MITSUBISHI

Mitsubishi Industrial Robot

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

Special Specifications Manual
(CR750-Q Controller)

MELFA

BFP-A8882-N

⚠ Safety Precautions

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

⚠ CAUTION

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

⚠ CAUTION

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

⚠ WARNING

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

⚠ CAUTION

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

⚠ WARNING

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

⚠ CAUTION

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

⚠ CAUTION

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

⚠ CAUTION

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

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

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

⚠ CAUTION

Do not stop the robot or apply emergency stop by turning the robot controller's main power OFF. If the robot controller main power is turned OFF during automatic operation, the robot accuracy could be adversely affected. Moreover, it may interfere with the peripheral device by drop or move by inertia of the arm.

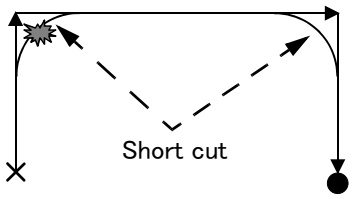
⚠ CAUTION

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.

⚠ 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.



Arch movement (example)

(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	・First print.
2012-06-11	BFP-A8882-A	・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	・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	・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	・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	・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	・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	・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	・The user's guide of KC mark was added.
2012-11-20	BFP-A8882-J	・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	・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	・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	・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.

■ 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.
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 10, "2 Robot arm", the specifications related to the controllerPage 99, "3 Controller", and software functions and a command list Page 140, "4 Software" separately.

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

*RH-6FH (CR750-Q controller) series
*RH-12FH (CR750-Q controller) series
*RH-20FH (CR750-Q controller) 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 159, "6.4 EMC installation guideline".
Please refer to it and carry out the measures against EMC of the automization system of the customer.

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1 General configuration

1.1 Structural equipment

Structural equipment consists of the following types.

1.1.1 Standard structural equipment

The following items are enclosed as a standard.

(1) Robot arm
(2) Controller (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

RH - ◇◇ FH □□ △△ ○ - ● Q ▲ - SMxx

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

(a). RH.....Indicates the horizontal multiple-joint robot.
Ex.)
RV: Vertical multiple-joint type.
RH: Horizontal multiple-joint type.

(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

(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.)

1.2.2 Combination of the robot arm and the controller

Table 1-1 : Combination of the robot arm and the controller

Protection specification	Robot arm	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 (CR750-MB).

1.3 CE marking specifications

The robot shown in the Table 1-2 is the CE Marking specification.

Table 1-2 : Robot models with CE marking specifications

Robot type Note1)	Controller	External signal logic	Language setting
RH-6FHxxyy-Q1-S15 Note2)	CR750-06HQ1-1-S15 Note3)	Source type	English (ENG)
RH-6FHxxyyC-Q1-S15 Note4)			

Note1) The "xx" indicate the arm length, "yy"indicate J3-axis stroke.
Note2) This robot's protection specification is IP54. Although bellows are not installed at the shaft, please give the dealer an order if needed. As long as there is no special description, refers to the details of RH-6FHxxyyM (oil-mist specification).
Note3) The specification and the handling method of the controller are the same as standard type controller CR750-06HD-1.
Note4) This robot is the clean specification. As long as there is no special description, refers to the contents of RH-6FHxxyyC (clean 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.

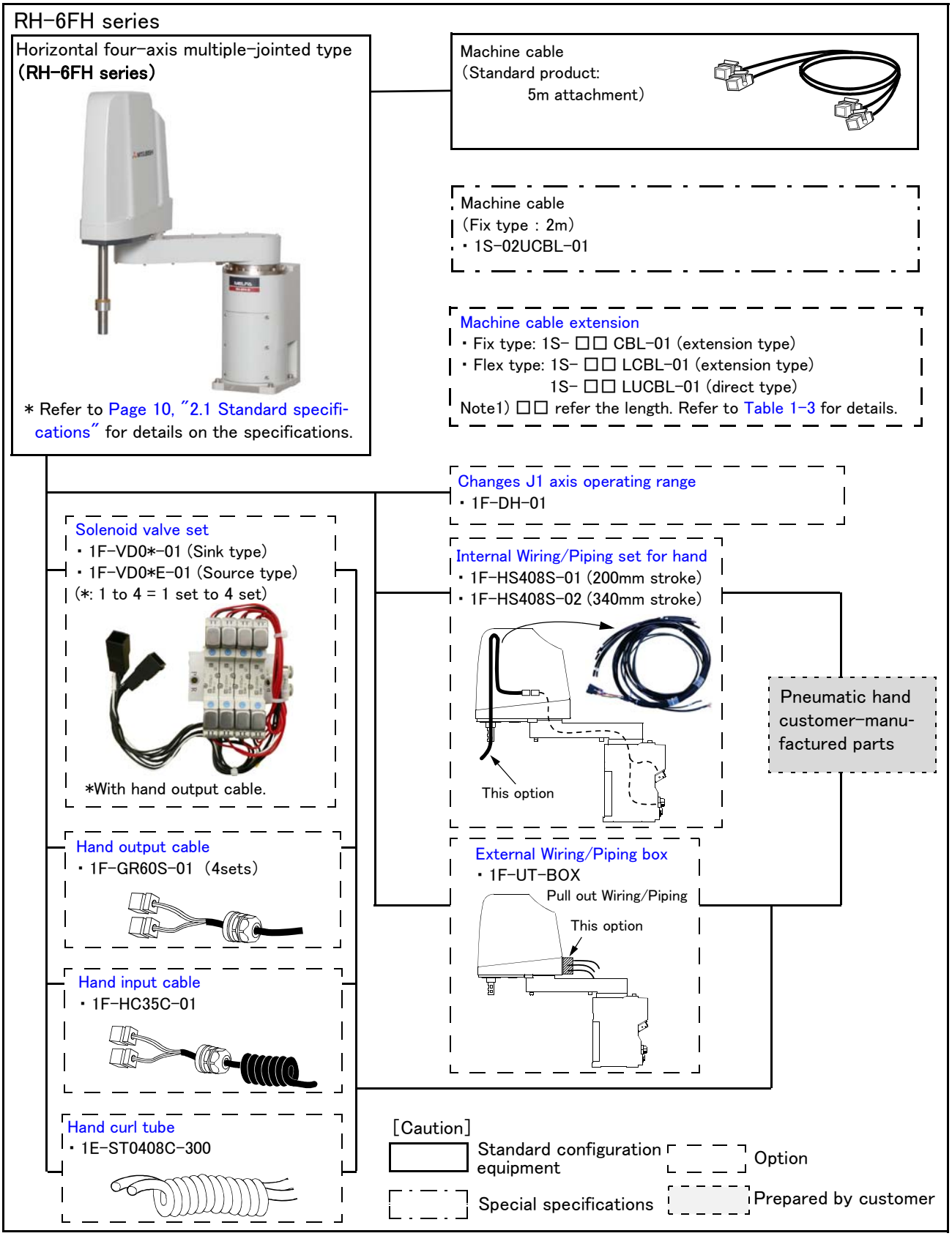


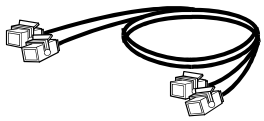
Fig.1-1 : Structural equipment (RH-6FH series)

RH-12FH/20FH series

Horizontal four-axis multiple-jointed type
(RH-12FH/20FH series)

* Refer to Page 10, "2.1 Standard specifications" for details on the specifications.

Machine cable
(Standard product:
5m attachment)

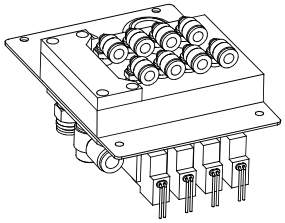


Machine cable
(Fix type : 2m)
・1S-02UCBL-01

Machine cable extension
Fix type:1S- ☐☐ CBL-01
Flex type:1S- ☐☐ LCBL-01
Note1) ☐☐ refer the length. Refer to Table 1-3 for details.
Note2) Connect the extension cables to the arm side of the standard cable to extend.

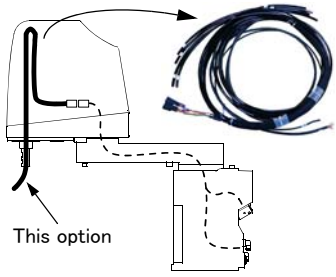
Changes J1 axis operating range
・1F-DH-02

Solenoid valve set
・1S-VD0*-01 (Sink type)
・1S-VD0*E-01 (Source type)
(*: 1 to 4 = 1 set to 4 set)



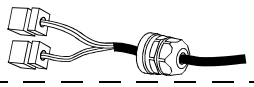
* With hand output cable.

Internal Wiring/Piping set for hand
・1F-HS604S-01(350mm stroke)
・1F-HS604S-02(450mm stroke)

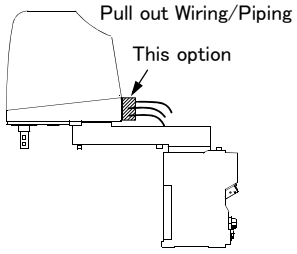


Pneumatic hand
customer-manufactured parts

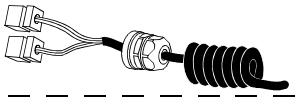
Hand output cable
・1F-GR60S-01 (4sets)



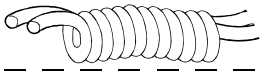
External Wiring/Piping box
・1F-UT-BOX-01



Hand input cable
・1F-HC35C-02



Hand curl tube
・1N-ST0608C-01



[Caution]
Standard configuration equipment
Option
Special specifications
Prepared by customer

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

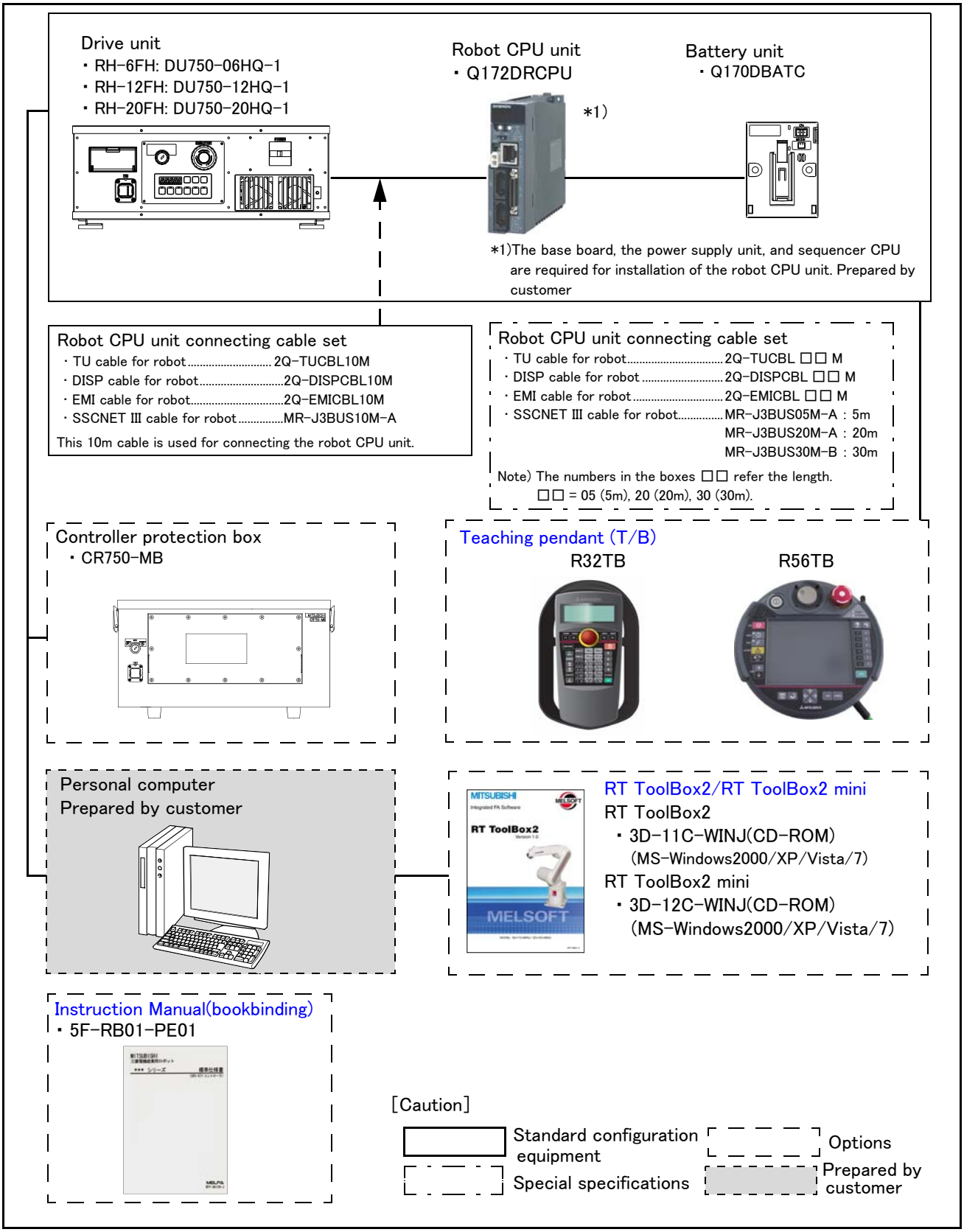


Fig.1-3 : Structural equipment

1.7 Contents of the Option equipment and special specification

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

Table 1-3 : The list of Option equipment and special specification

Item	Type	Specifications	Classification Note1)	Description
Stopper for changing the operating range (J1 axis)	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
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)
Extended machine cable	1S- □□ CBL-01	For fixing (Set of power and signal) Extension type	○	5、10、15m
	1S- □□ LCBL-01	For flexing (Set of power and signal) Extension type	○	
	1S- □□ LUCBL-01	For flexing (Set of power and signal) Direct type	○	
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-VD0*-01: Sink type 1F-VD0*E-01: Source type
	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-VD0*-01: Sink type 1S-VD0*E-01: Source type
	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)	○	
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
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.
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.:Φ6x4	○	Curl type air tube For RH-12FH/20FH 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.:Φ4x8	○	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 (eight points) + φ4 eight hoses	○	Wiring/Piping to pass in the shaft For RH-6FH series (200mm stroke)
	1F-HS408S-02	Hand input (eight points) + φ4 eight hoses	○	Wiring/Piping to pass in the shaft For RH-6FH series (340mm stroke)
	1F-HS604S-01	Hand input (eight points) + φ6 four hoses	○	Wiring/Piping to pass in the shaft For RH-12FH/20FH series (350mm stroke)
	1F-HS604S-02	Hand input (eight points) + φ6 four hoses	○	Wiring/Piping to pass in the shaft For RH-12FH/20FH series (450mm stroke)
Simple teaching pendant	R32TB	Cable length 7m	○	With 3-position enable switch IP65
	R32TB-15	Cable length 15m	○	
Highly efficient teaching pendant	R56TB	Cable length 7m	○	
	R56TB-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.

Item	Type	Specifications	Classification Note1)	Description
RT ToolBox2 (Personal computer Support software)	3D-11C-WINE	CD-ROM	○	MS-Windows2000/XP/Vista/7 (With the simulation function)
RT ToolBox2 mini (Personal computer Support software mini)	3D-12C-WINE	CD-ROM	○	MS-Windows2000/XP/Vista/7
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 05, 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	○	

Note1) ○ : option, □ : special specifications.

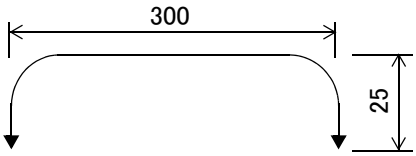
2 Robot arm
2.1 Standard specifications
2.1.1 Basic specifications

(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 (N)	3		
	Maximum		6		
Z axis pressing force [Note6]	Maximum	N	165		
Allowable inertia	Rating	$kg \cdot m^2$	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		℃	0 to 40		
Mass		k	36		37
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) [Note8]		
Tool pneumatic pipes			Primary: ϕ6 x two hoses, Secondary: ϕ4 x eight hoses [Note9]		
Supply pressure		MPa	0.5±10%		
Protection specification [Note10]			Standard specification: IP20 Clean specification: ISO class 3 [Note11] Oil mist specification: IP65 [Note12] [Note13] CE Marking specification: IP54 [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 16, "2.2.1 Pose repeatability".
Note8) The 8-wire cable designated for LAN wiring can also be used for backup wiring.
Note9) The ϕ4 secondary piping can be obtained with the electromagnetic valve (option). Details regarding the electromagnetic valve (optional) are shown on Page 84, "(3) Solenoid valve set".
Note10) The protection specification details are given in Page 25, "2.2.7 Protection specifications".
Note11) The details of the clean specifications are described in Page 27, "2.2.8 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 ϕ8 joint is prepared at the base rear part for suction.
The protection specification details are given in Page 25, "2.2.7 Protection specifications".
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.
Note14) Please contact dealer since the environmental resistance may not be secured depending on the characteristics of oil you use. (IP54 of the CE specifications prevent direct jet to the shaft.) Mounting a bellows to the shaft tip makes the protection degree compliant with IP65. However, avoid direct jet to the bellows. For the method to mount the bellows, consult with the dealer.

(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 (N)	3		
	Maximum		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		℃	0 to 40		
Mass		kg	65	67	69
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) [Note7]		
Tool pneumatic pipes			Primary: ϕ6 x two hoses, Secondary: ϕ4 x eight hoses [Note8]		
Supply pressure		MPa	0.5±10%		
Protection specification [Note9]			Standard specification: IP20 Clean specification: ISO class 3 [Note10] Oil mist specification: IP65 [Note11] [Note12]		
Painting color			Light gray (Equivalent to Munsell: 0.6B7.6/0.2)		

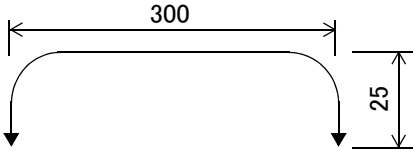
Note1) The table is joint writing on the general environment and clean and oil mist (IP65) specification. If the type ends in a letter C, this corresponds to the clean specification, and where it ends in a letter M, it corresponds to the mist specification. The type in which operating range of J3 axis (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 16, "2.2.1 Pose repeatability".

Note7) The 8-wire cable designated for LAN wiring can also be used for backup wiring.

Note8) The φ4 secondary piping can be obtained with the electromagnetic valve (option). Details regarding the electromagnetic valve (optional) are shown on Page 84, "(3) Solenoid valve set".

Note9) The protection specification details are given in Page 25, "2.2.7 Protection specifications".

Note10) The details of the clean specifications are described in Page 27, "2.2.8 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 60-140 L/min. A φ8 joint is prepared at the base rear part for suction.

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

Note12) 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

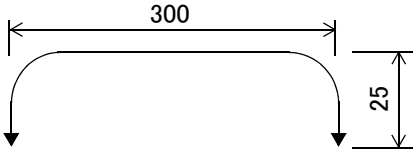
Item		Unit	Specifications	
Type[Note1]			RH-20FH8535/8545 RH-20FH8535C/8545C RH-20FH8535M/8545M	RH-20FH10035/10045 RH-20FH10035C/10045C RH-20FH10035M/10045M
Environment			Blank: Standard specification C: Clean specification M: Oil mist specification	
Installation posture			On floor	
Degree of freedom			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 (N)	5	
	Maximum		20	
Z axis pressing force [Note5]	Maximum	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		℃	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) [Note8]	
Tool pneumatic pipes			Primary: ϕ6 x two hoses, Secondary: ϕ4 x eight hoses [Note9]	
Supply pressure		MPa	0.5±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) 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 17, "2.2.2 Rated load (mass capacity)".
Note7) The pose repeatability details are given in Page 16, "2.2.1 Pose repeatability".
Note8) The 8-wire cable designated for LAN wiring can also be used for backup wiring.
Note9) The ϕ4 secondary piping can be obtained with the electromagnetic valve (option). Details regarding the electromagnetic valve (optional) are shown on Page 84, "(3) Solenoid valve set".
Note10) The protection specification details are given in Page 25, "2.2.7 Protection specifications".
Note11) The details of the clean specifications are described in Page 27, "2.2.8 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 60-140 L/min. A ϕ8 joint is prepared at the base rear part 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.

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 2-4 : 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

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 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

2.2.2 Rated load (mass capacity)

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

(1) The tooling should have the value less or equal than the smaller of the tolerable inertia and the tolerable moment found in Page 10, "2.1.1 Basic specifications".

(2) Fig. 2-1 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. 2-1 to Fig. 2-3, when loading mass is maximum (RH-6FH: 6kg, RH-12FH: 12kg, RH-20FH: 20kg).

(3) Even if the load is force, not the mass, design the tooling so that moment does not exceed the allowable moment. Refer to Page 10, "2.1 Standard specifications" for details of allowable moment value.

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

[Caution] The overhang amount of the load, 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 19, "2.2.3 Relationships Among Mass Capacity, Speed, and Acceleration/Deceleration Speed" in detail. When the load center-of-gravity position separate from the center of shaft (RH-6FH: more than 140mm, RH-12FH: more than 150mm, RH-20FH: more than 120mm), an overload alarm may occur depending on the posture. In this case, please reduce acceleration and deceleration (Accel command) speeds and movement speed (Ovrd 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.

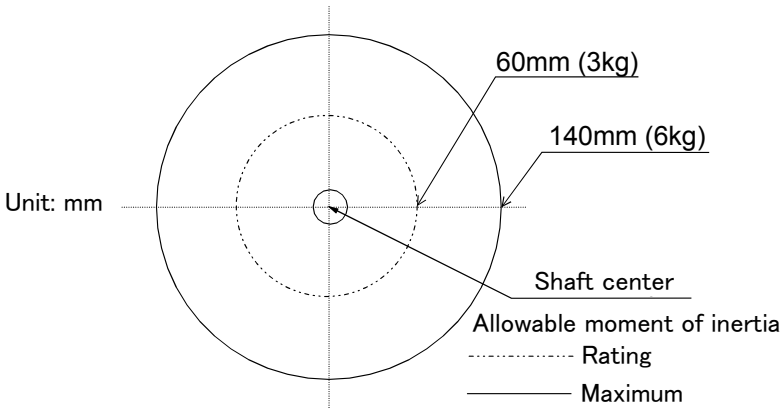


Fig.2-1 : Position of center of gravity for loads (for loads with comparatively small volume): RH-6FH series

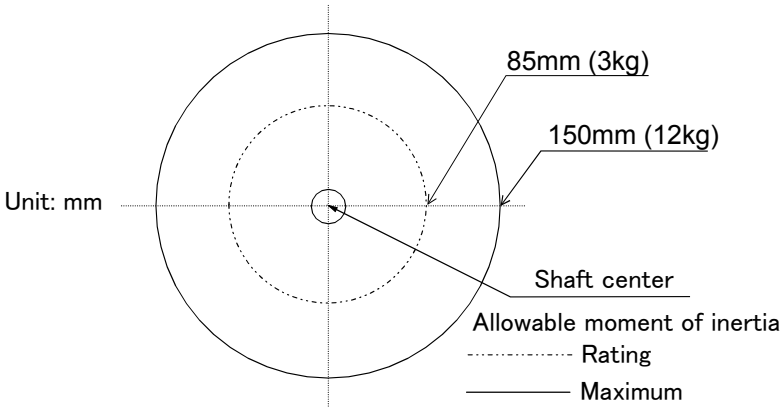


Fig.2-2 : Position of center of gravity for loads (for loads with comparatively small volume): RH-12FH series

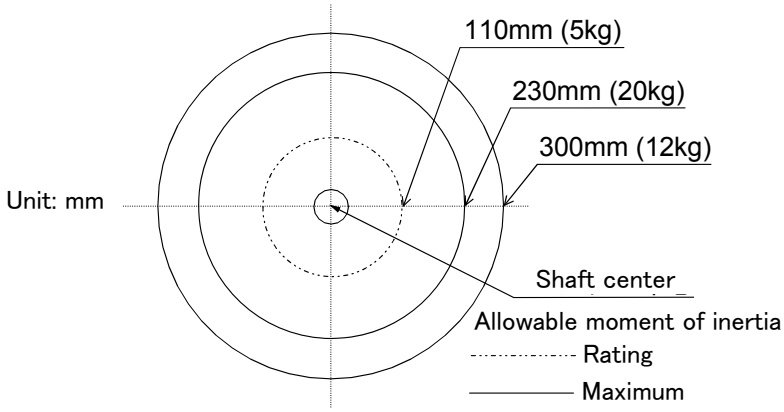


Fig.2-3 : Position of center of gravity for loads (for loads with comparatively small volume): RH-20FH series

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".

<Factor 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

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 19, "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. 2-4).

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

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

RH-20FH series: 5kg or less

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

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

RH-20FH series: 5kg or heavier

[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.

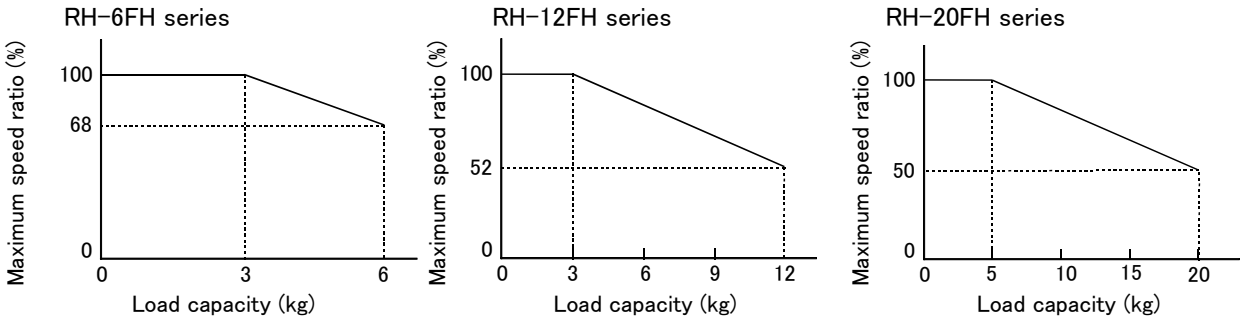


Fig.2-4 : Automatic compensation of speed

(2) Relationship Between Height of Shaft (J3 Axis) and Acceleration/Deceleration Speed

A function to optimize the acceleration/deceleration speed according to the height of the shaft (Refer to Fig. 2-5, Fig. 2-6) will be activated. This function is invalid if the shaft (axis J3) operates at a position above P3 in Fig. 2-5. Acceleration/deceleration is compensated for at a position below P3 in Fig. 2-5 if the position of the center of gravity of the load is located at the front edge of the shaft.

This function contains both a standard acceleration and deceleration pattern and a high acceleration and deceleration pattern, both of which can be selected in the parameters. The original settings are set to the standard acceleration and deceleration pattern, which enables operation while keeping vibration at the shaft tip (including residual vibration) to a minimum. Users are also able to select the high acceleration and deceleration pattern and operate the robot at high speed. When doing so, users should make sure that additional vibration will not have a negative impact on work carried out by the robot. Where necessary the pattern should be changed, allowing the robot to be used in the most effective way.

The relevant parameter names and their set values are shown below. For more details about parameters and how to change them, please refer to the separate "Instruction Manual/Detailed Explanation of Functions and Operations".

Parameter name.....MAPMODE (acceleration and deceleration optimization pattern selected)

Set value and function.....0: Standard acceleration and deceleration pattern (original setting)

1: High acceleration and deceleration pattern

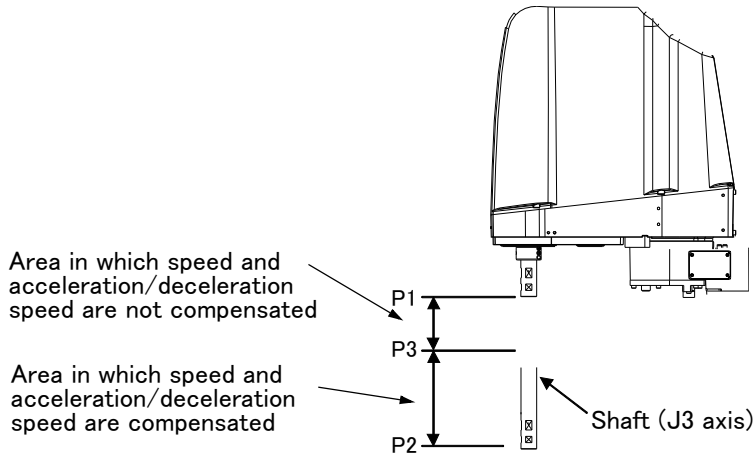


Fig.2-5 : Area in which acceleration/deceleration speed is compensated

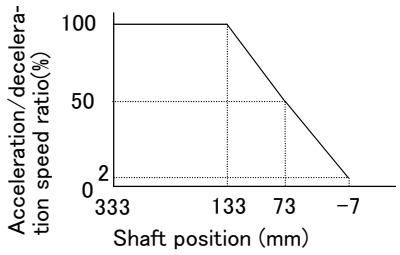
Table 2-5 : Area in which acceleration/deceleration speed is compensated

Type	J3 axis stroke (mm)			Compensation area (P2 to P3)
	Stroke length	P1(Upper end)	P2(Lower end)	
RH-6FH series Note1)	340	333	-7	-7 to 133
RH-12FH/20FH series	350	340	-10	-10 to 240
	450	340	-110	-110 to 155

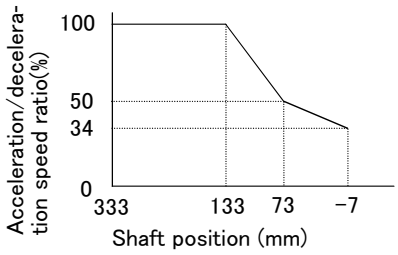
Note1) When stroke of J3 axis is 200mm this function is not operate.

RH-6FH series

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

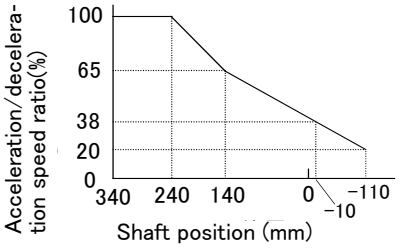


J3 axis (Z) stroke 340mm
(High acceleration and deceleration rate)

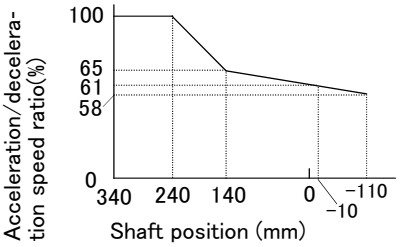


RH-12FH series

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

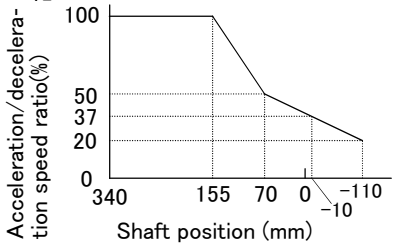


J3 axis (Z) stroke 350/450mm
(Standard Acceleration/deceleration speed)



RH-20FH series

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



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

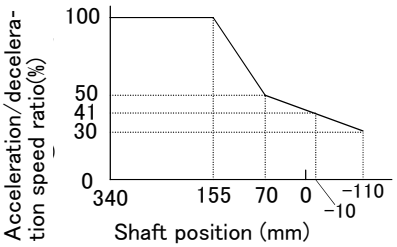


Fig.2-6 : Automatic compensation of acceleration/deceleration speed

(3) Relation between offset length and the maximum speed

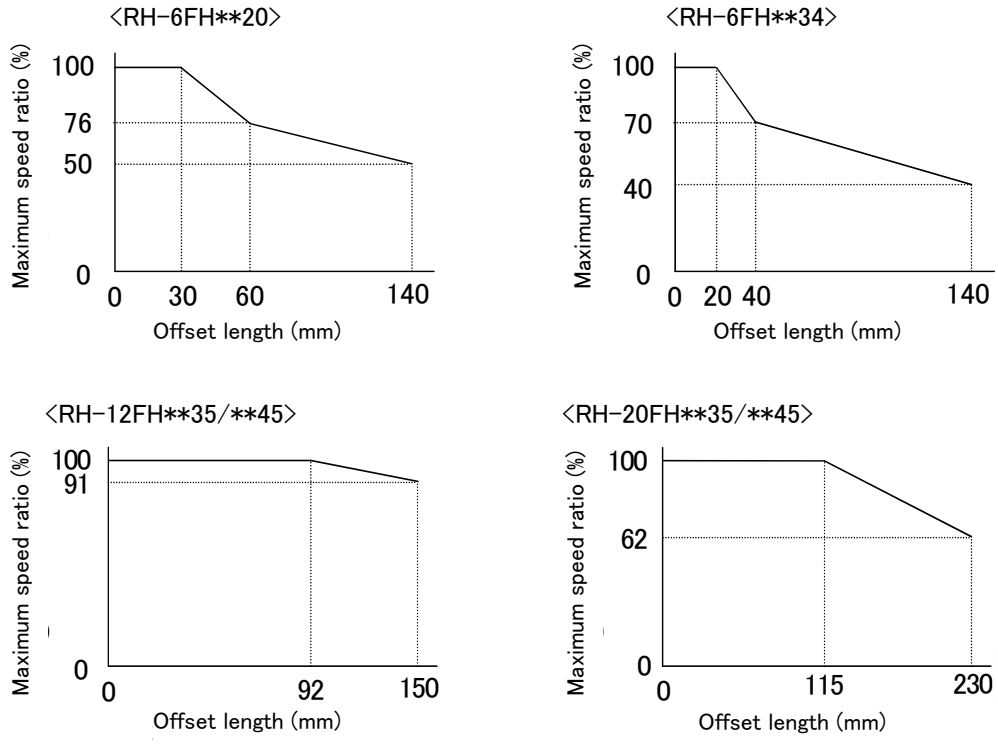


Fig.2-7 : Relationship of the offset length and maximum velocity

[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. 2-8).

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. 2-8).

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.

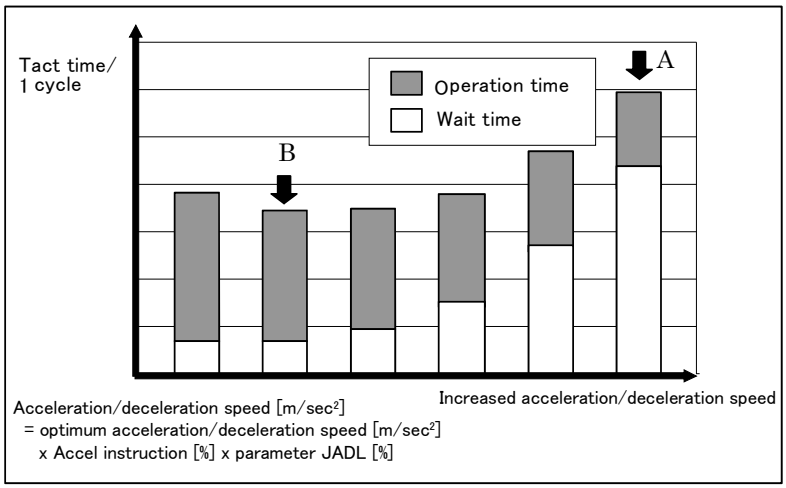


Fig.2-8 : Relationship between Acceleration/deceleration Speed and Tact Time (Conceptual Drawing)

(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. 2-9.)

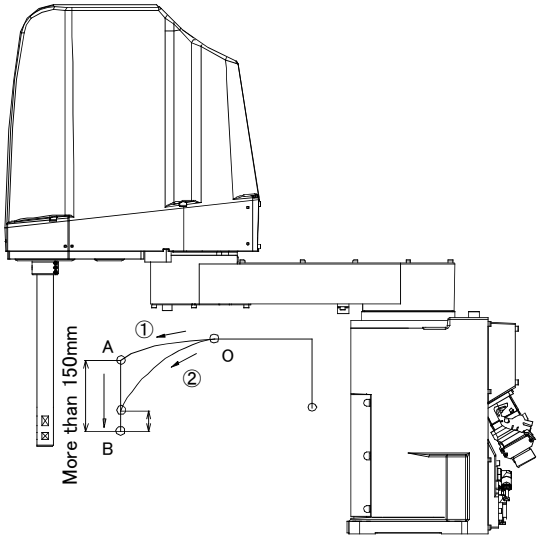


Fig.2-9 : Recommended path when positioning at the bottom edge of the Z axis

2.2.6 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 2-6 : Factory-shipments condition

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

2.2.7 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 2-7.
Even oil mist environment can be used in addition to the general environment.

Table 2-7 : Protection specifications and applicable fields

Type	Protection specifications (IEC Standards value)	Classification	Applicable field	Remarks
RH-6FHxx20/xx34 RH-12FHxx35/xx45 RH-20FHxx35/xx45	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-6FHxx20-S15/xx34-S15	Robot arm: IP54 (Direct jet flow to the bellows section is not included.)	CE marking 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.

Note1) The "-SM" specification comes with the controller protection box (CR750-MB) 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 2-7.

The IEC IP symbols define the degree of protection against solids and fluids, and do not indicate a protective structure against the entry of oil or water.
The IEC standard is described by the following "Information" And, the corrosion of the rust etc. may occur to the robot with the liquids, such as the water and the oil.

【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 kg±10%, from going through the opening in the outer sheath of the supplied equipment.

- The IEC IP54

  The IEC IP54 standard refers to protection structure designed to prevent any harmful effects by fresh water scattering vertically onto the testing equipment in a radius of 180 degrees from a distance of 300 to 500 mm, with 10 ± 0.5 liters of water every minute, at a water pressure of 80 to 100kPa, covering the entire area of the robot with the exception of the installation section at 1 ㎡ per minute, for a total of 5 minutes or more.

- The IEC IP65

  Protection against water infiltration as specified in IP65 indicates a protective structure that is not harmfully affected when 12.5±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 ϕ8 joint (AIR PURGE) to supply dry air for pressurizing. The ϕ8 joint (AIR PURGE) can be found at the base rear part of the robot arm.

Table 2-8 : 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 2-9 provides guidelines for replacing the packing.

Table 2-9 : 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 157, "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 2-8.

2.2.8 Clean specifications

(1) Types of clean specifications

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

Table 2-10 : Clean specifications

Type	Degree of cleanliness	Internal suction	Remarks
RH-6FHxx20C/xx34C RH-12FHxx35C/xx45C RH-20FHxx35C/xx45C	ISO class 3 Note1)	・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.

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 φ8 joint is prepared at the rear of the base for suction.

■ Precautions for use

1) A φ8 VACUUM coupling is provided in the base section of the robot arm for vacuum inside the robot arm. (Refer to Fig. 2-48) When using the robot, connect this coupling with the vacuum generating valve (Refer to Table 2-11) 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 2-11 : Specifications of vacuum generation valve (Confirmed in our company)

Type	Maker	Air pressure Note1)	Quantity
MEDT 14	KONEGAI CORPORATION	・Vacuum rate: 90.0 L/min(ANR)	RH-6FH series : 1 RH-12FH/20FH series : 2

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 and of RH-12FH/20FH series: 60-140L/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 VACUUME couplings. Please be sure to suck in using both of couplings.

3) Remove the CONBOX cover on the robot arm rear and install the attached ventilation duct (refer to Fig. 2-10). 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 flowing 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)

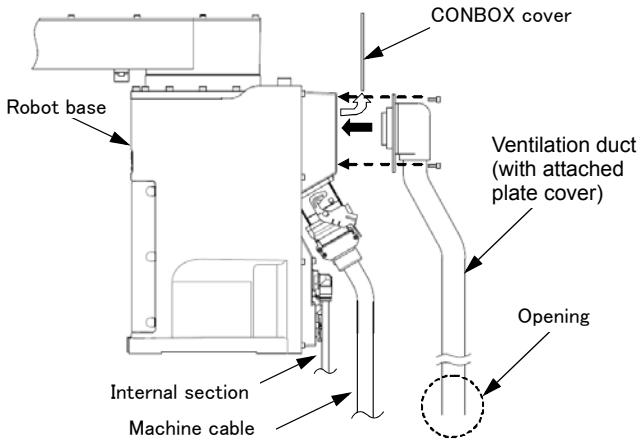
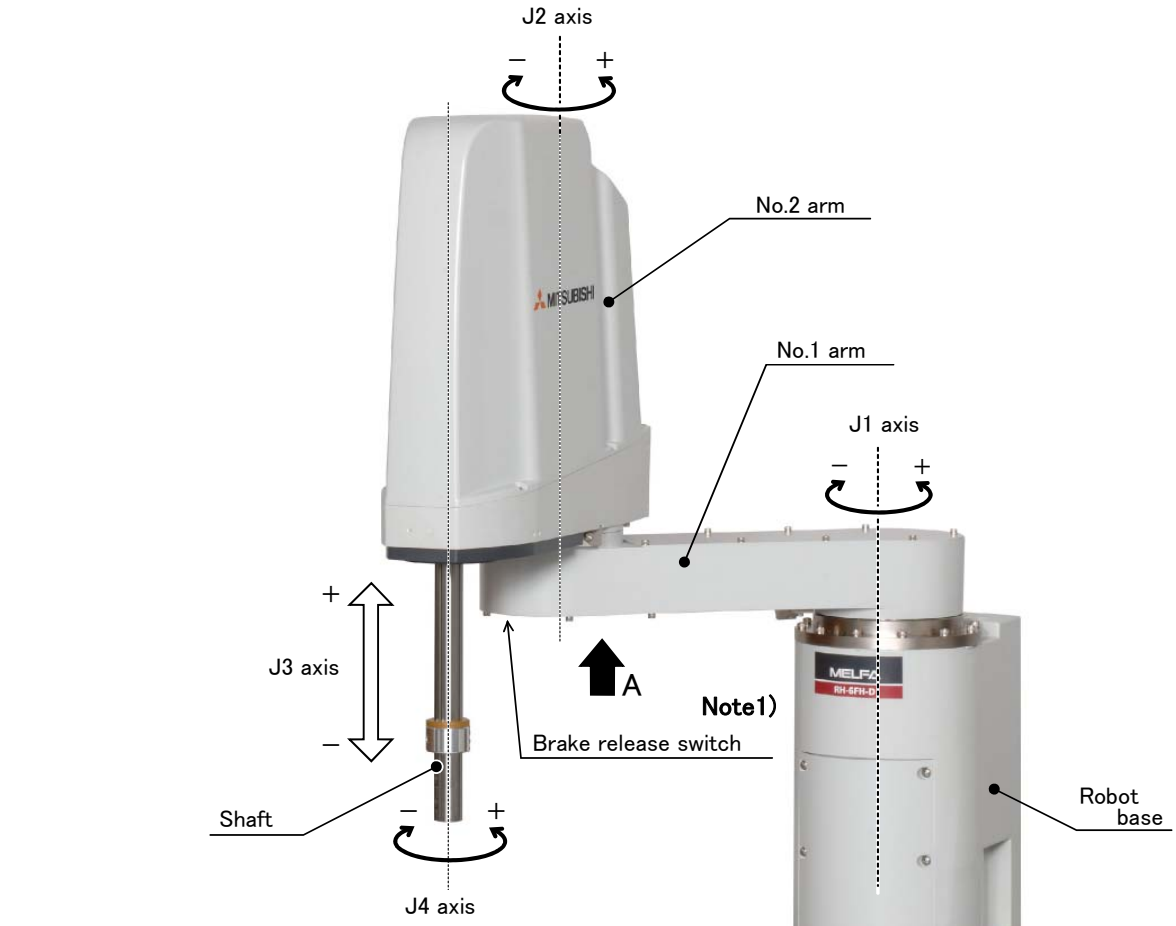


Fig.2-10 : Installation of Exhaust Duct

4) When using the optional electromagnetic valve set, we recommend using the primary piping's spare piping (φ6 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



Brake release switch

View A

Note 1) The operation method of the brake release switch.
The brake of J3 axis can be released with this switch and the enabling switch of T/B. The brake is released in an off-and-on way.
Please be sure to perform brake release operation by two-person operations. Always assign an operator other than the switch operator to prevent the arm from dropping. This operation must be carried out with the switch operator giving signals.

⚠ CAUTION When releasing the brake the J3 axis will drop. Be sure to perform brake release operation by two-person operations.

(1) One person supports so that the J3 axis may not drop.
(2) The one more person pushes the brake release switch of the robot arm, in the condition that the enabling switch of T/B is turned on. Only when both switches are pressed, the brake is released in an off-and-on way.

Fig.2-11 : Names of each part of the robot

2.4 Outside dimensions・Operating range diagram

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

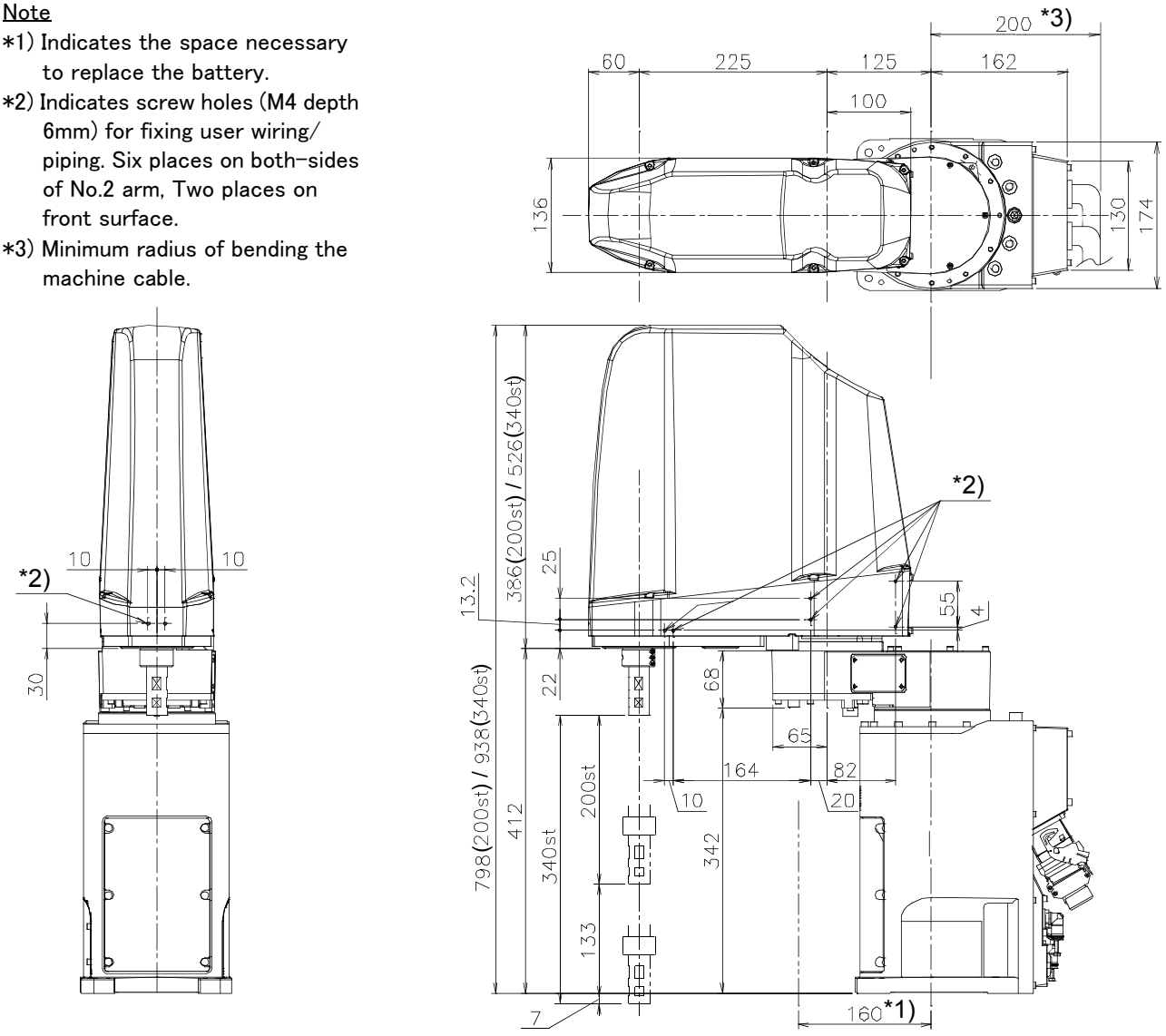
(1) Standard Specification

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) Minimum radius of bending the machine cable.



Note) Refer to Fig. 2-44 for the mechanical interface section and installation base section dimensions.

Fig.2-12 : Outside dimensions of RH-6FH35xx

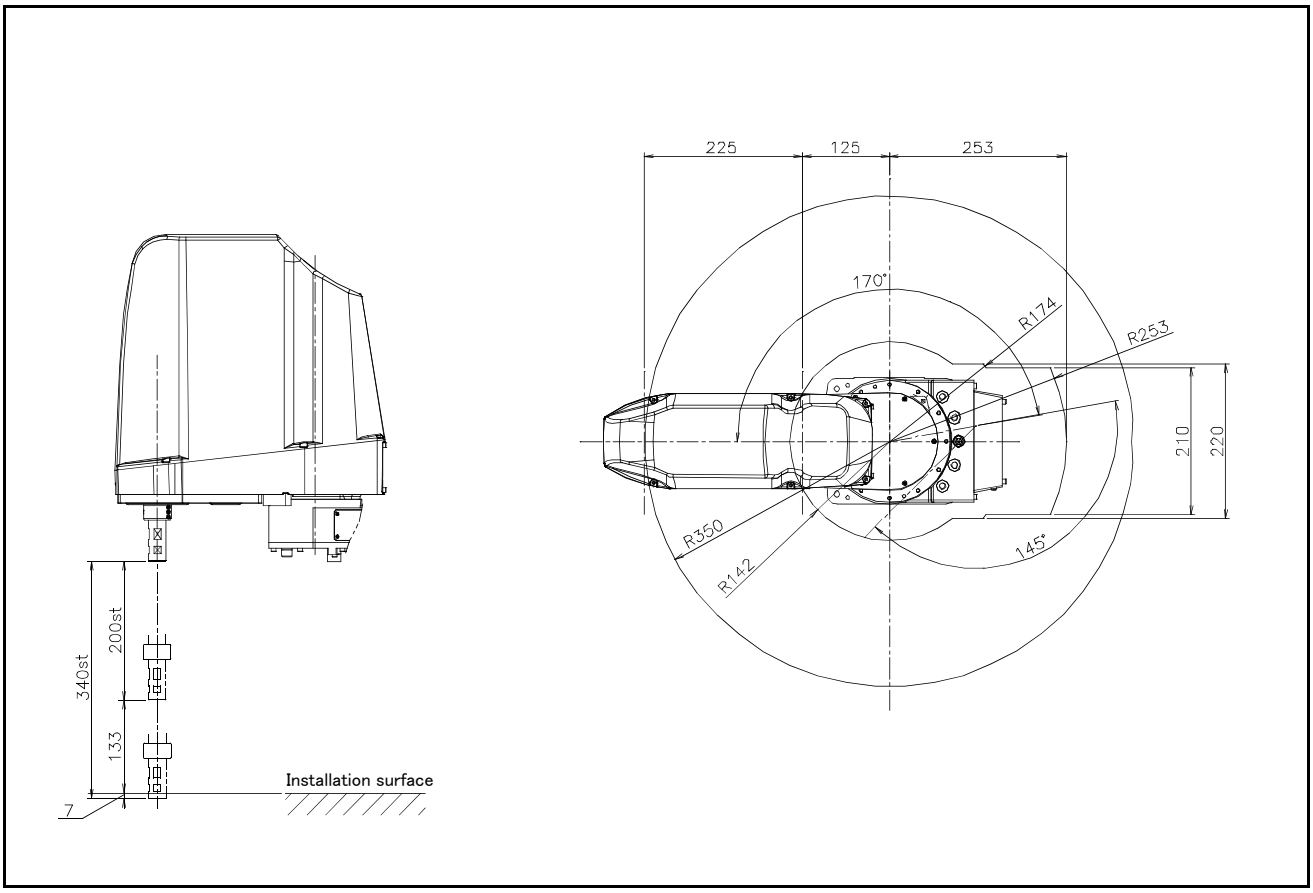


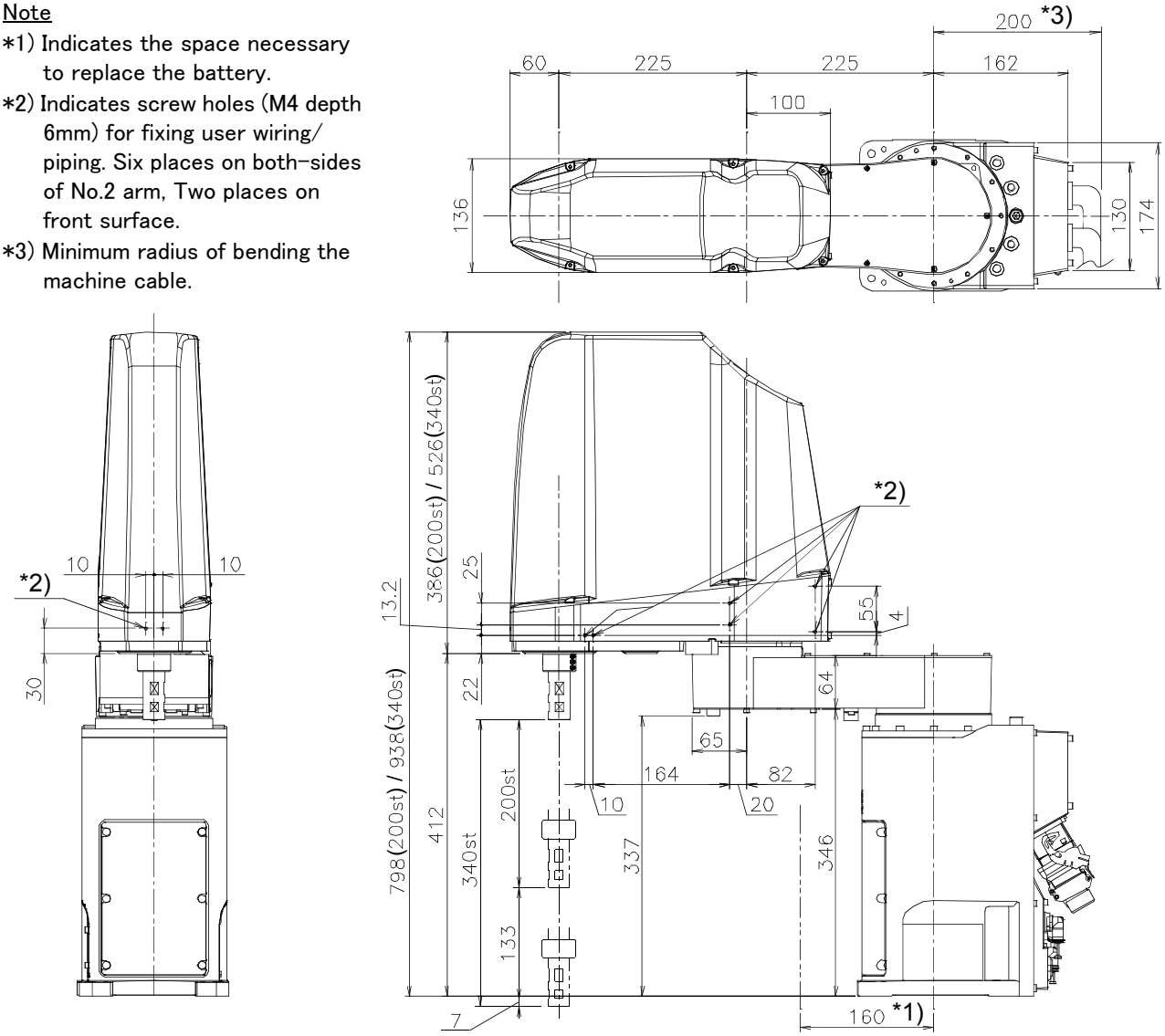
Fig.2-13 : Operating range diagram of RH-6FH35xx

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) Minimum radius of bending the machine cable.



Note) Refer to Fig. 2-44 for the mechanical interface section and installation base section dimensions.

Fig.2-14 : Outside dimensions of RH-6FH45xx

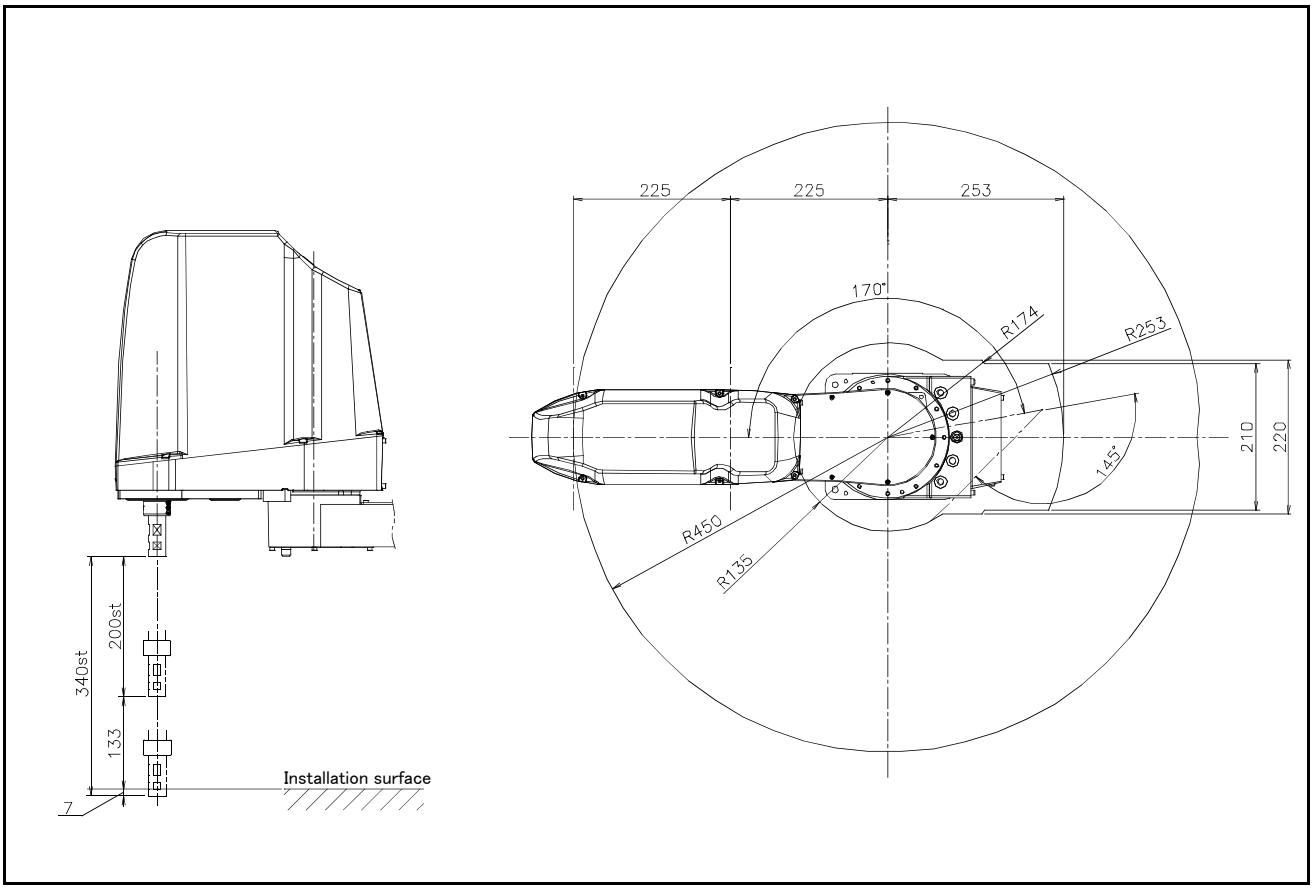


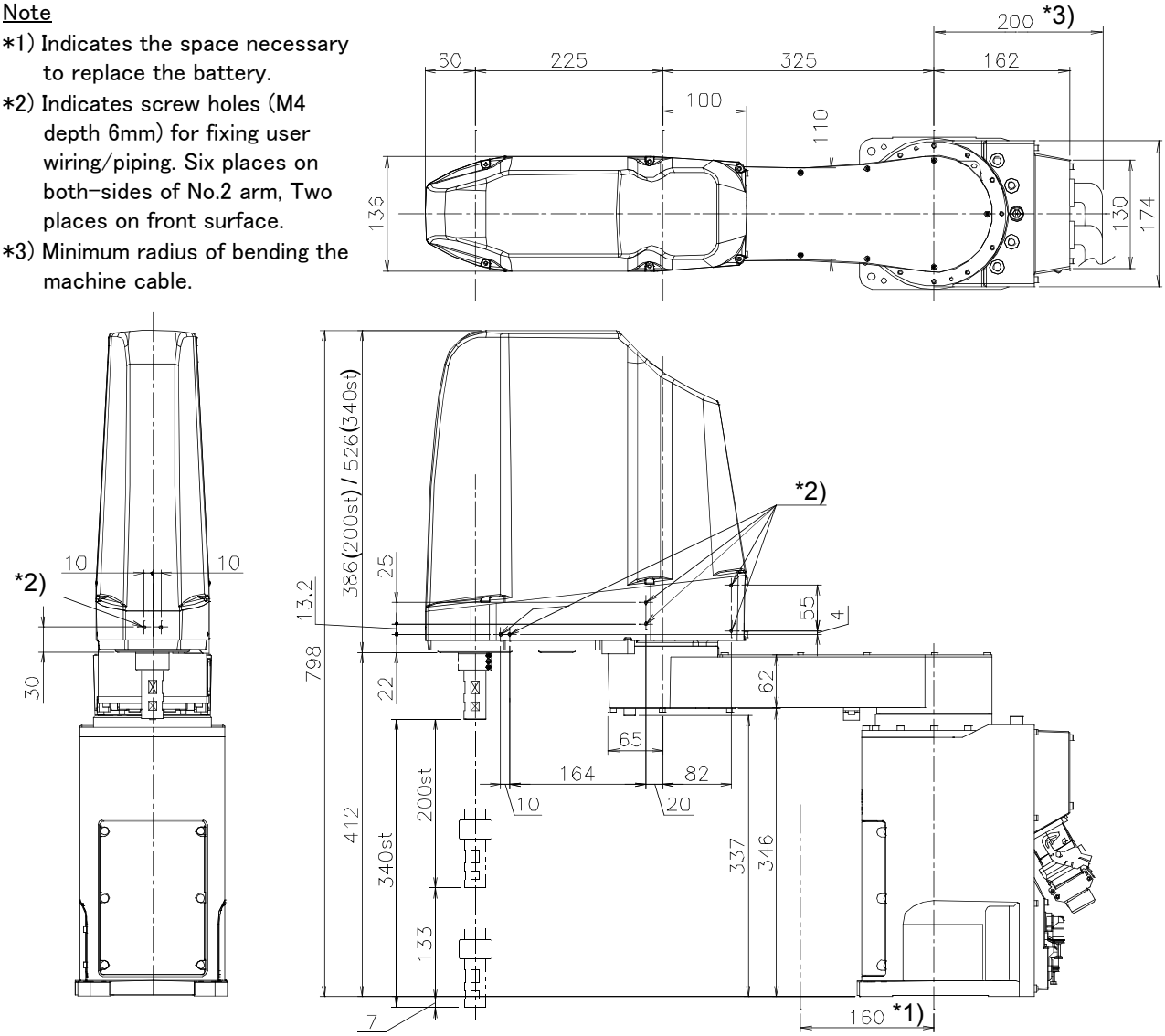
Fig.2-15 : Operating range diagram of RH-6FH45xx

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) Minimum radius of bending the machine cable.



Note) Refer to Fig. 2-44 for the mechanical interface section and installation base section dimensions.

Fig.2-16 : Outside dimensions of RH-6FH55xx

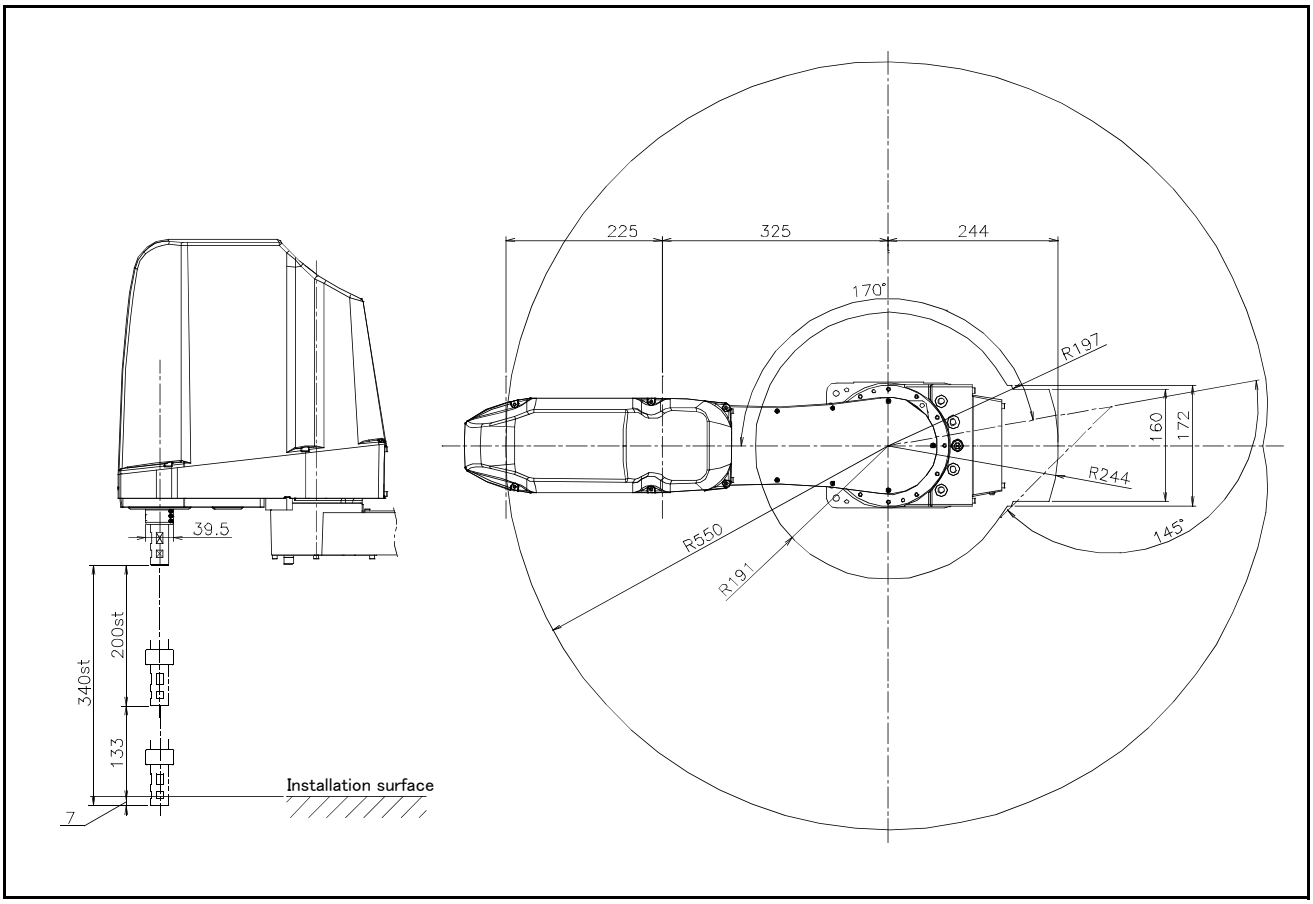


Fig.2-17 : Operating range diagram of RH-6FH55xx

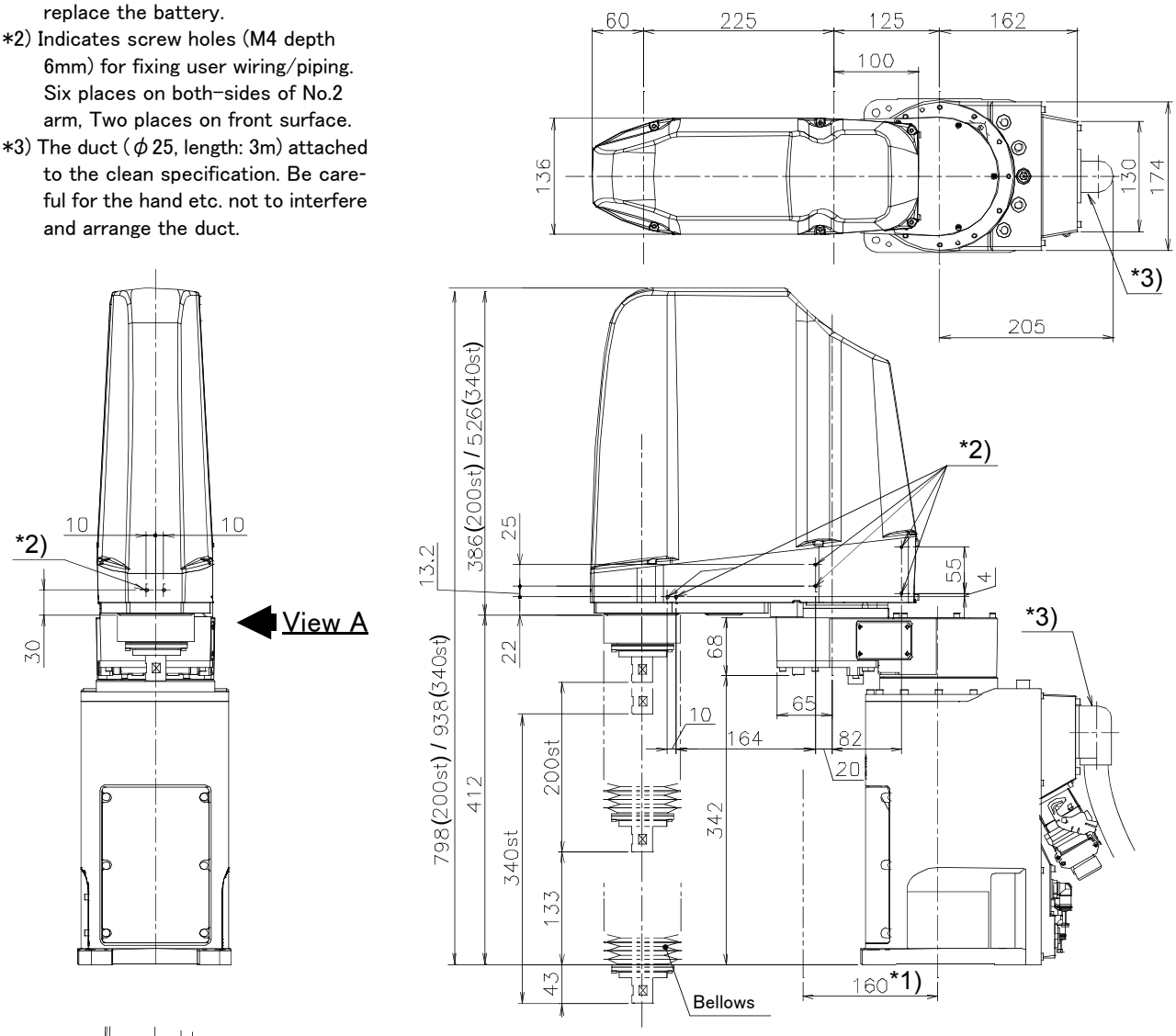
(2) Clean Specification and oil mist specification

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.



Note1) Refer to Fig. 2-44 for the mechanical interface section and installation base section dimensions.

Note2) Bellows are not installed in the CE Marking specification. Please give an order to the dealer if needed.

Fig.2-18 : Outside dimensions of RH-6FH35xxC/M

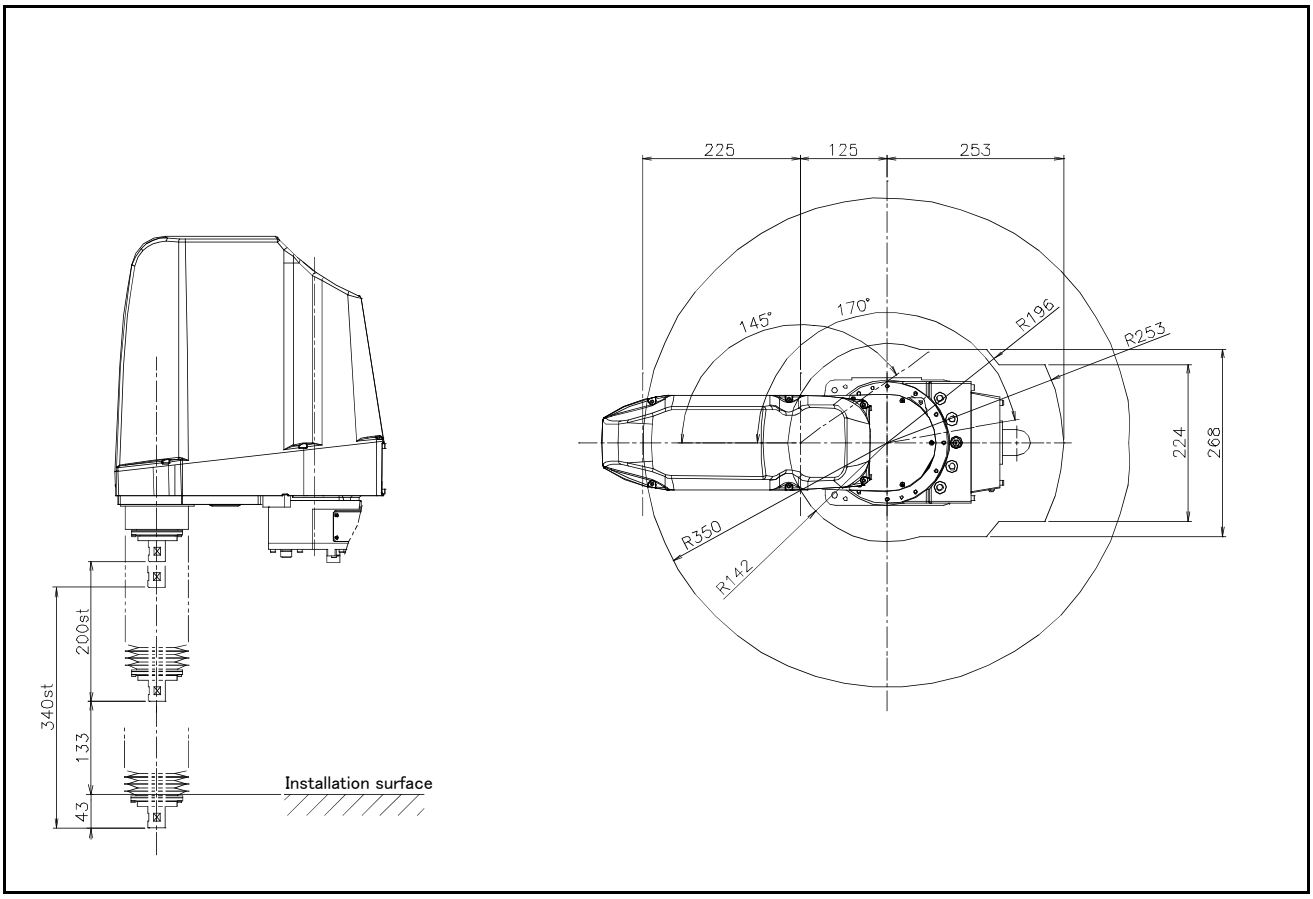


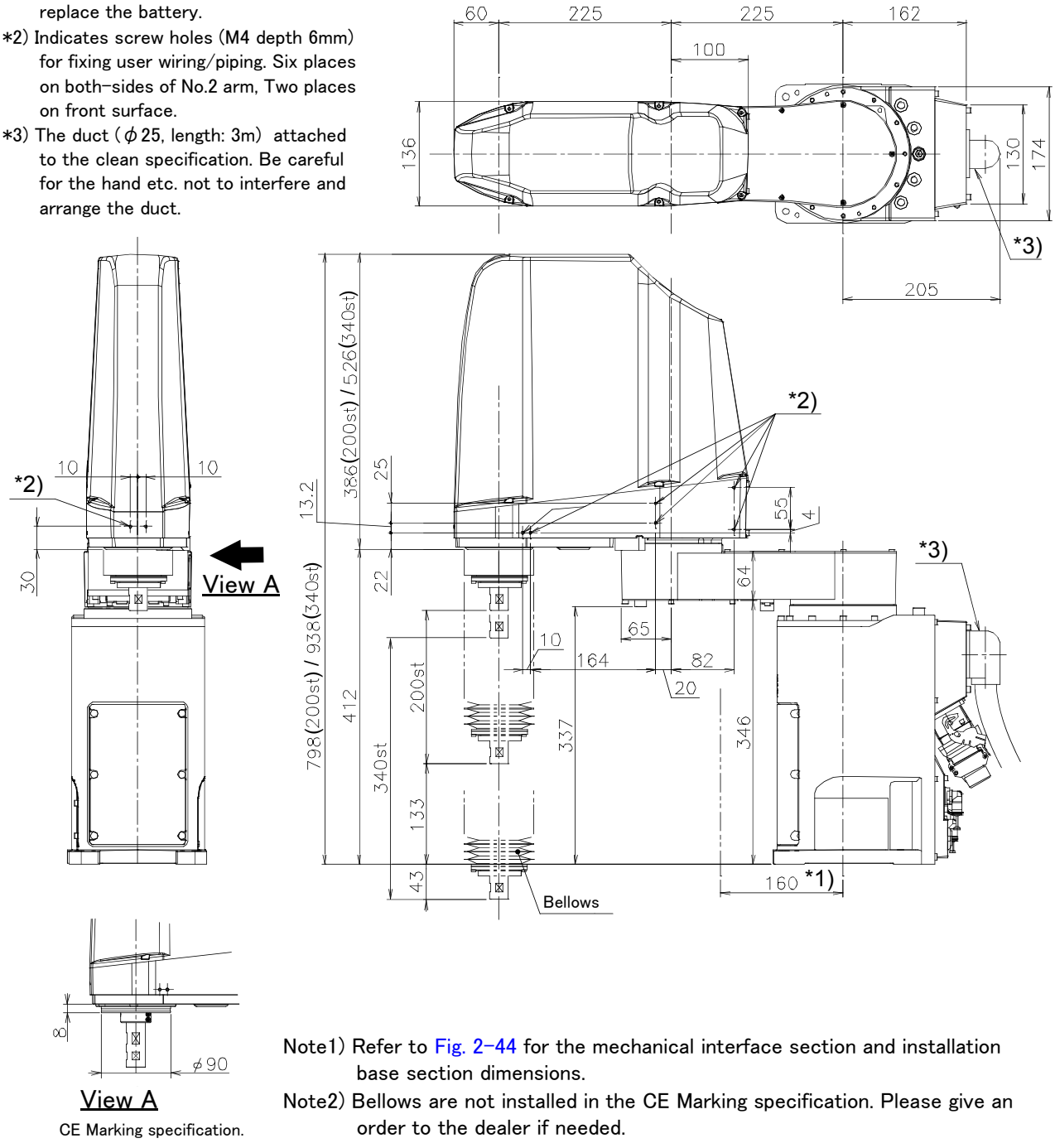
Fig.2-19 : Operating range diagram of RH-6FH35xxC/M

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.



Note1) Refer to Fig. 2-44 for the mechanical interface section and installation base section dimensions.

Note2) Bellows are not installed in the CE Marking specification. Please give an order to the dealer if needed.

Fig.2-20 : Outside dimensions of RH-6FH45xxC/M

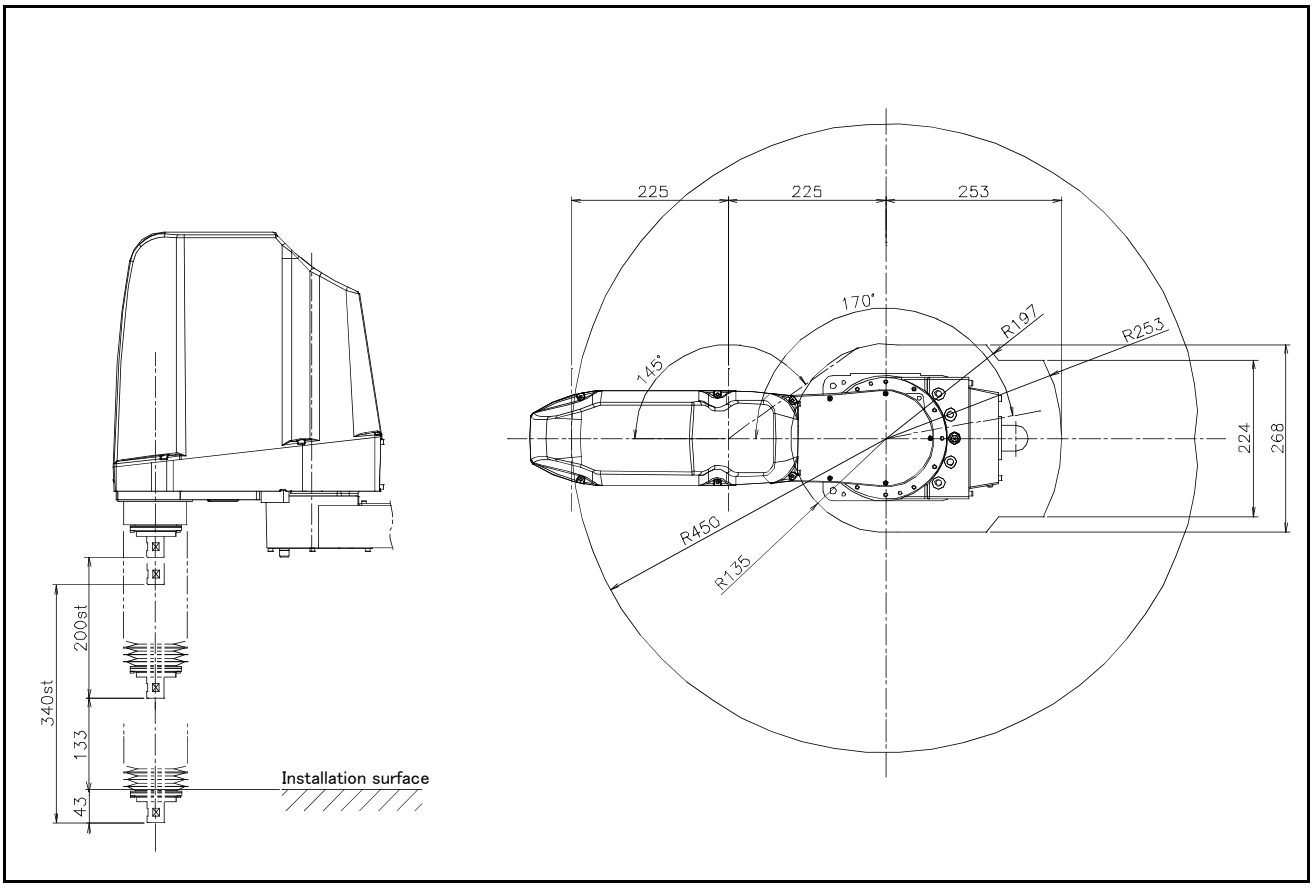


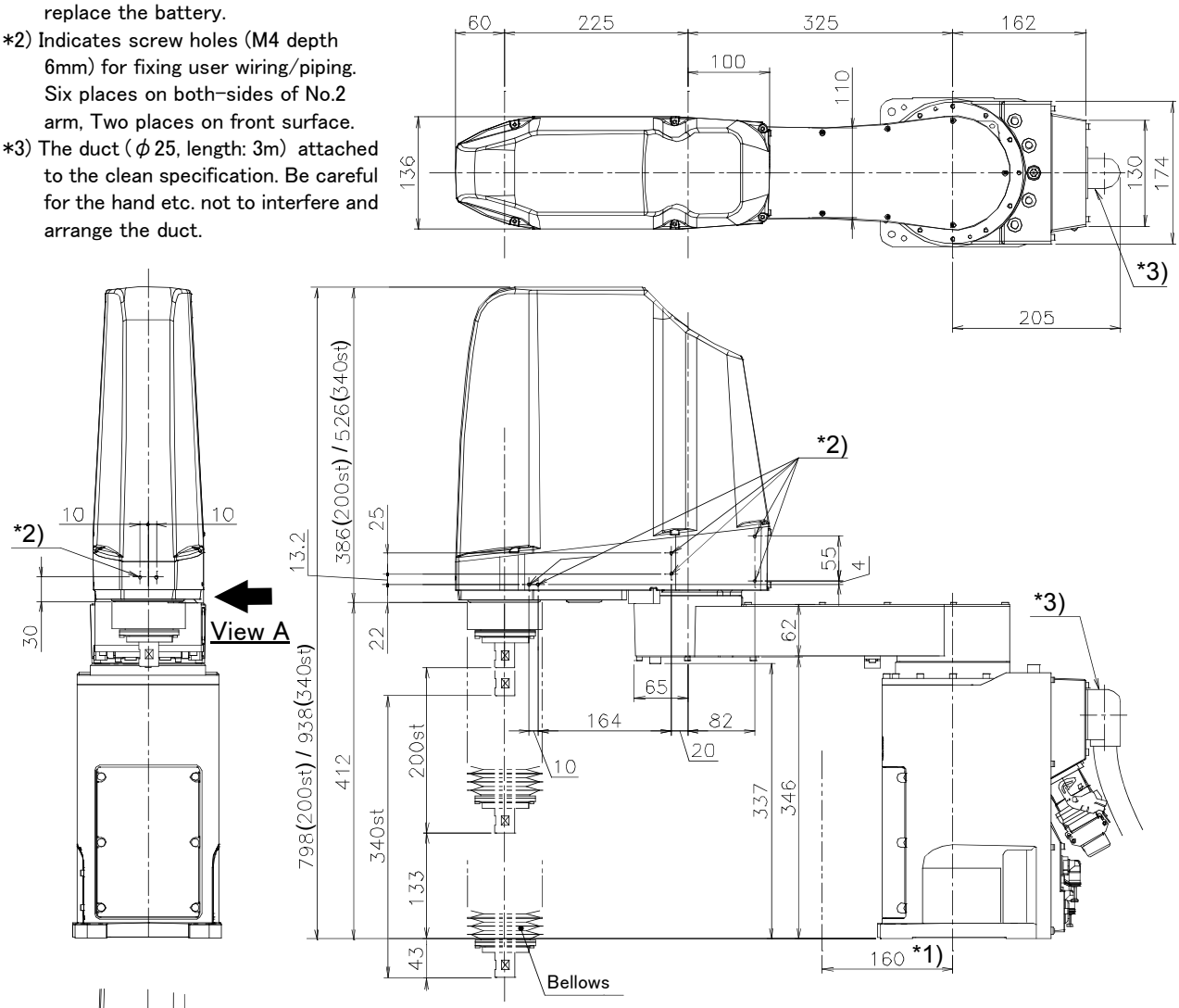
Fig.2-21 : Operating range diagram of RH-6FH45xxC/M

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.



CE Marking specification.

Note1) Refer to Fig. 2-44 for the mechanical interface section and installation base section dimensions.

Note2) Bellows are not installed in the CE Marking specification. Please give an order to the dealer if needed.

Fig.2-22 : Outside dimensions of RH-6FH55xxC/M

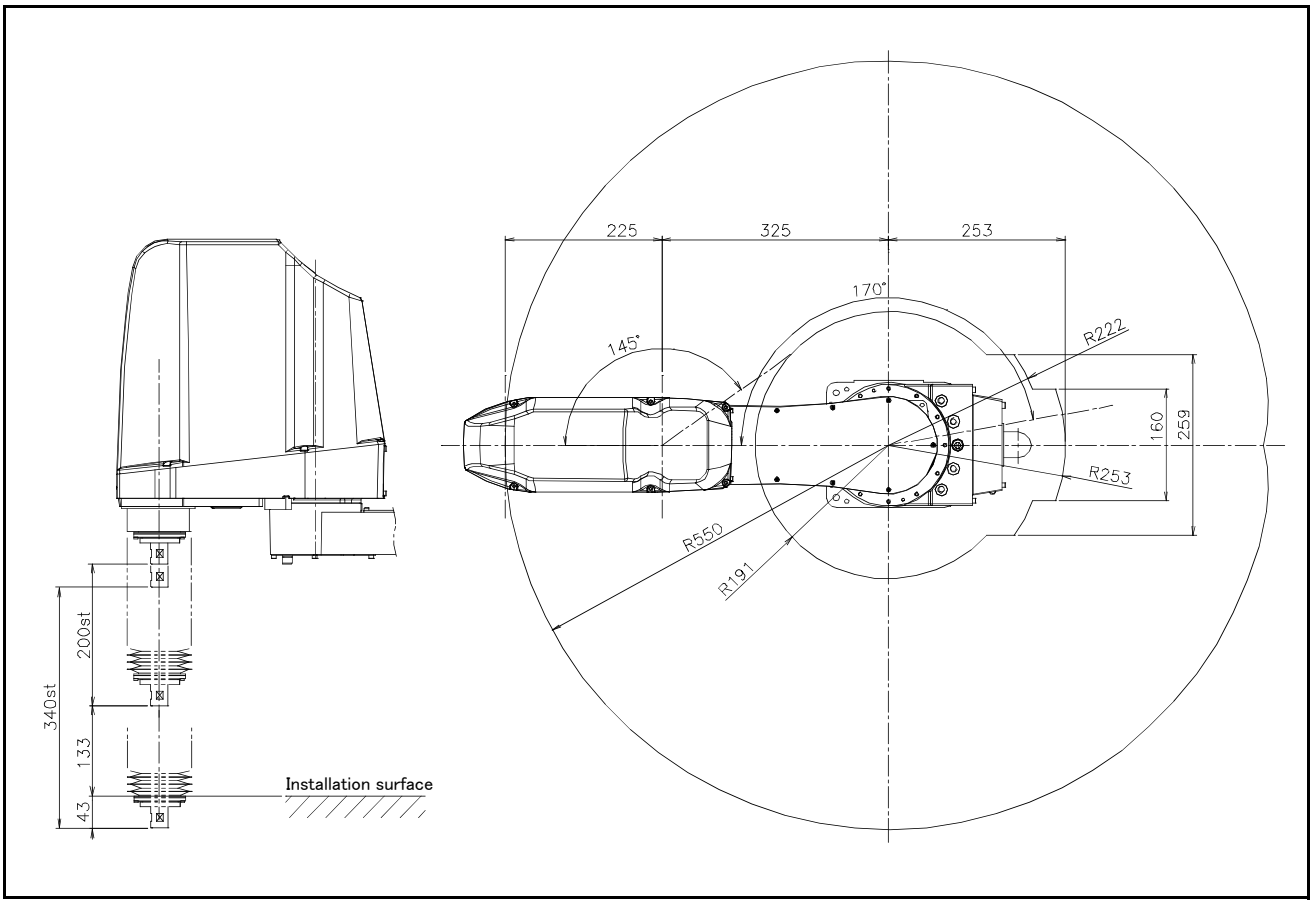
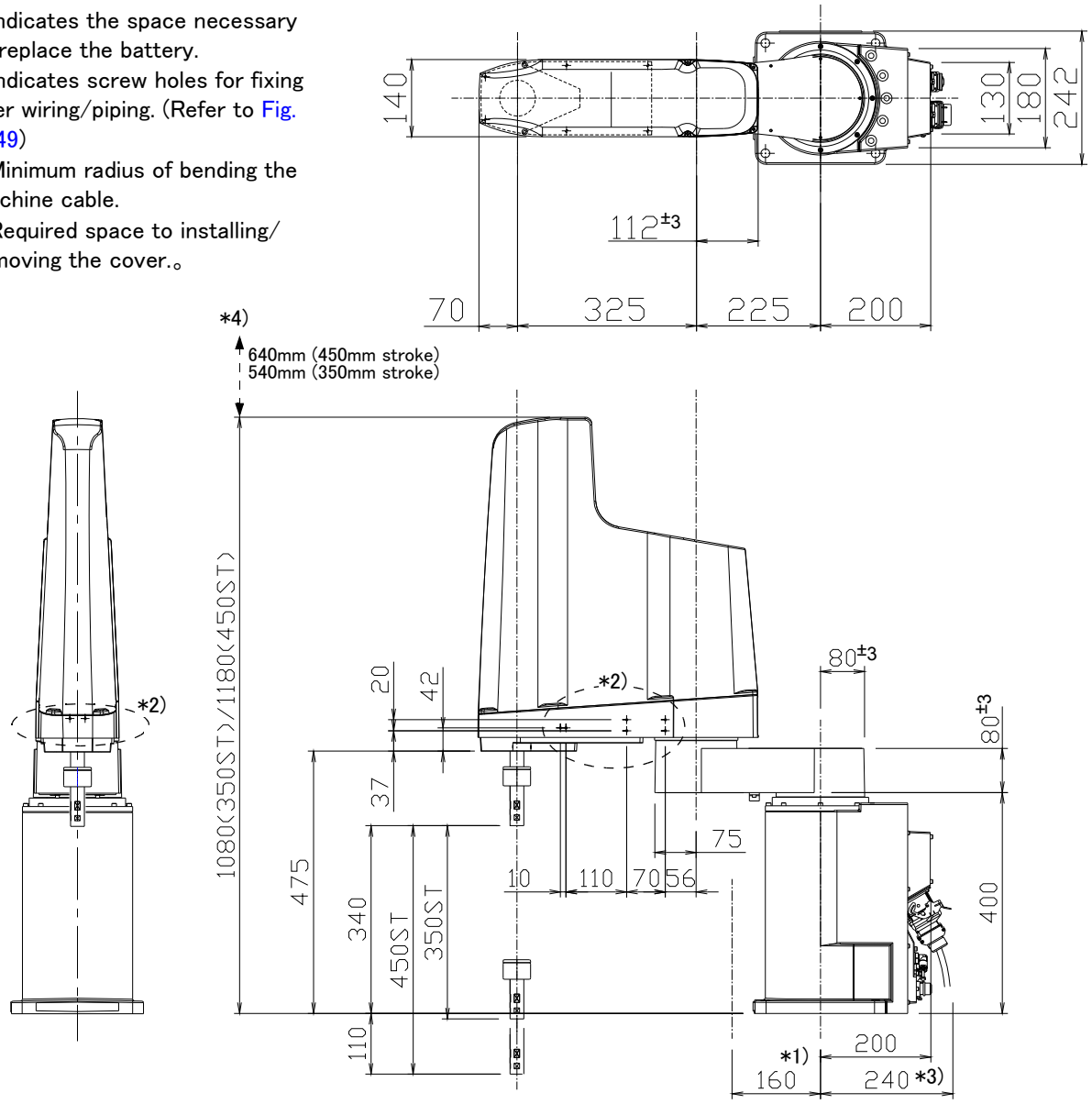


Fig.2-23 : Operating range diagram of RH-6FH55xxC/M

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. 2-49)
*3) Minimum radius of bending the machine cable.
*4) Required space to installing/ removing the cover.。



Note) Refer to Fig. 2-45 for the mechanical interface section and installation base section dimensions.

Fig.2-24 : Outside dimensions of RH-12FH55xx

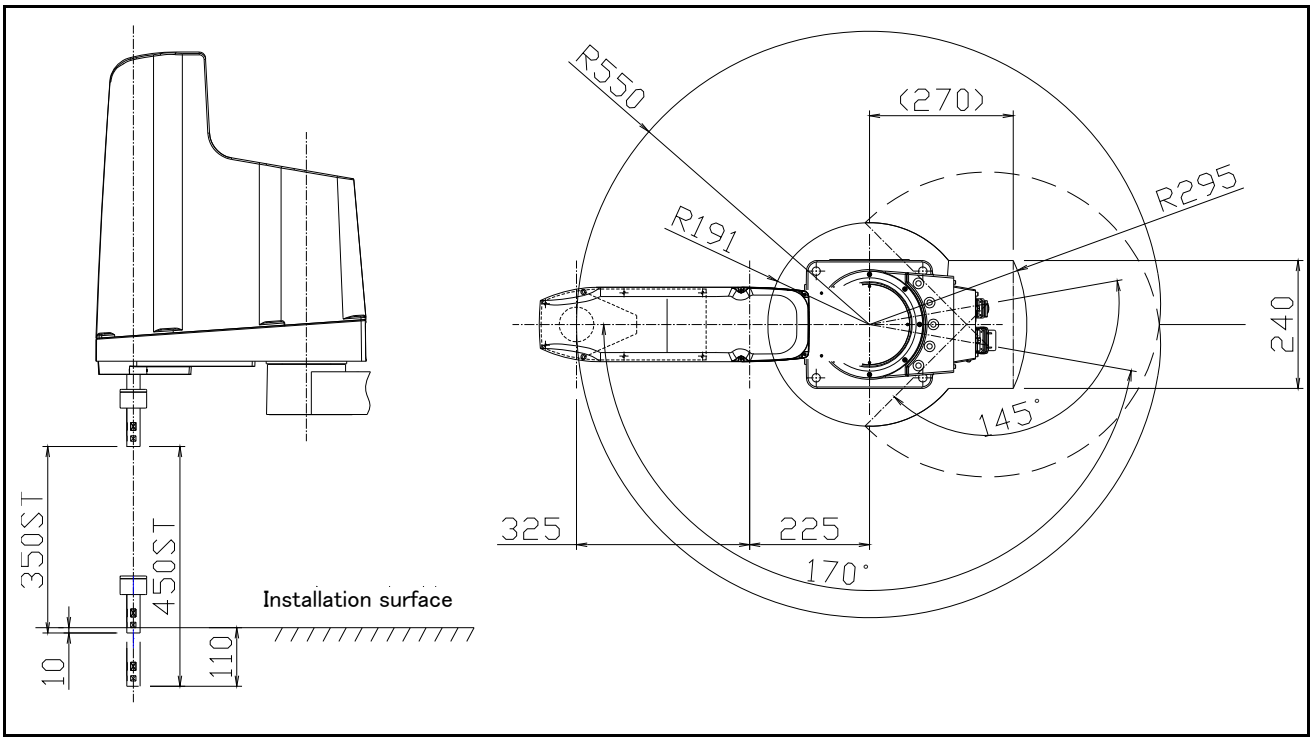
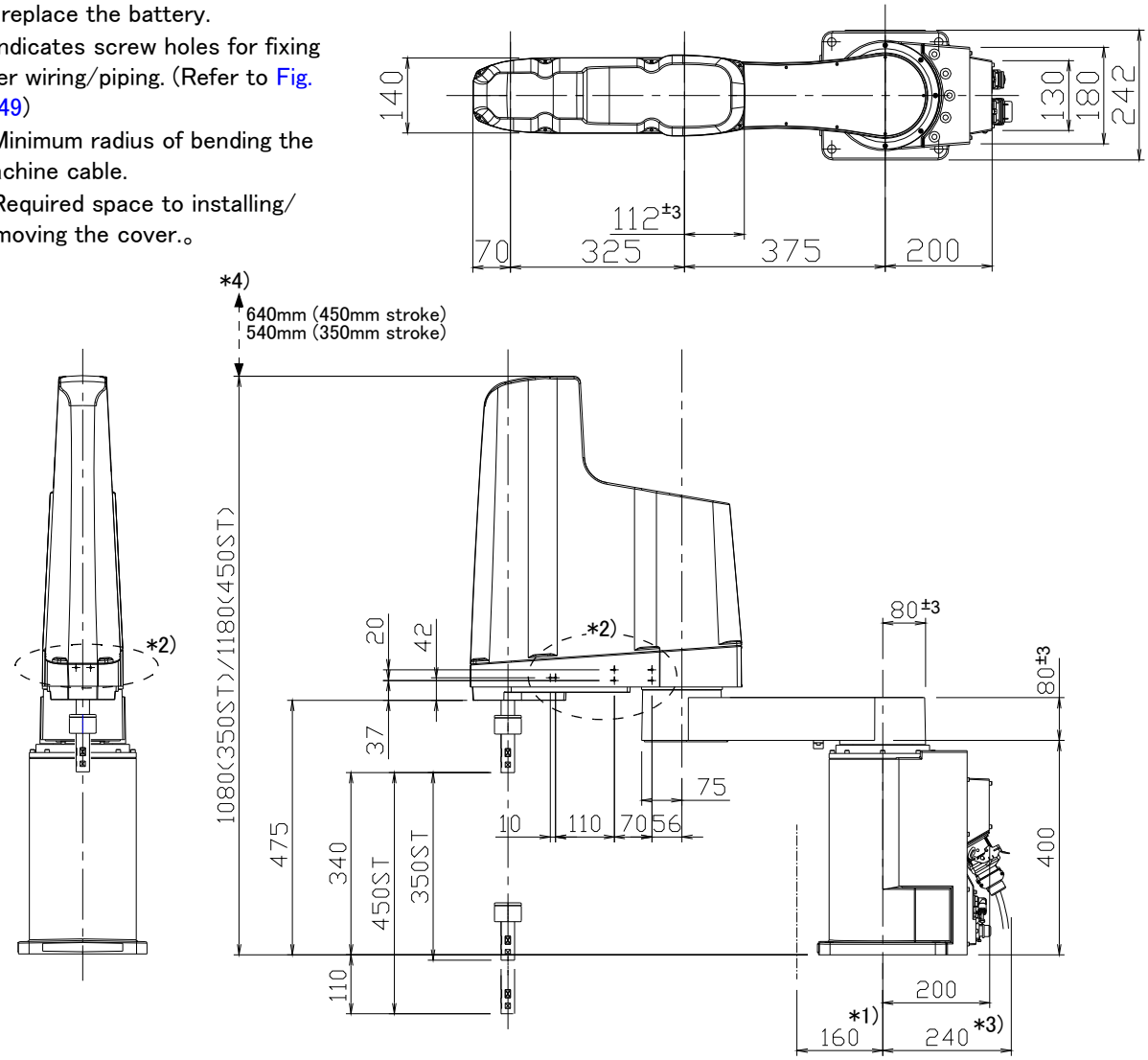


Fig.2-25 : Operating range diagram of RH-12FH55xx

Note
*1) Indicates the space necessary to replace the battery.
*2) Indicates screw holes for fixing user wiring/piping. (Refer to Fig. 2-49)
*3) Minimum radius of bending the machine cable.
*4) Required space to installing/ removing the cover.。



Note) Refer to Fig. 2-45 for the mechanical interface section and installation base section dimensions.

Fig.2-26 : Outside dimensions of RH-12FH70xx

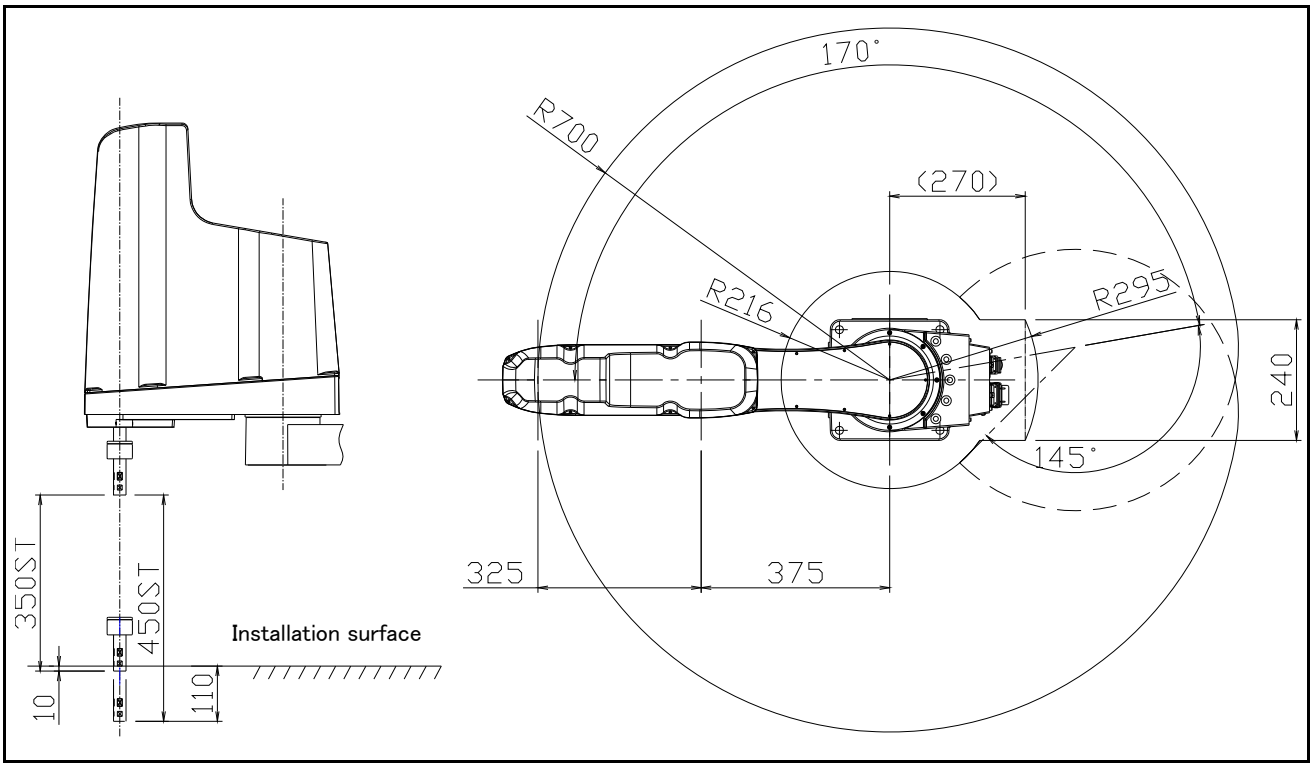
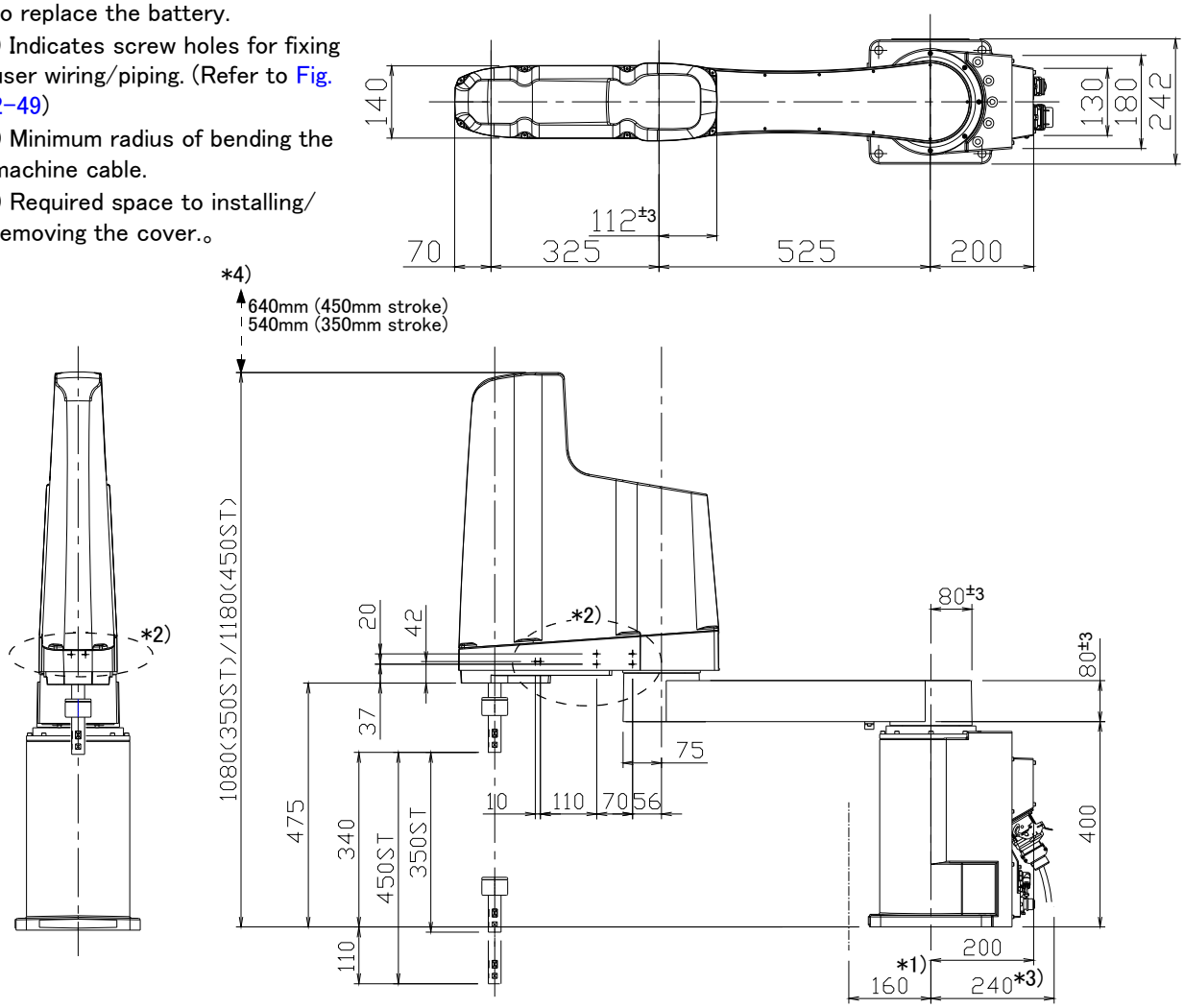


Fig.2-27 : Operating range diagram of RH-12FH70xx

Note
*1) Indicates the space necessary to replace the battery.
*2) Indicates screw holes for fixing user wiring/piping. (Refer to Fig. 2-49)
*3) Minimum radius of bending the machine cable.
*4) Required space to installing/ removing the cover.。



Note) Refer to Fig. 2-45 for the mechanical interface section and installation base section dimensions.

Fig.2-28 : Outside dimensions of RH-12FH85xx

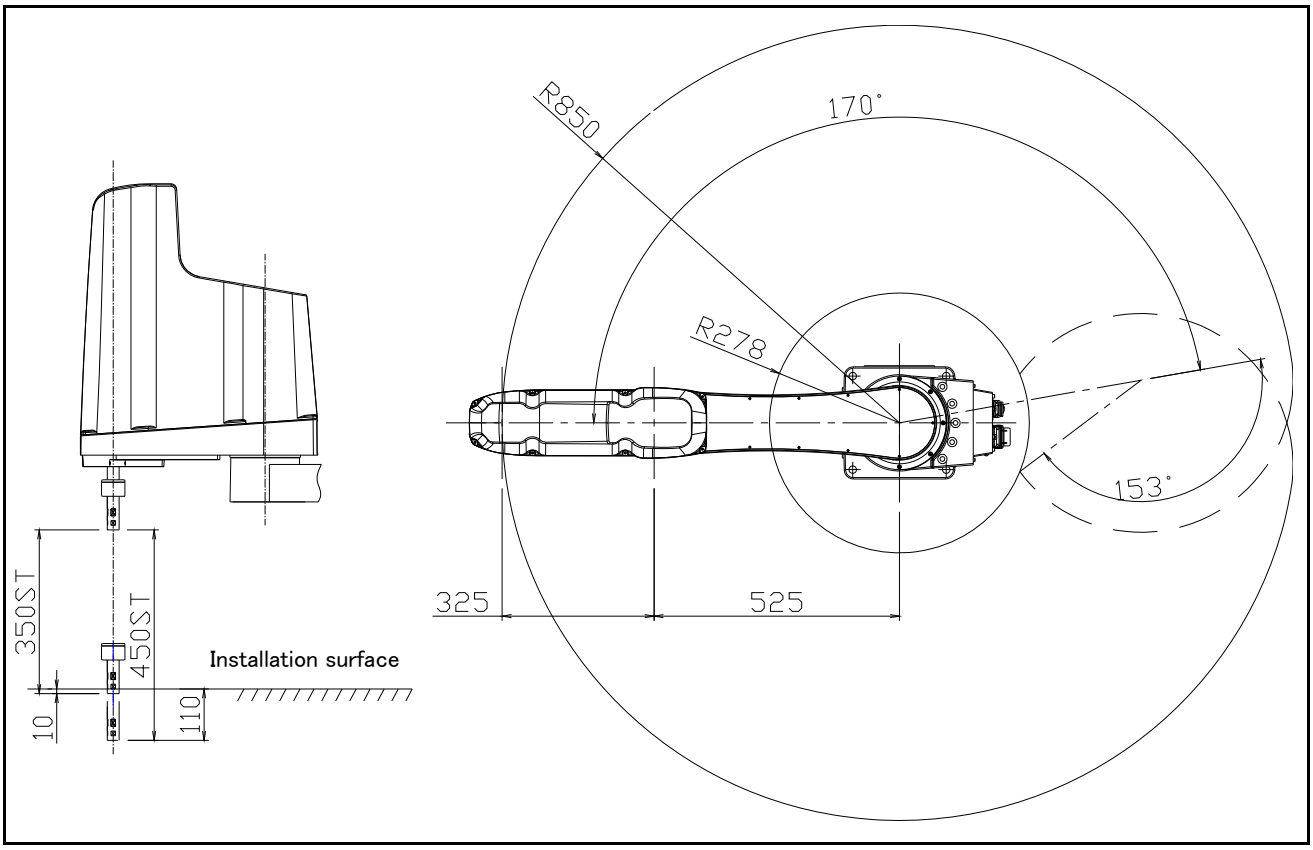
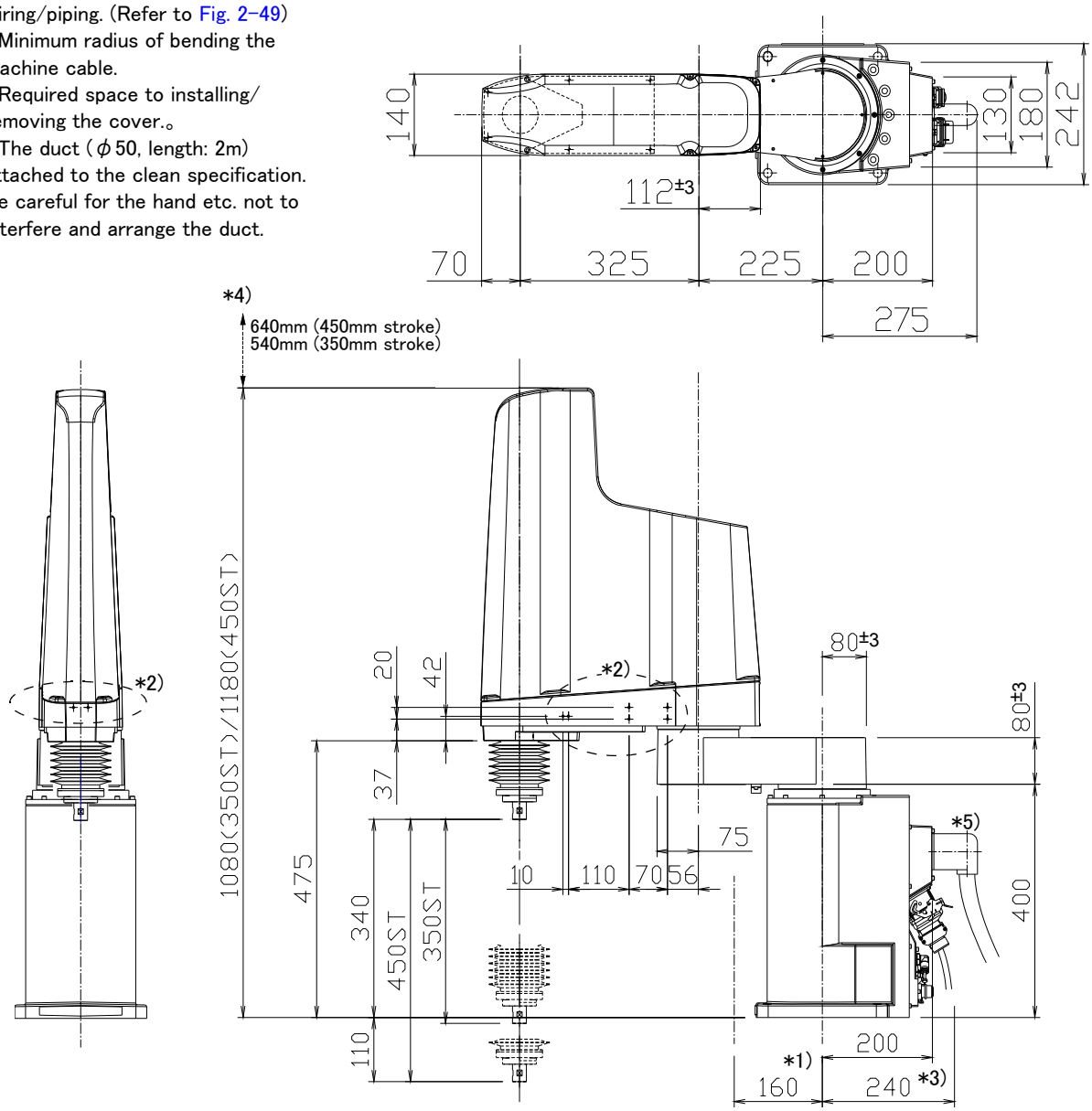


Fig.2-29 : Operating range diagram of RH-12FH85xx

(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. 2-49)
*3) Minimum radius of bending the machine cable.
*4) Required space to installing/ removing the cover.。
*5) The duct (φ50, length: 2m) attached to the clean specification. Be careful for the hand etc. not to interfere and arrange the duct.



Note) Refer to Fig. 2-45 for the mechanical interface section and installation base section dimensions.

Fig.2-30 : Outside dimensions of RH-12FH55xxC/M

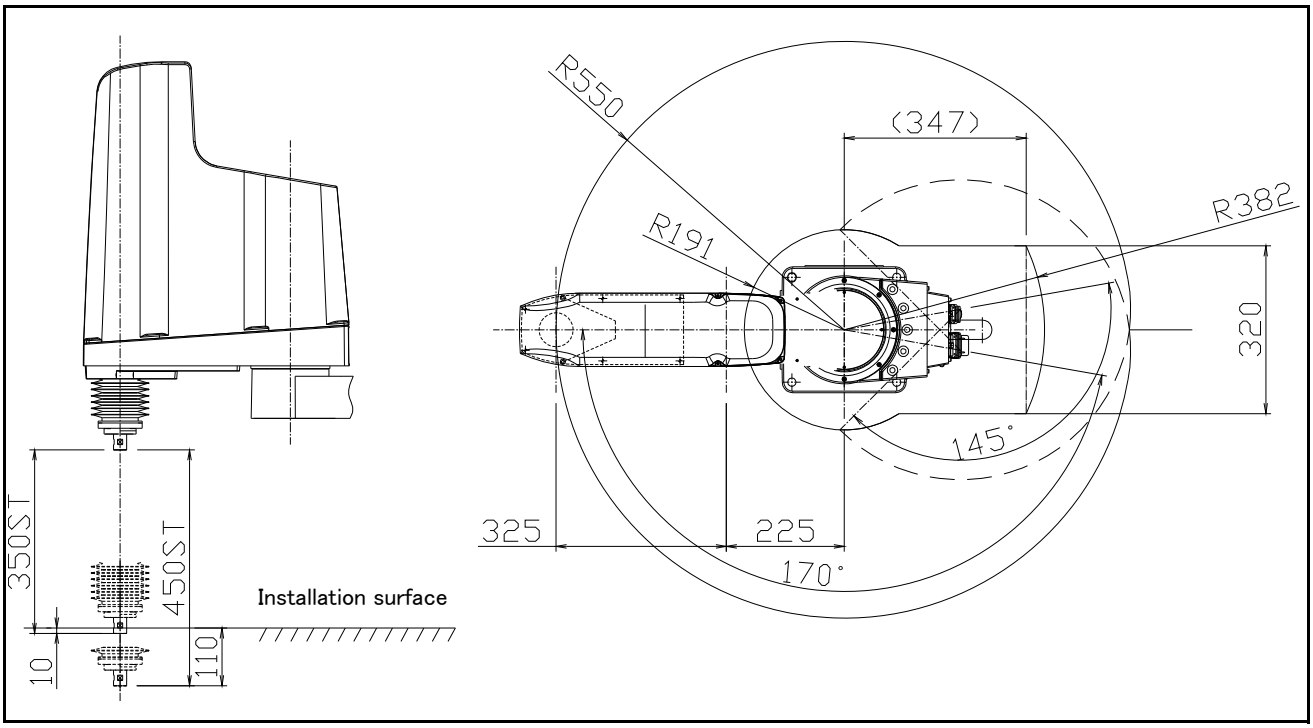
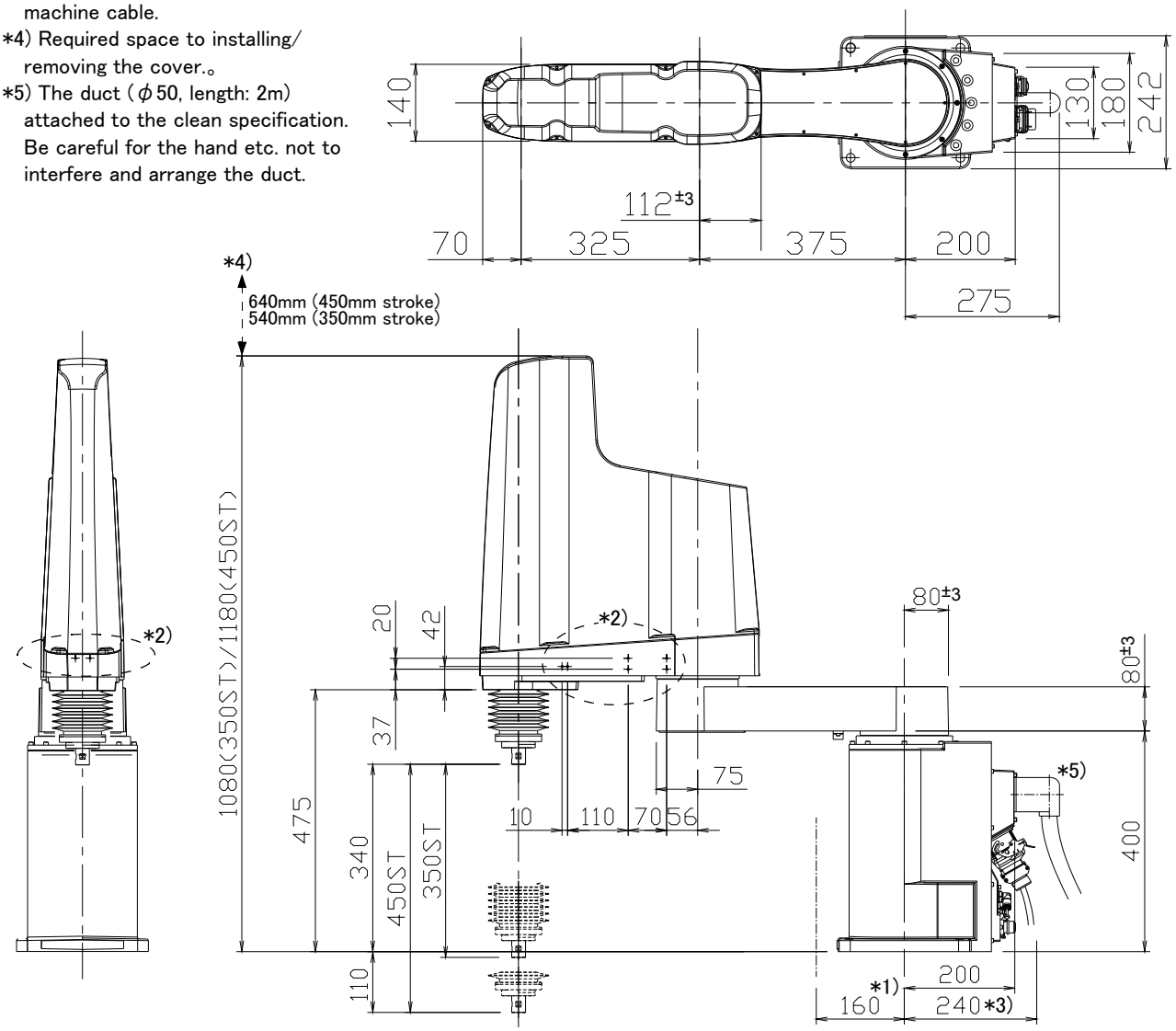


Fig.2-31 : Operating range diagram of RH-12FH55xxC/M

Note
*1) Indicates the space necessary to replace the battery.
*2) Indicates screw holes for fixing user wiring/piping. (Refer to Fig. 2-49)
*3) Minimum radius of bending the machine cable.
*4) Required space to installing/ removing the cover.。
*5) The duct (φ50, length: 2m) attached to the clean specification. Be careful for the hand etc. not to interfere and arrange the duct.



Note) Refer to Fig. 2-45 for the mechanical interface section and installation base section dimensions.

Fig.2-32 : Outside dimensions of RH-12FH70xxC/M

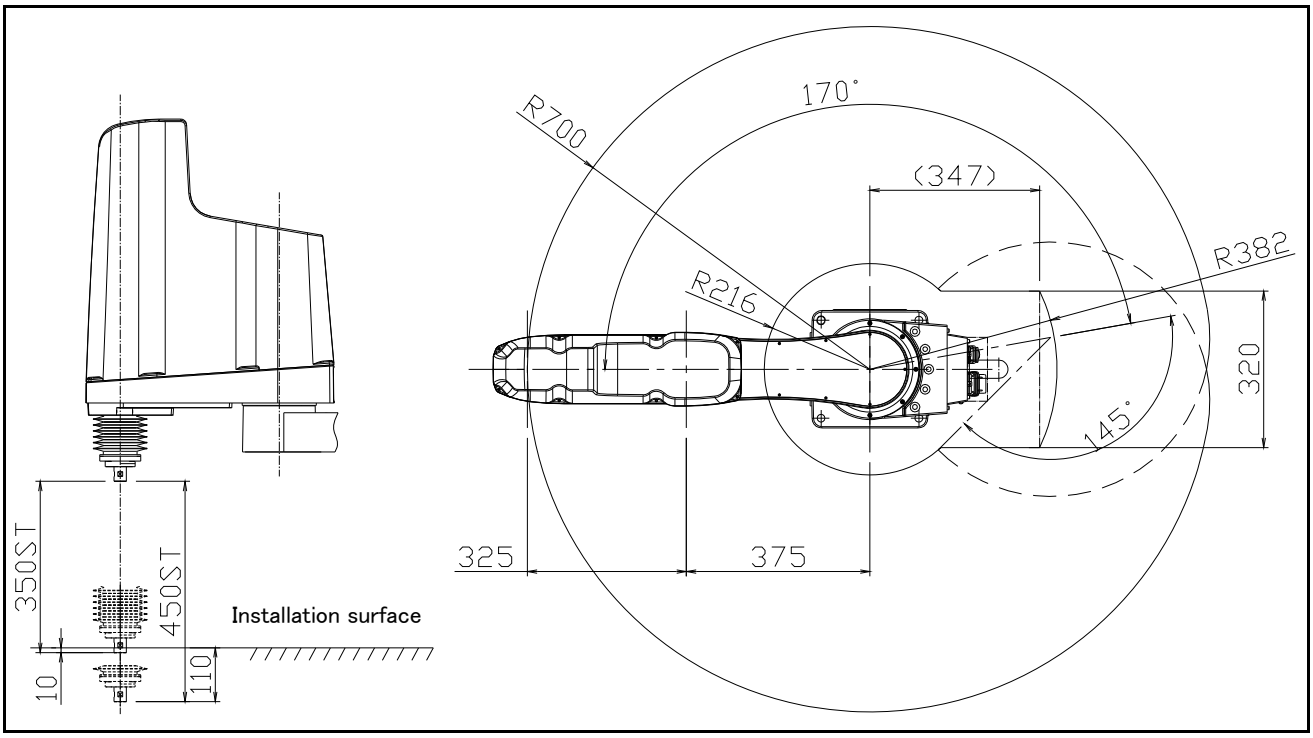
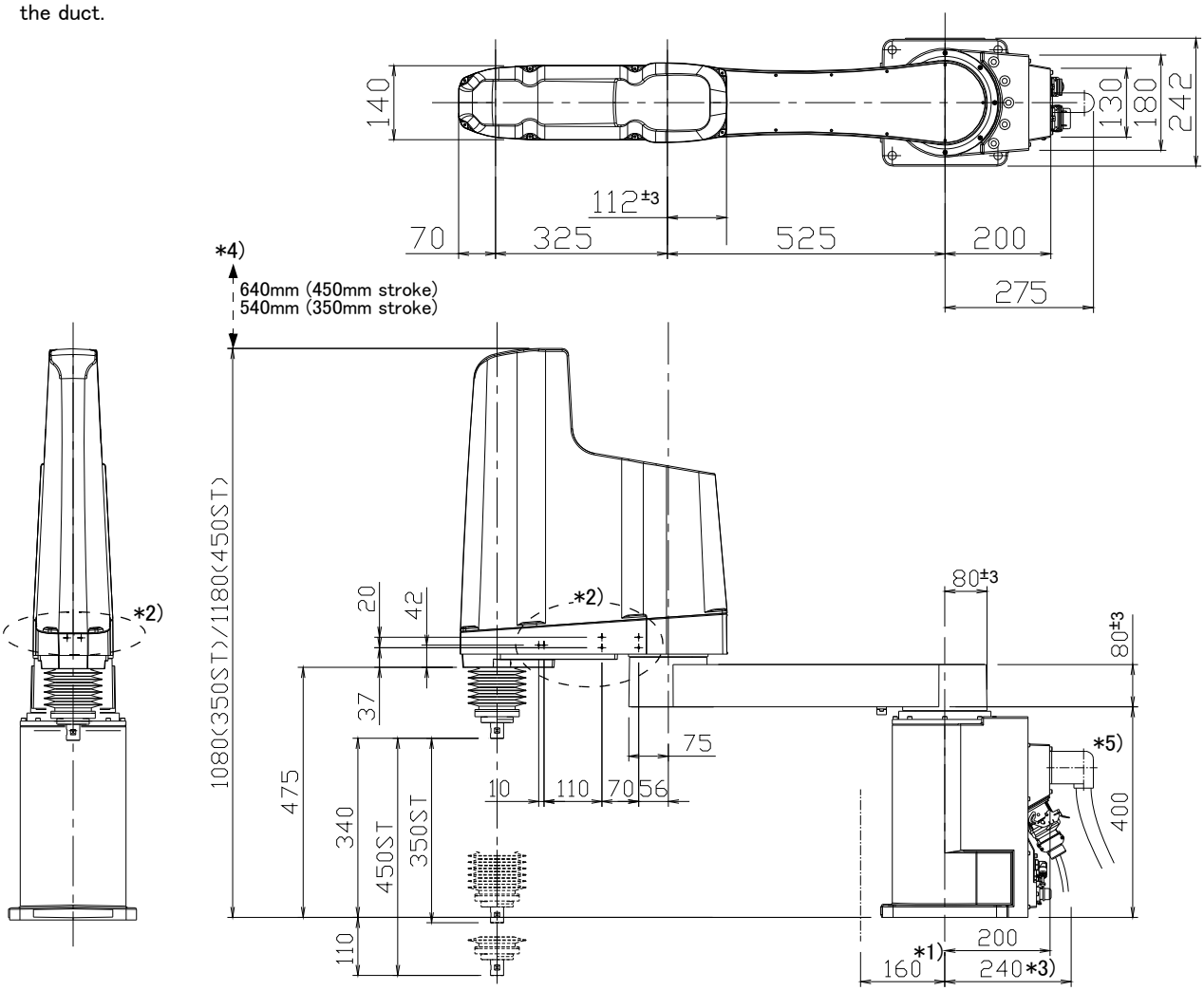


Fig.2-33 : Operating range diagram of RH-12FH70xxC/M

Note
*1) Indicates the space necessary to replace the battery.
*2) Indicates screw holes for fixing user wiring/piping. (Refer to Fig. 2-49)
*3) Minimum radius of bending the machine cable.
*4) Required space to installing/removing the cover.。
*5) The duct (φ50, length: 2m) attached to the clean specification. Be careful for the hand etc. not to interfere and arrange the duct.



Note) Refer to Fig. 2-45 for the mechanical interface section and installation base section dimensions.

Fig.2-34 : Outside dimensions of RH-12FH85xxC/M

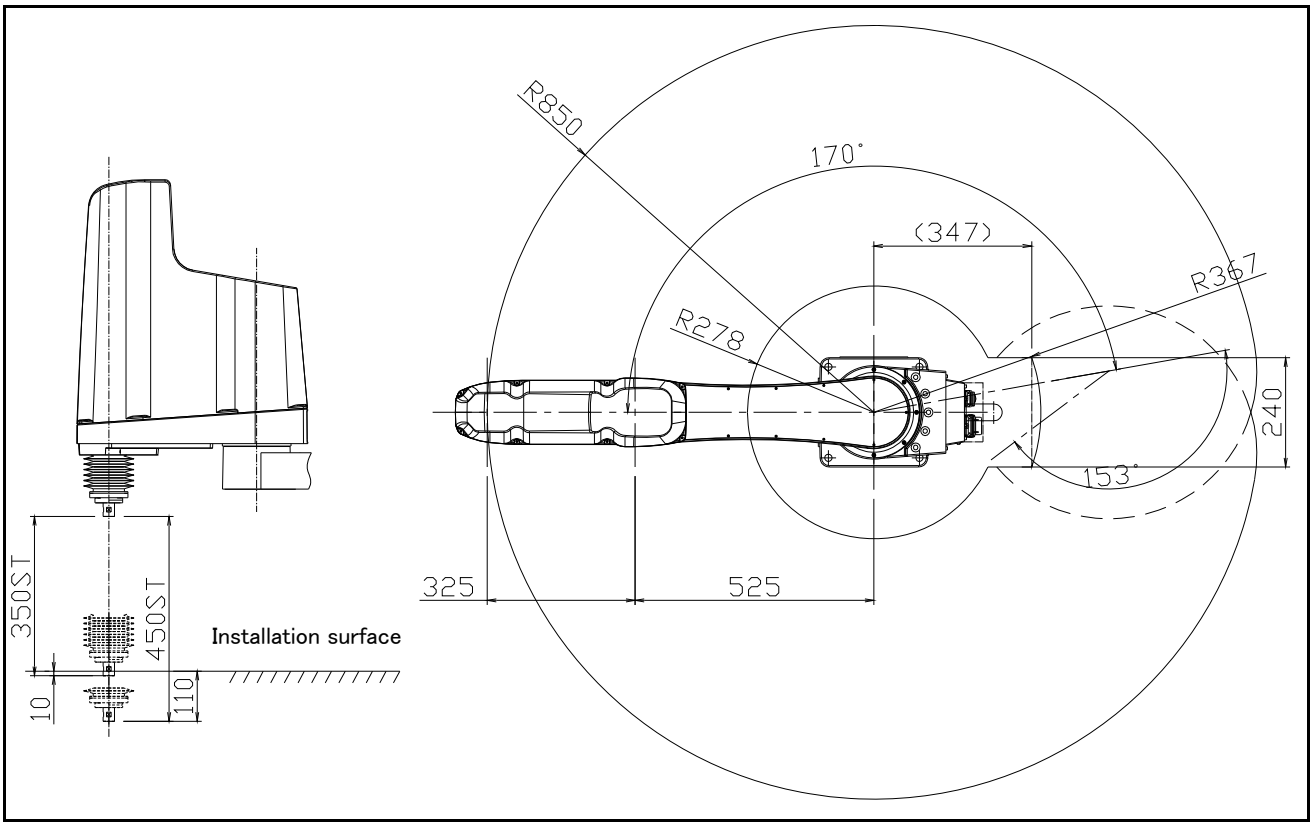
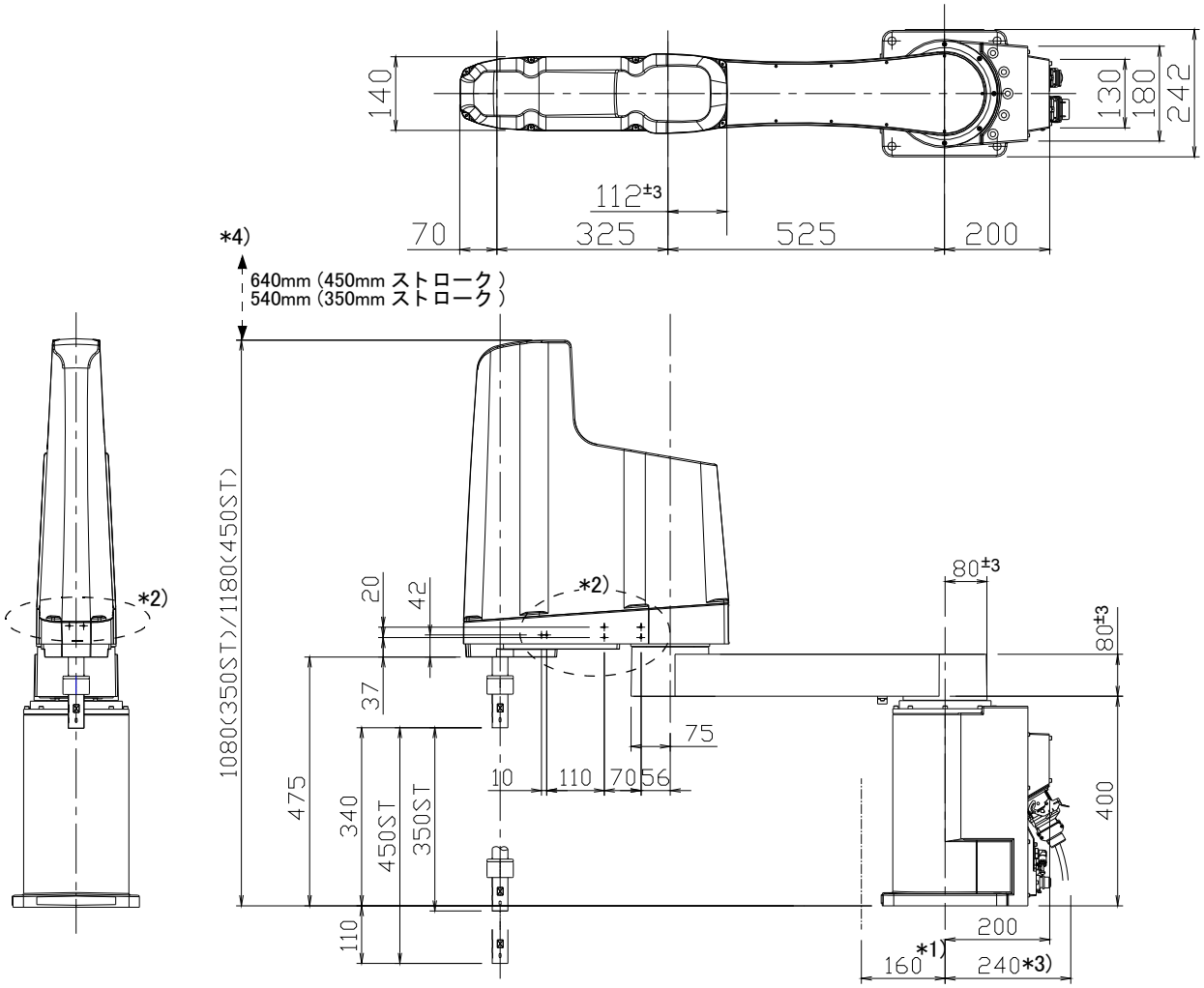


Fig.2-35 : Operating range diagram of RH-12FH85xxC/M

2.4.3 Outside dimensions・Operating range diagram (RH-20FH 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. 2-49)
*3) Minimum radius of bending the machine cable.
*4) Required space to installing/removing the cover.



Note) Refer to Fig. 2-46 for the mechanical interface section and installation base section dimensions.

Fig.2-36 : Outside dimensions of RH-20FH85xx

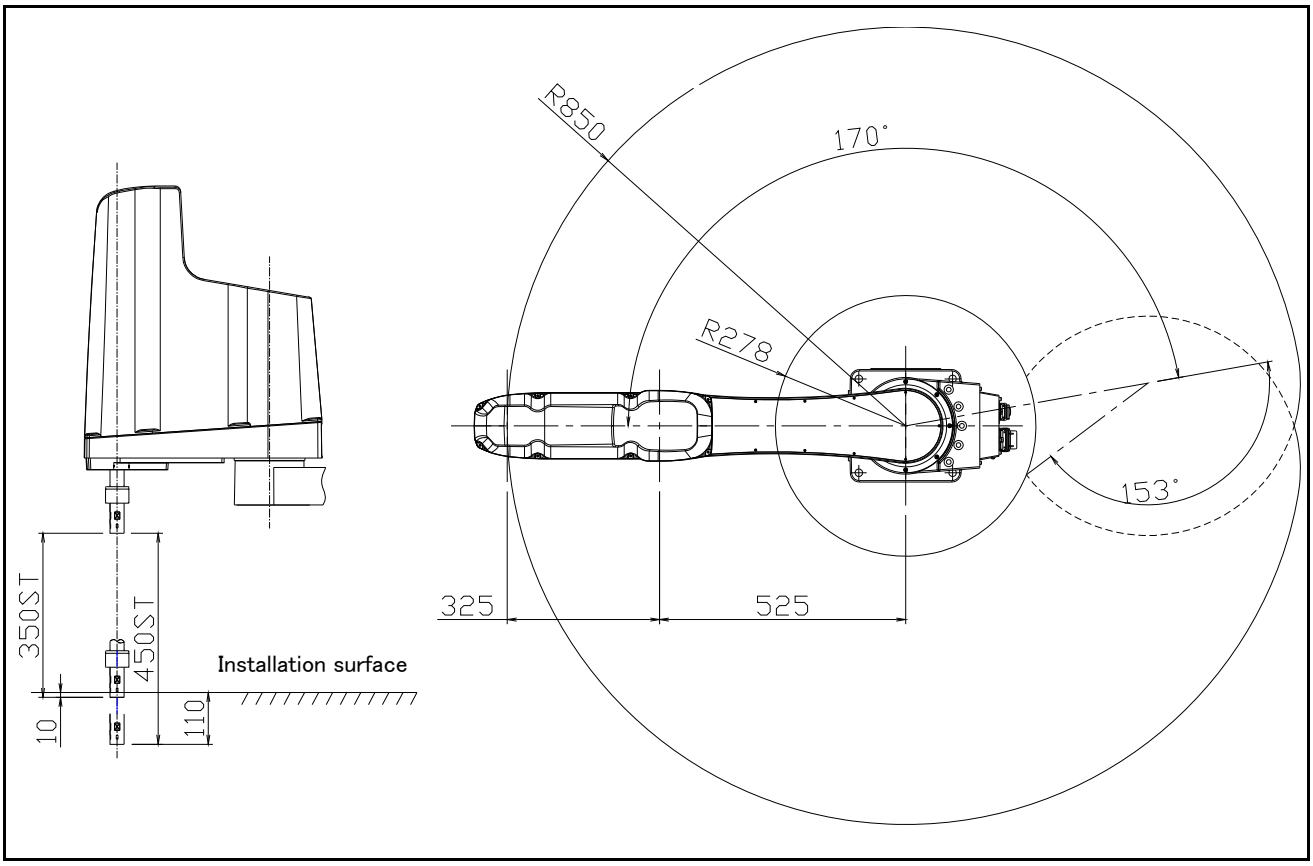
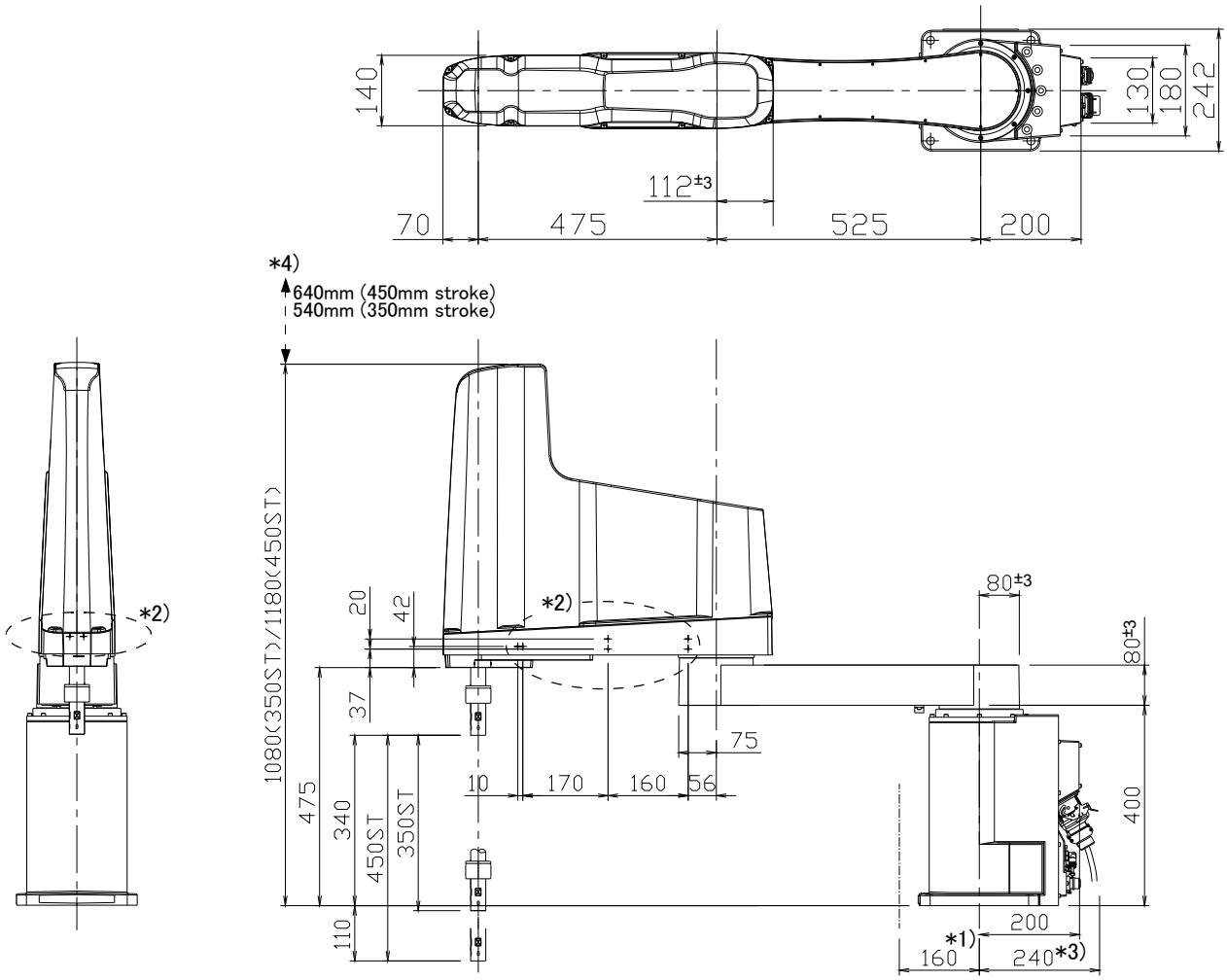


Fig.2-37 : Operating range diagram of RH-20FH85xx

Note
*1) Indicates the space necessary to replace the battery.
*2) Indicates screw holes for fixing user wiring/piping. (Refer to Fig. 2-49)
*3) Minimum radius of bending the machine cable.
*4) Required space to installing/removing the cover.。



Note) Refer to Fig. 2-46 for the mechanical interface section and installation base section dimensions.

Fig.2-38 : Outside dimensions of RH-20FH100xx

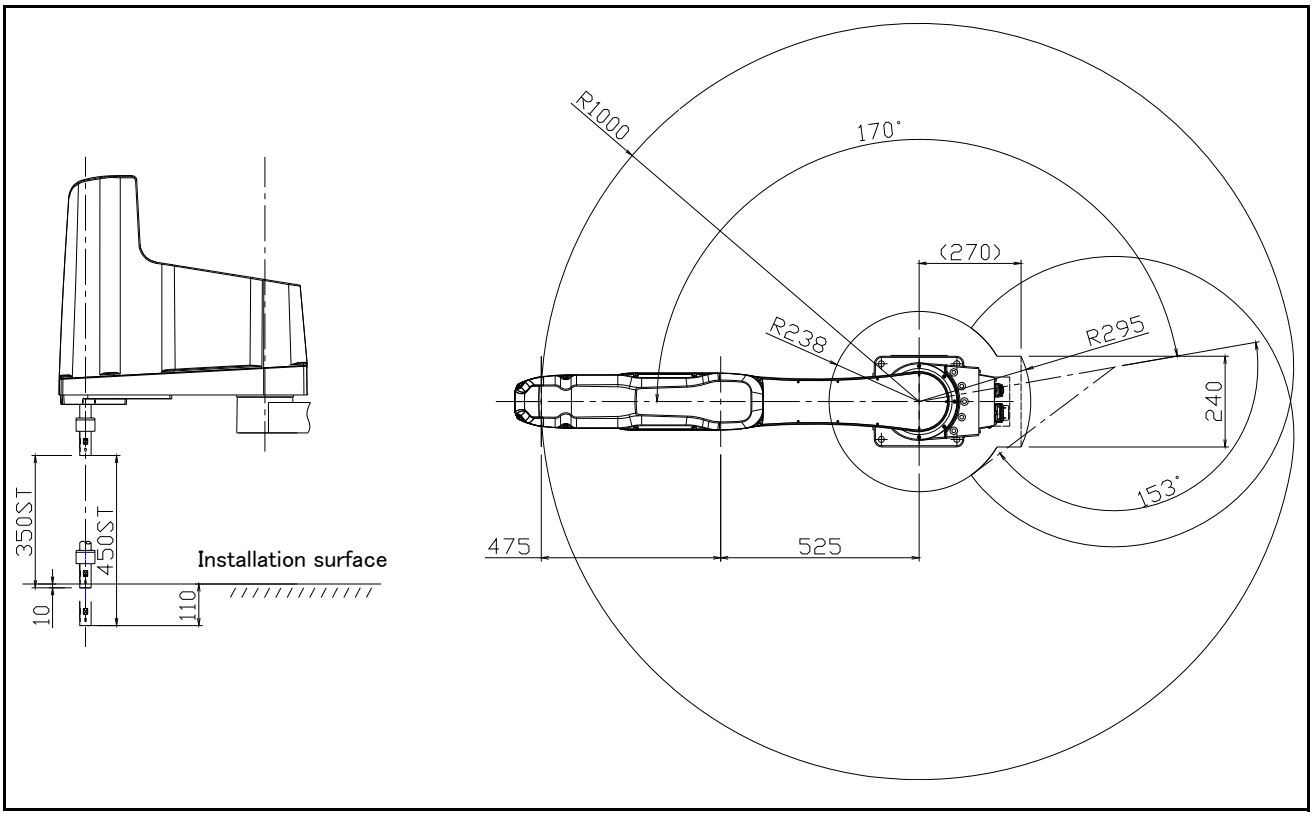
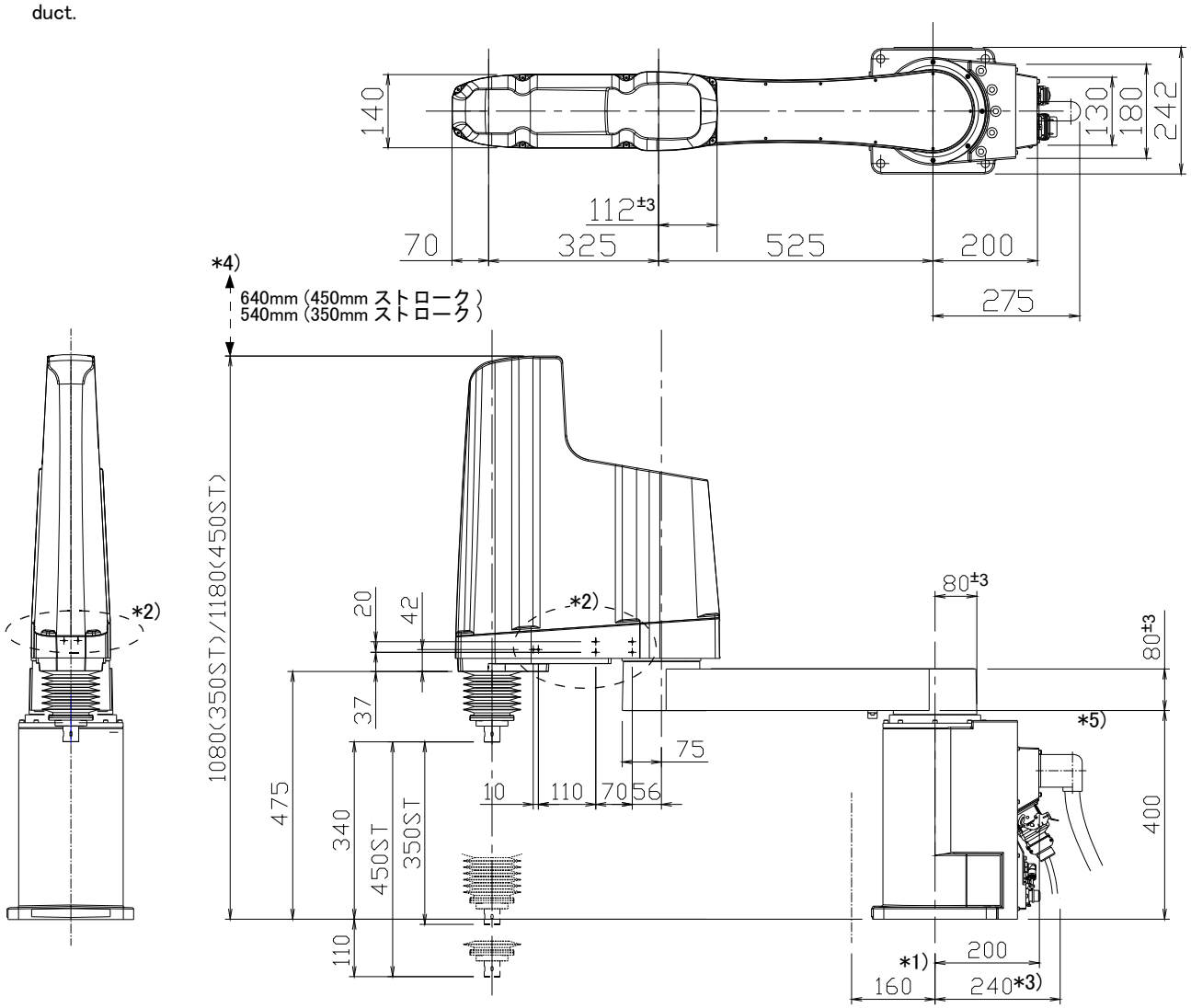


Fig.2-39 : Operating range diagram of RH-20FH100xx

(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. 2-49)
*3) Minimum radius of bending the machine cable.
*4) Required space to installing/removing the cover.。
*5) The duct (φ50, length: 2m) attached to the clean specification. Be careful for the hand etc. not to interfere and arrange the duct.



Note) Refer to Fig. 2-46 for the mechanical interface section and installation base section dimensions.

Fig.2-40 : Outside dimensions of RH-20FH85xxC/M

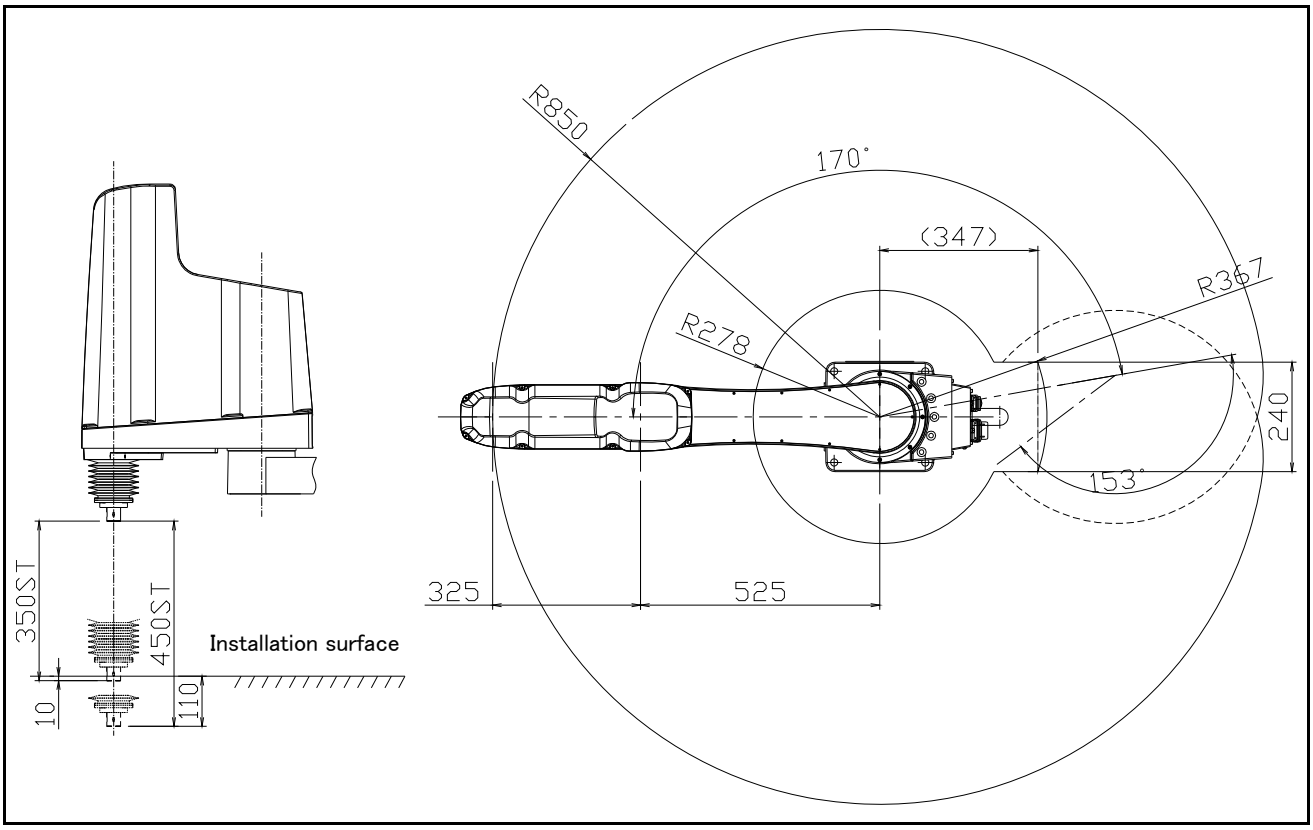
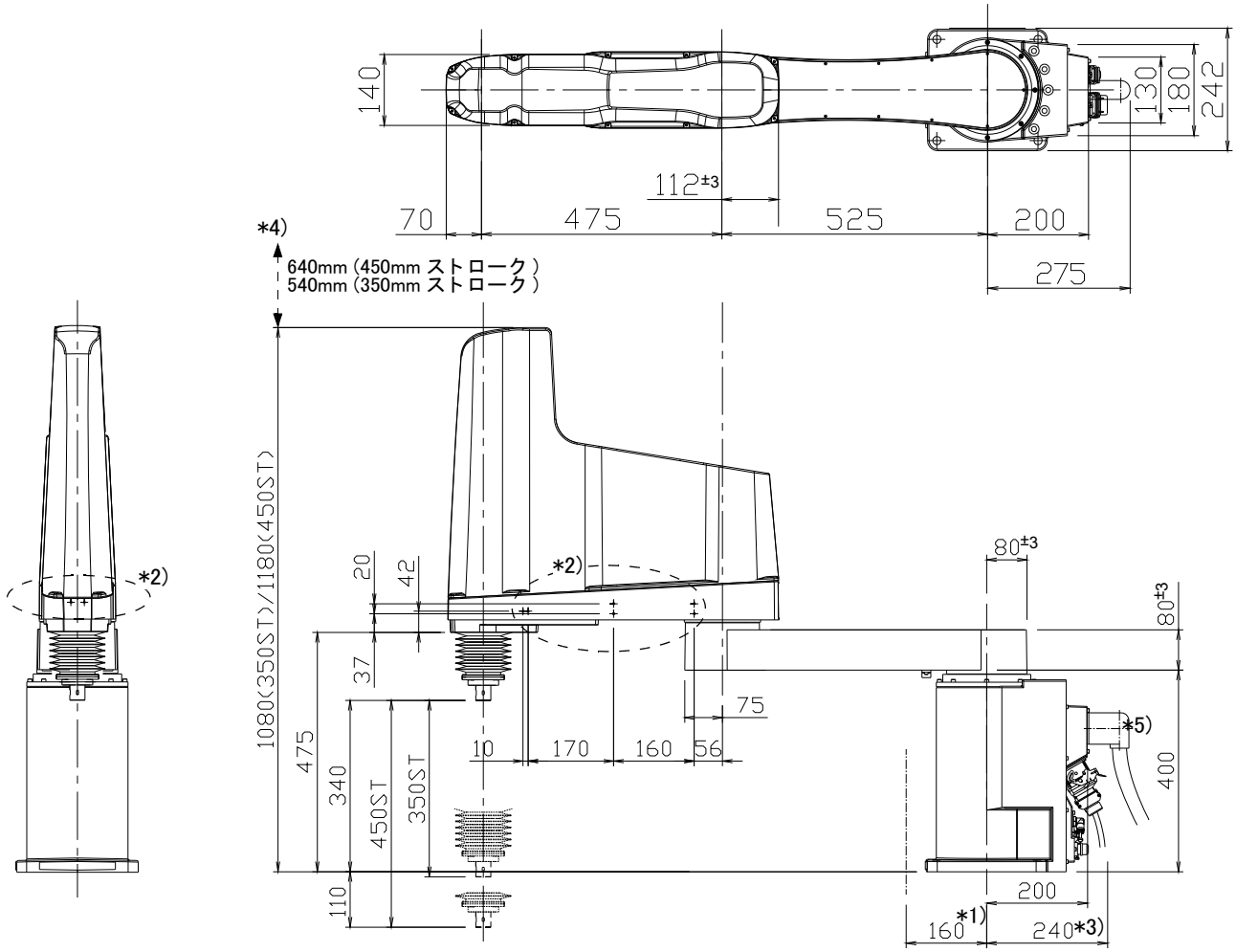


Fig.2-41 : Operating range diagram of RH-20FH85xxC/M

Note
*1) Indicates the space necessary to replace the battery.
*2) Indicates screw holes for fixing user wiring/piping. (Refer to Fig. 2-49)
*3) Minimum radius of bending the machine cable.
*4) Required space to installing/removing the cover.。
*5) The duct (φ50, length: 2m) attached to the clean specification. Be careful for the hand etc. not to interfere and arrange the duct.



Note) Refer to Fig. 2-46 for the mechanical interface section and installation base section dimensions.

Fig.2-42 : Outside dimensions of RH-20FH100xxC/M

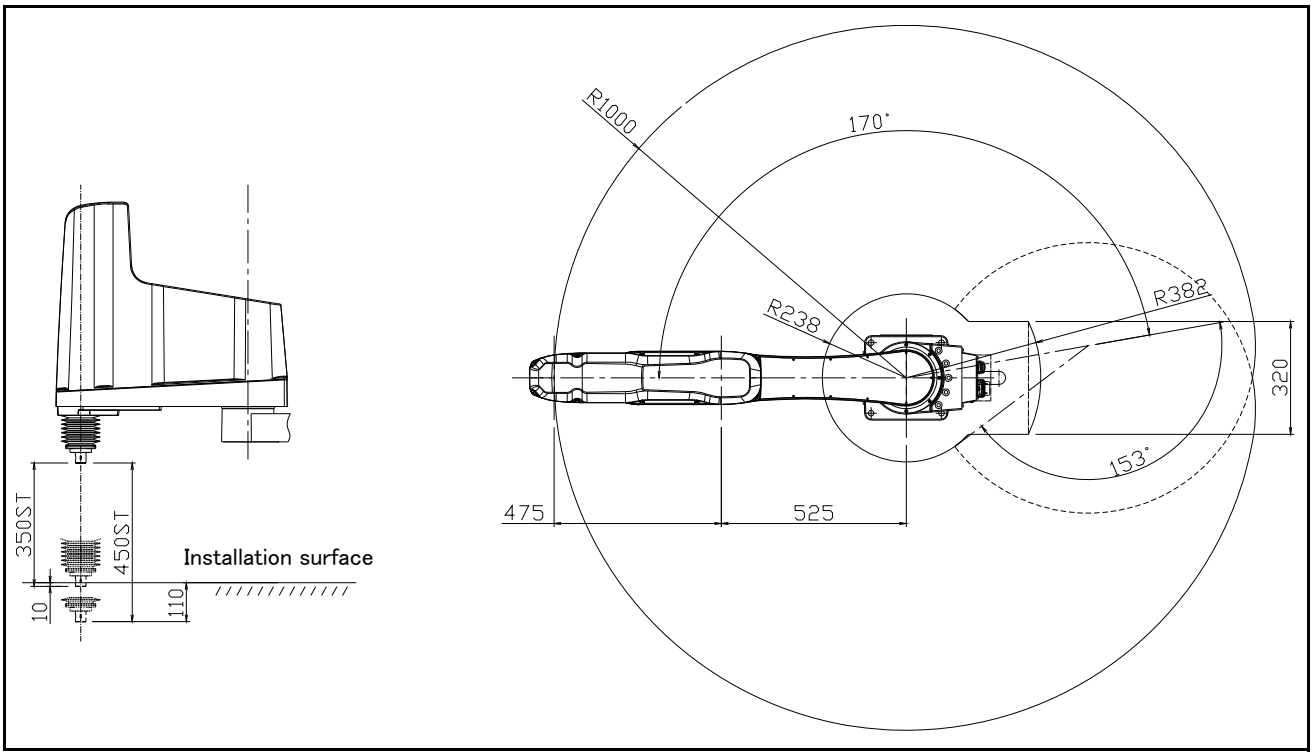
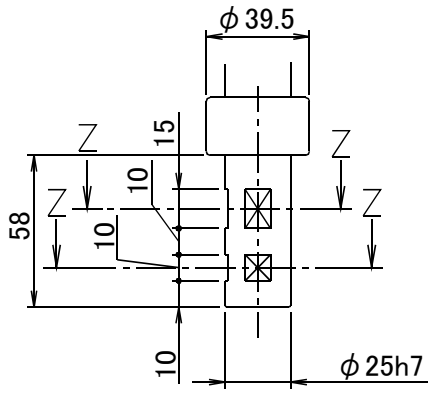


Fig.2-43 : Operating range diagram of RH-20FH100xxC/M

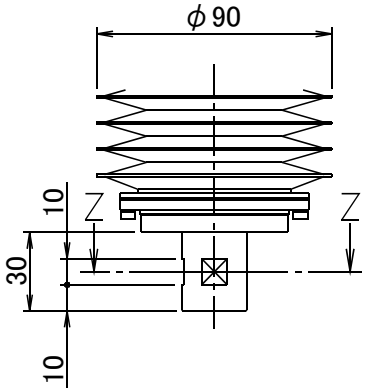
2.4.4 Mechanical interface and Installation surface

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

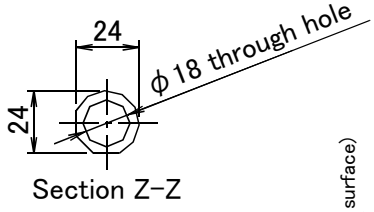
<Detail of Mechanical interface>



Standard, CE marking specification

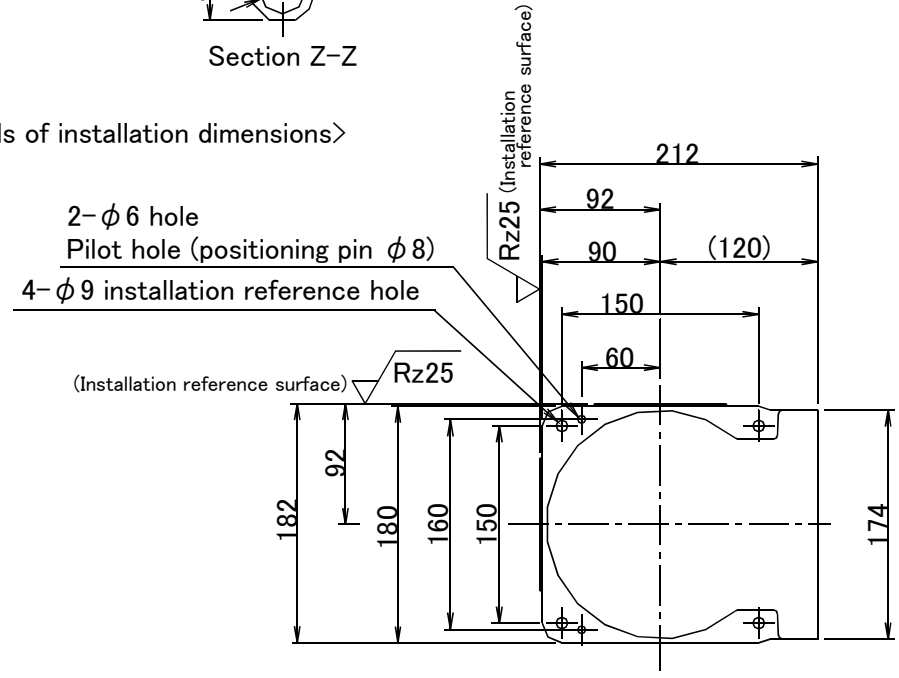


Clean and oil mist specification



Section Z-Z

<Details of installation dimensions>



Note) Don't install the robot arm in the position where direct rays or the heat of lighting hits. The skin temperature of the robot arm may rise, and the error may occur.

Fig.2-44 : Mechanical interface and Installation surface (RH-6FH series)

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

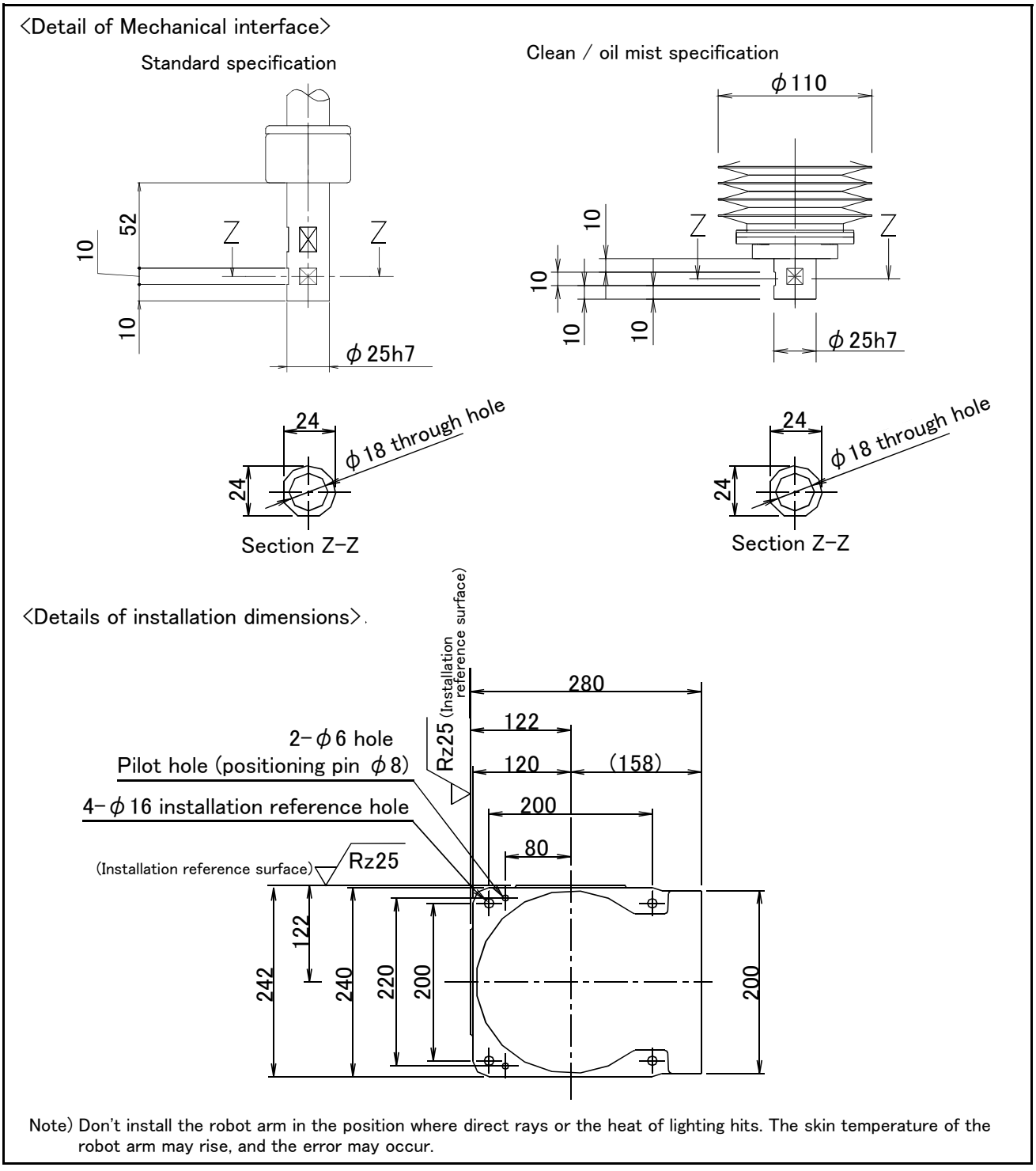
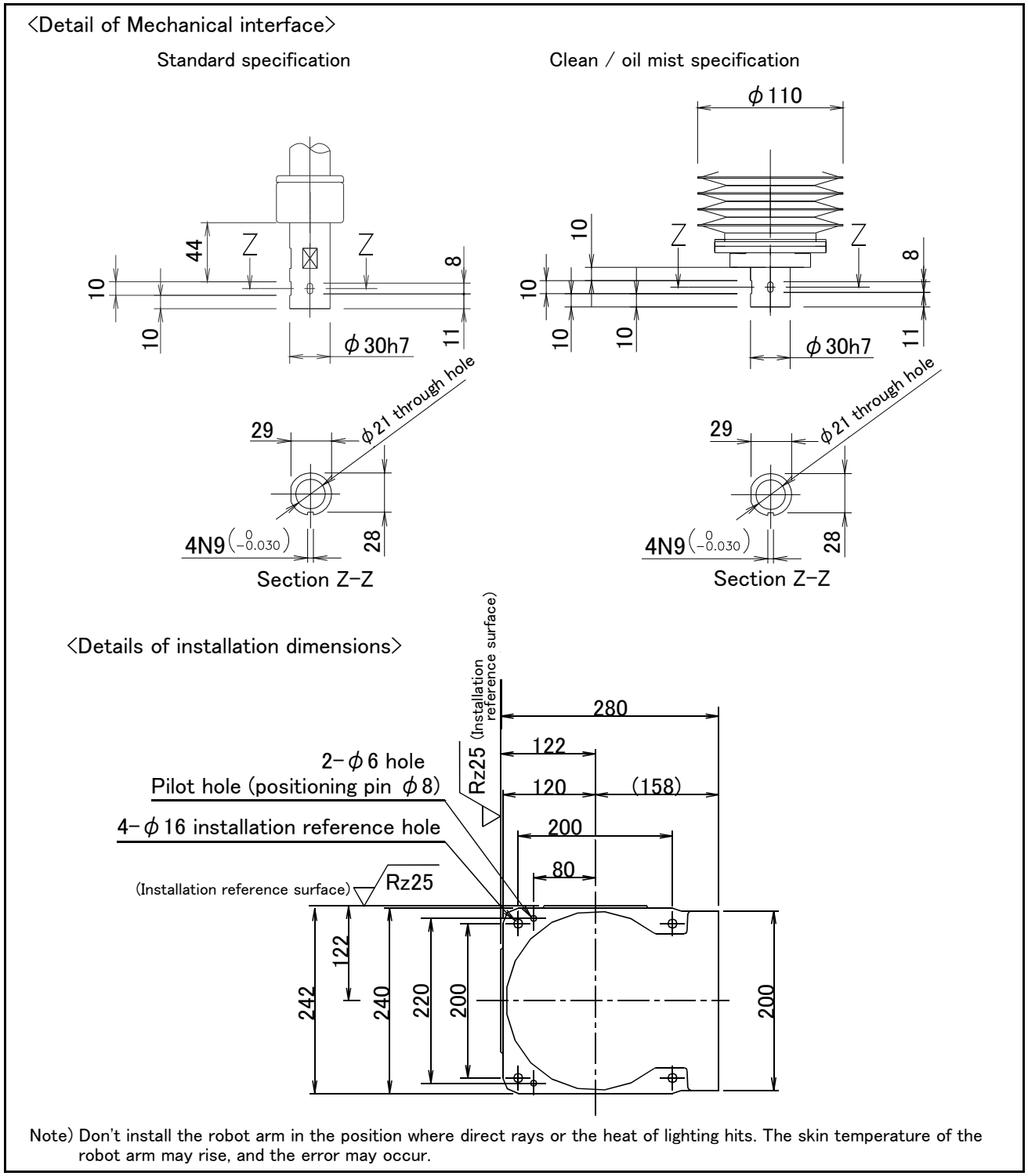


Fig.2-45 : Mechanical interface and Installation surface of RH-12FH series

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



Note) Don't install the robot arm in the position where direct rays or the heat of lighting hits. The skin temperature of the robot arm may rise, and the error may occur.

Fig.2-46 : Mechanical interface and Installation surface of RH-20FH series

2.4.5 Change the operating range

The operating ranges of J1 axis can be limited. Change the mechanical stopper and the operating range to be set inside of that area.

If the operating range must be limited to avoid interference with peripheral devices or to ensure safety, set up the operating range as shown below.

(1) Operating range changeable angle

The operating range must be set up at angels indicated by Table 2-12.

Table 2-12 : Operating range changeable angle

		Type Note1)	Direction Note2)	Standard	Change angle Note3) Note4)	
RH-6FH series						
	J1	RH-6FH35*/45*/55*	+ side	+170 deg	+150 deg	+130 deg
			Mechanical stopper angle	+172.3 deg	+152.3 deg	+132.3 deg
			Mechanical stopper position	P10	P11	P12
			− side	−170 deg	−150 deg	−130 deg
			Mechanical stopper angle	−172.3 deg	−152.3 deg	−132.3 deg
			Mechanical stopper position	P10	N11	N12
RH-12FH/20FH series						
	J1	RH-12FH55*/70*/85* RH-20FH85*/100*	+ side	+170 deg	+150 deg	+130 deg
			Mechanical stopper angle	+173.3 deg	+153.3 deg	+133.3 deg
			Mechanical stopper position	P10	P11	P12
			− side	−170 deg	−150 deg	−130 deg
			Mechanical stopper angle	−173.3 deg	−153.3 deg	−133.3 deg
			Mechanical stopper position	P10	N11	N12

Note1) The "*" of the robot type indicates up/down stroke length and environment specification. It is possible to change the movement ranges shown in Table 2-12 for any model.

Note2) Refer to Fig. 2-44 for mechanical stopper position.

Note3) The changeable angle shown in Table 2-12 indicates the operation range by the software. The mechanical stopper angle in the table shows the limit angle by the mechanical stopper. Use caution when layout designing of the robot.

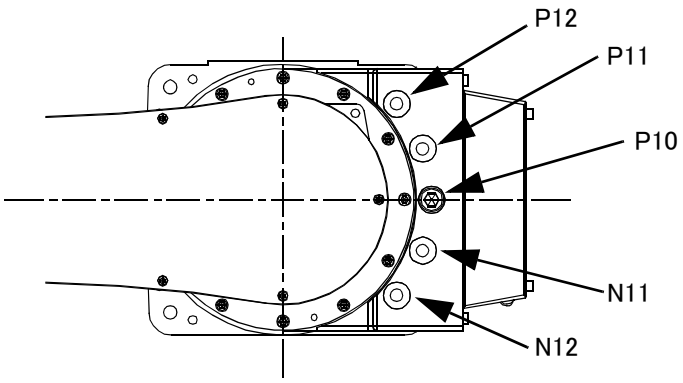
Note4) The changeable angle can be set independently on the + side and − side.

(2) The change method of the operating range

■ Installation of the mechanical stopper

1) Turn off power to the controller.

2) Install the hexagon socket bolt in the screw hole to the angle to set up referring to Table 2-12 and Fig. 2-47. About the mechanical stopper position and the relation of bolt size is shown in Fig. 2-47. When the screw hole is covered by the arm, move the No.1 armslowly by hand.



Installation bolt:
Hexagon socket head cap screw
- RH-6FH series: M10 x 20
- RH-12FH/20FH series: M12 x 20

* Changing the operating range is prepared optional.

Fig.2-47 : Mechanical stopper position

■ Change the operating range parameters

Specify the operating range to parameters MEJAR with appropriate values (variable angles given in Table 2-12) by the following steps:

1) Turn on power to the controller.

2) Set up the operating range changed into parameter MEJAR
MEJAR: (J1 minus (-) side, J1 plus (+) side, ☐ , ☐ , ☐ , ...).

■ Change the mechanical stopper origin position parameters

If you have changed operating range on the J1 minus(-) side, change mechanical stopper origin position parameters by the following step:

1) Set MORG parameter to the angle which set mechanical stopper position.
MORG: (J1 mechanical stopper position, ☐ , ☐ , ☐ , ...).

■ Check the operating range

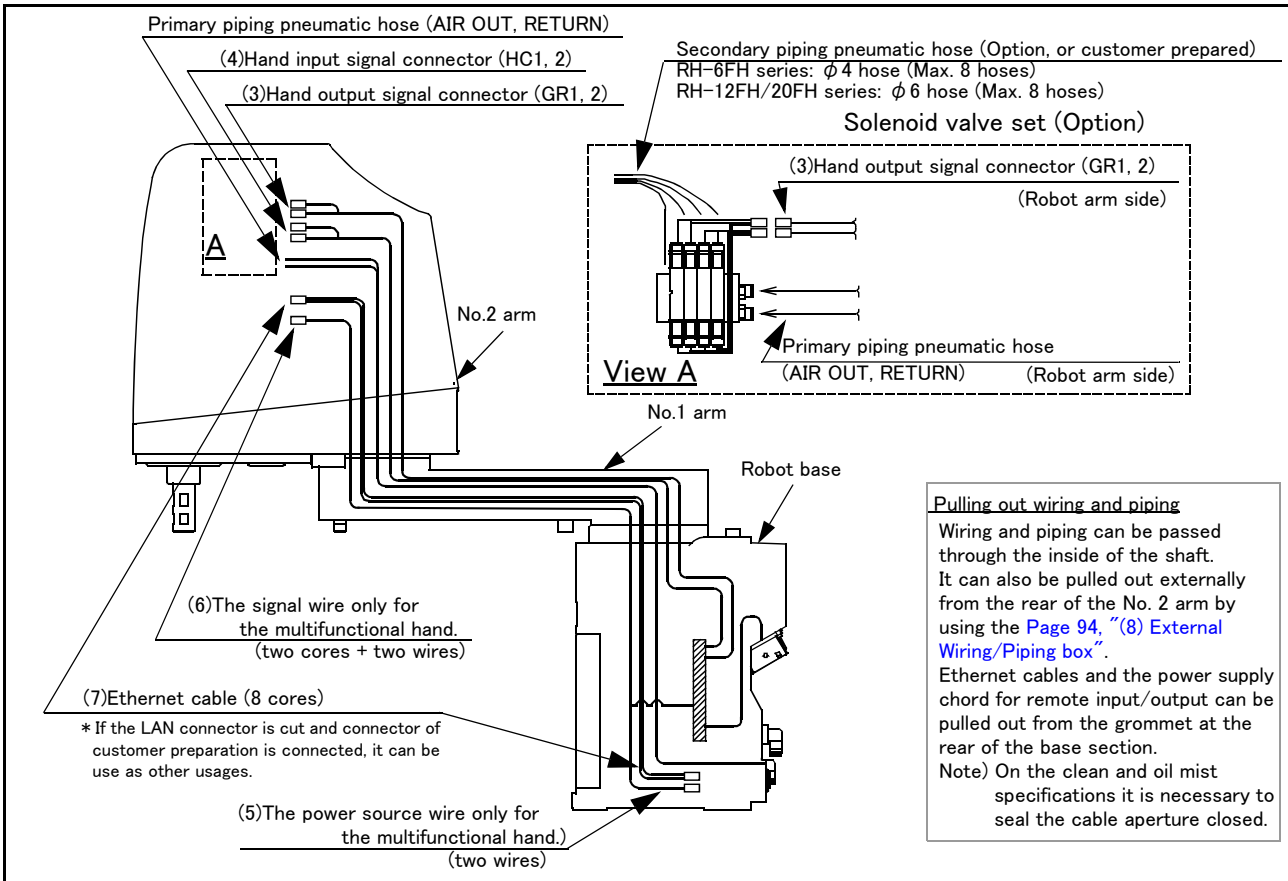
After changing the parameter, turn off the controller power and turn on again. Then, move the axis changed by joint jog operation to the limit of the operating range.
Confirm that the robot stops by limit over at the changed angle.

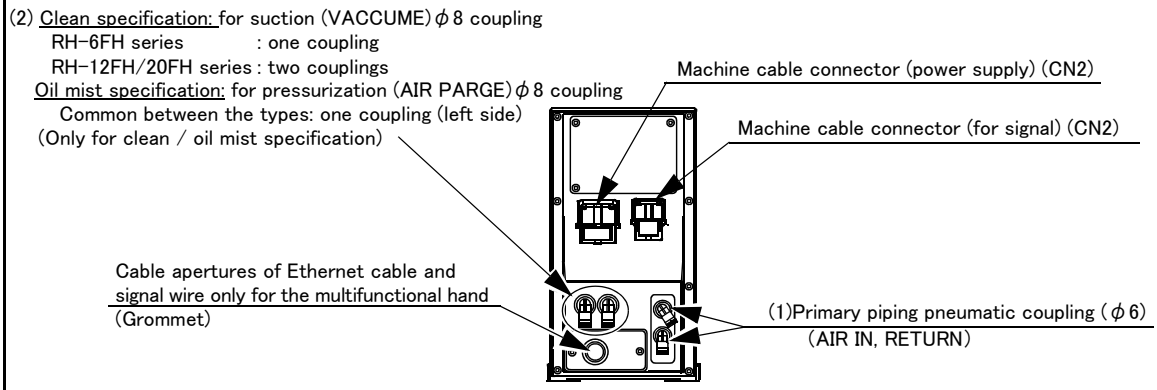
This completes the procedure to change the operating range.

2.5 Tooling

2.5.1 Wiring and piping for hand

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





Connector and pneumatic coupling

No.	Name	Qty.	Robot side (Robot arm side)		Counter side (customer-prepared)		Manufacturer
			Connectors, couplings	Connector pins	Connector	Connector pins	
(1)	Coupling	2	UKBL6	–	–	–	Koganei Corporation
(2)	Coupling	1 or 2 Note1)	UKBL8	–	–	–	Koganei Corporation
(3)	Connector	2	1-1717834-4	1318108-1	1-1318115-4	1318112-1	Tyco Electronics AMP
(4)	Connector	2	1-1717834-3	1318108-1	1-1318115-3	1318112-1	Tyco Electronics AMP
(5)	Connector	1	1-1318117-3	–	–	1318112-1	Tyco Electronics AMP
(6)	Connector	1	2-1717834-4	1318108-1	2-1318115-4	1318112-1	Tyco Electronics AMP
(7)	Connector	1	TM21P-88P	–	–	–	

Note1) The clean specification RH-6FH series: one coupling, RH-12FH/20FH series: two couplings. The oil-mist specification is common to between the types, and is one coupling. The general-purpose environment specification is nothing.

Fig.2-48 : Wiring and piping for hand

2.5.2 Internal air piping

(1) Standard type/Oil mist specifications

1) The robot has two φ6 x 4 urethane hoses from the pneumatic entrance on the base section to the No.2 arm. The base and No.2 arm sides of the hose end are two air joints for φ6 hoses.
2) The solenoid valve set (optional) can be installed to the side on No.2 arm.
3) Refer to Page 84, "(3) Solenoid valve set" for details on the electronic valve set (optional).
4) Protection performance can be improved by pressurizing the inside of the robot arm. Since the joint (AIR PURGE) of φ8 is prepared at the rear of the base section, please supply the dry air for pressurization from this joint. Refer to Page 25, "2.2.7 Protection specifications" for the details of dry air.

(2) Clean type

1) The clean specification basically includes the same piping as the standard type.
2) With the clean specification, a φ8 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).
3) Refer to Page 27, "2.2.8 Clean specifications" for details of the vacuum for suction.
4) Supply clean air to the vacuum generator.

2.5.3 Internal wiring for the hand output cable

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(0.2mm^2)) 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)

2.5.4 Internal wiring for the hand input cable

1) The hand input cable extends from the connector PCB of the base section to the No.2 arm. (AWG#24(0.2mm^2)x 2: 12 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 box ..... 1F-UT-BOX (RH-6FH series)
1F-UT-BOX-01 (RH-12FH/20FH series)

2.5.5 Ethernet cable

Ethernet cables are installed from the 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 as back up wiring, cut the LAN connectors off and use with user supplied connectors.

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 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. 2-49.)
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.

- 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.

(1) RH-6FH series

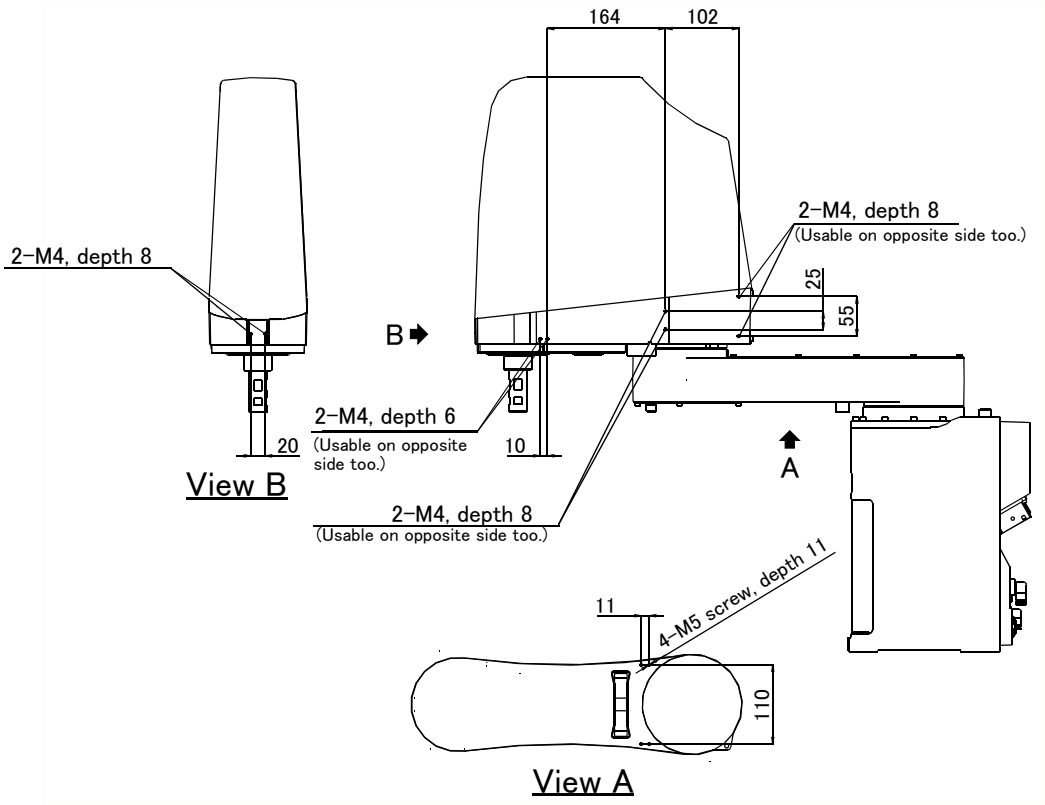


Fig.2-49 : Location of screw holes for fixing wiring/piping (RH-6FH)

(2) RH-12FH/20FH series

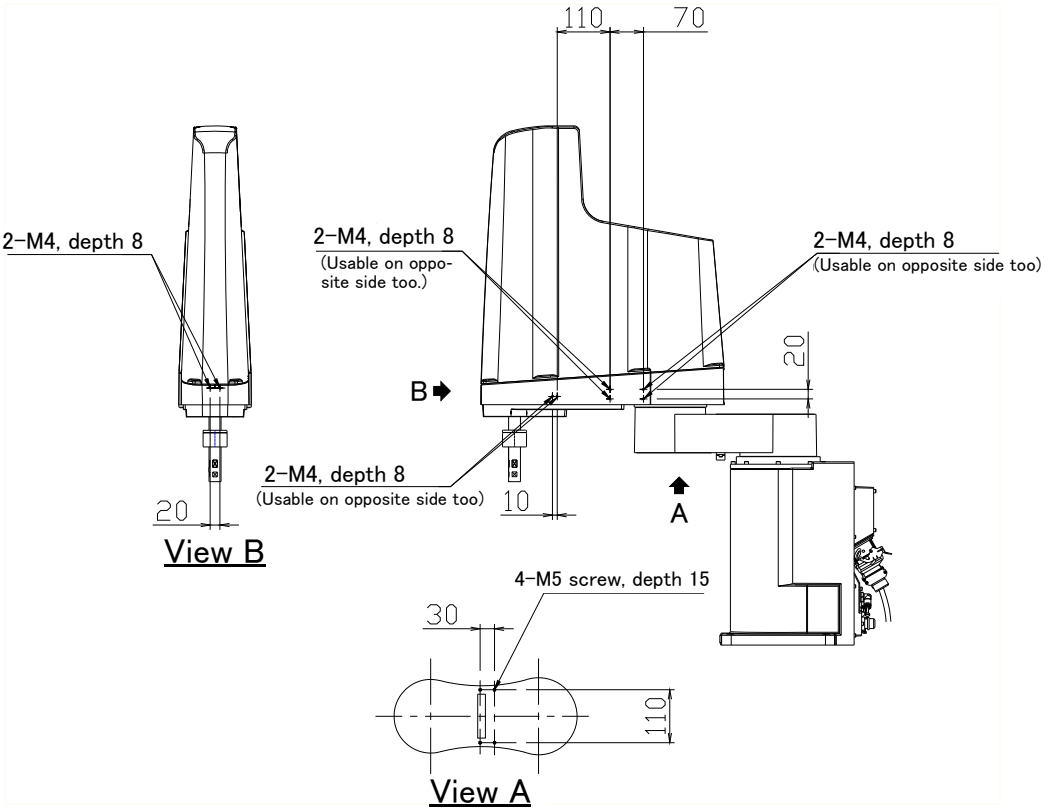


Fig.2-50 : Location of screw holes for fixing wiring/piping (RH-12FH/20FH)

(3) 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>

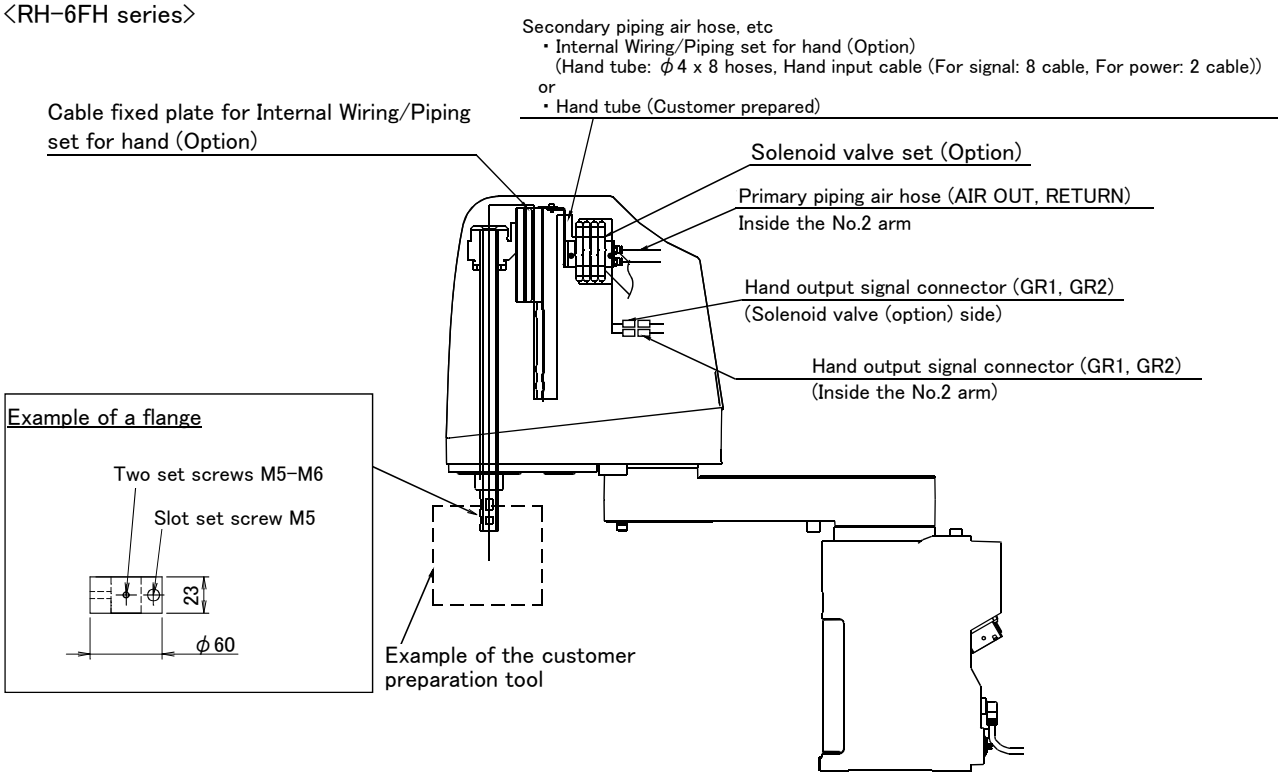


Fig.2-51 : Example of wiring and piping <1> (RH-6FH series)

<RH-12FH/20FH series>

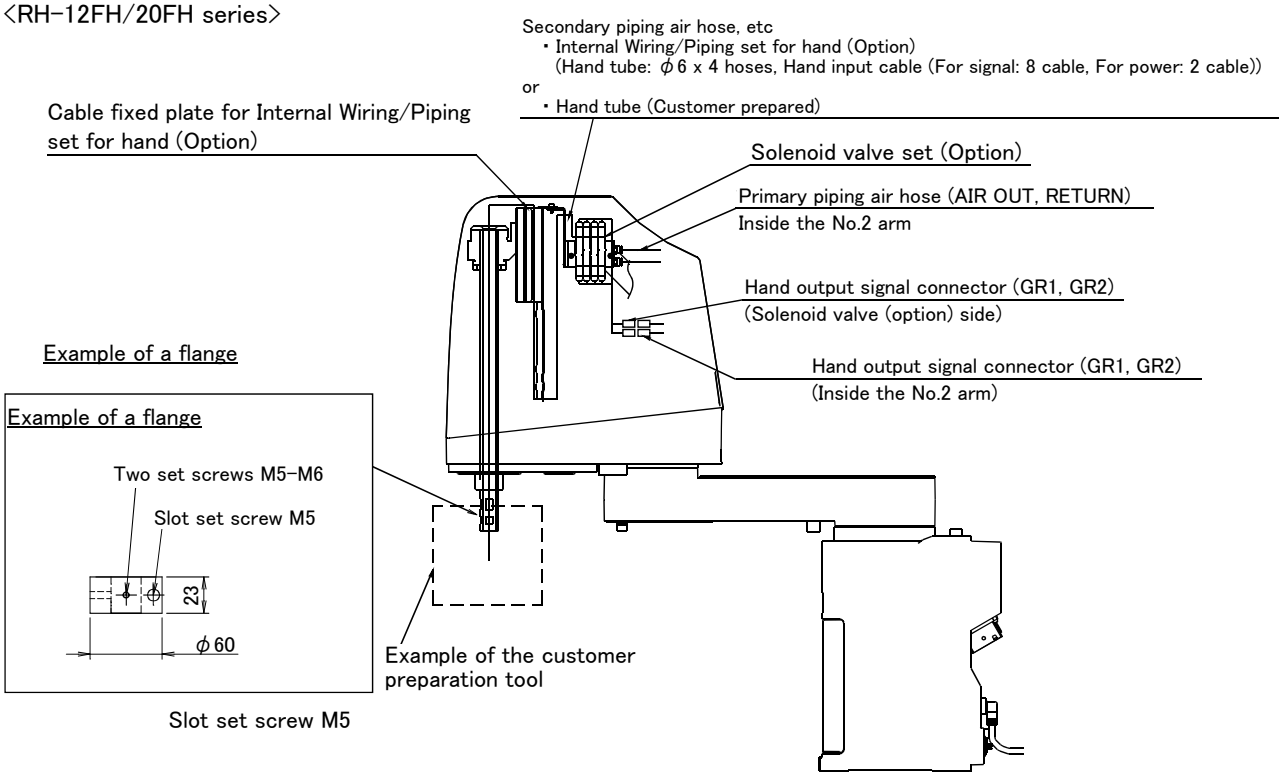


Fig.2-52 : Example of wiring and piping <1> (RH-12FH/20FH series)

(4) 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 ±90°), etc.

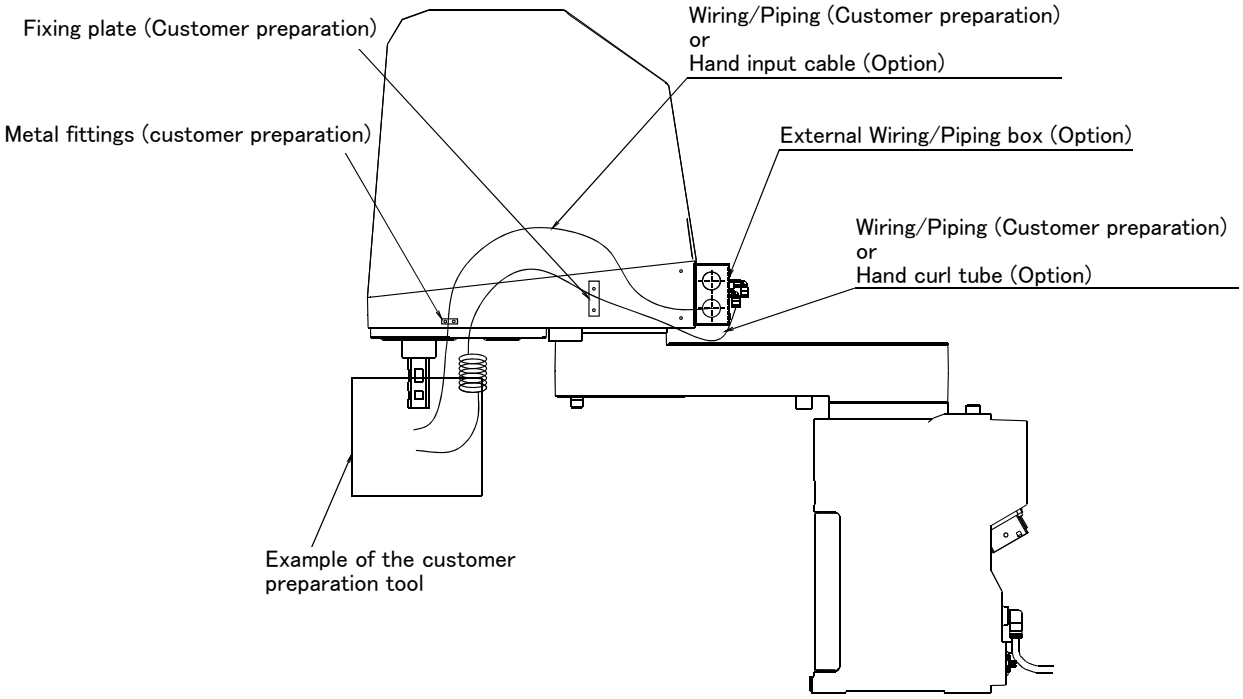


Fig.2-53 : Example of wiring and piping <2>

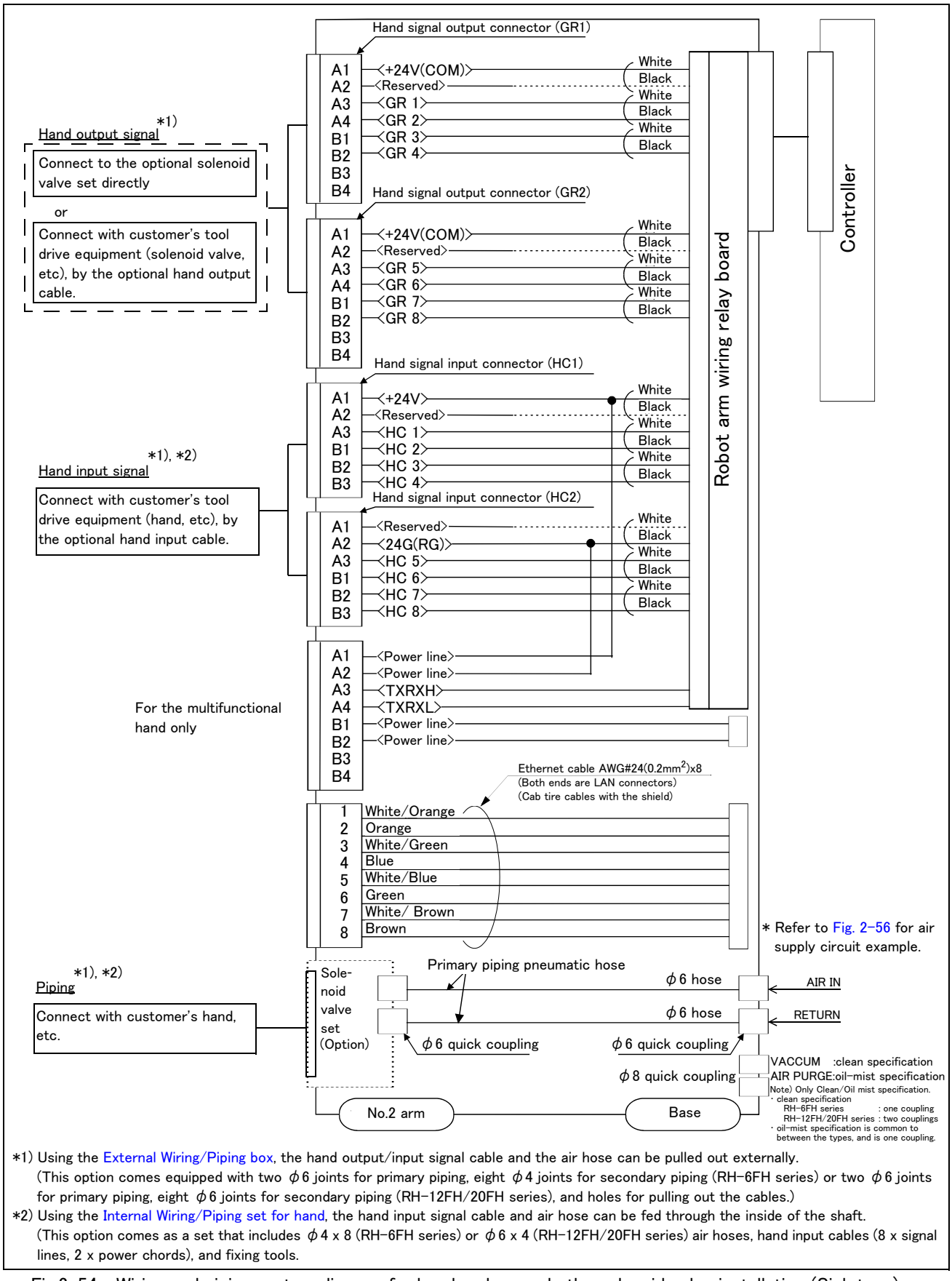
(5) Precautions for the clean specification

The top and bottom parts of the through hole of the tip shaft are taped at shipment.
Perform the following actions as necessary in order to ensure that the robot is sufficiently clean during the operation:

1) When the through hole of the shaft is not used
   - Keep the tip shaft taped while the robot is in use.
2) When the through hole of the shaft is used for wiring.
   - Peel the tape of the tip shaft off and perform the necessary wiring. Once the wiring is completed, seal the tip shaft using liquid seal in order to avoid accumulation of dust.
   - 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.

2.5.7 Wiring and piping system diagram for hand

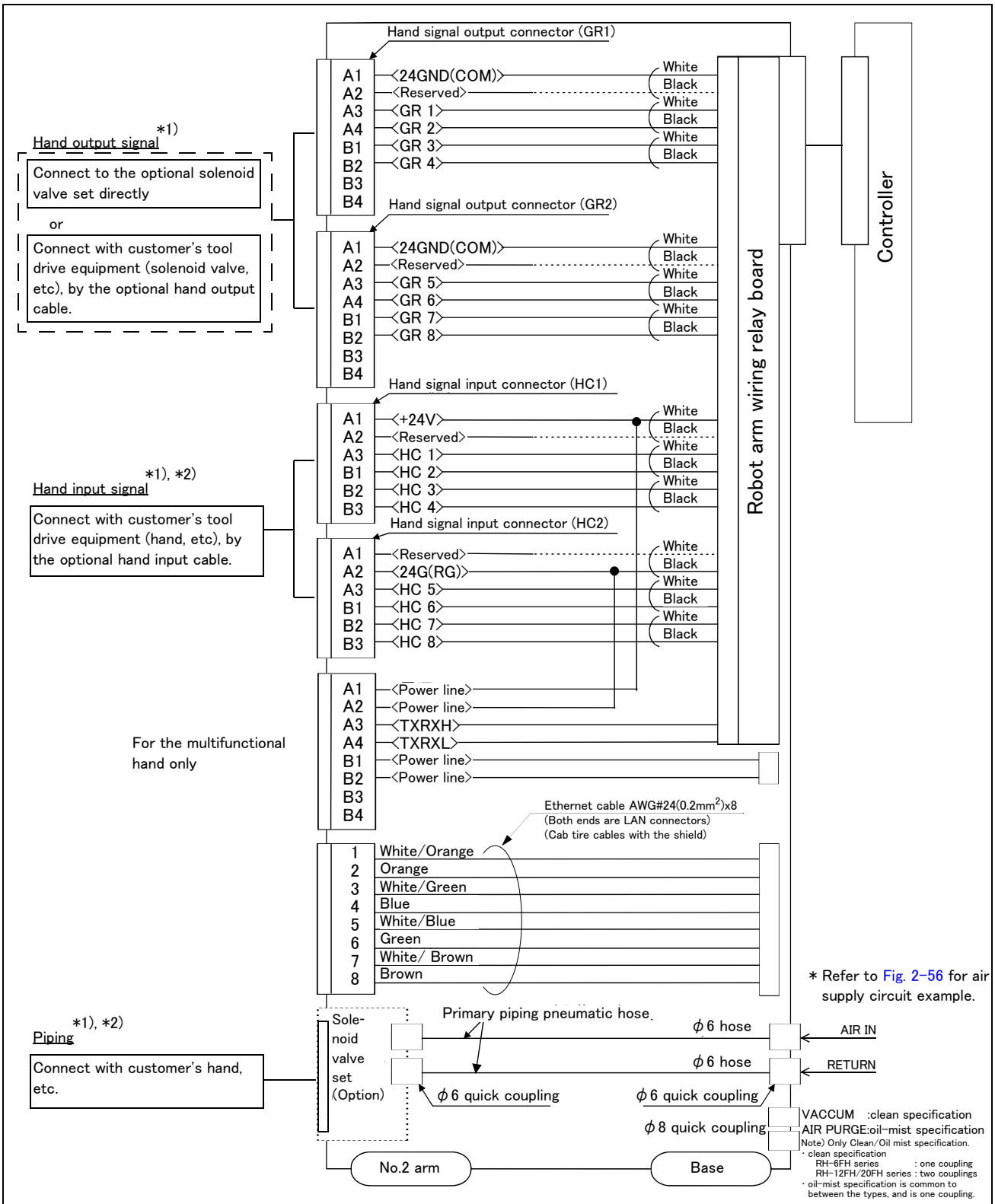
Shows the wiring and piping configuration for a standard-equipped hand.



*1) Using the External Wiring/Piping box, the hand output/input signal cable and the air hose can be pulled out externally.
(This option comes equipped with two φ6 joints for primary piping, eight φ4 joints for secondary piping (RH-6FH series) or two φ6 joints for primary piping, eight φ6 joints for secondary piping (RH-12FH/20FH series), and holes for pulling out the cables.)

*2) Using the Internal Wiring/Piping set for hand, the hand input signal cable and air hose can be fed through the inside of the shaft.
(This option comes as a set that includes φ4 x 8 (RH-6FH series) or φ6 x 4 (RH-12FH/20FH series) air hoses, hand input cables (8 x signal lines, 2 x power chords), and fixing tools.

Fig.2-54 : Wiring and piping system diagram for hand and example the solenoid valve installation (Sink type)



*1) Using the External Wiring/Piping box, the hand output/input signal cable and the air hose can be pulled out externally.
(This option comes equipped with two φ6 joints for primary piping, eight φ4 joints for secondary piping (RH-6FH series) or two φ6 joints for primary piping, eight φ6 joints for secondary piping (RH-12FH/20FH series), and holes for pulling out the cables.)

*2) Using the Internal Wiring/Piping set for hand, the hand input signal cable and air hose can be fed through the inside of the shaft.
(This option comes as a set that includes φ4 x 8 (RH-6FH series) or φ6 x 4 (RH-12FH/20FH series) air hoses, hand input cables (8 x signal lines, 2 x power chords), and fixing tools.

Fig.2-55 : Wiring and piping system diagram for hand and example the solenoid valve installation (Source type)

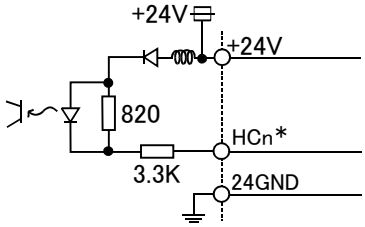
2.5.8 Electrical specifications of hand input/output

Table 2-14 : Electrical specifications of input circuit

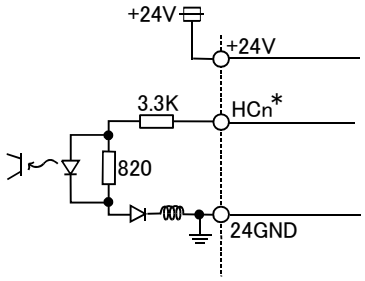
Item		Specifications
Type		DC input
No. of input points		8
Insulation method		Photo-coupler insulation
Rated input voltage		24VDC
Rated input current		approx. 7mA
Working voltage range		DC10.2 to 26.4V (ripple rate within 5%)
ON voltage/ON current		8VDC or more/2mA or more
OFF voltage/OFF current		4VDC or less/1mA or less
Input resistance		Approx. 3.3kΩ
Response time	OFF-ON	10ms or less (DC24V)
	ON-OFF	10ms or less (DC24V)

Internal circuit

<Sink type>



<Source type>



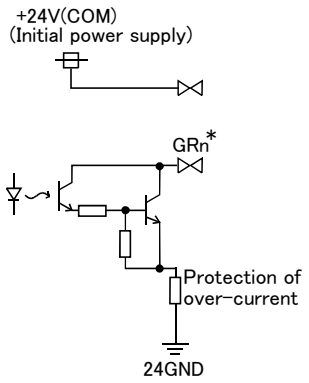
* HCn = HC1 to HC8

Table 2-15 : Electrical specifications of output circuit

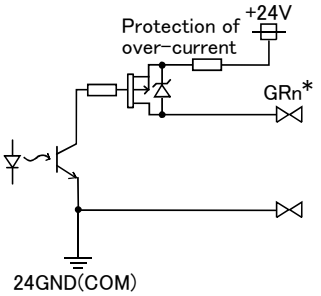
Item		Specification
Type		Transistor output
No. of output points		8
Insulation method		Photo coupler insulation
Rated load voltage		DC24V
Rated load voltage range		DC21.6 to 26.4VDC
Max. current load		0.1A/ 1 point (100%)
Current leak with power OFF		0.1mA or less
Maximum voltage drop with power ON		DC0.9V(TYP.)
Response time	OFF-ON	2ms or less (hardware response time)
	ON-OFF	2 ms or less (resistance load) (hardware response time)
Protects		Protects the over-current (0.9A)

Internal circuit

<Sink type>



<Source type>



* GRn = GR1 to GR8

2.5.9 Air supply circuit example for the hand

Fig. 2-56 shows an example of pneumatic supply circuitry for the hand.

(1) Place diodes parallel to the solenoid coil.

(2) When the factory pneumatic pressure drops, as a result of the hand clamp strength weakening, there can be damage to the work. To prevent it, install a pressure switch to the source of the air as shown in Fig. 2-56 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.

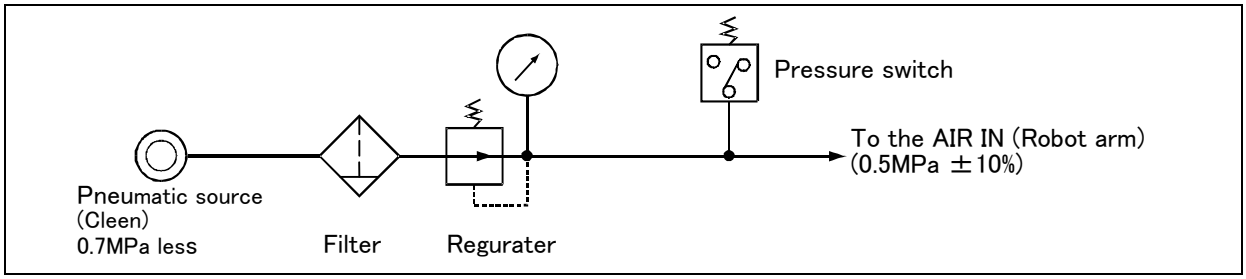


Fig.2-56 : Air supply circuit example for the hand

2.6 Shipping special specifications, options, and maintenance parts

2.6.1 Shipping special specifications

■ What are sipping 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.

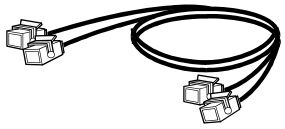
(2) Specify, before shipping from our company.

(3) Specified method …… Specify the part name, model, and robot model type.

(1) Machine cable

■ Order type : ● Fixed type.....1S-02UCBL-01 (2m)

■ Outline



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)
Fixed	Set of signal and power cables	1S-02UCBL-01	1 set	2.6	2m
	Motor signal cable	BKO-FA0741H02	(1 cable)	-	
	Motor power cable	BKO-FA0739H02	(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?

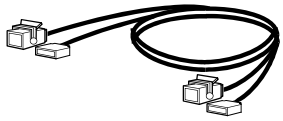
There are a variety of options for the robot designed to make the setting up process easier for customer needs. customer installation is required for the options. Options come in two types: ″set options″ and ″single options″.

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

(1) Machine cable extension

■ Order type: ● Fixed type.....1S- ☐☐ CBL-01(extension type)
● Flexed type .....1S- ☐☐ LCBL-01(extension type)
1S- ☐☐ LUCBL-01(direct type)
Note) The numbers in the boxes ☐☐ refer the length.

■ Outline



The distance between the robot controller and the robot arm is extensible by this option.
A fixed type and flexible type are available.
The extended method is discriminated as follows.
Fixed type ..... ・Adds to the machine cable attached in the standards.
Flexed type..... ・Adds to the machine cable attached in the standards.
・Exchanges with the machine cable attached in the standards.
The fix and flexible types are both configured of the motor signal cable and motor power cable.

■ Configuration
Table 2-17 : Configuration equipment and types

Part name		Type Note1)	Qty.			Mass (kg) Note2)	Remarks
			Fixed (extension type)	Flexed (extension type)	Flexed (direct type)		
Fixed	Set of signal and power cables	1S- ☐☐ CBL-01	1 set	–	–	6.7(5m) 12(10m) 17(15m)	5m, 10m, or 15m each
	Motor signal cable	1S- ☐☐ CBL(S)-01	(1 cable)	–	–		
	Motor power cable	1S- ☐☐ CBL(P)-01	(1 cable)	–	–		
Flexed	Set of signal and power cables	1S- ☐☐ LCBL-01	–	1 set	–	7(5m) 13(10m) 17(15m)	5m, 10m, or 15m each
	Motor signal cable	1S- ☐☐ LCBL(S)-01	–	(1 cable)	–		
	Motor power cable	1S- ☐☐ LCBL(P)-01	–	(1 cable)	–		
Flexed	Set of signal and power cables	1S- ☐☐ LUCBL-01	–	–	1 set	7(5m) 13(10m) 17(15m)	5m, 10m, or 15m each
	Motor signal cable	1S- ☐☐ LUCBL(S)-01	–	–	(1 cable)		
	Motor power cable	1S- ☐☐ LUCBL(P)-01	–	–	(1 cable)		
Nylon clamp		NK-14N	–	2 pcs.	2 pcs.	–	for motor signal cable
Nylon clamp		NK-18N	–	2 pcs.	2 pcs.	–	for motor power cable
Silicon rubber			–	4 pcs.	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
Minimum flexed radius		100R 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
Environmental proof		Oil-proof specification sheath (for silicon grease, cable sliding lubricant type) IP54
Cable configuration	Motor signal cable	φ6 x 5, φ8.5 x 1 and φ1.7 x 1
	Motor power cable	φ8.9 x 3 and φ6.5 x 6

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

■ 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)

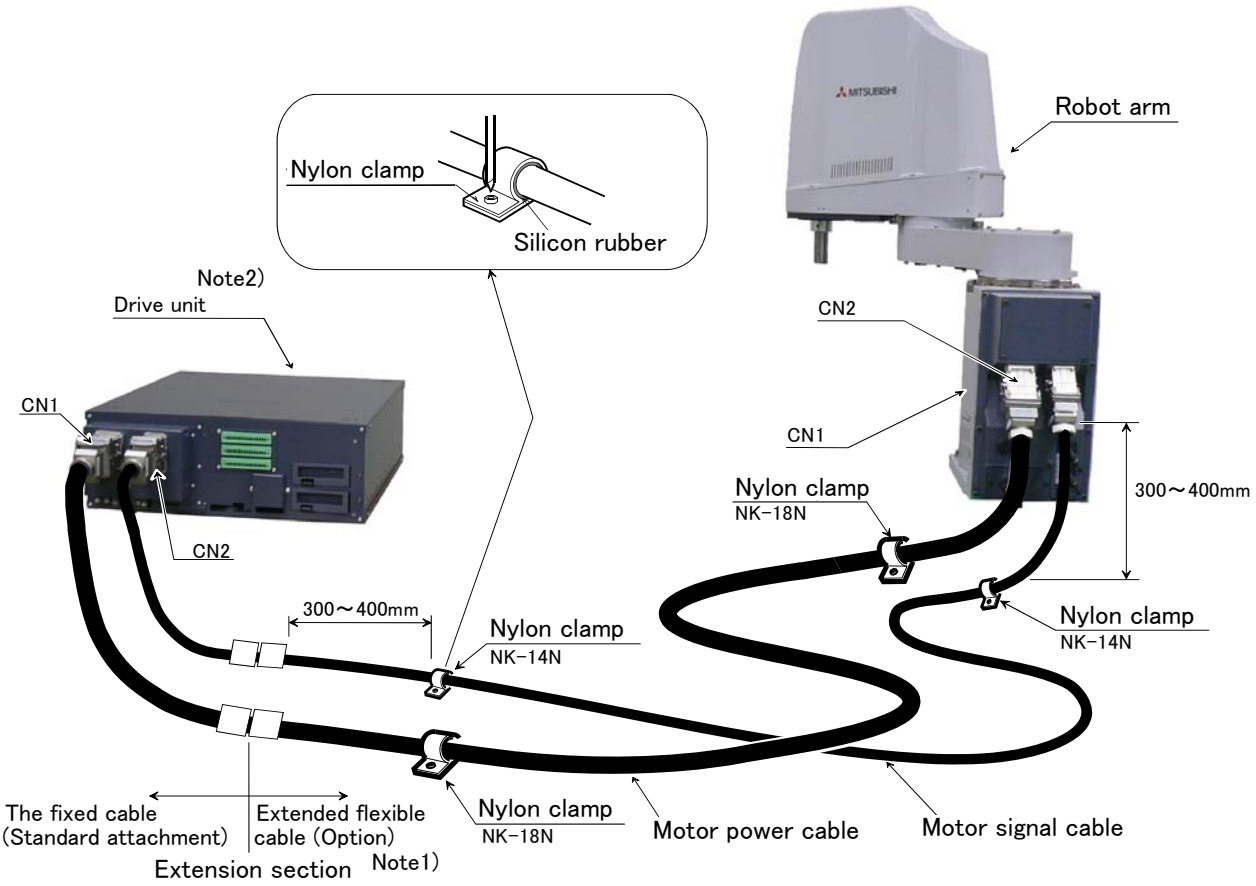
Item	Motor signal cable			Motor power cable	
No. of cores	AWG#24 (0.2mm^2)-4P	AWG#24 (0.2mm^2)-7P	AWG#18 (0.75mm^2)	AWG#16 (1.25mm^2)-4C	AWG#18 (0.75mm^2)-4C
Finish dimensions	Approx. φ6mm	Approx. φ8.5mm	Approx. φ1.7mm	Approx. φ8.9mm	Approx. φ6.5mm
No.of cables used	5 cables	1 cable	1 cable	3 cable	6 cable
No. in total	7 cables			9 cables	

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

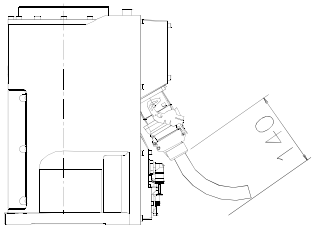
■ Fixing the flexible cable

(1) Connect the connector to the robot arm.

(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 in Fig. 2-57, and fix with the nylon clamp to protect the cable from external stress.



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



The cable shall bend and size shall be 140mm 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.2-57 : Fixing the flexible cable

(2) Changes J1 axis operating range

■ Order type: RH-6FH series .....J1 axis: 1F-DH-01
RH-12FH/20FH series .....J1 axis: 1F-DH-02

■ Outline

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

■ Configuration

Table 2-20 : 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

■ Specifications

Table 2-21 : Specifications

Axis		Standard	Changeable angle
J1	+/- side	+/- 170 deg	+/- 130 deg, +/- 150 deg

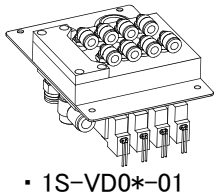
(1) The changeable angle shown in Table 2-21 indicates the operation range by the software.
The limit by the mechanical stopper is positioned 3 degrees outward from that angle, so take care when designing the layout.
(2) The operating range is changed with robot arm settings (insertion of the pin) and parameter settings. Refer to the separate "Instruction Manual/ROBOT ARM SETUP & MAINTENANCE", "Instruction Manual/Detailed Explanation of Functions and Operations"or Page 65, "2.4.5 Change the operating range" 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.

(3) Solenoid valve set

■ Order type: RH-6FH series ..... One set: 1F-VD01-01(Sink type)/1F-VD01E-01(Source type)
Two sets: 1F-VD02-01(Sink type)/1F-VD02E-01(Source type)
Three sets: 1F-VD03-01(Sink type)/1F-VD03E-01(Source type)
Four sets: 1F-VD04-01(Sink type)/1F-VD04E-01(Source type)
RH-12FH/20FH series ..... One set: 1S-VD01-01(Sink type)/1S-VD01E-01(Source type)
Two sets: 1S-VD02-01(Sink type)/1S-VD02E-01(Source type)
Three sets: 1S-VD03-01(Sink type)/1S-VD03E-01(Source type)
Four sets: 1S-VD04-01(Sink type)/1S-VD04E-01(Source type)

■ Outline

・1F-VD0*-01
・1F-VD0*E-01



・1S-VD0*-01
・1S-VD0*E-01

The solenoid valve set is an option that is used for controlling toolings when various toolings, such as the hand, are installed at the end of the arm.
Also, for easy installation of this electromaagnetic set onto the robot, it comes equipped with a manifold, couplings, silencers, among other things.

■ Configuration

Table 2-22 : Configuration equipment

Part name	Type	Q'ty	Mass(kg) Note1)	Remark
RH-6FH series				
Solenoid valve set (1 sets)	1F-VD01-01/ 1F-VD01E-01	Either one pc.	1.0	Hand output cable is already connected. Refer to Page 90, "(5) Hand output cable". M4 x 8 Two screws (Installation screws) 1F-VD0*-01: Sink type 1F-VD0*E-01: Source type.
Solenoid valve set (2 sets)	1F-VD02-01/ 1F-VD02E-01	Either one pc.	1.0	
Solenoid valve set (3 sets)	1F-VD03-01/ 1F-VD03E-01	Either one pc.	1.0	
Solenoid valve set (4 sets)	1F-VD04-01/ 1F-VD04E-01	Either one pc.	1.0	
RH-12FH/20FH series				
Solenoid valve set (1 sets)	1S-VD01-01/ 1S-VD01E-01	Either one pc.	1.0	Hand output cable is already connected. Refer to Page 90, "(5) Hand output cable". M4 x 8 Two screws (Installation screws) 1S-VD0*-01: Sink type 1S-VD0*E-01: Source type.
Solenoid valve set (2 sets)	1S-VD02-01/ 1S-VD02E-01	Either one pc.	1.0	
Solenoid valve set (3 sets)	1S-VD03-01/ 1S-VD03E-01	Either one pc.	1.0	
Solenoid valve set (4 sets)	1S-VD04-01/ 1S-VD04E-01	Either one pc.	1.0	

Note1) Mass indicates one set.

■ Specifications

Table 2-23 : Valve specifications

Item	Specifications
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)	0.64mm
Oiling	Unnecessary
Operating pressure range	0.1 to 0.7MPa
Response time	22msec or less (at 0.5 MPa)
Max. operating frequency	5Hz
Ambient temperature	-10 to 50 ℃ (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 plugs made by SMC).

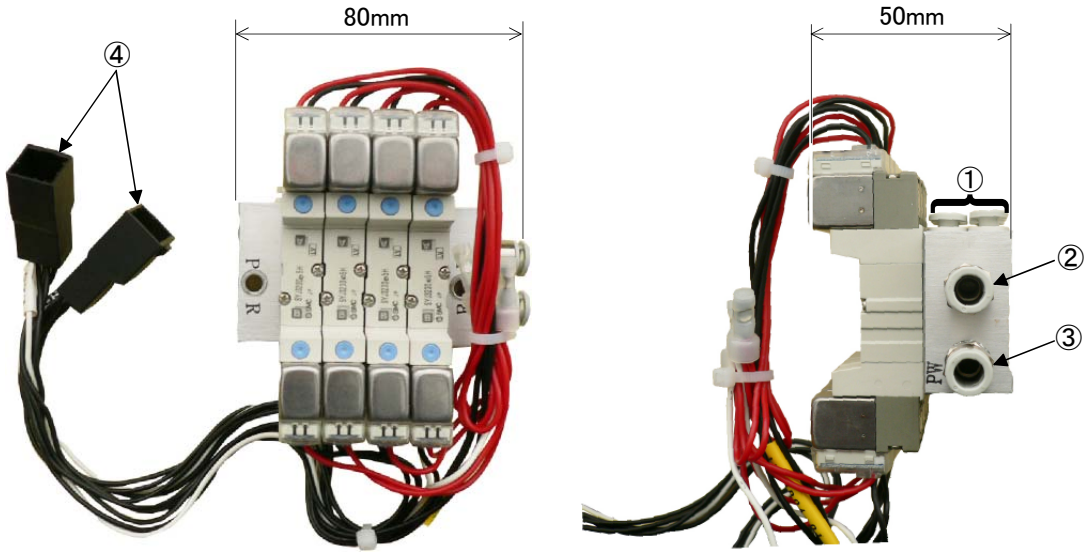
Note2)

⚠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

<RH-6FH series>



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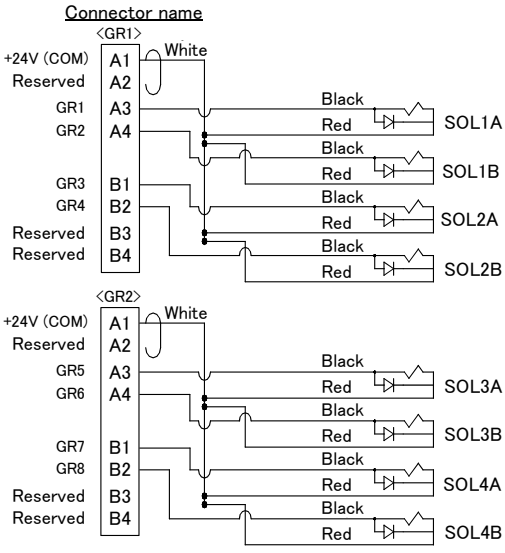

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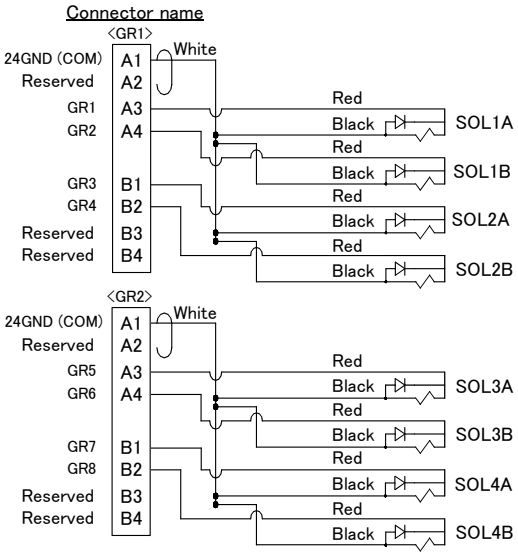
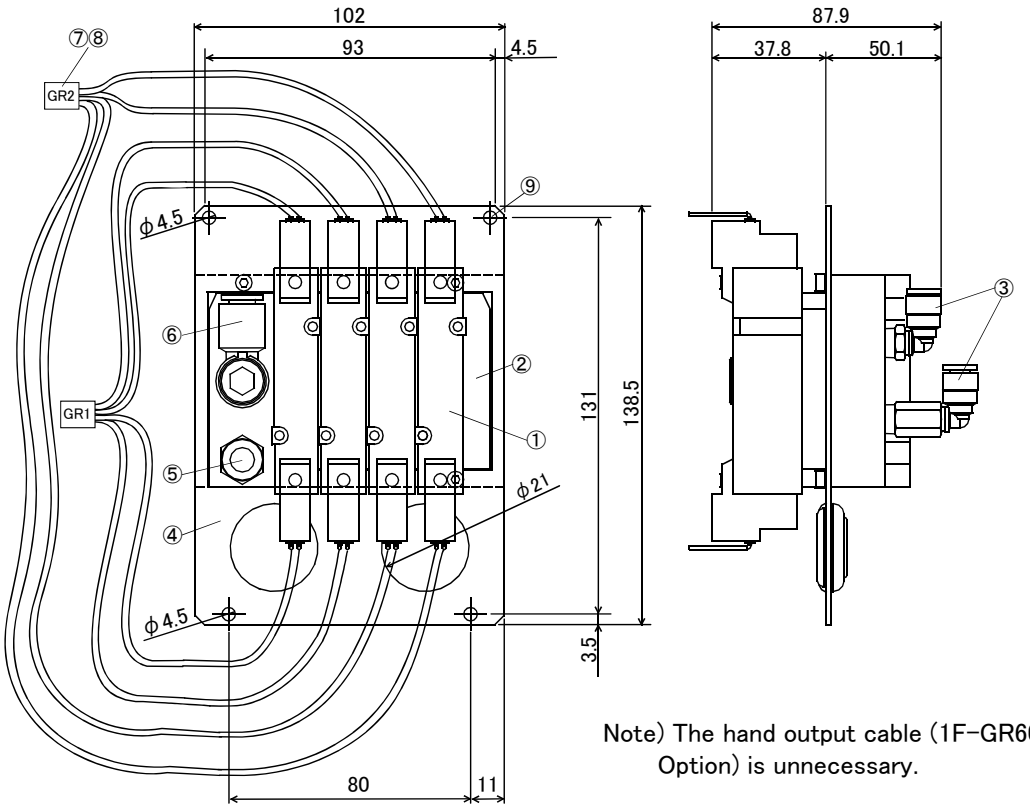


	Part name	Qty.	Specification
①	A, B port	4 peace for each	φ4
②	P port	1	φ6
③	R port	1	φ6
④	Hand output cable connection connector	2	GR1, GR2

Note) The hand output cable (1F-GR60S-01: Option) is unnecessary.

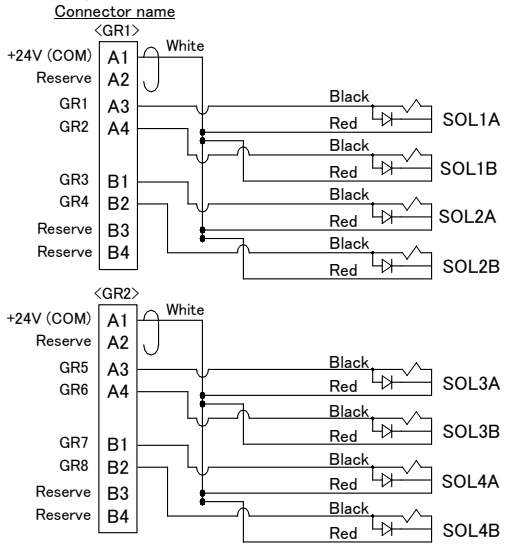
Fig.2-58 : Outline dimensional drawing (RH-6FH series)

<RH-12FH/20FH series>



Note) The hand output cable (1F-GR60S-01: Option) is unnecessary.

<Sink type>



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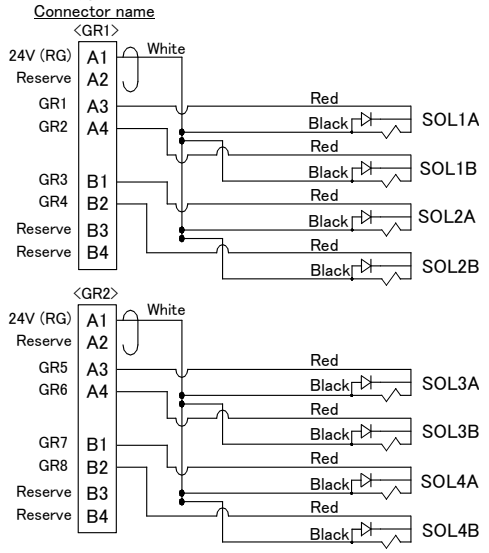


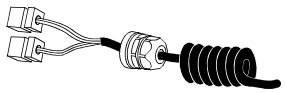
Part no.	Part name	1 sets	2 sets	3 sets	4 sets	Specifications
<1>	Solenoid valve	1	2	3	4	
<2>	Manifold block	1	1	1	1	
<3>	Quick coupling	2	4	6	8	φ6
<4>	Block plate	1	1	1	1	
<5>	Quick coupling	1	1	1	1	φ6
<6>	Quick coupling	1	1	1	1	φ6
<7>	Connector	1	1	2	2	1-1318115-4
<8>	Contact	6	6	12	12	1318112-1
<9>	Installation screw	4	4	4	4	M4×8

Fig.2-59 : Outline dimensional drawing (RH-12FH/20FH series)

(4) Hand input cable

■ Order type: RH-6FH series.....1F-HC35C-01
RH-12FH/20FH series.....1F-HC35C-02

■ 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

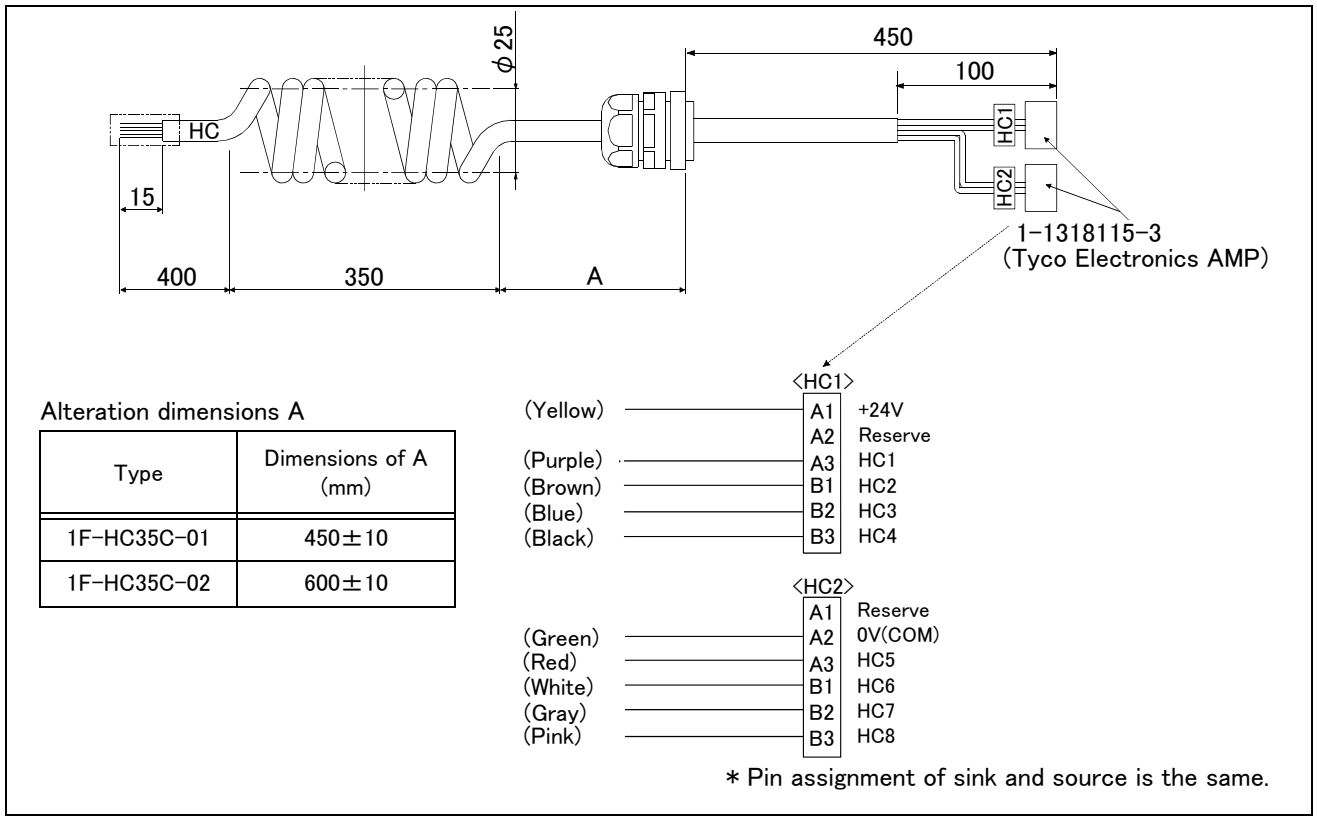
Part name	Type	Qty.	Mass (kg) Note1)	Remarks
RH-6FH series				
Hand input cable	1F-HC35C-01	1 cable	0.2	
RH-12FH/20FH series				
Hand input cable	1F-HC35C-02	1 cable	0.2	

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) × 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) × 12	One-sided connector, one-sided cable bridging
Total length	1,800mm (Including the curl section, which is 350mm long)	



Alteration dimensions A

Type	Dimensions of A (mm)
1F-HC35C-01	450±10
1F-HC35C-02	600±10

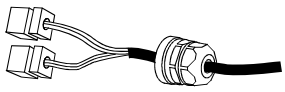
Fig.2-60 : Outside dimensional drawing and pin assignment

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

(5) Hand output cable

■ Order type: 1F-GR60S-01

■ 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	

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	

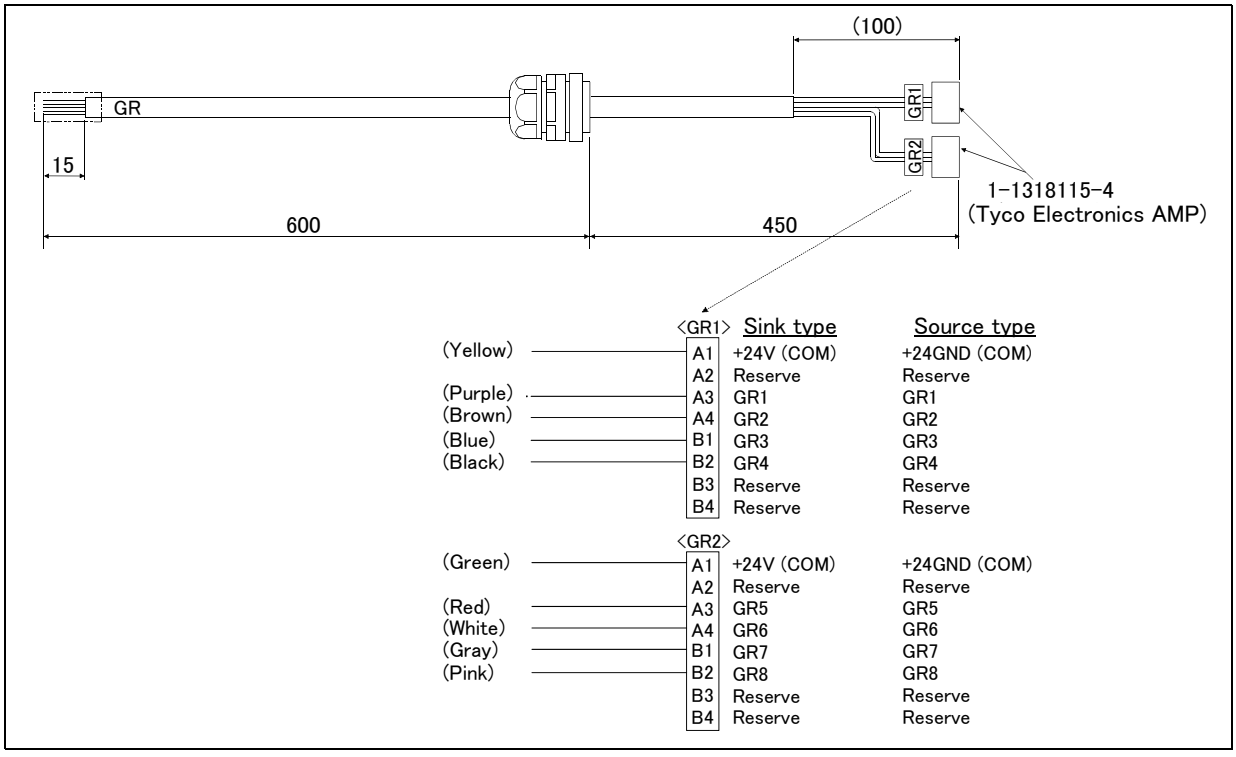


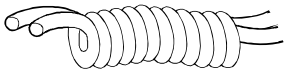
Fig.2-61 : Outline dimensional drawing and pin assignment

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

(6) Hand curl tube

■ Order type: RH-6FH series .....Four sets: 1E-ST0408C-300
RH-12FH/20FH series.....Four 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

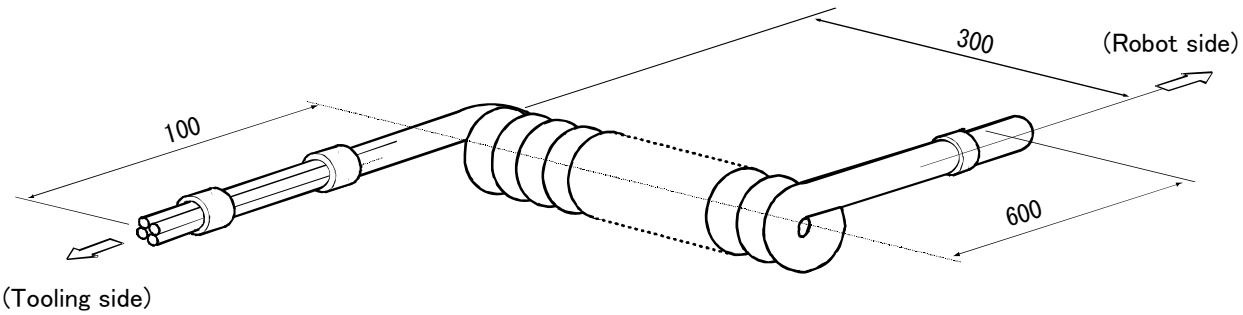
Note1) Mass indicates one set.

■ 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

RH-6FH series: 1E-ST0408C-300 (φ4 x 8pcs)



RH-12FH/20FH series: 1N-ST0608C-01 (φ6 x 8pcs)

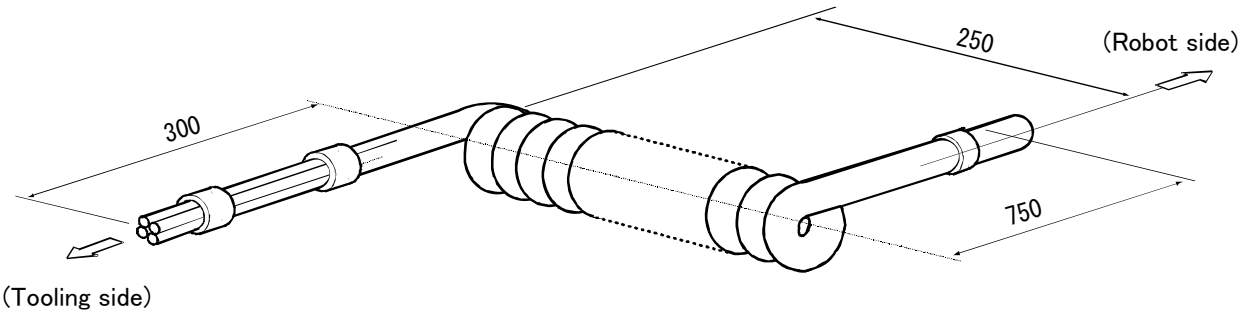


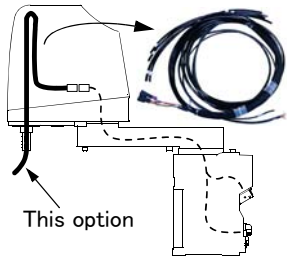
Fig.2-62 : Outline dimensional drawing

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

(7) 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 2-31 : 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 2-32 : Specification

Item		Specification			Remarks
		1F-HS408S-01 1F-HS408S-02	1F-HS604S-01	1F-HS604S-02	
Air hose		ϕ4 x 8pcs	ϕ4 x 8pcs		Both ends are free.
Hand input signal cable	Signal	AWG #25(0.2mm^2) × 8pcs			The robot arm side is connector (HC1, HC2), and one side is free.
	Power	AWG #23(0.3mm^2) × 2pcs			
Useable length from the shaft end		300mm	400mm	300mm	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.

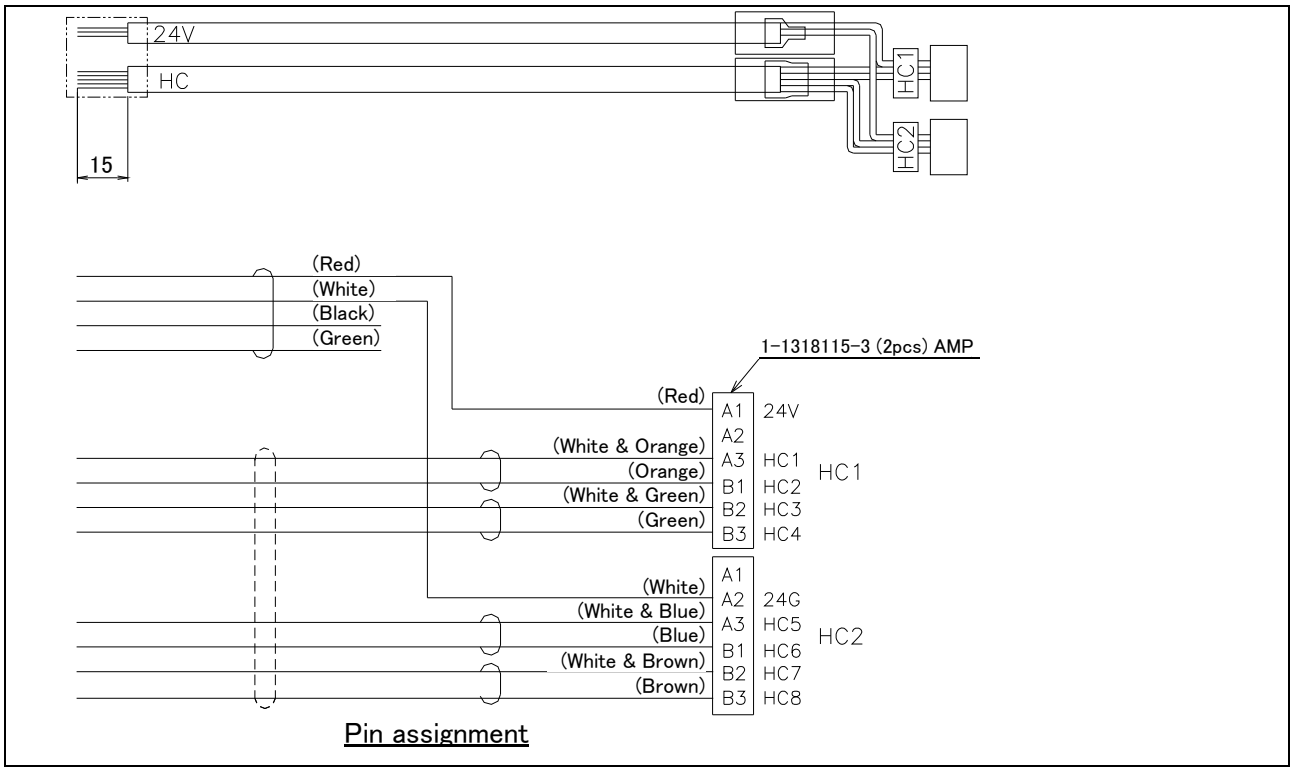
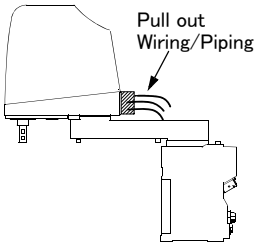


Fig.2-63 : Outline dimension drawing and pin assignment (Hand input cable)

(8) 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 2-33 : Configuration equipment

Part name	Type	Qty.	Mass (Kg) Note1)	Remarks
RH-6FH series				
External Wiring/Piping box	1F-UT-BOX	1	0.5	Attachment ・Eight Air hoses (φ4, connect to solenoid valve) ・Installation screw M4 x 12: 4 screws (Conical spring washer, Plain washer)
RH-12FH/20FH series				
External Wiring/Piping box	1F-UT-BOX-01	1	0.5	Attachment ・Eight Air hoses (φ6, connect to solenoid valve) ・Installation screw M4 x 12: 4 screws (Conical spring washer, Plain washer)

Note1) Mass indicates one set.

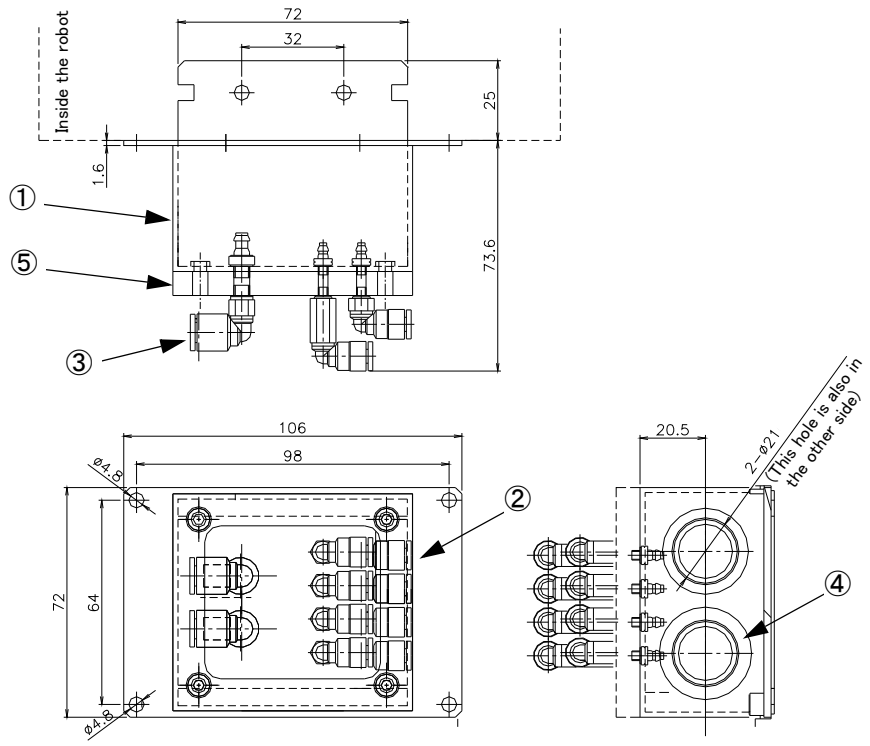
■ Specification

Table 2-34 : 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	φ21 x 4 places	Fix the cable by cable clamp etc.
	Coupling	For φ4 air hose x 8pcs	Installed previously
		For φ6 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	φ21 x 4 places	Fix the cable by cable clamp etc.
	Coupling	For φ6 air hose x 8pcs	Installed previously

An outside dimension and a component are shown in Fig. 2-64.

<RH-6FH series>

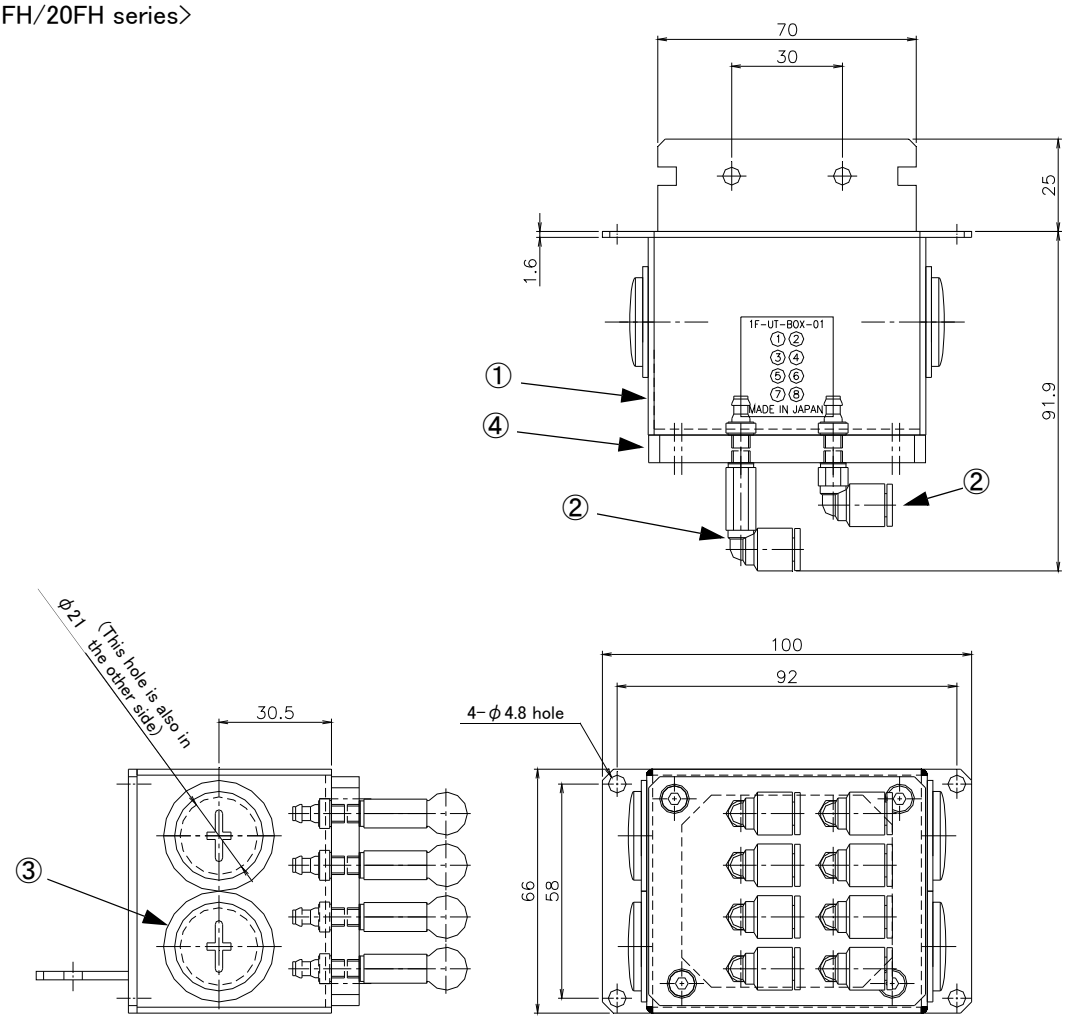


Configuration

	Part name	Qty.	Specification
①	External Wiring/Piping box housing	1	
②	Quick coupling	8	ϕ4 (Elbow)
③	Quick coupling	2	ϕ6 (Elbow)
④	ϕ21 hole	4	The grommet is attached to each hole. (Two holes are in the right and the left.)
⑤	Manifold block	1	
–	Plug	8	Stopper for ϕ4 quick coupling
–	Plug	2	Stopper for ϕ6 quick coupling
–	Installation screw	4	Installation screws M4 x 12 Conical spring washer, Plane washer (Attachment)

Fig.2-64 : Outline dimension and configurations (RH-6FH series)

<RH-12FH/20FH series>



Configuration

	Part name	Qty.	Specification
①	External Wiring/Piping box housing	1	
②	Quick coupling	8	φ6 (Elbow)
③	φ21 hole	4	The grommet is attached to each hole. (Two holes are in the right and the left.)
④	Manifold block	1	
–	Plug	8	Stopper for φ6 quick coupling
–	Installation screw	4	Installation screw M4 x 12 Conical spring washer, Plane washer (Attachment)

Fig.2-65 : 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. Overhaul interval for robots presumably varies with their operating conditions and thus with the degree of the equipment's wear and loss of performance. As a rule of thumb, however, it is recommended that overhaul be carried out before the total amount of servo-on time reaches the predetermined levels (24,000 hours for the robot body and 36,000 hours for the controller). (See Fig. 2-66.) For specific information about parts to be replaced and timing of overhaul, contact your local service representative.

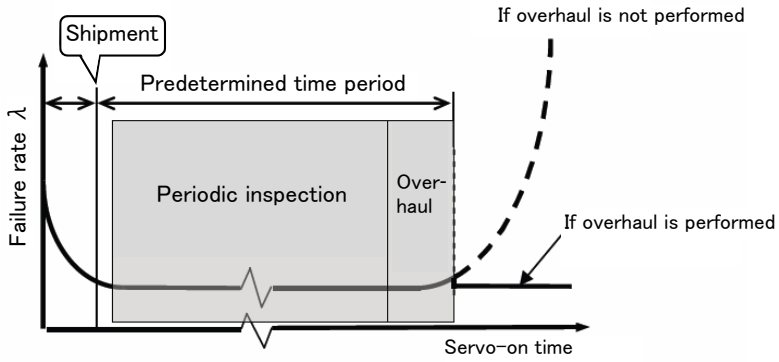


Fig.2-66 : Periodic inspection/overhaul periods

2.9 Maintenance parts

The consumable parts used in the robot arm are shown in Table 2-35. 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 2-35 : Consumable part list

No.	Part name	Type Note1)	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	ER6	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	

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

Use the robot CPU unit which consists of CR751-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 103 "Fig. 3-2"(Names of each part), Page 105 "Fig. 3-4" and Page 106 "Fig. 3-5" (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			CR750-06HQ-1 CR750-12HQ-1 CR750-20HQ-1	CR750-06HD1-1-S15 is the same
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 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	Dual line
	Door switch input	point	1	Dual line
	Enabling device input	point	1	Dual line
	Emergency stop output	point	1	Dual line
	Mode output	point	1	Dual line
	Robot error output	point	1	Dual line
	Addition axis synchronization	point	1	Dual line
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: 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: 1.0 RH-12/20FH series: 1.5	Does not include rush current Note3)
	Power supply frequency	Hz	50/60	
Outline dimensions Note4)		mm	430(W) x 425(D) x 174(H)	Excluding protrusions
Mass		kg	RH-6FH series : Approx. 16 RV-12FH/20FH series : Approx. 18	
Construction			Self-contained floor type, Opened type. Installation vertically or horizontally	IP20 Note5)
Operating temperature range		℃	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	

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 104, "3.4 Outside dimensions/Installation dimensions" for details.
Note5) This controller is standard specification. (Refer to Page 100, "3.2 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		℃	0 to 55	
Ambient humidity		%RH	5 to 95	Without dew drops

3.2 Protection specifications and operating supply

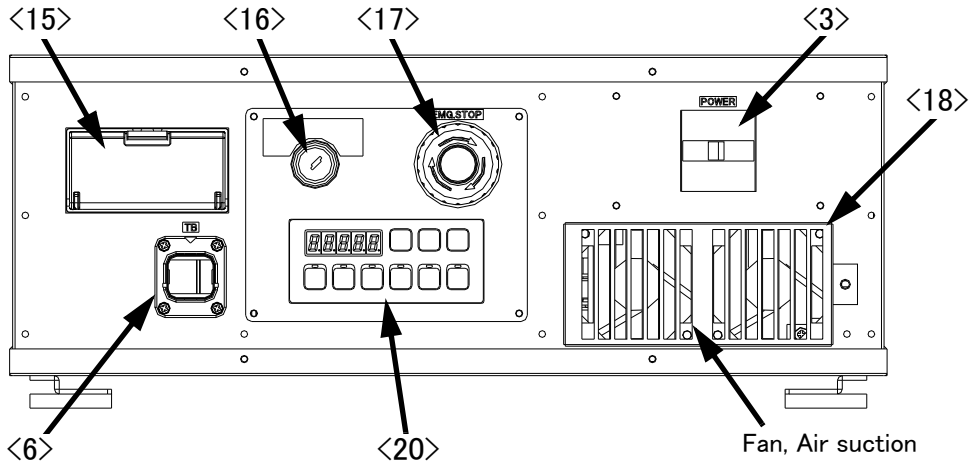
A protection method complying with the IEC Standard IP20 (Opened type) is adopted for the controller.
The IEC IP symbols refer only to the degree of protection between the solid and the fluids, and don't indicated that any special protection has been constructed for the prevention against oil and water.

【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 kg±10%, from going through the opening in the outer sheath of the supplied equipment.

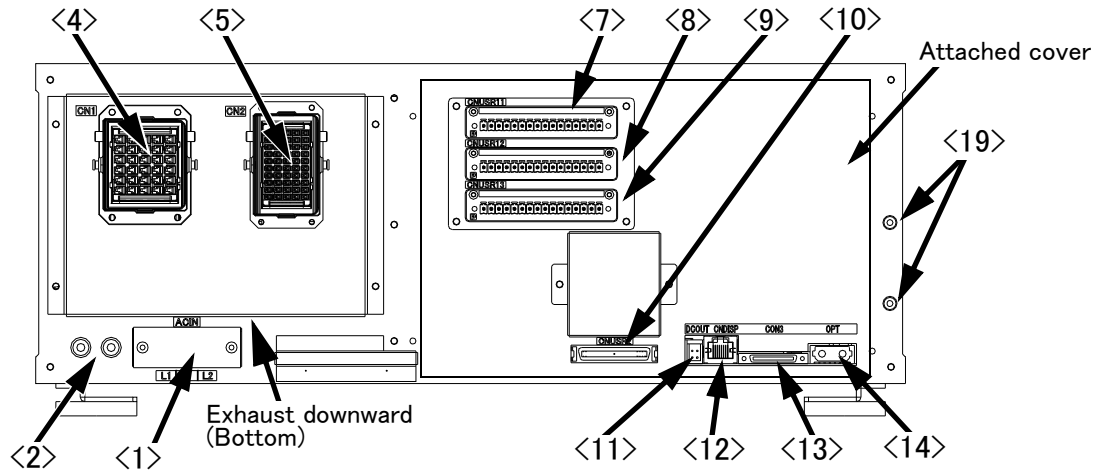
Refer to the section Page 157, "6.2 Working environment" for details on the working environment.

3.3 Names of each part

Drive unit (Front side)

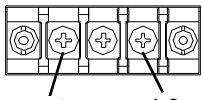


Drive unit (Rear side)

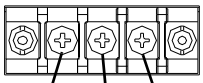


<1>: ACIN terminal

RH-6FH: Single phase



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



<20>: The operation panel

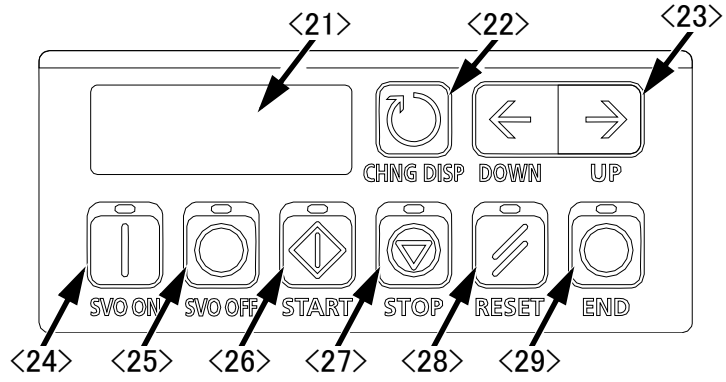


Fig.3-1 : Names of drive unit parts (CR750)

<1> ACIN terminal ..... The terminal box for AC power source (single phase or single phase/ three phase, AC200V) input. (Inner side of a cover)
Note)When using the RH-6FH series, connect the primary power supply to L1 and L2 terminal.
When using the RH-12FH/20FH series, connect the primary power supply to L1, L2 and L3 terminal when using the three phase primary power supply, and connect the primary power supply to L1 and L3 terminal when using the single phase primary power supply.
<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
<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
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> Interface cover ..... USB interface and battery are mounted.
<16> 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.
<17> Emergency stop switch..... This switch stops the robot in an emergency state. The servo turns OFF.
<18> Filter cover..... There is an air filter inside the cover.
<19> Grounding terminal..... The grounding terminal for connecting cables of option card. (M3 screw x 2 places)
<20> Operation panel..... The operation panel for servo ON/OFF, START/STOP the program etc.
<21> Display panel (STATUS.NUMBER)..... The alarm No., program No., override value (%), etc., are displayed.
<22> CHNGDISP button ..... This button changes the details displayed on the display panel in the order of "Override" → "Program No." → "Line No.".
<23> UP/DOWN button..... This scrolls up or down the details displayed on the "STATUS. NUMBER" display panel.
<24> SVO.ON button ..... This turns ON the servo power. (The servo turns ON.)
<25> SVO.OFF button..... This turns OFF the servo power. (The servo turns OFF.)
<26> START button..... This executes the program and operates the robot. The program is run continuously.
<27> STOP button ..... This stops the robot immediately. The servo does not turn OFF.
<28> RESET button ..... This resets the error. This also resets the program's halted state and resets the program.
<29> END button ..... This stops the program being executed at the last line or END statement.

3.3.1 Names of each part of the robot CPU

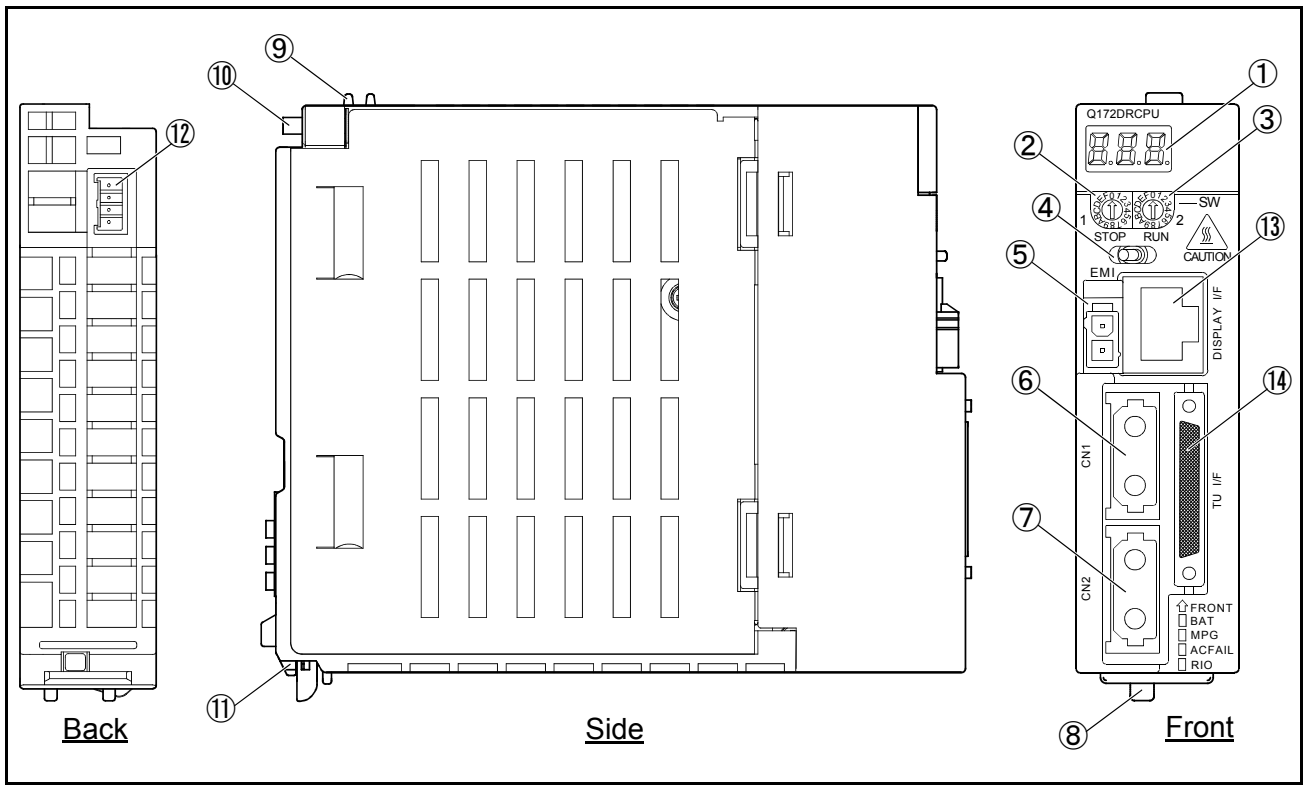


Fig.3-2 : Names of each part of the robot CPU

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.

3.4 Outside dimensions/Installation dimensions

3.4.1 Outside dimensions

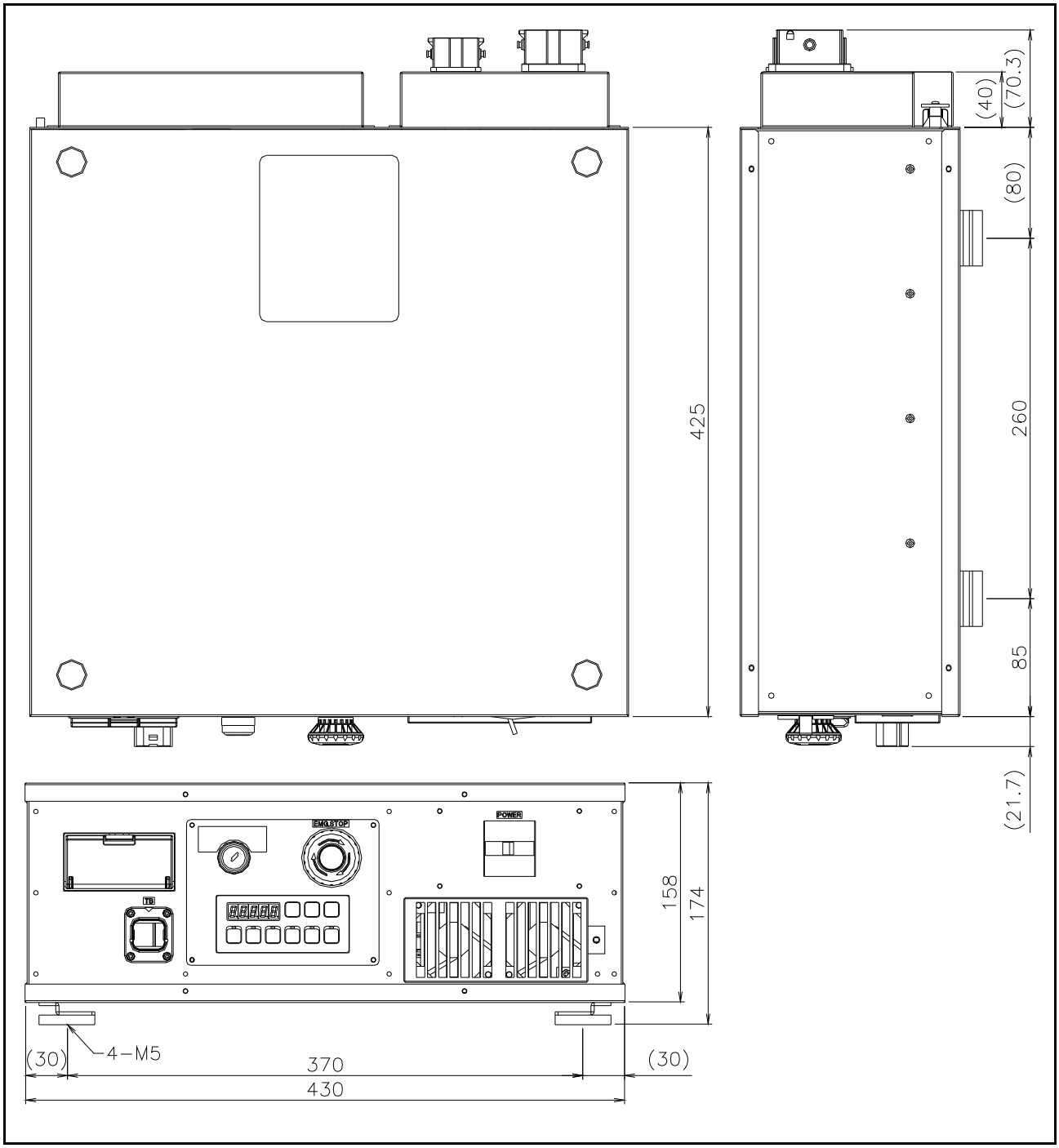
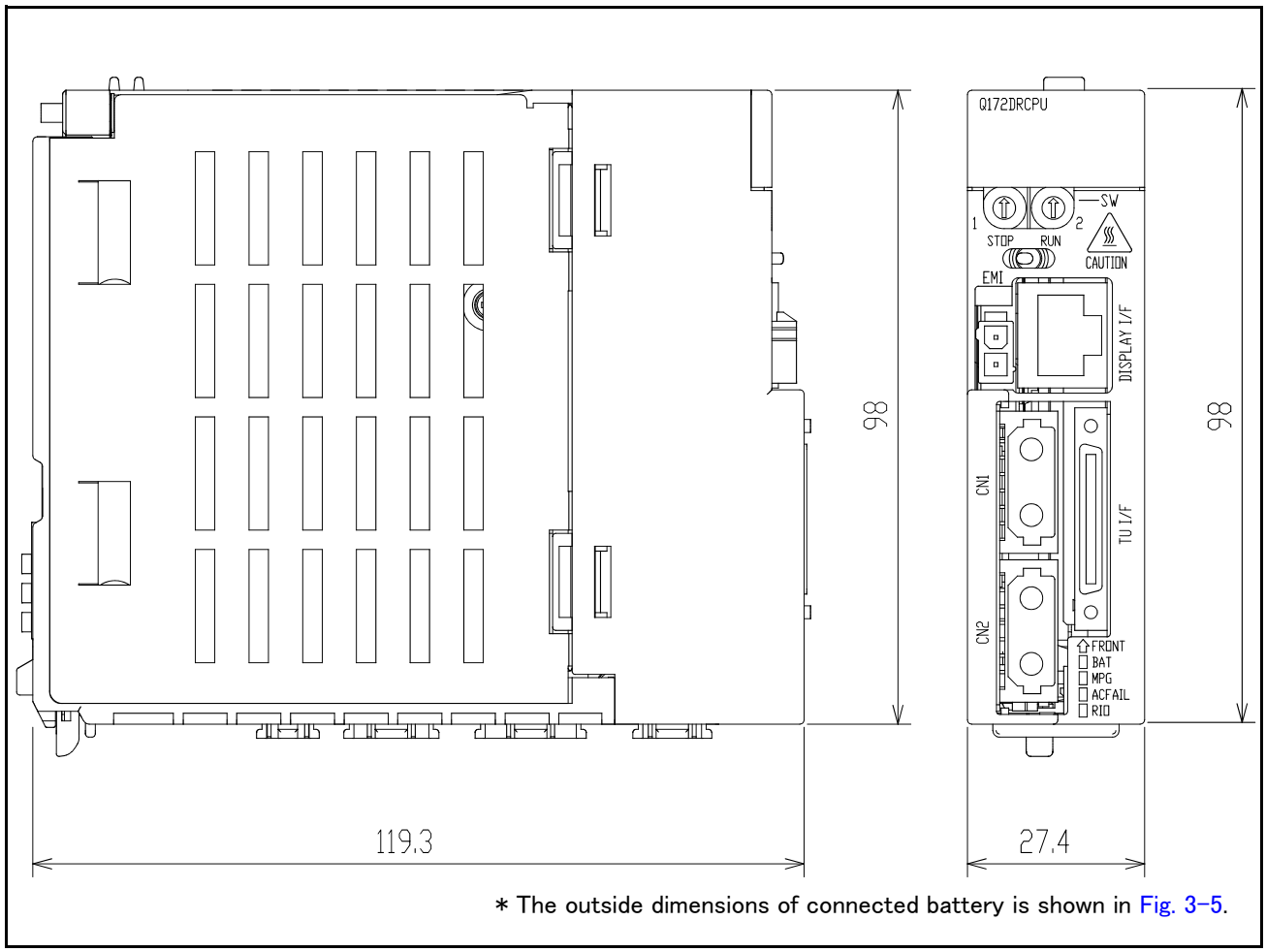


Fig.3-3 : Outside dimensions of drive unit (CR750)

(1) Outside dimensions of robot CPU unit



* The outside dimensions of connected battery is shown in Fig. 3-5.

Fig.3-4 : Outside dimensions of robot CPU

(2) Battery unit outside dimension

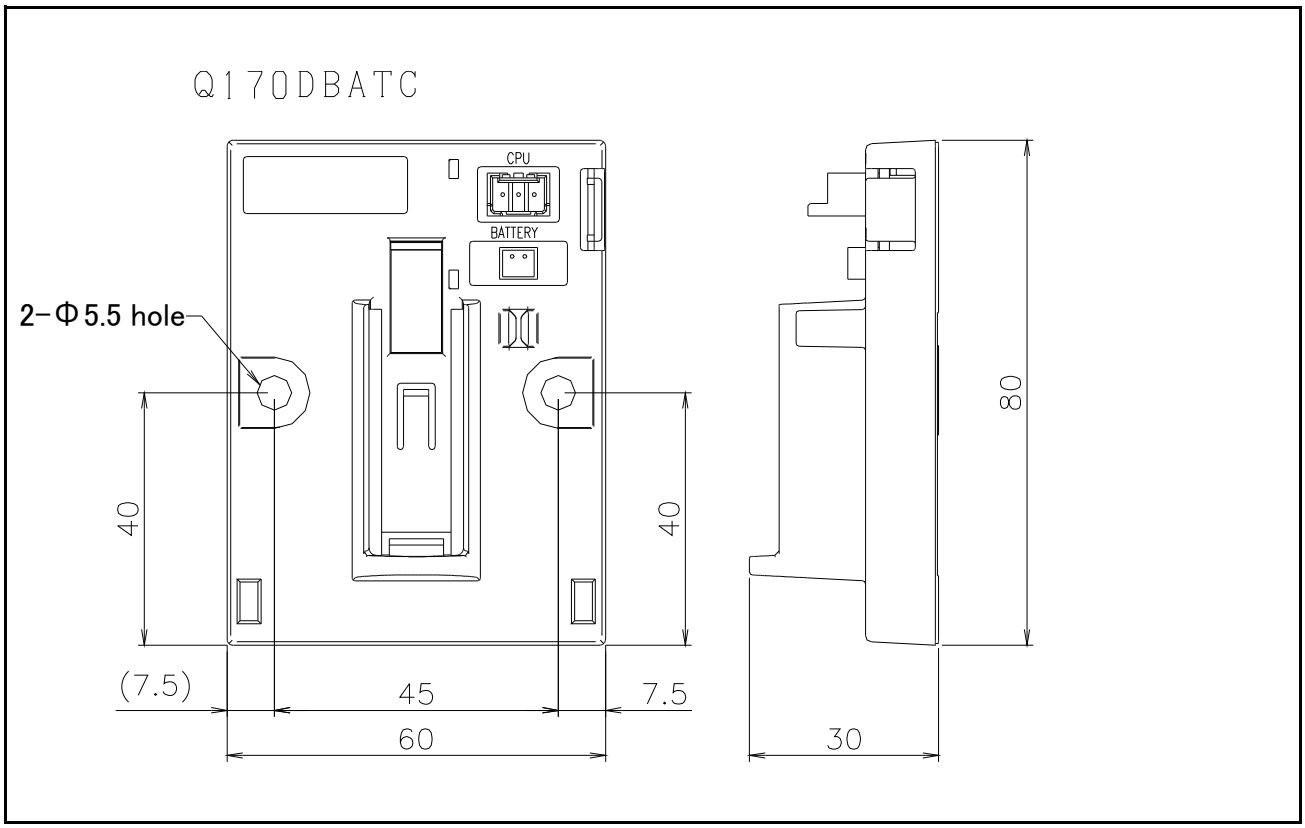
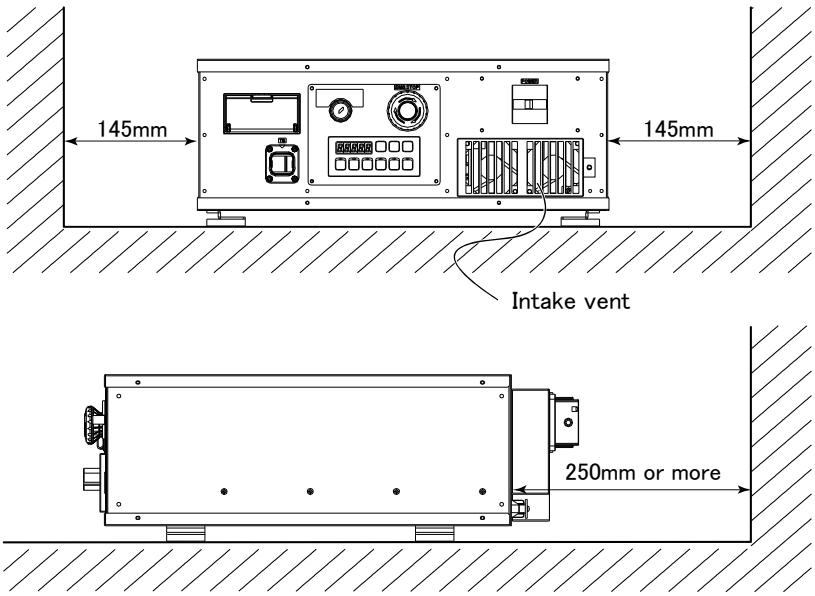


Fig.3-5 : Outside dimensions of battery unit

3.4.2 Installation dimensions

<Placed horizontally>



<Placed vertically>

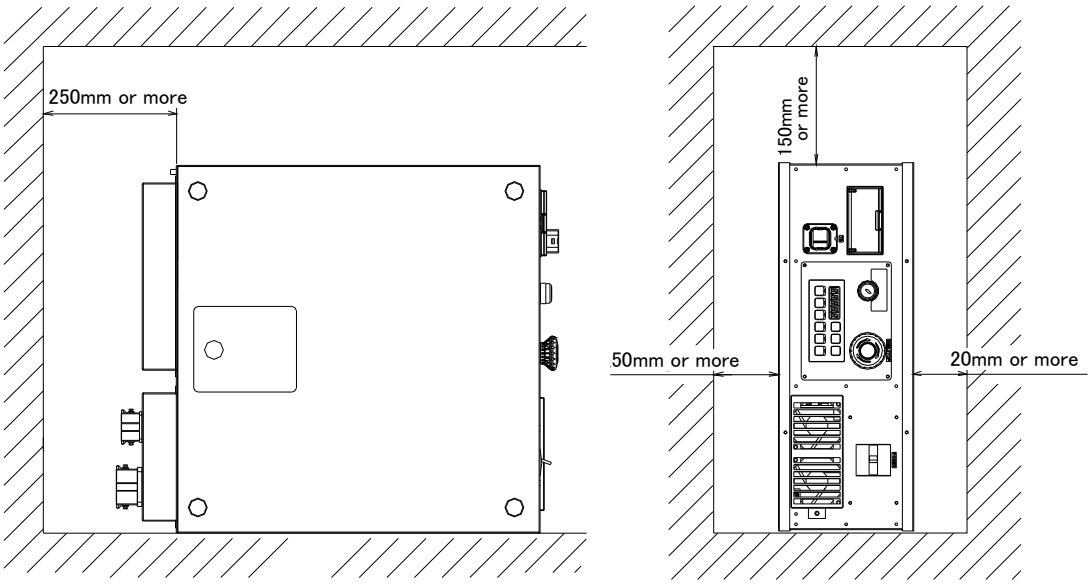


Fig.3-6 : Installation of controller (CR750)

⚠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. 3-7. 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.

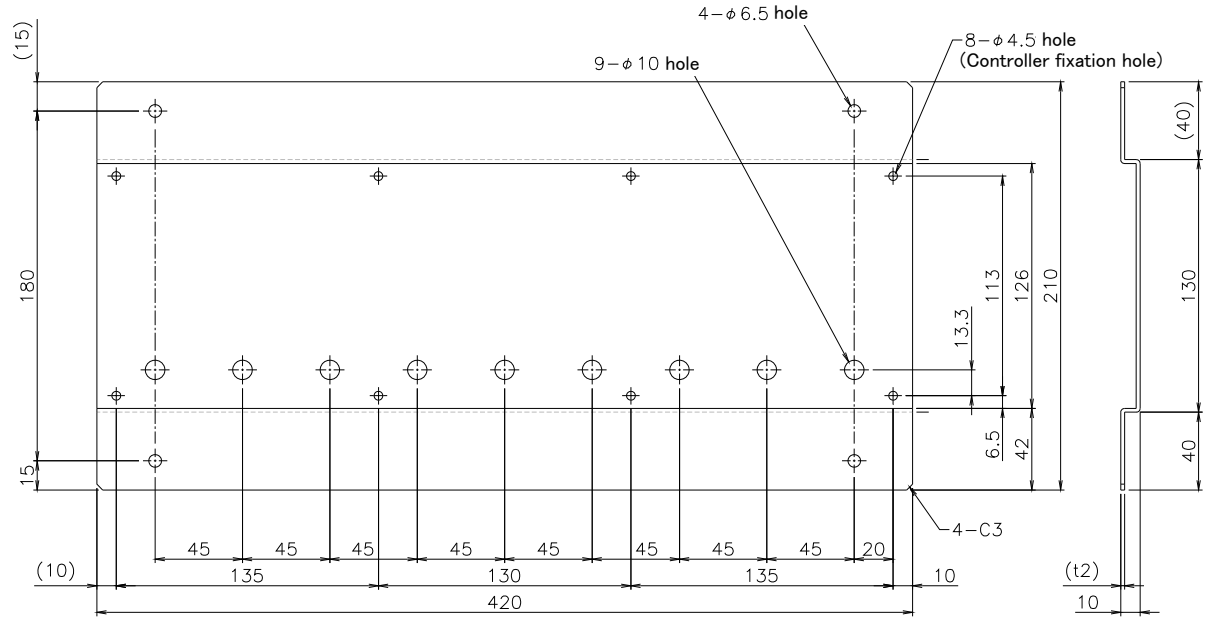


Fig.3-7 : Metal plate for fixation to placing vertically (Reference for CR750)

(1) 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.

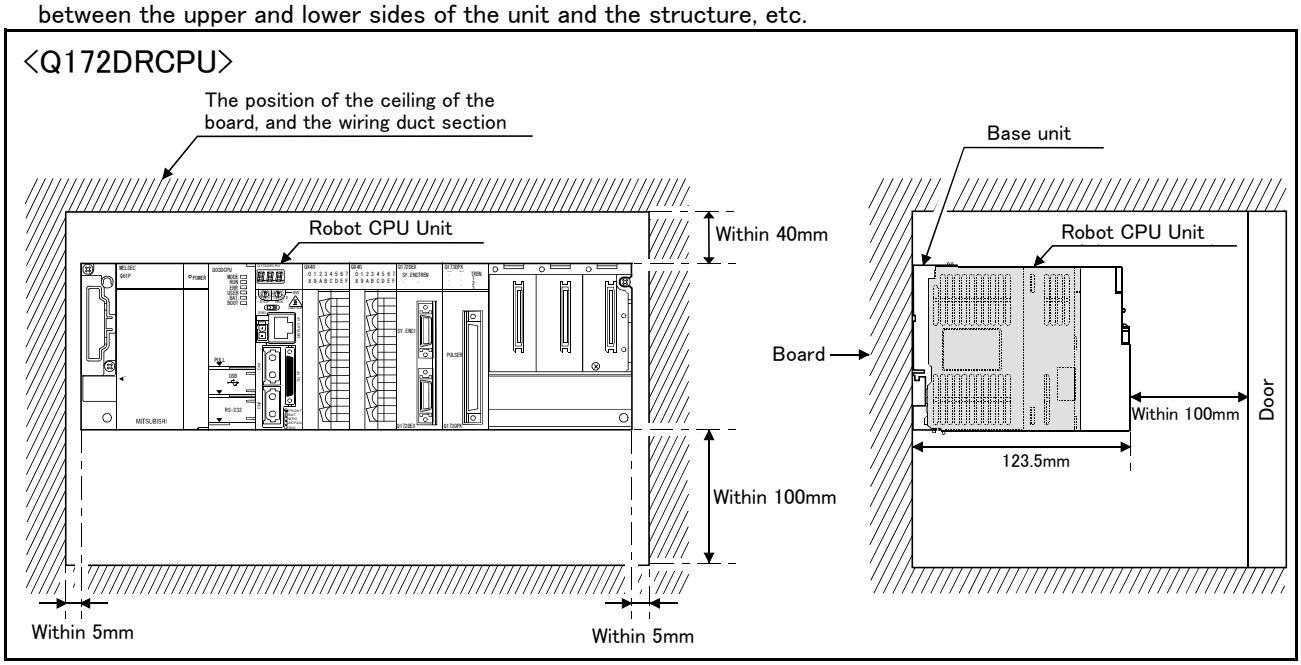


Fig.3-8 : Installation of robot CPU Unit

3.5 External input/output

3.5.1 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.....The wiring for the safe security of the emergency stop etc. is shown in on Page 114, "3.7 Emergency stop input and output etc." and on Page 149, "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).

3.6 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	Turns the servo ON for all mechanisms.	E	In servo ON output signal	Outputs the servo ON state.
IOENA	Operation rights input signal	Requests the operation rights for the external signal control.	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		Note1)	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	
HNDCNTL1 : HNDCNTL3	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.
USERAREA 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.

3.7 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 119, "3.7.2 Special stop input (SKIP)")
Input	Door switch	Servo-off. Dual line, normal close (Page 120, "3.7.3 Door switch function")
Input	Enabling device	Servo-off. Dual line, normal close (Page 120, "3.7.4 Enabling device function")
Output	Robot error output	Contactor 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 125, "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.

Pin number assignment of each terminal and the circuit diagram are shown in Fig. 3-10.

3.7.1 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. 3-10.
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 149, "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 switch
      ・CR750 drive unit.....CNUSR11 connector "between 3 and 4" and CNUSR12 Connector "between 3 and 4".
   b) Door switch
      ・CR750 drive unit.....CNUSR11 connector "between 7 and 8" and CNUSR12 connector "between 7 and 8".
   c) Enabling device
      ・CR750 drive unit.....CNUSR11 connector "between 9 and 10" and CNUSR12 connector "between 9 and 10".

[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.
And, the output contacts from the robot controller (robot error output, emergency stop output, mode output, addition axis contactor control output) are dual contacts (synchronizes). You should connect surely by dual line with the customer's equipment as well as connection of the emergency stop and the door switch.

⚠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).

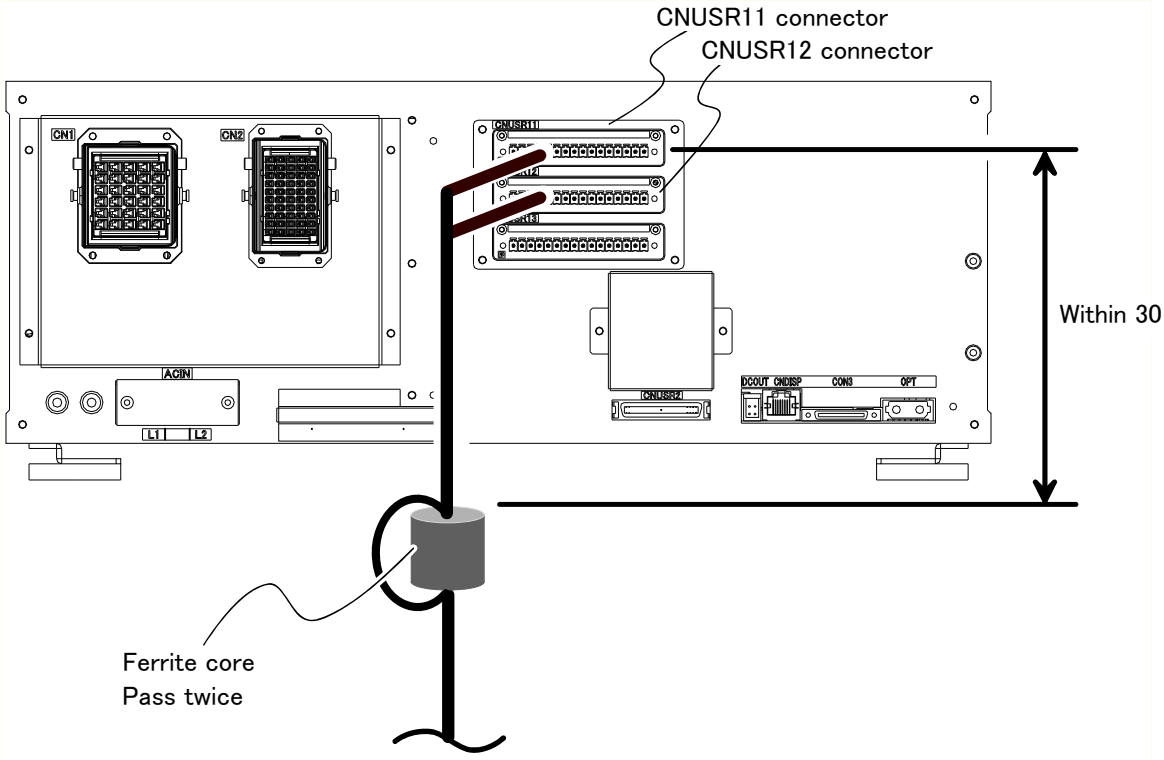
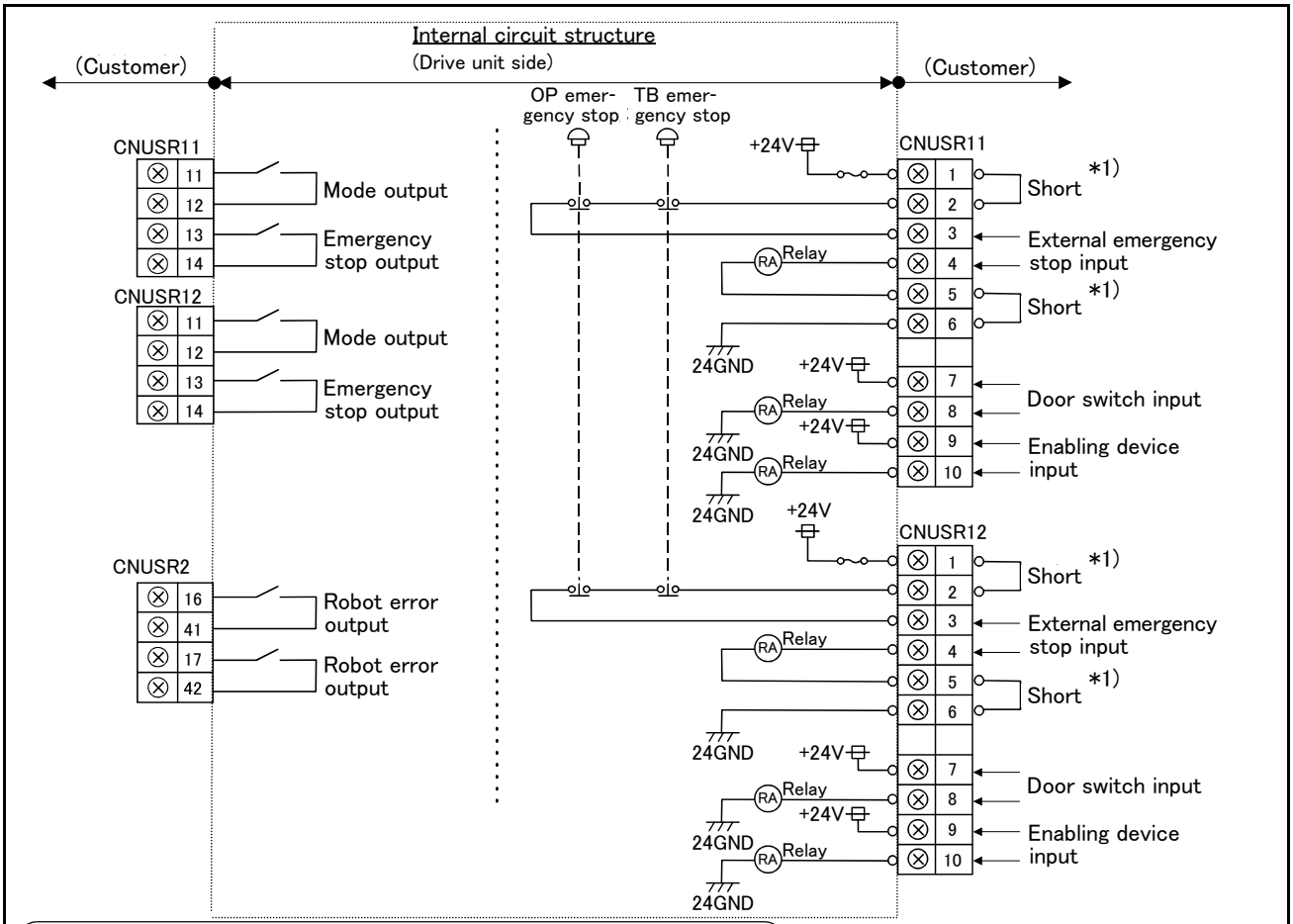


Fig.3-9 : Emergency stop cable connection (CR750)



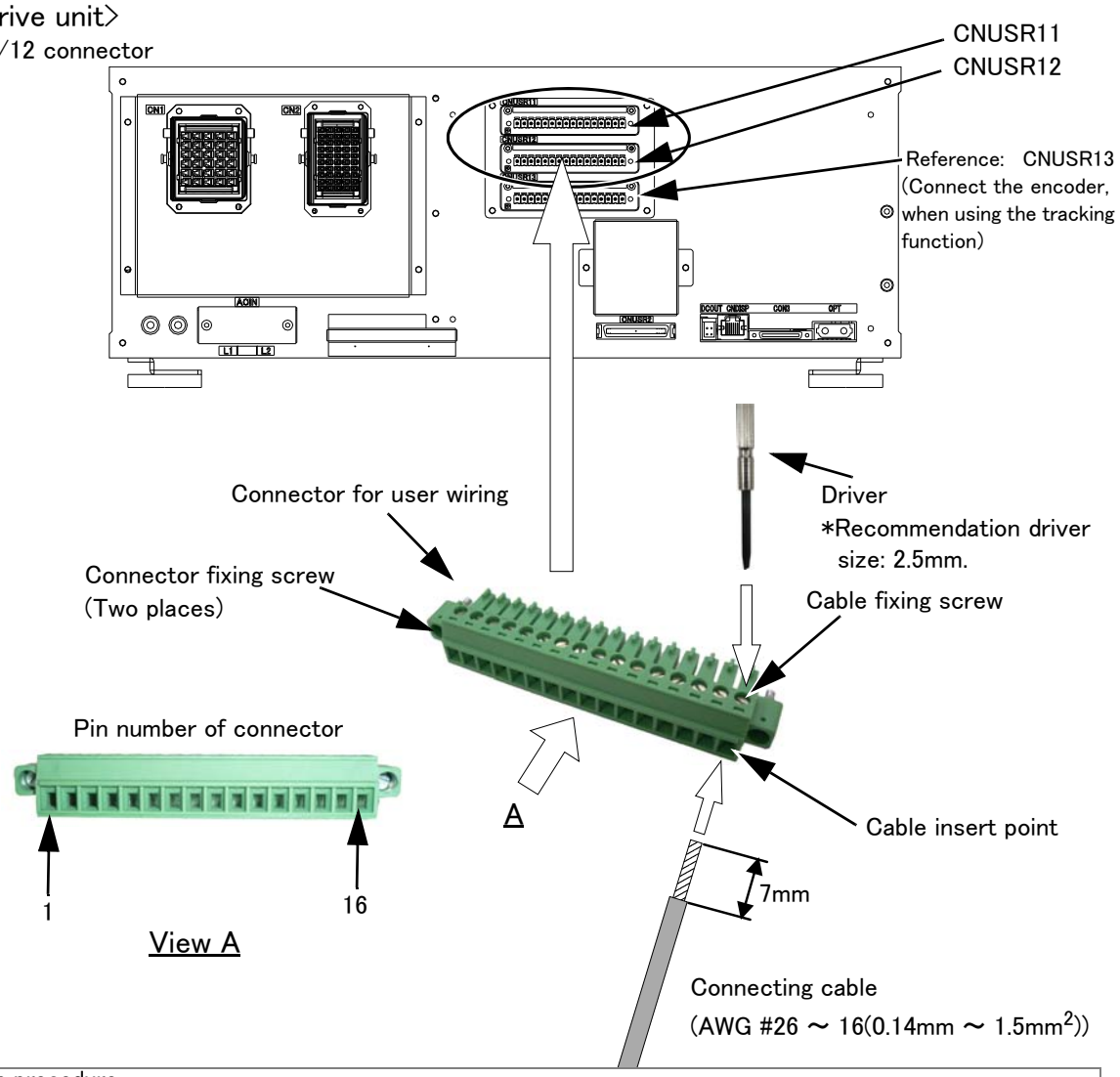
*1) This terminal is opened at factory shipping (unconnected). If power supply inside the drive unit is used, short-circuit the terminal.

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

Fig.3-10 : 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 149, "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.



Connection procedure

Insert the connection cable into the appropriate pin of the user wiring connector that accompanies the product. Fix it securely with a screw and connect the connector to the CNUSR11/CNUSR12 connector at the back of the controller.

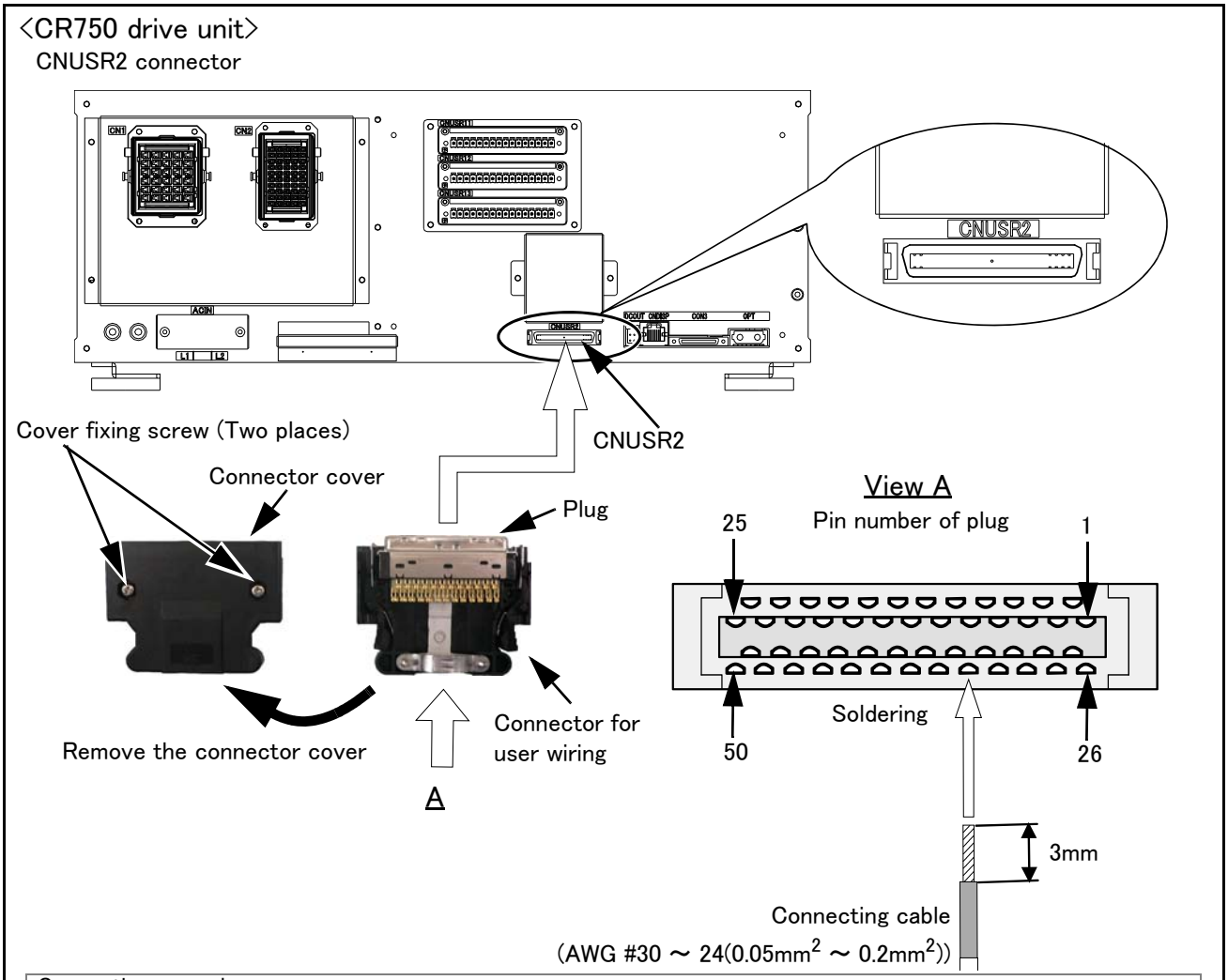
Please use an AWG #26 to 16 (0.14 to 1.5mm^2) connector cable.

1) Prepare the user wiring connector that accompanies the product.
2) Loosen the cable fixing screw at the point where the cable is to be inserted. Please use a screwdriver head with a width of 2.5mm to loosen the screw.
3) Peel the insulation of the connecting cable to 7mm, and insert it into the cable slot of the corresponding connector.
4) Be sure to fix the inserted cable securely by fastening a cable fixing screw. (tightening torque of 0.22 to 0.25Nm)
5) After the necessary cables save been fixed, connect the connector to the connector (CNUSR11/12) that correspond with the controller. Connect so that the cable fixing screw comes on top, and make sure to fix securely by fastening connector fixing screws in two places. A screwdriver head with a width of 2.5mm should be used to fix screws (tightening torque of 0.22 to 0.25Nm).

This concludes the connection procedure.

Fig.3-11 : Method of wiring for external emergency stop connection (CR750 (CNUSR11/12))

⚠CAUTION 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.



Connection procedure

Solder thepins of the user wiring connector that accompanies the product, and connect the connector to the CNUSR2 connector at the back of the drive unit. For the connection cables, please use AWG #30 to 24 (0.05 to 0.2mm^2).

1) Loosen the two fixing screws on the user wiring connector that accompanies the product, and remove the connector cover.
2) Peel the insulation of the connecting cable to 3mm, and solder it the appropriate connector pin number.
3) After the necessary cables have been soldered, re-fix the connector cover using the same fixing screws and make sure it is fastened securely.
4) Connect the connector to the corresponding connector (CNUSR2) on the drive unit. With pin number 1 facing to the upper right, insert firmly until you hear the connector's latch click in to place.

This concludes the connection procedure.

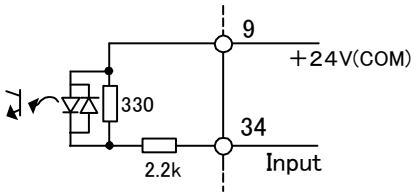
Fig.3-12 : Method of wiring for external emergency stop connection (CR750 (CNUSR2))

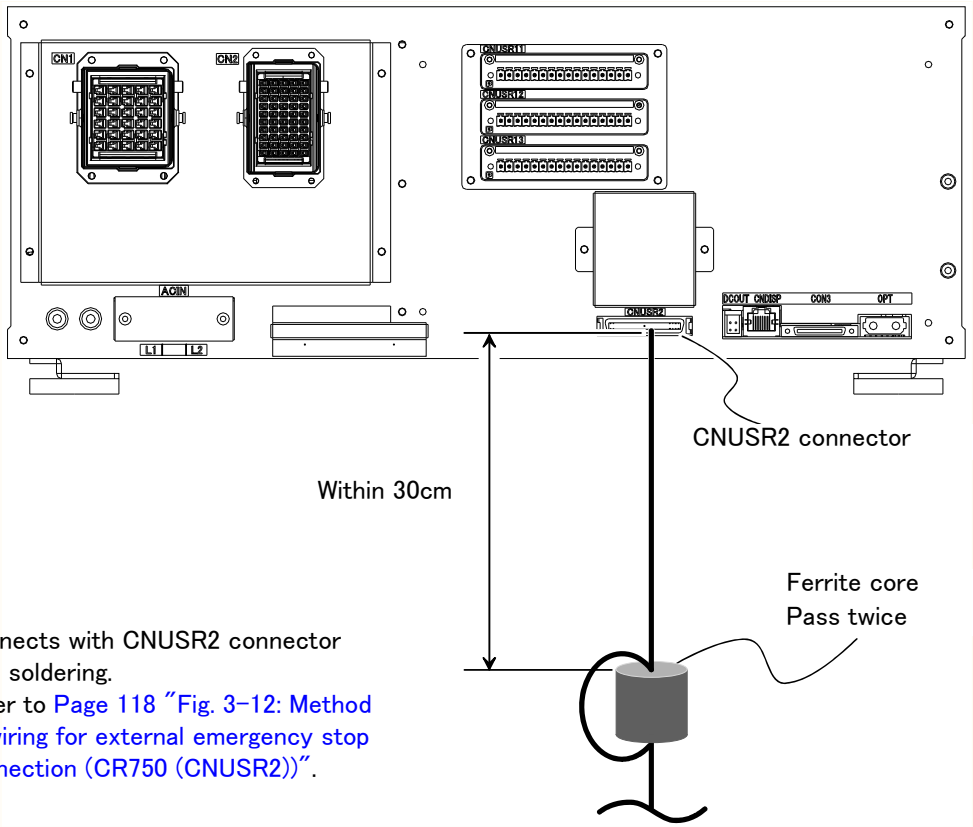
⚠CAUTION When soldering please take care to only connect to the specified pin number. Connecting to a different pin number or short-circuiting with another pin will result in the robot breaking down or malfunctioning.

3.7.2 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. 3-13.

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 → ON	1ms or less	
	ON → OFF	1ms or less	
Common method		1 point per common	
External wire connection method		Connector	



* Connects with CNUSR2 connector with soldering.
Refer to Page 118 "Fig. 3-12: Method of wiring for external emergency stop connection (CR750 (CNUSR2))".

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.3-13 : Connection of the special-stop-input (CR750)

3.7.3 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 116 "Fig. 3-10: External emergency stop connection (CR750)" and Page 149, "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.

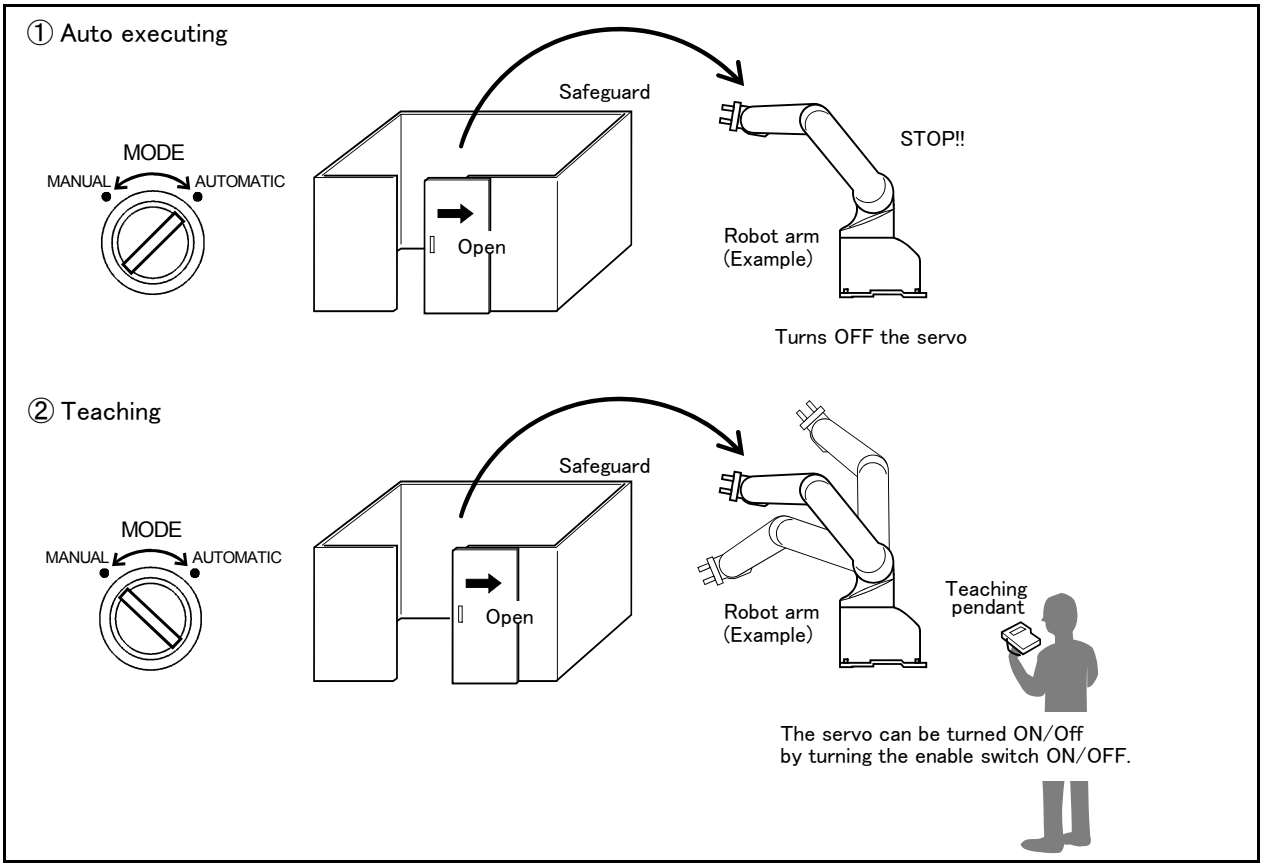


Fig.3-14 : Door switch function

3.7.4 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

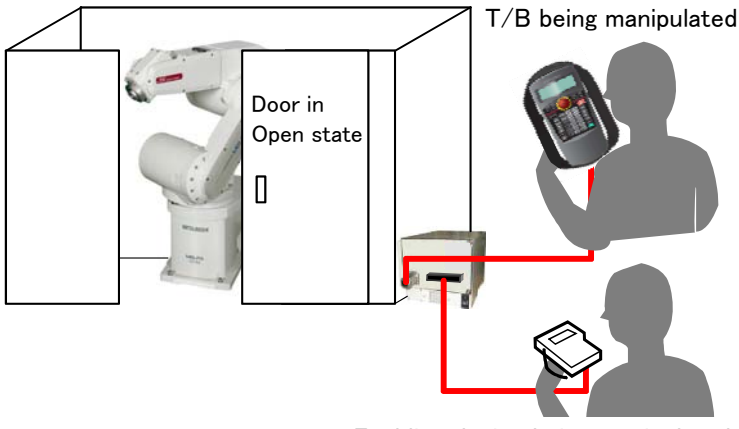
No	Operation	Related switch settings Note1)					Description
		Mode of controller	T/B enable/ disable	T/B enable switch	Enabling device input terminal	Door switch input terminal	
1	Jog operation	Manual	Enable	ON	Close(ON)	—	If the enabling device input is set to Close (On), the state of door switch input 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 controller: Page 101, "3.3 Names of each part"
- T/B enable/disable: Page 128, "(1) Teaching pendant (T/B)"
- T/B enable switch: Page 128, "(1) Teaching pendant (T/B)"
- Enabling device input terminal: Page 149, "6.1.7 Examples of safety measures"
- Door switch input terminal: Page 149, "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.



⚠CAUTION

Upon the release of brake, the robot arm may fall under its own weight depending on the axis which has been released. For added safety, provide support or take other precaution to prevent the falling of the arm.

Fig.3-15 : Brake release operation

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 interface Instruction Manual" for details on the additional axis function.

3.8.1 Wiring of the Additional Axis Interface

Table 3-7 shows the connectors for additional axes inside the drive unit. Fig. 3-16 shows a connection example (configuration example).

Table 3-7 : 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.

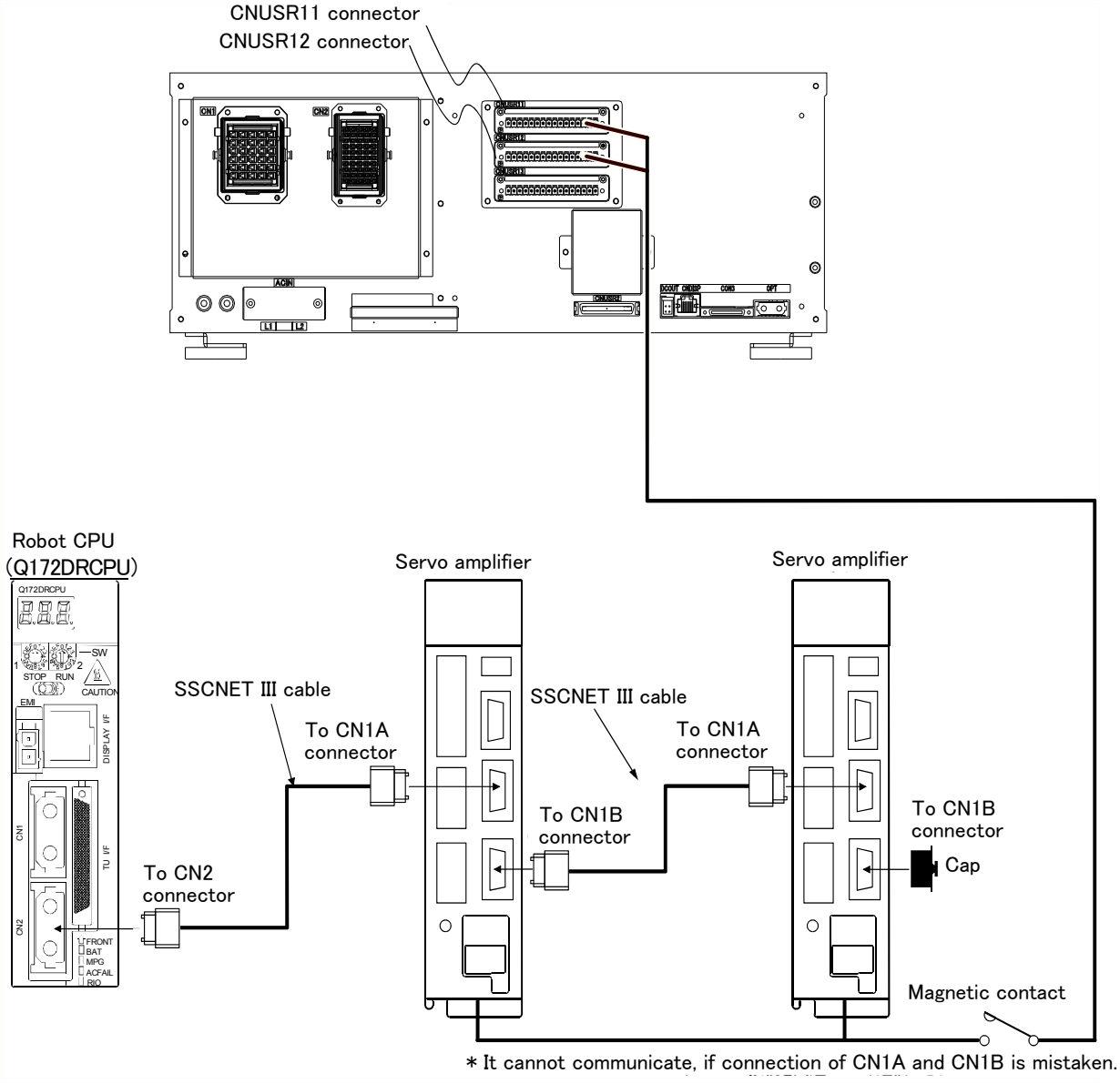


Fig.3-16 : Example of addition axis connection (CR750)

(1) Example of the installation of the noise filter

1) EMC filter (recommended)

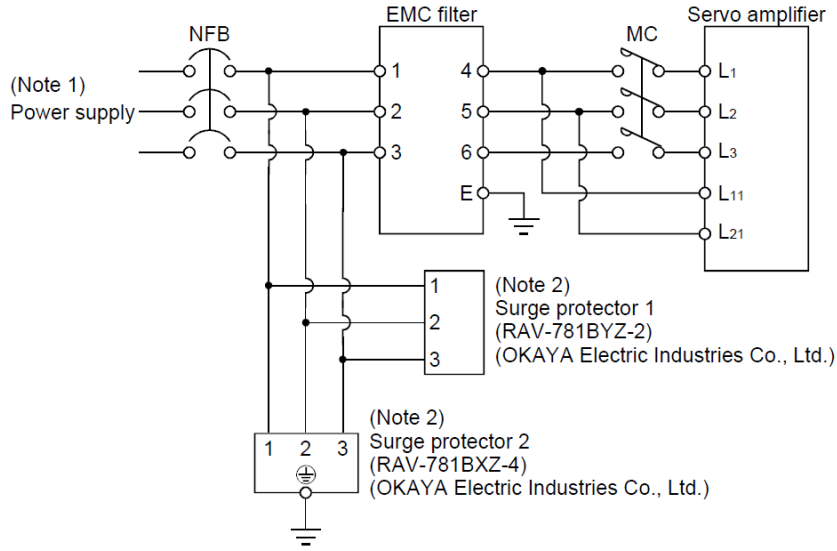
Please install the recommendation filter shown below according to the example of connection.

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		
MR-J3-11KB4	TF3030C-TX		7.5(16.54)
MR-J3-15KB4	TF3040C-TX		12.5(27.56)
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.3-17 : 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.

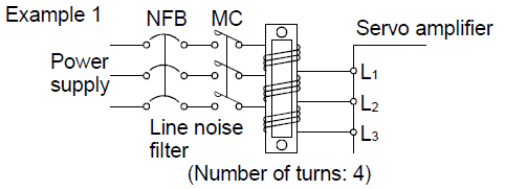
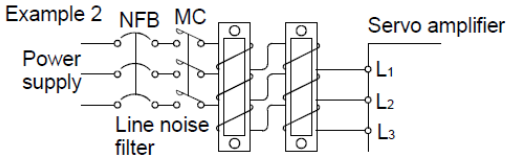
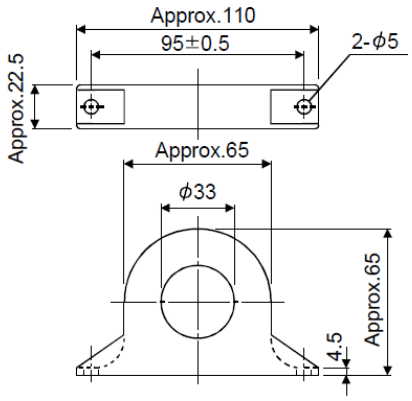
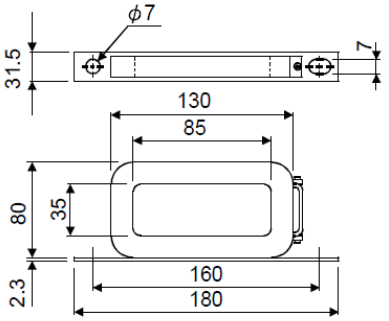
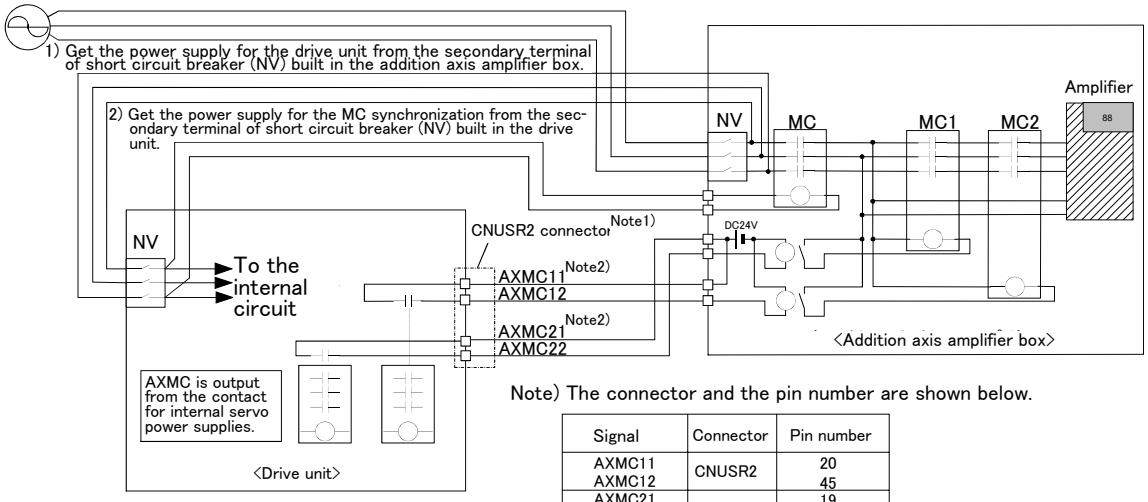
Connection diagram	Outline drawing [Unit: mm]
Use the line noise filters for wires of the main power supply (L_1 • L_2 • L_3) and of the motor power supply (U • V • W). Pass each of the 3-phase wires through the line noise filter an equal number of times in the same direction. For the main power supply, the effect of the filter rises as the number of passes increases, but generally four passes would be appropriate. For the motor power supply, passes must be four times or less. Do not pass the grounding (earth) wire through the filter, or the effect of the filter will drop. Wind the wires by passing through the filter to satisfy the required number of passes as shown in Example 1. If the wires are too thick to wind, use two or more filters to have the required number of passes as shown in Example 2. Place the line noise filters as close to the servo amplifier as possible for their best performance.  (Number of turns: 4)  Two filters are used (Total number of turns: 4)	FR-BSF01 (for wire size 3.5mm^2 (AWG12) or less))  FR-BLF(for wire size 5.5mm^2 (AWG10) or more)) 

Fig.3-18 : 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 and an image of how to connect the controller connector are shown below. When you are using an additional axis, please perform appropriate circuit connections by referring to these drawings.
Refer to the separate "Additional axis interface 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.



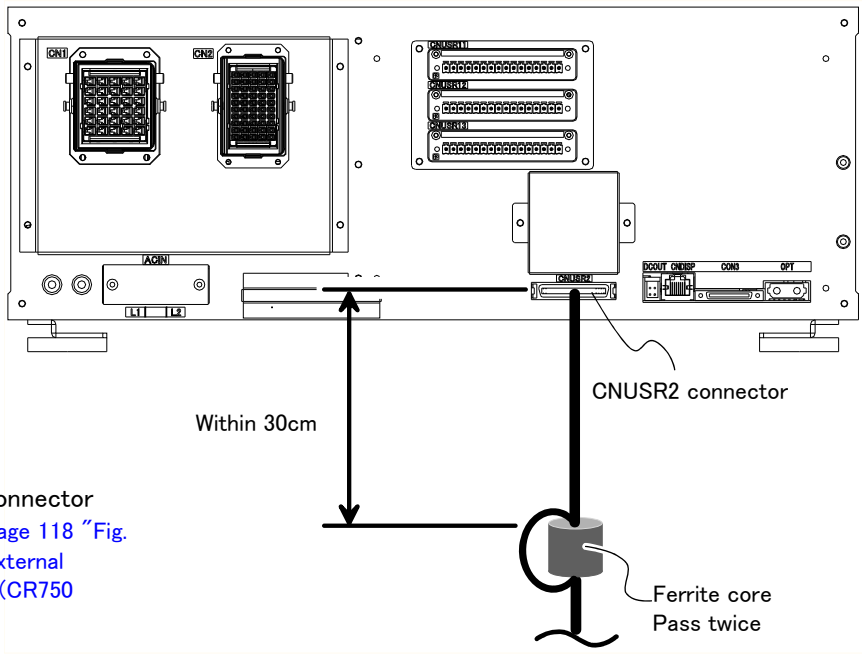
Note) The connector and the pin number are shown below.

Signal	Connector	Pin number
AXMC11 AXMC12	CNUSR2	20 45
AXMC21 AXMC22	CNUSR2	19 44

Note2) This output is opened, if the robot turns off the servo by occurrence of alarm etc.
<Electric specification>
DC24V/10mA to 100mA

[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.3-19 : Example of circuit for addition axes of Magnet contactor control output



*Connects with CNUSR2 connector with soldering. Refer to Page 118 "Fig. 3-12: Method of wiring for external emergency stop connection (CR750 (CNUSR2))".

Fig.3-20 : AXMC terminal connector (CR750)

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: R32TB :Cable length 7m
R32TB-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 3-8 : Configuration device

Part name	Type	Qty.	Mass (kg) Note1)	Remarks
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.

Note1) Mass indicates one set.

■ Specifications

Table 3-9 : 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. *)

*) Operations, such as program editing and status display, other than robot operation are possible.
Safety is secured as the servo power is turned OFF simultaneously with the input of the emergency stop.

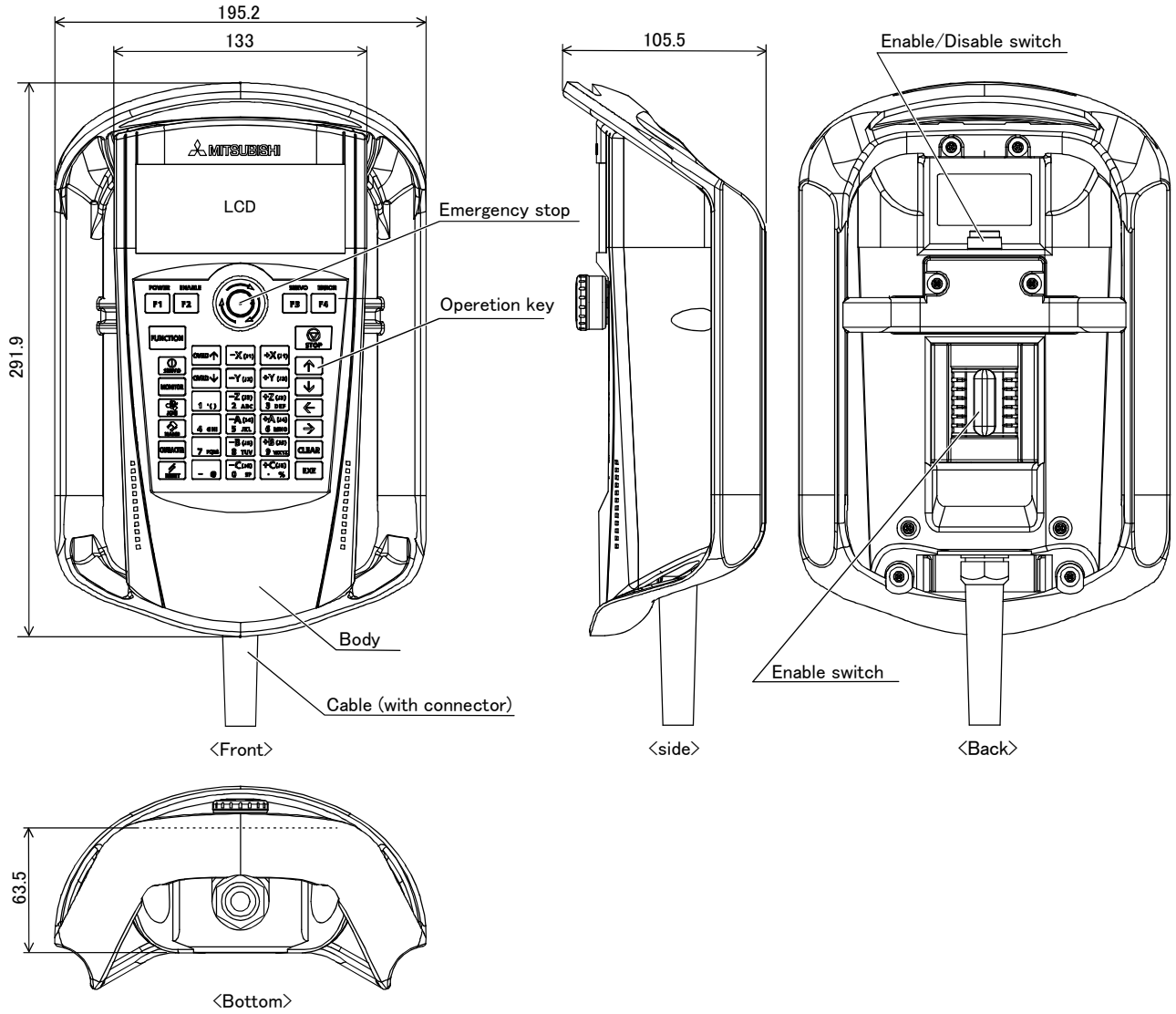
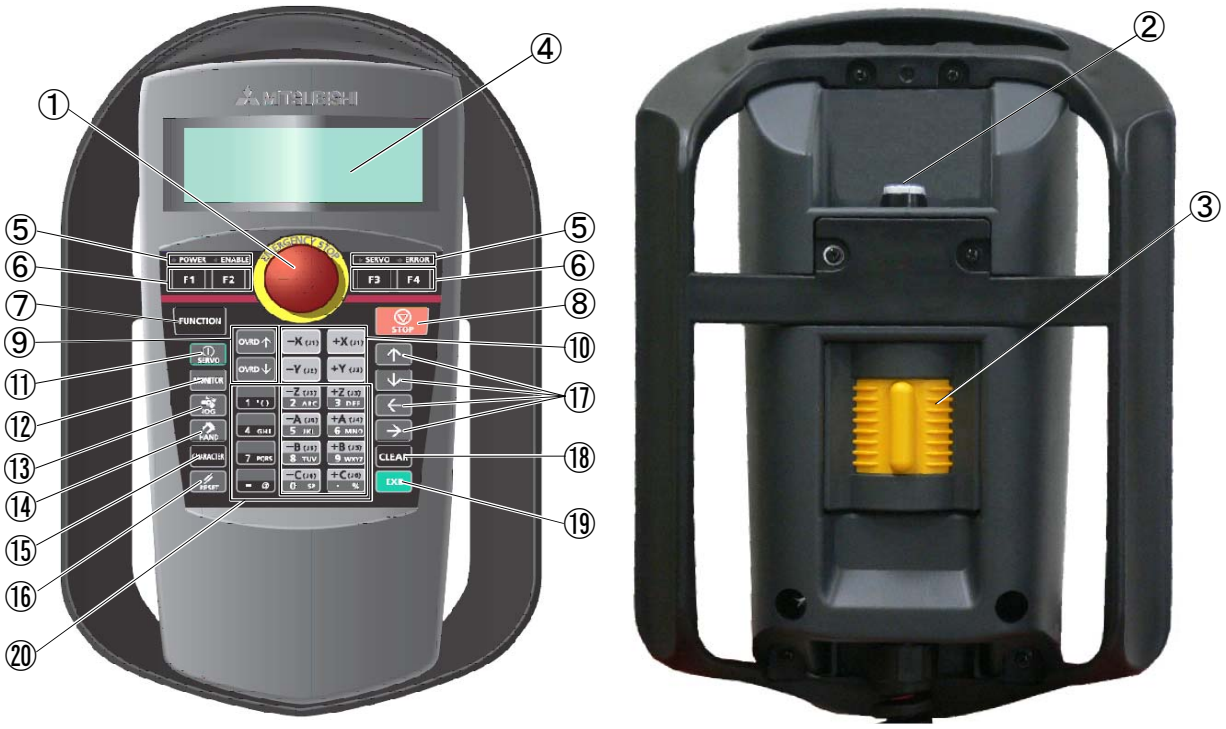


Fig.3-21 : Outside dimensions of teaching pendant

■ Installation method

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

■ Key layout and main functions



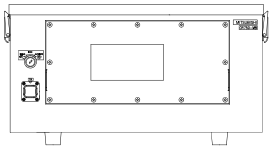
① [Emergency stop] switch ..... The robot servo turns OFF and the operation stops immediately.
② [Enable/Disable] switch ..... This switch changes the T/B key operation between enable and disable.
③ [Enable] switch..... When the [Enable/Disable] switch " ② " is enabled, and this key is released or pressed 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 [CHARCTER] 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.3-22 : Teaching pendant key layout and main functions

(2) Controller protection box

■ Order type: ● CR750-MB

■ Outline



By putting the controller in this box, the controller can be protected from oil mist environment.
Use this option, when the controller is installed where environment is oil mist such as machine shop etc. Therefore, the operation of installing and removing the T/B, and changing the mode switch can be done, with the controller put in.

■ Configuration

Table 3-10 : Configuration equipment and types

Part name	Type	Qty.	Mass (Kg)[Note1]	備考
Controller protection box	CR750-MB	1	22	
power supply wiring cable		3		For connection between the power supply relay terminal and controller inside this box
Grounding cable		1		For connection between the grounding terminal and controller inside this box
Seal for the serial number copy		1		
Protection seal clear		1		
Cable tie	T50L	4		
Screw for fixing of the controller mounting plate	M4x8	4		

Note1) Mass indicates one set.

■ Specifications

Table 3-11 : Specifications

Item	Unit	Specifications	Remarks
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	

(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 and controller setting position

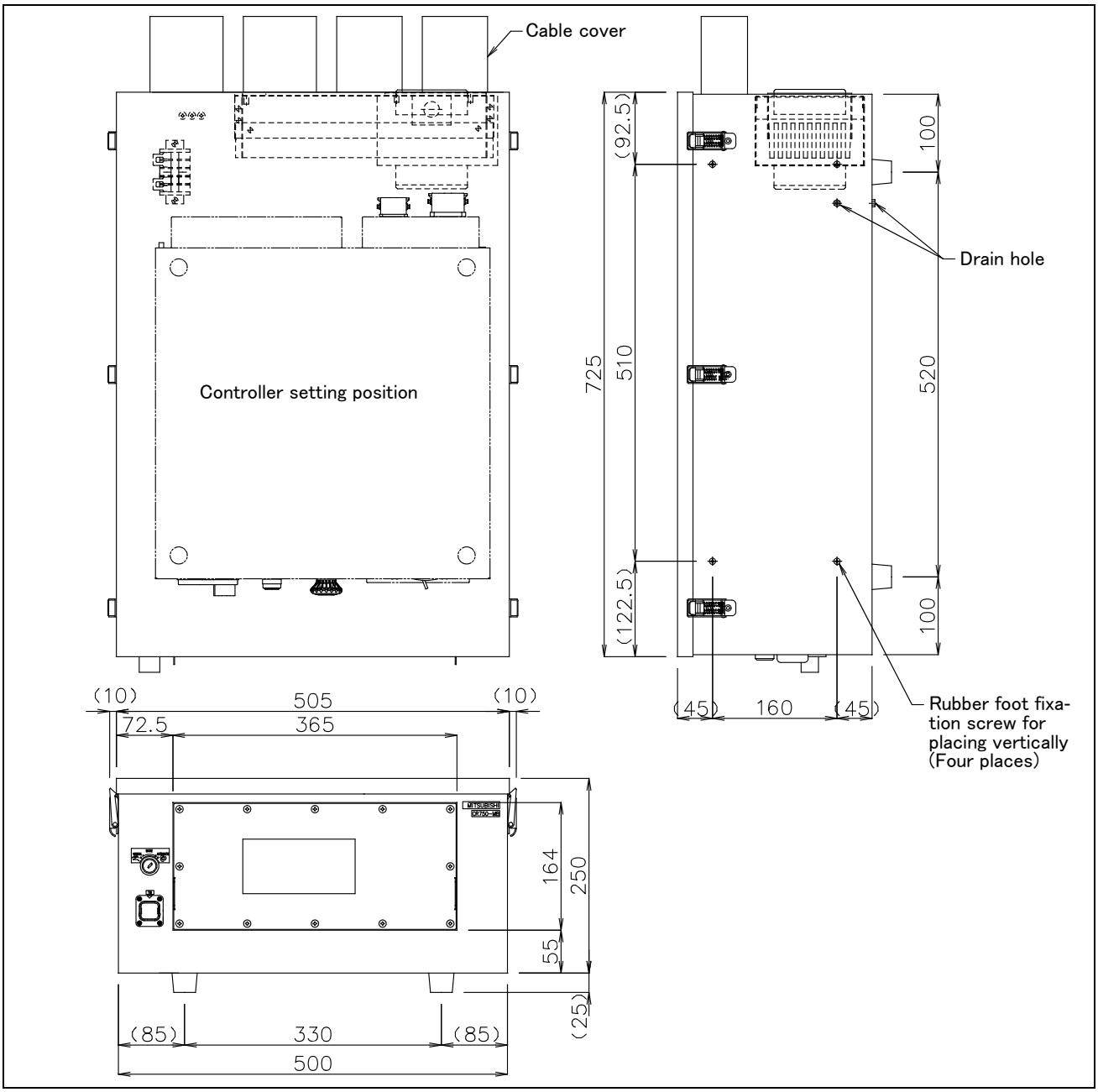


Fig.3-23 : Outside dimension and controller setting position

■ Names of each part

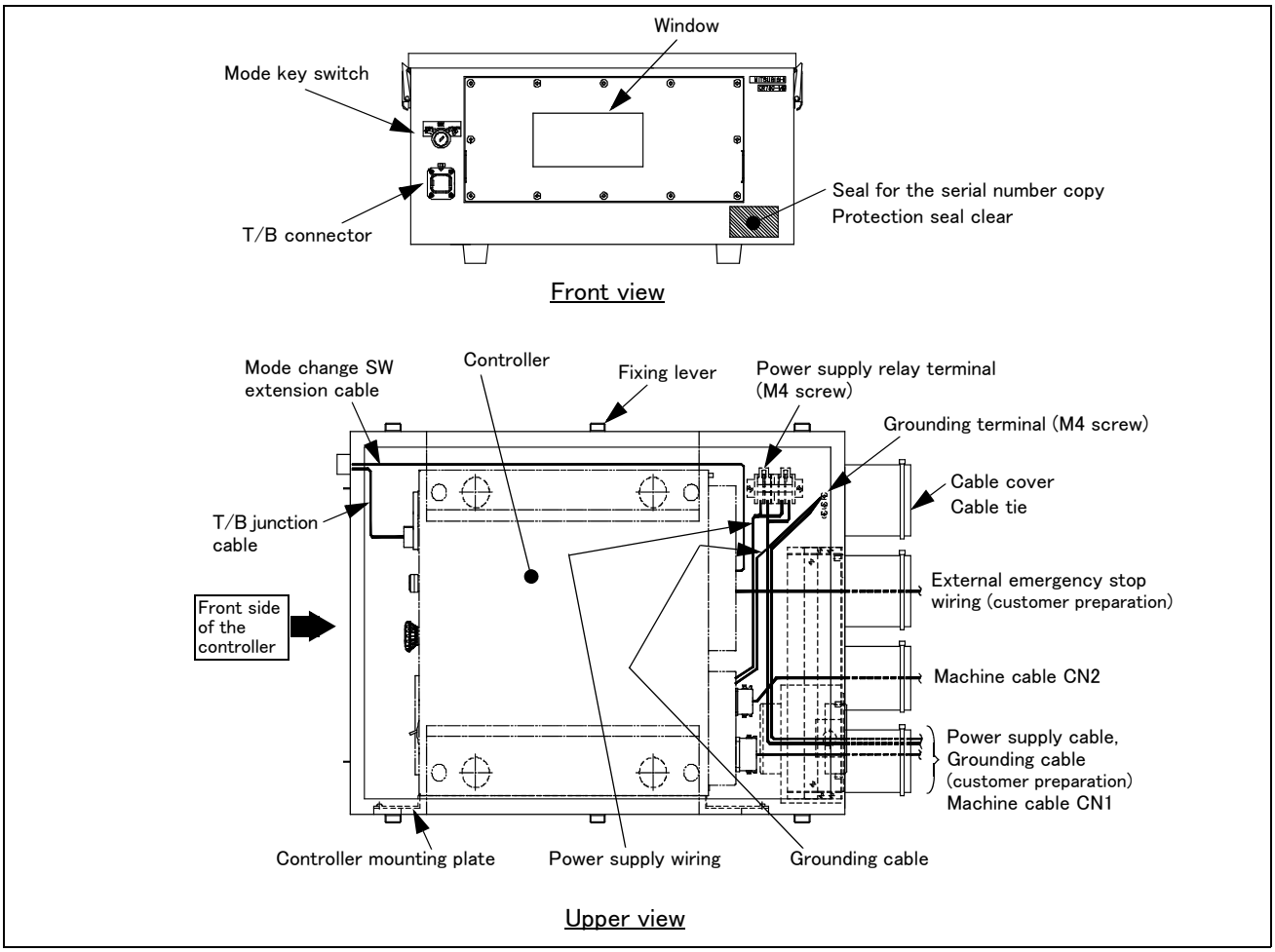
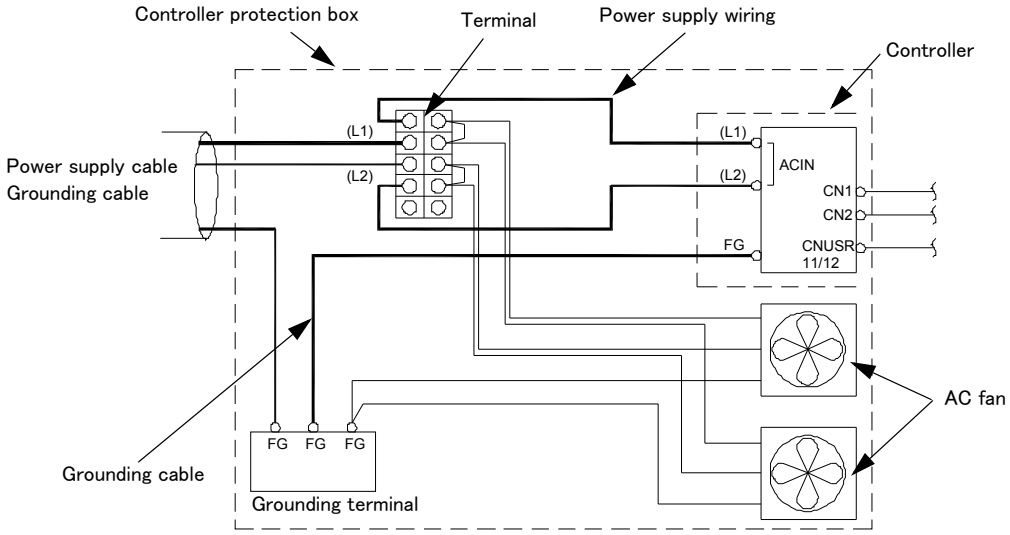


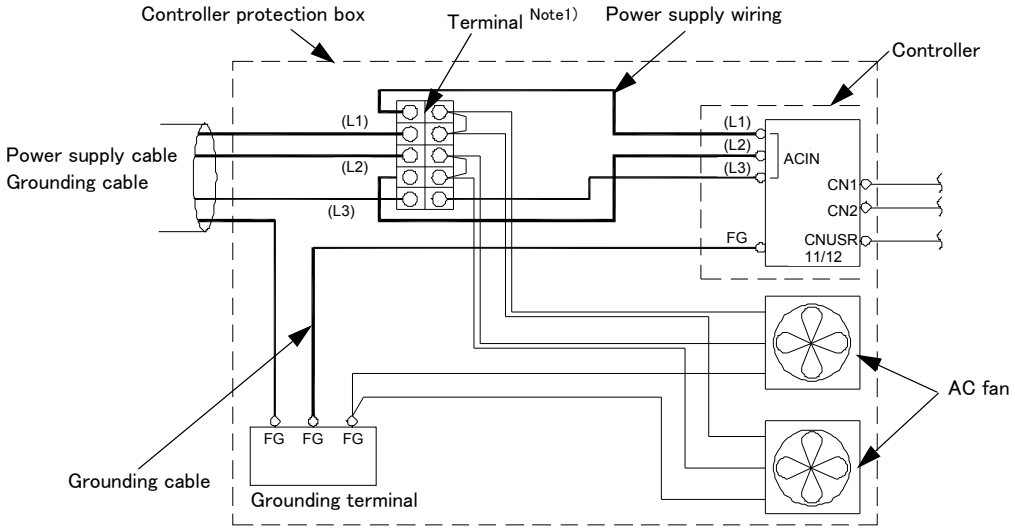
Fig.3-24 : Names of each part

■ Wiring system diagram

<Single phase: RH-6FH series>



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



Note1) When using the controller 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 controller. Refer to the separate manual "Controller setup, basic operation, and maintenance" for detail of connecting the power cable and the grounding cable.

Fig.3-25 : Wiring system diagram

■ Installation dimensions

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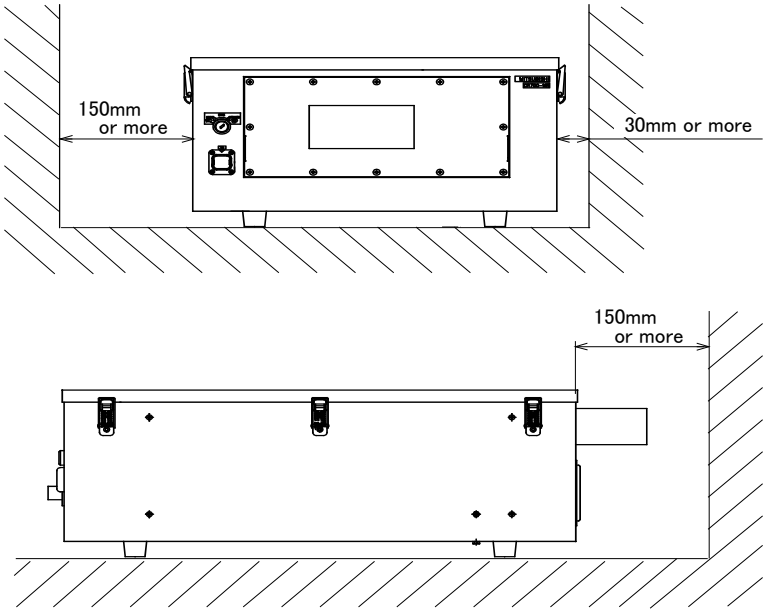


<Placed vertically>

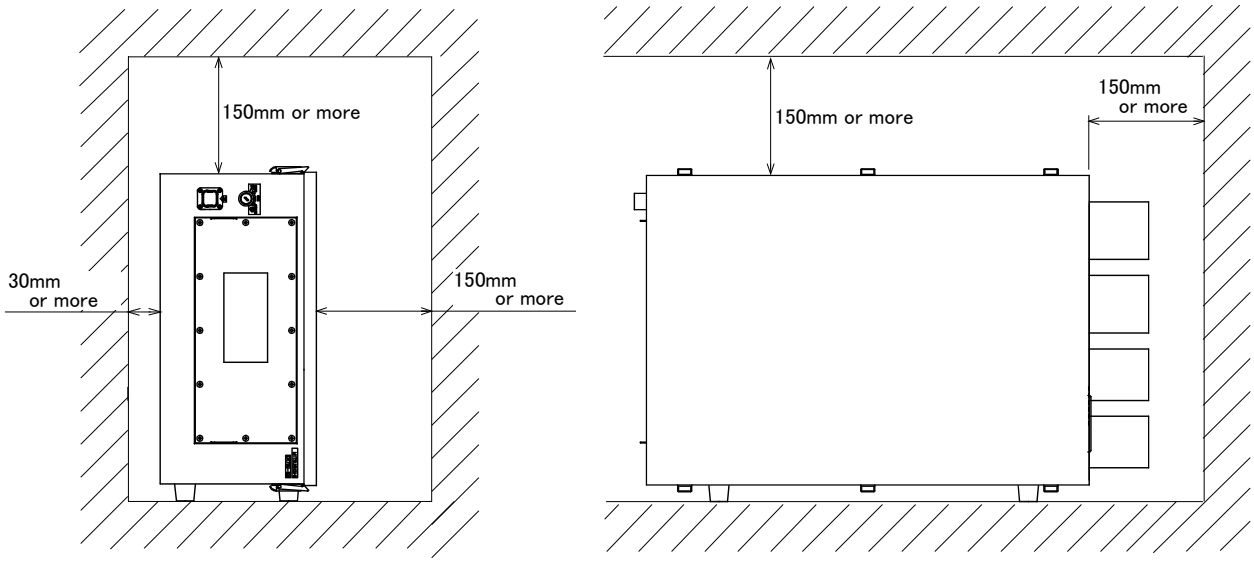


Fig.3-26 : Installation dimensions

(3) RT ToolBox2/RT ToolBox2 mini

■ Order type : ● RT ToolBox2
*For windows CD-ROM : 3D-11C-WINE
● 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 3-12 : 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 3-13 : Functions

Function		Functional existence[Note1)]		Details
Compatible model		○	○	Personal computer running Microsoft Windows2000/XP/Vista/7. [Note2)]
Program editing functions	Editing functions	○	○	・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	○	○	・Program file control (list, copy, movement, delete, content comparison, name change, protect)
	Debugging functions	○	○	・Direct editing of program in controller ・Confirmation of robot program operation (step execution, direct execution)
Simulation function		○	×	・Off-line simulation of robot program operation using CG (computer graphics) ・Tact time calculation
Monitor functions		○	○	・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		○	○	・Parameter setting ・Batch, divided backup

RT ToolBox2 mini (3D-12C-WINE)

RT ToolBox2 (3D-11C-WINE)

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-PE01.....RH-6FH/12FH/20FH-Q series

■ Outline

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

■ Configuration

Table 3-14 : Product configuration

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-A8863	-	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 3-15. 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 3-15 : 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	BKOFA0773H42	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).	Ovrd 100
		Designate the speed for joint interpolation operation with a percentage (0.1% unit).	JOvrd 100
		Designates the speed for linear and circular interpolation with a numerical value (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.	Wth
		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.	HOpen 1
	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
		efines 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]

Parameter		Details
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.
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	QMLTCPUN	At the multi CPU system, set the number of CPU units with which the standard base unit is equipped.
	QMLTCPUn	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.
	QMLTCPUS	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	MESNGLSW	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.	The drive circuit is shut off. The robot stops, and an alarm displays.
		Mechanical stopper	This is the mechanical stopper provided outside the software.	The robot mechanically stops, and function 1 or 2 activates.

Table 6-2 : List of stop functions

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

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 (CNUSR11/12)	–	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 (CNUSR11/12)	–	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	Sequencer unit	SRVON	The servo power ON/OFF state is output.	The servo power ON/OFF state is shown and alerted with the display lamps.
	Waiting		STOP	Outputs that the robot is temporarily stopped.	The temporary stop state is shown and alerted with the display lamps.
	In alarm	Connector (CNUSR2)	ERRRESET	Outputs when an alarm occurs in the robot.	The alarm state is shown and alerted with the display lamps.
			–		

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 149, "6.1.7 Examples of safety measures"for details.
And, refer to Page 121, "(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
- lways 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

Two emergency-stop input circuits are prepared on the user wiring terminal block of the drive unit. 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 154, "(2) External emergency stop connection [supplementary explanation]".

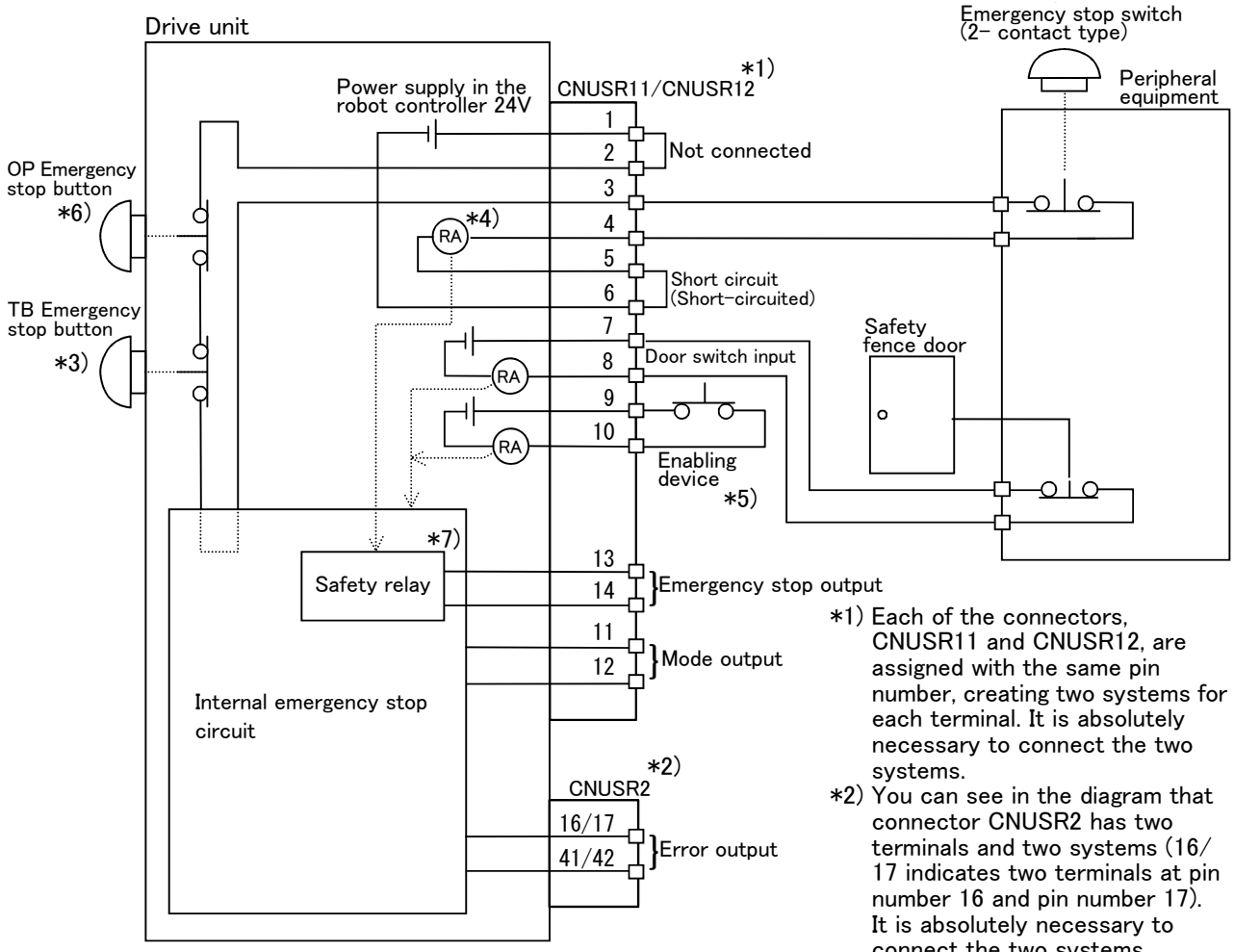
[Note] ・In the emergency-stop related wiring by the customer, if the coil (is not the contact points) of the relay prepared by the customer is connected to the drive unit, please be sure to implement the measure against the noise by the customer in the coil section. And, please also take the lifetime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

<Wiring example 1>: Connect the emergency stop switch of peripheral equipment to the drive unit.
The power supply for emergency stop input uses the power supply in the drive uni.
<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.



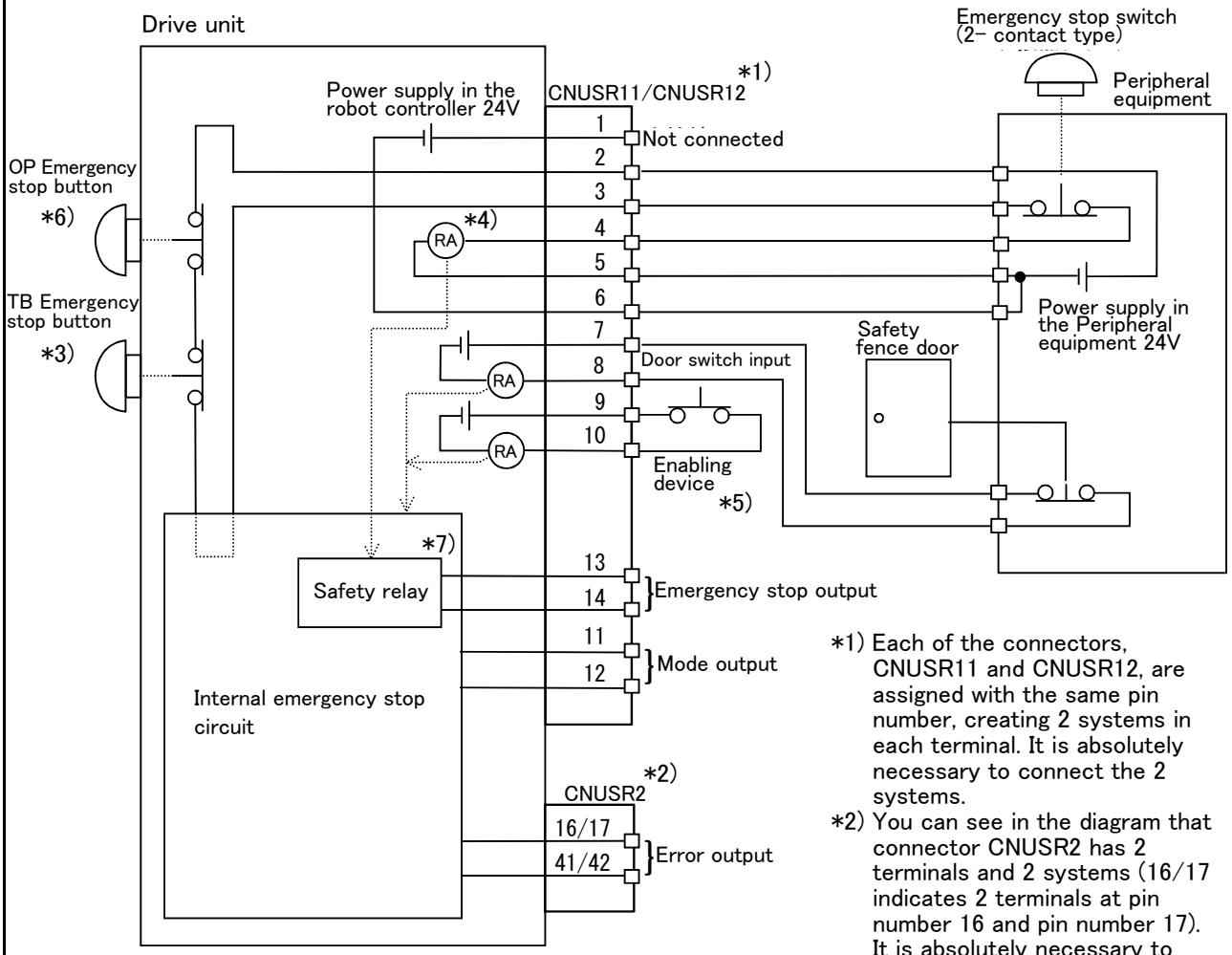
*1) Each of the connectors, CNUSR11 and CNUSR12, are assigned with the same pin number, creating two systems for each terminal. It is absolutely necessary to connect the two systems.

*2) You can see in the diagram that connector CNUSR2 has two terminals and two systems (16/17 indicates two terminals at pin number 16 and pin number 17). It is absolutely necessary to connect the two systems.

*3) The T/B emergency stop button connected with the drive unit.
*4) Emergency stop input relay.
*5) Refer to Standard specification manual for the enabling device.
*6) The emergency stop button of the robot controller. (Only specification with the operation panel.)
*7) The emergency stop input detection relay is used 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.6-1 : 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.



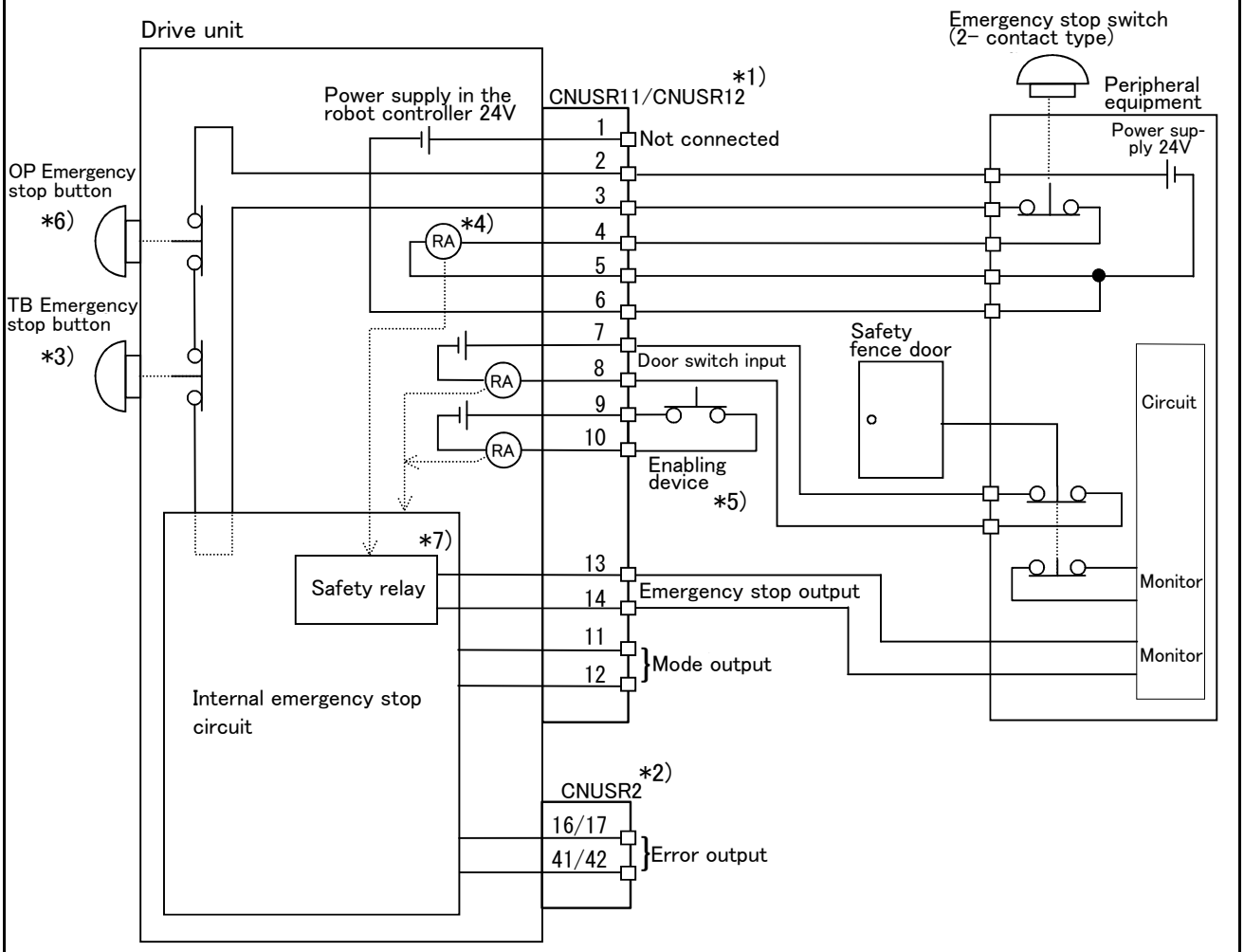
*1) Each of the connectors, CNUSR11 and CNUSR12, are assigned with the same pin number, creating 2 systems in each terminal. It is absolutely necessary to connect the 2 systems.

*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 button connected with the drive unit.
*4) Emergency stop input relay.
*5) Refer to Standard specification manual for the enabling device.
*6) The emergency stop button 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.



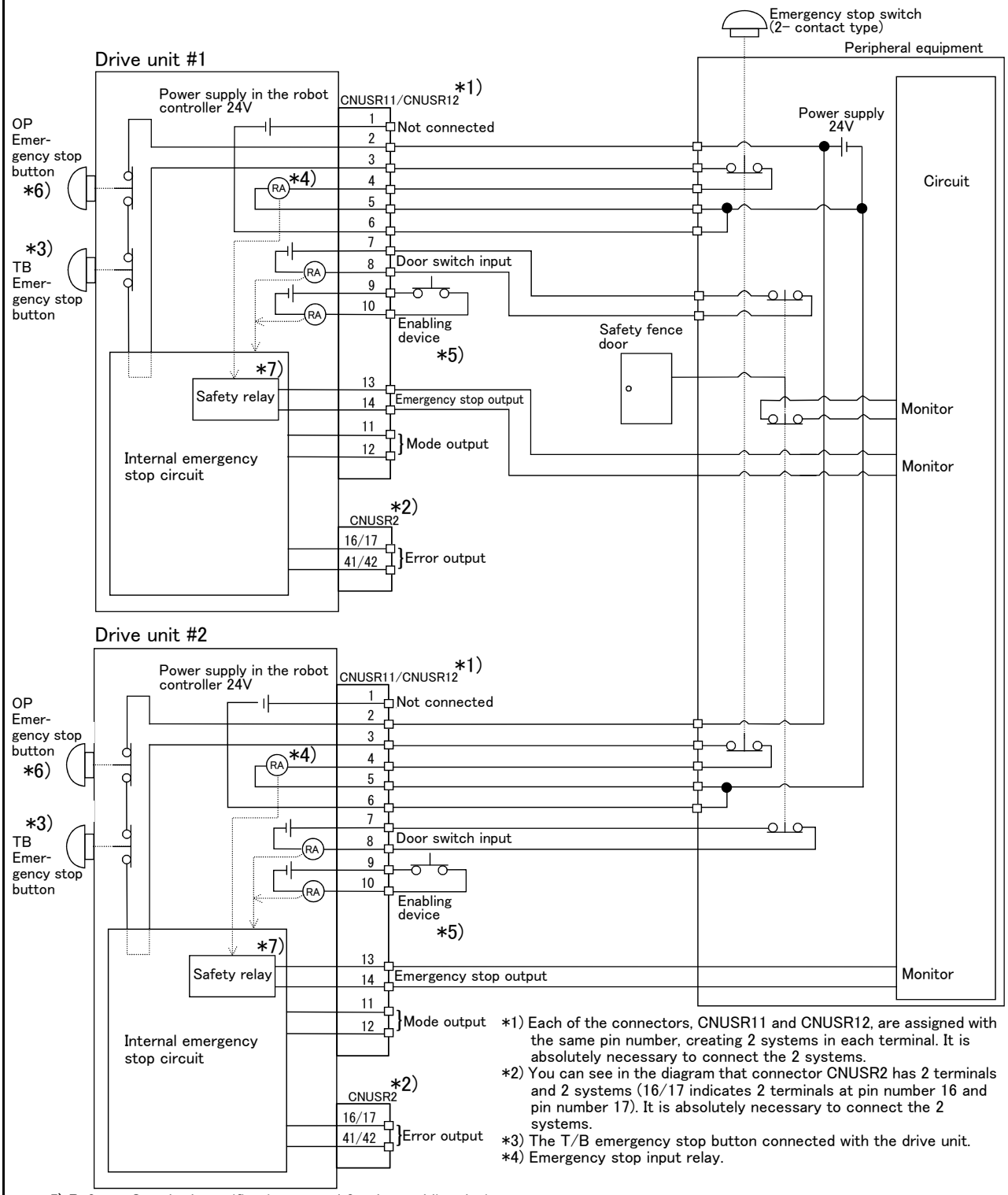
*1) Each of the connectors, CNUSR11 and CNUSR12, are assigned with the same pin number, creating 2 systems in each terminal. It is absolutely necessary to connect the 2 systems.
*2) You can see in the diagram that connector CNUSR2 has 2 terminals and 2 systems (16/17 indicates 2 terminals at pin number 16 and pin number 17). It is absolutely necessary to connect the 2 systems.
*4) Emergency stop input relay.
*5) Refer to Standard specification manual for the enabling device.
*6) The emergency stop button 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.



*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 button connected with the drive unit.

*4) Emergency stop input relay.

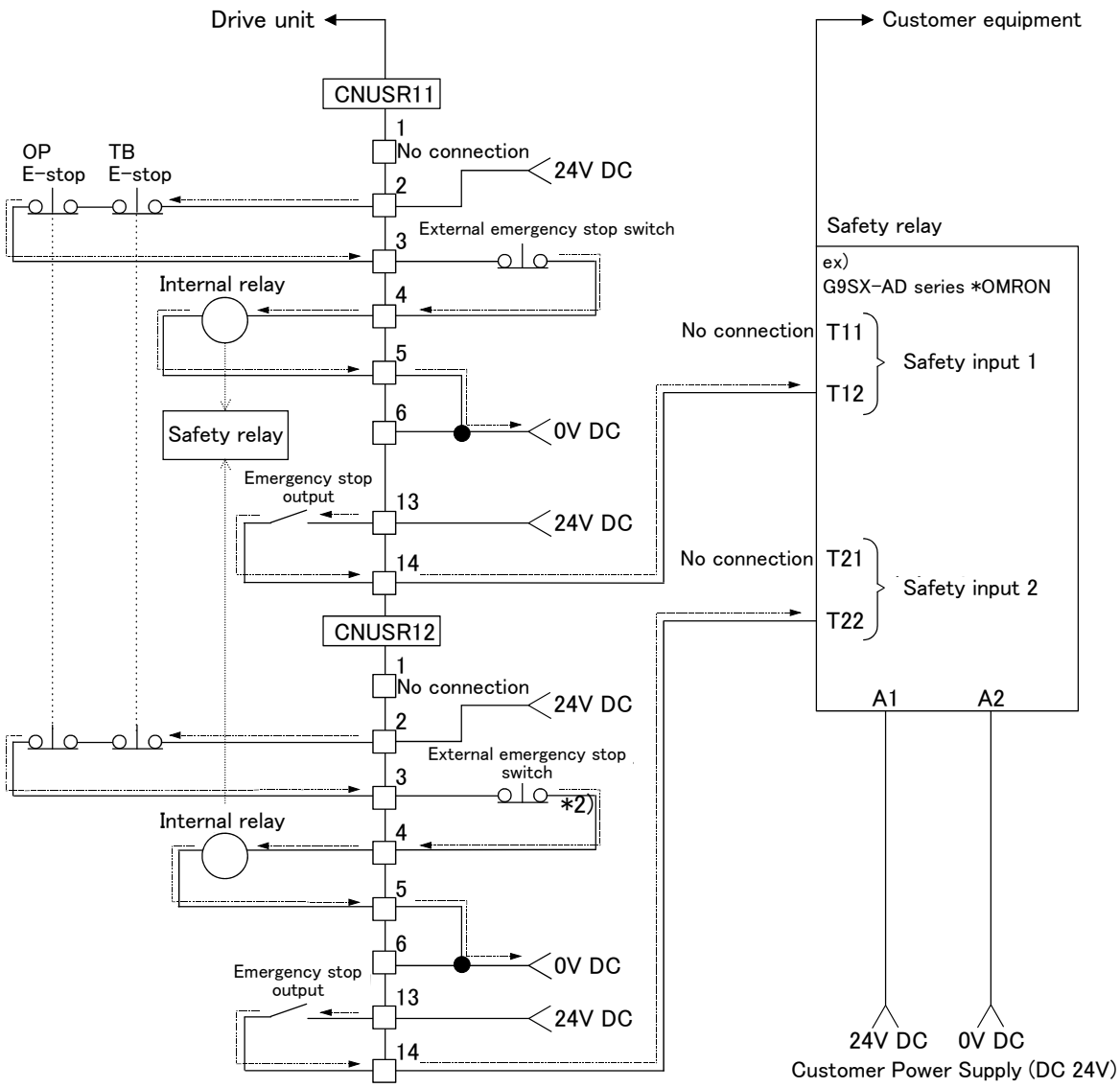
*5) Refer to Standard specification manual for the enabling device.

*6) The emergency stop button 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.6-4 : 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 button 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 controller's internal circuit has polarity. Please adhere to the polarity as detailed in the wiring examples, particularly for emergency stop button 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 button (or contact points) in the user equipment to across the terminals 3 and 4 of CNUSR11/12, and ultimately connect the negative side (0V DC).
3) When installing a safety relay to use it as an input point of the controller's emergency stop button command, use a safety relay that is activated by an input from one of the two systems (i.e. Omron's G9S Series).
4) The emergency stop input detection relay (internal relay) uses the controller'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 button 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) 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 button.
(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. 6-6)
- 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 (0.14mm^2 to 1.5mm^2)
  - CR750 drive unit..... CNUSR2 connector: AWG #30 to #24 (0.05mm^2 to 0.2mm^2)

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.

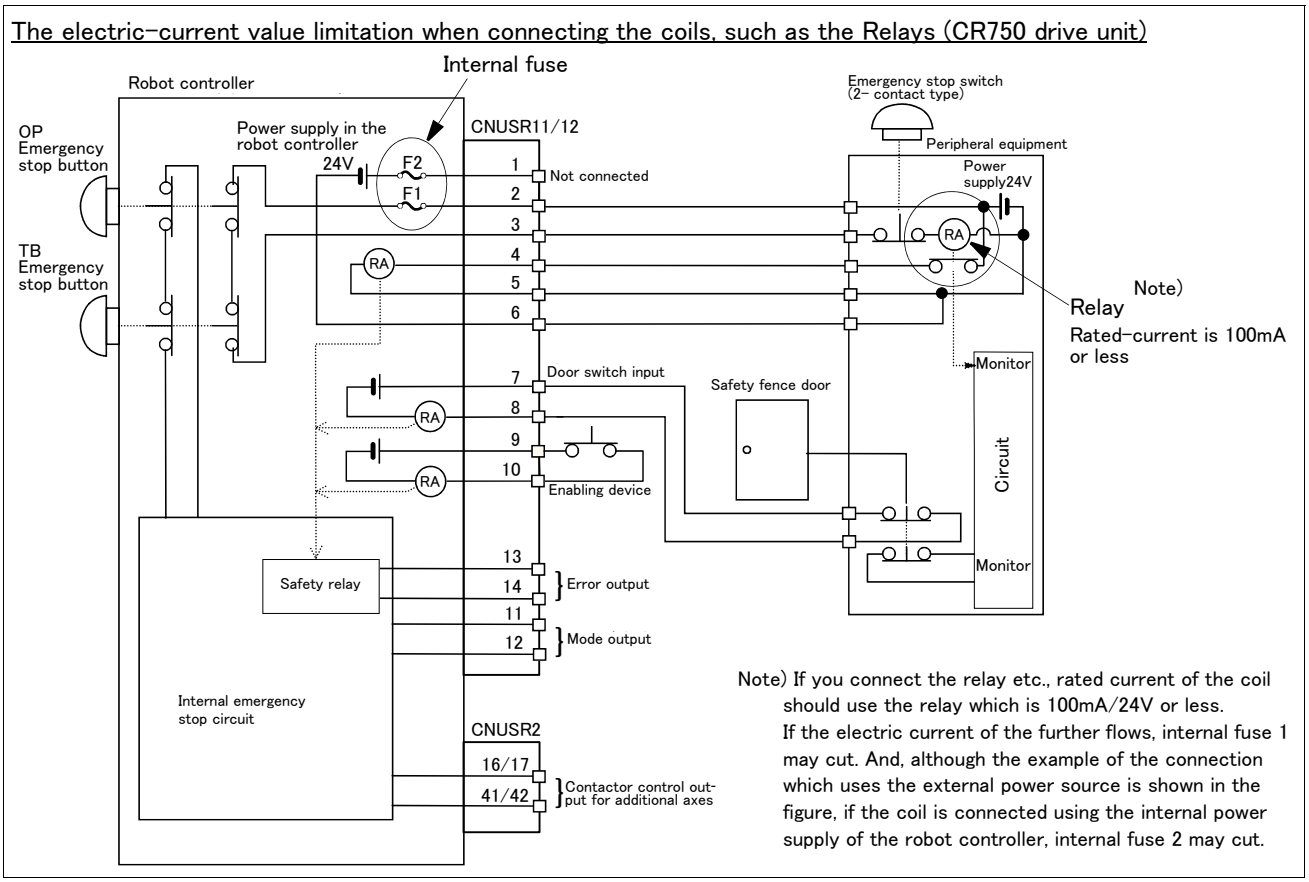
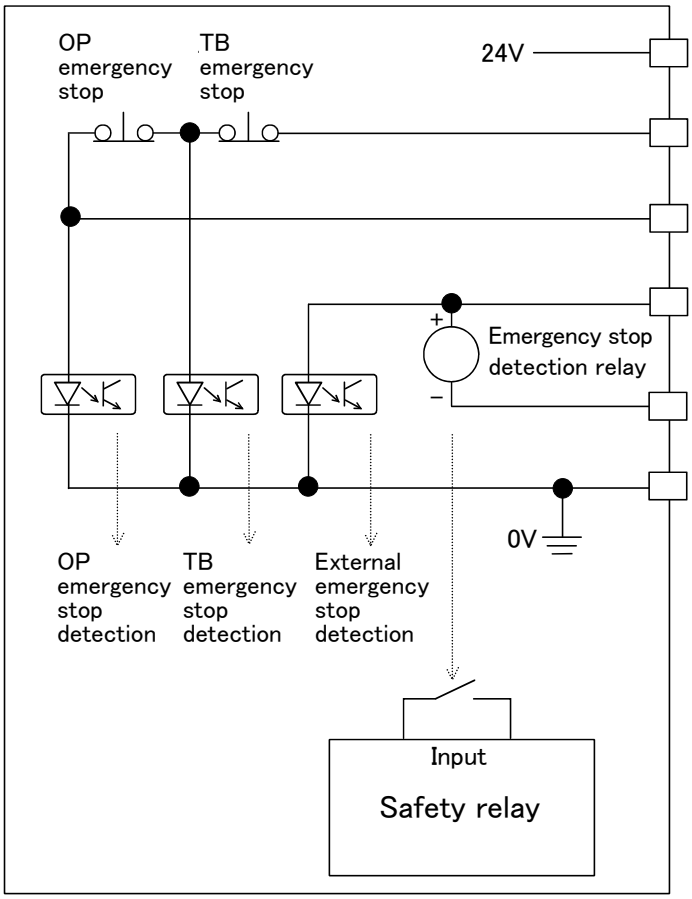


Fig.6-6 : Limitations when connecting the relay etc. (CR750)

[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 button is pressed.



⚠CAUTION Be sure to perform wiring correctly. If there are mistakes in the wiring, the robot may not stop when the emergency stop button 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 error may occur.

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

(3) Temperature and humidity
- Where the atmospheric temperature exceeds 40 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 is configured of precision parts such as bearings. Grease is used for lubricating these parts. When cold starting at low temperatures or starting operation after long-term stoppage, the position accuracy may drop or servo alarms may occur. If these problems occur, perform a 5 to 10 minute running-in operation at a low speed (about a half of normal operating speed).
(5) 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.
(6) The items described in these specifications are conditions for carrying out the periodic maintenance and inspections described in the instruction manual.
(7) When using the robot arm on a mobile axis or elevating table, the machine cables enclosed as standard configuration may break due to the fixed installation specifications. In this case, use "the machine cable extension (for flexed)" factory shipment special specifications or options.

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

(8) If this robot interferes with the workpiece or peripheral devices during operation, the position may deviate, etc. Take care to prevent interference with the workpiece or peripheral devices during operation.
(9) 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.
(10) 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.
(11) 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.
(12) 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.
(13) Do not conduct an insulated voltage test. If conducted by mistake, it may result in a breakdown.
(14) 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.
(15) 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.
(16) The United Nations' Recommendations on the Transport of Dangerous Goods must be observed for transborder transportation of lithium batteries by air, sea, and land. The lithium batteries (ER6, Q6BAT) used in Mitsubishi industrial robots contain less than 1 g of lithium and are not classified as dangerous goods. However, if the quantity of lithium batteries exceeds 24 batteries for storage, etc., they will be classified as Class 9: Miscellaneous dangerous substances and articles. Shipping less than 24 batteries is recommended to avoid having to carry out transport safety measures as the customer's consignor. Note that some transportation companies may request an indication that the batteries are not dangerous goods be included on the invoice. For shipping requirement details, please contact your transportation company.
(17) 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.
(18) 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.

6.4 EMC installation guideline

6.4.1 Outlines

The EMC directive is coerced from January 1, 1996, and it is necessary to attach the CE mark which shows that the product is in conformity to directive.

Since the industrial robot is the component of the automation system, it considers that the EMC directive is not the target product of the direct. However, because it is one of the main components, introduces the method and components of the measures for conforming the automation system to the EMC directive.

And also we are carrying out the qualification test about the conformity of the EMC directive under the environment based on the contents of this document. However, the noise level is changed by the kind of equipment to be used, the layout, the construction of the controlling board, the course of wiring, etc. Therefore, please confirm by the customer eventually.

6.4.2 EMC directive

The Mitsubishi Electric industrial robot follows the European EMC directive. 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 distrurbances 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.

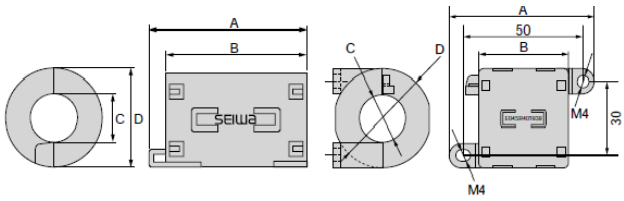
6.4.4 Component parts for EMC measures

(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.

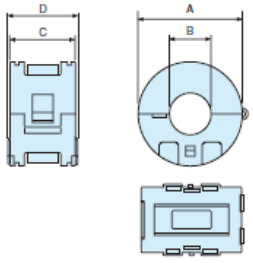
Maker: SEIWA ELECTRIC MFG. Co.,Ltd.

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



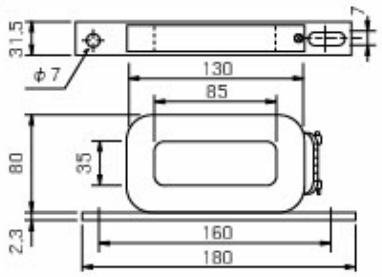
Maker: TAKACHI ELECTRONICS ENCLOSURE CO., LTD.

Type	Outside dimension (mm)				Diameter of the adaptation cable [max] (mm)
	A	B	C	D	
TFT-274015S	43.8	27.4	20.7	–	ϕ26.5



(2) Line noise filter

Type : FR-BLF (Mitsubishi Electric Corp.)



7 Appendix

Appendix 1 : Specifications discussion material (RH-6FH series)

■ Customer information

Company name		Name	
Address		Telephone	

■ Purchased mode

Item		Type	Arm length	Stroke	Controller
General specification		RH-6FH ☐☐△△ -Q	☐ 350 ☐ 450 ☐ 550	☐ 200 ☐ 340	CR750-06HQ-1
Clean specification		RH-6FH ☐☐△△ C-Q	☐ 350 ☐ 450 ☐ 550	☐ 200 ☐ 340	
Oil mist specification		RH-6FH ☐☐△△ M-Q	☐ 350 ☐ 450 ☐ 550	☐ 200 ☐ 340	
CE marking specification					
	Standard specification (IP54) Note1)	RH-6FH ☐☐△△ -Q1-S15	☐ 350 ☐ 450 ☐ 550	☐ 200 ☐ 340	CR750-06HQ1-1-S15
	Clean specification	RH-6FH ☐☐△△ C-Q1-S15	☐ 350 ☐ 450 ☐ 550	☐ 200 ☐ 340	

Note1) When you wish to have bellows, contact our dealer.

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

Item		Standard specification	Special shipping specifications
Robot arm	Machine cable	☐ 5m fixed type	☐ 2m fixed type: 1S-02UCBL-01
Controller	Robot CPU unit connecting cable set Note1)	☐ 10m	☐ 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-01	☐ Not provided ☐ Provided
	Machine cable extension	1S- ☐☐ CBL-01	Fixed type (extension type): ☐ Not provide ☐ 5m ☐ 10m ☐ 15m
		1S- ☐☐ LCBL-01	Flexed type (extension type): ☐ Not provide ☐ 5m ☐ 10m ☐ 15m
		1S- ☐☐ LUCBL-01	Flexed type (direct type): ☐ Not provide ☐ 5m ☐ 10m ☐ 15m
	Solenoid valve set	1F-VD0 ☐ -01 1F-VD0 ☐ E-01	☐ Not provide 1F-VD0 ☐ -01 (Sink type): ☐ 1set ☐ 2set ☐ 3set ☐ 4set 1F-VD0 ☐ E-01 (Source type): ☐ 1set ☐ 2set ☐ 3set ☐ 4set
	Hand input cable	1F-HC35C-01	☐ Not provided ☐ Provided
	Hand output cable	1F-GR60S-01	☐ Not provided ☐ Provided
	Hand curl tube	1E-ST0408C-300	☐ Not provided ☐ Provided
	External Wiring/Piping box	1F-UT-BOX	☐ Not provided ☐ Provided
	Internal Wiring/Piping for hand	1F-HS408S-01	☐ Not provided ☐ Provided (For 200mm stroke)
		1F-HS408S-02	☐ Not provided ☐ Provided (For 340mm stroke)
Controller	Simple teaching pendant	R32TB- ☐☐	☐ Not provided ☐ 7m ☐ 15m
	Highly efficient teaching pendant	R56TB- ☐☐	☐ Not provided ☐ 7m ☐ 15m
	Controller protection box	CR750-MB	☐ Not provided ☐ Provided
	RT ToolBox2	3D-11C-WINJ	☐ Not provided ☐ Windows2000/XP/Vista/7 English CD-ROM
	RT ToolBox2 mini	3D-12C-WINJ	☐ Not provided ☐ Windows2000/XP/Vista/7 English CD-ROM
	Network vision sensor	4D-2CG5***-PKG	☐ Not provided ☐ Provided
	Instructions manual	5F-RB01-PE01	☐ Not provided ☐ Provided ( ) sets

■ Maintenance parts (Consumable parts)

Maintenance parts	☐ Backup batteries ER6 ( ) 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 25, "2.2.7 Protection specifications" about oil resistance.

Appendix 2 : Specifications discussion material (RH-12FH series)

■ Customer information

Company name		Name	
Address		Telephone	

■ Purchased mode

Item	Type	Arm length	Stroke	Controller
General specification	RH-12FH ☐☐△△ -Q	☐ 550 ☐ 700 ☐ 850	☐ 350 ☐ 450	CR750-12HQ-1
Clean specification	RH-12FH ☐☐△△ C-Q	☐ 550 ☐ 700 ☐ 850	☐ 350 ☐ 450	
Oil mist specification	RH-12FH ☐☐△△ M-Q	☐ 550 ☐ 700 ☐ 850	☐ 350 ☐ 450	

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

Item		Standard specification	Special shipping specifications
Robot arm	Machine cable	☐ 5m fixed type	☐ 2m fixed type: 1S-02UCBL-01
Controller	Robot CPU unit connecting cable set Note1)	☐ 10m	☐ 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: ☐ Not provide ☐ 5m ☐ 10m ☐ 15m
		1S- ☐☐ LCBL-01	Flexed type: ☐ Not provide ☐ 5m ☐ 10m ☐ 15m
	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- ☐☐	☐ Not provided ☐ 7m ☐ 15m
	Highly efficient teaching pendant	R56TB- ☐☐	☐ Not provided ☐ 7m ☐ 15m
	Controller protection box	CR750-MB	☐ Not provided ☐ Provided
	RT ToolBox2	3D-11C-WINJ	☐ Not provided ☐ Windows2000/XP/Vista/7 English CD-ROM
	RT ToolBox2 mini	3D-12C-WINJ	☐ Not provided ☐ Windows2000/XP/Vista/7 English CD-ROM
	Network vision sensor	4D-2CG5***-PKG	☐ Not provided ☐ Provided
	Instructions manual	5F-RB01-PE01	☐ Not provided ☐ Provided ( ) sets

■ Maintenance parts (Consumable parts)

Maintenance parts	☐ Backup batteries ER6 ( ) 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 25, "2.2.7 Protection specifications" about oil resistance.

Appendix 3 : Specifications discussion material (RH-20FH series)

■ Customer information

Company name		Name	
Address		Telephone	

■ Purchased mode

Item	Type	Arm length	Stroke	Controller
General specification	RH-20FH ☐☐△△ -Q	☐ 850 ☐ 1000	☐ 350 ☐ 450	CR750-20HQ-1
Clean specification	RH-20FH ☐☐△△ C-Q	☐ 850 ☐ 1000	☐ 350 ☐ 450	
Oil mist specification	RH-20FH ☐☐△△ M-Q	☐ 850 ☐ 1000	☐ 350 ☐ 450	

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

Item		Standard specification	Special shipping specifications
Robot arm	Machine cable	☐ 5m fixed type	☐ 2m fixed type: 1S-02UCBL-01
Controller	Robot CPU unit connecting cable set Note1)	☐ 10m	☐ 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: ☐ Not provide ☐ 5m ☐ 10m ☐ 15m
		1S- ☐☐ LCBL-01	Flexed type: ☐ Not provide ☐ 5m ☐ 10m ☐ 15m
	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- ☐☐	☐ Not provided ☐ 7m ☐ 15m
	Highly efficient teaching pendant	R56TB- ☐☐	☐ Not provided ☐ 7m ☐ 15m
	Controller protection box	CR750-MB	☐ Not provided ☐ Provided
	RT ToolBox2	3D-11C-WINJ	☐ Not provided ☐ Windows2000/XP/Vista/7 English CD-ROM
	RT ToolBox2 mini	3D-12C-WINJ	☐ Not provided ☐ Windows2000/XP/Vista/7 English CD-ROM
	Network vision sensor	4D-2CG5***-PKG	☐ Not provided ☐ Provided
	Instructions manual	5F-RB01-PE01	☐ Not provided ☐ Provided ( ) sets

■ Maintenance parts (Consumable parts)

Maintenance parts	☐ Backup batteries ER6 ( ) 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 25, "2.2.7 Protection specifications" about oil resistance.

ZERTIFIKAT ◆ CERTIFICATE ◆ 認証書 ◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFICAT

Product Service

EC-Statement of Compliance

No. E6 12 11 25554 047

Holder of Certificate: **Mitsubishi Electric Corporation**
Tokyo 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.: 73539409

Date, 2012-11-26 (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.

TÜV SÜD Product Service GmbH · Zertifizierstelle · Ridlerstraße 65 · 80339 München · Germany

TÜV®

Attachment

Statement No.

E6 12 11 25554 047

Product Service

Nomenclature

A: Model name of **F** series Robot description is shown as follows.
A1:RH-3FH,RH6FHseries 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
6 : 6kg
(3) **F** : **F** series robot
(4)**H** :4 joints
(5) Robot Arm length(No1 and No2 arm) specification:
35 : 350 mm arm
45 : 450 mm arm
55 : 550 mm arm
(6) Z stroke length specification:
12 : 120 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

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 12 11 25554 047

Product Service

A3:RV-2Fseries 1.7kW

RV-x F x – x x x–Sxx
(1) (2) (3) (4) (5) (6) (7) (8)

(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) Type of Robot controller cabinet
[none] :CR750 controller
1 :CR751 controller
(6)Robot controller type:
D :Stand alone type
Q :iQ platform type
(7)Standard:
0: normal type
1:CE marking model
2:CE marking and UL model

(8)Optional Specification:
1 :normal type
SM :added cabinet box over Robot controller for oil mist resist
Sxx :Mechanical option

Attachment

Statement No.

E6 12 11 25554 047

Product Service

A4:RV-4F,7Fseries 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:

4 : 4kg

7 : 7kg

(3) **F** : **F** series robot

(4) Robot arm length:

L : Long arm model

[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

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
(2) Maximum Payload specification:
03 : 3kg
06 : 6kg
12 : 12kg
20 : 20kg
02 : 2kg
04 : 4kg
07 : 7kg
(3) Robot type
H : Horizontal robot
V : Vertical robot
(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

MITSUBISHI ELECTRIC
Changes for the Better

EC DECLARATION OF CONFORMITY
(According to EMC Directive)
EC DECLARATION OF INCORPORATION
(According to Machinery Directive)

We,

Manufacturer: MITSUBISHI ELECTRIC Corporation Nagoya Works

Address 1-14 Yada-Minami 5-Chome Higashi-Ku,Nagoya 461-8670, Japan

(Place of Declare):

Declare under our sole responsibility that the Product

Description: Industrial Robot

Type of Model: F series

Notice: Details of Serial No. are as per attached sheet(P7).

Restrictive use: For industrial environment only

Conforms with the essential requirements of the **EMC Directive 2004/108/EC** and the **Machinery Directive 2006/42/EC**, based on the following specifications applied:

EU Harmonized Standards		Non-harmonized Standard
EMC(2004/108/EC)	EN61000-6-4:2007 EN61000-6-2:2005	N/A
Machinery(2006/42/EC)	Type A:Fundamental safety standards EN ISO12100-1:2003 EN ISO12100-2:2003 EN 1050:1997 Type B:Group safety standards B1:Safety aspects EN60204-1:2006, EN294:1992, EN349:1993 ISO13849-1:2006 (Category 3 and Performance level "d") Type C:Machine Safety standard ISO10218-1:2011	N/A

and therefore complies with the essential requirements and provisions of the EMC Directive and the Machinery Directive.

< Partly completed Machinery>

This product meets the specification and/or the performance by correct installing.
So it must not be used until being installed into the final machinery of the customer.

Issue Date (Date of Declaration): November 5,2012

The identity and signature of the person empowered to bind the manufacturer or his authorized representative.

Tomoyuki Kobayashi
(signature)

[Tomoyuki Kobayashi]

Senior Manager
Robot Manufacturing Department
MITSUBISHI ELECTRIC Corporation Nagoya Works

Authorized representative in Europe
(The person authorized compiles the relevant Technical documentation)

(signature)

[Hartmut Putz]

FA Product Marketing Director FA Group
Gother St. 8, 40880 Ratingen ,Germany
MITSUBISHI Electric Europe B.V Germany

■ Declaration Type of models

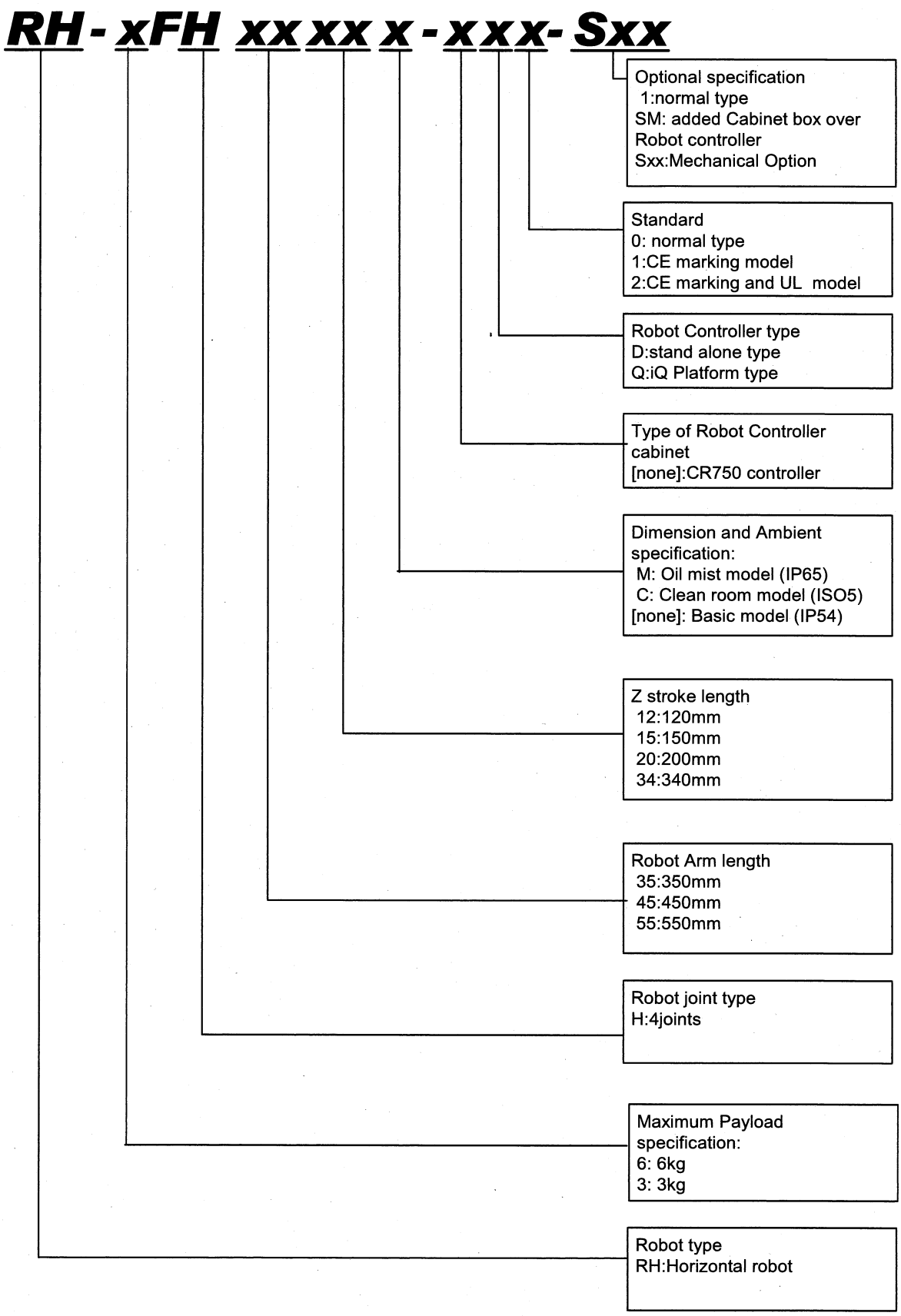


Fig.1-1 Nomenclature of F series robot (RH type Robot)

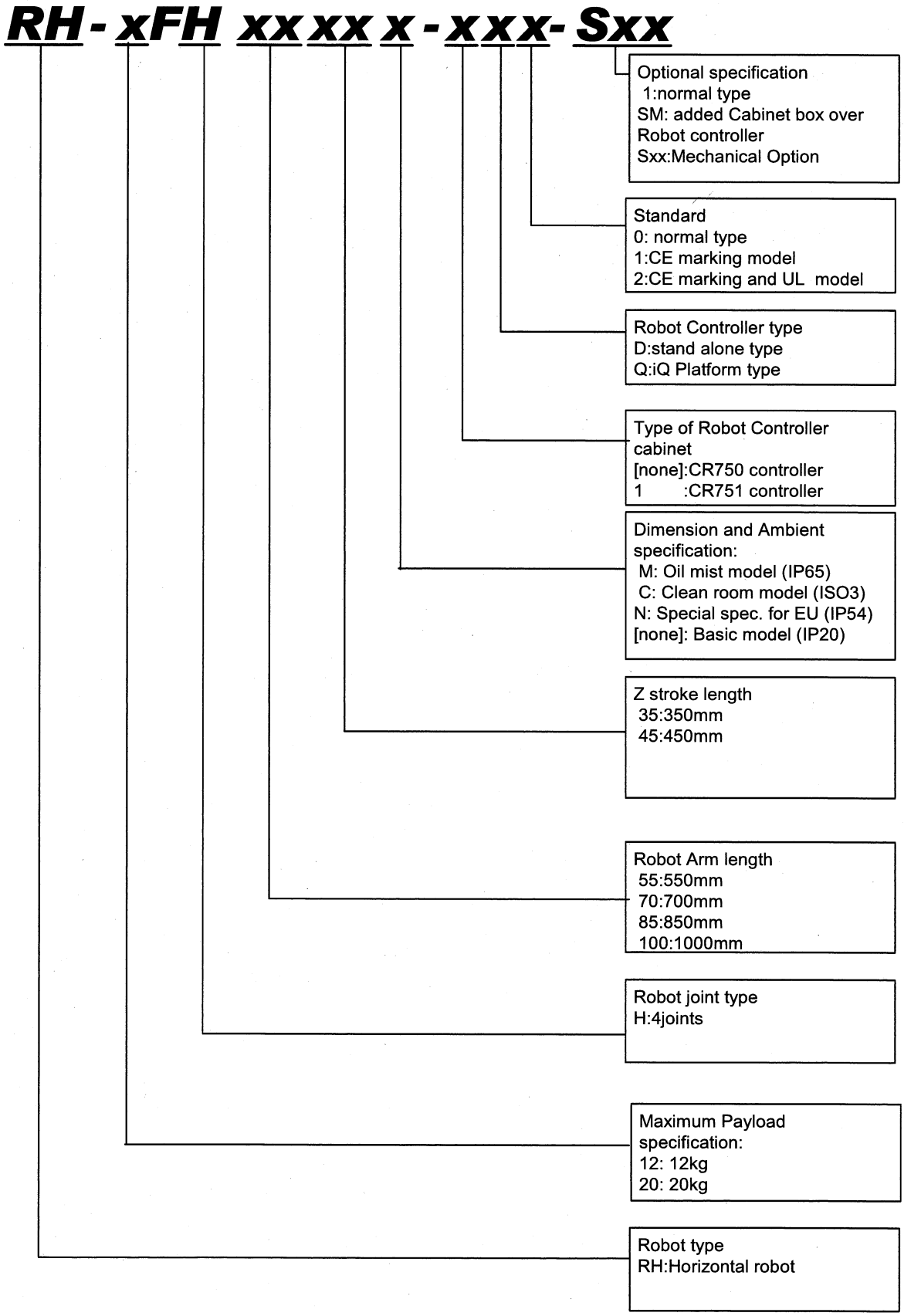


Fig.1-2 Nomenclature of F series robot of RH-12FH,20FH

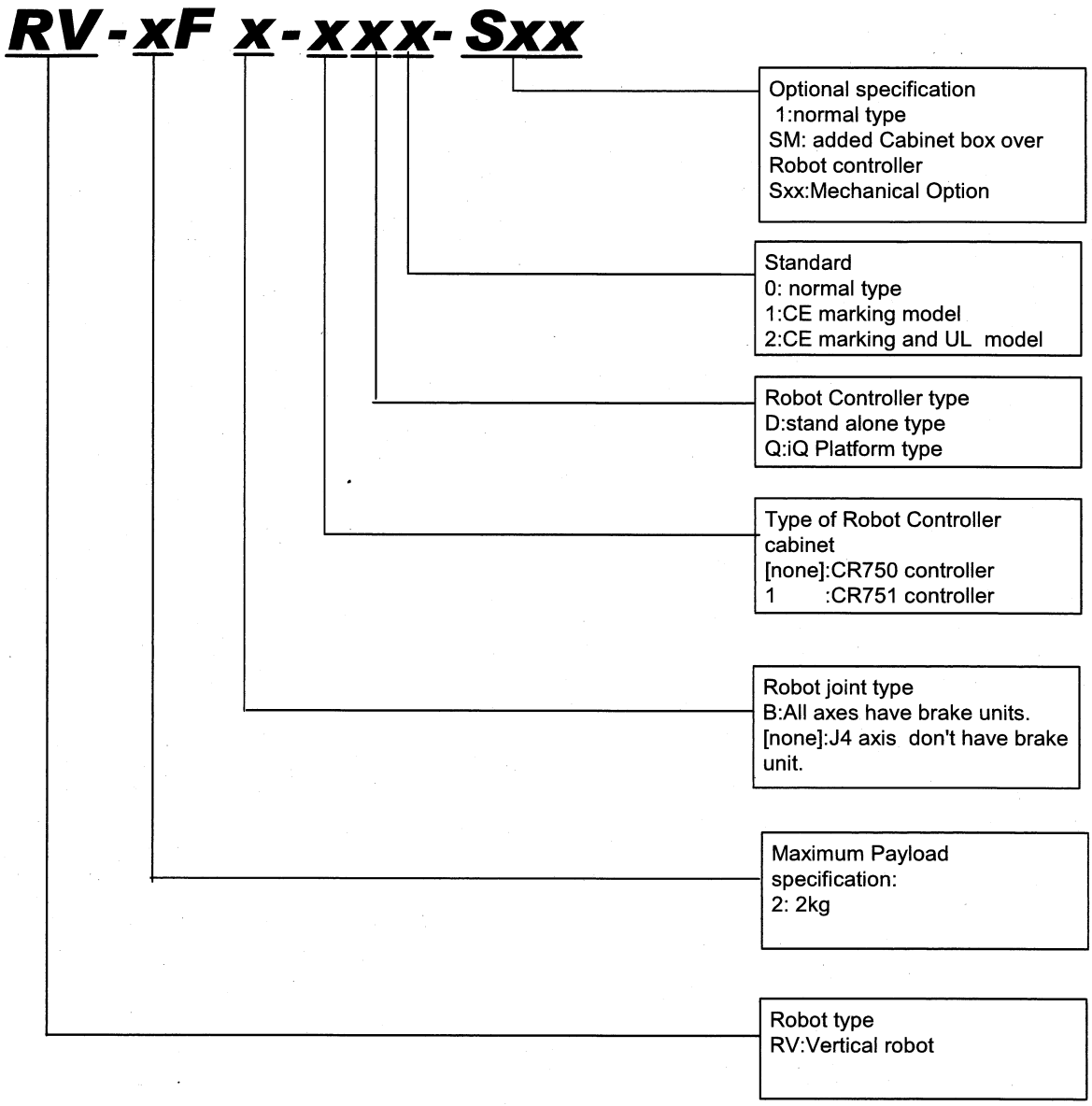


Fig.1-3 Nomenclature of F series robot of RV-2F

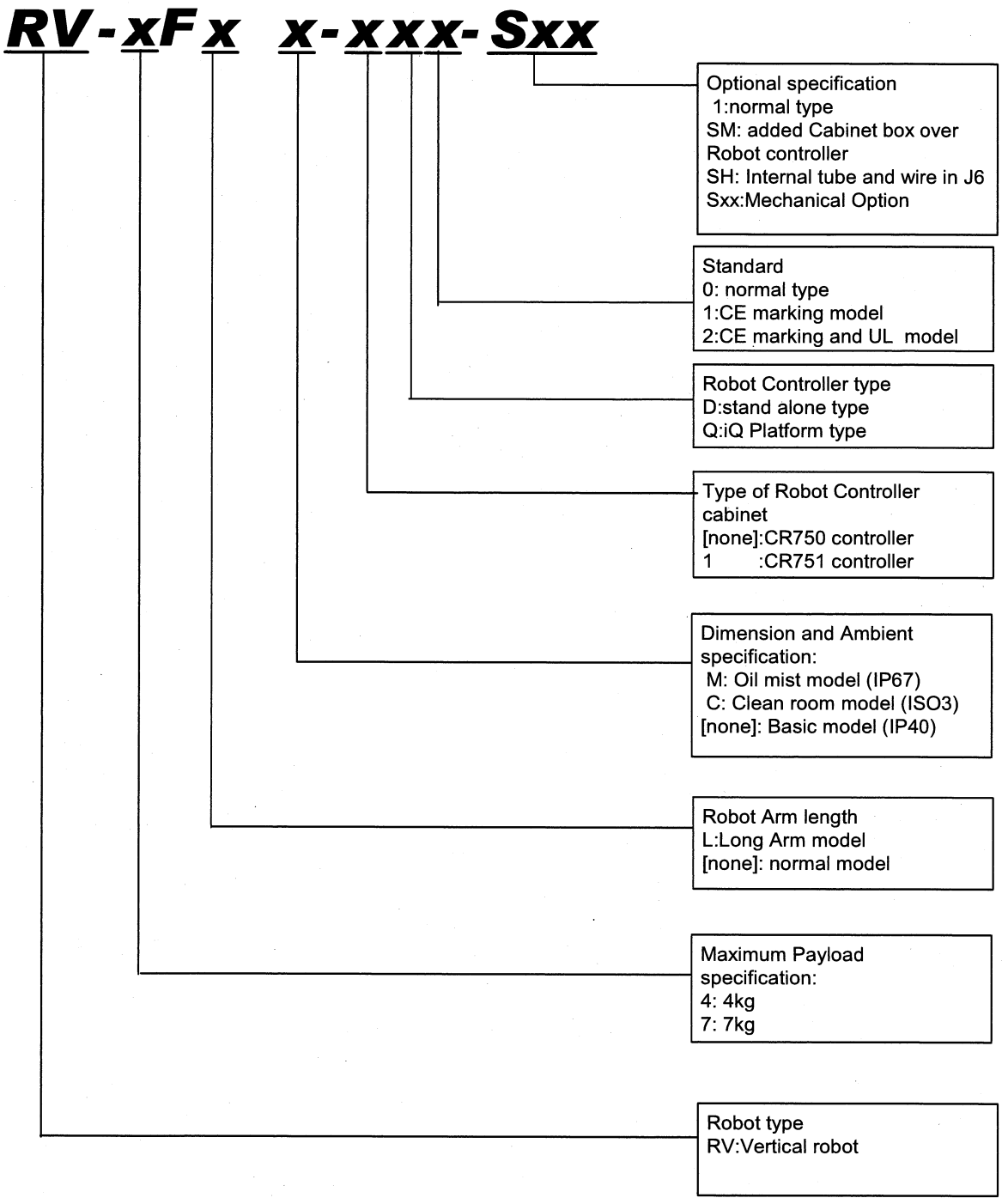


Fig.1-4 Nomenclature of F series robot of RV-4F,7F

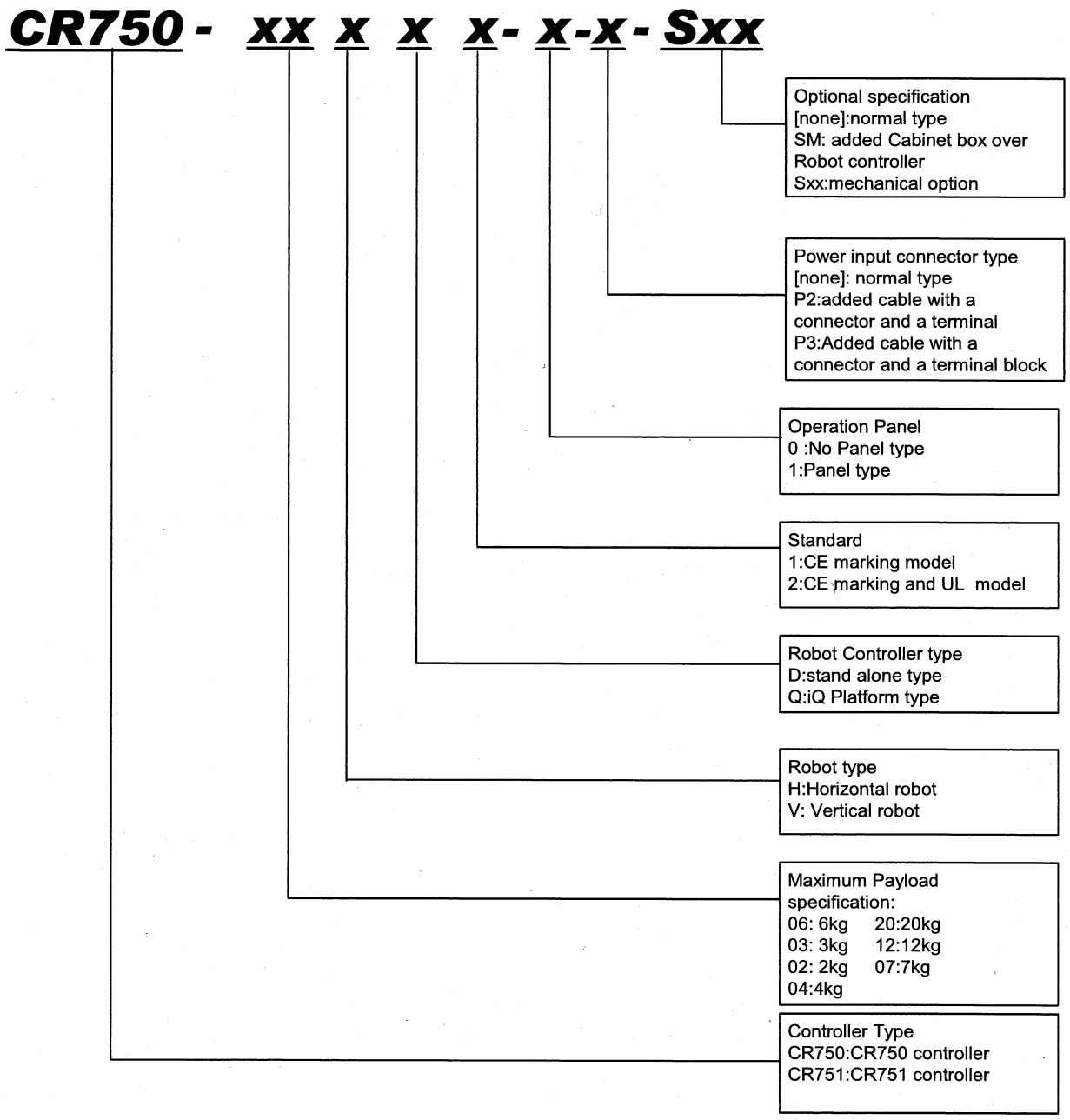


Fig.2-1 Nomenclature of F series robot controller

■ Details of serial number

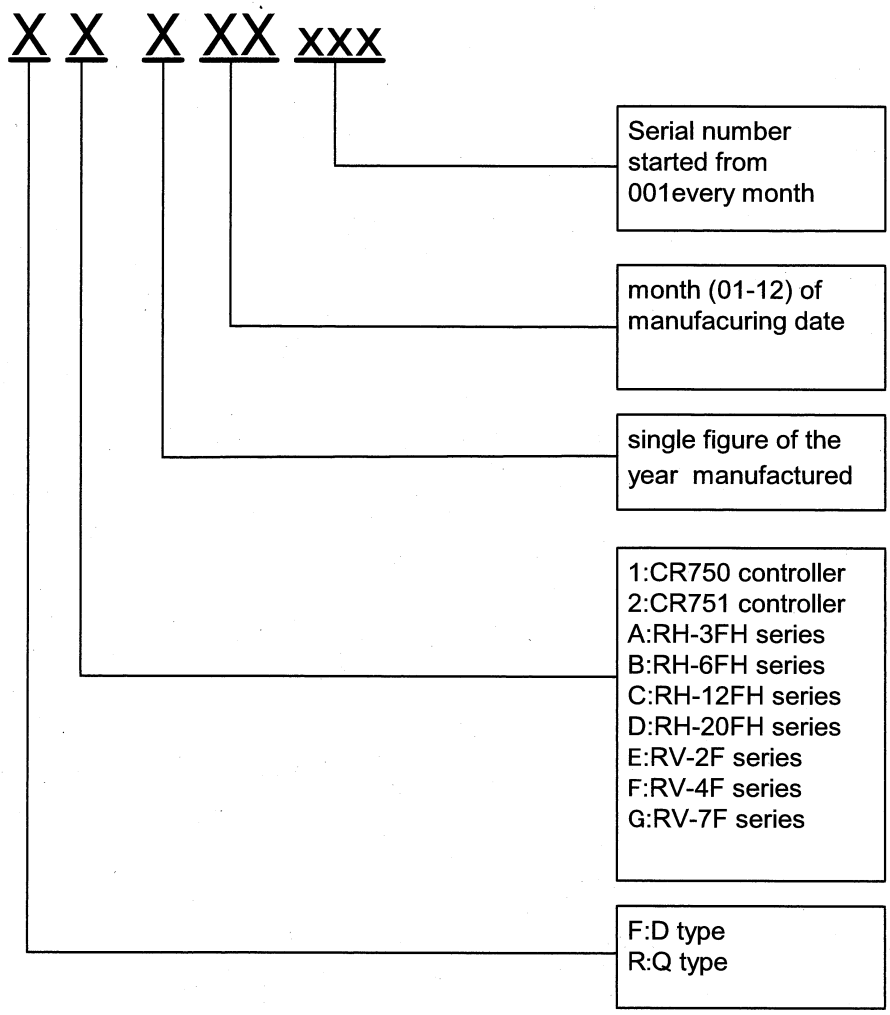


Fig.3.1 Nomenclature of serial number about F series Robot and robot controller

Revision history

Date	Specifications No.	Details of revisions	Rev.
April 16,2012		First print	*
May 25, 2012		Q type added	A
October 1,2012	Fig.1-2,1-3,1-4 added	RH-12/20FH-D series,RV-2F-D series,RV-4F/7F-D series added	B
November 1,2012	P1 P3-P7	Form changed RH-12/20FH-Q series,RV-2F-Q series,RV-4F/7F-Q series added "Details of serial No." added	C

사용자안내문
User's Guide

기종별 Type of Equipment	사용자안내문 User's Guide
A 급 기기 (업무용 방송통신기자재) Class A Equipment (Industrial Broadcasting & Communication Equipment)	이 기기는 업무용(A 급) 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다. 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.
B 급 기기 (가정용 방송통신기자재) Class B Equipment (For Home Use Broadcasting & Communication Equipment)	이 기기는 가정용(B 급) 전자파적합기기로서 주로 가정에서 사용하는 것을 목적으로 하며, 모든 지역에서 사용할 수 있습니다. 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.

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Mar., 2013 MEE Printed in Japan on recycled paper.

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