage | DC12/24V(DC10.2 ~ 30V) | |
| | Current | 60mA (TYP. 24VDC per common) (base drive current) | |

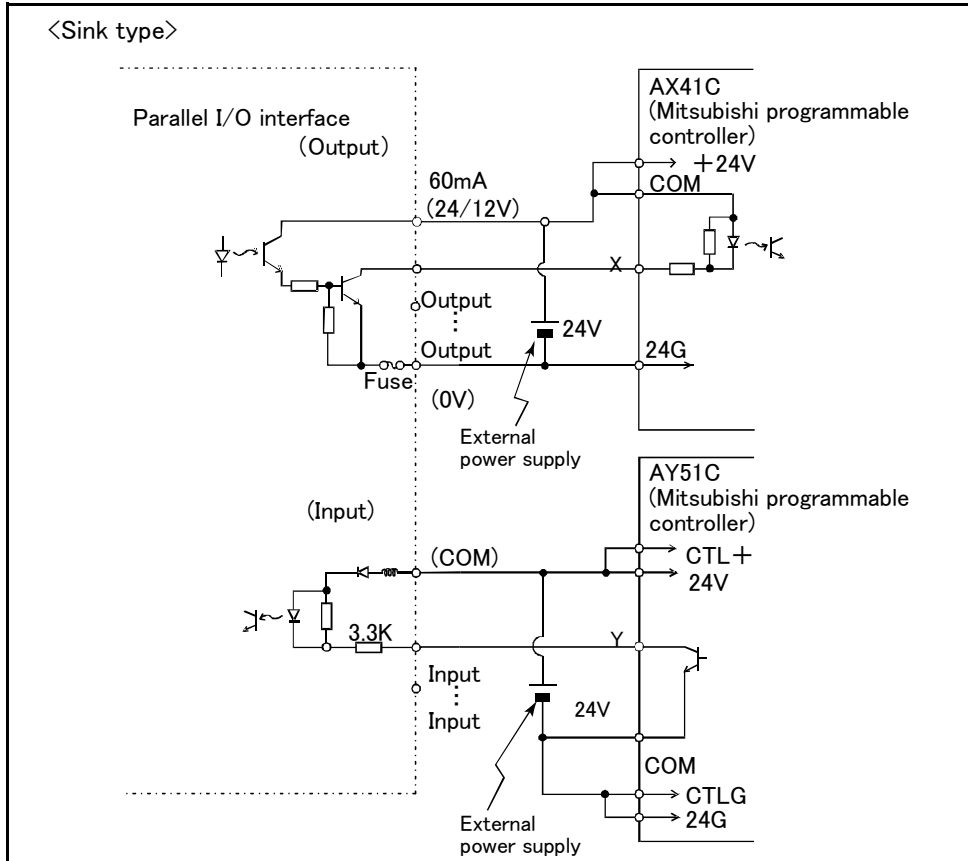


Fig.3-6 : Connection with a Mitsubishi PLC (Example of sink type)

*The input/output circuit external power supply (24 VDC) must be prepared by the customer.

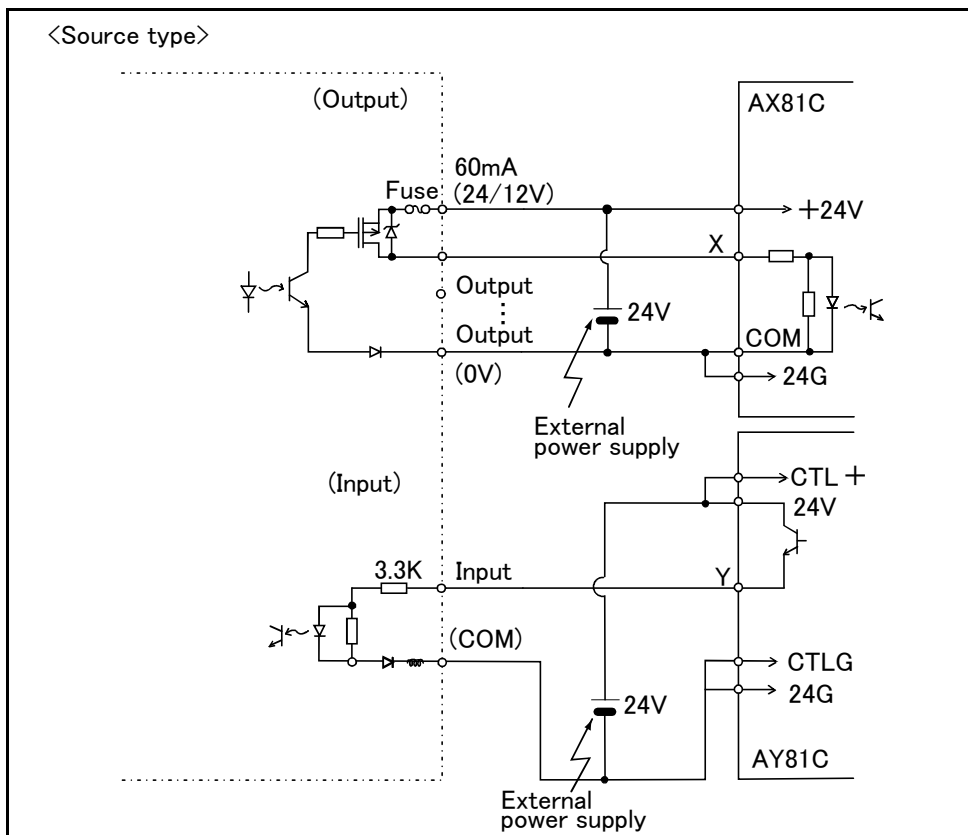


Fig.3-7 : Connection with a Mitsubishi PLC (Example of source type)

*The input/output circuit external power supply (24 VDC) must be prepared by the customer.

Table 3-6 : Standard parallel I/O interface CN100pin No. and signal assignment list <Sink type> (2A-CBL □□)

| Pin No. | Line color | Function name | | Pin No. | Line color | Function name | |
|---------|--------------|---------------------------|----------------------------------|---------|---------------|---------------------------|--------------------------------|
| | | General-purpose | Dedicated/power supply, common | | | General-purpose | Dedicated/power supply, common |
| 1 | Orange/Red A | | FG | 26 | Orange/Blue A | | FG |
| 2 | Gray/Red A | | 0V:For pins 4-7 | 27 | Gray/Blue A | | 0V:For pins 29-32 |
| 3 | White/Red A | | 12V/24V:For pins 4-7 | 28 | White/Blue A | | 12V/24V:For pins 29-32 |
| 4 | Yellow/Red A | General-purpose output 0 | Running | 29 | Yellow/Blue A | General-purpose output 4 | |
| 5 | Pink/Red A | General-purpose output 1 | Servo on | 30 | Pink/Blue A | General-purpose output 5 | |
| 6 | Orange/Red B | General-purpose output 2 | Error | 31 | Orange/Blue B | General-purpose output 6 | |
| 7 | Gray/Red B | General-purpose output 3 | Operation rights | 32 | Gray/Blue B | General-purpose output 7 | |
| 8 | White/Red B | | 0V:For pins 10-13 | 33 | White/Blue B | | 0V:For pins 35-38 |
| 9 | Yellow/Red B | | 12V/24V:For pins 10-13 | 34 | Yellow/Blue B | | 12V/24V:For pins 35-38 |
| 10 | Pink/Red B | General-purpose output 8 | | 35 | Pink/Blue B | General-purpose output 12 | |
| 11 | Orange/Red C | General-purpose output 9 | | 36 | Orange/Blue C | General-purpose output 13 | |
| 12 | Gray/Red C | General-purpose output 10 | | 37 | Gray/Blue C | General-purpose output 14 | |
| 13 | White/Red C | General-purpose output 11 | | 38 | White/Blue C | General-purpose output 15 | |
| 14 | Yellow/Red C | | COM0:For pins 15-22 | 39 | Yellow/Blue C | | COM1:For pins 40-47 |
| 15 | Pink/Red C | General-purpose input 0 | Stop(All slot) ^{Note1)} | 40 | Pink/Blue C | General-purpose input 8 | |
| 16 | Orange/Red D | General-purpose input 1 | Servo off | 41 | Orange/Blue D | General-purpose input 9 | |
| 17 | Gray/Red D | General-purpose input 2 | Error reset | 42 | Gray/Blue D | General-purpose input 10 | |
| 18 | White/Red D | General-purpose input 3 | Start | 43 | White/Blue D | General-purpose input 11 | |
| 19 | Yellow/Red D | General-purpose input 4 | Servo on | 44 | Yellow/Blue D | General-purpose input 12 | |
| 20 | Pink/Red D | General-purpose input 5 | Operation rights | 45 | Pink/Blue D | General-purpose input 13 | |
| 21 | Orange/Red E | General-purpose input 6 | | 46 | Orange/Blue E | General-purpose input 14 | |
| 22 | Gray/Red E | General-purpose input 7 | | 47 | Gray/Blue E | General-purpose input 15 | |
| 23 | White/Red E | | Reserved | 48 | White/Blue E | | Reserved |
| 24 | Yellow/Red E | | Reserved | 49 | Yellow/Blue E | | Reserved |
| 25 | Pink/Red E | | Reserved | 50 | Pink/Blue E | | Reserved |

Note1)The assignment of the dedicated input signal "STOP" is fixed.

Table 3-7 : Standard parallel I/O interface CN300pin No. and signal assignment list (2A-CBL □□)

| Pin No. | Line color | Function name | | Pin No. | Line color | Function name | |
|---------|--------------|---------------------------|--------------------------------|---------|---------------|---------------------------|--------------------------------|
| | | General-purpose | Dedicated/power supply, common | | | General-purpose | Dedicated/power supply, common |
| 1 | Orange/Red A | | FG | 26 | Orange/Blue A | | FG |
| 2 | Gray/Red A | | 0V:For pins 4-7 | 27 | Gray/Blue A | | 0V:For pins 29-32 |
| 3 | White/Red A | | 12V/24V:For pins 4-7 | 28 | White/Blue A | | 12V/24V:For pins 29-32 |
| 4 | Yellow/Red A | General-purpose output 16 | | 29 | Yellow/Blue A | General-purpose output 20 | |
| 5 | Pink/Red A | General-purpose output 17 | | 30 | Pink/Blue A | General-purpose output 21 | |
| 6 | Orange/Red B | General-purpose output 18 | | 31 | Orange/Blue B | General-purpose output 22 | |
| 7 | Gray/Red B | General-purpose output 19 | | 32 | Gray/Blue B | General-purpose output 23 | |
| 8 | White/Red B | | 0V:For pins 10-13 | 33 | White/Blue B | | 0V:For pins 35-38 |
| 9 | Yellow/Red B | | 12V/24V:For pins 10-13 | 34 | Yellow/Blue B | | 12V/24V:For pins 35-38 |
| 10 | Pink/Red B | General-purpose output 24 | | 35 | Pink/Blue B | General-purpose output 28 | |
| 11 | Orange/Red C | General-purpose output 25 | | 36 | Orange/Blue C | General-purpose output 29 | |
| 12 | Gray/Red C | General-purpose output 26 | | 37 | Gray/Blue C | General-purpose output 30 | |
| 13 | White/Red C | General-purpose output 27 | | 38 | White/Blue C | General-purpose output 31 | |
| 14 | Yellow/Red C | | COM0:For pins 15-22 | 39 | Yellow/Blue C | | COM1:For pins 40-47 |
| 15 | Pink/Red C | General-purpose input 16 | | 40 | Pink/Blue C | General-purpose input 24 | |
| 16 | Orange/Red D | General-purpose input 17 | | 41 | Orange/Blue D | General-purpose input 25 | |
| 17 | Gray/Red D | General-purpose input 18 | | 42 | Gray/Blue D | General-purpose input 26 | |
| 18 | White/Red D | General-purpose input 19 | | 43 | White/Blue D | General-purpose input 27 | |
| 19 | Yellow/Red D | General-purpose input 20 | | 44 | Yellow/Blue D | General-purpose input 28 | |
| 20 | Pink/Red D | General-purpose input 21 | | 45 | Pink/Blue D | General-purpose input 29 | |
| 21 | Orange/Red E | General-purpose input 22 | | 46 | Orange/Blue E | General-purpose input 30 | |
| 22 | Gray/Red E | General-purpose input 23 | | 47 | Gray/Blue E | General-purpose input 31 | |
| 23 | White/Red E | | Reserved | 48 | White/Blue E | | Reserved |
| 24 | Yellow/Red E | | Reserved | 49 | Yellow/Blue E | | Reserved |
| 25 | Pink/Red E | | Reserved | 50 | Pink/Blue E | | Reserved |

- The signals assigned as dedicated inputs can be used as general-purpose inputs during program execution. Note that for safety proposes, these should not be shared with the general-purpose inputs other than for numeric value inputs. The signals assigned as dedicated outputs cannot be used in the program. An alarm will occur during operation if used.

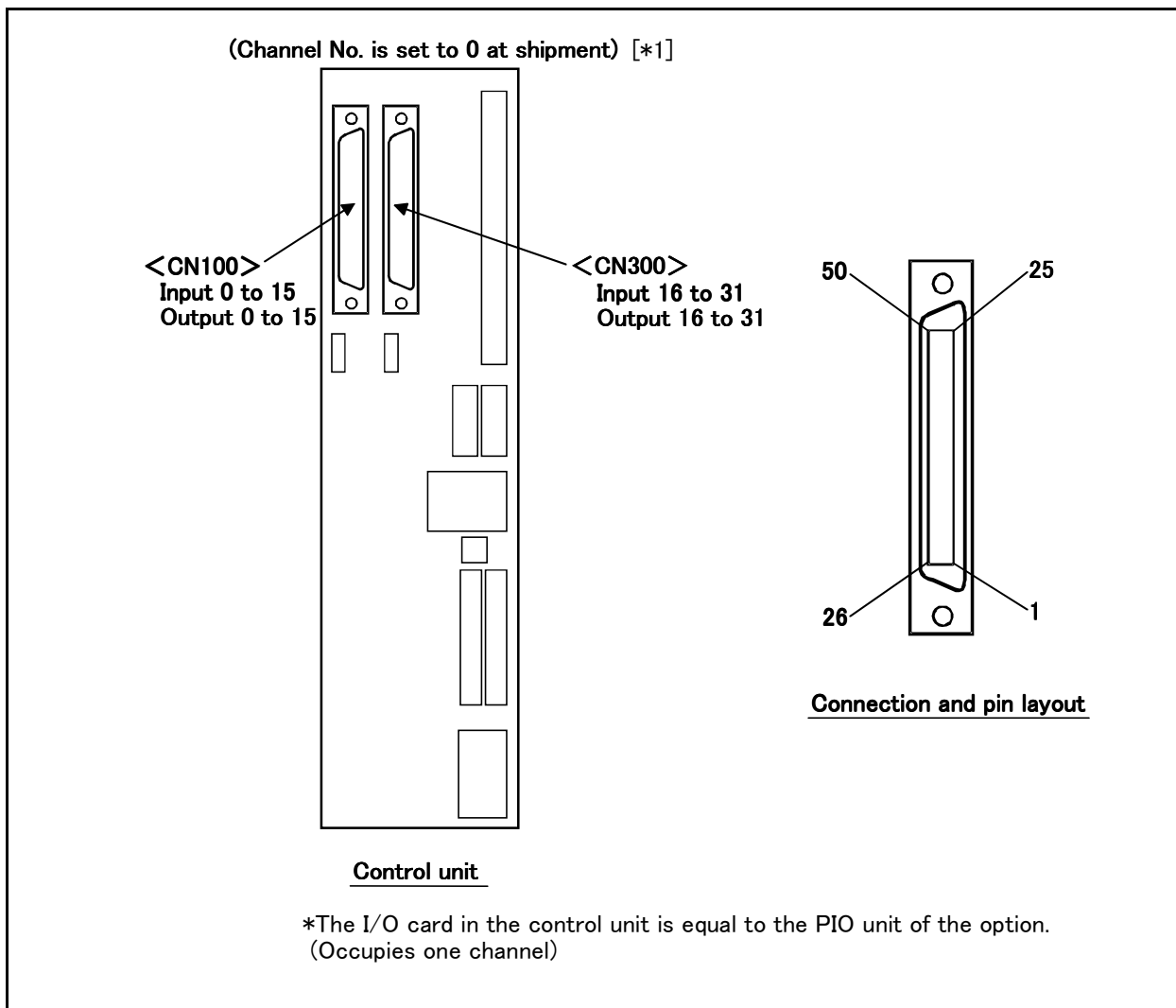


Fig.3-8 : Parallel input/output unit (in the control unit) connection and pin layout

⚠ CAUTION

[*1] The channel number is set to "0".
The channel No. of 8 to F is used for the maker test. If any value of 8 to F is set, it may be dangerous since the robot unexpectedly moves. Don't set any value of 8 to F.

3.8 Options

■ What are options?

There are a variety of options for the robot designed to make the setting up process easier for user needs.

User installation is required for the options.

Options come in two types: "set options" and "single options".

1. Set options.....A combination of single options and parts that together, form a set for serving some purpose.
2. Single options.....That are configured from the fewest number of required units of a part. Please choose user's purpose additionally.

(1) Teaching pendant (T/B)

- Order type: R28TB :Cable length 7m
R28TB-15 :Cable length 15m

■ Outline



This is used to create, edit and control the program, teach the operation position and for jog feed, etc.

For safety proposes, a 3-position deadman switch is mounted.^{Note1)}

If there are several robots, one teaching pendant can be used by connecting it to the respective robot.

■ Configuration

Table 3-8 : Configuration device

| Part name | Type | Qty. | Remarks |
|------------------|----------|---------------|-----------------------------------|
| Teaching pendant | R28TB | Eithe one pc. | Including 7m cable and hand strap |
| | R28TB-15 | | 15m cable |

■ Specifications

Table 3-9 : Specifications

| Items | Specifications | Remarks |
|---------------------------|---|---------|
| Outline dimensions | 95(W) x 236(H) x 34(D) (refer to outline drawing) | |
| Body color | Light gray (reference Munsell color: 7.65Y7.64/0.73) | |
| Mass | Approx. 0.5kg (only arm, excluding cable) | |
| Connection method | Connection with controller and round connector (30-pin) | |
| Interface | RS-422 | |
| Display method | LCD method: 16 characters x 4 lines, LCD illumination: with backlight | |
| Operation section | 28 keys | |
| Protection specifications | IP65 | Note2) |

Note2) The manual operation section of the teaching pendant has a protection method that complies with the IEC Standards IP65 (protection type).

[Reference] The IEC Standards IP65 refers to installing the test device in the testing room, and suspending talc powder, which passes through a nominal dimension 75 μm mesh sieve, as specified with JISZ8001 (standard sieve). This powder is continuously suspended around the device at a rate of 2kg per 1m³ volume of the testing room. The air in the testing device is discharged at a discharge rate less than 60-times the volume per hour. When the air is discharged at 80-times the test device capacity, the talc powder does not accumulate inside the test device even after eight hours.

Note1) <3-position deadman switch>

In ISO/10218 (1992) and JIS-B8433 (1993), this is defined as an "enable device". These standards specify that the robot operation using the teaching pendant is enabled only when the "enable device" is at a specified position. With the Mitsubishi Electric industrial robot, the above "enable device" is configured of an "Enable/Disable switch" and "Deadman switch".

The 3-position deadman switch has three statuses. The following modes are entered according to the switch state.

- "Not pressed"The robot does not operate. *)
- "Pressed lightly"The robot can be operated and teaching is possible.
- "Pressed with force"The robot does not operate. *)

*) Operations, such as program editing and status display, other than robot operation are possible.

Safety is secured as the servo power is turned OFF simultaneously with the input of the emergency stop.

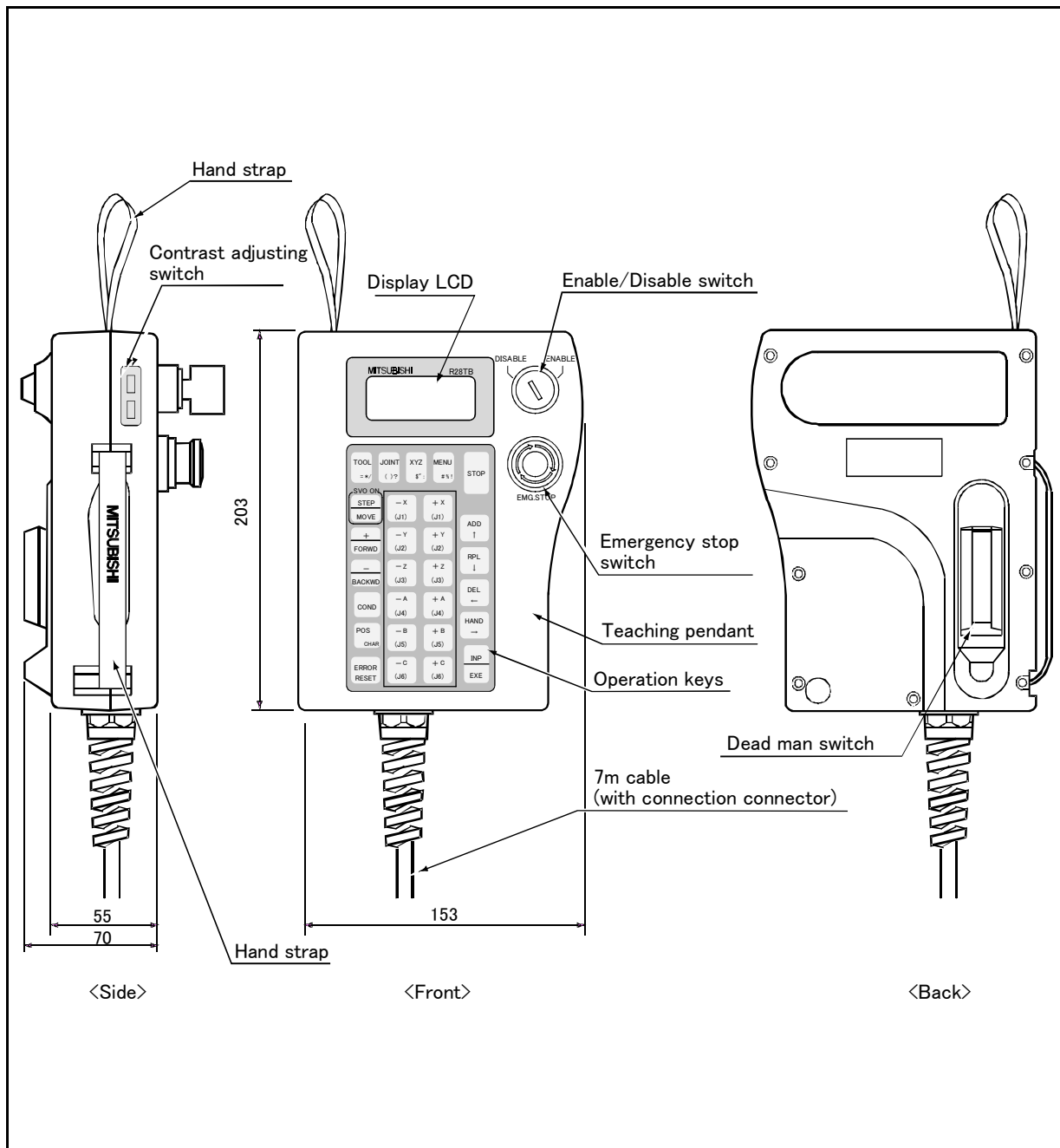
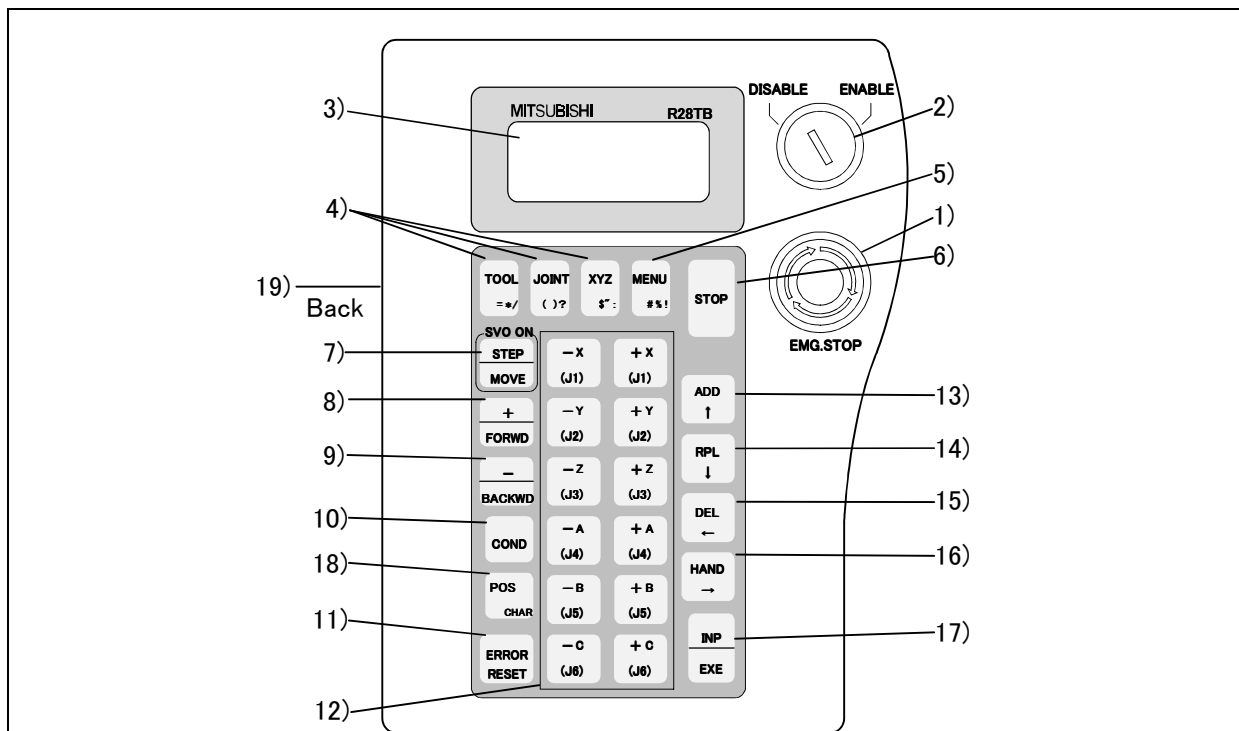


Fig.3-9 : Outside dimensions of teaching pendant

■ Installation method

The teaching pendant is connected to the T/B connector on the front of the controller.

■ Key layout and main functions



- 1) : Emergency stop switch.....The robot servo turns OFF and the operation stops immediately.
- 2) : T/B enable/disable changeover switch.....This switch changes the T/B key operation between enable and disable.
- 3) : LCD display panelThe robot status and various menus are displayed.
- 4) : <TOOL, JOINT, XYZ> key.....This selects the jog mode (JOINT, XYZ, 3-AXIS XYZ, CYLINDER, TOOL).
- 5) : <MENU> keyThis returns the display screen to the menu screen.
- 6) : <STOP> keyThis stops the program and decelerates the robot to a stop.
- 7) : <STEP/MOVE> key.....Jog operation is carried out when this key is pressed simultaneously with the jog operation key. This also turns the Servo ON and carries out step jump.
- 8) : << + FORWD> key.....This carries out step feed and increases the override.
- 9) : << - BACKWD> key.....This carries out step return (return along operation path) and decreases the override.
- 10) : <COND> keyThis sets the program.
- 11) : <ERROR RESET> key.....This resets the error, and releases the software limit.
- 12) : Jog operation keyThis operates the robot according to the jog mode. When inputting numeric values, this inputs each numeric value.
- 13) : <ADD/ ↑ > key.....This additionally registers the position data. It also moves the cursor upward.
- 14) : <RPL/ ↓ > key.....This corrects the position data. It also moves the cursor downward.
- 15) : <DEL/ ← > key.....This deletes the position data. It also moves the cursor to the left.
- 16) : <HAND/ → > key.....This opens and closes the hand. It also moves the cursor to the right.
- 17) : <INP/EXE> key.....This inputs the program, and carries out step feed/return.
- 18) : <POS CHAR> key.....This changes the edit screen, and changes between numbers and alphabetic characters.
- 19) : Deadman switchWhen the [Enable/Disable] switch "2)" is enabled, and this key is released or pressed with force, the servo will turn OFF, and the operating robot will stop immediately.

Fig.3-10 : Teaching pendant key layout and main functions

(2) Pneumatic hand interface

- Order type: 2A-RZ365(Sink type)
2A-RZ375(Source type)

- Outline



This interface is required to use the robot arm's hand output signals.

- Up to eight hand output points can be used with this interface.
- The eight hand input points can be used without this interface.
- When using more than eight hand input/output points, install the "Parallel I/O unit". Refer to [Page 68](#), "Parallel I/O unit" for detail.

- Configuration

Table 3-10 : Configuration device

| Part name | Type | Qty. | Remarks |
|--------------------------|-----------------------|------|--|
| Pneumatic hand interface | 2A-RZ365/ 2A-RZ375 | 1pc. | Output 8 point expansion. 2A-RZ365 is the sink type. 2A-RZ375 is the source type. |

- Specifications

Table 3-11 : Specifications

| Item | Specification | Internal circuit |
|------------------------------------|---|---|
| Type | Transistor output | <p><Sink type></p> <p><Source type></p> <p>* GR_n = GR1 ~ GR8</p> |
| No. of output points | 8 | |
| Insulation method | Photo coupler insulation | |
| Rated load voltage | DC24V | |
| Rated load voltage range | DC21.6 to 26.4VDC | |
| Max. current load | 0.1A/ 1 point (100%) | |
| Current leak with power OFF | 0.1mA or less | |
| Maximum voltage drop with power ON | DC0.9V(TYP.) | |
| Response time | OFF-ON 2ms or less (hardware response time) ON-OFF 2 ms or less (resistance load) (hardware response time) | |
| Fuse rating | Fuses 1.6A (each one common) | |
| Common method | 8 points, 1 common | |
| External cable connection method | Connector (Connected from RZ181) | |
| Supply voltage | DC5V (Supplied from RZ181) | |

■ Installation method

This is mounted on the control unit (RZ181 card) in the controller.

Securely insert the pneumatic hand interface (2A-RZ365/375) into the CNHNDOUT/CNHND connector on the control unit.

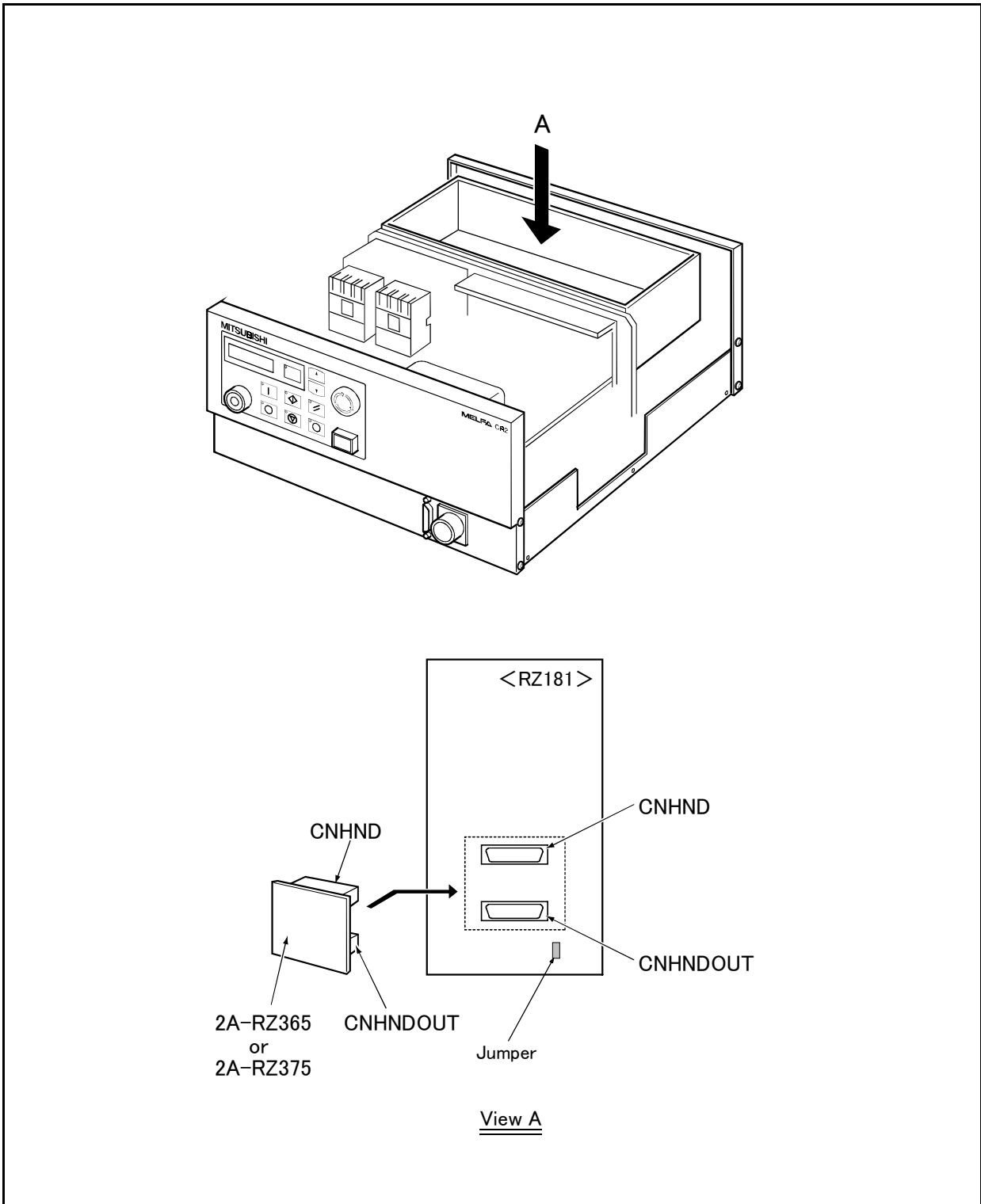
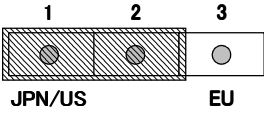
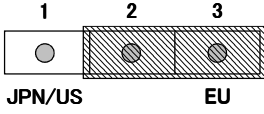


Fig.3-11 : Installation of pneumatic hand interface

■ Check it out

If you putted on the pneumatic interface card, please check out the setting of [Table 3-12](#).

Table 3-12 : Pneumatic interface sink/source I/O setting

| Case | Output setting | Input setting |
|----------------|------------------------------|--|
| | The pneumatic interface card | Jumper setting |
| Sink setting | 2A-RZ365 |  |
| Source setting | 2A-RZ375 |  |

(1) Sink I/O setting

If you want to use Sink I/O setting,

you must put on the "2A-RZ365" interface card, and set on the jumper pin to "JPN/US" as [Table 3-12](#).

(2) Source I/O setting

If you want to use Source I/O setting,

you must put on the "2A-RZ375" interface card, and set on the jumper pin to "EU" as [Table 3-12](#).

(3) Parallel I/O unit

- Order type: 2A-RZ361(Sink type)
2A-RZ371(Source type)

Outline



This is used to expand the external inputs and outputs. One one equal with this unit is built into the control unit among controllers the standard.

- The connection cable is not included. Prepare the optional external input/output cable (2A-CBL05 or 2A-CBL15).

Configuration

Table 3-13 : Configuration device

| Part name | Type | Qty. | Remarks |
|-------------------------------------|-----------------------|--------|--|
| Parallel I/O unit | 2A-RZ361/ 2A-RZ371 | 1 | Input/output 32 points/32 points 2A-RZ361 is the sink type. 2A-RZ371 is the source type. |
| Robot I/O link connection connector | NETcable-1 | 2 sets | Connector with pins. The cable must be prepared and wired by the customer. |
| Power connection connector | DCcable-2 | 1 sets | Connector with pins. The cable must be prepared and wired by the customer. |
| Terminator | R-TM | 1 | 150Ω (1/4W) |

Specifications

- Up to eight stations can be connected to this unit. (One station occupies one unit.)
One unit is built into the controller as a standard, so up to seven units can be installed as expansions.
- The power supply (24V) must be prepared by the customer and connected with the power connection cable (DCcable-2)
A separate 24V power supply is required for the input/output circuit wiring.

The detailed specifications of the input/output circuit are the same as the parallel input/output unit mounted as a standard. Refer to Page 57, "3.7 Parallel input/output unit" for details.

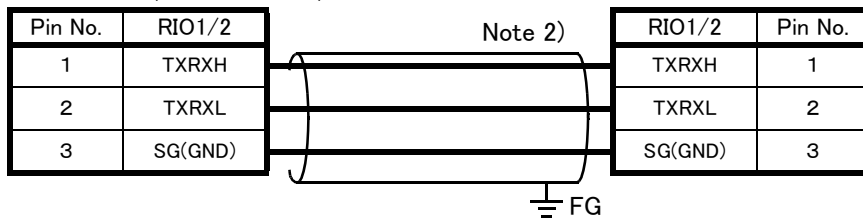
Table 3-14 : Electrical specifications of input circuits

| Item | Specification | Internal circuit | |
|----------------------------------|--|---|----------------------|
| Type | DC input | <div style="display: flex; flex-direction: column; align-items: center;"> <div style="text-align: center; margin-bottom: 20px;"> <p><Sink type></p> </div> <div style="text-align: center;"> <p><Source type></p> </div> </div> | |
| Number of input points | 32 | | |
| Insulation method | Photo coupler insulation | | |
| Rated input voltage | DC12V/DC24V | | |
| Rated input current | Approx 3mA/7mA | | |
| Working voltage range | DC10.2 to 26.4V(Ripple factor should be less than 5%.) | | |
| ON voltage/ON current | 8VDC or more/ 2mA or more | | |
| OFF voltage/ OFF current | 4VDC or less/ 1mA or less | | |
| Input resistance | Approx. 3.3kΩ | | |
| Response time | OFF-ON | | 10ms or less (24VDC) |
| | ON-OFF | | 10ms or less (24VDC) |
| Common method | 8 point 1 common | | |
| External cable connection method | Connector | | |

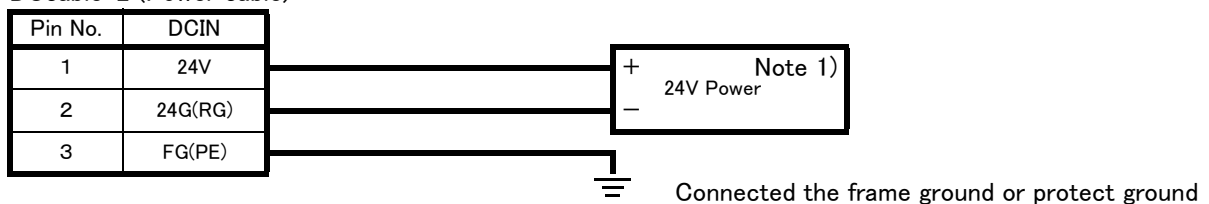
Table 3-15 : Electrical specifications for the output circuits

| Item | | Specification | Internal circuit |
|---------------------------------|---------|--|--|
| Type | | Transistor output | <div style="display: flex; flex-direction: column; align-items: center;"> <div style="text-align: center;"> <p><Sink type></p> </div> <div style="text-align: center; margin-top: 20px;"> <p><Source type></p> </div> </div> |
| No. of output points | | 32 | |
| Insulation method | | Photo-coupler insulation | |
| Rated load voltage | | DC12V/DC24V | |
| Rated load voltage range | | DC10.2 ~ 30V(peak voltage 30VDC) | |
| Max. load current | | 0.1A/point (100%) | |
| Leakage current at OFF | | 0.1mA or less | |
| Max. voltage drop at ON | | DC0.9V(TYP.) | |
| Response time | OFF-ON | 2ms or less (hardware response time) | |
| | ON-OFF | 2ms or less (Resistance load) (hardware response time) | |
| Fuse rating | | Fuse 3.2A (one per common) Replacement not possible | |
| Common method | | 4 points per common (common terminal: 4 points) | |
| External wire connection method | | Connector | |
| External power supply | Voltage | DC12/24V(DC10.2 ~ 30V) | |
| | Current | 60mA (TYP. 24VDC per common) (base drive current) | |

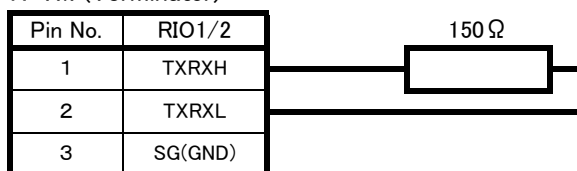
NETcable-1 (Network cable)



DCcable-2 (Power cable)



R-TM (Terminator)



List of parts and manufacturer

| Type | Connector type | Contact type | Resistant | Manufacturer |
|------------|----------------|--------------|-----------------|--------------------|
| NETcable-1 | 1-178288-3 (2) | 175218-3 (6) | — | AMP |
| DCcable-2 | 2-178288-3 (1) | 175218-3 (3) | — | AMP |
| R-TM | 1-178288-3 (1) | 175218-3 (2) | 150Ω (1/4W) (1) | Equivalent to KOA. |

Note 1) The 24V power supply is prepared by customer

Note 2) The cable for general purpose can be used to the network cable. However, use the twisted shield cable of AWG#22(0.3mm²) or more.

Fig.3-12 : Specifications for the connection cable

■ Installation method

The expansion parallel input/output unit is installed outside of the controller. The unit is connected from the control unit (R6CPU) in the controller with a network connection cable (NETcable-1).

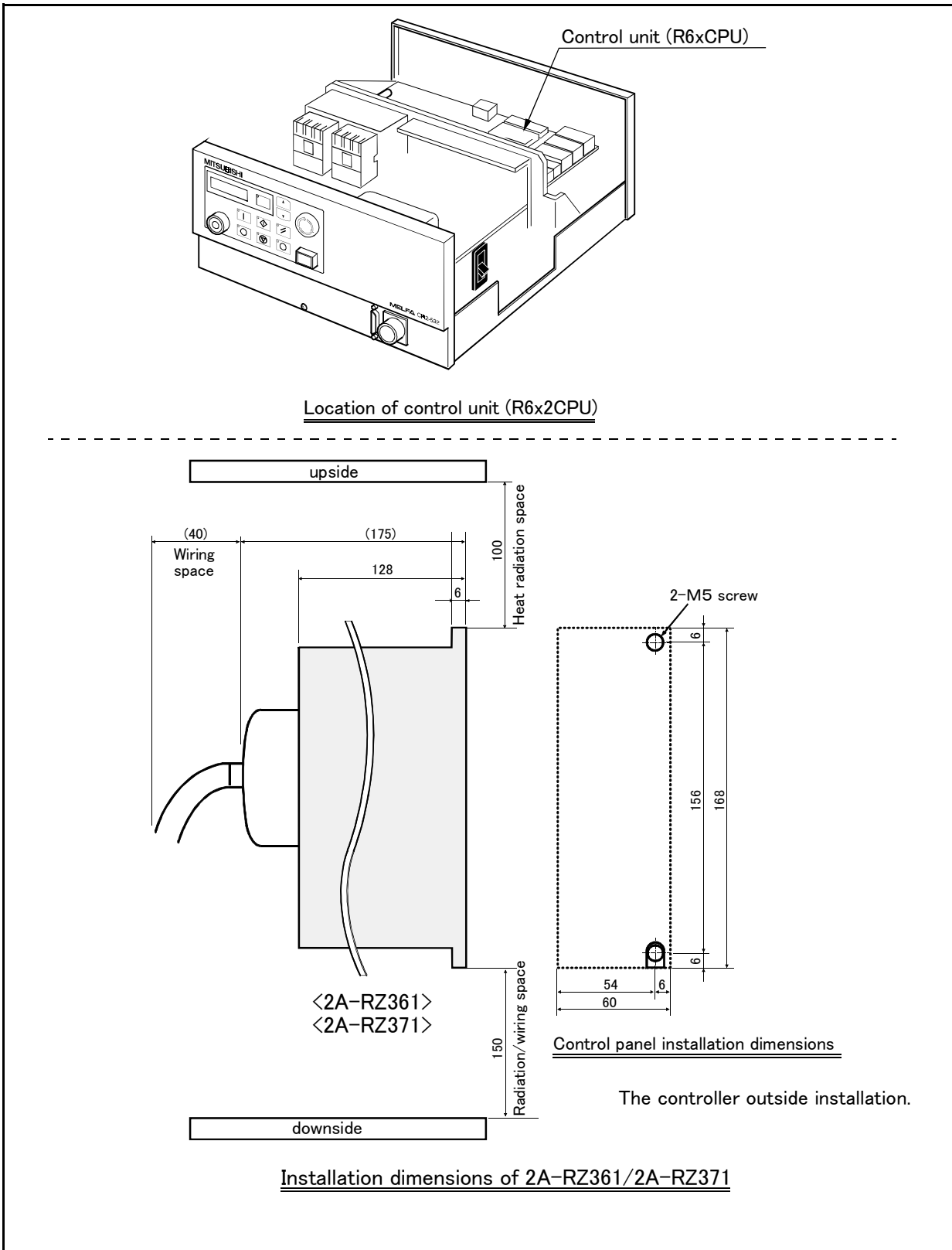


Fig.3-13 : Installing the parallel input/output unit

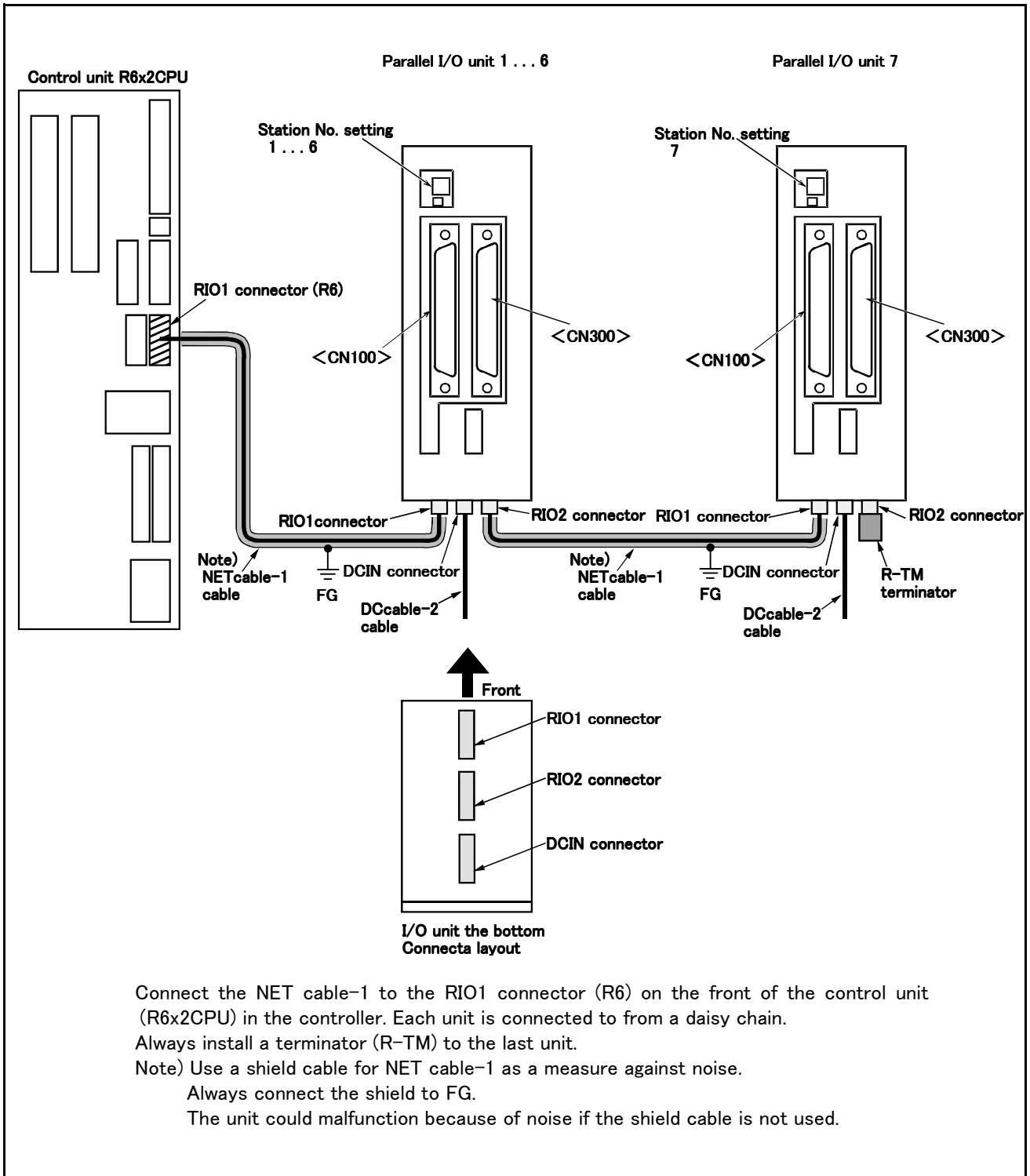


Fig.3-14 : Connection method of expansion parallel input/output unit

■ Parallel I/O interface (First expansion unit)

Table 3-16 : Connector CN100pin No. and signal assignment list (2A-CBL □□)

| Pin No. | Line color | Function name | | Pin No. | Line color | Function name | |
|---------|--------------|---------------------------|---|---------|---------------|---------------------------|---|
| | | General-purpose | Dedicated/power supply, common | | | General-purpose | Dedicated/power supply, common |
| 1 | Orange/Red A | General-purpose output 32 | FG | 26 | Orange/Blue A | General-purpose output 36 | FG |
| 2 | Gray/Red A | | 0V:For pins 4-7 | 27 | Gray/Blue A | | 0V:For pins 29-32 |
| 3 | White/Red A | | 12V/24V:For pins 4-7 | 28 | White/Blue A | | 12V/24V:For pins 29-32 |
| 4 | Yellow/Red A | | General-purpose output 33 | 29 | Yellow/Blue A | | General-purpose output 37 |
| 5 | Pink/Red A | | General-purpose output 34 | 30 | Pink/Blue A | | General-purpose output 38 |
| 6 | Orange/Red B | General-purpose output 35 | 0V:For pins 10-13 12V/24V:For pins 10-13 | 31 | Orange/Blue B | General-purpose output 39 | 0V:For pins 35-38 12V/24V:For pins 35-38 |
| 7 | Gray/Red B | General-purpose output 36 | | 32 | Gray/Blue B | General-purpose output 40 | |
| 8 | White/Red B | General-purpose output 37 | | 33 | White/Blue B | General-purpose output 41 | |
| 9 | Yellow/Red B | General-purpose output 38 | | 34 | Yellow/Blue B | General-purpose output 42 | |
| 10 | Pink/Red B | General-purpose output 39 | | 35 | Pink/Blue B | General-purpose output 43 | |
| 11 | Orange/Red C | General-purpose output 40 | COM0:For pins 15-22 | 36 | Orange/Blue C | General-purpose output 44 | COM1:For pins 40-47 |
| 12 | Gray/Red C | General-purpose output 41 | | 37 | Gray/Blue C | General-purpose output 45 | |
| 13 | White/Red C | General-purpose output 42 | | 38 | White/Blue C | General-purpose output 46 | |
| 14 | Yellow/Red C | General-purpose output 43 | | 39 | Yellow/Blue C | General-purpose output 47 | |
| 15 | Pink/Red C | General-purpose input 32 | | 40 | Pink/Blue C | General-purpose input 40 | |
| 16 | Orange/Red D | General-purpose input 33 | | 41 | Orange/Blue D | General-purpose input 41 | |
| 17 | Gray/Red D | General-purpose input 34 | | 42 | Gray/Blue D | General-purpose input 42 | |
| 18 | White/Red D | General-purpose input 35 | | 43 | White/Blue D | General-purpose input 43 | |
| 19 | Yellow/Red D | General-purpose input 36 | | 44 | Yellow/Blue D | General-purpose input 44 | |
| 20 | Pink/Red D | General-purpose input 37 | | 45 | Pink/Blue D | General-purpose input 45 | |
| 21 | Orange/Red E | General-purpose input 38 | | 46 | Orange/Blue E | General-purpose input 46 | |
| 22 | Gray/Red E | General-purpose input 39 | | 47 | Gray/Blue E | General-purpose input 47 | |
| 23 | White/Red E | | | 48 | White/Blue E | | |
| 24 | Yellow/Red E | | | 49 | Yellow/Blue E | | |
| 25 | Pink/Red E | | | 50 | Pink/Blue E | | |

Table 3-17 : Connector CN300pin No. and signal assignment list (2A-CBL □□)

| Pin No. | Line color | Function name | | Pin No. | Line color | Function name | |
|---------|--------------|---------------------------|---|---------|---------------|---------------------------|---|
| | | General-purpose | Dedicated/power supply, common | | | General-purpose | Dedicated/power supply, common |
| 1 | Orange/Red A | General-purpose output 48 | FG | 26 | Orange/Blue A | General-purpose output 52 | FG |
| 2 | Gray/Red A | | 0V:For pins 4-7 | 27 | Gray/Blue A | | 0V:For pins 29-32 |
| 3 | White/Red A | | 12V/24V:For pins 4-7 | 28 | White/Blue A | | 12V/24V:For pins 29-32 |
| 4 | Yellow/Red A | | General-purpose output 49 | 29 | Yellow/Blue A | | General-purpose output 53 |
| 5 | Pink/Red A | | General-purpose output 50 | 30 | Pink/Blue A | | General-purpose output 54 |
| 6 | Orange/Red B | General-purpose output 51 | 0V:For pins 10-13 12V/24V:For pins 10-13 | 31 | Orange/Blue B | General-purpose output 55 | 0V:For pins 35-38 12V/24V:For pins 35-38 |
| 7 | Gray/Red B | General-purpose output 52 | | 32 | Gray/Blue B | General-purpose output 56 | |
| 8 | White/Red B | General-purpose output 53 | | 33 | White/Blue B | General-purpose output 57 | |
| 9 | Yellow/Red B | General-purpose output 54 | | 34 | Yellow/Blue B | General-purpose output 58 | |
| 10 | Pink/Red B | General-purpose output 55 | | 35 | Pink/Blue B | General-purpose output 59 | |
| 11 | Orange/Red C | General-purpose output 56 | COM0:For pins 15-22 | 36 | Orange/Blue C | General-purpose output 60 | COM1:For pins 40-47 |
| 12 | Gray/Red C | General-purpose output 57 | | 37 | Gray/Blue C | General-purpose output 61 | |
| 13 | White/Red C | General-purpose output 58 | | 38 | White/Blue C | General-purpose output 62 | |
| 14 | Yellow/Red C | General-purpose output 59 | | 39 | Yellow/Blue C | General-purpose output 63 | |
| 15 | Pink/Red C | General-purpose input 48 | | 40 | Pink/Blue C | General-purpose input 56 | |
| 16 | Orange/Red D | General-purpose input 49 | | 41 | Orange/Blue D | General-purpose input 57 | |
| 17 | Gray/Red D | General-purpose input 50 | | 42 | Gray/Blue D | General-purpose input 58 | |
| 18 | White/Red D | General-purpose input 51 | | 43 | White/Blue D | General-purpose input 59 | |
| 19 | Yellow/Red D | General-purpose input 52 | | 44 | Yellow/Blue D | General-purpose input 60 | |
| 20 | Pink/Red D | General-purpose input 53 | | 45 | Pink/Blue D | General-purpose input 61 | |
| 21 | Orange/Red E | General-purpose input 54 | | 46 | Orange/Blue E | General-purpose input 62 | |
| 22 | Gray/Red E | General-purpose input 55 | | 47 | Gray/Blue E | General-purpose input 63 | |
| 23 | White/Red E | | | 48 | White/Blue E | | |
| 24 | Yellow/Red E | | | 49 | Yellow/Blue E | | |
| 25 | Pink/Red E | | | 50 | Pink/Blue E | | |

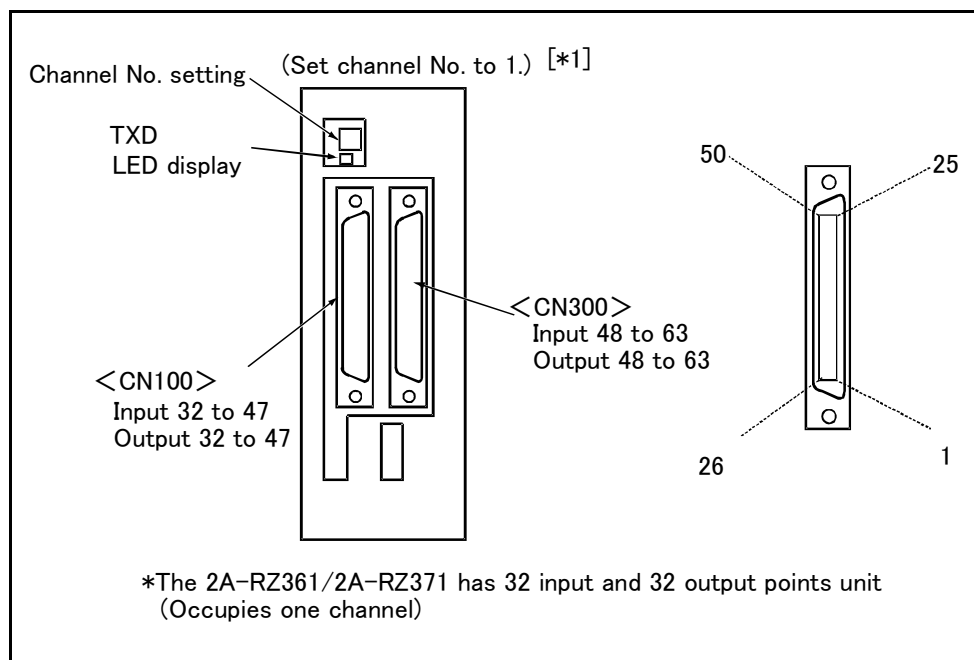


Fig.3-15 : Parallel input/output unit <2A-RZ361/2A-RZ371:First expansion> connection and pin layout

⚠ CAUTION

[*1] For the 1st expansion unit, set the channel No. to "1".

The channel No. of 8 to F is used for the maker test. If any value of 8 to F is set, it may be dangerous since the robot unexpectedly moves. Don't set any value of 8 to F.

■ Parallel I/O interface (Second expansion unit)

Table 3-18 : Connector CN100pin No. and signal assignment list (2A-CBL □□)

| Pin No. | Line color | Function name | | Pin No. | Line color | Function name | |
|---------|--------------|---------------------------|---|---------|---------------|---------------------------|---|
| | | General-purpose | Dedicated/power supply, common | | | General-purpose | Dedicated/power supply, common |
| 1 | Orange/Red A | General-purpose output 64 | FG | 26 | Orange/Blue A | General-purpose output 68 | FG |
| 2 | Gray/Red A | | 0V:For pins 4-7 | 27 | Gray/Blue A | | 0V:For pins 29-32 |
| 3 | White/Red A | | 12V/24V:For pins 4-7 | 28 | White/Blue A | | 12V/24V:For pins 29-32 |
| 4 | Yellow/Red A | | General-purpose output 65 | 29 | Yellow/Blue A | | General-purpose output 69 |
| 5 | Pink/Red A | | General-purpose output 66 | 30 | Pink/Blue A | | General-purpose output 70 |
| 6 | Orange/Red B | General-purpose output 67 | 0V:For pins 10-13 12V/24V:For pins 10-13 | 31 | Orange/Blue B | General-purpose output 71 | 0V:For pins 35-38 12V/24V:For pins 35-38 |
| 7 | Gray/Red B | General-purpose output 68 | | 32 | Gray/Blue B | General-purpose output 72 | |
| 8 | White/Red B | General-purpose output 69 | | 33 | White/Blue B | General-purpose output 73 | |
| 9 | Yellow/Red B | General-purpose output 70 | | 34 | Yellow/Blue B | General-purpose output 74 | |
| 10 | Pink/Red B | General-purpose output 71 | | 35 | Pink/Blue B | General-purpose output 75 | |
| 11 | Orange/Red C | General-purpose output 72 | COM0:For pins 15-22 | 36 | Orange/Blue C | General-purpose output 76 | COM1:For pins 40-47 |
| 12 | Gray/Red C | General-purpose output 73 | | 37 | Gray/Blue C | General-purpose output 77 | |
| 13 | White/Red C | General-purpose output 74 | | 38 | White/Blue C | General-purpose output 78 | |
| 14 | Yellow/Red C | General-purpose output 75 | | 39 | Yellow/Blue C | General-purpose output 79 | |
| 15 | Pink/Red C | General-purpose input 64 | | 40 | Pink/Blue C | General-purpose input 72 | |
| 16 | Orange/Red D | General-purpose input 65 | | 41 | Orange/Blue D | General-purpose input 73 | |
| 17 | Gray/Red D | General-purpose input 66 | | 42 | Gray/Blue D | General-purpose input 74 | |
| 18 | White/Red D | General-purpose input 67 | | 43 | White/Blue D | General-purpose input 75 | |
| 19 | Yellow/Red D | General-purpose input 68 | | 44 | Yellow/Blue D | General-purpose input 76 | |
| 20 | Pink/Red D | General-purpose input 69 | | 45 | Pink/Blue D | General-purpose input 77 | |
| 21 | Orange/Red E | General-purpose input 70 | | 46 | Orange/Blue E | General-purpose input 78 | |
| 22 | Gray/Red E | General-purpose input 71 | | 47 | Gray/Blue E | General-purpose input 79 | |
| 23 | White/Red E | | | 48 | White/Blue E | | |
| 24 | Yellow/Red E | | | 49 | Yellow/Blue E | | |
| 25 | Pink/Red E | | | 50 | Pink/Blue E | | |

Table 3-19 : Connector CN300pin No. and signal assignment list (2A-CBL □□)

| Pin No. | Line color | Function name | | Pin No. | Line color | Function name | |
|---------|--------------|---------------------------|---|---------|---------------|---------------------------|---|
| | | General-purpose | Dedicated/power supply, common | | | General-purpose | Dedicated/power supply, common |
| 1 | Orange/Red A | General-purpose output 80 | FG | 26 | Orange/Blue A | General-purpose output 84 | FG |
| 2 | Gray/Red A | | 0V:For pins 4-7 | 27 | Gray/Blue A | | 0V:For pins 29-32 |
| 3 | White/Red A | | 12V/24V:For pins 4-7 | 28 | White/Blue A | | 12V/24V:For pins 29-32 |
| 4 | Yellow/Red A | | General-purpose output 81 | 29 | Yellow/Blue A | | General-purpose output 85 |
| 5 | Pink/Red A | | General-purpose output 82 | 30 | Pink/Blue A | | General-purpose output 86 |
| 6 | Orange/Red B | General-purpose output 83 | 0V:For pins 10-13 12V/24V:For pins 10-13 | 31 | Orange/Blue B | General-purpose output 87 | 0V:For pins 35-38 12V/24V:For pins 35-38 |
| 7 | Gray/Red B | General-purpose output 84 | | 32 | Gray/Blue B | General-purpose output 88 | |
| 8 | White/Red B | General-purpose output 85 | | 33 | White/Blue B | General-purpose output 89 | |
| 9 | Yellow/Red B | General-purpose output 86 | | 34 | Yellow/Blue B | General-purpose output 90 | |
| 10 | Pink/Red B | General-purpose output 87 | | 35 | Pink/Blue B | General-purpose output 91 | |
| 11 | Orange/Red C | General-purpose output 88 | COM0:For pins 15-22 | 36 | Orange/Blue C | General-purpose output 92 | COM1:For pins 40-47 |
| 12 | Gray/Red C | General-purpose output 89 | | 37 | Gray/Blue C | General-purpose output 93 | |
| 13 | White/Red C | General-purpose output 90 | | 38 | White/Blue C | General-purpose output 94 | |
| 14 | Yellow/Red C | General-purpose output 91 | | 39 | Yellow/Blue C | General-purpose output 95 | |
| 15 | Pink/Red C | General-purpose input 80 | | 40 | Pink/Blue C | General-purpose input 88 | |
| 16 | Orange/Red D | General-purpose input 81 | | 41 | Orange/Blue D | General-purpose input 89 | |
| 17 | Gray/Red D | General-purpose input 82 | | 42 | Gray/Blue D | General-purpose input 90 | |
| 18 | White/Red D | General-purpose input 83 | | 43 | White/Blue D | General-purpose input 91 | |
| 19 | Yellow/Red D | General-purpose input 84 | | 44 | Yellow/Blue D | General-purpose input 92 | |
| 20 | Pink/Red D | General-purpose input 85 | | 45 | Pink/Blue D | General-purpose input 93 | |
| 21 | Orange/Red E | General-purpose input 86 | | 46 | Orange/Blue E | General-purpose input 94 | |
| 22 | Gray/Red E | General-purpose input 87 | | 47 | Gray/Blue E | General-purpose input 95 | |
| 23 | White/Red E | | | 48 | White/Blue E | | |
| 24 | Yellow/Red E | | | 49 | Yellow/Blue E | | |
| 25 | Pink/Red E | | | 50 | Pink/Blue E | | |

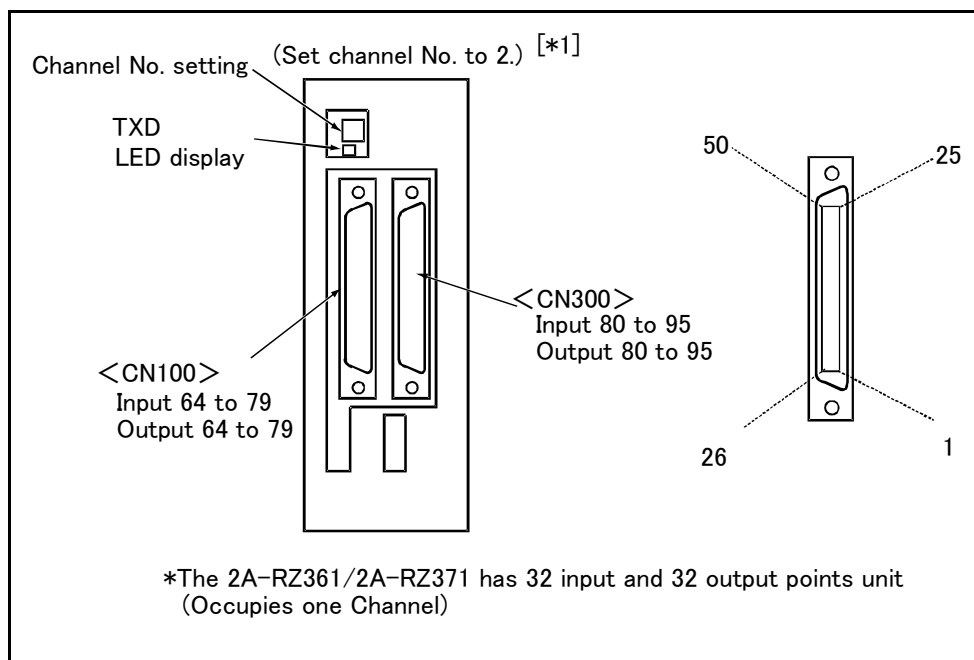


Fig.3-16 : Parallel input/output unit <2A-RZ361/2A-RZ371:Second expansion unit> connection and pin layout

⚠ CAUTION

[*1] For the 2nd expansion unit, set the channel No. to "2".
The channel No. of 8 to F is used for the maker test. If any value of 8 to F is set, it may be dangerous since the robot unexpectedly moves. Don't set any value of 8 to F.

(4) External I/O cable

■ Order type: 2A-CBL □□ Note) The numbers in the boxes □□ refer to the length. (05: 5m、 15: 15m)

■ Outline



This is the dedicated cable used to connect an external peripheral device to the connector on the parallel input/output unit.

One end matches the connector on the parallel input/output unit, and the other end is free. Connect the peripheral device's input/output signal using the free end.

One cable correspond to the input 16 points and output 16 points.

Two cables are needed to connection of (input 32 points and output 32 points) with built-in standard.

■ Configuration

Table 3-20 : Configuration device

| Part name | Type | Qty. | Remarks |
|--------------------|-----------|------|-----------|
| External I/O cable | 2A-CBL □□ | 1pc. | 5m or 15m |

■ Specifications

Table 3-21 : Specifications

| Items | Specifications |
|-------------------------------|----------------------|
| Number of cables x cable size | 25 pairs x A.W.G #28 |
| Total length | 5m or 15m |

■ Connector pin numbers and cable colors

Table 3-22 : Connector pin numbers and cable colors

| Pin no. | Cable colors | Pin no. | Cable colors | Pin no. | Cable colors | Pin no. | Cable colors | Pin no. | Cable colors |
|---------|--------------|---------|--------------|---------|---------------|---------|---------------|---------|---------------|
| 1 | Orange/Red A | 11 | Orange/Red C | 21 | Orange/Red E | 31 | Orange/Blue B | 41 | Orange/Blue D |
| 2 | Gray/Red A | 12 | Gray/Red C | 22 | Gray/Red E | 32 | Gray/Blue B | 42 | Gray/Blue D |
| 3 | White/Red A | 13 | White/Red C | 23 | White/Red E | 33 | White/Blue B | 43 | White/Blue D |
| 4 | Yellow/Red A | 14 | Yellow/Red C | 24 | Yellow/Red E | 34 | Yellow/Blue B | 44 | Yellow/Blue D |
| 5 | Pink/Red A | 15 | Pink/Red C | 25 | Pink/Red E | 35 | Pink/Blue B | 45 | Pink/Blue D |
| 6 | Orange/Red B | 16 | Orange/Red D | 26 | Orange/Blue A | 36 | Orange/Blue C | 46 | Orange/Blue E |
| 7 | Gray/Red B | 17 | Gray/Red D | 27 | Gray/Blue A | 37 | Gray/Blue C | 47 | Gray/Blue E |
| 8 | White/Red B | 18 | White/Red D | 28 | White/Blue A | 38 | White/Blue C | 48 | White/Blue E |
| 9 | Yellow/Red B | 19 | Yellow/Red D | 29 | Yellow/Blue A | 39 | Yellow/Blue C | 49 | Yellow/Blue E |
| 10 | Pink/Red B | 20 | Pink/Red D | 30 | Pink/Blue A | 40 | Pink/Blue C | 50 | Pink/Blue E |

(5) Personal computer cable

■ Order type: ● For PC/AT : RS-MAXY-CBL

■ Outline



This is the RS-232C interface cable used for connecting the controller with a personal computer. The personal computer on hand may be usable with the above interface cable. Confirm the connection specifications when placing an order. Personal computer cables for the PC/AT compatible model is available. The cable for the NEC PC9821 (half-pitch 14-pin) must be manufactured by the customer.

■ Configuration

Table 3-23 : Configuration device

| Part name | Type | Qty. | Remarks |
|-------------------------------------|-------------|------|-----------------------------------|
| Personal computer cable (for PC/AT) | RS-MAXY-CBL | 1pc. | 3m, D-SUB 9 pin ^{Note1)} |

Note1)The personal computer cable is the same as that for use with "Movemaster M1/M2/E/EN series".

■ Specifications

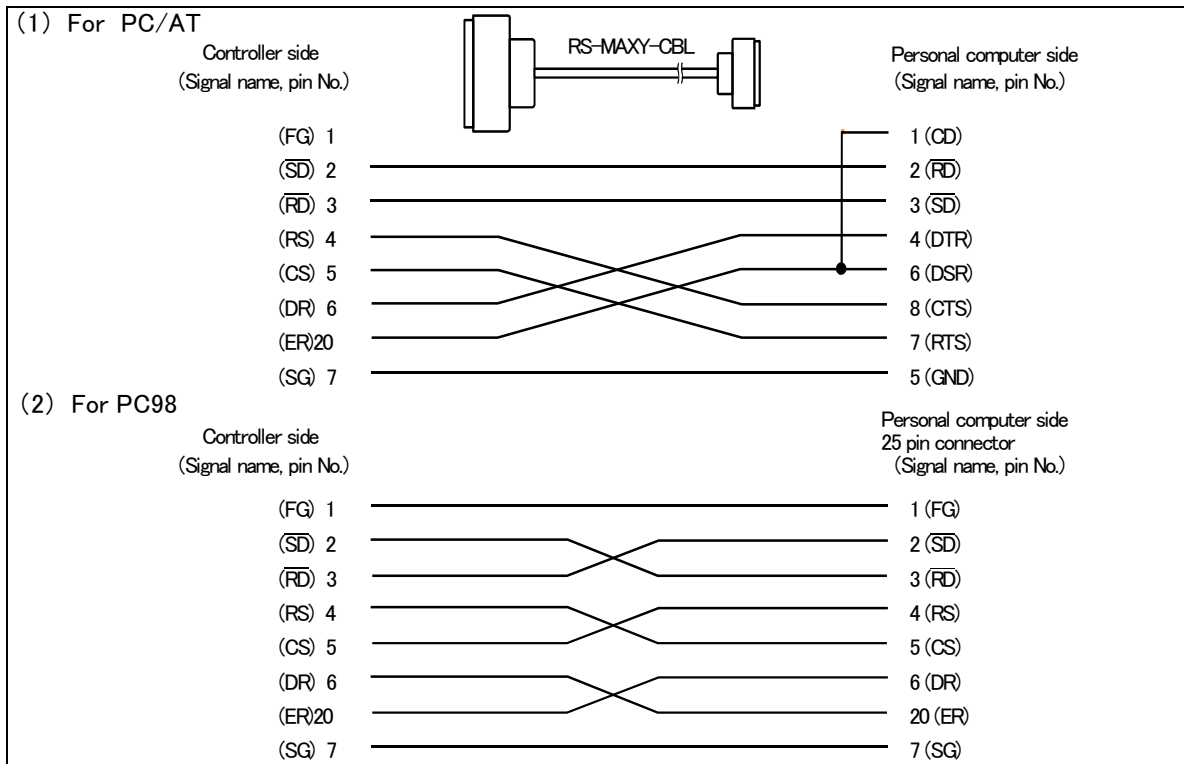


Fig.3-18 : Personal computer cable connection

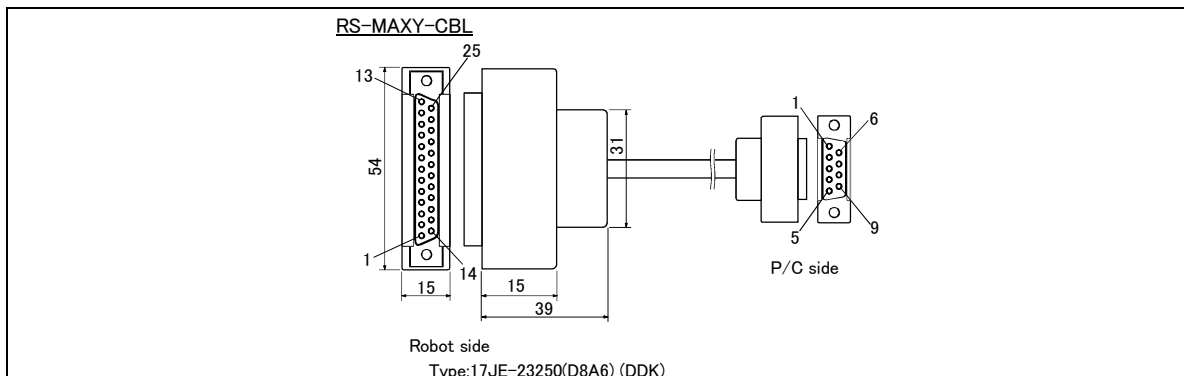


Fig.3-19 : Personal computer cable connector

(6) Personal computer support software/Personal computer support software mini

- Order type :
 - Personal computer support software
 - *For windows CD-ROM : 3A-01C-WINE
 - *For windows Floppy disk : 3A-01F-WINE
 - Personal computer support software mini
 - *For windows CD-ROM : 3A-02C-WINE
 - *For windows Floppy disk : 3A-02F-WINE

■ Outline



This is handy software that fully uses the personal computer functions. It can be used in various stages from the robot specifications study (tact study, etc.) to the design support (creation and editing of programs), start up support (execution, control and debugging of program), and maintenance (remote maintenance.)

The "personal computer support software" which supports these function fully, and the "personal computer support software mini" which does not have the simulation function are available. Select according to the required application.

The CD-ROM version and the floppy disk version are prepared.

■ Configuration

Table 3-24 : Product configuration

| Part name | Type | Medium | Remarks |
|---|-------------|-------------|-------------------------------|
| Personal computer support software | 3A-01C-WINE | CD-ROM | One operation manual included |
| | 3A-01F-WINE | FD 3.5 inch | |
| Personal computer support software mini | 3A-02C-WINE | CD-ROM | One operation manual included |
| | 3A-02F-WINE | FD 3.5 inch | |

■ Features

(1) Simple operation with guidance method and menu method

The Windows standard is used for windows operation, so the controller initialization and startup operations can be carried out easily by following the instructions given on the screen. Even a beginner can easily carry out the series of operations from program creation to execution.

(2) Increased work efficiency with ample support functions

The work efficiency is greatly improved with the multi-window method that carries out multiple steps and displays in parallel. The renumbering function, and copy, search, syntax check and step execution are especially sufficient, and are extremely useful when editing or debugging the program.

With the simulation function support, the program can be debugged and the tact checked before starting the machine at the site. This allows the on-site startup work efficiently to be greatly improved.

(3) Increased maintenance efficiency with remote maintenance function

With remote operations over a telephone line, the robot's operation status can be monitored without going to the site. Losses incurred while moving to the site can be reduced, and the time required to investigate the trouble and determine measures to be taken can be shortened.

■ Functions

Table 3-25 : Functions

| Function | | Functional existence ^{Note1)} | | Details |
|---------------------------------------|---------------------|--|---|--|
| Compatible model | | ○ | ○ | Personal computer running Microsoft Windows 95/98/NT 4.0 |
| Program editing functions | Editing functions | ○ | ○ | <ul style="list-style-type: none"> ▪ MELFA BASIC IV language compatible ▪ Multiple editing screen simultaneously display ▪ Command input, comment writing ▪ Position data editing ▪ File operation (writing to controller, floppy disk, personal computer) ▪ Search and replace function (using characters, line Nos., labels) ▪ Copy, cut, paste, insert (per character, line), undo (per command statement, position conversion) ▪ Line No. automatic generation, renumbering ▪ Batch syntax check ▪ Command template ▪ Position conversion batch editing ▪ Position variable template ▪ Print, print preview |
| | Control functions | ○ | ○ | <ul style="list-style-type: none"> ▪ Program file control (list, copy, movement, delete, content comparison, name change, protect) |
| | Debugging functions | ○ | ○ | <ul style="list-style-type: none"> ▪ Direct editing of program in controller ▪ Confirmation of robot program operation (step execution, direct execution) ▪ Tact time measurement^{Note2)} |
| Simulation function ^{Note3)} | | ○ | × | <ul style="list-style-type: none"> ▪ Off-line simulation of robot program operation using CG (computer graphics) ▪ Tact time calculation |
| Monitor functions | | ○ | ○ | <ul style="list-style-type: none"> ▪ Robot operation monitor (robot operation state, stop signal, error monitor, program monitor (execution program, variables), general-purpose input/output signals (forced output possible), dedicated input/output signals, operation confirmation (operation range, current position, hand, etc.) ▪ Operation monitor (working time statistics, production information, robot version) ▪ Servo monitor (position, speed, current, load, power) |
| Maintenance function | | ○ | ○ | <ul style="list-style-type: none"> ▪ Parameter setting ▪ Batch, divided backup |
| Remote maintenance function | | ○ | ○ | <ul style="list-style-type: none"> ▪ Monitoring and maintenance of robot state at remote site using telephone line. (A separate modem is required for this function.) |

○ Personal computer support software mini
 (3A-01C-WINE/3A-01F-WINE)
 ○ Personal computer support software
 (3A-02C-WINE/3A-02F-WINE)

Note1)The functions included with the personal computer support software and the personal computer support software mini are shown below. ○ : Function provided × : Function not provided

Note2)When using the "personal computer support software mini", connect with the controller and measure.

Note3)A simulation function is available only with "MELFA-BASIC IV".

3.9 Maintenance parts

The consumable parts used in the controller are shown in [Table 3-26](#). Purchase these parts from your dealer when required. Some Mitsubishi-designated parts differ from the maker's standard parts. Thus, confirm the part name, robot arm and controller serial No. and purchase the parts from your dealer.

Table 3-26 : Controller consumable parts list

| No. | Part name | Type | Qty. | Usage place | Manufacturer |
|-----|-----------------|-------------------|------|--------------|---------------------|
| 1 | Lithium battery | ER6 BKO-NC2157H01 | 1 | Control unit | Mitsubishi Electric |

4 Software

4.1 List of commands

(1) MELFA-BASIC IV commands

Table 4-1 : List of MELFA-BASIC IV commands

| Type | Class | Function | Input format (example) | |
|--|------------------------|---|---|--|
| Position and operation control | Joint interpolation | Moves to the designated position with joint interpolation. | MOV P1 | |
| | Linear interpolation | Moves to the designated position with linear interpolation. | MVS P1 | |
| | Circular interpolation | Moves along a designated arc (start point → passing point → start point (end point)) with 3-dimensional circular interpolation (360 degrees). | MVC P1,P2,P1 | |
| | | Moves along a designated arc (start point → passing point → end point) with 3-dimensional circular interpolation. | MVR P1,P2,P3 | |
| | | Moves along the arc on the opposite side of a designated arc (start point → reference point → end point) with 3-dimensional circular interpolation. | MVR2 P1,P9,P3 | |
| | | Moves along a set arc (start point → end point) with 3-dimensional circular interpolation. | MVR3 P1,P9,P3 | |
| | Speed designation | Designates the speed for various interpolation operations with a percentage (0.1% unit). | OVRD 100 | |
| | | Designate the speed for joint interpolation operation with a percentage (0.1% unit). | JOVRD 100 | |
| | | Designates the speed for linear and circular interpolation with a numerical value (0.1mm/s unit). | SPD 123.5 | |
| | | Designates the acceleration/deceleration time as a percentage in respect to the predetermined maximum acceleration/deceleration. (1% unit) | ACCEL 50,80 | |
| | | Automatically adjusts the acceleration/deceleration according to the parameter setting value. | OADL 1,5,20 | |
| | | ets the hand and work conditions for automatic adjustment of the acceleration/deceleration. | LOADSET 1,1 | |
| | Operation | Adds a process unconditionally to the operation. | WTH | |
| | | Adds a process conditionally to the operation. | WTHIF | |
| | | Designates smooth operation. | CNT 1,100,200 | |
| | | Designates the positioning completion conditions with a No. of pulses. | FINE 200 | |
| | | Turns the servo power ON/OFF for all axes. | SERVO OFF | |
| | | Limits the operation of each axis so that the designated torque is not exceeded. | TORQ 4,60 | |
| | Position control | Designates the base conversion data. | BASE P1 | |
| | | Designates the tool conversion data. | TOOL P1 | |
| | Float control | The robot arm rigidity is lowered and softened. | CMP POSE ,00000011 | |
| | | The robot arm rigidity is returned to the normal state. | CMP OFF | |
| | | The robot arm rigidity is designated. | CMPG 1,0,1,0,1,0,1,0,1,0,1,0 | |
| | Pallet | Defines the pallet. | DEF PLT 1,P1,P2,P3,P4,5,3,1 | |
| | | Operates the pallet grid point position. | PLT 1,M1 | |
| | Program control | Branching | Branches unconditionally to the designated place. | GOTO 120 |
| | | | Branches according to the designated conditions. | IF IN1=1 THEN GOTO 100 ELSE GOTO 20 |
| Repeats until the designated end conditions are satisfied. | | FOR M1=1 to 10 | | |
| | | NEXT | | |
| Repeats while the designated conditions are satisfied. | | WHILE M1<10 | | |
| | | WEND | | |
| Branches corresponding to the designated expression value. | ON M1 GOTO 100,200,300 | | | |

| Type | Class | Function | Input format (example) |
|---|---|--|--|
| Program control | Branching | Executes program block corresponding to the designated expression value.. | SELECT CASE 1 CASE 2 END SELECT |
| | | Moves the program process to the next line. | SKIP |
| | Subroutine | Executes the designated subroutine. (Within program) | GOSUB 200 |
| | | Returns from the subroutine. | RETURN |
| | | Executes the designated program. | CALLP "P10",M1,P1 |
| | | Defines the program argument executed with the CALLP command. | FPRM M10,P10 |
| | | Executes the subroutine corresponding to the designated expression value. | ON M1 GOSUB 100,200,300 |
| | Interrupt | Defines the interrupt conditions and process. | DEF ACT 1 IN1=1 GOTO 100 |
| | | Enables/disables the interrupt. | ACT 1=1 |
| | | Defines the start line of the program to be executed when an interrupt is generated from the communication line. | ON COM(1) GOSUB 100 |
| | | Enables the interrupt from the communication line. | COM(1) ON |
| | | Disables the interrupt from the communication line. | COM(1) OFF |
| | Pre-read | Stops the execution of pre-read. | COM(1) STOP |
| | | Stops the execution of pre-read. | SYNC |
| | Wait | Designates the wait time, and the output signal pulse output time. (0.01s unit) | DLY 0.5 |
| | | Waits until the variable becomes the designated value. | WAIT M_IN(1)=1 |
| Stop | Stops the program execution. | HLT | |
| | Generates an error. During program execution, continue, stop or servo OFF can be designated. | ERROR 9000 | |
| End | Ends the program execution. | END | |
| Hand | Hand open | Opens the designated hand. | HOPEN |
| | Hand close | Closes the designated hand. | HCLOSE |
| Input/output | Assignment | Defines the input/output variables. | DEF IO PORT1=BIT,0 |
| | Input | Retrieves the general-purpose input signal. | M1=IN 1 |
| | Output | Calls out the general-purpose output signal. | OUT 1=0 |
| Parallel execution | Mechanism designation | Acquires the mechanism with the designated mechanism No. | GETM 1 |
| | | Releases the mechanism with the designated mechanism No. | RELM 1 |
| | Selection | Selects the designated program for the designated slot. | XLOAD 2,"P102" |
| | Start/stop | Carries out parallel execution of the designated program. | XRUN 3,"100",0 |
| Stops parallel execution of the designated program. | | XSTP 3 | |
| | Returns the designated program's execution line to the head and enters the program selection enabled state. | XRST 3 | |
| Others | Definition | Defines the integer type or real number type variable. | DEF INT KAISUU |
| | | Defines the character string variable. | DEF CHAR MESSAGE |
| | | Defines the layout variable. (Up to 3-dimensional possible) | DIM PDATA(2,3) |
| | | Defines the joint variable. | DEF JNT TAIHI |
| | | Defines the position variable. | DEF POS TORU |
| | | Defines the function. | DEF FNTASU(A,B)=A+B |
| | Clear | Clears the general-purpose output signal, variables in program, variables between programs, etc. | CLR 1 |
| | File | Opens a file. | OPEN "COM1:" AS #1 |
| | | Closes a file. | CLOSE #1 |
| | | Inputs data from a file. | INPUT# 1,M1 |
| | | Outputs data to a file. | PRINT# 1,M1 |
| | Comment | Describes a comment. | REM "ABC" |
| Label | Indicates the branching destination. | *SUB1 | |

4.2 List of parameters

Table 4-2 : List of parameters

| Parameter | | Details |
|----------------------------------|-------------------------|---|
| Standard tool coordinates. | MEXTL | Set the default value for the tool data. Unit: mm or deg. |
| Standard base coordinates | MEXBS | Set the relation of the world coordinate system and robot coordinate system. Unit: mm or deg. |
| xyz operation range | MEPAR | Designate the overrun limit value for the world coordinate system. |
| Joint operation range | MEJAR | Set the overrun limit value for each joint axis. |
| Free plane limit | | This is the overrun limit set with the free plane. Create a plane with the three coordinates x1, y1, z1 to x3, y3, z3, and set the outer side of the plane as the outside operation range (error). The following three types of parameters are used. |
| | SFC1P : SFC8P | Eight types of free plane limits can be set in SFC1P to SFC8P. There are nine elements, set in the order of x1, y1, z1, x2, y2, z2, x3, y3, z3. |
| | SFC1ME : SFC8ME | Designate which mechanism to use eight types of set free plane limits. The mechanism No. to use is set with 1 to 8. |
| | SFC1AT : SFC8AT | Set the validity of the eight types of set free plane limits. (Valid/invalid = 1/0) |
| User-defined area | | An area (cube) defined with two XYZ coordinate points can be designated and that area set as the outside operation range. Furthermore, a signal can be output when the axis enters that area. Up to eight types of area can be designated. |
| | AREA1P1 : AREA8P1 | Designated the 1st point of the area. There are eight elements, set in the order of x, y, z, a, b, c, L1, L2. (L1 and L2 are the additional axes.) |
| | AREA1P2 : AREA8P2 | Designated the 2nd point of the area. There are eight elements, set in the order of x, y, z, a, b, c, L1, L2. (L1 and L2 are the additional axes.) |
| | AREA1ME : AREA8ME | Designate which mechanism to use the eight types of set area. The mechanism No. to use is set with 1 to 8 |
| | AREA1AT : AREA8AT | Designate the area check type. (Invalid/zone/interference = 0/1/2) Zone: The dedicated output signal USRAREA turns ON. Interference: An error occurs.. |
| Automatic return setting | RETPATH | Set to restart the program after returning to the interrupt position when resuming operation after an interruption. |
| Buzzer ON/OFF | BZR | Designate whether to the turn buzzer ON or OFF. |
| Jog setting | JOGJSP | Designate the joint jog and step operation speed. (Set dimension H/L amount, max. override.) |
| | JOGPSP | Designate the linear jog and step operation speed. (Set dimension H/L amount, max. override.) |
| Jog speed limit value | JOGSPMX | Limit the operation speed during the teaching mode. Max. 250[mm/s] |
| Hand type | HANDTYPE | Set the hand type of the single/double solenoid, and the signal No. (Single/double = S/D) Set the signal No. after the hand type. Example) D900 |
| Stop input B contact designation | INB | Change the dedicated input (stop) between the A contact and B contact. |
| User-designated origin | USERORG | Designate the user-designated origin position. |
| Program selection memory | SLOTON | Select the program selected previously when initializing the slot. The non-selected state will be entered when not set. |

| Parameter | | Details |
|-----------------------|-------------------|---|
| Communication setting | CBAU232 | Set the baud rate. |
| | CLEN232 | Set the character length. |
| | CPRTY232 | Set the parity. |
| | CSTOP232 | Set the stop bit. |
| | CTERM232 | Set the end code. |
| Slot table | SLT : SLT32 | Make settings (program name, operation type, order of priority, etc.) for each slot during slot initialization. |
| No. of multi-tasks | TASKMAX | Designate the No. of programs to be executed simultaneously. |

5 Safety

5.1 Safety

Measures to be taken regarding safety of the industrial robot are specified in the "Labor Safety and Sanitation Rules". Always follow these rules when using the robot to ensure safety.

5.1.1 Self-diagnosis stop functions

This robot has the self-diagnosis stop functions shown in [Table 5-1](#) and the stop functions shown in [Table 5-2](#) for safe use.

Table 5-1 : Self-diagnosis stop functions

| No. | Function | Details | Remarks |
|-----|--|---|---|
| 1 | Overload protection function | Activates when the total servo current time exceeds the specified value. | The drive circuit is shut off. The robot stops, and an alarm displays. |
| 2 | Overcurrent diagnosis function | Activates when an overcurrent flows to the motor circuit. | The drive circuit is shut off. The robot stops, and an alarm displays. |
| 3 | Encoder disconnection diagnosis function | Activates when the encoder cable is disconnected. | The drive circuit is shut off. The robot stops, and an alarm displays. |
| 4 | Deflection over diagnosis function | Activates when an error occurs between the command value and actual position, and the error exceeds the specified amount. | The drive circuit is shut off. The robot stops, and an alarm displays. |
| 5 | AC power voltage drop diagnosis function | Activates when the AC power voltage drops below the specified value. | The drive circuit is shut off. The robot stops, and an alarm displays. |
| 6 | CPU error detection function | Activates when an error occurs in the CPU. | The drive circuit is shut off. The robot stops, and an alarm displays. |
| 7 | Overrun prevention function | Software limit detection | This is the limit provided by the software to enable operation only in the operation range. |
| | | Mechanical stopper | This is the mechanical stopper provided outside the software. |

Table 5-2 : List of stop functions

| Stop function | Operation panel | Teaching pendant | External input | Details |
|----------------|-----------------|------------------|----------------|---|
| Emergency stop | ○ | ○ | ○ | This is the stop with the highest degree of emergency. The servo power is shut off, and the mechanical brakes (all axes) activate to stop the robot. To recover, reset the alarm, and turn the servo ON with the servo ON command. |
| Stop | ○ | ○ | ○ | This is a stop operation with a high degree of emergency. The robot immediately decelerates and stops. Note that the servo power is not shut off. Use this when using the collision evasion sensor, etc. |

5.1.2 External input/output signals that can be used for safety protection measures

Table 5-3 : External input/output signals that can be used for safety protection measures

| | Signal | Command | Functions | Usage method |
|--------|----------------------------|----------------|---|--|
| Input | External emergency stop | (Input signal) | This servo power is shut off, and the robot stops immediately. | Externally installed emergency stop switch. Door switch on safety protection fence. Stopping at high-level error occurrence. |
| | Stop | STOP | The program execution is stopped, and the robot stops. The servo power is not shut off. | The robot is stopped when a peripheral device fault occurs. The servo power is not shut off. |
| | Servo OFF | SRVOFF | The servo power can be shut off. | The robot is stopped when a peripheral device fault occurs. The servo power is not shut off. |
| | Automatic operation enable | AUTOENA | Disables automatic operation when inactive. | Door switch on safety protection fence |
| Output | In servo ON | SRVON | The servo power ON/OFF state is output. | The servo power ON/OFF state is shown and alerted with the display lamps. |
| | Waiting | STOP | Outputs that the robot is temporarily stopped. | The temporary stop state is shown and alerted with the display lamps. |
| | In alarm | ERRRESET | Outputs when an alarm occurs in the robot. | The alarm state is shown and alerted with the display lamps. |

[Caution] The external emergency stop input is prepared as a b contact for safety proposes. Thus, if the emergency stop input circuit is opened when the robot is started up, the robot will not operate. Refer to "Fig. 5-1 Example of safety measures" for details.

5.1.3 Precautions for using robot

The safety measures for using the robot are specified in the "Labor Safety and Sanitation Rules". An outline of the rules is given below.

(1) Robot installation

- Secure sufficient work space required to safely perform work such as teaching and maintenance related to the robot.
- Install the controller outside the robot's motion space. (If a safety fence is provided, install outside the fence.)
- Install the controller where the entire robot operation can be viewed.
- Install display lamps, etc., to indicate the robot's operation state.
- Securely fix the robot arm onto the fixing table with the designated bolts.

(2) Prevention of contact with operator

- Install a safety fence or enclosure so that the operator cannot easily enter the robot's motion space.
- Install an interlock function that will stop the robot if the safety fence or enclosure door is opened.

(3) Work procedures

- Create and observe work procedures for the robot teaching, operation, inspection and emergencies.
- Create hand signals to be followed when several operators are working together.
- Create displays such as "Teaching in Progress" and "Inspection in Progress" to be put up when an operator is in the robot's motion space so that other operators will not operate the operation panel (controller, control panel).

(4) Training

- Train the operators about the operations, maintenance and safety required for the robot work.
- Only trained and registered operators must operate the robot.
Participation in the "Special training for industrial robots" sponsored by the Labor Safety and Sanitation Committee, etc., is recommended for safety training.

(5) Daily inspection and periodic inspection

- Always inspect the robot before starting daily operations and confirm that there are no abnormalities.
- Set the periodic inspection standards in view of the robot's ambient environment and operation frequency, and perform periodic inspections.
- Make records when periodic inspections and repairs have been done, and store the records for three or more years.

5.1.4 Safety measures for automatic operation

- (1) Install safety fences so that operators will not enter the operation area during operation and indicate that automatic operation is in progress with lamps, etc.
- (2) Create signals to be given when starting operation, assign a person to give the signal, and make sure that the operator follows the signals.

5.1.5 Safety measures for teaching

Observe the following measures when teaching, etc., in the robot's operation range.

- (1) Specify and follow items such as procedures related to teaching work, etc.
- (2) Take measures so that operation can be stopped immediately in case of trouble, and measures so that operation can be restarted.
- (3) Take measures with the robot start switch, etc., to indicate that teaching work is being done.
- (4) Always inspect that stop functions such as the emergency stop device before starting the work.
- (5) Immediately stop the work when trouble occurs, and correct the trouble.
- (6) Take measures so that the work supervisor can immediately stop the robot operation when trouble occurs.
- (7) The teaching operator must have completed special training regarding safety. (Training regarding industrial robots and work methods, etc.)
- (8) Create signals to be used when several operators are working together.

5.1.6 Safety measures for maintenance and inspections, etc.

Turn the power OFF and take measures to prevent operators other than the relevant operator from pressing the start switch when performing inspections, repairs, adjustments, cleaning or oiling.

If operation is required, take measures to prevent hazards caused by unintentional or mistaken operations.

- (1) Specify and follow items such as procedures related to maintenance work, etc.
- (2) Take measures so that operation can be stopped immediately in case of trouble, and measures so that operation can be restarted.
- (3) Take measures with the robot start switch, etc., to indicate that work is being done.
- (4) Take measures so that the work supervisor can immediately stop the robot operation when trouble occurs.
- (5) The operator must have completed special training regarding safety. (Training regarding industrial robots and work methods, etc.)
- (6) Create signals to be used when several operators are working together.

5.1.7 Examples of safety measures

Two emergency stop input circuits are prepared on the user wiring terminal block of the controller. Create a circuit as shown below for safety measures

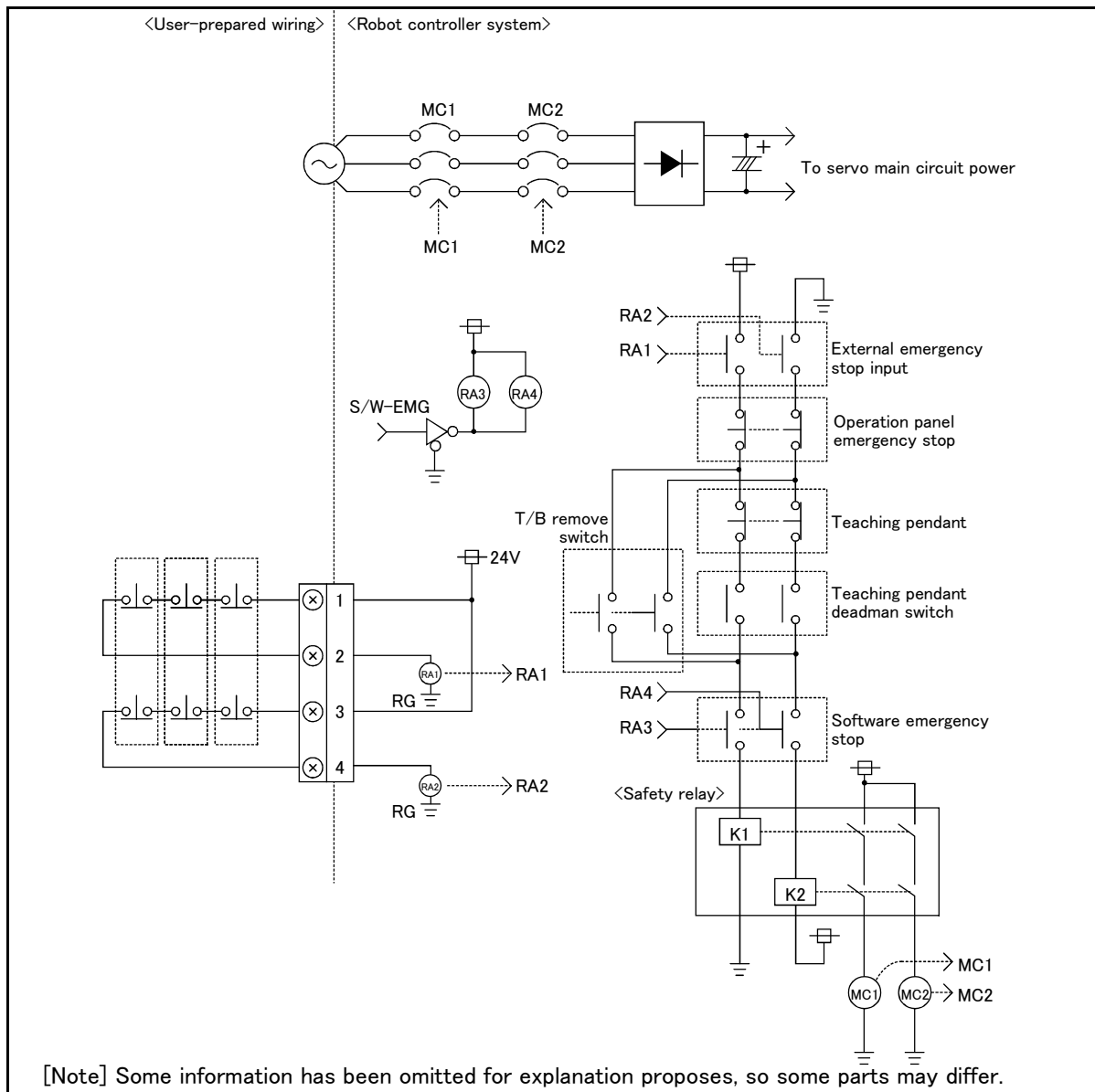


Fig.5-1 : Example of safety measures

- (1) Use a 2-contact type switch for all switches.
- (2) Install a limit switch on the safety fence's door. With a constantly open contact (a contact), wire so that the switch turns ON (is conducted) when the door is closed, and turns OFF (is opened) when the door is open.
- (3) Use a b contact manual-return type operator emergency stop switch.
- (4) Classify the faults into minor faults (faults that are easily restored and that do not have a great effect) and major faults (faults that cause the entire system to stop immediately, and that require care in restoration), and wire accordingly.

[Caution] The emergency stop input(terminal block) on the user wiring in the controller can be used for safety measures as shown in Fig. 5-1. Note that there are limits to the No. of switch contacts, capacity and cable length, so refer to the following and install.

- Switch contactPrepare a 2-contact type.
- Switch contact capacity..... Use a contact that operates with a switch contact capacity of approx. 1mA to 100mA/24V.
- Cable length..... The length of the wire between the switch and terminal block must be max. 15m or less.

[Reference] The specifications of the RA1 and RA2 coil shown in Fig. 5-1 are as follow.

- Rated voltage DC24V \pm 10%
- Rated excitation current 12.5mA \pm 10% (@ 25 °C)

* Note that these specifications are subject to change without prior notice for modification purposes.

The emergency stop circuit in the robot is a duplex type to ensure safety.

Thus, if a 1b contact type is used, faults such as fusing in the emergency stop circuit will not be detected, and could lead to fires.

If a 1b contact type is used and the emergency stop is input with only one side (across No. 1-2 or No. 5-6), the contact fusing alarm will occur, and resetting of the alarm will not be possible.

5.2 Working environment

Avoid installation in the following places as the equipment's life and operation will be affected by the ambient environment conditions. When using in the following conditions, the customer must pay special attention to the preventive measures.

(1) Power supply

- Where the voltage fluctuation will exceed the input voltage range.
- Where a momentary power failure exceeding 20ms may occur.
- Where the power capacity cannot be sufficiently secured.

(2) Noise

- Where a surge voltage exceeding 1000V, 1 μ s may be applied on the primary voltage. Near large inverters, high output frequency oscillator, large contactors and welding machines. Static noise may enter the lines when this product is used near radios or televisions. Keep the robot away from these items.

(3) Temperature and humidity

- Where the atmospheric temperature exceeds 40 °C , lower than 0 °C .
- Where the relative humidity exceeds 85%, lower than 45%, and where dew may condense.
- Where the robot will be subject to direct sunlight or near heat generating sources such as heaters.

(4) Vibration

- Where excessive vibration or impact may be applied. (Use in an environment of 34m/s² or less during transportation and 5m/s² or less during operation.)

(5) Installation environment

- Where strong electric fields or magnetic fields are generated.
- Where the installation surface is rough. (Avoid installing the robot on a bumpy or inclined floor.)

5.3 Precautions for handling

- (1) This robot has brakes on all axes. The precision of the robot may drop, looseness may occur and the reduction gears may be damaged if the robot is moved with force with the brakes applied.
- (2) Avoid moving the robot arm by hand. When unavoidable, gradually move the arm. If moved suddenly, the accuracy may drop due to an excessive backlash, or the backed up data may be destroyed.
- (3) Note that depending on the posture, even when within the movement range, the wrist section could interfere with the base section. Take care to prevent interference during jog. ^{Note1)}
- (4) The robot arm is configured of precision parts such as bearings. Grease is used for lubricating these parts. When cold starting at low temperatures or starting operation after long-term stoppage, the position accuracy may drop or servo alarms may occur. If these types of phenomena occur, run the robot with low-speed operation for a short time.
- (5) The robot arm and controller must be grounded with Class D grounding to secure the noise resistance and to prevent electric shocks.
- (6) The items described in these specifications are conditions for carrying out the periodic maintenance and inspections described in the instruction manual.
- (7) When using the robot arm on a mobile axis or elevating table, the machine cables enclosed as standard configuration may break due to the fixed installation specifications. In this case, use the machine cable extension (for bending)" factory shipment special specifications or options.
- (8) If this robot interferes with the workpiece or peripheral devices during operation, the position may deviate, etc. Take care to prevent interference with the workpiece or peripheral devices during operation.
- (9) The hanging installation jig can be borrowed from the maker. Order to dealer when need.
- (10) Do not attach a tape or a label to the robot arm and the controller. If a tape or a label with strong adhesive power, such as a packaging tape, is attached to the coated surfaces of the robot arm and controller, the coated surface may be damaged when such tape or label is peeled off.

Note1) Jog operation refers to operating the robot manually using the teaching pendant.

6 Appendix

Appendix 1 : Specifications discussion material

■ Customer information

| | | | |
|--------------|--|-----------|--|
| Company name | | Name | |
| Address | | Telephone | |

■ Purchased mode

| Specification | Type | | | |
|-------------------------------|------------------------------------|-------------------------------------|-------------------------------------|--------------------------------------|
| Standard specification(IP54F) | <input type="checkbox"/> RV-4A | <input type="checkbox"/> RV-5AJ | <input type="checkbox"/> RV-3AL | <input type="checkbox"/> RV-4AJL |
| Clean specifications(Special) | <input type="checkbox"/> RV-4AC-SA | <input type="checkbox"/> RV-5AJC-SA | <input type="checkbox"/> RV-3ALC-SA | <input type="checkbox"/> RV-4AJLC-SA |
| | <input type="checkbox"/> RV-4AC-SB | <input type="checkbox"/> RV-5AJC-SB | <input type="checkbox"/> RV-3ALC-SB | <input type="checkbox"/> RV-4AJLC-SB |

■ Shipping special specifications (Settings can be made only at time of shipment)

| Item | | Standard specifications | Special shipping specifications |
|------------|----------------------|--|---|
| Robot arm | Operating range | J1 axis + side <input type="checkbox"/> +160° | <input type="checkbox"/> +135° <input type="checkbox"/> +90° <input type="checkbox"/> +45° |
| | | J1 axis - side <input type="checkbox"/> -160° | <input type="checkbox"/> -135° <input type="checkbox"/> -90° <input type="checkbox"/> -45° |
| | Machine cable | <input type="checkbox"/> 5m stationary type | <input type="checkbox"/> 10m stationary type <input type="checkbox"/> 15m stationary type <input type="checkbox"/> 5m bending type <input type="checkbox"/> 10m bending type <input type="checkbox"/> 15m bending type |
| Controller | Controller structure | <input type="checkbox"/> Floor type (IP20) | <input type="checkbox"/> Closed type (IP54) |

■ Options (Installable after shipment)

| Item | | Provision, and specifications when provided. |
|---|---|---|
| Robot arm | Operating range change | 1E-DH <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> - <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> J1 axis + side: <input type="checkbox"/> +160° <input type="checkbox"/> +135° <input type="checkbox"/> +90° <input type="checkbox"/> +45° J1 axis - side: <input type="checkbox"/> -160° <input type="checkbox"/> -135° <input type="checkbox"/> -90° <input type="checkbox"/> -45° |
| | Pneumatic hand set | 4E-HP02/4E-HP02E <input type="checkbox"/> Not provided <input type="checkbox"/> 4E-HP02 <input type="checkbox"/> 4E-HP02E |
| | Solenoid valve set | 1E-VD0 <input type="checkbox"/> /1E-VD0 <input type="checkbox"/> E <input type="checkbox"/> Not provided 1E-VD0 <input type="checkbox"/> : <input type="checkbox"/> 1 set <input type="checkbox"/> 2 sets <input type="checkbox"/> 3 sets 1E-VD0 <input type="checkbox"/> E : <input type="checkbox"/> 1 set <input type="checkbox"/> 2 sets <input type="checkbox"/> 3 sets |
| | Hand input cable | 1E-HC15C <input type="checkbox"/> Not provided <input type="checkbox"/> Provided |
| | Hand output cable | 1E-GR35S/GR35S03 <input type="checkbox"/> Not provided <input type="checkbox"/> 1, 2 sets <input type="checkbox"/> 3 sets |
| | Hand curl tube | 1E-ST040 <input type="checkbox"/> C <input type="checkbox"/> Not provided <input type="checkbox"/> 1 pc. <input type="checkbox"/> 2 pc. <input type="checkbox"/> 3 pc. |
| Controller | Teaching pendant | R28TB- <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Not provided <input type="checkbox"/> 7m <input type="checkbox"/> 15m |
| | Pneumatic hand interface | 2A-RZ365/2A-RZ375 <input type="checkbox"/> Not provided <input type="checkbox"/> Provided |
| | Parallel I/O interface ^{Note1)} | 2A-RZ361/2A-RZ371 <input type="checkbox"/> Not provided <input type="checkbox"/> 1pc. <input type="checkbox"/> 2pc. <input type="checkbox"/> 3pc. <input type="checkbox"/> 4pc. <input type="checkbox"/> 5pc. <input type="checkbox"/> 6pc. <input type="checkbox"/> 7pc. |
| | External I/O cable | 2A-CBL <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Not provided <input type="checkbox"/> 5m-1pc. <input type="checkbox"/> 5m-2pc. <input type="checkbox"/> 5m-3pc. <input type="checkbox"/> 15m-1pc. <input type="checkbox"/> 15m-2pc. <input type="checkbox"/> 15m-3pc. |
| | CC-LINK interface | 2A-HR575-E <input type="checkbox"/> Not provided <input type="checkbox"/> Provided |
| | ETHERNET interface | 2A-HR533-E <input type="checkbox"/> Not provided <input type="checkbox"/> Provided |
| | Extended serial interface | 2A-RZ581-E <input type="checkbox"/> Not provided <input type="checkbox"/> Provided |
| | Extended memory cassette | 2A-HR432 <input type="checkbox"/> Not provided <input type="checkbox"/> Provided |
| | Personal computer cable | RS-MAXY-CBL <input type="checkbox"/> Not provided <input type="checkbox"/> Provided |
| Personal computer support software | 3A-01 <input type="checkbox"/> -WINE <input type="checkbox"/> Not provided <input type="checkbox"/> Windows95/98/NT4.0 CD-ROM <input type="checkbox"/> Windows95/98/NT4.0 Floppy disk | |
| Personal computer support software mini | 3A-02 <input type="checkbox"/> -WINE <input type="checkbox"/> Not provided <input type="checkbox"/> Windows95/98/NT4.0 CD-ROM <input type="checkbox"/> Windows95/98/NT4.0 Floppy disk | |

Note1) Up to eight units, including the one unit mounted as a standard.

■ Maintenance parts (consumable parts)

| | |
|-------------------|--|
| Maintenance parts | <input type="checkbox"/> Backup batteries A6BAT () pcs. <input type="checkbox"/> Backup batteries ER6 () pcs. <input type="checkbox"/> Grease () cans |
|-------------------|--|

■ Robot selection check list

| | | | |
|----------------------|--|------------|--|
| Work description | <input type="checkbox"/> Material handling <input type="checkbox"/> Assembly <input type="checkbox"/> Machining L/UL <input type="checkbox"/> Sealing <input type="checkbox"/> Testing and inspection <input type="checkbox"/> Other () | | |
| Workpiece mass () g | Hand mass () g | Atmosphere | <input type="checkbox"/> General environment <input type="checkbox"/> Clean <input type="checkbox"/> Dust provided <input type="checkbox"/> Other() |
| Remarks | | | |

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