MITSUBISHI Mitsubishi Industrial Robot

CR751-Q Controller RV-4F-Q/7F-Q/13F-Q/20F-Q Series Standard Specifications Manual



▲ Safety Precautions

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

▲ CAUTION	All teaching work must be carried out by an operator who has received special training. (This also applies to maintenance work with the power source turned ON.) Enforcement of safety training
▲ CAUTION	For teaching work, prepare a work plan related to the methods and procedures of operating the robot, and to the measures to be taken when an error occurs or when restarting. Carry out work following this plan. (This also applies to maintenance work with the power source turned ON.) Preparation of work plan
⚠ WARNING	Prepare a device that allows operation to be stopped immediately during teaching work. (This also applies to maintenance work with the power source turned ON.) Setting of emergency stop switch
▲ CAUTION	During teaching work, place a sign indicating that teaching work is in progress on the start switch, etc. (This also applies to maintenance work with the power source turned ON.) Indication of teaching work in progress
▲ 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.
A 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.
<u>∕</u> MWARNING	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.
	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.
A 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.
	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.



ACAUTION

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.

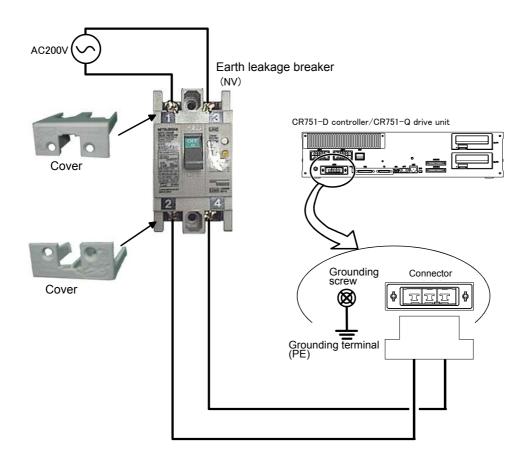
Do not turn off the main power to the robot controller while rewriting the internal information of the robot controller such as the program or parameters. If the main power to the robot controller is turned off while in automatic operation or rewriting the program or parameters, the internal information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

*CR751-D or CR751-Q controller

Notes of the basic component are shown.



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



■Revision history

Date of print	Specifications No.	Details of revisions
2013-03-11	BFP-A8973	First print.
2013-04-04	BFP-A8973-A	 The diameter of A/B ports on the optional solenoid valve set for RV-13F/20F series were corrected. (formerly: \$\overline{0}4\$) The values of "Allowable moment load" and "Allowable inertia" of RV-20F were corrected. "Table 2-4: Position of center of gravity for loads (for loads with comparatively small volume): RV-20F" was added.
2013-07-19	BFP-A8973-B	 The length of the machine cable of a RV-13F series standard configuration equipment was added. "Declaration of Incorporation" and "EC-Statement of Compliance" were updated. "Table 2-28: Pin assign of hand input cable" was corrected. The variations of an optional hand curl tube for RV-13F/13FL/20F were added. "6.4 EMC installation guideline" was added. Outside dimensions and operating range diagrams of RV-7FLL, RV-13F/20F and RV-13FL were changed. "1.3 CE marking specifications" was added. The outside dimension and shape of the optional solenoid valve set for RV-13F series was changed. The color of wires of GR2 connector in "2.5.6 Wiring and piping system diagram for hand" was corrected. The cautions for handling" were modified. The caution about fumigation of wood packing was added to "6.3 Precautions for handling". The caution about fumigation of yood packing was added to "6.3 Precautions for handling". The caution about fumigation of wood packing was added to "6.3 Precautions for handling".
2013-09-18	BFP-A8973-C	 "Fig.6-6: Limitations when connecting the relay etc. (CR751)" was corrected. (Error output → Emergency stop output, Contactor controleoutput for additional axes → Error output) The drawings of mechanical interface of SH01 to SH05 of RV-13F/13FL/20F robot were added to "2.5.1 Wiring and piping for hand". The outline drawing and attachments of the solenoid valve set for RV-4F/7F series are changed. "1.2.1 How to identify the robot model" was modified. "1.3 CE marking specifications" was corrected.
2014-01-08	BFP-A8973-D	 The descriptions of RV-4FJL were added. The descriptions of clean and oil mist specifications of RV-7FLL were added. The cable fixation plate was added to Fig.3-3 and Fig.3-4 (Outside dimensions of drive unit) Conditions for the flexed type cables were corrected. The description of "MELFA BASIC IV" was added to "Table 3-1: Specifications of controller". The type name of the SSCNET III cable (5m) was corrected to MR-J3BUS5 M-A. The outside dimensions of RV-13F series (RV-7FLL, RV-13F/FL, and RV-20F) were updated to Rev. B.
2014-03-31	BFP-A8973-E	 The grounding representation was corrected. The shape of the left shoulder part of RV-4F/4FL and RV-7F/7FL were changed. The types of the ACIN terminal were added.

Introduction

This series is a full-scale industrial vertical multi-joint type robot that is designed for use in machining processes and assembling. This series supports varied environments, offering a variety of specifications including clean specification, oil mist specification and long-arm specification.

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 9, "2 Robot arm", the specifications related to the controllerPage 77, "3 Controller", and software functions and a command list Page 116, "4 Software" separately.

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

- *RV-4F-Q/RV-4FL-Q/RV-4FJL-Q (CR751-Q controller) series Note) Indicates it as RV-4F series.
- *RV-7F-Q/RV-7FL-Q (CR751-Q controller) series Note) Indicates it as RV-7F series.
- *RV-7FLL-Q (CR751-Q controller) series *1)
- *RV-13F-Q/RV-13FL-Q (CR751-Q controller) series *1)
- *RV-20F-Q (CR751-Q controller) series ^{*1)} Note) *1) Indicates it as "RV-13F series" for a general name of these robots.

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- The specifications values are based on Mitsubishi standard testing methods.
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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

 $\frac{\mathbf{RV}}{_{(a)}} - \underbrace{\diamondsuit}_{(b)} \frac{\mathbf{F}}{_{(c)}} \frac{\mathbf{J}}{_{(d)}} \frac{\mathbf{L}}{_{(e)}} \underbrace{\mathbf{\Phi}}_{(f)} - \underbrace{\mathbf{1}}_{(g)} \frac{\mathbf{\Phi}}{_{(h)}} \underbrace{\mathbf{\Delta}}_{(i)} \frac{\mathbf{-Sxx}}{_{(j)}}$ (a). RV Indicates the vertical multiple-joint robot. Ex.) RV: Vertical multiple-joint type. RH: Horizontal multiple-joint type. (b). \diamondsuit Indicates the maximum load. Ex) 4: 4kg 7: 7kg 13: 13kg 20: 20kg (c). F..... Indicates the F series. (d). J..... Indicates axis configuration. Ex) Omitted: 6-axis type J: 5-axis type (RV-4FJL only) (e). L.....Indicates long arm type. Ex) Omitted: Standard type L or LL: Long arm type (f). •.....Indicates environment specification. Ex) Omitted: General specifications (IP40) M: Oil mist specifications (IP67) C: Clean specifications (ISO class3) Note) RV-7FLL has only general environment specification. (g). 1.....Indicates the controller series. 1: CR751 controller (h). Q..... Indicates the controller type. Q: iQ Platform (i). ▲..... Technical standard of Conformity. Ex) Omitted: No conformity of technical standard. 1: Conforms to the CE Marking (j). <u>-Sxx</u>.....Indicates a special model. In order, limit special specification. Ex) -SHxx: Indicates the internal wiring and piping specification. -Sxx: Indicates a special model.

Robot arm						
Type name ^{Note1)}	Protection specification	Arm length Note2)	Internal wiring and piping specification (Mechanical I/F)	Axial constitution	Controller	
RV- 🗆 F-1Q		Standard arm		CR751- 🗆 VQ-0		
RV-20F-1Q				6-axis type	CR751-20VQ-0	
RV- 🗆 FL-1Q] –		CR751- 🗆 VQ-0	
RV-4FJL-1Q		Long arm		5-axis type	CR751-04VJQ-0	
RV-7FLL-1Q	Standard				CR751-07VLQ-0	
RV- 🗆 F-1Q-SH	specification	Standard arm		6-avia tura	CR751- 🗆 VQ-0	
RV-20F-1Q-SH		Standard arm		6-axis type	CR751-20VQ-0	
RV- 🗆 FL-1Q-SH		equipped ^{Note3)} Long arm	CR751- 🗆 VQ-0			
RV-4FJL-1Q-SH				5-axis type	CR751-04VJQ-0	
RV-7FLL-1Q-SH					CR751-07VLQ-0	
RV− □ FM−1Q		Standard arm		6-axis type	CR751- 🗆 VQ-0	
RV-20FM-1Q	Protection	Standard ann			CR751-20VQ-0	
RV- 🗆 FLM-1Q	specification Note4)			CR751- 🗆 VQ-0		
RV-4FJLM-1Q	Note4)	Long arm		5-axis type	CR751-04VJQ-0	
RV-7FLLM-1Q					CR751-07VLQ-0	
RV- 🗆 FC-1Q				6-axis type	CR751- 🗆 VQ-0	
RV-20FC-1Q		Stanuard arm		o-axis type	CR751-20VQ-0	
RV- 🗆 FLC-1Q	Clean specifi- cation ^{Note5)}				CR751- 🗆 VQ-0	
RV-4FJLC-1Q		Long arm		5-axis type	CR751-04VJQ-0	
RV-7FLLC-1Q]				CR751-07VLQ-0	

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

Note1) The " []" indicates the load mass."4" for 4kg, "7" for 7kg, "13" for 13kg. (" []" of the controller type name is "04", "07" or "13".)

Note2) The RV-4FJL (5-axis type robot) is long arm type only.

Note3) The types of the internal wiring and piping specification models are shown in Page 4, "1.2.3 Internal wiring and piping specification types". This robot arm is a shipping special specification model. Check the delivery date.

Note4) This robot arm's protective structure is IP67. The protective structure of all the drive units is IP20 (open type). To protect a drive unit, use the optional controller protection box (IP54).

Note5) The protective structure of all the drive units is IP20 (open type). To use a drive units in a clean environment, install the drive units to a place that does not violate the cleanliness.

1.2.3 Internal wiring and piping specification types

The robot arm with in-wrist cables and piping is available. Before the robot arm is shipped from the factory, the tool cables/piping are built into the robot arm's wrist and pulled out from the side of the mechanical interface. This robot arm model eases wiring/piping tasks at the customer's side and improves the reliability against cable disconnections, etc. The following section shows the types. For wiring/piping system diagram for hand of each models, refer to Page 46, "2.5.6 Wiring and piping system diagram for hand".

(The unlisted robot arms do not have internal cables/pipes. However, they can use the hand input signals and devices such as a visual sensor.)

0						
Robot-arm type ^{Note1)}		Wiring (cable for				
RV-	Piping	Hand input signal	Vision sensor camera	Force sensor unit	Base section external wiring set ^{Note2)}	
01	ϕ 4x4 $^{ m Note3)}$	8 points	Not av	Not available		
02	Not available	8 points	1 1		1F-HA01S-01	
03	Not available	Not available	1	1	1F-HA02S-01	
04	φ 4x2	8 points	_	1	1F-HA01S-01	
05	φ 4x2	8 points	1	_	1F-HA01S-01	

Table 1-2: Internal wiring and piping specification types

Note1) " [" shows the load. 4kg: "4", 7kg: "7", 13kg: "13". The numeral in the table shows the applicable numeral to "**" of the type.

Example) When internal wiring/piping specification is "01" in the standard arm and load is 4 kg, the type name is RV-4F-1Q-SH01.

Note2) The corresponding base external wiring set is attached.

Note3) It can use as a secondary piping of the solenoid-valve set option.

1.3 CE marking specifications

The robot shown in the Table 1-3 is the CE Marking specification.

Table 1-3 : Robot models with C	E marking specifications
---------------------------------	--------------------------

Robot type	Controller	External signal logic	Language setting	
RV- [] F-1Q1-S15 RV- [] FL-1Q1-S15 RV- [] FM-1Q1-S15 RV- [] FLM-1Q1-S15 RV- [] FLM-1Q1-S15 RV- [] FC-1Q1-S15 RV- [] FLC-1Q1-S15	CR751- 🗆 VQ1-0-S15			
RV- □ F-1Q1-SH15xx RV- □ FL-1Q1-SH15xx	CR751- 🗆 VQ1-0-S15xx	Source type	English (ENG)	
RV-7FLL-1Q1-S15	CR751-07VLQ1-0-S15			
RV-20F-1Q1-S15 RV-20FM-1Q1-S15 RV-20FC-1Q1-S15	CR751-20VQ1-0-S15			
RV-20F-1Q1-SH15xx	CR751-20VQ1-0-S15xx			

Note 1) " \square " shows the load. 4kg: "04", 7kg: "07", 13kg: "13". Note 2) "xx" shows the number of the special specification.

1.4 Contents of the structural equipment

1.4.1 Robot arm

The list of structural equipment is shown in below.

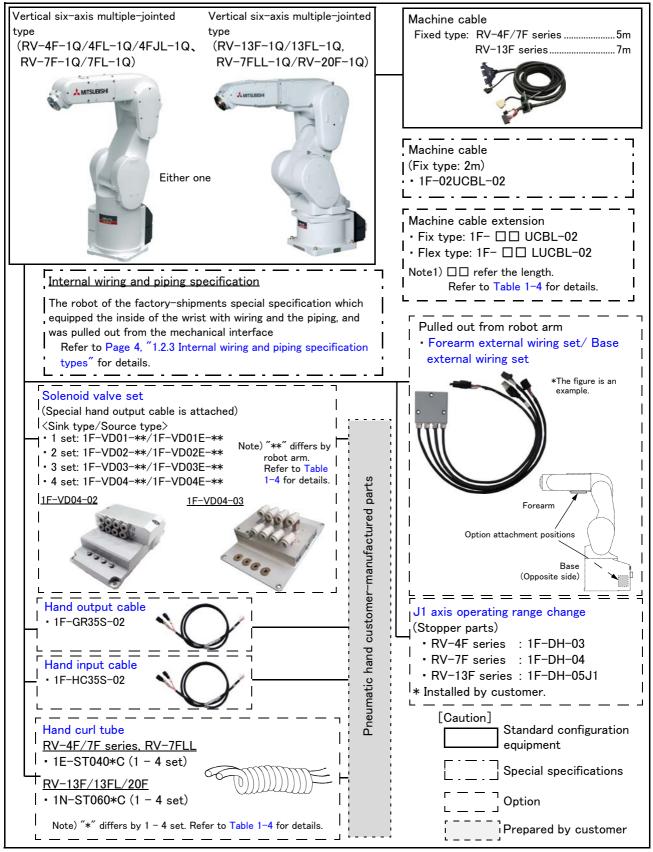


Fig.1-1 : Structural equipment (Robot arm)

1.4.2 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".)

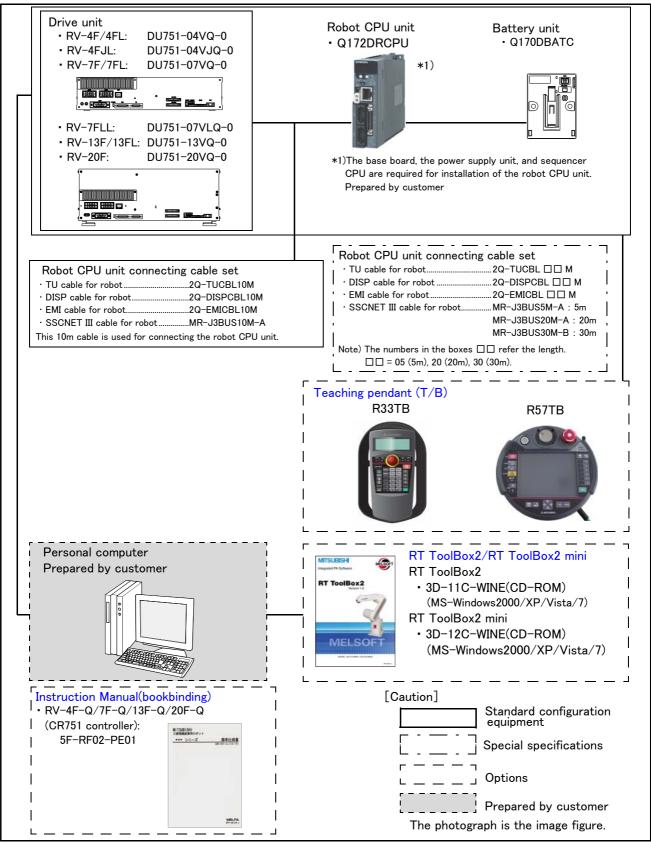


Fig.1-2 : Structural equipment

1.5 Contents of the Option equipment and special specification

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

Item	Туре	Specifications	Classification Note1)	Description
Internal wiring and piping specification (robot arm)	RV- FL-1Q-SH01 RV- FL-1Q-SH01 RV-4FJL-1Q-SH01 RV-7FLL-1Q-SH01 RV-20F-1Q-SH01	Functions equipped inside of wrist: Air-hose ϕ 4 x 4, Eight hand input signals.	0	
	RV- □ F-1Q-SH02 RV- □ FL-1Q-SH02 RV-4FJL-1Q-SH02 RV-7FLL-1Q-SH02 RV-20F-1Q-SH02	Functions equipped inside of wrist: Eight hand input signals, connec- tion cable for vision-sensor cam- era, connection cable for force sensor unit.	0	 The connection with the force sensor unit uses the attached adapter cable in the force-sensor option. The force-sensor option does not sup- port RV-4FJL. The corresponding base external wiring
	RV- □ F-1Q-SH03 RV- □ FL-1Q-SH03 RV-4FJL-1Q-SH03 RV-7FLL-1Q-SH03 RV-20F-1Q-SH03	Functions equipped inside of wrist: Connection cable for vision-sen- sor camera and force sensor unit.	0	set is attached. • The $\square \square$ indicates the load mass. ("4" for 4kg, "7" for 7kg, "13" for 13kg.)
	RV- □ F-1Q-SH04 RV- □ FL-1Q-SH04 RV-4FJL-1Q-SH04 RV-7FLL-1Q-SH04 RV-20F-1Q-SH04	Functions equipped inside of wrist: Air-hose $\phi 4 \times 2$, Eight hand input signals, connection cable for force sensor unit.	0	
	RV- □ F-1Q-SH05 RV- □ FL-1Q-SH05 RV-4FJL-1Q-SH05 RV-7FLL-1Q-SH05 RV-20F-1Q-SH05	Functions equipped inside of wrist: Air-hose $\phi 4 \times 2$, Eight hand input signals, connection cable for vision-sensor camera.	0	
J1 axis operating range change	1F-DH-03	Stopper part for RV-4F series: Sets as the + side/- side each by the combination within 30, 73, 103 and 146.	0	This must be installed and setting the parameter by the customer. * Refer to Page 59, "(2) J1 axis operating range change" for details.
	1F-DH-04	Stopper part for RV-7F series: Sets as the + side/- side each by the combination within 35, 77, 99 and 141.	0	
	1F-DH-05J1	Stopper part for RV-13F series: Sets as the + side/- side each by the combination within 30, 73, 103 and 146.	0	
Machine cable (Replaced to shorter cable)	1F-02UCBL-02	For fixing (Set of power and signal)	0.0	2m (A 2m cable is supplied instead of the supplied standard cable.)
Extended machine cable	1F- 🗆 UCBL-02	For fixing (Set of power and signal)	0	10, 15, 20m
	1F- 🗆 LUCBL-02	For flexing (Set of power and signal)	0	10, 15, 20m
Solenoid valve set	1F-VD01-02/VD01E-02	1 set (Sink type)/(Source type)	0	The solenoid-valve set for the hand of
	1F-VD02-02/VD02E-02	2 set (Sink type)/(Source type)	0	the customer setup.
	1F-VD03-02/VD03E-02	3 set (Sink type)/(Source type)	0	Use for RV-4F/7F series and RV-7FLL.
	1F-VD04-02/VD04E-02	4 set (Sink type)/(Source type)	0	
	1F-VD01-03/VD01E-03	1 set (Sink type)/(Source type)	0	The solenoid-valve set for the hand of
	1F-VD02-03/VD02E-03	2 set (Sink type)/(Source type)	0	the customer setup.
	1F-VD03-03/VD03E-03	3 set (Sink type)/(Source type)	0	Use for RV-13F/13FL and RV-20F.
	1F-VD04-03/VD04E-03	4 set (Sink type)/(Source type)	0	
Hand input cable	1F-HC35S-02	Robot side: connector. Hand side: wire.	0	The cable is connected to the sensor by the customer.
Hand output cable	1F-GR35S-02	Robot side: connector. Hand side: wire	0	This cable can be used for the solenoid valve prepared by the customer.

Table 1-4 : The list of Option equipment and special specification

Item	Туре	Specifications	Classification Note1)	Description	
Hand curl tube	1E-ST0402C	For solenoid valve 1set.: ϕ 4x2	0	Curl type air tube	
	1E-ST0404C	For solenoid valve 2set.: ϕ 4x4	0	For RV-4F/7F series and RV-7FLL.	
	1E-ST0406C	For solenoid valve 3set.: ϕ 4x6	0		
	1E-ST0408C	For solenoid valve 4set.: ϕ 4x8	0		
	1N-ST0602C	For solenoid valve 1set.: ϕ 6x2	0	Curl type air tube	
	1N-ST0604C	For solenoid valve 2set.: ϕ 6x4	0	For RV-13F/13FL and RV-20F.	
	1N-ST0606C	For solenoid valve 3set.: ϕ 6x6	0		
	1N-ST0608C	For solenoid valve 4set.: ϕ 6x8	0		
Forearm external wiring set	1F-HB01S-01	The following cables can be wired outside: hand input signals, force sensor and vision sensor.	0	Pulls out from forearm lower part.	
	1F-HB02S-01	The following cables can be wired outside: force sensor and vision-sensor.	0		
Base external wiring set	1F-HA01S-01	The following cables can be wired outside: force sensor and vision-sensor.	0	Pulls out from base side.	
	1F-HA02S-01	The following cables can be wired outside: force sensor and vision-sensor.	0	Puils out from base side.	
Simple teaching pendant	R33TB	Cable length 7m	0	With 3-position enable switch IP65	
	R33TB-15	Cable length 15m	0		
Highly efficient teaching	R57TB	Cable length 7m	0		
pendant	R57TB-15	Cable length 15m	0		
RT ToolBox2 (Personal computer Sup- port software)	3D-11C-WINE	CD-ROM	0	MS-Windows2000/XP/Vista/7 (With the simulation function)	
RT ToolBox2 mini (Personal computer Sup- port software mini)	3D-12C-WINE	CD-ROM	0	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 5, 20m		For the servo communication between	
	MR-J3BUS30M-B	Cable length 30m		robot CPU and DU .	
Instruction Manual	5F-RF02-PE01	RV-4F/7F/13F-Q series (CR751 drive unit)	0		

Note1) O : option, \Box : special specifications.

2 Robot arm

2.1 Standard specifications 2.1.1 Basic specifications

(1) RV-4F/7F series

Table 2-1 : Standard specifications of robot (with no internal wiring and piping)

					0 11 0,			
	Item	Unit			Specifications			
Туре			RV-4F	RV-4FL	RV-4FJL	RV-7F	RV-7FL	
Environment				C: Cle	ed: Standard specific an specification mist specification	cation		
Degree of free	edom		6 5			6		
Installation posture				On floor,	hanging, (against wa	ll ^{Note1)})		
Structure				Ver	tical, multiple-joint t	уре		
Drive system				AC servo m	otor (brake provided	on all axes)		
Position deteo	ction method				Absolute encoder			
Motor capac-	Waist (J1)	W		400			50	
ity	Shoulder (J2)			400		7	50	
	Elbow (J3)			100		4	00	
	Wrist twist (J4)		1	00	-	1	00	
	Wrist pitch (J5)				100			
	Wrist roll (J6)		50					
Operating	Waist (J1)	Degree		±240				
range Shoulder (J2)				±120		-115 to 125	-110 to 130	
	Elbow (J3)		0 to 161	0 to	o 164	0 to 156	0 to 162	
	Wrist twist (J4)		±	200	-	±	200	
	Wrist pitch (J5)							
	Wrist roll (J6)							
Speed of Waist (J1)		Degree/s	450 420		360	288		
-	Shoulder (J2)	-	450 336		401	321		
	Elbow (J3)		300	2	50	450	360	
	Wrist twist (J4)		540 –			3	37	
	Wrist pitch (J5)			623		4	50	
	Wrist roll (J6)				720			
	h radius (P point)	mm	514.5	64	18.7	713.4	907.7	
Maximum resi	Itant velocity ^{Note2)}	mm/sec	9,	000	8,800	11	,000	
_oad		kg(N)		4			7	
⊃ose repeatal		mm			±0.02			
Cycle time ^{Note}		sec		0.36		0.32	0.35	
Ambient temp	erature ^{Note5)}	°C			0 to 40			
Mass	•	kg	39	41	39	65	67	
Allowable	Wrist twist (J4)		6	.66	-	1	6.2	
moment load	Wrist pitch (J5)	N·m		6.66		16.2		
	Wrist roll (J6)			3.90	1	6.86		
Allowable nertia	Wrist twist (J4)		0	.20	-	0	.45	
norua	Wrist pitch (J5)	kg · m ²		0.20		0	.45	
	Wrist roll (J6)		0.10					
Fool wiring	Hand input/output		Hand input eight points / hand output eight points					
	LAN cable		Equipped (eight cores) <100BASE-TX>					
	Wiring for user			Equipped	(24 cores) <force ser<="" td=""><td>nsor etc.></td><td></td></force>	nsor etc.>		
Tool pneu-	Primary piping				ϕ 6 × 2			
matic pipes	Secondary piping				ϕ 4 × 8			
Supply pressu	ire	MPa			0.54			

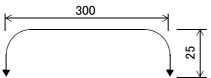
Item	Unit	Specifications
Protection specification ^{Note6)}		Standard specification: IP40 Clean specification: ISO class 3 ^{Note7)} Oil mist specification: IP67 ^{Note8)}
Painting color		Light gray (Equivalent to Munsell: 0.6B7.6/0.2)

Note1) When used by mounting on the wall, a special specification that limits the operating range of the J1 axis will be used. Please give an order separately.

This is the value on the mechanical interface surface when all axes are combined. Note2)

Note3) The pose repeatability details are given in Page 17, "2.2.1 Pose repeatability

Note4) The required time period to execute one cycle of the following operation pattern with 1kg load. The cycle time may be longer depending on the required positioning accuracy for the workpiece and the operating position.



Note5) Sets the robot's operating environmental temperature as parameter OLTMX. Corresponding to the environment, the continuous control action performance and the overload-protection function are optimized. (Refers to "Optimizing the overload level" described in "Chapter 5 Functions set with parameters" of separate instruction manual/ Detailed explanations of functions and operations for details.)

Note6) The protection specification details are given in Page 22, "2.2.6 Protection specifications". Note7) The details of the clean specifications are described in Page 23, "2.2.7 Clean specifications"

Note8) The protection performance cannot be ensured with some oil characteristics. Please contact the dealer.

Table 2-2 : Standard specifications of robot (with internal wiring and p	oiping))
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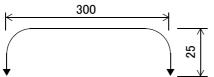
	Item	Unit		internal wiring a	Specifications			
Τ		onne	RV-4F-SH	RV-4FL-SH	RV-4FJL-SH	RV-7F-SH	RV-7FL-SH	
Туре			RV-4F-5H				RV-/FL-SH	
Environment			Standard specification 6 5 6				6	
Degree of free						Note1)	0	
Installation po	sture		On floor, hanging, (against wall ^{Note1)})					
Structure			Vertical, multiple-joint type					
Drive system			AC servo motor (brake provided on all axes)					
Position detec				400	Absolute encoder	750		
Motor capac- ity	Waist (J1)	W		400			750	
Shoulder (J2)		-		400			750	
	Elbow (J3)	-		100	I		100	
Wrist twist (J4)		-	1	00	-		00	
	Wrist pitch (J5)	-			100			
Wrist roll (J6)					50			
Operating range	Waist (J1)	Degree			±240			
5	Shoulder (J2)			±120		-115 ~ 125	-110 ~ 130	
	Elbow (J3)		0 to 161		0 164	0 to 156	0 to 162	
	Wrist twist (J4)	-	±	200	-	<u>±</u>	200	
	Wrist pitch (J5)	-	±120					
	Wrist roll (J6)				±200 Note2)		1	
Speed of motion	Waist (J1)	Degree/s	450	4	20	360	288	
motion	Shoulder (J2)	_	450	3	36	401	321	
	Elbow (J3)	_	300	2	50	450	360	
	Wrist twist (J4)	_	540			3	337	
	Wrist pitch (J5)	_	623			4	150	
	Wrist roll (J6)			720		720		
	n radius (P point)	mm	514.5 648.7		713.4	907.7		
Maximum resu	Iltant velocity ^{Note3)}	mm/sec	10,000 9,900		12,000	11,700		
Load		kg(N)	4 7				7	
Pose repeatab		mm			±0.02			
Cycle time ^{Note}		sec	0.36		0.32	0.35		
Ambient temp	erature ^{Note6)}	°C			0 to 40			
Mass		kg	40	42	40	66	68	
	Wrist twist (J4)		6	.66	-	1	6.2	
moment load	Wrist pitch (J5)	N·m		6.66		16.2		
	Wrist roll (J6)			3.90		6.86		
Allowable	Wrist twist (J4)		0	.20	-	0.45		
inertia	Wrist pitch (J5)	$kg \cdot m^2$		0.20		0	.45	
	Wrist roll (J6)				0.10			
Tool wiring	Hand input/output			Hand input eig	ht points / hand outpu	ut eight points		
	LAN cable			Equipped	l (eight cores) <100BA	SE-TX>		
	Wiring for user			Equipped	(24 cores) <force sen<="" td=""><td>sor etc.></td><td></td></force>	sor etc.>		
т.,	Primary piping	Ì			ϕ 6 × 2			
Tool pneu - matic pipes	Secondary piping			ϕ 4 × 4: foreau ϕ 4 × 4: passe	rm section s through in the wris	t. ^{Note7)}		
Supply pressu	re	MPa			0.54			
Protection sp	ecification Note8)			Standard	specification: IP40			
				Light grove (E	Equivalent to Munsell: (

Note1) When used by mounting on the wall, a special specification that limits the operating range of the J1 axis will be used. Please give an order separately.

Note2) The operating range of the wrist roll is small compared to the model without internal cables/pipes.

Note3) This is the value on the mechanical interface surface when all axes are combined. Note4) The pose repeatability details are given in Page 17, "2.2.1 Pose repeatability"

Note5) The required time period to execute one cycle of the following operation pattern with 1kg load. The cycle time may be longer depending on the required positioning accuracy for the workpiece and the operating position.



- Note6) Sets the robot's operating environmental temperature as parameter OLTMX. Corresponding to the environment, the continuous control action performance and the overload-protection function are optimized. (Refers to "Optimizing the overload level" described in "Chapter 5 Functions set with parameters" of separate instruction manual/ Detailed explanations of functions and operations for details.)
- Note7) The internal wiring and piping specification is ϕ 4x4.
- Note8) The protection specification details are given in Page 22, "2.2.6 Protection specifications".

(2) RV-13F series

Table 2-3 : Standard specifications of robot (with no internal wiring and piping)

Item Unit			Specifications					
Туре			RV-13F	RV-13FL	RV-20F	RV-7FLL		
Environment			Omitted: Standard specification C: Clean specification M: Oil mist specification					
Degree of free	edom				6			
Installation posture				On floor, hanging	(against wall ^{Note1)})			
Structure				Vertical, mul	tiple-joint type			
Drive system				AC servo motor (bral	ke provided on all axes)			
Position detec	ction method			Absolut	e encoder			
Motor capac⁻	Waist (J1)	w		1	500			
ity	Shoulder (J2)			1	500			
	Elbow (J3)			7	/50			
	Wrist twist (J4)			2	100			
	Wrist pitch (J5)			200		100		
	Wrist roll (J6)			50				
Operating	Waist (J1)	Degree		<u>+</u>	190			
range	Shoulder (J2)		-90 to +150					
	Elbow (J3)		-10 to +157.5					
	Wrist twist (J4)		±200					
	Wrist pitch (J5)		±120					
Wrist roll (J6)			± 360					
Speed of	Waist (J1)	Degree/s	290	234	110	234		
motion	Shoulder (J2)		234	164	110	164		
	Elbow (J3)		312	219	110	219		
	Wrist twist (J4)		375		124	375		
	Wrist pitch (J5)		375		125	450		
	Wrist roll (J6)		720		360	720		
Maximum react	h radius (P point)	mm	1,094	1,388	1,094	1,503		
Maximum resu	ultant velocity ^{Note2)}	mm/sec	10,450	9,700	4,200	15,300		
Load Rating	(Maximum)	kg	1:	2(13)	15(20)	7(7)		
Pose repeatat	pility ^{Note3)}	mm		±0.05		±0.06		
Cycle time ^{Note}	4)	sec	0.53	0.68	0.70	0.63		
Ambient temp	erature ^{Note5)}	°C		0 t	io 40			
Mass		kg	120	130	120	130		
Allowable	Wrist twist (J4)	N·m		19.3	49	16.2		
moment load	Wrist pitch (J5)	[19.3	49	16.2		
	Wrist roll (J6)			11	•	6.86		
Allowable	Wrist twist (J4)	kg • m ²	(0.47	1.4	0.45		
inertia	Wrist pitch (J5)		(0.47	1.4	0.45		
	Wrist roll (J6)	1		0.14	•	0.1		

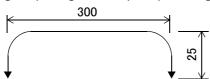
Item Unit		Unit	Specifications		
Tool wiring	Hand input/output		Hand input eight points / hand output eight points		
	LAN cable		Equipped (eight cores) <100BASE-TX>		
	Wiring for user		Equipped (24 cores) <force etc.="" sensor=""></force>		
Tool pneu-	Promary piping		φ 6 × 2		
matic pipes	Secondary piping		φ 6 × 8		
Supply pressur	e	MPa	0.54		
Protection specification ^{Note6)}			Standard specification: IP40Clean specification: ISO class 3 Note7)Oil mist specification: IP67 Note8)		
Painting color			Light gray (Equivalent to Munsell: 0.6B7.6/0.2)		

Note1) When used by mounting on the wall, a special specification that limits the operating range of the J1 axis will be used. Please give an order separately.

Note2) This is the value on the mechanical interface surface when all axes are combined.

Note3) The pose repeatability details are given in Page 17, "2.2.1 Pose repeatability"

Note4) The required time period to execute one cycle of the following operation pattern with 5kg load. The cycle time may be longer depending on the required positioning accuracy for the workpiece and the operating position.



Note5) Sets the robot's operating environmental temperature as parameter OLTMX. Corresponding to the environment, the continuous control action performance and the overload-protection function are optimized. (Refers to "Optimizing the overload level" described in "Chapter 5 Functions set with parameters" of separate instruction manual/ Detailed explanations of functions and operations for details.)

Note6) The protection specification details are given in Page 22, "2.2.6 Protection specifications".

- Note7) The details of the clean specifications are described in Page 23, "2.2.7 Clean specifications"
- Note8) The protection performance cannot be ensured with some oil characteristics. Contact the dealer.

Table 2-4 : Standard specifications of robot (with internal wiring and piping)

I	tem	Unit	Specifications					
Туре			RV-13F-SH	RV-13FL-SH	RV-20F-SH	RV-7FLL-SH		
Environment			Standard specification					
Degree of free	dom		6					
Installation pos	ture		On floor, hanging (against wall ^{Note1)})					
Structure				Vertical, multi	ple-joint type			
Drive system				AC servo motor (brake	e provided on all axes)			
Position detection method				Absolute	encoder			
Motor capac-	Waist (J1)	w	1500					
ity	Shoulder (J2)			15	00			
	Elbow (J3)			75	0			
	Wrist twist (J4)			40	10			
	Wrist pitch (J5)			200		100		
Wrist roll (J6)	Wrist roll (J6)			100		50		
Operating	Waist (J1)	Degree		±1	90			
range	Shoulder (J2)		-90 to +150					
	Elbow (J3)		-10 to +157.5					
	Wrist twist (J4)			±2	200			
	Wrist pitch (J5)		±120					
	Wrist roll (J6)		$\pm 200^{Note2)}$					
Speed of	Waist (J1)	Degree/s	290	234	110	234		
motion	Shoulder (J2)		234	164	110	164		
	Elbow (J3)		312	219	110	219		
	Wrist twist (J4)		;	375	124	375		
	Wrist pitch (J5)		:	375	125	450		
	Wrist roll (J6)		-	720	360	720		
Maximum reach	radius (P point)	mm	1,094	1,388	1,094	1,503		
Maximum resul	tant velocity ^{Note3)}	mm/sec	10,450	9,700	4,200	15,300		
Load Rating (Maximum)	kg	12(13)		15(20)	7(7)		
Pose repeatabi	lity ^{Note4)}	mm		±0.05		±0.06		
Cycle time ^{Note5)}		sec	0.53	0.68	0.70	0.63		
Ambient tempe	rature ^{Note6)}	°C		0-4	40			
Mass		kg	120	130	120	130		
Allowable	Wrist twist (J4)	N·m	1	9.3	49	16.2		
moment load	Wrist pitch (J5)] [1	9.3	49	16.2		
	Wrist roll (J6)			11		6.86		
Allowable	Wrist twist (J4)	kg · m ²	C).47	1.4	0.45		
inertia	Wrist pitch (J5)] [C).47	1.4	0.45		
	Wrist roll (J6)] [0.14 0.1					
Tool wiring	Hand input/outpu	ıt	ŀ	land input eight points /	hand output eight poin	ts		
	LAN cable			Equipped (eight core	es) <100BASE-TX>			
	Wiring for user			Equipped (24 cores)	<force etc.="" sensor=""></force>			

I	Item Unit		Specifications	
Tool pneu- Promary piping			\$\$\$ \$	
matic pipes			ϕ 4 × 4 ^{Note7)}	
Supply pressure MPa		MPa	0.54	
Protection specification Note8)			Standard specification: IP40	
Painting color			Light gray (Equivalent to Munsell: 0.6B7.6/0.2)	

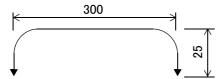
Note1) When used by mounting on the wall, a special specification that limits the operating range of the J1 axis will be used. Please give an order separately.

Note2) The operating range of the wrist roll is small compared to the model without internal cables/pipes.

Note3) This is the value on the mechanical interface surface when all axes are combined.

Note4) The pose repeatability details are given in Page 17, "2.2.1 Pose repeatability"

Note5) The required time period to execute one cycle of the following operation pattern with 5kg load. The cycle time may be longer depending on the required positioning accuracy for the workpiece and the operating position.



Note6) Sets the robot's operating environmental temperature as parameter OLTMX. Corresponding to the environment, the continuous control action performance and the overload-protection function are optimized. (Refers to "Optimizing the overload level" described in "Chapter 5 Functions set with parameters" of separate instruction manual/ Detailed explanations of functions and operations for details.)

Note7) The internal wiring and piping specification is ϕ 4x4.

Note8) The protection specification details are given in Page 22, "2.2.6 Protection specifications".

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.

Item	Unit	Value			
Item	Onit	RV-4F series	RV-7F series	RV-13F series	
Falls moment: M _L	N·m	410	900	2,060	
Torsion moment: M _T	N·m	400	900	2,060	
Horizontal translation force: F _H	Ν	700	1,000	1,750	
Vertical translation force: F_V	Ν	1,200	1,700	2,900	

Table 2-5 : Value of each counter-force

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 9, "2.1.1 Basic specifications".
- (2) Fig. 2-1, Fig. 2-2, Fig. 2-3 and Fig. 2-4 shows the distribution dimensions for the center of gravity in the case where the volume of the load is relatively small. Use this figure as a reference when designing the tooling.
- (3) Even if the load is force, not the mass, design the tooling so that moment does not exceed the allowable moment. Refer to Page 9, "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.
- [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.

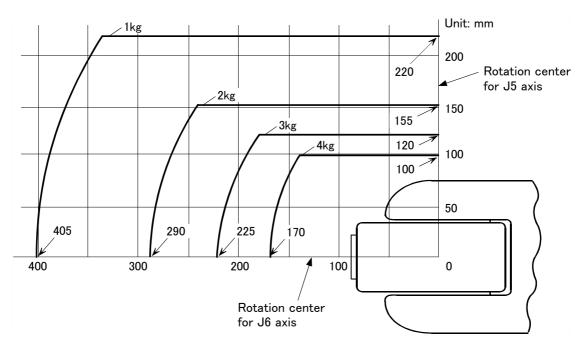


Fig.2-1 : Position of center of gravity for loads (for loads with comparatively small volume): RV-4F/4FL/4FJL

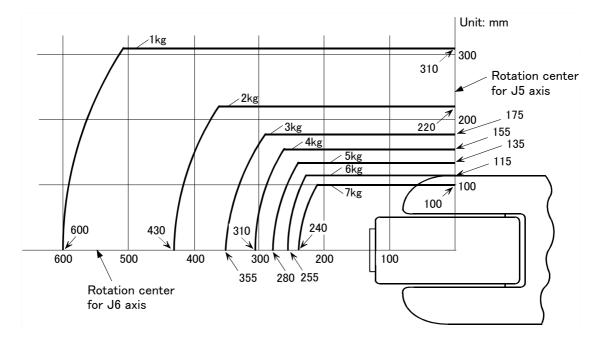


Fig.2-2 : Position of center of gravity for loads (for loads with comparatively small volume): RV-7F/7FL/7FLL

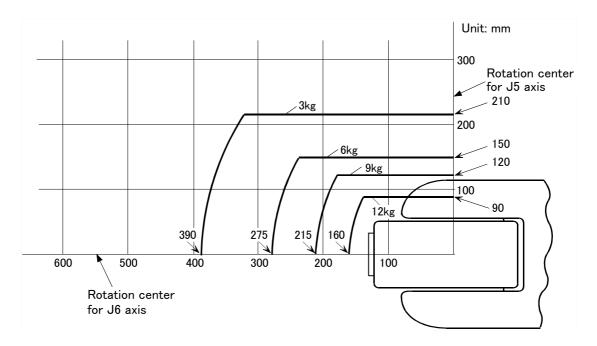


Fig.2-3 : Position of center of gravity for loads (for loads with comparatively small volume): RV-13F/13FL

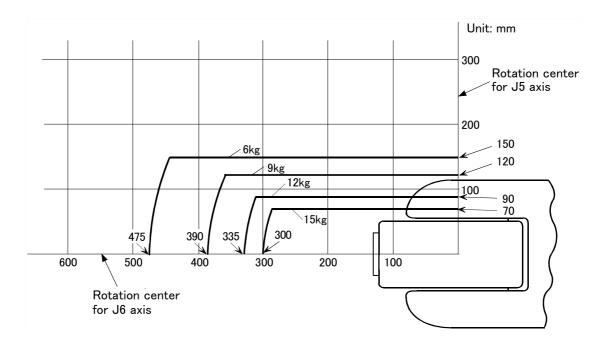


Fig.2-4 : Position of center of gravity for loads (for loads with comparatively small volume): RV-20F

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 such a case, change the setting value to the +20% range.

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".

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) Lower the robot's operating speed by approximately 5% from high speed 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 Collision detection

This series have the "collision detection function" which detects the abnormalities by the collision of the robot arm, however initial setting is in invalid condition.

The enable/disable of this function can be changed by parameter: COL and command: ColChk, this function is effective for protect 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.

2.2.6 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 2-6.

Even oil mist environment can be used in addition to the general environment.

Table 2-6 . Duatast	ion on olfications on	d annliaghla fiolda
Table Z=0 . Frolect	ion specifications and	applicable fields

Туре	Protection specifications (IEC Standards value)	Classification	Applicable field	Remarks
RV-4F-1Q/4FL-1Q/4FJL- 1Q RV-7F-1Q/7FL-1Q RV-7FLL-1Q RV-13F-1Q/13FL-1Q RV-20F-1Q	IP40	General environ- ment specifications	General assembly Slightly dusty environment	
RV-4FM-1Q/4FLM-1Q/ 4FJLM-1Q RV-7FM-1Q/7FLM-1Q RV-7FLLM-1Q RV-13FM-1Q/13FLM-1Q RV-20FM-1Q	IP67	Oil mist specifica- tions	Machine tool (cutting) Machine shop with heavy oil mist Dusty work shop	Note that if the cutting machine is using abra- sive materials, the robot's life will be shortened.

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 IP40

The protection standard for approach in the dangerous spot in the tool. It indicates the protective structure that the proximity probe 2.5mm in diameter must not advance.

The IEC IP67

Protection against water infiltration as specified in IP67 indicates a protective structure that is not harmfully affected, even if the test device dives underwater for the 30 minutes. The diving depth is shown below. When the height of the test device is less than 850 mm, the position of the lowest part is 1 m from the water surface.

When the height of the test device is 850 mm or more, the position of the highest part is 150 mm from the water surface.

(2) About the use with the bad environment

The robot arm with protection specification (oil mist specification) is made by order. This robot has protection methods that conform to IEC's IP67 standards (splashproof type). Recommended usage conditions.

- 1) The robot is designed for use in combination with machining device.
- 2) To ensure IP67 over the warranty period and further, the inside of the robot arm needs to be pressurized. Use the provided ϕ 8 joint (AIR PURGE) to supply dry air for pressurizing. The ϕ 8 joint (AIR PURGE) can be found at the base rear part of the robot arm.

Item	Dew point	Pressure
Specification	The atmospheric pressure dew point is - 20 degree or less.	0.01MPa or less

Table 2-7 : Specification of the dry air for pressurization

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 is 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.

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 132, "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 2-7.

2.2.7 Clean specifications

(1) Types of clean specifications

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

Туре	Degree of cleanliness	Internal suction	Remarks
RV-4FC-1Q/4FLC-1Q/ 4FJLC-1Q RV-7FC-1Q/7FLC-1Q RV-7FLLC-1Q RV-13FC-1Q/13FLC-1Q RV-20FC-1Q	ISO class3	Concentrated suction with vacuum generating valve. 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.

Table 2-8 : Clean specifications

Precautions for use

- 1) A ϕ 8 VACUUM coupling is provided in the base section of the robot arm for vacuum inside the robot arm. (Refer to Fig. 2-20) When using the robot, connect this coupling with the vacuum generating valve (Refer to Table 2-9) 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 2-9 : Specifications of vacuum generation valve (Confirmed in our company)

Тур	e	Maker	Air pressure ^{Note1)}	Quantity
MEDT 14		KONEGAI CORPORATION	• Vacuum rate: 90.0 L/min(ANR)	1

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

b) When using the vacuum pump

Assure the vacuum flow rate of more than 30 L/min. And, secure the exhaust course from the pump not to affect the power supply and the cleanness for the vacuum pumps.

2.3 Names of each part of the robot

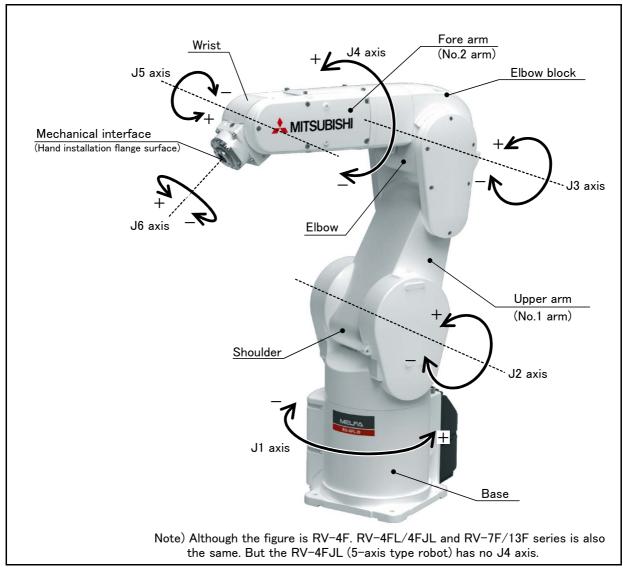


Fig.2-5 : Names of each part of the robot

2.4 Outside dimensions • Operating range diagram (1) RV-4F

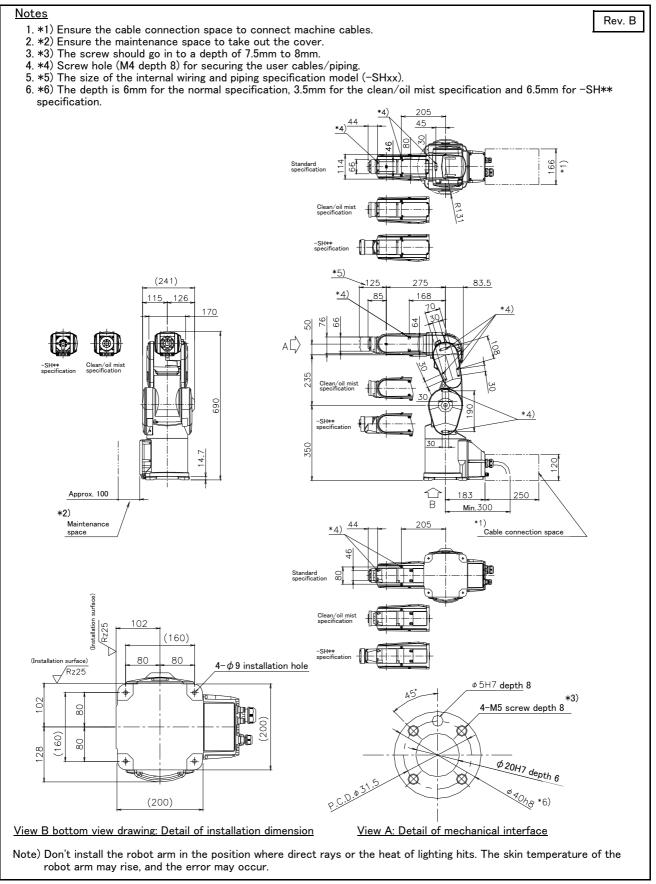


Fig.2-6 : Outside dimensions: RV-4F

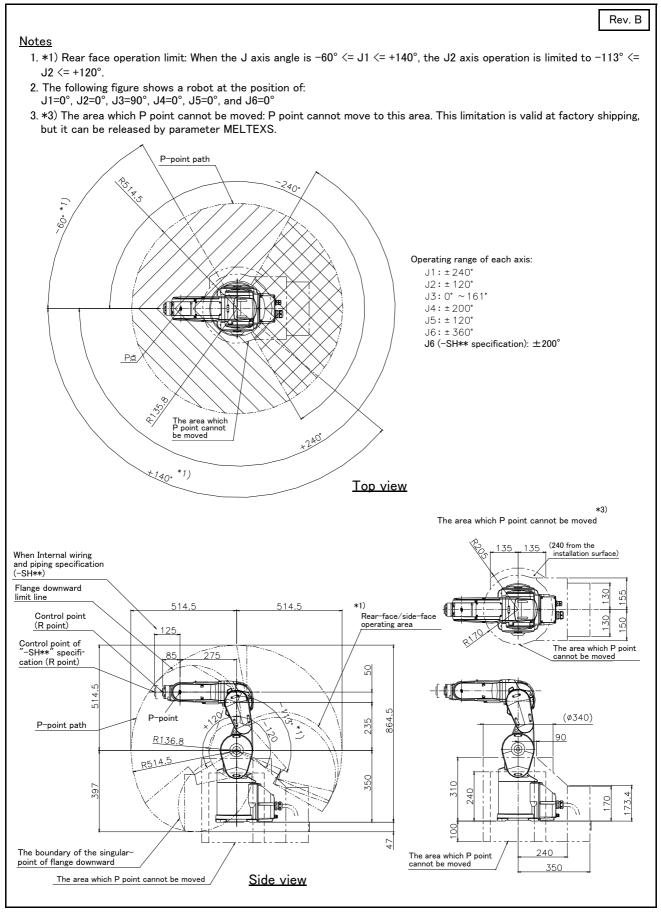
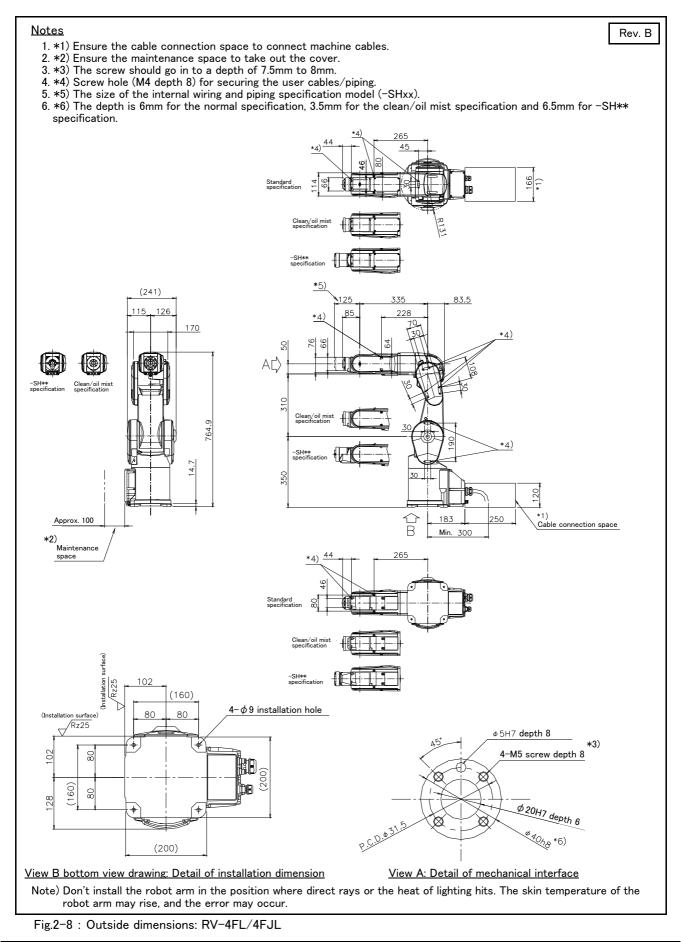


Fig.2-7 : Operating range diagram: RV-4F

(2) RV-4FL/4FJL



<u>Notes</u>

1. *1) Rear face operation limit: When the J axis angle is $-35^{\circ} \le J1 \le +35^{\circ}$, the J2 axis operation is limited to $-114^{\circ} \le J2 \le +120^{\circ}$.

Rev. B

- 2. The following figure shows a robot at the position of:
- J1=0°, J2=0°, J3=90°, J4=0°, J5=0°, and J6=0°
- 3. *3) The area which P point cannot be moved: P point cannot move to this area. This limitation is valid at factory shipping, but it can be released by parameter MELTEXS.

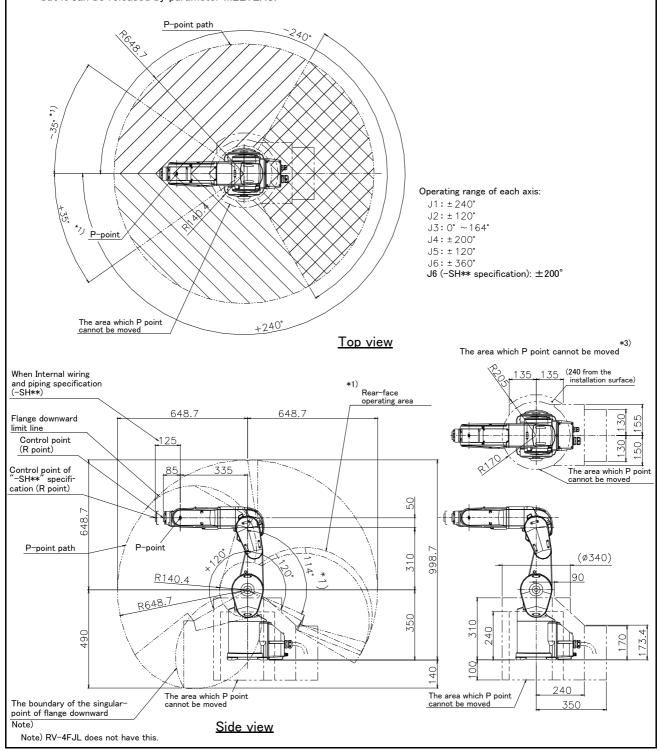
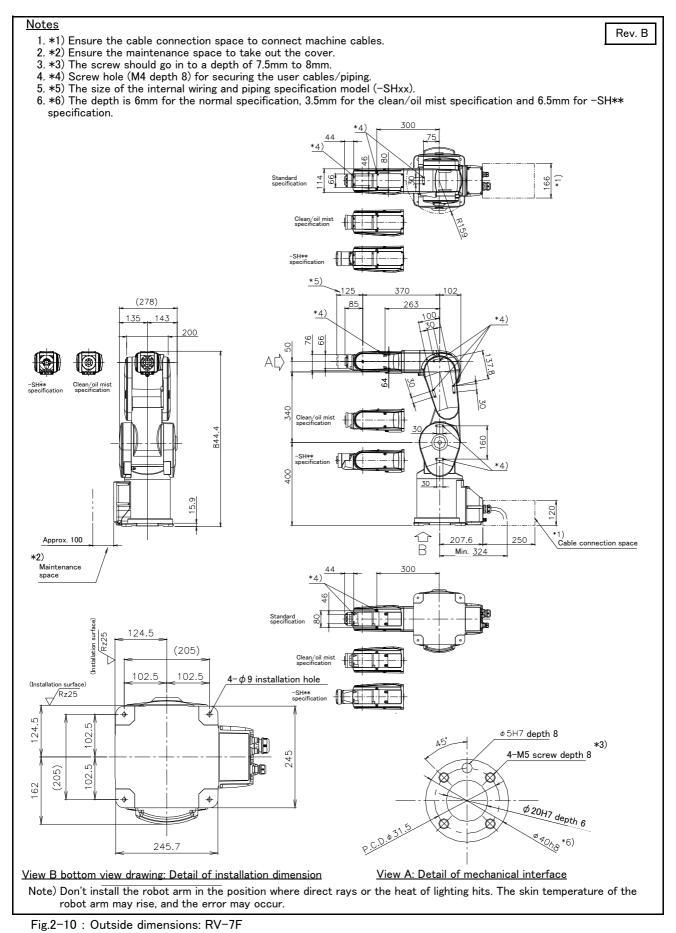


Fig.2-9 : Operating range diagram: RV-4FL/4FJL

(3) RV-7F



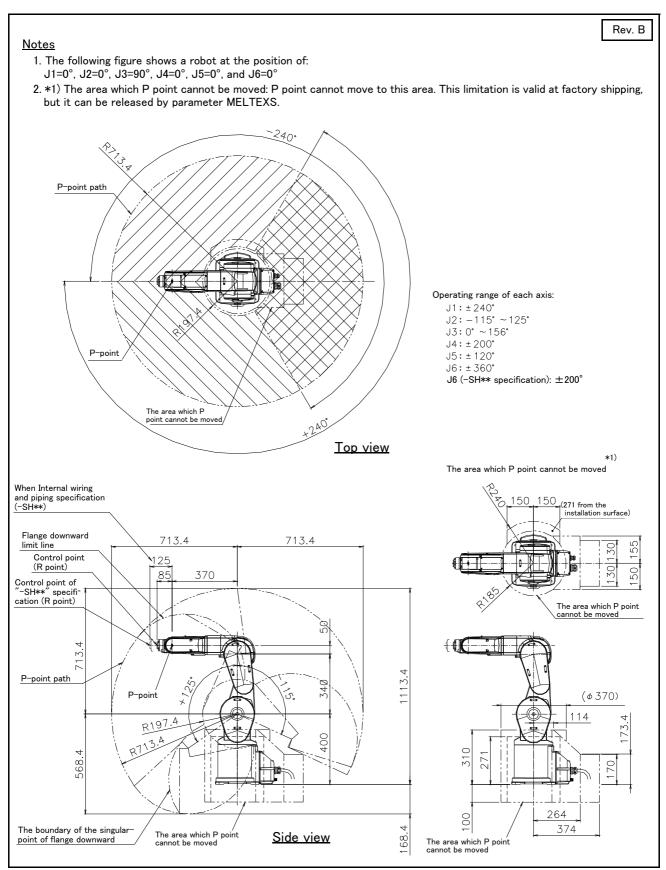


Fig.2-11 : Operating range diagram: RV-7F

(4) RV-7FL

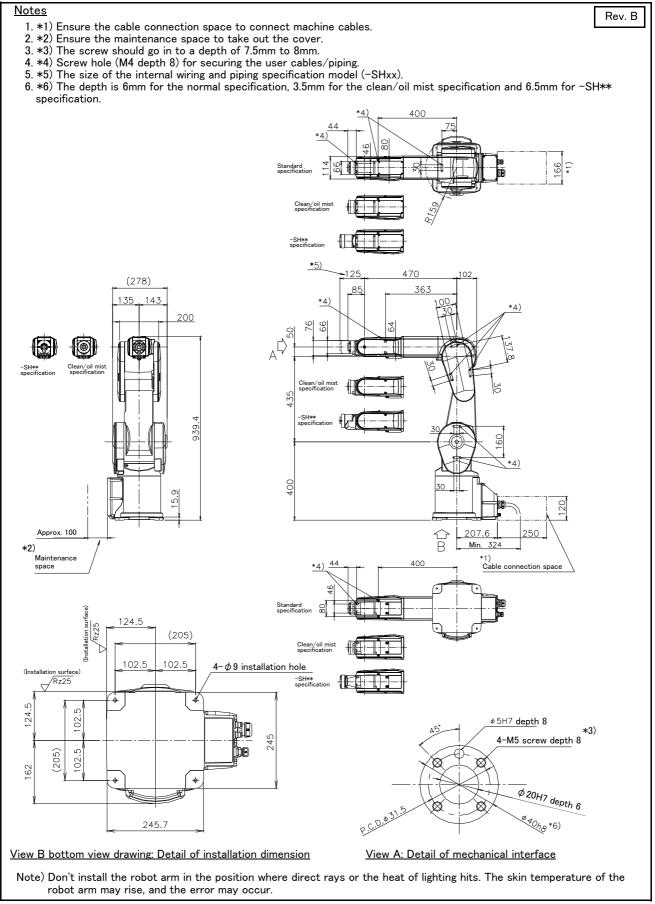


Fig.2-12 : Outside dimensions: RV-7FL

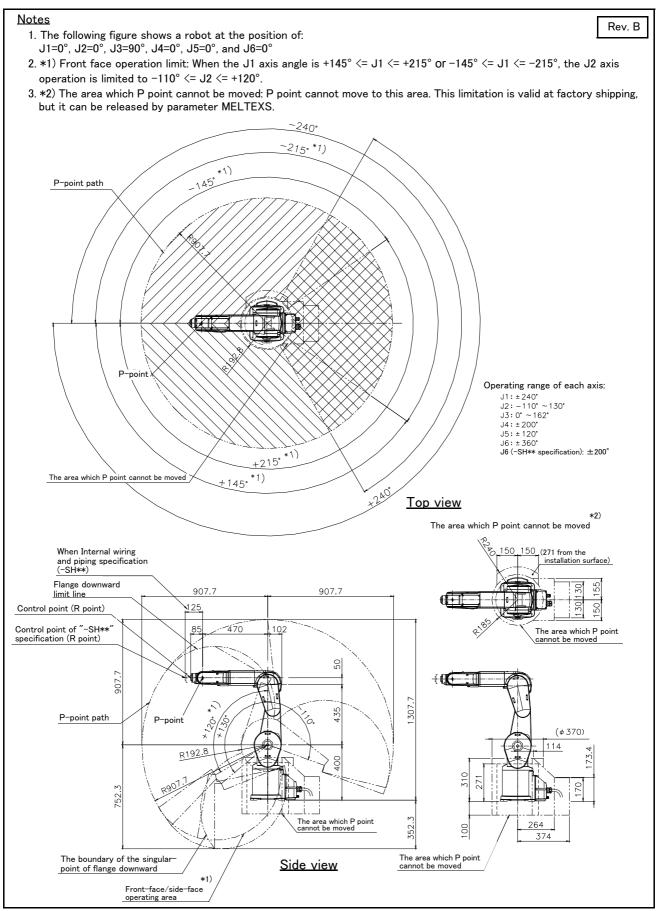


Fig.2-13 : Operating range diagram: RV-7FL

(5) RV-7FLL

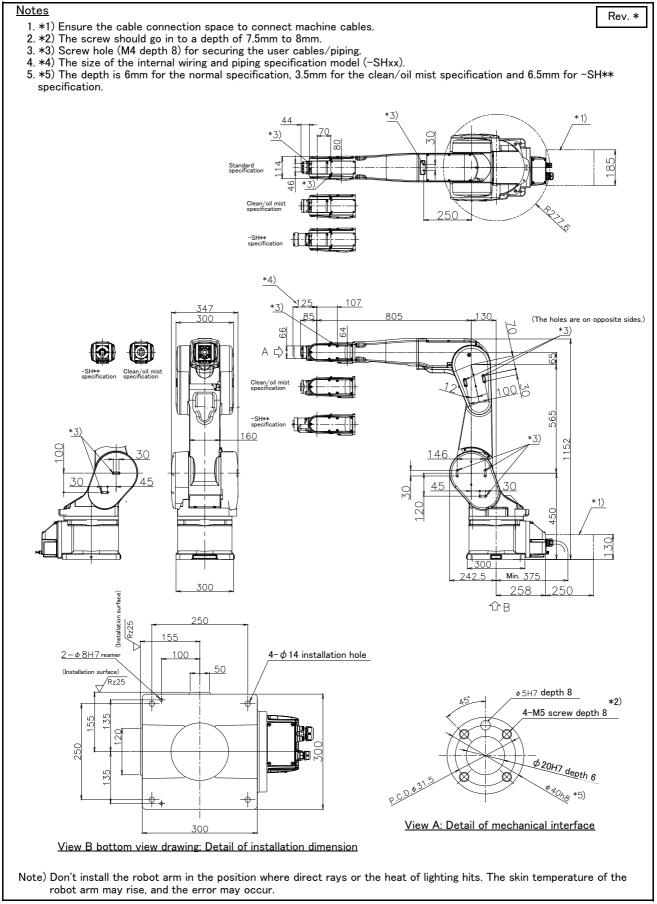


Fig.2-14 : Outside dimensions: RV-7FLL

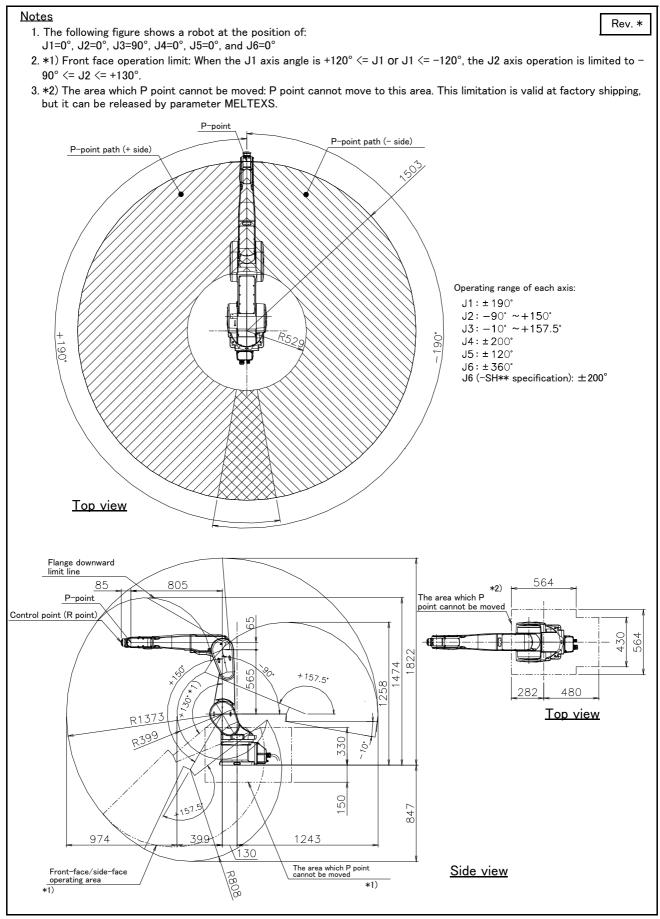


Fig.2-15 : Operating range diagram: RV-7FLL

(6) RV-13F/20F

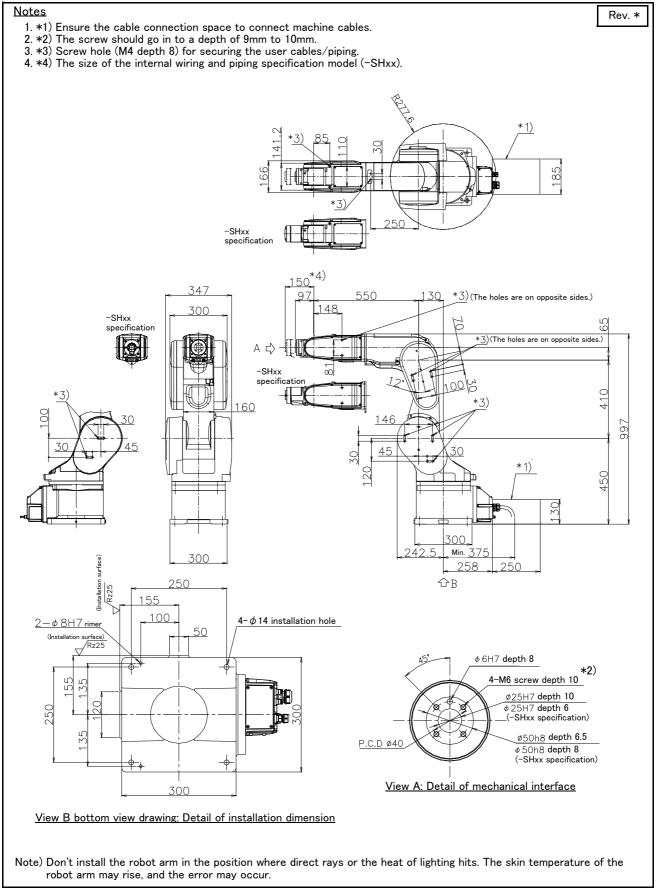


Fig.2-16 : Outside dimensions: RV-13F/20F

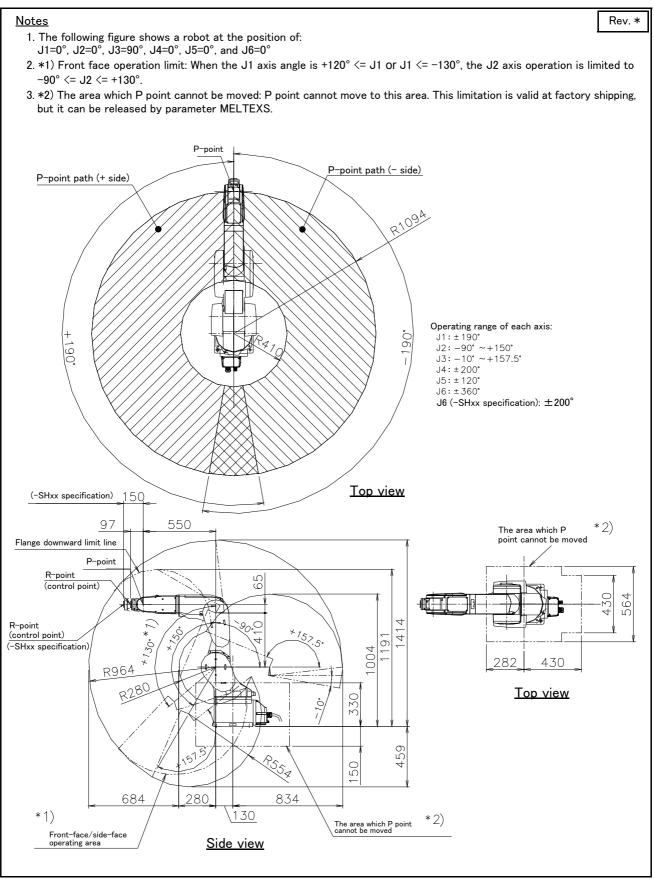
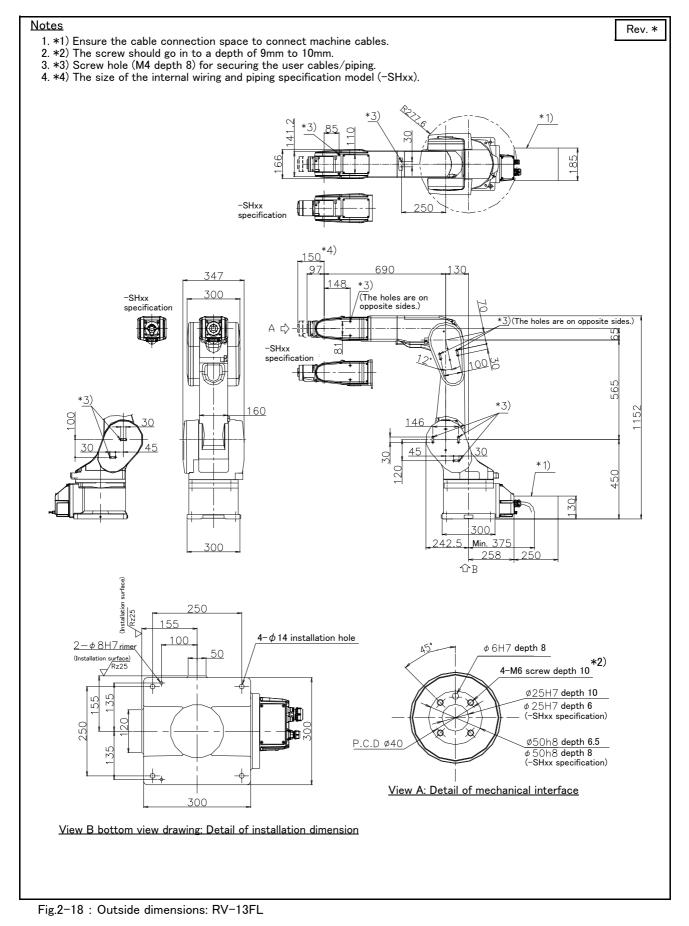


Fig.2-17 : Operating range diagram: RV-13F/20F

(7) RV-13FL



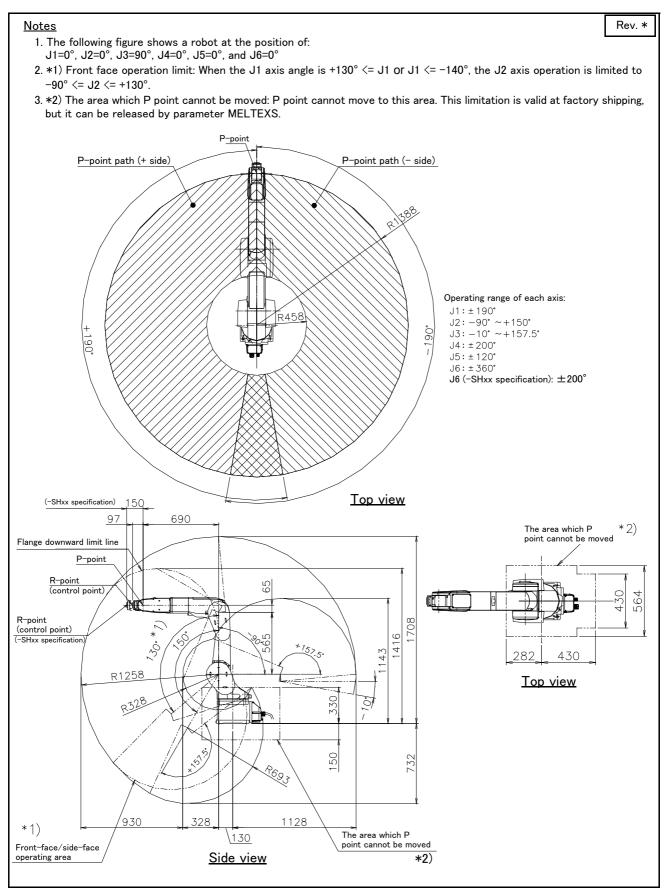
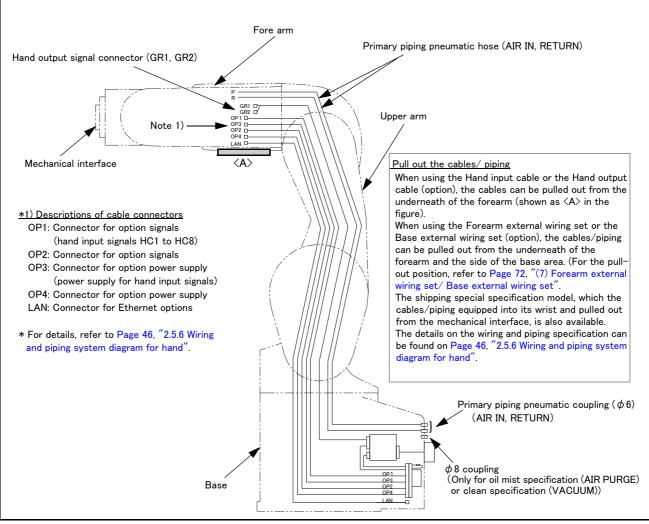


Fig.2-19 : Operating range diagram: RV-13FL

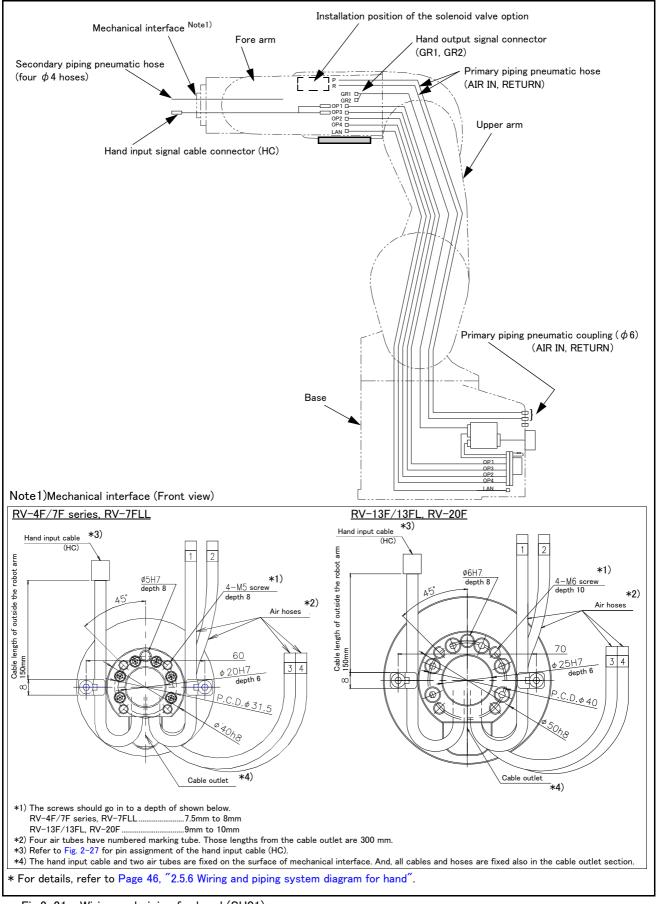
2.5 Tooling

- 2.5.1 Wiring and piping for hand
- Shows the wiring and piping configuration for a standard-equipped hand.
- (1) Standard specification (with no internal wiring and piping)



 $Fig.2\mathchar`-20$: Wiring and piping for hand





(3) Internal wiring and piping specification (SH02)

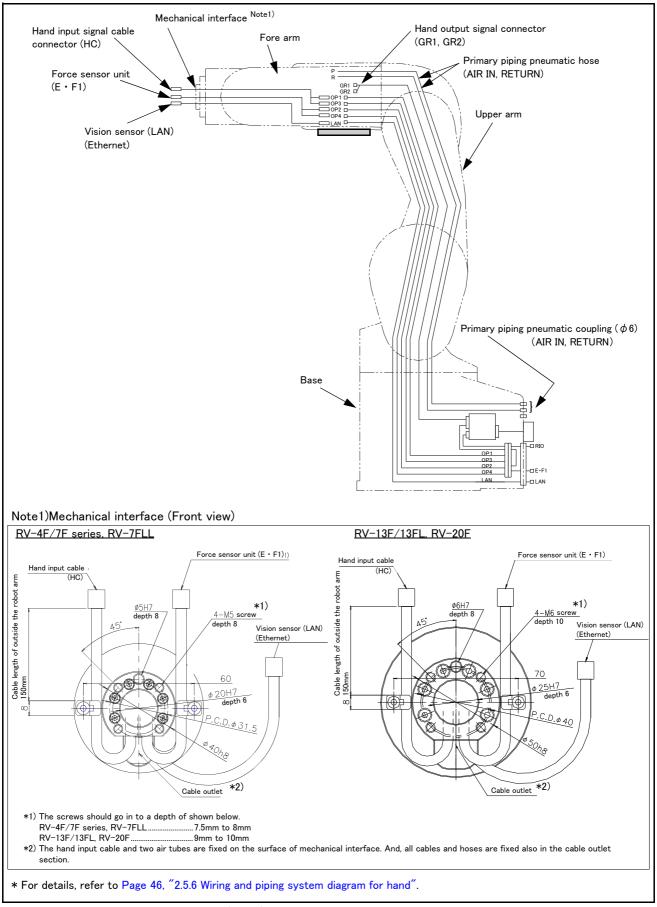


Fig.2-22 : Wiring and piping for hand (SH02)

(4) Internal wiring and piping specification (SH03)

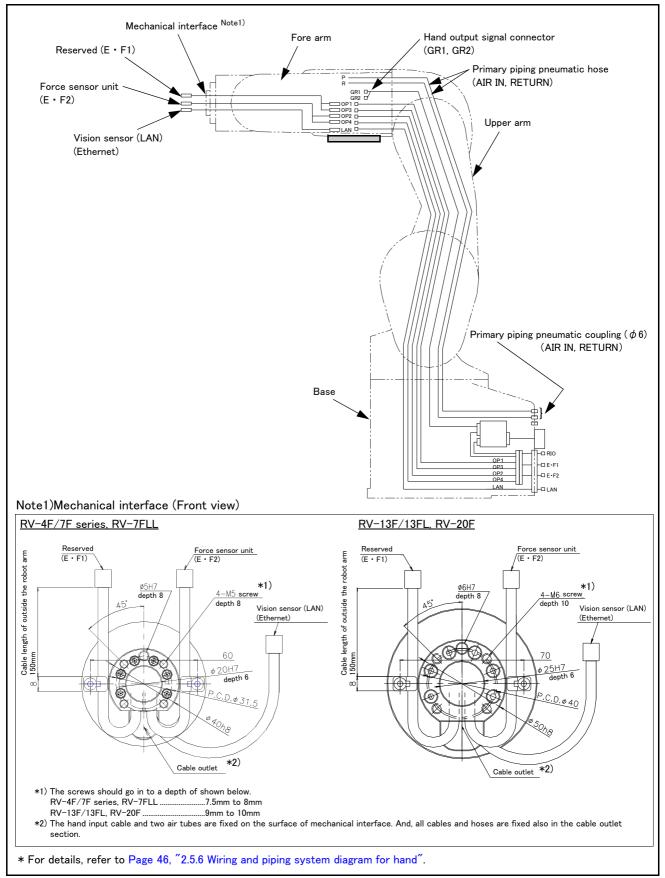


Fig.2-23 : Wiring and piping for hand (SH03)

(5) Internal wiring and piping specification (SH04)

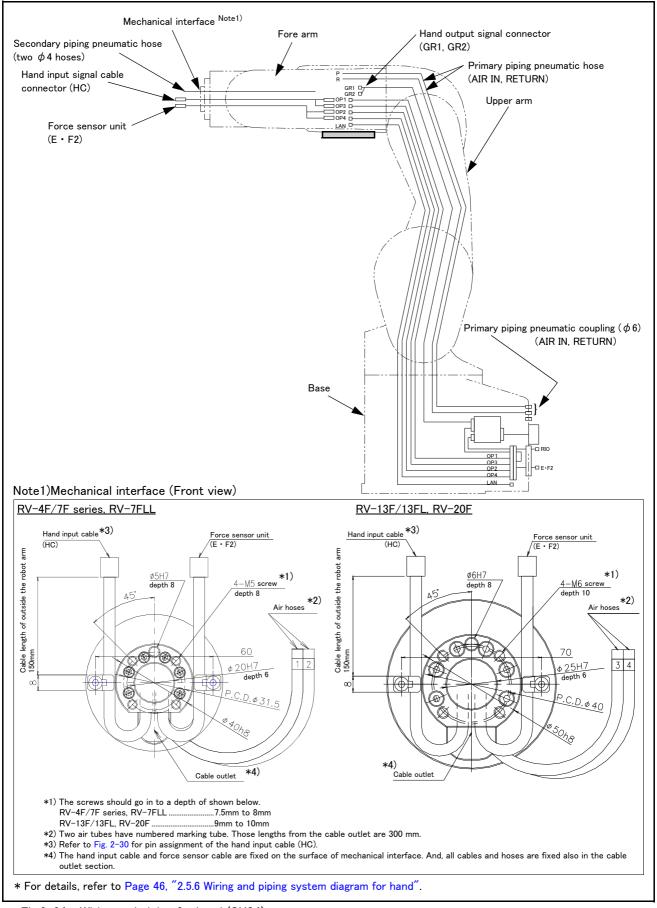


Fig.2-24 : Wiring and piping for hand (SH04)



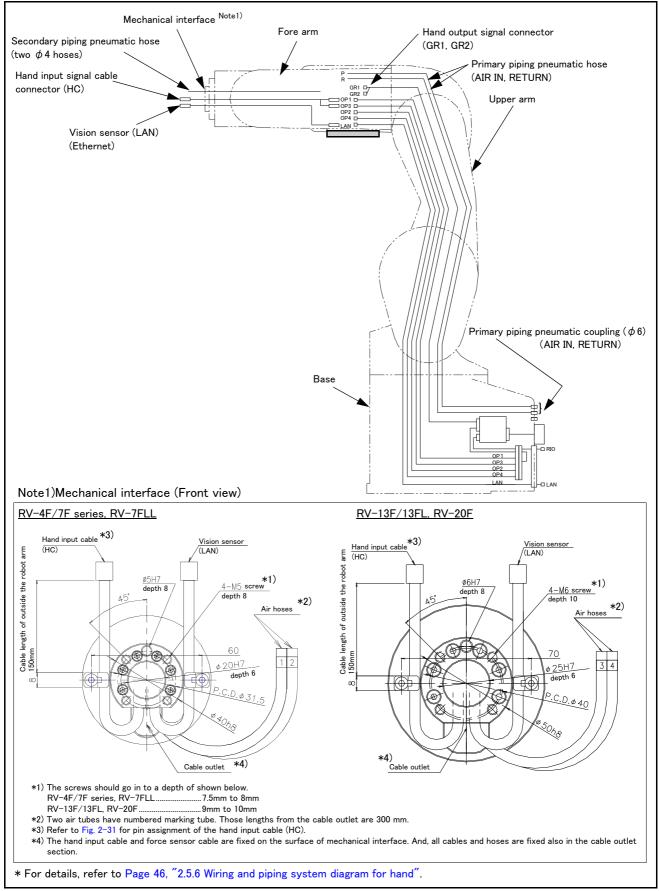


Fig.2-25 : Wiring and piping for hand (SH05)

2.5.2 Internal air piping

- (1) Standard type/Oil mist specifications
 - 1) The robot has two ϕ 6 urethane hoses from the pneumatic entrance on the base section to the shoulder cover. One hose is the primary piping for the pneumatic equipment, and the other pipe is used for air exhaust.
 - 2) The optional solenoid is provided with a maximum of eight couplings for the air hose. The diameter of the couplings are shown below.

1F-VD0*-02 (Sink type)/1F-VD0*E-02 (Source type): ϕ 4

1F-VD0*-03 (Sink type)/1F-VD0*E-03 (Source type): ϕ 6

- 3) The pneumatic inlet in the base section has a ϕ 6 pneumatic coupling bridge.
- 4) Refer to Page 65, "(3) Solenoid valve set" for details on the electronic valve set (optional).
- 5) Protection performance can be improved by pressurizing the inside of the robot arm. Since the joint (AIR PURGE) of ϕ 8 is prepared at the rear of the base section, please supply the dry air for pressurization from this joint. Refer to Page 22, "2.2.6 Protection specifications" for the details of dry air.

(2) Clean type

- 1) The primary piping is the same piping as the standard type.
- 2) With the clean specification, a ϕ 8 coupling is provided in the base section for suction inside the machine. For use, connect it to the suction port of the vacuum pump or the coupling on the "VACUUM" side of the vacuum generating valve. Moreover, to clean the exhaust from the vacuum pump or vacuum generator, use the exhaust filter (prepared by the customer).
- 3) Refer to Page 23, "2.2.7 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

 The hand output primary cable extends from the connector PCB of the base section to the inside of the forearm. (AWG#24(0.2mm²) x 2 cores: 8 cables) The cable terminals have connector bridges for eight hand outputs. The connector names are GR1 and GR2.

To extend the wiring to the outside of the arm, a separate cable (optional "hand output cable 1F-GR35S-02") is required.

- 2.5.4 Internal wiring for the hand input cable
 - The hand input cable extends from the connector PCB of the base section to the inside of the forearm. (AWG#24(0.2mm²) for eight points) The cable terminals have connector bridges for eight hand inputs. The connector names are OP1 and OP3.
 - The hand check signal of the pneumatic hand is input by connecting this connector. To extend the wiring to the outside of the arm, a separate cable (optional "hand input cable "1F-HC35C-02") is required.

2.5.5 Ethernet cable, option wiring cable

Ethernet cables, eight option signal cables, and four power supply cables internally run from the robot's base section up to the forearm area.

These cables can be also pulled out from the underneath of the forearm or from the side of the base area by using options. (Options "Forearm external wiring set" and "Base external wiring set".)

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

Table 2-10 : Ethernet cable specification

2.5.6 Wiring and piping system diagram for hand

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

(1) Standard specification (with no internal wiring and piping)

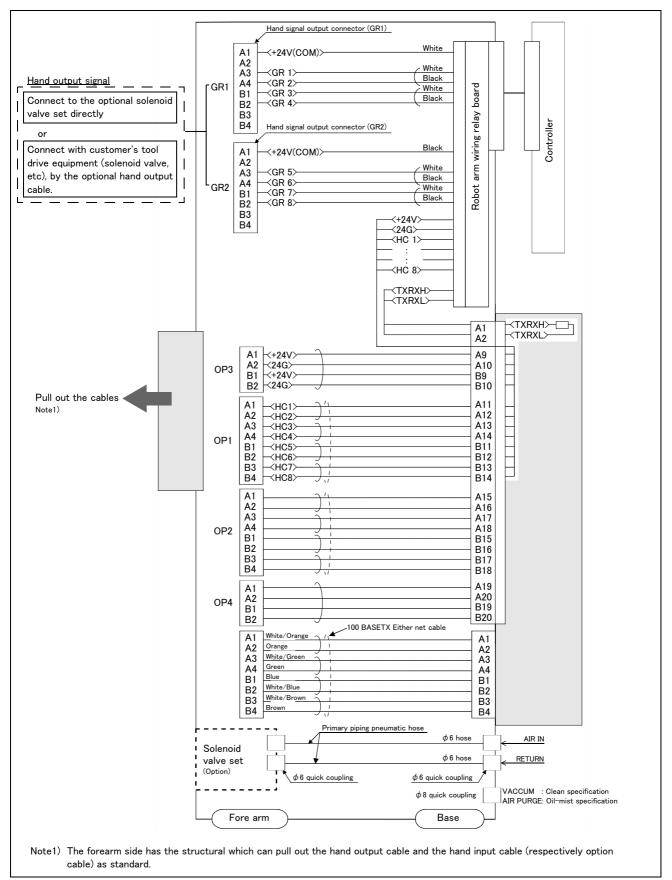


Fig.2-26 : Wiring and piping system diagram for hand and example the solenoid valve installation

(2) Internal wiring and piping specification (SH01)

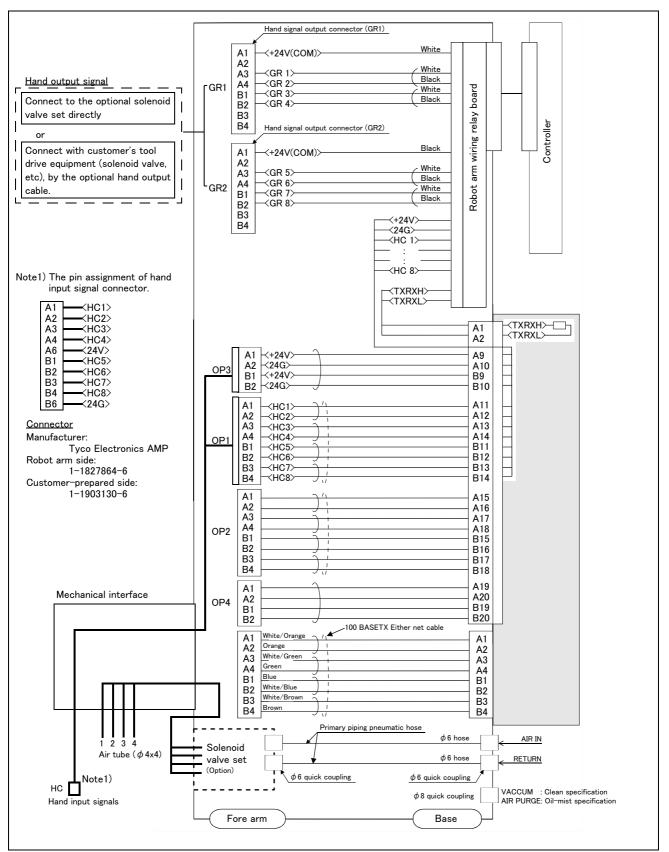


Fig.2-27 : Wiring and piping system diagram for hand and example the solenoid valve installation: SH01

(3) Internal wiring and piping specification (SH02)

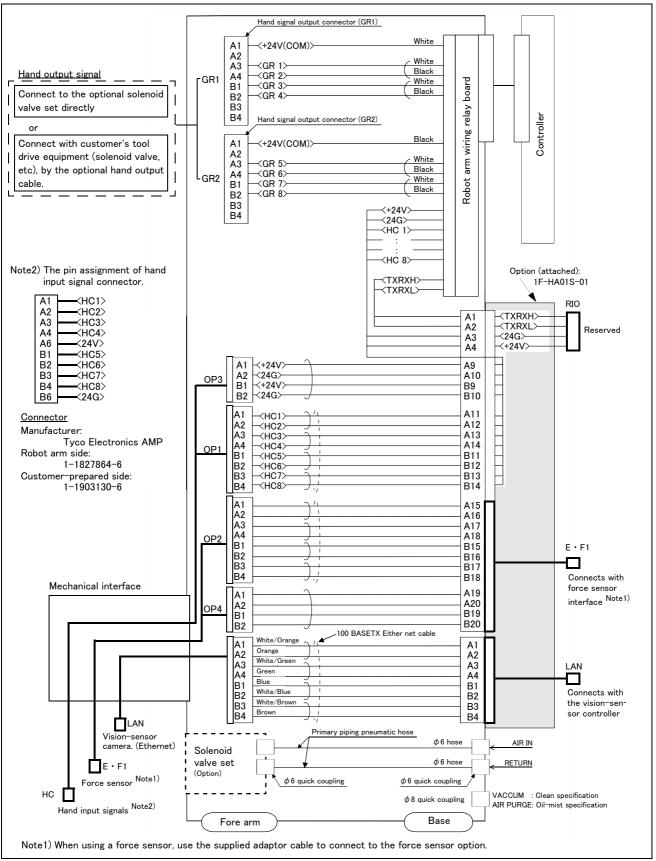


Fig.2-28 : Wiring and piping system diagram for hand and example the solenoid valve installation: SH02

(4) Internal wiring and piping specification (SH03)

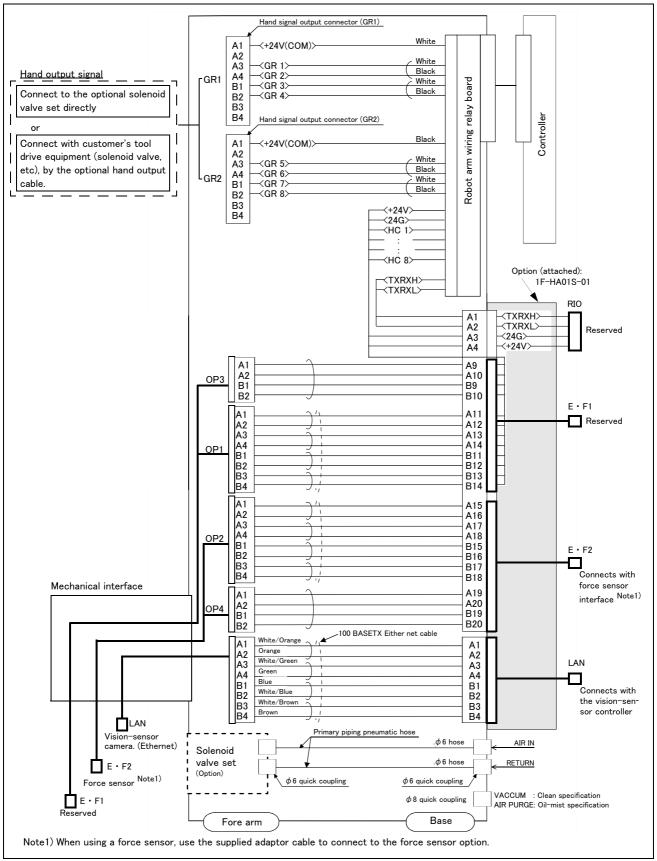


Fig.2-29 : Wiring and piping system diagram for hand and example the solenoid valve installation: SH03

(5) Internal wiring and piping specification (SH04)

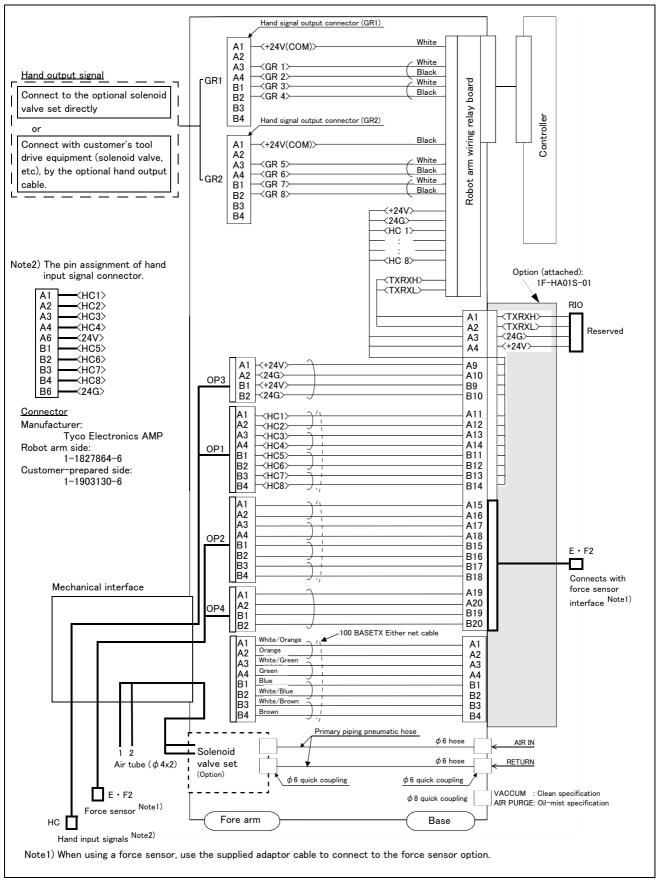


Fig.2-30 : Wiring and piping system diagram for hand and example the solenoid valve installation: SH04

(6) Internal wiring and piping specification (SH05)

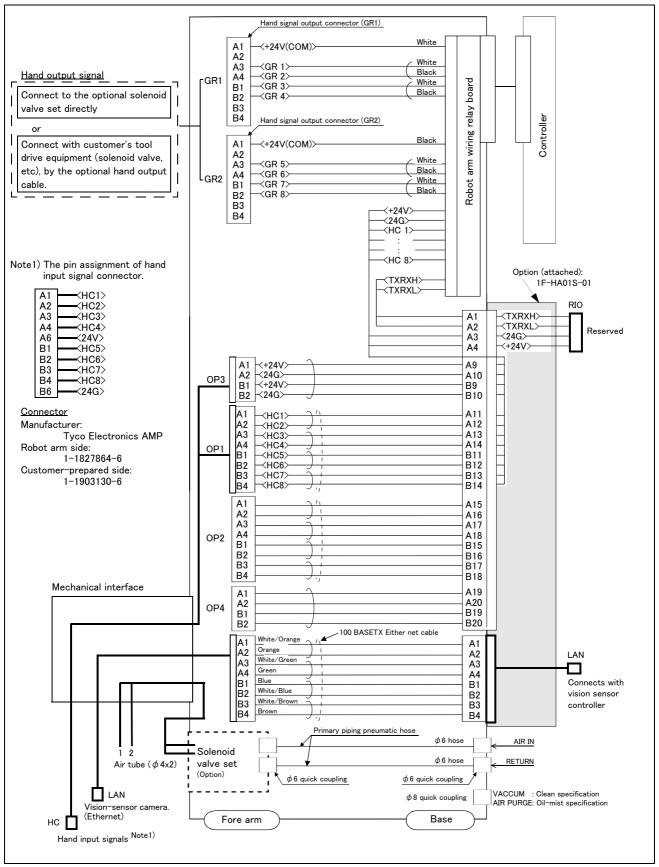


Fig.2-31 : Wiring and piping system diagram for hand and example the solenoid valve installation: SH05

2.5.7 Electrical specifications of hand input/output

Item		Specifications	Internal circuit
Туре		DC input	<sink type=""></sink>
No. of input point	s	8	+24V 무
Insulation method		Photo-coupler insulation	
Rated input voltag	ge	24VDC	
Rated input curre	nt	approx. 7mA	
Working voltage ra	ange	DC10.2 to 26.4V (ripple rate within 5%)	
ON voltage/ON c	urrent	8VDC or more/2mA or more	3.3K24G
OFF voltage/OFF	current	4VDC or less/1mA or less	¹
Input resistance		Approx. 3.3kΩ	<source type=""/>
Response time	OFF-ON	10ms or less (DC24V)	+24V ♀
	ON-OFF	10ms or less (DC24V)	<u>+24V</u>
			3.3K HCn* 3.2K HCn* 820 ↓ 24G
			* HCn = HC1 to HC8

Table 2-11 :	Electrical	specifications	of input circuit	

Table 2-12 : Electrical specifications of output circuit

Item		Specification	Internal circuit	
Туре		Transistor output	<sink type=""></sink>	
No. of output points		8	+24V(COM)	
Insulation method		Photo coupler insulation	(Initial power supply)	
Rated load voltage		DC24V		
Rated load voltage ran	ge	DC21.6 to 26.4VDC	*	
Max. current load		0.1A/ 1 point (100%)		
Current leak with powe	er 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)	Protection of over-current	
Protects		Protects the over-current (0.9A)		
			24G	
			<source type=""/>	
			+24V Protection of over~current :	
			GRn* ↓∽↓	
			* GRn = GR1 to GR8	

2.5.8 Air supply circuit example for the hand

Fig. 2-32 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. 2-32 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.

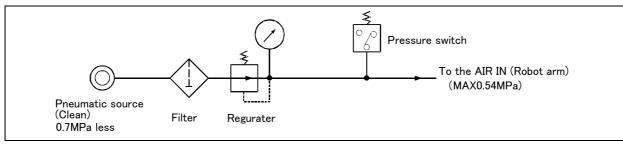


Fig.2-32 : Air supply circuit example for the hand

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 1F-02UCBL-02 (2m)

Outline



This cable is exchanged for the machine cable that was supplied as standard to shorten the distance between the controller and the robot arm.

Configuration

Table 2-13 : Configuration equipment and types

	Part name	Туре	Qty.	Mass(kg) ^{Note1)}	Remarks ^{Note2)}
Fixed	Set of signal and power cables	1F-02UCBL-02	1 set	2.6	2m
	Motor signal cable		(1 cable)	-	
	Motor power cable		(1 cable)	_	

Note1) Mass indicates one set.

Note2) Standard machine cable (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 that was supplied as standard is not reclaimed.

2.7 Options

■ What are options?

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

- 1. Set optionsA combination of single options and parts that together, from a set for serving some purpose.

(1) Machine cable extension

Order type:	Fixed type	1F- 🗆 🗆 UCBL-02
	Flexed type	1F- 🗆 🗆 LUCBL-02

Note) The numbers in the boxes $\Box\Box$ refer the length.

Outline



The distance between the robot controller and the robot arm is extensible by this option. This cable is extended to the machine cable attached as standard. A fixed type and flexible type are available.

The extended method is discriminated as follows.

Fixed type/Flexed type:

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 2-14 : Configuration equipment and types

Part name		Type ^{Note1)}	Qty.		Mass(kg)	Remarks	
	T di c hamo	Type	Fixed	Flexed	Note2)	Romanio	
Fixed	Set of signal and power cables	1F- 🗆 🗆 UCBL-02	1 set	-	6.7(10m)	10m, 15m or 20m each	
	Motor signal cable		(1 cable)	-	12(15m) 17(20m)		
	Motor power cable		(1 cable)	-	17(2011)		
Flexed	Set of signal and power cables	1F- 🗆 🗆 LUCBL-02	-	1 set	7(10m)	10m, 15m or 20m each	
	Motor signal cable		-	(1 cable)	13(15m) 17(20m)		
	Motor power cable		-	(1 cable)	17(2011)		
Nylon cla	mp	NK-14N	-	2 pcs.	_	for motor signal cable	
Nylon cla	Imp	NK-18N	-	2 pcs.	_	for motor power cable	
Silicon ru	ıbber		-	4 pcs.	_		

Note1) The numbers in the boxes $\Box \Box$ 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 2-15.

Table 2-15 : Conditions for the flexed type cables

	Item	Specifications		
Minimum flexed radius		100mm or more		
Cableveyor, etc., occupat	tion rate	50% or less		
Maximum movement speed		2,000mm/s or less		
Guidance of life count 7.5 million times (With silicone g		7.5 million times (With silicone grease coating)		
Environmental proof		$\ensuremath{\text{IP54}}$ (except for the area approximately 500 mm from the end of the connector on the controller side)		
Cable configuration	Motor signal cable	φ6 x 7 and φ1.7 x 1		
Motor power cable		ϕ 6.5 x 8 and ϕ 8.9 x 2		

[Caution] The guidance of life count may greatly differ according to the usage state items related to Table 2-15 and to the amount of silicon grease applied in the cableveyor.

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

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

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

Cable configuration

The configuration of the flexible cable is shown in Table 2-16. Refer to this table when selecting the cableveyor.

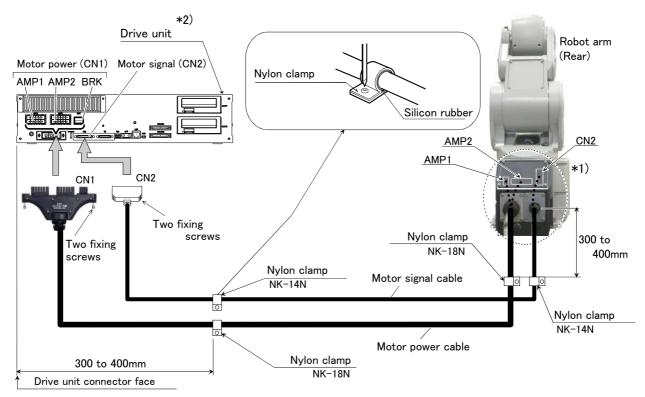
Item	Motor signal cable		Motor power cable	
No. of cores	AWG#24 (0.2mm ²)-4P	AWG#18 (0.75mm ²)	AWG#16 (1.25mm ²)-4C	AWG#18 (0.75mm ²)-3C
Finish dimensions	Approx. ϕ 6mm	Approx. ϕ 1.7mm	Approx. ϕ 8.9mm	Approx. ϕ 6.5mm
No.of cables used	7 cables	1 cable	2 cable	8 cable
No. in total	8 cables		10 ca	ables

Table 2-16 : Cable configuration (Flexed type)

Fixing the flexible cable

(1) Connect the connector to the robot arm.

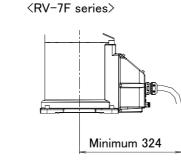
(2) Wind the silicon rubber around the cable at a position 300 to 400 mm from the side of robot arm and drive unit as shown in Fig. 2-33, and fix with the nylon clamp to protect the cable from external stress.



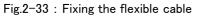
*1) Connect the robot arm side connector to the connector which is inside the CONBOX cover.
*2) Although the figure is CR750-D, the connection method is the same also in CR750-Q.

The bend size of cables are as follows.

<RV-4F series>



<RV-7FLL/13F/20F series>



Minimum 300

(2) J1 axis operating range change

```
■ Order type RV-4F series: 1F-DH-03
RV-7F series: 1F-DH-04
RV-13F series: 1F-DH-05J1
```

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

(1) RV-4F series (1F-DH-03)

Table 2-17 : Configuration devices (RV-4F series)

Install each parts to the upper arm lower part with attached screw.

Item	Standard	Changeable	angle (combination	of + side/- side) (U	nit: Degree)
+ (plus) side	+240	+30	+73	+103	+146
Variable stopper block angle	-	+33	+76	+106	+149
Variable stopper block position Note1)	-	(a)	(b)	(a)	(b)
Mechanical stopper screw A ^{Note2)}	-	- Use		Disuse ^{Note3)}	
Parameter (MEJAR) setting value	+240	+30	+73	+103	+146
– (minus) side	-240	-30	-73	-103	-146
Variable stopper block angle	-	-33	-76	-106	-149
Variable stopper block position Note1)	-	(d)	(c)	(d)	(c)
Mechanical stopper screw B Note2)	-	U	se	Disuse Note3)	
Parameter (MEJAR) setting value	-240	-30	-73	-103	-146

Table 2-18 : Changeable angle (RV-4F series)

Note1) Symbol: "(a)" - "(d)" are related with the symbol of Page 62 "Fig. 2-34: Installation image of J1axis operating range change option (RV-4F/7F series)".

Note2) In the table, it means that "Disuse" does not install the screw, and "Use" does install the screw.

Note3) Mechanical stopper screw which is either one of the two is always necessary. For this reason, the combination enclosed by the thick line of the square in the table (both of + (plus) side and - (minus) side are 103 or 146) cannot be used.

Example) It cannot be used that set +146 as the plus side and set -103 as the minus side simultaneously. The other combination can be set up.

- 1) The changeable angle of RV-4F series is shown in Table 2-18. The changeable angle shown in Table 2-18 indicates the operation range by the software. The limit by the mechanical stopper is positioned three degrees outward from that angle, so take care when designing the layout.
- 2) The changeable angle can be set independently on the + (plus) side/ (minus) side, within the condition shown in Table 2-18.
- 3) The operating range is changed with robot arm settings and parameter settings. Refer to the separate "Instruction Manual/ROBOT ARM SETUP & MAINTENANCE" or "Instruction Manual/Detailed Explanation of Functions and Operations" for details.

(2) RV-7F series (1F-DH-04)

Table 2-19 : Configuration devices

No.	Part name	Qty.	Mass (kg)	Remarks
<1>	Stopper plate	2		One piece each for + side/- side
<2>	Fixing block A	2		One piece each for + side/- side
<3>	Fixing block B	1		+ side
<4>	Fixing block C	1	1.1	- side
<5>	Variable stopper block	2		One piece each for + side/- side
<6>	Screw (M12x25)	2		Use for mechanical stopper screw A and B
<7>	Screw (M8x25)	14		For fixing
<8>	Screw (M8x20)	4		For fixing

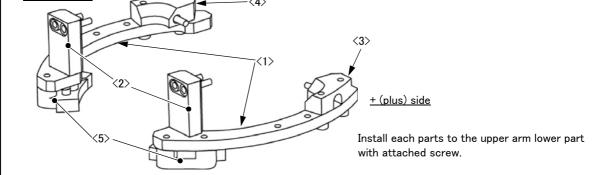


Table 2-20 :	Changeable	angle	(RV-7F	series)
--------------	------------	-------	--------	---------

Item	Standard	Changeable angle (combination of + side/- side) (Unit: Degree)				
+ (plus) side	+240	+35	+77	+99	+141	
Variable stopper block angle	-	+38	+80	+102	+144	
Variable stopper block position Note1)	-	(a)	(b)	(a)	(b)	
Mechanical stopper screw A ^{Note2)}	-	Use		Disuse Note3)		
Parameter (MEJAR) setting value	+240	+35	+77	+99	+141	
– (minus) side	-240	-35	-77	-99	-141	
Variable stopper block angle	-	-38	-80	-102	-144	
Variable stopper block position Note1)	-	(d)	(c)	(d)	(c)	
Mechanical stopper screw B Note2)	-	Use		Disuse Note3)		
Parameter (MEJAR) setting value	-240	-35	-77	-99	-141	

Note1) Symbol: "(a)" - "(d)" are related with the symbol of Page 62 "Fig. 2-34: Installation image of J1axis operating range change option (RV-4F/7F series)".

Note2) In the table, it means that "Disuse" does not install the screw, and "Use" does install the screw.

Note3) Mechanical stopper screw which is either one of the two is always necessary. For this reason, the combination enclosed by the thick line of the square in the table (both of + (plus) side and - (minus) side are 99 or 141) cannot be used.

Example) It cannot be used that set +141 as the plus side and set -99 as the minus side simultaneously. The other combination can be set up.

- The changeable angle of RV-7F series is shown in Table 2-20. The changeable angle shown in Table 2-20 indicates the operation range by the software. The limit by the mechanical stopper is positioned three degrees outward from that angle, so take care when designing the layout.
- 2) The changeable angle can be set independently on the + (plus) side/ (minus) side, within the condition shown in Table 2-20.

- 3) The operating range is changed with robot arm settings and parameter settings. Refer to the separate "Instruction Manual/ROBOT ARM SETUP & MAINTENANCE" or "Instruction Manual/Detailed Explanation of Functions and Operations" for details.
- (3) Installation image (RV-4F/7F series)

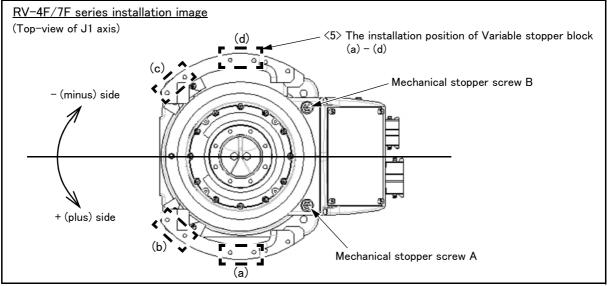


Fig.2-34 : Installation image of J1axis operating range change option (RV-4F/7F series)

[Example] In the RV-7F series, when limiting the +side to +35 degree, and the -side to -141 degree, install as following.

Variable stopper block: Installs in the position of (a), and the position of (c). Mechanical stopper screw A: Install.

Mechanical stopper screw B: Do not install.

(4) RV-13F series (1F-DH-05J1)

No.	Part name	Qty.	Mass (kg)	Remarks	
(1)	Stopper Block J1	1			
<2>	Resin Stopper B	2		One piece each for + side/- side	
<3>	Screw (M12 × 20)	2	0.3	Mechanical Stopper screw	
<4>	Screw (M10 × 40)	2		For Stopper Block J1 fixing	
<5>	Screw (M4 × 12)	4		For Resin Stopper B fixing	
<	1>Stopper Block J1 <2	≻Resin Stopper B			
<	1>Stopper Block J1 <2	Resin Stopper B			

Table 2-22 : Changeable angle (RV-13F series)

	Item	Standard	Changeable angle	
+	(plus) side	+190	+30	+120
	Mechanical Stopper screw position Note1)	-	(A)	(B)
	Mechanical Stopper position	+193	+32.5	+122.5
	Parameter (MEJAR) setting value	+190	+30	+120
+	(minus) side	-190	-30	-120
	Mechanical Stopper screw position ^{Note1)}	-	(D)	(C)
	Mechanical Stopper position	-193	-32.5	-122.5
	Parameter (MEJAR) setting value	-190	-30	-120

Note1) Symbol: "(A)" - "(D)" in the Table 2-22 is related with the symbol of "Fig. 2-35: Installation image of J1axis operating range change option (RV-13F series)".

- The changeable angle of RV-13F series is shown in Table 2-22. The changeable angle shown in Table 2-22 indicates the operation range by the software. The limit by the mechanical stopper is positioned three degrees outward from that angle, so take care when designing the layout.
- 2) The changeable angle can be set independently on the + (plus) side/ (minus) side, within the condition shown in Table 2-22.
- 3) The operating range is changed with robot arm settings and parameter settings. Refer to the separate "Instruction Manual/ROBOT ARM SETUP & MAINTENANCE" or "Instruction Manual/Detailed Explanation of Functions and Operations" for details.

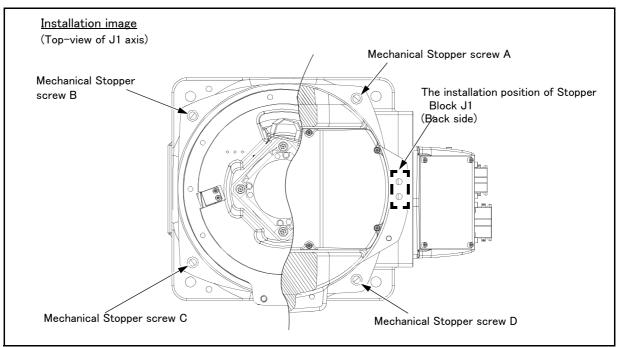


Fig.2-35 : Installation image of J1axis operating range change option (RV-13F series)

[Example] In the RV-13F series, when limiting + side to +32.5 degree and - side to -122.5 degree, install the Mechanical Stopper screw in the position of (A) and (C).

(3) Solenoid valve set

```
Order type: One set:
                         1F-VD01-**(Sink type)/1F-VD01E-**(Source type)
              Two sets: 1F-VD02-**(Sink type)/1F-VD02E-**(Source type)
              Three sets: 1F-VD03-**(Sink type)/1F-VD03E-**(Source type)
              Four sets: 1F-VD04-**(Sink type)/1F-VD04E-**(Source type)
              Note) "-**" differs by robot arm.
              \cdot RV-4F/7F series and RV-7FLL......"-02"
              · RV-13F/13FL and RV-20F......"-03"
Outline
```



The solenoid valve set is an option that is used for controlling toolings when various toolings, such as the hand, are installed at the end of the arm.

Also, for easy installation of this electromaagnetic set onto the robot, it comes equipped with a manifold, couplings, connectors, among other things.

Configuration

Table 2-23 : Configuration equipment

	Type ^{Note1)}	Q'ty				Mass(kg)		
Part name		One	Two	Three	Four	Note2)	Remark	
		set	sets	sets	sets			
Solenoid valve set (1 set)	1F-VD01-**/	1 pc.	_	_	_	0.3	Hand output cable is already connected.	
	1F-VD01E-**	T pc.				0.5	Refer to Page 69, "(5) Hand output cable".	
Solenoid valve set (2 sets)	1F-VD02-**/	_	1 no	_	_	0.4	1F-VD0*-01: Sink type	
	1F-VD02E-**		1 pc.			0.4	1F-VD0*E-01: Source type.	
Solenoid valve set (3 sets)	1F-VD03-**/	_	_	1	_	0.4	Coupling size of A/B-port (output side of sole-	
	1F-VD03E-**			1 pc.		0.4	noid valve)	
Solenoid valve set (4 sets)	1F-VD04-**/	_	_	_	1 no	0.5	 • 1F−VD0*−02/1F−VD0*E−02 : Ф4 	
	1F-VD04E-**				1 pc.	0.0	 • 1F−VD0*−03/1F−VD0*E−03 : Ф6 	

Note1) "-**" differs by robot arm. (Refer to " ■ Order type"above) Note2) Mass indicates one set.

Specifications

Table 2-24 : 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)	1.1mm ² (0.06)			
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 °C (However, there must be no condensation.)			

Note1) Couplings of unused solenoid valves must be blocked with plugs. If they are not blocked, supplied air will blow out from the couplings, lowering the air pressure of the solenoid valves being used and making them nonfunctional. Recommended plugs: KQ2P-04 plug 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 2-25 : Solenoid specifications

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

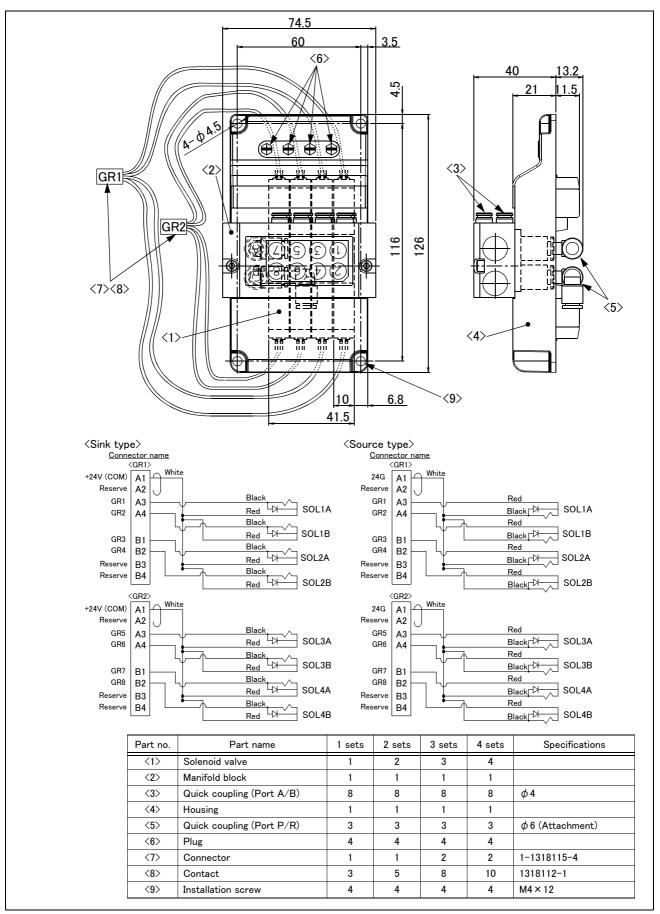


Fig.2-36 : Outline dimensional drawing (1F-VD0*-02/1F-VD0*E-02)

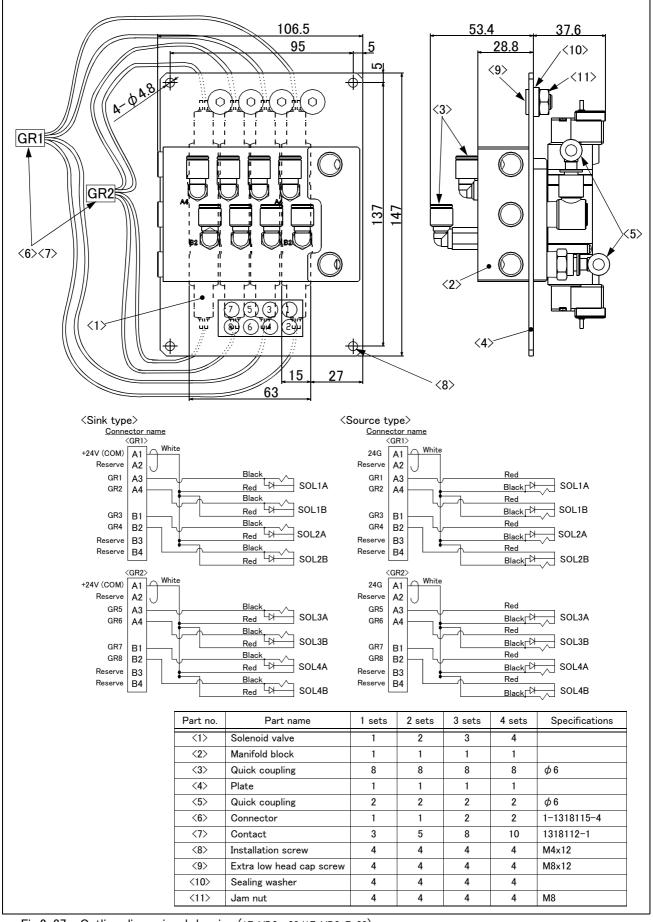


Fig.2-37 : Outline dimensional drawing (1F-VD0*-03/1F-VD0*E-03)

- (4) Hand input cable
- Order type: 1F-HC35S-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.

Configuration

Table 2-26 : Configuration equipment

Part name	Туре	Qty.	Mass (kg) ^{Note1)}	Remarks
Hand input cable	1F-HC35S-02	1 cable	0.2	

Note1) Mass indicates one set.

Specifications

Table 2-27 : Specifications

Item	Specifications	Remarks
Size x cable core	AWG#24 (0.2 mm ²) × 10 cores	One-sided connector, one-sided cable bridging
Total length	1,000 mm	

Pin assign of the hand input cable is shown in Table 2-28.

Table 2-28 : Pin assign of hand input cable

Color	Connector Note1)	Pin number: names	Color	Connector Note1)	Pin number: names
Purple		A1: HC1	Yellow		A1: +24V
Brown		A2: HC2	Green	OP3	A2: 24G
Blue		A3: HC3	-		Reserved
Black	OP1	A4: HC4	-		Reserved
Red	OPT	B1: HC5			
White		B2: HC6		_	
Gray		B3: HC7			
Pink		B4: HC8			

Note1) The connector shows the connector name connected to the robot-arm side.

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

(5) Hand output cable

■ Order type: 1F-GR35S-02

Outline



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

Configuration

Table 2-29 : Configuration equipment

Part name	Туре	Qty.	Mass (kg) ^{Note1)}	Remarks
Hand output cable	1F-GR35S-02	1 cable	0.1	

Note1) Mass indicates one set.

Specifications

Table 2-30 : Specifications

Item	Specifications	Remarks
Size x Cable core	AWG#24(0.2 mm ²) x 10 cores	One side connector and one side cable connection
Total length	500 mm	

Pin assign of the hand output cable is shown in Table 2-31.

Table 2-31 : Pin assign of hand output cable

Color	Connector	Pin number: names	Color	Connector	Pin number: names
Yellow		A1: +24V	Green		A1: +24V
-		A2: Reserved	-		A2: Reserved
Purple		A3: GR1 (Hand output 1)	Red	0.00	A3: GR5 (Hand output 5)
Brown	- GR1	A4: GR2 (Hand output 2)	White		A4: GR6 (Hand output 6)
Blue		B1: GR3 (Hand output 3)	Gray	GR2	B1: GR7 (Hand output 7)
Black		B2: GR4 (Hand output 4)	Pink		B2: GR8 (Hand output 8)
-		B3: Reserved	-		B3: Reserved
-		B4: Reserved	_		B4: Reserved

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

(6) Hand curl tube

■ Order type: RV-4F/7F series, RV-7FLL	One set:	1E-ST0402C
	Two sets:	1E-ST0404C
	Three sets:	1E-ST0406C
	Four sets:	1E-ST0408C
RV-13F/13FL/20F	One set:	1N-ST0602C
	Two sets:	1N-ST0604C
	Three sets:	1N-ST0606C
	Four sets:	1N-ST0608C

Outline

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

Configuration

Table 2-32 : Configuration equipment

Part name		Туре	Qty.	Mass(kg) ^{Note1)}	Remarks
Fo	r RV-4F/7F series, RV-7FLL				
	Hans curl tube (One set: 2 pcs.)	1E-ST0402C	1 pc.	0.1	ϕ 4 tube, 2pcs.
	Hans curl tube (Two sets: 4 pcs.)	1E-ST0404C	1 pc.	0.1	ϕ 4 tube, 4pcs.
	Hans curl tube (Three sets: 6 pcs.)	1E-ST0406C	1 pc.	0.1	ϕ 4 tube, 6pcs.
	Hans curl tube (Four sets: 8 pcs.)	1E-ST0408C	1 pc.	0.1	ϕ 4 tube, 8pcs.
Fo	r RV-13F/13FL/20F				
	Hans curl tube (One set: 2 pcs.)	1N-ST0602C	1 pc.	0.1	ϕ 6 tube, 2pcs.
	Hans curl tube (Two sets: 4 pcs.)	1N-ST0604C	1 pc.	0.1	ϕ 6 tube, 4pcs.
	Hans curl tube (Three sets: 6 pcs.)	1N-ST0606C	1 pc.	0.1	ϕ 6 tube, 6pcs.
	Hans curl tube (Four sets: 8 pcs.)	1N-ST0608C	1 pc.	0.1	ϕ 6 tube, 8pcs.

Note1) Mass indicates one set.

Specifications

Table 2-33 : Specifications

Item	Specifications
Material	Urethane
Size	1E−ST040*C : Outside diameter ϕ 4× Inside diameter ϕ 2.5 1N−ST060*C : Outside diameter ϕ 6× Inside diameter ϕ 4

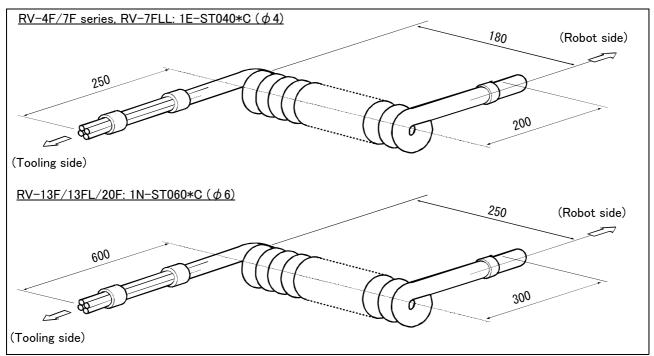


Fig.2-38 : Outline dimensional drawing

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

(7) Forearm external wiring set/ Base external wiring set

Order type

```
      Forearm external wiring set:
      1F-HB01S-01 (Hand input signals, force sensor and vision sensor)

      1F-HB02S-01 (Force sensor and vision-sensor)

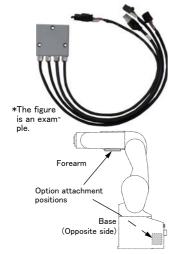
      Base external wiring set:
      1F-HA01S-01 (Force sensor and vision-sensor)

      1F-HA02S-01 (Force sensor and vision-sensor)

      1F-HA02S-01 (Force sensor and vision-sensor)

      Note)
      In the Internal wiring and piping specification, the corresponding base external wiring set is attached.
```

Outline



The Forearm external wiring set and the Base external wiring set are used to pull out the hand input signal cables and communication cables etc. from the underneath of the forearm and the side of the base.

This option consists of the cable clamp box and the cable for hand input signals or the cable for communication.

1) Hand input cable

The hand input cable of the option (equivalent of 1F-HC35C-02) is installed. Connect to the connectors OP1 and OP3 of the hand input cable, which is built into the forearm. Connect the user connection side of pulled-out cable to the tools etc, and input the signals.

2) Communication cable

Pulls out the cable which attached the connector for connecting with vision sensor etc.

The pulled out cables from the underneath of the forearm are connected with a vision sensor camera, or a force sensor. The pulled out cables from the side of the base are connected with a vision sensor controller, or a force sensor interface. (To connect to a force sensor, use the adaptor cable that is supplied in the force sensor option.)

Configuration

Table 2-34 : Configuration equipment

Part name	Туре	Qty.	Remarks
Forearm external wiring set	1F-HB01S-01	Either one	
	1F-HB02S-01	pc.	
Base external wiring set	1F-HA01S-01	Either one	
	1F-HA02S-01	pc.	

Specification

The kind of cable which can be pulled out for each option is shown in Table 2-35. Because to pull out the cable of the same purpose also as the forearm side and the base side, you should use the option in pair shown in "the pairing (recommendation)" of the table. And, each wiring system figure is shown after the following page.

Table 2-35 : Internal wiring and piping specification types

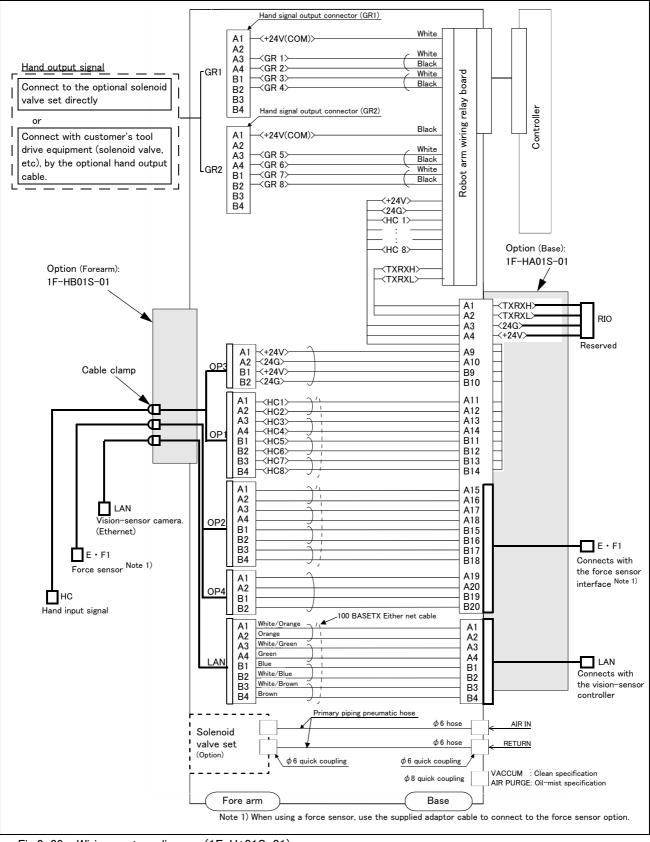
Pairing	Ortion trace	Cable length	Wiring (cable for the connection to each equipment)			
(recommendation)	Option type	(mm) ^{Note1)}	Hand input signal ^{Note2)}	Vision sensor camera	Force sensor unit	
4	1F-HB01S-01 (Forearm)	1,000	eight points	1	Either one unit	
I	1F-HA01S-01 (Base)	500	Not available	1	Either one unit	
0	1F-HB02S-01 (Forearm)	1,000	Not available	1	1	
Z	1F-HA02S-01 (Base)	500	Not available	1	1	

Note1) The length from the cable clamp box to the connector.

Note2) Although the connector is attached to the customer wiring side of hand input cable, the connector can be cut, and connect to the tool of the customer preparation. The color and signal name of the wire are shown in Table 2-36.

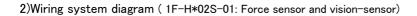
Table 2-36 : Color of the wire and signal name (hand input cable)

Color	Signal name	Connector (HC)	Color	Signal name	Connector (HC)	Color	Signal name	Connector (HC)	Color	Signal name	Connector (HC)
Violet	HC1	A1	Brown	HC2	A2	Blue	HC3	A3	Black	HC4	A4
Red	HC5	B1	White	HC6	B2	Gray	HC7	В3	Pink	HC8	B4
Yellow	+24V	A6	Green	+24G(RG)	B6			-	-		



1) Wiring system diagram (1F-H*01S-01: Hand input signals, force sensor and vision sensor)

Fig.2-39 : Wiring system diagram (1F-H*01S-01)



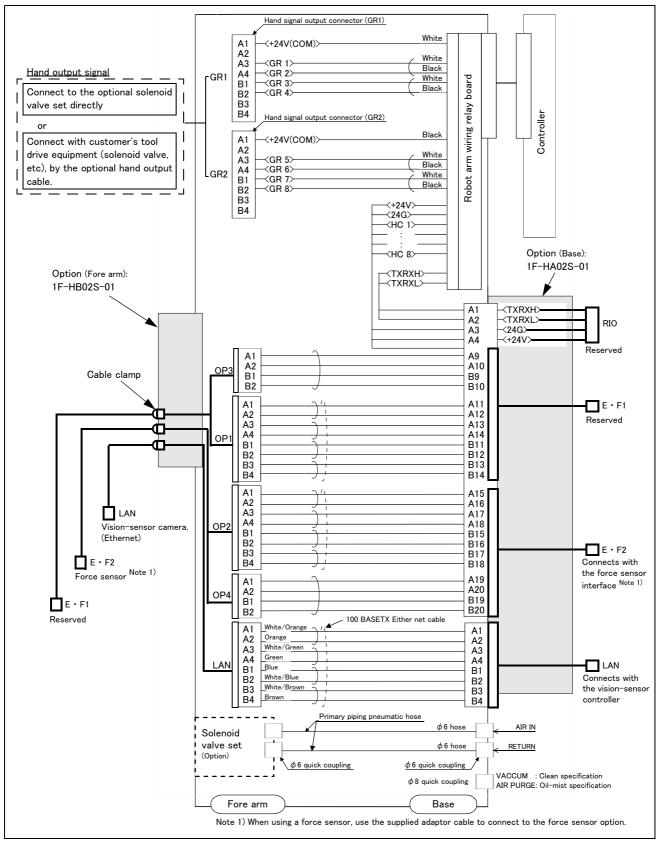


Fig.2-40 : Wiring system diagram (1F-H*02S-01)

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. 2–41.) For specific information about parts to be replaced and timing of overhaul, contact your local service representative.

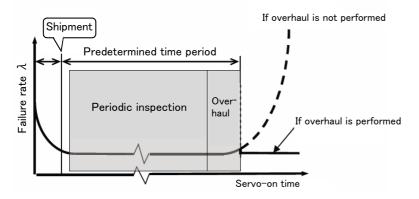


Fig.2-41 : Periodic inspection/overhaul periods

2.9 Maintenance parts

The consumable parts used in the robot arm are shown in Table 2–37. Purchase these parts from the designated maker or dealer when required. Some Mitsubishi–designated parts differ from the maker's standard parts. Thus, confirm the part name, robot arm and controller serial No. and purchase the parts from the dealer.

Table 2-37 : Consumable part list

No.	Part name	Type ^{Note1)}	Usage place	Qty.	Supplier
1	Grease		Reduction gears of each axis	As needed	Mitsubishi Electric
2	Lithium battery	ER6	Inside the CONBOX cover	3 pcs.	

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 81 "Fig. 3-2" (Names of each part), Page 84 "Fig. 3-5" and Page 85 "Fig. 3-6" (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.

	Item	Unit	Specification	Remarks
Туре			CR751- □ VQ-0 CR751-04VJQ-0 CR751-07VLQ-0	[™] □ [™] in type name shows the load (04, 07, 13 or 20) of robot arm. CR751-04VJQ-0 controller is only for RV-4FJL. CR751-07VLQ-0 controller is only for RV-7FLL.
Number of o	control axis		Simultaneously 6	
Memory	Programmed positions	point	13,000	
capacity	No. of steps	step	26,000	
	Number of program		256	
Robot langu	age		MELFA-BASIC IV, V	
Teaching m	ethod		Pose teaching method, MDI method $^{Note1)}$	
External input and	Input and output	point	0/0	Multi-CPU shared device
output	Dedicated input/output		Assign to the multi-CPU shared device.	Input 8192/Output 8192 (Max.)
	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
	Mode changeover switch input	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	RV-4F series: Single phase AC180 to 253 RV-7F/13F series ^{Note2)} : Three phase AC180 to 253, or Single phase AC207 to 253	
	Power capacity	kVA	RV-4F series: 1.0RV-7F series: 2.0RV-13F series: 3.0	Does not include rush current ^{Note3)}
	Power supply frequency	Hz	50/60	
Outline dimensions ^{Note4)}		mm	RV-4F/7F series: 430(W) x 425(D) x 98(H) RV-13F series: 430(W) x 425(D) x 174(H)	Excluding protrusions
Mass		kg	RV-4F/7F series: Approx. 12 RV-13F series: Approx. 15	
Constructio	n		Self-contained floor type, Opened type. Installation vertically or horizontally	IP20 Note5)

Item	Unit	Specification	Remarks
Operating temperature range	°C	0 to 40	
Ambient humidity	%RH	45 to 85	Without dew drops
Grounding	Ω	100 or less	$100\Omega\text{or}\text{less}(\text{class}D\text{grounding})^{Note6)}$
Paint color		Dark gray	Equivalent to Munsell: 3.5PB3.2/0.8

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

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

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

Note3) The power capacity is the rating value for normal operation. The power capacity does not include the rush current when the power is turned ON. The power capacity is a guideline and the actual operation is affected by the input power voltage. The 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 82, "3.4 Outside dimensions/Installation dimensions" for details. Note5) This controller is standard specification. (Refer to Page 78, "3.2 Protection specifications and operating supply".)

Note6) The robot must be grounded by the customer.

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

Table 3-2 : Robot CPU unit standard specification

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.

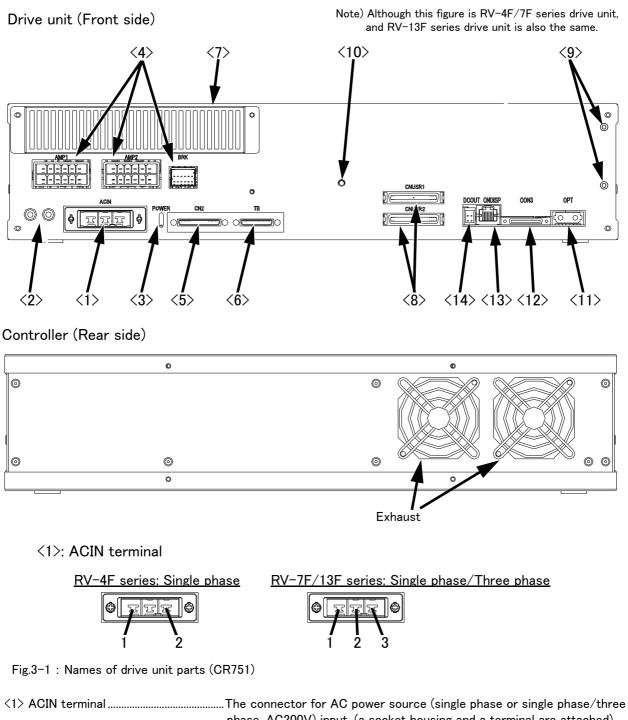
[Information]

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 132, "6.2 Working environment" for details on the working environment.

3.3 Names of each part



<6>T/B connection connector (TB)	This is a dedicated connector for connecting the R33TB. When not using T/B, connect the attached dummy plug.
<7>Filter cover	There is an air filter and buttery inside this cover.
<8>CNUSR connector	The connector for input/ output connection dedicated for robot.
(CNUSR1、CNUSR2)	(a plug connector attached)
<9>Grounding terminal	The grounding terminal for connecting cables of option card. (M3 screw x 2
	places)
<10>Power supply charge lamp (CRAR	GE)
	The lamp is to ensure safe timing (prevent electric shocks) when removing
	the cover (users are not normally required to remove the cover).
	This lamp is illuminated (red) when electrical energy accumulates on the controller's power supply circuit board due to the robot's servo being ON.
	After turning the control power OFF and allowing a few minutes to pass,
	the lamp will go out.
<11>OPT connector (OPT)	For SSCNETIII connection
<12>CON3 connector (CON3)	For RS422 of T/B connection
<13>CNDISP connector (CNDISP)	For LAN of T/B connection
<14>DCOUT connector (DCOUT)	For emergency stop

3.3.1 Names of each part of the robot CPU

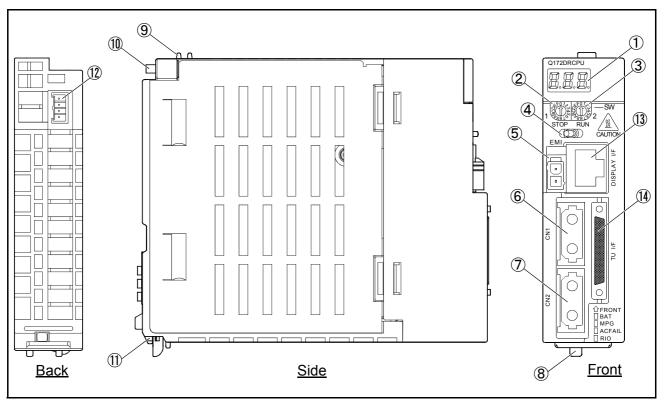


Fig.3-2 : Names of each part of the robot CPU

- 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)
- O CN2 connector^{*2)}Connect to the servo amplifier of the addition axis (Eight axes)
- B 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)
- 1 The projection for unit fixing The projection for fixing to the base unit
- Description (BAT)*4) The connector for connection with battery holder unit Q170DBATC.
- 3 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) $\,$
- (I) 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

(1) RV-4F/7F series

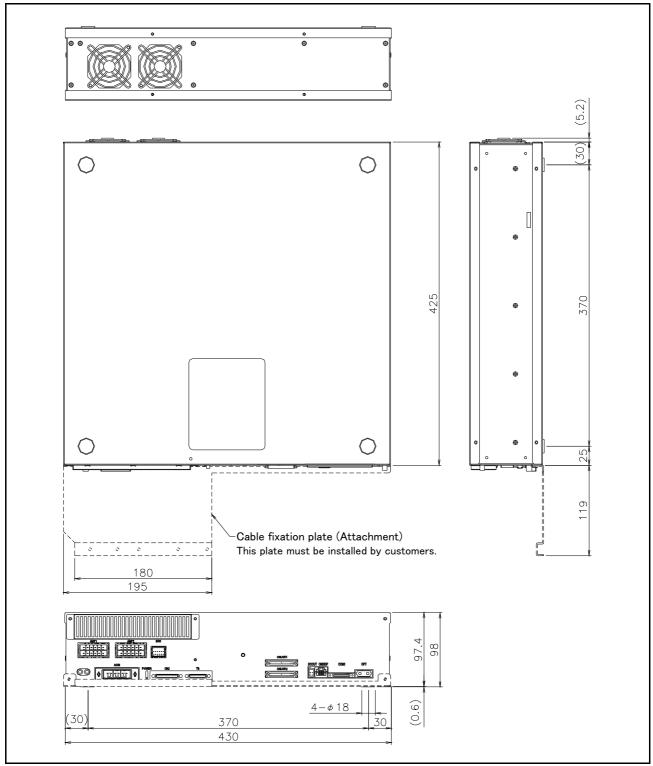


Fig.3-3 : Outside dimensions of drive unit (CR751: RV-4F/7F series)

(2) RV-13F series

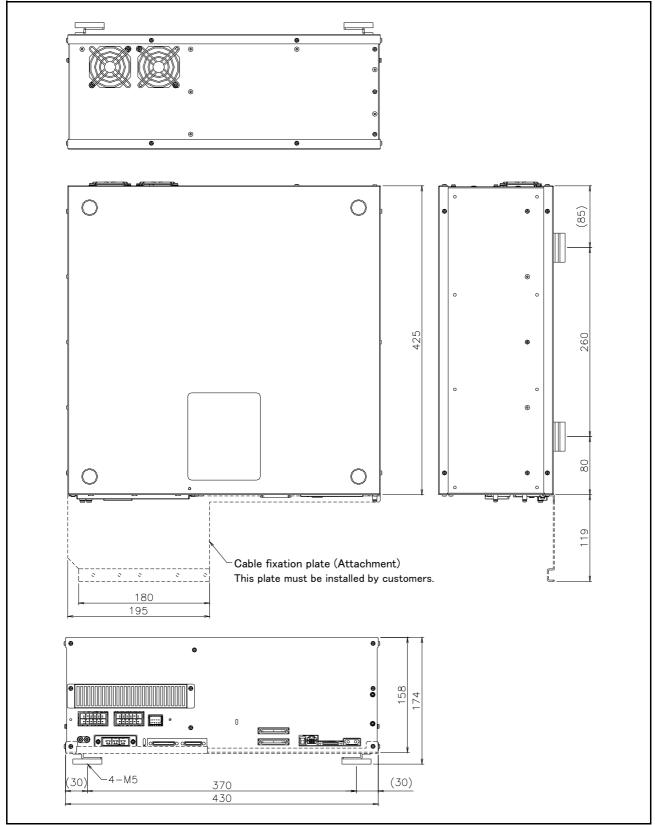
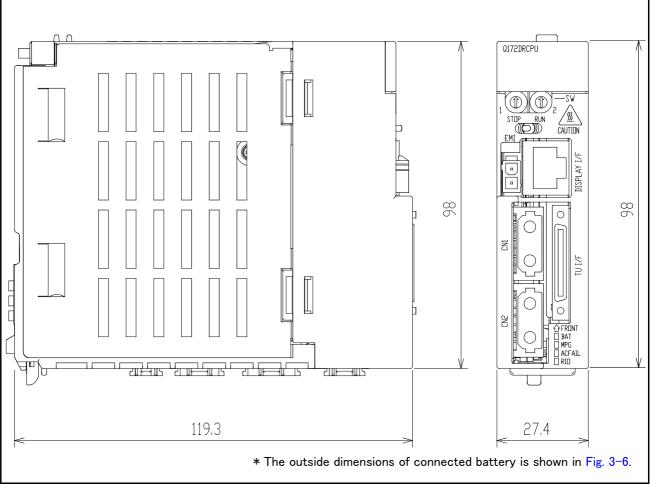


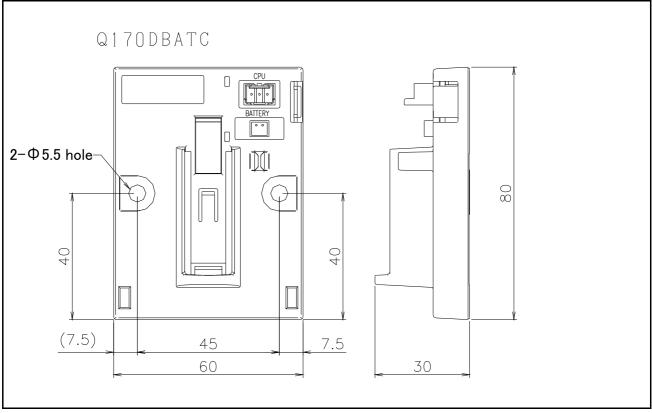
Fig.3-4 : Outside dimensions of drive unit (CR751: RV-13F series)

(3) Outside dimensions of robot CPU unit



 ${\sf Fig. 3-5}$: Outside dimensions of robot CPU

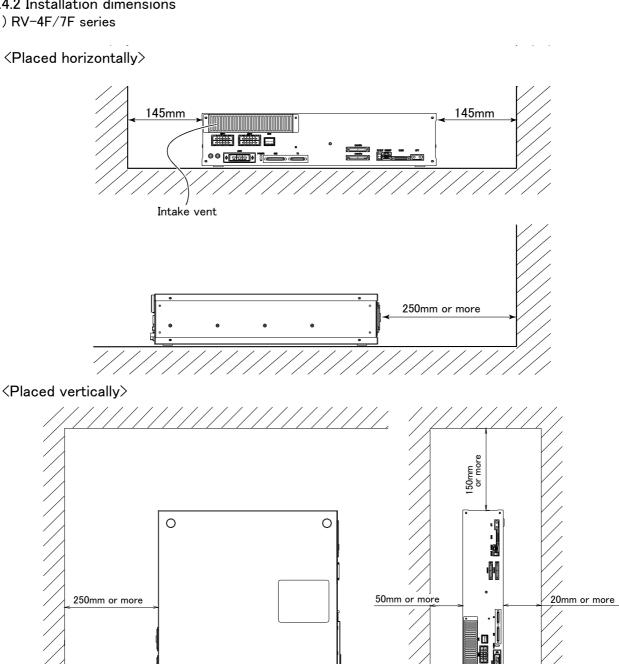
(4) Battery unit outside dimension



 ${\sf Fig. 3-6}$: Outside dimensions of battery unit

3.4.2 Installation dimensions





0

Fig.3-7 : Installation of controller (RV-4F/7F series)

Ο

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. 3-8. You should install the metal plate for fixation to the controller with M4 x 8 or the shorter screw. The screw projection length inside the drive unit (side board thickness is 1.2mm) surely makes 6.8mm or less.

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.

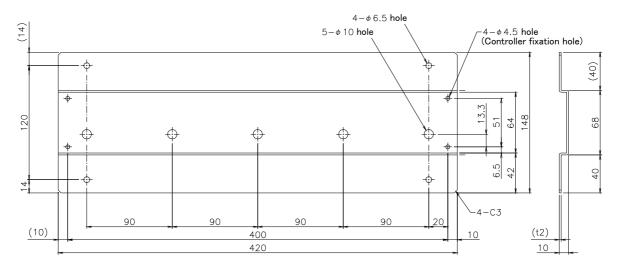


Fig.3-8 : Metal plate for fixation to placing vertically (Reference for RV-4F/7F series)

(2) RV-13F series

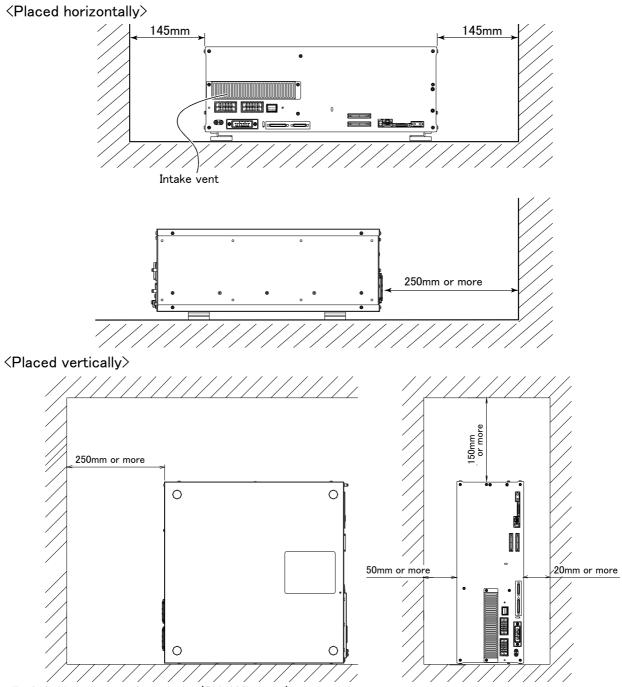


Fig.3-9 : Installation of controller (RV-13F series)

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. 3–10. You should install the metal plate for fixation to the controller with M4 x 8 or the shorter screw. The screw projection length inside the drive unit (side board thickness is 1.2mm) surely makes 6.8mm or less.

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.

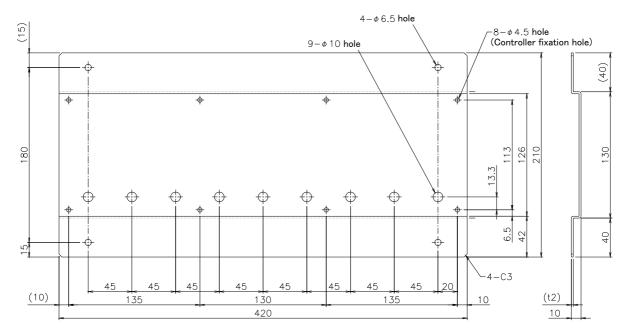


Fig.3-10 : Metal plate for fixation to placing vertically (Reference for RV-13F series)

(3) Robot CPU Unit installation dimensions

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

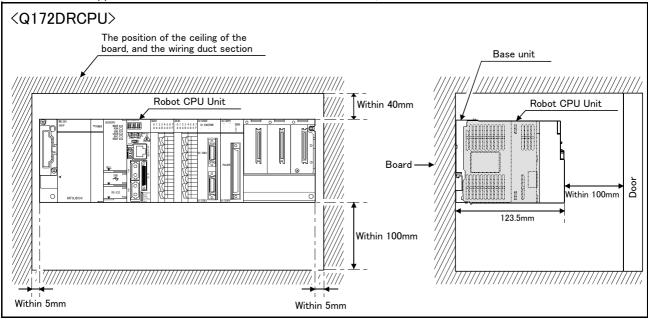


Fig.3-11 : Installation of robot CPU Unit

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 95, "3.7 Emergency stop input and output etc." and on Page 125, "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.

Parameter	Input _{Note1})			Output	
name	Name	Function	Level	Name	Function
TEACHMD		None		Teaching mode out [_] put signal	Outputs that the teaching mode is entered.
ATTOPMD	None			Automatic mode out- put 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 opera- tion 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.	Е	Operating output sig- nal	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 out [_] put signal	Outputs that an error has occurred.
CYCLE	Cycle stop input signal	Carries out cycle stop.	E	In cycle stop opera- tion output signal	Outputs that the cycle stop is operat- ing.
SRVOFF	Servo ON enabled input signal	Turns the servo OFF for all mech- anisms.	L	Servo ON enabled output signal	Outputs servo-on disable status. (Echo back)
SRVON	Servo ON input signal	Turns the servo ON for all mecha- nisms.	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 out- put 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 out- put signal	Outputs the machine lock state.
SAFEPOS	Evasion point return input signal	Requests the evasion point return operation.	Е	In evasion point return output signal	Outputs that the evasion point return is taking place.
OUTRESET	General-purpose Resets the general-purpose output signal reset signal.		Е	None	
EMGERR	None			Emergency stop out- put 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.

Table 3-3 : Dedicated input/output list

Parameter	Input		Note1)		Output
name	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. out- put request	Requests output of the program name.	E	Program No. output signal	Outputs that the program name is being output to the numeric value out- put signal.
LINEOUT	Line No. output request	Requests output of the line No.	E	Line No. output signal	Outputs that the line No. is being out- put to the numeric value output signal.
OVRDOUT	Override value out- put request	Requests the override output.	E	Override value out- put signal	Outputs that the override value is being output to the numeric value output sig- nal.
ERROUT	Error No. output request	Requests the error No. output.	E	Error No. output sig- nal	Outputs that the error No. is being out- put to the numeric value output signal.
JOGENA	Jog valid input sig- nal	Validates jog operation with the external signals	E	Jog valid output sig- nal	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 occur- rence.	L	Mechanism 1 hand error output signal : Mechanism 3 hand error output signal	Outputs that a hand error is occurring.

Parameter	Input		Note1)	Output	
name	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 \rightarrow The designated function is validated when the signal is ON, and is invalidated when the signal is OFF.

E: Edge signal \rightarrow 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.

Item	Name	Function		
Input	Emergency stop	Applies the emergency stop. Dual emergency line		
Input	Special stop input	Applies the stop. (Refer to Page 99, "3.7.2 Special stop input (SKIP)")		
Input	Door switch	Servo-off. Dual line, normal close (Page 100, "3.7.3 Door switch function")		
Input	Enabling device	Servo-off. Dual line, normal close (Page 100, "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 addi- tion axes	When an additional axis is used, the servo ON/OFF status of the additional axis can be synchronized with the robot arm. (Page 107, " 3.10 Magnet contactor control connector output (AXMC) for addition axes")		

Table 3-4 : Special input/output terminal

*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. 3-12.

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. 3-12.

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 125, "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
 - CR751 drive unit....... CNUSR1 connector "between 2 and 27" and "between 7 and 32".
 - b) Door switch
 - CR751 drive unit...... CNUSR1 connector "between 4 and 29" and "between 9 and 34".
 - c) Enabling device
 - CR751 drive unit...... CNUSR1 connector "between 5 and 30" and "between 10 and 35".
- [Caution] Be sure to use a shield cable for the emergency stop wiring cable. And when operating in an environment that is easily affected by noise, be sure to fix the attached ferrite core (model number: E04SR301334, manufacturer: Seiwa Electric Mfg. Co., Ltd.). Be sure to place the ferrite core more than 30 cm from the connecting terminal section.



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

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.



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).

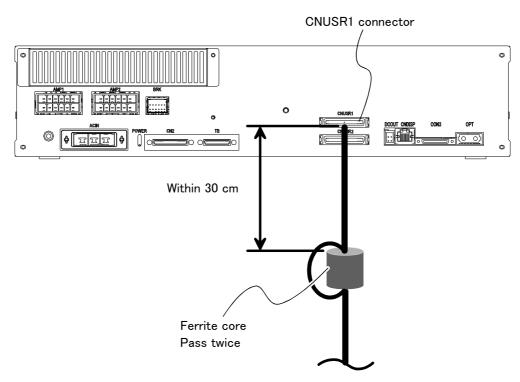
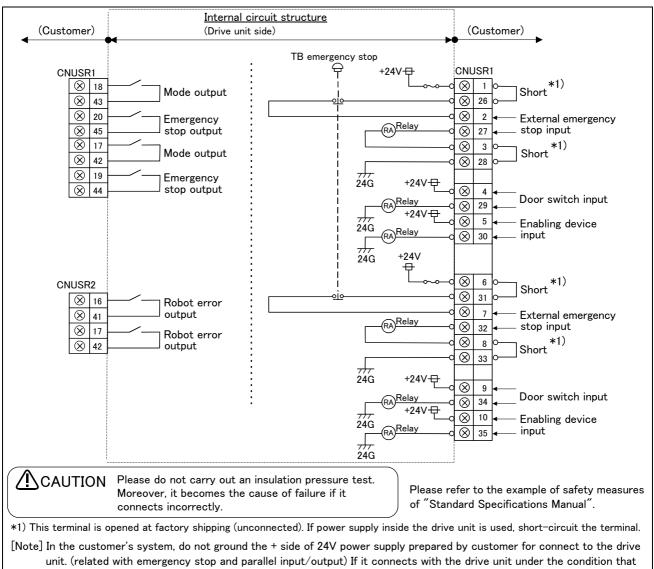


Fig.3-12 : Emergency stop cable connection (CR751)

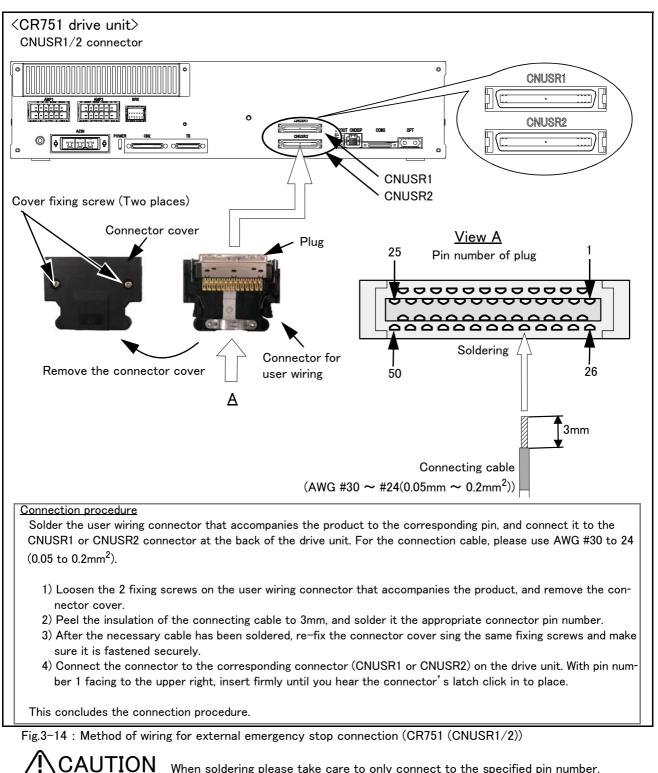


the + side is grounded, it will lead to failure of drive unit.

Fig.3-13 : External emergency stop connection (CR751)

Place the emergency stop switch in an easily operable position, and be sure to wire it to the emergency stop correctly by referencing Page 125, "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.



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

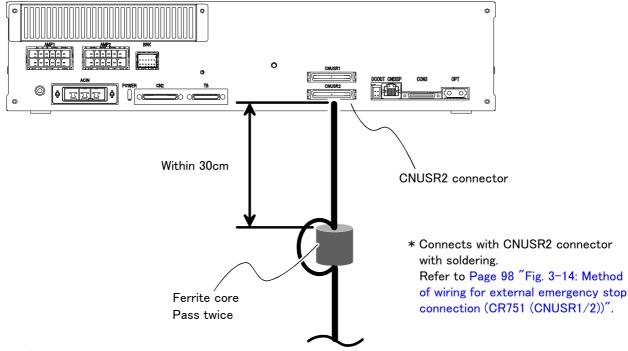
The connectors on the drive unit side are CNUSR1 (upper side) and CNUSR2 (lower side). Makes sure that there is no mistake when connecting to the target connectors. Connecting incorrectly will result in the robot breaking down or malfunctioning.

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. 3-15.

Item		Specifications	Internal circuit		
Туре		DC input			
No. of input p	pint	1			
Insulation met	hod	Photo-coupler insulation			
Rated input vo	oltage	DC24V	1		
Rated input c	urrent	Approx. 11mA	9 +24V(COM)		
Working voltage range		DC 21.6 ~ 26.4V (Ripple rate within 5%)	330 34		
ON voltage/O	N current	DC 8V or more / 2mA or more			
OFF voltage/	OFF current	DC 4V or less / 1mA or less	2.2K		
Input resistan	се	Approx. 2.2 k Ω			
Response $OFF \rightarrow ON$		1ms or less			
time $ON \rightarrow OFF$		1ms or less			
Common method		1 point per common	1		
External wire	connection method	Connector]		

Table 3-5 : Special stop input electric specification

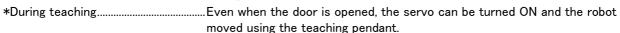


Note) In the customer's system, do not ground the + side of 24V power supply prepared by customer for connect to the controller. (related with emergency stop and parallel input/output) If it connects with the controller under the condition that the + side is grounded, it will lead to failure of controller.

Fig.3-15 : Connection of the special-stop-input (CR751)

3.7.3 Door switch function

The process of the restoration: Close the door, reset the alarm, turn on the servo, and restart



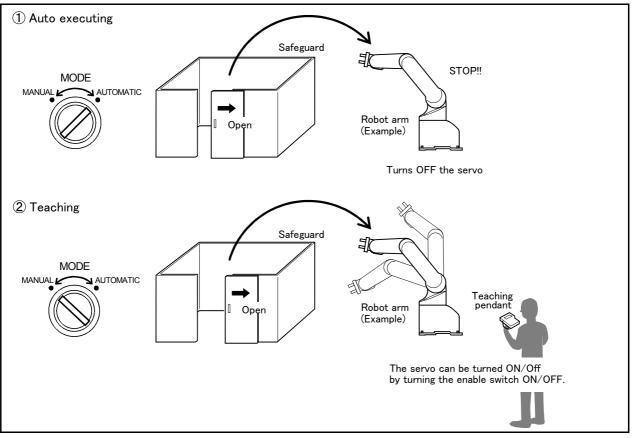


Fig.3-16 : Door switch function

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.

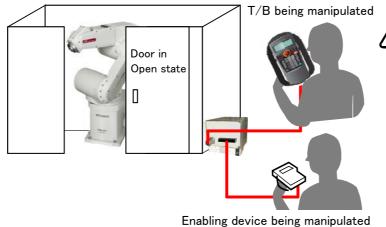
		Related switch settings ^{Note1)}					
No	Operation	Mode of controller	T/B enable/ disable	T/B enable switch	Enabling device input terminal	Door switch input terminal	Description
1	Jog operation	Manual	Enable	ON	Close(ON)	_	If the enabling device input is set to Close (On), the state of door switch input 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).

Table 3-6	:	Various	operations	and	necessary	switch	settings
-----------	---	---------	------------	-----	-----------	--------	----------

Note1) "-" in the table indicates that the state of switch concerned does not matter. Refer to the following for operation of each switch.

- T/B enable/disable:.....Page 109, "(1) Teaching pendant (T/B)"

- 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.



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.3-17 : Brake release operation

3.8 Mode changeover switch input

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

<Right of operation (mode)>

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

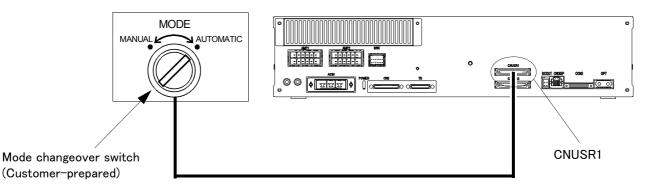


Fig.3-18 : Mode changeover switch image figure (CR751)

(1) Specification of the key switch interface

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

Pin number and	Function (Connector: CNUSR1)	Change m	ode ^{Note1)}
Pin number	Function	MANUAL	AUTOMATIC
49	1st line KEY input	line KEY input	
24	Power supply +24V of pin number 49	Open	Close
50	2nd line KEY input		
25	Power supply +24V of pin number 50	Open	Close

Table 3-7 : Function of the key switch interface

Note1) The mode changes by both opening or both closing between 30-5 pin and between 35-10 pin. Maintain the current mode except it.

[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.

Table 3-8 : Specification of	of the mode chang	geover switch input
T.	0 ic ii	

Item	Specification	Remarks
Rated voltage	DC24V	Supply from the drive unit.
Current rating	Approx. 10mA	Select the switch or button which operates normally in $24V/10$ mA.
Input resistance	Approx. 2.2kΩ	
Response time (OFF->ON)	Approx. 15ms	Example: The response time the program starts, after pushing the run button.
Common method	1 point per common	
Connection method	Connector	
Conformity electric wire size	AWG#24 to #18	0.2 to 0.75mm ²
Maker/Type	-	Maker: PHOENIX CONTACT/ Type: FKC2.5/4-STF-5.0B

(2) Connection of the mode changeover switch input

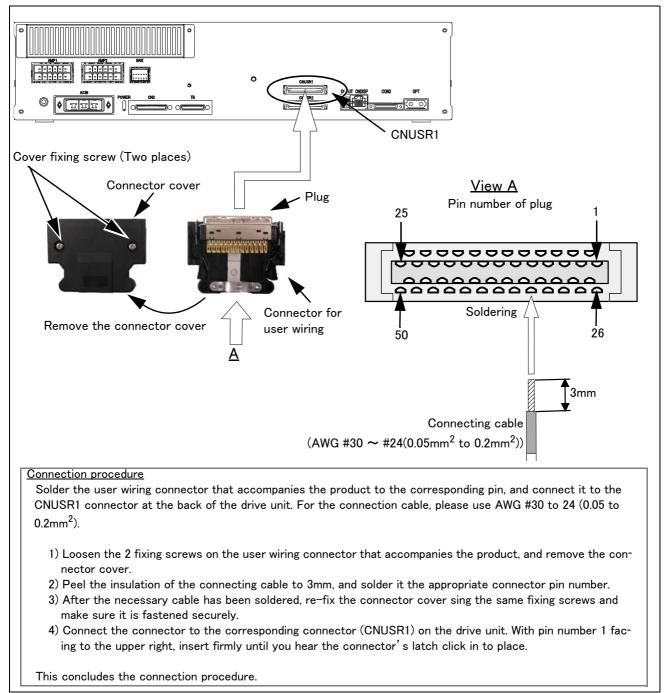


Fig.3-19 : Connection of the mode changeover switch input (CR751)

3.9 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.

3.9.1 Wiring of the Additional Axis Interface

Table 3–9 shows the connectors for additional axes inside the drive unit. Fig. 3–20 shows a connection example (configuration example).

Table 3-9 : Dedicated connectors inside the drive unit

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

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

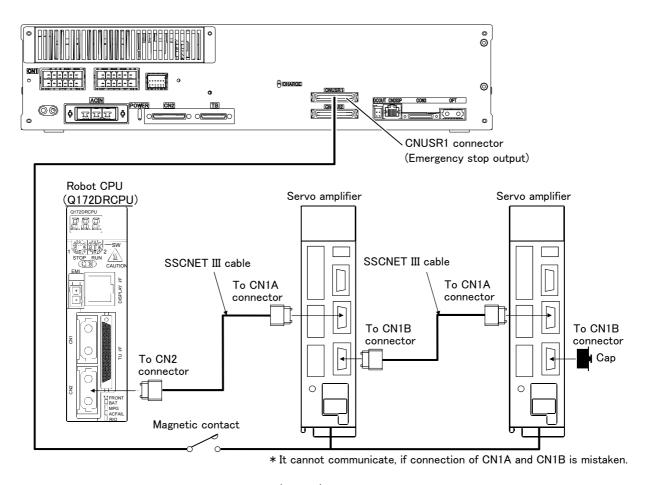


Fig.3-20 : Example of addition axis connection (CR751)

(1) Example of the installation of the noise filter

1) EMC filter (recommended)

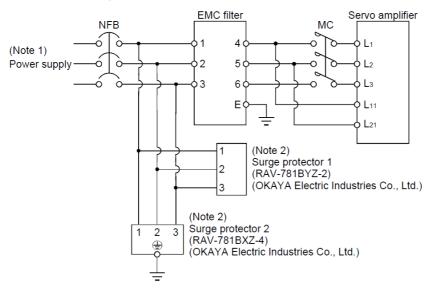
Please install the recommendation filter shown below according to the example of connection.

1) Combination with the servo amplifier

Servo amplifier	Recommended filt			
Servo ampliner	Model	Leakage current [mA]	Mass [kg]([lb])	
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		6(12.02)	
MR-J3-200B4 to MR-J3-700B4	TF3020C-TX		6(13.23)	
MR-J3-11KB4	TF3030C-TX	5.5	7.5(16.54)	
MR-J3-15KB4	TF3040C-TX		12 5(27 56)	
MR-J3-22KB4	TF3060C-TX		12.5(27.56)	

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.



2) Line noise filter

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

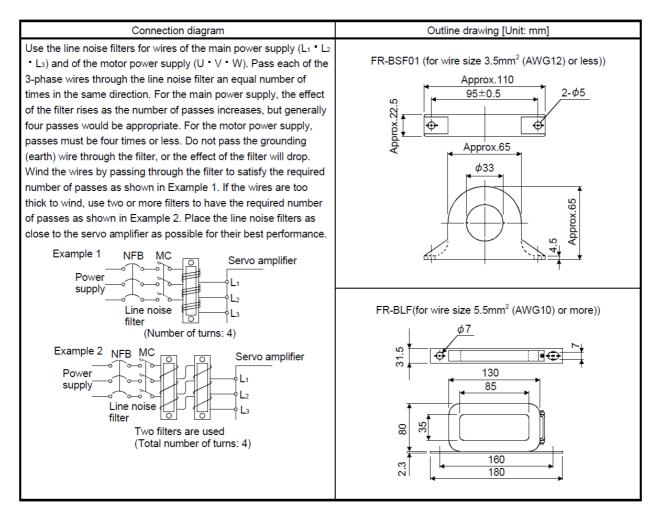


Fig.3-22 : Example of noise filter installation

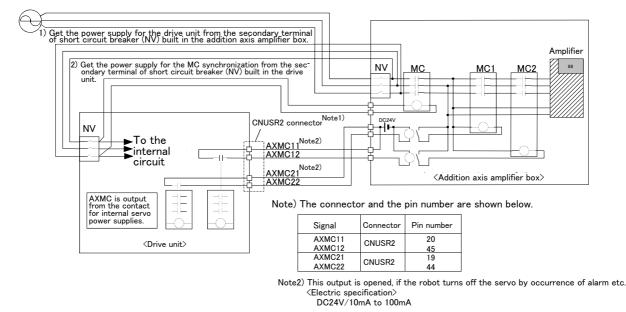
3.10 Magnet contactor control connector output (AXMC) for addition axes

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] 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.3-23 : Example of circuit for addition axes of Magnet contactor control output

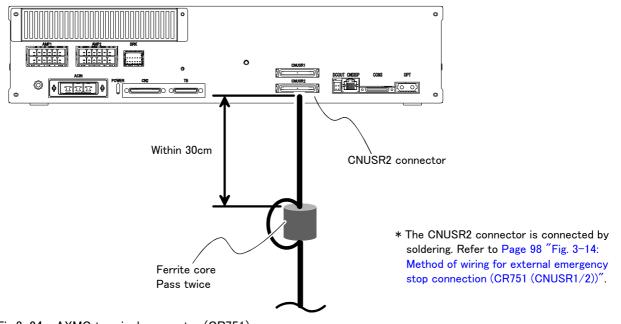


Fig.3-24 : AXMC terminal connector (CR751)

3.11 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 optionsA 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: R33TB R33TB-15

:Cable length 7m 5 :Cable length 15m

Outline



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

For safety proposes, a 3-position enable switch is mounted.*1)

Configuration

Table 3-10 : Configuration device

Part name	Туре	Qty.	Mass (kg) ^{Note1)}	Remarks
Teaching pendant	R33TB	Either one pc.	1.7	Cable length is 7m. Hand strap is attached.
	R33TB-15	Either one pc.	2.8	Cable length is 15m. Hand strap is attached.

Note1) Mass indicates one set.

Specifications

Table 3-11 : Specifications

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

*1) <3-position enable switch>

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. $^{*)}$

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".

^{*)} 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.

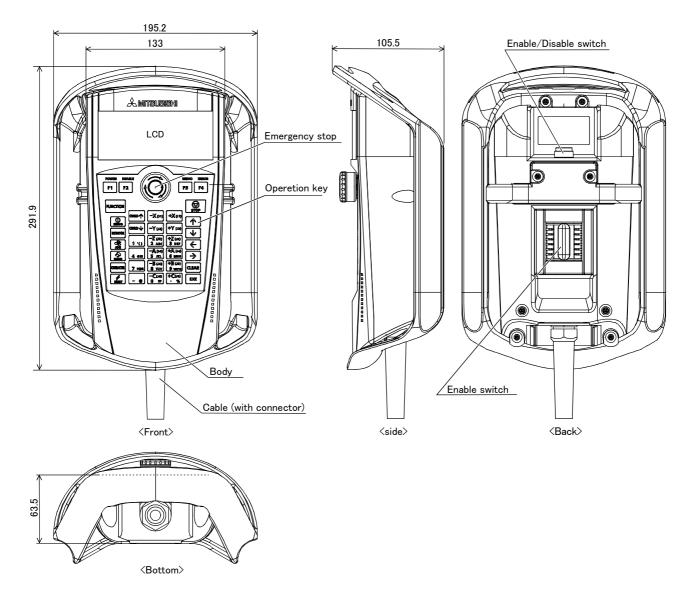


Fig.3-25 : Outside dimensions of teaching pendant

Installation method

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

Key layout and main functions

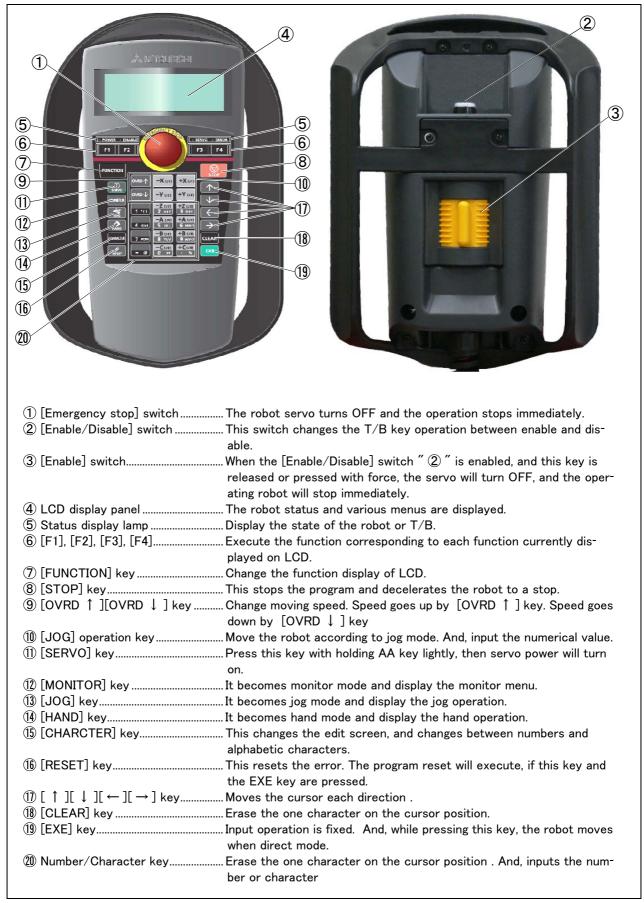


Fig.3-26 : Teaching pendant key layout and main functions

(2) 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	Туре	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

Fun	ction	Functional ex	(istence ^{Note1)}	Details	
Compatible mode		0	0	Personal computer running Microsoft Windows2000/XP/Vista/7. Note2	
Program editing functions	Editing functions	0	0	 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 func- tions	0	0	• Program file control (list, copy, movement, delete, content comparison, name change, protect)	
	Debugging func- tions	0	0	 Direct editing of program in controller Confirmation of robot program operation (step execution, direct execution) 	
Simulation func- tion		0	×	 Off-line simulation of robot program operation using CG (computer graphics) Tact time calculation 	
Monitor func- tions		0	0	 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		0	0	 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.

O : Function provided × : Function not provided

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

(3) Instruction Manual(bookbinding)

■ Order type: ● 5F-RF02-PE01RV-4F/7F/13F-Q series (CR751 drive unit)

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-RF02-PE01		The instructions manual set of RV-4F-Q series and RV-7F-Q series and RV-13F-Q series robot with CR751 drive unit.	
Safety Manual	BFP-A8006	-	Items relating to safety in handling the robot	
Standard Specifications	BFP-A8973	-	Specification of the robot arm and controller	
Robot Arm Setup & Maintenance	BFP-A8935	-	Installation method of the robot arm, jog operation, and maintenance and inspection procedures	
Controller Setup, Basic Operation and Maintenance	BFP-A8886	-	Installation method of the controller, basic operation, and maintenance and inspection procedures	
Detailed Explanation of Functions and Operations	BFP-A8869	-	Functions of the controller and T/B, operation method, and explanation of MELFA-BASIC V	
Troubleshooting	BFP-A8871	-	Causes of errors occurred and their countermeasures	
Additional axis function	BFP-A8663	-	Function of the additional axis, operation method.	
Tracking Function Manual	BFP-A8664	-	Function of the Tracking, operation method.	
Extended Function	BFP-A8787	-	Function of the Extended, operation method.	

Note1) Mass indicates one set.

3.12 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 con- nected to the robot CPU unit	Mitsubishi Electric
2	Filter	BKOFA0773H41	1	Inside the filter cover	

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

4 Software

4.1 List of commands

The available new functions in MELFA-BASIC V are given in Table 4-1.

Table 4-1	List of MELFA-BASIC V comn	nands
		lanus

уре	Class	Function	Input format (example)	
	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 \rightarrow passing point \rightarrow start point (end point)) with 3-dimensional circular interpolation (360 degrees).	Mvc P1,P2,P1	
		Moves along a designated arc (start point \rightarrow passing point \rightarrow 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 \rightarrow reference point \rightarrow end point) with 3-dimensional circular interpolation.	Mvr2 P1,P9,P3	
		Moves along a set arc (start point \rightarrow end point) with 3-dimensional circular interpolation.	Mvr3 P1,P9,P3	
	Speed designation	Designates the speed for various interpolation operations with a per- centage (0.1% unit).	Ovrd 100	
		Designate the speed for joint interpolation operation with a percentage $(0.1\% \text{ unit})$.	JOvrd 100	
		Designates the speed for linear and circular interpolation with a numerical value (mm/s unit).	Spd 123.5	
0		Designates the acceleration/deceleration time as a percentage in respect to the predetermined maximum acceleration/deceleration. (1% unit)	Accel 50,80	
Position and operation control		Automatically adjusts the acceleration/deceleration according to the parameter setting value.	Oadl ON	
ation		Sets the hand and work conditions for automatic adjustment of the acceleration/deceleration.	Loadset 1,1	
Geo	Operation	Adds a process unconditionally to the operation.	Wth	
ŏ		Adds a process conditionally to the operation.	WthIf	
anc		Designates smooth operation.		
		Performance of movement is upgraded corresponding to the application.	MvTune 4	
		Designates the positioning completion conditions with a No. of pulses.	Fine 200	
ő		Designates the positioning completion conditions with a distance in a straight line	Fine 1, P	
		Designates the positioning completion conditions with a joint interpola- tion.	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 sys- tem)	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 pas- sage	Move to a specified position using linear interpolation passing through a singular point.	Mvs P1 Type 0,2	

ranching	Function	Input format (example)
	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	Select
	value	Case 1
		Break
		Case 2
		Break
		End Select
	Moves the program process to the next line.	Skip
ollision detection	Set to enable/disable the collision detection.	ColChk ON/OFF
	Set the detection level of the collision detection.	ColLvl 100,80,,,,,,
ubroutine	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
nterrupt	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	On Com(1) GoSub *L100
	generated from the communication line.	Com(1) On
	Enables the interrupt from the communication line. Disables the interrupt from the communication line.	Com(1) On Com(1) Off
		Com(1) Stop
1-14	Stops the interrupt from the communication line.	Com(1) Stop
lait	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
itop	Stops the program execution.	Hlt
	Generates an error. During program execution, continue, stop or servo OFF can be designated.	Error 9000
nd	Ends the program execution.	End
	Opens the designated hand.	HOpen 1
land open	Closes the designated hand.	HClose 1
land open land close	Defines the input/output variables.	Def IO PORT1=BIT,0
land close	Retrieves the general-purpose input signal.	M1=M_In(1)
land close ssignment	Calls out the general-purpose output signal.	_ · ·
land close ssignment nput		M_Out(1) =0
land close ssignment		GetM 1
land close ssignment nput	Acquires the mechanism with the designated mechanism No.	
land close ssignment nput Dutput	Acquires the mechanism with the designated mechanism No. Releases the mechanism with the designated mechanism No.	RelM 1
land close ssignment nput Dutput fechanism designa-		
land close ssignment put Dutput lechanism designa- on	Releases the mechanism with the designated mechanism No.	RelM 1
land close ssignment put Dutput fechanism designa- on ielection	Releases the mechanism with the designated mechanism No. Selects the designated program for the designated slot.	RelM 1 XLoad 2,"P102"
land (ssigr nput Outpu	nism designa-	

Туре	Class	Function	Input format (example)	
	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	
Others	Clear	Clears the general-purpose output signal, variables in program, variables	Clr 1	
Gt		between programs, etc.	en i	
-	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
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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 desig- nation	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 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	Make settings (program name, operation type, order of priority, etc.) for each slot during slot initialization.			
	SLT32				
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, sys- tem 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, com- mands used in the program, connection with the external input/output device, and parame- ters, 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 Func- tion Manual	Explains the control function and specifications of conveyor tracking
Extended Func- tion Instruc- tion 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.

No.	. Function		Details	Remarks	
1	Overload protection func- tion		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 com- mand 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 func- tion		Activates when an error occurs in the CPU.	The drive circuit is shut off. The robot stops, and an alarm displays.	
7	Overrun prevention			The drive circuit is shut off. The robot stops, and an alarm displays.	
	function	Mechanical stopper	This is the mechanical stopper provided outside the software.	The robot mechanically stops, and function 1 or 2 activates.	

Table 6-1 : Self-diagnosis stop functions

Table	6-2	:	List	of	stop	functions
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Stop function	Teaching pen- dant	External input	Details
Emergency stop	0	0	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	0	0	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

			-		
Signal		Connection point	Parameter	Functions	Usage method
Input	External emer- gency stop Note1)	Connector (CNUSR1)	-	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 oper- ation enable		AUTOENA	Disables automatic operation when inac- tive.	Door switch on safety protection fence
Output	Emergency stop output	Connector (CNUSR1)	_	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.

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

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 125, "6.1.7 Examples of safety measures" for details.

And, refer to Page 101, "(3) Automatic Operation/Jog Operation/Brake Release and Necessary Switch Settings" for the function of the door switch input and the enabling device input.

6.1.3 Precautions for using robot

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

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

(2) Prevention of contact with operator

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

(3) Work procedures

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

(4) Training

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

- (5) Daily inspection and periodic inspection
 - Always inspect the robot before starting daily operations and confirm that there are no abnormalities.
 - Set the periodic inspection standards in view of the robot's ambient environment and operation frequency, and perform periodic inspections.
 - Make records when periodic inspections and repairs have been done, and store the records for three or more years.
- 6.1.4 Safety measures for automatic operation
 - (1) Install safety fences so that operators will not enter the operation area during operation and indicate that automatic operation is in progress with lamps, etc.
 - (2) Create signals to be given when starting operation, assign a person to give the signal, and make sure that the operator follows the signals.

6.1.5 Safety measures for teaching

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

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

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

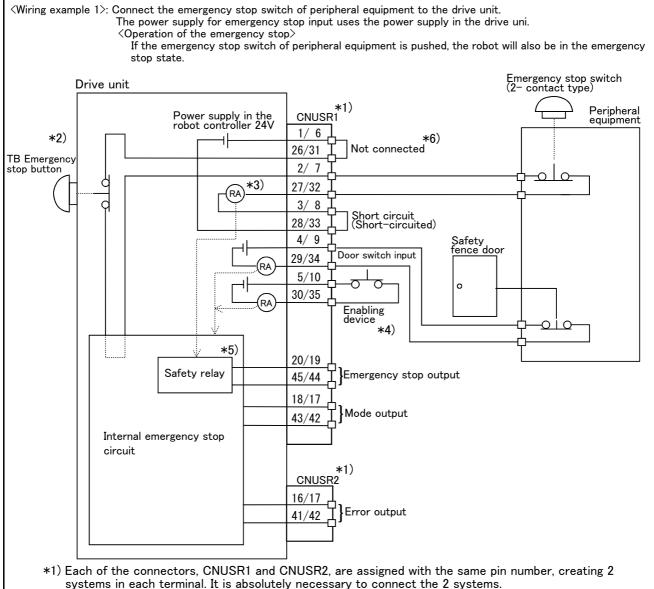
If operation is required, take measures to prevent hazards caused by unintentional or mistaken operations.

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

6.1.7 Examples of safety measures

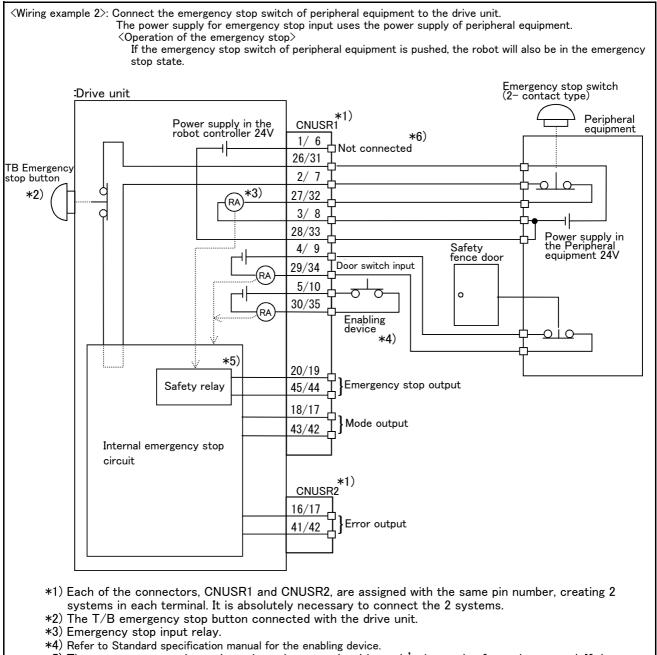
Two emergency-stop input circuits are prepared on the user wiring terminal block of the drive unit. Create a circuit as shown below for safety measures. In addition, the figure shows the normal state which is not in the emergency stop state.

- [Caution] Since we have omitted the information in part because of explanation, there is the section different from the product. Also refer to Page 130, "(1) 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.



- *2) The T/B emergency stop button connected with the drive unit.
- *3) Emergency stop input relay.
- *4) Refer to Standard specification manual for the enabling device.
- *5) The emergency stop input detection relay uses the drive unit's internal safety relay control. If the emergency stop input detection relay is switched OFF, emergency stop is detected and the safety relay is also switched OFF.

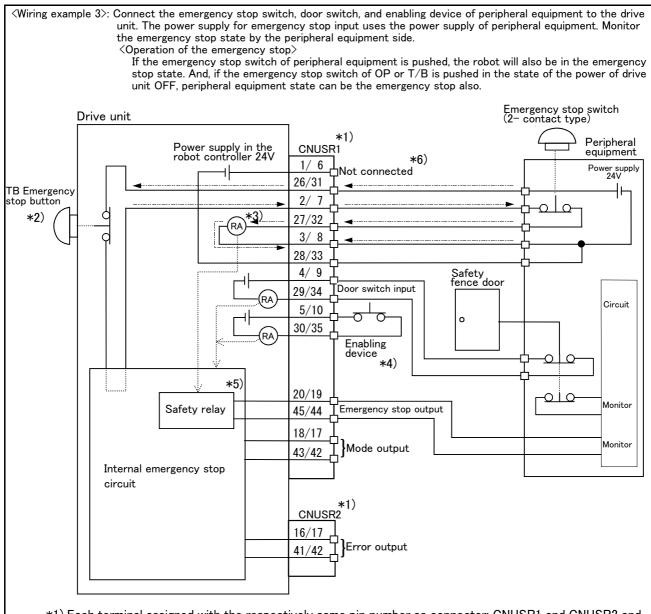
Fig.6-1 : Example of safety measures (CR751 wiring example 1)



*5) The emergency stop input detection relay uses the drive unit's internal safety relay control. If the emergency stop input detection relay is switched OFF, emergency stop is detected and the safety relay is also switched OFF.

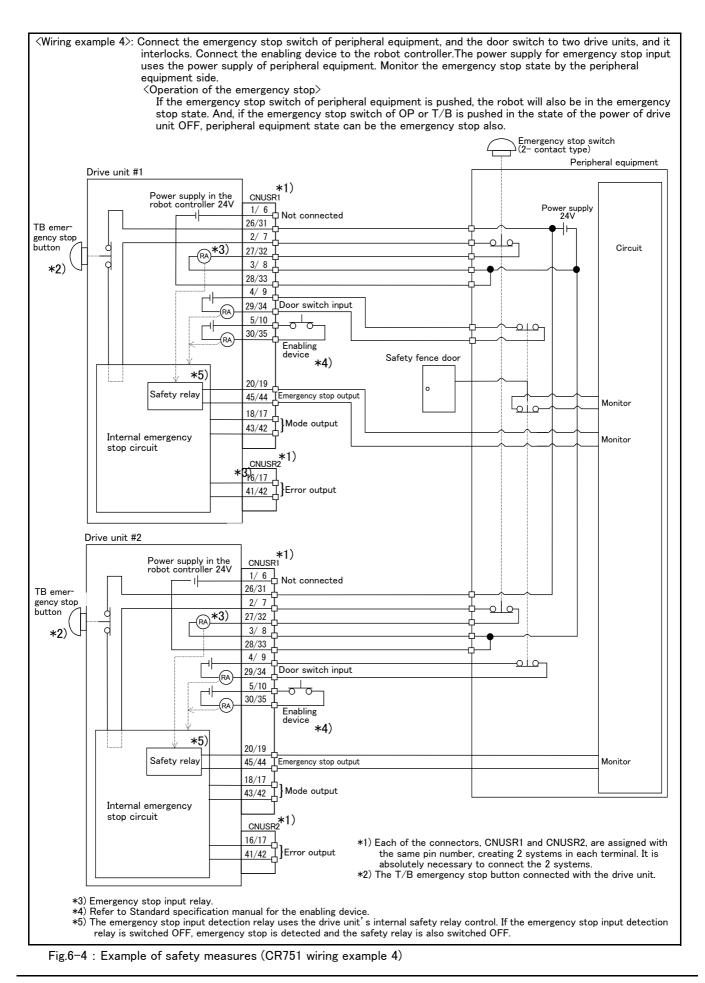
*6) Connect the 24V power supply to 26/31 terminals.

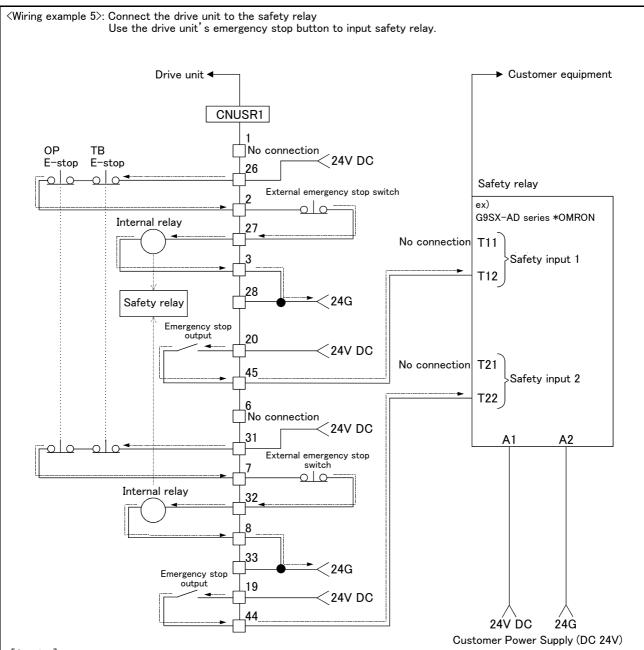
Fig.6-2 : Example of safety measures (CR751 wiring example 2)



- *1) Each terminal assigned with the respectively same pin number as connector: CNUSR1 and CNUSR2 and each is dual line. Always connect the two lines.
- *2) The T/B emergency stop button connected with the drive unit.
- *3) Emergency stop input relay.
- *4) Refer to Standard specification manual for the enabling device.
- *5) The emergency stop input detection relay uses the drive unit's internal safety relay control. If the emergency stop input detection relay is switched OFF, emergency stop is detected and the safety relay is also switched OFF.
- *6) Connect the 24V power supply to 26/31 terminals.







[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 two terminals 26/31, then connect the emergency stop button (or contact points) in the user equipment to the 2-27 and 7-32 terminals, and ultimately connect to the negative side (24G).
- 3) Setup a safety relay on the user equipment, and when using to input the emergency stop button on the controller, please only use a safety relay that functions when connecting the input to the one end of the 2 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 exterior safety relay, please take note of the polarity and make sure that the electrical current flows in the same direction as indicated by the dotted arrows in the two places in the diagram. If the polarity is setup incorrectly this function will not operate correctly. Please connect 20/19 terminal to 24V.

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

(1) 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.
 - CR751 drive unit CNUSR1/2 connector:
 - AWG #30 to #24 (0.05mm² to 0.2mm²)

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

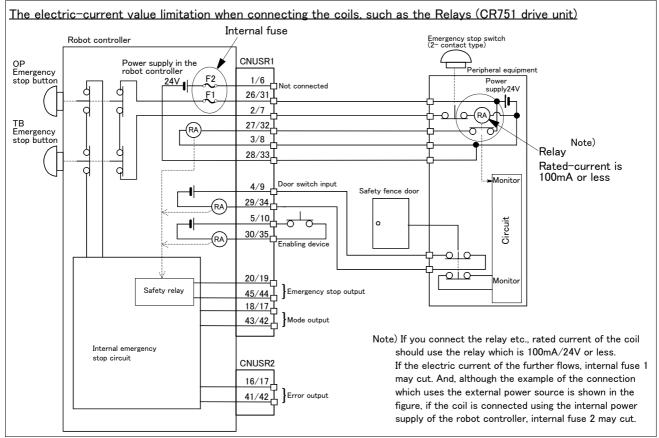
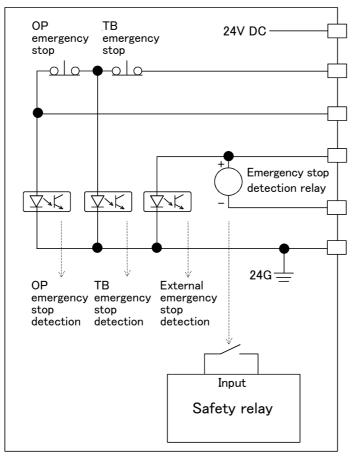


Fig.6-6 : Limitations when connecting the relay etc. (CR751)

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

[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.

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.)
 - \cdot Where there is heavy powder dust and oil mist present.

6.3 Precautions for handling

- (1) This robot has brakes on all axes. The precision of the robot may drop, looseness may occur and the reduction gears may be damaged if the robot is moved with force with the brakes applied.
- (2) Avoid moving the robot arm by hand. When unavoidable, gradually move the arm. If moved suddenly, the accuracy may drop due to an excessive backlash, or the backed up data may be destroyed.
- (3) Note that depending on the posture, even when within the movement range, the wrist section could interfere with the base section. Take care to prevent interference during jog. *1)
- (4) The robot arm consists of precision parts such as bearing. Lubricants such as grease are also applied on the moving parts to keep the mechanical accuracy. In a cold start under low temperature or in the first start after being stored for one month or longer, lubricants may not be spread enough. Such condition may lower the positioning accuracy, cause servo and overload alarms, and early wearing of the moving parts. To avoid such situation, perform warm-up operation of the machine at a low speed (at about 20% of normal operation speed). Move the robot arm from the lower to the upper limit of the movable range with the 30 degree joint angle or more for about 10 minutes. After that, speed up the operation gradually.
 Please use the warm-up operation (About the details of the warm-up operation refer to "INSTRUCTION").

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

(5) The robot arm and controller must be grounded with $100\,\Omega$ or less (class D grounding) to secure the noise resistance and to prevent electric shocks.

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

- (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.
- (8) If this robot interferes with the workpiece or peripheral devices during operation, the position may deviate, etc. Take care to prevent interference with the workpiece or peripheral devices during operation.
- (9) The hanging installation jig can be borrowed from the maker. Order to dealer when need.
- (10) Do not attach a tape or a label to the robot arm and the controller. If a tape or a label with strong adhesive power, such as a packaging tape, is attached to the coated surfaces of the robot arm and controller, the coated surface may be damaged when such tape or label is peeled off.
- (11) If the robot is operated with a heavy load and at a high speed, the surface of the robot arm gets very hot. It would not result in burns, however, it may cause secondary accidents if touched carelessly.
- (12) Do not shut down the input power supply to stop the robot. If the power supply is frequently shut down during a heavy load or high-speed operation, the speed reducer may be damaged, backlash may occur, and the program data may be destroyed.
- (13) If the J1, J2 and J3 axes collide with the mechanical stopper during the automatic operation of the robot, it is necessary to replace the resin part of the mechanical stopper unit. For the replacement of the resin parts, please contact Mitsubishi or Mitsubishi's dealer.

If the resin part is not replaced, the mechanism unit and the speed reducer may be damaged significantly when the axes collide with the mechanical stopper next or subsequent time.

- (14) 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.
- (15) The J1 to J3 axes of the RV-13F series generate loud noise during high-speed operation because of their reduction gear structure, but it does not affect the robot's function, performance, and a life.
- (16) Do not conduct an insulated voltage test. If conducted by mistake, it may result in a breakdown.
- (17) 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.
- (18) 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.
- (19) 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.
- (20) 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.
- (21) When fumigants that contain halogen materials such as fluorine, chlorine, bromine, and iodine are used for disinfecting and protecting wooden packaging from insects, they cause malfunction when entering our products. Please take necessary precautions to ensure that remaining materials from fumigant do not enter our products, or treat packaging with methods other than fumigation (heat method). Additionally, disinfect and protect wood from insects before packing products.

6.4 EMC installation guideline

6.4.1 Outlines

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 dis-

Each contents are shown below.

turbance noise from the outside.

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		
	Electrical-conduction noise disturbance	The electromagnetism noise etc. which flow out of the power-supply line.	EN62061:2005(Annex E)		
Immunity	Electrostatic discharge immunity test	The noise from the electrified human body.			
(EMS)	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

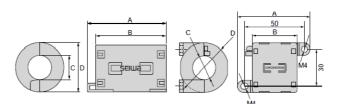
(1) Ferrite core

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.

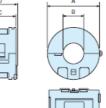
Maker: SEIWA ELECTRIC MFG. Co., Ltd.

.	Out	side dim	Diameter of the		
Туре	А	В	С	D	adaptation cable [max] (mm)
E04SR401938	61	38	19	40	19.0
E04SR301334	39	34	13	30	13.0



Maker: TAKACHI ELECTRONICS ENCLOSURE CO., LTD.

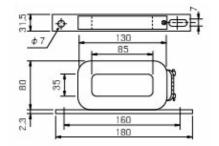
Time	Out	side dim	Diameter of the		
Туре	А	В	С	D	adaptation cable [max] (mm)
TFT-274015S	43.8	27.4	20.7	-	φ 26.5





(2) Line noise filter

Type : FR-BLF (Mitsubishi Electric Corp.)



7 Appendix

Appendix 1 : Specifications discussion material (RV-4F/7F series)

Customer	inform	ation
Gustomer	Inform	ation

Company name	Name	
Address	Telephone	

Purchased mode

Type ^{Note1)}					
🗆 RV-4F-Q	RV-4FL-Q	RV-4FJL-Q	🗆 RV-7F-Q	RV-7FL-Q	

Note1) Refer to the Page 2, "1.2 Model type name of robot" for the details of the robot arm type name.

Purchased mode

Item		Standard specifications	Shipping special specifications
Robot arm	Oil mist specification (IP67)	General environment specification (IP40)	□ Not provided □ Provided
	Clean specification (ISO class3)	General environment specification (IP40)	□ Not provided □ Provided
	Internal wiring and piping specification ^{Note1)}	Equipped to the forearm	□ Not provided □ -SH01 □ -SH02 □ -SH03 □ -SH04 □ -SH05
Machine cable	•	☐ 5m fixed type	□ 2m fixed type: 1F-02UCBL-02
Controller	Robot CPU unit connecting cable set ^{Note2)}	□ 10m	□ Not provided □ 5m □ 20m □ 30m: 2Q-RC-CBL □ □ M

Note1) The corresponding base external wiring set is attached. Note2) 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		Туре	Provision, and specifications when provided.			
	J1 axis operating range change	1F-DH-03	For RV-4F series: 🗆 Not provided 🛛 Provided			
		1F-DH-04	For RV-7F series: 🗆 Not provided 🛛 Provided			
~	Machine cable extension	1F- 🗆 🗆 UCBL-02	Fixed type: 🗌 Not provide 🔲 10m 🔲 15m 🗌 20m			
arm		1F- 🗆 🗆 LUCBL-02	Flexed type: 🗌 Not provide 🔲 10m 🔲 15m 🔲 20m			
Robot	Solenoid valve set	1F-VD0 □ -02 1F-VD0 □ E-02	□ Not provide 1F-VD0 □ -02 (Sink type): □ 1set □ 2set □ 3set □ 4set 1F-VD0 □ E-02 (Source type): □ 1set □ 2set □ 3set □ 4set			
	Hand input cable	1F-HC35S-02	□ Not provided □ Provided			
	Hand output cable	1F-GR35S-02	□ Not provided □ Provided			
	Hand curl tube	1E-ST040 🗆 C	Not provided 1 set 2 set 3 set 4 set Not provided 1 F-HB01S-01 1 F-HB02S-01 Not provided 1 F-HA01S-01 1 F-HA02S-01 Not provided 1 F-HA01S-01 1 F-HA02S-01 Not provided 1 F-HA01S-01 1 F-HA02S-01			
	Forearm external wiring set	1F-HB0 🗆 S-01				
	Base external wiring set	1F-HA0 🗆 S-01				
le ^r	Simple teaching pendant	R33TB- 🗆 🗆				
Controller	Highly efficient teaching pendant	R57TB- 🗆 🗆	□ Not provided □ 7m □ 15m			
⁵ Co	RT ToolBox2	3D-11C-WINE	□ Not provided □ Windows2000/XP/Vista/7 English CD-ROM			
	RT ToolBox2 mini	3D-12C-WINE	□ Not provided □ Windows2000/XP/Vista/7 English CD-ROM			
	Network vision sensor	4D-2CG5***-PKG	 Not provided Provided Provided () sets 			
	Instructions manual	5F-RF02-PE01				
Nain	<u>itenance parts (Consumable</u>	parts)				
Ma	Maintenance parts Backup batteries ER6 () pcs. Backup batteries Q6BAT () pcs. Grease () cans Robot selection check list					
Robo						
Wor	k description 🛛 Material handling	Assembly Machinir	ng L/UL \square Sealing \square Testing and inspection \square Other ()			
Wor	kpiece mass ()g Hand mass		□ General environment □ Clean □ Oil mist: □ Confirm oil proof □ request (Oil name:)/ □ not request ^{Note:} □ Other ()			
Rem	narks	•				

Note1) Refer to Page 22, "2.2.6 Protection specifications" about oil resistance.

Appendix 2 : Specifications discussion material (RV-7FLL)

Customer information Company name Name Address Telephone

Purchased mode

Type Note1)

RV-7FLL-Q

Note1) Refer to the Page 2, "1.2 Model type name of robot" for the details of the robot arm type name.

Purchased mode

	Item	Standard specifications	Shipping special specifications
Robot arm	Oil mist specification (IP67)	General environment specification (IP40)	□ Not provided □ Provided
	Clean specification (ISO class3)	General environment specification (IP40)	□ Not provided □ Provided
	Internal wiring and piping specification ^{Note1)}	Equipped to the forearm	□ Not provided □ -SH01 □ -SH02 □ -SH03 □ -SH04 □ -SH05
Machine cable		☐ 5m fixed type	2m fixed type: 1F-02UCBL-02
Controller	Robot CPU unit connecting cable set $\frac{Note2}{}$	□ 10m	□ Not provided □ 5m □ 20m □ 30m: 2Q-RC-CBL □□ M

Options (Installable after shipment)

	Item	Туре	Provision, and specifications when provided.		
	J1 axis operating range change	1F-DH-05J1	□ Not provided □ Provided		
_	Machine cable extension	1F- 🗆 UCBL-02	Fixed type: □ Not provide □ 10m □ 15m □ 20m		
arm		1F- 🗆 LUCBL-02	Flexed type: 🗌 Not provide 📋 10m 📋 15m 📋 20m		
Robot	Solenoid valve set	1F-VD0 □ -02 1F-VD0 □ E-02	□ Not provide 1F-VD0 □ -02 (Sink type): □ 1set □ 2set □ 3set □ 4set 1F-VD0 □ E-02 (Source type): □ 1set □ 2set □ 3set □ 4set		
	Hand input cable	1F-HC35S-02	□ Not provided □ Provided		
	Hand output cable	1F-GR35S-02	□ Not provided □ Provided		
	Hand curl tube	1E-ST040 🗆 C	□ Not provided □ 1set □ 2set □ 3set □ 4set		
	Forearm external wiring set	1F-HB0 🗆 S-01	□ Not provided □ 1F-HB01S-01 □ 1F-HB02S-01		
	Base external wiring set	1F-HA0 🗆 S-01	□ Not provided □ 1F-HA01S-01 □ 1F-HA02S-01		
ler	Simple teaching pendant	R33TB- 🗆 🗆	□ Not provided □ 7m □ 15m		
Controller	Highly efficient teaching pendant	R57TB- 🗆 🗆	□ Not provided □ 7m □ 15m		
Cor	RT ToolBox2	3D-11C-WINE	□ Not provided □ Windows2000/XP/Vista/7 English CD-ROM		
	RT ToolBox2 mini	3D-12C-WINE	□ Not provided □ Windows2000/XP/Vista/7 English CD-ROM		
	Network vision sensor	4D-2CG5***-PKG	□ Not provided □ Provided		
	Instructions manual	5F-RF01-PE01	□ Not provided □ Provided () sets		
Mair	ntenance parts (Consumable	parts)			
Ma	aintenance parts 🛛 Backup batt	eries ER6 () pcs. 🛛 E	Backup batteries Q6BAT ()pcs. 🛛 Grease()cans		
Robot selection check list					
Work description Atterial handling Assembly Machining L/UL Sealing Testing and inspection Other ()					
Work description Imatema handling Assembly Imatema handling Imatema					

Note1) Refer to Page 22, "2.2.6 Protection specifications" about oil resistance.

Remarks

Appendix 3 : Specifications discussion material (RV-13F/13FL)

Customer information

Company name	Name	
Address	Telephone	

Purchased mode

□ RV-13F-Q

Type ^{Note1)}	
RV-13FL-Q	

Note1) Refer to the Page 2, "1.2 Model type name of robot" for the details of the robot arm type name.

Purchased mode

Item		Standard specifications	Shipping special specifications
Robot arm	Oil mist specification (IP67)	General environment specification (IP40)	□ Not provided □ Provided
	Clean specification (ISO class3)	General environment specification (IP40)	□ Not provided □ Provided
	Internal wiring and piping specification	Equipped to the forearm	□ Not provided □ -SH01 □ -SH02 □ -SH03 □ -SH04 □ -SH05
Machine cable		☐ 7m fixed type	2m fixed type: 1F-02UCBL-02
Controller	Robot CPU unit connecting cable set Note2)	□ 10m	□ Not provided □ 5m □ 20m □ 30m: 2Q-RC-CBL □ □ M

Note1) The corresponding base external wiring set is attached.

Note2) 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		Туре	Provision, and specifications when provided.	
	J1 axis operating range change	1F-DH-05J1	□ Not provided □ Provided	
~	Machine cable extension	1F- 🗆 🗆 UCBL-02	Fixed type: 🛛 Not provide 🗆 10m 🗖 15m 🗖 20m	
arm		1F- 🗆 🗆 LUCBL-02	Flexed type: 🗌 Not provide 🔲 10m 🔲 15m 🔲 20m	
Robot	Solenoid valve set	1F-VD0 □ -03 1F-VD0 □ E-03	□ Not provide 1F-VD0 □ -03 (Sink type): □ 1set □ 2set □ 3set □ 4set 1F-VD0 □ E-03 (Source type): □ 1set □ 2set □ 3set □ 4set	
	Hand input cable	1F-HC35S-02	□ Not provided □ Provided	
	Hand output cable	1F-GR35S-02	□ Not provided □ Provided	
	Hand curl tube	1N-ST060 □ C	🗆 Not provided 🛛 1 set 🔲 2 set 🔲 3 set 🔲 4 set	
	Forearm external wiring set	1F-HB0 🗆 S-01	□ Not provided □ 1F-HB01S-01 □ 1F-HB02S-01	
	Base external wiring set	1F-HA0 🗆 S-01	□ Not provided □ 1F-HA01S-01 □ 1F-HA02S-01	
ller	Simple teaching pendant	R33TB- 🗆 🗆	□ Not provided □ 7m □ 15m	
Controller	Highly efficient teaching pendant	R57TB- 🗆 🗆	□ Not provided □ 7m □ 15m	
So Co	RT ToolBox2	3D-11C-WINE	□ Not provided □ Windows2000/XP/Vista/7 English CD-ROM	
	RT ToolBox2 mini	3D-12C-WINE	□ Not provided □ Windows2000/XP/Vista/7 English CD-ROM	
	Network vision sensor	4D-2CG5***-PKG	□ Not provided □ Provided	
	Instructions manual	5F-RF01-PE01	□ Not provided □ Provided () sets	
Maintenance parts (Consumable parts)				
Ма	aintenance parts 🛛 Backup batt	eries ER6 () pcs. 🛛 B	Backup batteries Q6BAT () pcs. 🛛 Grease () cans	
Robot selection check list				
Wor	k description 🛛 Material handling	Assembly Machinir	ng L/UL \Box Sealing \Box Testing and inspection \Box Other ()	

Workpiece mass ()g	Hand mass ()g	Atmosphere General environment Clean Oil mist: Confirm oil proof request (Oil name: Other ())
Remarks				

Note1) Refer to Page 22, "2.2.6 Protection specifications" about oil resistance.

Appendix 4 : Specifications discussion material (RV-20F)

Customer information

	Company name	Name	
	Address	Telephone	
_			

Purchased mode

Type	Note1)

RV-20F-Q

Note1) Refer to the Page 2, "1.2 Model type name of robot" for the details of the robot arm type name.

Purchased mode

Item		Standard specifications	Shipping special specifications
Robot arm	Oil mist specification (IP67)	General environment specification (IP40)	□ Not provided □ Provided
	Clean specification (ISO class3)	General environment specification (IP40)	□ Not provided □ Provided
	Internal wiring and piping specification ^{Note1)}	Equipped to the forearm	□ Not provided □ -SH01 □ -SH02 □ -SH03 □ -SH04 □ -SH05
Machine cable		☐ 7m fixed type	2m fixed type: 1F-02UCBL-02
Controller	Robot CPU unit connecting cable set $\frac{Note2}{}$	□ 10m	□ Not provided □ 5m □ 20m □ 30m: 2Q-RC-CBL □□ M

Note1) The corresponding base external wiring set is attached.

Note2) 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	Туре	Provision, and specifications when provided.
	J1 axis operating range change	1F-DH-05J1	□ Not provided □ Provided
~	Machine cable extension	1F- 🗆 🗆 UCBL-02	Fixed type: 🗌 Not provide 🔲 10m 🔲 15m 🗌 20m
arm		1F- 🗆 🗆 LUCBL-02	Flexed type: 🗌 Not provide 🔲 10m 🔲 15m 🔲 20m
Kobot	Solenoid valve set	1F-VD0 □ -03 1F-VD0 □ E-03	□ Not provide 1F-VD0 □ -03 (Sink type): □ 1set □ 2set □ 3set □ 4set 1F-VD0 □ E-03 (Source type): □ 1set □ 2set □ 3set □ 4set
	Hand input cable	1F-HC35S-02	□ Not provided □ Provided
	Hand output cable	1F-GR35S-02	□ Not provided □ Provided
	Hand curl tube	1N-ST060 🗆 C	🗆 Not provided 🛛 1 set 🔲 2 set 🔲 3 set 🔲 4 set
	Forearm external wiring set	1F-HB0 🗆 S-01	□ Not provided □ 1F-HB01S-01 □ 1F-HB02S-01
	Base external wiring set	1F-HA0 🗆 S-01	□ Not provided □ 1F-HA01S-01 □ 1F-HA02S-01
er	Simple teaching pendant	R33TB- 🗆 🗆	□ Not provided □ 7m □ 15m
Controller	Highly efficient teaching pendant	R57TB- 🗆 🗆	□ Not provided □ 7m □ 15m
ŝ	RT ToolBox2	3D-11C-WINE	□ Not provided □ Windows2000/XP/Vista/7 English CD-ROM
	RT ToolBox2 mini	3D-12C-WINE	□ Not provided □ Windows2000/XP/Vista/7 English CD-ROM
	Network vision sensor	4D-2CG5***-PKG	□ Not provided □ Provided
	Instructions manual	5F-RF01-PE01	□ Not provided □ Provided () sets
lair	ntenance parts (Consumable	parts)	
Ma	aintenance parts 🛛 Backup batt	eries ER6 () pcs. 🛛 I	Backup batteries Q6BAT () pcs. 🛛 Grease () cans
lob	ot selection check list		
Wor	k description 🛛 Material handling	Assembly Machinir	ng 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: Other ())∕□not request ^{Note1)}
Remarks					

Note1) Refer to Page 22, "2.2.6 Protection specifications" about oil resistance.

EC-Statement of Compliance

No. E6 13 05 25554 050

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
 EN 61000-6-4/A1:2011

 according to:
 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.:	73542809	
		530050
Date, 2013-05-28	(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.

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ZERTIFIKAT



Nomenclature

A: Model name of **F** series Robot description is shown as follows.

A1:RH-3FH,RH6FH,RH-2FH series 1.7kW

<u>RH-x FH xx xx x - x x x-Sxx</u>

(1) (2) (3) (4) (5) (6) (7) (8) (9) (10) (11) (1)RH: Horizontal Robot (2) Maximum Payload specification: 3 : 3kg 2 : 2kg 6 : 6kg : F series robot (3) **F** (4)**H** :4 joints (5) Robot Arm length(No1 and No2 arm) specification: : 150 mm arm : 350 mm arm 15 35 45 : 450 mm arm 55 : 550 mm arm (6) Z stroke length specification: 12 : 120 mm arm 25 : 250 mm arm 15 : 150 mm arm 20 : 200 mm arm : 340 mm arm 34 (7) Dimension and Ambient specification: : Oil mist model(IP65) M : Clean room model(ISO5) С [none] : Basic model(IP54) (8) Type of Robot controller cabinet :CR750 controller [none] :CR751 controller 1 (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: :normal type 1 added cabinet box over Robot controller for oil mist resist SM :Mechanical option Sxx

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A1 / 04.11



A2:RH-12FH,RH-20FHseries 1.7kW

<u>RH-x FH xx xx x - x x x-Sxx</u>

(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 type1:CE marking model2: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

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A3:RV-2Fseries 1.7kW

<u>RV-x F x - x x x-Sxx</u>

(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 typeB :All axes have brake units.[none] :J4 axis doesn't have brake unit.

(5) Type of Robot controller cabinet[none] :CR750 controller1 :CR751 controller

(6)Robot controller type:

D :Stand alone type**Q** :iQ platform type

(7)Standard:0: normal type1:CE marking model2: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

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A1 / 04.11





A4:RV-4F,7Fseries 1.7kW

<u>RV-x F x x - x x x-Sxx</u>

(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

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7

L

С

Attachment Statement No. E6 13 05 25554 050 A5:RV-13F,20F,7FLLseries 1.7kW <u>RV-x F x x - x x x-Sxx</u> (6)(7)(8)(9)(1) (2) (3) (4) (5) (1)RV: Vertical Robot (2) Maximum Payload specification: : 20kg 20 13 : 13kg : 7kg : F series robot (3) **F** (4) Robot arm length: : Long arm model : Long reach(1503mm) model (for onlyRV-7FLL series) LL [none] : normal model (5) Dimension and Ambient specification: : Oil mist model(IP67) M : Clean room model(ISO3) [none] : Basic model(IP40)

(6) Type of Robot controller cabinet :CR750 controller [none] :CR751 controller 1

(7)Robot controller type:

- :Stand alone type D
- Q :iQ platform type

(8)Standard: 0: normal type 1:CE marking model 2:CE marking and UL model

(9)Optional Specification:

- :normal type 1
- added cabinet box over Robot controller for oil mist resist SM
- :Internal tube and wires are extended to J6 axis. SH
- :Mechanical option Sxx

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B: Model name of F series Robot controller description is shown as follows.

<u>CR750- xx x x x - x- x- Sxx</u>

(6) (7) (8) (2) (3) (4) (5) (1)

(1)CR750: CR750 controller CR751: CR751 controller

(2) Maximum Payload specification:

(Z) Wax	mum Payloau specification.
03	: 3kg
06	: 6kg
12	: 12kg
20	: 20kg
02	: 2kg
04	: 4kg
07	: 7kg
13	: 13kg
(3) Rob	
	: Horizontal robot
	: Vertical robot
VL	: for only RV-7FLL series
(4)Rob	ot controller type
D	:stand alone
Q	:iQ platform type
(5)Stan	
1	:CE marking model
2	:CE marking and UL model
	ration Panel
[none]	
	1 :Panel type
	er input connector type
[none]	normal type
P2 23	Added cable with a connector and a terminal Added cable with a connector and a terminal block
ΓJ	
	onal Specification
[none]	:normal

[none]	normal
SM	:Added Cabinet box over robot controller for oil mist resist
Sxx	:mechanical option

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A1 / 04.11



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 so	le responsibility that the Product
Description:	Industrial Robot
Type of Model:	F series
Notice:	Details of Serial number are as per attached sheet(P8).
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 Standar	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): April 19,2013

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

lomojuki Kolnyashi

(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

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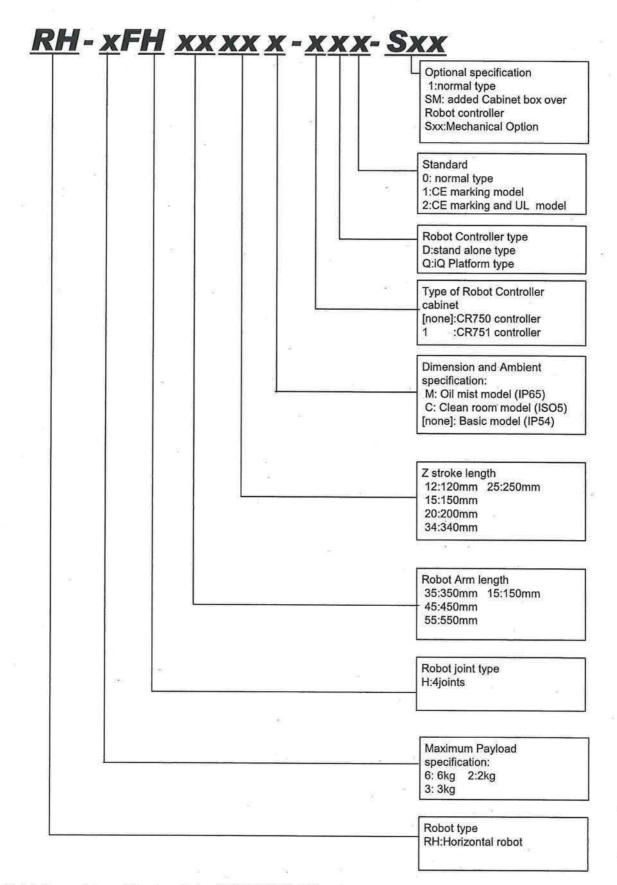


Fig.1-1 Nomenclature of F series robot of RH-6FH,3FH ,2FH series

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<u>RH-xFH xxxxx-xxx-Sxx</u>

-					Optional specification 1:normal type SM: added Cabinet box over Robot controller Sxx:Mechanical Option
					Standard 0: normal type 1:CE marking model 2:CE marking and UL model
					Robot Controller type D:stand alone type Q:iQ Platform type
					Type of Robot Controller cabinet [none]:CR750 controller 1 :CR751 controller
	- A.		28		Dimension and Ambient specification: M: Oil mist model (IP65) C: Clean room model (ISO3) N: Special spec. for EU (IP54) [none]: Basic model (IP20)
		-			Z stroke length 35:350mm 45:450mm
				21	Robot Arm length
				1	55:550mm 70:700mm 85:850mm 100:1000mm
				1.12	Robot joint type H:4joints
		t.			Maximum Payload specification:
					12: 12kg 20: 20kg
					Robot type RH:Horizontal robot

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

<u>RV-xF x-xxx-Sxx</u>

			Optional specification 1:normal type SM: added Cabinet box over Robot controller Sxx:Mechanical Option
	2		Standard 0: normal type 1:CE marking model 2:CE marking and UL model
	e		Robot Controller type D:stand alone type Q:iQ Platform type
		л С ⁷	Type of Robot Controller cabinet [none]:CR750 controller 1 :CR751 controller
	27	a	Robot joint type B:All axes have brake units. [none]:J4 axis don't have brake unit.
			Maximum Payload specification: 2: 2kg
ý s			Robot type RV:Vertical robot

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

<u>RV-xFx x-xxx-Sxx</u>

				Optional specification 1:normal type SM: added Cabinet box over Robot controller SH: Internal tube and wire in J6 Sxx:Mechanical Option
			h.	Standard 0: normal type 1:CE marking model 2:CE marking and UL model
				Robot Controller type D:stand alone type Q:iQ Platform type
			2	Type of Robot Controller cabinet [none]:CR750 controller 1 :CR751 controller
			51 	Dimension and Ambient specification: M: Oil mist model (IP67) C: Clean room model (ISO3) [none]: Basic model (IP40)
660			E.	Robot Arm length L:Long Arm model [none]: normal model
	đ	25		Maximum Payload specification: 4: 4kg 7: 7kg
	×	 E 1	4 	Robot type RV:Vertical robot

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

<u>RV-xFx x-xxx-Sxx</u>

	-			Optional specification 1:normal type SM: added Cabinet box over Robot controller SH: Internal tube and wire in J6 Sxx:Mechanical Option
		20		 Standard 0: normal type 1:CE marking model 2:CE marking and UL model
-	54			 Robot Controller type D:stand alone type Q:iQ Platform type
	ĸ	т	¥	\$ Type of Robot Controller cabinet [none]:CR750 controller 1 :CR751 controller
				Dimension and Ambient specification: M: Oil mist model (IP67) C: Clean room model (ISO3) [none]: Basic model (IP40)
		0		 Robot Arm length L:Long Arm model LL: Long reach(1503 mm) model(for only 7kg payload model) [none]: normal model
	1		2 2	Maximum Payload specification: 13: 13kg 20:20kg 7: 7kg (only for LL arm model)
				 Robot type RV:Vertical robot

Fig.1-5 Nomenclature of F series robot of RV-13F,20F,7FLL series

			Optional specification [none]:normal type SM: added Cabinet box over Robot controller Sxx:mechanical option
			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 Operation Panel 0 :No Panel type 1:Panel type
N.	1 2 -		Standard 1:CE marking model 2:CE marking and UL model Robot Controller type D:stand alone type Q:IQ Platform type
		2 	Robot type H:Horizontal robot V: Vertical robot VL :for only RV-7FLL type
	i. X		Maximum Payload specification: 06: 6kg 20:20kg 03: 3kg 12:12kg 02: 2kg 07:7kg 04:4kg 13: 13kg
ļ			Controller Type CR750:CR750 controller CR751:CR751 controller

Fig.2-1 Nomenclature of F series robot controller

Details of serial number

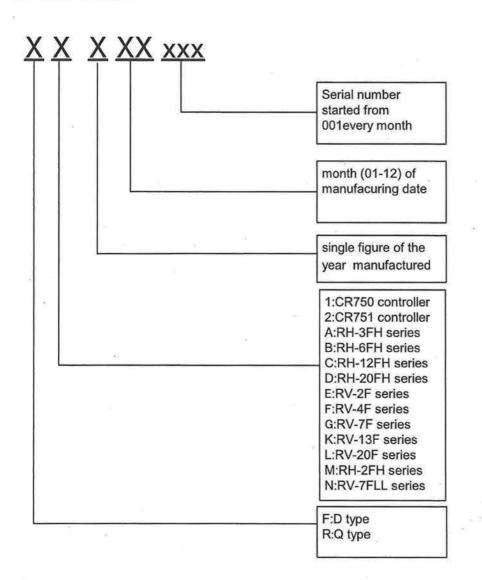


Fig.3.1 Nomenclature of serial number about F series Robot and robot controller

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	в
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	С
April 15, 2013	P2,P6,P7,P8	RH-2FH series, RV-13F, 20FH, 7FLL series added	D

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<u>사용자안내문</u> <u>User's Guide</u>

기종별	사용자안내문
Type of Equipment	User's Guide
A급 기기 (업무용 방송통신기자재)	이 기기는 업무용(A 급) 전자파적합기기로서 판 매자 또는 사용자는 이 점을 주의하시기 바라 며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.
Class A Equipment (Industrial Broadcasting & Communication Equipment)	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.
B급 기기 (가정용 방송통신기자재)	이 기기는 가정용(B급) 전자파적합기기로서 주 로 가정에서 사용하는 것을 목적으로 하며, 모 든 지역에서 사용할 수 있습니다.
Class B Equipment (For Home Use Broadcasting & Communication Equipment)	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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Authorised representative: MITSUBISHI ELECTRIC EUROPE B.V. GERMANY Gothaer Str. 8, 40880 Ratingen / P.O. Box 1548, 40835 Ratingen, Germany

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