



Mitsubishi Industrial Robot

CR750-Q/CR751-Q Controller

RH-6FH-Q/12FH-Q/20FH-Q Series

RH-3FHR-Q Series

Standard Specifications Manual

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
-  **DANGER** 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.

- ⚠ DANGER** When automatic operation of the robot is performed using multiple control devices (GOT, programmable controller, push-button switch), the interlocking of operation rights of the devices, etc. must be designed by the customer.
- ⚠ 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. Moreover, it may interfere with the peripheral device by drop or move by inertia of the arm.

 **CAUTION**

Do not turn off the main power to the robot controller while rewriting the internal information of the robot controller such as the program or parameters. If the main power to the robot controller is turned off while in automatic operation or rewriting the program or parameters, the internal information of the robot controller may be damaged.

 **DANGER**

Do not connect the Handy GOT when using the GOT direct connection function of this product. Failure to observe this may result in property damage or bodily injury because the Handy GOT can automatically operate the robot regardless of whether the operation rights are enabled or not.

 **DANGER**

Do not connect the Handy GOT to a programmable controller when using an iQ Platform compatible product with the CR7xx-Q controller. Failure to observe this may result in property damage or bodily injury because the Handy GOT can automatically operate the robot regardless of whether the operation rights are enabled or not.

 **DANGER**

Do not remove the SSCNET III cable while power is supplied to the multiple CPU system or the servo amplifier. Do not look directly at light emitted from the tip of SSCNET III connectors or SSCNET III cables of the Motion CPU or the servo amplifier. Eye discomfort may be felt if exposed to the light. (Reference: SSCNET III employs a Class 1 or equivalent light source as specified in JIS C 6802 and IEC60825-1 (domestic standards in Japan).)

 **DANGER**

Do not remove the SSCNET III cable while power is supplied to the controller. Do not look directly at light emitted from the tip of SSCNET III connectors or SSCNET III cables. Eye discomfort may be felt if exposed to the light. (Reference: SSCNET III employs a Class 1 or equivalent light source as specified in JIS C 6802 and IEC60825-1 (domestic standards in Japan).)

 **DANGER**

Attach the cap to the SSCNET III connector after disconnecting the SSCNET III cable. If the cap is not attached, dirt or dust may adhere to the connector pins, resulting in deterioration connector properties, and leading to malfunction.

 **CAUTION**

Make sure there are no mistakes in the wiring. Connecting differently to the way specified in the manual can result in errors, such as the emergency stop not being released. In order to prevent errors occurring, please be sure to check that all functions (such as the teaching box emergency stop, customer emergency stop, and door switch) are working properly after the wiring setup is completed.

CAUTION

Use the network equipments (personal computer, USB hub, LAN hub, etc) confirmed by manufacturer. The thing unsuitable for the FA environment (related with conformity, temperature or noise) exists in the equipments connected to USB. When using network equipment, measures against the noise, such as measures against EMI and the addition of the ferrite core, may be necessary. Please fully confirm the operation by customer. Guarantee and maintenance of the equipment on the market (usual office automation equipment) cannot be performed.

CAUTION

To maintain the security (confidentiality, integrity, and availability) of the robot and the system against unauthorized access, DoS*¹ attacks, computer viruses, and other cyberattacks from unreliable networks and devices via network, take appropriate measures such as firewalls, virtual private networks (VPNs), and antivirus solutions.

Mitsubishi Electric shall have no responsibility or liability for any problems involving robot trouble and system trouble by unauthorized access, DoS attacks, computer viruses, and other cyberattacks.

*1 DoS: A denial-of-service (DoS) attack disrupts services by overloading systems or exploiting vulnerabilities, resulting in a denial-of-service (DoS) state.

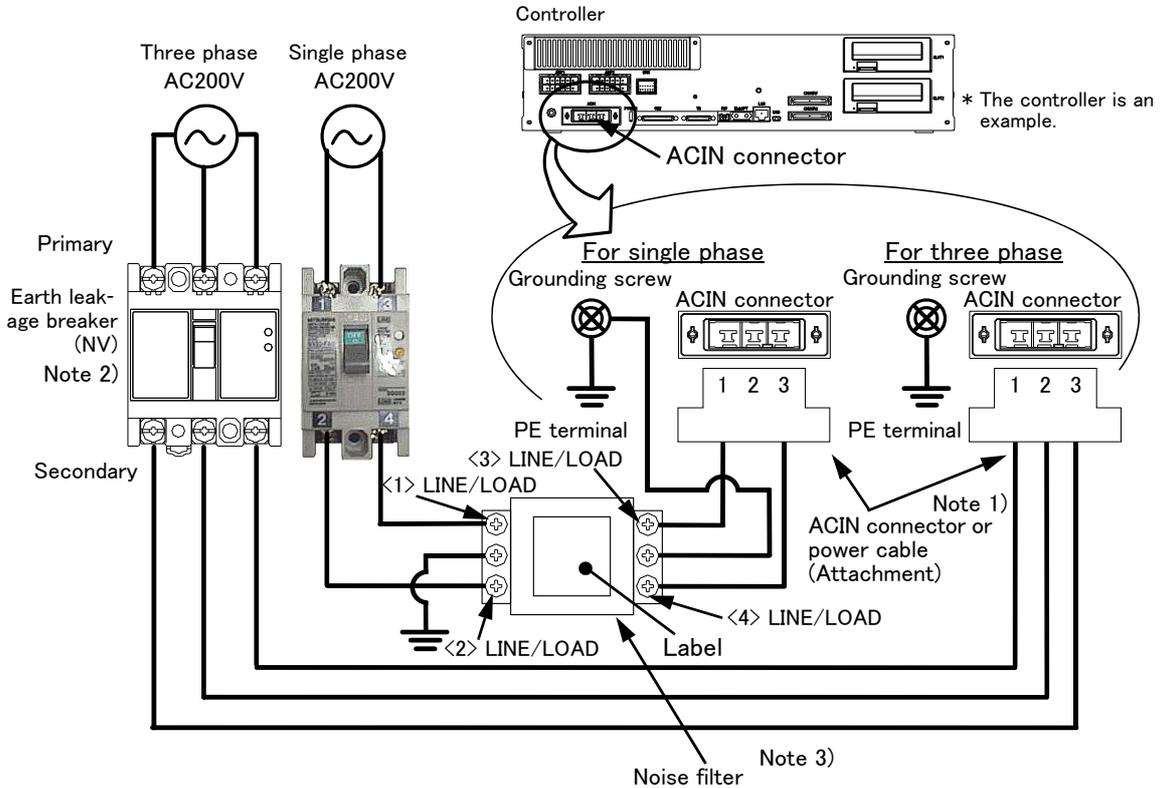
*CR751-D or CR751-Q controller

Notes of the basic component are shown.



CAUTION

Please install the earth leakage breaker in the primary side supply power supply of the controller of CR751-D or CR751-Q because of leakage protection.



Note 1) Crimping swage is recommended for connecting the attachment ACIN connector (soldering is also possible)
Recommendation compression tools: 234171-1(Tyco Electronics)

Note 2) The earth leakage breaker is the customer preparation. Always use the cover below.

Recommendation: For single primary power supply NV30FAU-2P-10A-AC100-240V-30mA, (Cover: TCS-05FA2)

For three primary power supply NV30FAU-3P-10A-AC100-240V-30mA, (Cover: TCS-05FA3)

Note 3) If necessary, as shown in the figure, connects the noise filter between ACIN terminal blocks and primary power supply.
(Recommended noise filter: SUP-EL20-ER6 *OKAYA ELECTRIC INDUSTRIES)

1) Please prepare the following: Leakage current breaker (with the terminal cover), cable for connecting the primary power supply (AWG #14 (2mm² or above), cables to ground the primary power supply (AWG #12 (3.5mm² or above).

The secondary power cable (with the ACIN connector) for single phase or three phase power is supplied with the product to match the specifications. When you build a cable suitable for your environment using the ACIN connector and the ACIN terminal supplied, prepare a secondary power cable (AWG #14 (2mm² or above).

2) Confirm that the primary power matches the specifications.

3) Confirm that the primary power is OFF and that the earth leakage breaker power switch is OFF.

4) Connect the secondary power cable.

a) When using the supplied power cable with the ACIN connector

Refer to the figure above and connect the cable from the secondary side of the earth leakage breaker.

b) When building a power cable using the ACIN connector and the ACIN terminals supplied

Connect the ACIN terminals with the secondary power cable (prepared by customers), and insert the ACIN terminals to the ACIN connector pins with the following numbers. Crimping caulking is recommended to connect the ACIN terminals.

For single phase: 1 and 3

For three phase: 1, 2, and 3

Refer to the figure above and connect the cable from the secondary side of the earth leakage breaker.

5) Connect this ACIN connector to the ACIN connector on the front of the controller.

6) Connect the grounding cable to the PE terminal. (M4 screw)

7) Connect the primary power cable to the primary side terminal of the earth leakage breaker.

⚠ CAUTION

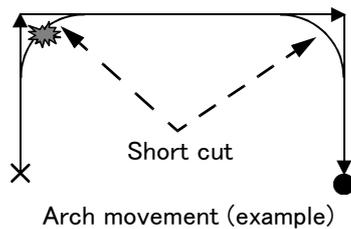
Be careful of interference with peripheral equipment.

Especially don't give a shock to the shaft (J3 axis). When you install the hand, be careful not to knock at the shaft end by the hammer etc. The shaft may be damaged.

Take care also of the following items.

(1) The robot's locus of movement may change with specified speed.

Especially as for the corner section, short cut distance may change. Therefore, when beginning automatic operation, moves at low speed at first, and you should gather speed slowly with being careful of interference with peripheral equipment.



(2) It can be confirmed whether the specified position exist in the defined area by using the instruction command "Zone". It can utilize as one of the methods for collision evasion. Refer to the "detailed description of the instructions manual/function, and operation" of the separate volume for the details of the instruction command.

■Revision history

| Date of print | Specifications No. | Details of revisions |
|---------------|--------------------|--|
| 2012-06-05 | BFP-A8882 | <ul style="list-style-type: none"> First print. |
| 2012-06-11 | BFP-A8882-A | <ul style="list-style-type: none"> The specification (the suction flow rate, the vacuum generator quantity) of inside suction for clean type of RH-12FH/20FH was changed. The note about the load center-of-gravity position of RH-20FH was added, and the related graph of the offset length and the maximum-speed was corrected. |
| 2012-06-14 | BFP-A8882-B | <ul style="list-style-type: none"> The specification and dimension of duct was added. The upper limit of load center-of-gravity position was added. The quantity of the coupling for the internal suction of RH-12FH / 20FH clean specification was changed. |
| 2012-06-21 | BFP-A8882-C | <ul style="list-style-type: none"> The graph of "Relationship Between Height of Shaft (J3 Axis) and Acceleration/Deceleration Speed" was corrected. (error in writing) EC-Statement of Compliance was replaced. (RH-3FH-Q and RH-6FH-Q were added) |
| 2012-07-19 | BFP-A8882-D | <ul style="list-style-type: none"> The input voltage range (1-phase: AC207 to 253V) was added to RH-12FH/20FH series. The error in writing of the connector name and the example of the connection in "3.8.1 Wiring of the Additional Axis Interface" was corrected. ("ExtOPT" was mistake) |
| 2012-07-31 | BFP-A8882-E | <ul style="list-style-type: none"> The connector name of hand input signal/output signal of "Fig.2-48: Wiring and piping for hand" was corrected. The outside dimension (moving position of the 340mm stroke type) of RH-6FH series clean/oil mist specification were corrected. |
| 2012-09-03 | BFP-A8882-F | <ul style="list-style-type: none"> The power supply capacity of RH-6FH/12FH/20FH was corrected. The attachments of optional Internal Wiring/Piping set for hand were corrected. |
| 2012-10-09 | BFP-A8882-G | <ul style="list-style-type: none"> The notes were added to "Fig 3-17: Example of EMC noise filter installation". The lithium battery (ER6) was added to The United Nations' Recommendations on the Transport of Dangerous Goods. The notes about installation of the controller and the robot arm were added. (neither direct rays nor the heat of lighting) |
| 2012-10-18 | BFP-A8882-H | <ul style="list-style-type: none"> The user's guide of KC mark was added. |
| 2012-11-20 | BFP-A8882-J | <ul style="list-style-type: none"> The statement about trademark registration was added. The center distance of Pilot hole of Installation surface was added. (RH-6FH) The die center distance of Pilot hole of Installation surface was added and changed. (RH-12FH/20FH) The notes about the input-output connected to the controller were added. (do not ground the + side of 24V power supply prepared by customer) "Declaration of Incorporation" was updated. The metal plate which fixes "Hand internal wiring and piping set (option)" was changed to attachment of the robot arm in standard. |
| 2012-12-05 | BFP-A8882-K | <ul style="list-style-type: none"> The terminal name to connect when using the three phase specification by the single phase power supply was added. EC-Statement of Compliance was updated. |
| 2013-01-11 | BFP-A8882-M | <ul style="list-style-type: none"> Note of the external emergency stop were added (opens the connector terminal at factory shipping). The specification description of CR750-MB was added. |
| 2013-03-19 | BFP-A8882-N | <ul style="list-style-type: none"> The metal plate which fixes CR750 controller vertically was changed. (upward compatibility) "Table 3-2: Robot CPU unit standard specification" was added. The mass of the controller was shown which was divided by each robot type. |
| 2013-07-19 | BFP-A8882-P | <ul style="list-style-type: none"> The simple spanner for resin nuts was added to the attachments of the external wiring/piping box (option). "Declaration of Incorporation" and "EC-Statement of Compliance" were updated. "Fig.2-54 : Wiring and piping system diagram for hand and example the solenoid valve installation" was modified. The cautions of operating in a low temperature environment or after a prolonged stop in "6.3 Precautions for handling" were modified. The caution about fumigation of wood packing was added to "6.3 Precautions for handling". |

| Date of print | Specifications No. | Details of revisions |
|---------------|--------------------|---|
| 2013-09-19 | BFP-A8882-R | <ul style="list-style-type: none"> • RH-3FHR-Q series were added. • "Fig.6-6: Limitations when connecting the relay etc. (CR750)" was corrected. (Error output → Emergency stop output, Contactor control output for additional axes → Error output) • The description of Internal Wiring/Piping set for hand for RH-12FH/20FH series were corrected. • The numbers of hand curl tube for RH-12FH/20FH series was corrected. • The following descriptions of (5) in "Fig.2-48 : Wiring and piping for hand" were corrected. The power source wire only for the multifunctional hand → Spare wire The connector pins name of robot side and connector name of counter side were added. The connector pins name of counter side was corrected. • The descriptions of solenoid valve set were corrected, and explanations were added. • "Fig.2-50 : Location of screw holes for fixing wiring/piping (RH-12FH/20FH)" was corrected • "Fig.2-54 : Wiring and piping system diagram for hand and example the solenoid valve installation" was corrected. • The descriptions about the ventilation duct which the robot of clean specification has were corrected. |
| 2014-01-08 | BFP-A8882-S | <ul style="list-style-type: none"> • "Fig. 2-10: Relationship of the offset length and maximum velocity" was corrected. • Conditions for the flexed type cables were corrected. • The note about an ambient temperature was added to "2.1.1 Basic specifications". • The description of "MELFA BASIC IV" was added to "Table 3-1: Specifications of controller". • The type name of the SSCNET III cable (5m) was corrected to MR-J3BUS5 M-A. |
| 2014-03-31 | BFP-A8882-T | <ul style="list-style-type: none"> • The grounding representation was corrected. • The types of the ACIN terminal were added. |
| 2014-07-04 | BFP-A8882-U | <ul style="list-style-type: none"> • Type name of the optional solenoid valve set of the clean specification for RH-3FHR series was corrected. |
| 2014-08-20 | BFP-A8882-V | <ul style="list-style-type: none"> • The cover and corporate logo mark of this manual was changed. • The statement about trademark registration was modified. • The explanation of CR751 drive unit was added. • A connection space for a machine cable was added. • The description about screw holes using for tooling wiring and piping was added. • Correction of errors in the hand input cable (Option). • A safety relay in "example of safety measures (wiring example 5) " both CR750 and CR751 controller were changed. • "Declaration of Incorporation" and "EC-Statement of Compliance" were updated. |
| 2014-12-17 | BFP-A8882-W | <ul style="list-style-type: none"> • Allowance value of the offset amount were added to "2.2.2 Mass capacity". • The description of how to change the operating range moved into "INSTRUCTION MANUAL/ROBOT ARM SETUP & MAINTENANCE". • Correction of errors in the Specifications discussion materials. (Network vision sensor: 4D-2CG5***-PKG was deleted.) • The corporate logo mark of illustrations in this manual was changed. |
| 2015-02-10 | BFP-A8882-X | <ul style="list-style-type: none"> • The description in case the ethernet cable is used as a backup wiring for data communication was added. |
| 2015-11-17 | BFP-A8882-Y | <ul style="list-style-type: none"> • "Declaration of Incorporation" and "EC-Statement of Compliance" were updated. • Transportation precaution of the lithium battery was modified. • Note1) in "Table3-6: Function of the key switch interface" was corrected. |
| 2015-12-14 | BFP-A8882-AA | <ul style="list-style-type: none"> • Circuit diagrams in "3.6.1 Connection of the external emergency stop" and "6.1.7 Examples of safety measures" were modified. |
| 2016-04-07 | BFP-A8882-AB | <ul style="list-style-type: none"> • Windows10 was supported by RT ToolBox2. • "EC DECLARATION OF CONFORMITY" pages were deleted. |
| 2017-05-22 | BFP-A8882-AC | <ul style="list-style-type: none"> • Contact information of the authorized representative was updated. |
| 2017-09-25 | BFP-A8882-AD | <ul style="list-style-type: none"> • "2.8 About Overhaul" was modified. |
| 2018-06-01 | BFP-A8882-AE | <ul style="list-style-type: none"> • Description of countermeasures against unauthorized access was added. • Referenced Standard (Requirement of Chinese standardized law) was added. • Notes were added to section 3.6. • Environmental conditions of electromagnetic noise was modified. • "3.9 Magnet contactor control connector output (AXMC) for addition axes" was modified. |
| 2018-12-25 | BFP-A8882-AF | <ul style="list-style-type: none"> • The attachments for the external wiring/piping box were corrected. • "3.7 Mode changeover switch input" was modified. |
| 2019-04-19 | BFP-A8882-AG | <ul style="list-style-type: none"> • Correction of figures. (Fig. 2-30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 52 to 54) |

| Date of print | Specifications No. | Details of revisions |
|---------------|--------------------|---|
| 2020-01-24 | BFP-A8882-AH | <ul style="list-style-type: none"> • Added information on the space required for installing and removing the cover. (Fig. 2-18, 20, 22, 24, 26, 28) • Correction of errors. • Corrected the specifications of valves for solenoid valve sets. (Table 2-23) |
| 2020-10-30 | BFP-A8882-AJ | <ul style="list-style-type: none"> • Amended the precautions regarding the prevention of unauthorized access. • Added "Appendix 1: Origin position adjustment of J2 axis". • Corrected the battery name. (ER6 → ER6V) • Corrected other mistakes and changed some sections. |
| 2021-01-29 | BFP-A8882-AK | <ul style="list-style-type: none"> • Updated contents for the optional product "MELFA-3D Vision 3.0 (3F-53U-WINM)". |
| 2021-06-25 | BFP-A8882-AM | <ul style="list-style-type: none"> • Corrected examples of safety measures. (Fig. 6-1 to 6-4, 6-6 to 6-9) • Corrected limitations when connecting the relay etc. (Fig. 6-11, 12) • Added "Appendix 1: Classification of functions using external input/output signals". |
| 2021-11-30 | BFP-A8882-AN | <ul style="list-style-type: none"> • Corrected the explanation of the parameter "SRVON". • Corrected other mistakes and changed some sections. |
| 2022-01-31 | BFP-A8882-AP | <ul style="list-style-type: none"> • Revised "6.4 EMC installation guideline". • Corrected other mistakes and changed some sections. |
| | | |

■ Introduction

This series offers small-size industrial robots developed using Mitsubishi's latest technology. They are especially designed to handle and assemble mechanical parts. They are Mitsubishi's answer to the customer's need to achieve a compact manufacturing facility capable of highly flexible production, as necessitated by the diffusion of high-density product groups and the shorter product life cycles that have become common-place in recent years.

About RH-3FHR-Q series, because the installation surface does not give limitation to the operating range, it can work to the layout in the customer flexibly.

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.

Note that in this specification document the specifications related to the robot arm is described [Page 15, "2 Robot arm"](#), the specifications related to the controller [Page 126, "3 Controller"](#), and software functions and a command list [Page 187, "4 Software"](#) separately.

This document has indicated the specification of the following types robot.

On floor type.....*RH-6FH-Q series
 *RH-12FH-Q series
 *RH-20FH-Q series
Hanging type*RH-3FHR-Q series

· About CE Marking in the automization system

The Guidelines of the measures against EMC in the automization system manufactured by the customer is shown in [Page 211, "6.4 EMC installation guideline"](#).

Please refer to it and carry out the measures against EMC of the automization system of the customer.

- 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." or "alarm may occur".
Please contact your nearest dealer if you find any doubtful, wrong or skipped point.
- This specifications is original.
- Microsoft, Windows, Windows XP, Windows Vista, Windows 7, Windows 8, Windows 8.1, Windows 10 are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries.
- The official name of Windows® is Microsoft®Windows®Operating System.
- Windows®XP, Windows Vista®, Windows® 7, Windows® 8, Windows® 8.1, Windows® 10 are either product names of Microsoft Corporation in the United States.
- Ethernet is registered trademarks or trademarks of Xerox Corporation in the United States.
- All other company names and production names in this document are the trademarks or registered trademarks of their respective owners.
- Referenced Standard (Requirement of Chinese standardized law): This Product is designed and manufactured accordance with GB 11291.1.
- Illustrations in this Instruction Manual may differ from the actual products.

Contents

| | Page |
|--|------|
| 1 General configuration | 1-1 |
| 1.1 Structural equipment | 1-1 |
| 1.1.1 Standard structural equipment | 1-1 |
| 1.1.2 Special specifications | 1-1 |
| 1.1.3 Options | 1-1 |
| 1.1.4 Maintenance parts | 1-1 |
| 1.2 Model type name of robot | 1-2 |
| 1.2.1 How to identify the robot model | 1-2 |
| (1) Floor installation type | 1-2 |
| (2) Hanging installation type | 1-3 |
| 1.2.2 Combination of the robot arm and the controller | 1-4 |
| (1) CR750 controller | 1-4 |
| (2) CR751 controller | 1-5 |
| 1.3 CE marking specifications | 1-6 |
| (1) CR750 controller | 1-6 |
| (2) CR751 controller | 1-7 |
| 1.4 Indirect export | 1-7 |
| 1.5 Instruction manuals | 1-7 |
| 1.6 Contents of the structural equipment | 1-8 |
| 1.6.1 Robot arm | 1-8 |
| (1) Floor installation type | 1-8 |
| (2) Hanging installation type | 1-10 |
| 1.6.2 Controller | 1-11 |
| (1) CR750controller | 1-11 |
| (2) CR751 controller | 1-12 |
| 1.7 Contents of the Option equipment and special specification | 1-13 |
| 2 Robot arm | 2-15 |
| 2.1 Standard specifications | 2-15 |
| 2.1.1 Basic specifications | 2-15 |
| (1) RH-6FH series | 2-15 |
| (2) RH-12FH series | 2-17 |
| (3) RH-20FH series | 2-19 |
| (4) RH-3FHR series | 2-21 |
| 2.1.2 The counter-force applied to the installation surface | 2-22 |
| 2.1.3 RH-3FHR installation stage | 2-23 |
| (1) Example which uses the iron material | 2-23 |
| (2) Example which uses the aluminum | 2-24 |
| 2.2 Definition of specifications | 2-25 |
| 2.2.1 Pose repeatability | 2-25 |
| 2.2.2 Mass capacity | 2-26 |
| 2.2.3 Relationships Among Mass Capacity, Speed, and Acceleration/Deceleration Speed | 2-28 |
| (1) Setting Load Capacity and Size (Hand Conditions) | 2-28 |
| 2.2.4 Vibrations at the Tip of the Arm during Low-Speed Operation of the Robot | 2-28 |
| 2.2.5 Vibration of shaft (J3 axis) position and arm end | 2-29 |
| (1) Relationship Between Mass Capacity and Speed | 2-29 |
| (2) Relationship Between Height of Shaft (J3 Axis) and Acceleration/Deceleration Speed | 2-30 |
| (3) Relation between offset length and the maximum speed | 2-32 |
| (4) Time to reach the position repeatability | 2-34 |
| 2.2.6 About moving speed at singular point and near singular point. (RH-3FHR series) | 2-35 |
| 2.2.7 Collision detection | 2-36 |
| 2.2.8 Protection specifications | 2-37 |
| (1) Types of protection specifications | 2-37 |
| (2) About the use with the bad environment | 2-38 |
| 2.2.9 Clean specifications | 2-39 |
| (1) Types of clean specifications | 2-39 |

Contents

| | Page |
|--|-------|
| 2.3 Names of each part of the robot | 2-41 |
| 2.4 Outside dimensions • Operating range diagram | 2-43 |
| 2.4.1 Outside dimensions • Operating range diagram (RH-6FH series) | 2-43 |
| (1) Standard Specification | 2-43 |
| (2) Clean Specification and oil mist specification | 2-49 |
| 2.4.2 Outside dimensions • Operating range diagram (RH-12FH series) | 2-55 |
| (1) Standard Specification | 2-55 |
| (2) Clean Specification and oil mist specification | 2-61 |
| 2.4.3 Outside dimensions • Operating range diagram (RH-20FH series) | 2-67 |
| (1) Standard Specification | 2-67 |
| (2) Clean Specification and oil mist specification | 2-71 |
| 2.4.4 Outside dimensions • Operating range diagram of RH-3FHR series | 2-75 |
| (1) Standard Specification | 2-75 |
| (2) Clean/Waterproof Specification | 2-76 |
| 2.4.5 Mechanical interface and Installation surface | 2-77 |
| (1) Mechanical interface and Installation surface of RH-6FH series | 2-77 |
| (2) Mechanical interface and Installation surface of RH-12FH series | 2-78 |
| (3) Mechanical interface and Installation surface of RH-20FH series | 2-79 |
| (4) Mechanical interface and Installation surface of RH-3FHR series (Standard specification) | 2-80 |
| (5) Mechanical interface and Installation surface of RH-3FHR series (Clean/Waterproof specification) | 2-81 |
| 2.4.6 Outside dimensions of machine cables | 2-82 |
| (1) Connection with the CR750 controller | 2-82 |
| (2) Connection with the CR751 controller | 2-82 |
| 2.5 Tooling | 2-83 |
| 2.5.1 Wiring and piping for hand | 2-83 |
| 2.5.2 Internal air piping | 2-85 |
| (1) Floor installation type | 2-85 |
| (2) Hanging installation type | 2-85 |
| 2.5.3 Internal wiring for the hand output cable | 2-85 |
| (1) Floor installation type | 2-85 |
| (2) Hanging installation type | 2-85 |
| 2.5.4 Internal wiring for the hand input cable | 2-86 |
| (1) Floor installation type | 2-86 |
| (2) Hanging installation type | 2-86 |
| 2.5.5 Ethernet cable (For RH-6FH/12FH/20FH series) | 2-86 |
| 2.5.6 Spare Wiring (For FH-3FHR series) | 2-87 |
| 2.5.7 About the Installation of Tooling Wiring and Piping (Examples of Wiring and Piping) | 2-88 |
| (1) RH-6FH series | 2-88 |
| (2) RH-12FH/20FH series | 2-89 |
| (3) RH-3FHR series | 2-90 |
| (4) Example of wiring and piping <1> | 2-91 |
| (5) Wiring and piping example <2> | 2-92 |
| (6) Precautions for the oil mist/clean specification | 2-93 |
| 2.5.8 Wiring and piping system diagram for hand | 2-94 |
| 2.5.9 Electrical specifications of hand input/output | 2-96 |
| 2.5.10 Air supply circuit example for the hand | 2-97 |
| 2.6 Shipping special specifications, options, and maintenance parts | 2-98 |
| 2.6.1 Shipping special specifications | 2-98 |
| (1) Machine cable | 2-99 |
| 2.7 Options | 2-100 |
| (1) Machine cable extension | 2-101 |
| (2) Stopper for changing the operating range | 2-107 |
| (3) Solenoid valve set | 2-108 |
| (4) Hand input cable | 2-114 |
| (5) Hand output cable | 2-116 |
| (6) Hand curl tube | 2-117 |

Contents

| | Page |
|---|-------|
| (7) Hand tube | 2-118 |
| (8) Internal Wiring/Piping set for hand | 2-119 |
| (9) External Wiring/Piping box | 2-121 |
| 2.8 About Overhaul | 2-124 |
| 2.9 Maintenance parts | 2-125 |
| 3 Controller | 3-126 |
| 3.1 Standard specifications | 3-126 |
| 3.1.1 Basic specifications | 3-126 |
| 3.1.2 Protection specifications and operating supply | 3-127 |
| 3.2 Names of each part | 3-128 |
| 3.2.1 Drive unit | 3-128 |
| (1) CR750 drive unit | 3-128 |
| (2) CR751 drive unit | 3-131 |
| 3.2.2 Robot CPU | 3-133 |
| 3.3 Outside dimensions/Installation dimensions | 3-134 |
| 3.3.1 Outside dimensions | 3-134 |
| (1) CR750 drive unit | 3-134 |
| (2) CR751 drive unit | 3-135 |
| (3) Outside dimensions of robot CPU unit | 3-136 |
| (4) Battery unit outside dimension | 3-137 |
| 3.3.2 Installation dimensions | 3-138 |
| (1) CR750 drive unit | 3-138 |
| (2) CR751 drive unit | 3-140 |
| (3) Robot CPU Unit installation dimensions | 3-142 |
| 3.4 External input/output | 3-143 |
| 3.4.1 Types | 3-143 |
| 3.5 Dedicated input/output | 3-144 |
| 3.6 Emergency stop input and output etc. | 3-147 |
| 3.6.1 Connection of the external emergency stop | 3-147 |
| (1) CR750 drive unit | 3-148 |
| (2) CR751 drive unit | 3-152 |
| 3.6.2 Special stop input (SKIP) | 3-155 |
| (1) CR750 drive unit | 3-155 |
| (2) CR751 drive unit | 3-156 |
| 3.6.3 Door switch function | 3-157 |
| 3.6.4 Enabling device function | 3-157 |
| (1) When door is opening | 3-157 |
| (2) When door is closing | 3-157 |
| (3) Automatic Operation/Jog Operation/Brake Release and Necessary Switch Settings | 3-158 |
| 3.7 Mode changeover switch input | 3-159 |
| (1) Specification of the key switch interface | 3-159 |
| (2) Connection of the mode changeover switch input | 3-161 |
| 3.8 Additional Axis Function | 3-162 |
| 3.8.1 Wiring of the Additional Axis Interface | 3-162 |
| (1) CR750 drive unit | 3-162 |
| (2) CR751 drive unit | 3-163 |
| (3) Example of the installation of the noise filter | 3-164 |
| 3.9 Magnet contactor control connector output (AXMC) for addition axes | 3-166 |
| (1) Example circuit | 3-166 |
| (2) Image of how to connect the controller connector | 3-168 |
| 3.10 Options | 3-169 |
| (1) Teaching pendant (T/B) | 3-170 |
| (2) Controller protection box | 3-173 |
| (3) MELSOFT RT ToolBox2/RT ToolBox2 mini | 3-183 |
| (4) Instruction Manual (bookbinding) | 3-185 |

Contents

| | Page |
|--|--------------|
| 3.11 Maintenance parts | 3-186 |
| 4 Software | 4-187 |
| 4.1 List of commands | 4-187 |
| 4.2 List of parameters | 4-190 |
| 5 Instruction Manual | 5-192 |
| 5.1 The details of each instruction manuals | 5-192 |
| 6 Safety | 6-193 |
| 6.1 Safety | 6-193 |
| 6.1.1 Self-diagnosis stop functions | 6-193 |
| 6.1.2 External input/output signals that can be used for safety protection measures | 6-194 |
| 6.1.3 Precautions for using robot | 6-194 |
| (1) Robot installation | 6-194 |
| (2) Prevention of contact with operator | 6-194 |
| (3) Work procedures | 6-194 |
| (4) Training | 6-194 |
| (5) Daily inspection and periodic inspection | 6-195 |
| 6.1.4 Safety measures for automatic operation | 6-195 |
| 6.1.5 Safety measures for teaching | 6-195 |
| 6.1.6 Safety measures for maintenance and inspections, etc. | 6-195 |
| 6.1.7 Examples of safety measures | 6-196 |
| (1) CR750 drive unit | 6-196 |
| (2) CR751 drive unit | 6-201 |
| (3) External emergency stop connection [supplementary explanation] | 6-206 |
| 6.2 Working environment | 6-209 |
| (1) Power supply | 6-209 |
| (2) Noise | 6-209 |
| (3) Temperature and humidity | 6-209 |
| (4) Vibration | 6-209 |
| (5) Installation environment | 6-209 |
| 6.3 Precautions for handling | 6-209 |
| 6.4 EMC installation guideline | 6-211 |
| 6.4.1 Outlines | 6-211 |
| 6.4.2 EMC | 6-211 |
| 6.4.3 EMC measures | 6-212 |
| 6.4.4 Component parts for EMC measures | 6-212 |
| (1) Ferrite core | 6-212 |
| (2) Line noise filter | 6-212 |
| 7Appendix | Appendix-213 |
| Appendix 1 : Classification of functions using external input/output signals | Appendix-213 |
| Appendix 2 : Origin position adjustment of J2 axis | Appendix-214 |
| Appendix 3 : Specifications discussion material (RH-6FH series: Floor installation type) | Appendix-215 |
| Appendix 4 : Specifications discussion material (RH-12FH series: Floor installation type) | Appendix-216 |
| Appendix 5 : Specifications discussion material (RH-20FH series: Floor installation type) | Appendix-217 |
| Appendix 6 : Specifications discussion material (RH-3FHR series: Hanging installation type) | Appendix-218 |

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 (CPU unit + Drive unit)
- (3) The connecting cable for the CPU unit and the drive unit
- (4) Machine cable
- (5) Robot arm installation bolts
- (6) Safety manual, CD-ROM (Instruction manual)
- (7) Guarantee card

1.1.2 Special specifications

For the special specifications, some standard configuration equipment and specifications have to be changed before factory shipping. Confirm the delivery date and specify the special specifications at the order.

1.1.3 Options

User can install options after their delivery.

1.1.4 Maintenance parts

Materials and parts for the maintenance use.

1.2 Model type name of robot

This robot has arranged the type name corresponding to load mass, arm length, and environment specification. Details are shown below, please select the robot suitable for the customer's use.

1.2.1 How to identify the robot model

There are two types of robot, one is "Floor installation type" and the other is "Hanging installation type", each of which are different in installation posture.

(1) Floor installation type

RH - **◇◇** **FH** **□□** **△△** **○** - **●** **Q** **▲** - **SMxx**

(a) (b) (c) (d) (e) (f) (g) (h) (i) (j)

(a). RH Indicates the horizontal multiple-joint robot.

(b). ◇◇ Indicates the maximum load.
Ex.)
6: 6kg
12: 12kg
20: 20kg

(c). FH Indicates the FH series.

(d). □□ Indicates the arm length.
Ex.)
35: 350mm
45: 450mm
55: 550mm
70: 700mm
85: 850mm
100: 1000mm

(e). △△ Indicates the vertical stroke length.
Ex.)
20: 200mm stroke
34: 340mm stroke
35: 350mm stroke
45: 450mm stroke

(f). ○ Indicates environment specification.
Ex.)
Omitted: General specifications
C: Clean specifications
M: Oil mist specifications

(g). ● Indicates the controller series.
Ex.)
Omitted: CR750 controller
1: CR751 controller

(h). Q Indicates the controller type.
Q: iQ Platform

(i). ▲ Technical standard of Conformity.
Ex.)
Omitted: No conformity of technical standard.
1: Conforms to the CE Marking

(j). - S M xx Indicates a special model. In order, limit special specification.
[1] [2]

[1] S: Indicates a special model.

[2] M: Indicates a specification with protection specification controller. (The controller protection box is attached.)

(2) Hanging installation type

RH - 3 FH R 35 $\Delta\Delta$ \bigcirc - \bullet Q \blacktriangle - Sxx
 (a) (b) (c) (d) (e) (f) (g) (h) (i) (j) (k)

- (a). RH.....Indicates the horizontal multiple-joint robot.
- (b). 3.....Indicates the maximum load.
 Ex.)
 3: 3kg
- (c). FH.....Indicates the FH series.
- (d). R.....Indicates the installation posture is hung.
- (e). $\square\square$Indicates the arm length.
 Ex.)
 35: 350mm
- (f). $\Delta\Delta$Indicates the vertical stroke length.
 Ex.)
 12: 120mm stroke
 15: 150mm stroke
- (g). \bigcircIndicates environment specification.
 Ex.)
 Omitted: General specifications
 C: Clean specifications
 W: Waterproof specifications (IP 65)
- (h). \bulletIndicates the controller series.
 Ex.)
 Omitted: CR750 controller
- (i). Q.....Indicates the controller type.
 Q: iQ Platform
- (j). \blacktriangleTechnical standard of Conformity.
 Ex.)
 Omitted: No conformity of technical standard.
 1: Conforms to the CE Marking
- (k). - S xx.....Indicates a special model. In order, limit special specification.

1.2.2 Combination of the robot arm and the controller

(1) CR750 controller

Table 1-1 : Combination of the robot arm (floor installation type) and the CR750 controller

| Protection specification | Robot arm (Floor installation type) | Arm length (mm) | J3-axis stroke (mm) | Controller ^{Note1)} |
|-----------------------------|--|-----------------------|------------------------|------------------------------|
| RH-6FH series | | | | |
| General-purpose environment | RH-6FH3520-Q | 350 | 200 | CR750-06HQ-1 |
| | RH-6FH4520-Q | 450 | | |
| | RH-6FH5520-Q | 550 | | |
| | RH-6FH3534-Q | 350 | 340 | |
| | RH-6FH4534-Q | 450 | | |
| | RH-6FH5534-Q | 550 | | |
| Clean specifications | RH-6FH3520C-Q | 350 | 200 | |
| | RH-6FH4520C-Q | 450 | | |
| | RH-6FH5520C-Q | 550 | | |
| | RH-6FH3534C-Q | 350 | 340 | |
| | RH-6FH4534C-Q | 450 | | |
| | RH-6FH5534C-Q | 550 | | |
| Oil mist specifications | RH-6FH3520M-Q | 350 | 200 | |
| | RH-6FH4520M-Q | 450 | | |
| | RH-6FH5520M-Q | 550 | | |
| | RH-6FH3534M-Q | 350 | 340 | |
| | RH-6FH4534M-Q | 450 | | |
| | RH-6FH5534M-Q | 550 | | |
| RH-12FH series | | | | |
| General-purpose environment | RH-12FH5535-Q | 550 | 350 | CR750-12HQ-1 |
| | RH-12FH7035-Q | 700 | | |
| | RH-12FH8535-Q | 850 | | |
| | RH-12FH5545-Q | 550 | 450 | |
| | RH-12FH7045-Q | 700 | | |
| | RH-12FH8545-Q | 850 | | |
| Clean specifications | RH-12FH5535C-Q | 550 | 350 | |
| | RH-12FH7035C-Q | 700 | | |
| | RH-12FH8535C-Q | 850 | | |
| | RH-12FH5545C-Q | 550 | 450 | |
| | RH-12FH7045C-Q | 700 | | |
| | RH-12FH8545C-Q | 850 | | |
| Oil mist specifications | RH-12FH5535M-Q | 550 | 350 | |
| | RH-12FH7035M-Q | 700 | | |
| | RH-12FH8535M-Q | 850 | | |
| | RH-12FH5545M-Q | 550 | 450 | |
| | RH-12FH7045M-Q | 700 | | |
| | RH-12FH8545M-Q | 850 | | |
| RH-20FH series | | | | |
| General-purpose environment | RH-20FH8535-Q | 850 | 350 | CR750-20HQ-1 |
| | RH-20FH10035-Q | 1000 | | |
| | RH-20FH8545-Q | 850 | 450 | |
| | RH-20FH10045-Q | 1000 | | |
| Clean specifications | RH-20FH8535C-Q | 850 | 350 | |
| | RH-20FH10035C-Q | 1000 | | |
| | RH-20FH8545C-Q | 850 | 450 | |
| | RH-20FH10045C-Q | 1000 | | |
| Oil mist specifications | RH-20FH8535M-Q | 850 | 350 | |
| | RH-20FH10035M-Q | 1000 | | |
| | RH-20FH8545M-Q | 850 | 450 | |
| | RH-20FH10045M-Q | 1000 | | |

Note1) When you use by adverse environment, please use the controller protection box.

Table 1-2 : Combination of the robot arm (hanging installation type) and the CR750 controller

| Protection specification | Robot arm (Hanging installation type) | Arm length (mm) | J3-axis stroke (mm) | Controller ^{Note1)} |
|----------------------------------|--|-----------------------|------------------------|------------------------------|
| RH-3FHR series | | | | |
| General-purpose environment | RH-3FHR3515-Q | 350 | 150 | CR750-03HRQ-1 |
| Clean specifications | RH-3FHR3512C-Q | 350 | 120 | |
| Waterproof specifications (IP65) | RH-3FHR3512W-Q | 350 | 120 | |

Note1) When you use by adverse environment, please use the controller protection box.

(2) CR751 controller

Table 1-3 : Combination of the robot arm (floor installation type) and the CR751 controller

| Protection specification | Robot arm (Floor installation type) | Arm length (mm) | J3-axis stroke (mm) | Controller ^{Note1)} |
|-----------------------------|--|-----------------------|------------------------|------------------------------|
| RH-6FH series | | | | |
| General-purpose environment | RH-6FH3520-1Q | 350 | 200 | CR751-06HQ-0 |
| | RH-6FH4520-1Q | 450 | | |
| | RH-6FH5520-1Q | 550 | | |
| | RH-6FH3534-1Q | 350 | 340 | |
| | RH-6FH4534-1Q | 450 | | |
| | RH-6FH5534-1Q | 550 | | |
| Clean specifications | RH-6FH3520C-1Q | 350 | 200 | |
| | RH-6FH4520C-1Q | 450 | | |
| | RH-6FH5520C-1Q | 550 | | |
| | RH-6FH3534C-1Q | 350 | 340 | |
| | RH-6FH4534C-1Q | 450 | | |
| | RH-6FH5534C-1Q | 550 | | |
| Oil mist specifications | RH-6FH3520M-1Q | 350 | 200 | |
| | RH-6FH4520M-1Q | 450 | | |
| | RH-6FH5520M-1Q | 550 | | |
| | RH-6FH3534M-1Q | 350 | 340 | |
| | RH-6FH4534M-1Q | 450 | | |
| | RH-6FH5534M-1Q | 550 | | |
| RH-12FH series | | | | |
| General-purpose environment | RH-12FH5535-1Q | 550 | 350 | CR751-12HQ-0 |
| | RH-12FH7035-1Q | 700 | | |
| | RH-12FH8535-1Q | 850 | | |
| | RH-12FH5545-1Q | 550 | 450 | |
| | RH-12FH7045-1Q | 700 | | |
| | RH-12FH8545-1Q | 850 | | |
| Clean specifications | RH-12FH5535C-1Q | 550 | 350 | |
| | RH-12FH7035C-1Q | 700 | | |
| | RH-12FH8535C-1Q | 850 | | |
| | RH-12FH5545C-1Q | 550 | 450 | |
| | RH-12FH7045C-1Q | 700 | | |
| | RH-12FH8545C-1Q | 850 | | |
| Oil mist specifications | RH-12FH5535M-1Q | 550 | 350 | |
| | RH-12FH7035M-1Q | 700 | | |
| | RH-12FH8535M-1Q | 850 | | |
| | RH-12FH5545M-1Q | 550 | 450 | |
| | RH-12FH7045M-1Q | 700 | | |
| | RH-12FH8545M-1Q | 850 | | |

| Protection specification | Robot arm (Floor installation type) | Arm length (mm) | J3-axis stroke (mm) | Controller ^{Note1)} |
|-----------------------------|--|--------------------|------------------------|------------------------------|
| RH-20FH series | | | | |
| General-purpose environment | RH-20FH8535-1Q | 850 | 350 | CR751-20HQ-0 |
| | RH-20FH10035-1Q | 1000 | | |
| | RH-20FH8545-1Q | 850 | 450 | |
| | RH-20FH10045-1Q | 1000 | | |
| Clean specifications | RH-20FH8535C-1Q | 850 | 350 | |
| | RH-20FH10035C-1Q | 1000 | | |
| | RH-20FH8545C-1Q | 850 | 450 | |
| | RH-20FH10045C-1Q | 1000 | | |
| Oil mist specifications | RH-20FH8535M-1Q | 850 | 350 | |
| | RH-20FH10035M-1Q | 1000 | | |
| | RH-20FH8545M-1Q | 850 | 450 | |
| | RH-20FH10045M-1Q | 1000 | | |

Note1) When you use by adverse environment, please use the controller protection box.

Table 1-4 : Combination of the robot arm (hanging installation type) and the CR751 controller

| Protection specification | Robot arm (Hanging installation type) | Arm length (mm) | J3-axis stroke (mm) | Controller ^{Note1)} |
|----------------------------------|--|--------------------|------------------------|------------------------------|
| RH-3FHR series | | | | |
| General-purpose environment | RH-3FHR3515-1Q | 350 | 150 | CR751-03HRQ-0 |
| Clean specifications | RH-3FHR3512C-1Q | 350 | 120 | |
| Waterproof specifications (IP65) | RH-3FHR3512W-1Q | 350 | 120 | |

Note1) When you use by adverse environment, please use the controller protection box.

1.3 CE marking specifications

The robot shown in [Table 1-5](#) or [Table 1-6](#) are the CE marking/KC mark specification.

(1) CR750 controller

Table 1-5 : Robot models with CE marking specifications

| Robot type ^{Note1)} | Controller ^{Note2)} | External signal logic | Language setting |
|---------------------------------------|------------------------------|-----------------------|------------------|
| RH-6FHxxyy-Q1-S13 | CR750-06HQ1-1-S13 | Source type | English (ENG) |
| RH-6FHxxyyC-Q1-S13 ^{Note3)} | | | |
| RH-6FHxxyyM-Q1-S13 ^{Note4)} | | | |
| RH-12FHxxyy-Q1-S15 | CR750-12HQ1-1-S15 | | |
| RH-12FHxxyyC-Q1-S15 ^{Note3)} | | | |
| RH-12FHxxyyM-Q1-S15 ^{Note4)} | | | |
| RH-20FHxxyy-Q1-S15 | CR750-20HQ1-1-S15 | | |
| RH-20FHxxyyC-Q1-S15 ^{Note3)} | | | |
| RH-20FHxxyyM-Q1-S15 ^{Note4)} | | | |

Note1) The “xx” indicate the arm length, “yy” indicate J3-axis stroke.

Note2) The specification and the handling method of the controller are the same as standard type controller.

Note3) This robot is the clean specification. As long as there is no special description about CE marking specification, refers to the contents of standard type clean specification.

Note4) This robot is the oil mist specification. As long as there is no special description about CE marking specification, refers to the contents of standard type oil mist specification.

(2) CR751 controller

Table 1-6 : Robot models with CE marking specifications

| Robot type ^{Note1)} | Controller ^{Note2)} | External signal logic | Language setting |
|---|------------------------------|-----------------------|------------------|
| RH-6FH _{xx} yy-1Q1-S13 | CR751-06HQ1-0-S13 | Source type | English (ENG) |
| RH-6FH _{xx} yyC-1Q1-S13 ^{Note3)} | | | |
| RH-6FH _{xx} yyM-1Q1-S13 ^{Note4)} | | | |
| RH-12FH _{xx} yy-1Q1-S15 | CR751-12HQ1-0-S15 | | |
| RH-12FH _{xx} yyC-1Q1-S15 ^{Note3)} | | | |
| RH-12FH _{xx} yyM-1Q1-S15 ^{Note4)} | | | |
| RH-20FH _{xx} yy-1Q1-S15 | CR751-20HQ1-0-S15 | | |
| RH-20FH _{xx} yyC-1Q1-S15 ^{Note3)} | | | |
| RH-20FH _{xx} yyM-1Q1-S15 ^{Note4)} | | | |

Note1) The “xx” indicate the arm length, “yy” indicate J3-axis stroke.

Note2) The specification and the handling method of the controller are the same as standard type controller.

Note3) This robot is the clean specification. As long as there is no special description about CE marking specification, refers to the contents of standard type clean specification.

Note4) This robot is the oil mist specification. As long as there is no special description about CE marking specification, refers to the contents of standard type oil mist specification.

1.4 Indirect export

The display in English is available by setting parameter LNG as “ENG.”

1.5 Instruction manuals

The instruction manuals supplied in CD-ROM, except for the Safety Manual. This CD-ROM (electronic manual) includes instruction manuals in both Japanese and English versions.

1.6 Contents of the structural equipment

1.6.1 Robot arm

The list of structural equipment is shown in below.

(1) Floor installation type

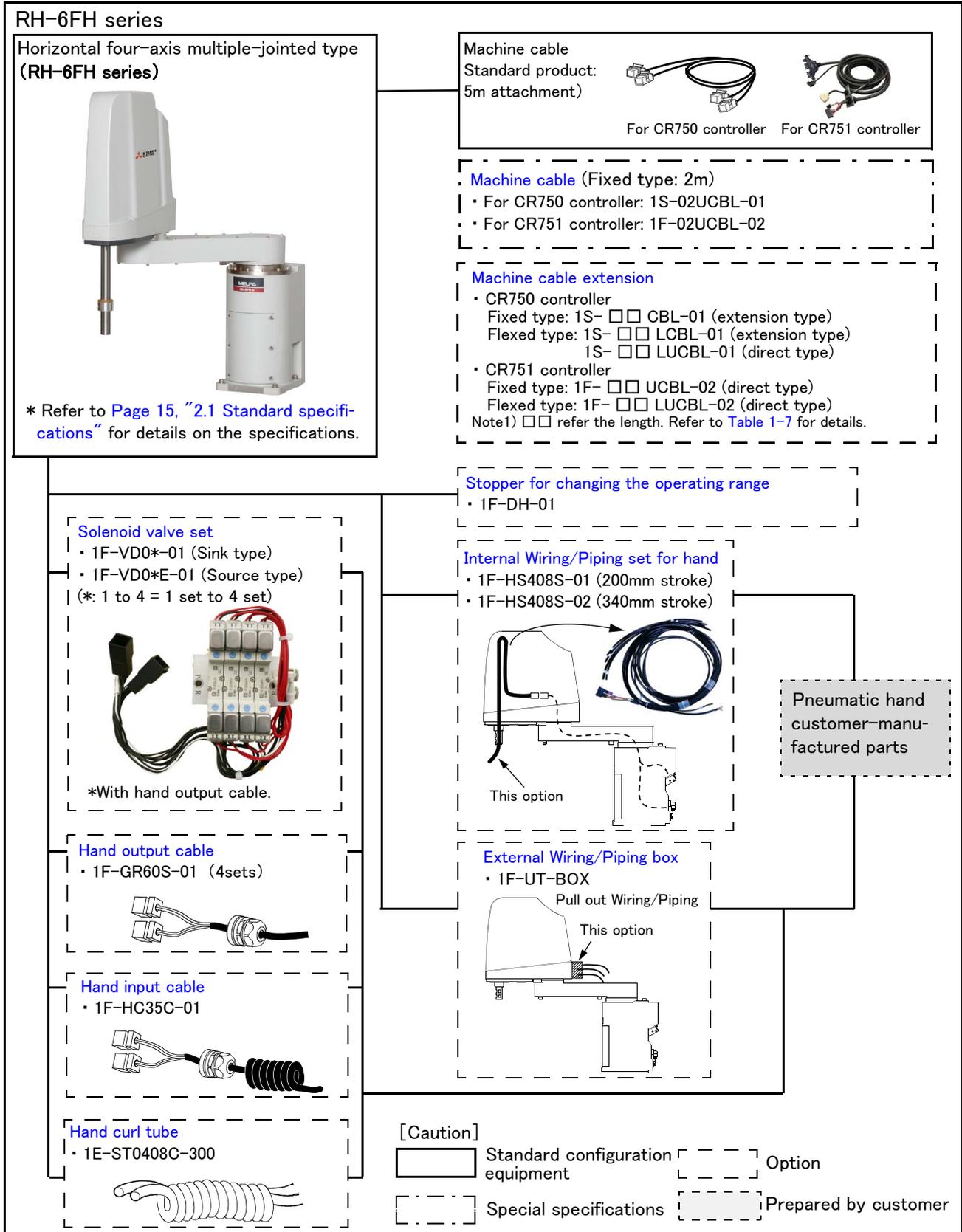


Fig.1-1 : Structural equipment (RH-6FH series)

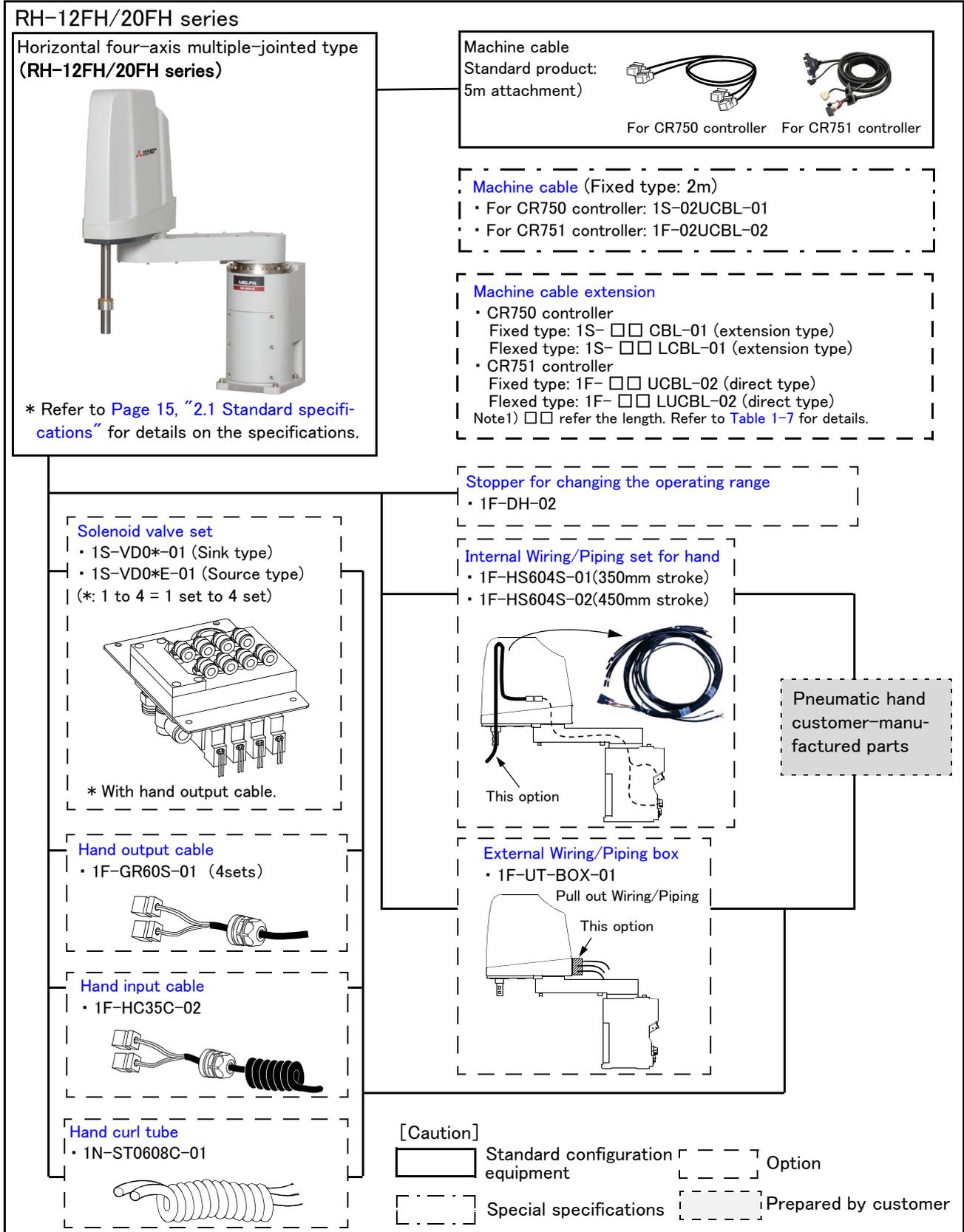


Fig.1-2 : Structural equipment (RH-12FH/20FH series)

(2) Hanging installation type

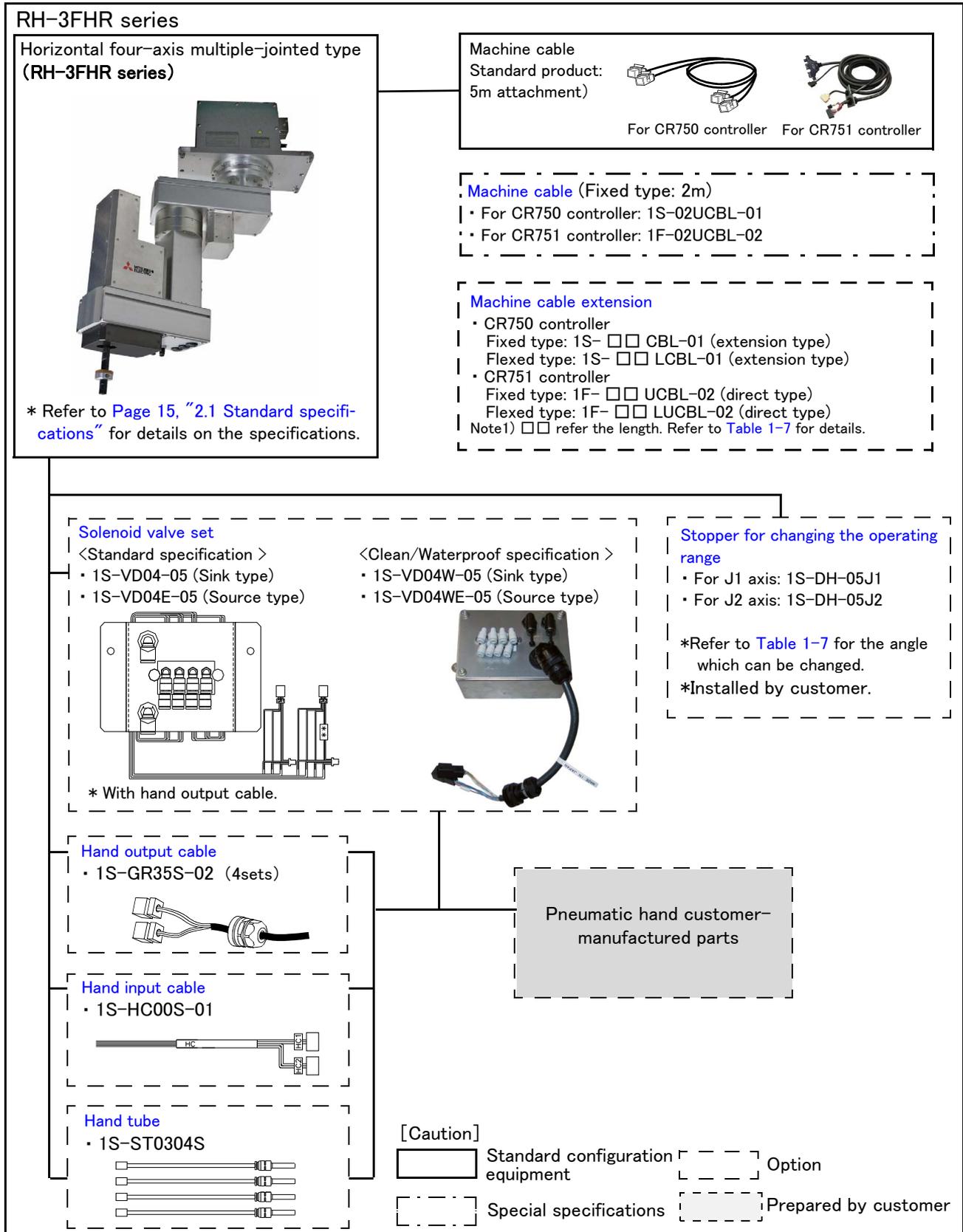


Fig.1-3 : Structural equipment (RH-3FHR series)

1.6.2 Controller

The devices shown below can be installed on the controller.

The controllers that can be connected differ depending on the specification of the robot. (Refer to Page 2, "1.2 Model type name of robot".)

(1) CR750controller

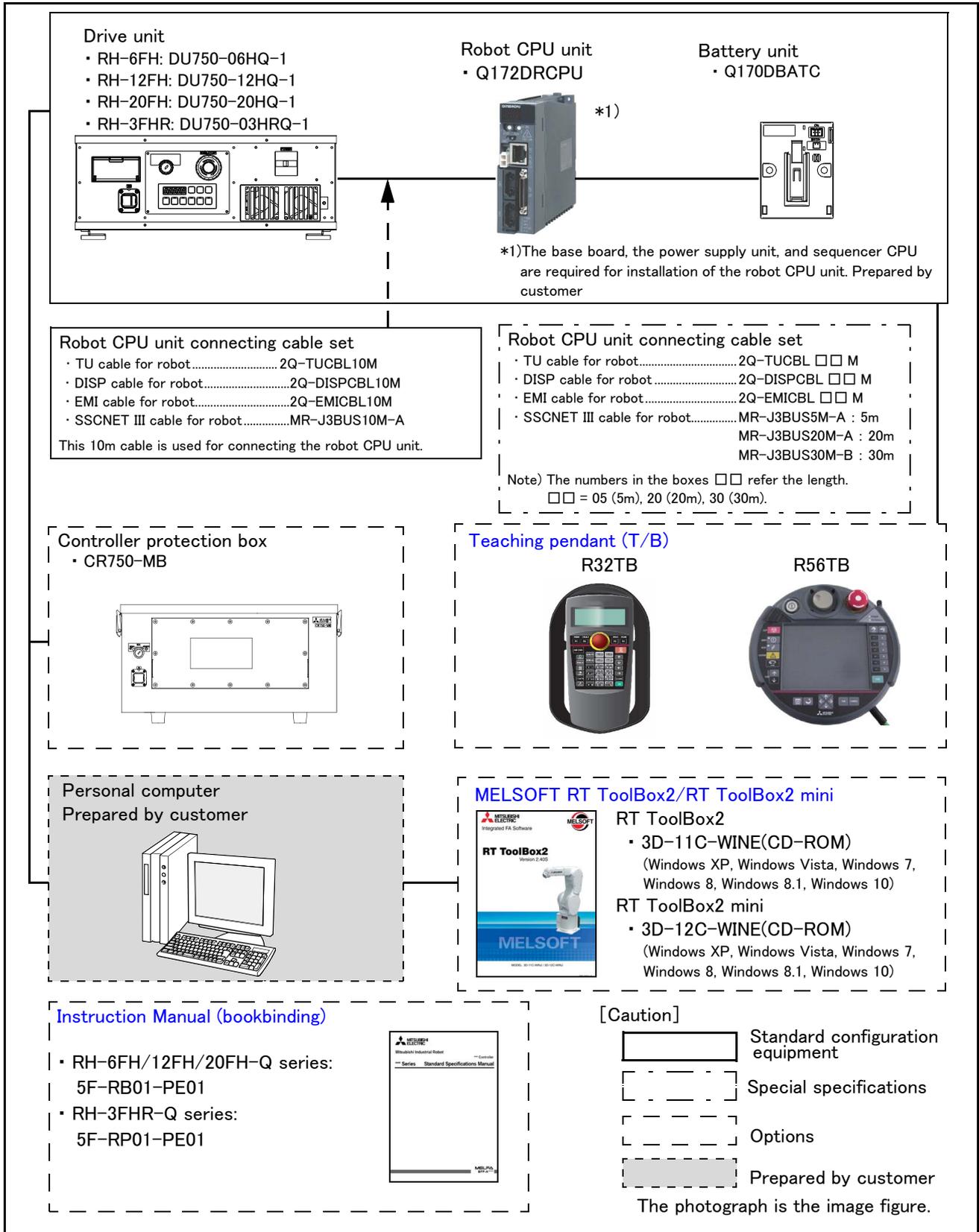


Fig.1-4 : Structural equipment

(2) CR751 controller

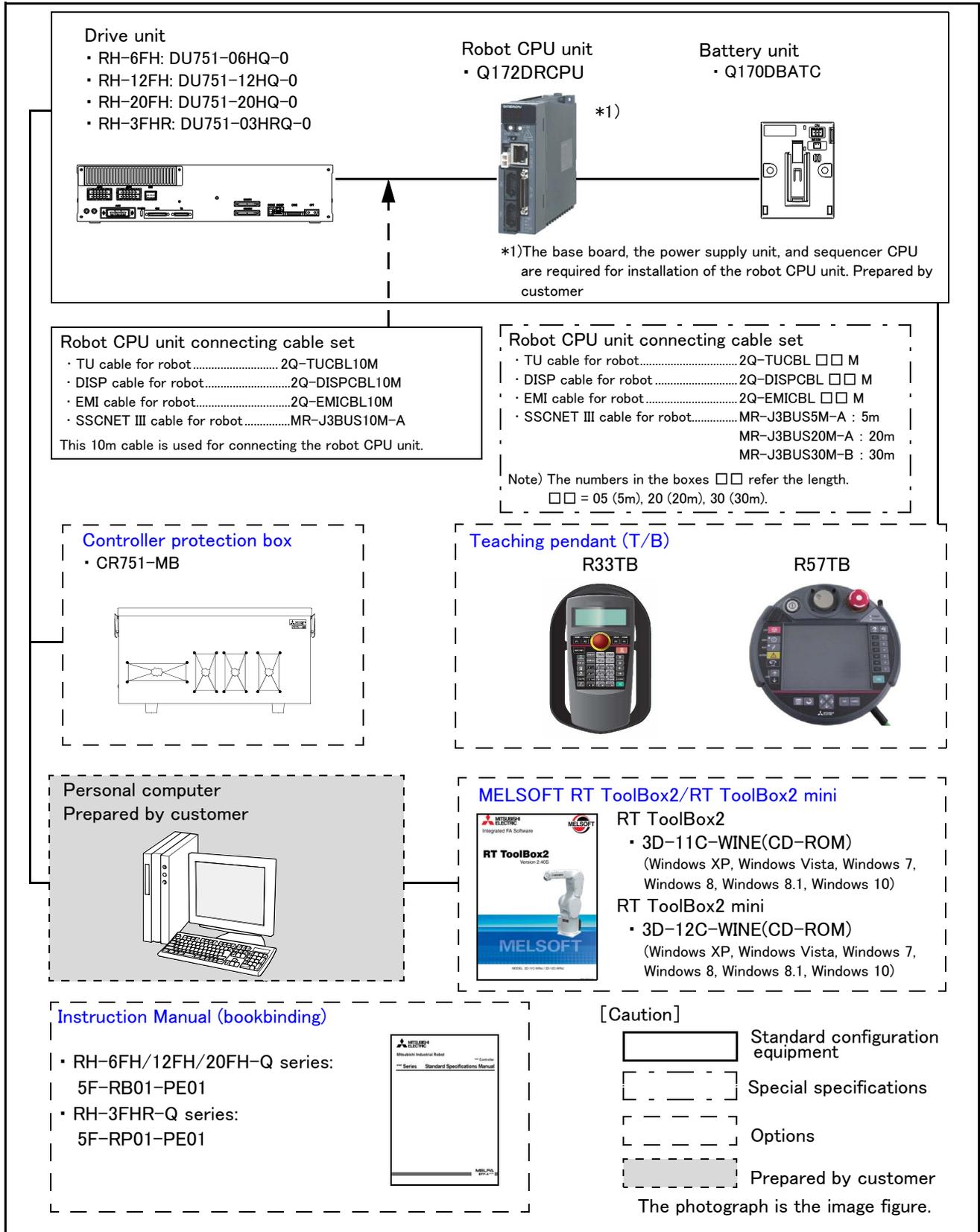


Fig.1-5 : Structural equipment

1.7 Contents of the Option equipment and special specification

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

Table 1-7 : The list of the robot arm option equipment and special specification

| Item | Type | Specifications | Classification Note1) | | Description |
|--|---|--|--------------------------|-------|---|
| | | | CR750 | CR751 | |
| Stopper for changing the operating range | 1F-DH-01 | The stopper parts for J1 axis | ○ | ○ | This must be installed by the customer. For RH-6FH series |
| | 1F-DH-02 | The stopper parts for J1 axis | ○ | ○ | This must be installed by the customer. For RH-12FH/20FH series |
| | 1S-DH-05J1 | The stopper parts for J1 axis Plus side / Minus side both are 90 degree. * Change both simultaneously Standard specification is +/- 225 degree. | ○ | ○ | This must be installed by the customer. For RH-3FHR series |
| | 1S-DH-05J2 | The stopper parts for J2 axis Plus side / Minus side both are 60 degree. * Change both simultaneously Standard specification is +/- 225 degree. | ○ | ○ | |
| Machine cable (Replaced to shorter cable) | 1S-02UCBL-01 | For fixing (Set of power and signal) | ○·□ | - | 2m (A 2m cable is supplied instead of the 5m cable that is supplied as standard) |
| | 1F-02UCBL-02 | For fixing (Set of power and signal) | - | ○·□ | |
| Extended machine cable (extension type) | 1S- □□ CBL-01 | For fixing (Set of power and signal) | ○ | - | " □□ " in type shows the length of the cables as follows. 05=5m, 10=10m, 15=15m |
| | 1S- □□ LCBL-01 | For flexing (Set of power and signal) | ○ | - | |
| Extended machine cable (direct type) | 1S- □□ LUCBL-01 | For flexing (Set of power and signal) | ○ | - | " □□ " in type shows the length of the cables as follows. 10=10m, 15=15m, 20=20m |
| | 1F- □□ UCBL-02 | For fixing (Set of power and signal) | - | ○ | |
| | 1F- □□ LUCBL-02 | For flexing (Set of power and signal) | - | ○ | |
| Solenoid valve set | 1F-VD01-01/VD01E-01 | 1 set (Sink type)/(Source type) | ○ | ○ | The solenoid-valve set for the hand of the customer setup. For RH-6FH series. |
| | 1F-VD02-01/VD02E-01 | 2 set (Sink type)/(Source type) | ○ | ○ | |
| | 1F-VD03-01/VD03E-01 | 3 set (Sink type)/(Source type) | ○ | ○ | |
| | 1F-VD04-01/VD04E-01 | 4 set (Sink type)/(Source type) | ○ | ○ | |
| | 1S-VD01-01/VD01E-01 | 1 set (Sink type)/(Source type) | ○ | ○ | The solenoid-valve set for the hand of the customer setup. For RH-12FH/20FH series. |
| | 1S-VD02-01/VD02E-01 | 2 set (Sink type)/(Source type) | ○ | ○ | |
| | 1S-VD03-01/VD03E-01 | 3 set (Sink type)/(Source type) | ○ | ○ | |
| | 1S-VD04-01/VD04E-01 | 4 set (Sink type)/(Source type) | ○ | ○ | |
| | 1S-VD04-05/ 1S-VD04E-05 | 4 set (Sink type)/(Source type) For Standard specification | ○ | ○ | The solenoid-valve set for the hand of the customer setup. For RH-3FHR series. |
| 1S-VD04W-05/ 1S-VD04WE-05 | 4 set (Sink type)/(Source type) For Clean/Waterproof specification | ○ | ○ | | |
| Hand input cable | 1F-HC35C-01 | Robot side: connector. Hand side: wire. | ○ | ○ | The cable is connected to the sensor by the customer. Attaches the cable clamp (drip proof type) For RH-6FH series |
| | 1F-HC35C-02 | Robot side: connector. Hand side: wire. | ○ | ○ | The cable is connected to the sensor by the customer. Attaches the cable clamp (drip proof type) For RH-12FH/20FH series |
| | 1S-HC00S-01 | Robot side: connector. Hand side: wire. | ○ | ○ | The cable is connected to the sensor by the customer. For RH-3FHR series |
| Hand output cable | 1F-GR60S-01 | Robot side: connector. Hand side: wire | ○ | ○ | This cable can be used for the solenoid valve prepared by the customer. |
| | 1S-GR35S-02 | Robot side: connector. Hand side: wire | ○ | ○ | This cable can be used for the solenoid valve prepared by the customer. |
| Hand curl tube | 1E-ST0408C-300 | For solenoid valve 4set.:Φ4x8 | ○ | ○ | Curl type air tube For RH-6FH series |
| | 1N-ST0608C-01 | For solenoid valve 4set.:Φ6x8 | ○ | ○ | Curl type air tube For RH-12FH/20FH series |

1 General configuration

| Item | Type | Specifications | Classification Note1) | | Description |
|-------------------------------------|--------------|--|--------------------------|-------|--|
| | | | CR750 | CR751 | |
| Hand tube | 1S-ST0304S | For solenoid valve 4set.:Φ3x4 | ○ | ○ | The tube for piping the hand through the ball screw shaft by the customer. For RH-3FHR series |
| External Wiring/Piping box | 1F-UT-BOX | For solenoid valve 4set.:Φ4x8 | ○ | ○ | Box which pulls out the Wire/Piping (Hand I/O cable, Hand curl tube) For RH-6FH series |
| | 1F-UT-BOX-01 | For solenoid valve 4set.:Φ6x8 | ○ | ○ | Box which pulls out the Wire/Piping (Hand I/O cable, Hand curl tube) For RH-12FH/20FH series |
| Internal Wiring/Piping set for hand | 1F-HS408S-01 | Hand input cable (eight signal lines and two power lines), φ 4 eight hoses | ○ | ○ | Wiring/Piping to pass in the shaft For RH-6FH series (200mm stroke) |
| | 1F-HS408S-02 | Hand input cable (eight signal lines and two power lines), φ 4 eight hoses | ○ | ○ | Wiring/Piping to pass in the shaft For RH-6FH series (340mm stroke) |
| | 1F-HS604S-01 | Hand input cable (eight signal lines and two power lines), φ 6 four hoses | ○ | ○ | Wiring/Piping to pass in the shaft For RH-12FH/20FH series (350mm stroke) |
| | 1F-HS604S-02 | Hand input cable (eight signal lines and two power lines), φ 6 four hoses | ○ | ○ | Wiring/Piping to pass in the shaft For RH-12FH/20FH series (450mm stroke) |

Note1) ○ : option, □ : special specifications.

Table 1-8 : The list of the controller option equipment and special specification

| Item | Type | Specifications | Classification Note1) | | Description |
|--|-----------------|---------------------------|--------------------------|-------|--|
| | | | CR750 | CR751 | |
| Simple teaching pendant | R32TB | Cable length 7m | ○ | - | With 3-position enable switch IP65 |
| | R32TB-15 | Cable length 15m | ○ | - | |
| | R33TB | Cable length 7m | - | ○ | |
| | R33TB-15 | Cable length 15m | - | ○ | |
| Highly efficient teaching pendant | R56TB | Cable length 7m | ○ | - | |
| | R56TB-15 | Cable length 15m | ○ | - | |
| | R57TB | Cable length 7m | - | ○ | |
| | R57TB-15 | Cable length 15m | - | ○ | |
| Controller protection box | CR750-MB | IP54 | ○ | - | The controller protection box is used to protect the controller from an oil mist or other operating environment. |
| | CR751-MB | | - | ○ | |
| RT ToolBox2 (Personal computer Support software) | 3D-11C-WINE | CD-ROM | ○ | ○ | Windows XP, Windows Vista, Windows 7, Windows 8, Windows 8.1, Windows 10 (With the simulation function) |
| RT ToolBox2 mini (Personal computer Support software mini) | 3D-12C-WINE | CD-ROM | ○ | ○ | Windows XP, Windows Vista, Windows 7, Windows 8, Windows 8.1, Windows 10 |
| Robot CPU unit connection cable set | 2Q-RC-CBL □ □ M | Cable length 05, 20, 30m | □ | □ | This option include TU, DISP, EMI and SSCNET cables. |
| TU cable for robot | 2Q-TUCBL □ M | Cable length 05, 20, 30m | □ | □ | For communication between robot CPU and DU. |
| DISP cable for robot | 2Q-DISPCBL □ M | Cable length 05, 20, 30m | □ | □ | For communication between robot CPU and DU. |
| EMI cable for robot | 2Q-EMICBL □ M | Cable length 05, 20, 30m | □ | □ | For a robot CPU emergency stop input. |
| SSCNET III cable for robot | MR-J3BUS □ M-A | Cable length 5, 20m | □ | □ | For the servo communication between robot CPU and DU . |
| | MR-J3BUS30M-B | Cable length 30m | □ | □ | |
| Instruction Manual | 5F-RB01-PE01 | RH-6FH/12FH/20FH-Q series | ○ | ○ | |
| | 5F-RP01-PE01 | RH-3FHR-Q series | ○ | ○ | |

Note1) ○ : option, □ : special specifications.

2 Robot arm

2.1 Standard specifications

2.1.1 Basic specifications

(1) RH-6FH series

Table 2-1 : Standard specifications of robot arm

| Item | | Unit | Specifications | | |
|--|---------------------|---------------------|--|---|---|
| Type ^{Note1)} | | | RH-6FH3520/3534 RH-6FH3520C/3534C RH-6FH3520M/3534M | RH-6FH4520/4534 RH-6FH4520C/4534C RH-6FH4520M/4534M | RH-6FH5520/5534 RH-6FH5520C/5534C RH-6FH5520M/5534M |
| Environment | | | Blank: Standard specification C: Clean specification M: Oil mist specification ^{Note2)} | | |
| Installation posture | | | On floor | | |
| Degree of freedom | | | 4 | | |
| Structure | | | Horizontal, multiple-joint type | | |
| Drive system | | | AC servo motor | | |
| Position detection method | | | Absolute encoder | | |
| Motor capacity | J1 | W | 750 | | |
| | J2 | W | 400 | | |
| | J3 (Z) | W | 200 | | |
| | J4 (θ axis) | W | 100 | | |
| Brake | | | J1, J2, J4: no brake, J3: with brake | | |
| Arm length | No. 1 arm | mm | 125 | 225 | 325 |
| | No. 2 arm | mm | 225 | | |
| Max.reach radius(No. 1+ No. 2) | | mm | 350 | 450 | 550 |
| Operating range | J1 | deg | ± 170 | | |
| | J2 | deg | ± 145 | | |
| | J3 (Z) | mm | RH-6FH**20/**20C/**20M: 200 (+133 to +333) RH-6FH**34: 340 (-7 to +333) RH-6FH**34C/**34M: 340 (-43 to +297) | | |
| | J4 (θ axis) | deg | ± 360 | | |
| Speed of motion ^{Note3)} | J1 | deg/s | 400 | | |
| | J2 | deg/s | 670 | | |
| | J3 (Z) | mm/s | 2,400 | | |
| | J4 (θ axis) | deg/s | 2,500 | | |
| Maximum horizontal composite speed ^{Note4)} | | mm/s | 6,900 | 7,600 | 8,300 |
| Cycle time ^{Note5)} | | sec | 0.29 | | |
| Load | Rating | kg | 3 | | |
| | Maximum | (N) | 6 | | |
| Z axis pressing force ^{Note6)} | Maximum | N | 165 | | |
| Allowable inertia | Rating | kg · m ² | 0.01 | | |
| | Maximum | | 0.12 | | |
| Pose repeatability ^{Note7)} | X-Y direction | mm | ± 0.010 | ± 0.010 | ± 0.012 |
| | J3 (Z) | mm | ± 0.010 | | |
| | J4 (θ axis) | deg | ± 0.004 | | |
| Ambient temperature ^{Note8)} | | °C | 0 to 40 | | |
| Mass | | k | 36 | | 37 |
| Tool wiring | | | <ul style="list-style-type: none"> · Input 8 points/Output 8 points, (total 20 cores) · Dedicated signal cable for multifunctional hand (Two cores + Power cable two cores) · Ethernet cable one cable (100BASE-TX, eight cores)^{Note9)} | | |
| Tool pneumatic pipes | | | Primary: $\phi 6$ x two hoses, Secondary: $\phi 4$ x eight hoses ^{Note10)} | | |
| Supply pressure | | MPa | 0.5 \pm 10% | | |
| Protection specification ^{Note11)} | | | Standard specification: IP20 Clean specification: ISO class 3 ^{Note12)} Oil mist specification: IP65 ^{Note13)} ^{Note14)} | | |
| Painting color | | | Light gray (Equivalent to Munsell: 0.6B7.6/0.2) | | |

Note1) The table is joint writing on the general environment and clean and oil mist (IP65) specification. If the type ends in a letter C, this corresponds to the clean specification, and where it ends in a letter M, it corresponds to the mist specification. The type in which operating range of J3 axis (Z) is 200mm and 340mm are shown together.

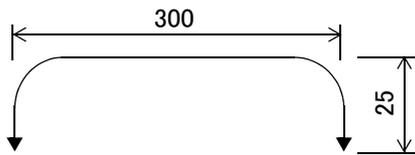
Note2) The oil-mist specification of CE specification is the standards.

Note3) The maximum speed is the value which applied MvTune2 (high-speed movement mode).

Note4) At the maximum speed on the X-Y flat surface in the robot's control point, it is obtained with each speed of J1, J2, and J4. The control point is the position offset by the rated inertia from the flange.

Note5) The value of the following movement which applied MvTune2 (high-speed movement mode) with the carrying mass of 2kg.

- The cycle time may increase with the case where the positioning accuracy of the work etc. is necessary, or by the moving position.



Note6) This is the downwards pressing force that occurs at the end of the load when the maximum load is on board and the J1, J2 and J4 axis are in their resting state. Please operate at this level or below. When pressing for long periods of time, an excess load error may occur. Please operate in a manner that does not cause errors.

Note7) The pose repeatability details are given in [Page 25, "2.2.1 Pose repeatability"](#).

Note8) Sets the robot's operating environmental temperature as parameter OLTMX. Corresponding to the environment, the continuous control action performance and the overload-protection function are optimized. (Refers to "Optimizing the overload level" described in "Chapter 5 Functions set with parameters" of separate instruction manual/ Detailed explanations of functions and operations for details.)

Note9) The 8-wire cable designated for LAN wiring can also be used for backup wiring.

Note10) The $\phi 4$ secondary piping can be obtained with the electromagnetic valve (option). Details regarding the electromagnetic valve (optional) are shown on [Page 108, "\(3\) Solenoid valve set"](#).

Note11) The protection specification details are given in [Page 37, "2.2.8 Protection specifications"](#).

Note12) The details of the clean specifications are described in [Page 39, "2.2.9 Clean specifications"](#). The conditions necessary to guarantee cleanliness are as follows: clean room down flow 0.3 m/s or greater, robot internal suction of 30-50L/min and installation of an exhaust duct at the rear of the robot's main base. A $\phi 8$ joint is prepared at the rear of the base for suction.

Note13) Direct jet flow to the bellows section is not included.

Note14) If you use the controller in oil mist or similar environments, use the controller protection box to protect the controller from the operation environment. A robot equipped with the controller protection box as standard is available.

(2) RH-12FH series

Table 2-2 : Standard specifications of robot arm

| Item | | Unit | Specifications | | |
|--|---------------------|---------------------|--|--|--|
| Type ^{Note1)} | | | RH-12FH5535/5545 RH-12FH5535C/5545C RH-12FH5535M/5545M | RH-12FH7035/7045 RH-12FH7035C/7045C RH-12FH7035M/7045M | RH-12FH8535/8545 RH-12FH8535C/8545C RH-12FH8535M/8545M |
| Environment | | | Blank: Standard specification C: Clean specification M: Oil mist specification | | |
| Installation posture | | | On floor | | |
| Degree of freedom | | | 4 | | |
| Structure | | | Horizontal, multiple-joint type | | |
| Drive system | | | AC servo motor | | |
| Position detection method | | | Absolute encoder | | |
| Motor capacity | J1 | W | 750 | | |
| | J2 | W | 750 | | |
| | J3 (Z) | W | 400 | | |
| | J4 (θ axis) | W | 200 | | |
| Brake | | | J1, J2, J4: no brake, J3: with brake | | |
| Arm length | No. 1 arm | mm | 225 | 375 | 525 |
| | No. 2 arm | mm | 325 | | |
| Max.reach radius(No. 1+ No. 2) | | mm | 550 | 700 | 850 |
| Operating range | J1 | deg | ± 170 | | |
| | J2 | deg | ± 145 | | ± 153 |
| | J3 (Z) | mm | RH-12FH**35/**35C/**35M: 350 (-10 ~ +340) RH-12FH**45/**45C/**45M: 450 (-110 ~ +340) | | |
| | J4 (θ axis) | deg | ± 360 | | |
| Speed of motion ^{Note2)} | J1 | deg/s | 420 | | 280 |
| | J2 | deg/s | 450 | | |
| | J3 (Z) | mm/s | 2,800 | | |
| | J4 (θ axis) | deg/s | 2,400 | | |
| Maximum horizontal composite speed ^{Note3)} | | mm/s | 11,435 | 12,535 | 11,350 |
| Cycle time ^{Note4)} | | sec | 0.30 | | |
| Load | Rating | kg | 3 | | |
| | Maximum | (N) | 12 | | |
| Z axis pressing force ^{Note5)} | | Maximum | N 200 | | |
| Allowable inertia | Rating | kg · m ² | 0.025 | | |
| | Maximum | | 0.3 | | |
| Pose repeatability ^{Note6)} | X-Y direction | mm | ± 0.012 | ± 0.015 | |
| | J3 (Z) | mm | ± 0.010 | | |
| | J4 (θ axis) | deg | ± 0.005 | | |
| Ambient temperature ^{Note7)} | | °C | 0 to 40 | | |
| Mass | | kg | 65 | 67 | 69 |
| Tool wiring | | | <ul style="list-style-type: none"> · Input 8 points/Output 8 points, (total 20 cores) · Dedicated signal cable for multifunctional hand (Two cores + Power cable two cores) · Ethernet cable one cable (100BASE-TX, eight cores)^{Note8)} | | |
| Tool pneumatic pipes | | | Primary: $\phi 6$ x two hoses, Secondary: $\phi 6$ x eight hoses ^{Note9)} | | |
| Supply pressure | | MPa | $0.5 \pm 10\%$ | | |
| Protection specification ^{Note10)} | | | Standard specification: IP20 Clean specification: ISO class 3 ^{Note11)} Oil mist specification: IP65 ^{Note12)} ^{Note13)} | | |
| Painting color | | | Light gray (Equivalent to Munsell: 0.6B7.6/0.2) | | |

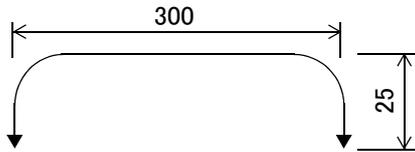
Note1) The table is joint writing on the general environment and clean and oil mist (IP65) specification. If the type ends in a letter C, this corresponds to the clean specification, and where it ends in a letter M, it corresponds to the mist specification. The type in which operating range of J3 axis (Z) is 350mm and 450mm are shown together.

Note2) The maximum speed is the value which applied MvTune2 (high-speed movement mode).

Note3) At the maximum speed on the X-Y flat surface in the robot's control point, it is obtained with each speed of J1, J2, and J4. The control point is the position offset by the rated inertia from the flange.

Note4) The value of the following movement which applied MvTune2 (high-speed movement mode) with the carrying mass of 2kg.

- The cycle time may increase with the case where the positioning accuracy of the work etc. is necessary, or by the moving position.



Note5) This is the downwards pressing force that occurs at the end of the load when the maximum load is on board and the J1, J2 and J4 axis are in their resting state. Please operate at this level or below. When pressing for long periods of time, an excess load error may occur. Please operate in a manner that does not cause errors.

Note6) The pose repeatability details are given in [Page 25, "2.2.1 Pose repeatability"](#).

Note7) Sets the robot's operating environmental temperature as parameter OLTMX. Corresponding to the environment, the continuous control action performance and the overload-protection function are optimized. (Refers to "Optimizing the overload level" described in "Chapter 5 Functions set with parameters" of separate instruction manual/ Detailed explanations of functions and operations for details.)

Note8) The 8-wire cable designated for LAN wiring can also be used for backup wiring.

Note9) The $\phi 6$ secondary piping can be obtained with the electromagnetic valve (option). Details regarding the electromagnetic valve (optional) are shown on [Page 108, "\(3\) Solenoid valve set"](#).

Note10) The protection specification details are given in [Page 37, "2.2.8 Protection specifications"](#).

Note11) The details of the clean specifications are described in [Page 39, "2.2.9 Clean specifications"](#). The conditions necessary to guarantee cleanliness are as follows: clean room down flow 0.3 m/s or greater, robot internal suction of 60-140L/min and installation of an exhaust duct at the rear of the robot's main base. A $\phi 8$ joint is prepared at the rear of the base for suction.

Note12) Direct jet flow to the bellows section is not included.

Note13) If you use the controller in oil mist or similar environments, use the controller protection box to protect the controller from the operation environment. A robot equipped with the controller protection box as standard is available.

(3) RH-20FH series

Table 2-3 : Standard specifications of robot arm

| Item | | Unit | Specifications | |
|--|---------------------|---------------------|---|--|
| Type ^{Note1)} | | | RH-20FH8535/8545 RH-20FH8535C/8545C RH-20FH8535M/8545M | RH-20FH10035/10045 RH-20FH10035C/10045C RH-20FH10035M/10045M |
| Environment | | | Blank: Standard specification C: Clean specification M: Oil mist specification | |
| Installation posture | | | On floor | |
| Degree of freedom | | | 4 | |
| Structure | | | Horizontal, multiple-joint type | |
| Drive system | | | AC servo motor | |
| Position detection method | | | Absolute encoder | |
| Motor capacity | J1 | W | 750 | |
| | J2 | W | 750 | |
| | J3 (Z) | W | 400 | |
| | J4 (θ axis) | W | 200 | |
| Brake | | | J1, J2, J4: no brake, J3: with brake | |
| Arm length | No. 1 arm | mm | 525 | |
| | No. 2 arm | mm | 325 | 475 |
| Max.reach radius(No. 1+ No. 2) | | mm | 850 | 1,000 |
| Operating range | J1 | deg | ± 170 | |
| | J2 | deg | ± 153 | |
| | J3 (Z) | mm | RH-20FH**35/**35C/**35M: 350 (-10 ~ +340) RH-20FH**45/**45C/**45M: 450 (-110 ~ +340) | |
| | J4 (θ axis) | deg | ± 360 | |
| Speed of motion ^{Note2)} | J1 | deg/s | 280 | |
| | J2 | deg/s | 450 | |
| | J3 (Z) | mm/s | 2,400 | |
| | J4 (θ axis) | deg/s | 1,700 | |
| Maximum horizontal composite speed ^{Note3)} | | mm/s | 11,372 | 13,283 |
| Cycle time ^{Note4)} | | sec | 0.30 | 0.36 |
| Load | Rating | kg | 5 | |
| | Maximum | (N) | 20 | |
| Z axis pressing force ^{Note5)} | | N | 230 | |
| Allowable inertia | Rating | kg · m ² | 0.065 | |
| | Maximum | | 1.05 ^{Note6)} | |
| Pose repeatability ^{Note7)} | X-Y direction | mm | ± 0.015 | ± 0.020 |
| | J3 (Z) | mm | ± 0.010 | |
| | J4 (θ axis) | deg | ± 0.005 | |
| Ambient temperature ^{Note8)} | | °C | 0 to 40 | |
| Mass | | kg | 75 | 77 |
| Tool wiring | | | · Input 8 points/Output 8 points, (total 20 cores) · Dedicated signal cable for multifunctional hand (Two cores + Power cable two cores) · Ethernet cable one cable (100BASE-TX, eight cores) ^{Note9)} | |
| Tool pneumatic pipes | | | Primary: $\phi 6$ x two hoses, Secondary: $\phi 6$ x eight hoses ^{Note10)} | |
| Supply pressure | | MPa | 0.5 \pm 10% | |
| Protection specification ^{Note11)} | | | Standard specification: IP20 Clean specification: ISO class 3 ^{Note12)} Oil mist specification: IP65 ^{Note13)} ^{Note14)} | |
| Painting color | | | Light gray (Equivalent to Munsell: 0.6B7.6/0.2) | |

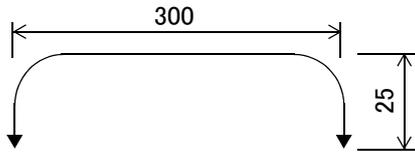
Note1) The table is joint writing on the general environment and clean and oil mist (IP65) specification. If the type ends in a letter C, this corresponds to the clean specification, and where it ends in a letter M, it corresponds to the mist specification. The type in which operating range of J3 axis (Z) is 350mm and 450mm are shown together.

Note2) The maximum speed is the value which applied MvTune2 (high-speed movement mode).

Note3) At the maximum speed on the X-Y flat surface in the robot's control point, it is obtained with each speed of J1, J2, and J4. The control point is the position offset by the rated inertia from the flange.

Note4) The value of the following movement which applied MvTune2 (high-speed movement mode) with the carrying mass of 2kg.

- The cycle time may increase with the case where the positioning accuracy of the work etc. is necessary, or by the moving position.



Note5) This is the downwards pressing force that occurs at the end of the load when the maximum load is on board and the J1, J2 and J4 axis are in their resting state. Please operate at this level or below. When pressing for long periods of time, an excess load error may occur. Please operate in a manner that does not cause errors.

Note6) When offset hand is used, the adjustment of moving speed and acceleration/deceleration speeds may be the Required.

Refers to it, because the details is shown in [Page 26, "2.2.2 Mass capacity"](#).

Note7) The pose repeatability details are given in [Page 25, "2.2.1 Pose repeatability"](#).

Note8) Sets the robot's operating environmental temperature as parameter OLTMX. Corresponding to the environment, the continuous control action performance and the overload-protection function are optimized. (Refers to "Optimizing the overload level" described in "Chapter 5 Functions set with parameters" of separate instruction manual/ Detailed explanations of functions and operations for details.)

Note9) The 8-wire cable designated for LAN wiring can also be used for backup wiring.

Note10) The $\phi 6$ secondary piping can be obtained with the electromagnetic valve (option). Details regarding the electromagnetic valve (optional) are shown on [Page 108, "\(3\) Solenoid valve set"](#).

Note11) The protection specification details are given in [Page 37, "2.2.8 Protection specifications"](#).

Note12) The details of the clean specifications are described in [Page 39, "2.2.9 Clean specifications"](#). The conditions necessary to guarantee cleanliness are as follows: clean room down flow 0.3 m/s or greater, robot internal suction of 60-140L/min and installation of an exhaust duct at the rear of the robot's main base. A $\phi 8$ joint is prepared at the rear of the base for suction.

Note13) Direct jet flow to the bellows section is not included.

Note14) If you use the controller in oil mist or similar environments, use the controller protection box to protect the controller from the operation environment. A robot equipped with the controller protection box as standard is available.

(4) RH-3FHR series

Table 2-4 : Standard specifications of robot arm

| Item | | Unit | Specifications | | |
|--|---------------------|---------------------|--|---------------------------------------|-------------------------------------|
| Type ^{Note1)} | | | RH-3FHR3515 | RH-3FHR3512C | RH-3FHR3512W |
| Environment | | | Standard specification | Clean specification | Waterproof specification |
| Installation posture | | | Hanging | | |
| Degree of freedom | | | 4 | | |
| Structure | | | Horizontal, multiple-joint type | | |
| Drive system | | | AC servo motor | | |
| Position detection method | | | Absolute encoder | | |
| Motor capacity | J1 | W | 750 | | |
| | J2 | W | 200 | | |
| | J3 (Z) | W | 200 | | |
| | J4 (θ axis) | W | 100 | | |
| Brake | | | J1, J2, J4: no brake J3: with brake | | |
| Arm length | No. 1 arm | mm | 175 | | |
| | No. 2 arm | mm | 175 | | |
| Max.reach radius(No. 1+ No. 2) | | mm | 350 | | |
| Operating range | J1 | deg | ± 225 | | |
| | J2 | deg | ± 225 | | |
| | J3 (Z) | mm | 150 | 120 | |
| | J4 (θ axis) | deg | ± 720 | | |
| Speed of motion ^{Note2)} | J1 | deg/s | 672 | | |
| | J2 | deg/s | 708 | | |
| | J3 (Z) | mm/s | 1,500 | | |
| | J4 (θ axis) | deg/s | 3,146 | | |
| Maximum horizontal composite speed ^{Note3)} | | mm/s | 6,267 | | |
| Cycle time ^{Note4)} | | sec | 0.32 | | |
| Load | Rating | kg | 1 | | |
| | Maximum | (N) | 3 | | |
| Allowable inertia | Rating | kg · m ² | 0.005 | | |
| | Maximum | | 0.05 ^{Note5)} | | |
| Pose repeatability ^{Note6)} | X-Y direction | mm | ± 0.01 | | |
| | J3 (Z) | mm | ± 0.01 | | |
| | J4 (θ axis) | deg | ± 0.01 | | |
| Ambient temperature ^{Note7)} | | °C | 0 ~ 40 | | |
| Mass | | kg | 24 | 28 | |
| Tool wiring | | | Input 8 points/Output 8 points, eight spare wires | | |
| Tool pneumatic pipes | | | Primary: $\phi 6$ x two hoses, Secondary: $\phi 4$ x eight hoses ^{Note8)} | | |
| Supply pressure | | MPa | 0.5 \pm 10% | | |
| Protection specification ^{Note9)} | | | General-purpose environment: IP20 | Clean: ISO class 5 ^{Note10)} | Waterproof: IP65 ^{Note11)} |
| Painting color | | | Not painting. Plating (silver) | | |

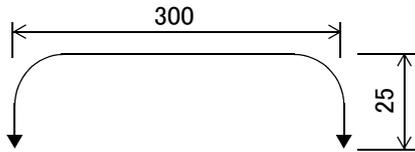
Note1) The table is joint writing on the general environment and clean and waterproof (IP65) specification. If the type ends in a letter C, this corresponds to the clean specification, and where it ends in a letter W, it corresponds to the waterproof specification.

Note2) The maximum speed is the value which applied MvTune2 (high-speed movement mode).

Note3) At the maximum speed on the X-Y flat surface in the robot's control point, it is obtained with each speed of J1, J2, and J4. The control point is the position offset by the rated inertia from the flange.

Although based on specified speed, speed drops generally. Refer to [Page 35, "2.2.6 About moving speed at singular point and near singular point. \(RH-3FHR series\)"](#) for details.

- Note4) The value of the following movement which applied MvTune2 (high-speed movement mode) with the carrying mass of 1kg.
- The cycle time may increase with the case where the positioning accuracy of the work etc. is necessary, or by the moving position.



- The robot's moving time is influenced by the posture etc. As reference, the reduction method of cycle time is shown in Page 32, "[Supplementary explanation 1]: The setting which shortens execution time".

Note5) When offset hand is used, the adjustment of moving speed and acceleration/deceleration speeds may be the Required. Refers to it, because the details is shown in Page 26, "2.2.2 Mass capacity".

Note6) The pose repeatability details are given in Page 25, "2.2.1 Pose repeatability".

Note7) Sets the robot's operating environmental temperature as parameter OLTMX. Corresponding to the environment, the continuous control action performance and the overload-protection function are optimized. (Refers to "Optimizing the overload level" described in "Chapter 5 Functions set with parameters" of separate instruction manual/ Detailed explanations of functions and operations for details.)

Note8) The $\phi 4$ secondary piping can be obtained with the electromagnetic valve (option). Details regarding the electromagnetic valve (optional) are shown on Page 108, "(3) Solenoid valve set".

Note9) The protection specification details are given in Page 37, "2.2.8 Protection specifications".

Note10) The details of the clean specifications are described in Page 39, "2.2.9 Clean specifications". Protection of the cleanness of the robot is required if the down flow in a clean room is 0.3 m/s or more and robot internal suction is 30-50 L/min. A $\phi 8$ joint is prepared at the base rear part for suction.

Note11) Direct jet flow to the bellows section is not included.

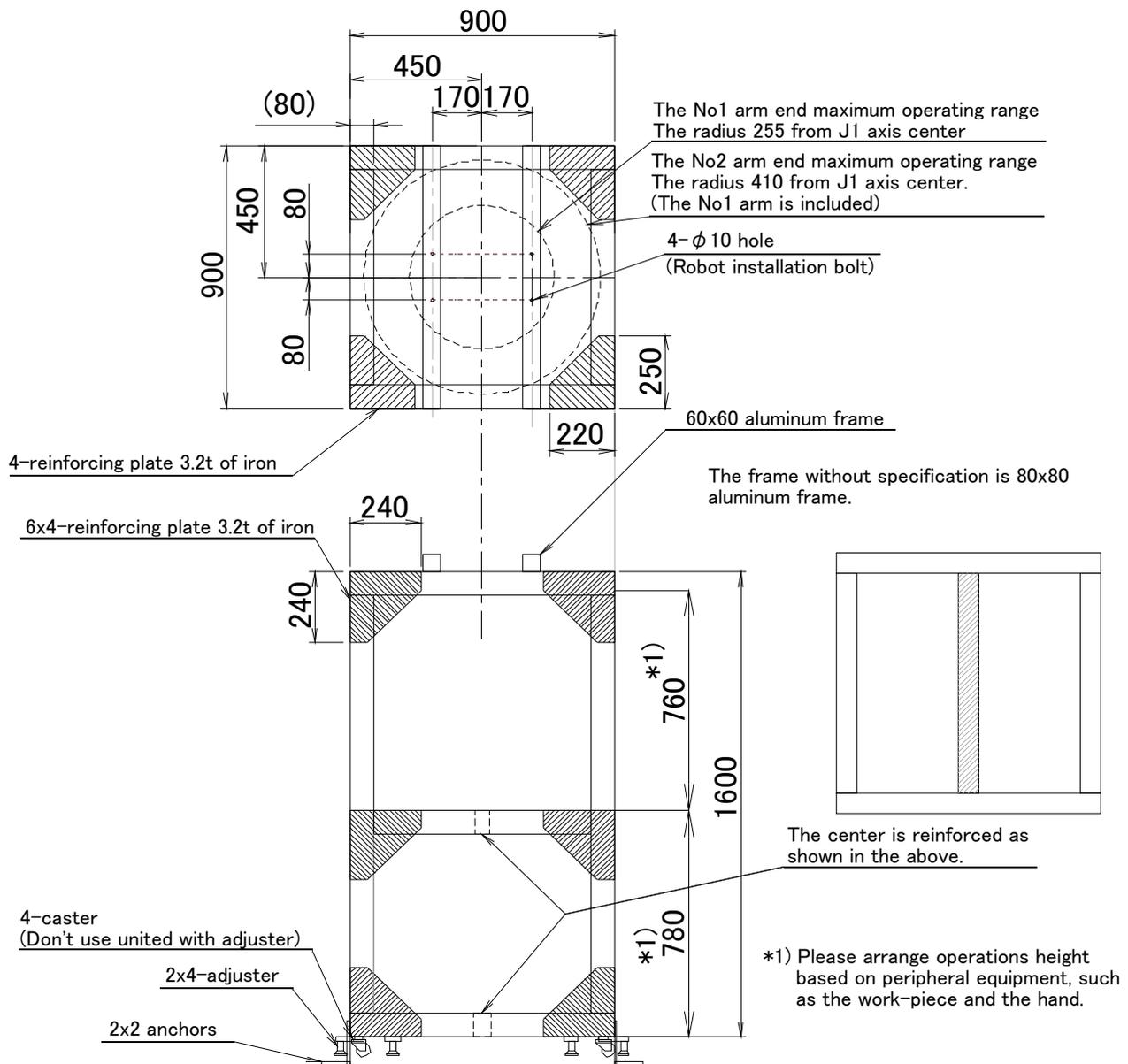
2.1.2 The counter-force applied to the installation surface

The counter-force applied to the installation surface for the strength design of the robot installation surface is shown.

Table 2-5 : Value of each counter-force

| Item | Unit | Value |
|-------------------------------------|------|-------|
| RH-6FH series | | |
| Falls moment: M_L | N•m | 1,640 |
| Torsion moment: M_T | N•m | 710 |
| Horizontal translation force: F_H | N | 1,653 |
| Vertical translation force: F_V | N | 2,318 |
| RH-12FH/20FH series | | |
| Falls moment: M_L | N•m | 3,190 |
| Torsion moment: M_T | N•m | 1,840 |
| Horizontal translation force: F_H | N | 2,240 |
| Vertical translation force: F_V | N | 2,500 |
| RH-3FHR series | | |
| Falls moment: M_L | N•m | 380 |
| Torsion moment: M_T | N•m | 410 |
| Horizontal translation force: F_H | N | 920 |
| Vertical translation force: F_V | N | 570 |

(2) Example which uses the aluminum



Note1) The gross weight of this stage is about 200kg.
 Note2) This stage is an example. Please design based on the conditions of the system.
 Note3) Fixing the stage to the floor by anchor etc. If the center of gravity of the stage is in the high position, the stage may fall by movement of the robot.

Fig.2-2 : Installation stage (Example of aluminum frame use)

2.2 Definition of specifications

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

2.2.1 Pose repeatability

For this robot, the pose repeatability is given in accordance with JIS B 8432 (Pose repeatability). Note that the value is based on 100 measurements (although 30 measurements are required according to JIS).

[Caution] The specified "pose repeatability" is not guaranteed to be satisfied under the following conditions.

- [1] Operation pattern factors
 - 1) When an operation that approaches from different directions and orientations are included in relation to the teaching position during repeated operations
 - 2) When the speed at teaching and the speed at execution are different
- [2] Load fluctuation factor
 - 1) When work is present/absent in repeated operations
- [3] Disturbance factor during operation
 - 1) Even if approaching from the same direction and orientation to the teaching position, when the power is turned OFF or a stop operation is performed halfway
- [4] Temperature factors
 - 1) When the operating environment temperature changes
 - 2) When accuracy is required before and after a warm-up operation
- [5] Factors due to differences in accuracy definition
 - 1) When accuracy is required between a position set by a numeric value in the robot's internal coordinate system and a position within the actual space
 - 2) When accuracy is required between a position generated by the pallet function and a position within the actual space
- [6] Positioning movement near the singular point (RH-3FHR)

2.2.2 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 allowable moment of inertia found in [Page 15, "2.1.1 Basic specifications"](#).
- (2) [Fig. 2-3](#) to [Fig. 2-6](#) 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. Please use the robot in the allowable moment of inertia of maximum moment of inertia shown in [Fig. 2-3](#) to [Fig. 2-6](#).

[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, a vibration, an overload or generate an overcurrent alarm could occur. In such cases, please reduce acceleration and deceleration (Accel command) speeds and movement speed (Ovr command). Although the standard value to reduce is 50% for each command, please adjust corresponding to the movement posture. Refer to separate "Instruction Manual/Detailed Explanation of Functions and Operations" for details of each command. Moreover, if hand/workpiece parameters are not set exactly, the similar phenomenon will be easier to occur.

[Caution] Refer to [Page 28, "2.2.3 Relationships Among Mass Capacity, Speed, and Acceleration/Deceleration Speed"](#), and set the values of the mass, magnitude, and distance to the centroid of a tool and a workpiece to parameters.

If parameters are not set exactly, the lifetime of reduction gears, a belt, etc. is affected.

[Caution] The overhang amount of the load, such as the mass capacity and the allowable moment of inertia defined in this section, are dynamic limit values determined by the capacity of the motor that drives axes or the capacity of the speed reducer. Therefore, it does not guarantee the accuracy on all areas of tooling. Guaranteed accuracy is measured from the center point of the mechanical interface surface. Please note that if the point of operation is kept away from the mechanical interface surface by long and low-rigid tooling, the positioning accuracy may deteriorate or may cause vibration.

Note that the allowable offset value (Z direction) from the lower edge of the shaft to the position of center of gravity is 100 mm.

[Caution] Even within the allowable range previously mentioned, an overload alarm may be generated if an ascending operation continues at a micro-low speed. In such a case, it is necessary to increase the ascending speed.

[Caution] This robot will restrict speed automatically by internal controls when the load center-of-gravity position separates from the shaft center. Refer to [Page 28, "2.2.3 Relationships Among Mass Capacity, Speed, and Acceleration/Deceleration Speed"](#) in detail.

The allowance distance (allowance offset amount) from the center of the shaft to the gravity center of loading weight are shown below.

RH-6FH: less than 140mm, RH-12FH: less than 240mm, RH-20FH: less than 320mm, RH-3FHR: less than 50mm.

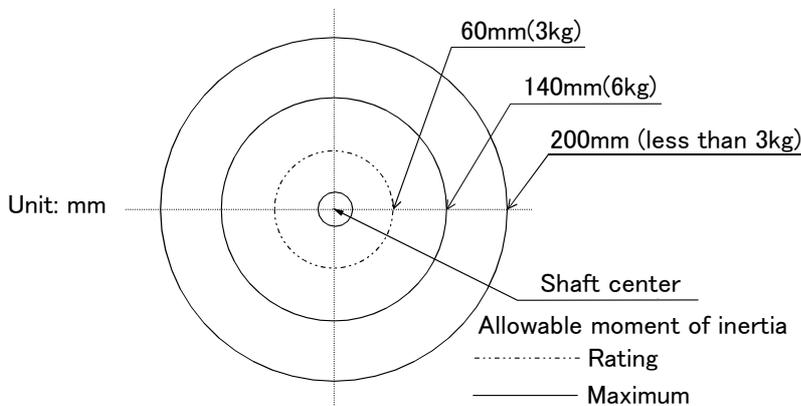


Fig.2-3 : Position of center of gravity for loads (for loads with comparatively small volume): RH-6FH series

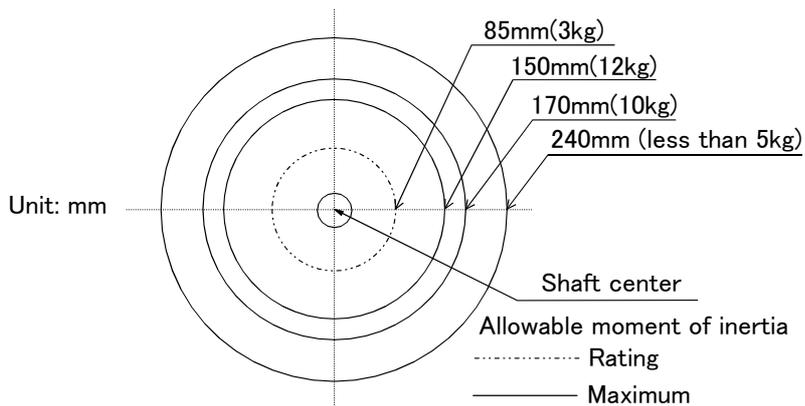


Fig.2-4 : Position of center of gravity for loads (for loads with comparatively small volume): RH-12FH series

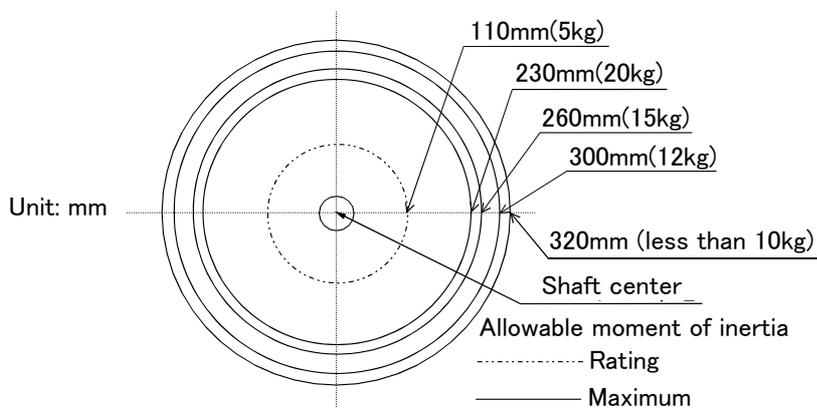


Fig.2-5 : Position of center of gravity for loads (for loads with comparatively small volume): RH-20FH series

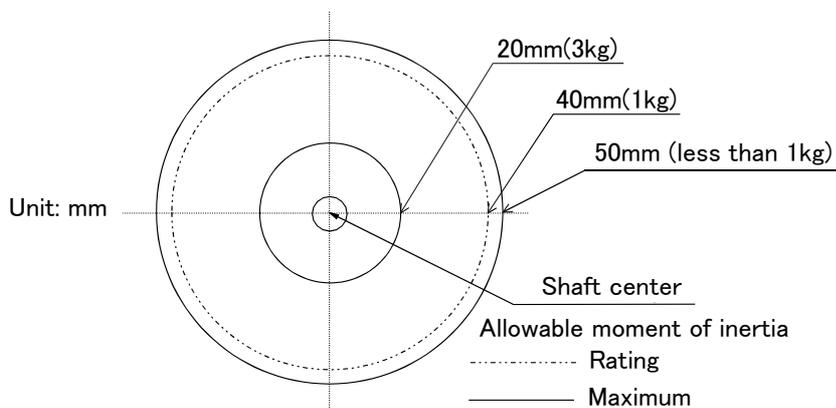


Fig.2-6 : Position of center of gravity for loads (for loads with comparatively small volume): RH-3FHR series

2.2.3 Relationships Among Mass Capacity, Speed, and Acceleration/Deceleration Speed

This robot automatically sets the optimum acceleration and deceleration speeds and maximum speed, according to the load capacity and size that have been set, and operates using these automatically set speeds.

To achieve that, it is necessary to correctly set the actual load data (mass and size of hand and work) to be used. However, vibration, overheating and errors such as excessive margin of error and overload may occur, depending on the robot operation pattern or ambient temperature.

In this case, reduce the speed and the acceleration and deceleration rate before continuing to use. This is done by accessing the robot program and adjusting the speed settings (Ovrd) and the acceleration and deceleration settings (Accel).

If a setting is performed in such a way that it falls below the mounted load, the life span of the mechanism elements used in the robot may be shortened. In the case of a work requiring a high degree of accuracy, set up the load correctly and use the robot by lowering the ratios of the acceleration and deceleration speeds.

(1) Setting Load Capacity and Size (Hand Conditions)

Set up the capacity and size of the hand with the "HNDDAT*" parameter (optimum acceleration/deceleration setting parameter), and set up the capacity and size of the work with the "WRKDAT*" parameter. Numbers 0 to 8 can be used for the asterisk (*) part. Designate the "HNDDAT*" and "WRKDAT*" parameters to be used using the "LoadSet" command in a program.

For more details, refer to the separate "Instruction Manual/Detailed Explanation of Functions and Operations." It is the same meaning as "LoadSet 0.0" if not using the "LoadSet".

<Factory default settings>

| | Hand mass kg | size X mm | size Y mm | size Z mm | center-of-gravity position X mm | center-of-gravity position Y mm | center-of-gravity position Z mm |
|----------------|-----------------|--------------|--------------|--------------|------------------------------------|------------------------------------|------------------------------------|
| RH-6FH series | | | | | | | |
| HNDDAT* | 6.0 | 99.0 | 99.0 | 76.0 | 0.0 | 0.0 | 38.0 |
| WRKDAT* | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| RH-12FH series | | | | | | | |
| HNDDAT* | 12.0 | 165.0 | 165.0 | 64.0 | 0.0 | 0.0 | 16.0 |
| WRKDAT* | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| RH-20FH series | | | | | | | |
| HNDDAT* | 20.0 | 165.0 | 165.0 | 109.0 | 0.0 | 0.0 | 37.0 |
| WRKDAT* | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| RH-3FHR series | | | | | | | |
| HNDDAT* | 3.0 | 76.0 | 76.0 | 58.0 | 0.0 | 0.0 | 24.0 |
| WRKDAT* | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

Note) The position of the center of gravity is located at the center of the surface at the bottom of the shaft. Set the X, Y and Z center of gravity positions for the tool coordinate directions (the Z center of gravity position will be a plus for downward directions).

2.2.4 Vibrations at the Tip of the Arm during Low-Speed Operation of the Robot

Vibrations at the tip of the arm may increase substantially during the low-speed operation of the robot, depending on the combination of robot operation, hand mass and hand inertia. This problem occurs when the vibration count specific to the robot arm and the vibration count of the arm driving force are coming close to each other. These vibrations at the tip of the arm can be reduced by taking the following measures:

- 1) Change the robot's operating speed by using the Ovrd command.
- 2) Change and move the teaching points of the robot.
- 3) Change the hand mass and hand inertia.

2.2.5 Vibration of shaft (J3 axis) position and arm end

Vibrations at the tip of the arm may increase substantially during operation under the shaft position near the low end or the high end of the robot, depending on the combination of hand mass and hand inertia. This problem occurs according to that inertia, because the distance from the shaft support section to the shaft end becomes long. When this vibration affects the robot's operations, please change operating speed etc. like the above [Page 28, "2.2.4 Vibrations at the Tip of the Arm during Low-Speed Operation of the Robot"](#).

(1) Relationship Between Mass Capacity and Speed

A function to optimize the maximum speed of each axis according to the setting value of the load capacity will be activated (Refer to [Fig. 2-7](#)).

However, this function does not work with the following load mass:

RH-6FH/12FH series: 3kg or less

RH-20FH series: 5kg or less

RH-3FHR series: 1kg or less

When the load mass is changed to following, the maximum speed is compensated according to the load mass:

RH-6FH/12FH series: exceed 3kg

RH-20FH series: exceed 5kg

RH-3FHR series: exceed 1kg

[CAUTION] Depending on the operation pattern, the speed and/or acceleration/deceleration at the front edge may not be parallel with the speed and the rate of change of acceleration/deceleration specified in a program.

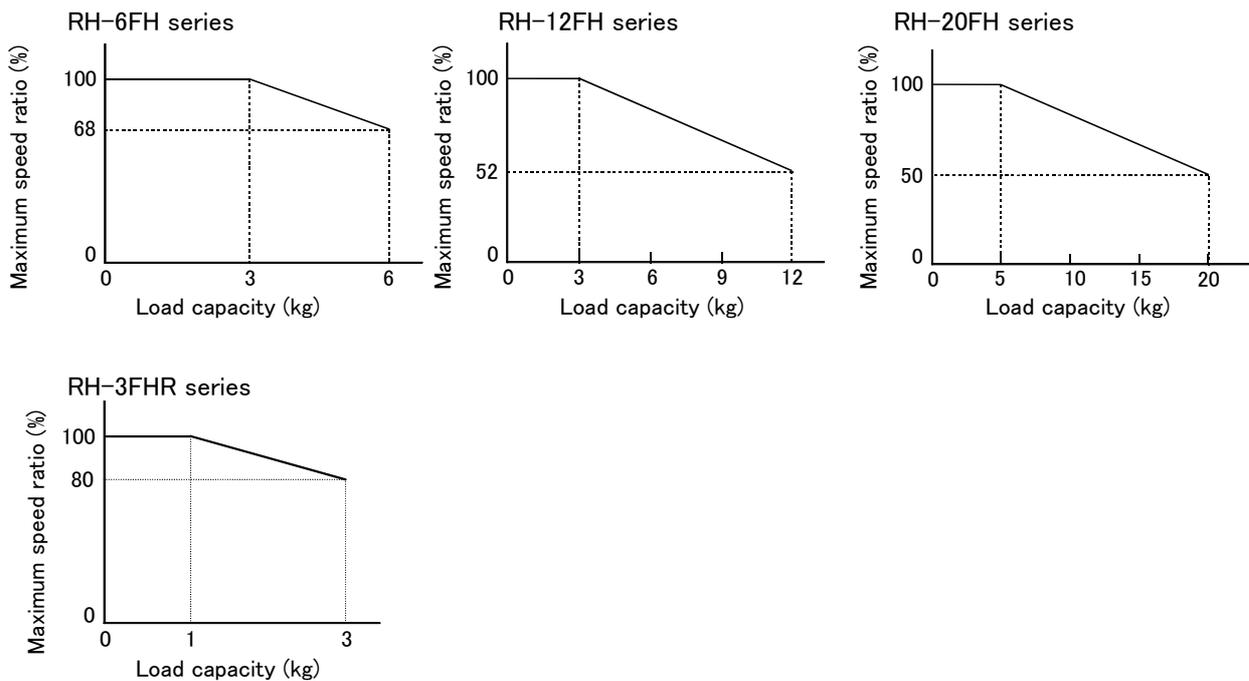
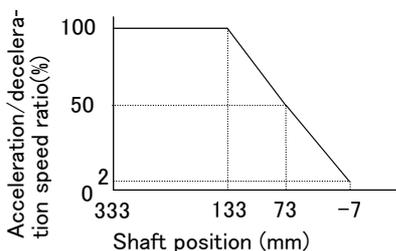


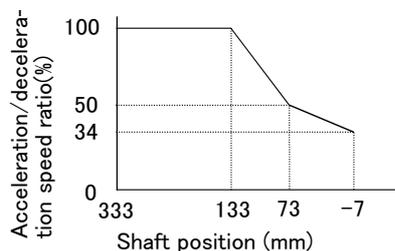
Fig.2-7 : Automatic compensation of speed

RH-6FH series

J3 axis (Z) stroke 340mm
(Standard Acceleration/deceleration speed)

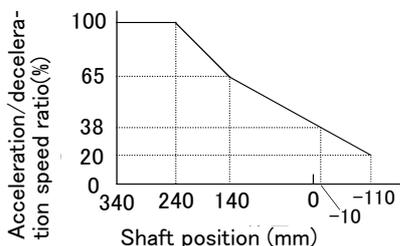


J3 axis (Z) stroke 340mm
(High acceleration and deceleration rate)

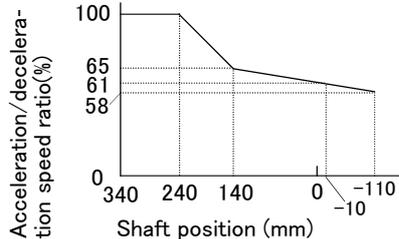


RH-12FH series

J3 axis (Z) stroke 350/450mm
(Standard Acceleration/deceleration speed)

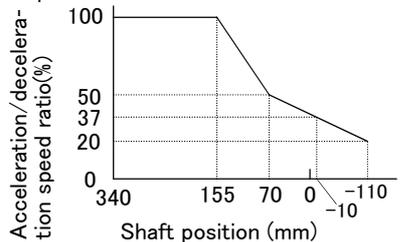


J3 axis (Z) stroke 350/450mm
(Standard Acceleration/deceleration speed)

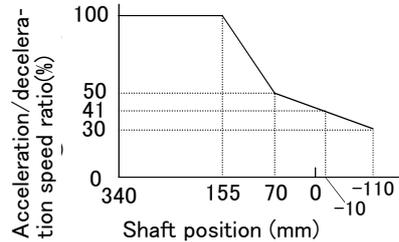


RH-20FH series

J3 axis (Z) stroke 350/450mm
(Standard Acceleration/deceleration speed)

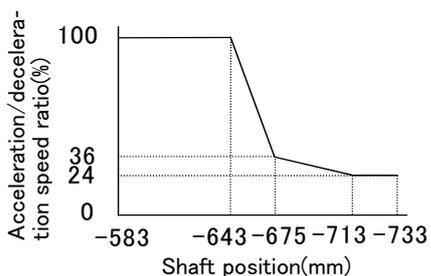


J3 axis (Z) stroke 350/450mm
(Standard Acceleration/deceleration speed)



RH-3FHR series

J3 axis (Z) stroke: 150mm
(Standard Acceleration/deceleration speed)



Note) The high acceleration-and-deceleration pattern of the type without illustration of the high acceleration-and-deceleration pattern is the same as the standard acceleration-and-deceleration pattern.

Fig.2-9 : Automatic compensation of acceleration/deceleration speed

(3) Relation between offset length and the maximum speed

A function to optimize the maximum speed of each axis according to the offset length will be activated. (Refer to Fig. 2-10)

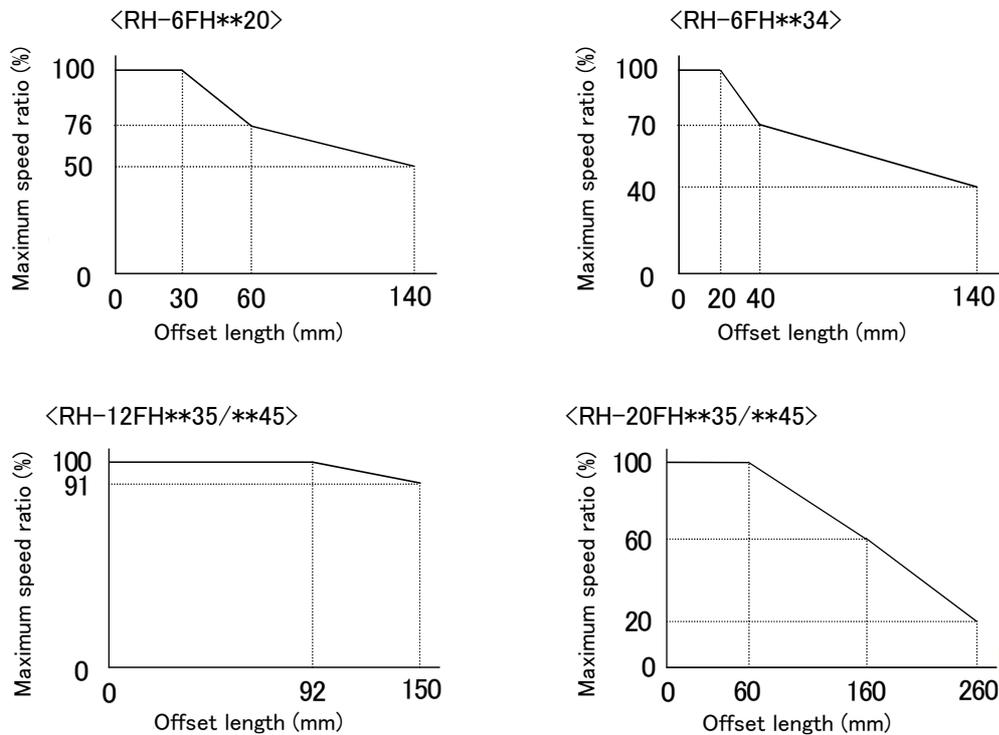


Fig.2-10 : Relationship of the offset length and maximum velocity

[Supplementary explanation 1]: The setting which shortens execution time

The execution time can be improved by using the following methods.

- 1) Perform continuous path operation using the Cnt command.
- 2) Control the optimum acceleration/deceleration using the Oadl command.
- 3) Control the optimum speed using the Spd command.
- 4) Setting a larger value in the optimum acceleration/deceleration adjustment rate parameter: JADL. (Maximum 100)

The moving time can be shortened by setting a larger value in the optimum acceleration/deceleration adjustment rate parameter (JADL). In this robot, the acceleration/deceleration speed is initialized to allow continuous moving with a short wait time (setting of B in the Fig. 2-11).

This setting is suited for continuous operations that have a short tact time, such as palletizing work.

Conversely, if quick moves (short moving time) are required, such as L/UL work on machined parts, the acceleration/deceleration speed can be increased by initial setting (setting of A in the Fig. 2-11).

However, please note that some setting values of acceleration/deceleration speed tend to cause overload and overheat errors. In such a case, extend the wait time, reduce the acceleration/deceleration speed, or decrease the moving speed.

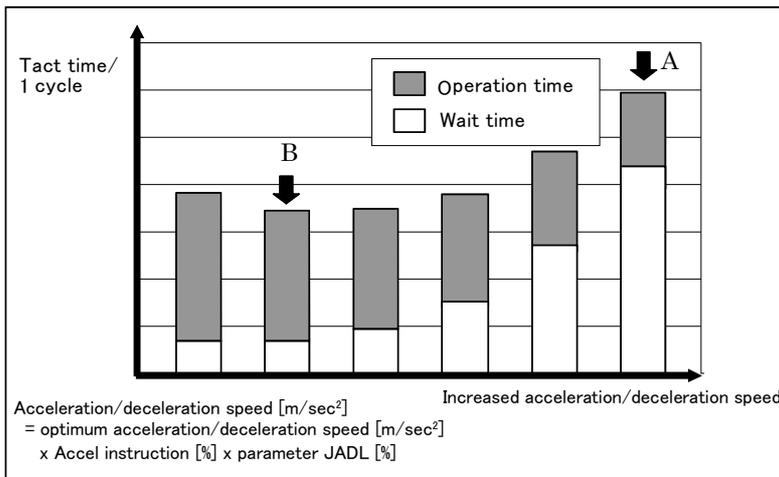


Fig.2-11 : Relationship between Acceleration/deceleration Speed and Tact Time (Conceptual Drawing)

5) Move without changing the posture. (RH-3FHR series)

The robot's moving time is influenced not only by the size of moving distance but by posture change. The example is shown in Fig. 2-12. When moving changing the posture (left side of the figure), the movement distance is shorter, but moving time may become long conversely. Conversely, When moving without changing the posture, moving time may become shorter (right side of the figure).

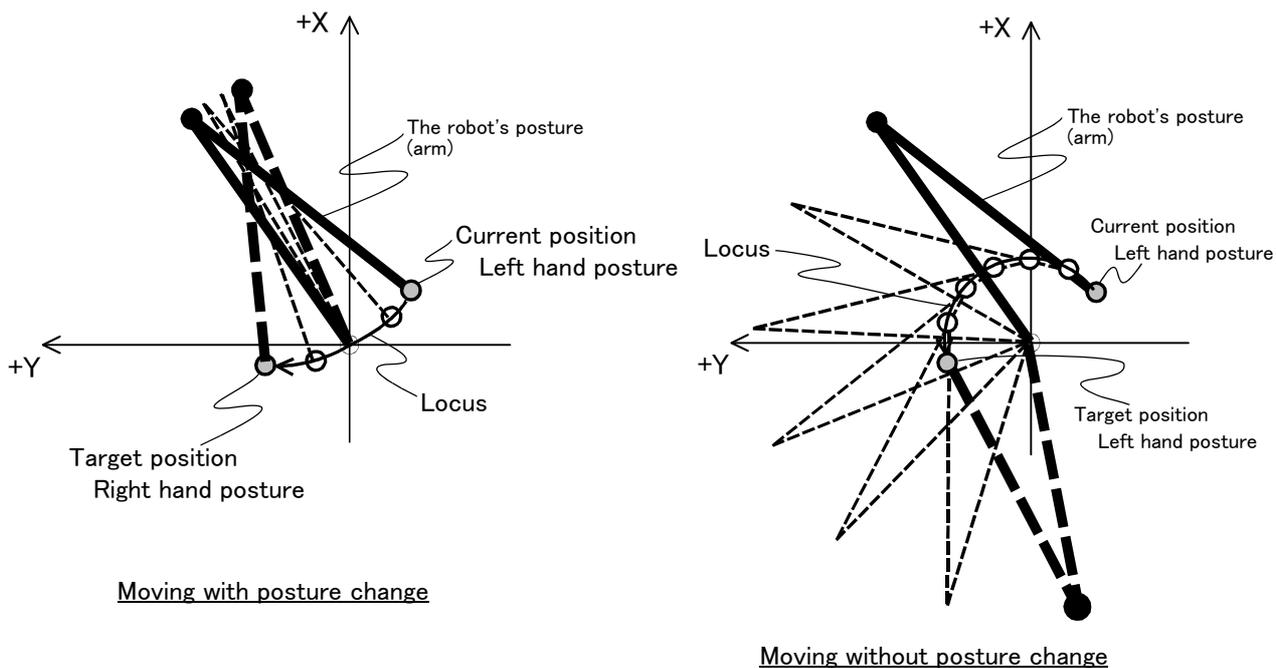


Fig.2-12 : Moving time by posture change (Conceptual Drawing)

(4) Time to reach the position repeatability

When using this robot, the time to reach the position repeatability may be prolonged due to the effect of residual vibration at the time of stopping. If this happens, take the following measures:

- 1) Change the operation position of the Z axis to the location near the top as much as possible.
- 2) Increase the operation speed prior to stopping.
- 3) When positioning the work near the bottom edge of the Z axis, if no effectiveness is achieved in step "2" above, perform operation ① (robot path: O → A → C). In the case of operation ② (robot path: O → B → C), residual vibration may occur. (Refer to Fig. 2-13.)

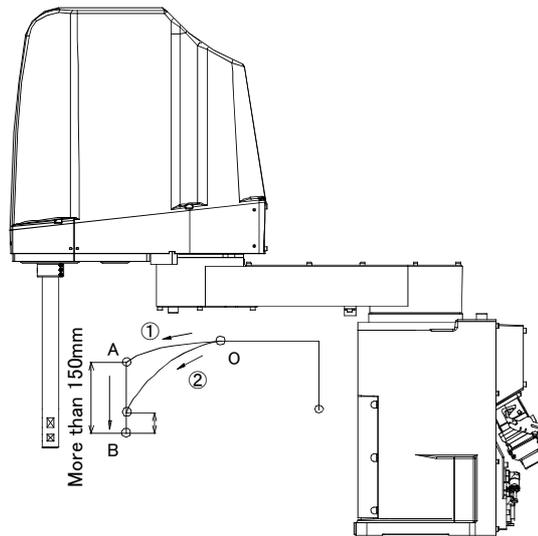


Fig.2-13 : Recommended path when positioning at the bottom edge of the Z axis

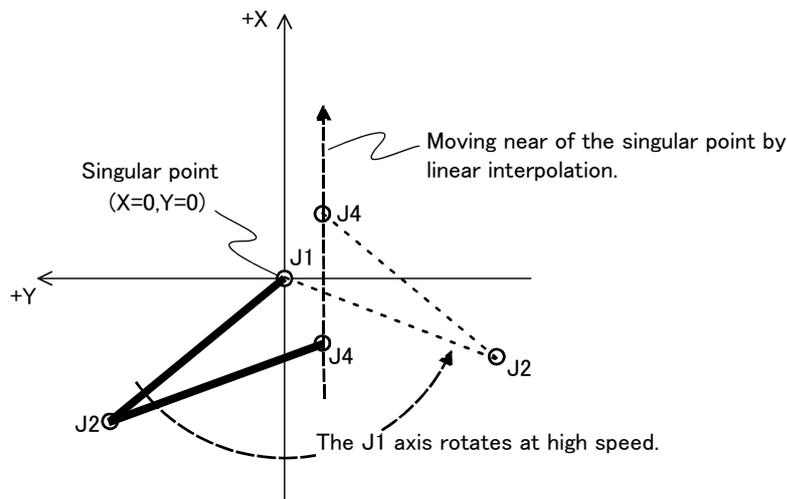
2.2.6 About moving speed at singular point and near singular point. (RH-3FHR series)

The robot of our company has memorized the teaching position and calculates of linear interpolation movement using the position data in the XYZ coordinate system. Even if it is the same position data, the robot can take two or more postures.

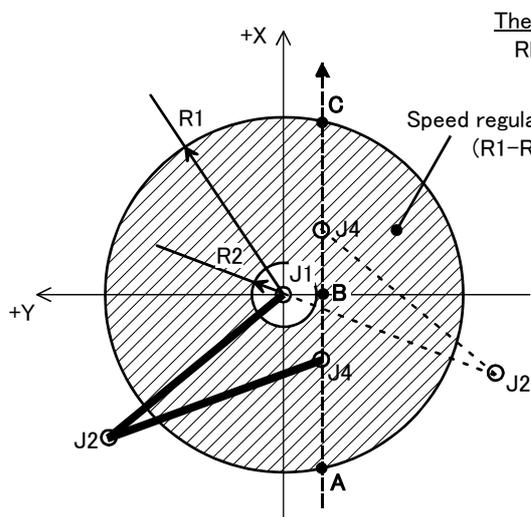
For example, if X coordinate value is "0" and Y coordinate value is also "0", the rotation angle of J1 axis is not decided uniquely. This position is called singular point, and positioning or passing with XYZ JOG and linear interpolation will not be performed. And, even though based on the specified speed, when moving near singular point with linear interpolation, the error occurs, because the J1 axis must rotate at the big speed. ("a") of Fig. 2-14) However, in RH-3FHR series, speed was lowered automatically and it has the function which can be passed without the error.

In addition, this function can be changed valid/invalid by setting of parameter:SPDOPT, and SpdOpt command. Refer to the separate manual "Detailed explanations of functions and operations" for details.

And, the area in R2 shown in "b)" of Fig. 2-14 is the singular point, and positioning and passage with linear interpolation movement cannot be performed. In joint interpolation movement, positioning and passage are possible. It is in valid condition at shipping.



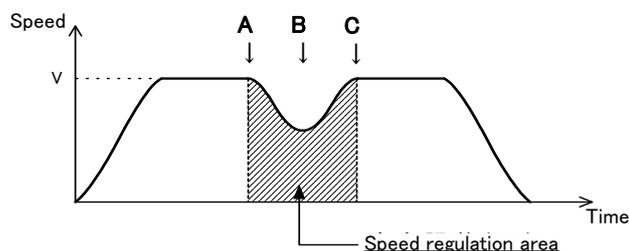
a) The singular point and the movement near the singular point



b) Speed regulation area

The range of the speed regulation area
RH-3FHR series
R1=240.0mm, R2=1.0mm

A: Starts the slowdown if robot goes into the speed regulation area.
B: Accelerates slowly towards going out.
C: If robot goes out completely from speed regulation area, it returns to specification speed.



c) Speed change in the speed regulation area

Fig.2-14 : The singular point and the speed regulation near the singular point

2.2.7 Collision detection

This series have the "collision detection function" which detects the abnormalities by the collision of the robot arm, and the initial setting has set this function as the enable to suppress damage to the minimum.

Although the enable/disable of this function can be changed by parameter: COL and command: ColChk, you should use in valid condition of this function for protection of the robot and of the peripheral equipment.

The abnormalities are detected by the robot's kinetics model, presuming torque necessary for movement at any time. Therefore, the setting parameter (HNDDAT*, WRKDAT*) of the hand and the work piece conditions should be right. And, it may be detected as the collision in movement as speed and motor torque are changed rapidly. (for example, the movement near the place of the origin by linear interpolation, the reversal movement, the cold condition, the operation after long term stoppage)

In such a case, by adjusting the value of the setting parameter (COLLVL, COLLVLJG) of the collision detection level according to actual use environment, the sensitivity of collision detection can be optimized and the damage risk can be reduced further. And, in the operation after the low temperature or long term stoppage, please operate by accustoming at low speed (warm-up), or use the warm-up operation mode.

Refer to the separate instruction manual "Detailed explanations of functions and operations" for details of related parameter.

Table 2-7 : Factory-shipments condition

| | JOG operation | Automatic |
|-------------------------|---------------|-----------|
| RH-6FH/12FH/20FH series | Valid | Invalid |
| RH-3FHR series | Valid | Valid |

2.2.8 Protection specifications

(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 2-8](#).

Table 2-8 : Protection specifications and applicable fields

| Type | Protection specifications (IEC Standards value) | Classification | Applicable field | Remarks |
|--|---|--|---|---|
| RH-6FHxx20/xx34 RH-12FHxx35/xx45 RH-20FHxx35/xx45 RH-3FHR3515 | Robot arm: IP20 | General-purpose environment specifications | General assembly Slightly dusty environment | |
| RH-6FHxx20M/xx34M RH-6FHxx20-SM/xx34-SM Note1) RH-12FHxx35M/xx45M RH-12FHxx35M-SM/xx45M-SM Note1) RH-20FHxx35M/xx45M RH-20FHxx35M-SM/xx45M-SM Note1) | Robot arm: IP65 (Direct jet flow to the bellows section is not included.) | Oil mist specifications | Machine tool (cutting) Machine shop with heavy oil mist Dusty work shop | Note that if the cutting machine is using abrasive materials, the robot's life will be shortened. |
| RH-3FHR3512W | Robot arm: IP65 (Direct jet flow to the bellows section is not included.) | Waterproof specifications | Food processing (handling) The work shops which requires washing of a robot arm. | |

Note1) The “-SM” specification comes with the controller protection box as standard.



CAUTION

Use the controller protection box to protect the controller from the environment when the controller will be used in the environment such as the oil mist shown in the [Table 2-8](#).

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.

The IEC standard is described by the following “Information” And, the corrosion of the rust etc. may occur to the robot with the liquids.

【Information】

- The IEC IP20

It indicates the protective structure that prevents an iron ball $12^{+0.05}_0$ mm diameter, which is being pressed with the power of $3.1 \text{ kg} \pm 10\%$, from going through the opening in the outer sheath of the supplied equipment.

- The IEC IP65

Protection against water infiltration as specified in IP65 indicates a protective structure that is not harmfully affected when $12.5 \pm 5\%$ liters of water is supplied from a test device at a position approx. 3m away in various directions and a water pressure of 30kPa at the nozzle section. The water is filled one minute per 1m² of test device surface area for a total of three minutes.

(2) About the use with the bad environment

The protection specifications robot has protection methods that conform to IEC's IP65 standards. (Direct jet flow to the bellows section is not included.)

It has protection structure designed to prevent harmful effects caused by splashing water coming from various directions, as the robot is operating. (Direct jet flow to the bellows section is not included.)

Recommended usage conditions

- 1) The robot is designed for use in combination with machining device.
- 2) Robot's protection performance can be improved by pressurizing its interior. If you use a robot in an environment where oil mist is present, it is recommended that the interior of the robot be pressurized to ensure its reliability over a long period of time. Use the provided $\phi 8$ joint (AIR PURGE) to supply dry air for pressurizing. The $\phi 8$ joint (AIR PURGE) can be found at the base rear part of the robot arm.

Table 2-9 : Specification of the dry air for pressurization

| Item | Dew point | Pressure |
|---------------|--|-----------|
| Specification | The atmospheric pressure dew point is - 20 degree or less. | 0 to 3kPa |

- 3) We are confirming examining with the cutting oil, and satisfying protection specification. Our warranty does not cover damages or failure resulting from the robot being operated in any environment where other cutting oils than those listed in the table are used (except cutting oils with respect to which the robot's compatibility with the protection specification is verified through our operability evaluation) or where the robot body may be directly splashed with water, oil or dust in quantities larger than stated in the protection specification.
- 4) Take measures so that the robot will not be exposed to water, oil and/or chips for a long period of time.
- 5) The packing gets deteriorated with the passage of time and must be replaced as required. [Table 2-10](#) provides guidelines for replacing the packing.

Table 2-10 : Packing replacement guideline

| Environment | Whether or not robot is pressurized | When packing must be replaced |
|---------------------|-------------------------------------|---|
| General environment | Not pressurized ^{Note1)} | When signs of cracking or peeling are noted in the packing. |
| Clean room | Not pressurized ^{Note1)} | |
| Oil mist | Pressurized | |
| | Not pressurized | When removing and installing the cover. |

Note1) The pressurization inside the robot arm is unnecessary in general environment and clean room environment.

Failure to replace deteriorated packing permits water or oil to enter the interior of the robot, possibly causing it to become inoperable.

Packing required and liquid gasket used therewith are available from dealer.

Also, entrained water droplets lead to the formation of rust on the robot, but would not usually affect the robot's ability to operate normally.

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

Also, if the cover and/or other parts are damaged by interferences caused by the peripheral devices and the robot, the protection specification (seal performance, etc.) may be degraded. Therefore, please pay extra attention when handling the robot.

Refer to [Page 209, "6.2 Working environment"](#).

- 1) In surroundings that generate inflammable gases or corrosive gasses.
- 2) Atmosphere of the mist containing polish liquid etc.
- 3) Atmosphere in which the water, the oil, and the dust exceeding protection specification fall on the robot arm directly.
- 4) Pressurization by the dry air exceeding the specification of [Table 2-9](#).

2.2.9 Clean specifications

(1) Types of clean specifications

The robot arm with clean specification is made by order. Please check the delivery schedule.

Table 2-11 : Clean specifications

| Type | Degree of cleanliness | Internal suction | Remarks |
|---|-------------------------------|---|--|
| RH-6FHxx20C/xx34C RH-12FHxx35C/xx45C RH-20FHxx35C/xx45C | ISO class 3 ^{Note1)} | <ul style="list-style-type: none"> Suck the inside of robot arm with vacuum pump. (prepared by customer) Use it in the clean room with the down flow (flow velocity 0.3 m/s above). | The use of a vacuum generating valve is recommended. |
| RH-3FHR3512C | ISO class 5 ^{Note2)} | | |

Note1) The conditions necessary to guarantee cleanliness are as follows: clean room down flow 0.3 m/s or greater, robot internal suction of RH-6FH series: 30-50L/min, RH-12FH/20FH series: 60-140L/min, and installation of an exhaust duct at the rear of the robot's main base. A $\phi 8$ joint is prepared at the rear of the base for suction.

Note2) The conditions necessary to guarantee cleanliness are as follows: clean room down flow 0.3 m/s or greater, robot internal suction of 3-5L/min. A $\phi 8$ joint is prepared at the rear of the base for suction.

■ Precautions for use

- 1) A $\phi 8$ VACUUM coupling is provided in the base section of the robot arm for vacuum inside the robot arm. (Refer to Fig. 2-57 or Fig. 2-58) When using the robot, connect this coupling with the vacuum generating valve (Refer to Table 2-12) and vacuum pump (furnished by the customer).
- 2) To suck in the robot arm, use the vacuum generator of the specification shown in following a) and b).
 - a) When using the vacuum generator

Table 2-12 : Specifications of vacuum generation valve (Confirmed in our company)

| Type | Maker | Air pressure ^{Note1)} | Quantity |
|---------|---------------------|--------------------------------|--|
| MEDT 14 | KOGANEI CORPORATION | • Vacuum rate: 90.0 L/min(ANR) | RH-6FH series : 1 RH-12FH/20FH series : 2 |
| ME05 | KOGANEI CORPORATION | • Vacuum rate: 6.3 L/min(ANR) | RH-3FHR series : 1 |

Note1) It is the vacuum pump maker's written specification.

b) When using the vacuum pump

Assure the vacuum flow rate of RH-6FH series: 30-50L/min, RH-12FH/20FH series: 60-140L/min, and RH-3FHR series: 3-5L/min. And, secure the exhaust course from the pump not to affect the power supply and the cleanness for the vacuum pumps. RH-12FH/20FH has two VACUUM couplings. Please be sure to suck in using both of couplings.

- 3) The ventilation duct is attached to the robot arm rear (refer to Fig. 2-15). As the Z axis moves up and down the volume of the bellows varies, and air is sucked in and released out of the robot's ventilation duct opening. Be sure to locate the ventilation duct's opening in a position that will not affect the robot's cleanliness.

Furthermore, whilst it is only a small amount, internal suction results in external air flows into the robot through the ventilation duct's opening, and therefore the following two points should be considered when deciding where to locate the ventilation duct's opening.

- The opening should be facing downwards
- The opening should not be located in the vicinity of dust/dirt or liquids, etc.
(Recommended cleanliness of surrounding area: less than ISO class 5)

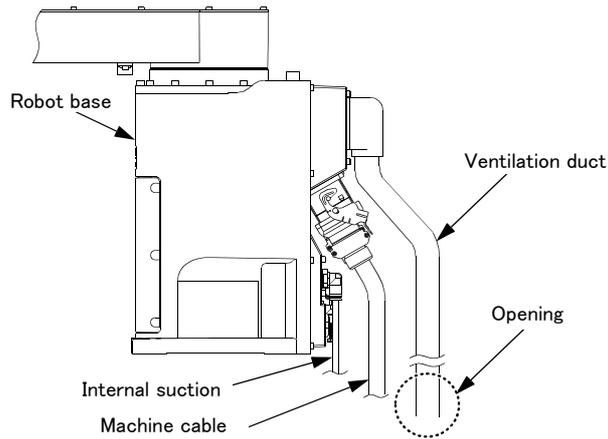


Fig.2-15 : Installation of Ventilation Duct

- 4) When using the optional electromagnetic valve set, we recommend using the primary piping's spare piping ($\phi 6$ air hose) to release the exhaust fumes. Please take care as leaking exhaust fumes inside the robot may have an impact on the robot's cleanliness.

2.3 Names of each part of the robot



Fig.2-16 : Names of each part of the robot (Floor installation type)



Fig.2-17 : Names of each part of the robot (Hanging installation type)

2.4 Outside dimensions • Operating range diagram

2.4.1 Outside dimensions • Operating range diagram (RH-6FH series)

(1) Standard Specification

Note

- *1) Indicates the space necessary to replace the battery.
- *2) Indicates screw holes (M4 depth 6mm) for fixing user wiring/piping. Six places on both-sides of No.2 arm, Two places on front surface.
- *3) The distance to a minimum bendable radius of the machine cable for CR750/751 controller.
- *4) Indicates the space necessary to connect the machine cable for CR750/751 controller.
- *5) Required space to installing/removing the cover.

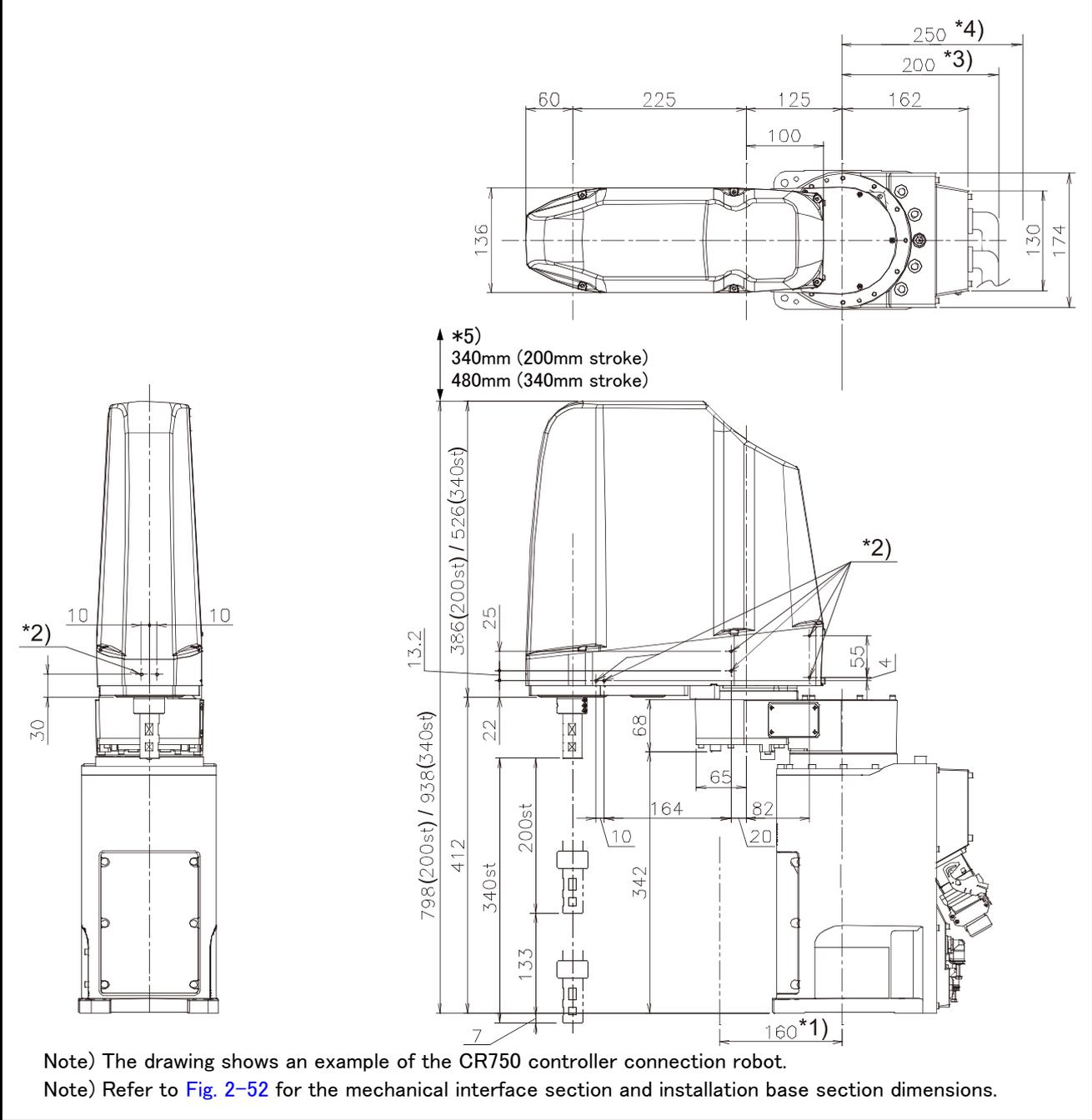


Fig.2-18 : Outside dimensions of RH-6FH35xx

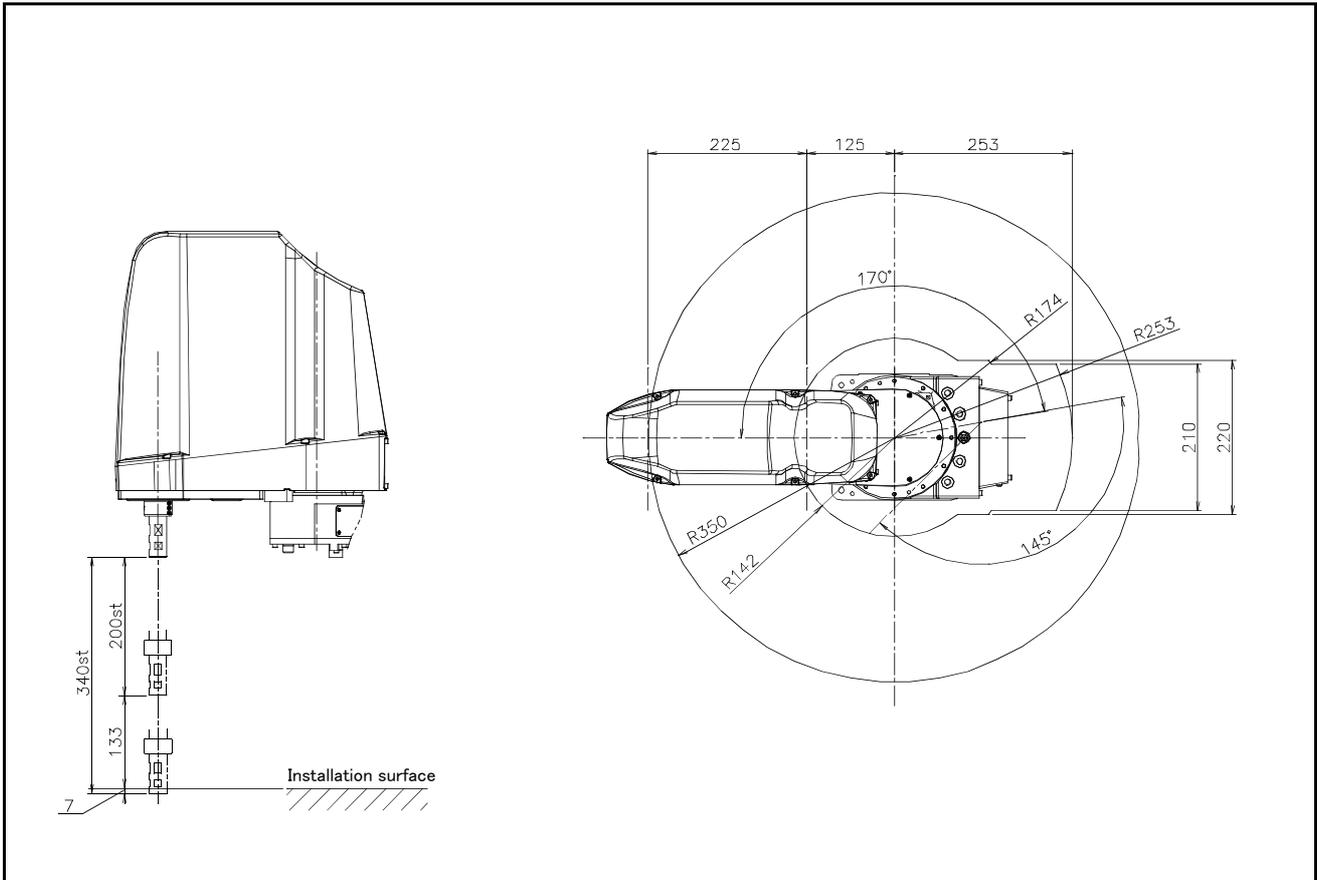
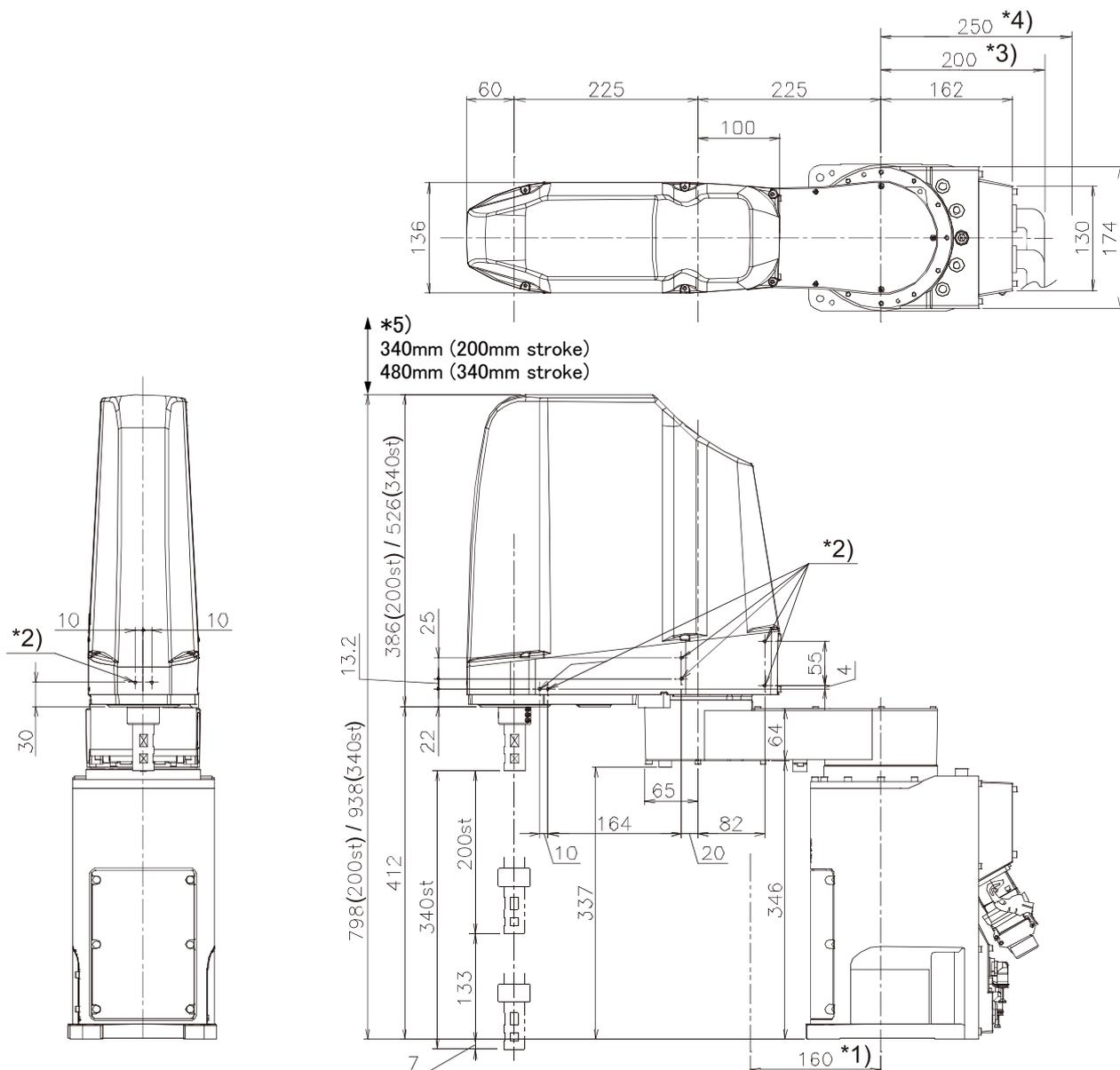


Fig.2-19 : Operating range diagram of RH-6FH35xx

Note

- *1) Indicates the space necessary to replace the battery.
- *2) Indicates screw holes (M4 depth 6mm) for fixing user wiring/piping. Six places on both-sides of No.2 arm, Two places on front surface.
- *3) The distance to a minimum bendable radius of the machine cable for CR750/751 controller.
- *4) Indicates the space necessary to connect the machine cable for CR750/751 controller.
- *5) Required space to installing/removing the cover.

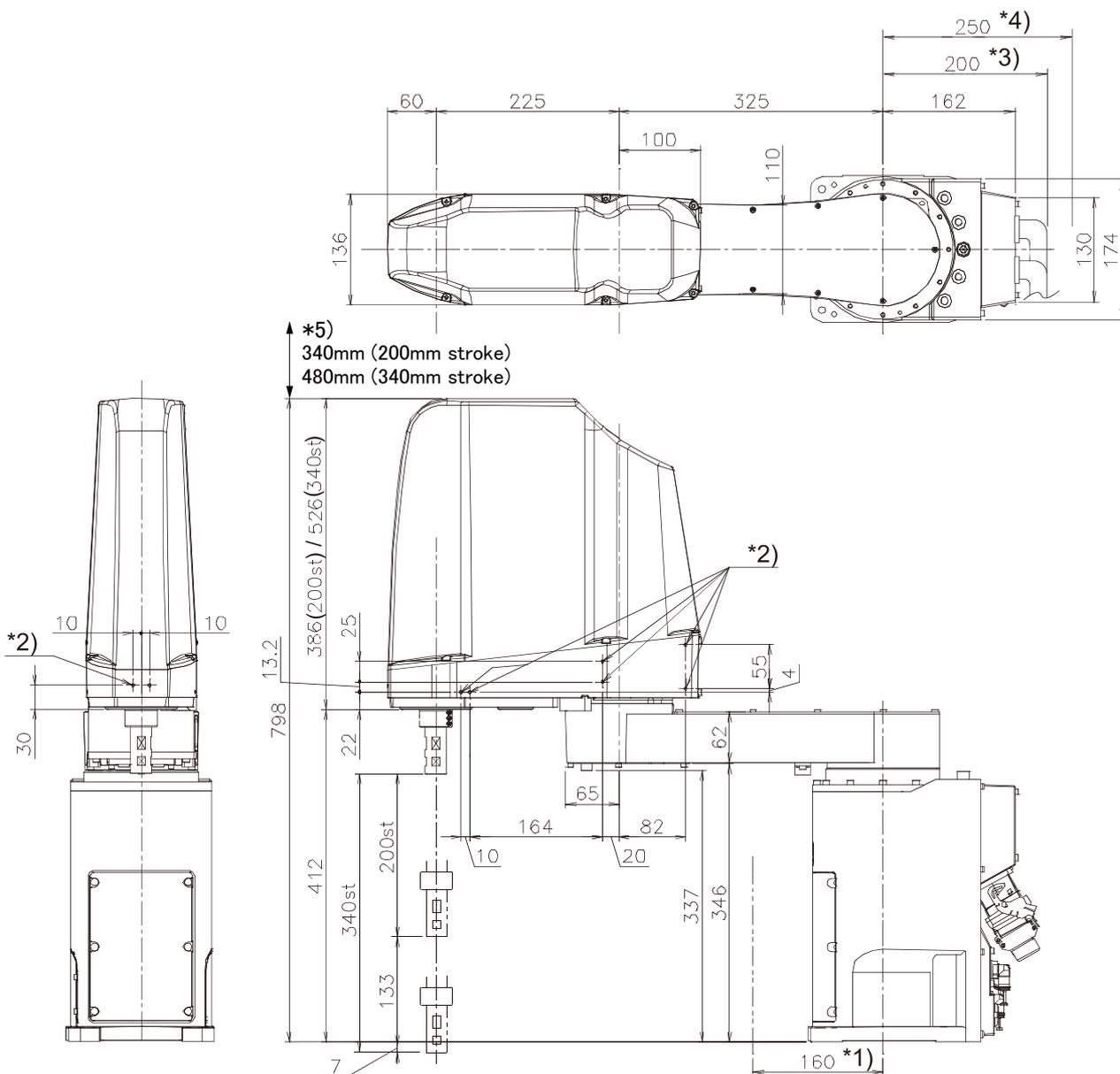


Note) The drawing shows an example of the CR750 controller connection robot.
 Note) Refer to Fig. 2-52 for the mechanical interface section and installation base section dimensions.

Fig.2-20 : Outside dimensions of RH-6FH45xx

Note

- *1) Indicates the space necessary to replace the battery.
- *2) Indicates screw holes (M4 depth 6mm) for fixing user wiring/piping. Six places on both-sides of No.2 arm, Two places on front surface.
- *3) The distance to a minimum bendable radius of the machine cable for CR750/751 controller.
- *4) Indicates the space necessary to connect the machine cable for CR750/751 controller.
- *5) Required space to installing/removing the cover.



Note) The drawing shows an example of the CR750 controller connection robot.

Note) Refer to Fig. 2-52 for the mechanical interface section and installation base section dimensions.

Fig.2-22 : Outside dimensions of RH-6FH55xx

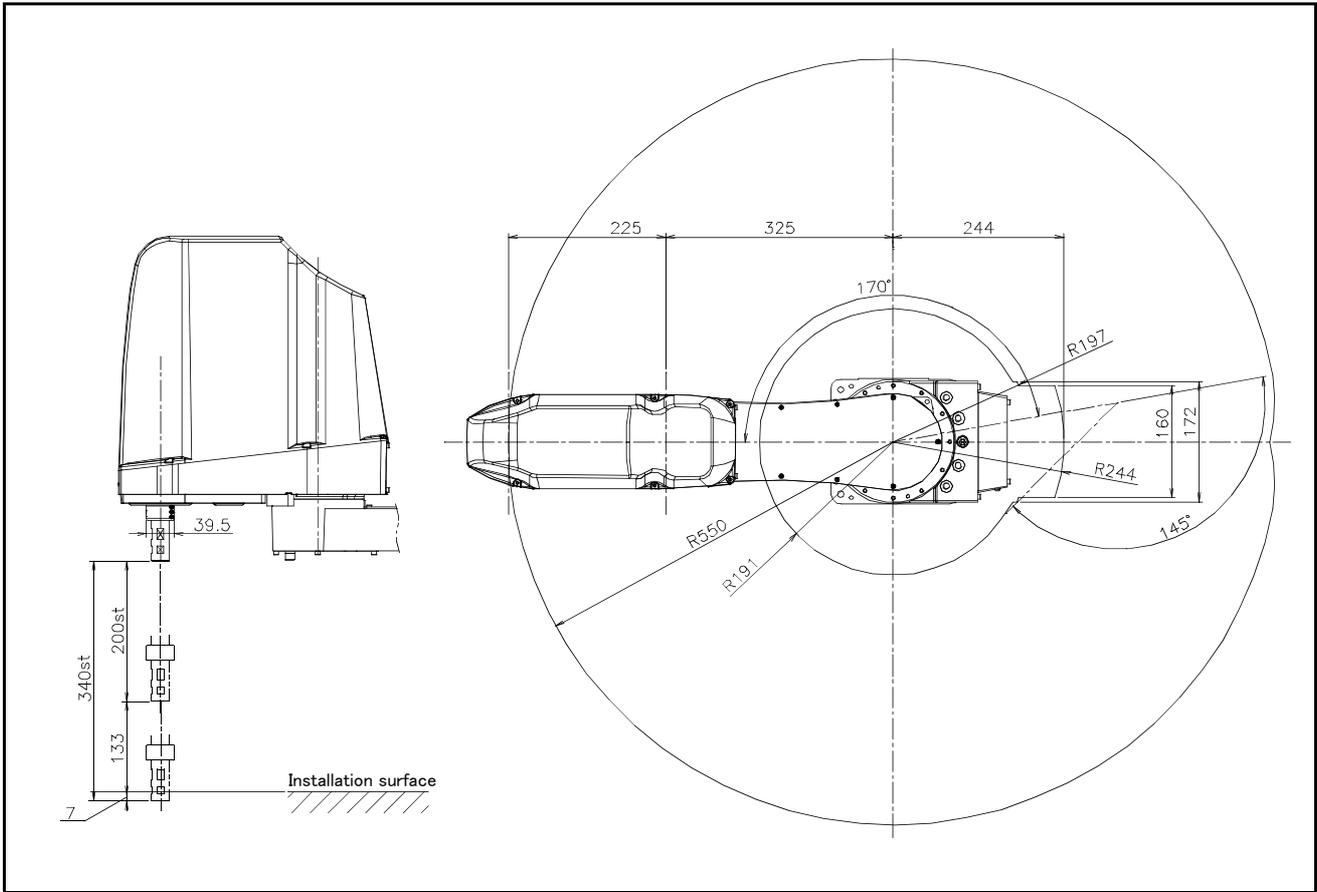
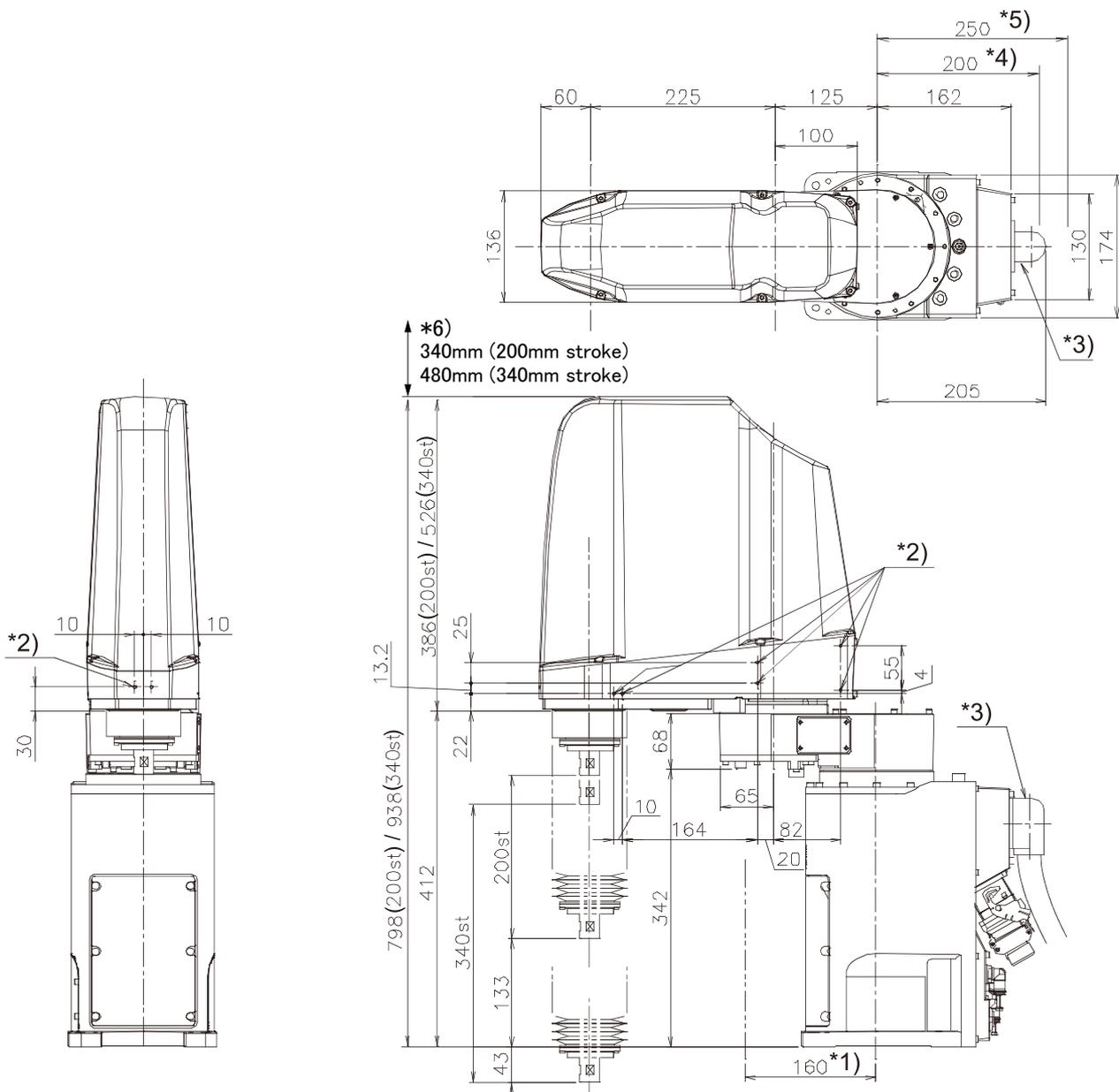


Fig.2-23 : Operating range diagram of RH-6FH55xx

(2) Clean Specification and oil mist specification

Note

- *1) Indicates the space necessary to replace the battery.
- *2) Indicates screw holes (M4 depth 6mm) for fixing user wiring/piping. Six places on both-sides of No.2 arm, Two places on front surface.
- *3) The duct (φ 25, length: 3m) attached to the clean specification. Be careful for the hand etc. not to interfere and arrange the duct.
- *4) The distance to a minimum bendable radius of the machine cable for CR750/751 controller.
- *5) Indicates the space necessary to connect the machine cable for CR750/751 controller.
- *6) Required space to installing/removing the cover.



Note) The drawing shows an example of the CR750 controller connection robot.
 Note) Refer to Fig. 2-52 for the mechanical interface section and installation base section dimensions.

Fig.2-24 : Outside dimensions of RH-6FH35xxC/M

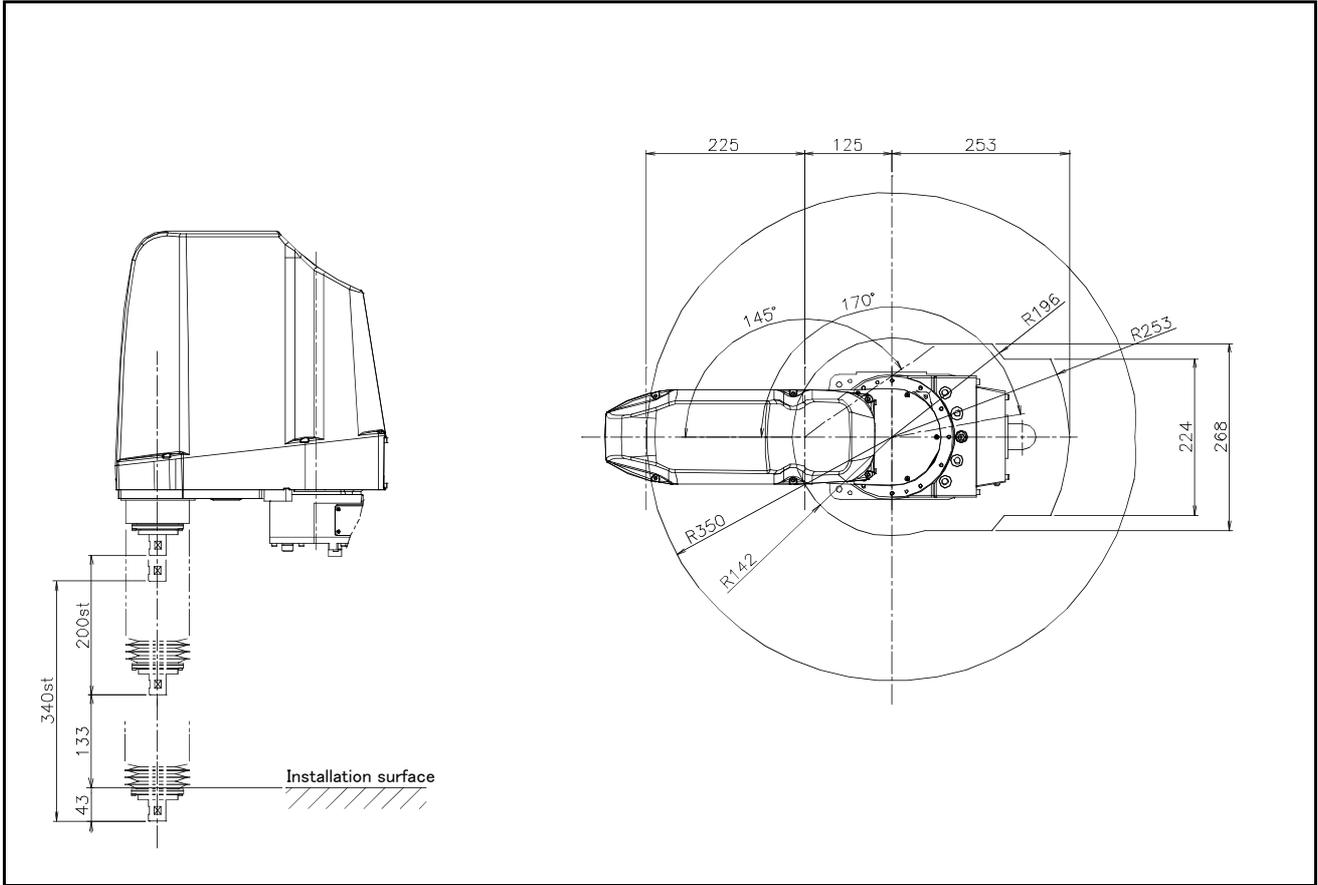
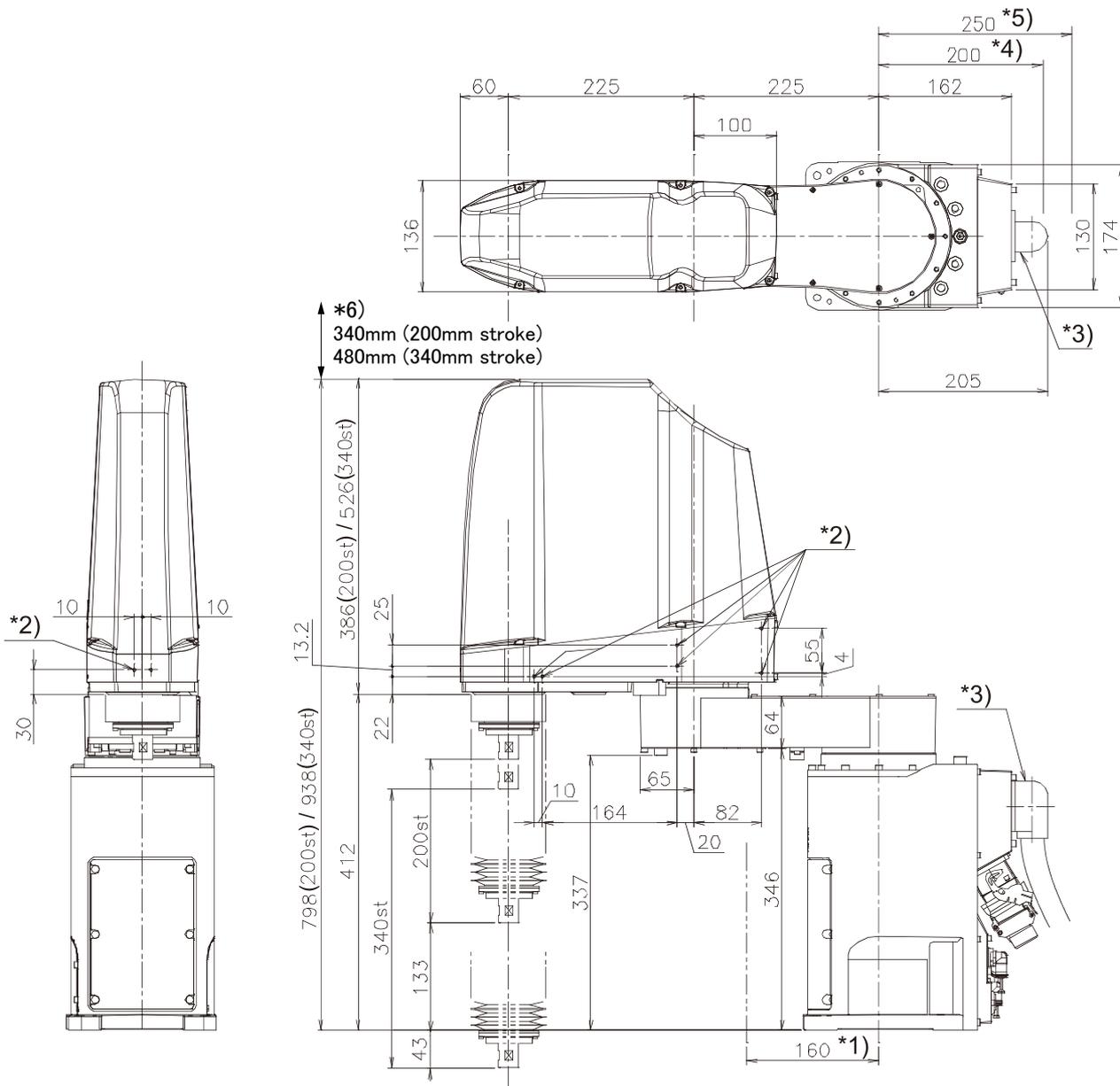


Fig.2-25 : Operating range diagram of RH-6FH35xxC/M

Note

- *1) Indicates the space necessary to replace the battery.
- *2) Indicates screw holes (M4 depth 6mm) for fixing user wiring/piping. Six places on both-sides of No.2 arm, Two places on front surface.
- *3) The duct (φ 25, length: 3m) attached to the clean specification. Be careful for the hand etc. not to interfere and arrange the duct.
- *4) The distance to a minimum bendable radius of the machine cable for CR750/751 controller.
- *5) Indicates the space necessary to connect the machine cable for CR750/751 controller.
- *6) Required space to installing/removing the cover.



Note) The drawing shows an example of the CR750 controller connection robot.

Note) Refer to Fig. 2-52 for the mechanical interface section and installation base section dimensions.

Fig.2-26 : Outside dimensions of RH-6FH45xxC/M

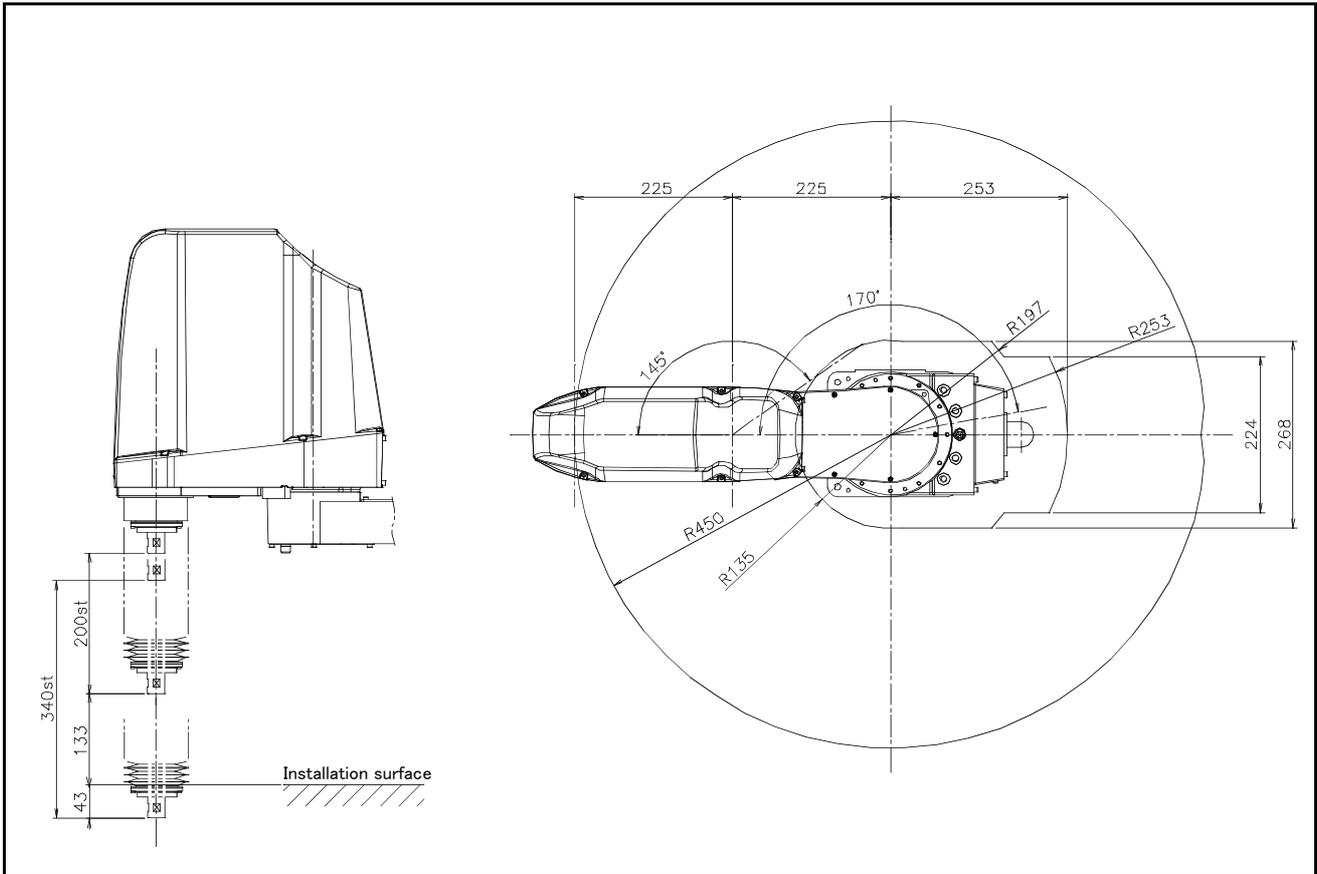
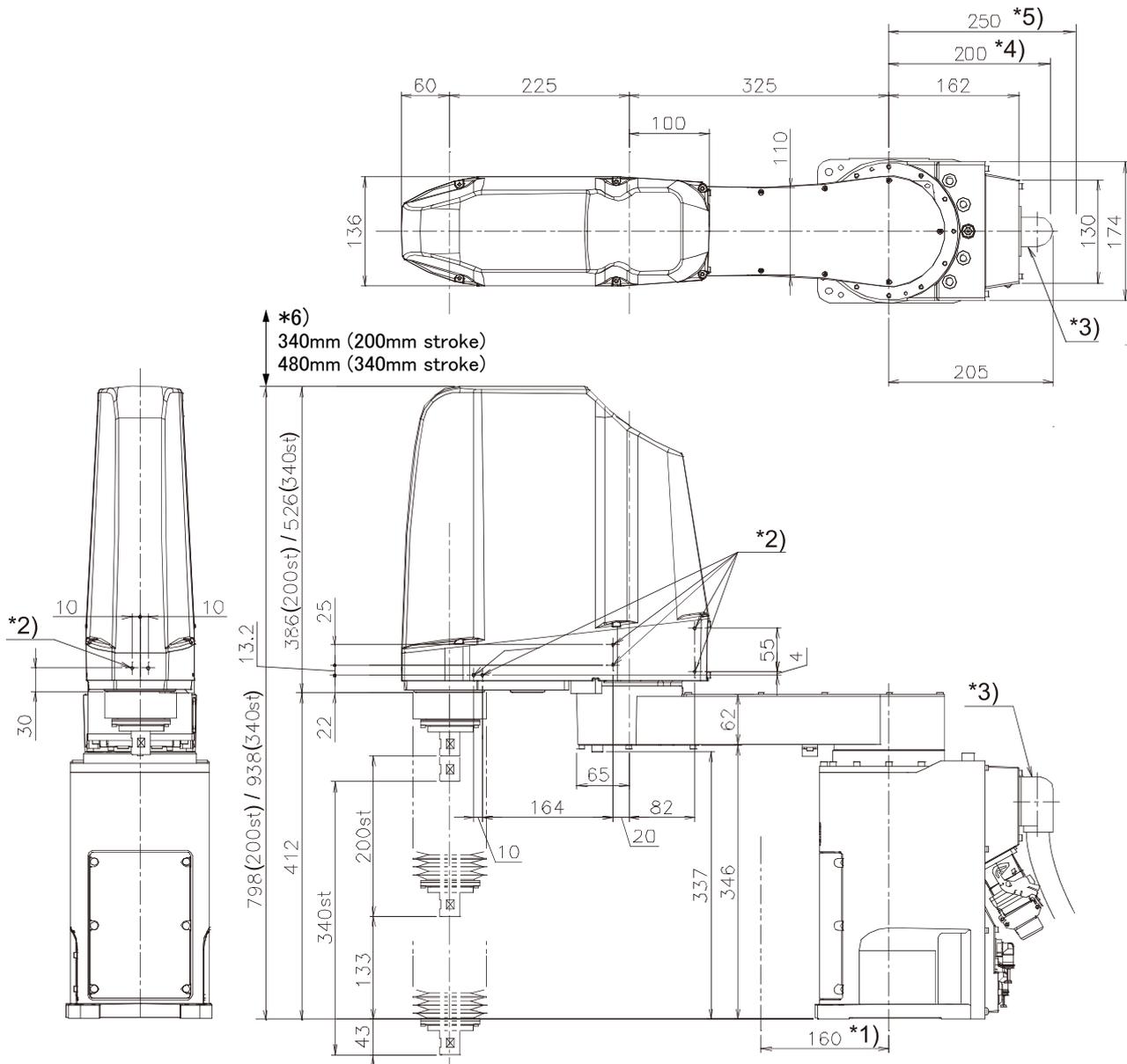


Fig.2-27 : Operating range diagram of RH-6FH45xxC/M

Note

- *1) Indicates the space necessary to replace the battery.
- *2) Indicates screw holes (M4 depth 6mm) for fixing user wiring/piping. Six places on both-sides of No.2 arm, Two places on front surface.
- *3) The duct (φ 25, length: 3m) attached to the clean specification. Be careful for the hand etc. not to interfere and arrange the duct.
- *4) The distance to a minimum bendable radius of the machine cable for CR750/751 controller.
- *5) Indicates the space necessary to connect the machine cable for CR750/751 controller.
- *6) Required space to installing/removing the cover.



Note) The drawing shows an example of the CR750 controller connection robot.
 Note) Refer to Fig. 2-52 for the mechanical interface section and installation base section dimensions.

Fig.2-28 : Outside dimensions of RH-6FH55xxC/M

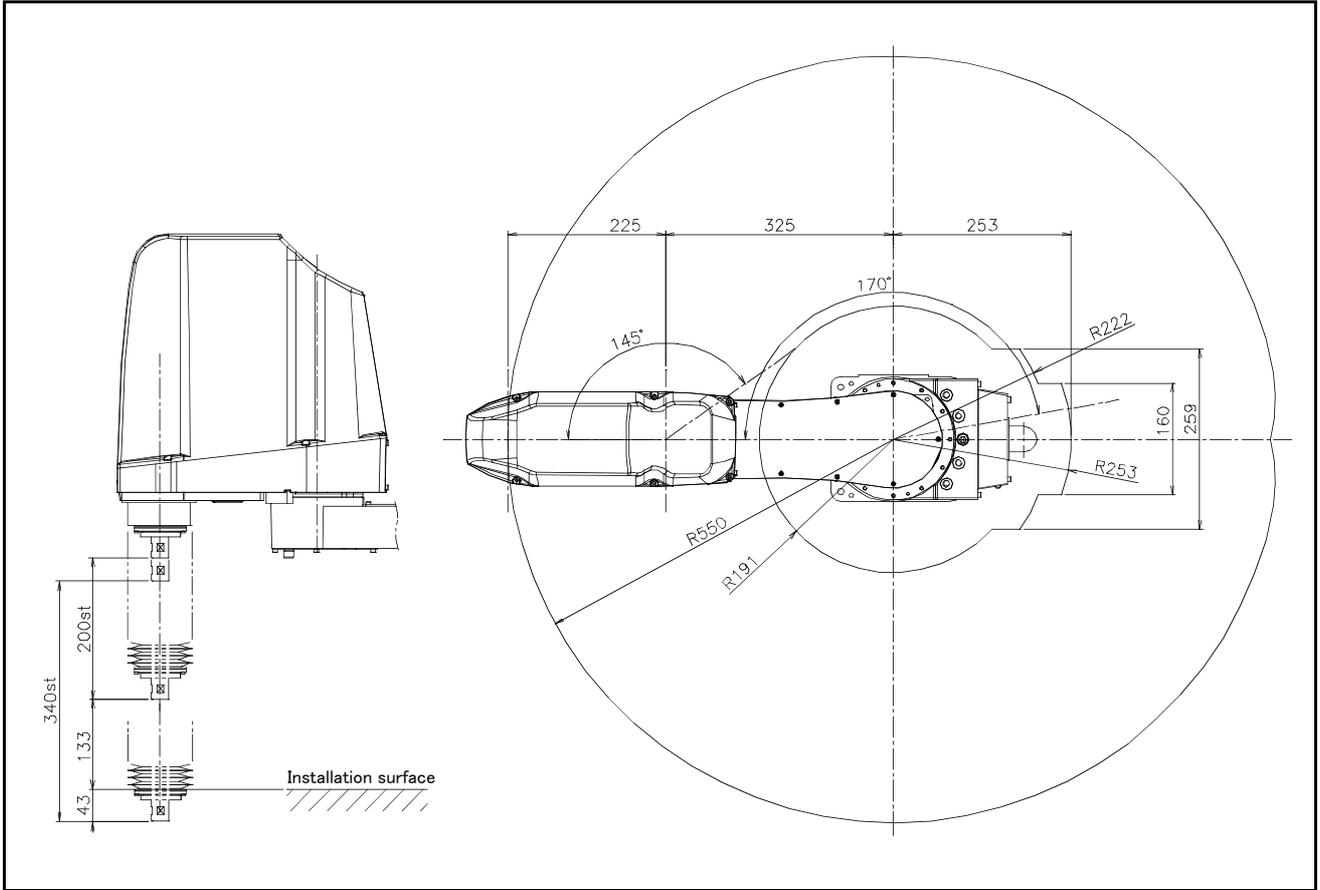


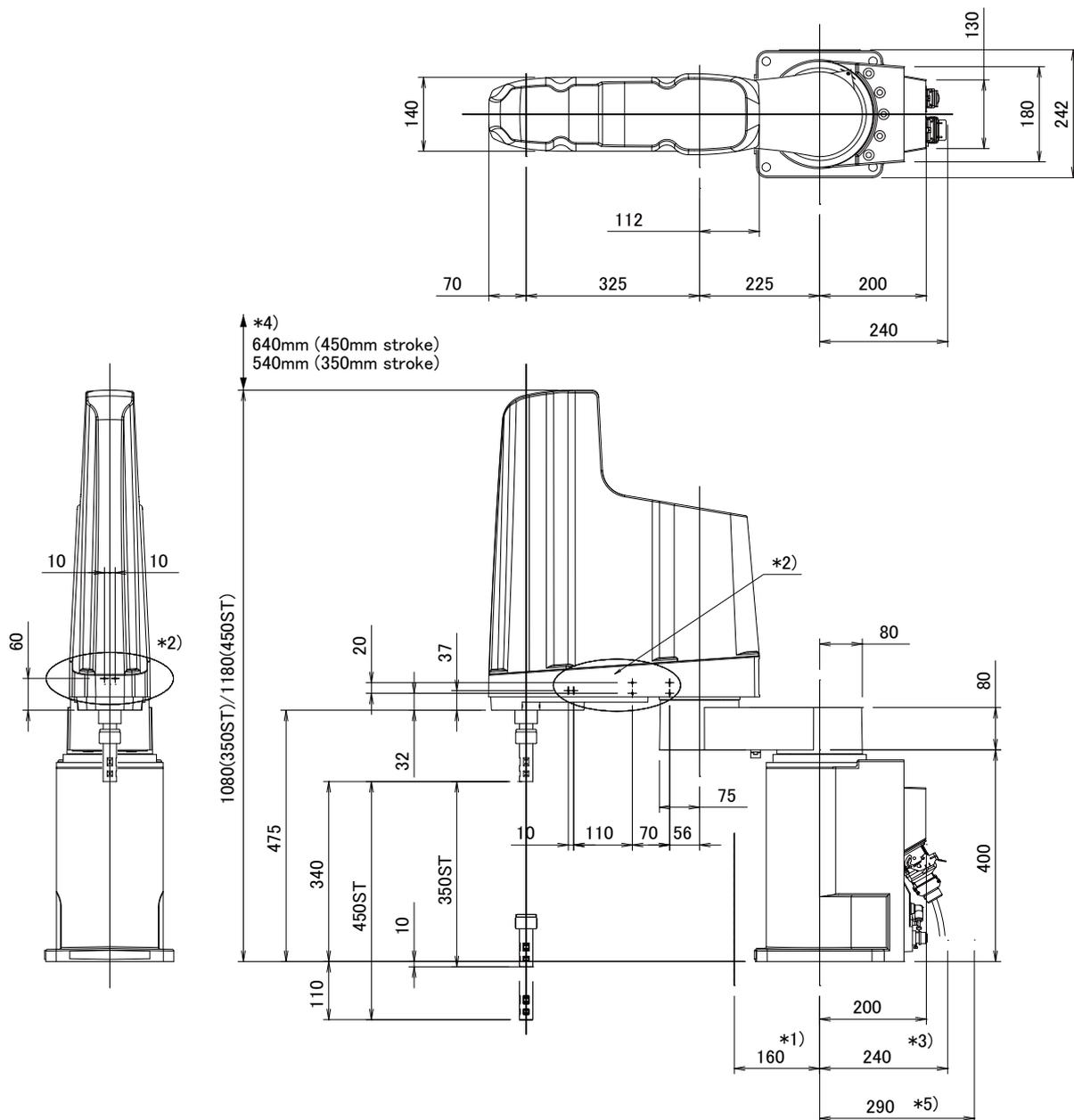
Fig.2-29 : Operating range diagram of RH-6FH55xxC/M

2.4.2 Outside dimensions • Operating range diagram (RH-12FH series)

(1) Standard Specification

Note

- *1) Indicates the space necessary to replace the battery.
- *2) Indicates screw holes for fixing user wiring/piping. (Refer to Fig. 2-59)
- *3) The distance to a minimum bendable radius of the machine cable for CR750/751 controller.
- *4) Required space to installing/removing the cover.
- *5) Indicates the space necessary to connect the machine cable for CR750/751 controller.



Note) The drawing shows an example of the CR750 controller connection robot.

Note) Refer to Fig. 2-53 for the mechanical interface section and installation base section dimensions.

Fig.2-30 : Outside dimensions of RH-12FH55xx

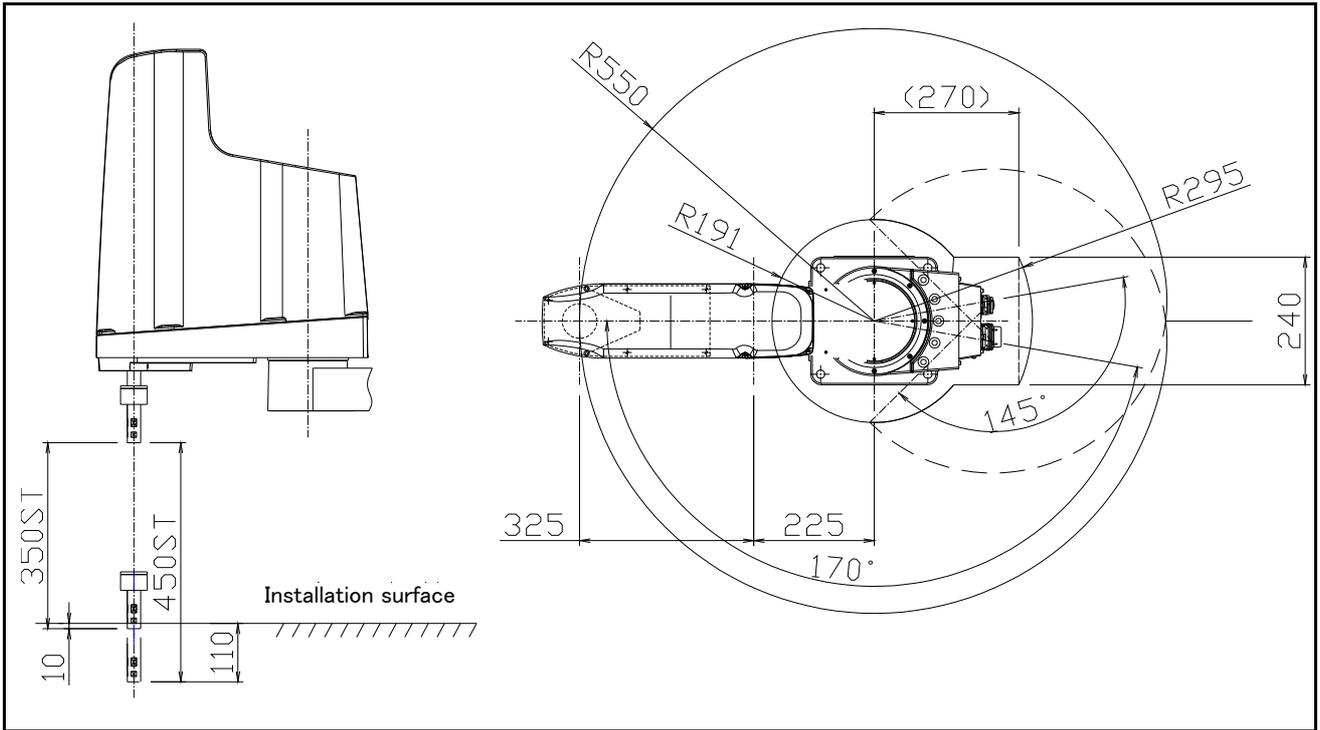
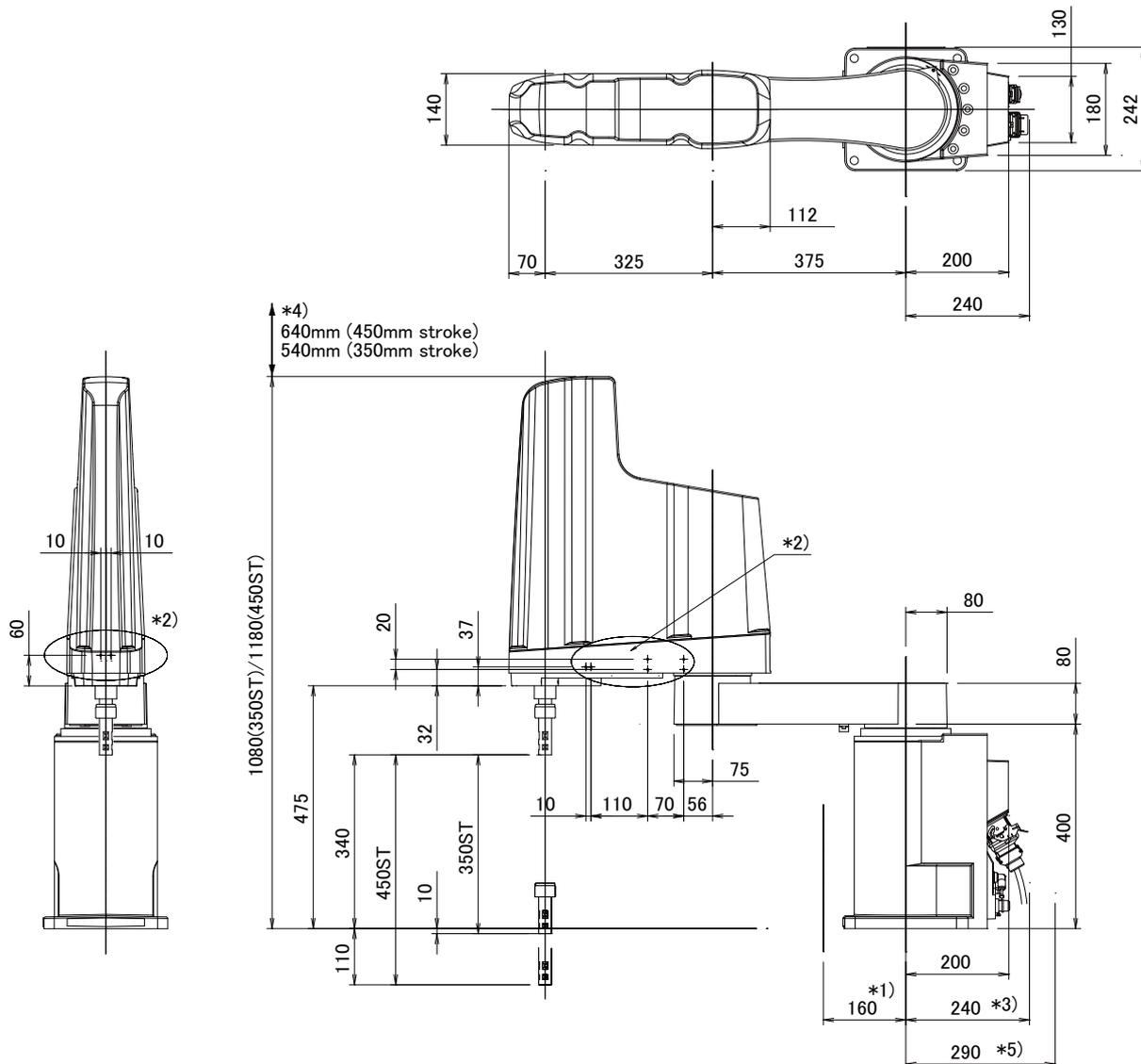


Fig.2-31 : Operating range diagram of RH-12FH55xx

Note

- *1) Indicates the space necessary to replace the battery.
- *2) Indicates screw holes for fixing user wiring/piping. (Refer to Fig. 2-59)
- *3) The distance to a minimum bendable radius of the machine cable for CR750/751 controller.
- *4) Required space to installing/removing the cover.
- *5) Indicates the space necessary to connect the machine cable for CR750/751 controller.



Note) The drawing shows an example of the CR750 controller connection robot.

Note) Refer to Fig. 2-53 for the mechanical interface section and installation base section dimensions.

Fig.2-32 : Outside dimensions of RH-12FH70xx

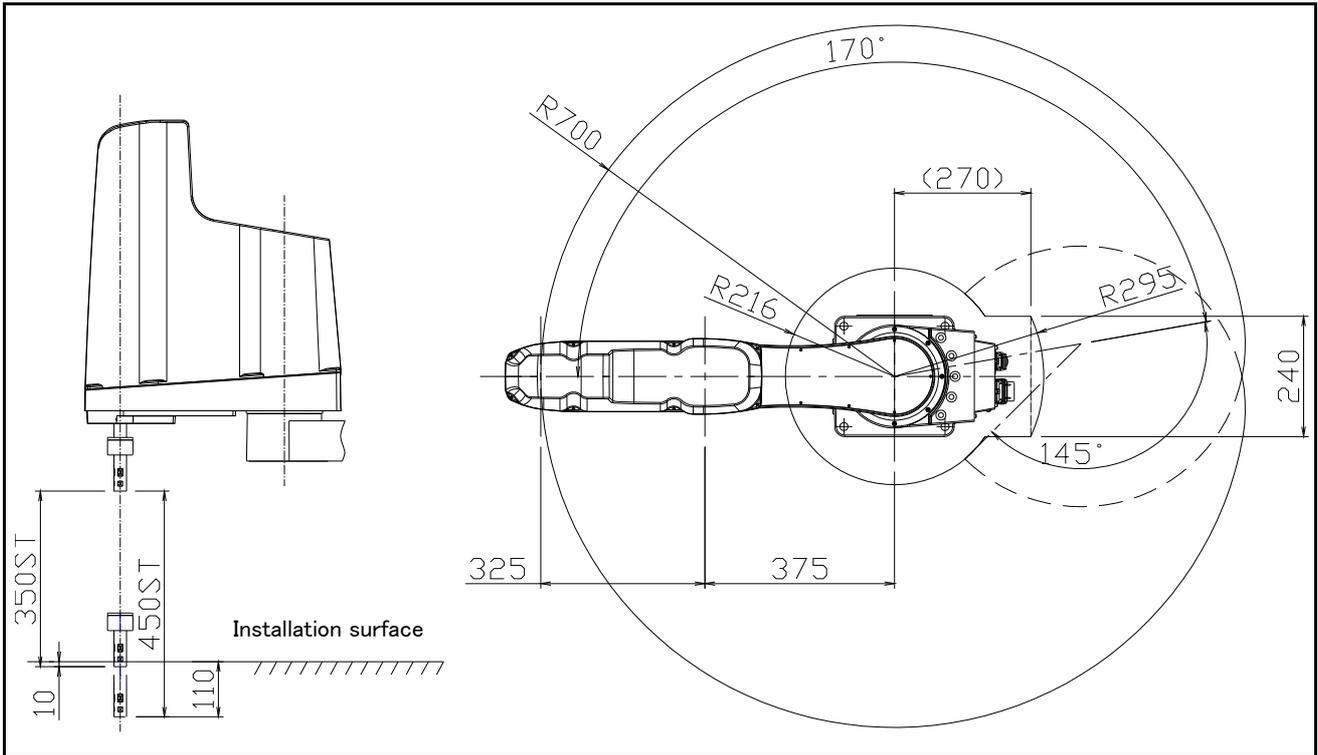


Fig.2-33 : Operating range diagram of RH-12FH70xx

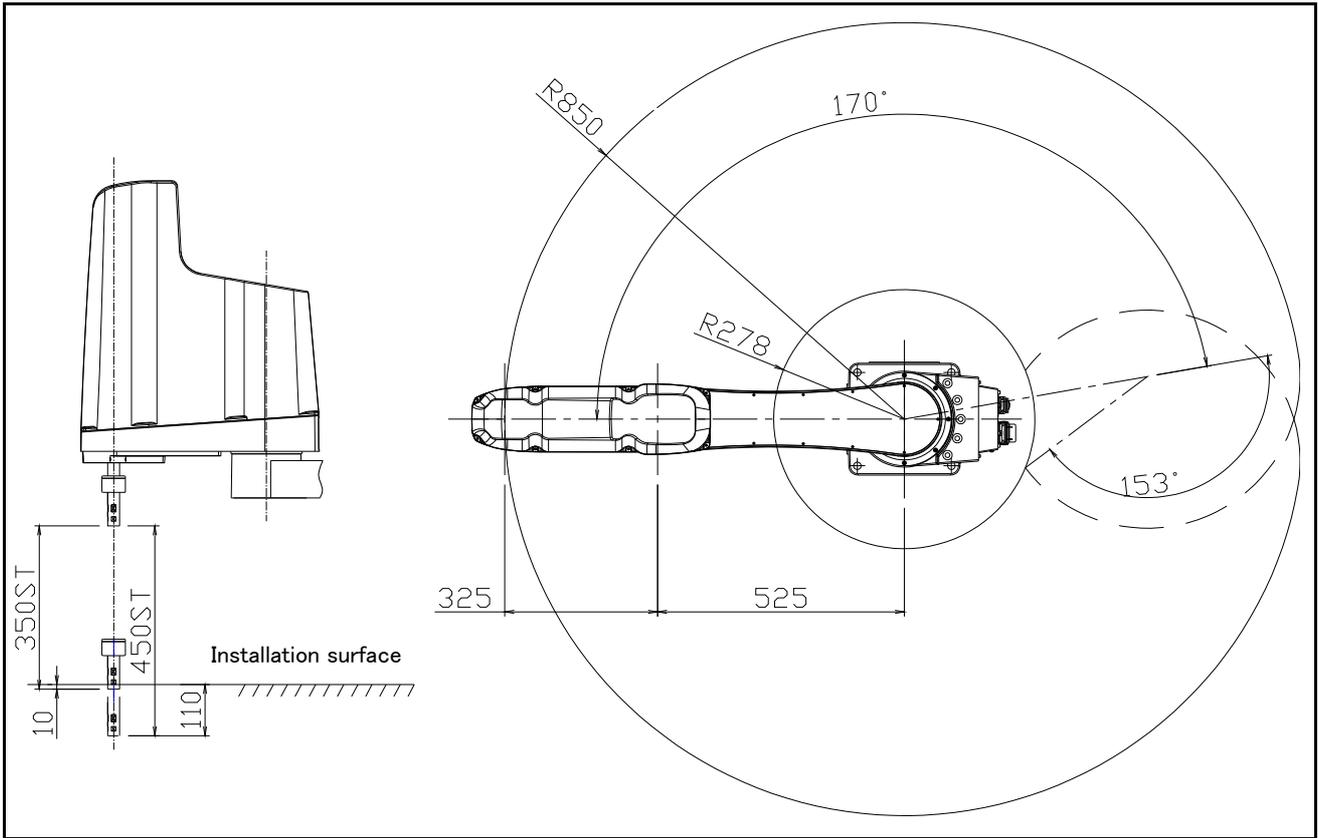
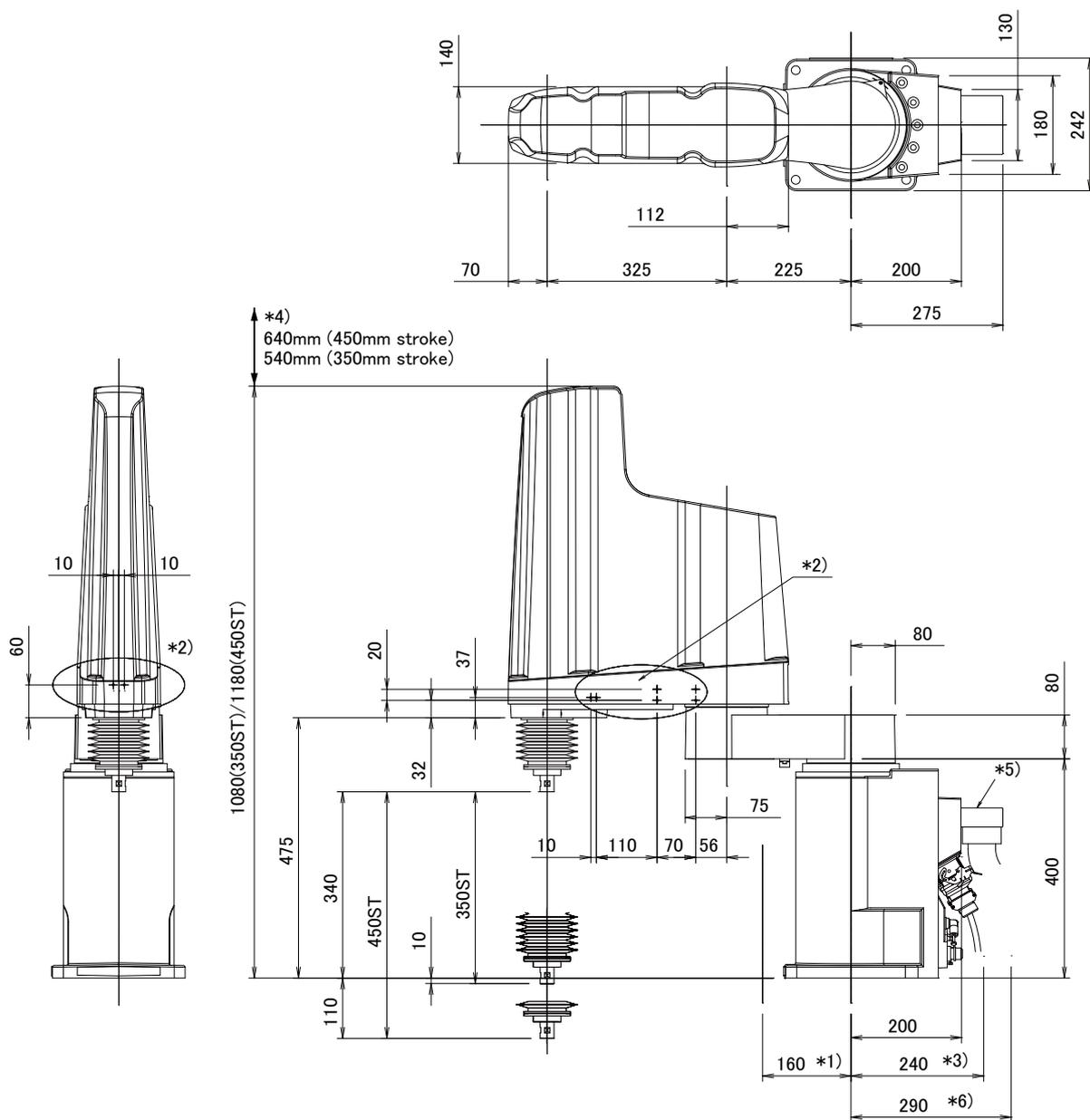


Fig.2-35 : Operating range diagram of RH-12FH85xx

(2) Clean Specification and oil mist specification

Note

- *1) Indicates the space necessary to replace the battery.
- *2) Indicates screw holes for fixing user wiring/piping. (Refer to Fig. 2-59)
- *3) The distance to a minimum bendable radius of the machine cable for CR750/751 controller.
- *4) Required space to installing/removing the cover.
- *5) The duct (φ 50, length: 2m) attached to the clean specification. Be careful for the hand etc. not to interfere and arrange the duct.
- *6) Indicates the space necessary to connect the machine cable for CR750/751 controller.



Note) The drawing shows an example of the CR750 controller connection robot.
 Note) Refer to Fig. 2-53 for the mechanical interface section and installation base section dimensions.

Fig.2-36 : Outside dimensions of RH-12FH55xxC/M

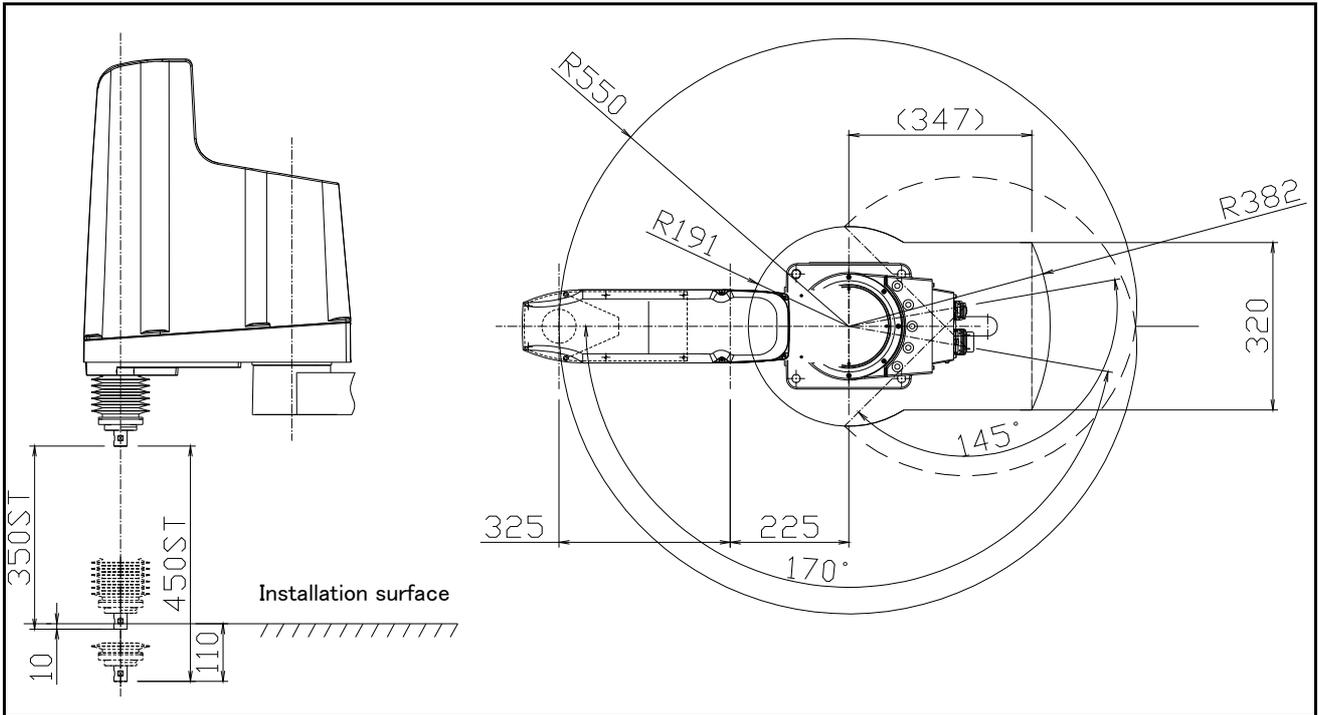
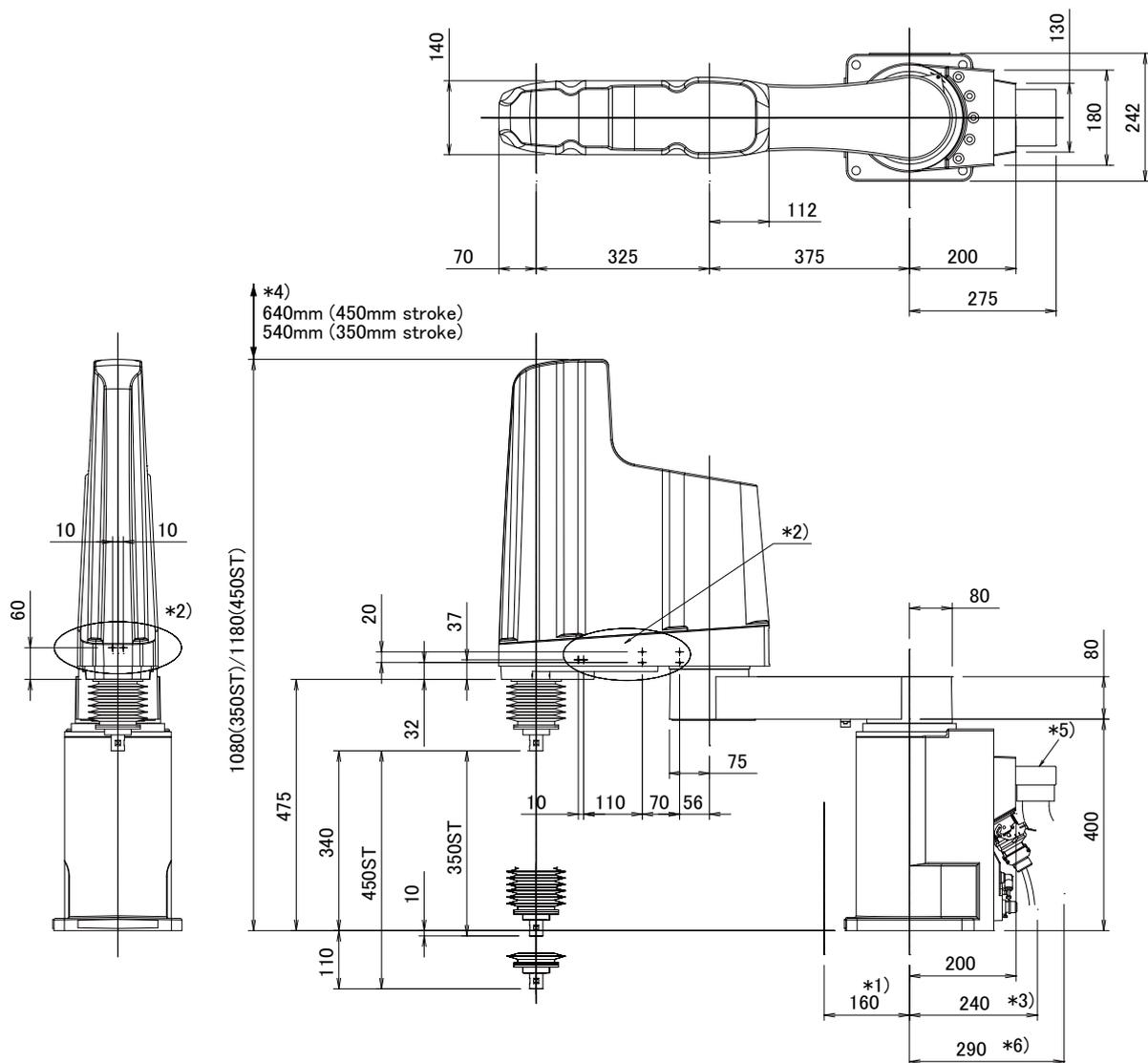


Fig.2-37 : Operating range diagram of RH-12FH55xxC/M

Note

- *1) Indicates the space necessary to replace the battery.
- *2) Indicates screw holes for fixing user wiring/piping. (Refer to Fig. 2-59)
- *3) The distance to a minimum bendable radius of the machine cable for CR750/751 controller.
- *4) Required space to installing/removing the cover.
- *5) The duct (φ 50, length: 2m) attached to the clean specification. Be careful for the hand etc. not to interfere and arrange the duct.
- *6) Indicates the space necessary to connect the machine cable for CR750/751 controller.



Note) The drawing shows an example of the CR750 controller connection robot.
 Note) Refer to Fig. 2-53 for the mechanical interface section and installation base section dimensions.

Fig.2-38 : Outside dimensions of RH-12FH70xxC/M

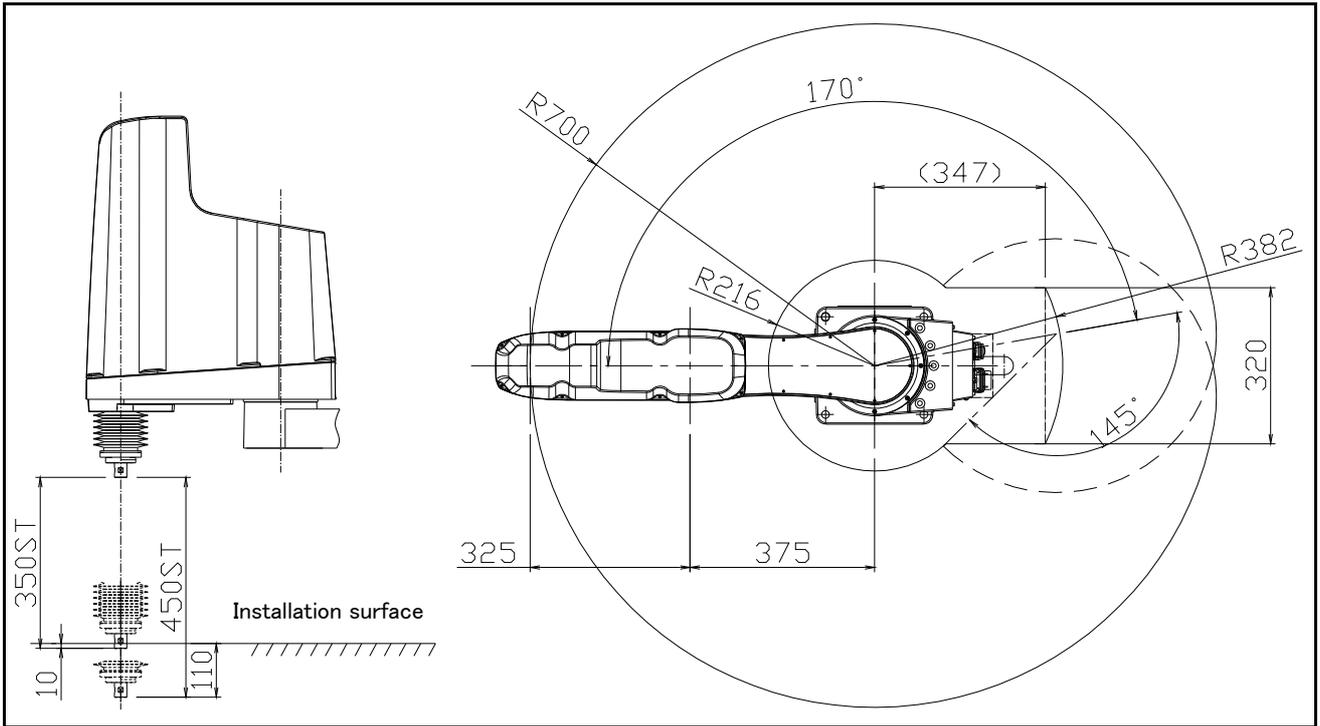
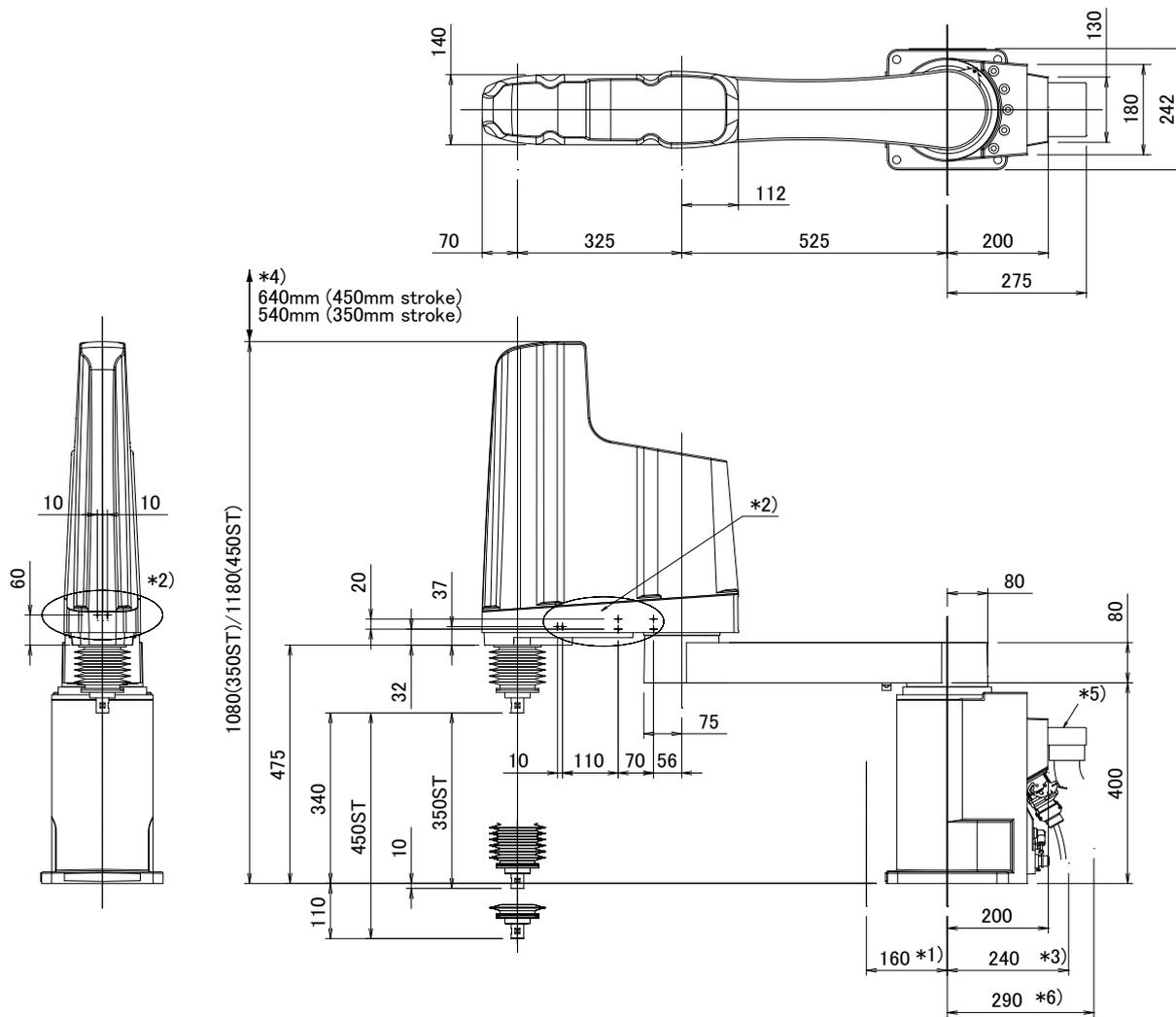


Fig.2-39 : Operating range diagram of RH-12FH70xxC/M

Note

- *1) Indicates the space necessary to replace the battery.
- *2) Indicates screw holes for fixing user wiring/piping. (Refer to Fig. 2-59)
- *3) The distance to a minimum bendable radius of the machine cable for CR750/751 controller.
- *4) Required space to installing/removing the cover.
- *5) The duct (φ 50, length: 2m) attached to the clean specification. Be careful for the hand etc. not to interfere and arrange the duct.
- *6) Indicates the space necessary to connect the machine cable for CR750/751 controller.



Note) The drawing shows an example of the CR750 controller connection robot.
 Note) Refer to Fig. 2-53 for the mechanical interface section and installation base section dimensions.

Fig.2-40 : Outside dimensions of RH-12FH85xxC/M

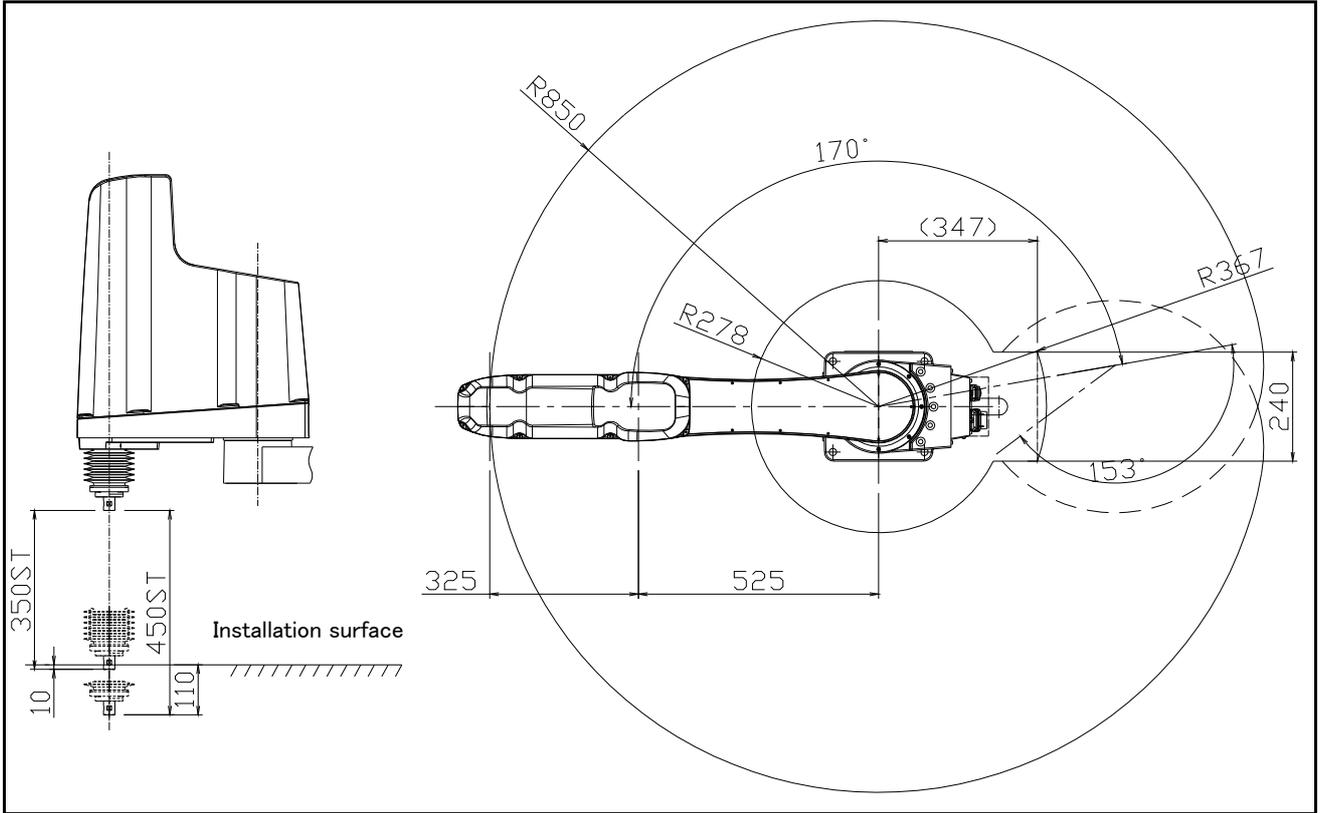


Fig.2-41 : Operating range diagram of RH-12FH85xxC/M

2.4.3 Outside dimensions • Operating range diagram (RH-20FH series)

(1) Standard Specification

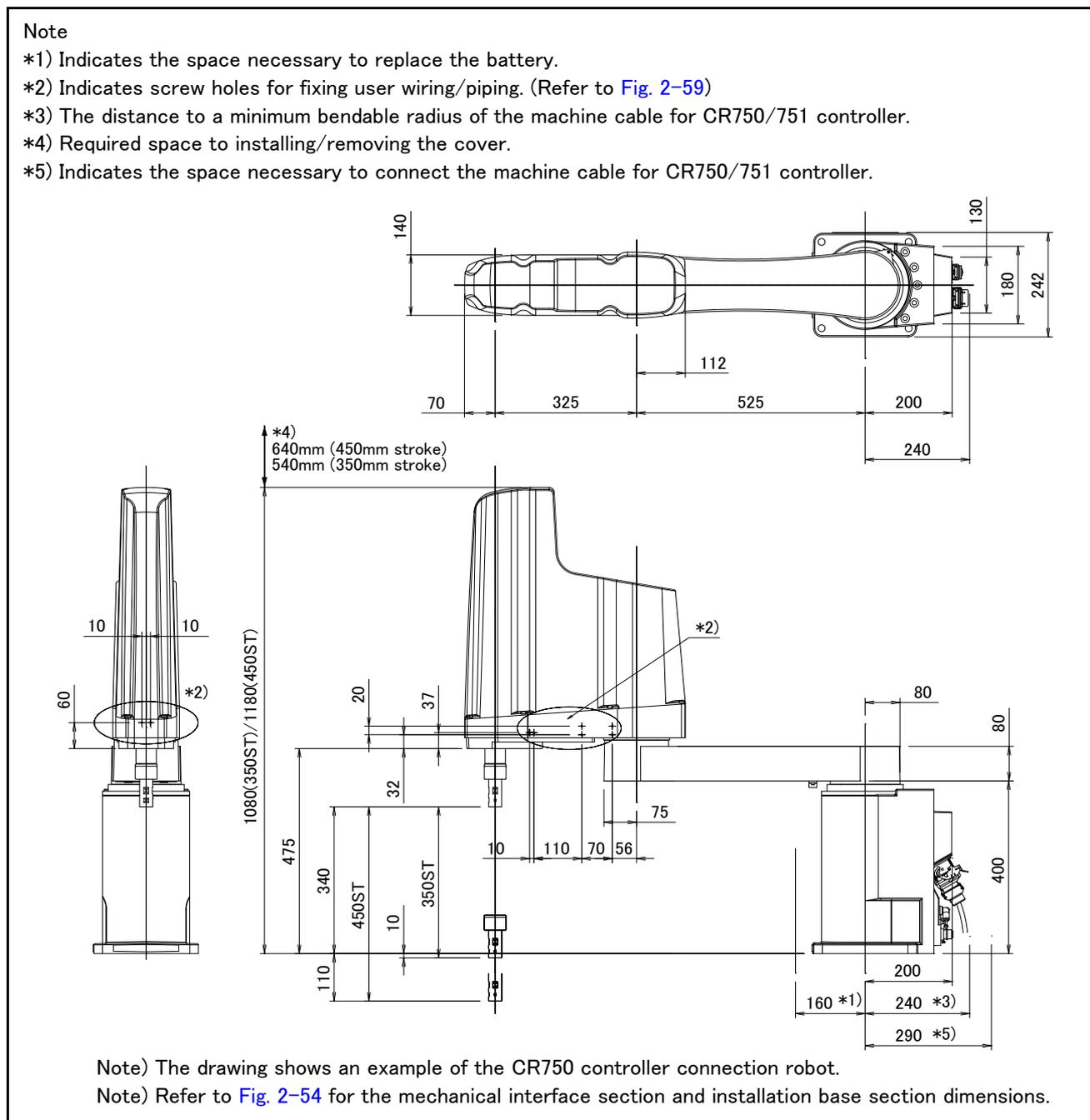


Fig.2-42 : Outside dimensions of RH-20FH85xx

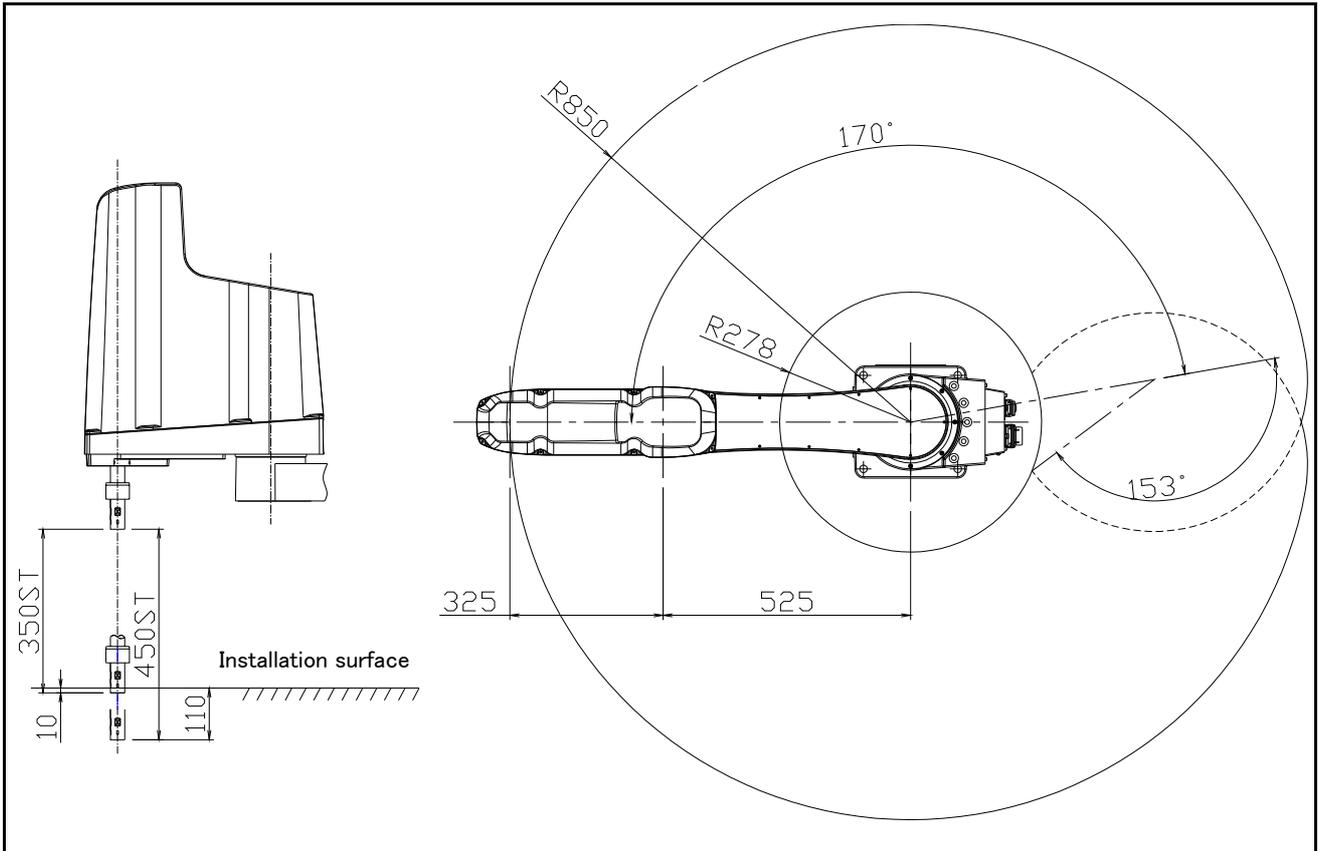
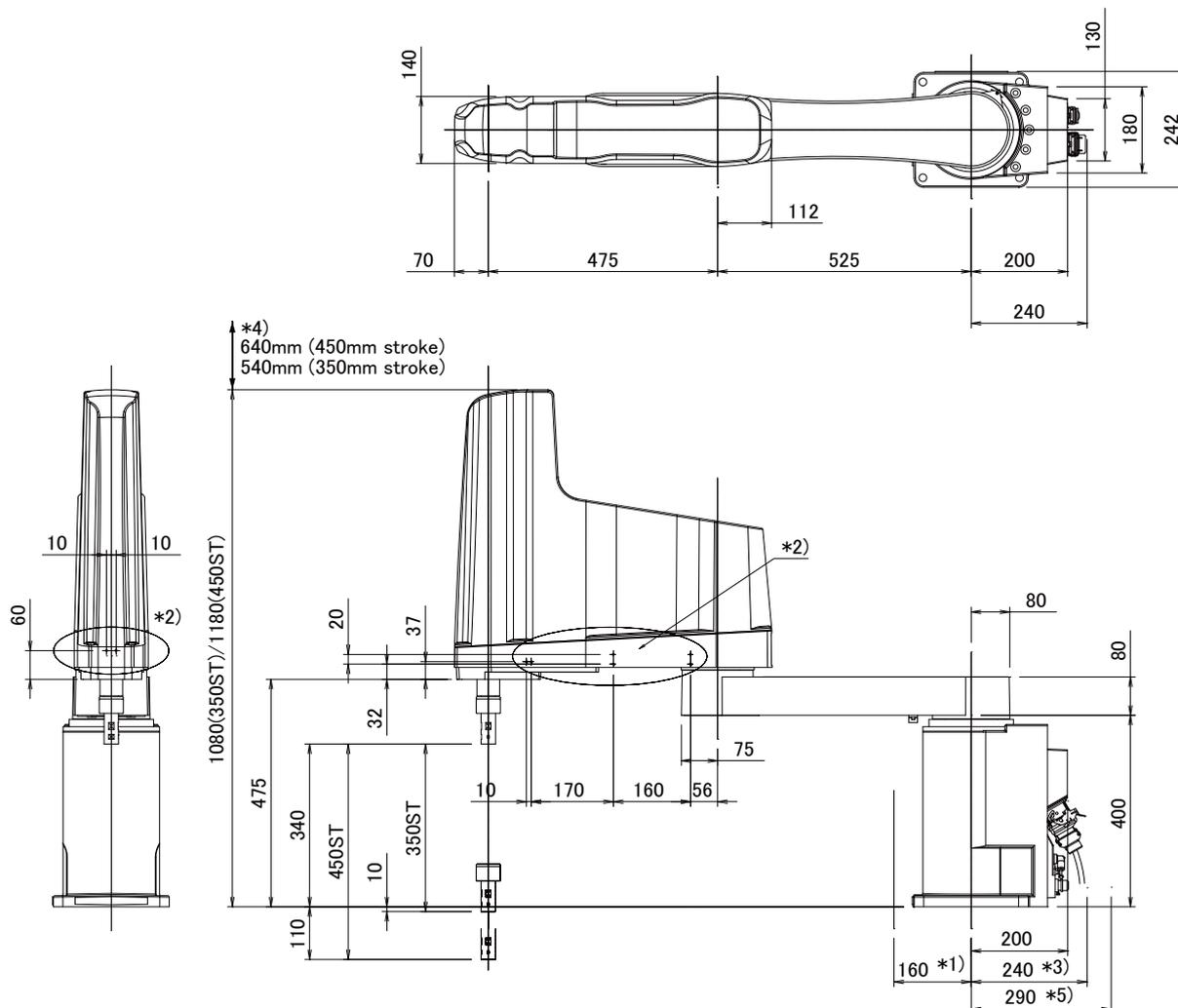


Fig.2-43 : Operating range diagram of RH-20FH85xx

Note

- *1) Indicates the space necessary to replace the battery.
- *2) Indicates screw holes for fixing user wiring/piping. (Refer to Fig. 2-59)
- *3) The distance to a minimum bendable radius of the machine cable for CR750/751 controller.
- *4) Required space to installing/removing the cover.
- *5) Indicates the space necessary to connect the machine cable for CR750/751 controller.



Note) The drawing shows an example of the CR750 controller connection robot.

Note) Refer to Fig. 2-54 for the mechanical interface section and installation base section dimensions.

Fig.2-44 : Outside dimensions of RH-20FH100xx

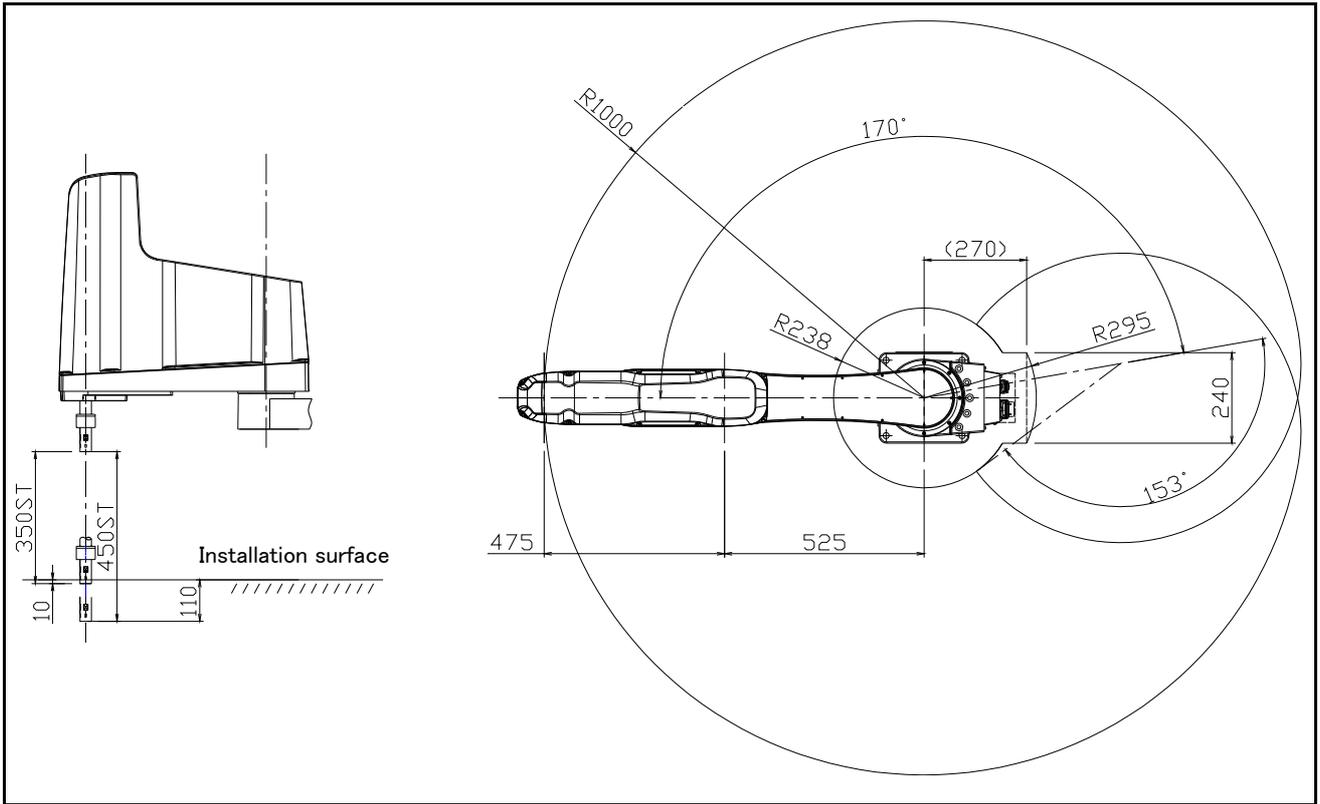


Fig.2-45 : Operating range diagram of RH-20FH100xx

(2) Clean Specification and oil mist specification

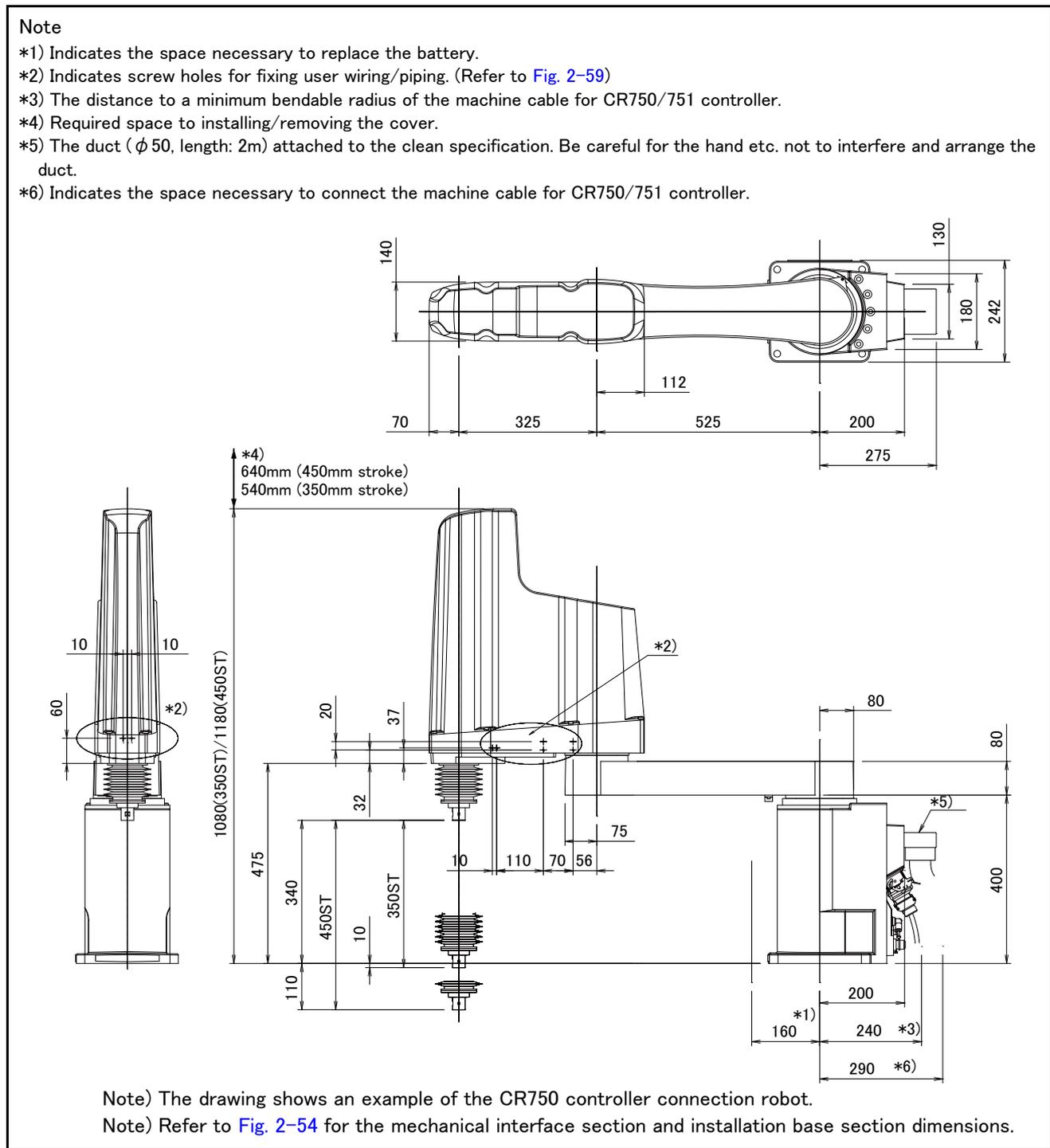


Fig.2-46 : Outside dimensions of RH-20FH85xxC/M

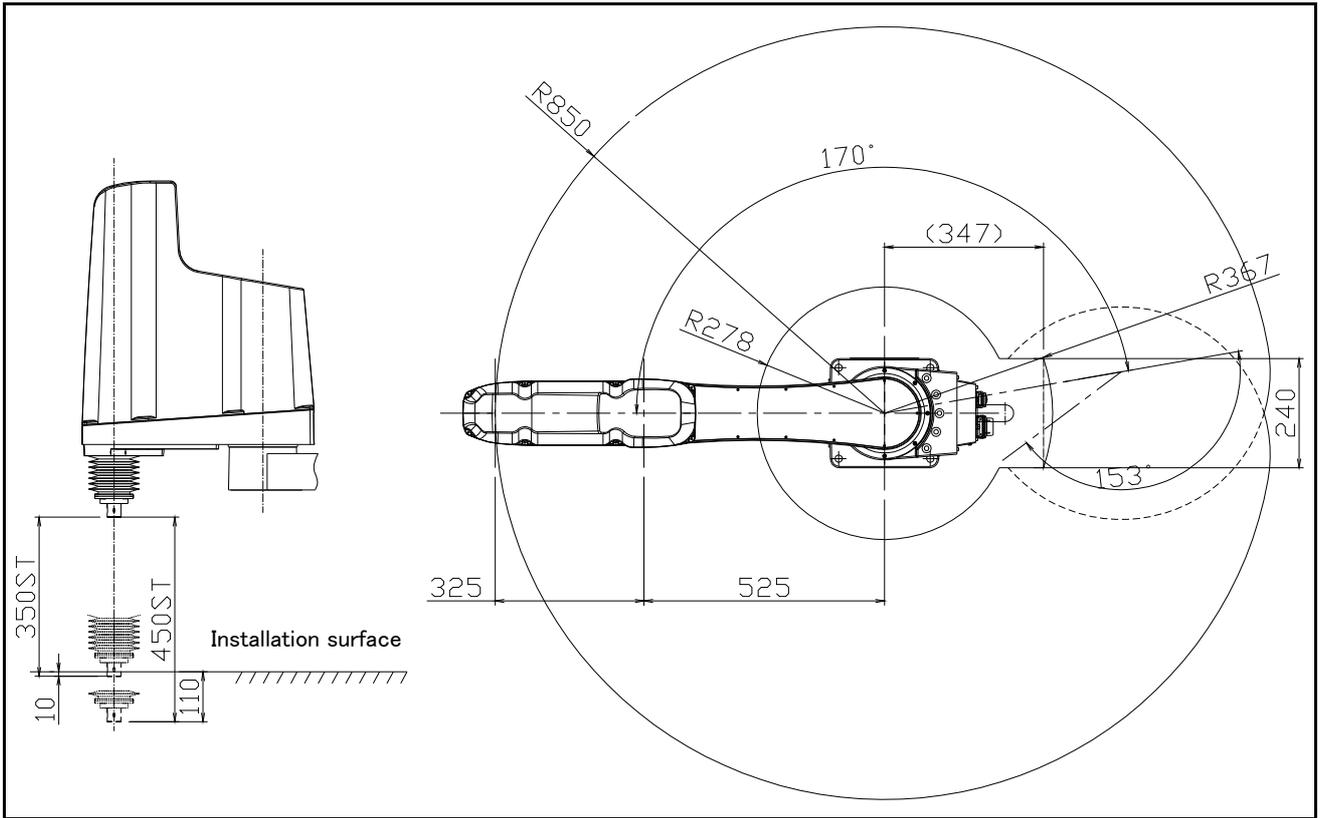
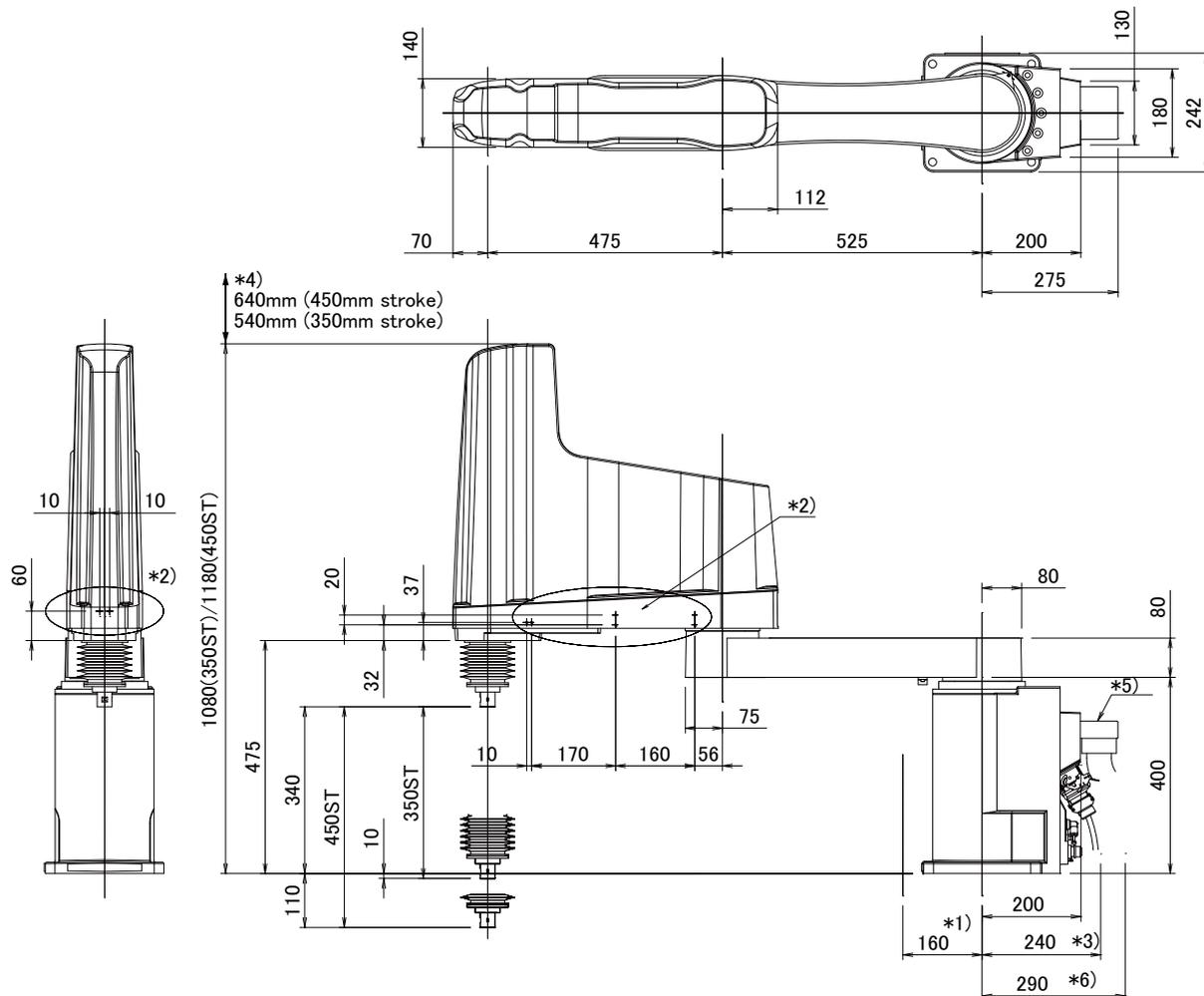


Fig.2-47 : Operating range diagram of RH-20FH85xxC/M

Note

- *1) Indicates the space necessary to replace the battery.
- *2) Indicates screw holes for fixing user wiring/piping. (Refer to Fig. 2-59)
- *3) The distance to a minimum bendable radius of the machine cable for CR750/751 controller.
- *4) Required space to installing/removing the cover.
- *5) The duct (φ 50, length: 2m) attached to the clean specification. Be careful for the hand etc. not to interfere and arrange the duct.
- *6) Indicates the space necessary to connect the machine cable for CR750/751 controller.



Note) The drawing shows an example of the CR750 controller connection robot.
 Note) Refer to Fig. 2-54 for the mechanical interface section and installation base section dimensions.

Fig.2-48 : Outside dimensions of RH-20FH100xxC/M

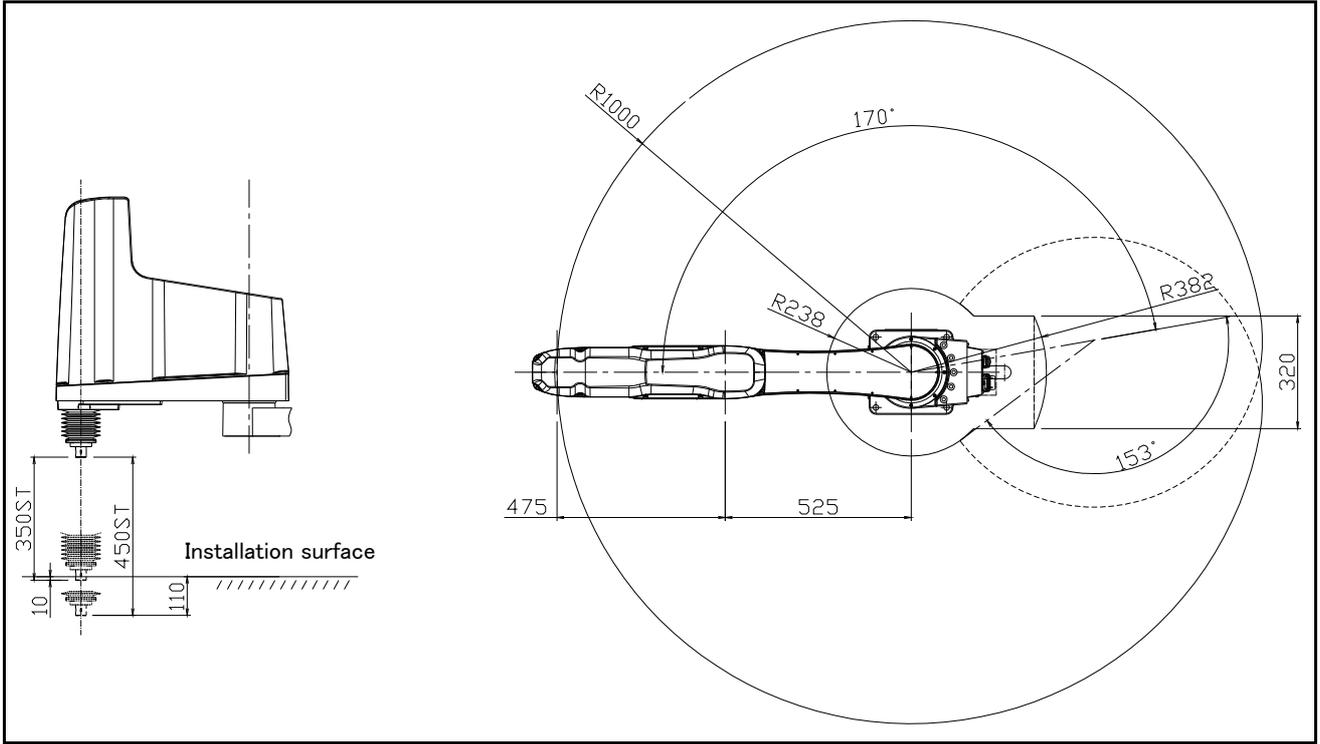


Fig.2-49 : Operating range diagram of RH-20FH100xxC/M

2.4.4 Outside dimensions • Operating range diagram of RH-3FHR series

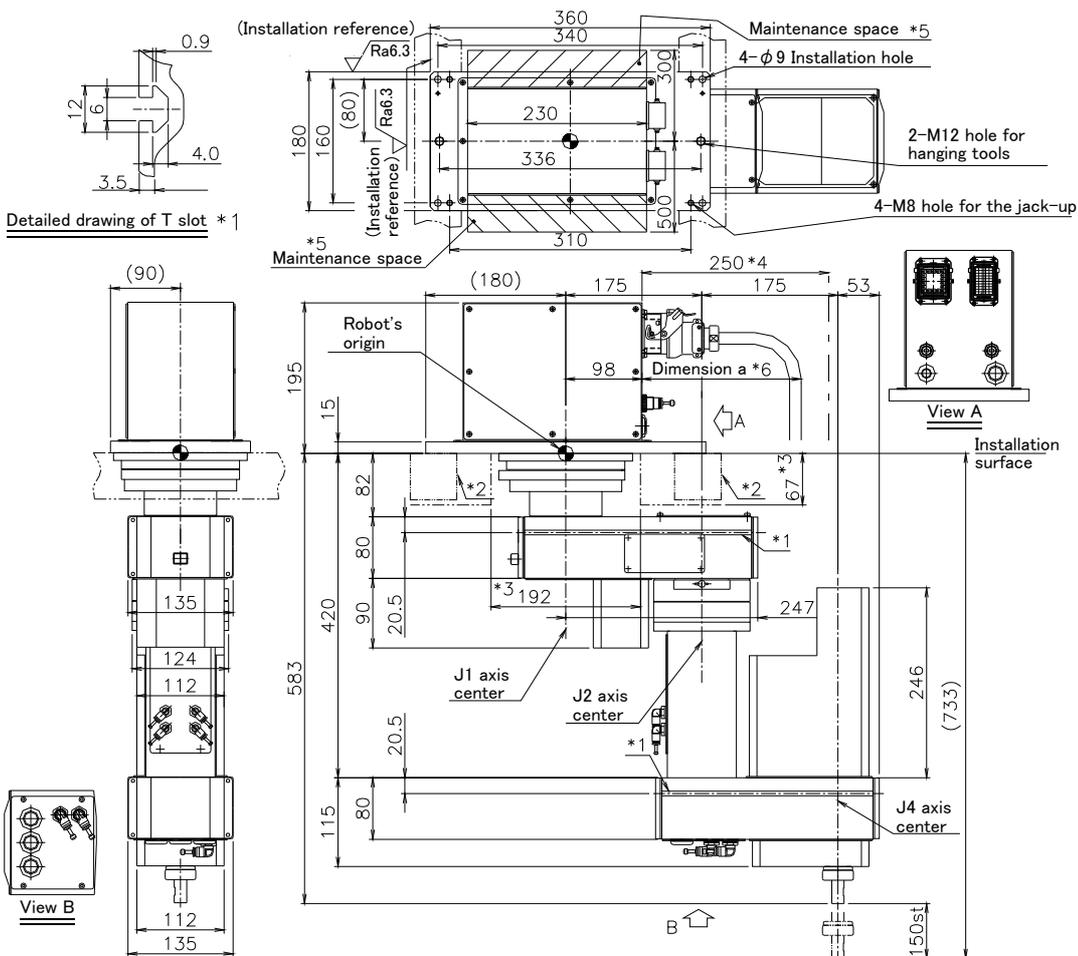
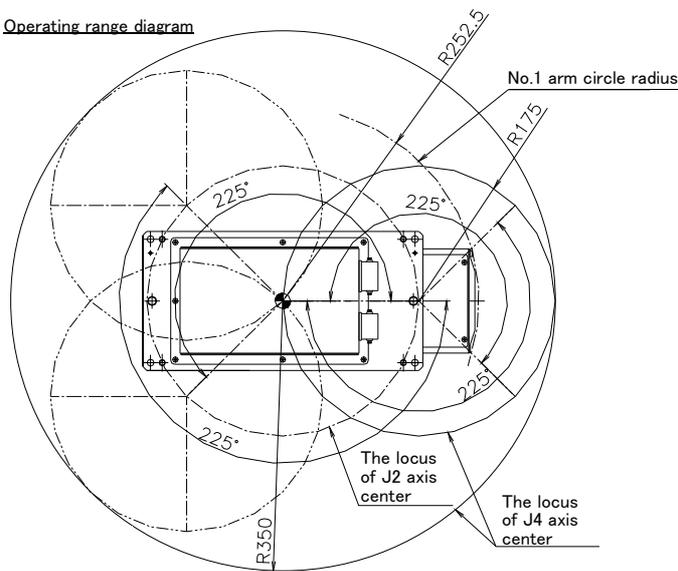
(1) Standard Specification

Notice

1. The outside dimensions exclude projecting parts.
2. The posture of the figure are J1=0 degree, J2=+180 degree, J3=-583mm, and J4=0 degree.
3. *1 is the T slot for piping, wiring, and solenoid valve installation. (Attach the M5 nut)
4. *2 is the installation stage (customer arrangements).
5. *3 is allowance stage dimensions.
6. *4 is the space necessary for connection of the machine cable for CR750/751 controller.
7. *5 is the maintenance space necessary for battery replacement etc.
8. *6 is the distance to a minimum bendable radius of the machine cable for CR750/751 controller.

| Controller | Dimension a |
|------------|-------------|
| CR750 | 183 |
| CR751 | 127 |

Operating range diagram



- Note1) The drawing shows an example of the CR750 controller connection robot.
- Note2) Refer to Fig. 2-55 for the mechanical interface section and installation base section dimensions.
- Note3) Use of the optional solenoid valve set. The solenoid valve set installed at the side on the No.2 arm. (*1 mark) Take care at layout design.
- Note4) The position on the vertical extension of the "robot origin" becomes the singular point. Positioning and passage to this position with linear interpolation movement cannot be performed. Take care at layout design.

Fig.2-50 : Outside dimensions, Operating range diagram of RH-3FHR series (Standard specification)

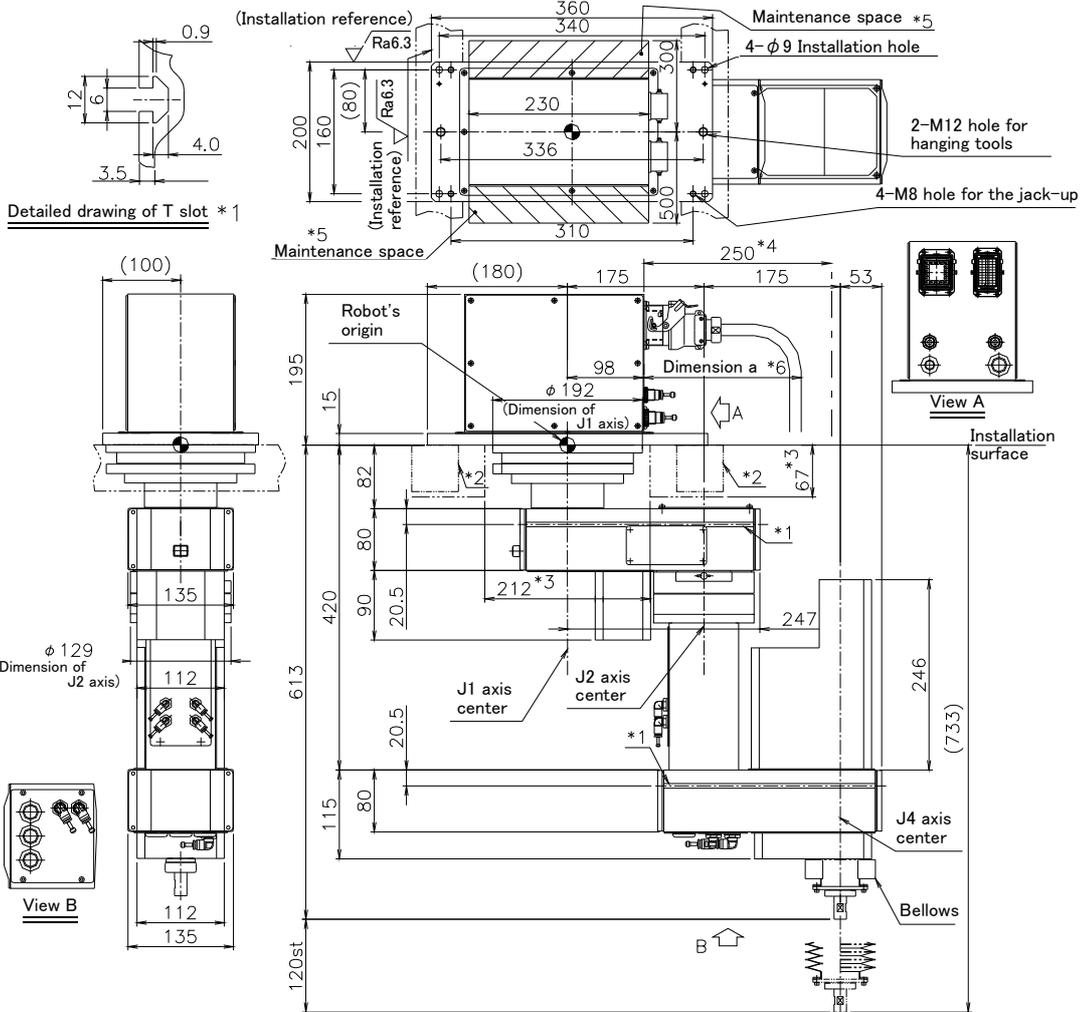
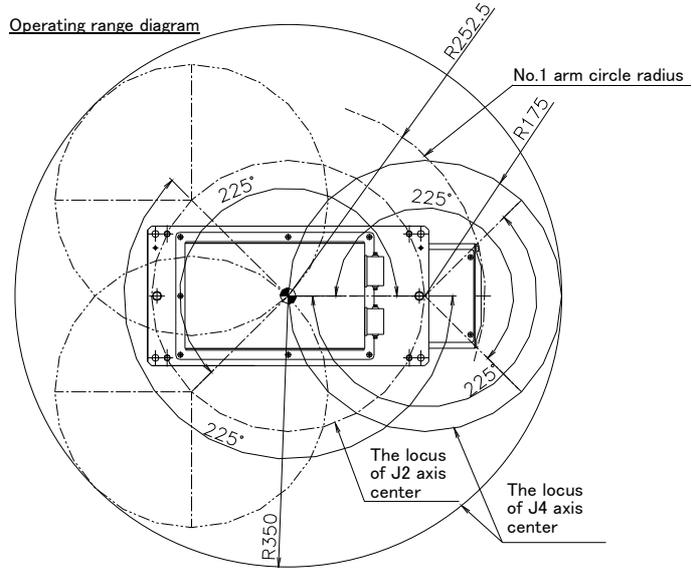
(2) Clean/Waterproof Specification

Notice

1. The outside dimensions exclude projecting parts.
2. The posture of the figure are J1=0 degree, J2=+180 degree, J3=-583mm, and J4=0 degree.
3. *1 is the T slot for piping, wiring, and solenoid valve installation. (Attach the M5 nut)
4. *2 is the installation stage (customer arrangements).
5. *3 is allowance stage dimensions.
6. *4 is the space necessary for connection of the machine cable for CR750/751 controller.
7. *5 is the maintenance space necessary for battery replacement etc.
8. *6 is the distance to a minimum bendable radius of the machine cable for CR750/751 controller.

| Controller | Dimension a |
|------------|-------------|
| CR750 | 183 |
| CR751 | 127 |

Operating range diagram



- Note1) The drawing shows an example of the CR750 controller connection robot.
 Note2) Refer to Fig. 2-56 for the mechanical interface section and installation base section dimensions.
 Note3) Use of the optional solenoid valve set. The solenoid valve set installed at the side on the No.2 arm. (*1 mark) Take care at layout design.
 Note4) The position on the vertical extension of the "robot origin" becomes the singular point. Positioning and passage to this position with linear interpolation movement cannot be performed. Take care at layout design.

Fig.2-51 : Outside dimensions, Operating range diagram of RH-3FHR series (Clean/Waterproof specification)

2.4.5 Mechanical interface and Installation surface

(1) Mechanical interface and Installation surface of RH-6FH series

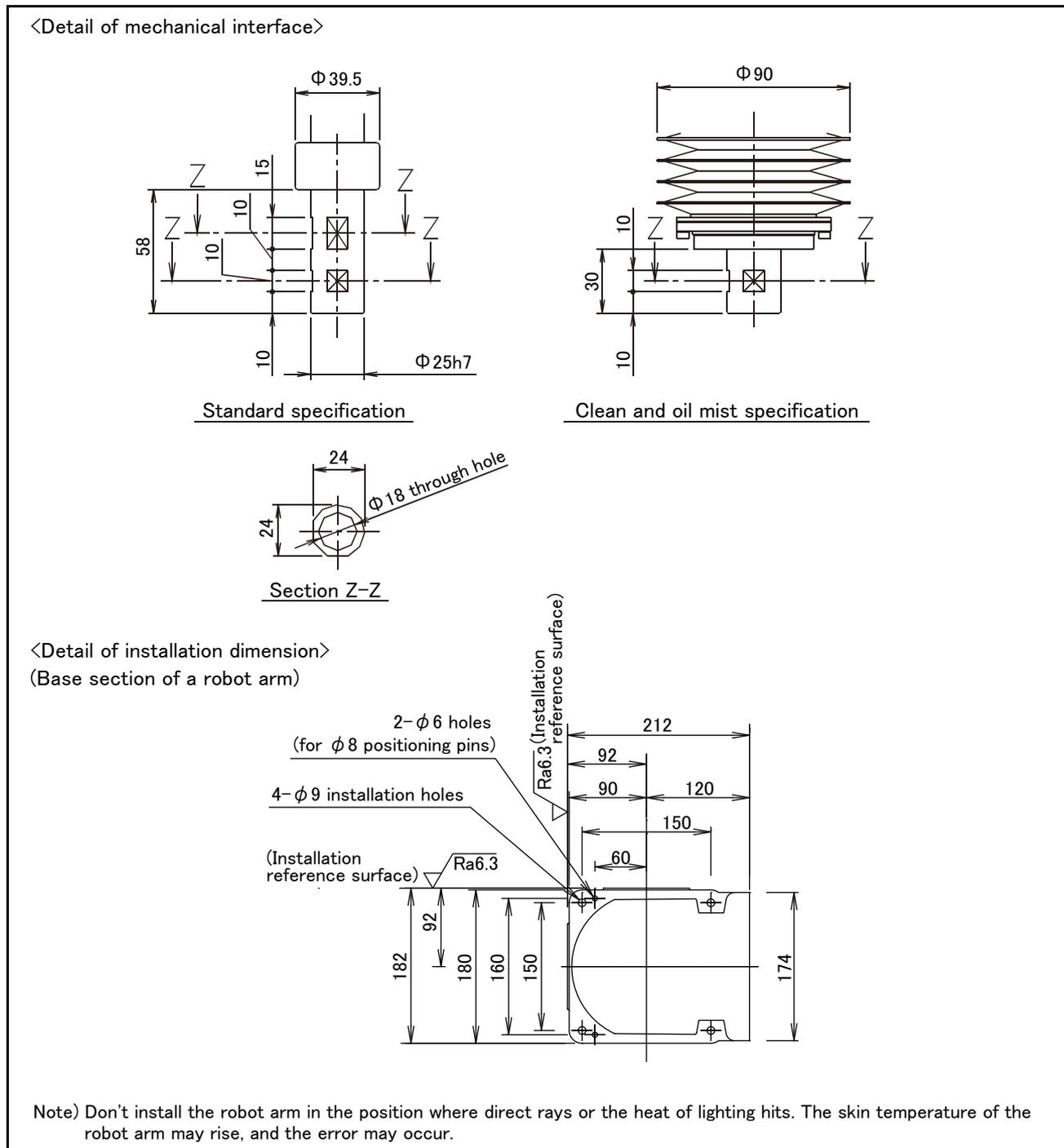


Fig.2-52 : Mechanical interface and Installation surface (RH-6FH series)

(2) Mechanical interface and Installation surface of RH-12FH series

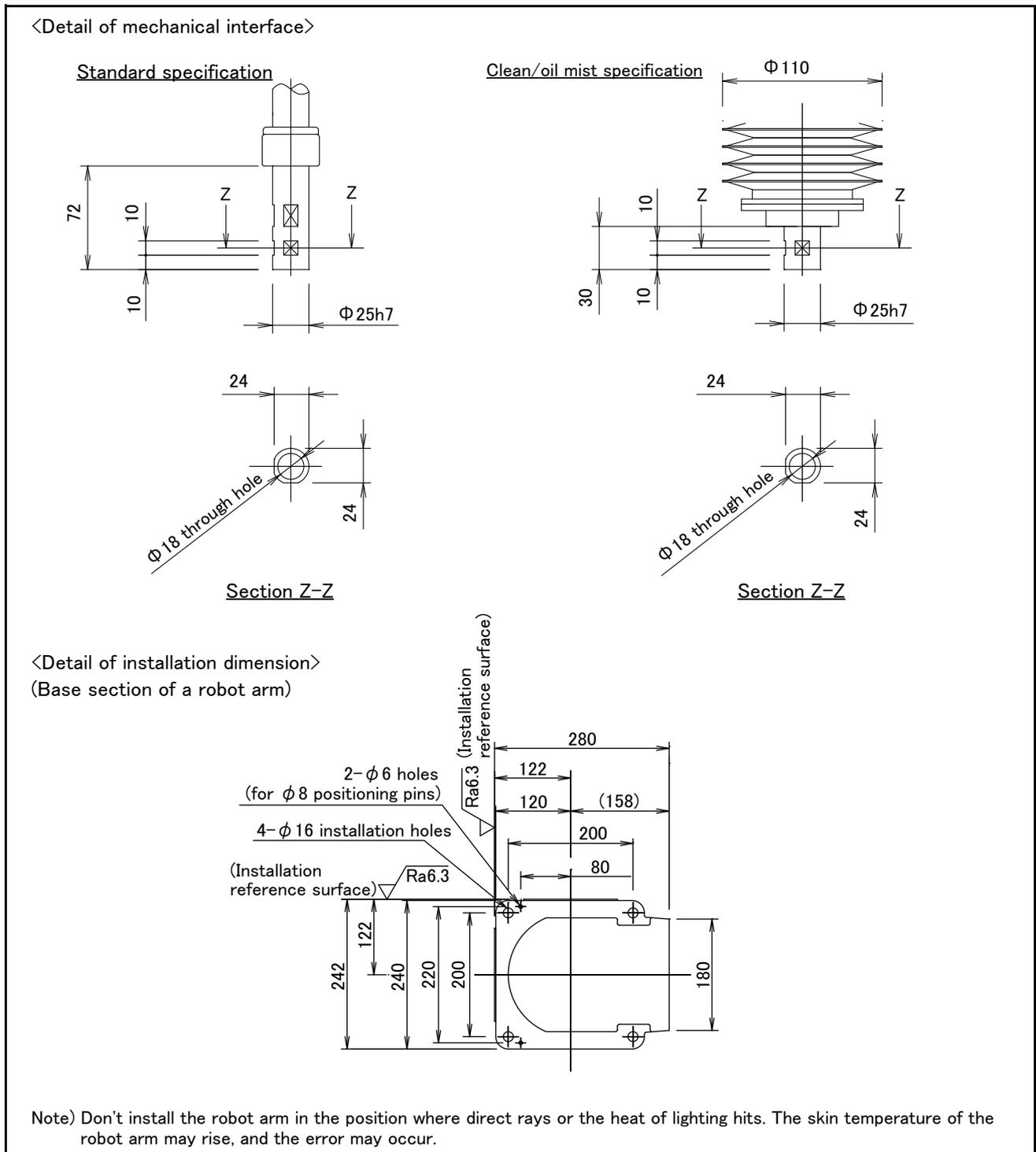


Fig.2-53 : Mechanical interface and Installation surface of RH-12FH series

(3) Mechanical interface and Installation surface of RH-20FH series

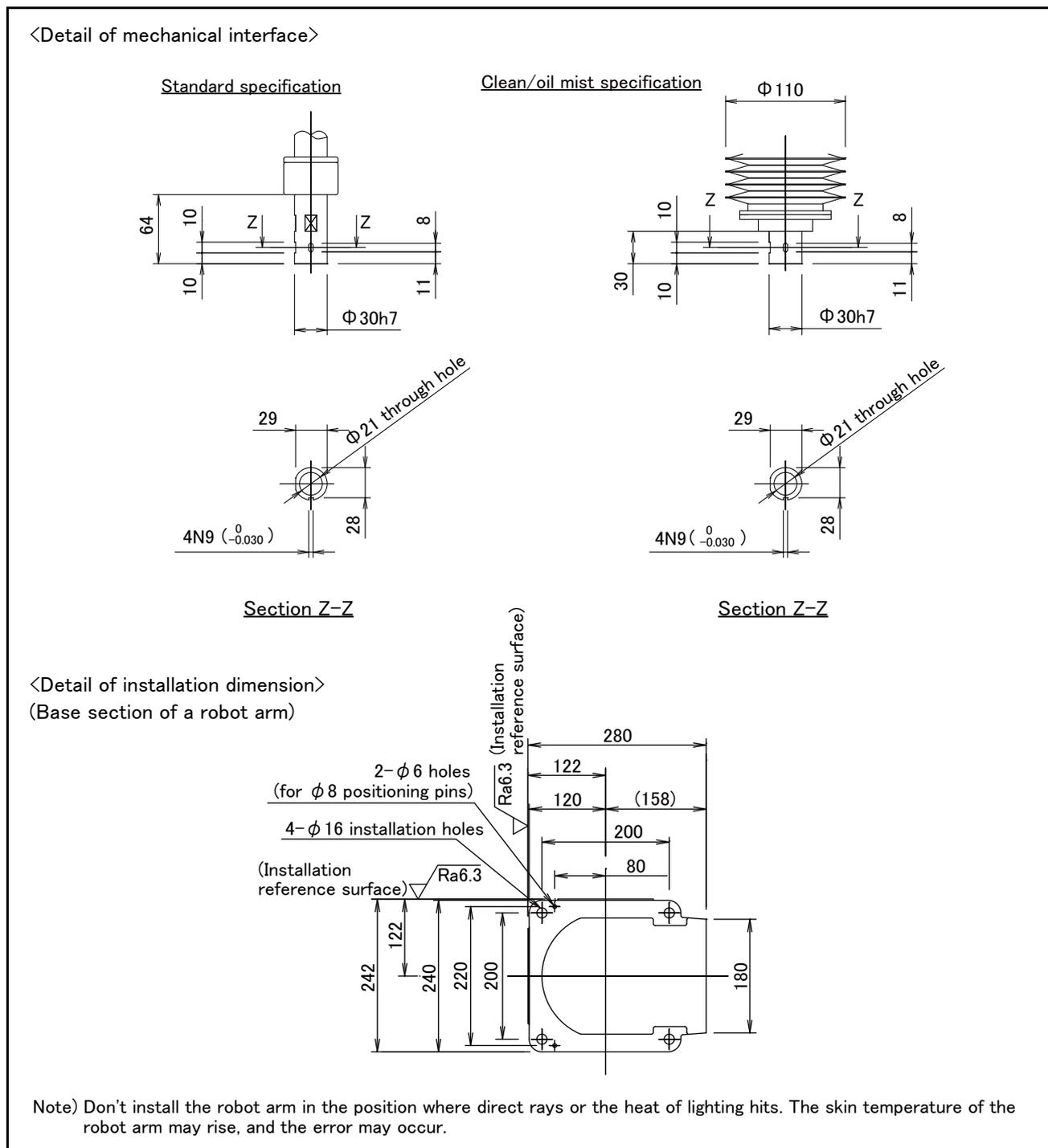


Fig.2-54 : Mechanical interface and Installation surface of RH-20FH series

(4) Mechanical interface and Installation surface of RH-3FHR series (Standard specification)

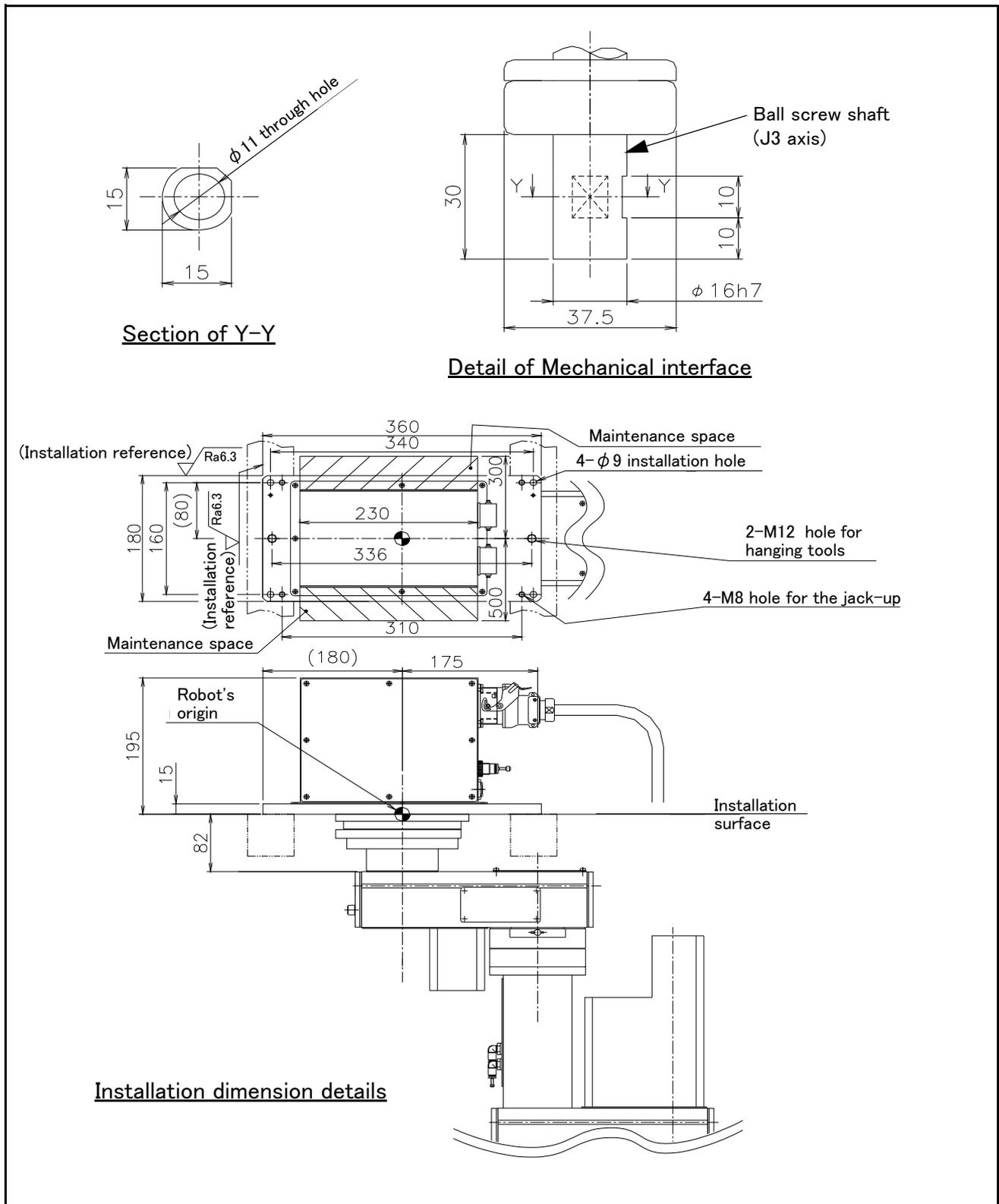


Fig.2-55 : Mechanical interface and Installation surface of RH-3FHR series (Standard specification)

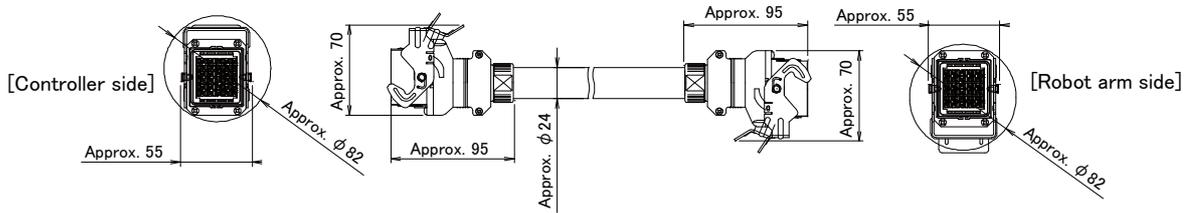
CAUTION

Don't give a shock to the ball screw shaft at the time of hand installation. Especially don't strike the shaft end by hammer etc. The ball screw shaft may be damaged.

2.4.6 Outside dimensions of machine cables

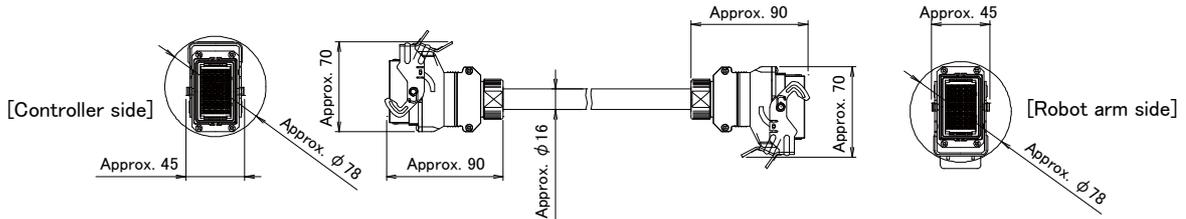
(1) Connection with the CR750 controller

1) Power cable



Note) If using an optional machine cable extension, refer to Page 101, "(1) Machine cable extension" in a diameter of the cable.

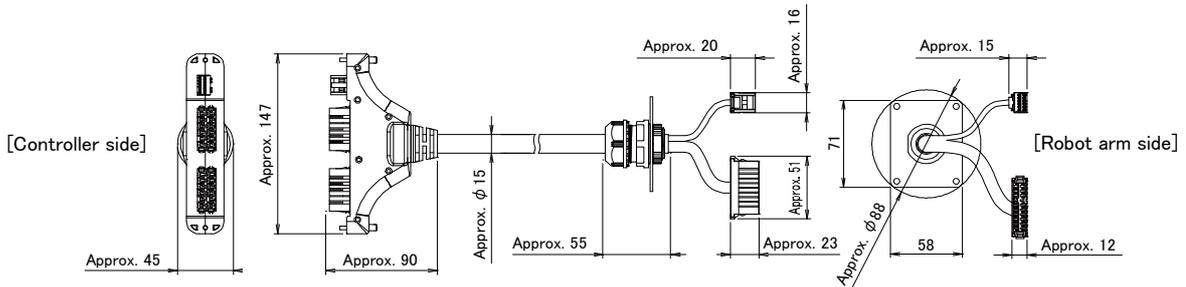
2) Signal cable



Note) If using an optional machine cable extension, refer to Page 101, "(1) Machine cable extension" in a diameter of the cable.

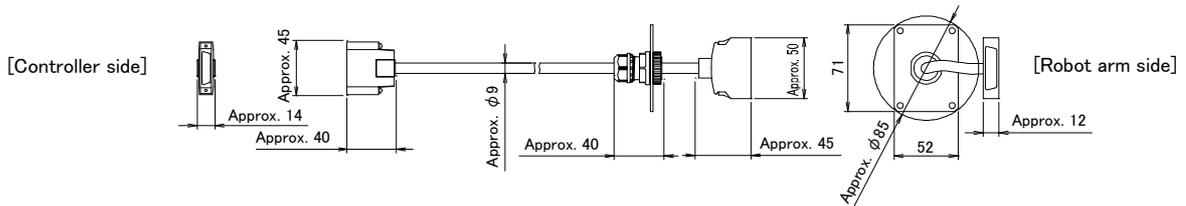
(2) Connection with the CR751 controller

1) Power cable



Note) If using an optional machine cable extension, refer to Page 101, "(1) Machine cable extension" in a diameter of the cable.

2) Signal cable



Note) If using an optional machine cable extension, refer to Page 101, "(1) Machine cable extension" in a diameter of the cable.

2.5 Tooling

2.5.1 Wiring and piping for hand

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

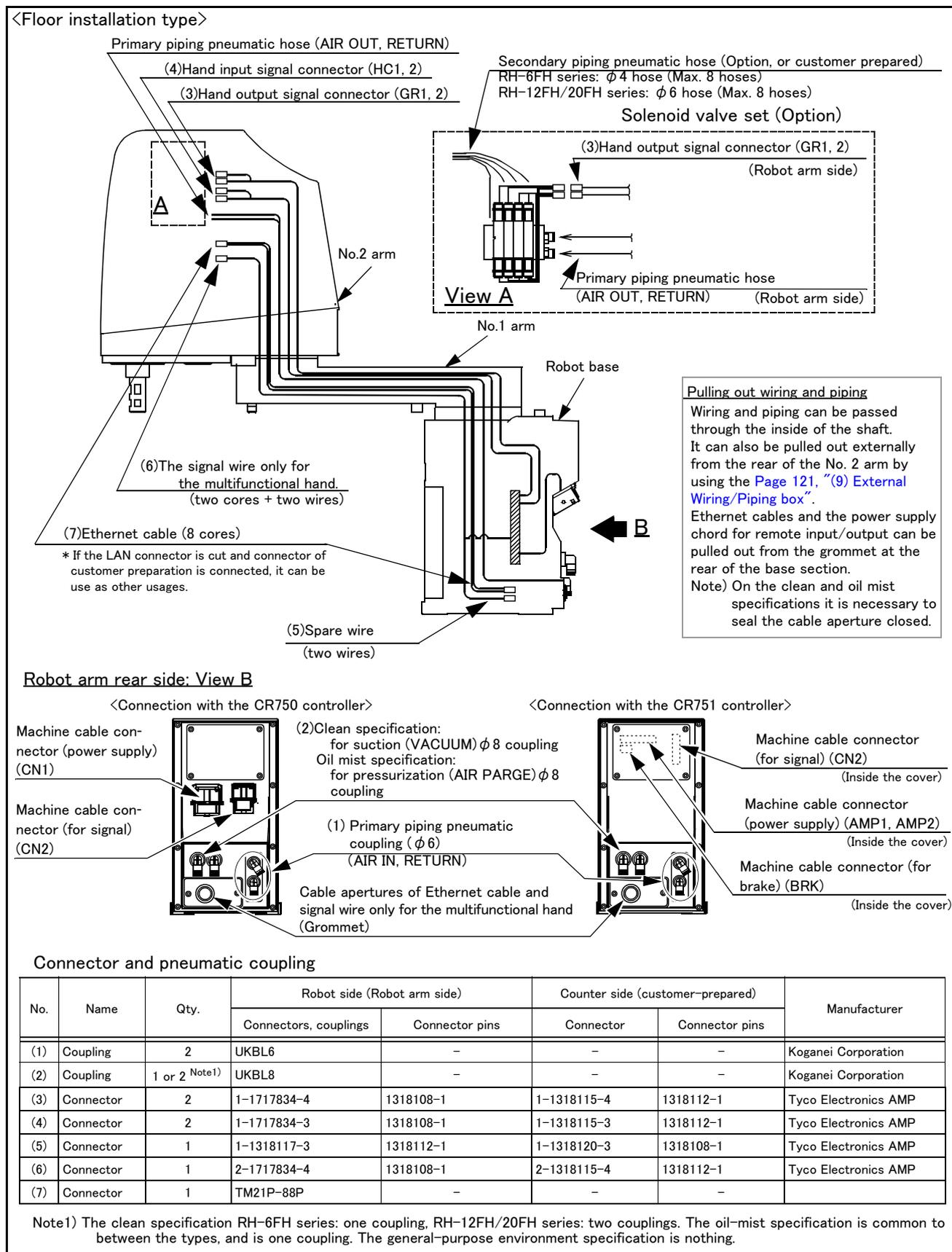


Fig.2-57 : Wiring and piping for hand (Floor installation type)

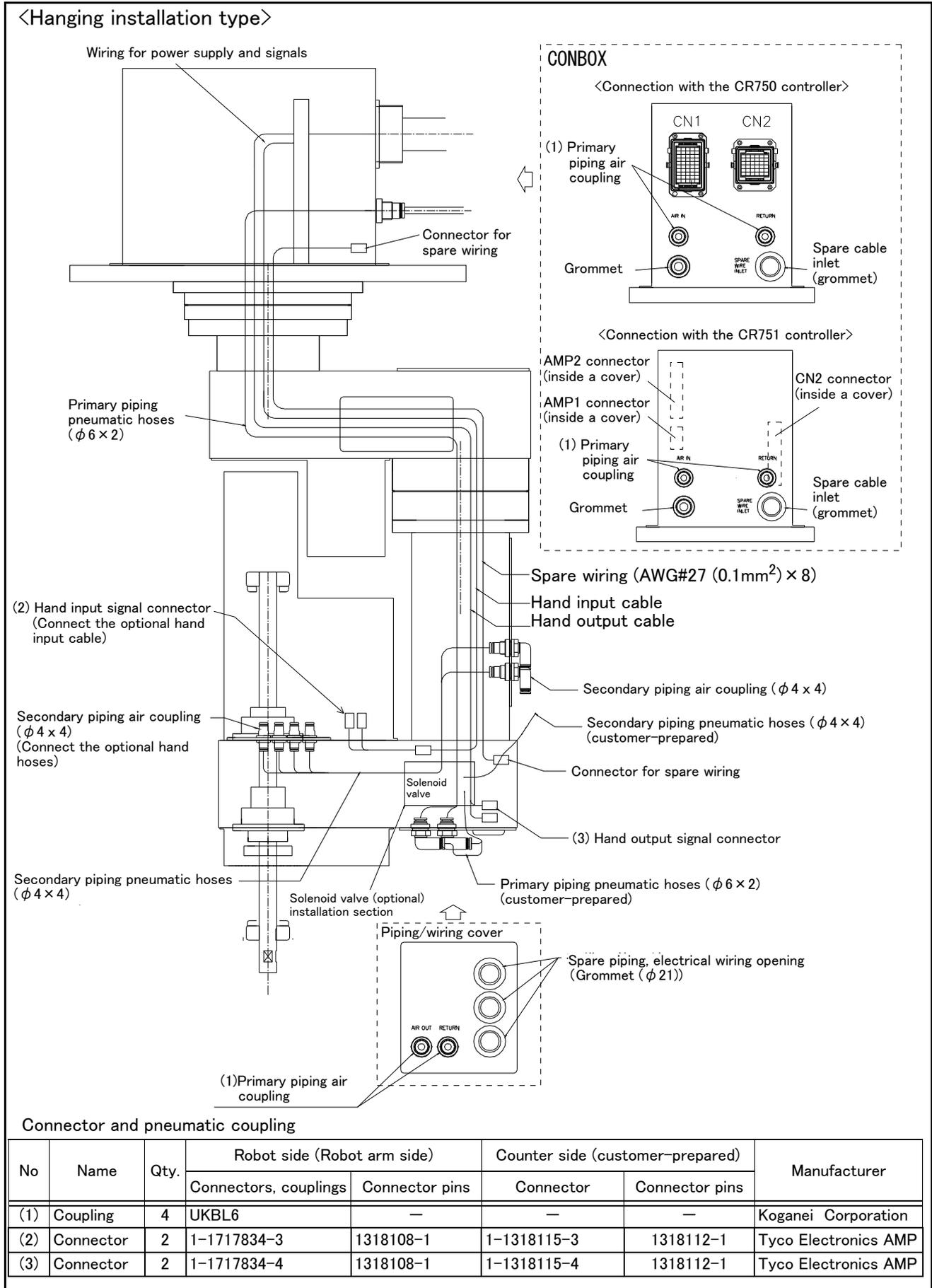


Fig.2-58 : Wiring and piping for hand (Hanging installation type)

2.5.2 Internal air piping

(1) Floor installation type

1) Standard type/Oil mist specifications

- The robot has two $\phi 6$ urethane hoses from the pneumatic entrance on the base section to the No.2 arm. One hose is the primary piping for the pneumatic equipment, and the other pipe is used for air exhaust.
- The pneumatic inlet in the base section has a $\phi 6$ pneumatic coupling bridge.
- The solenoid valve set (optional) can be installed to the side on No.2 arm.
- Refer to [Page 108](#), “(3) Solenoid valve set” for details on the electronic valve set (optional).
- Protection performance can be improved by pressurizing the inside of the robot arm. Since the joint (AIR PURGE) of $\phi 8$ is prepared at the rear of the base section, please supply the dry air for pressurization from this joint. Refer to [Page 37](#), “2.2.8 Protection specifications” for the details of dry air.

2) Clean type

- The primary piping is the same piping as the standard type.
- With the clean specification, a $\phi 8$ coupling is provided in the base section for suction inside the machine. 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).
- Refer to [Page 39](#), “2.2.9 Clean specifications” for details of the vacuum for suction.
- Supply clean air to the vacuum generator.

(2) Hanging installation type

1) Standard type/Waterproof type

- The robot has two $\phi 6$ urethane hoses from the pneumatic entrance on the base section to the No.2 arm. One hose is the primary piping for the pneumatic equipment, and the other pipe is used for air exhaust.
- The pneumatic inlet in the base section has a $\phi 6$ pneumatic coupling bridge.
- The solenoid valve set (optional) can be installed to the side on No.2 arm.
- Refer to [Page 108](#), “(3) Solenoid valve set” for details on the electronic valve set (optional).
- The four air hoses ($\phi 4$) are piped as the secondary from the No.2 arm back end to near the shaft.

2) Clean type

- The primary piping is the same piping as the standard type.
- With the clean specification, a $\phi 8$ coupling is provided in the base section for suction inside the machine. 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).
- Refer to [Page 39](#), “2.2.9 Clean specifications” for details of the vacuum for suction.
- Supply clean air to the vacuum generator.

2.5.3 Internal wiring for the hand output cable

(1) Floor installation type

- 1) The hand output primary cable extends from the connector PCB of the base section to the back side of the No.2 arm. (AWG#24(0.2mm²): 10 cables) The cable terminals have connector bridges for eight hand outputs. The connector names are GR1 and GR2.

To pull the wiring out of the arm, following separate options are required.

- Hand output cable 1F-GR60S-01
- External wiring and piping box 1F-UT-BOX (RH-6FH series)
1F-UT-BOX-01 (RH-12FH/20FH series)

(2) Hanging installation type

- 1) The hand output primary cable extends from the connector of the base section to the back side of the No.2 arm. (AWG#24(0.2mm²)) The cable terminals have connector bridges for eight hand outputs. The connector names are GR1 and GR2. The separate cable (optional “hand output cable 1S-GR35S-02”) is necessary, to extend the cable to outside of the arm.

2.5.4 Internal wiring for the hand input cable

(1) Floor installation type

- 1) The hand input cable extends from the connector PCB of the base section to the No.2 arm.
(AWG#24(0.2mm²): 10 cables) The cable terminals have connector bridges for eight hand inputs. The connector names are HC1 and HC2.
- 2) The hand check signal of the pneumatic hand is input by connecting this connector.
To extend the wiring to the outside of the arm, following separate options are required.
 - Hand input cable.....1F-HC35C-01 (RH-6FH series)
1F-HC35C-02 (RH-12FH/20FH series)
 - External wiring and piping box1F-UT-BOX (RH-6FH series)
1F-UT-BOX-01 (RH-12FH/20FH series)

(2) Hanging installation type

- 1) The hand input cable extends from the connector PCB of the base section to the No.2 arm.
(AWG#24(0.2mm²)) The cable terminals have connector bridges for four hand inputs. The connector names are HC1 and HC2.
- 2) The hand check signal of the pneumatic hand is input by connecting this connector.

2.5.5 Ethernet cable (For RH-6FH/12FH/20FH series)

Ethernet cables are installed from the RH-6FH/12FH/20FH series robot's base section up to the No. 2 arm section, and can be used. Similar to on our previous models, these cables can also be used for backup wiring. For further details please refer to the separate "Instruction Manual/Robot Arm Setup".

Example of use for backup wiring.

- When connecting previously used tools to the robot
- Folding back the hand output cable when attaching the electromagnetic valve to the robot's exterior.
- When attaching 8 devices or more to the hand section such as sensors, (8 input and 8 output dedicated points are available for hand signals.). In this case connect the signals (of the sensors, etc.) to parallel input/output signals.

When shipped from the factory, both ends are LAN connectors.

When using it as backup wiring, cut the LAN connectors off and use with user supplied connectors.

When using it as backup wiring for data communication, the shield wire must be grounded. If the shield wire is not grounded, it may cause a communication abnormality by noise superposed on the cable.

Table 2-13 : Ethernet cable specification

| Item | Specification |
|--------------------------|--|
| Communication speed | 100BASE-TX |
| Size | AWG #26 (0.13mm ²) x four pair (total eight cores) |
| Externality of insulator | Approx. 0.98 mm |

2.5.6 Spare Wiring (For FH-3FHR series)

As spare wiring, four pairs of cable cables (AWG#27(0.1mm²), total is eight cores both) are preinstalled between the base section and the No.2 arm rear section in the RH-3FHR series robot. Customer can utilize it. Refer to the separate "Instruction Manual/ROBOT ARM SETUP & MAINTENANCE" for details.

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.)

Reference) Pin assignment of the connector, and the matching connector

Pin assignment

| Pin | Color |
|-----|--------|
| A1 | Red |
| A2 | Brown |
| A3 | Green |
| A4 | Black |
| B1 | Orange |
| B2 | White |
| B3 | Yellow |
| B4 | Blue |

Robot side connector

| Connection place | Connector | Contactora | Maker |
|------------------|-------------|------------|---------------------------|
| Base portion | 2-1318115-4 | - | Tyco Electronics AMP K.K. |
| Fore arm portion | 2-1717834-4 | - | |

Other party connector (recommendation)

| Connection place | Connector | Contactora | Maker |
|------------------|-------------|------------|---------------------------|
| Base portion | 2-1717834-4 | 1318108-1 | Tyco Electronics AMP K.K. |
| Fore arm portion | 2-1318115-4 | 1318112-1 | |

2.5.7 About the Installation of Tooling Wiring and Piping (Examples of Wiring and Piping)

The customer is required to provide tooling wiring, piping and metal fixtures.

Screw holes are provided on the robot arm for the installation of tooling wiring, piping and metal fixtures. (Refer to the Fig. 2-59 to Fig. 2-61.)

The length of wiring and piping and the installation position on the robot must be adjusted according to the work to be done by the robot. Please use the following example as reference.

<Precautions>

- A hand input cable and a hand curl cable are available as optional accessories for your convenience.
- After performing wiring and piping to the robot, operate the robot at low speed to make sure that each part does not interfere with the robot arm and the peripheral devices.
Confirm that there is no interference also with bellows of the shaft section by clean specification and oil mist specification.
- Please be aware that dust may be generated from friction if wires and pipes come into contact with the robot arm when using it according to the clean specifications.
- If you install metal fixtures and a solenoid valve using the screw holes on the No.2 arm portion, add the mass of the metal fixtures and the solenoid valve to mass of a hand then set the HNDDAT parameter. Moreover, Fix the parts, such as a solenoid valve, firmly to prevent the parts getting shaky during operation of a robot.

(1) RH-6FH series

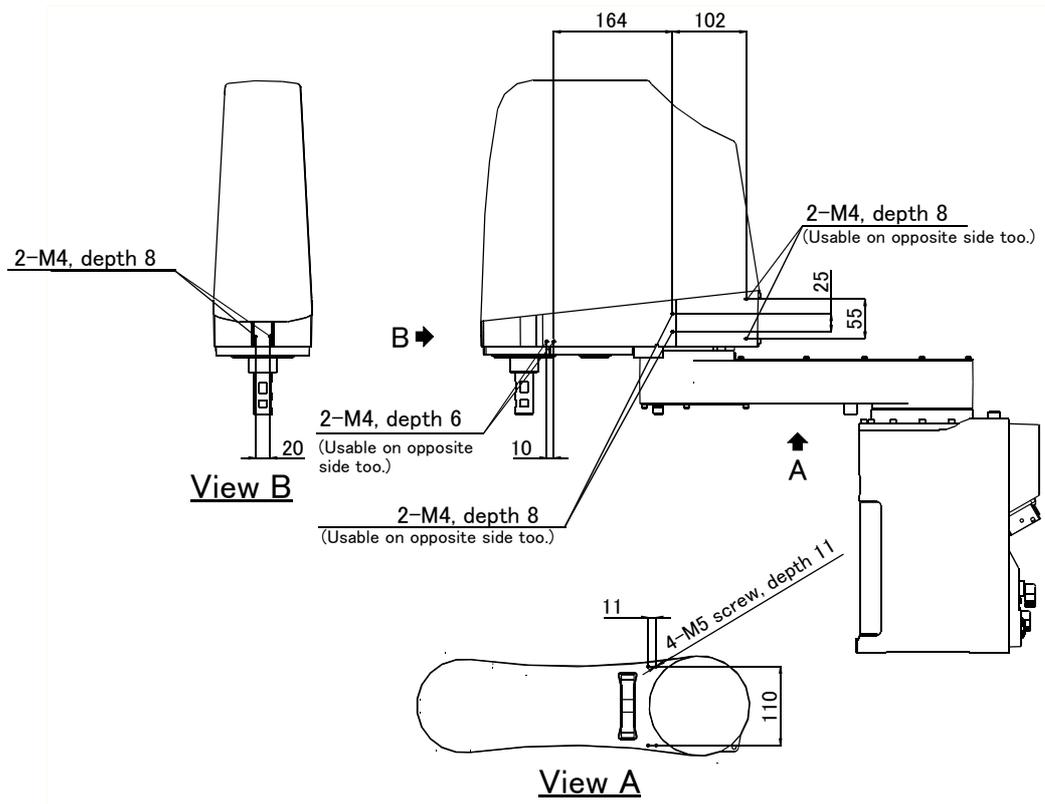


Fig.2-59 : Location of screw holes for fixing wiring/piping (RH-6FH)

(2) RH-12FH/20FH series

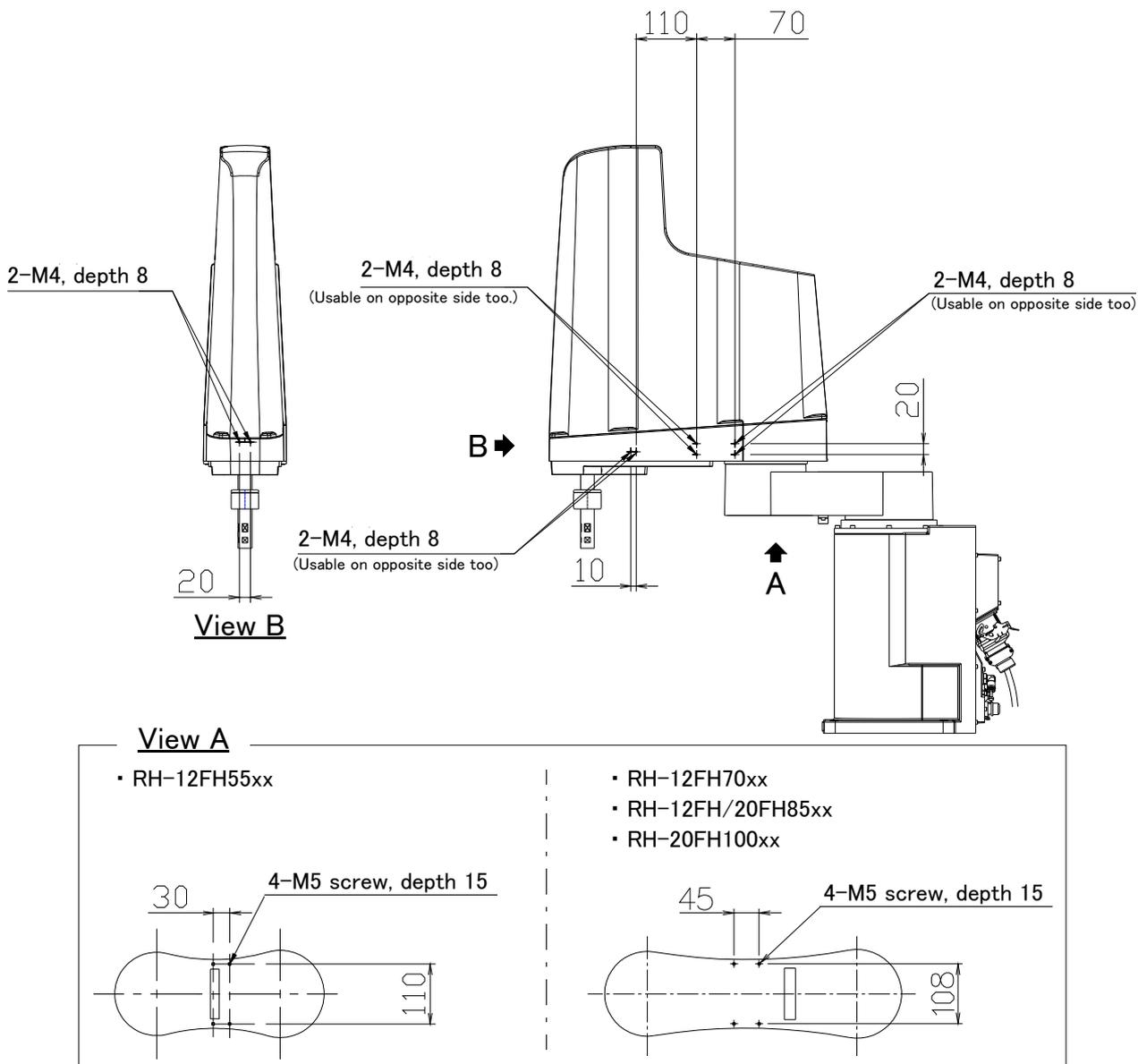
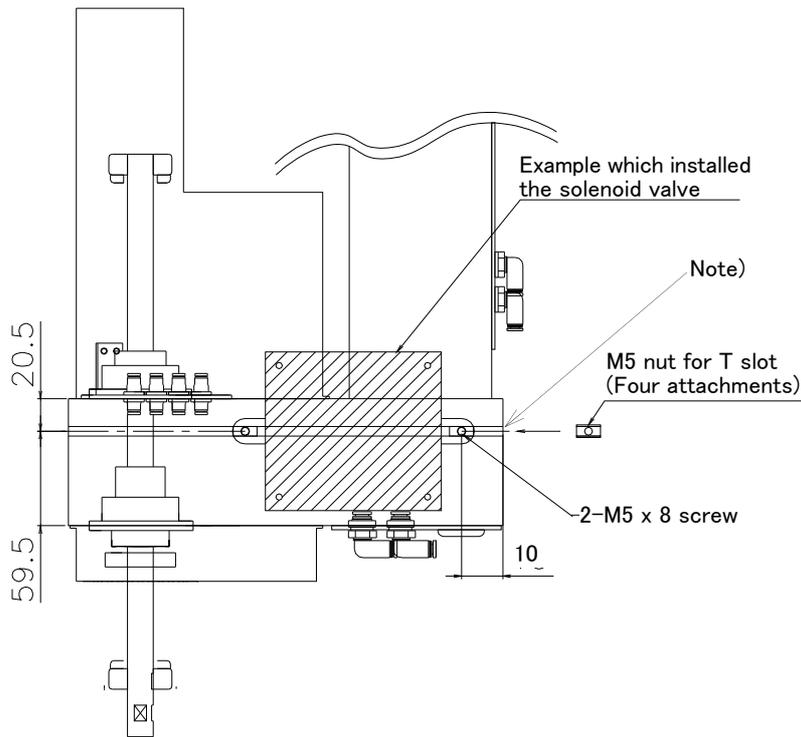


Fig.2-60 : Location of screw holes for fixing wiring/piping (RH-12FH/20FH)

(3) RH-3FHR series



Note) T slot
 The T slot is on the side of the No.2 arm. (Two of right and left)
 Utilize the M5 screw and T slot for fixing the hose or wire.
 Refer to "Page 75, "Fig.2-50 : Outside dimensions, Operating range diagram of RH-3FHR series (Standard specification)" or Page 76, "Fig.2-51 : Outside dimensions, Operating range diagram of RH-3FHR series (Clean/Waterproof specification)" for detail of T slot.
 The Clean/Waterproof robot are supplied with the packing. After fixation of wirings and pipings, stuff the packing into the T slot.

Fig.2-61 : Location of screw holes for fixing wiring/piping (RH-3FHR series)

(4) Example of wiring and piping <1>

By feeding wiring and piping through the inside of the shaft, the wiring and piping to the hand becomes compact.

<RH-6FH series>

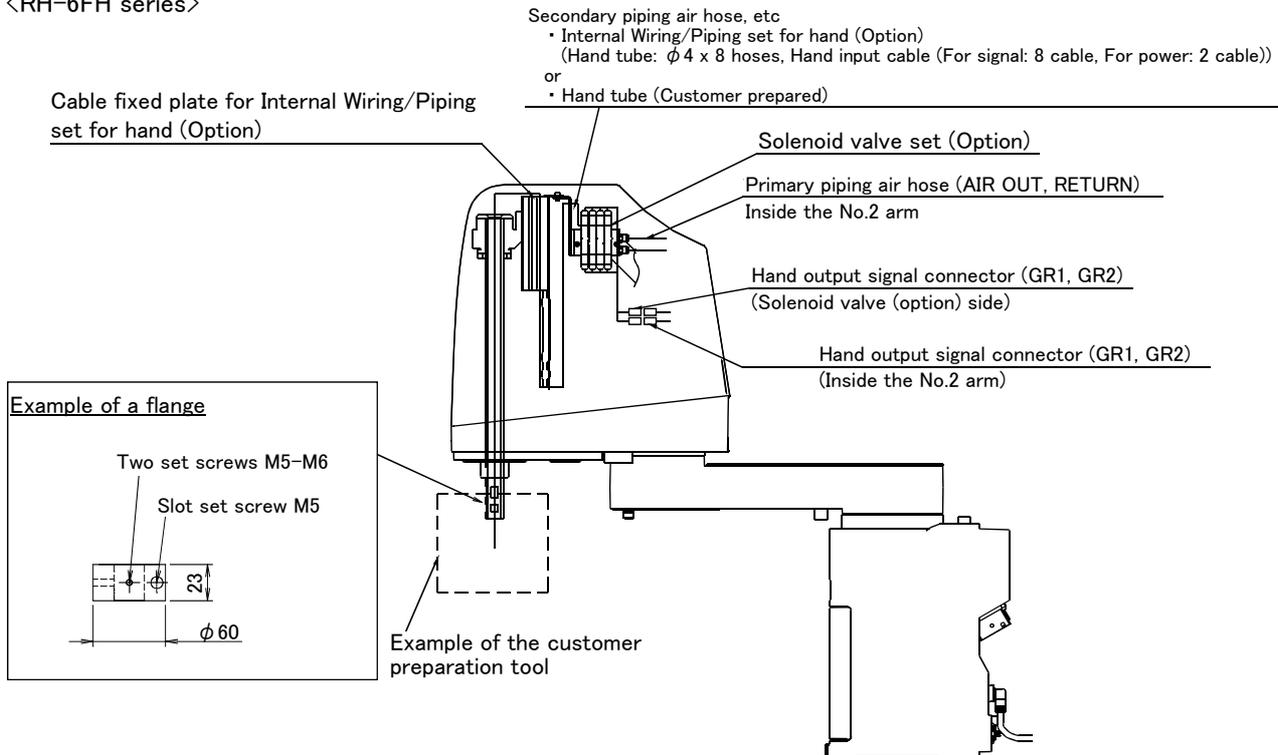


Fig.2-62 : Example of wiring and piping <1> (RH-6FH series)

<RH-12FH/20FH series>

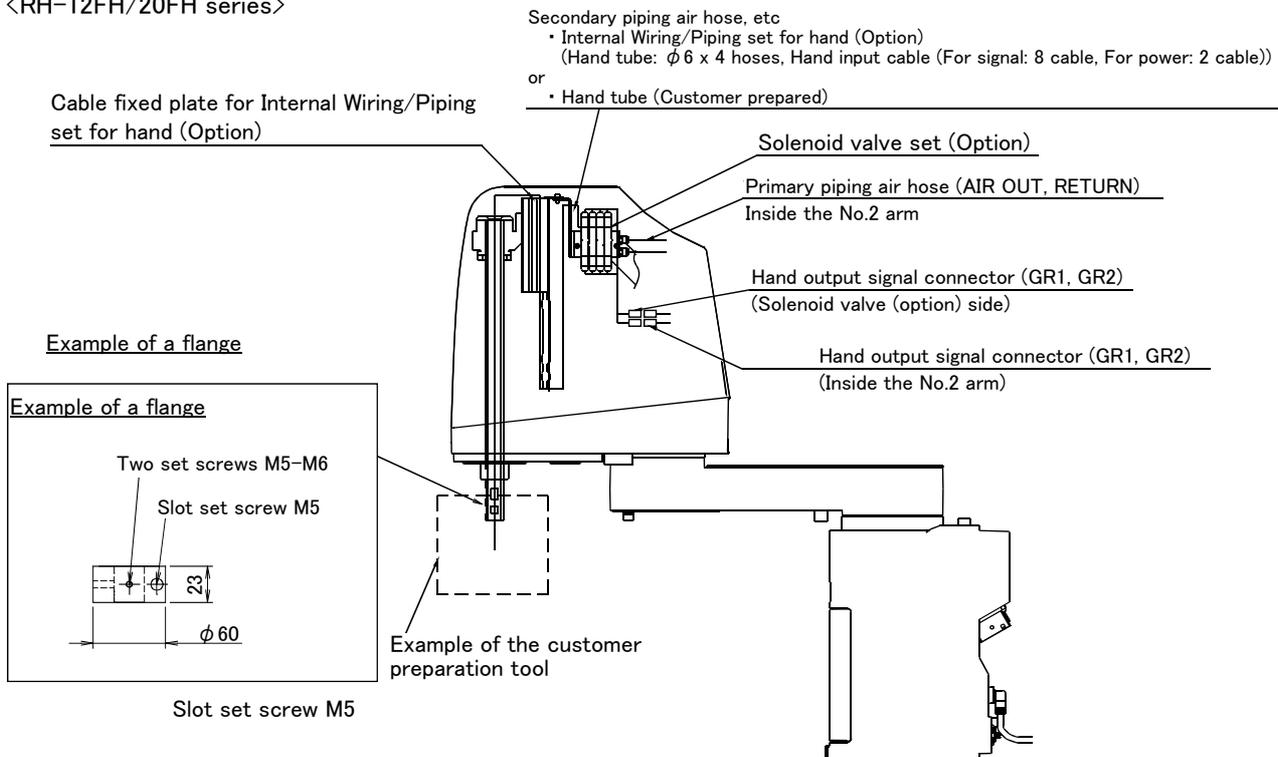
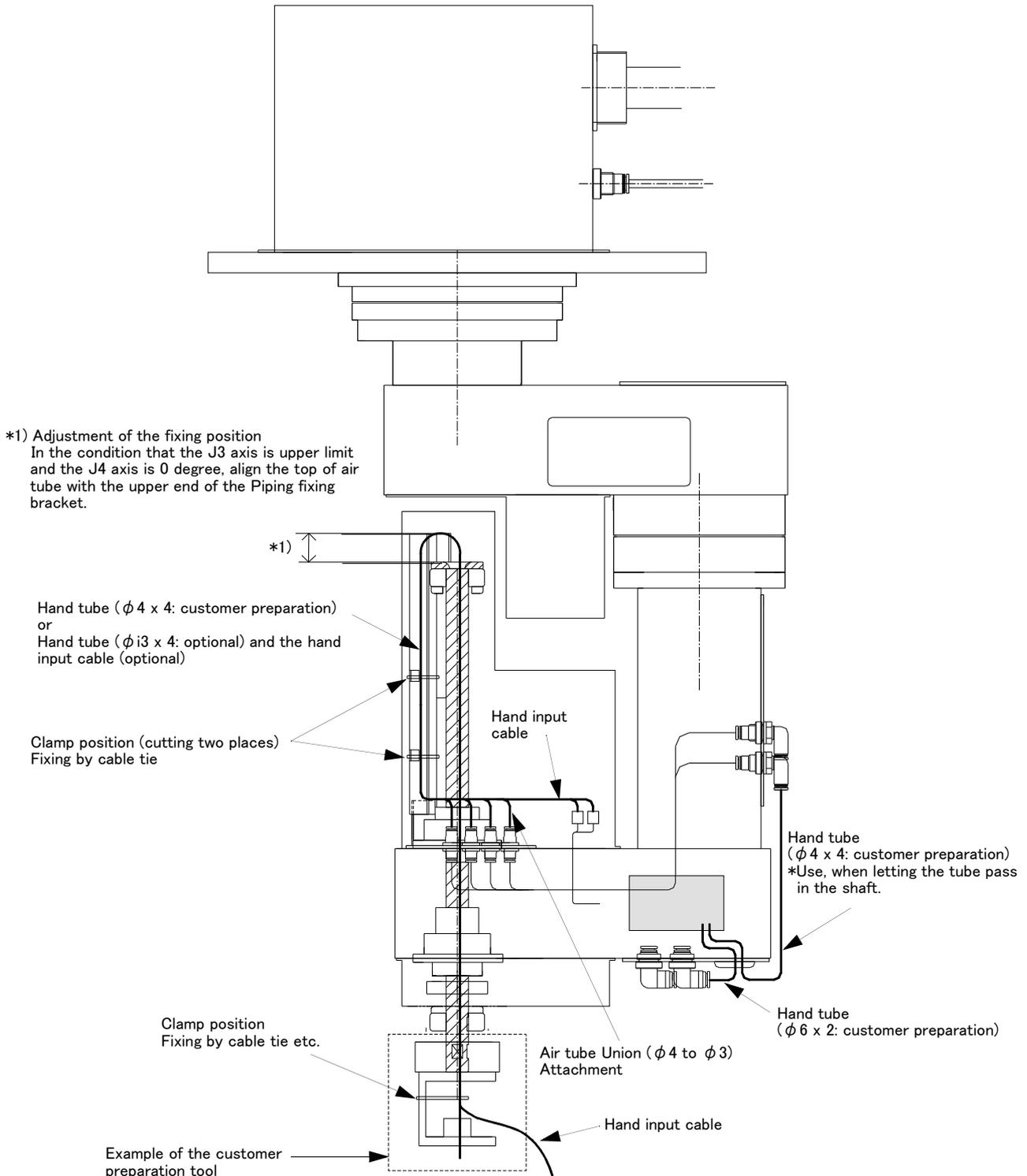


Fig.2-63 : Example of wiring and piping <1> (RH-12FH/20FH series)

<Floor installation type>

Example) How to pass the phi 4 air hose into the shaft



Notes in wiring

1. The air hose which can be passed in the shaft is four $\phi 4$ hoses maximum. (Customer preparations)
2. Wire the cable and piping the tube without interference with ball screw and cover.
3. Because to prevent the bend of the air tube, secure the minimum radius with which tube can be bent.
4. When using an optional solenoid valve, add the mass of solenoid valve to mass of hand and set to parameter: HNDDAT. (RH-3FHR series only)
5. The hand tube (four $\phi 3$ tubes) and the hand input cable (4 point) are prepared optional. Please confirm that there is no rubbing or crack etc per six months.

Fig.2-64 : Example of wiring and piping <1> (Hanging installation type)

(5) Wiring and piping example <2>

This is an effective method in cases where the wiring and piping is often changed, or when the hand rotation is minimal (within $\pm 90^\circ$), etc.

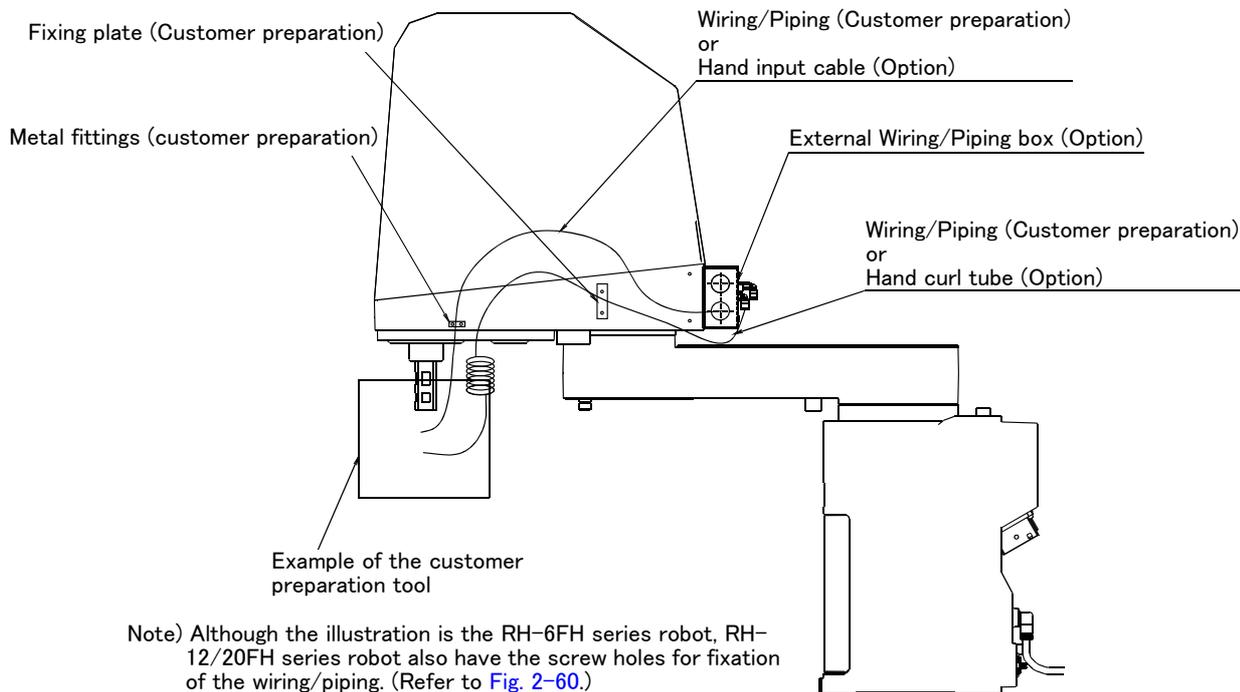


Fig.2-65 : Example of wiring and piping <2>

(6) Precautions for the oil mist/clean specification

The through hole of the top part of the tip shaft are taped at shipment.

Perform the following actions as necessary in order to ensure that the robot keeps sufficiently protective performance during the operation:

- 1) When the through hole of the shaft is not used
 - Keep the top part of the tip shaft taped while the robot is in use.
- 2) When the through hole of the shaft is used for wiring.
 - Remove the rubber cap on top of the tip shaft and perform the necessary wiring. Once the wiring is completed, seal the bottom part of the tip shaft using liquid seal in order to avoid accumulation of dust and to protect from oil mist
 - Perform the wiring in such a way that the wires around the area below the tip shaft will not get into contact with other parts while the robot is operating.

2.5.8 Wiring and piping system diagram for hand

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

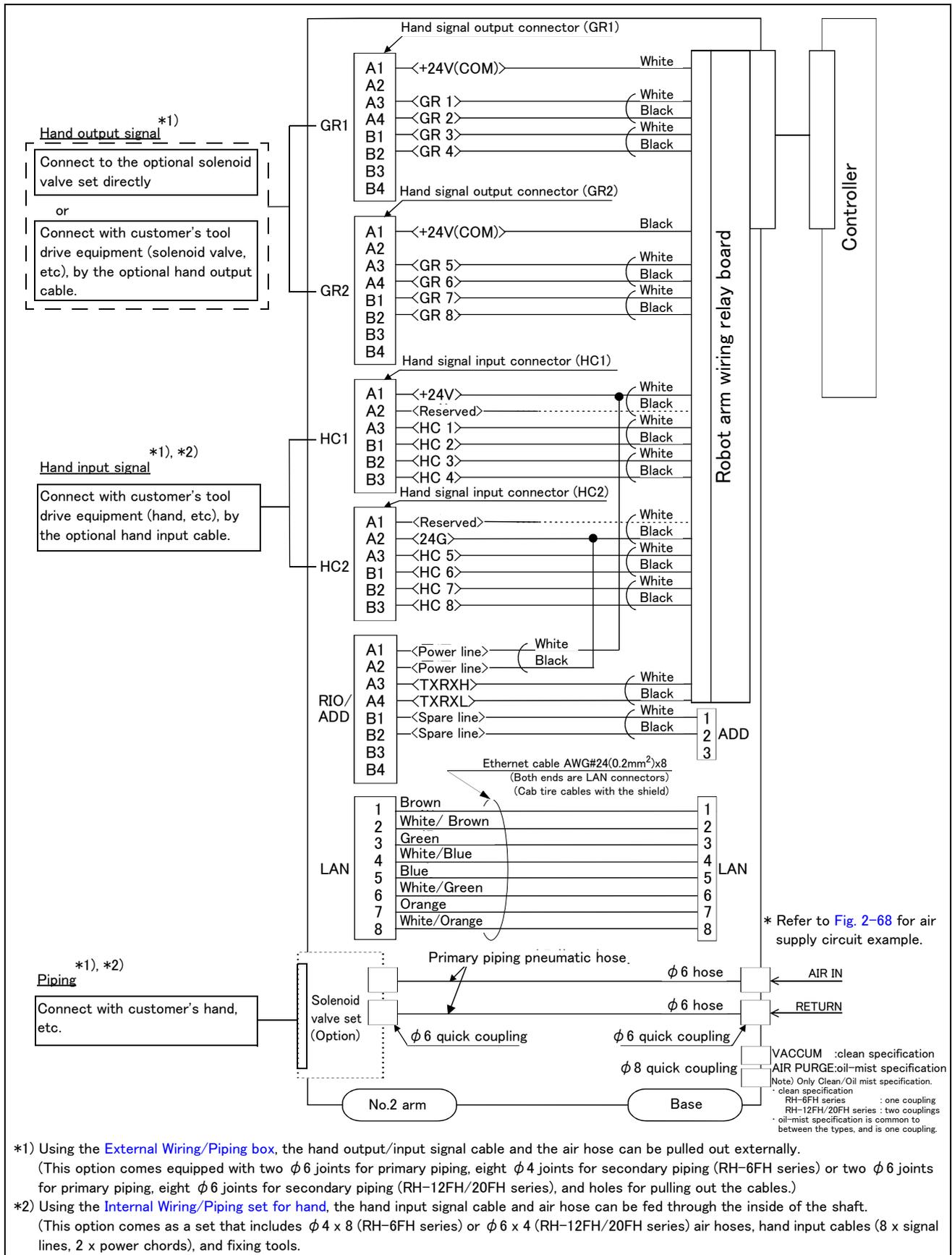


Fig.2-66 : Wiring and piping system diagram for hand and example the solenoid valve installation (RH-6FH/12FH/20FH series)

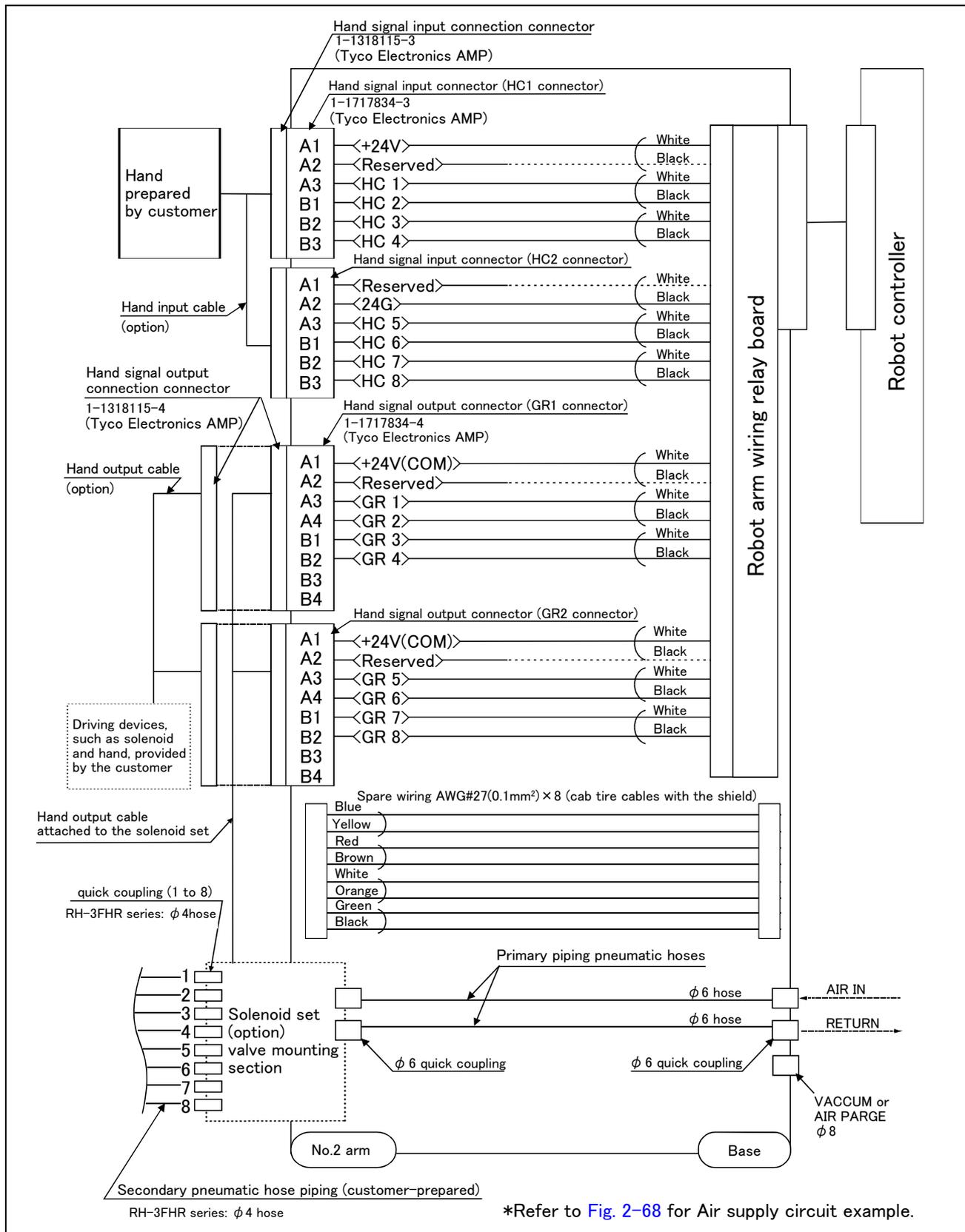


Fig.2-67 : Wiring and piping system diagram for hand and example the solenoid valve installation (RH-3FHR series)

2.5.9 Electrical specifications of hand input/output

Table 2-14 : Electrical specifications of input circuit

| Item | Specifications | Internal circuit | |
|-------------------------|---|---|----------------------|
| Type | DC input | <div style="display: flex; flex-direction: column; align-items: center;"> <div style="margin-bottom: 20px;"> <p><Sink type></p> </div> <div> <p><Source type></p> </div> </div> <p>* HCn = HC1 to HC8</p> | |
| No. of input points | 8 | | |
| Insulation method | Photo-coupler insulation | | |
| Rated input voltage | 24VDC | | |
| Rated input current | approx. 7mA | | |
| Working voltage range | DC10.2 to 26.4V (ripple rate within 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 (DC24V) |
| | ON-OFF | | 10ms or less (DC24V) |

Table 2-15 : Electrical specifications of output circuit

| Item | Specification | Internal circuit | |
|------------------------------------|----------------------------------|---|--|
| Type | Transistor output | <div style="display: flex; flex-direction: column; align-items: center;"> <div style="margin-bottom: 20px;"> <p><Sink type></p> </div> <div> <p><Source type></p> </div> </div> <p>* GRn = GR1 to 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 | | 2ms or less (resistance load) (hardware response time) |
| Protects | Protects the over-current (0.9A) | | |

2.5.10 Air supply circuit example for the hand

An example of pneumatic supply circuitry for the hand is shown below.

- (1) Make sure that a surge voltage protection circuit such as a diode is connected to the solenoid coil in parallel.
- (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. 2-68 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.
- (5) If the air supply temperature (primary piping) used for the tool etc. is lower than ambient air temperature, the dew condensation may occur on the coupling or the hose surface.

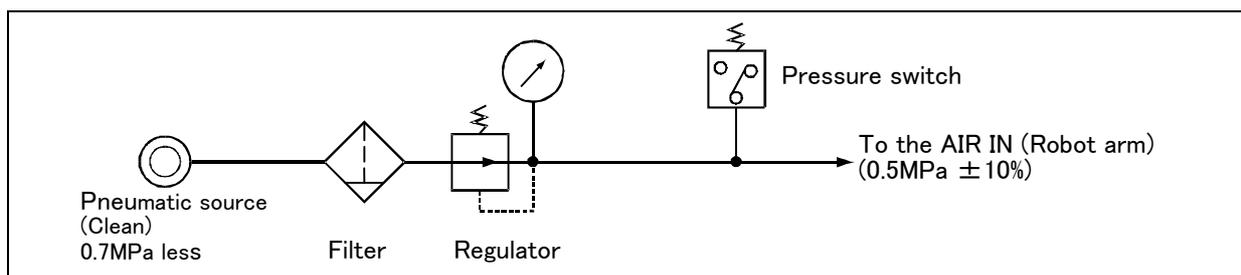


Fig.2-68 : Air supply circuit example for the hand

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 before shipping from the factory. Consequently, it is necessary to confirm the delivery date by the customer.

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) Specify, before shipping from our company.
- (3) Specified method ····· Specify the part name, model, and robot model type.

(1) Machine cable

- Order type : ● Fixed type..... CR750 drive unit: 1S-02UCBL-01 (2m)
CR751 drive unit: 1F-02UCBL-02 (2m)

■ Outline

<CR750 drive unit>



<CR751 drive unit>



This cable is exchanged for the machine cable (5 m for fixed type) that was supplied as standard to shorten the distance between the controller and the robot arm.

■ Configuration

Table 2-16 : Configuration equipment and types

| Part name | | Type | Qty. | Mass (Kg) ^{Note1)} | Remarks ^{Note2)} |
|-------------------|--------------------------------|--------------|-----------|-----------------------------|---------------------------|
| CR750 drive unit | | | | | |
| Fixed | Set of signal and power cables | 1S-02UCBL-01 | 1 set | 3.4 | 2m |
| | Motor signal cable | | (1 cable) | - | |
| | Motor power cable | | (1 cable) | - | |
| RCR751 drive unit | | | | | |
| Fixed | Set of signal and power cables | 1F-02UCBL-02 | 1 set | 2.6 | 2m |
| | Motor signal cable | | (1 cable) | - | |
| | Motor power cable | | (1 cable) | - | |

Note1) Mass indicates one set.

Note2) Standard 5 m (for fixed type) is not attached.

[Caution] Orders made after purchasing a robot are treated as purchases of optional equipment. In this case, the machine cable (5 m for fixed type) that was supplied as standard is not reclaimed.

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".

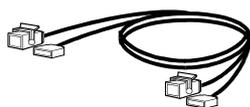
1. Set optionsA combination of single options and parts that together, from a set for serving some purpose.
2. Single optionsThat are configured from the fewest number of required units of a part. Please choose customer's purpose additionally.

(1) Machine cable extension

- Order type:
 - CR750 drive unit.....Fixed type: 1S- □□ CBL-01 (extension type)
 - Flexed type: 1S- □□ LCBL-01 (extension type)
 - Flexed type: 1S- □□ LUCBL-01 (direct type)
 - CR751 drive unit.....Fixed type: 1F- □□ UCBL-02 (direct type)
 - Flexed type: 1F- □□ LUCBL-02 (direct type)
 Note) □□ refer the length.

■ Outline

<CR750drive unit>



<CR751drive unit>



The distance between the robot controller and the robot arm is extensible by this option.

A fixed type and flexible type are available.

The fix and flexible types are both configured of the motor signal cable and motor power cable.

The extended method is discriminated as follows.

Direct type * Exchanges with the machine cable attached in the standards.

Extension type..... * Adds to the machine cable attached in the standards.

■ Configuration

Table 2-17 : Configuration equipment and types

| Part name | Type Note1) | Qty. | | Mass (kg) Note2) | Remarks |
|---------------------------------------|--------------------|-----------|-----------|---------------------|---------------------------------------|
| | | Fixed | Flexed | | |
| CR750 drive unit | | | | | |
| Fixed Set of signal and power cables | 1S- □□ CBL-01 | 1 set | - | 6.7(5m) | 5m, 10m or 15m each Extension type |
| | Motor signal cable | (1 cable) | - | 12(10m) | |
| | Motor power cable | (1 cable) | - | 17(15m) | |
| Flexed Set of signal and power cables | 1S- □□ LCBL-01 | - | 1 set | 7(5m) | 5m, 10m or 15m each Extension type |
| | Motor signal cable | - | (1 cable) | 13(10m) | |
| | Motor power cable | - | (1 cable) | 17(15m) | |
| Flexed Set of signal and power cables | 1S- □□ LUCBL-01 | - | 1 set | 7(5m) | 5m, 10m or 15m each Direct type |
| | Motor signal cable | - | (1 cable) | 13(10m) | |
| | Motor power cable | - | (1 cable) | 17(15m) | |
| Nylon clamp | NK-14N | - | 2 pcs. | - | for motor signal cable |
| Nylon clamp | NK-18N | - | 2 pcs. | - | for motor power cable |
| Silicon rubber | | - | 4 pcs | - | |
| CR751 drive unit | | | | | |
| Fixed Set of signal and power cables | 1F- □□ UCBL-02 | 1 set | - | 6.7(10m) | 10m, 15m or 20m each Direct type |
| | Motor signal cable | (1 cable) | - | 12(15m) | |
| | Motor power cable | (1 cable) | - | 17(20m) | |
| Flexed Set of signal and power cables | 1F- □□ LUCBL-02 | - | 1 set | 7(10m) | 10m, 15m or 20m each Direct type |
| | Motor signal cable | - | (1 cable) | 13(15m) | |
| | Motor power cable | - | (1 cable) | 17(20m) | |
| Nylon clamp | NK-14N | - | 2 pcs. | - | for motor signal cable |
| Nylon clamp | NK-18N | - | 2 pcs. | - | for motor power cable |
| Silicon rubber | | - | 4 pcs | - | |

Note1) The numbers in the boxes □□ refer the length.

Note2) Mass indicates one set.

■ 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 2-18](#).

Table 2-18 : Conditions for the flexed type cables

| Item | | Specifications | |
|-----------------------------------|--------------------|---|--|
| Cable | | 1S- □□ LCBL-01 1S- □□ LUCBL-01 | 1F- □□ LUCBL-02 |
| Minimum flexed radius | | 100mm or more | |
| Cableveyor, etc., occupation rate | | 50% or less | |
| Maximum movement speed | | 2,000mm/s or less | |
| Guidance of life count | | 7.5 million times (With silicone grease coating) | |
| Environmental proof | | IP54 | IP54 (except for the area approximately 500 mm from the end of the connector on the controller side) |
| Cable configuration | Motor signal cable | $\phi 6 \times 5$, $\phi 8.5 \times 1$, and $\phi 1.7 \times 1$ | $\phi 6 \times 7$ and $\phi 1.7 \times 1$ |
| | Motor power cable | $\phi 8.9 \times 2$ and $\phi 6.5 \times 8$ | $\phi 6.5 \times 8$ and $\phi 8.9 \times 2$ |

[Caution] The guidance of life count may greatly differ according to the usage state items related to [Table 2-18](#) and to the amount of silicon grease applied in the cableveyor.

Recommendation grease: G-501 (Supplier: Shin-Etsu Chemical Co., Ltd.)

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

[Caution] When a cableveyor is used, partitions are required to avoid overlapping or riding up of the cables. Also, adjust the cable length to eliminate tension or excessive looseness, and fix it securely.

■ Cable configuration

The configuration of the flexible cable is shown in [Table 2-19](#). Refer to this table when selecting the cableveyor.
The configuration is the same between the length difference in the cable, and extension type / direct type.

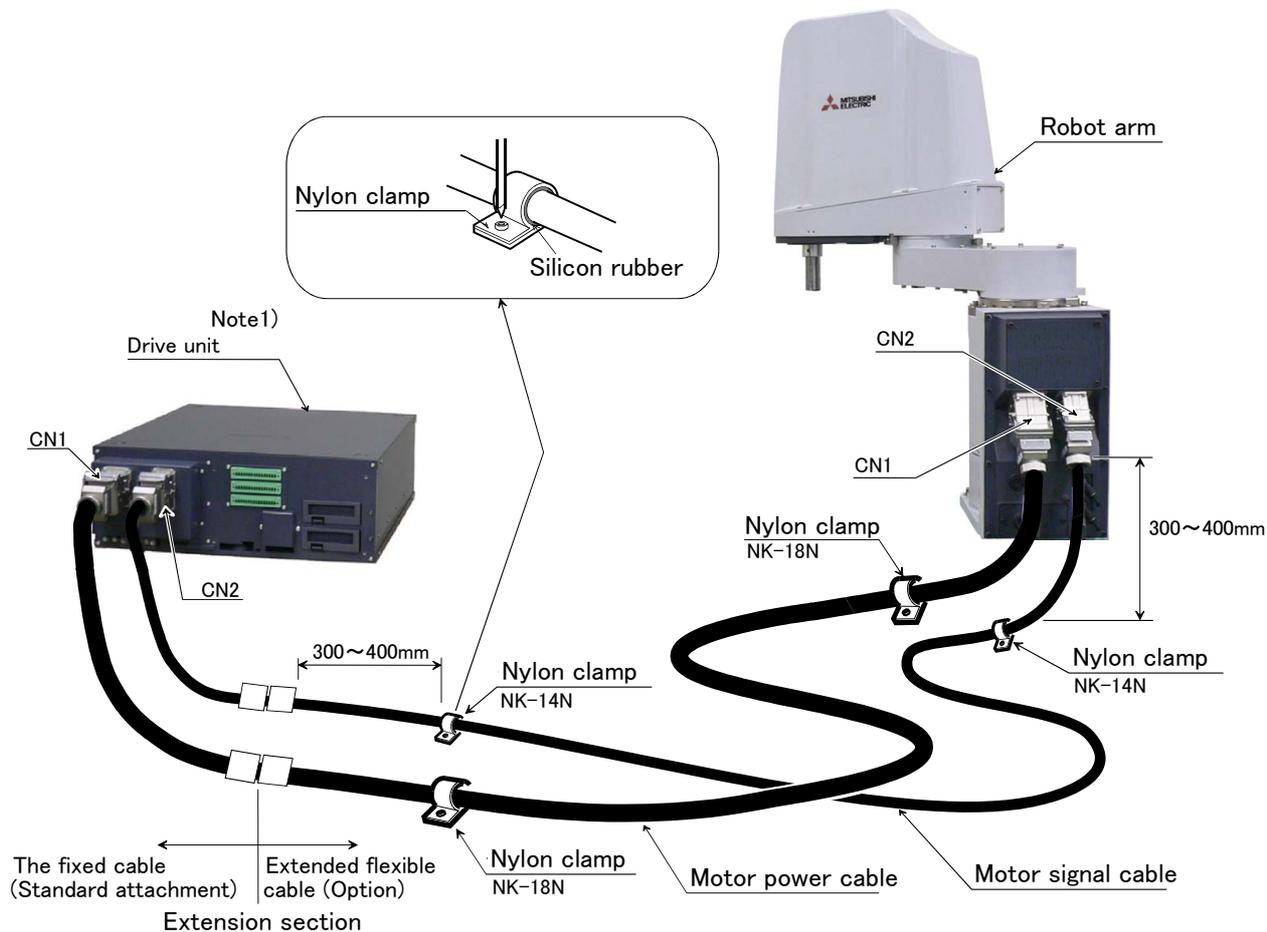
Table 2-19 : Cable configuration (Flexed type)

| Item | Motor signal cable | | | Motor power cable | |
|--------------------|------------------------------------|------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|
| CR750 drive unit | | | | | |
| No. of cores | AWG#24 (0.2mm ²)-4P | AWG#24 (0.2mm ²)-7P | AWG#18 (0.75mm ²) | AWG#16 (1.25mm ²)-4C | AWG#18 (0.75mm ²)-4C |
| Finish dimensions | Approx. $\phi 6$ mm | Approx. $\phi 8.5$ mm | Approx. $\phi 1.7$ mm | Approx. $\phi 8.9$ mm | Approx. $\phi 6.5$ mm |
| No. of cables used | 5 cables | 1 cable | 1 cable | 3 cable | 6 cable |
| No. in total | 7 cables | | | 9 cables | |
| CR751 drive unit | | | | | |
| No. of cores | AWG#24 (0.2mm ²)-4P | AWG#18 (0.75mm ²) | AWG#16 (1.25mm ²)-4C | AWG#18 (0.75mm ²)-3C | |
| Finish dimensions | Approx. $\phi 6$ mm | Approx. $\phi 1.7$ mm | Approx. $\phi 8.9$ mm | Approx. $\phi 6.5$ mm | |
| No. of cables used | 7 cables | 1 cable | 2 cable | 8 cable | |
| No. in total | 8 cables | | 10 cables | | |

■ Fixing the flexible cable

<CR750 drive unit with RH-6/12/20FH series robot>

- (1) Connect the connector to the robot arm.
The connection method to a robot arm is the same as a standard machine cable. Please refer to the separate "Instruction Manual/ROBOT ARM SETUP & MAINTENANCE" and connect.
- (2) Wind the silicon rubber around the cable at a position 300 to 400 mm from the side of robot arm and extension section as shown below, and fix with the nylon clamp to protect the cable from external stress.



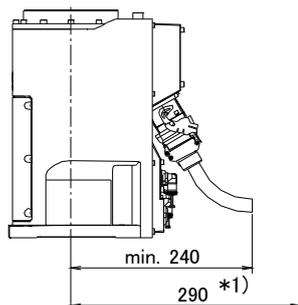
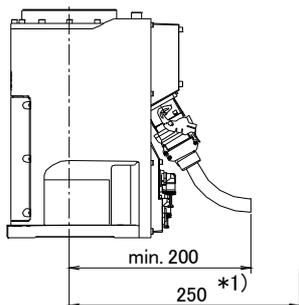
Note1) Although the picture is the CR751-D controller, also the connection method is the same in the CR751-Q controller.

CAUTION Cover the extension terminal area with the cover etc. so that it may not be easily touched to the latch lever.

The bend size of cables are as follows.

<RH-6FH series>

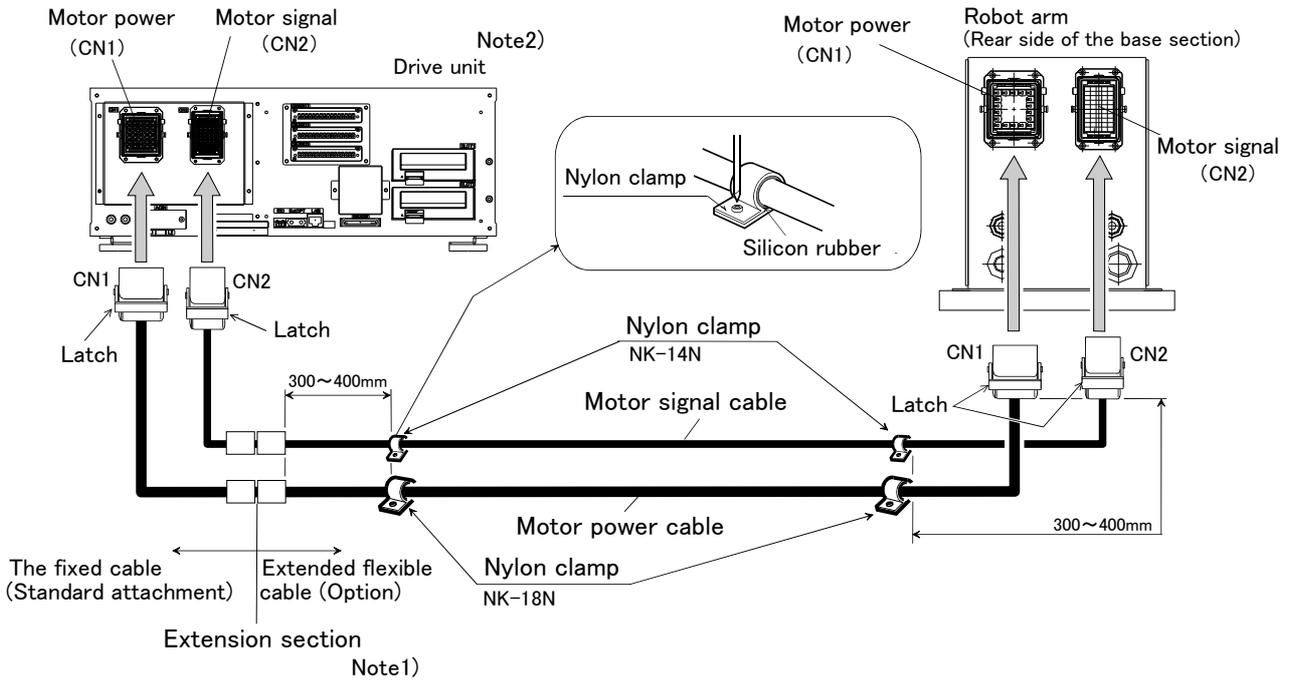
<RH-12/20FH series>



*1) The connection space for a machine cable.

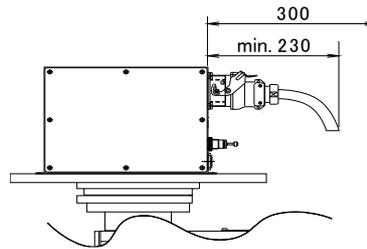
Fig.2-69 : Fixing the flexible cable (CR750 drive unit with RH-6/12/20FH series robot)

<CR750 drive unit with RH-3FHR series robot>



CAUTION

Cover the extension terminal area with the cover etc. so that it may not be easily touched to the latch lever.



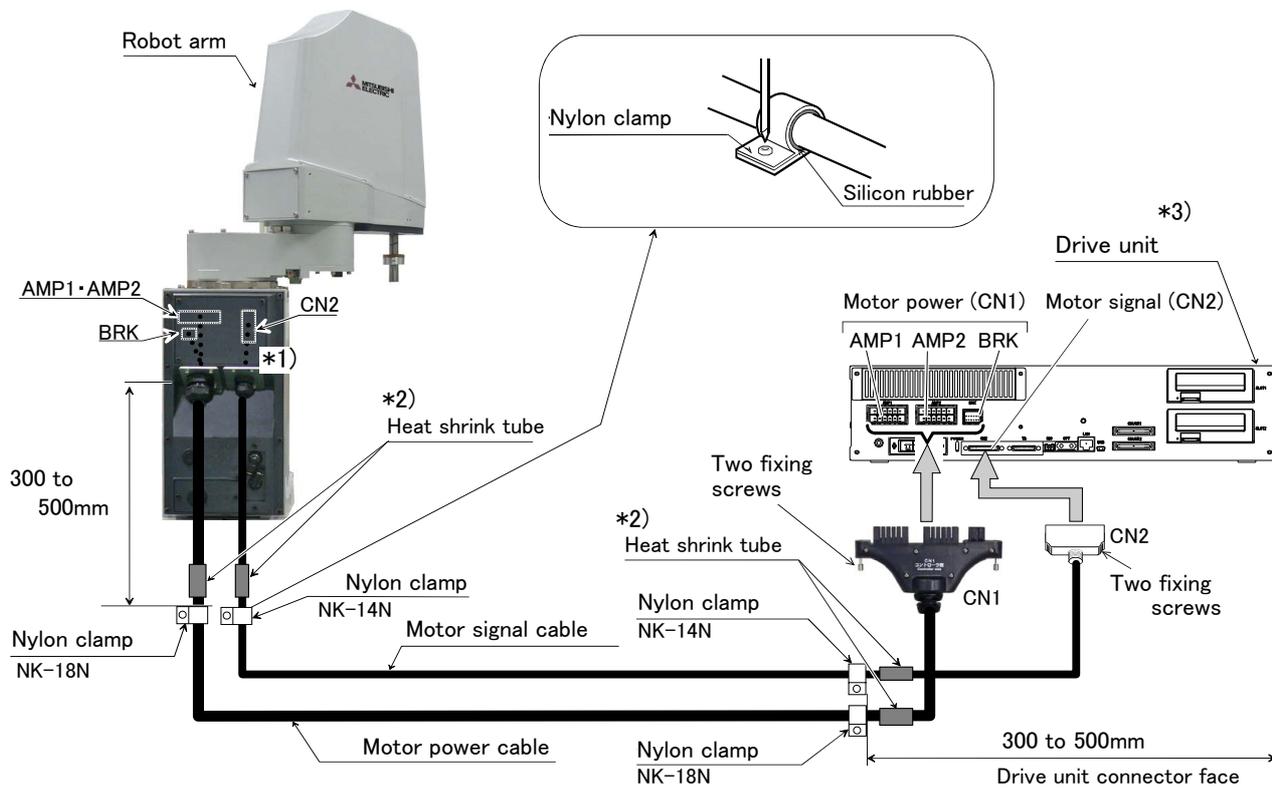
The cable should bend and the size should be 230mm or more. And a connection space for a machine cable needs 300mm or more.

- Note1) When direct type, exchanges with the standard cable and connect directly.
 Note2) Although the picture is the CR751-D controller, also the connection method is the same in the CR751-Q controller.

Fig.2-70 : Fixing the flexible cable (CR750 drive unit with RH-3FHR series robot)

<CR751 drive unit with RH-6/12/20FH series robot>

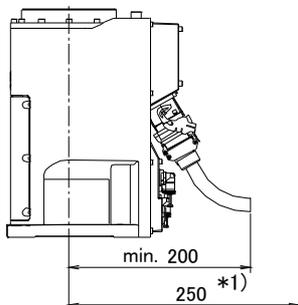
- (1) Connect the connector to the robot arm.
The connection method to a robot arm is the same as a standard machine cable. Please refer to the separate "Instruction Manual/ROBOT ARM SETUP & MAINTENANCE" and connect.
- (2) For protection of wires from external stress, refer to following. Wrap the cable with the supplied silicon rubber and fix the cable with nylon clamps in the area between the heat shrink tubes on the robot and the controller sides (flexible cable area).



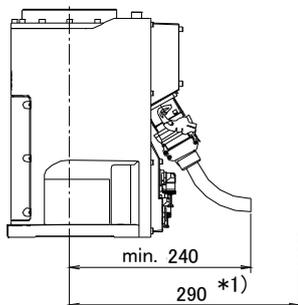
- *1) Connect the robot arm side connector to the connector which is inside the CONBOX cover.
- *2) The flexible cable area is the area between the heat shrink tubes on the robot and the drive unit sides.
- *3) Although the figure is CR750-D, the connection method is the same also in CR750-Q.

The bend size of cables are as follows.

<RH-6FH series>



<RH-12/20FH series>



*1) The connection space for a machine cable.

Fig.2-71 : Fixing the flexible cable (CR751 drive unit with RH-6/12/20FH series robot)

<CR751 drive unit with RH-3FHR series robot>

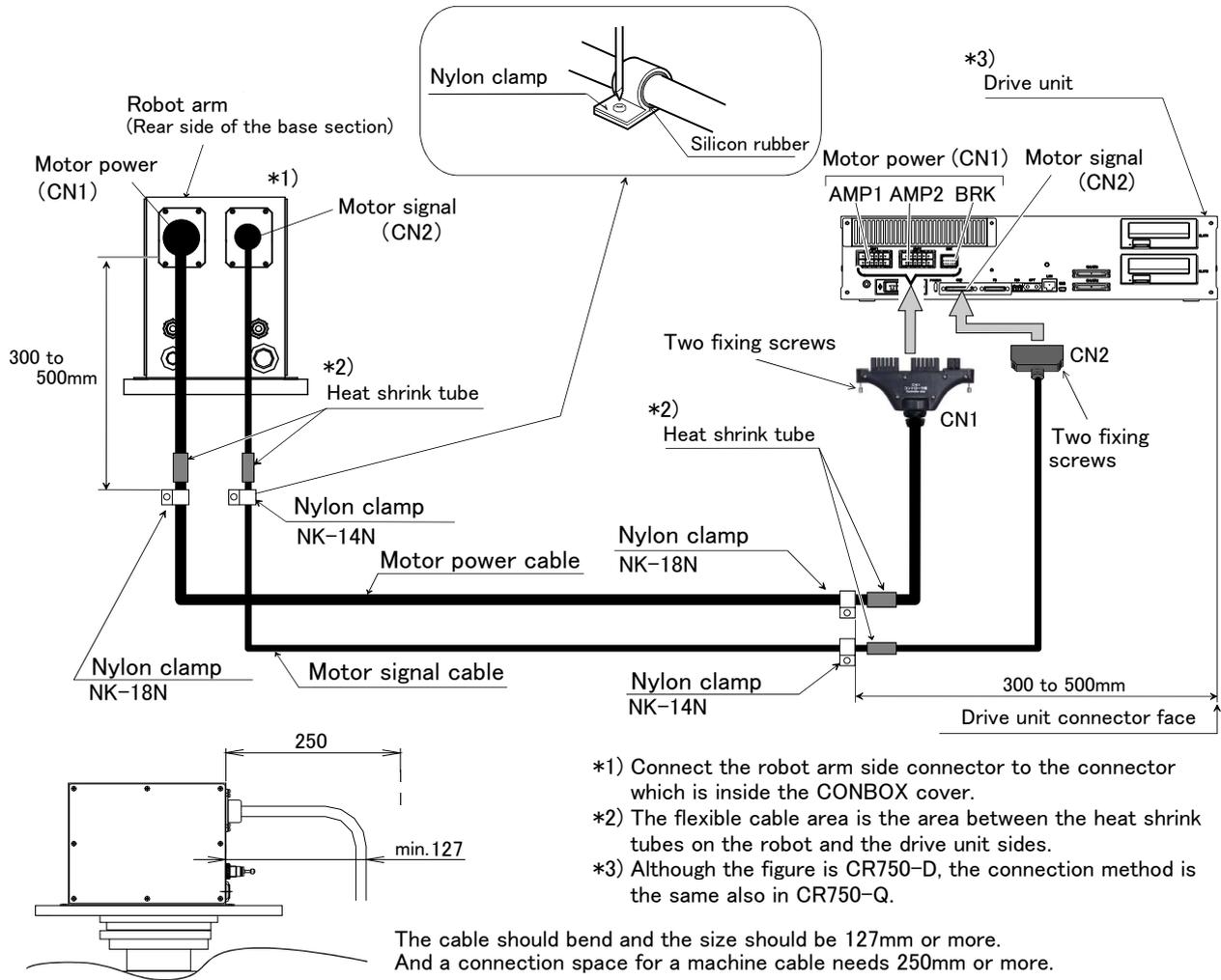


Fig.2-72 : Fixing the flexible cable (CR751 drive unit with RH-3FHR series robot)

(2) Stopper for changing the operating range

- Order type: RH-6FH seriesJ1 axis: 1F-DH-01
 RH-12FH/20FH series.....J1 axis: 1F-DH-02
 RH-3FHR series.....J1 axis: 1S-DH-05J1
 J2 axis: 1S-DH-05J2

■ Outline

RH-6FH/12FH/20FH series



The operating range axis is limited by the robot arm's mechanical stopper and the controller parameters.

You can change the operating range of the RH-6FH/12FH/20FH series robot's J1 axis. And the RH-3FHR series robot, you can change the operating range of J1 and J2 axis.

RH-3FHR series



If the axis could interfere with the peripheral devices, etc., and the operating range need to be limited, use this.

■ Configuration

Table 2-20 : Configuration devices

| Part name | Type | Qty. | Mass(kg) | Remarks |
|--|------------|-------|----------|--|
| RH-6FH series | | | | |
| Stopper for changing the operating range | 1F-DH-01 | 1 set | 0.05 | hexagon socket head bolt (M10 x 20): 2 bolts |
| RH-12FH/20FH series | | | | |
| Stopper for changing the operating range | 1F-DH-02 | 1 set | 0.05 | hexagon socket head bolt (M12 x 20): 2 bolts |
| RH-3FHR series | | | | |
| Stopper for changing the operating range | 1S-DH-05J1 | 1 set | 0.1 | Pin (φ 10 x 2) Installation bolt (M4 x 12): two attachments |
| | 1S-DH-05J2 | 1 set | 0.1 | Pin (φ 8 x 2) Installation bolt (M4 x 12): two attachments |

■ Specifications

Table 2-21 : Specifications

| Axis | Standard | Changeable angle |
|----------------------------------|----------|---------------------------------------|
| RH-6FH/12FH/20FH series | | |
| J1 | +/- side | +/- 170 deg, +/- 130 deg, +/- 150 deg |
| RH-3FHR series ^{Note1)} | | |
| J1 | +/- side | +/- 225 deg, +/- 90 deg |
| J2 | +/- side | +/- 225 deg, +/- 60 deg |

Note1) Although the J1 axis and the J2 axis can be changed independently (independent per axis), each axis changes plus side /minus side both simultaneously per axis.

- (1) The changeable angle shown in Table 2-21 indicates the operation range by the software. The limit by the mechanical stopper is positioned 3 degrees outward from that angle, so take care when designing the layout.
- (2) The operating range is changed with robot arm settings (insertion of the pin) and parameter settings. Refer to the separate "Instruction Manual/ROBOT ARM SETUP & MAINTENANCE" and "Instruction Manual/Detailed Explanation of Functions and Operations" for details.
- (3) If the arm collides with mechanical stopper for operating range change at the automatic operation, replacement of the mechanical stopper is necessary.

| Part name | Type | Q'ty | Mass(kg) Note1) | Remark |
|---|------------------------------|-------------------|--------------------|--|
| RH-3FHR series | | | | |
| Solenoid valve set (4 sets) For Standard specification | 1S-VD04-05/ 1S-VD04E-05 | Either one pc. | 0.6 | For Standard specification M5 x 8 Two screws (Installation screws) Fixing nut for T slot : Two nuts 1S-VD04-05: Sink type 1S-VD04E-05: Source type |
| Solenoid valve set (4 sets) For Clean/Waterproof specification | 1S-VD04W-05/ 1S-VD04WE-05 | Either one pc. | 0.6 | For Clean/Waterproof specification M5 x 8 Two screws (Installation screws) Fixing nut for T slot : Two nuts 1S-VD04W-05: Sink type 1S-VD04WE-05: Source type |

Note1) Mass indicates one set.

Specifications

Table 2-23 : Valve specifications

| Item | Specifications | |
|-------------------------------------|---|-----------------------------|
| Solenoid valve set type | 1F-VD0*-01, 1F-VD0*E-01 1S-VD04-05, 1S-VD04E-05 1S-VD04W-05, 1S-VD04WE-05 | 1S-VD0*-01, 1S-VD0*E-01 |
| Number of positions | 2 | |
| Port | 5 Note1) | |
| Valve function | Double solenoid | |
| Operating fluid | Clean air Note2) | |
| Operating method | Internal pilot method | |
| Effective sectional area (CV value) | 1.1mm ² (0.06) | 7.92mm ² (0.44) |
| Oiling | Unnecessary | |
| Operating pressure range | 0.1 to 0.7MPa | |
| Response time | 15msec or less (at 0.5 MPa) | 22msec or less (at 0.5 MPa) |
| Max. operating frequency | 10Hz | 5Hz |
| Ambient temperature | -10 to 50 °C (However, there must be no condensation.) | |

Note1) Couplings of unused solenoid valves must be blocked with plugs. If they are not blocked, supplied air will blow out from the couplings, lowering the air pressure of the solenoid valves being used and making them nonfunctional.

Recommended plugs: KQ2P-04 plug (RH-6FH series, RH-3FHR series) made by SMC
KQ2P-06 plug (RH-12FH/20FH series) made by SMC.

Note2)

 **CAUTION** The air to be provided must be clean, i.e., filtered with a mist separator or air filter. Failing to do so may lead to malfunctions.

Table 2-24 : Solenoid specifications

| Item | Specifications |
|--|---|
| Method | Built-in fly-wheel diodes with surge protection |
| Coil rated voltage | DC24V ±10% |
| Power consumption | 0.55W |
| Voltage protection circuit with power surge protection | Diode |

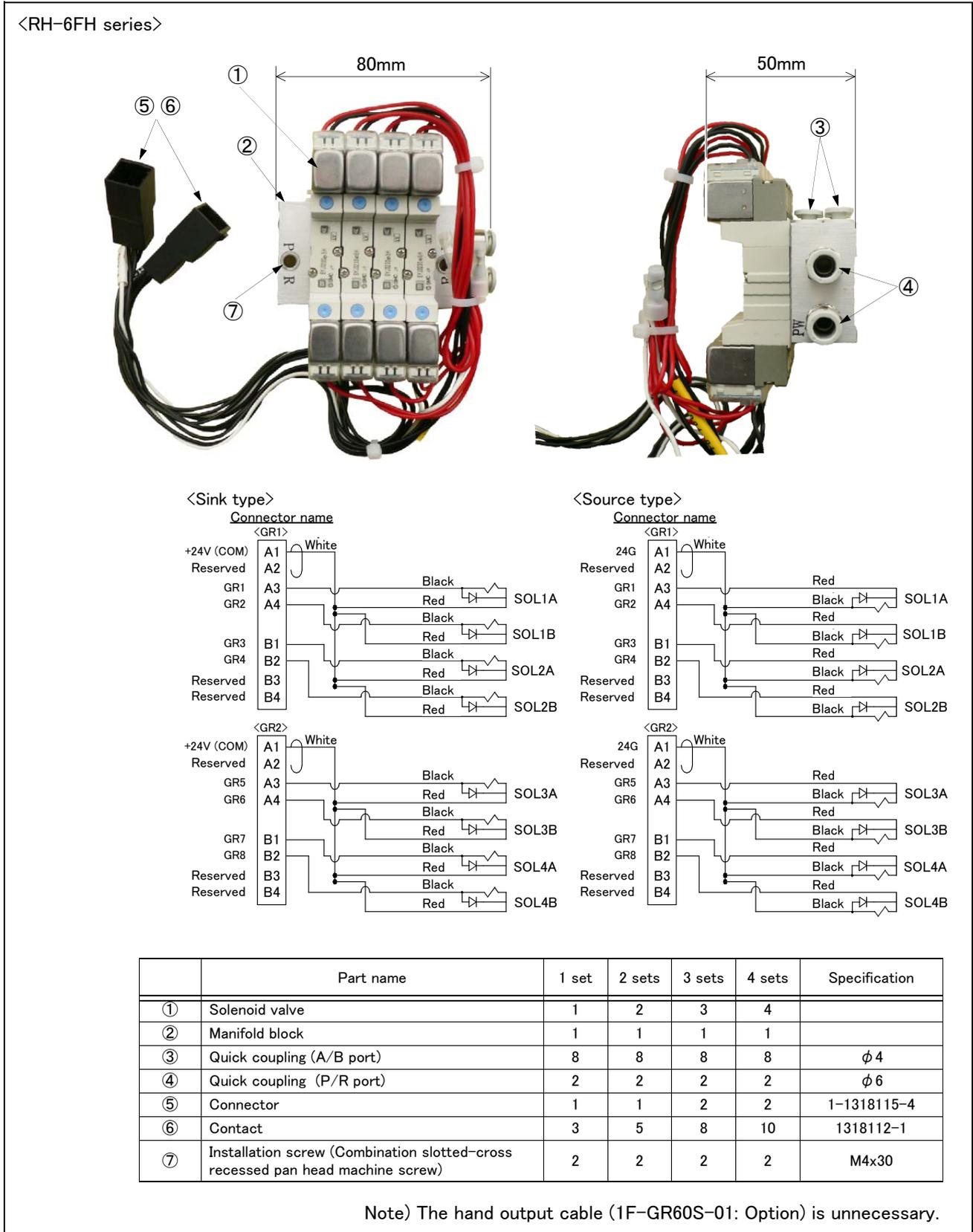


Fig.2-73 : Outline dimensional drawing (RH-6FH series)

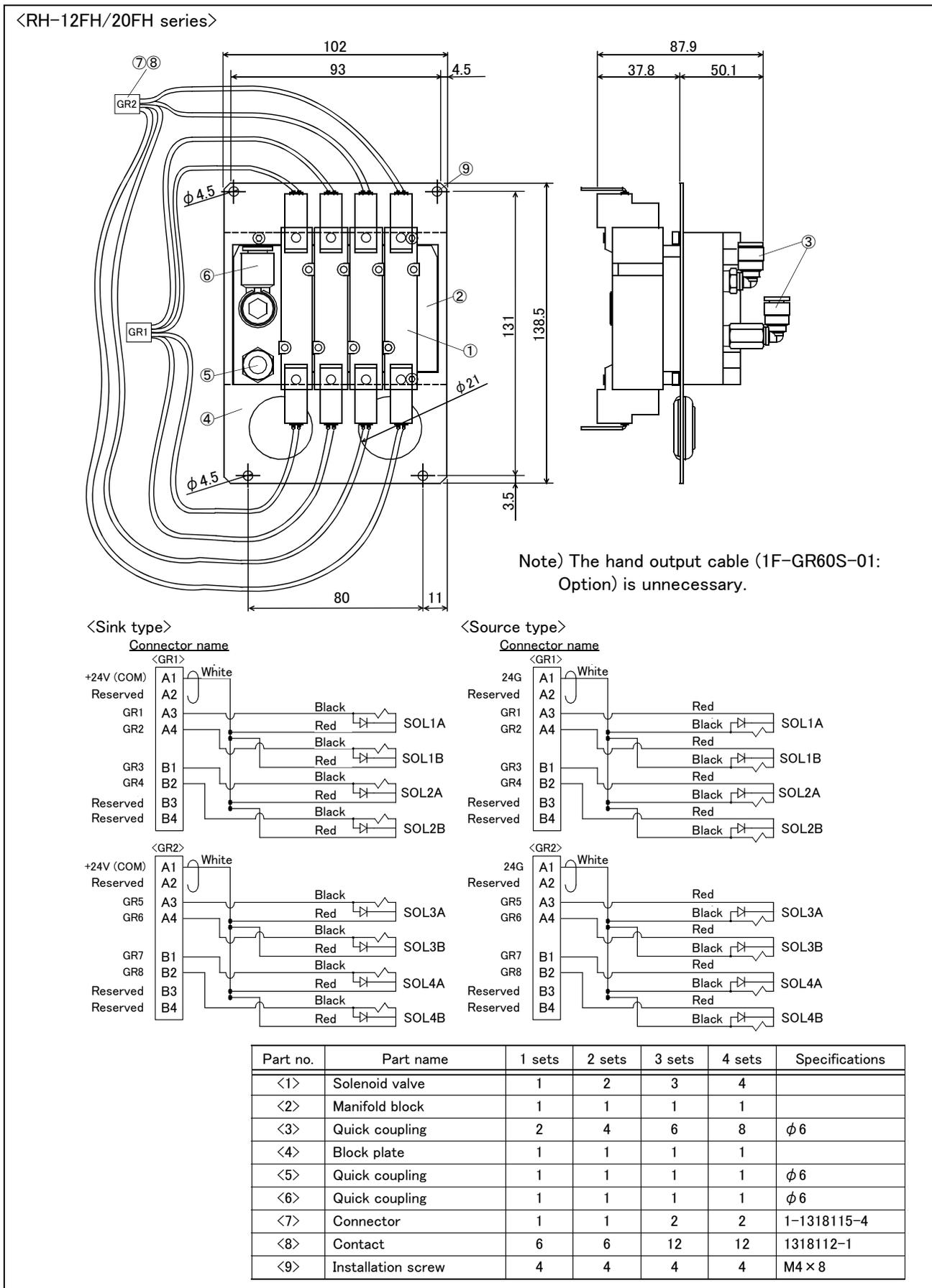


Fig.2-74 : Outline dimensional drawing (RH-12FH/20FH series)

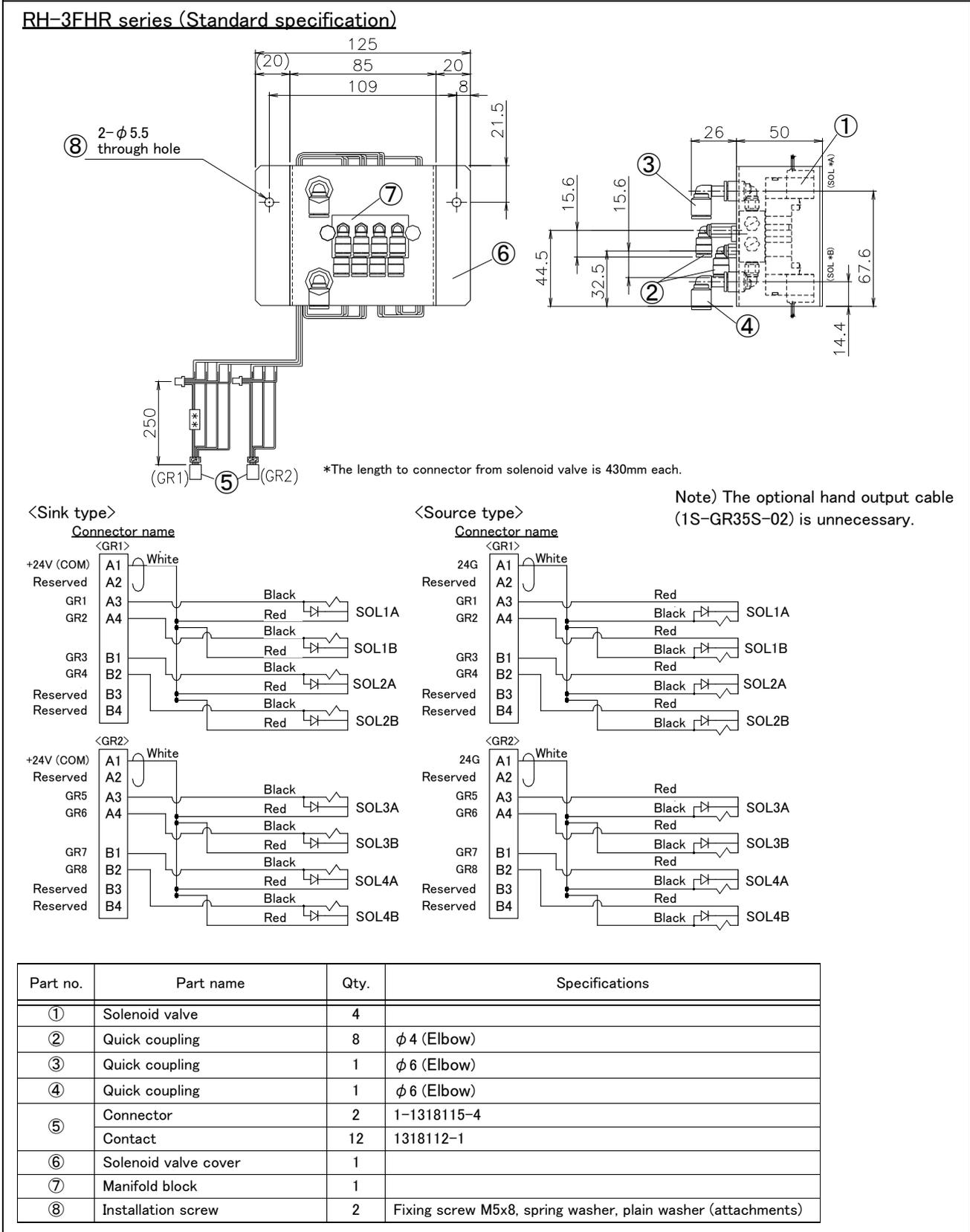
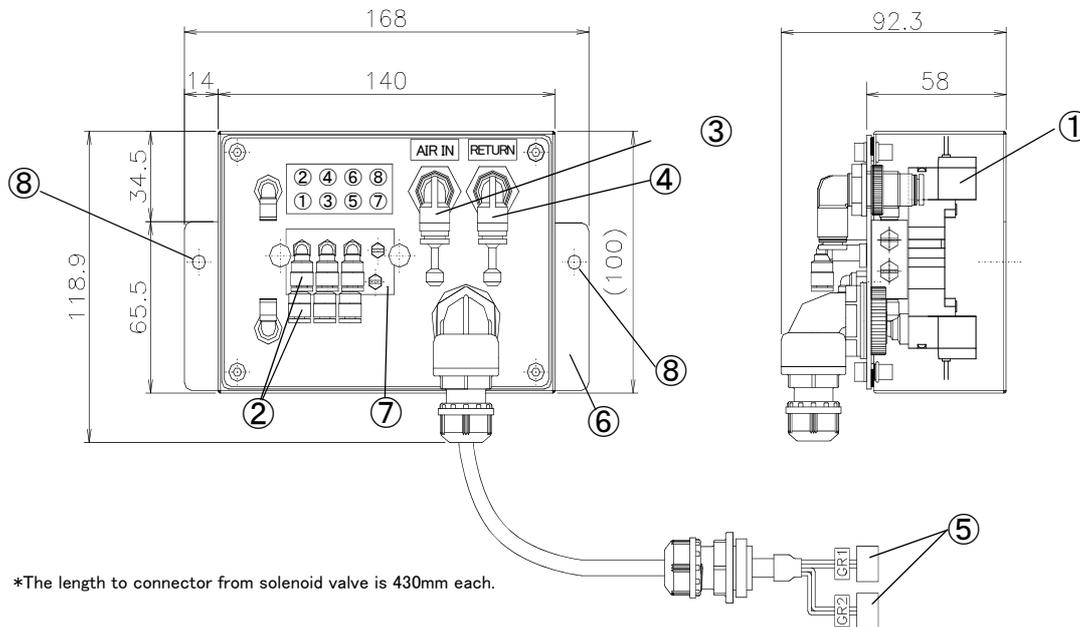
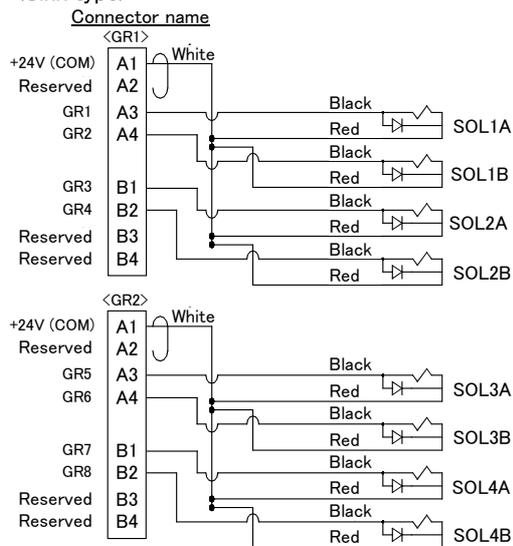


Fig.2-75 : Outline dimensional drawing (RH-3FHR series: Standard specification)

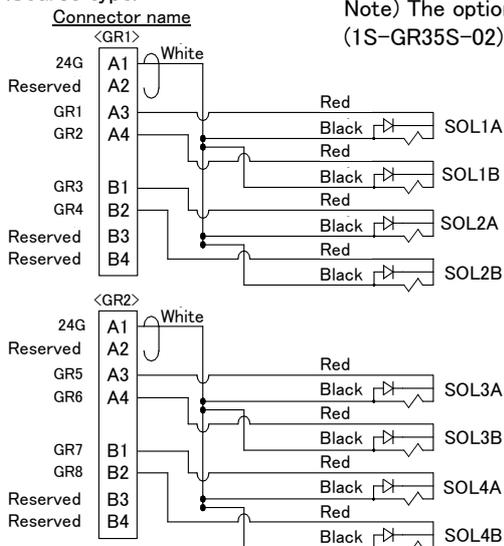
RH-3FHR series (Clean/Waterproof specification)



<Sink type>



<Source type>



Note) The optional hand output cable (1S-GR35S-02) is unnecessary.

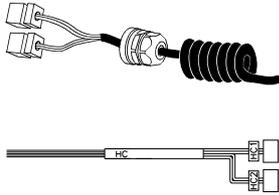
| Part no. | Part name | Qty. | Specifications |
|----------|----------------------|------|--|
| ① | Solenoid valve | 4 | |
| ② | Quick coupling | 8 | φ 4 (Elbow) |
| ③ | Quick coupling | 1 | φ 6 (Elbow) |
| ④ | Quick coupling | 1 | φ 6 (Elbow) |
| ⑤ | Connector | 2 | 1-1318115-4 |
| | Contact | 12 | 1318112-1 |
| ⑥ | Solenoid valve cover | 1 | |
| ⑦ | Manifold block | 1 | |
| ⑧ | Installation screw | 2 | Fixing screw M5x8, spring washer, plain washer (attachments) |

Fig.2-76 : Outline dimensional drawing (RH-3FHR series: Clean/Waterproof specification)

(4) Hand input cable

- Order type: RH-6FH series 1F-HC35C-01
 RH-12FH/20FH series 1F-HC35C-02
 RH-3FHR series 1S-HC00S-01

■ 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 connected to the sensor inside the hand customer designed.

To extend the wiring to the outside of the robot arm, optional external wiring and piping box (RH-6FH series: 1F-UT-BOX, RH-12FH/20FH series: 1F-UT-BOX-01) is required.

■ Configuration

Table 2-25 : Configuration equipment

| Part name | Type | Qty. | Mass (kg) ^{Note1)} | Remarks |
|---------------------|-------------|---------|-----------------------------|---|
| RH-6FH series | | | | |
| Hand input cable | 1F-HC35C-01 | 1 cable | 0.2 | |
| RH-12FH/20FH series | | | | |
| Hand input cable | 1F-HC35C-02 | 1 cable | 0.2 | |
| RH-3FHR series | | | | |
| Hand input cable | 1S-HC00S-01 | 1 cable | 0.1 | Three rubber sheets, seven cable clamp attachment |

Note1) Mass indicates one set.

■ Specifications

Table 2-26 : Specifications

| Item | Specifications | Remarks |
|---------------------|---|---|
| RH-6FH series | | |
| Size x cable core | AWG#24 (0.2mm ²) x 12 | One-sided connector, one-sided cable bridging |
| Total length | 1,650mm (Including the curl section, which is 350mm long) | |
| RH-12FH/20FH series | | |
| Size x cable core | AWG#24 (0.2mm ²) x 12 | One-sided connector, one-sided cable bridging |
| Total length | 1,800mm (Including the curl section, which is 350mm long) | |
| RH-3FHR series | | |
| Size x cable core | AWG#24 (0.2mm ²) x 6 | One-sided connector, one-sided cable bridging |
| Total length | 1,210mm | |

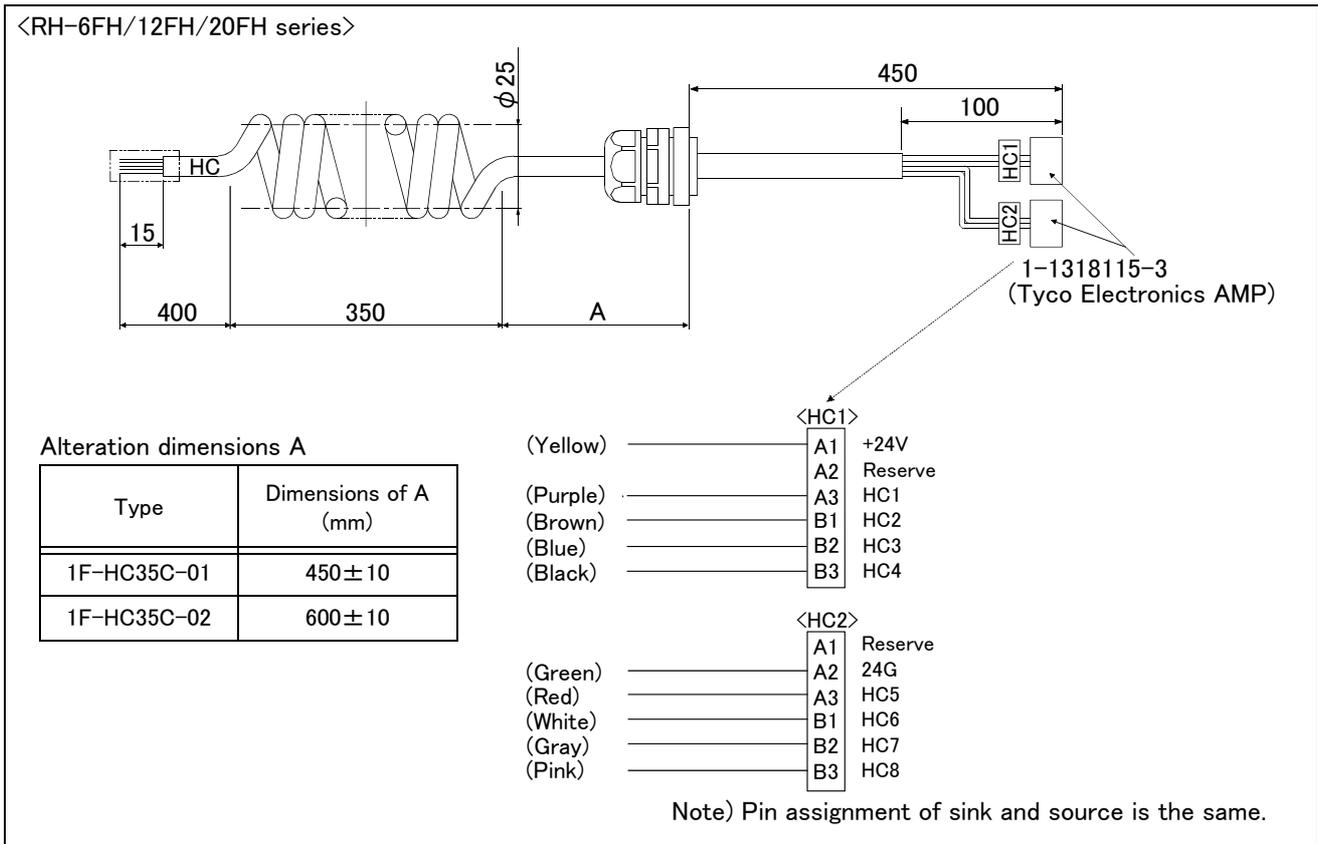


Fig.2-77 : Outside dimensional drawing and pin assignment (RH-6FH/12FH/20FH series)

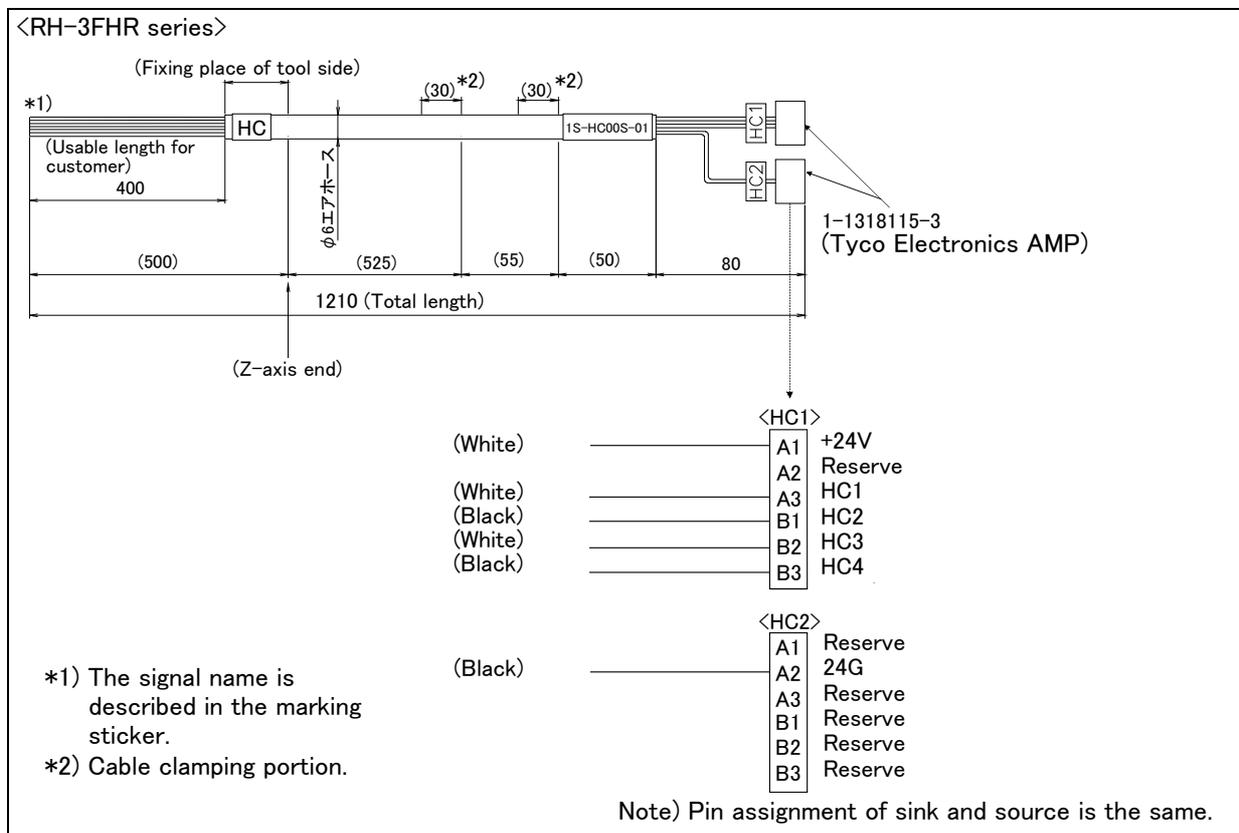


Fig.2-78 : Outside dimensional drawing and pin assignment (RH-3FHR series)

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

(5) Hand output cable

- Order type: RH-6FH/12FH/20FH series.....1F-GR60S-01
RH-3FHR series.....1S-GR35S-02

■ Outline



The hand output cable (solenoid valve connection cable) is an option that is used when a 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. To extend the wiring to the outside of the robot arm, optional external wiring and piping box (RH-6FH series: 1F-UT-BOX, RH-12FH/20FH series: 1F-UT-BOX-01) is required.

■ Configuration

Table 2-27 : Configuration equipment

| Part name | Type | Qty. | Mass (kg) ^{Note1)} | Remarks |
|-------------------|-------------|---------|-----------------------------|-----------------------------|
| Hand output cable | 1F-GR60S-01 | 1 cable | 0.3 | For RH-6FH/12FH/20FH series |
| Hand output cable | 1S-GR35S-02 | 1 cable | 0.2 | For RH-3FHR series |

Note1) Mass indicates one set.

■ Specifications

Table 2-28 : Specifications

| Item | Specifications | Remarks |
|-------------------|--|--|
| Size x Cable core | AWG#24(0.2mm ²) x 12 cores | One side connector and one side cable connection |
| Total length | 1,050mm | For RH-6FH/12FH/20FH series (1F-GR60S-01) |
| | 450mm | For RH-3FHR series (1S-GR35S-02) |

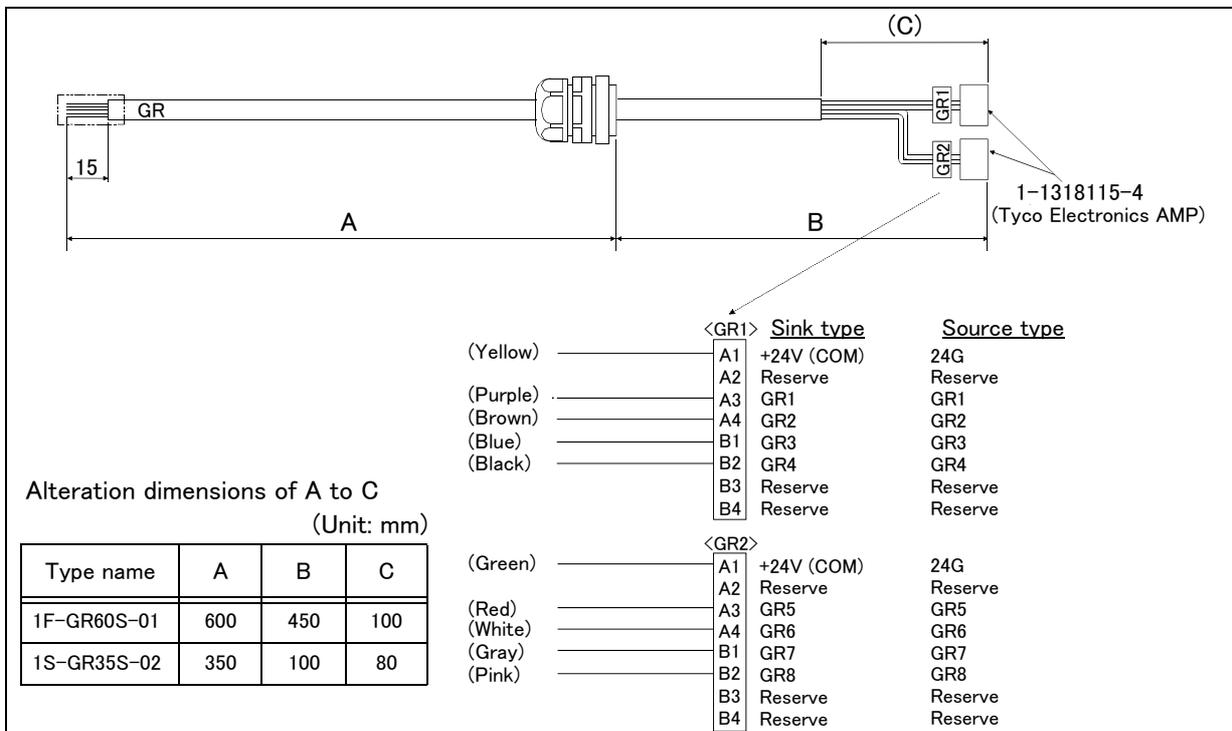


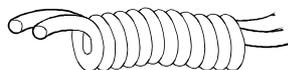
Fig.2-79 : Outline dimensional drawing and pin assignment

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

(6) Hand curl tube

- Order type: RH-6FH seriesFour sets: 1E-ST0408C-300
 RH-12FH/20FH seriesFour sets: 1N-ST0608C-01

Outline



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

Configuration

Table 2-29 : Configuration equipment

| Part name | Type | Qty. | Mass(kg) ^{Note1)} | Remarks |
|-----------------------------------|----------------|-------|----------------------------|---------------|
| RH-6FH series | | | | |
| Hand curl tube (Four set: 8 pcs.) | 1E-ST0408C-300 | 1 pc. | 0.1 | Φ4 tube, 8pcs |
| RH-12FH/20FH series | | | | |
| Hand curl tube (Four set: 8 pcs.) | 1N-ST0608C-01 | 1 pc. | 0.4 | Φ6 tube, 8pcs |

Note1) Mass indicates one set.

Specifications

Table 2-30 : Specifications

| Item | Specifications | |
|----------|--|--|
| | RH-6FH series | RH-12FH/20FH series |
| Material | Urethane | Urethane |
| Size | Outside diameter: Φ4 x Inside diameterΦ2.5 | Outside diameter: Φ6 x Inside diameterΦ4 |

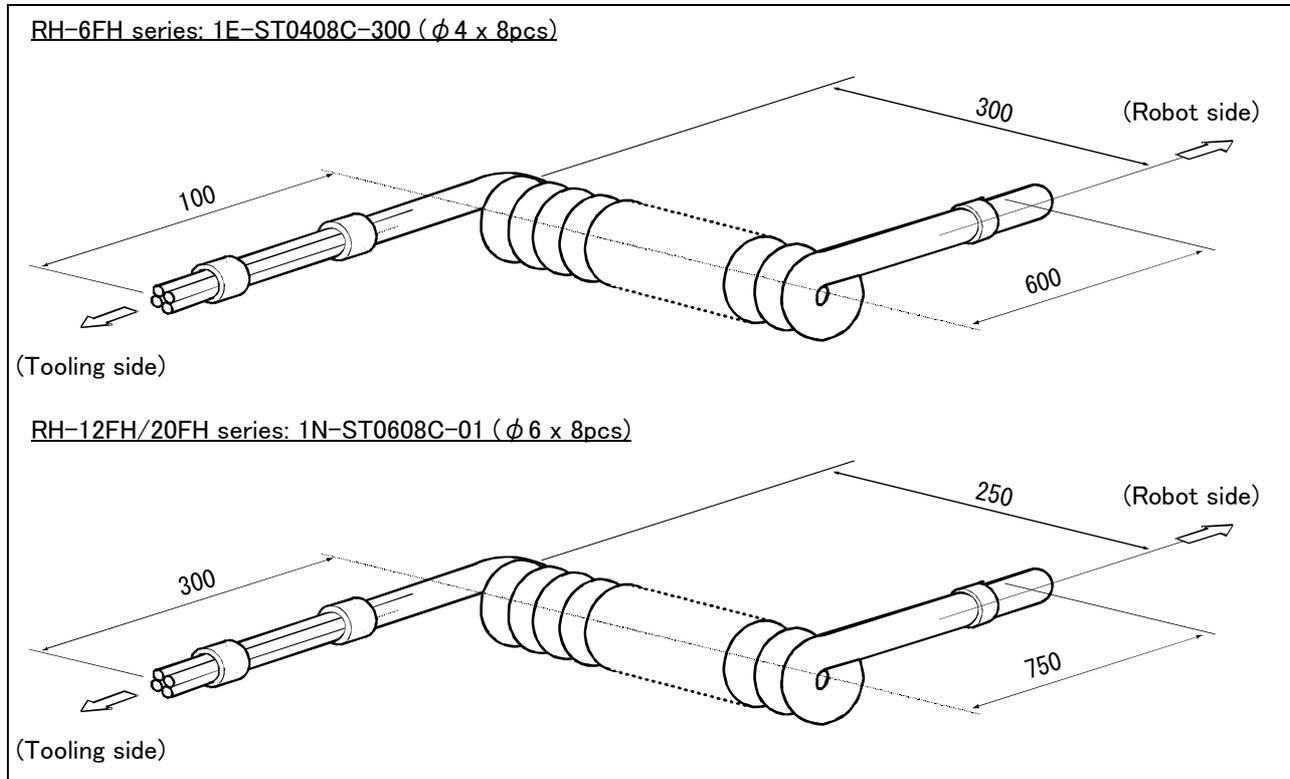


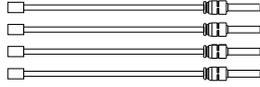
Fig.2-80 : Outline dimensional drawing

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

(7) Hand tube

■ Order type: RH-3FHR series1E-ST0304S

■ Outline



The hand tube is a tube for the pneumatic hand.

■ Configuration

Table 2-31 : Configuration equipment

| Part name | Type | Qty. | Mass(kg) ^{Note1)} | Remarks |
|--------------------|------------|-------|----------------------------|---|
| RH-3FHR series | | | | |
| Hand tube (4 pcs.) | 1E-ST0304S | 1 pc. | 0.1 | Union (φ 4 to φ 3): Eight piece attachment (Four of them is installing at shipping) Three rubber sheets, six cable clamp attachment |

Note1) Mass indicates one set.

■ Specifications

Table 2-32 : Specifications

| Item | Specifications | |
|----------|--|----------------------------|
| Material | Urethane | One side is with the tape. |
| Size | Outside diameter: Φ 3 x Inside diameterΦ 1.5: 4 pcs. | |

* We recommend confirming of the wear and tear and the rub in the cycle of the six months and please prepare as service parts.

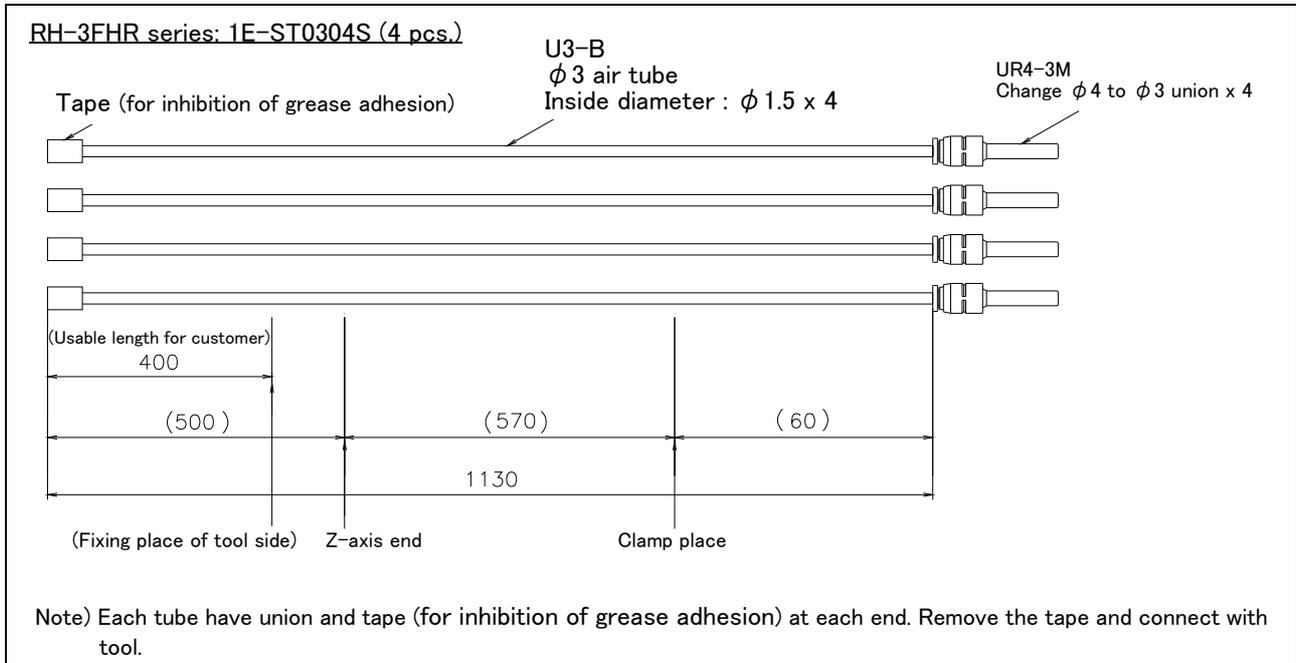


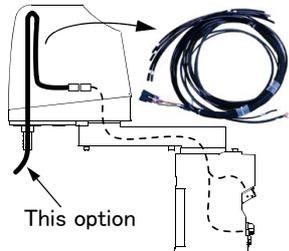
Fig.2-81 : Outline dimensional drawing

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

(8) Internal Wiring/Piping set for hand

- Order type: RH-6FH series, 200mm stroke..... 1F-HS408S-01
 RH-6FH series, 340mm stroke 1F-HS408S-02
 RH-12FH/20FH series, 350mm stroke..... 1F-HS604S-01
 RH-12FH/20FH series, 450mm stroke..... 1F-HS604S-02

■ Outline



This set, consisting of air hoses and cables, is for feeding air hoses and hand input signal cables from the No. 2 arm through to the shaft tip.
 A plate is already attached to be fixed onto the No. 2 arm, and therefore it is easy to ensure the necessary space for wiring and piping.
 This can be used together with the separately sold electromagnetic valve set option.

■ Configuration

Table 2-33 : Configuration equipment

| Item | Type | Qty. | Mass (Kg) ^{Note1)} | Remarks |
|--|--------------|------|-----------------------------|---|
| RH-6FH series | | | | |
| Internal Wiring/Piping set for hand (For 200mm stroke) | 1F-HS408S-01 | 1 | 0.4 | The air hose and the cable for hand input signals are contained. The grease (for application to shaft top) and the union band (for fixation of the hose and the cable) are attached. |
| Internal Wiring/Piping set for hand (For 340mm stroke) | 1F-HS408S-02 | 1 | 0.4 | |
| RH-12FH/20FH series | | | | |
| Internal Wiring/Piping set for hand (For 350mm stroke) | 1F-HS604S-01 | 1 | 0.4 | The air hose and the cable for hand input signals are contained. The grease (for application to shaft top) and the union band (for fixation of the hose and the cable) are attached. |
| Internal Wiring/Piping set for hand (For 450mm stroke) | 1F-HS604S-02 | 1 | 0.4 | |

Note1) Mass indicates one set.

■ Specification

Table 2-34 : Specification

| Item | Specification | | Remarks |
|-----------------------------------|------------------------------|--------------------------------------|---|
| | 1F-HS408S-01 1F-HS408S-02 | 1F-HS604S-01 1F-HS604S-02 | |
| Air hose | φ 4 x 8pcs | φ 6 x 4pcs | Both ends are free. |
| Hand input signal cable | Signal | AWG #26(0.13mm ²) × 8pcs | The robot arm side is connector (HC1, HC2), and one side is free. |
| | Power | AWG #22(0.35mm ²) × 2pcs | |
| Useable length from the shaft end | 380mm | 420mm | The length from the shaft end which can be used of customer. |

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

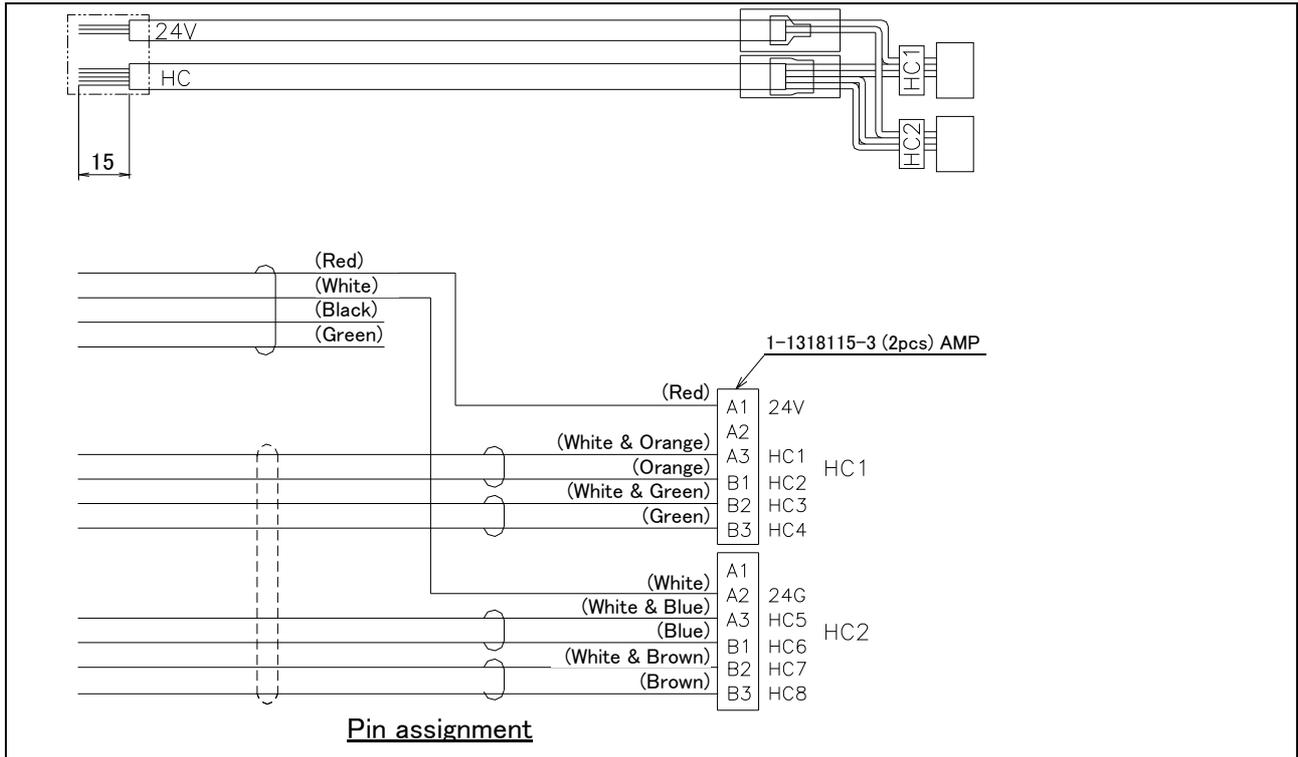
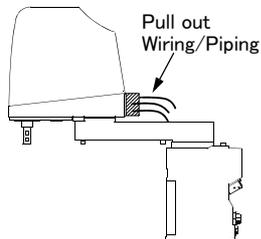


Fig.2-82 : Outline dimension drawing and pin assignment (Hand input cable)

(9) External Wiring/Piping box

- Order type: RH-6FH series 1F-UT-BOX
 RH-12FH/20FH series..... 1F-UT-BOX-01

■ Outline



This is a very useful option when removing the air hoses and signal lines from the rear of the No. 2 arm, and pulling hand wiring and piping out to the robot's exterior. The joint for connects to the external hose is prepared, and the holes which fixes the signal cable to pull out with cable clamp are prepared. Optional hand output cables and hand input cables can be fixed here.

This option can also be used on the oil mist and clean specifications.

■ Configuration

Table 2-35 : Configuration equipment

| Part name | Type | Qty. | Mass (Kg) ^{Note1)} | Remarks |
|----------------------------|--------------|------|-----------------------------|--|
| RH-6FH series | | | | |
| External Wiring/Piping box | 1F-UT-BOX | 1 | 0.6 | Attachments: • Air hose (black) ϕ 4-8 • Air hose (black) ϕ 6-1 • Air hose (white) ϕ 6-1 • Installation screw M4x8: 4 (Plain washer) • Cable tie: 4 • Coupling: 2 • Simple spanner for resin nuts |
| RH-12FH/20FH series | | | | |
| External Wiring/Piping box | 1F-UT-BOX-01 | 1 | 0.6 | Attachments: • Air hose (black) ϕ 6-8 • Installation screw M4x12: 4 (Plain washer) • Cable tie: 4 • Simple spanner for resin nuts |

Note1) Mass indicates one set.

■ Specification

Table 2-36 : Specification

| Item | Specification | Remarks |
|-----------------------------|------------------------------|-----------------------------------|
| RH-6FH series | | |
| Outline | 106(W) x 73.6(D) x 72(H) | The coupling is included. |
| The hole for wiring drawers | ϕ 21 x 4 places | Fix the cable by cable clamp etc. |
| Coupling | For ϕ 4 air hose x 8pcs | Installed previously |
| | For ϕ 6 air hose x 2pcs | |
| RH-12FH/20FH series | | |
| Outline | 100(W) x 91.9(D) x 70(H) | The coupling is included. |
| The hole for wiring drawers | ϕ 21 x 4 places | Fix the cable by cable clamp etc. |
| Coupling | For ϕ 6 air hose x 8pcs | Installed previously |

An outside dimension and a component are shown in Fig. 2-83 or Fig. 2-84.

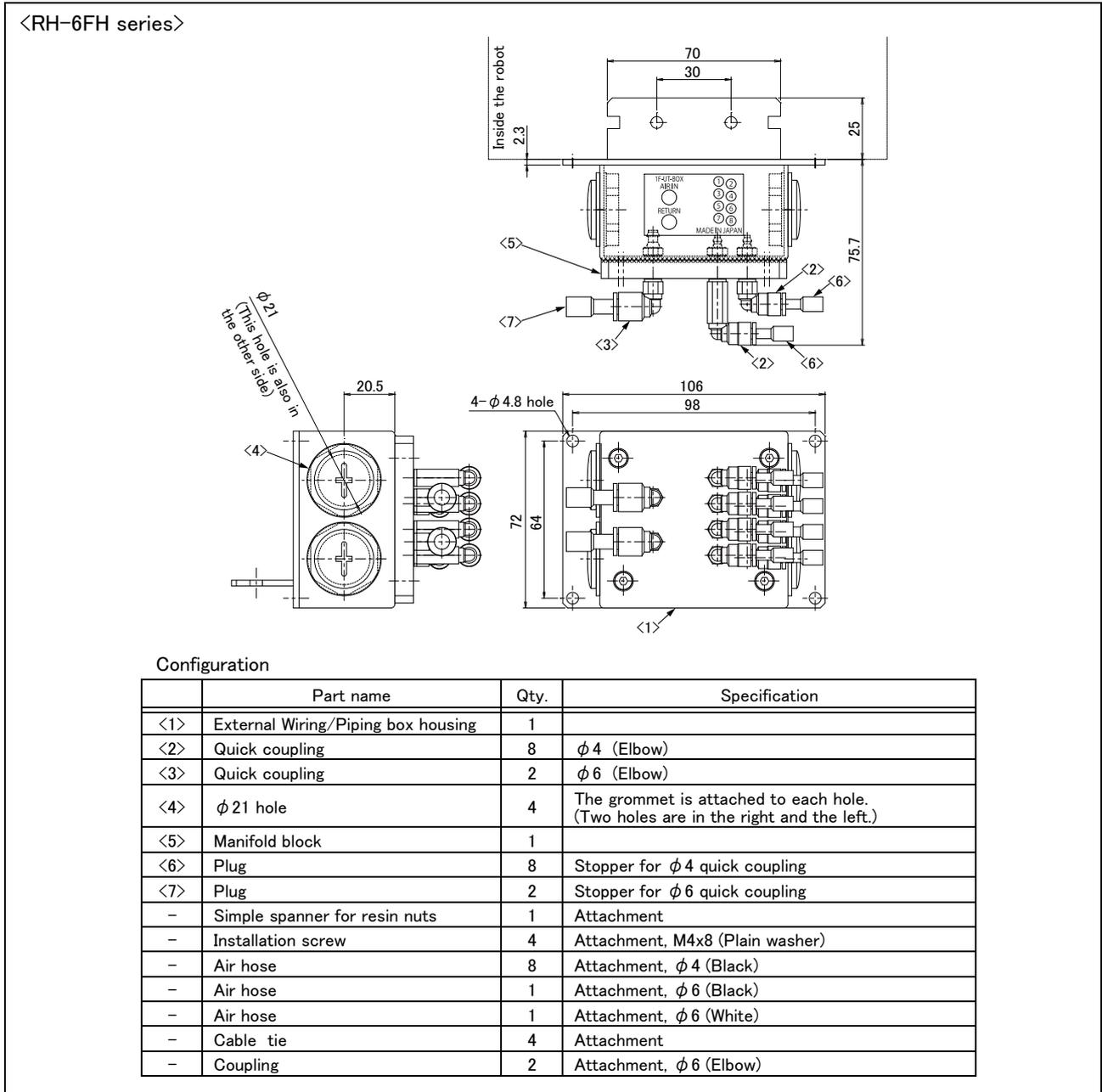


Fig.2-83 : Outline dimension and configurations (RH-6FH series)

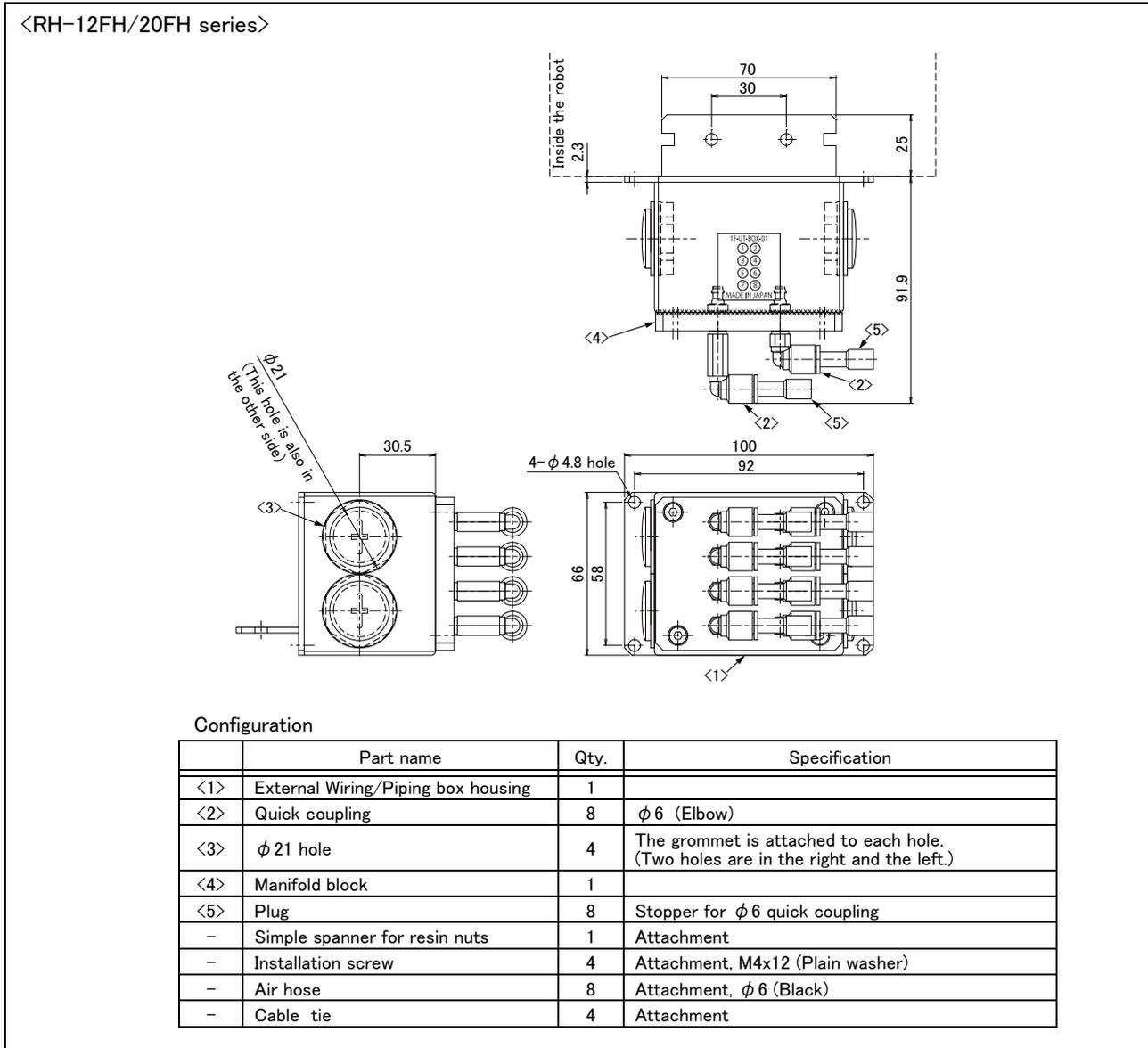


Fig.2-84 : Outline dimension and configurations (RH-12FH/20FH series)

2.8 About Overhaul

Robots which have been in operation for an extended period of time can suffer from wear and other forms of deterioration. In regard to such robots, we define overhaul as an operation to replace parts running out of specified service life or other parts which have been damaged, so that the robots may be put back in shape for continued use. As a rule of thumb, it is recommended that overhaul be carried out before the total amount of servo-on time reaches the specified time (24,000 hours for the robot arm and 36,000 hours for the controller) (See Fig. 2-85). However, the degree of the equipment's wear and deterioration presumably varies depending on their operating conditions. Especially for operation with high load and frequency, the maintenance cycle may be shorter. For details on the part selection for replacement and the timing of overhaul, contact your dealer.

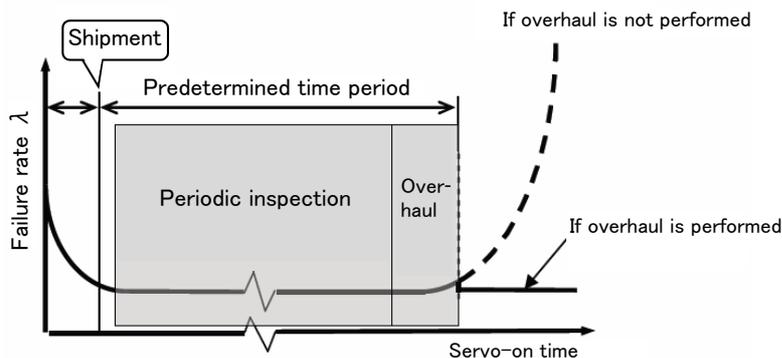


Fig.2-85 : Periodic inspection/overhaul periods

2.9 Maintenance parts

The consumable parts used in the robot arm are shown in [Table 2-37](#). 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 2-37 : Consumable part list

| No. | Part name | Type <small>Note1)</small> | Usage place | Qty. | Supplier |
|---------------------------------|-----------------|----------------------------|------------------------------|-----------|---------------------|
| Common parts between robot type | | | | | |
| 1 | Grease | | Reduction gears of each axis | As needed | Mitsubishi Electric |
| 2 | | | Ball screw Ball spline | As needed | |
| 3 | Lithium battery | ER6V | Front section of the base | 3 | |
| RH-6FH series | | | | | |
| 4 | Timing belt | | J3 axis | 1 | Mitsubishi Electric |
| 5 | | | J4 axis motor side | 1 | |
| 6 | | | J4 axis shaft side | 1 | |
| RH-12FH series | | | | | |
| 7 | Timing belt | | J3 axis | 1 | Mitsubishi Electric |
| 8 | | | J4 axis motor side | 1 | |
| 9 | | | J4 axis shaft side | 1 | |
| RH-20FH series | | | | | |
| 10 | Timing belt | | J3 axis | 1 | Mitsubishi Electric |
| 11 | | | J4 axis motor side | 1 | |
| 12 | | | J4 axis shaft side | 1 | |
| RH-3FHR series | | | | | |
| 13 | Timing belt | | J1 axis | 1 | Mitsubishi Electric |
| 14 | | | J2 axis | 1 | |
| 15 | | | J3 axis | 1 | |
| 16 | | | J4 axis motor side | 1 | |
| 17 | | | J4 axis shaft side | 1 | |

Note1) Confirm the robot arm serial No., and contact the dealer or service branch of Mitsubishi Electric Co., for the type.

3 Controller

3.1 Standard specifications

3.1.1 Basic specifications

Use the robot CPU unit which consists of CR750-Q/CR751-Q/CR760-Q controllers, equipping the base unit of the sequencer of the MELSEC-Q series of our company. Specifications such as the power supply and outside dimension of the robot CPU unit are the same as the sequencer's specification. Refer to [Page 133 "Fig. 3-3"](#)(Names of each part), [Page 136 "Fig. 3-6"](#) and [Page 137 "Fig. 3-7"](#) (Outside dimensions)

Although the specification with which the robot CPU unit and the drive unit (box which mounts the servo amplifier for the robots, the safety circuit, etc.) were put together is shown in [Table 3-1](#), the specification of the drive unit is mainly described.

Table 3-1 : Specifications of controller

| Item | Unit | Specification | Remarks | |
|--------------------------------------|-------------------------------|--|---|--|
| Type | | CR750- □ HQ-1 CR751- □ HQ-0 CR750-03HRQ-1 CR751-03HRQ-0 | " □ " in type name shows the load (6kg: "06", 12kg: "12", 20kg: "20") of the robot arm. CR750-03HRQ-1 and CR751-0.HRQ-0 controller are for RH-3FHR only. | |
| Number of control axis | | Simultaneously 4 | | |
| Memory capacity | Programmed positions | point | 13,000 | |
| | No. of steps | step | 26,000 | |
| | Number of program | | 256 | |
| Robot language | | MELFA-BASIC IV, V | | |
| Teaching method | | Pose teaching method, MDI method ^{Note1)} | | |
| External input and output | Input and output | point | 0/0 | Multi-CPU shared device Input 8192/Output 8192 (Max.) |
| | | Dedicated input/output | Assign to the multi-CPU shared device. | |
| | Hand open/close input/output | point | 8/8 | Built-in |
| | Emergency stop input | point | 1 | Duplicated |
| | Door switch input | point | 1 | Duplicated |
| | Enabling device input | point | 1 | Duplicated |
| | Emergency stop output | point | 1 | Duplicated |
| | Mode output | point | 1 | Duplicated |
| | Robot error output | point | 1 | Duplicated |
| | Addition axis synchronization | point | 1 | Duplicated |
| Mode changeover switch input | point | 1 | Duplicated (CR751 controller only) | |
| Interface | RS-422 | port | 1 | Only for T/B |
| | Ethernet | port | 1 | 10BASE-T/100BASE-Tx |
| | Additional axis interface | Channel | 1 | SSCNET III (Connects with MR-J3-BS, MR-J4-B series) |
| Power source | Input voltage range | V | RH-6FH series, RH-3FHR series: Single phase AC180 to 253 RH-12FH/20FH series ^{Note2)} : Three phase AC180 to 253, or Single phase AC207 to 253 | |
| | Power capacity | kVA | RH-6FH series, RH-3FHR series: 1.0 RH-12/20FH series: 1.5 | Does not include rush current. ^{Note3)} |
| | Power supply frequency | Hz | 50/60 | |
| Outline dimensions ^{Note4)} | mm | CR750 controller 430(W) x 425(D) x 174(H) | Excluding protrusions | |
| | | CR751 controller 430(W) x 425(D) x 98(H) | | |
| Mass | kg | CR750 controller RH-6FH series: Approx. 16 RV-12FH/20FH series: Approx. 18 | | |
| | | CR751 controller: Approx. 12 | | |

| Item | Unit | Specification | Remarks |
|-----------------------------|------|--|--|
| Construction | | Self-contained floor type, Opened type. Installation vertically or horizontally | IP20 ^{Note5)} |
| Operating temperature range | °C | 0 to 40 | |
| Ambient humidity | %RH | 45 to 85 | Without dew drops |
| Grounding | Ω | 100 or less | 100Ω or less (class D grounding) ^{Note6)} |
| Paint color | | Dark gray | Equivalent to Munsell: 3.5PB3.2/0.8 |

Note1) Pose teaching method: The method to register the current position of the robot arm.

MDI method: The method to register by inputting the numerical value Immediate.

Note2) Both the three phase power supply and the single phase power supply can use this product according to voltage conditions.

Note3) The power capacity is the 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 RH-6FH is approx. 0.3kW and RH-20FH is approx. 0.49kW. The short circuit breaker should use the following.

* Operate by the current leakage under the commercial frequency domain (50–60Hz). If sensitive to the high frequency ingredient, it will become the cause in which below the maximum leak current value carries out the trip.

Note4) Refer to [Page 134](#), “3.3.1 Outside dimensions” for details.

Note5) This controller is standard specification. (Refer to [Page 127](#), “3.1.2 Protection specifications and operating supply”.)

Note6) The robot must be grounded by the customer.

Table 3–2 : Robot CPU unit standard specification

| Item | Unit | Specification | Remarks |
|-----------------------------|-------------------------------|---------------|------------------------------|
| Type | | Q172DRCPU | |
| Interface | Addition axis synchronization | port | 1 |
| Power source | Power capacity (DC5V) | A | 1.25 |
| Outline dimension | | mm | 98(W) x 27.4(D) x 119.3(H) |
| Mass | | kg | 0.33 |
| Operating temperature range | | °C | 0 to 55 |
| Ambient humidity | | %RH | 5 to 95 Without dew drops |

3.1.2 Protection specifications and operating supply

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

The IEC 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.

【Information】

- The IEC IP20

It indicates the protective structure that prevents an iron ball $12^{+0.05}_0$ mm diameter, which is being pressed with the power of $3.1 \text{ kg} \pm 10\%$, from going through the opening in the outer sheath of the supplied equipment.

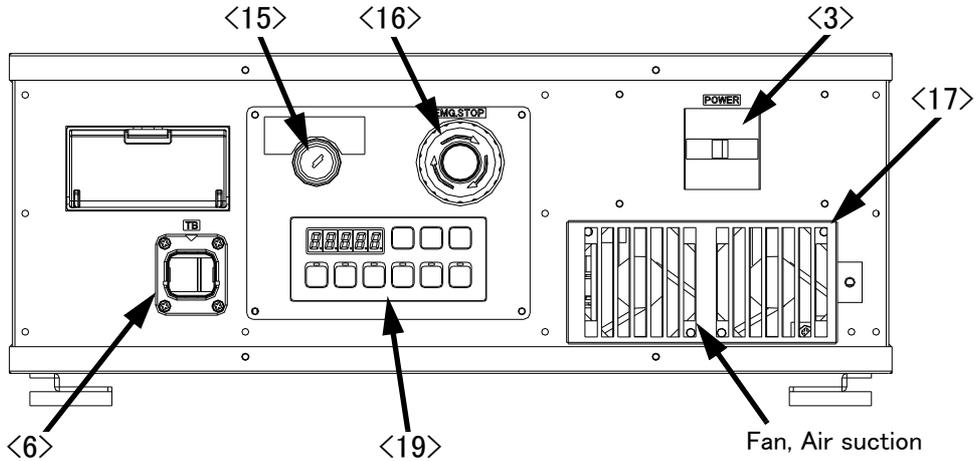
Refer to the section [Page 209](#), “6.2 Working environment” for details on the working environment.

3.2 Names of each part

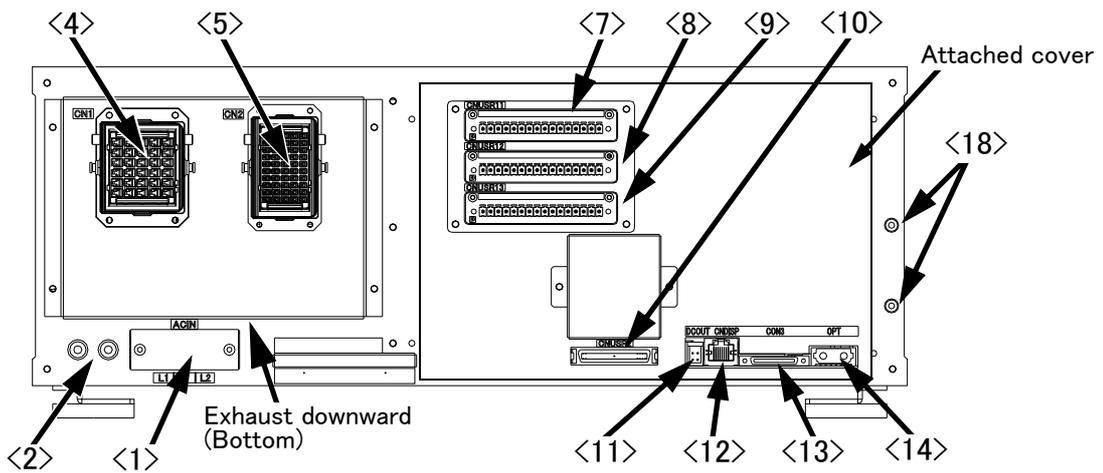
3.2.1 Drive unit

(1) CR750 drive unit

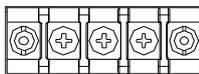
Drive unit (Front side)



Drive unit (Rear side)



<1>: ACIN terminal



There are three types (Type A, B, and C) of the terminals. Refer to next page for details.

<19>: The operation panel

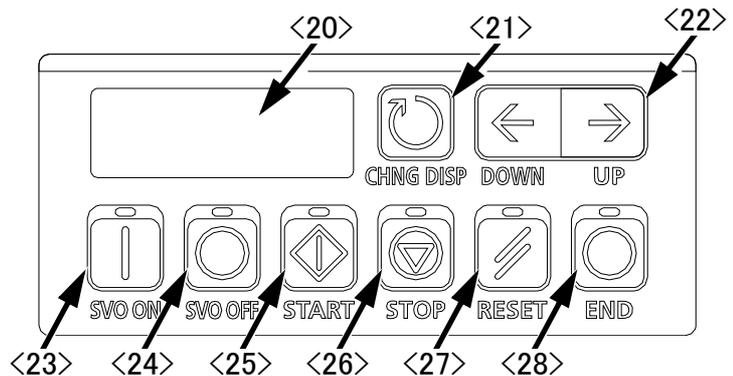
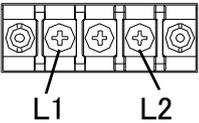
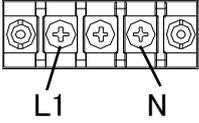
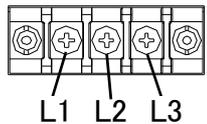


Fig.3-1 : Names of drive unit parts (CR750)

- <1> ACIN terminal The terminal box for AC power source (single phase or single phase/three phase, AC200V) input. (Inner side of a cover)
There are three types of the terminal and the terminal differs depending on the model and specification (CE or non-CE).

| Model | Non-CE specification | CE specification |
|----------------------------------|---|--|
| RH-6FH series RH-3FHR series | <p><u>Type A:</u> For single phase</p>  <p>Connect the primary power supply to L1 and L2 terminal.</p> | <p><u>Type C:</u> For single phase</p>  <p>Connect the primary power supply to L1 and N terminal.</p> |
| RH-12FH series RH-20FH series | <p><u>Type B:</u> For single phase/three phase</p>  <p>When using the three phase primary power supply, connect to L1, L2, and L3 terminal. When using the single phase primary power supply, connect to L1 and L3 terminal.</p> | |

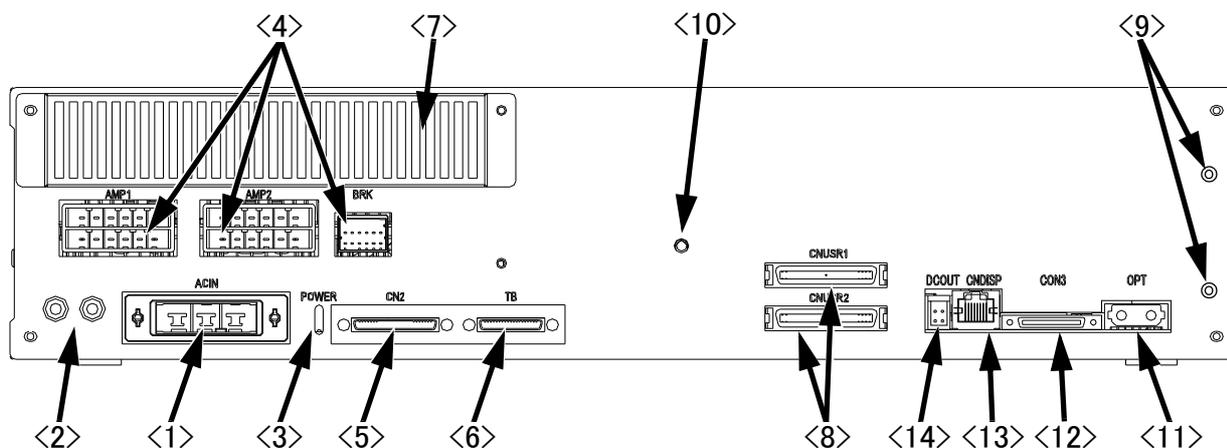
Refer to a separate manual “INSTRUCTION MANUAL/Controller setup, basic operation, and maintenance” for how to connect a power cable.

- <2> PE terminal The screw for grounding of the cable. (M4 screw x 2 place)
- <3> Power switch This turns the control power ON/OFF. (With earth leakage breaker function)
- <4> Machine cable connector (motor signal) (CN1)
Connect with the CN1 connector of the robot arm.
- <5> Machine cable connector (motor power) (CN2)
Connect with the CN2 connector of the robot arm.
- <6> T/B connection connector (TB) This is a dedicated connector for connecting the T/B. When not using T/B, connect the attached dummy connector.
- <7><8><9><10> CNUSR connector The connector for input/ output connection dedicated for robot. (a plug connector attached)
<7>: CNUSR11, <8>: CNUSR12, <9>: CNUSR13, <10>: CNUSR2
Refer to a separate manual “INSTRUCTION MANUAL/Controller setup, basic operation, and maintenance” for the connection method and the further description of pin assign.
Note) <9>: CNUSR13 connector is not used in this controller.
- <11> DCOUT connector (DCOUT) For emergency stop
- <12> CNDISP connector (CNDISP) For LAN of T/B connection
- <13> CON3 connector (CON3) For RS422 of T/B connection
- <14> OPT connector (OPT) For SSCNETIII connection
- <15> Mode key switch This key switch changes the robot's operation mode.
AUTOMATIC Operations from the controller or external equipment are valid. Operations for which the operation mode must be at the external device or T/B are not possible. (Exclude the start of automatic operation.)
MANUAL 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.
- <16> Emergency stop switch This switch stops the robot in an emergency state. The servo turns OFF.
- <17> Filter cover There is an air filter inside the cover.
- <18> Grounding terminal The grounding terminal for connecting cables of option card. (M3 screw x 2 places)
- <19> Operation panel The operation panel for servo ON/OFF, START/STOP the program etc.
- <20> Display panel (STATUS.NUMBER) The alarm No., program No., override value (%), etc., are displayed.
- <21> CHNGDISP button This button changes the details displayed on the display panel in the order of “Override” → “Line No.” → “Program No.” → “User information.” → “Maker information..”

- <22> UP/DOWN button This scrolls up or down the details displayed on the "STATUS. NUMBER" display panel.
- <23> SVO.ON button..... This turns ON the servo power. (The servo turns ON.)
- <24> SVO.OFF button..... This turns OFF the servo power. (The servo turns OFF.)
- <25> START button..... This executes the program and operates the robot. The program is run continuously.
- <26> STOP button This stops the robot immediately. The servo does not turn OFF.
- <27> RESET button This resets the error. This also resets the program's halted state and resets the program.
- <28> END button..... This stops the program being executed at the last line or End statement.

(2) CR751 drive unit

Drive unit (Front side)



Drive unit (Rear side)

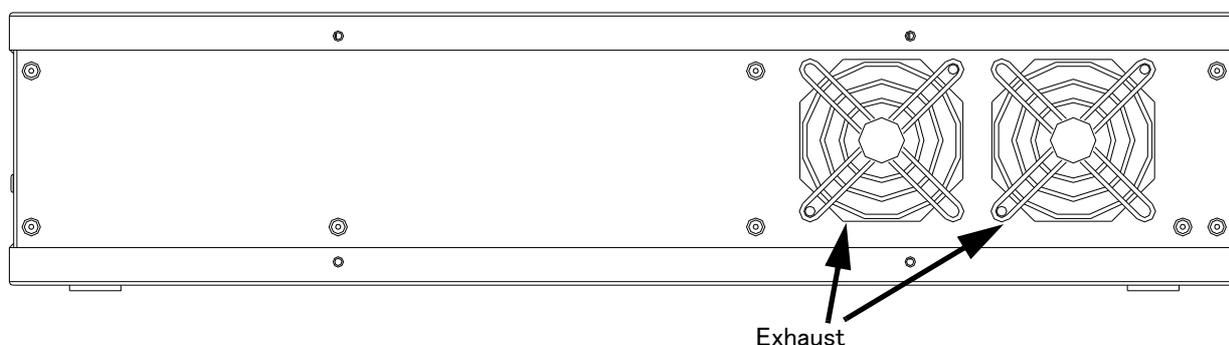


Fig.3-2 : Names of drive unit parts (CR751)

- <1> ACIN terminalThe connector for AC power source (single phase or single phase/three phase, AC200V) input. (a socket housing and a terminal are attached). Refer to a separate manual “INSTRUCTION MANUAL/Controller setup, basic operation, and maintenance” for how to connect a power cable.
- <2> PE terminal.....The screw for grounding of the cable. (M4 screw x 2 place)
- <3> POWER lamp.....Lamp of control power source
- <4> Machine cable connector (motor power)
AMP1, AMP2: Motor power, BRK: Motor brake
- <5> Machine cable connector (motor signal)
CN2: Motor signal
- <6>T/B connection connector (TB).....This is a dedicated connector for connecting the R33TB. When not using T/B, connect the attached dummy plug.
- <7>Filter cover.....There is an air filter inside this cover.
- <8>CNUSR connectorThe connector for input/ output connection dedicated for robot. (a plug connector attached)
(CNUSR1、CNUSR2)
Refer to a separate manual “INSTRUCTION MANUAL/Controller setup, basic operation, and maintenance” for the connection method and the further description of pin assign.
- <9>Grounding terminal.....The grounding terminal for connecting cables of option card. (M3 screw x 2 places)
- <10>Power supply charge lamp (CRARGE)
The lamp is to ensure safe timing (prevent electric shocks) when removing the cover (users are not normally required to remove the cover). This lamp is illuminated (red) when electrical energy accumulates on the controller’s power supply circuit board due to the robot’s servo being ON.

After turning the control power OFF and allowing a few minutes to pass,
the lamp will go out.

- <11>OPT connector (OPT).....For SSCNETIII connection
- <12>CON3 connector (CON3).....For RS422 of T/B connection
- <13>CNDISP connector (CNDISP).....For LAN of T/B connection
- <14>DCOUT connector (DCOUT)For emergency stop

3.2.2 Robot CPU

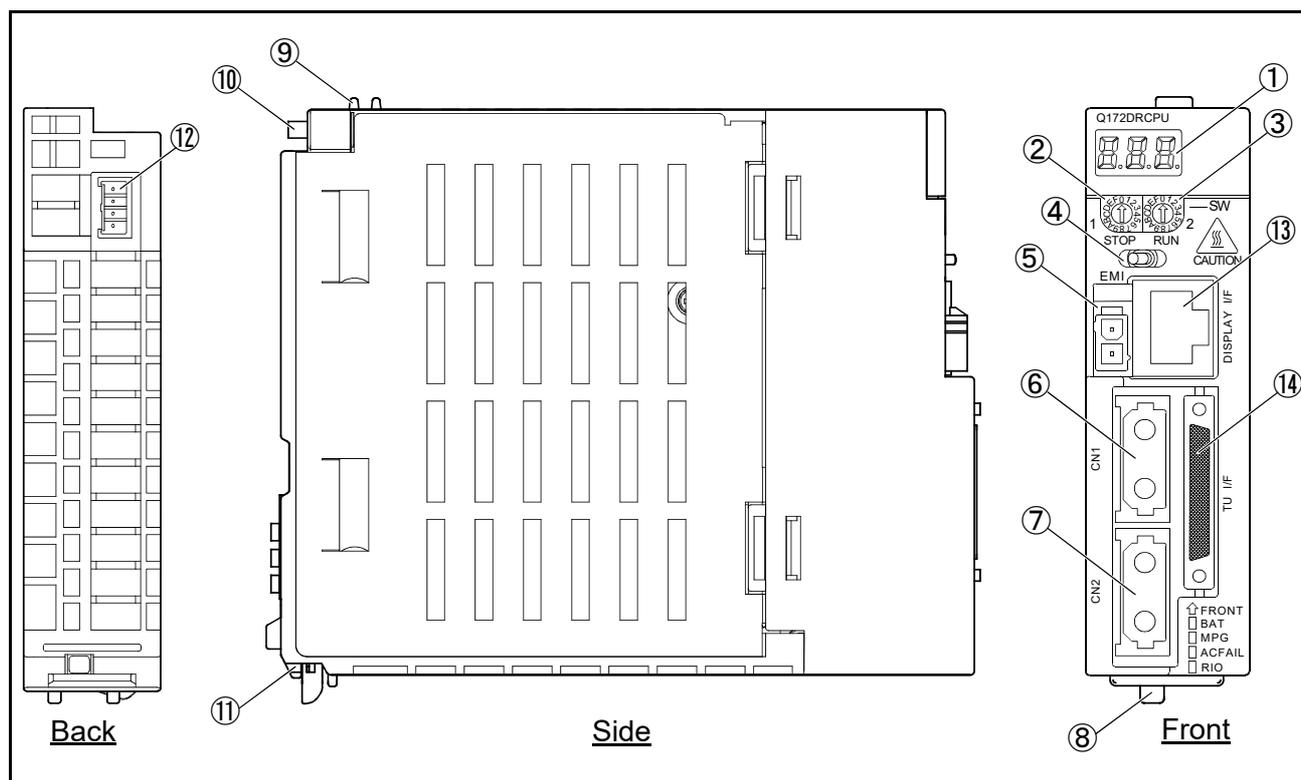


Fig.3-3 : Names of each part of the robot CPU

- ① Seven segments LED.....Indicates operational status and error information
- ② Rotary switch (SW1).....Set up operation mode. Always set it as "0."
- ③ Rotary switch (SW2).....Set up operation mode. Always set it as "0."
- ④ RUN/STOP switch.....Unused
- ⑤ Emergency stop input (EMI)*1) .. Connects with the connector (DCOUT) of the controller by the EMI cable for robot. (For the emergency stops)
- ⑥ CN1 connector*2) Connects with the connector (OPT) of the controller by the SSCNET III cable for robot. (For the robot-arm servo amplifier connection)
- ⑦ CN2 connector*2) Connect to the servo amplifier of the addition axis (Eight axes)
- ⑧ Lever for unit installation Use this lever, when installing the unit in the base unit.
- ⑨ Hook for unit fixing*3) The hook which fixes the unit to the base unit (For the support at installation)
- ⑩ Unit fixing screw..... The screw for fixing to the base unit (M3 × 13)
- ⑪ The projection for unit fixing The projection for fixing to the base unit
- ⑫ Battery connector (BAT)*4) The connector for connection with battery holder unit Q170DBATC.
- ⑬ The connector for the networks (DISPLAY I/F)
Connects with the connector (CNDISP) of the controller by the DISP cable for robot. (For the LAN of T/B)
- ⑭ RS422 connector (TU I/F) Connects with the connector (CON3) of the controller by the TU cable for robot. (For the RS-422 of T/B)

*1) Please be sure to use the emergency stop input cable. The emergency stop cannot be canceled if it does not use. If it manufactures the emergency stop input cable in the customer, cable length should use 30m or less.

*2) Please store in the duct or fix the cable section near robot CPU with the bunch wire rod so that prudence of the cable is not applied to CN1 and CN2 connector section.

*3) It is equipment for the support when installing the unit in the basic base unit. Please be sure to fix the unit to the basic base unit with the attached fixing screw.

*4) Please be sure to use the external battery. Unless the battery cable is connected surely, the program in SRAM with a built-in robot CPU, the parameter, origin position data, etc. are not held.

3.3 Outside dimensions/Installation dimensions

3.3.1 Outside dimensions

(1) CR750 drive unit

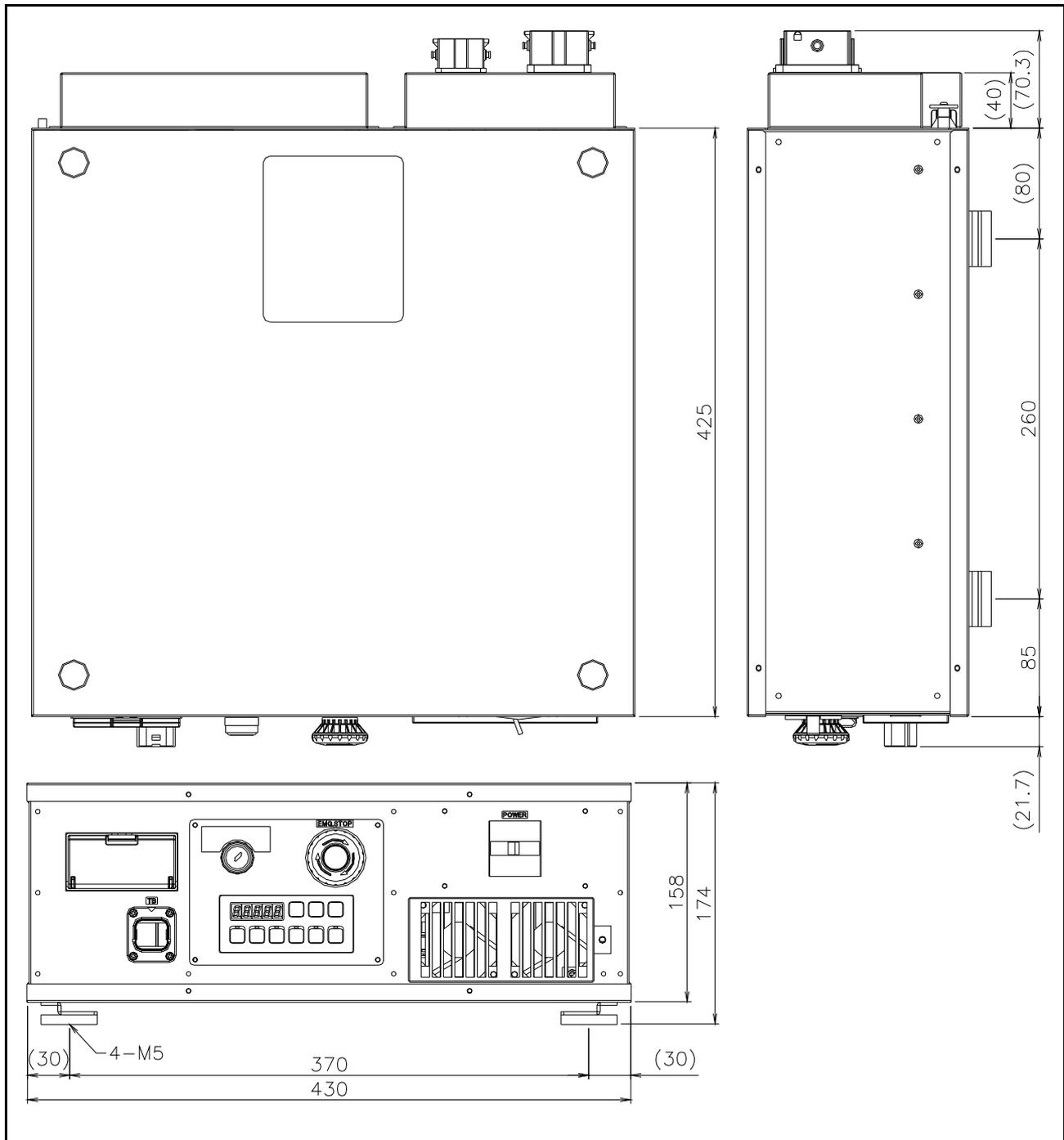


Fig.3-4 : Outside dimensions of drive unit (CR750)

(2) CR751 drive unit

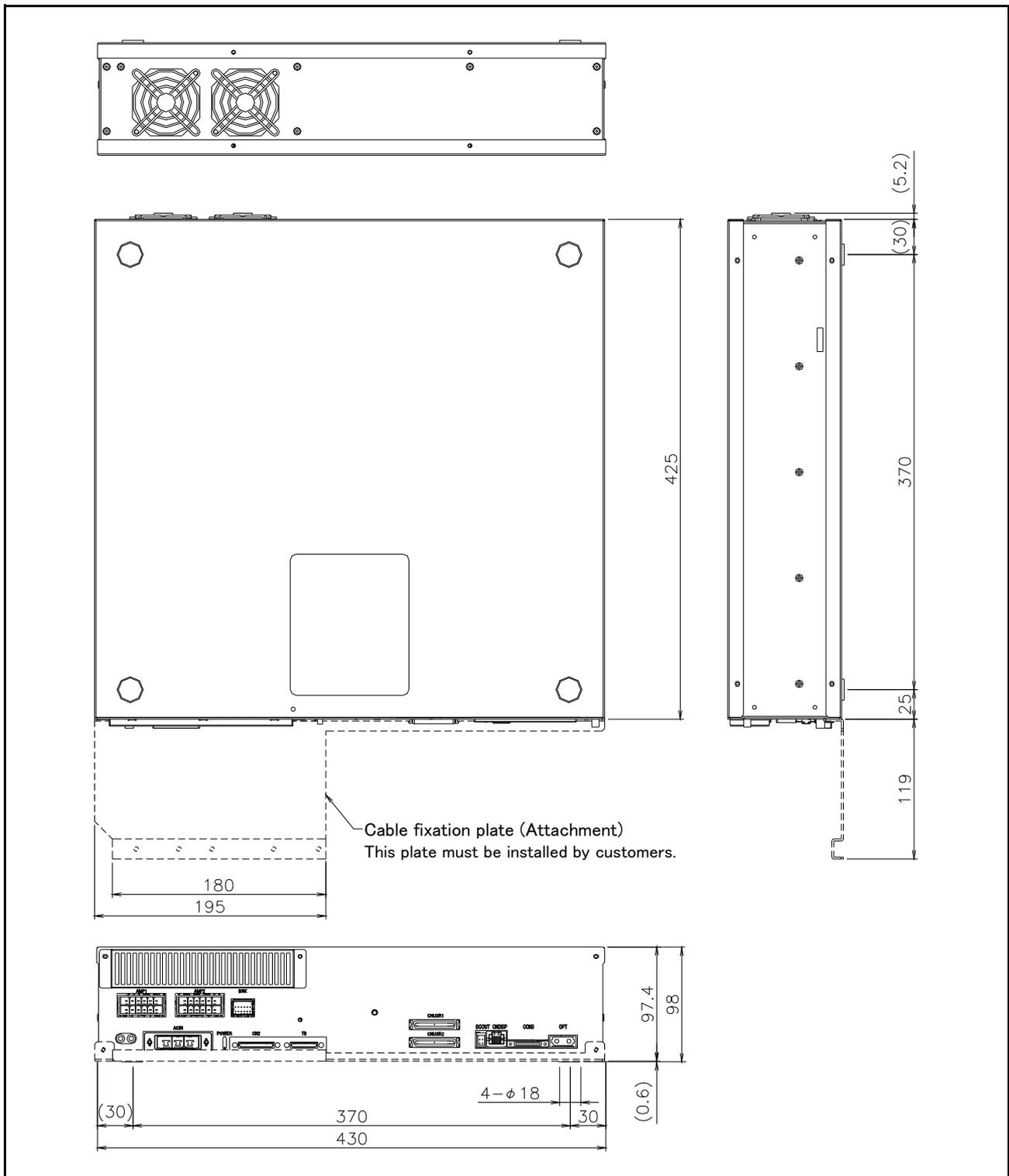
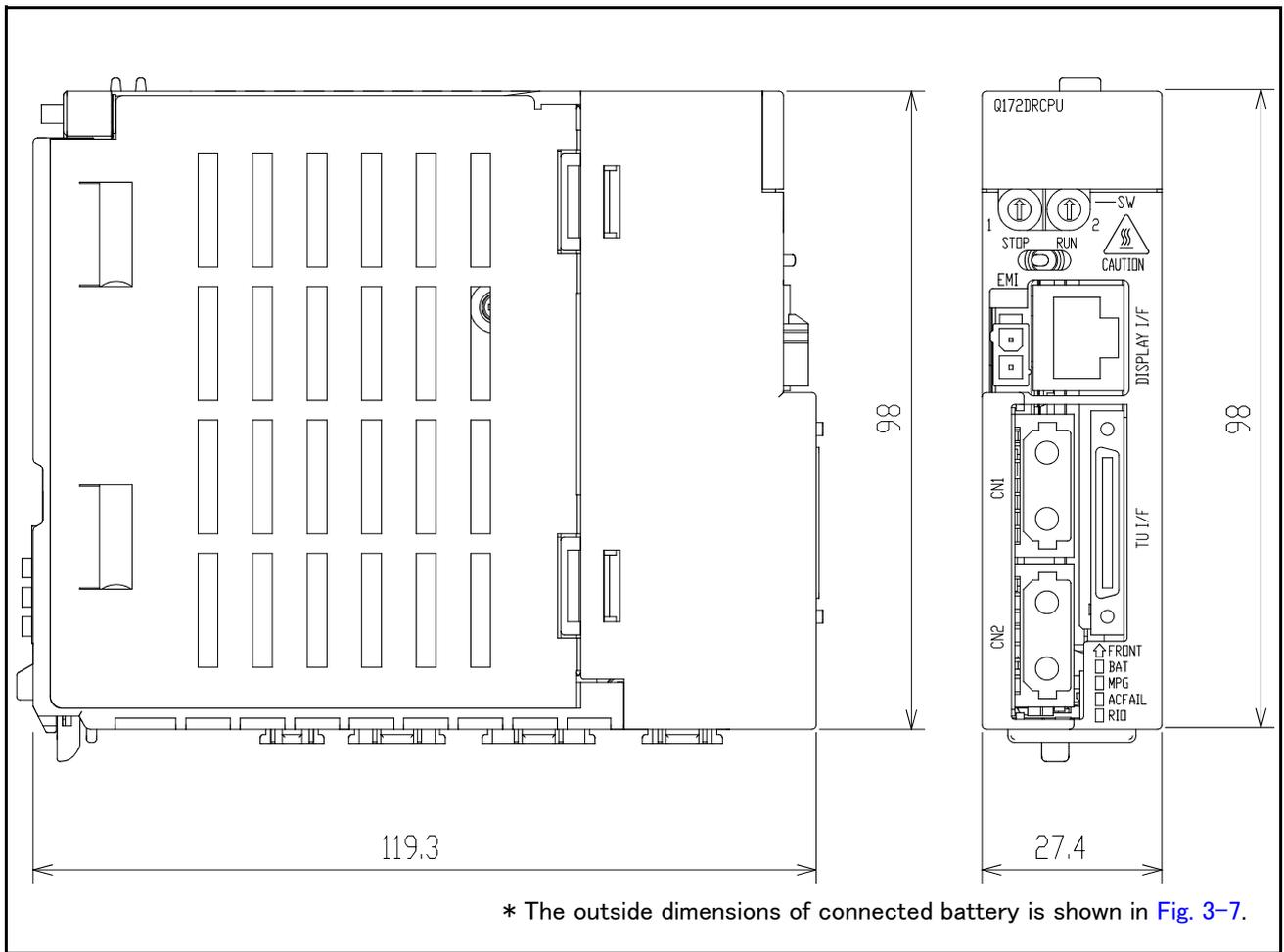


Fig.3-5 : Outside dimensions of drive unit (CR751)

(3) Outside dimensions of robot CPU unit



* The outside dimensions of connected battery is shown in Fig. 3-7.

Fig.3-6 : Outside dimensions of robot CPU

(4) Battery unit outside dimension

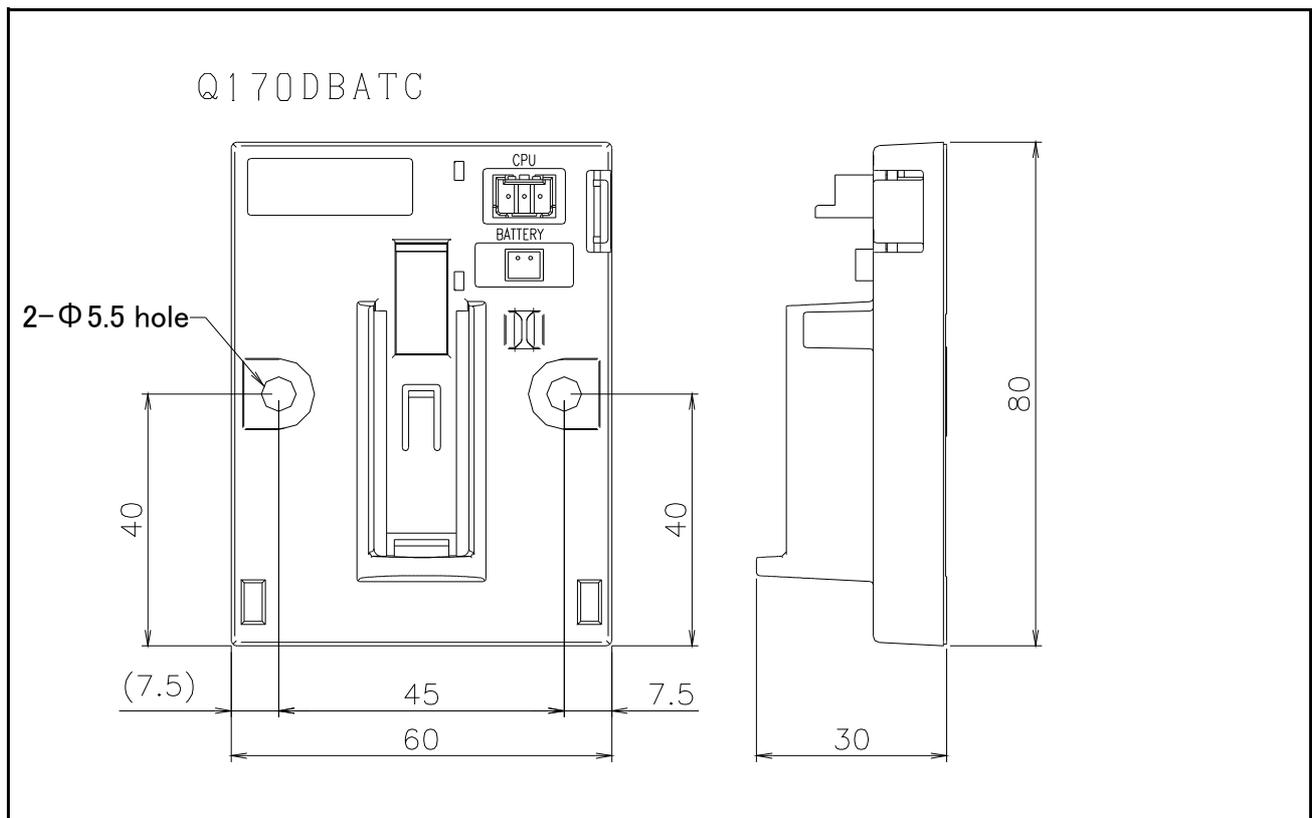
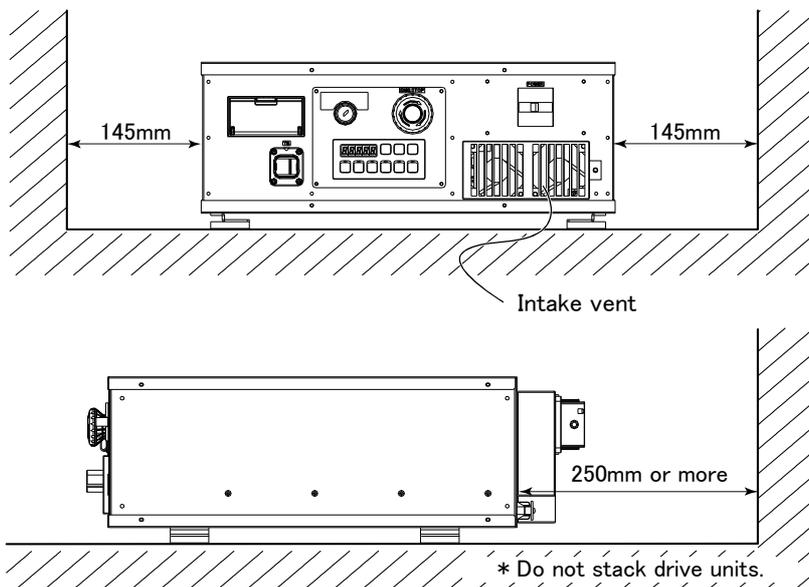


Fig.3-7 : Outside dimensions of battery unit

3.3.2 Installation dimensions

(1) CR750 drive unit

<Placed horizontally>



<Placed vertically>

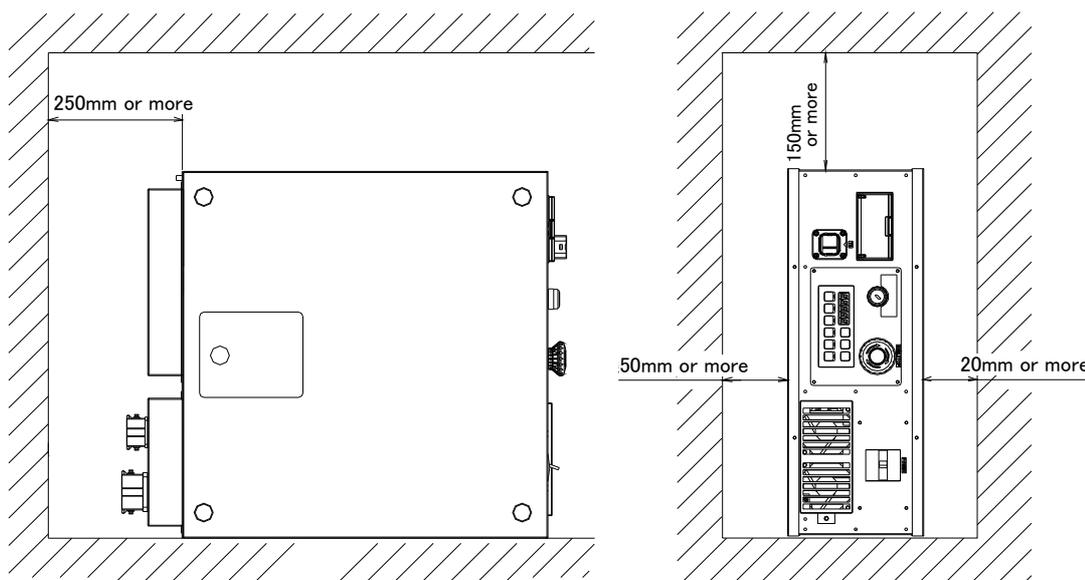


Fig.3-8 : Installation of controller (CR750)

⚠ CAUTION

Fixing installation section sure for prevention from the fall, when using the drive unit placing vertically. The reference figure of the metal plate for fixing is shown in Fig. 3-9. You should install the metal plate for fixation to the drive unit with M4 x 8 or the shorter screw. The screw projection length inside the controller (side board thickness is 1.2 mm) surely makes 6.8 mm or less.

⚠ CAUTION

When storing the drive unit in a cabinet, etc., take special care to the heat radiating properties and ventilation properties so that the ambient temperature remains within the specification values. And, don't install the drive unit in the position where direct rays or the heat of lighting hits. The skin temperature of the drive unit may rise, and the error may occur.

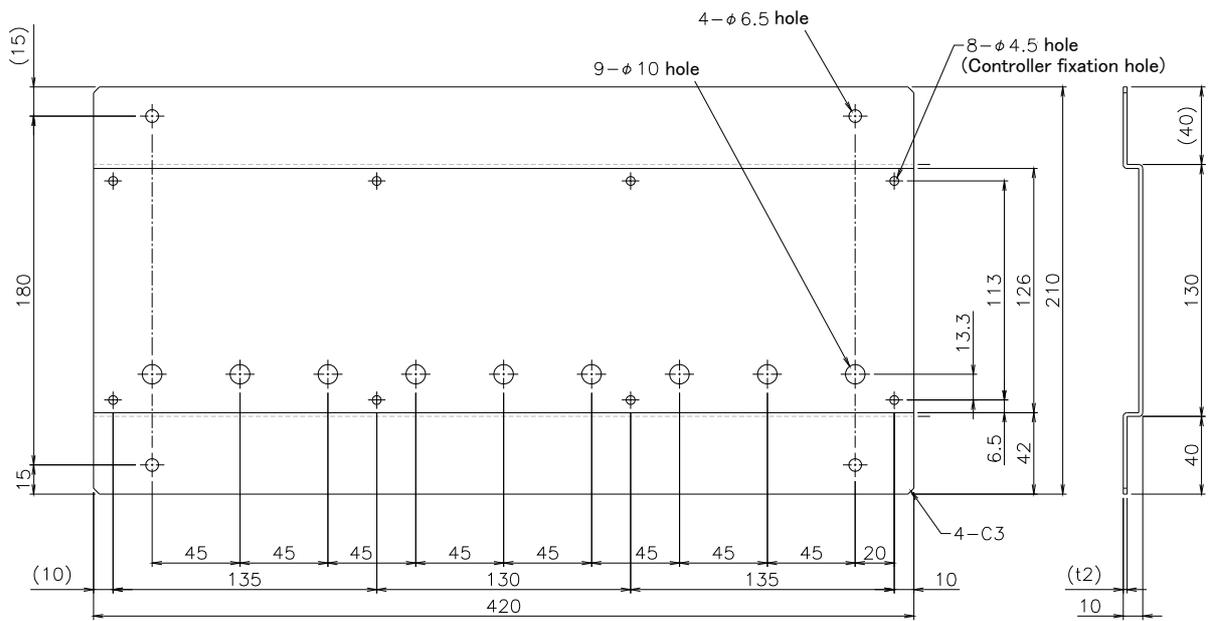
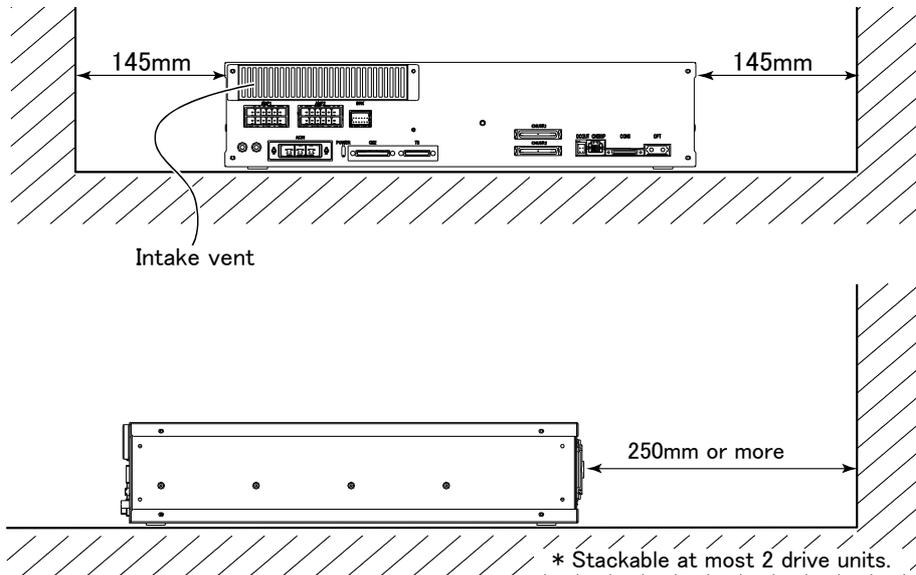


Fig.3-9 : Metal plate for fixation to placing vertically (Reference for CR750)

(2) CR751 drive unit

<Placed horizontally>



<Placed vertically>

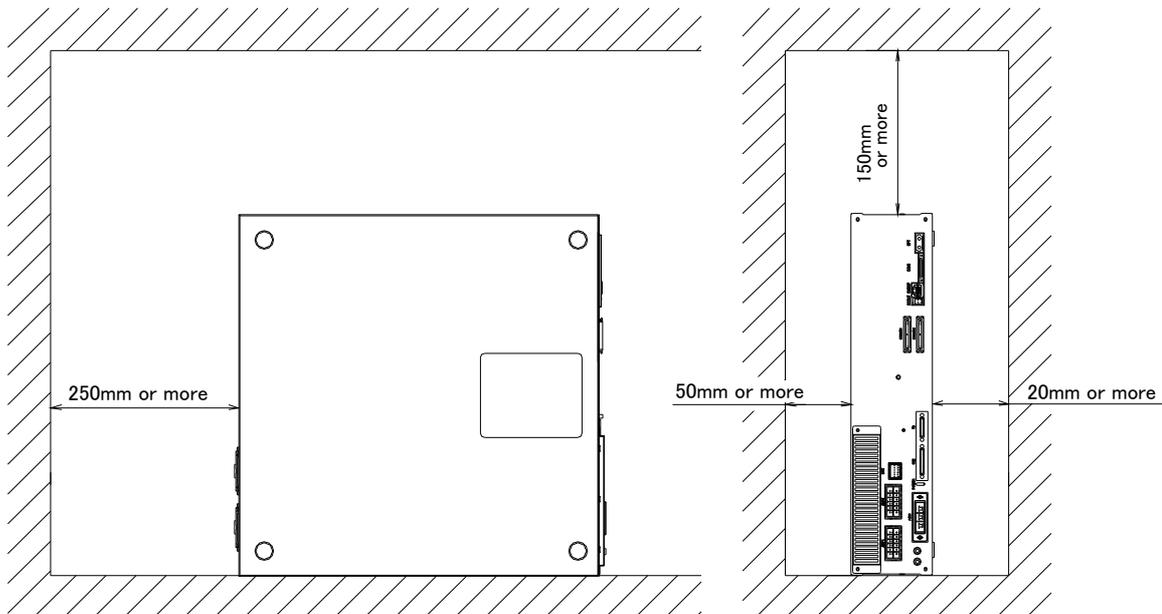


Fig.3-10 : Installation of controller (CR751)

CAUTION

Fixing installation section sure for prevention from the fall, when using the drive unit placing vertically. The reference figure of the metal plate for fixing is shown in Fig. 3-11. You should install the metal plate for fixation to the controller with M4 x 8 or the shorter screw. The screw projection length inside the drive unit (side board thickness is 1.2mm) surely makes 6.8mm or less.

CAUTION

When storing the drive unit in a cabinet, etc., take special care to the heat radiating properties and ventilation properties so that the ambient temperature remains within the specification values. And, don't install the drive unit in the position where direct rays or the heat of lighting hits. The skin temperature of the drive unit may rise, and the error may occur.

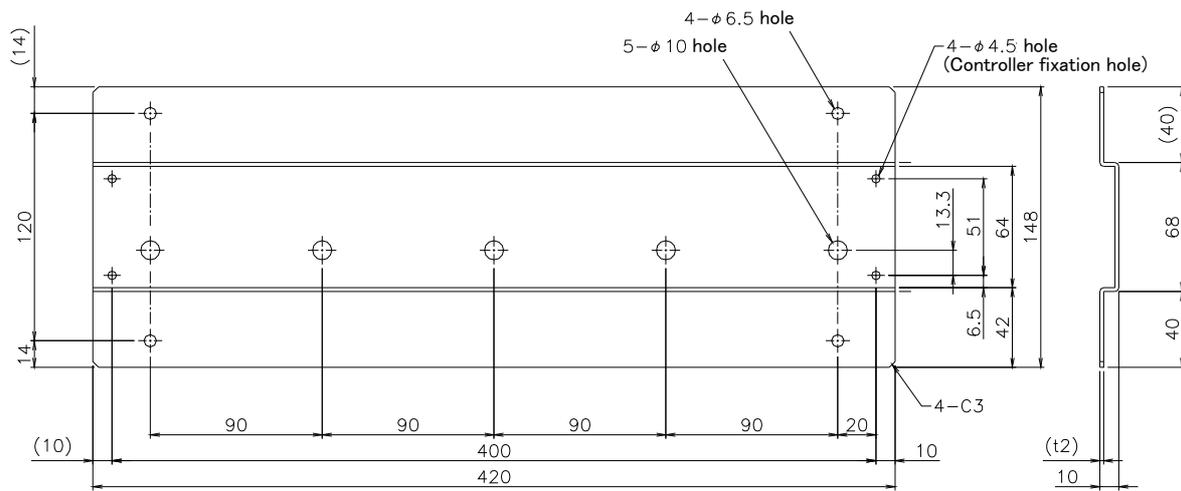


Fig.3-11 : Metal plate for fixation to placing vertically (Reference for CR751)

(3) Robot CPU Unit installation dimensions

Because to improve ventilation and to make unit replacement easy, please secure the following distance between the upper and lower sides of the unit and the structure, etc.

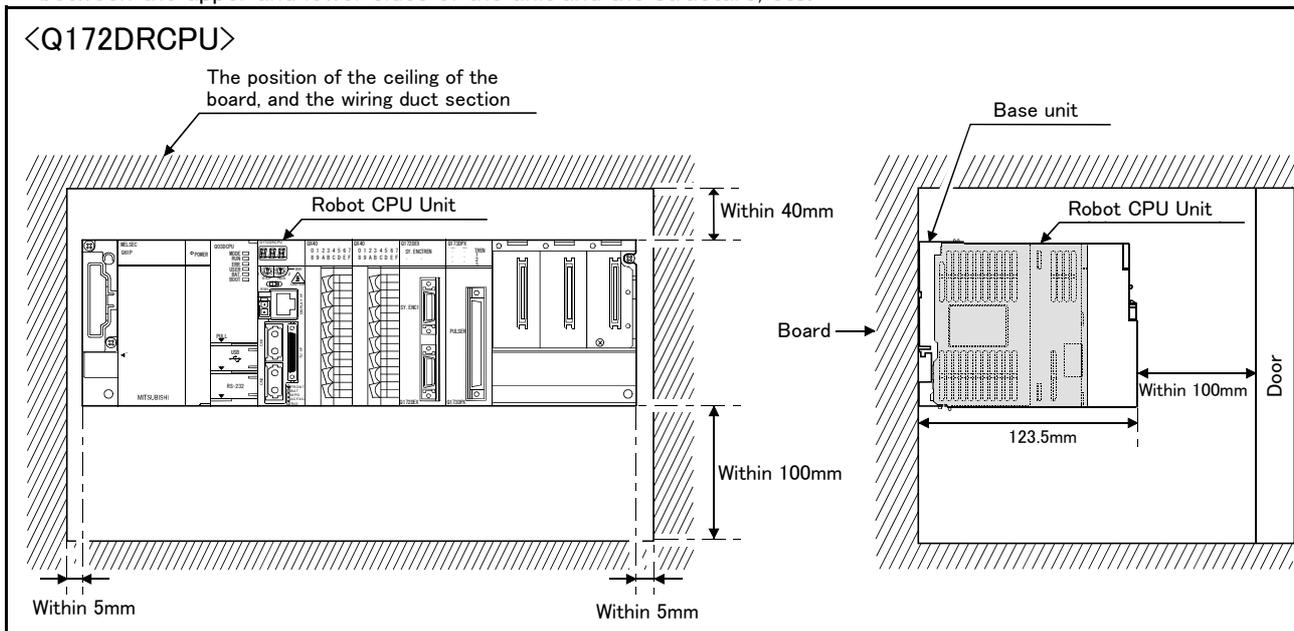


Fig.3-12 : Installation of robot CPU Unit

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.
- (4)Emergency stop/Door switch input.....Information on wiring the emergency stop and wiring used to ensure safety can be found on [Page 147, "3.6 Emergency stop input and output etc."](#) and on [Page 196, "6.1.7 Examples of safety measures"](#).

<For Reference>

Linking our GOT1000 Series (GT15) display equipment to the robot controller over the Ethernet permits you to control robot controller's input/output from a GOT (graphic operation terminal).

3.5 Dedicated input/output

Show the main function of dedicated input/output in the [Table 3-3](#). Refer to attached instruction manual "Detailed explanations of functions and operations" in the product for the other 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.

Table 3-3 : 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. |
| RCREADY | None | | | Controller power ON complete signal | Outputs that external input signals can be received. |
| AUTOENA | Automatic operation enabled input signal | Allows automatic operation. | 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. |
| STOP2 | Stop input signal | The program during operation is stopped. Unlike the STOP parameter, change of the signal number is possible. Notes) Specification is the same as the STOP parameter. | L | Wait output signal | Outputs that the slot is temporarily stopped. Notes) Specification is the same as the STOP parameter. |
| SLOTINIT | Program reset input signal | Resets the wait state. | 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. | E | In cycle stop operation output signal | Outputs that the cycle stop is operating. |
| SRVOFF | Servo ON enabled input signal | Turns the servo OFF for all mechanisms. | L | Servo ON enabled output signal | Outputs servo-on disable status. (Echo back) |
| SRVON | Servo ON input signal | Powers on the robot servos. For multiple mechanisms, it powers on the servos of all the mechanisms. | E | In servo ON output signal | Outputs the servo ON state. For multiple mechanisms, the output is performed when at least one of the mechanisms is in the servo ON state. |
| IOENA | Operation rights input signal | Requests the operation rights for the external signal control. | L | 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. |

| Parameter name | Input | | | Output | |
|---------------------------|---|---|-------|---|--|
| | Name | Function | Level | Name | Function |
| S1STOP : S32STOP | Stop input | Stops each slot. | L | In wait output | Outputs that each slot is temporarily stopped. |
| PRGSEL | Program selection input signal | Designates the setting value for the program No. with numeric value input signals. | E | None | |
| OVRDSEL | Override selection input signal | Designates the setting value for the override with the numeric value input signals. | E | None | |
| IODATA Note2) | Numeric value input (start No., end No.) | Used to designate the program name, override value., mechanism value. | L | Numeric value output (start No., end No.) | Used to output the program name, override value., mechanism No. |
| PRGOUT | Program No. output request | Requests output of the program name. | E | Program No. output signal | Outputs that the program name 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 | |
| HNDCTRL1 : HNDCTRL3 | None | | | Mechanism 1 hand output signal status : Mechanism 3 hand output signal status | Mechanism 1: Outputs the status of general-purpose outputs 900 to 907. Mechanism 2: Outputs the status of general-purpose outputs 910 to 917. Mechanism 3: Outputs the status of general-purpose outputs 920 to 927. |
| HNDSTS1 : HNDSTS3 | None | | | Mechanism 1 hand input signal status : Mechanism 3 hand input signal status | Mechanism 1: Outputs the status of hand inputs 900 to 907. Mechanism 2: Outputs the status of hand inputs 910 to 917. Mechanism 3: Outputs the status of hand inputs 920 to 927. |
| HNDERR1 : HNDERR3 | Mechanism 1 hand error input signal : Mechanism 3 hand error input signal | Requests the hand error occurrence. | L | Mechanism 1 hand error output signal : Mechanism 3 hand error output signal | Outputs that a hand error is occurring. |

| Parameter name | Input Note1) | | | Output | |
|-----------------------------|---|--|-------|---|---|
| | Name | Function | Level | Name | Function |
| AIRERR1 : AIRERR3 | Pneumatic pressure error 1 input signal : Pneumatic pressure error 3 input signal | Request the pneumatic pressure error occurrence. | L | Pneumatic pressure error 1 output signal. : Pneumatic pressure error 3 output signal. | Outputs that a pneumatic pressure error is occurring. |
| M1PTEXC : M3PTEXC | None | | L | Maintenance parts replacement time warning signal | Outputs that the maintenance parts have reached the replacement time. |
| 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 and output etc.

Do wiring of the external emergency stop, the special stop input, the door switch, and the enabling device from the "special input/output" terminal connector.

Table 3-4 : Special input/output terminal

| Item | Name | Function |
|--------|---|--|
| Input | Emergency stop | Applies the emergency stop. Dual emergency line |
| Input | Special stop input | Applies the stop. (Refer to Page 155, "3.6.2 Special stop input (SKIP)") |
| Input | Door switch | Servo-off. Dual line, normal close (Page 157, "3.6.3 Door switch function") |
| Input | Enabling device | Servo-off. Dual line, normal close (Page 157, "3.6.4 Enabling device function") |
| Output | Robot error output | Contact is opening during error occurrence. |
| Output | Emergency stop output | The point of contact opens under occurrence of emergency stop of external input signal, emergency stop of OP, emergency stop of T/B. |
| Output | Mode output | MANUAL mode: contactor is opening, AUTOMATIC mode: contactor is closing. |
| Output | Magnet contactor control connector output for addition axes | When an additional axis is used, the servo ON/OFF status of the additional axis can be synchronized with the robot arm. (Page 166, "3.9 Magnet contactor control connector output (AXMC) for addition axes") |

*At the time of the power supply OFF, the output point of contact is always open.

[Note] The contact capacity of each input/output terminal is DC24V/10mA – 100mA. Don't connect the equipment except for this range. The use exceeding contact capacity causes failure.
In the customer's system, do not ground the + side of 24V power supply prepared by customer for connect to the controller. (related with emergency stop and parallel input/output) If it connects with the controller under the condition that the + side is grounded, it will lead to failure of controller.

[Note] If a stop signal or servo OFF signal is input simultaneously with a door switch open/emergency stop input, the error, H056n "Servo sys. error (A/D)" may occur.
When a door switch open/emergency stop is input, the robot turns off the servo after it stops. It is unnecessary to input a stop signal or servo OFF signal. To input a stop signal or servo OFF signal with a door switch open/emergency stop input, wait for 100ms or more after a door switch open/emergency stop input.

Pin number assignment of each terminal and the circuit diagram are shown in [Fig. 3-14 \(CR750\)](#) or [Fig. 3-18 \(CR751\)](#).

3.6.1 Connection of the external emergency stop

The external emergency stop input and door switch input and enabling device input are opened at shipment as shown in [Fig. 3-14 \(CR750\)](#) or [Fig. 3-18 \(CR751\)](#).

Connect the external emergency stop switch and door switch with the following procedure.

And, the example of the connection and notes of the emergency stop are described in [Page 196, "6.1.7 Examples of safety measures"](#) Refer to it together

[Caution] The emergency stop circuit is duplicated inside the drive unit. The emergency stop switch uses a double contact-type switch, so please be sure to fix both of the contacts to the connector pins as shown below in order to ensure the wiring is duplicated. An error will continue to occur in the event that only one of the pins is connected.

1) Please prepare the emergency stop switch, door switch and enabling device.

a) External emergency stop switch

- CR750 drive unit.....CNUSR11 connector "between 3 and 4" and CNUSR12 Connector "between 3 and 4".
- CR751 drive unit.....CNUSR1 connector "between 2 and 27" and "between 7 and 32".

b) Door switch

- CR750 drive unit.....CNUSR11 connector "between 7 and 8" and CNUSR12 connector "between 7 and 8".
- CR751 drive unit.....CNUSR1 connector "between 4 and 29" and "between 9 and 34".

c) Enabling device

- CR750 drive unit.....CNUSR11 connector "between 9 and 10" and CNUSR12 connector "between 9 and 10".
- CR751 drive unit.....CNUSR1 connector "between 5 and 30" and "between 10 and 35".

[Caution] Be sure to use a shield cable for the emergency stop wiring cable. And when operating in an environment that is easily affected by noise, be sure to fix the attached ferrite core (model number:

E04SR301334, manufacturer: Seiwa Electric Mfg. Co., Ltd.). Be sure to place the ferrite core more than 30 cm from the connecting terminal section.

CAUTION Make sure there are no mistakes in the wiring. Connecting differently to the way specified in the manual can result in errors, such as the emergency stop not being released. In order to prevent errors occurring, please be sure to check that all functions (such as the teaching box emergency stop, customer emergency stop, and door switch) are working properly after the wiring setup is completed.

CAUTION You should always connect doubly connection of the emergency stop, the door switch, and the enabling switch. In connection of only one side, if the relay of customer use should break down, it may not function correctly. The robot output contacts (error output, emergency stop output, mode output, addition axis contactor control output) are duplicated output contacts that are wired in series. As with emergency stop switches and door switches, ensure that all connections to customer devices are duplicated to achieve redundancy.

CAUTION Please make sure to wire the multiple emergency stop switches so that they each function independently. Check and make sure that the emergency stop doesn't only function under an AND condition (when multiple emergency stop switches are ON at the same time).

(1) CR750 drive unit

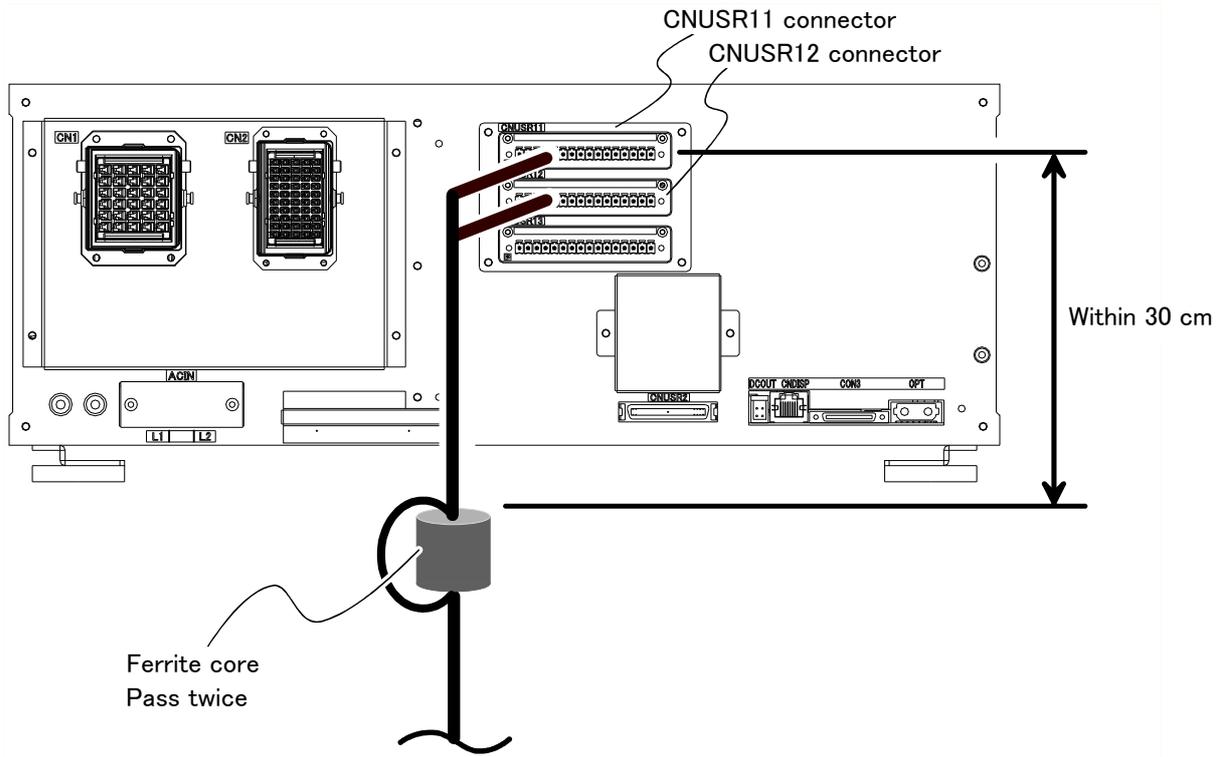


Fig.3-13 : Emergency stop cable connection (CR750)

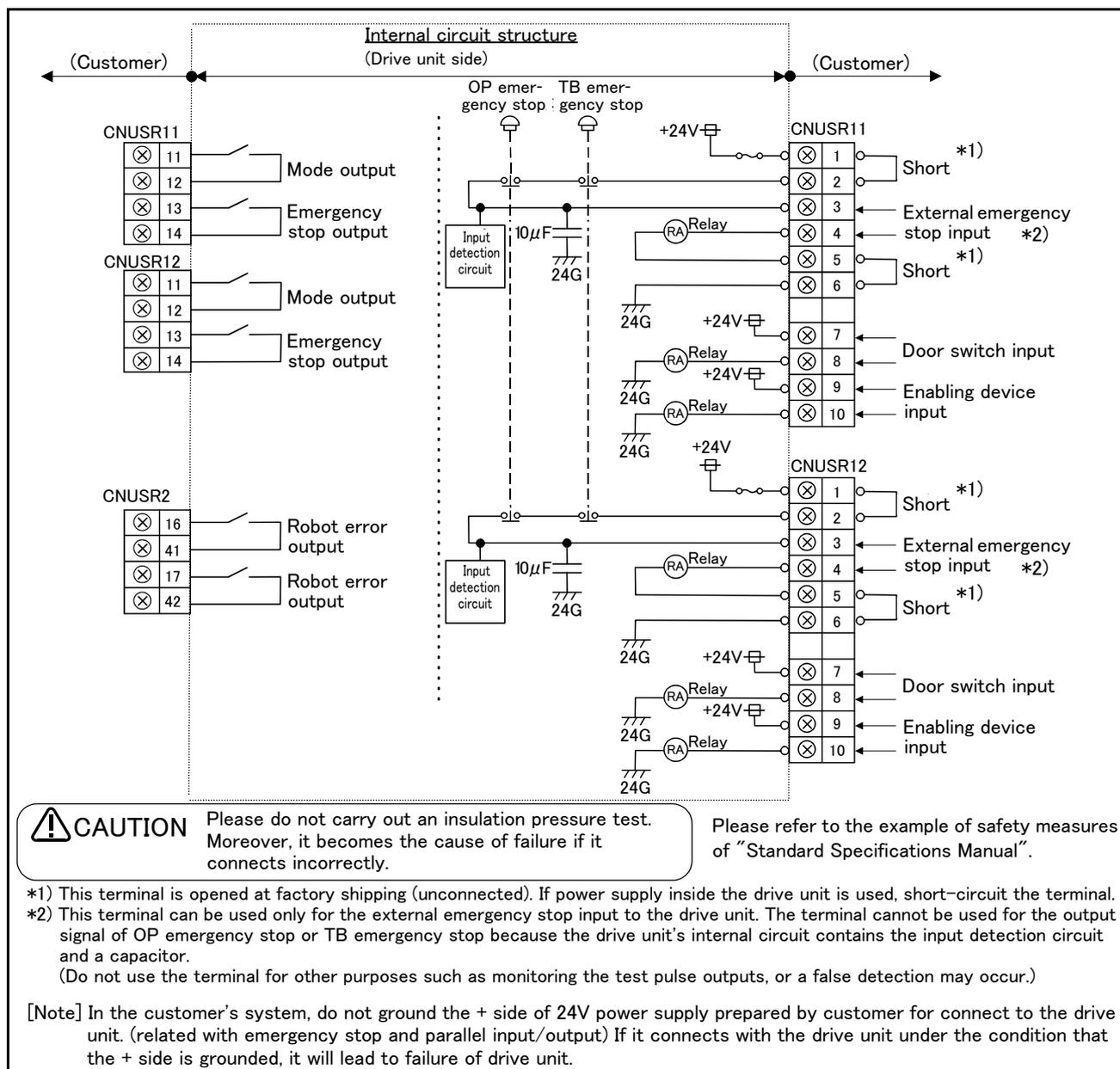


Fig.3-14 : External emergency stop connection (CR750)

CAUTION

Place the emergency stop switch in an easily operable position, and be sure to wire it to the emergency stop correctly by referencing [Page 196, "6.1.7 Examples of safety measures"](#).

This is a necessary measure in order to ensure safe operation so that the robot can be stopped immediately by pressing the emergency stop switch in the event that the robot malfunctions.

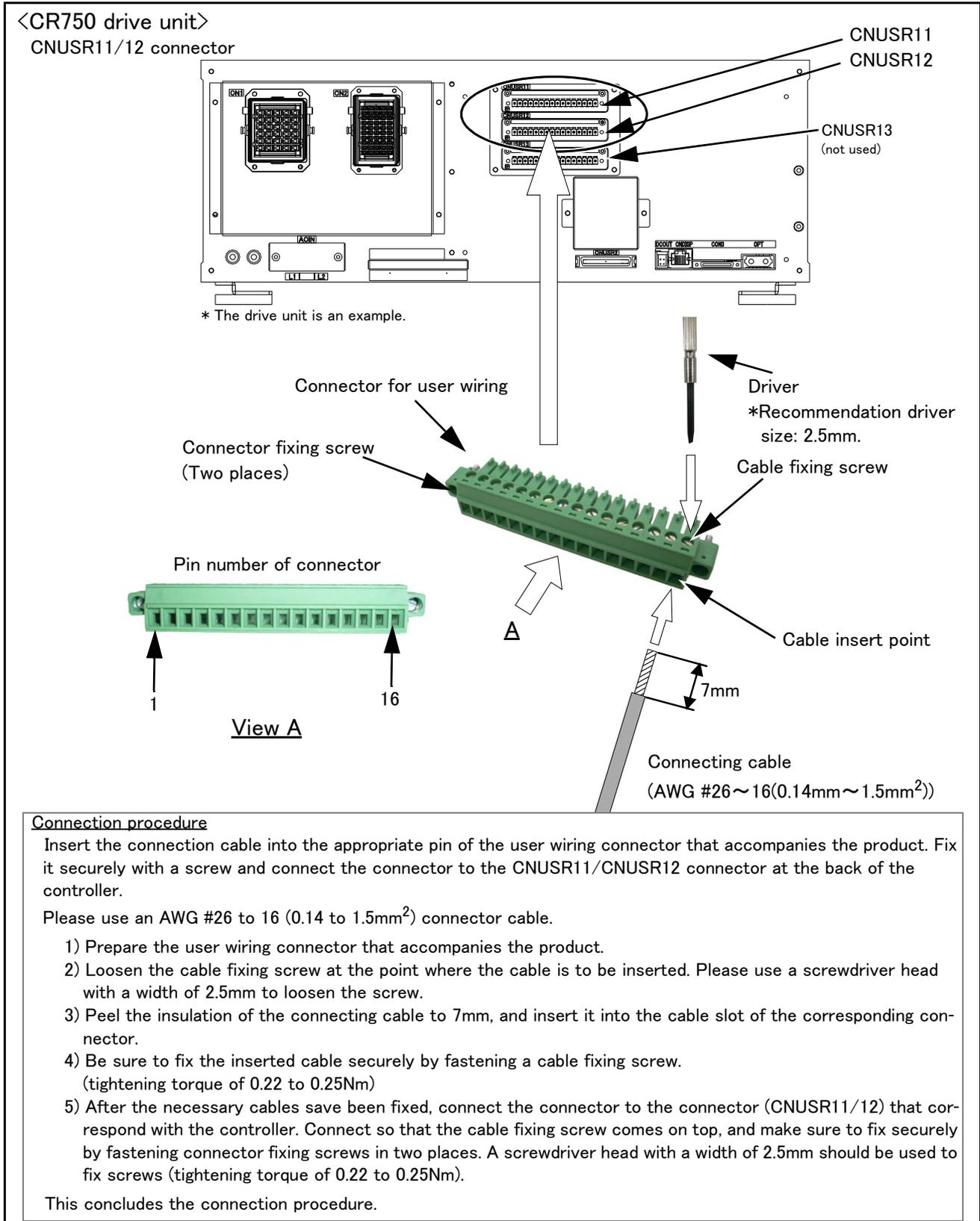


Fig.3-15 : Method of wiring for external emergency stop connection (CR750 (CNUSR11/12))

⚠ CAUTION

Makes sure that there is no mistake when connecting to the target connectors. Connecting incorrectly will result in the robot breaking down or malfunctioning. The connector on the controller side that connects to the user wiring connector is CNUSR11 or CNUSR12. Be careful not to connect to CNUSR13 as the robot will not operate properly.

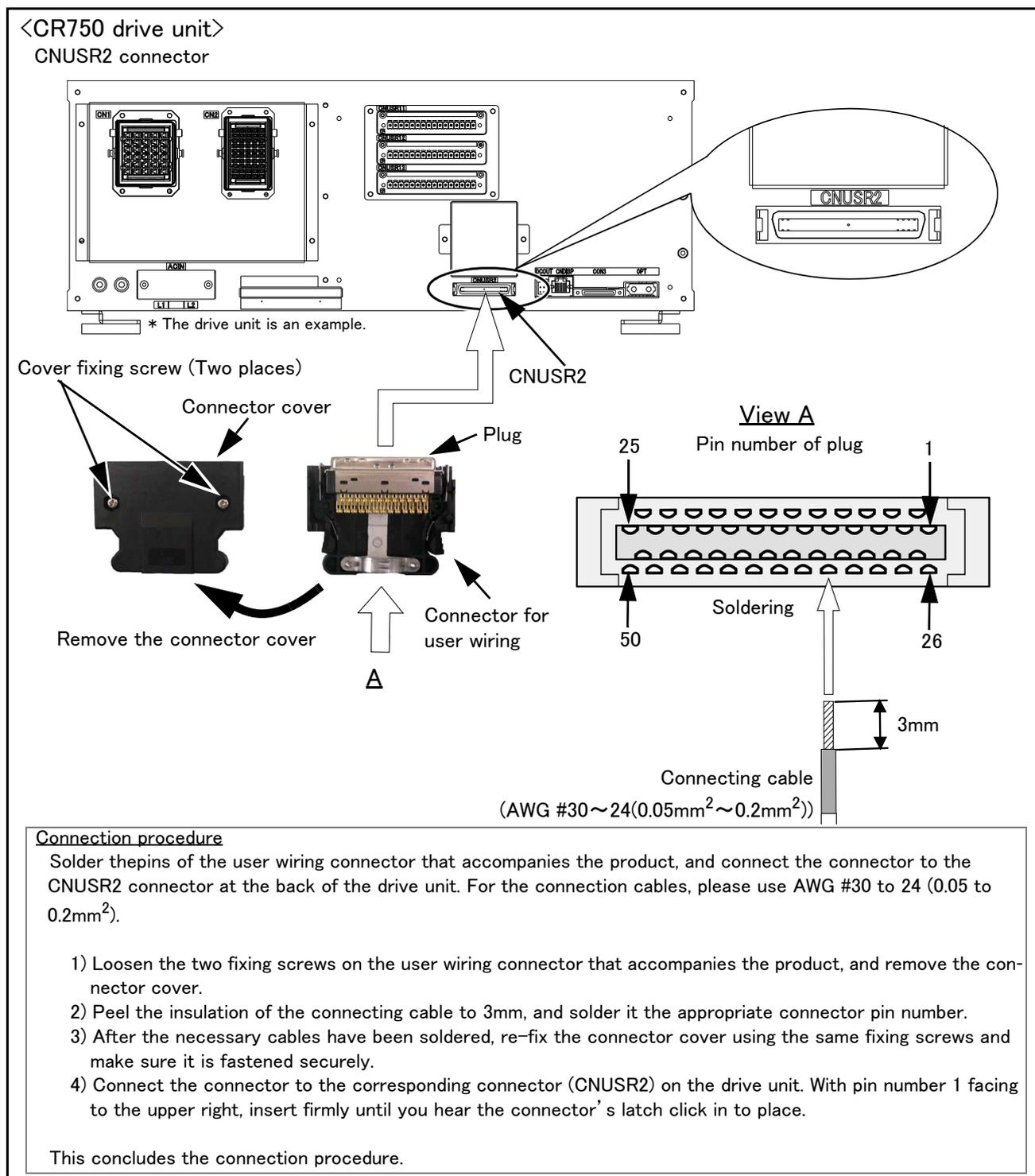


Fig.3-16 : Method of wiring for external emergency stop connection (CR750 (CNUSR2))

⚠ CAUTION

When soldering please take care to only connect to the specified pin number. Connecting to a different pin number or short-circuiting with another pin will result in the robot breaking down or malfunctioning.

(2) CR751 drive unit

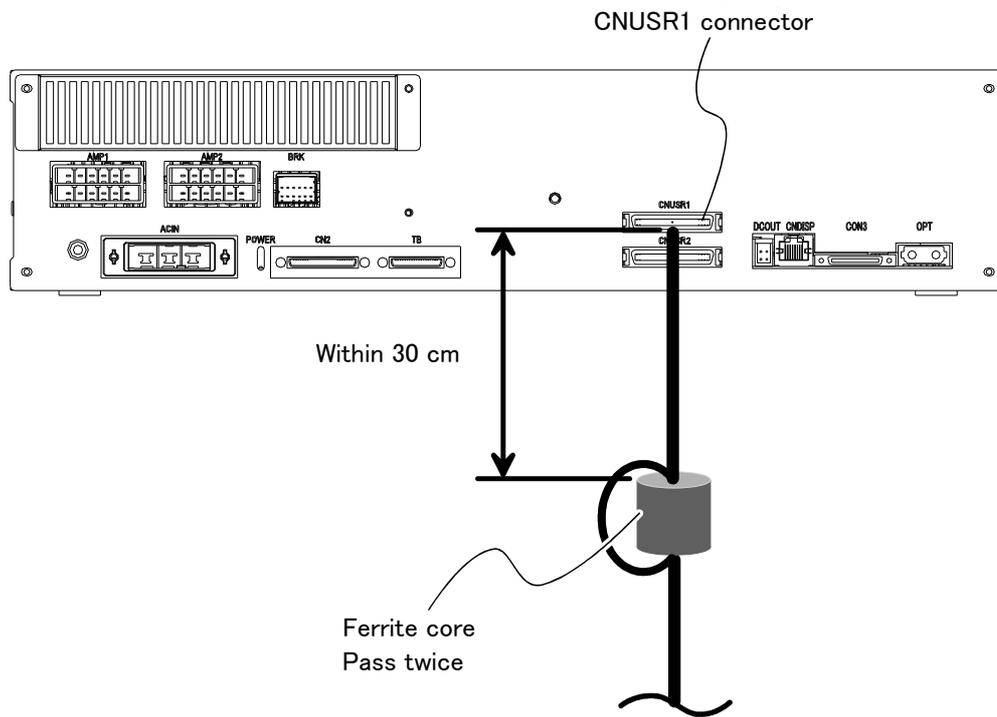


Fig.3-17 : Emergency stop cable connection (CR751)

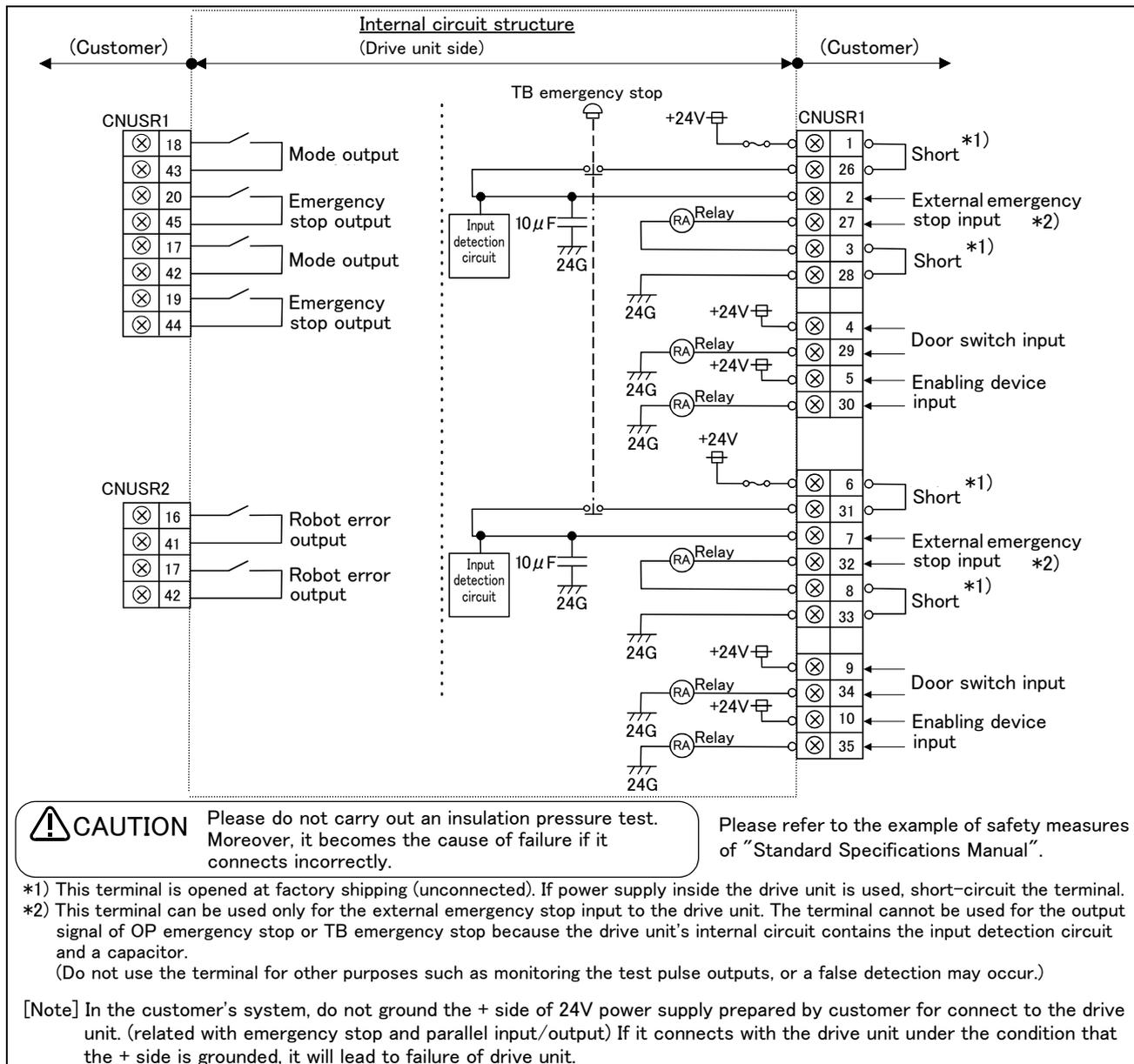


Fig.3-18 : External emergency stop connection (CR751)

CAUTION

Place the emergency stop switch in an easily operable position, and be sure to wire it to the emergency stop correctly by referencing [Page 196, "6.1.7 Examples of safety measures"](#).

This is a necessary measure in order to ensure safe operation so that the robot can be stopped immediately by pressing the emergency stop switch in the event that the robot malfunctions.

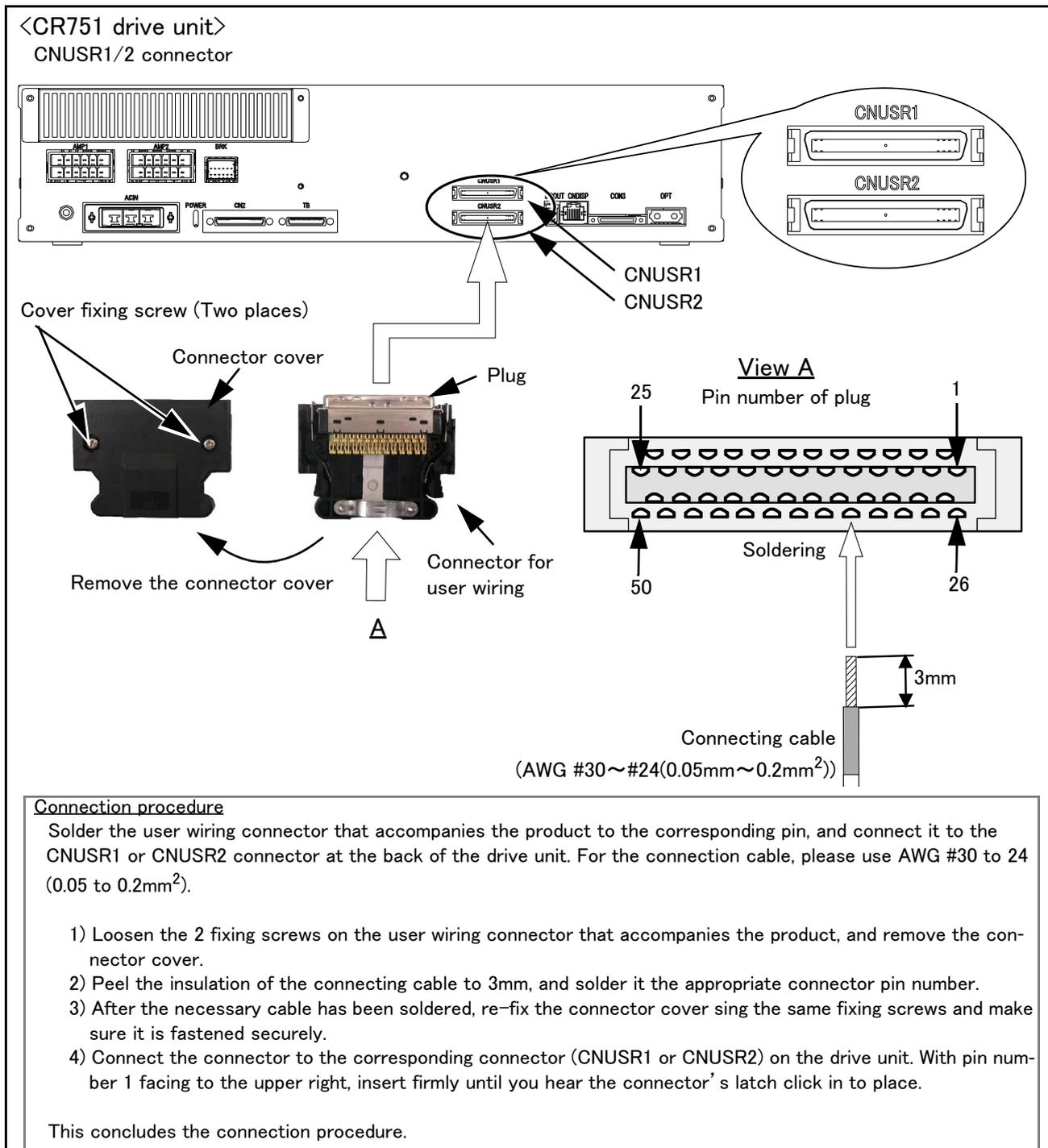


Fig.3-19 : Method of wiring for external emergency stop connection (CR751 (CNUSR1/2))

CAUTION

When soldering please take care to only connect to the specified pin number. Connecting to a different pin number or short-circuiting with another pin will result in the robot breaking down or malfunctioning. The connectors on the drive unit side are CNUSR1 (upper side) and CNUSR2 (lower side). Make sure that there is no mistake when connecting to the target connectors. Connecting incorrectly will result in the robot breaking down or malfunctioning.

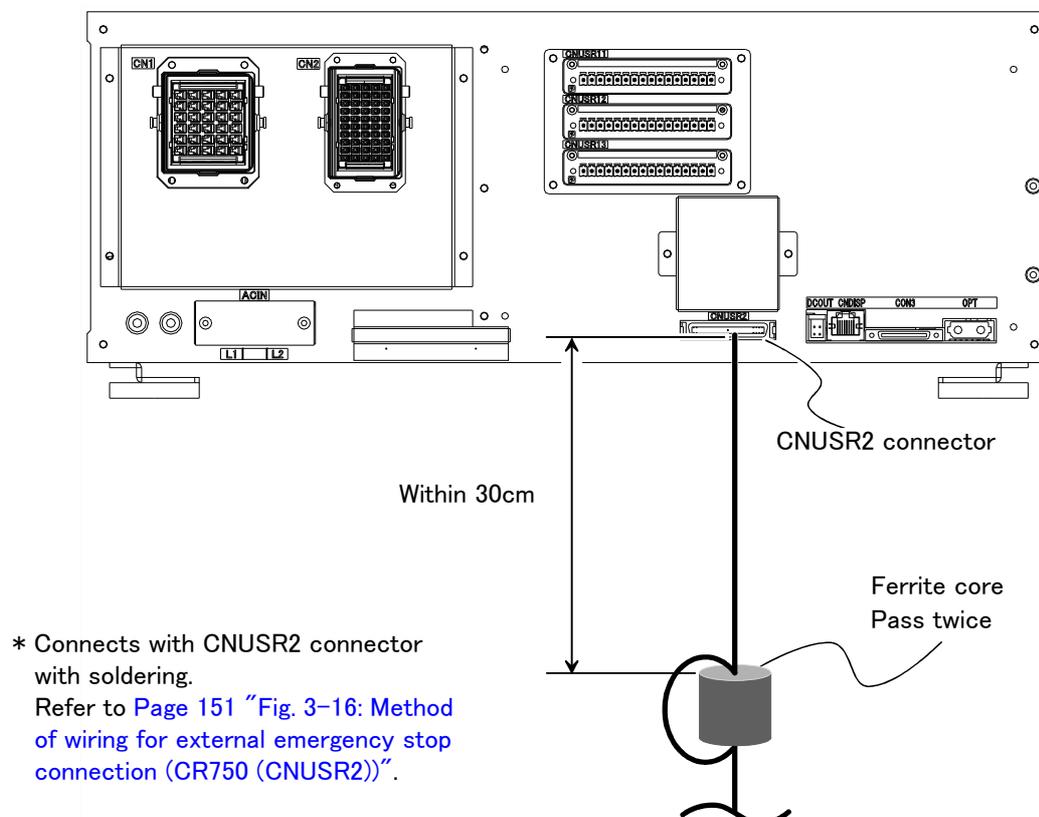
3.6.2 Special stop input (SKIP)

The skip is the input signal to stop the robot. The pin 9, 34 of the CNUSR2 connector shown in Fig. 3-20 (CR750) or Fig. 3-21 (CR751).

Table 3-5 : Special stop input electric specification

| Item | | Specifications | Internal circuit |
|---------------------------------|----------------------|--|------------------|
| Type | | DC input | |
| No. of input point | | 1 | |
| Insulation method | | Photo-coupler insulation | |
| Rated input voltage | | DC24V | |
| Rated input current | | Approx. 11mA | |
| Working voltage range | | DC 21.6 ~ 26.4V (Ripple rate within 5%) | |
| ON voltage/ON current | | DC 8V or more / 2mA or more | |
| OFF voltage/OFF current | | DC 4V or less / 1mA or less | |
| Input resistance | | Approx. 2.2 k Ω | |
| Response time | OFF \rightarrow ON | 1ms or less | |
| | ON \rightarrow OFF | 1ms or less | |
| Common method | | 1 point per common | |
| External wire connection method | | Connector | |

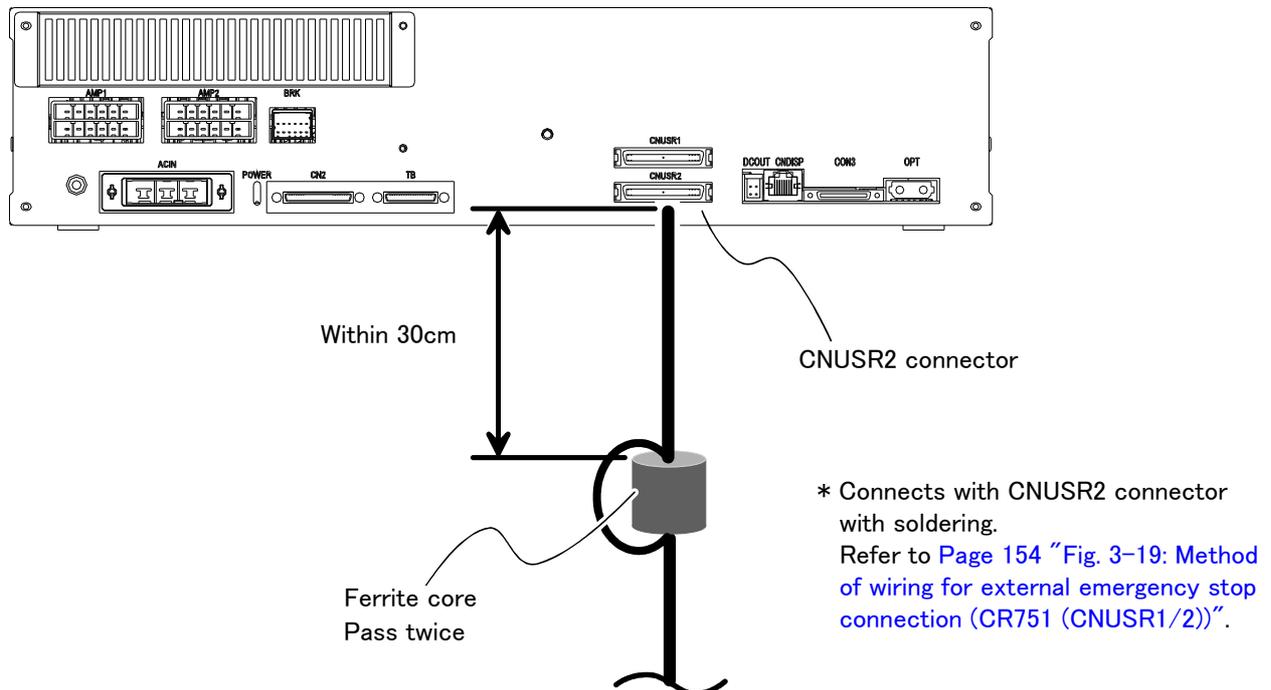
(1) CR750 drive unit



Note) In the customer's system, do not ground the + side of 24V power supply prepared by customer for connect to the controller. (related with emergency stop and parallel input/output) If it connects with the controller under the condition that the + side is grounded, it will lead to failure of controller.

Fig.3-20 : Connection of the special-stop-input (CR750)

(2) CR751 drive unit



Note) In the customer's system, do not ground the + side of 24V power supply prepared by customer for connect to the controller. (related with emergency stop and parallel input/output) If it connects with the controller under the condition that the + side is grounded, it will lead to failure of controller.

Fig.3-21 : Connection of the special-stop-input (CR751)

3.6.3 Door switch function

This function retrieves the status of the switch installed on the door of the safety fence, etc., and stops the robot when the door is opened. This differs from an emergency stop in that the servo turns OFF when the door is opened and an error does not occur. Follow the wiring example shown in [Page 149 "Fig. 3-14: External emergency stop connection \(CR750\)"](#) or [Page 153 "Fig. 3-18: External emergency stop connection \(CR751\)"](#), and [Page 196, "6.1.7 Examples of safety measures"](#). Those figure explains the wire is contact closes when the door is closed. Details of this function according to the robot status are shown below.

*During automatic operation When the door is opened, the servo turns OFF and the robot stops. An error occurs. The process of the restoration: Close the door, reset the alarm, turn on the servo, and restart

*During teaching..... Even when the door is opened, the servo can be turned ON and the robot moved using the teaching pendant.

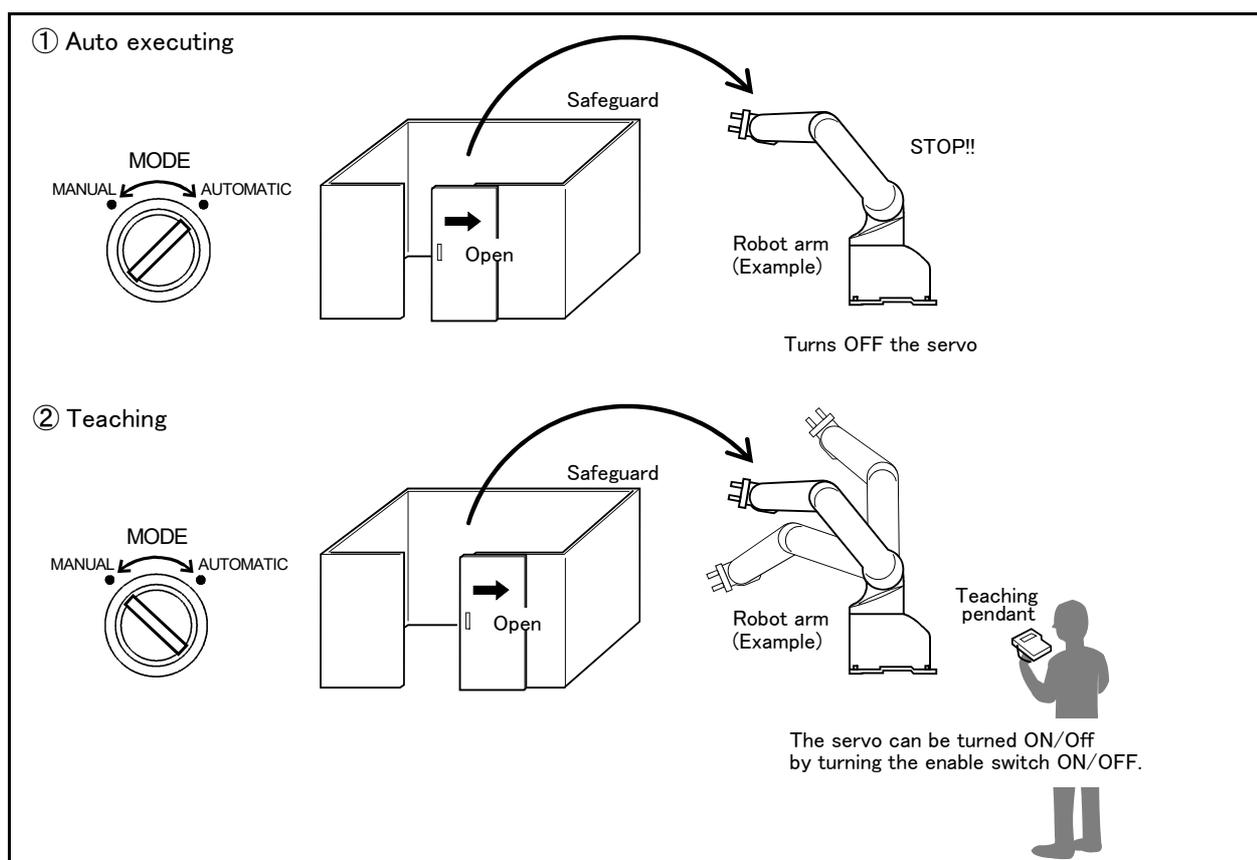


Fig.3-22 : Door switch function

3.6.4 Enabling device function

When the abnormalities occur in teaching operations etc., the robot's servo power can be immediately cut only by switch operation of the enabling device^{*1)} (servo-off), and the safety increases. To use the robot safely, please be sure to connect the enabling device.

(1) When door is opening

Please do teaching by two-person operations. One person has T/B, the other has enabling device. Turn on the servo power, in the condition that both of switches are pushed. (Enable switch of T/B and enabling device) Then the jog operation will be available. You can off the servo power only by releasing the switch of the enabling device. And, care that the servo-on and releasing the brake cannot be done in the condition that the switch of the enabling device is released.

(2) When door is closing

You can turn on the servo power by operation of only T/B. In this case perform jog operation outside the safeguard sure.

*1) Recommendation products: HE1G-L20MB (IDEC)

(3) Automatic Operation/Jog Operation/Brake Release and Necessary Switch Settings

The following is a description of various operations performed on the robot and switch settings that are required.

Table 3-6 : Various operations and necessary switch settings

| No | Operation | Related switch settings ^{Note1)} | | | | | Description |
|----|---------------------------------|---|--------------------|-------------------|--------------------------------|----------------------------|---|
| | | Mode of controller | T/B enable/disable | T/B enable switch | Enabling device input terminal | Door switch input terminal | |
| 1 | Jog operation | Manual | Enable | ON | Close(ON) | — | If the enabling device input is set to Close (On), the state of door switch input does not matter. |
| 2 | Jog operation ^{Note2)} | Manual | Enable | ON | Open(OFF) | Close (Door Close) | If the enabling device input is set to Open (Off), door switch input must be in a state of Close |
| 3 | Brake release ^{Note3)} | Manual | Enable | ON | Close(ON) | — | Irrespective of the state of door switch input, enabling device input must be in a state of Close (On). |
| 4 | Automatic operation | Automatic | Disable | — | — | Close (Door Close) | Door switch input must always be in a state of Close (Door Close). |

Note1) “—” in the table indicates that the state of switch concerned does not matter.

Refer to the following for operation of each switch.

- Mode of CR750 controller:Page 128, “3.2 Names of each part”
- Mode of CR751 controller:Page 159, “3.7 Mode changeover switch input”
- T/B enable/disable:..... Page 170, “(1) Teaching pendant (T/B)”
- T/B enable switch:..... Page 170, “(1) Teaching pendant (T/B)”
- Enabling device input terminal:Page 196, “6.1.7 Examples of safety measures”
- Door switch input terminal:Page 196, “6.1.7 Examples of safety measures”

Note2) Jog operation, if door switch input is set for Close (Door Close), must be performed outside the safety barrier.

Note3) It is imperative that brake release operation be carried out by two persons. One person turns on the enabling device (“Close” on the enabling device input terminal) while the other manipulates the T/B. Brake release can be effected only when both of the enabling switch device and the T/B enable switch are placed in intermediate position (lightly gripped position). At this point, the state of door switch input does not matter.

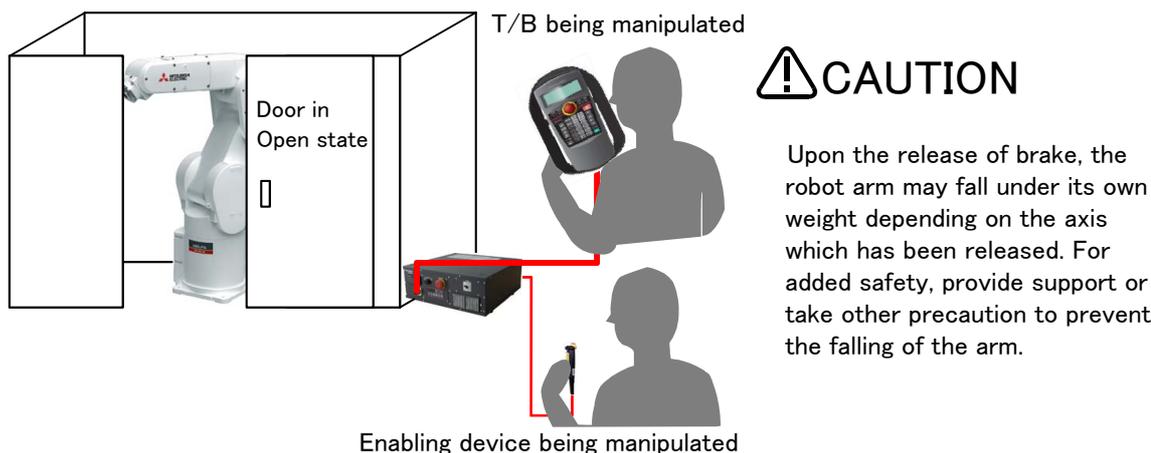


Fig.3-23 : Brake release operation

3.7 Mode changeover switch input

Connect the key switch of customer prepared and change the right of robot's operation by switch operation. The key switch can be installed in the operation panel of customer preparation.

<Right of operation (mode)>

AUTOMATICThe operation from external equipment becomes available. Operation which needs the right of operation from T/B cannot be performed. It is necessary to set the parameter for the rights of operation to connection with external equipment. Refer to the separate volume, "Instruction Manual/Detailed Explanation of Functions and Operations" for detail.

MANUALWhen T/B is available, only the operation from T/B becomes available. Operation which needs the right of operation from external equipment cannot be performed.

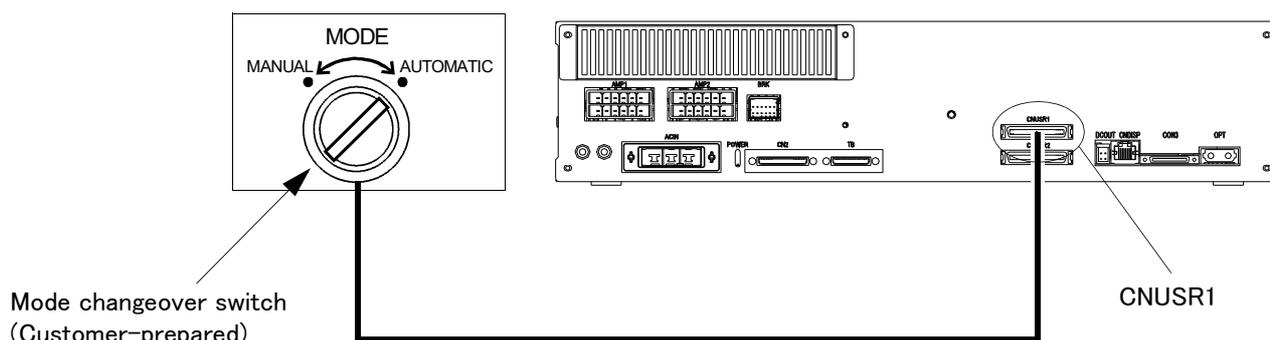


Fig.3-24 : Mode changeover switch image figure (CR751)

(1) Specification of the key switch interface

The function and specification of the key switch interface are shown below.

Table 3-7 : Function of the key switch interface

| Pin number and Function (Connector: CNUSR1) | | Change mode ^{Note1)} | |
|---|--|-------------------------------|-----------|
| Pin number | Function | MANUAL | AUTOMATIC |
| 49 | 1st line KEY input | Open | Close |
| 24 | Internal power supply of 1st line KEY input +24V output | | |
| 50 | 2nd line KEY input | Open | Close |
| 25 | Internal power supply of 2nd line KEY input +24V output | | |

Note1) The mode changes by both opening or both closing between 49-24 pin and between 50-25 pin. When input states differ between two lines, error H0044 (OP Mode key line is faulty) will occur.

[Note] For the input/output cable (CNUSR connector cable) that connects customer's system and the controller, prevent ground faults from occurring at the + side of the 24V power supply prepared by customer. A ground fault may lead to a failure of the protection device in the controller.

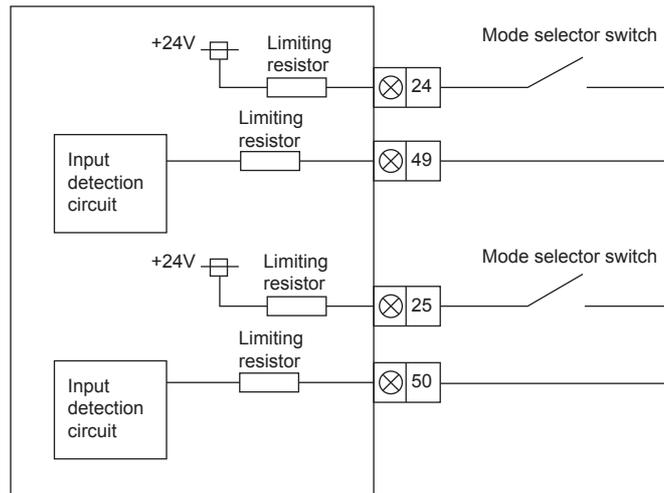


Fig.3-25 : Mode selector switch connection diagram

Table 3-8 : Specification of the mode changeover switch input

| Item | Specification | Remarks |
|-------------------------------|--------------------|--|
| Rated voltage | DC24V | Supply from the drive unit. |
| Current rating | Approx. 10mA | Select the switch or button which operates normally in 24V/10mA. |
| Input resistance | Approx. 2.2kΩ | |
| Response time (OFF->ON) | Approx. 15ms | Example: The response time the program starts, after pushing the run button. |
| Common method | 1 point per common | |
| Connection method | Connector | |
| Conformity electric wire size | AWG#24 to #30 | 0.2 to 0.05 mm ² |
| Maker/Type | - | Manufacturer: 3M / 10150-3000PE, 10350-52Y0-008 (cover) |

(2) Connection of the mode changeover switch input

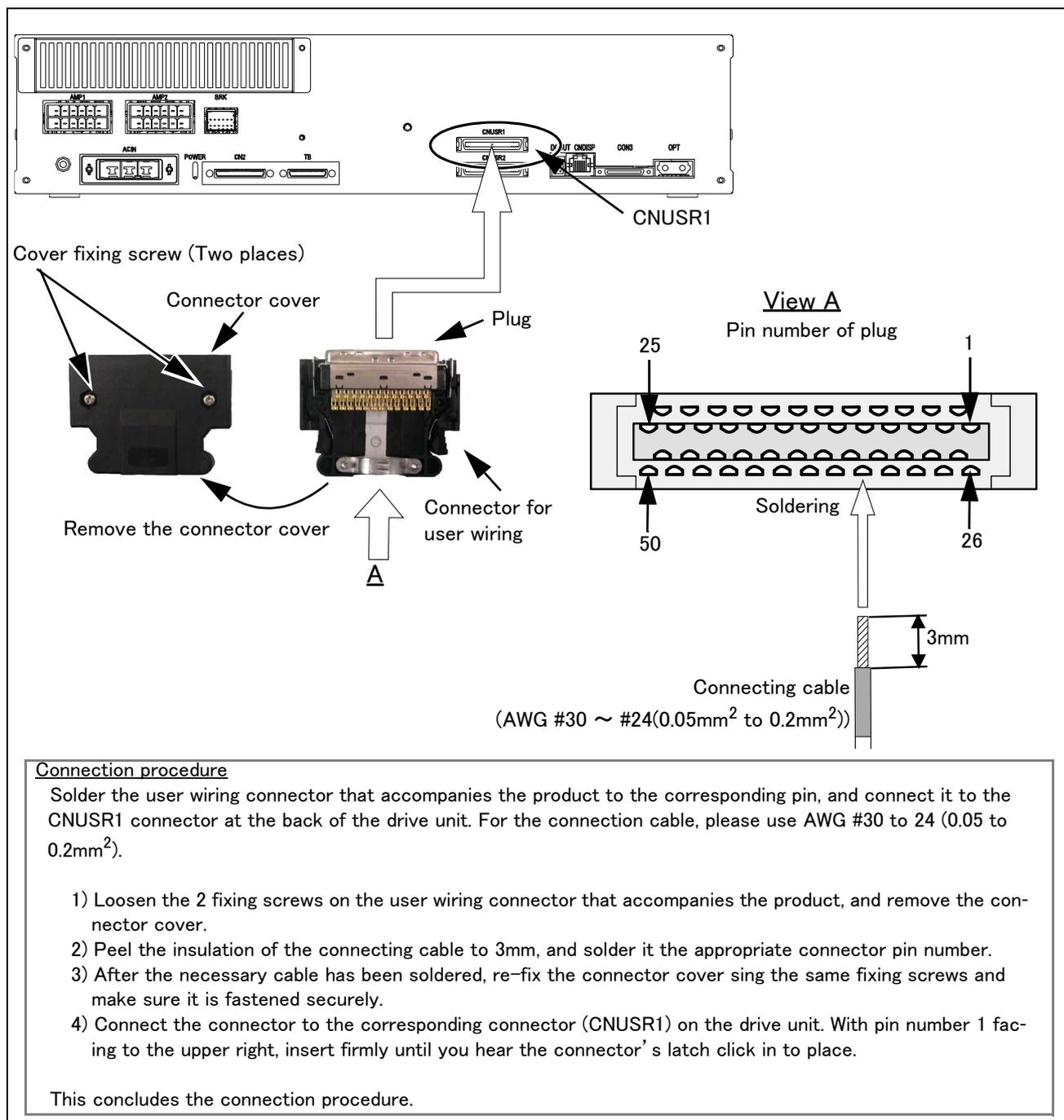


Fig.3-26 : Connection of the mode changeover switch input (CR751)

3.8 Additional Axis Function

This controller is equipped with an additional axis interface for controlling an additional axis when a traveling axis or rotary table is added to the robot. A maximum of eight axes of servo motors can be controlled at the same time by connecting a general-purpose servo amplifier (MR-J3-B, MR-J4-B series) that supports Mitsubishi's SSCNET III. Refer to the separate "Additional axis function Instruction Manual" for details on the additional axis function.

3.8.1 Wiring of the Additional Axis Interface

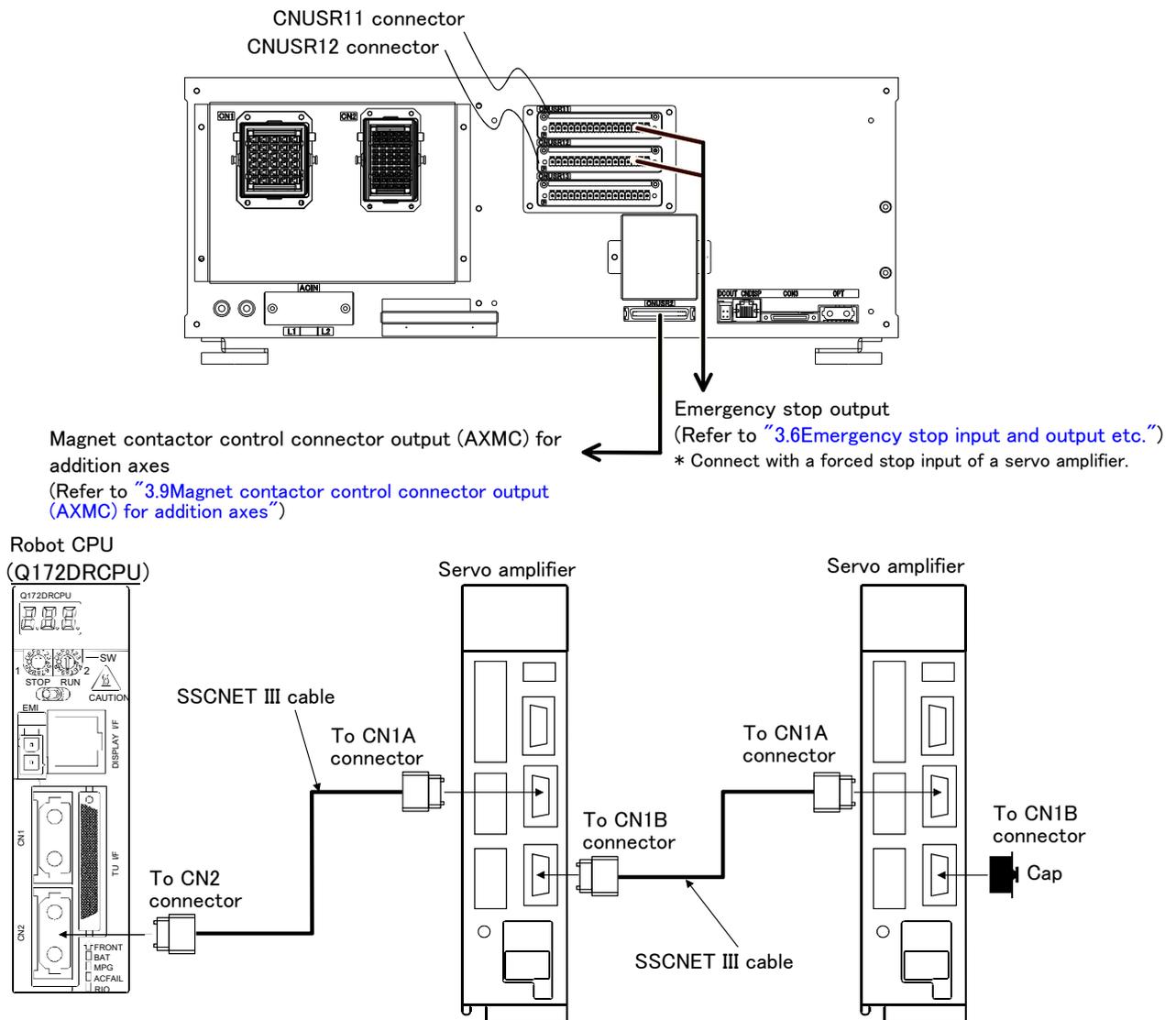
Table 3-9 shows the connectors for additional axes inside the drive unit. Fig. 3-27 (CR750) and Fig. 3-28 (CR751) shows a connection example (configuration example).

Table 3-9 : Dedicated connectors inside the drive unit

| Name | Connector name | Details |
|-------------------------------|----------------------------------|---|
| Connector for additional axes | CN2(Robot CPU) ^{Note1)} | The connector for connecting the general-purpose servo amplifier. |

Note1) Since the CN1 connector is used for the robot arms, it cannot be used for the addition axis.

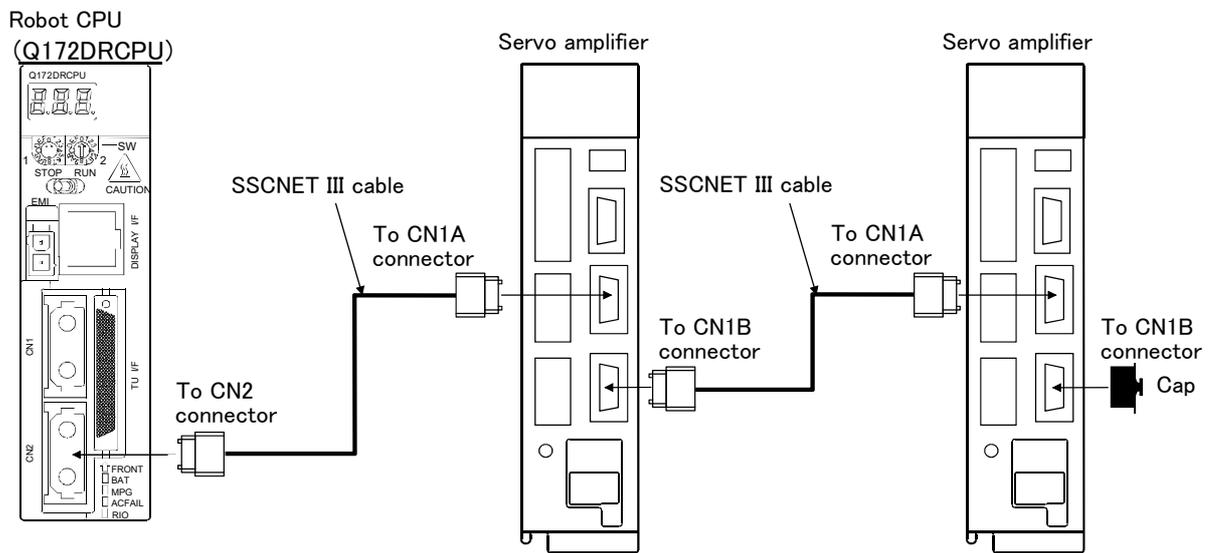
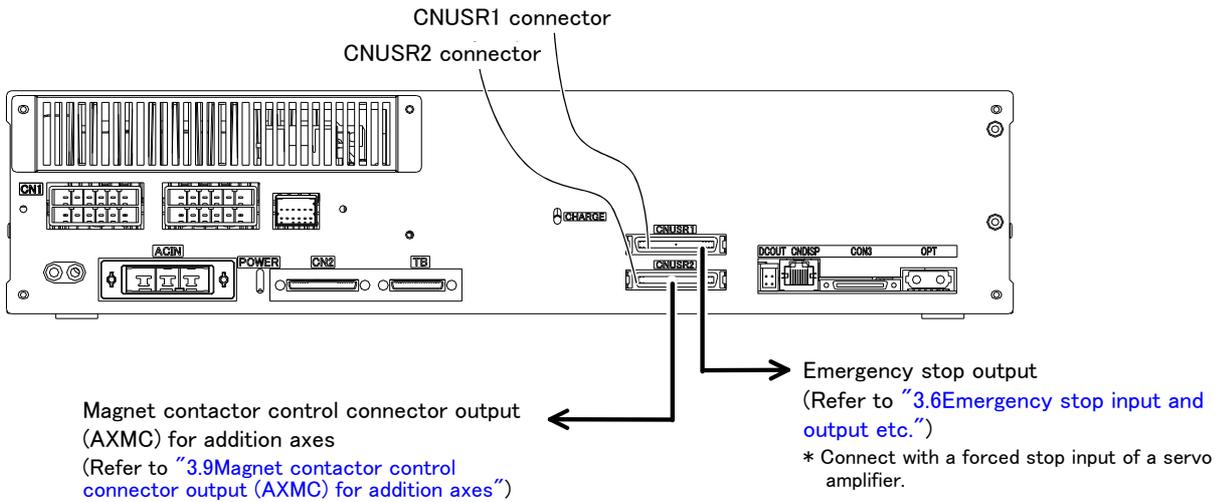
(1) CR750 drive unit



* It cannot communicate, if connection of CN1A and CN1B is mistaken.

Fig.3-27 : Example of addition axis connection (CR750)

(2) CR751 drive unit



* It cannot communicate, if connection of CN1A and CN1B is mistal

Fig.3-28 : Example of addition axis connection (CR751)

(3) Example of the installation of the noise filter

1) EMC filter (recommended)

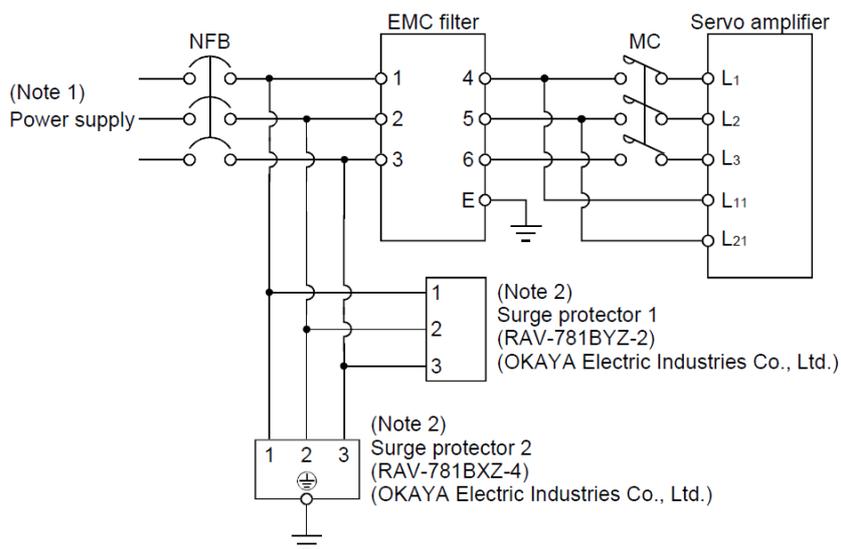
Please install the recommendation filter shown below according to the example of connection.

1) Combination with the servo amplifier

| Servo amplifier | Recommended filter (Soshin Electric) | | Mass [kg]([lb]) |
|---|--------------------------------------|----------------------|-----------------|
| | Model | Leakage current [mA] | |
| MR-J3-10B to MR-J3-100B MR-J3-10B1 to MR-J3-40B1 | (Note) HF3010A-UN | 5 | 3 (6.61) |
| MR-J3-250B ▪ MR-J3-350B | (Note) HF3030A-UN | | 5.5 (12.13) |
| MR-J3-500B ▪ MR-J3-700B | (Note) HF3040A-UN | 1.5 | 6.0 (13.23) |
| MR-J3-11KB to MR-J3-22KB | (Note) HF3100A-UN | 6.5 | 15 (33.07) |
| MR-J3-60B4 ▪ MR-J3-100B4 | TF3005C-TX | 5.5 | 6(13.23) |
| MR-J3-200B4 to MR-J3-700B4 | TF3020C-TX | | 7.5(16.54) |
| MR-J3-11KB4 | TF3030C-TX | | |
| MR-J3-15KB4 | TF3040C-TX | | |
| MR-J3-22KB4 | TF3060C-TX | | |

Note. A surge protector is separately required to use any of these EMC filters.

2) Connection example



Note1) For 1-phase 200V to 230VAC power supply, connect the power supply to L1, L2 and leave L3 open.

There is no L3 for 1-phase 100 to 120 VAC power supply.

Note2) The example is when a surge protector is connected.

Fig.3-29 : Example of EMC noise filter installation

2) Line noise filter

This filter is effective in suppressing noises radiated from the power supply side and output side of the servo amplifier and also in suppressing high-frequency leakage current (zero-phase current) especially within 0.5MHz to 5MHz band.

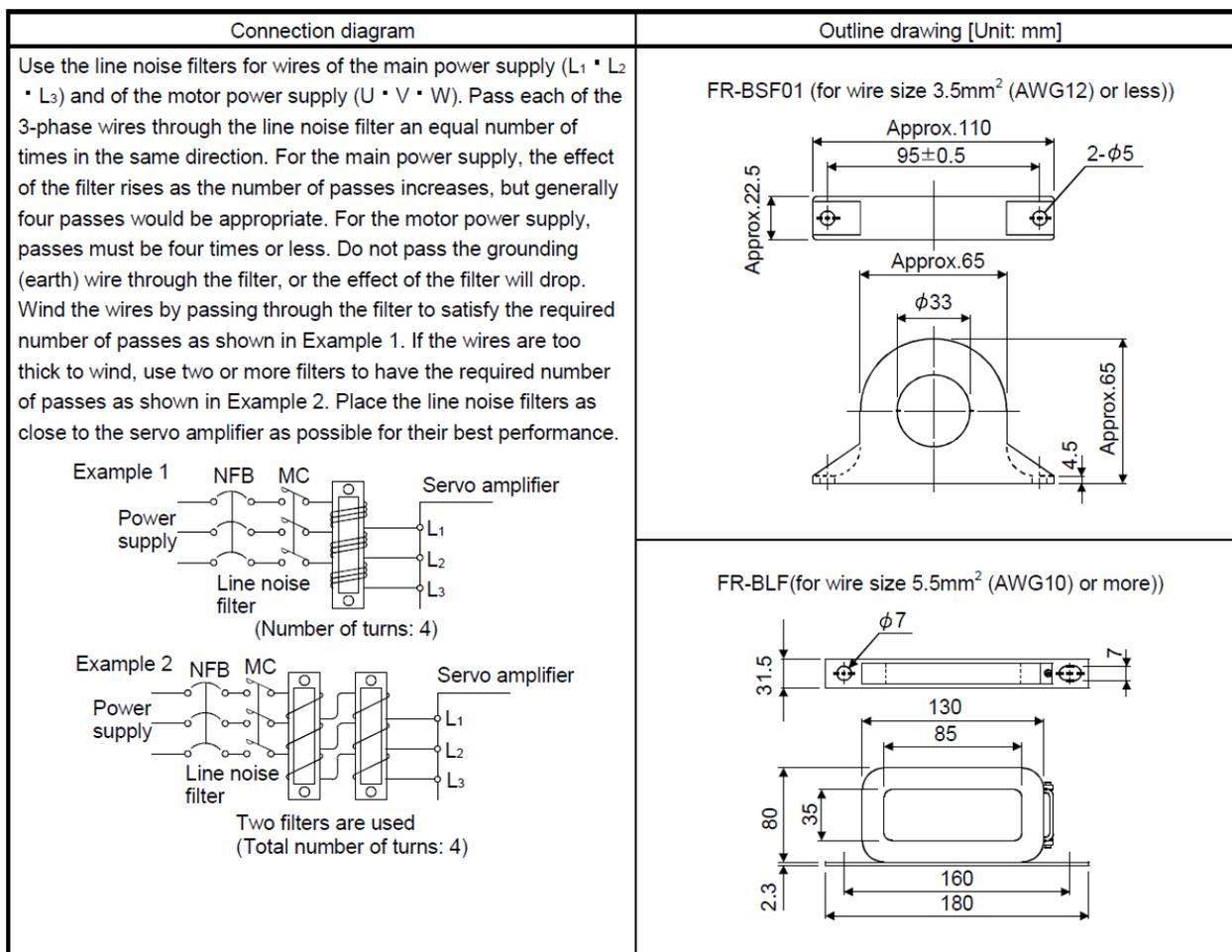


Fig.3-30 : Example of noise filter installation

3.9 Magnet contactor control connector output (AXMC) for addition axes

When an additional axis is used, the servo ON/OFF status of the additional axis can be synchronized with the servo ON/OFF status of the robot itself by using the output contact (AXMC) provided on the rear or inside of the drive unit and configuring a circuit so that the power to the servo amplifier for the additional axis can be turned off when this output is open.

An example circuit is shown in "(1)Example circuit". An image of how to connect the controller connector is shown in "(2)Image of how to connect the controller connector".

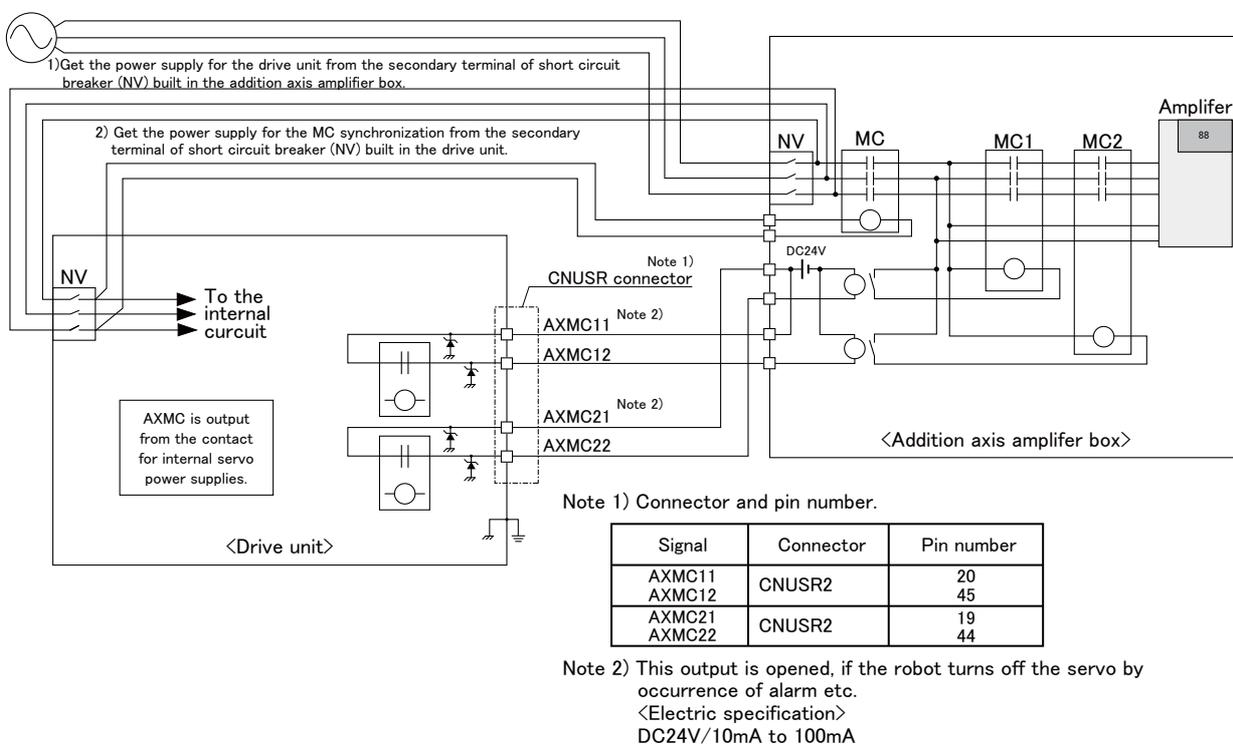
When you are using an additional axis, please perform appropriate circuit connections by referring to these drawings.

Refer to the separate "Additional axis function Instruction Manual" for details on the additional axis function.

Note1) you use the addition axis function as a user mechanism who became independent of the robot arm, please do not connect this output signal. Servo-on of the user mechanism may be unable.

(1) Example circuit

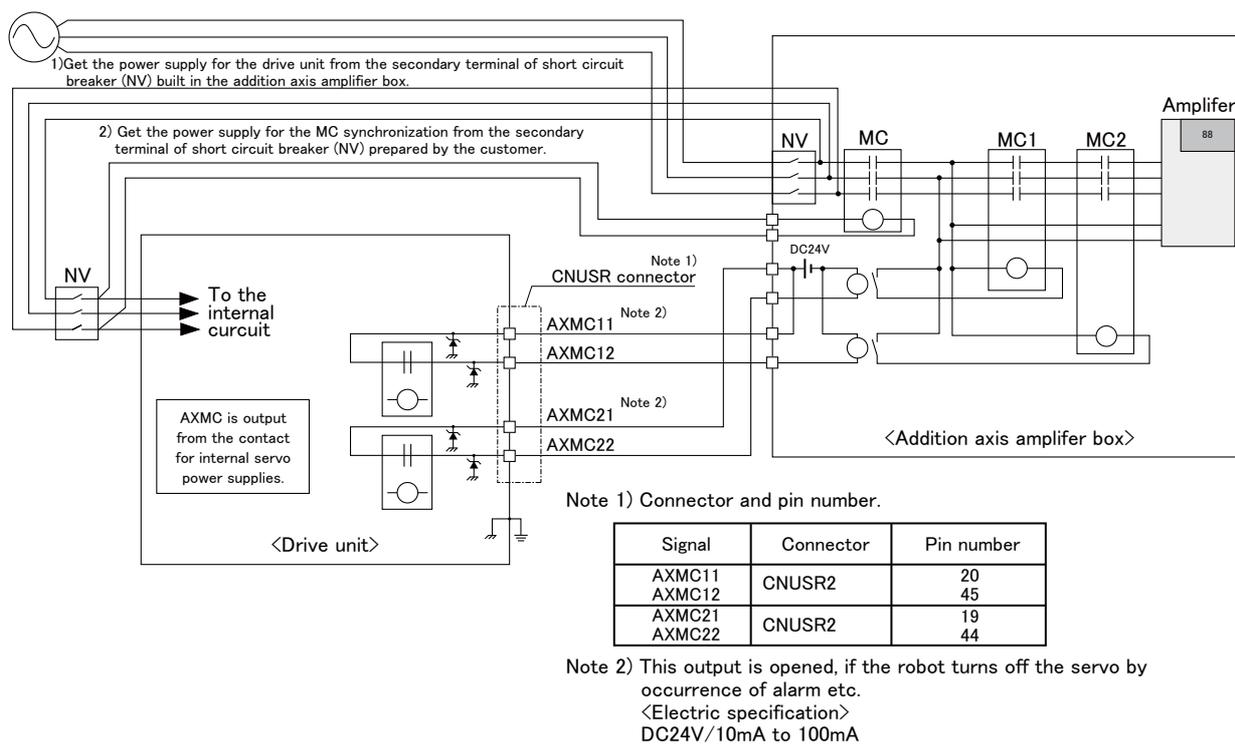
■ CR750 drive unit



[Note] For the input/output cable (CNUSR connector cable) that connects customer's system and the drive unit, prevent ground faults from occurring at the + side of the 24V power supply prepared by customer. A ground fault may lead to a failure of the protection device in the drive unit. Bending or frictional forces may be applied to the input/output cable repeatedly depending on the system configuration or layout. In this case, use a flexible cable for the input/output cable. Note that a fixed cable may be broken, resulting in a ground fault.

Fig.3-31 : Example of circuit for addition axes of Magnet contactor control output (CR750 drive unit)

■ CR751 drive unit

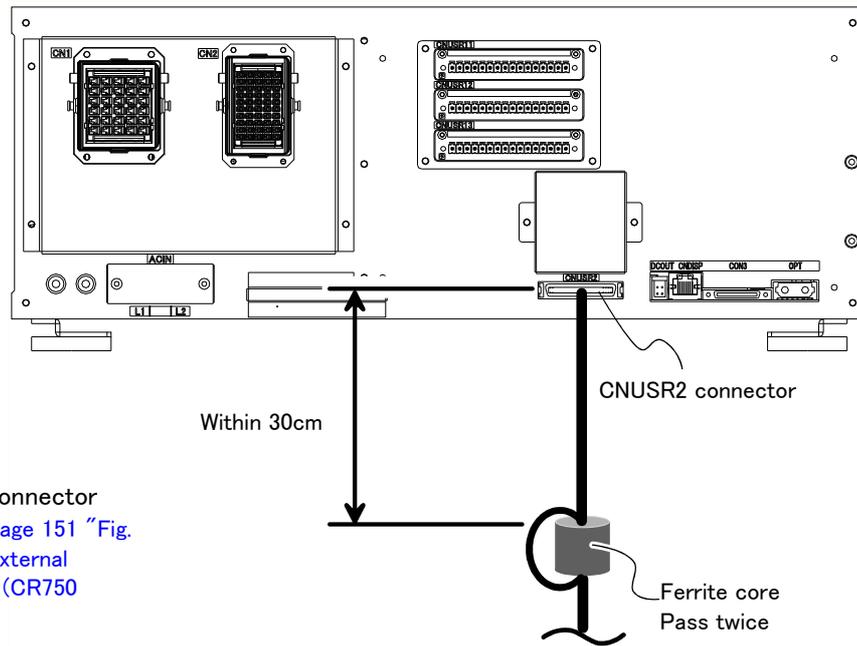


[Note] For the input/output cable (CNUSR connector cable) that connects customer's system and the drive unit, prevent ground faults from occurring at the + side of the 24V power supply prepared by customer. A ground fault may lead to a failure of the protection device in the drive unit.
Bending or frictional forces may be applied to the input/output cable repeatedly depending on the system configuration or layout. In this case, use a flexible cable for the input/output cable. Note that a fixed cable may be broken, resulting in a ground fault.

Fig.3-32 : Example of circuit for addition axes of Magnet contactor control output (CR751 drive unit)

(2) Image of how to connect the controller connector

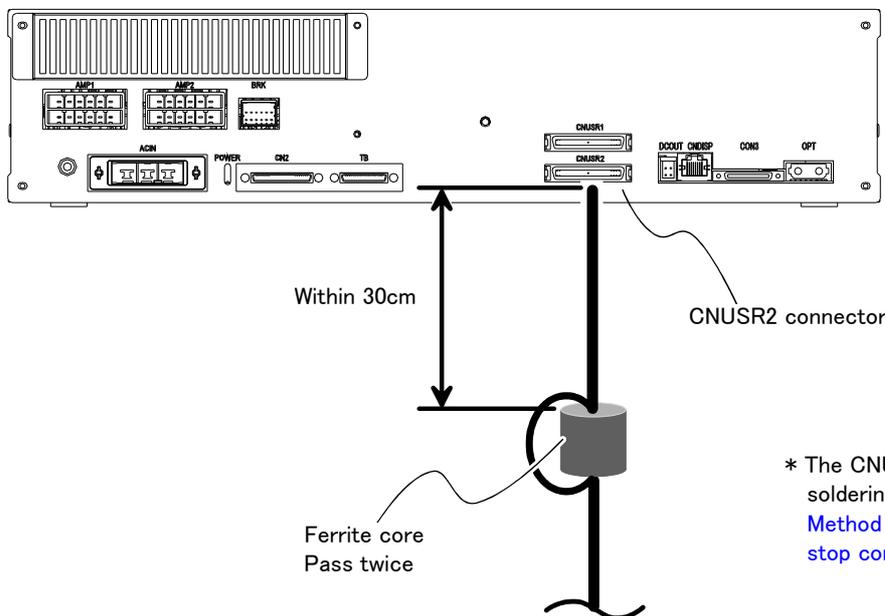
■ CR750 drive unit



*Connects with CNUSR2 connector with soldering. Refer to Page 151 "Fig. 3-16: Method of wiring for external emergency stop connection (CR750 (CNUSR2))".

Fig.3-33 : AXMC terminal connector (CR750)

■ CR751 drive unit



* The CNUSR2 connector is connected by soldering. Refer to Page 154 "Fig. 3-19: Method of wiring for external emergency stop connection (CR751 (CNUSR1/2))".

Fig.3-34 : AXMC terminal connector (CR751)

3.10 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: CR750 drive unit..... ● R32TB: Cable length 7m
- R32TB-15: Cable length 15m
- CR751 drive unit ● R33TB: Cable length 7m
- R33TB-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 enable switch is mounted.*1)

■ Configuration

Table 3-10 : Configuration device

| Part name | Type | Qty. | Mass (kg) ^{Note1)} | Remarks |
|------------------|----------|----------------|-----------------------------|--|
| CR750 drive unit | | | | |
| Teaching pendant | R32TB | Either one pc. | 1.7 | Cable length is 7m. Hand strap is attached. |
| | R32TB-15 | | 2.8 | Cable length is 15m. Hand strap is attached. |
| CR751 drive unit | | | | |
| Teaching pendant | R33TB | Either one pc. | 1.7 | Cable length is 7m. Hand strap is attached. |
| | R33TB-15 | | 2.8 | Cable length is 15m. Hand strap is attached. |

Note1) Mass indicates one set.

■ Specifications

Table 3-11 : Specifications

| Items | Specifications | Remarks |
|--------------------|---|-------------|
| Outline dimensions | 195(W) x 292(H) x 106(D) (refer to outline drawing) | |
| Body color | Dark gray | |
| Mass | Approx. 0.9kg (only arm, excluding cable) | |
| Connection method | Connection with drive unit and connector. | |
| Interface | RS-422 | |
| Display method | LCD method: 24 characters x 8 lines, LCD illumination: with backlight | At 8x8 font |
| Operation section | 36 keys | |

*1) <3-position enable 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 "Enable switch".

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

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

*) Releasing or forcefully pressing the 3-position enable switch cuts power to the servos in the same way as when the emergency stop is input. This helps to ensure safety.

Operations such as editing programs and displaying the robot's status are possible while the 3-position enable switch is released or forcefully pressed (excludes operating the robot).

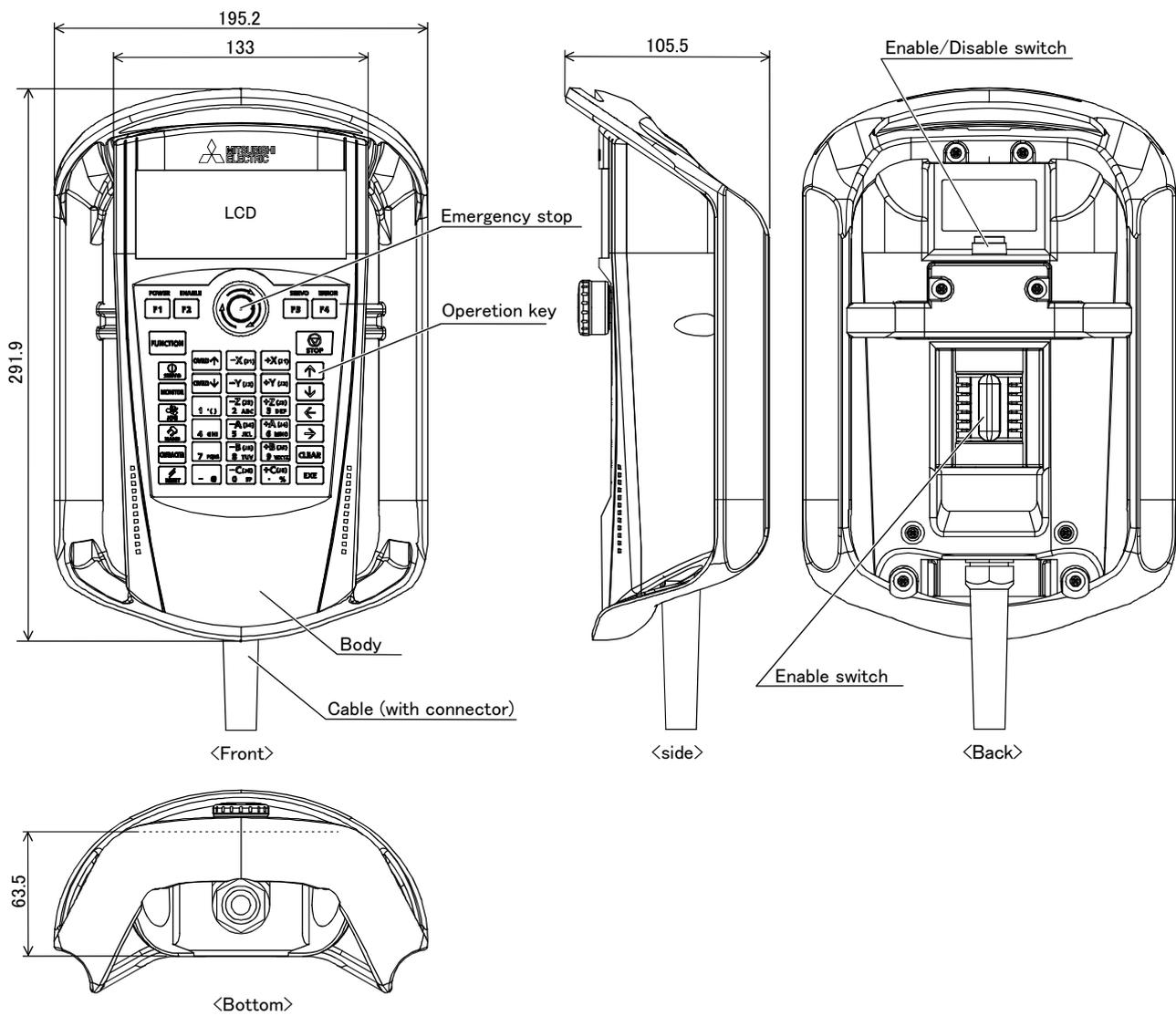
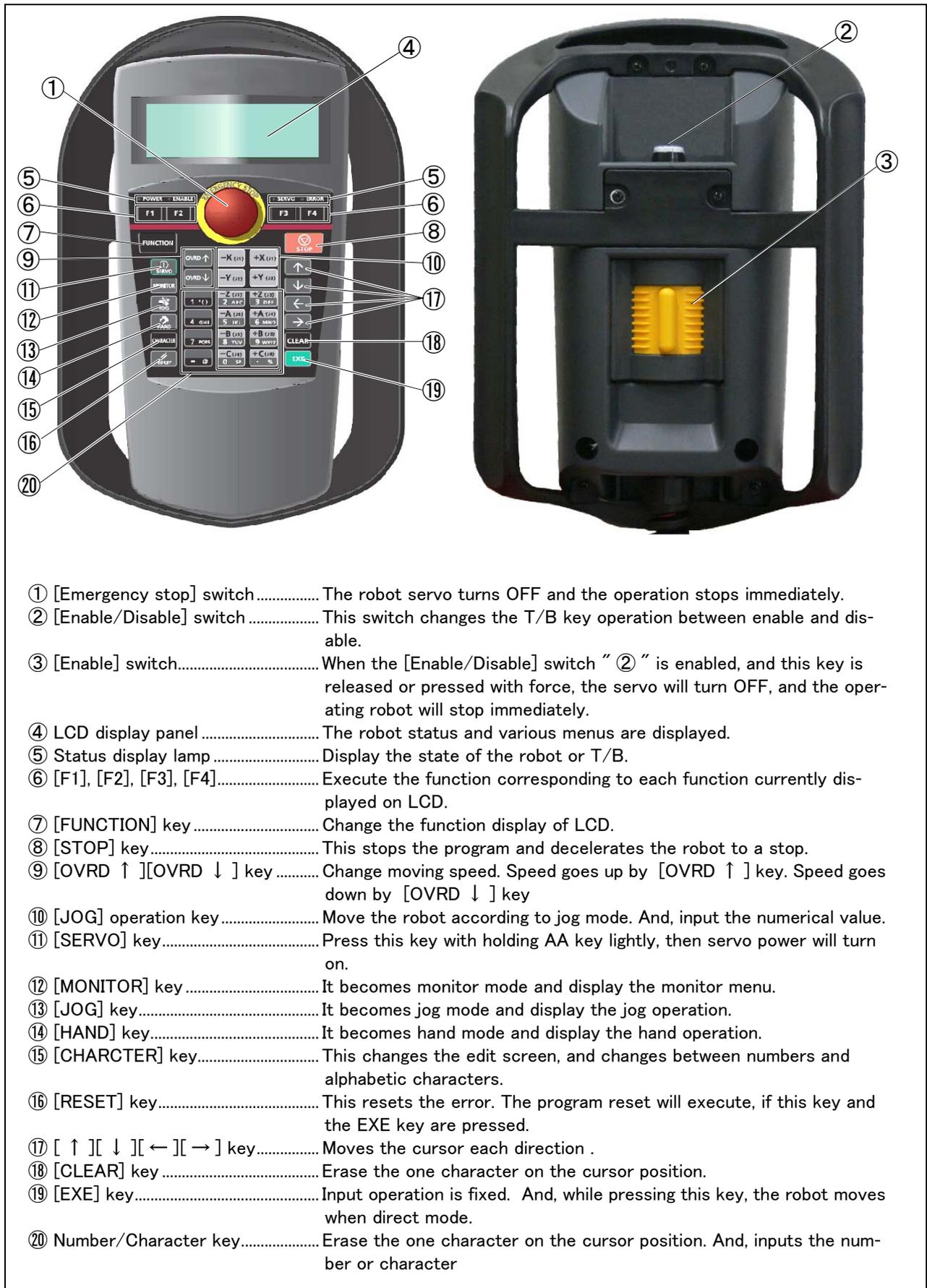


Fig.3-35 : Outside dimensions of teaching pendant

■ Installation method

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

■ Key layout and main functions



- ① [Emergency stop] switch..... The robot servo turns OFF and the operation stops immediately.
- ② [Enable/Disable] switch This switch changes the T/B key operation between enable and disable.
- ③ [Enable] switch..... When 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.
- ④ LCD display panel The robot status and various menus are displayed.
- ⑤ Status display lamp Display the state of the robot or T/B.
- ⑥ [F1], [F2], [F3], [F4]..... Execute the function corresponding to each function currently displayed on LCD.
- ⑦ [FUNCTION] key Change the function display of LCD.
- ⑧ [STOP] key..... This stops the program and decelerates the robot to a stop.
- ⑨ [OVRD ↑][OVRD ↓] key Change moving speed. Speed goes up by [OVRD ↑] key. Speed goes down by [OVRD ↓] key
- ⑩ [JOG] operation key Move the robot according to jog mode. And, input the numerical value.
- ⑪ [SERVO] key Press this key with holding AA key lightly, then servo power will turn on.
- ⑫ [MONITOR] key It becomes monitor mode and display the monitor menu.
- ⑬ [JOG] key..... It becomes jog mode and display the jog operation.
- ⑭ [HAND] key..... It becomes hand mode and display the hand operation.
- ⑮ [CHARACTER] key..... This changes the edit screen, and changes between numbers and alphabetic characters.
- ⑯ [RESET] key..... This resets the error. The program reset will execute, if this key and the EXE key are pressed.
- ⑰ [↑][↓][←][→] key..... Moves the cursor each direction .
- ⑱ [CLEAR] key Erase the one character on the cursor position.
- ⑲ [EXE] key..... Input operation is fixed. And, while pressing this key, the robot moves when direct mode.
- ⑳ Number/Character key..... Erase the one character on the cursor position. And, inputs the number or character

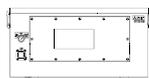
Fig.3-36 : Teaching pendant key layout and main functions

(2) Controller protection box

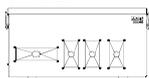
- Order type: CR750 drive unit CR750-MB
CR751 drive unit..... CR751-MB

■ Outline

<CR750-MB>



<CR751-MB>



By putting the drive unit in this box, the drive unit can be protected from oil mist environment.

Use this option, when the drive unit is installed where environment is oil mist such as machine shop etc.

■ Configuration

Table 3-12 : Configuration equipment and types

| Part name | Type | Qty. | Mass (Kg) ^{Note1)} | Remarks |
|---|-----------|------|-----------------------------|---|
| CR750 drive unit | | | | |
| Controller protection box | CR750-MB | 1 | 22 | |
| Internal power cable | | 3 | | For connection between the power supply relay terminal and drive unit inside this box |
| Internal earth cable | | 1 | | For connection between the grounding terminal and drive unit inside this box |
| Label for serial number | | 1 | | |
| Transparent seal | | 1 | | |
| Cable tie | T50L | 4 | | |
| Screw for fixing of the controller mounting plate | M4x8 | 4 | | |
| Instruction Manual | BFP-A8896 | 1 | - | |
| CR751 drive unit | | | | |
| Controller protection box | CR751-MB | 1 | 21 | |
| Internal power cable | | 2 | | For connection between the power supply relay terminal and drive unit inside this box |
| Internal earth cable | | 1 | | For connection between the grounding terminal and drive unit inside this box |
| Label for serial number | | 1 | | |
| Transparent seal | | 1 | | |
| Cable tie | T50L | 4 | | |
| Screw for fixing of the controller mounting plate | M4x8 | 4 | | |
| Instruction Manual | BFP-A8997 | 1 | - | |

Note1) Mass indicates one set.

■ Specifications

Table 3-13 : Specifications

| Item | Unit | Specifications | Remarks |
|-------------------|------|---------------------------------|-------------------------------------|
| CR750 drive unit | | | |
| Outside dimension | mm | 500(W) × 725(D) × 250(H) | Excluding protrusions |
| Mass | Kg | 22 | |
| Construction | | Self-contained floor type | IP54 |
| Grounding | Ω | 100 or less (class D grounding) | |
| Paint color | | Dark gray | Equivalent to Munsell: 3.5PB3.2/0.8 |
| CR751 drive unit | | | |
| Outside dimension | mm | 500(W) × 725(D) × 250(H) | Excluding protrusions |
| Mass | Kg | 21 | |
| Construction | | Self-contained floor type | IP54 |
| Grounding | Ω | 100 or less (class D grounding) | |
| Paint color | | Dark gray | Equivalent to Munsell: 3.5PB3.2/0.8 |

(1) The robot must be grounded by the customer.

(2) The cable for primary power supply connection and the grounding cable are customer preparations.

■ Outside dimension

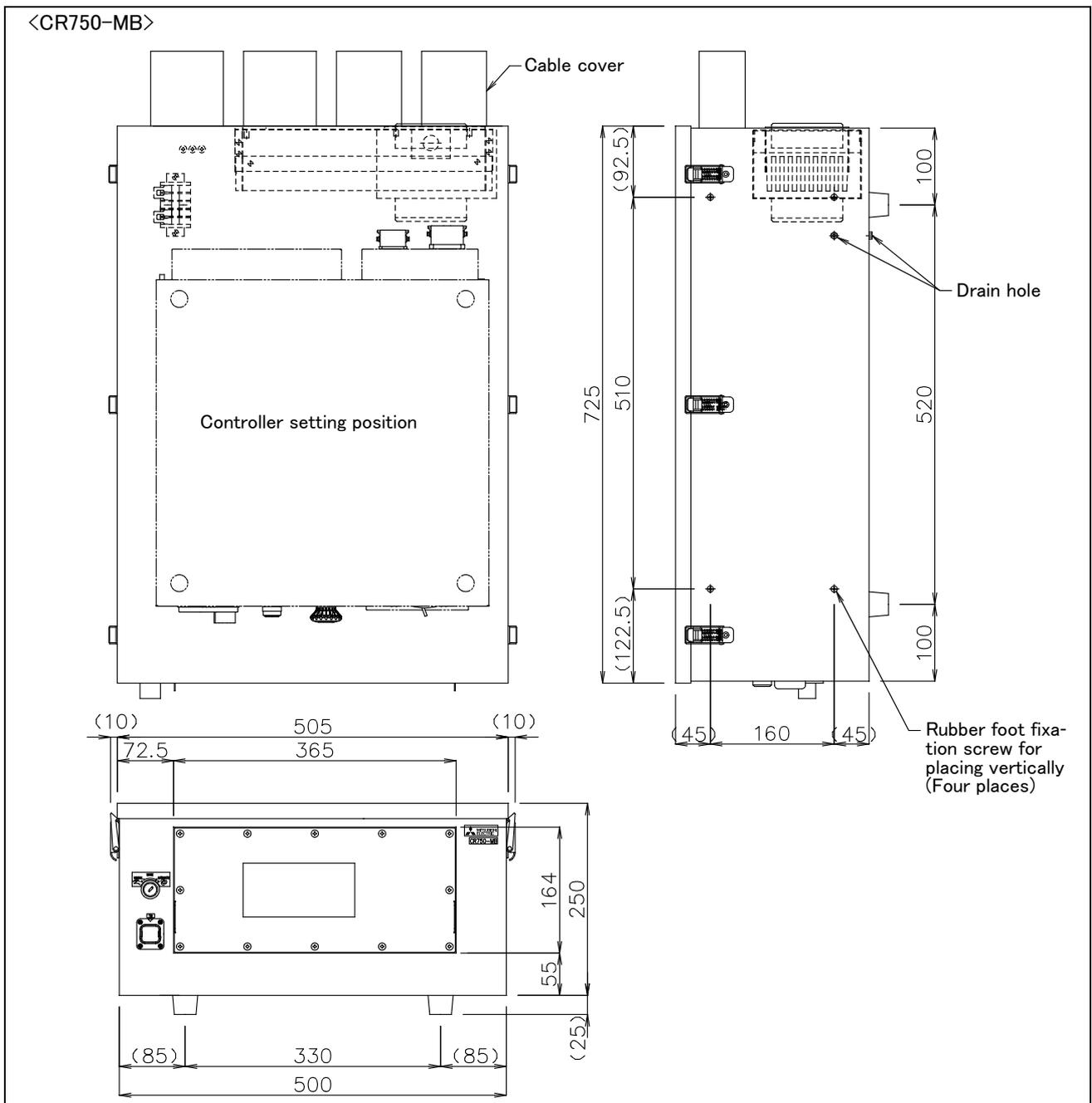


Fig.3-37 : Outside dimension of CR750-MB

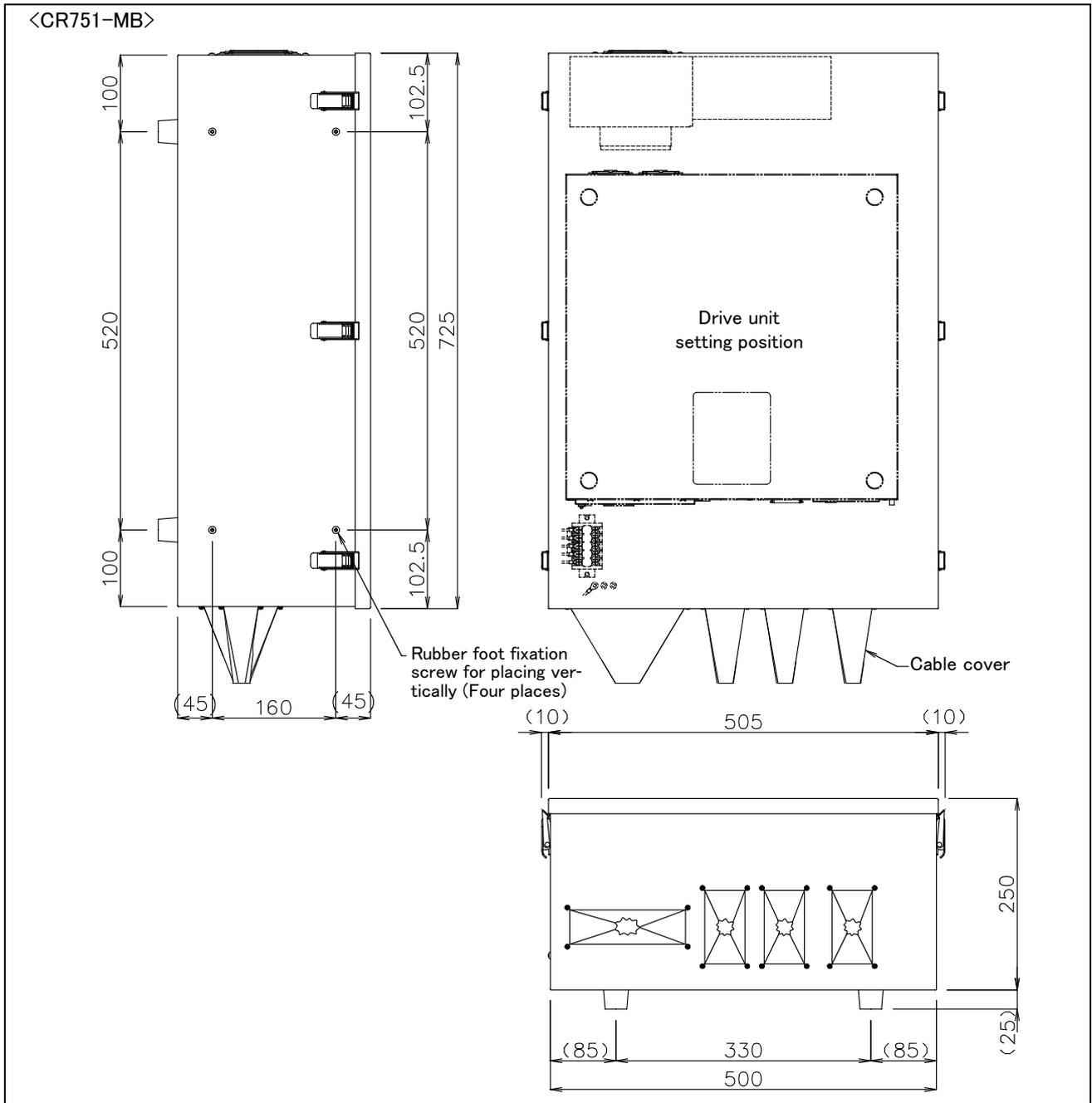


Fig.3-38 : Outside dimension of CR751-MB

■ Names of each part

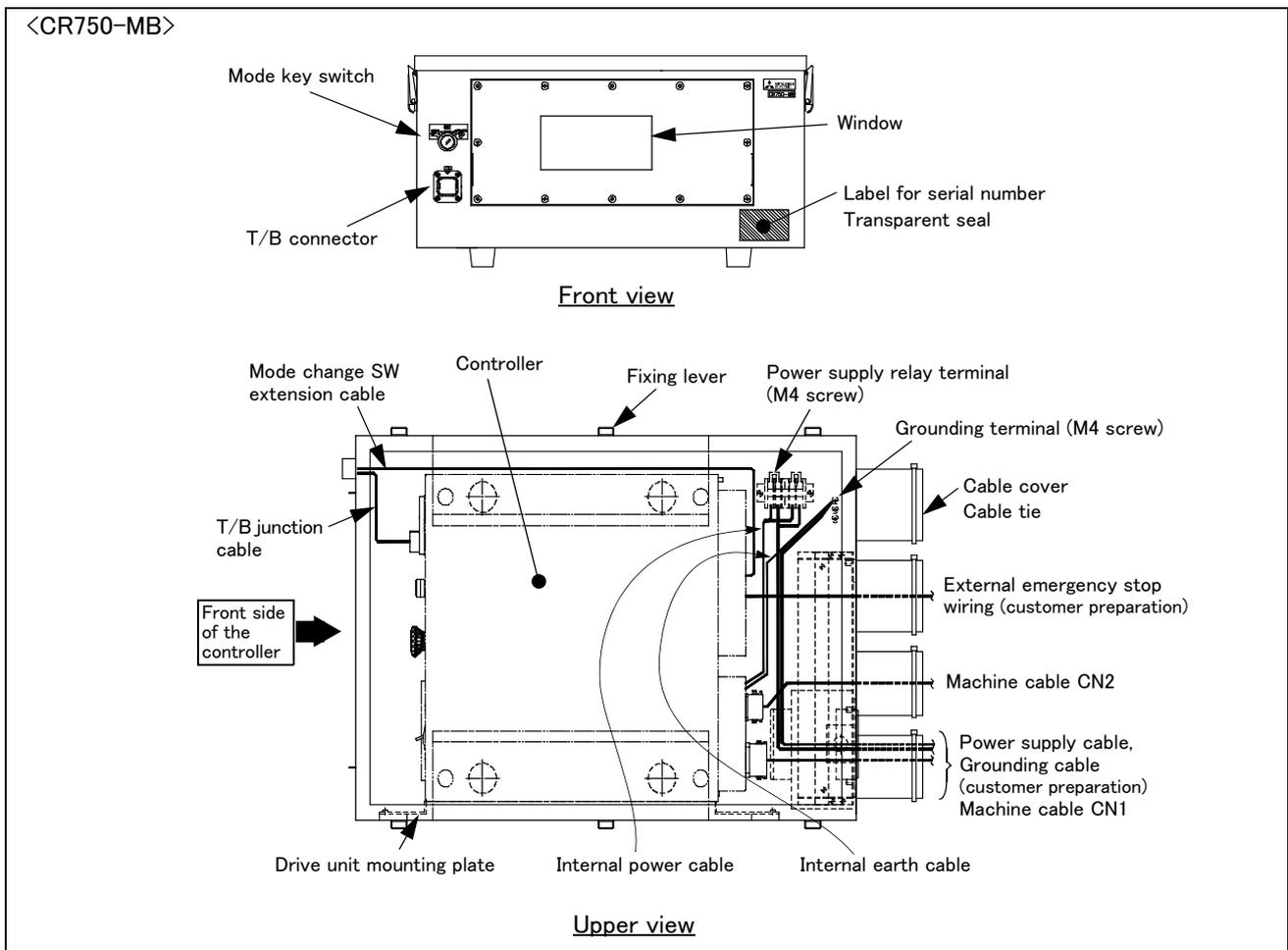


Fig.3-39 : Names of each part (CR750-MB)

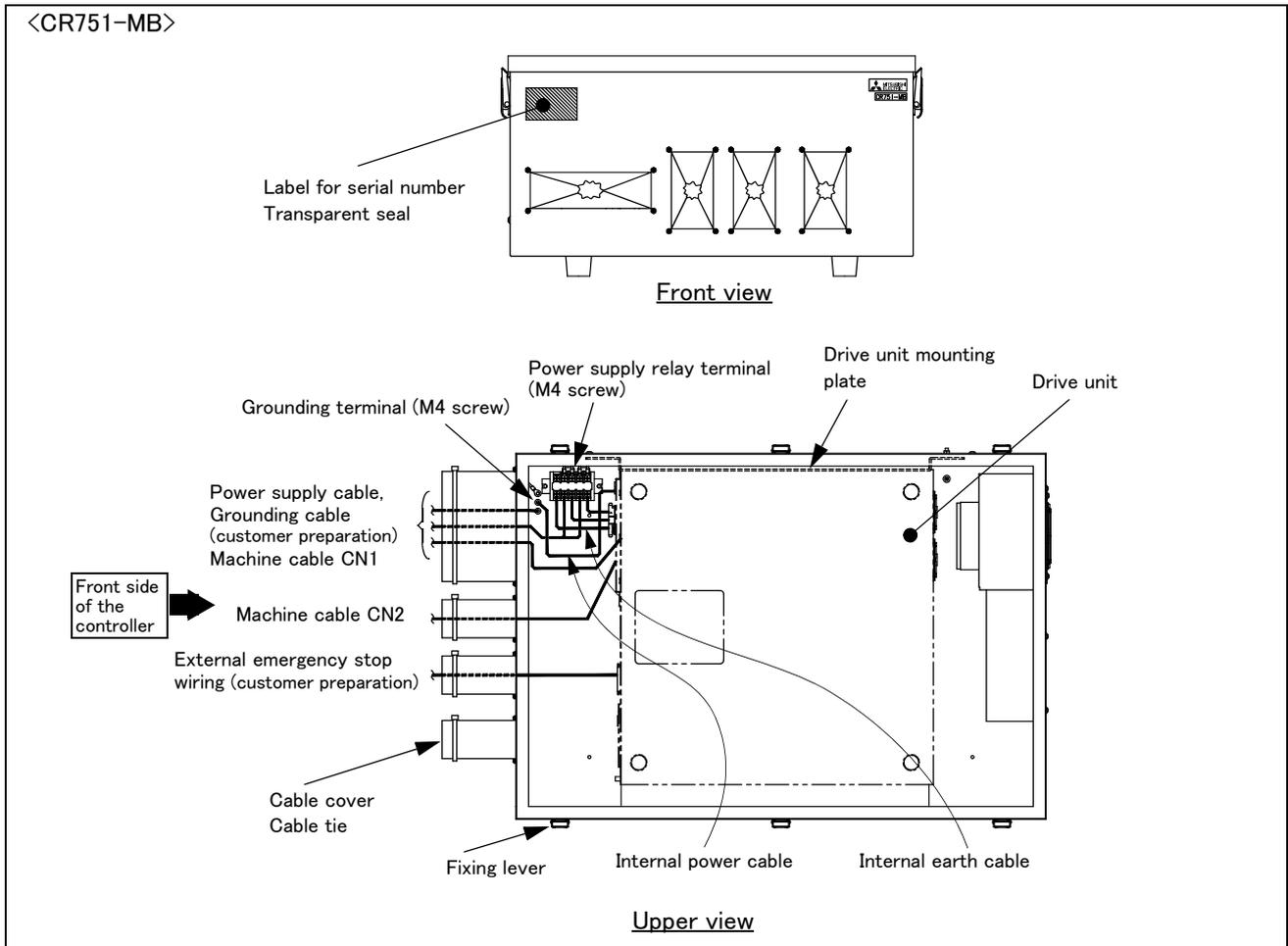


Fig.3-40 : Names of each part (CR751-MB)

■ Wiring system diagram

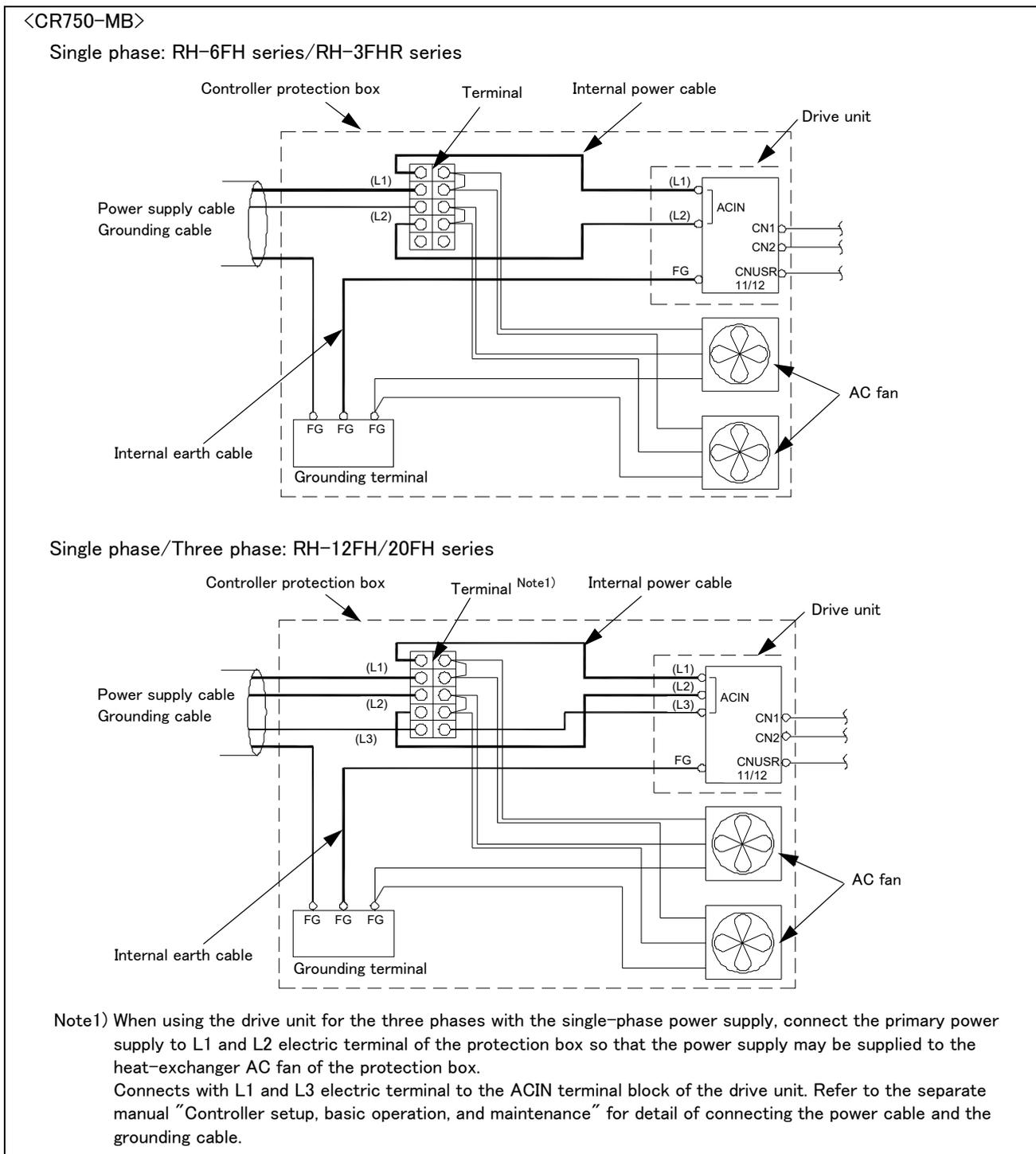
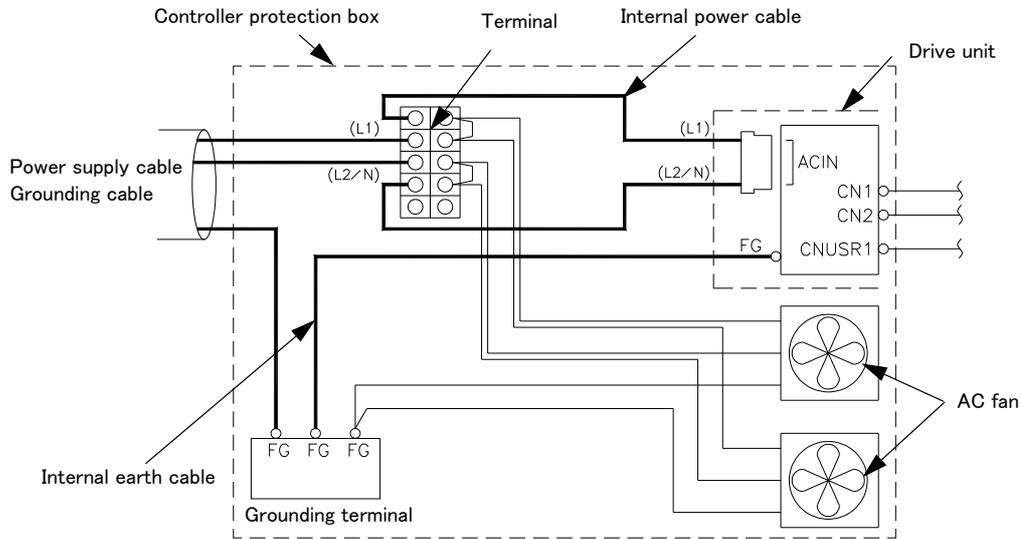


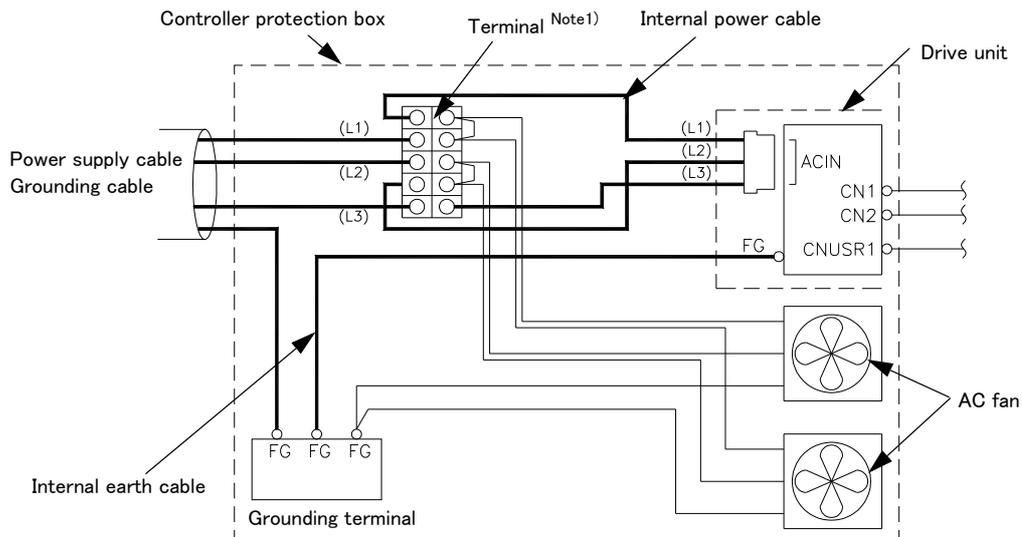
Fig.3-41 : Wiring system diagram (CR750-MB)

<CR751-MB>

Single phase: RH-6FH series/RH-3FHR series



Single phase/Three phase: RH-12FH/20FH series



Note1) When using the drive unit for the three phases with the single-phase power supply, connect the primary power supply to L1 and L2 electric terminal of the protection box so that the power supply may be supplied to the heat-exchanger AC fan of the protection box.

Connects with L1 and L3 electric terminal to the ACIN terminal block of the drive unit. Refer to the separate manual "Controller setup, basic operation, and maintenance" for detail of connecting the power cable and the grounding cable.

Fig.3-42 : Wiring system diagram (CR751-MB)

■ Installation dimensions

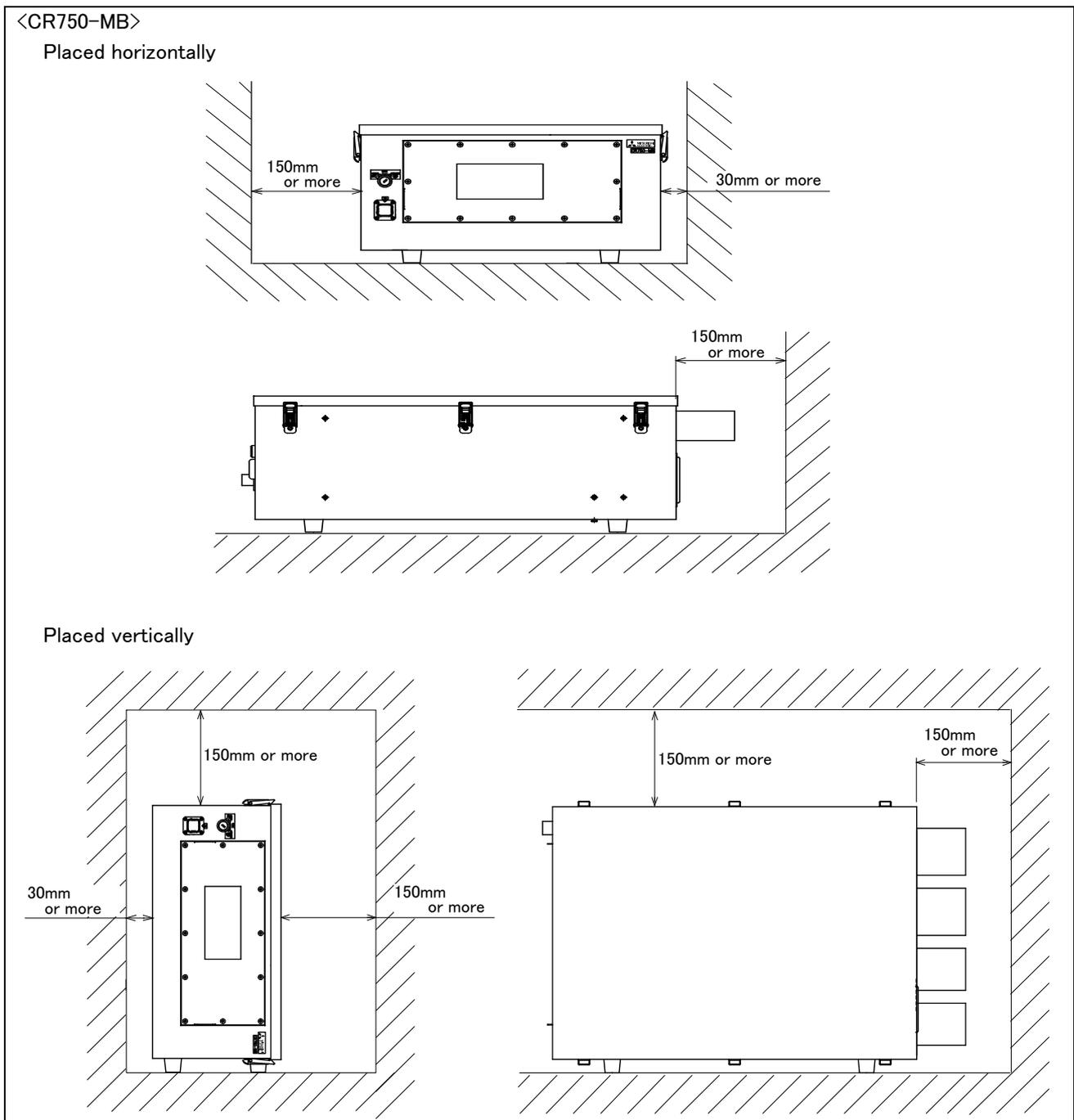


Fig.3-43 : Installation dimensions (CR750-MB)

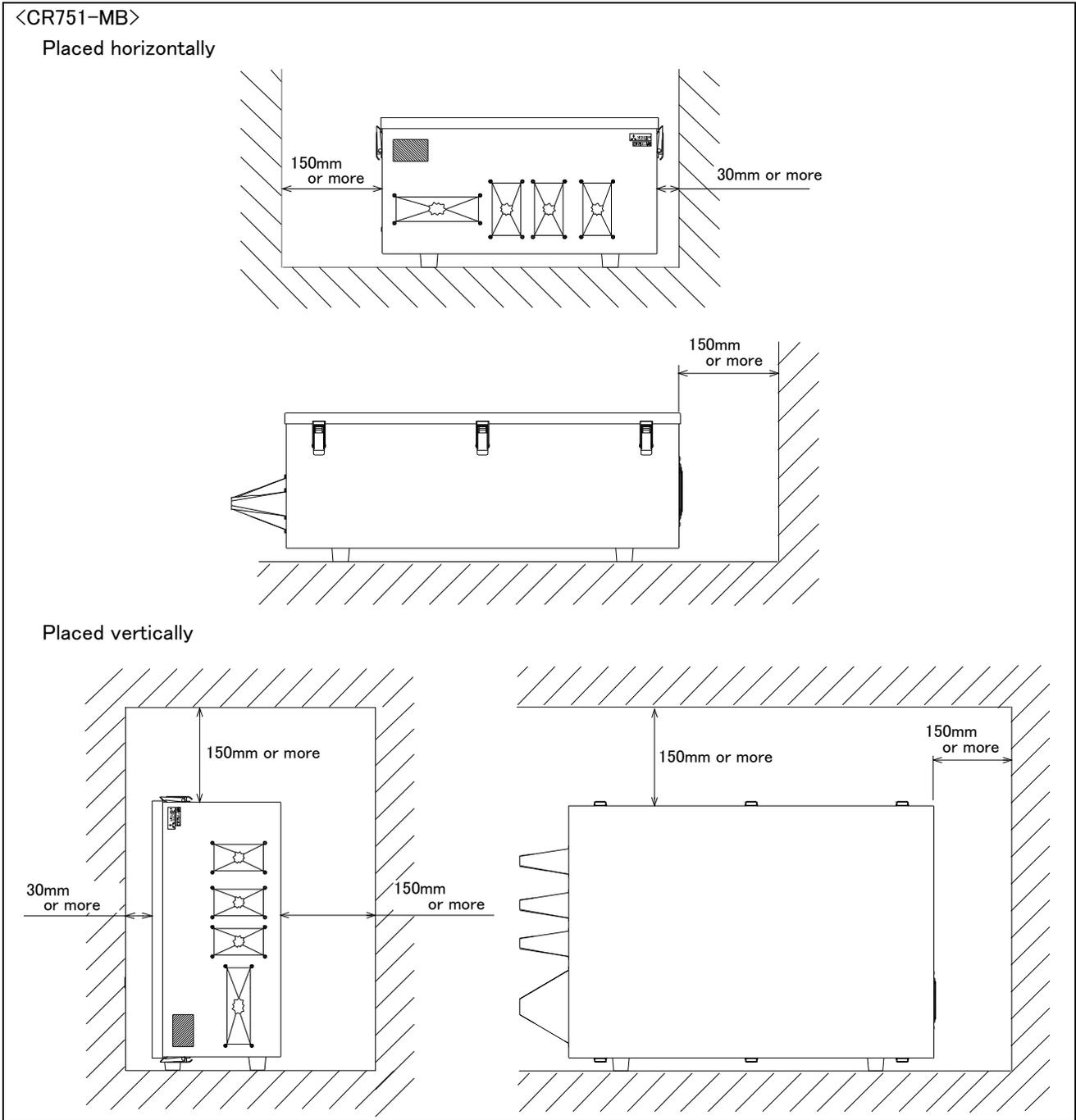


Fig.3-44 : Installation dimensions (CR751-MB)

(3) MELSOFT RT ToolBox2/RT ToolBox2 mini

- Order type : ● MELSOFT RT ToolBox2
 *For windows CD-ROM : 3D-11C-WINE
 ● MELSOFT RT ToolBox2 mini
 *For windows CD-ROM : 3D-12C-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.

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.

■ Configuration

Table 3-14 : Product configuration

| Part name | Type | Medium | Mass (kg) ^{Note1)} | Remarks |
|------------------|-------------|--------|-----------------------------|---------|
| RT ToolBox2 | 3D-11C-WINE | CD-ROM | 0.2 | |
| RT ToolBox2 mini | 3D-12C-WINE | CD-ROM | 0.2 | |

Note1) Mass indicates one set.

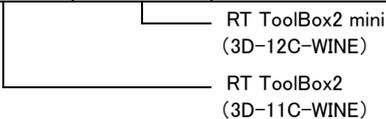
■ Features

- (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) The maintenance forecast function increases the efficiency of maintenance work. Analyze the load condition while the robot is actually operating. Based on this analysis, calculate the time for maintenance, such as lubrication and belt replacement. By utilizing this information, the line stop time as well as the maintenance costs can be reduced.
- (4) The position recovery support function increases the recovery efficiency in the event of origin position displacement. This function compensates the origin settings and position data by just reproducing several previous teaching points when hand and/or arm displacement occurs, when replacing the motor and the belts, or when reloading the robot. This function can reduce the time required for recovery.

■ Functions

Table 3-15 : Functions

| Function | | Functional existence ^{Note1)} | | Details |
|---------------------------|---------------------|--|---|---|
| Compatible model | | ○ | ○ | Personal computer running Windows XP, Windows Vista, Windows 7, Windows 8, Windows 8.1, or Windows 10. ^{Note2)} |
| Program editing functions | Editing functions | ○ | ○ | <ul style="list-style-type: none"> ▪ MELFA BASIC V 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) |
| Simulation function | | ○ | × | <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 (load) |
| Maintenance function | | ○ | ○ | <ul style="list-style-type: none"> ▪ Parameter setting ▪ Batch, divided backup |



Note1) The functions included with the RT ToolBox2 and the RT ToolBox2 mini are shown below.

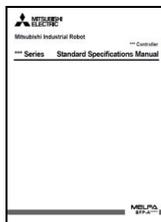
○ : Function provided × : Function not provided

Note2) Recommend corresponding to CE Marking, an FCC standard, and a VCCI standard.

(4) Instruction Manual (bookbinding)

- Order type: ● 5F-RB01-PE01RH-6FH/12FH/20FH-Q series
- 5F-RP01-PE01RH-3FHR-Q series

■ Outline



This is a printed version of the CD-ROM (instruction manual) supplied with this product.

■ Configuration

Table 3-16 : Product configuration (RH-6FH/12FH/20FH-Q series)

| Name | Type | Mass (Kg) ^{Note1)} | Specifications |
|---|--------------|-----------------------------|---|
| Instruction Manual | 5F-RB01-PE01 | 2.6 | The instructions manual set of "RH-6FH/12FH/20FH-Q series". |
| Safety Manual | BFP-A8006 | - | Items relating to safety in handling the robot |
| Standard Specifications | BFP-A8882 | - | Specification of the robot arm and controller |
| Robot Arm Setup & Maintenance | BFP-A8865 | - | Installation method of the robot arm, jog operation, and maintenance and inspection procedures |
| Controller Setup, Basic Operation and Maintenance | BFP-A8886 | - | Installation method of the controller, basic operation, and maintenance and inspection procedures |
| Detailed Explanation of Functions and Operations | BFP-A8869 | - | Functions of the controller and T/B, operation method, and explanation of MELFA-BASIC V |
| Troubleshooting | BFP-A8871 | - | Causes of errors occurred and their countermeasures |
| Additional axis function | BFP-A8663 | - | Function of the additional axis, operation method. |
| Tracking Function Manual | BFP-A8664 | - | Function of the Tracking, operation method. |
| Extended Function | BFP-A8787 | - | Function of the Extended, operation method. |

Note1) Mass indicates one set.

Table 3-17 : Product configuration (RH-3FHR-Q series)

| Name | Type | Mass (Kg) ^{Note1)} | Specifications |
|---|--------------|-----------------------------|---|
| Instruction Manual | 5F-RP01-PE01 | 2.6 | The instructions manual set of "RH-3FHR-Q series". |
| Safety Manual | BFP-A8006 | - | Items relating to safety in handling the robot |
| Standard Specifications | BFP-A8882 | - | Specification of the robot arm and controller |
| Robot Arm Setup & Maintenance | BFP-A8993 | - | Installation method of the robot arm, jog operation, and maintenance and inspection procedures |
| Controller Setup, Basic Operation and Maintenance | BFP-A8886 | - | Installation method of the controller, basic operation, and maintenance and inspection procedures |
| Detailed Explanation of Functions and Operations | BFP-A8869 | - | Functions of the controller and T/B, operation method, and explanation of MELFA-BASIC V |
| Troubleshooting | BFP-A8871 | - | Causes of errors occurred and their countermeasures |
| Additional axis function | BFP-A8663 | - | Function of the additional axis, operation method. |
| Tracking Function Manual | BFP-A8664 | - | Function of the Tracking, operation method. |
| Extended Function | BFP-A8787 | - | Function of the Extended, operation method. |

Note1) Mass indicates one set.

3.11 Maintenance parts

The consumable parts used in the controller are shown in [Table 3-18](#). 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 3-18 : Controller consumable parts list

| No. | Name | Type ^{Note1)} | Qty. | Usage place | Supplier |
|-----|-----------------|--|------|--|---------------------|
| 1 | Lithium battery | Q6BAT | 1 | The battery unit connected to the robot CPU unit | Mitsubishi Electric |
| 2 | Filter | CR750 drive unit: BKOFA0773H42 CR751 drive unit: BKOFA0773H41 | 1 | Inside the filter cover | |

Note1) Confirm the robot arm serial No., and contact the dealer or service branch of Mitsubishi Electric Co., for the type.

4 Software

4.1 List of commands

The available new functions in MELFA-BASIC V are given in [Table 4-1](#).

Table 4-1 : List of MELFA-BASIC V 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). |
| | 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 (mm/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 ON |
| | Sets the hand and work conditions for automatic adjustment of the acceleration/deceleration. | | Loadset 1,1 |
| | Operation | | Adds a process unconditionally to the operation. |
| | | Adds a process conditionally to the operation. | WthIf |
| | | Designates smooth operation. | Cnt 1,100,200 |
| | | Performance of movement is upgraded corresponding to the application. | MvTune 4 |
| | | Designates the positioning completion conditions with a No. of pulses. | Fine 200 |
| | | Designates the positioning completion conditions with a distance in a straight line | Fine 1, P |
| | | Designates the positioning completion conditions with a joint interpolation. | Fine 0.5, J, 2 |
| | | 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 4,10 |
| | 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. (XYZ coordinate system) | Cmp Pos ,&B00000011 |
| | | The robot arm rigidity is lowered and softened. (JOINT coordinate system) | Cmp Jnt ,&B00000011 |
| | | The robot arm rigidity is lowered and softened. (TOOL coordinate system) | Cmp Tool ,&B00000011 |
| | | The robot arm rigidity is returned to the normal state. | Cmp Off |
| | | The robot arm rigidity is designated. | CmpG 1.0,1.0,1.0,1.0,1.0,1.0,1.0,1.0 |
| | Pallet | Defines the pallet. | Def Plt 1,P1,P2,P3,P4,5,3,1 |
| | | Operates the pallet grid point position. | Plt 1,M1 |
| | Singular point passage | Move to a specified position using linear interpolation passing through a singular point. | Mvs P1 Type 0,2 |

| Type | Class | Function | Input format (example) |
|---|-----------------------|--|--|
| Program control | Branching | Branches unconditionally to the designated place. | GoTo 120 |
| | | Branches according to the designated conditions. | If M1=1 Then GoTo *L100 Else GoTo 20 End If |
| | | Repeats until the designated end conditions are satisfied. | For M1=1 TO 10 Next M1 |
| | | Repeats while the designated conditions are satisfied. | While M1<10 WEnd |
| | | Branches corresponding to the designated expression value. | On M1 GoTo *La1, *Lb2, *Lc3 |
| | | Executes program block corresponding to the designated expression value.. | Select Case 1 Break Case 2 Break End Select |
| | | Moves the program process to the next line. | Skip |
| | Collision detection | Set to enable/disable the collision detection. | ColChk ON/OFF |
| | | Set the detection level of the collision detection. | ColLvl 100,80,..... |
| | Subroutine | Executes the designated subroutine. (Within program) | GoSub *L200 |
| | | 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 *La1, *Lb2, *Lc3 |
| | Interrupt | Defines the interrupt conditions and process. | Def Act 1, M1=1 GoTo *L100 |
| | | 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 *L100 |
| | | Enables the interrupt from the communication line. | Com(1) On |
| | | Disables the interrupt from the communication line. | Com(1) Off |
| | | Stops the interrupt from the communication line. | Com(1) Stop |
| | 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. |
| Hand close | | Closes the designated hand. | HClose 1 |
| Input/output | Assignment | Defines the input/output variables. | Def IO PORT1=BIT,0 |
| | Input | Retrieves the general-purpose input signal. | M1=M_In(1) |
| | Output | Calls out the general-purpose output signal. | M_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 | | |

| Type | Class | Function | Input format (example) |
|--------|------------|--|------------------------|
| Others | Definition | Defines the integer type or real number type variable. | Def Inte 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 FN TASU(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

Show the main parameter in the [Table 4-2](#).

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 3. |
| | SFC1AT : SFC8AT | Set the validity of the eight types of set free plane limits. (Valid 1/Valid 2/invalid = 1/-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 32 types of area can be designated. |
| | AREA1CS : AREA32CS | Specify the coordinate system of the user definition area *. 0: Base coordinate system (conventional compatibility) 1: Robot coordinate system |
| | AREA1P1 : AREA32P1 | 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 : AREA32P2 | 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 : AREA32ME | Designate which mechanism to use the 32 types of set area. The mechanism No. to use is set with 1 to 3. |
| | AREA1AT : AREA32AT | 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) to either of normal open or normal close. |

| Parameter | | Details |
|--|--------------------|--|
| 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. |
| 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 | SLT1 : 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. (Max. 32) |
| Multi CPU system setting | QMLTCPU N | At the multi CPU system, set the number of CPU units with which the standard base unit is equipped. |
| | QMLTCPU n | At the multi CPU system, set the number of points performing transmission and receipt between each CPU unit for the high speed communication function between multi CPU nos. 1 to 4. |
| | QMLTCPU S | At the CR750-Q/CR751-Q series controller, set the robot input signal offset for the multi CPU. |
| Select the function of singular point adjacent alarm | MESNGLS W | Designate the valid/invalid of the singular point adjacent alarm. (Invalid/Valid = 0/1) When this parameter is set up "VALID", this warning sound is buzzing even if parameter: BZR (buzzer ON/OFF) is set up "OFF". |
| Display language. | LNG | Change the language to display on the LCD display of teaching pendant. |

5 Instruction Manual

5.1 The details of each instruction manuals

The contents and purposes of the documents enclosed with this product are shown below. Use these documents according to the application.

Instruction manuals enclosed in dashed lines in the list below are for optional products.

For special specifications, a separate instruction manual describing the special section may be enclosed.

| | |
|---|---|
| Safety Manual | Explains the common precautions and safety measures to be taken for robot handling, system design and manufacture to ensure safety of the operators involved with the robot. |
| Standard Specifications | Explains the product's standard specifications, factory-set special specifications, option configuration and maintenance parts, etc. Precautions for safety and technology, when incorporating the robot, are also explained. |
| Robot Arm Setup & Maintenance | Explains the procedures required to operate the robot arm (unpacking, transportation, installation, confirmation of operation), and the maintenance and inspection procedures. |
| Controller Setup, Basic Operation and Maintenance | Explains the procedures required to operate the controller (unpacking, transportation, installation, confirmation of operation), basic operation from creating the program to automatic operation, and the maintenance and inspection procedures. |
| Detailed Explanation of Functions and Operations | Explains details on the functions and operations such as each function and operation, commands used in the program, connection with the external input/output device, and parameters, etc. |
| Troubleshooting | Explains the causes and remedies to be taken when an error occurs. Explanations are given for each error No. |
| Additional axis function | Explains the specifications, functions and operations of the additional axis control. |
| Tracking Function Manual | Explains the control function and specifications of conveyor tracking |
| Extended Function Instruction Manual | Explains the detailed description of data configuration of shared memory, monitoring, and operating procedures, about the PLC(CR750-Q/CR751-Q controller) and the GOT(CR750-D/CR751-D controller). |

6 Safety

6.1 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.

6.1.1 Self-diagnosis stop functions

This robot has the self-diagnosis stop functions shown in [Table 6-1](#) and the stop functions shown in [Table 6-2](#) for safe use.

Table 6-1 : 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 6-2 : List of stop functions

| Stop function | Operation panel ^{Note1)} | 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. |

Note1) Only CR750 drive unit has operation panel.

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

Table 6-3 : External input/output signals that can be used for safety protection measures

| Signal | Connection point | Parameter | Functions | Usage method | |
|--------|-----------------------------------|---|-----------|--|--|
| Input | External emergency stop Note1) | Connector (CR750 drive unit: CNSUSR11/12) (CR751 drive unit: CNSUSR1) | - | 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. |
| | Door switch | | | | The door switch of the safe protection fence |
| | Enabling device input | | | | Enabling device. The safety switch during teaching work |
| | Stop | Sequencer unit | 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 | Emergency stop output | Connector (CR750 drive unit: CNSUSR11/12) (CR751 drive unit: CNSUSR1) | - | Outputs the input signal of external emergency stop or emergency stop switch of T/B turned on. | Display and warn the pilot lamp, the input signal of external emergency stop or the emergency stop switch of T/B turned on. |
| | In servo ON | | | | |
| | Waiting | Connector (CR750/CR751 controllerdrive unit: CNUSR2) | - | Outputs when an alarm occurs in the robot. | The temporary stop state is shown and alerted with the display lamps. |
| | In alarm | | | | |

Note1) The external emergency stop input is prepared as a normal close 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 [Page 196, "6.1.7 Examples of safety measures"](#) for details.

And, refer to [Page 158, "\(3\) Automatic Operation/Jog Operation/Brake Release and Necessary Switch Settings"](#) for the function of the door switch input and the enabling device input.

6.1.3 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.

6.1.4 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.

6.1.5 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.

6.1.6 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.

6.1.7 Examples of safety measures

The drive unit's dedicated I/O terminal connector has a duplicate emergency stop circuit.

Create a circuit as shown below for safety measures. In addition, the figure shows the normal state which is not in the emergency stop state.

[Caution] Since we have omitted the information in part because of explanation, there is the section different from the product. Also refer to [Page 206, "\(3\) External emergency stop connection \[supplementary explanation\]"](#).

[Note] · In the emergency-stop related wiring by the customer, if the coil (is not the contact points) of the relay prepared by the customer is connected to the drive unit, please be sure to implement the measure against the noise by the customer in the coil section. And, please also take the lifetime of noise suppression parts into consideration.

- Electric specification of the emergency-stop-related output terminal: 100mA/24V or less
- In the customer's system, do not ground the + side of 24V power supply prepared by customer for connect to the controller. (related with emergency stop and parallel input/output) If it connects with the controller under the condition that the + side is grounded, it will lead to failure of controller.

(1) CR750 drive unit

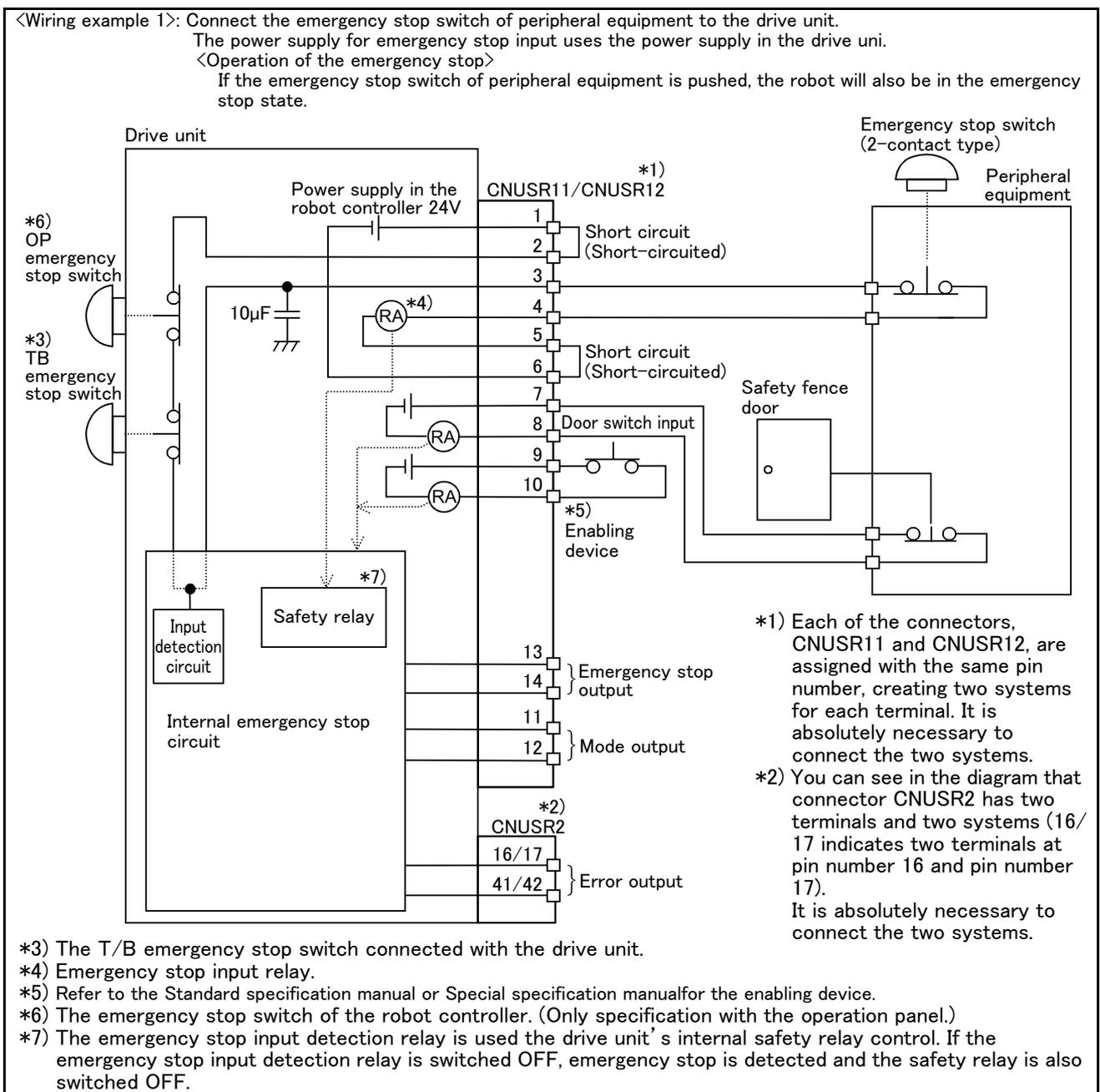
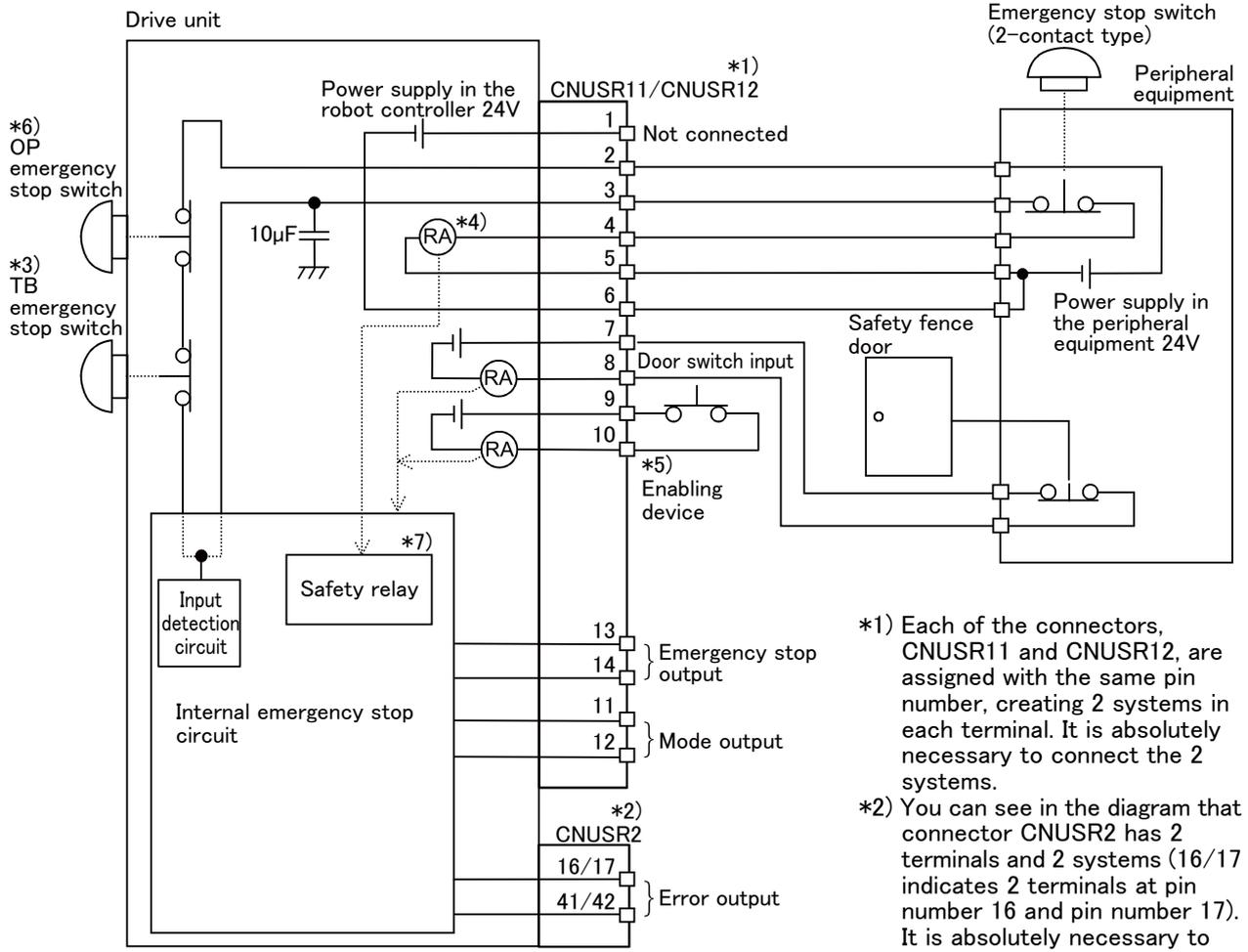


Fig.6-1 : Example of safety measures (CR750 wiring example 1)

<Wiring example 2>: Connect the emergency stop switch of peripheral equipment to the drive unit.
 The power supply for emergency stop input uses the power supply of peripheral equipment.
 <Operation of the emergency stop>
 If the emergency stop switch of peripheral equipment is pushed, the robot will also be in the emergency stop state.



*1) Each of the connectors, CNUSR11 and CNUSR12, are assigned with the same pin number, creating 2 systems in each terminal. It is absolutely necessary to connect the 2 systems.
 *2) You can see in the diagram that connector CNUSR2 has 2 terminals and 2 systems (16/17 indicates 2 terminals at pin number 16 and pin number 17). It is absolutely necessary to connect the 2 systems.

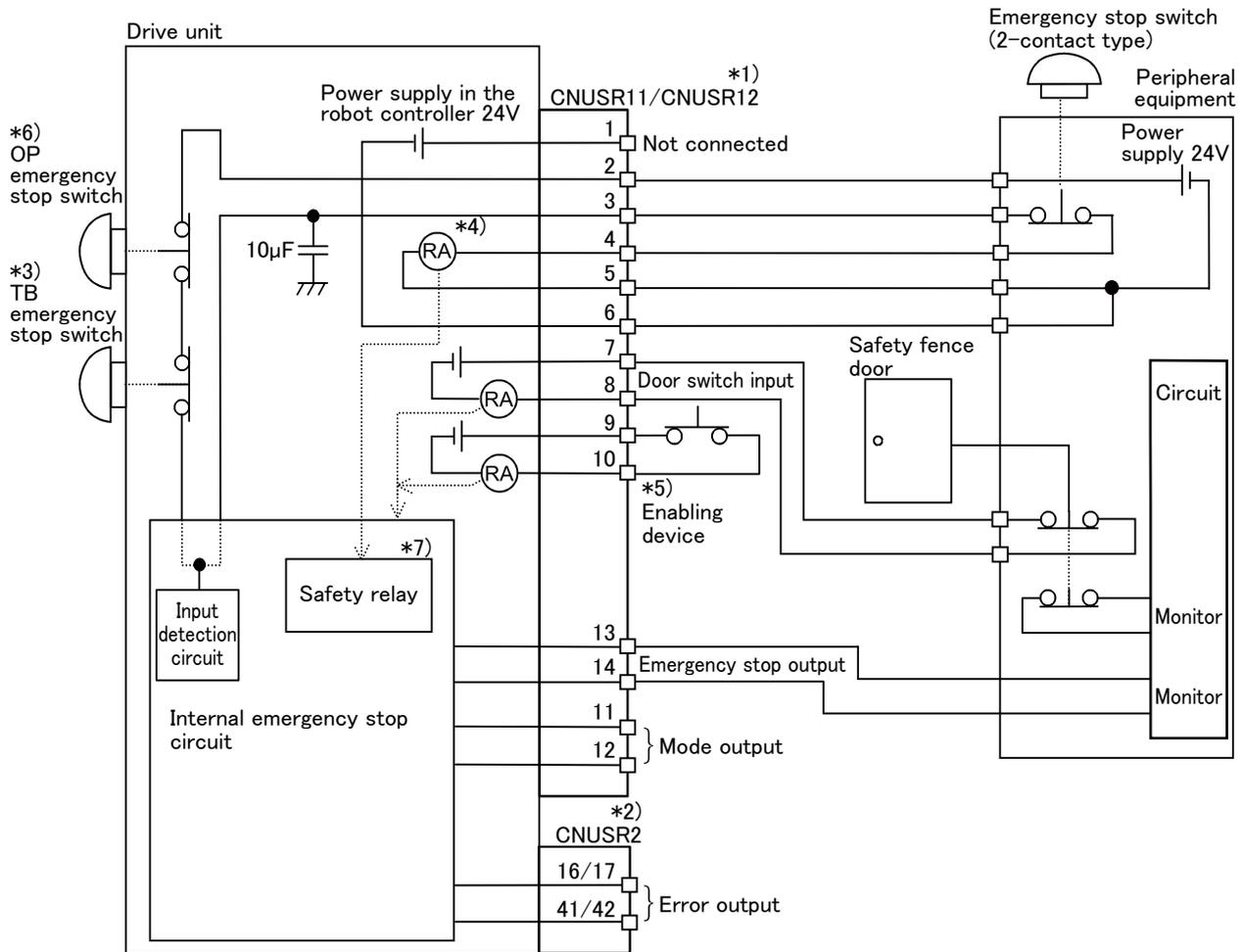
- *3) The T/B emergency stop switch connected with the drive unit.
- *4) Emergency stop input relay.
- *5) Refer to the Standard specification manual or the Special specification manual for the enabling device.
- *6) The emergency stop switch of the robot controller.
(Only specification with the operation panel.)
- *7) The emergency stop input detection relay uses the drive unit's internal safety relay control. If the emergency stop input detection relay is switched OFF, emergency stop is detected and the safety relay is also switched OFF.

Fig.6-2 : Example of safety measures (CR750 wiring example 2)

<Wiring example 3>: Connect the emergency stop switch, door switch, and enabling device of peripheral equipment to the drive unit. The power supply for emergency stop input uses the power supply of peripheral equipment. Monitor the emergency stop state by the peripheral equipment side.

<Operation of the emergency stop>

If the emergency stop switch of peripheral equipment is pushed, the robot will also be in the emergency stop state. And, if the emergency stop switch of OP or T/B is pushed in the state of the power of drive unit OFF, peripheral equipment state can be the emergency stop also.



- *1) Each of the connectors, CNUSR11 and CNUSR12, are assigned with the same pin number, creating 2 systems in each terminal. It is absolutely necessary to connect the 2 systems.
- *2) You can see in the diagram that connector CNUSR2 has 2 terminals and 2 systems (16/17 indicates 2 terminals at pin number 16 and pin number 17). It is absolutely necessary to connect the 2 systems.
- *3) The T/B emergency stop switch connected with the controller.
- *4) Emergency stop input relay.
- *5) Refer to the Standard specification manual or the Special specification manual for the enabling device.
- *6) The emergency stop switch of the robot controller.
(Only specification with the operation panel.)
- *7) The emergency stop input detection relay uses the drive unit's internal safety relay control. If the emergency stop input detection relay is switched OFF, emergency stop is detected and the safety relay is also switched OFF.

Fig.6-3 : Example of safety measures (CR750 wiring example 3)

<Wiring example 4>: Connect the emergency stop switch of peripheral equipment, and the door switch to two drive units, and it interlocks. Connect the enabling device to the robot controller. The power supply for emergency stop input uses the power supply of peripheral equipment. Monitor the emergency stop state by the peripheral equipment side.

<Operation of the emergency stop>

If the emergency stop switch of peripheral equipment is pushed, the robot will also be in the emergency stop state. And, if the emergency stop switch of OP or T/B is pushed in the state of the power of drive unit OFF, peripheral equipment state can be the emergency stop also.

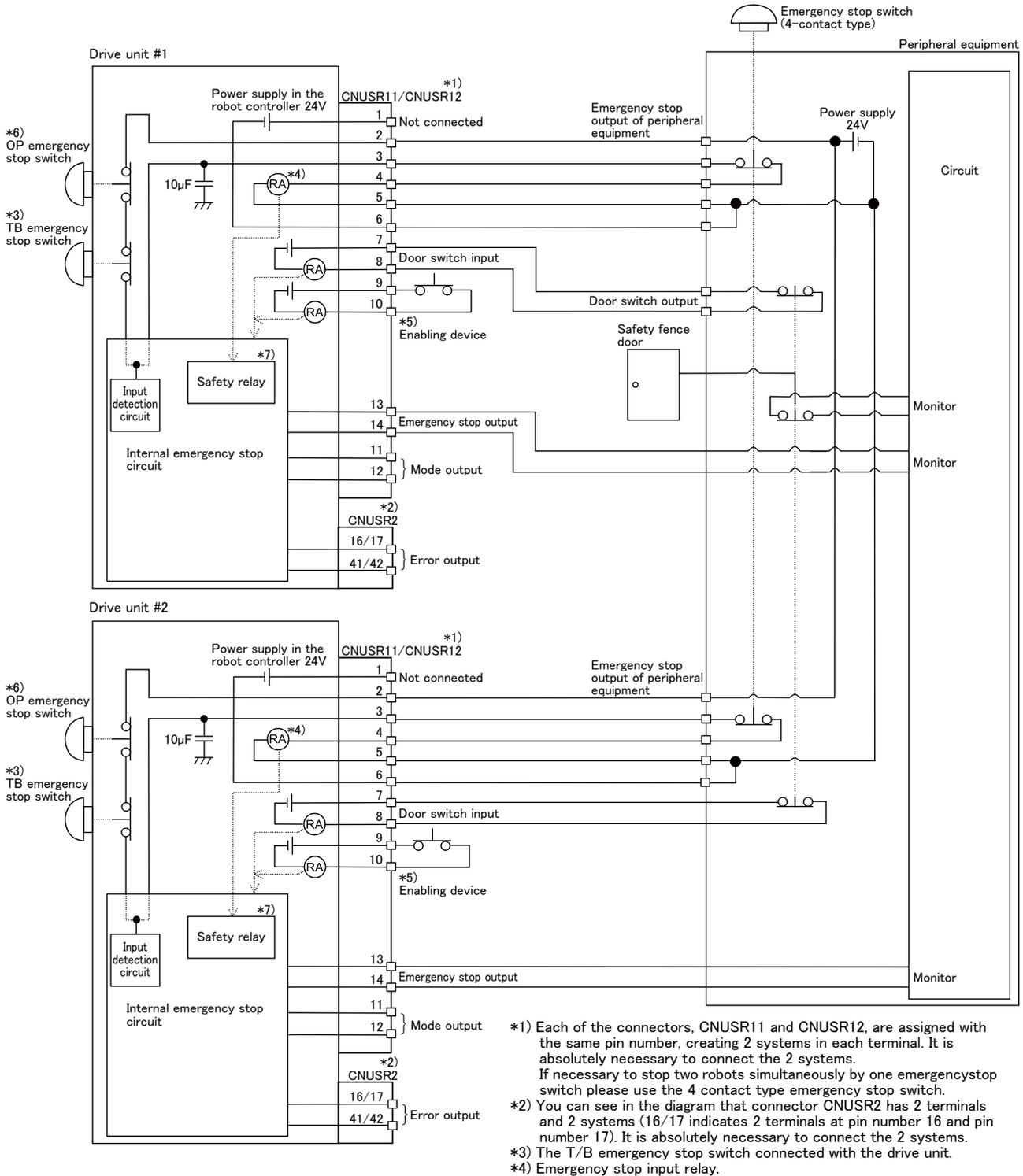
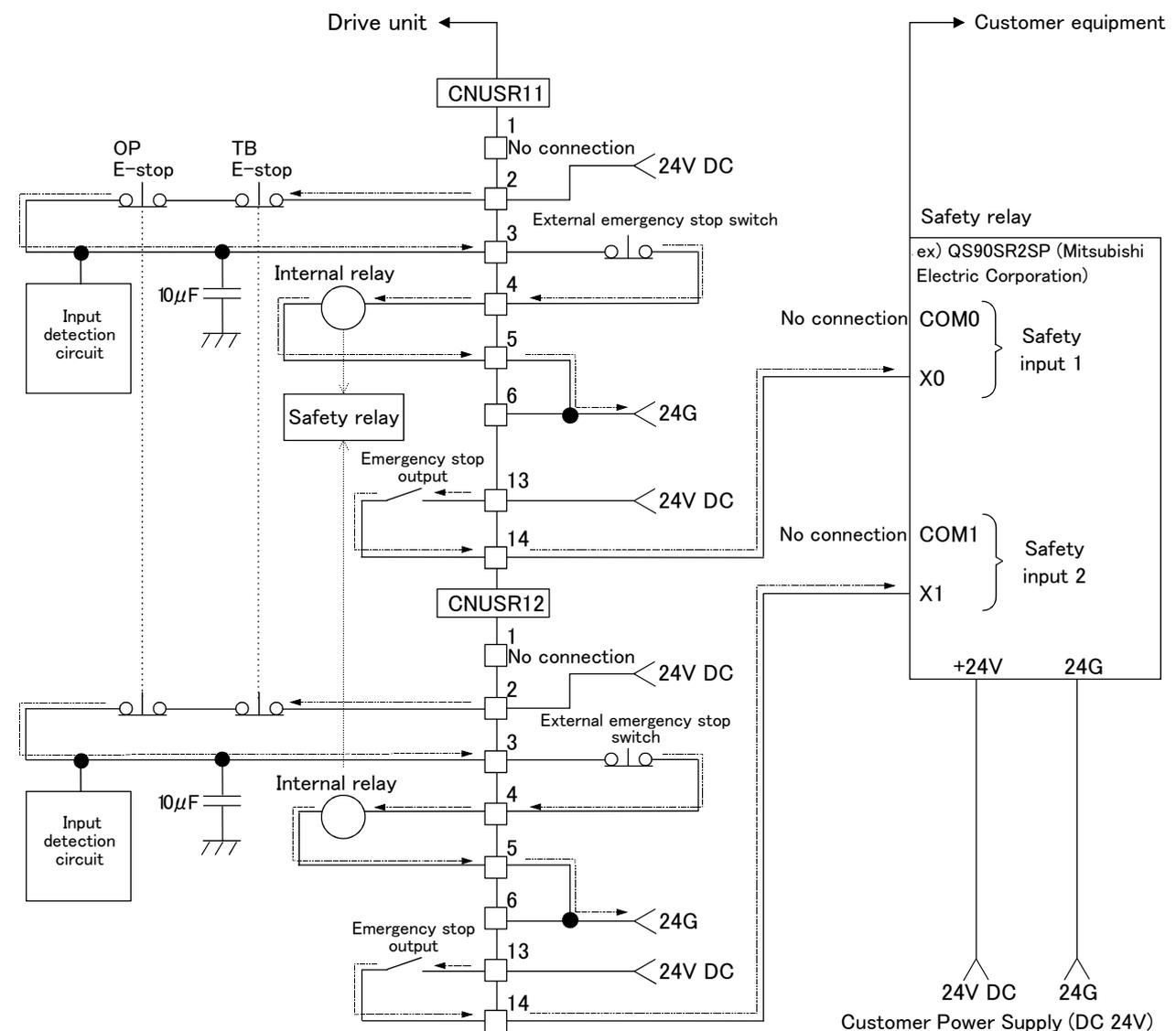


Fig.6-4 : Example of safety measures (CR750 wiring example 4)

<Wiring example 5>: Connect the drive unit to the safety relay

Use the drive unit's emergency stop switch command as an input to the safety relay.



[Caution]

- 1) This product has category 3 functionality and therefore the robot's whole unit cannot be set to category 4.
- 2) The drive unit's internal circuit has polarity. Please adhere to the polarity as detailed in the wiring examples, particularly for emergency stop switch output when using user equipment. Connect the positive side of the user equipment (24V DC) to the terminal 2 of CNUSR11/12, then connect the emergency stop switch (or contact points) in the user equipment to across the terminals 3 and 4 of CNUSR11/12, and ultimately connect the negative side (24G).
- 3) When installing a safety relay to use it as an input point of the drive unit's emergency stop switch command, use a safety relay that is activated by an input from one of the two systems (i.e. QS90SR2SP (Manufacture: Mitsubishi Electric Corporation)).
- 4) The emergency stop input detection relay (internal relay) uses the drive unit's internal safety relay control. If the emergency stop input detection relay is switched OFF, emergency stop is detected and the safety relay is also switched OFF.
- 5) When connecting emergency stop switch output to an external safety relay, please take note of the polarity and make sure that the electrical current flows in the same direction as indicated by the dotted arrows in the two places in the diagram. If the polarity is setup incorrectly, this function will not operate correctly. Please connect the terminal 13 of CNUSR11/12 to 24V.

Fig.6-5 : Example of safety measures (CR750 wiring example 5)

(2) CR751 drive unit

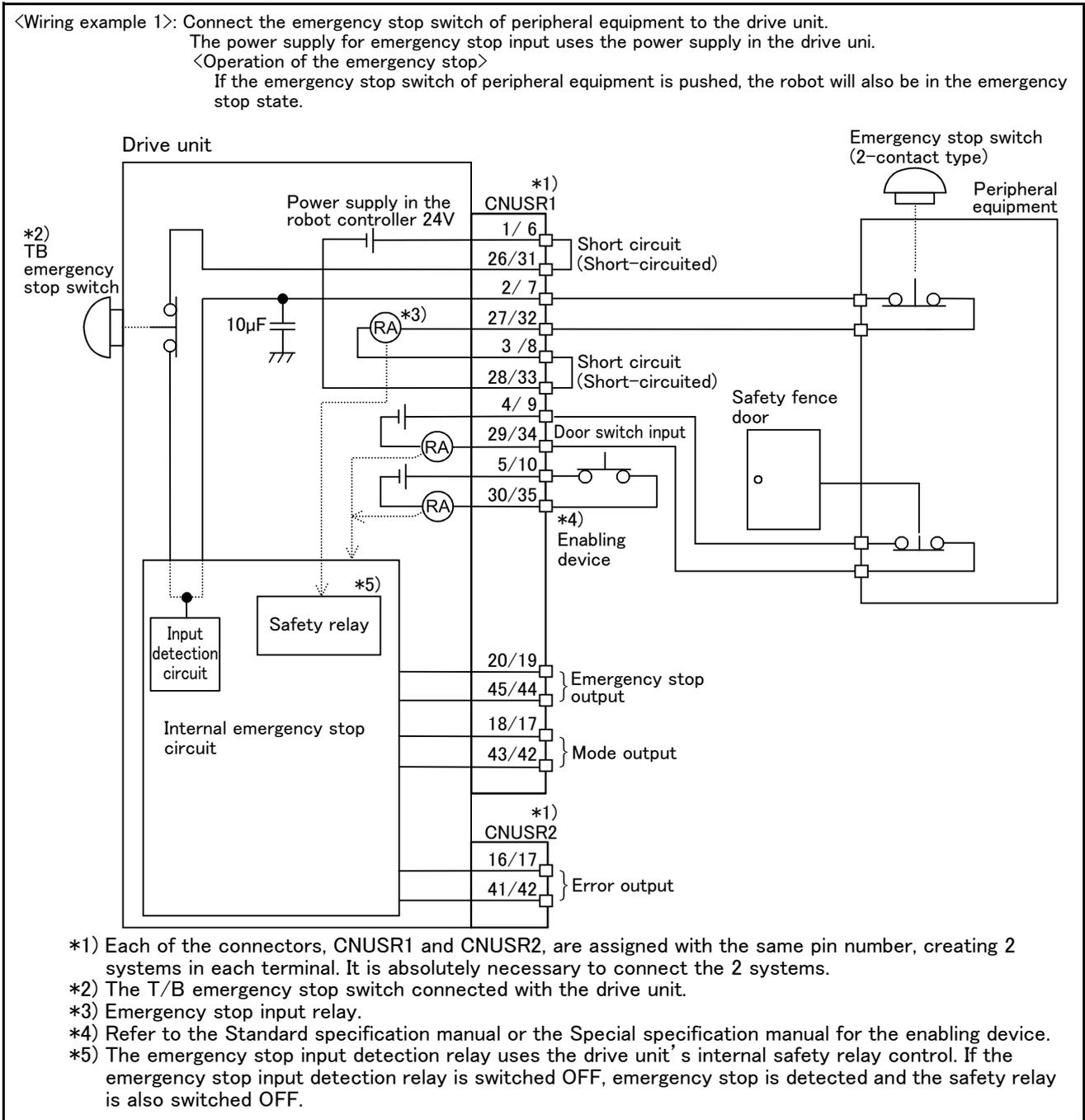
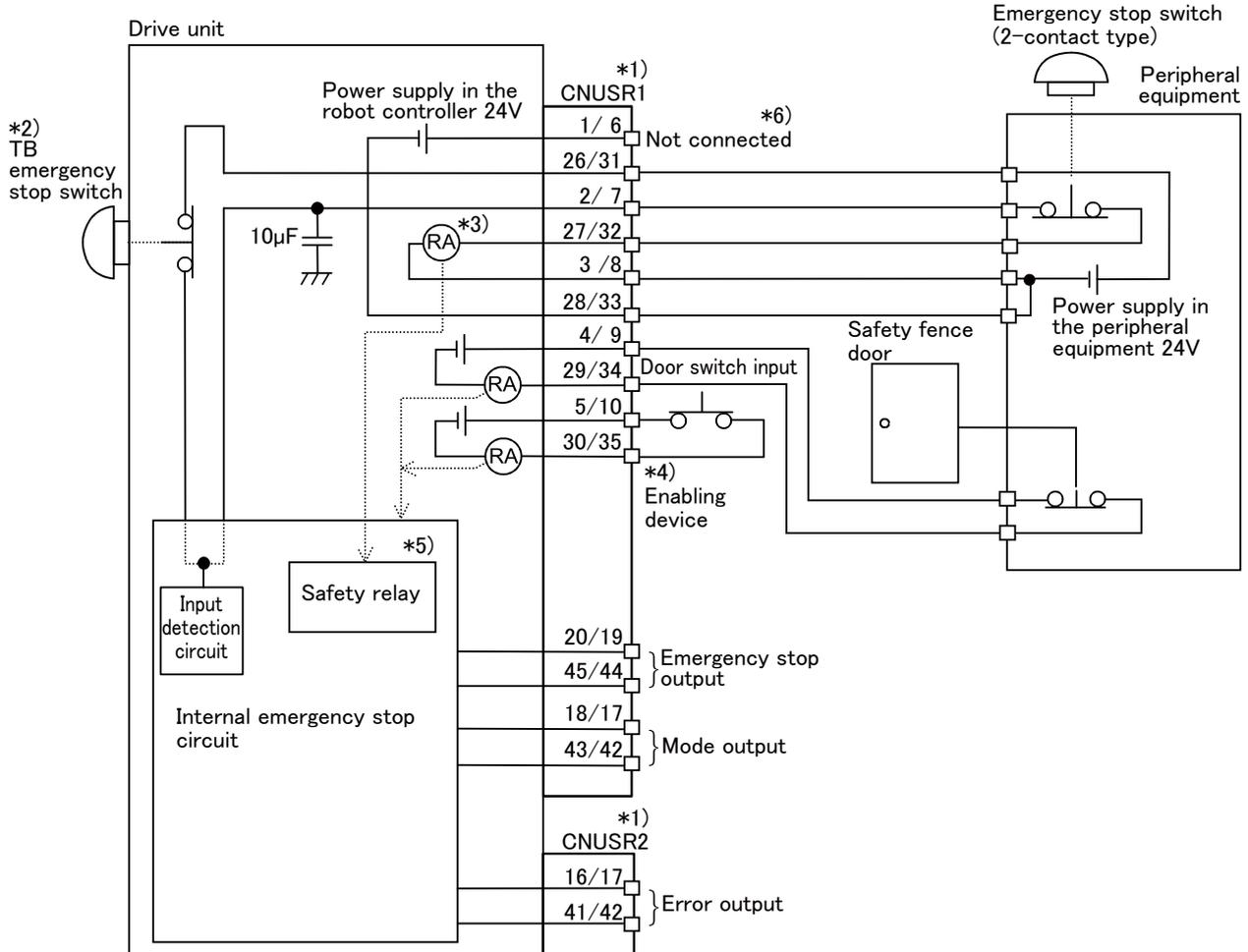


Fig.6-6 : Example of safety measures (CR751 wiring example 1)

<Wiring example 2>: Connect the emergency stop switch of peripheral equipment to the drive unit.
 The power supply for emergency stop input uses the power supply of peripheral equipment.
 <Operation of the emergency stop>
 If the emergency stop switch of peripheral equipment is pushed, the robot will also be in the emergency stop state.



- *1) Each of the connectors, CNUSR1 and CNUSR2, are assigned with the same pin number, creating 2 systems in each terminal. It is absolutely necessary to connect the 2 systems.
- *2) The T/B emergency stop switch connected with the drive unit.
- *3) Emergency stop input relay.
- *4) Refer to the Standard specification manual or the Special specification manual for the enabling device.
- *5) The emergency stop input detection relay uses the drive unit's internal safety relay control. If the emergency stop input detection relay is switched OFF, emergency stop is detected and the safety relay is also switched OFF.
- *6) Connect the 24V power supply to 26/31 terminals.

Fig.6-7 : Example of safety measures (CR751 wiring example 2)

<Wiring example 3>: Connect the emergency stop switch, door switch, and enabling device of peripheral equipment to the drive unit. The power supply for emergency stop input uses the power supply of peripheral equipment. Monitor the emergency stop state by the peripheral equipment side.

<Operation of the emergency stop>

If the emergency stop switch of peripheral equipment is pushed, the robot will also be in the emergency stop state. And, if the emergency stop switch of OP or T/B is pushed in the state of the power of drive unit OFF, peripheral equipment state can be the emergency stop also.

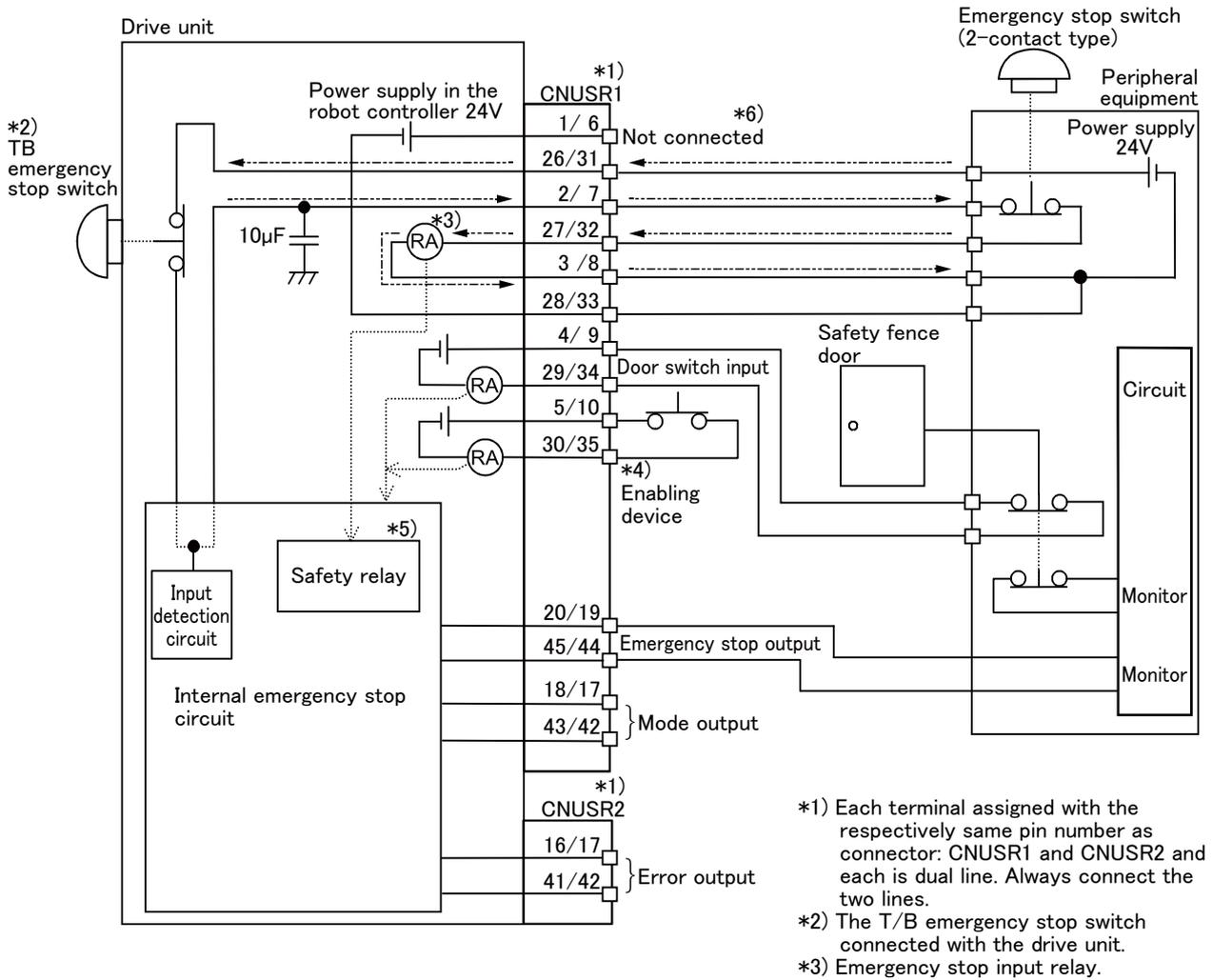
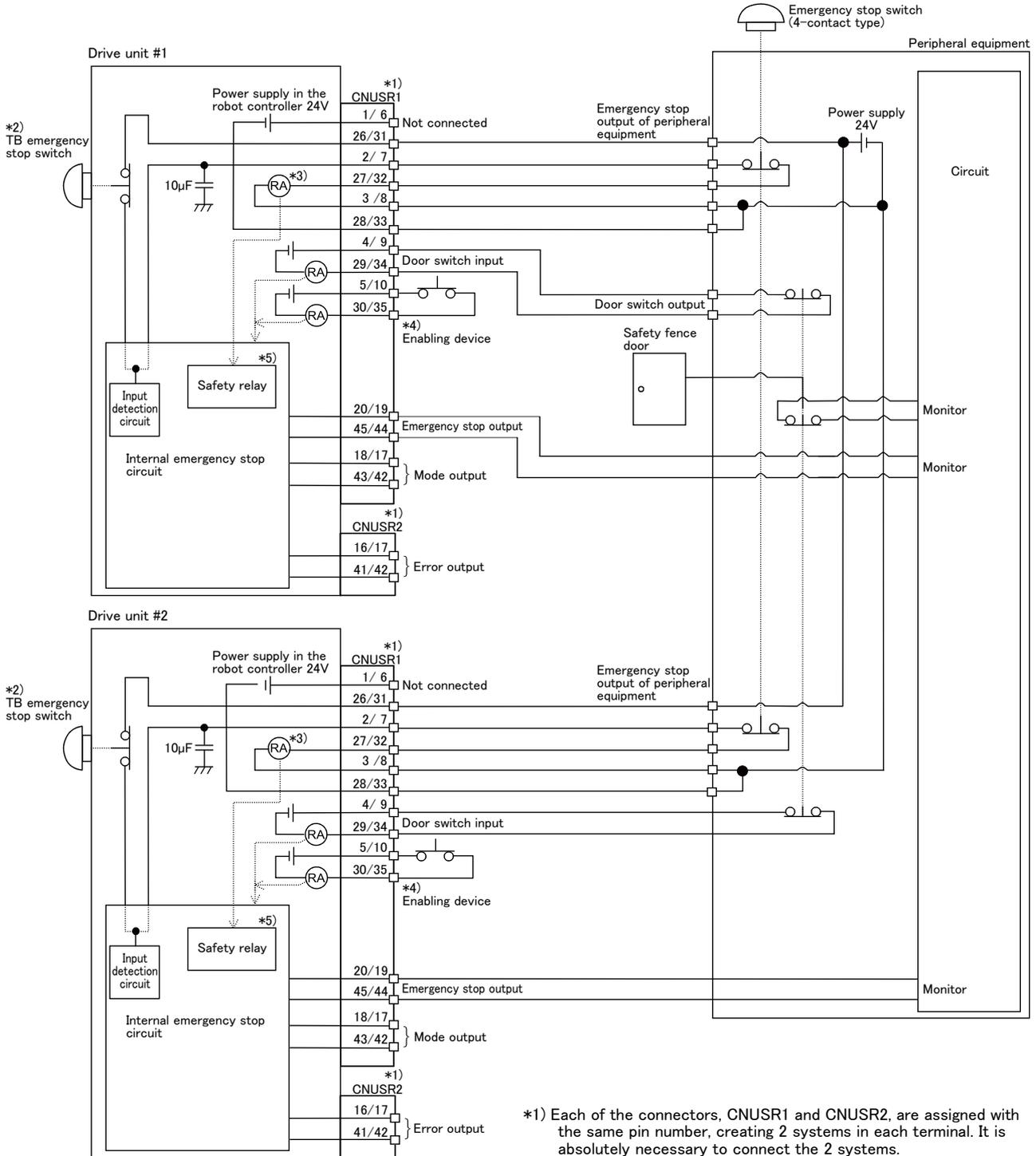


Fig.6-8 : Example of safety measures (CR751 wiring example 3)

<Wiring example 4>: Connect the emergency stop switch of peripheral equipment, and the door switch to two drive units, and it interlocks. Connect the enabling device to the robot controller. The power supply for emergency stop input uses the power supply of peripheral equipment. Monitor the emergency stop state by the peripheral equipment side.

<Operation of the emergency stop>

If the emergency stop switch of peripheral equipment is pushed, the robot will also be in the emergency stop state. And, if the emergency stop switch of OP or T/B is pushed in the state of the power of drive unit OFF, peripheral equipment state can be the emergency stop also.

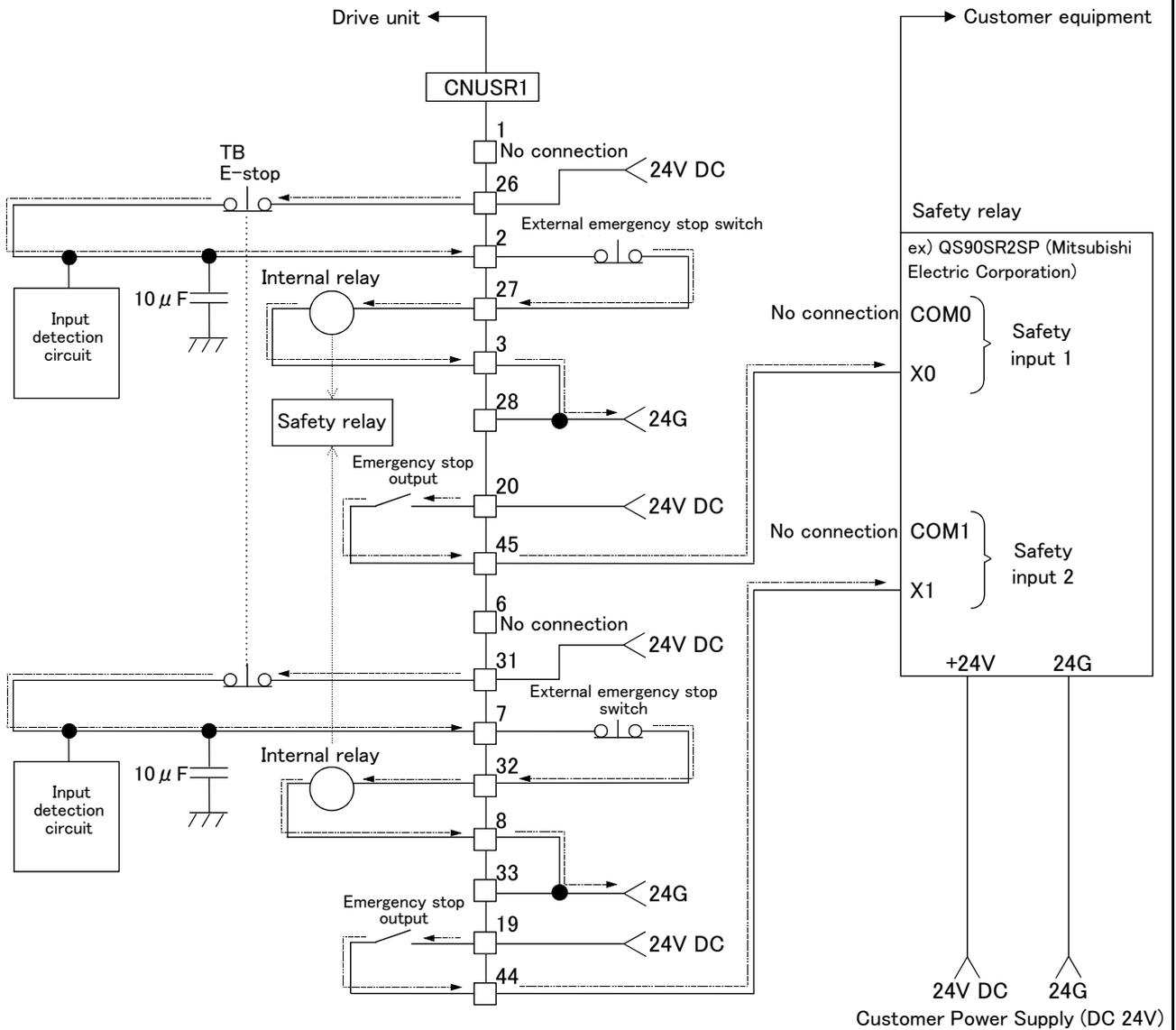


*1) Each of the connectors, CNUSR1 and CNUSR2, are assigned with the same pin number, creating 2 systems in each terminal. It is absolutely necessary to connect the 2 systems.
If necessary to stop two robots simultaneously by one emergency stop switch please use the 4 contact type emergency stop switch.
*2) The T/B emergency stop switch connected with the drive unit.

*3) Emergency stop input relay.
*4) Refer to the Standard specification manual or the Special specification manual for the enabling device.
*5) The emergency stop input detection relay uses the drive unit's internal safety relay control. If the emergency stop input detection relay is switched OFF, emergency stop is detected and the safety relay is also switched OFF.

Fig.6-9 : Example of safety measures (CR751 wiring example 4)

<Wiring example 5>: Connect the drive unit to the safety relay
 Use the drive unit's emergency stop switch to input safety relay.



[Caution]

- 1) This product has category 3 functionality and therefore the robot's whole unit cannot be set to category 4.
- 2) The drive unit's internal circuit has polarity. Please adhere to the polarity as detailed in the wiring examples, particularly for emergency stop switch output when using user equipment. Connect the positive side of the user equipment (24V DC) to the two terminals 26/31, then connect the emergency stop switch (or contact points) in the user equipment to the 2-27 and 7-32 terminals, and ultimately connect to the negative side (24G).
- 3) Setup a safety relay on the user equipment, and when using to input the emergency stop switch on the drive unit, please only use a safety relay that functions when connecting the input to the one end of the 2 systems (i.e. QS90SR2SP (Manufacture: Mitsubishi Electric Corporation)).
- 4) The emergency stop input detection relay (internal relay) uses the drive unit's internal safety relay control. If the emergency stop input detection relay is switched OFF, emergency stop is detected and the safety relay is also switched OFF.
- 5) When connecting emergency stop switch output to an exterior safety relay, please take note of the polarity and make sure that the electrical current flows in the same direction as indicated by the dotted arrows in the two places in the diagram. If the polarity is setup incorrectly this function will not operate correctly. Please connect 20/19 terminal to 24V.

Fig.6-10 : Example of safety measures (CR751 wiring example 5)

(3) External emergency stop connection [supplementary explanation]

- (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 (normal open), wire to the door switch input terminal 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 manual-return type of normal close which have two lines for the 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 drive unit can be used for safety measures as shown in figure above. Note that there are limits to the No. of switch contacts, capacity and cable length, so refer to the following and install.

- Switch contact..... Prepare a 2-contact type. *1)
- Switch contact capacity..... Use a normal open contact that operates with a switch contact capacity of approx. 1mA to 100mA/24V. *1)
If you connect the relay etc., rated current of the coil should use the relay which is 100mA/24V or less. (Refer to Fig. 6-12, Fig. 6-11)
- Cable length..... The length of the wire between the switch and terminal block must be max. 15m or less. Please use the shield line, in case of the cable may receive the noise etc. by other equipment, such as servo amplifier. And, since the ferrite core is attached as noise measures parts, please utilize.

The size of the wire that fits to use is shown below.

- CR750 drive unit CNUSR11/12/13 connector:
AWG #26 to #16 (0.14mm² to 1.5mm²)
- CR750 drive unit CNUSR2 connector:
AWG #30 to #24 (0.05mm² to 0.2mm²)
- CR751 drive unit CNUSR1/2 connector:
AWG #30 to #24 (0.05mm² to 0.2mm²)

Electric specification of the emergency stop related output circuit is 100mA/24V or less. Don't connect the equipment except for this range.

*1) The minimum load electric current of the switch is more than 5mA/24V.

The electric-current value limitation when connecting the coils, such as the Relays (CR750 drive unit)

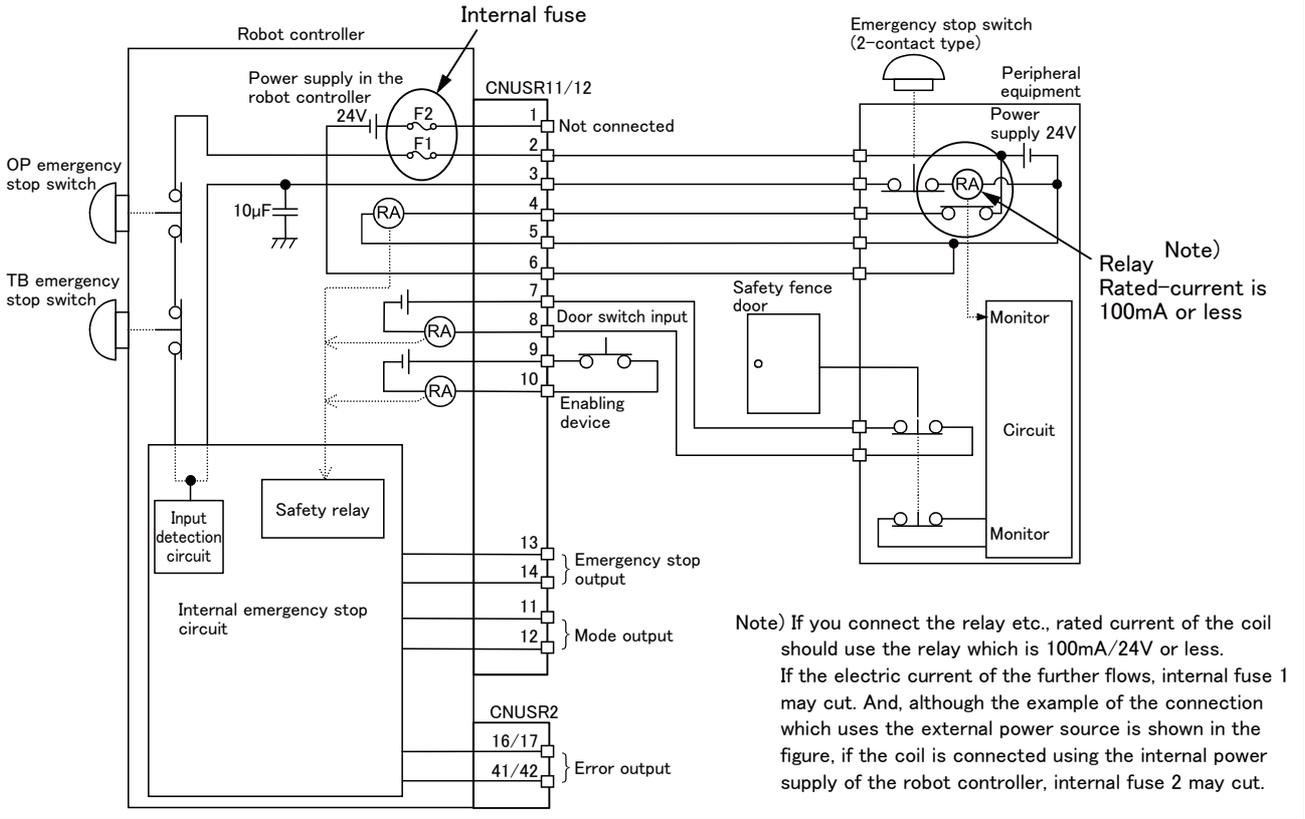


Fig.6-11 : Limitations when connecting the relay etc. (CR750)

The electric-current value limitation when connecting the coils, such as the Relays (CR751 drive unit)

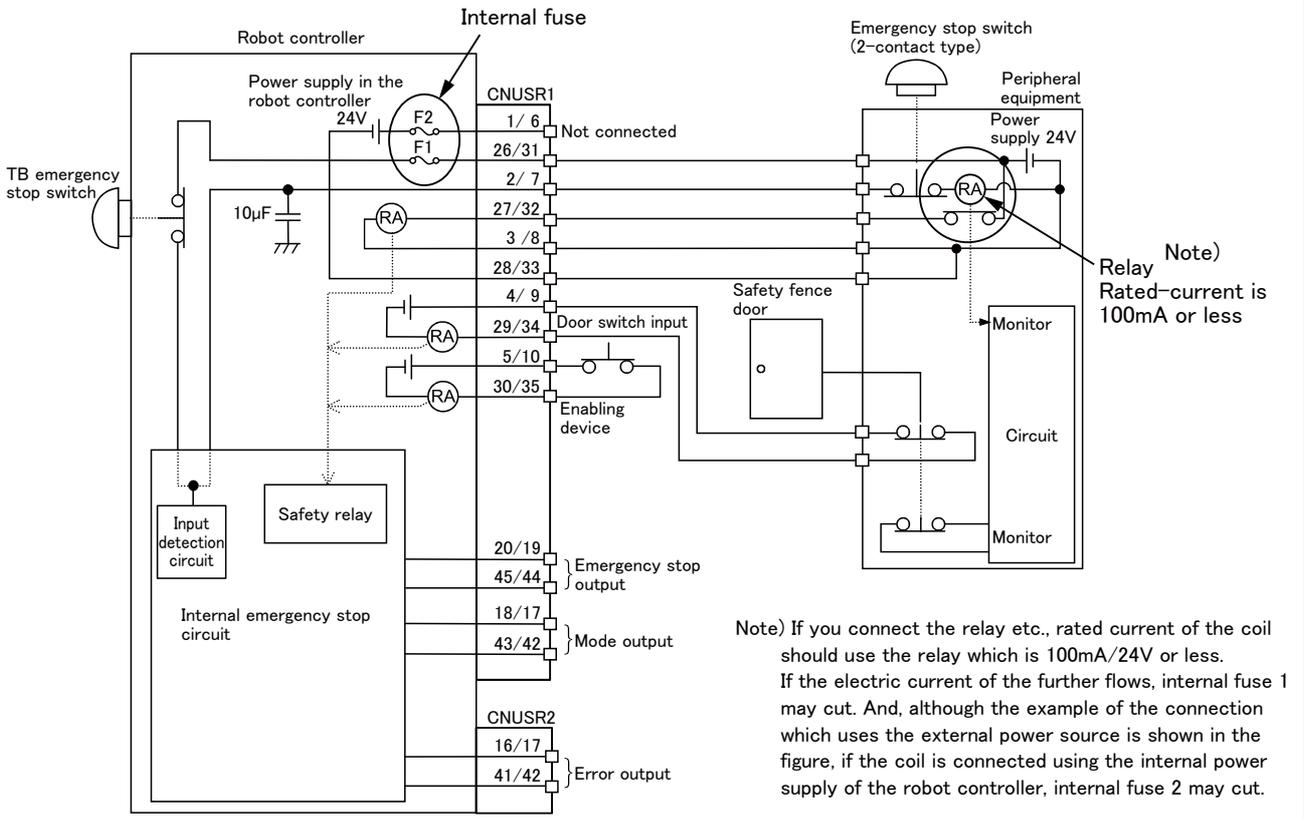


Fig.6-12 : Limitations when connecting the relay etc. (CR751)

[Supplementary explanation regarding emergency stop circuit]

The drive unit's internal circuit is as shown in the below diagram. Be sure to build a circuit that properly shuts off the emergency stop detection relay when the emergency stop switch is pressed.

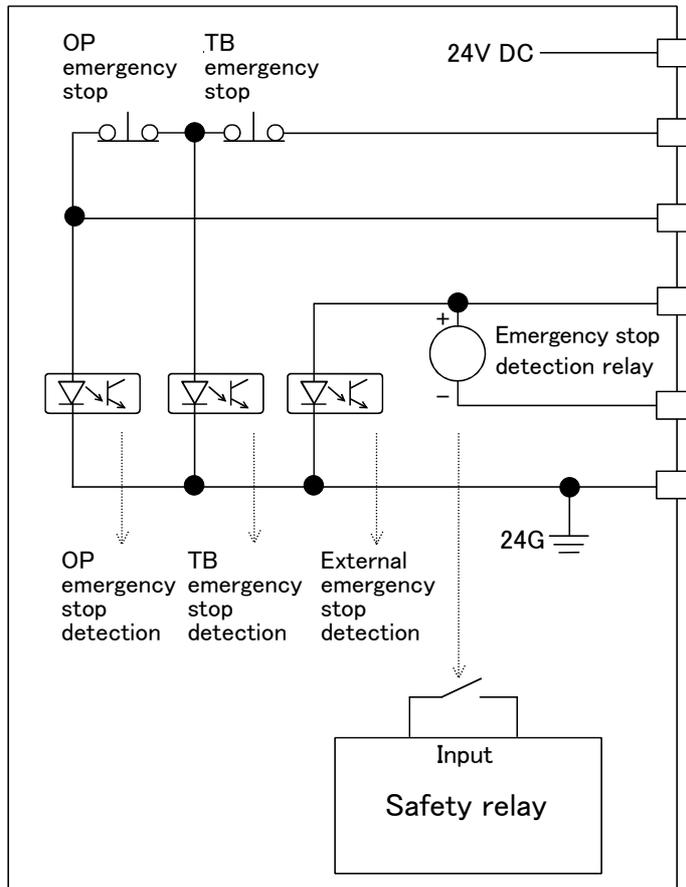


Fig.6-13 : Internal circuit of controller

⚠ CAUTION

Be sure to perform wiring correctly. If there are mistakes in the wiring, the robot may not stop when the emergency stop switch is pressed and there will be a risk of damage or personal injury occurring.

After wiring, be sure to press each of the installed emergency stop switches and check whether the emergency stop circuit works properly.

⚠ CAUTION

Be sure to duplicate connection of the emergency stop, door switch and enabling switch. If not duplicated, these functions may fail due to a broken relay used by customer, etc.

6.2 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.

CAUTION

Please use the controller with an input power supply voltage fluctuation rate of 10% or less. In the case of 200 VAC input, for example, if the controller is used with 180 VAC during the day and 220 VAC during the night, turn the servo off once and then on again. If this is not performed, an excessive regeneration or overvoltage error may occur.

(2) Noise

- Where a surge voltage exceeding 2000V, 5kHz (equivalent to EN61000-4-4) 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 degree , lower than 0 degree.
- 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/s^2 or less during transportation and 5m/s^2 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.)
- Where there is heavy powder dust and oil mist present.

6.3 Precautions for handling

- (1) This robot has brakes on J3 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 shaft section could interfere with the base section. Take care to prevent interference during jog. ^{*1)}
- (4) The robot arm consists of precision parts such as bearing. Lubricants such as grease are also applied on the moving parts to keep the mechanical accuracy. In a cold start under low temperature or in the first start after being stored for one month or longer, lubricants may not be spread enough. Such condition may lower the positioning accuracy, cause servo and overload alarms, and early wearing of the moving parts. To avoid such situation, perform warm-up operation of the machine at a low speed (at about 20% of normal operation speed). Move the robot arm from the lower to the upper limit of the movable range with the 30 degree joint angle or more for about 10 minutes (RH-3FHR series: for about 30 minutes). After that, speed up the operation gradually.

Please use the warm-up operation. (About the details of the warm-up operation, refer to "INSTRUCTION MANUAL/Detailed explanations of functions and operations".)

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

- (5) When the air hoses and cables are used inside the shaft (J3 axis), the grease for cable protection may ooze out or abrasion powders may be generated from the tip of the shaft while the robot is moving. However, movements and performance of the robot are not affected. Wipe off the grease or powders as required.
- (6) The robot arm and controller must be grounded with 100Ω or less (class D grounding) to secure the noise resistance and to prevent electric shocks.
- (7) The items described in these specifications are conditions for carrying out the periodic maintenance and inspections described in the instruction manual.
- (8) 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 flexed)" factory shipment special specifications or options.
- (9) 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.
- (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.
- (11) If the robot is operated with a heavy load and at a high speed, the surface of the robot arm gets very hot. It would not result in burns, however, it may cause secondary accidents if touched carelessly.
- (12) Do not shut down the input power supply to stop the robot. If the power supply is frequently shut down during a heavy load or high-speed operation, the speed reducer may be damaged, backlash may occur, and the program data may be destroyed.
- (13) During the robot's automatic operation, a break is applied to the robot arm when the input power supply is shut down by a power failure, for instance. When a break is applied, the arm may deviate from the operation path predetermined by automatic operation and, as a result, it may interfere with the mechanical stopper depending on the operation at shutdown. In such a case, take an appropriate measure in advance to prevent any dangerous situation from occurring due to the interference between the arm and peripheral devices.
Example) Installing a UPS (uninterruptible power supply unit) to the primary power source in order to reduce interference.
- (14) Do not conduct an insulated voltage test. If conducted by mistake, it may result in a breakdown.
- (15) When the sequencer system becomes large too much, the robot's locus may deteriorate uncommonly. If this phenomenon occurs, inform to the dealer. And, when it turns out that the system is enlarged in advance, please inform our company.
- (16) Fretting may occur on the axis which moving angle or moving distance move minutely, or not moves. Fretting is that the required oil film becomes hard to be formed if the moving angle is small, and wear occurs. The axis which not moved is moving slightly by vibration etc. To make no fretting recommends to move these axes about once every day the 30 degree or more, or the 20mm or more.
- (17) The United Nations' Recommendations on the Transport of Dangerous Goods must be observed for trans-border transportation of lithium batteries by air, sea, and land. The lithium batteries (ER6V, Q6BAT) used in Mitsubishi industrial robots contain lithium and fall under the definition.
When the lithium batteries are shipped for storage, etc., they will be classified as Class 9: Miscellaneous dangerous substances and articles. Please contact your transportation company and must provide appropriate transport safety measures as the customer's consignor.
- (18) If the air supply temperature (primary piping) used for the tool etc. is lower than ambient air temperature, the dew condensation may occur on the coupling or the hose surface.
- (19) Collision detection function is valid condition for both of automatic and jog operation at shipping.
So, the robot stops immediately if the robot's tool or arm interferes with a peripheral device, minimizing damage. Therefore, please use in the valid condition.
- (20) When fumigants that contain halogen materials such as fluorine, chlorine, bromine, and iodine are used for disinfecting and protecting wooden packaging from insects, they cause malfunction when entering our products. Please take necessary precautions to ensure that remaining materials from fumigant do not enter our products, or treat packaging with methods other than fumigation (heat method). Additionally, disinfect and protect wood from insects before packing products.

6.4 EMC installation guideline

6.4.1 Outlines

Industrial robots are one of the components of automation systems as well as main components. This section introduces methods and parts to ensure electromagnetic compatibility (EMC) in automation systems.

We test for EMC in the environment described in this manual, but the noise level varies depending on device types, layout, control panel structure, and wiring, etc. Please make final checks for EMC.

6.4.2 EMC

This technical standard regulates the following two items.

- (1) Emission (EMI : Electromagnetic Interference).....The capacity not to generate the disturbance noise which has a bad influence outside.
- (2) Immunity (EMS : Electromagnetic Susceptibility).....The capacity which does not malfunction for the disturbance noise from the outside.

Each contents are shown below.

| Item | Name | Contents | Testing technical-standard number |
|----------------|--|---|---|
| Emission (EMI) | Radiative noise disturbance | The electromagnetic noise etc. which are emitted to environs. | EN61000-6-2 : 2005 EN61000-6-4 : 2007 EN62061:2005(Annex E) |
| | Electrical-conduction noise disturbance | The electromagnetism noise etc. which flow out of the power-supply line. | |
| Immunity (EMS) | Electrostatic discharge immunity test | The noise from the electrified human body. | |
| | Radiated, radio-frequency, electromagnetic field immunity test susceptibility test | The electromagnetism noise from the transceiver, the broadcasting station, etc. | |
| | Electrical fast transient burst immunity test | The relay noise or the electromagnetism noise etc. which are caused in power-supply ON/OFF. | |
| | Immunity to conducted disturbances induced radio-frequency fields | The electromagnetism noise etc. which flow in through the power source wire and the grounding wire. | |
| | Power frequency magnetic field immunity test | The electromagnetism noise with a power supply frequency of 50/60 Hz etc. | |
| | Voltage dips, short interruptions and voltage variations immunity test | The noise in the variation of the source voltage of the power dispatching, etc. | |
| | Surge immunity test | The electromagnetism noise by the thunderbolt, etc. | |

6.4.3 EMC measures

There are mainly following items in the EMC measures.

- (1) Store into the sealed metal board.
- (2) Grounding all the conductor that have floated electrically (makes the impedance low).
- (3) Wiring so that the power source wire and signal wire are separated.
- (4) Use the shield cable for the cable which wired outside of the metal board.
- (5) Install the noise filter.

To suppress the noise emitted out of the board, be careful of the following item.

- (1) Ensure grounding of the equipment.
- (2) Use the shield cable.
- (3) Separate the metal board electrically. Narrows the distance/hole.

The strength of electromagnetic noise emitted to environment is changed a lot by the shielding efficiency of cable and the distance of metal board, so it should be careful.

6.4.4 Component parts for EMC measures

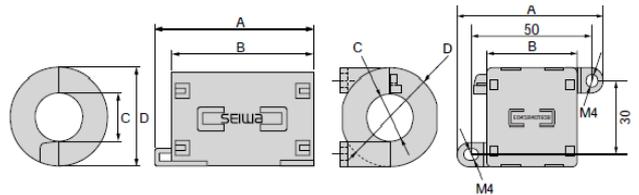
(1) Ferrite core

The ferrite core is mounted by the plastics case as one. It can attach by the one-touch, without cutting the cable. This has the effect in the common-mode noise. The measures against the noise are made not influential in the quality of the signal.

There are the following as an example.

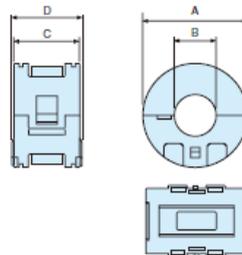
Maker: SEIWA ELECTRIC MFG. Co.,Ltd.

| Type | Outside dimension (mm) | | | | Diameter of the adaptation cable [max] (mm) |
|-------------|------------------------|----|----|----|---|
| | A | B | C | D | |
| E04SR401938 | 61 | 38 | 19 | 40 | 19.0 |
| E04SR301334 | 39 | 34 | 13 | 30 | 13.0 |



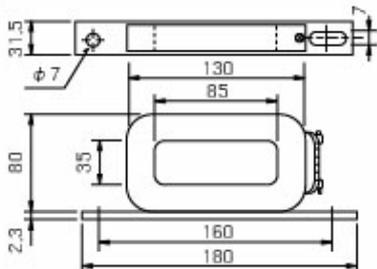
Maker: TAKACHI ELECTRONICS ENCLOSURE CO., LTD.

| Type | Outside dimension (mm) | | | | Diameter of the adaptation cable [max] (mm) |
|-------------|------------------------|------|------|---|---|
| | A | B | C | D | |
| TFT-274015S | 43.8 | 27.4 | 20.7 | - | φ 26.5 |



(2) Line noise filter

Type : FR-BLF (Mitsubishi Electric Corp.)



7 Appendix

Appendix 1 : Classification of functions using external input/output signals

Before using the functions, note the following.

Table 7-1 : Classification of functions using external input/output signals

| Classification | Function | Description |
|-------------------|---|--|
| Safety signal | Emergency stop input | Detects emergency stop inputs. This function meets the requirements of category 3 and PL d. |
| | Door switch input | Receives the status of the switch installed on the door of the safety fence to detect the opening of the door. |
| | Enabling device input | This function checks the state of the switch on the enabling device. |
| Non-safety signal | Mode changeover switch input | Switches the controller mode between MANUAL and AUTOMATIC. |
| | Emergency stop output | Monitors whether the robot is in the emergency stop state. |
| | Mode output | Monitors whether the robot operates in MANUAL or AUTOMATIC mode. |
| | Robot error output | Monitors the error status of the robot. |
| | Magnet contactor control connector output for addition axes | Synchronizes the state of the additional axes (servo ON/OFF) with that of the robot arm. For details, refer to Page 166 , "3.9 Magnet contactor control connector output (AXMC) for addition axes". |

Appendix 2 : Origin position adjustment of J2 axis

When a calculated point is used for a robot's work point, the accuracy of J2 axis is important. This paragraph "Appendix 2 : Origin position adjustment of J2 axis" gives the details of an origin position adjustment by the configuration flag (RIGHT/LEFT).

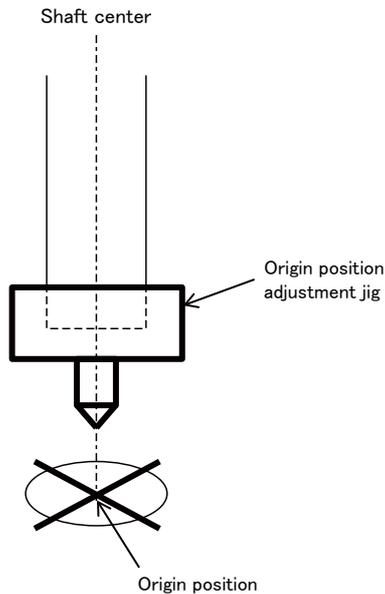


Fig.7-1 : Origin position adjustment

For the origin position adjustment, a reference point is an axis center of a shaft. When a center of the hand is offset from a center of the shaft, the hand must be removed before the origin position adjustment.

Origin position adjustment procedure

- 1) Designate any point as an origin position.
- 2) Match the center of the shaft with the origin position in a right hand coordinate system.
- 3) Perform teaching work to the joint variables JR.
- 4) Match the center of the shaft with the origin position in a left hand coordinate system.
- 5) Perform teaching work to the joint variables JL.
- 6) Execute the following commands in the order presented.

```
MDJNT_J2=(JR.J2+JL.J2)/2
JDJNT_Data=(0,0,0,0,0)
JDJNT_Data.J2=JDJNT_Data.J2-(MDJNT_J2)
PrmWrite 1,"DJNT",JDJNT_Data
```

- 7) Move J2 axis to 0 degrees, and check the robot position.

After the origin position adjustment, an adjusted value is stored in the parameter DJNT.
 For another origin position adjustment with retaining an earlier adjusted value after the first adjustment is finished, change "JDJNT_Data=(0,0,0,0,0)" into "PrmRead 1,"DJNT",JDJNT_Data" before command execution.
 As a repeat of command execution causes an accumulation of the adjusted values, clear the parameter DJNT back to 0 before another origin position adjustment.

Appendix 3 : Specifications discussion material (RH-6FH series: Floor installation type)

■ Customer information

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

■ Purchased model

| Item | Type | Arm length | Stroke | Controller |
|------------------------|---|--|---|---------------------------------------|
| General specification | RH-6FH <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> -Q | <input type="checkbox"/> 350 <input type="checkbox"/> 450 <input type="checkbox"/> 550 | <input type="checkbox"/> 200 <input type="checkbox"/> 340 | <input type="checkbox"/> CR750-06HQ-1 |
| | RH-6FH <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> -1Q | | | <input type="checkbox"/> CR751-06HQ-0 |
| Clean specification | RH-6FH <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> C-Q | <input type="checkbox"/> 350 <input type="checkbox"/> 450 <input type="checkbox"/> 550 | <input type="checkbox"/> 200 <input type="checkbox"/> 340 | <input type="checkbox"/> CR750-06HQ-1 |
| | RH-6FH <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> C-1Q | | | <input type="checkbox"/> CR751-06HQ-0 |
| Oil mist specification | RH-6FH <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> M-Q | <input type="checkbox"/> 350 <input type="checkbox"/> 450 <input type="checkbox"/> 550 | <input type="checkbox"/> 200 <input type="checkbox"/> 340 | <input type="checkbox"/> CR750-06HQ-1 |
| | RH-6FH <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> M-1Q | | | <input type="checkbox"/> CR751-06HQ-0 |

■ Shipping special specifications

| Item | Standard specification | Special shipping specifications |
|------------|---|---|
| Robot arm | Machine cable | <input type="checkbox"/> 5m fixed type |
| | CE Marking specification | Not conforming with EMC directive. |
| Controller | Robot CPU unit connecting cable set ^{Note1)} | <input type="checkbox"/> Not provided <input type="checkbox"/> 5m <input type="checkbox"/> 20m <input type="checkbox"/> 30m: 2Q-RC-CBL <input type="checkbox"/> M |
| | | 2m fixed type: <input type="checkbox"/> 1S-02UCBL-01 (For CR750 controller) <input type="checkbox"/> 1F-02UCBL-02 (For CR751 controller) |
| | | <input type="checkbox"/> Not provided <input type="checkbox"/> -S13 |

Note1) The four type cables shown in below are contained. (Each cable length is the same.)

- 1)2Q-TUCBL M, 2)2Q-DISPCBL M, 3)2Q-EMICBL M,
4)MR-J3BUS M-A (5m, 20m) or MR-J3BUS M-B (30m)

■ Options (Installable after shipment)

| Item | Type | Provision, and specifications when provided. | |
|---------------------------------|--|--|---|
| Robot arm | J1 axis operating range change | 1F-DH-01 | |
| | Machine cable extension (extension type) | 1S- <input type="checkbox"/> <input type="checkbox"/> CBL-01 | Fixed type (For CR750 controller): <input type="checkbox"/> Not provide <input type="checkbox"/> 5m <input type="checkbox"/> 10m <input type="checkbox"/> 15m |
| | | 1S- <input type="checkbox"/> <input type="checkbox"/> LCBL-01 | Flexed type (For CR750 controller): <input type="checkbox"/> Not provide <input type="checkbox"/> 5m <input type="checkbox"/> 10m <input type="checkbox"/> 15m |
| | Machine cable extension (direct type) | 1S- <input type="checkbox"/> <input type="checkbox"/> LUCBL-01 | Flexed type (For CR750 controller): <input type="checkbox"/> Not provide <input type="checkbox"/> 5m <input type="checkbox"/> 10m <input type="checkbox"/> 15m |
| | | 1F- <input type="checkbox"/> <input type="checkbox"/> UCBL-02 | Fixed type (For CR751 controller): <input type="checkbox"/> Not provide <input type="checkbox"/> 10m <input type="checkbox"/> 15m <input type="checkbox"/> 20m |
| | | 1F- <input type="checkbox"/> <input type="checkbox"/> LUCBL-02 | Flexed type ((For CR751 controller): <input type="checkbox"/> Not provide <input type="checkbox"/> 10m <input type="checkbox"/> 15m <input type="checkbox"/> 20m |
| | Solenoid valve set | 1F-VD0 <input type="checkbox"/> -01 1F-VD0 <input type="checkbox"/> E-01 | <input type="checkbox"/> Not provide 1F-VD0 <input type="checkbox"/> -01 (Sink type): <input type="checkbox"/> 1set <input type="checkbox"/> 2set <input type="checkbox"/> 3set <input type="checkbox"/> 4set 1F-VD0 <input type="checkbox"/> E-01 (Source type): <input type="checkbox"/> 1set <input type="checkbox"/> 2set <input type="checkbox"/> 3set <input type="checkbox"/> 4set |
| | Hand input cable | 1F-HC35C-01 | <input type="checkbox"/> Not provided <input type="checkbox"/> Provided |
| | Hand output cable | 1F-GR60S-01 | <input type="checkbox"/> Not provided <input type="checkbox"/> Provided |
| | Hand curl tube | 1E-ST0408C-300 | <input type="checkbox"/> Not provided <input type="checkbox"/> Provided |
| External Wiring/Piping box | 1F-UT-BOX | <input type="checkbox"/> Not provided <input type="checkbox"/> Provided | |
| Internal Wiring/Piping for hand | 1F-HS408S-01 | <input type="checkbox"/> Not provided <input type="checkbox"/> Provided (For 200mm stroke) | |
| | 1F-HS408S-02 | <input type="checkbox"/> Not provided <input type="checkbox"/> Provided (For 340mm stroke) | |
| Controller | Simple teaching pendant | R32TB- <input type="checkbox"/> <input type="checkbox"/> R33TB- <input type="checkbox"/> <input type="checkbox"/> | |
| | Highly efficient teaching pendant | R56TB- <input type="checkbox"/> <input type="checkbox"/> R57TB- <input type="checkbox"/> <input type="checkbox"/> | |
| | Controller protection box | CR750-MB | For CR750 drive unit: <input type="checkbox"/> Not provided <input type="checkbox"/> Provided |
| | | CR751-MB | For CR751 drive unit: <input type="checkbox"/> Not provided <input type="checkbox"/> Provided |
| | RT ToolBox2 | 3D-11C-WINE | <input type="checkbox"/> Not provided <input type="checkbox"/> Windows XP/Vista/7/8/8.1/10 English CD-ROM |
| | RT ToolBox2 mini | 3D-12C-WINE | <input type="checkbox"/> Not provided <input type="checkbox"/> Windows XP/Vista/7/8/8.1/10 English CD-ROM |
| | MELFA-3D Vision 3.0 | 3F-53U-WINM | <input type="checkbox"/> Not provided <input type="checkbox"/> Provided |
| Instructions manual | 5F-RB01-PE01 | <input type="checkbox"/> Not provided <input type="checkbox"/> Provided () sets | |

■ Maintenance parts (Consumable parts)

| | |
|-------------------|---|
| Maintenance parts | <input type="checkbox"/> Backup batteries ER6V () pcs. <input type="checkbox"/> Backup batteries Q6BAT () 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"/> Oil mist: Confirm oil proof <input type="checkbox"/> request (Oil name:)/ <input type="checkbox"/> not request ^{Note1)} | |
| Remarks | | <input type="checkbox"/> Dusts (Please take measures such as a jacket.), <input type="checkbox"/> Chemicals (Please consult), <input type="checkbox"/> Other () | |

Note1) Refer to Page 37, "2.2.8 Protection specifications" about oil resistance.

Appendix 4 : Specifications discussion material (RH-12FH series: Floor installation type)

Customer information

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

Purchased model

| Item | Type | Arm length | Stroke | Controller |
|------------------------|------------------|-------------------|-------------|----------------|
| General specification | RH-12FH □□△△-Q | □ 550 □ 700 □ 850 | □ 350 □ 450 | □ CR750-12HQ-1 |
| | RH-12FH □□△△-1Q | | | □ CR751-12HQ-0 |
| Clean specification | RH-12FH □□△△C-Q | □ 550 □ 700 □ 850 | □ 350 □ 450 | □ CR750-12HQ-1 |
| | RH-12FH □□△△C-1Q | | | □ CR751-12HQ-0 |
| Oil mist specification | RH-12FH □□△△M-Q | □ 550 □ 700 □ 850 | □ 350 □ 450 | □ CR750-12HQ-1 |
| | RH-12FH □□△△M-1Q | | | □ CR751-12HQ-0 |

Shipping special specifications

| Item | Standard specification | Special shipping specifications |
|------------|---|--|
| Robot arm | Machine cable | □ 5m fixed type 2m fixed type: □ 1S-02UCBL-01 (For CR750 controller) □ 1F-02UCBL-02 (For CR751 controller) |
| | CE Marking specification | Not conforming with EMC directive. □ Not provided □ -S15 |
| Controller | Robot CPU unit connecting cable set ^{Note1)} | □ Not provided □ 5m □ 20m □ 30m: 2Q-RC-CBL □□ M |

Note1) The four type cables shown in below are contained. (Each cable length is the same.)

- 1)2Q-TUCBL □□ M, 2)2Q-DISPCBL □□ M, 3)2Q-EMICBL □□ M,
- 4)MR-J3BUS □□ M-A (5m, 20m) or MR-J3BUS □□ M-B (30m)

Options (Installable after shipment)

| item | Type | Provision, and specifications when provided. | |
|---------------------------------|-----------------------------------|---|--|
| Robot arm | J1 axis operating range change | 1F-DH-02 □ Not provided □ Provided | |
| | Machine cable extension | 1S- □□ CBL-01 | Fixed type (For CR750 controller): □ Not provide □ 5m □ 10m □ 15m |
| | | 1S- □□ LCBL-01 | Flexed type (For CR750 controller): □ Not provide □ 5m □ 10m □ 15m |
| | | 1F- □□ UCBL-02 | Fixed type (For CR751 controller): □ Not provide □ 10m □ 15m □ 20m |
| | | 1F- □□ LUCBL-02 | Flexed type ((For CR751 controller): □ Not provide □ 10m □ 15m □ 20m |
| | Solenoid valve set | 1S-VD0 □ -01 1S-VD0 □ E-01 □ Not provide 1S-VD0 □ -01 (Sink type): □ 1set □ 2set □ 3set □ 4set 1S-VD0 □ E-01 (Source type): □ 1set □ 2set □ 3set □ 4set | |
| | Hand input cable | 1F-HC35C-02 □ Not provided □ Provided | |
| | Hand output cable | 1F-GR60S-01 □ Not provided □ Provided | |
| | Hand curl tube | 1N-ST0608C-01 □ Not provided □ Provided | |
| | External Wiring/Piping box | 1F-UT-BOX-01 □ Not provided □ Provided | |
| Internal Wiring/Piping for hand | 1F-HS604S-01 | □ Not provided □ Provided (For 350mm stroke) | |
| | 1F-HS604S-02 | □ Not provided □ Provided (For 450mm stroke) | |
| Controller | Simple teaching pendant | R32TB- □□ R33TB- □□ □ Not provided R32TB (CR750): □ 7m □ 15m R33TB (CR751): □ 7m □ 15m | |
| | Highly efficient teaching pendant | R56TB- □□ R57TB- □□ □ Not provided R56TB (CR750): □ 7m □ 15m R57TB (CR751): □ 7m □ 15m | |
| | Controller protection box | CR750-MB | CR750 : □ Not provided □ Provided |
| | | CR751-MB | CR751 : □ Not provided □ Provided |
| | RT ToolBox2 | 3D-11C-WINE □ Not provided □ Windows XP/Vista/7/8/8.1/10 English CD-ROM | |
| | RT ToolBox2 mini | 3D-12C-WINE □ Not provided □ Windows XP/Vista/7/8/8.1/10 English CD-ROM | |
| | MELFA-3D Vision 3.0 | 3F-53U-WINM □ Not provided □ Provided | |
| | Instructions manual | 5F-RB01-PE01 □ Not provided □ Provided () sets | |

Maintenance parts (Consumable parts)

| | |
|-------------------|--|
| Maintenance parts | □ Backup batteries ER6V () pcs. □ Backup batteries Q6BAT () pcs. □ Grease () cans |
|-------------------|--|

Robot selection check list

| | | | |
|----------------------|--|--|--|
| Work description | □ Material handling □ Assembly □ Machining L/UL □ Sealing □ Testing and inspection □ Other () | | |
| Workpiece mass () g | Hand mass () g | Atmosphere □ General environment, □ Clean □ Oil mist: Confirm oil proof □ request (Oil name:)/ □ not request ^{Note1)} □ Dusts (Please take measures such as a jacket), □ Chemicals (Please consult), □ Other () | |
| Remarks | | | |

Note1) Refer to Page 37, "2.2.8 Protection specifications" about oil resistance.

Appendix 5 : Specifications discussion material (RH-20FH series: Floor installation type)

■ Customer information

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

■ Purchased model

| Item | Type | Arm length | Stroke | Controller |
|------------------------|------------------|--------------|-------------|----------------|
| General specification | RH-20FH □□△△-Q | □ 850 □ 1000 | □ 350 □ 450 | □ CR750-20HQ-1 |
| | RH-20FH □□△△-1Q | | | □ CR751-20HQ-0 |
| Clean specification | RH-20FH □□△△C-Q | □ 850 □ 1000 | □ 350 □ 450 | □ CR750-20HQ-1 |
| | RH-20FH □□△△C-1Q | | | □ CR751-20HQ-0 |
| Oil mist specification | RH-20FH □□△△M-Q | □ 850 □ 1000 | □ 350 □ 450 | □ CR750-20HQ-1 |
| | RH-20FH □□△△M-1Q | | | □ CR751-20HQ-0 |

■ Shipping special specifications

| Item | Standard specification | Special shipping specifications |
|------------|---|--|
| Robot arm | Machine cable | □ 5m fixed type 2m fixed type: □ 1S-02UCBL-01 (For CR750 controller) □ 1F-02UCBL-02 (For CR751 controller) |
| | CE Marking specification | Not conforming with EMC directive. □ Not provided □ -S15 |
| Controller | Robot CPU unit connecting cable set ^{Note1)} | □ Not provided □ 5m □ 20m □ 30m: 2Q-RC-CBL □□ M |

Note1) The four type cables shown in below are contained. (Each cable length is the same.)

1)2Q-TUCBL □□ M, 2)2Q-DISPCBL □□ M, 3)2Q-EMICBL □□ M,

4)MR-J3BUS □□ M-A (5m, 20m) or MR-J3BUS □□ M-B (30m)

■ Options (Installable after shipment)

| item | Type | Provision, and specifications when provided. | |
|---------------------------------|--|---|--|
| Robot arm | J1 axis operating range change | 1F-DH-02 □ Not provided □ Provided | |
| | Machine cable extension | 1S- □□ CBL-01 | Fixed type (For CR750 controller): □ Not provide □ 5m □ 10m □ 15m |
| | | 1S- □□ LCBL-01 | Flexed type (For CR750 controller): □ Not provide □ 5m □ 10m □ 15m |
| | | 1F- □□ UCBL-02 | Fixed type (For CR751 controller): □ Not provide □ 10m □ 15m □ 20m |
| | | 1F- □□ LUCBL-02 | Flexed type ((For CR751 controller): □ Not provide □ 10m □ 15m □ 20m |
| | Solenoid valve set | 1S-VD0 □ -01 1S-VD0 □ E-01 □ Not provide 1S-VD0 □ -01 (Sink type): □ 1set □ 2set □ 3set □ 4set 1S-VD0 □ E-01 (Source type): □ 1set □ 2set □ 3set □ 4set | |
| | Hand input cable | 1F-HC35C-02 □ Not provided □ Provided | |
| | Hand output cable | 1F-GR60S-01 □ Not provided □ Provided | |
| | Hand curl tube | 1N-ST0608C-01 □ Not provided □ Provided | |
| External Wiring/Piping box | 1F-UT-BOX-01 □ Not provided □ Provided | | |
| Internal Wiring/Piping for hand | 1F-HS604S-01 | □ Not provided □ Provided (For 350mm stroke) | |
| | 1F-HS604S-02 | □ Not provided □ Provided (For 450mm stroke) | |
| Controller | Simple teaching pendant | R32TB- □□ R33TB- □□ □ Not provided R32TB (CR750): □ 7m □ 15m R33TB (CR751): □ 7m □ 15m | |
| | Highly efficient teaching pendant | R56TB- □□ R57TB- □□ □ Not provided R56TB (CR750): □ 7m □ 15m R57TB (CR751): □ 7m □ 15m | |
| | Controller protection box | CR750-MB | CR750: □ Not provided □ Provided |
| | | CR751-MB | CR751: □ Not provided □ Provided |
| | RT ToolBox2 | 3D-11C-WINE □ Not provided □ Windows XP/Vista/7/8/8.1/10 English CD-ROM | |
| | RT ToolBox2 mini | 3D-12C-WINE □ Not provided □ Windows XP/Vista/7/8/8.1/10 English CD-ROM | |
| | MELFA-3D Vision 3.0 | 3F-53U-WINM □ Not provided □ Provided | |
| Instructions manual | 5F-RB01-PE01 □ Not provided □ Provided () sets | | |

■ Maintenance parts (Consumable parts)

| | |
|-------------------|--|
| Maintenance parts | □ Backup batteries ER6V () pcs. □ Backup batteries Q6BAT () pcs. □ Grease () cans |
|-------------------|--|

■ Robot selection check list

| | | | |
|----------------------|--|--|--|
| Work description | □ Material handling □ Assembly □ Machining L/UL □ Sealing □ Testing and inspection □ Other () | | |
| Workpiece mass () g | Hand mass () g | Atmosphere □ General environment, □ Clean □ Oil mist: Confirm oil proof □ request (Oil name:)/ □ not request ^{Note1)} □ Dusts (Please take measures such as a jacket), □ Chemicals (Please consult), □ Other () | |
| Remarks | | | |

Note1) Refer to Page 37, "2.2.8 Protection specifications" about oil resistance.

Appendix 6 : Specifications discussion material (RH-3FHR series: Hanging installation type)

Customer information

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

Purchased model

| Item | Type | Arm length | Stroke | Controller |
|------------------------|-----------------|------------|--------|---------------|
| General specification | RH-3FHR3515-Q | ■ 350 | ■ 150 | CR750-03HRQ-1 |
| | RH-3FHR3515-1Q | | | CR751-03HRQ-0 |
| Clean specification | RH-3FHR3512C-Q | | ■ 120 | CR750-03HRQ-1 |
| | RH-3FHR3512C-1Q | | | CR751-03HRQ-0 |
| Oil mist specification | RH-3FHR3512W-Q | | | CR750-03HRQ-1 |
| | RH-3FHR3512W-1Q | | | CR751-03HRQ-0 |

Shipping special specifications

| Item | Standard specification | Special shipping specifications |
|------------|---|---|
| Robot arm | Machine cable <input type="checkbox"/> 5m fixed type | 2m fixed type: <input type="checkbox"/> 1S-02UCBL-01 (For CR750 controller) <input type="checkbox"/> 1F-02UCBL-02 (For CR751 controller) |
| Controller | Robot CPU unit connecting cable set ^{Note1)} <input type="checkbox"/> 10m | <input type="checkbox"/> Not provided <input type="checkbox"/> 5m <input type="checkbox"/> 20m <input type="checkbox"/> 30m: 2Q-RC-CBL <input type="checkbox"/> M |

Note1) The four type cables shown in below are contained. (Each cable length is the same.)

- 1)2Q-TUCBL M, 2)2Q-DISPCBL M, 3)2Q-EMICBL M,
- 4)MR-J3BUS M-A (5m, 20m) or MR-J3BUS M-B (30m)

Options (Installable after shipment)

| item | Type | Provision, and specifications when provided. | |
|------------|--|--|--|
| Robot arm | Stopper for changing the operating range | 1S-DH-05J1 1S-DH-05J2 | <input type="checkbox"/> Not provided <input type="checkbox"/> Provided <input type="checkbox"/> Not provided <input type="checkbox"/> Provided |
| | Machine cable extension | 1S- <input type="checkbox"/> CBL-01 | Fixed type (For CR750 controller): <input type="checkbox"/> Not provide <input type="checkbox"/> 5m <input type="checkbox"/> 10m <input type="checkbox"/> 15m |
| | | 1S- <input type="checkbox"/> LCBL-01 | Flexed type (For CR750 controller): <input type="checkbox"/> Not provide <input type="checkbox"/> 5m <input type="checkbox"/> 10m <input type="checkbox"/> 15m |
| | | 1F- <input type="checkbox"/> UCBL-02 | Fixed type (For CR751 controller): <input type="checkbox"/> Not provide <input type="checkbox"/> 10m <input type="checkbox"/> 15m <input type="checkbox"/> 20m |
| | | 1F- <input type="checkbox"/> LUCBL-02 | Flexed type ((For CR751 controller): <input type="checkbox"/> Not provide <input type="checkbox"/> 10m <input type="checkbox"/> 15m <input type="checkbox"/> 20m |
| | Solenoid valve set | 1S-VD04-05 1S-VD04E-05 | Standard specification: <input type="checkbox"/> Not provide <input type="checkbox"/> 1S-VD04-05 (Sink type) <input type="checkbox"/> 1S-VD04E-05(Source type) |
| | | 1S-VD04W-05 1S-VD04WE-05 | Clean/Waterproof specification: <input type="checkbox"/> Not provide <input type="checkbox"/> 1S-VD04W-05 (Sink type) <input type="checkbox"/> 1S-VD04WE-05(Source type) |
| | Hand input cable | 1S-HC00S-01 | <input type="checkbox"/> Not provided <input type="checkbox"/> Provided |
| | Hand output cable | 1S-GR35S-02 | <input type="checkbox"/> Not provided <input type="checkbox"/> Provided |
| | Hand tube | 1S-ST0304S | <input type="checkbox"/> Not provided <input type="checkbox"/> Provided |
| Controller | Simple teaching pendant | R32TB- <input type="checkbox"/> <input type="checkbox"/> R33TB- <input type="checkbox"/> <input type="checkbox"/> | <input type="checkbox"/> Not provided R32TB (CR750): <input type="checkbox"/> 7m <input type="checkbox"/> 15m R33TB (CR751): <input type="checkbox"/> 7m <input type="checkbox"/> 15m |
| | Highly efficient teaching pendant | R56TB- <input type="checkbox"/> <input type="checkbox"/> R57TB- <input type="checkbox"/> <input type="checkbox"/> | <input type="checkbox"/> Not provided R56TB (CR750): <input type="checkbox"/> 7m <input type="checkbox"/> 15m R57TB (CR751): <input type="checkbox"/> 7m <input type="checkbox"/> 15m |
| | Controller protection box | CR750-MB | CR750 : <input type="checkbox"/> Not provided <input type="checkbox"/> Provided |
| | | CR751-MB | CR751 : <input type="checkbox"/> Not provided <input type="checkbox"/> Provided |
| | RT ToolBox2 | 3D-11C-WINE | <input type="checkbox"/> Not provided <input type="checkbox"/> Windows XP/Vista/7/8/8.1/10 English CD-ROM |
| | RT ToolBox2 mini | 3D-12C-WINE | <input type="checkbox"/> Not provided <input type="checkbox"/> Windows XP/Vista/7/8/8.1/10 English CD-ROM |
| | MELFA-3D Vision 3.0 | 3F-53U-WINM | <input type="checkbox"/> Not provided <input type="checkbox"/> Provided |
| | Instructions manual | 5F-RP01-PE01 | <input type="checkbox"/> Not provided <input type="checkbox"/> Provided () sets |

Maintenance parts (Consumable parts)

| | |
|-------------------|---|
| Maintenance parts | <input type="checkbox"/> Backup batteries ER6V () pcs. <input type="checkbox"/> Backup batteries Q6BAT () 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"/> Oil mist: Confirm oil proof <input type="checkbox"/> request (Oil name:)/ <input type="checkbox"/> not request ^{Note1)} <input type="checkbox"/> Dusts (Please take measures such as a jacket.), <input type="checkbox"/> Chemicals (Please consult), <input type="checkbox"/> Other () |
| Remarks | | | |

Note1) Refer to Page 37, "2.2.8 Protection specifications" about oil resistance.



Product Service

EC-Statement of Compliance

No. E6 15 02 25554 053

Holder of Certificate: Mitsubishi Electric CorporationTokyo BILD., 2-7-3 Marunouchi,
Chiyoda-ku
Tokyo
100-8310 JAPAN**Name of Object: Industrial, Scientific and Medical
equipment
Industrial Robot****Model(s): F series
(See Attachment for Nomenclature)****Description of Object:** Rated Voltage: 230 VAC
Rated Power: 1.7 kW
Protection Class: I**Tested according to:** EN 61000-6-4/A1:2011
EN 61000-6-2:2005

This EC-Statement of Compliance is issued according to the Directive 2004/108/EC relating to electromagnetic compatibility. It confirms that the listed apparatus complies with such aspects of the essential requirements of the EMC directive as specified by the manufacturer or his authorized representative in the European Community and applies only to the sample and its technical documentation submitted to TÜV SÜD Product Service GmbH for testing and certification. See also notes overleaf.

Technical report no.: 73552066**Date,** 2015-02-10

(Johann Roidt)



TÜV SÜD Product Service GmbH is Notified Body to the Directive 2004/108/EC of the European Parliament and of the council with the identification number 0123.

Page 1 of 8

Attachment

Statement No.

E6 15 02 25554 053



Product Service

A: Model name of **F** series Robot description is shown as follows.

A1:RH-3FH,RH6FH,RH-2FH series 1.7kW

RH-x FH xx xx x - x x x-Sxx

(1) (2) (3) (4) (5) (6) (7) (8) (9) (10) (11)

(1)**RH**: Horizontal Robot

(2) Maximum Payload specification:

3 : 3kg **2** : 2kg

6 : 6kg

(3) **F** : **F** series robot

(4)**H** :4 joints

(5) Robot Arm length(No1 and No2 arm) specification:

35 : 350 mm arm **15** : 150 mm arm

45 : 450 mm arm

55 : 550 mm arm

(6) Z stroke length specification:

12 : 120 mm arm **25** : 250 mm arm

15 : 150 mm arm

20 : 200 mm arm

34 : 340 mm arm

(7) Dimension and Ambient specification:

M : Oil mist model(IP65)

C : Clean room model(ISO5)

[none] : Basic model(IP54)

(8) Type of Robot controller cabinet

[none] :CR750 controller

1 :CR751 controller

(9)Robot controller type:

D :Stand alone type

Q :iQ platform type

(10)Standard:

0: normal type

1:CE marking model

2:CE marking and UL model

(11)Optional Specification:

1 :normal type

SM :added cabinet box over Robot controller for oil mist resist

Sxx :Mechanical option

Attachment

Statement No.

E6 15 02 25554 053



Product Service

A2:RH-12FH,RH-20FHseries 1.7kW

RH-x FH xx xx x - x x x-Sxx

(1) (2) (3) (4) (5) (6) (7) (8) (9) (10) (11)

(1)RH: Horizontal Robot

(2) Maximum Payload specification:

12 : 12kg

20 : 20kg

(3) **F** : **F** series robot

(4)**H** :4 joints

(5) Robot Arm length(No1 and No2 arm) specification:

55 : 550 mm arm

70 : 700 mm arm

85 : 850 mm arm

100 : 1000 mm arm

(6) Z stroke length specification:

35 : 350 mm arm

45 : 450 mm arm

(7) Dimension and Ambient specification:

M : Oil mist model(IP65)

C : Clean room model(ISO3)

N : Special spec. For EU(IP54)

[none]: Basic model(IP20)

(8) Type of Robot controller cabinet

[none] :CR750 controller

1 :CR751 controller

(9)Robot controller type:

D :Stand alone type

Q :iQ platform type

(10)Standard:

0: normal type

1:CE marking model

2:CE marking and UL model

(11)Optional Specification:

1 :normal type

SM :added cabinet box over Robot controller for oil mist resist

Sxx :Mechanical option

Attachment

Statement No.

E6 15 02 25554 053



Product Service

A3:RV-2Fseries 1.7kW

RV-x F x x - x x x-Sxx

(1) (2) (3) (4)(5) (6)(7) (8) (9)

(1) **RV**: Vertical Robot

(2) Maximum Payload specification:

2 : 2kg

(3) **F** : **F** series robot

(4) Robot Joint type

B : All axes have brake units.

[none] : J4 axis doesn't have brake unit.

(5) Robot Arm length

L : Long Arm model

[none] : normal model

(6) Type of Robot controller cabinet

[none] : CR750 controller

1 : CR751 controller

(7) Robot controller type:

D : Stand alone type

Q : iQ platform type

(8) Standard:

0: normal type

1: CE marking model

2: CE marking and UL model

(9) Optional Specification:

1 : normal type

SM : added cabinet box over Robot controller for oil mist resist

Sxx : Mechanical option

Attachment

Statement No.

E6 15 02 25554 053



Product Service

A4:RV-4F,7Fseries 1.7kW

RV-x F x x x - x x x - Sxx

(1) (2) (3) (4)(5) (6) (7) (8) (9) (10)

(1) **RV**: Vertical Robot

(2) Maximum Payload specification:

4 : 4kg

7 : 7kg

(3) **F** : **F** series robot

(4) Robot axes:

J : 5 axes model

[none]: normal model

(5) Robot arm length:

L : Long arm model

[none]: normal model

(6) Dimension and Ambient specification:

M : Oil mist model(IP67)

C : Clean room model(ISO3)

[none] : Basic model(IP40)

(7) Type of Robot controller cabinet

[none] :CR750 controller

1 :CR751 controller

(8)Robot controller type:

D :Stand alone type

Q :iQ platform type

(9)Standard:

0: normal type

1:CE marking model

2:CE marking and UL model

(10)Optional Specification:

1 :normal type

SM :added cabinet box over Robot controller for oil mist resist

SH :Internal tube and wires are extended to J6 axis.

Sxx :Mechanical option

Attachment

Statement No.

E6 15 02 25554 053



Product Service

A5:RV-13F,20F,7FLLseries 1.7kW

RV-x F x x - x x x-Sxx

(1) (2) (3) (4) (5) (6) (7) (8) (9)

(1) **RV**: Vertical Robot

(2) Maximum Payload specification:

13 : 13kg **20** : 20kg

7 : 7kg

(3) **F** : **F** series robot

(4) Robot arm length:

L : Long arm model

LL : Long reach(1503mm) model (for onlyRV-7FLL series)

[none]: normal model

(5) Dimension and Ambient specification:

M : Oil mist model(IP67)

C : Clean room model(ISO3)

[none] : Basic model(IP40)

(6) Type of Robot controller cabinet

[none] :CR750 controller

1 :CR751 controller

(7)Robot controller type:

D :Stand alone type

Q :iQ platform type

(8)Standard:

0: normal type

1:CE marking model

2:CE marking and UL model

(9)Optional Specification:

1 :normal type

SM :added cabinet box over Robot controller for oil mist resist

SH :Internal tube and wires are extended to J6 axis.

Sxx :Mechanical option

Attachment

Statement No.

E6 15 02 25554 053



Product Service

A6:RH-1FHR,RH-3FHR series 1.7kW

RH-x F HR xx xx x - x x x-Sxx

(1) (2) (3) (4) (5) (6) (7) (8) (9) (10) (11)

(1) **RH**: Horizontal Robot

(2) Maximum Payload specification:

1 : 1kg

3 : 3kg

(3) **F** : **F** series robot

(4) **HR** : 4 joints ,reverse mount model

(5) Robot Arm length(No1 and No2 arm) specification:

35 : 350 mm arm **75** : 750 mm arm

55 : 550 mm arm

(6) Z stroke length specification:

12 : 120 mm arm

15 : 150 mm arm

(7) Dimension and Ambient specification:

W : Water proof model

M : Oil mist model

C : Clean room model(ISO5)

[none] : Basic model(IP54)

(8) Type of Robot controller cabinet

[none] :CR750 controller

1 :CR751 controller

(9)Robot controller type:

D :Stand alone type

Q :iQ platform type

(10)Standard:

0: normal type

1:CE marking model

2:CE marking and UL model

(11)Optional Specification:

1 :normal type

SM :added cabinet box over Robot controller for oil mist resist

Sxx :Mechanical option

Attachment

Statement No.

E6 15 02 25554 053



Product Service

B: Model name of **F** series Robot controller description is shown as follows.

CR750- xx x x x - x - x - Sxx

(1) (2) (3) (4) (5) (6) (7) (8)

(1) **CR750**: CR750 controller

CR751: CR751 controller

(2) Maximum Payload specification:

01 : 1kg

03 : 3kg

06 : 6kg

12 : 12kg

20 : 20kg

02 : 2kg

04 : 4kg

07 : 7kg

13 : 13kg

(3) Robot type

H : Horizontal robot

HR : Horizontal robot(reverse mount)

V : Vertical robot

VJ : 5 axes Vertical robot

VL : for only RV-7FLL series

(4) Robot controller type

D : stand alone

Q : iQ platform type

(5) Standard

1 : CE marking model

2 : CE marking and UL model

(6) Operation Panel

[none] : No panel type

1 : Panel type

(7) Power input connector type

[none] : normal type

P2 : Added cable with a connector and a terminal

P3 : Added cable with a connector and a terminal block

(8) Optional Specification

[none] : normal

SM : Added Cabinet box over robot controller for oil mist resist

Sxx : mechanical option

사용자안내문 User's Guide

| 기종별 Type of Equipment | 사용자안내문 User's Guide |
|--|---|
| <p>A 급 기기 (업무용 방송통신기자재)</p> <p>Class A Equipment (Industrial Broadcasting & Communication Equipment)</p> | <p>이 기기는 업무용(A 급) 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.</p> <p>This equipment is Industrial (Class A) electromagnetic wave suitability equipment and seller or user should take notice of it, and this equipment is to be used in the places except for home.</p> |
| <p>B 급 기기 (가정용 방송통신기자재)</p> <p>Class B Equipment (For Home Use Broadcasting & Communication Equipment)</p> | <p>이 기기는 가정용(B 급) 전자파적합기기로서 주로 가정에서 사용하는 것을 목적으로 하며, 모든 지역에서 사용할 수 있습니다.</p> <p>This equipment is home use (Class B) electromagnetic wave suitability equipment and to be used mainly at home and it can be used in all areas.</p> |

MITSUBISHI ELECTRIC CORPORATION

HEAD OFFICE: TOKYO BUILDING, 2-7-3, MARUNOUCHI, CHIYODA-KU, TOKYO 100-8310, JAPAN
NAGOYA WORKS: 5-1-14, YADA-MINAMI, HIGASHI-KU NAGOYA 461-8670, JAPAN

Authorised representative:

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