

MELFA

Industrial robots

Installation description

RV-FR-D/RH-FRH-D
RV-FR-R/RH-FRH-R



Short operating instructions
Industrial robot RV-FR-D/RH-FRH-D/RV-FR-R/RH-FRH-R
Article No.: 325252

Version			Changes/Additions/Corrections	
A	02/2018	pdp – gb	—	
B	07/2019	pdp – gb	Section 1.4	Procedure for enabling the safety diagnosis function (STO function) added
C	12/2023	MEU	Section 3.3.1	Correction of fixing screws size
D	01/2024	MEU		Deletion of certificates

About this manual

The texts, figures, diagrams and examples contained in this manual are exclusively intended to explain the installation, operation and control of the industrial robots described in this manual.

If questions arise concerning the installation and operation of the units described in this manual then please do not hesitate to contact your responsible sales office or sales partner (see cover page).

Current information as well as answers to frequently asked questions are located on the internet at: <http://www.mitsubishi-automation.com>.

MITSUBISHI ELECTRIC EUROPE B.V. reserves the right to make technical alterations to this manual at any time without notice.

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Safety instructions

Target group

This manual is aimed solely at recognised, trained professional electricians acquainted with the safety standards valid within automation technology. Planning, installation, startup, maintenance and checking of the robot and its accessories may only be carried out by approved, trained professional electricians acquainted with the safety standards of automation technology. Any interference/tampering with the hardware and software of our products not described in this manual may only be carried out by our expert personnel.

Use in accordance to the instructions

The industrial robot FR series is only intended to be used within the scope described in this manual. Make sure that all technical data contained in the manual is observed. The products have been developed, produced, tested and documented taking into consideration all relevant safety standards. In normal conditions, there are no dangers or hazards to property or persons when the handling instructions and safety instructions for planning, assembly and correct operation are observed. Unqualified tampering in the hardware or software or non-observance of the warning instructions contained in this manual or attached to the product may result in serious damage/injury to property and persons. Only those auxiliary units and expansion units recommended by MITSUBISHI ELECTRIC may be used together with the FR robot system.

Any and all other use is determined as not in accordance to the instructions.

The industrial robots may only be switched on after all protective equipment has been installed and tested for correct function. This includes:

- the electrical connection and attachment of external EMERGENCY-STOP switches,
- the housing of the robot by separating protective equipment,
- the electrical connection and attachment of the door contact pushbutton.

A function test at a reduced speed of (T1) maximum 250 mm/s can be carried out in "Manual" operating mode with the keyswitch in the "Manual" position. This test can be carried out with the protective housing opened (open door contact circuit).



DANGER:

To simplify the drawings, the robots are shown without separating protective equipment in the following description. Automatic mode is forbidden without separating protective equipment or suitable safety light barriers. Non-observance of this may result in serious injuries of the persons located within the working area of the robot.

Safety-relevant regulations

During planning, installation, startup, maintenance and testing/checking of the units, the safety and accident-prevention regulations valid for the case in question must be observed.



CAUTION:

A safety manual is included with the robot. This manual deals with the safety aspects of installation/set up, startup and maintenance. You must always work through this manual thoroughly before installation/set up, startup or any other work with or on the robot. All specifications and details contained within it must be observed at all times without exception! If this manual is not included with the delivery then please immediately contact your Mitsubishi Electric sales partner.

Furthermore, the following regulations must be observed (without claim to completeness):

- German VDE regulations
 - VDE 0100
Regulations on the installation of high voltage systems with a rated voltage above 1000 V
 - VDE 0105
Operation of high voltage systems
 - VDE 0113
Electrical plants with electronic equipment
 - VDE 0160
Fitting of high voltage systems and electrical equipment
 - VDE 0550/0551
Regulations for transformers
 - VDE 0700
Safety of electrical devices for domestic and similar uses
 - VDE 0860
Safety regulations for mains-operated electronic devices and their accessories for domestic and similar uses
- Fire-protection regulations
- Accident-prevention regulations
 - VBG No. 4
Electrical plants and equipment

Comments on the hazard instructions

There are instructions within this manual that are important for the correct and safe handling of the robot.

The individual instructions mean the following:



DANGER:

Means that there is a danger to life and health of the user, e.g. from electrical voltage, e.g. when the appropriate safety measures have not been taken.



CAUTION:

Is a warning of possible damages to the robot, its periphery or other valuable property if the appropriate safety measures are not taken.

General hazard instructions and safety measures

The following hazard instructions should be understood as general regulations for handling the robot system. These instructions must always be observed in the planning, installation and operation of the robot system.



DANGER:

- *The safety and accident-prevention regulations that apply to the specific use must be observed. Installation, wiring and opening of assemblies, components and devices/units must be carried out when the system is disconnected (dead).*
- *Regularly check the live cable and lines to which the devices/units are connected for insulation faults or breaks. If you detect a fault in the wiring/cable then you must immediately switch off the devices and disconnect power from the cable and then replace the defective cable.*
- *Before startup, check whether the permissible mains voltage range accords to the local mains voltage rating.*
- *Take appropriate measures to restart any interrupted program after voltage failures and malfunctions. No hazardous/dangerous operating conditions must arise when doing this, even temporarily. If necessary, force an "EMERGENCY-STOP".*
- *EMERGENCY-STOP equipment compliant to EN 60204/IEC 204 VDE 0113 must remain effective during all applications. Unlocking the EMERGENCY-STOP equipment must never result in uncontrolled movements of the robot arm.*

General safety instructions during handling

Detailed information on safety and protection is contained in the safety manual.



DANGER:

- *Some of the robot arms are made of plastic. The robot arm does not take attachments of components or gross force effects in these parts. The covers are oil-resistant.*
- *The robot axis are fitted with brakes. You should not apply any manual pressure to the robot joints to avoid damage to the gear reduction.*
- *Even when the robot arm is within its normal working area, the wrist (articulated arm robot) or spindle (SCARA robot) may nevertheless collide. Pay special attention to this situation in jog mode.*
- *The robot arm is comprised of precision parts that require suitable lubrication. During a cold start at low temperatures, a servo alarm may be triggered or positional accuracy may be lost. In such a situation, you should first operate the robot arm in standby.*
- *The robot arm and the controller require a class 3 grounding to permanently prevent risk of electrical shock and disturbances.*
- *All details and specifications in the manuals are only valid if you carry out the maintenance work stipulated in the technical manual.*



DANGER:

- *Before using the robot together with a linear unit or a lifting table, you must replace the lines with a highly-flexible alternative (trailing cable) to ensure that no cable break results in the standard connection cables.*
- *If mounting an articulated robot on to the wall, then you must limit the range of movement of the J1 axis.*
- *Make sure that the workpiece does not collide with any units in its immediate vicinity during robot movements because such collision may shift the position of the workpiece.*
- *If the axis are moved with a very high level of accuracy then the position of the workpiece may be shifted. Make sure that there are no collisions between the workpiece or units in its immediate vicinity.*
- *Do not fix any adhesive tape or labels to the robot arm or to the controller. The adhesive tape may damage the coated surface. The IEC IP protection indicated by the appropriate symbol can then no longer be guaranteed.*
- *If heavy loads are moved by the robot and the robot is moved at high speeds, the surface of the robot may become hot. Touching the robot arm in these circumstances will not result in burns but minor injuries may occur.*
- *Do not switch off the power supply to stop the robot. If the voltage is regularly interrupted when the robot is moving a heavy load or is moving at high speeds then the reduction gearing may be damaged or the gear tolerance may be negatively affected (backlash).*
- *If the J1, J2 and J3 axes collide with the mechanical end stops when an articulated robot is in automatic mode then the plastic buffers of the end stops must be replaced. Otherwise, the reduction gearing may be severely damaged on the next collision. Please contact your Mitsubishi Electric partner to replace the buffers.*
- *When the power supply is interrupted then the brakes grip the robot arm. If this happens, the robot arm may deviate from its predefined travel path. Depending on where automatic operation has been interrupted, this may result in difficulties with the mechanical end stops. Take suitable measures to ensure that any collision of the robot arm with the peripheral devices is prevented.*
- *Do not carry out any surge voltage test. If any test is run accidentally then this may result in a malfunction. The surge voltage test is not covered by the warranty. If it is nevertheless run, then set the leakage current to 100 mA. If the leakage current has been set to just 10 mA, then a smaller measured value is displayed, owing to the leakage current of the installed AC filter.*
- *If no cable is connected then always place the protection cap onto the SSCNETIII/H connection of FR-R series devices. Otherwise, impurities may impair transmission behaviour and result in malfunction.*
- *Do not remove the SSCNETIII/H cable from FR-R series devices as long as the power supply of the CPU system or of the drive unit is still switched on.
Never look directly into the light emitted from the robot CPU or the SSCNETIII/H connections of the drive unit, or into the open end of the SSCNETIII/H cable. The light emitted from these complies with the IEC60825-1 standard of laser class 1 and may result in an irritation to the eyes if viewed directly.*

Symbols used in the manual

The use of instructions

Instructions concerning important information is are marked separately and are displayed as follows:

NOTE

| Text of instruction

Use of numbering in the figures

Numbering within the figures is displayed by white numbers within black circles and is explained in a table following it using the same number, e.g.:

① ② ③ ④

Use of handling instructions

Handling instructions are steps that must be carried out in their exact sequence during startup, operation, maintenance and similar operations.

They are numbered consecutively (black numbers in white circles):

① Text

② Text

③ Text

Use of footnotes in tables

Instructions in tables are explained in footnotes underneath the tables (in superscript). There is a footnote character at the appropriate position in the table (in superscript).

If there are several footnotes for one table then these are numbered consecutively underneath the table (black numbers in white circles, in superscript):

① Text

② Text

③ Text

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1 Introduction

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of the information that describes the product features or the technical data.

This manual describes the unpacking, installation, connection and initial startup of the FR-D and FR-R series robots.

The operating steps shown in this manual refer to the Teaching Box R32TB.

This manual applies to the following robots and controllers:

Series	Model	Construction	Handling weight [kg]	Controller
FR-D	RV-2FR(B)-D	Vertical articulated arm	2	CR800-D
	RV-2FRL(B)-D		2	
	RV-4FRM-D		4	
	RV-4FRLM-D		4	
	RV-7FRM-D		7	
	RV-7FRLM-D		7	
	RV-7FRLLM-D		7	
	RV-13FRM-D		13	
	RV-13FRLM-D		13	
	RV-20FRM-D		20	
	RH-1FRHR-D	SCARA	1	
	RH-3FRHR-D		3	
	RH-3FRH-D		3	
	RH-6FRH-D		6	
	RH-12FRH-D		12	
	RH-20FRH-D		20	
FR-R	RV-2FR(B)-R	Vertical articulated arm	2	CR800-R
	RV-2FRL(B)-R		2	
	RV-4FRM-R		4	
	RV-4FRLM-R		4	
	RV-7FRM-R		7	
	RV-7FRLM-R		7	
	RV-7FRLLM-R		7	
	RV-13FRM-R		13	
	RV-13FRLM-R		13	
	RV-20FRM-R		20	
	RH-1FRHR-R	SCARA	1	
	RH-3FRHR-R		3	
	RH-3FRH-R		3	
	RH-6FRH-R		6	
	RH-12FRH-R		12	
	RH-20FRH-R		20	

Tab. 1-1: Overview of robot models and controllers

1.1 Name of model

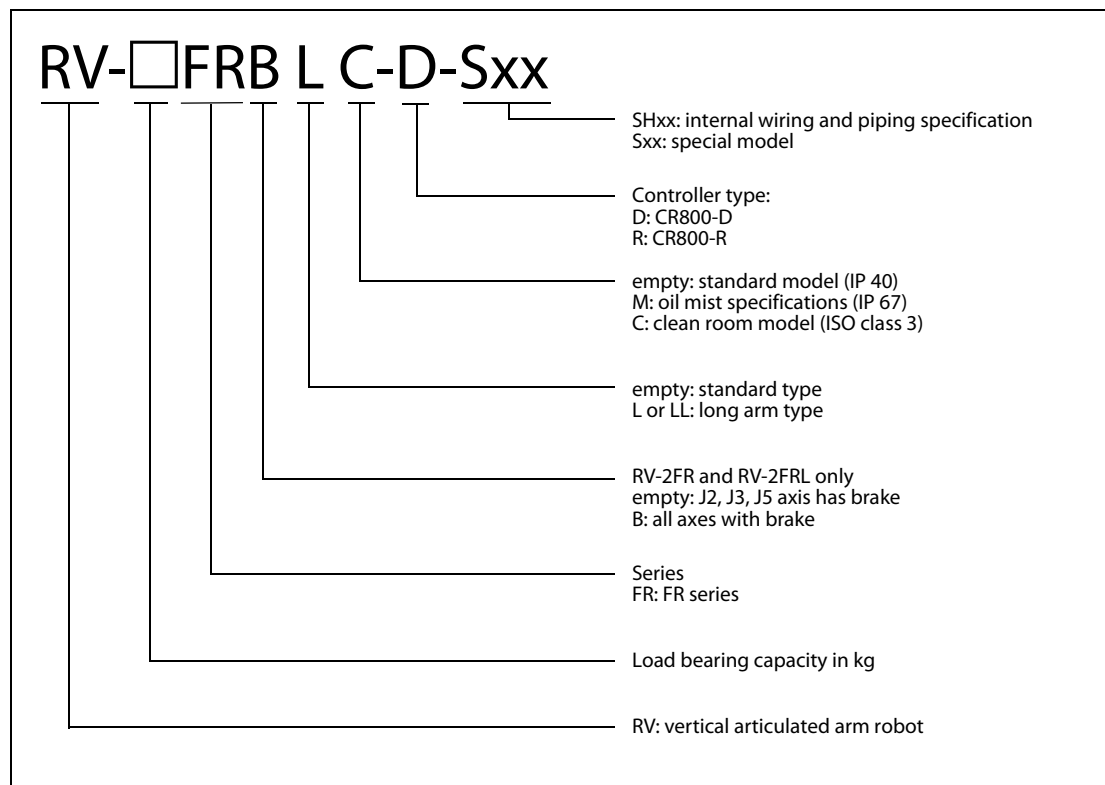


Fig. 1-1: Model name of vertical articulated arm robot

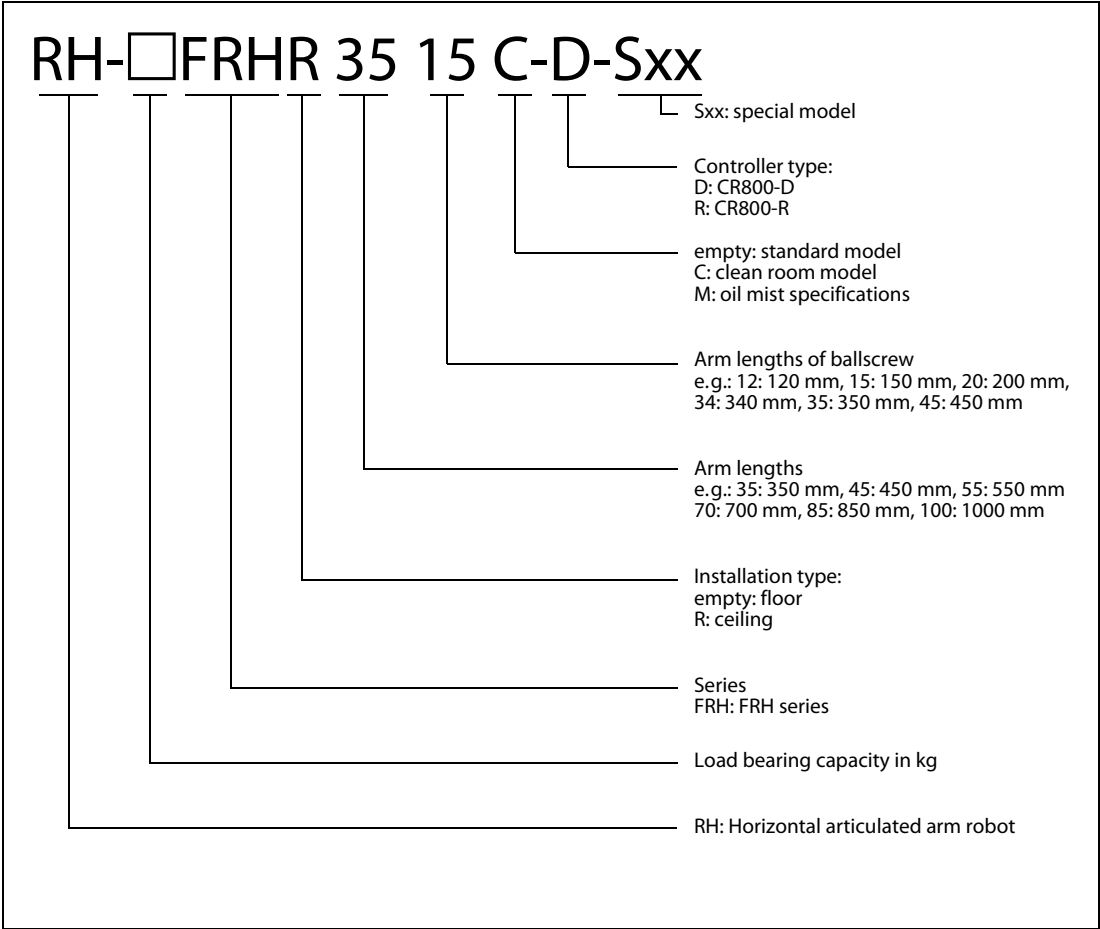


Fig. 1-2: Name of model of the horizontal articulated arm robot (SCARA)

1.2 Basic safety instructions

The MELFA robot has been constructed according to the state-of-the-art and has been configured for operational safety. Nonetheless, dangers/hazards may arise from the robot if it is not operated by trained personnel or at least by instructed personnel, or if it is used in an improper manner or not compliant to its intended use.

In particular, this means:

- **Danger to the life and limb of the user or of third-parties**
- **Impairments to the robot, other machines and other property of the user**

**CAUTION:**

Every person authorised within the company of the operator to install, startup, operate, maintain and repair the robot must have read and understood the technical documentation for the robot and must pay special attention to the supplied SAFETY MANUAL.

**CAUTION:**

Strictly observe the safety regulations. The following, additional instructions are provided within the scope of these introductory safety instructions:

The robot may only be operated by trained and authorised operating personnel.

Responsibilities for the various activities when operating the robot must be clearly defined and observed to ensure that there are no unclarities or unclear duties regarding the safety aspects.

For all work relating to the installation, startup, equipping/fitting, operation, changes to operating conditions and modes of operation, maintenance, inspection and repairs, the switch-off procedures stipulated in the manual must be observed.

The position of the EMERGENCY-STOP pushbutton must be known and the EMERGENCY-STOP pushbutton must be accessible at all times.

No operating methods may be employed that impair the safety of the machine.

The operator must ensure that no unauthorized persons work at the robot (e.g. including enabling of equipment against unauthorized use).

The company used must ensure that the robot is always operated in perfect condition.

The company using the robot must provide special training to the appropriate operating personnel and obligate them to carry out all maintenance and inspection work only when the robot and all of its peripheral equipment is switched off.

**DANGER:**

The controller must only (i.e. exclusively) be connected by a circuit breaker to the mains supply. There is a risk of electrical shock if this is not observed.

A detailed description of the mains connection is contained in section 4.2.

1.3 Environmental conditions for operation

Because the environmental conditions have a significant effect on the operational life of the equipment, you should not install the robot system in the following conditions:

- Power supply

Do not use when

- the power supply is below 180 V AC or above 253 V AC,
- transient power failures last more than 20 ms,
- the mains supply is unable to provide an output of at least 0.5 kVA (RV-2FR/RH-3FRH), 1.0 kVA (RH-3FRHR/RV-4FR/RH-6FRH), 1.5 kVA (RH-12FRH/20FRH), 2.0 kVA (RH-1FRHR/FR-7FR) or 3.0 kVA (RV-7FRLL/RV-13FR/RV-20FR).

- HF interference

Do not use when

- there are voltage peaks on the mains supply greater than 1000 V and longer than 1 μ s,
- there are large frequency inverters, transformers, magnetic switches or welding devices in the vicinity,
- there are radios or televisions in the vicinity.

- Temperature/Humidity

Do not use when

- the ambient temperature is above 40 °C or below 0 °C,
- the robot is subjected to direct sunlight,
- the air humidity is below 45% or above 85%,
- condensation can occur.

- Vibrations

Do not use when

- the robot is subjected to heavy vibrations or knocks,
- the maximum load of the robot is above 34 m/s² during transport and above 5 m/s² in operation.

- Installation location

Do not use when

- subjected to strong electrical or magnetic fields,
- the stand space is very uneven,
- there is heavy contamination from dust and oil mist.

1.4 Performance Level (PL) compliant with EN ISO 13849-1

The robot systems listed in the following are compliant with

- STO: Performance Level (PL): e
Category: 4
At factory setting, the STO function meets the requirements of Performance Level d and Category 3.
To make the STO function meet the Performance Level e and Category 4, change the setting of parameter TPOEMG.

Item	Description
Parameter name	TPOEMG
Function	This enables configuring the pulse output function for outputting test pulse signals from emergency stop ports (EXTEMG11, EXTEMG21).
What parameter settings mean	0: Outputs no test pulses 1: Outputs test pulses
Default	0

Tab. 1-2: Parameter details

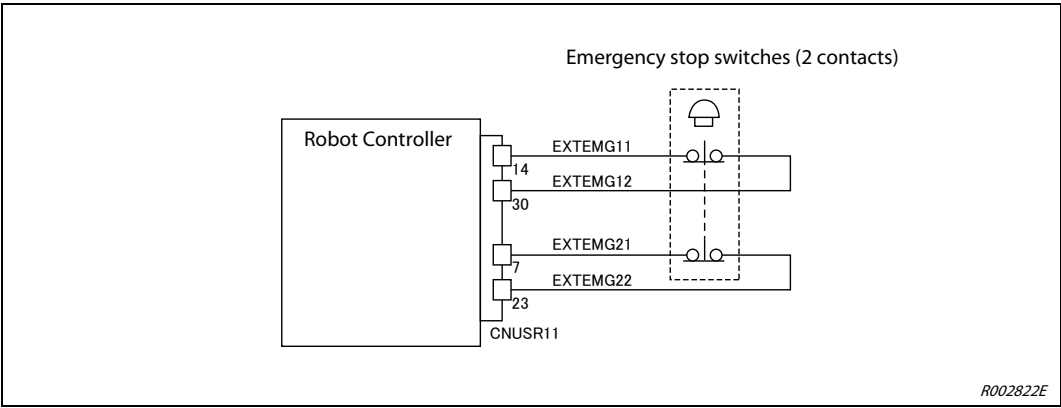


Fig. 1-3: How to wire emergency stop lines

- SS1, SOS, SS2, SLS, SLP: Performance Level (PL): d
Category: 3

2 System overview

All devices and system parts belonging to the industrial robots from the MELFA FR series that are required for basic operation of the robot are described in this chapter. Options and spare parts are listed in the technical manual.

2.1 Scope of delivery

2.1.1 FR-D series

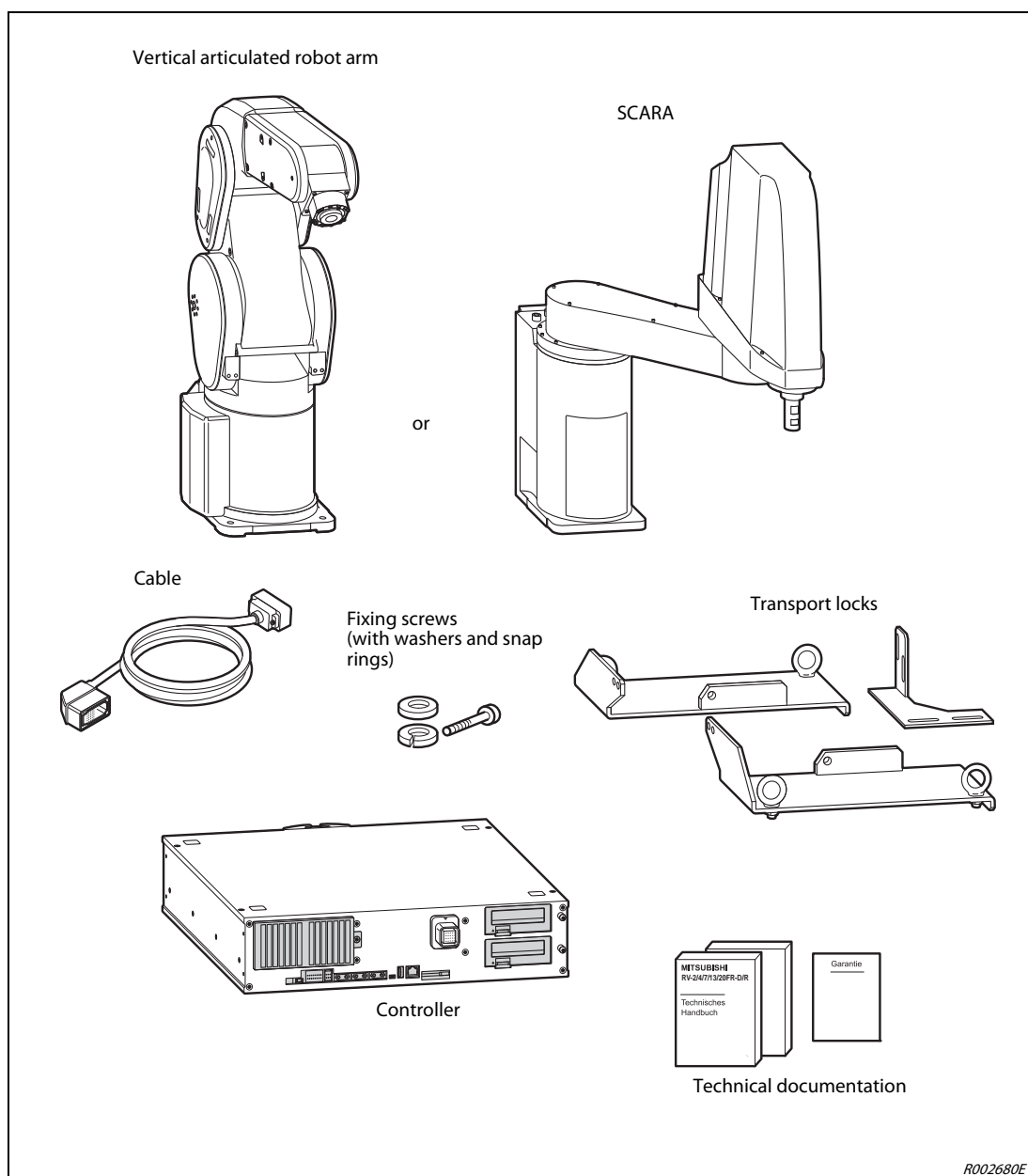


Fig. 2-1: Scope of delivery of robot systems RV-FR-D and RH-FRH-D

2.1.2 FR-R series

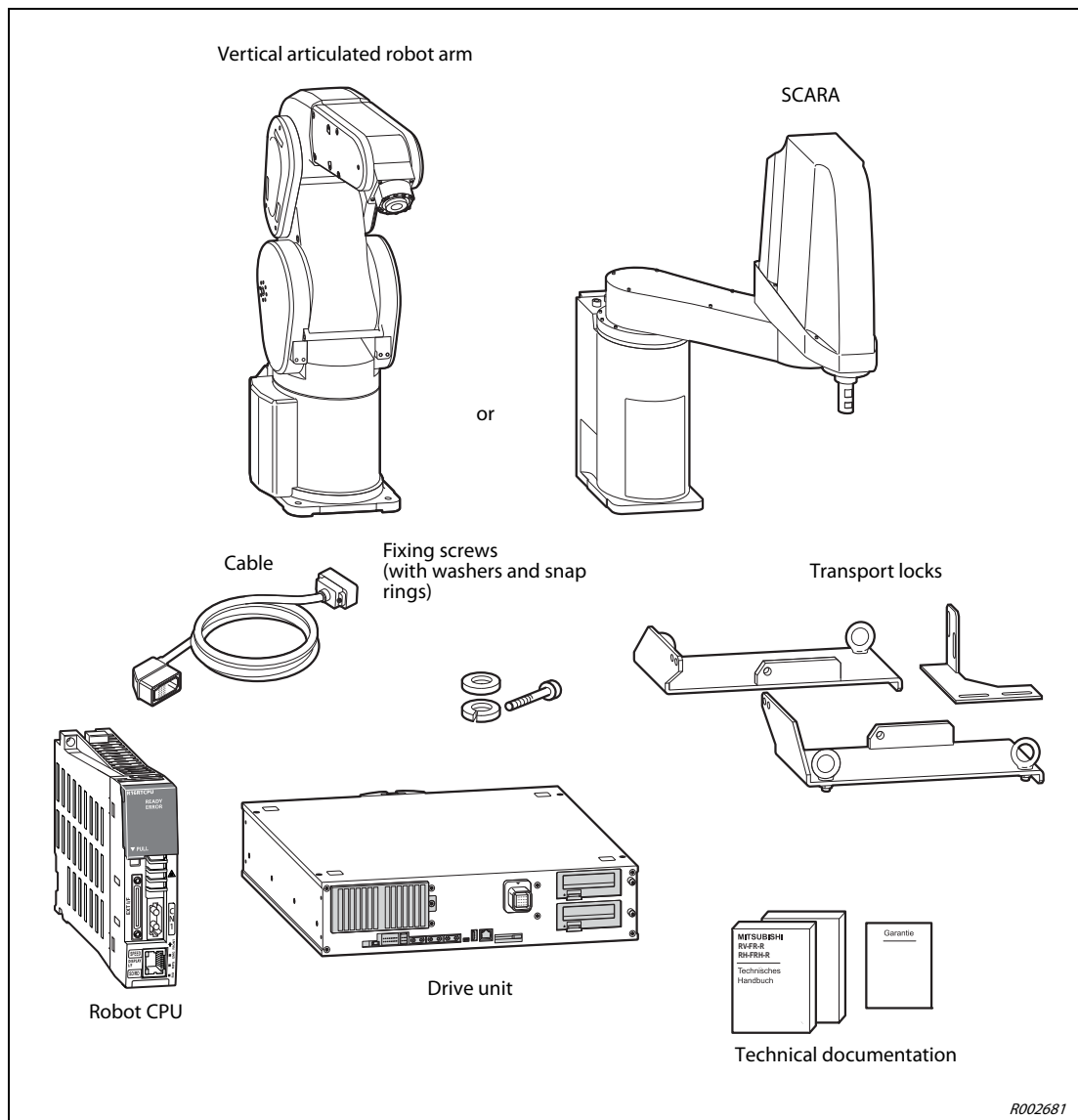


Fig. 2-2: Scope of delivery of robot systems RV-FR-R and RH-FRH-R

2.2 System configuration

This section describes the components required for the basic configuration of a robot system.

Following controllers are available for the different systems:

- CR800-D controller
- CR800-R controller: CR800 drive unit and Robot CPU R16RTCPU

2.2.1 FR-D series

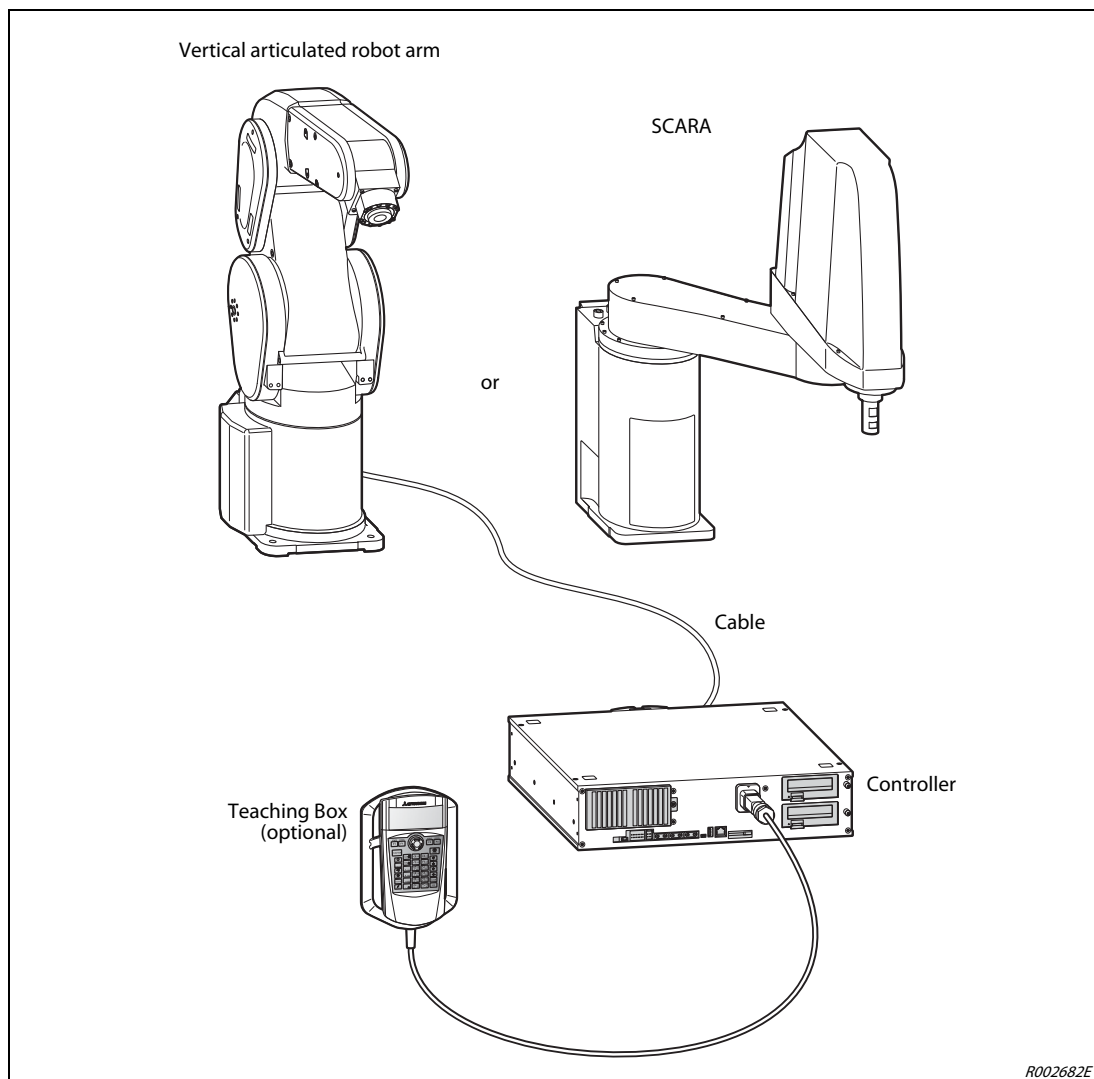


Fig. 2-3: Configuration of an FR-D series robot system

NOTE

The Teaching Box is an optional extra. It is required for basic operation of the robot.

2.2.2 FR-R series

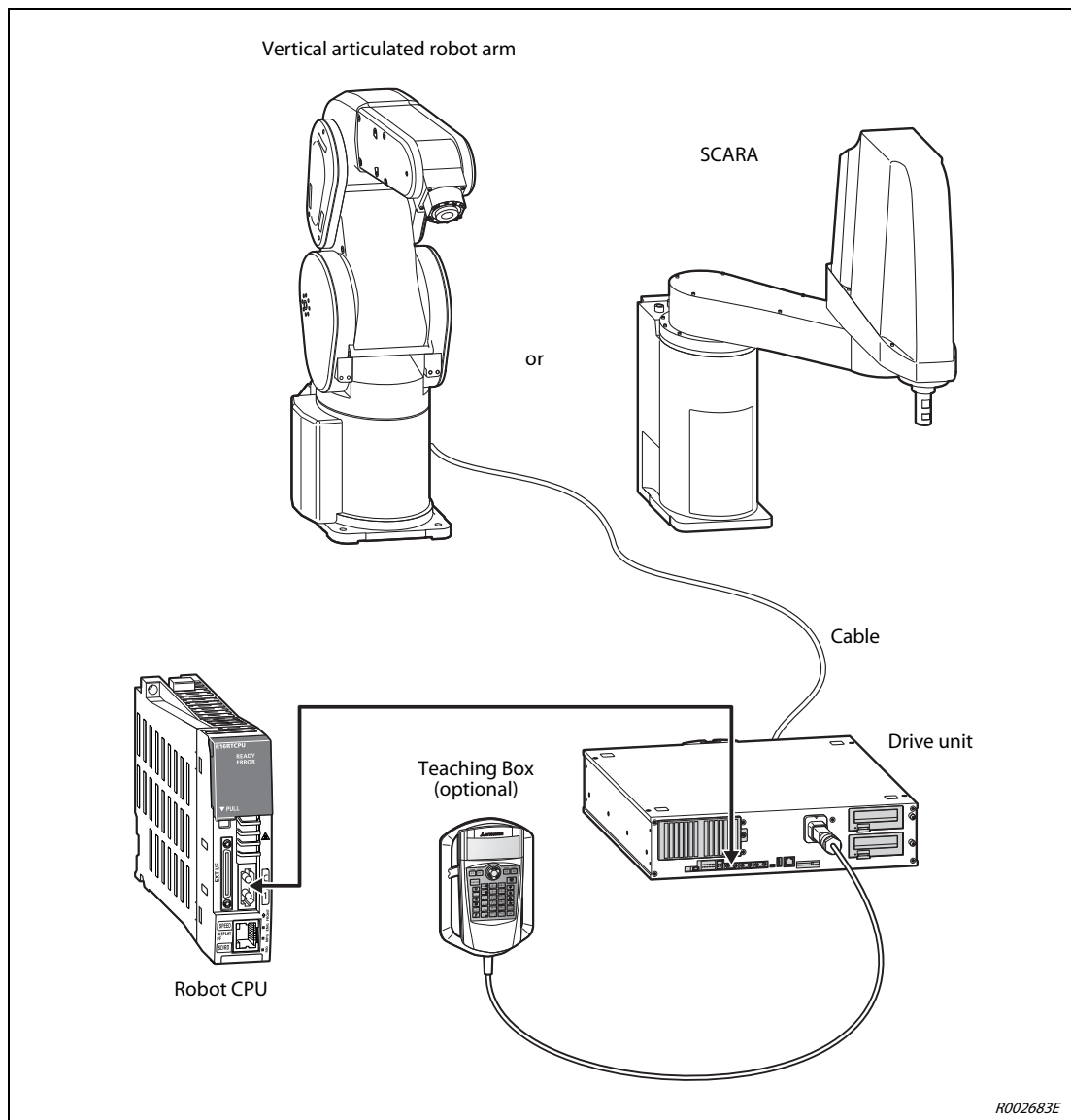


Fig. 2-4: Configuration of an FR-R series robot system

NOTE

The Teaching Box is an optional extra. It is required for basic operation of the robot.

2.2.3 Components of the robot arm

RV-2FR/4FR/7FR/13FR/20FR

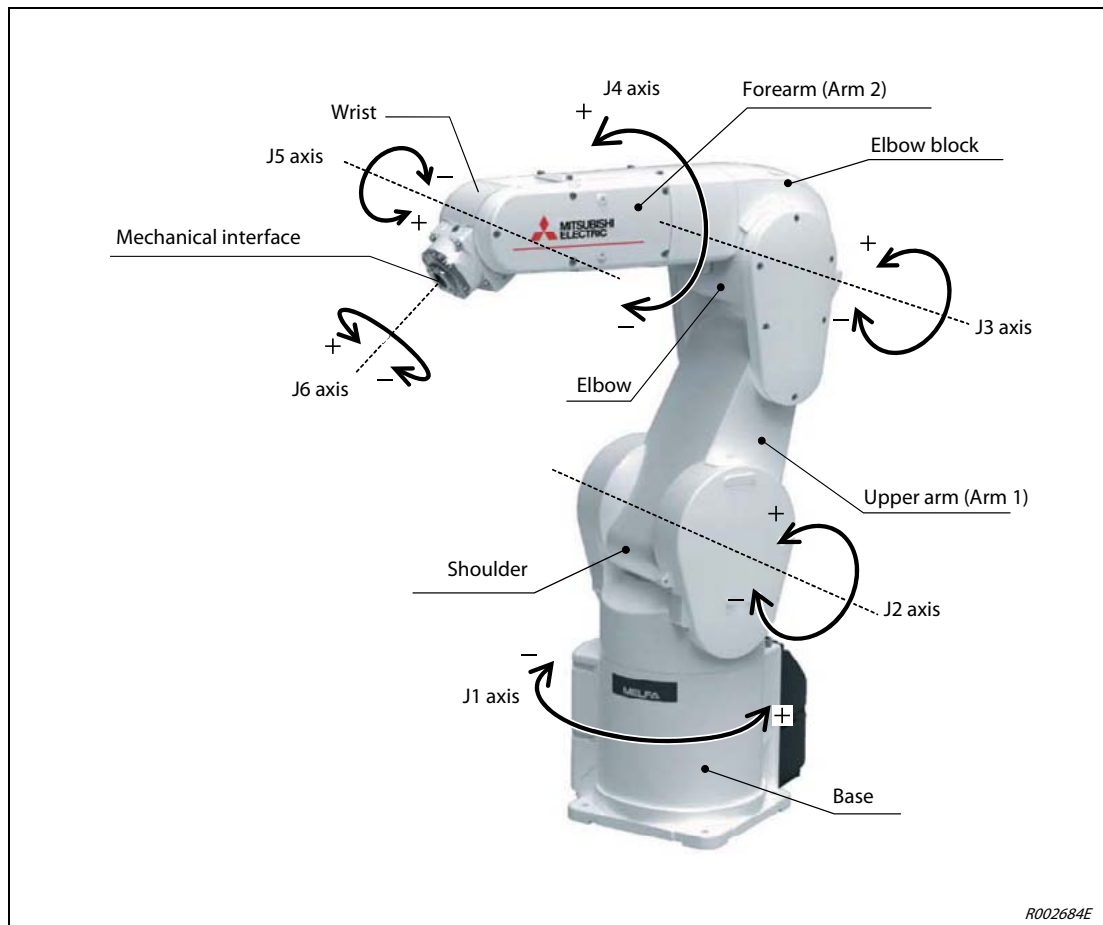


Fig. 2-5: Components of the robot arm on the vertical articulated arm robot RV-2FR/4FR/7FR/13FR/20FR

Name of axis	Meaning
J1 axis	Base axis
J2 axis	Shoulder axis
J3 axis	Elbow axis
J4 axis	Rotating forearm axis
J5 axis	Wrist tilting axis
J6 axis	Wrist rotating axis

Tab. 2-1: Overview of axis names

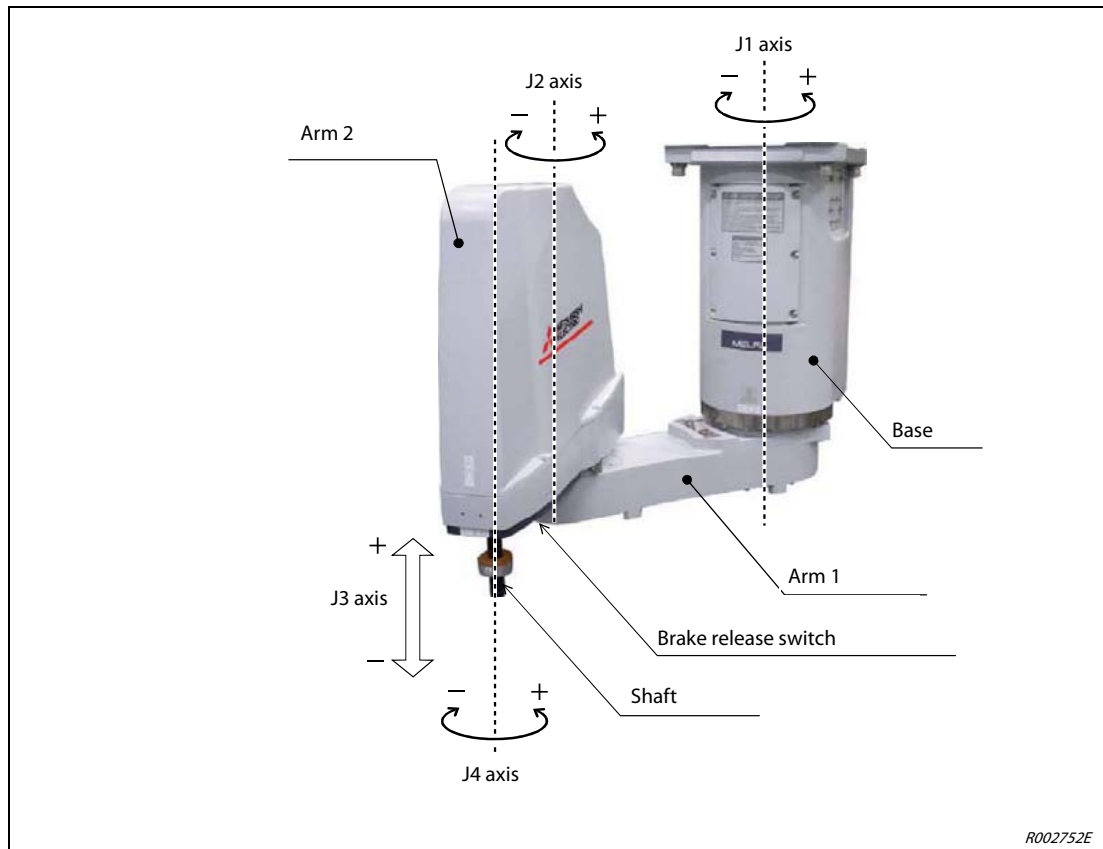
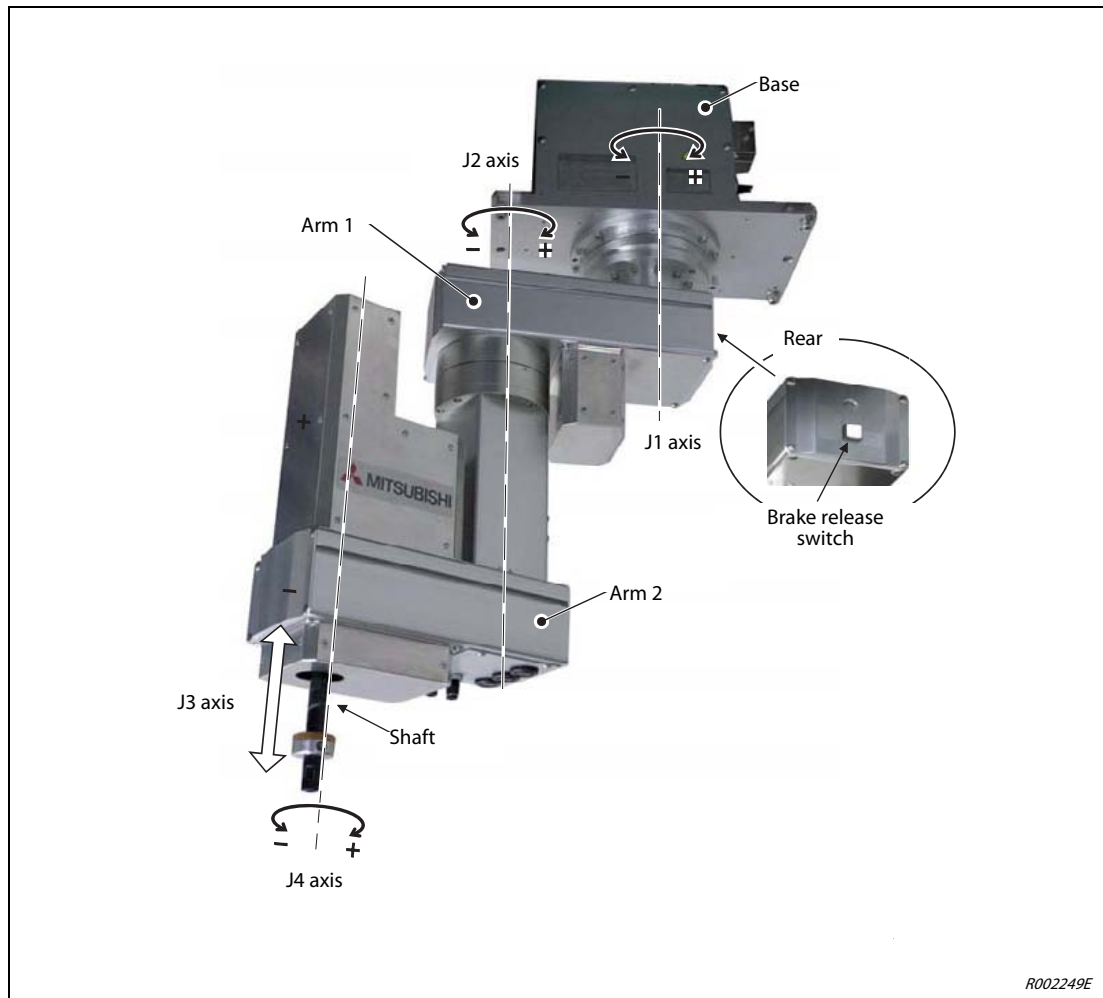
RH-1FRHR5515

Fig. 2-6: Components of the robot arm in the SCARA RH-1FRHR5515

RH-3FRHR3515/12**Fig. 2-7:** Components of the robot arm RH-3FRHR3515/12

RH-3FRH/6FRH/12FRH/20FRH

Fig. 2-8: Components of the robot arm RH-3FRH/6FRH/12FRH/20FRH

2.3 Controller CR800

2.3.1 Front side

The following figure shows the front view of the controller CR800.

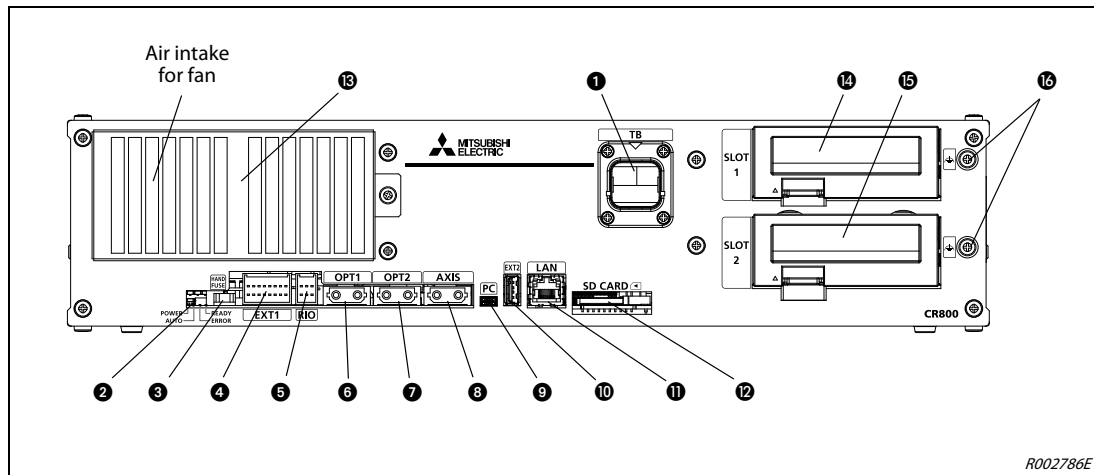


Fig. 2-9: Front view of the controller CR800

No.	Name	Function	
①	T/B connection	Port to connect the Teaching Box R32TB or R56TB	
②	LED	Four LEDs indicating the controller status	
		LED	Details
		POWER	Indicates the control power status. On: Control power ON Off: Control power OFF
		AUTO	Indicates the controller mode. On: AUTOMATIC mode Off: MANUAL mode
		ERROR	Indicates the error status. On: Error occurred. Rapid flashing: High-level error occurred. Off: Normal operation
		READY	Indicates the operation status. On: ON (ready) Slow flashing: During operation Rapid flashing: Operation suspended.
③	HANDFUSE	Fuse for the Hand	
④	EXT1	Connector for function extension	
⑤	RIO	Parallel I/O extension connector	
⑥	OPT1	Connector for communication with another controller or the robot CPU	
⑦	OPT2	Connector for communication with another controller	
⑧	AXIS	Connector for additional axis connection	
⑨	PC	Connector for communication with a personal computer	
⑩	EXT2	Connector for function extension	

Tab. 2-2: Overview of components on the front side of the controller CR800 (1)

No.	Name	Function
⑪	LAN	Connector for Ethernet communication
⑫	SD CARD	SD memory card slot
⑬	Filter cover	Dustproof dust filter cover. An air filter is provided inside the filter cover.
⑭	Option SLOT 1	Option card slots (must be covered when not used)
⑮	Option SLOT 2	
⑯	FG terminal	Option card cable terminals for grounding

Tab. 2-2: Overview of components on the front side of the controller CR800 (2)

2.3.2 Rear

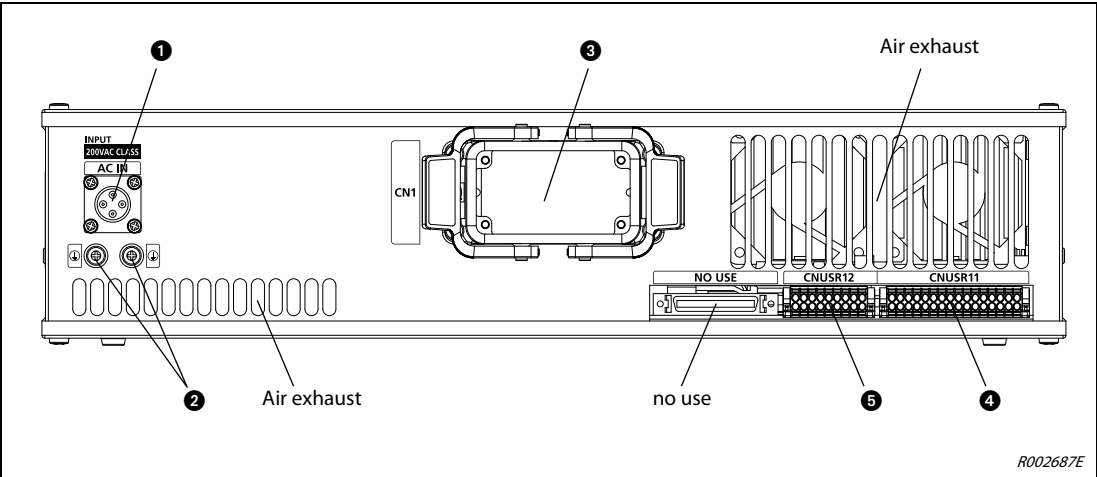
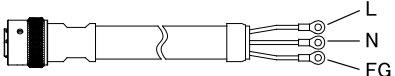
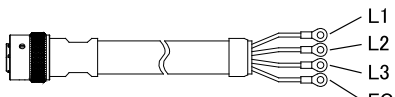
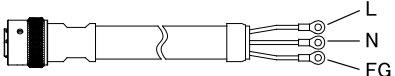
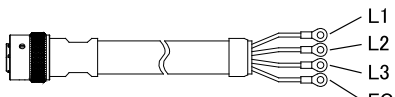
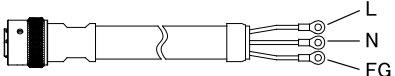
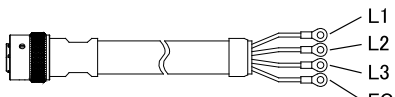


Fig. 2-10: Rear of the controller CR800

No.	Name	Function						
①	ACIN connector	AC power source input						
		<table><tr><th>Number of phase</th><th>ACIN cable</th></tr><tr><td>Single phase</td><td><p>Terminal: M5, cable length: 3 m</p></td></tr><tr><td>Three phase</td><td><p>Terminal: M5, cable length: 3 m</p></td></tr></table>	Number of phase	ACIN cable	Single phase	 <p>Terminal: M5, cable length: 3 m</p>	Three phase	 <p>Terminal: M5, cable length: 3 m</p>
		Number of phase	ACIN cable					
		Single phase	 <p>Terminal: M5, cable length: 3 m</p>					
Three phase	 <p>Terminal: M5, cable length: 3 m</p>							
②	PE terminal (M4 × 2)	Terminals for grounding						
③	CN1 connector	Machine cable connector						
④	CNUSR11 connector	Robot I/O cable connectors (including emergency stop connector)						
⑤	CNUSR12 connector							

Tab. 2-3: Components on the rear of the controller CR800

2.4 Robot CPU (FR-R series only)

The controllers of the FR-R series have an external CPU, which can be added to an already existing iQ-R system.

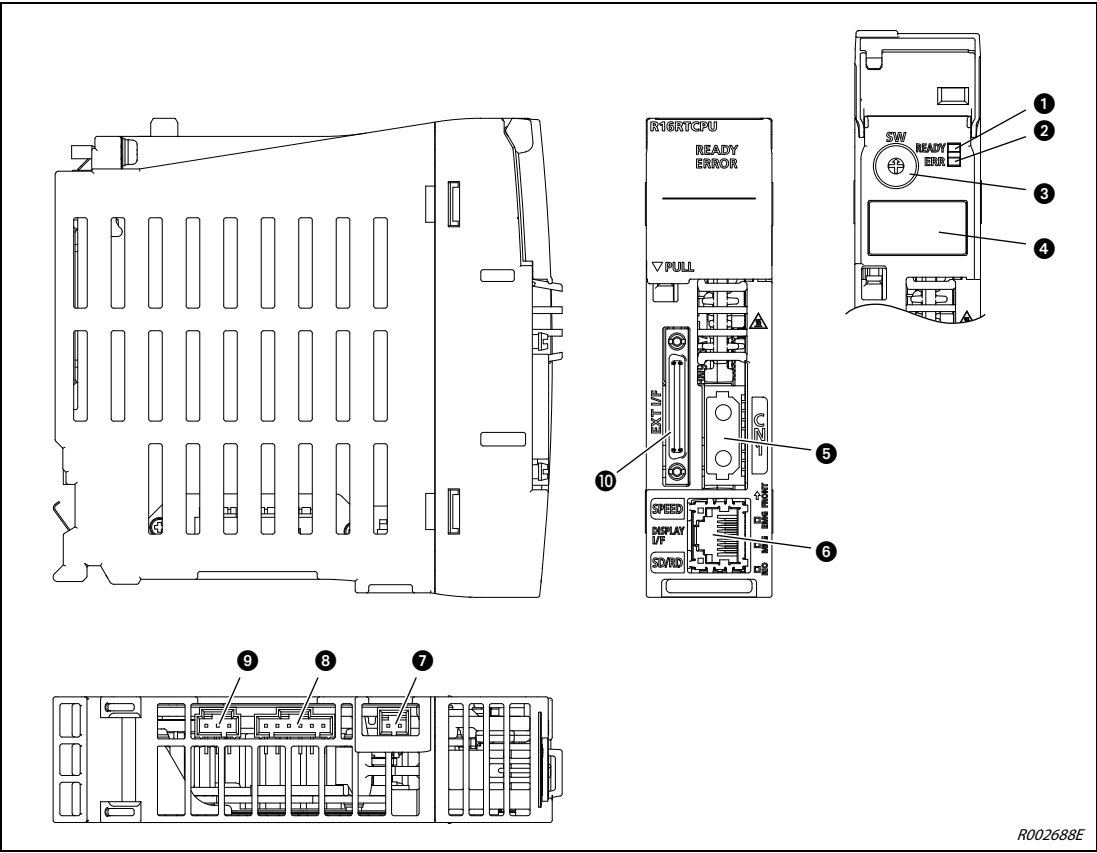


Fig. 2-11: Robot CPU R16RTCPU

No.	Name	Function																				
① ②	LED	Status and alarm display																				
		<table><tr><th colspan="2">LED</th><th rowspan="2">CPU status</th></tr><tr><th>READY</th><th>ERROR</th></tr><tr><td>OFF</td><td>ON</td><td>Power is off or a hardware error occurred.</td></tr><tr><td>Flashing</td><td>OFF</td><td>During initialization</td></tr><tr><td>ON</td><td>OFF</td><td>Normal operation</td></tr><tr><td>ON</td><td>Flashing</td><td>Moderate error occurred.</td></tr><tr><td>OFF</td><td>ON/flashing</td><td>Critical error occurred.</td></tr></table>	LED		CPU status	READY	ERROR	OFF	ON	Power is off or a hardware error occurred.	Flashing	OFF	During initialization	ON	OFF	Normal operation	ON	Flashing	Moderate error occurred.	OFF	ON/flashing	Critical error occurred.
		LED		CPU status																		
		READY	ERROR																			
		OFF	ON	Power is off or a hardware error occurred.																		
		Flashing	OFF	During initialization																		
		ON	OFF	Normal operation																		
ON	Flashing	Moderate error occurred.																				
OFF	ON/flashing	Critical error occurred.																				
③	Code switch SW1	Provided for maintenance. Always set it as "0".																				
④	3-digit dot matrix LED display	Status and alarm display																				
⑤	CN1 connector	Connect the SSCNETIII/H cable between the OPT1 connector on the controller and this connector.																				
⑥	Network connector	Connector for Ethernet communication																				
⑦	EMG connector	Unused																				
⑧	MPG connector	Unused																				
⑨	RIO connector	Unused																				
⑩	EXT I/F	Unused																				

Tab. 2-4: Overview of robot CPU components

2.5 Teaching Box

2.5.1 R32TB



Fig. 2-12: Views of Teaching Box R32TB

No.	Name	Function
①	[EMG.STOP] pushbutton switch	EMERGENCY-STOP pushbutton with locking function If you press the pushbutton then the robot arm stops instantaneously. The servo power supply is switched off. The pushbutton switch is unlocked by turning it clockwise.
②	[ENABLE/DISABLE] selector switch	Releases control over the Teaching Box Put switch into "ENABLE" position to control the robot arm via the Teaching Box. As long as the Teaching Box is enabled, the robot arm can neither be controlled from the control panel of the controller nor externally.
③	Three-step switch	The three-step enable switch must be actuated to switch on the servo drive when the Teaching Box is switched on.
④	LCD display	The status of the program or the robot arm is displayed on the LCD.
⑤	Status display	The LED displays the status of the robot or the Teaching Box.
⑥	[F1], [F2], [F3], [F4] key	Run the functions currently shown on the display
⑦	[FUNCTION] key	Toggle the displayed functions
⑧	[STOP] key	Cancel the running program and stop the robot This function is the same as the function of the [STOP] key on the control panel of the controller. This key function is always available, independent of the position of the [ENABLE/DISABLE] selector switch.
⑨	[OVRD ↑]-, [OVRD ↓] key	Change the movement speed Press the [OVRD ↑] key to increase the movement speed, and press the [OVRD ↓] key to decrease the speed.
⑩	12 keys for JOG mode: [-X/(J1)] ... [+C/(J6)]	Function key for jog mode All articulated joints can be moved individually in articulated joint-jog mode. The robot arm can be moved along any of the coordinate axes in XYZ jog mode. These keys are also used to enter the menu selection numbers or step numbers.

Tab. 2-5: Overview of controls on Teaching Box R32TB (1)

No.	Name	Function
⑪	[SERVO] key	Press the [SERVO] key with the three-step switch, pressed halfway down to switch on the servo power supply.
⑫	[MONITOR] key	Switches to monitor mode and pops up the monitor menu
⑬	[JOG] key	Switches to jog mode and pops up the jog menu
⑭	[HAND] key	Switches to hand mode and pops up the hand menu
⑮	[CHARACTER] key	Calls up the Edit menu and switches between numbers and letters, e.g. when editing position data
⑯	[RESET] key	Acknowledges an error code A program is reset when used together with the [EXE] key.
⑰	[↑], [↓], [←], [→] key	Moves the cursor in the appropriate direction
⑱	[CLEAR] key	Deletes the character at the cursor position
⑲	[EXE] key	Enter data or move the robot in direct mode
⑳	Data key	Overwrites the character at the cursor position

Tab. 2-5: Overview of controls on Teaching Box R32TB (2)

2.5.2

R56TB

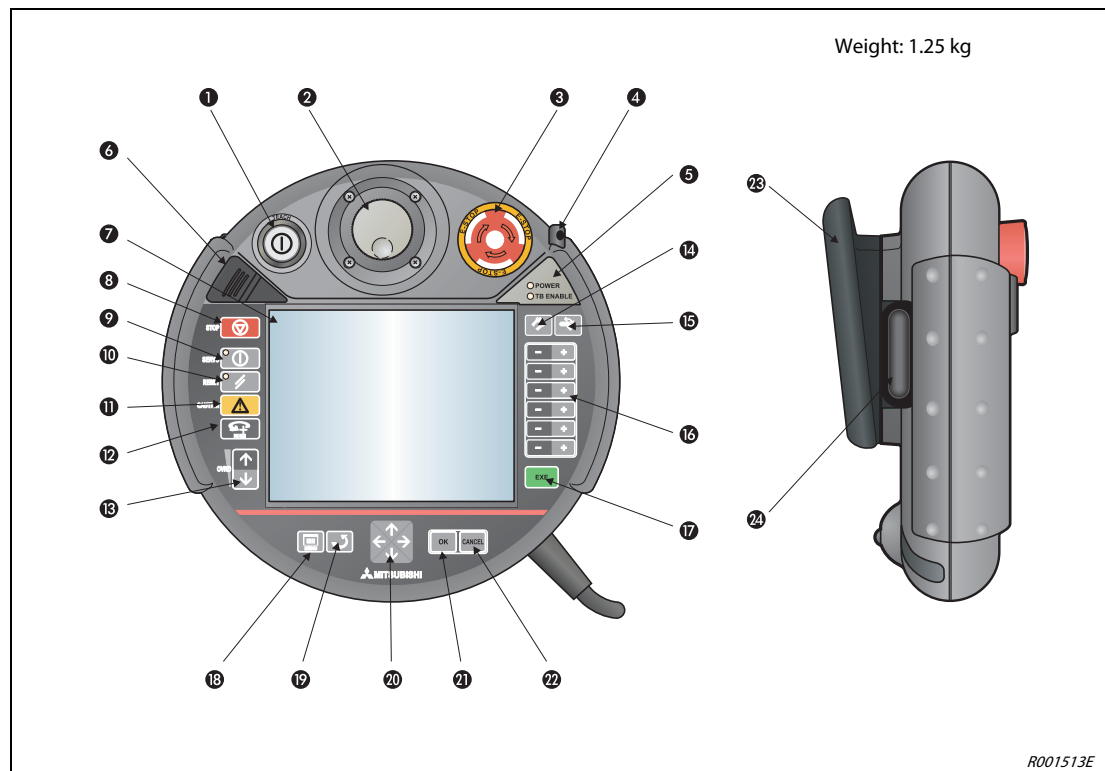


Fig. 2-13: Views of Teaching Box R56TB

No.	Name	Function
①	[TEACH] switch	The operator device is switched on by this pushbutton switch. A white LED lights up when the TEACH pushbutton switch is locked on. Enable control via the operator device Press the pushbutton until it locks on ("ENABLE" position) to transfer control to the operator device. As long as the operator device is enabled, the control can neither be controlled from the control panel of the controller nor externally. You can also toggle to enable operation even when the unit is locked, depending on the display and the override value. Once more press the pushbutton and the lock is disabled ("DISABLE" position); you can now save the current program and cancel editing with the operator device.
②	Thumb and scroll wheel	Move within the screen menus of the operator device with the thumb and scroll wheel.
③	[E-STOP] pushbutton	Pushbutton switch with locking function for EMERGENCY-STOP After pressing this, the robot is immediately stopped, irrespective of the respective operating condition. The pushbutton is once more unlocked by turning it to the right.
④	Stylus (inserted into housing)	The touchscreen can be operated with this stylus. It is contained in a slot in the housing of the operator device and should be stored there after being used.
⑤	POWER LED TB ENABLE LED	The POWER LED lights when the power supply is connected and switched on. The green TB ENABLE LED lights up when the touchscreen has been enabled with the TEACH key ①.
⑥	Protective cover with rear USB connection	For USB memory sticks
⑦	Screen with touchscreen function	Touch-sensitive 6.5" backlit TFT monitor with 640 x 480 pixel resolution; the touchscreen can be operated with your fingers or even better with the supplied stylus ④.
⑧	[STOP] key	To instantaneously stop the robot. The servo is not switched off.
⑨	[SERVO] key	The servos are started by simultaneously pressing the SERVO key and the three-step switch. A green LED lights up when the servos are switched on.

Tab. 2-6: Overview of controls on Teaching Box R56TB (1)

No.	Name	Function
10	[RESET] key	If an error occurs, this is reset by pressing the RESET key.
11	[CAUTION] key	A limit switch can be ignored in JOG mode by pressing this key. Additionally, this key can also be used to trigger the brake.
12	[HOME] key	Is not used here.
13	[OVRD] key	Use arrow keys ↑ and ↓ to increase or lower the JOG speed and the speed in automatic mode.
14	[HAND] key	This key calls up the "HAND" screen menu.
15	[JOG] key	This key calls up the "JOG" screen menu.
16	[+/-] key	The movements of the entry fields accord to the options in the respective screen menu using these keys.
17	[EXE] key	Entries are executed by the robot using this key, e.g. when aligning the hand gripper.
18	[MENU] key	This key calls up the start menu
19	[RETURN] key	Jump back to the previous menu using this key.
20	[↑], [↓], [←], [→] key	Move the cursor through the screen menus and entry fields using these arrow keys.
21	[OK] key	Accept the settings in the current menu or entry field using this key.
22	[CANCEL] key	Reject the settings in the current menu or entry field using this key.
23	Multi-grip hand gripper	The multi-grip hand gripper provides for a sure and comfortable grip of the operator device and is suitable both for right- and left-handed operation.
24	Three-step switch	The three-step enable switch ensures that the user is not exposed to any dangers during operation. All entries at the operation terminal are only accepted and executed when the enable switch is held in the middle position. You can feel a slight pressure point at the beginning. After overcoming this pressure point, the switch can easily be held in the enable position without having to use force. The third level ("step") of the enable switch, also referred to as the panic position, in turn guarantees that the enable function is always cancelled in case of an emergency.

Tab. 2-6: Overview of controls on Teaching Box R56TB (2)

3 Installation

This chapter describes all preparations required for a successful use of the robot system, from unpacking right up to installation.

3.1 Unpacking the robot system

**CAUTION:**

Always unpack the robot only on a stable and even surface. If you do not then the robot may fall and be damaged.

3.1.1 Unpack the articulated arm robot

RV-2FR

The robot arm is packaged in a box. The following figure shows you step-by-step how to unpack the robot arm.

- ① Lay the robot arm box on its side on the floor, as shown in ①.
- ② Use a knife or similar object to open the packaging tape.
- ③ Pull the inner packaging out of the box horizontally, as shown in ②.
- ④ Set the robot arm upright together with the inner packaging, as shown in ③.
- ⑤ Open the inner packaging as shown in ④ and remove the robot.
- ⑥ Transport the robot arm to the place of installation, as described in Section 3.2.

NOTE

Keep the packaging and transport locks for later transport.

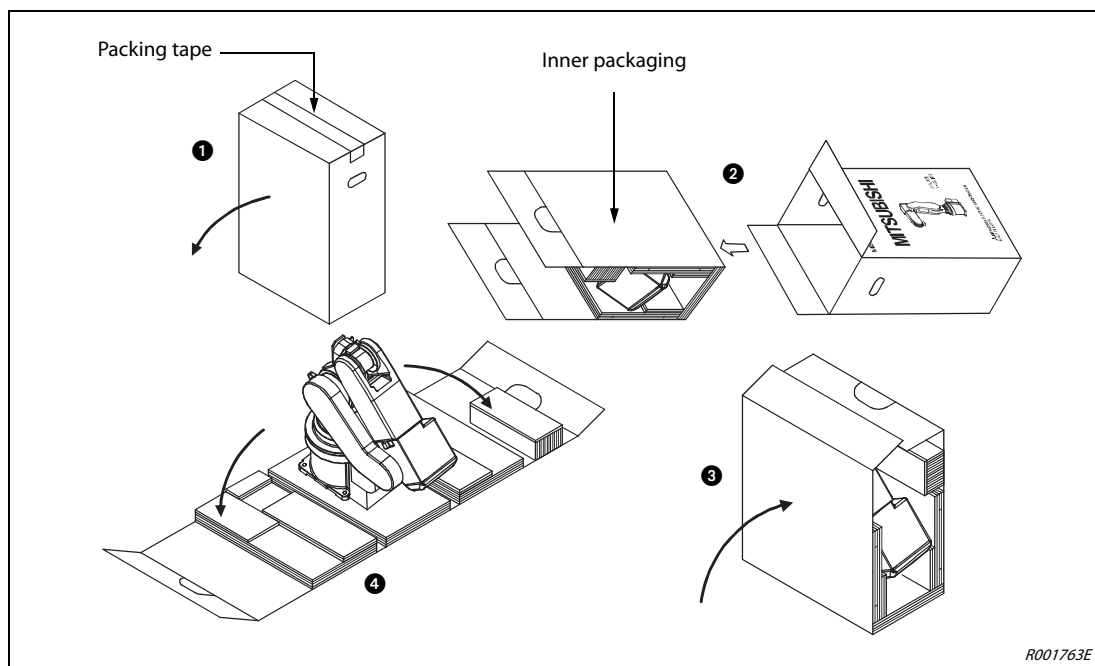


Fig. 3-1: Unpack articulated arm robot RV-2FR

RV-4FR, RV-7FR, RV-13FR and RV-20FR

The robot arm is packaged in a box. The following figure shows you step-by-step how to unpack the robot arm.

- ① Use a knife or similar object to open the packaging tape, as shown in ①.
- ② Using both hands, remove the upper part of the packaging as shown in ②.
- ③ Remove the four screws with which the base is screwed onto the lower section.
- ④ Transport the robot arm to the place of installation, as described in Section 3.2.

NOTE

Keep the packaging and transport locks for later transport.

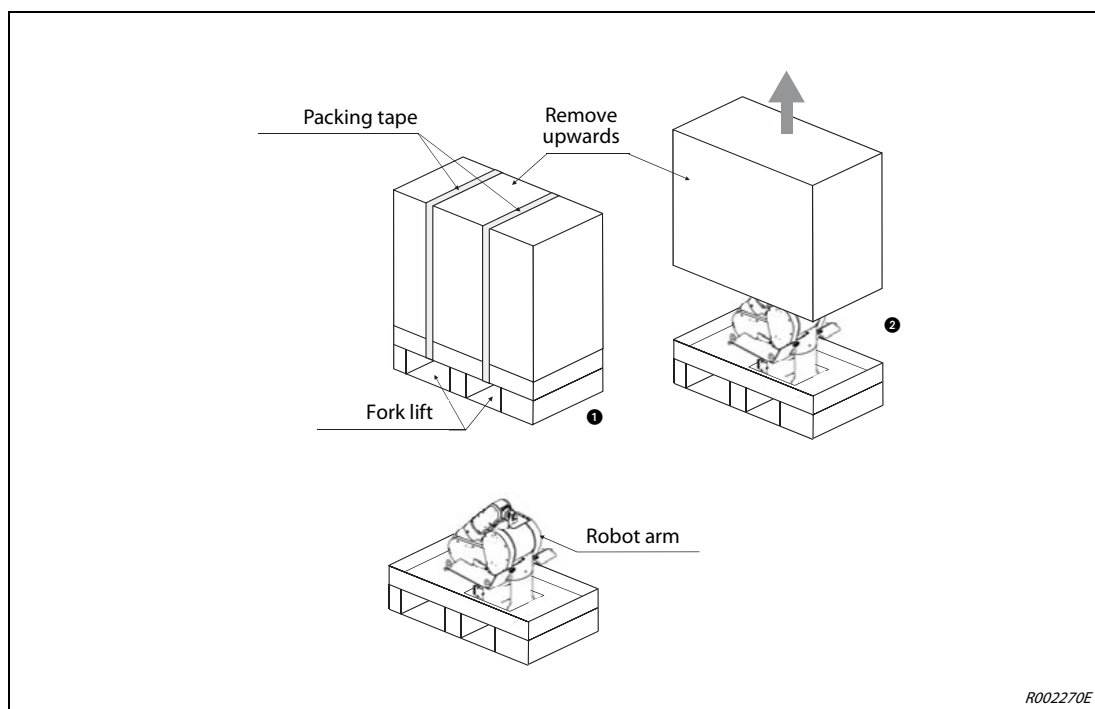


Fig. 3-2: Unpack articulated arm robot RV-4FR, RV-7FR, RV-13FR and RV-20FR

3.1.2 Unpack SCARA robot

RH-1FRHR5515

The robot arm is fixed to a wooden frame and packaged in a box. The following figure shows you step-by-step how to unpack the robot arm.

- ① Place the box on an even surface.
- ② Use a knife or similar object to open the packaging tape, as shown in ①.
- ③ Remove Part A of the packaging as shown in ②.
- ④ Remove the four fixing screws with which the base is screwed onto the wooden frame (see ③).
- ⑤ Transport the robot arm to the place of installation, as described in Section 3.2.

NOTE

Keep the packaging and transport locks for later transport.

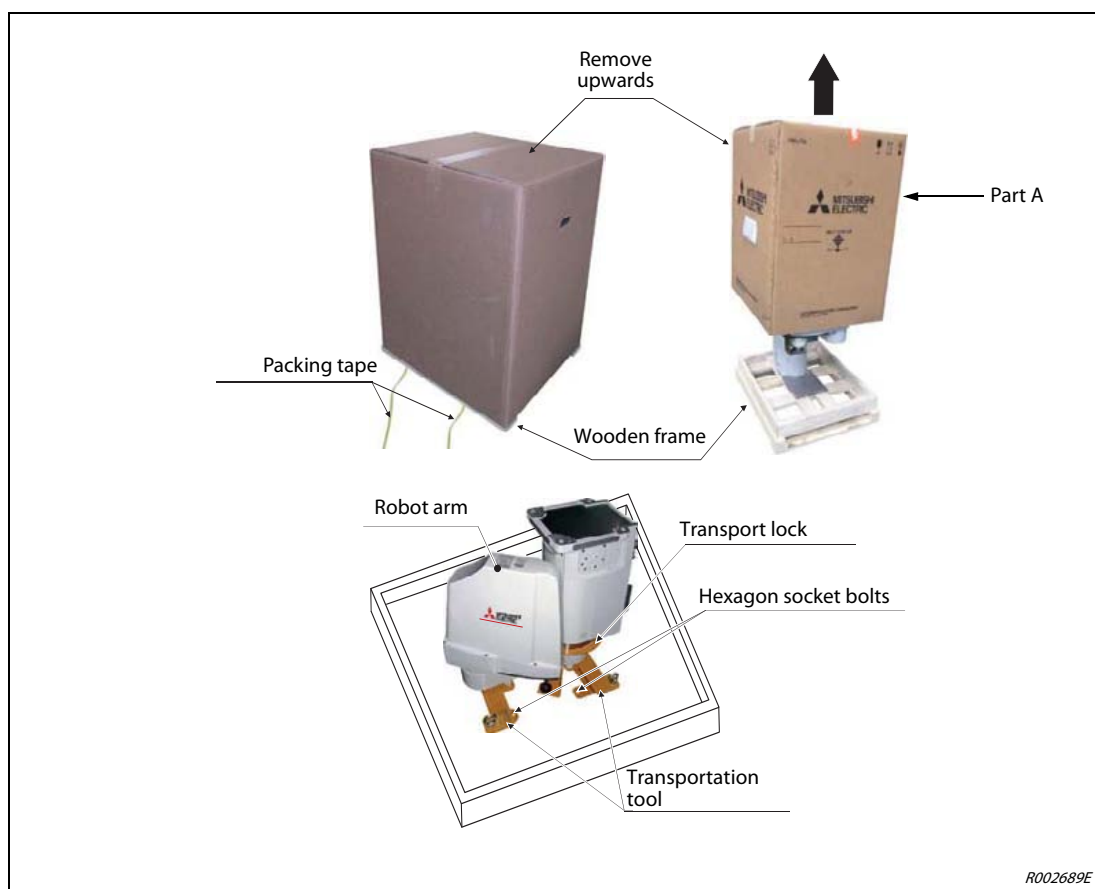


Fig. 3-3: Unpack the SCARA robot RH-1FRHR5515

**CAUTION:**

The robot must be transported without removing the transport lock or transportation tool. Remove after installing.

RH-3FRHR

The robot arm is packaged in a box. The following figure shows you step-by-step how to unpack the robot arm.

- ① Place the box on an even surface.
- ② Use a knife or similar object to open the packaging tape, as shown in ①.
- ③ Raise and remove upper cover ②.
- ④ Remove packing material (cardboard) ③ in the inside.
- ⑤ Open the vinyl and confirm the hanging tools (two places) ④. Hang the hook of the crane here (two places).
- ⑥ Hoist with the crane and separate the robot arm together with packing material from the packing box.
- ⑦ Cut with scissors etc. tape ⑥ which fixed packing material ⑤, and remove packing material.
- ⑧ Transport the robot arm to the place of installation, as described in Section 3.2.

NOTES

Keep the packaging and transport locks for later transport.

Please unpack near the installation place.

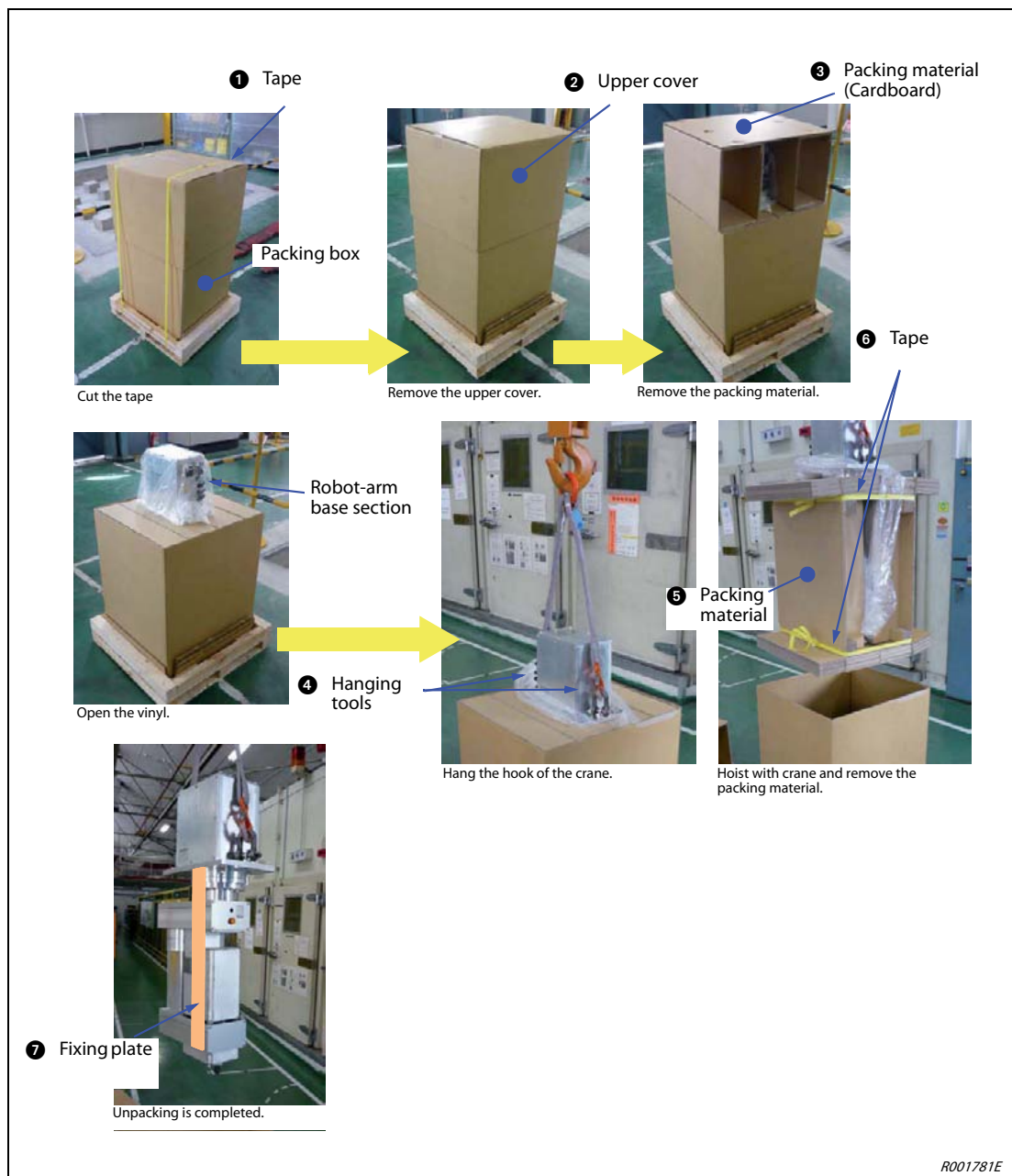


Fig. 3-4: Unpack the SCARA robot RH-3FRHR



CAUTION:

Don't remove fixing plate 7 till installation is completed.

RH-3/6/12/20FRH

The robot arm is fixed to a wooden frame and packaged in a box. The following figure shows you step-by-step how to unpack the robot arm.

- ① Place the box on an even surface.
- ② Use a knife or similar object to open the packaging tape, as shown in ①.
- ③ Remove Part A of the packaging as shown in ②.
- ④ Remove the four fixing screws with which the base is screwed onto the wooden frame (see ③).
- ⑤ Transport the robot arm to the place of installation, as described in Section 3.2.

NOTE

Keep the packaging and transport locks for later transport.

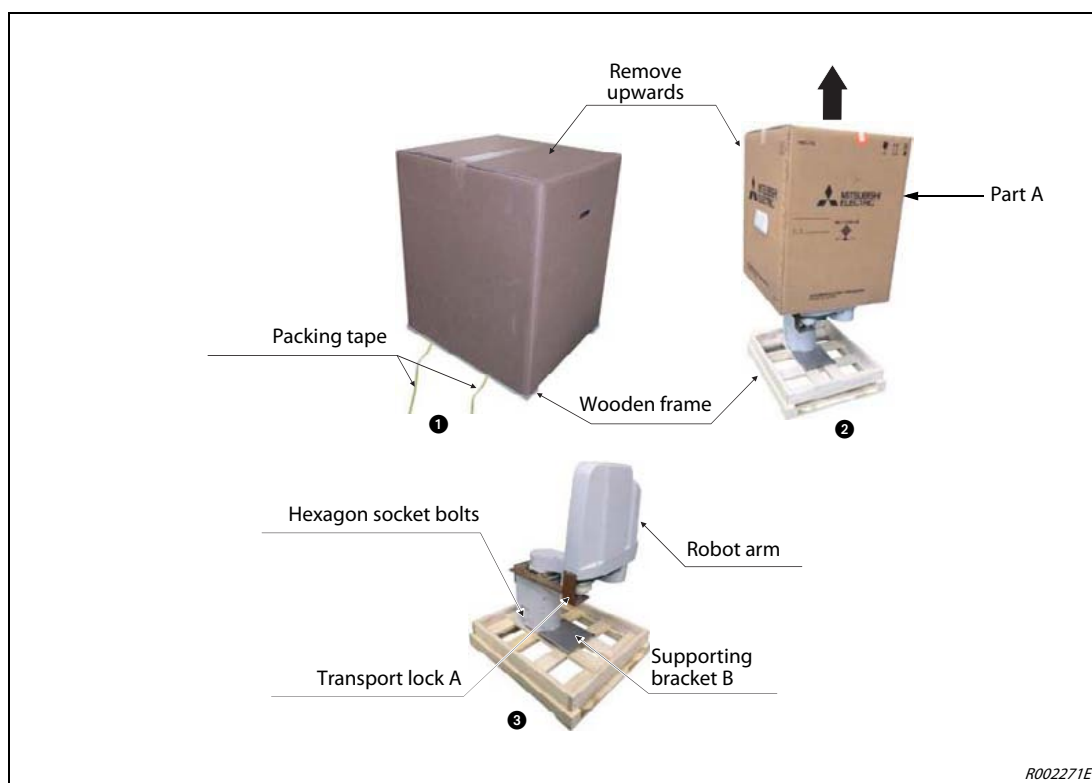


Fig. 3-5: Unpack the SCARA robots RH-3/6/12/20FRH

**CAUTION:**

The robot must be transported without removing the transport lock A or supporting bracket B. Remove after installing.

3.2 Transport robot arm

3.2.1 RV-2FR


CAUTION:

When carrying the robot arm always hold it by the designated holding points ① and ②. Never try to lift the robot arm by its covers as this can cause damage.

NOTE

Keep the transport locks and their fastening screws in a safe place for later transport.

- ① Always lift the robot by the designated holding points ① at the base and ② at the elbow. Never try to lift the robot arm by the sides or covers as this can cause serious damage to the robot arm.

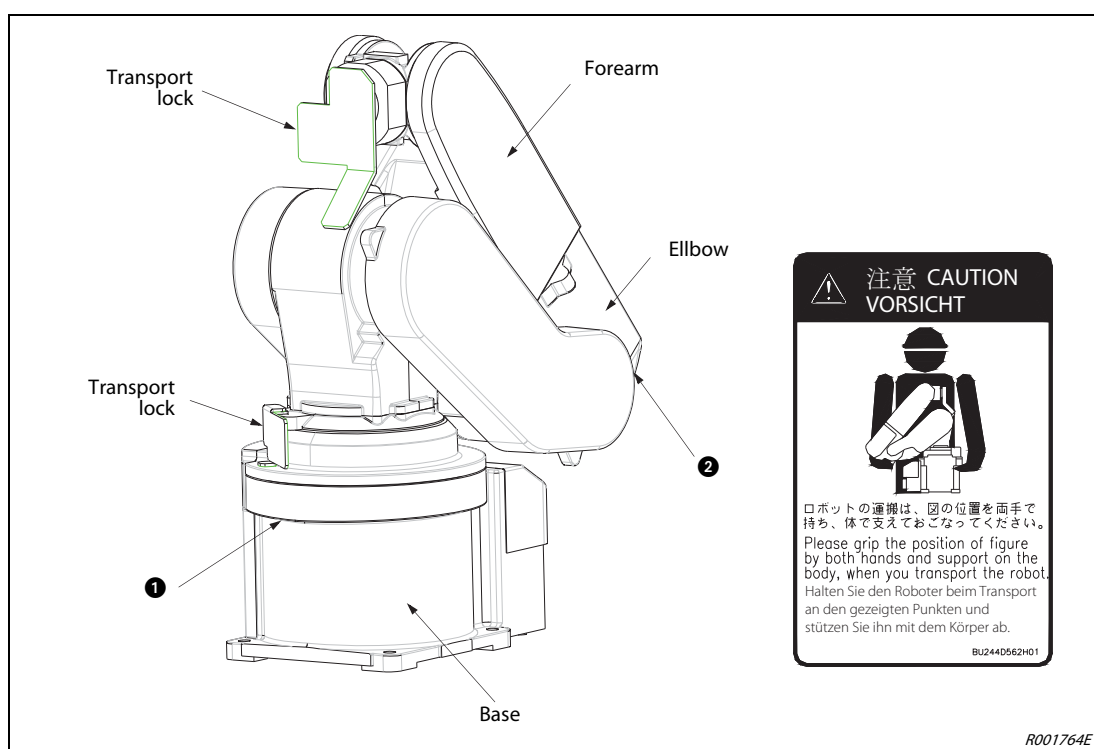


Fig. 3-6: Transporting the RV-2FR robot arm

- ② Never try to lift the robot arm sideways or at the joints without using the proper holding points as this can cause serious damage.
- ③ Always use a dolly or truck for extended transport. The holding points are only for brief lifting purposes.
- ④ Take care to prevent impacts to the robot arm during transport.


CAUTION:

Do not remove the transport locks until the robot arm has been installed.

3.2.2 RV-4FR, RV-7FR, RV-13FR and RV-20FR

**CAUTION:**

- *Always use a crane to transport the robot arm. The transport lock must not be removed before transport.*
- *The fixing screws of the transport lock and the transport bracket must be removed after transport.*

NOTE

Keep the transport lock, the transport angle and their appropriate fixing screws in a safe place for any later transport.

**CAUTION:**

To avoid faults, the wire rope of the crane must be attached as shown in Fig. 3-7 or Fig. 3-8.

- ① Fix the transport bracket in the shoulder area of the robot. Use the supplied Allen head screws for this.

NOTE

The transport brackets are already mounted at the factory. Step ① is therefore redundant if the robot arm is being transported for the first time.

- ② Fix the crane hook onto the eyes of the transport bracket. You can now transport the robot.
- ③ Remove the attached transport angel after transport.

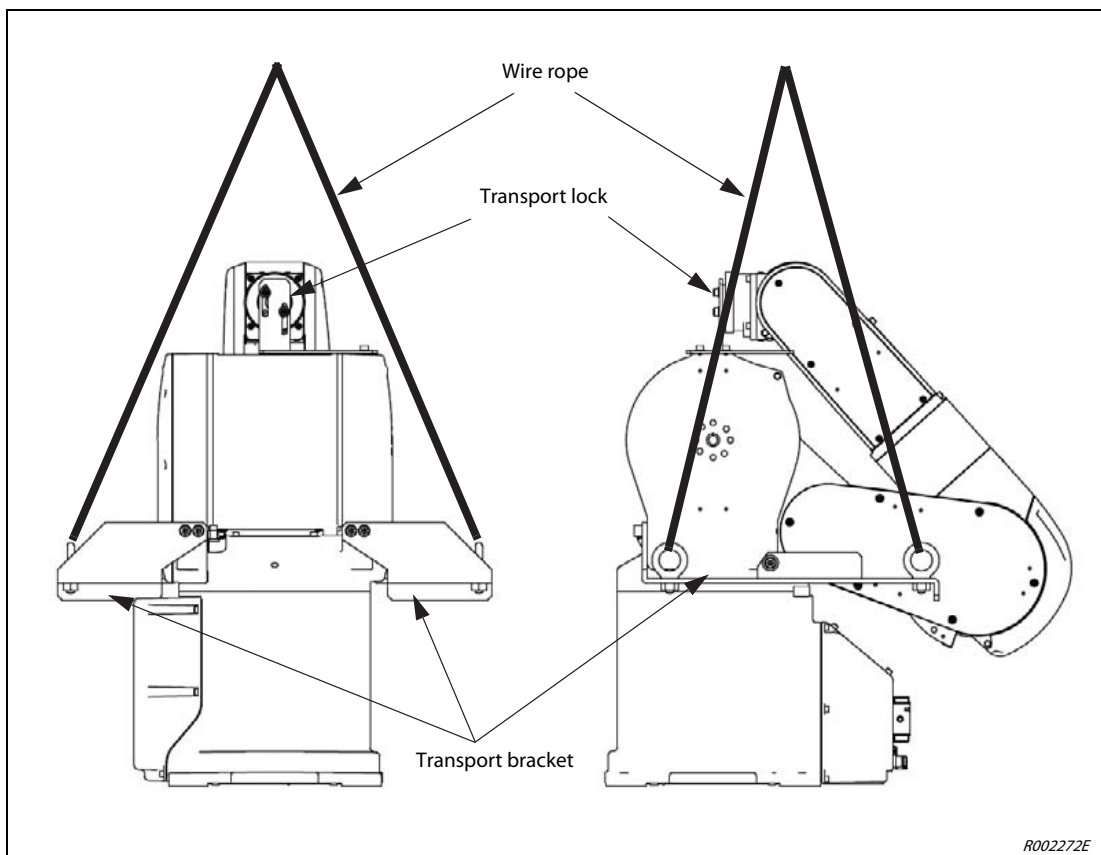


Fig. 3-7: Fix the transport bracket (RV-4FR and RV-7FR)

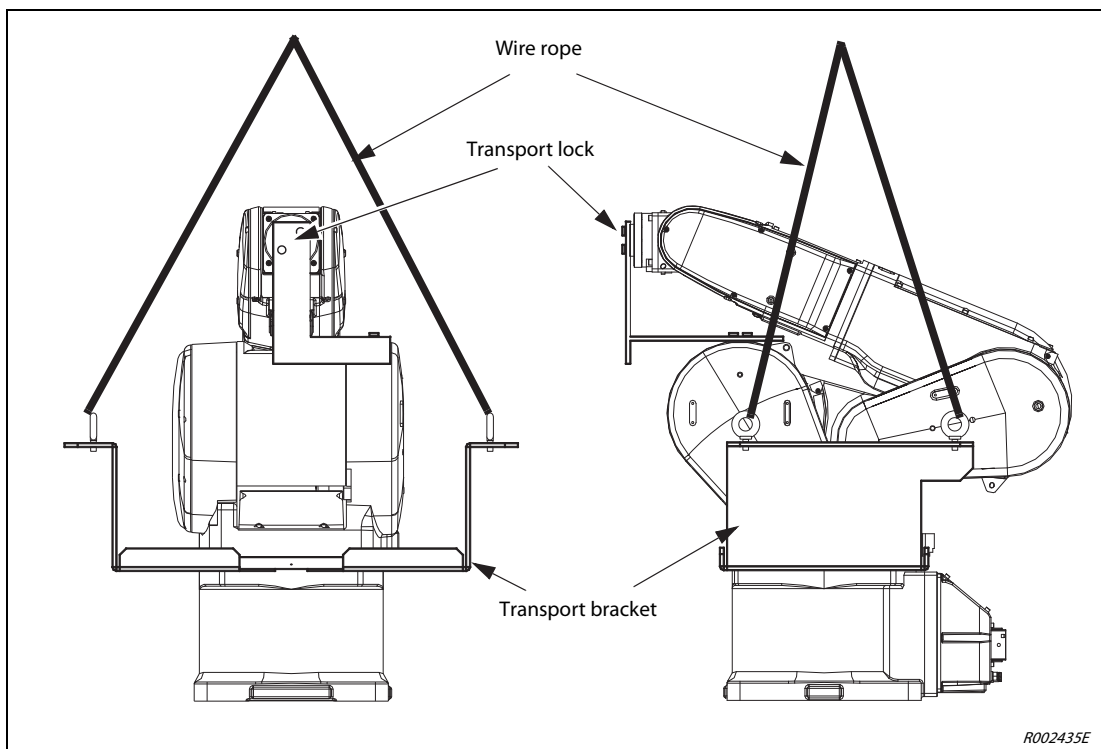


Fig. 3-8: Fix the transport bracket (RV-13FR and RV-20FR)

3.2.3 RH-1FRHR

Transporting with a crane


CAUTION:

- **To avoid faults, the wire rope of the crane must be attached as shown in Fig. 3-9.**
- **Always use four supporting ropes to transport the robot with a crane.**
- **The robot should keep vertical (not be horizontal). It becomes the cause of the grease leakage or the trouble.**

NOTE

Keep the transport and support brackets as well as the transport lock and their fixing screws in a safe place for any later transport.

- ① Fix the crane hook onto the four eyes of the transport suspension. Make sure that the hooks are seated firmly in the eyes.
- ② You can now transport the robot. During transport, the wire ropes and the robot arm or the arm covers must not touch each other. Protect endangered areas using cloths or similar material.
- ③ Only release the wire rope after installing the robot and remove the attached transportation tools and the transport lock.

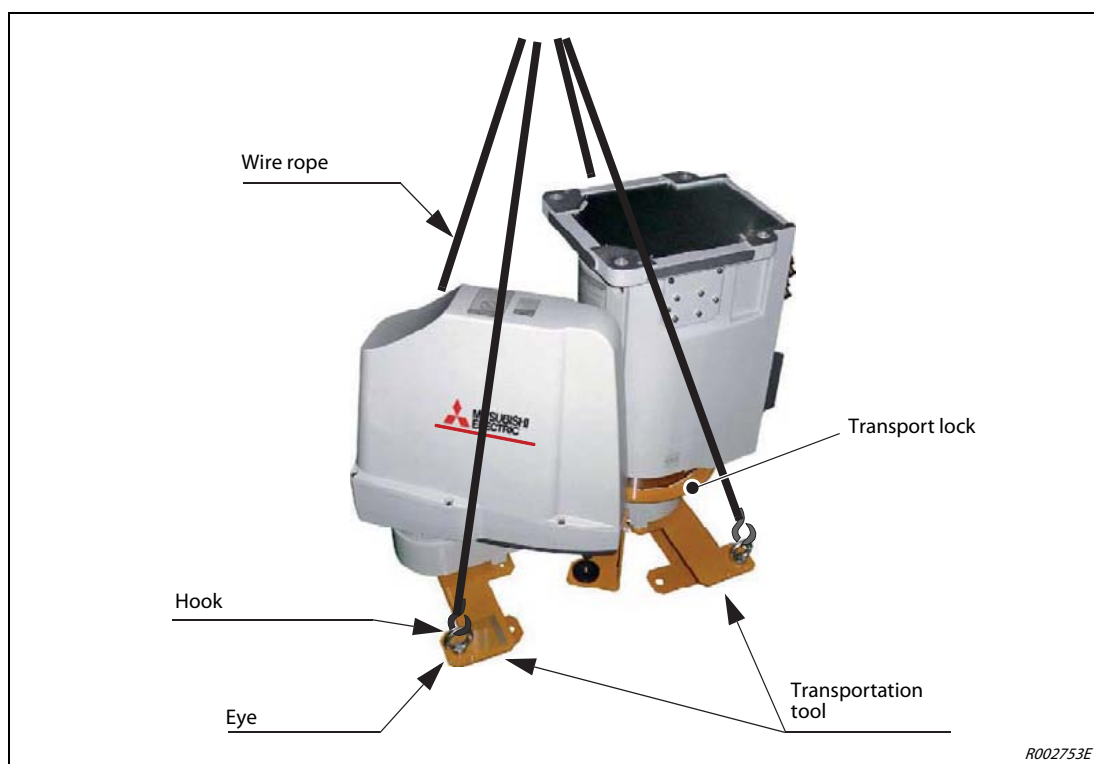


Fig. 3-9: Fix the transport suspensions


CAUTION:

Also observe the above-mentioned steps when transporting the robot at a later time – e. g. when changing the installation location. If the robot is transported without the attached transportation tools or the transport lock, or if it is transported in operating position, then dangerous situations might arise due to a shifting of the centre of gravity during transport.

Transporting with a manual pallet jack


CAUTION:

The robot should keep vertical (not be horizontal). It becomes the cause of the grease leakage or the trouble.

NOTE

Keep the transport tools as well as the transport lock and their fixing screws in a safe place for any later transport.

- ① Insert the forks of a manual pallet jack surely into the fork insertion segment of the transportation tool.
- ② Lift up the robot with a manual pallet jack to transport it to the designated location.
- ③ After installing the robot pull out the forks and remove the transportation tools and the transport lock.



Fig. 3-10: Fork insertion segment of the robot

**CAUTION:**

Also observe the above-mentioned steps when transporting the robot at a later time – e. g. when changing the installation location. If the robot is transported without the attached transport tools and the transport lock, or if it is transported in operating position, then dangerous situations might arise due to a shifting of the centre of gravity during transport.

3.2.4 RH-3FRHR


CAUTION:

- **Transport by using the crane with fixing plate still being installed is necessary.**
- **Transport carefully so that the robot may not tilt by using two wires. Take care sufficiently not to give the interference and the shock with the installation stage etc.**

NOTE

Keep the transporting jigs, the transport lock and their fixing screws in a safe place for any later transport.

- ① Transport the robot by the crane from the condition which unpacking completed to the fixing position of installation stage ①.
- ② Fixing the robot by four installation bolts ② (attached) certainly to installation stage ①.
- ③ Remove the wire ropes and the transporting jigs ③ after installation. Loosen the screw (4 × M5, 1 × M4) fixing the transport lock ④, and remove the transport lock. Also remove the nut for T slots.

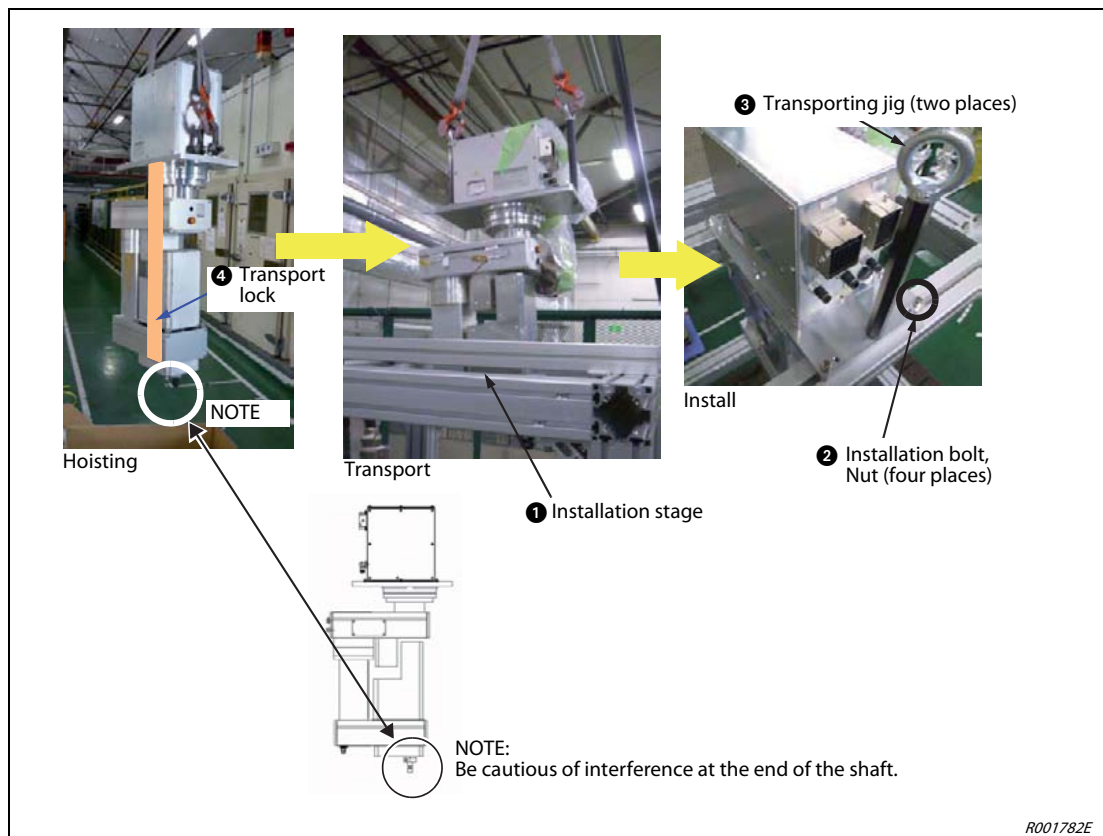


Fig. 3-11: Transporting the robot arm


CAUTION:

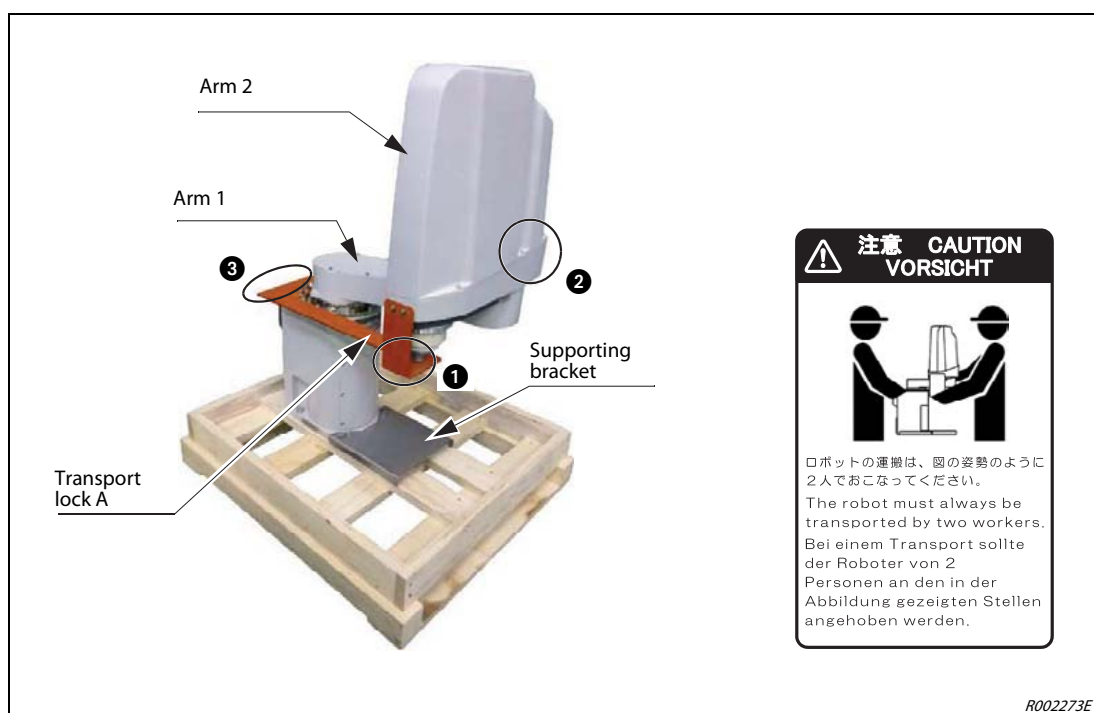
Also observe the above-mentioned steps when transporting the robot at a later time – e. g. when changing the installation location. If the robot is transported without the attached transport lock or if it is transported in operating position, then dangerous situations might arise due to a shifting of the centre of gravity during transport.

3.2.5 RH-3FRH/6FRH


CAUTION:

- *The transport locks must not be removed before transport.*
- *Two persons are always required to carry the robot arm.*
- *Always carry the robot arm at holding points ①, ② and ③. Never carry the robot arm at the covers because this may result in damages.*
- *The robot should keep vertical (not be horizontal). It becomes the cause of the grease leakage or the trouble.*

- ① Two persons are always required for transport. When doing so, one person should hold the robot arm at point ① at the transport lock A of arm 2 and point ② on arm 2 and another person should hold the transport lock A of base at point ③ (see Fig. 3-12). Never carry the robot at the sides or at its covers because these may become loose and can destroy the robot arm.



R002273E

Fig. 3-12: Holding points on robot arm

- ② Never carry the robot at its side or at the axes without holding points because this could result in damages.
- ③ Use a dolly if transporting longer distances. Only carry at the holding points for short periods of time.
- ④ Do not strain any covers.
- ⑤ Avoid knocks (impact loads) when transporting the robot arm.
- ⑥ Only remove the transport locks after installing the robot arm.

3.2.6 RH-12FRH/20FRH

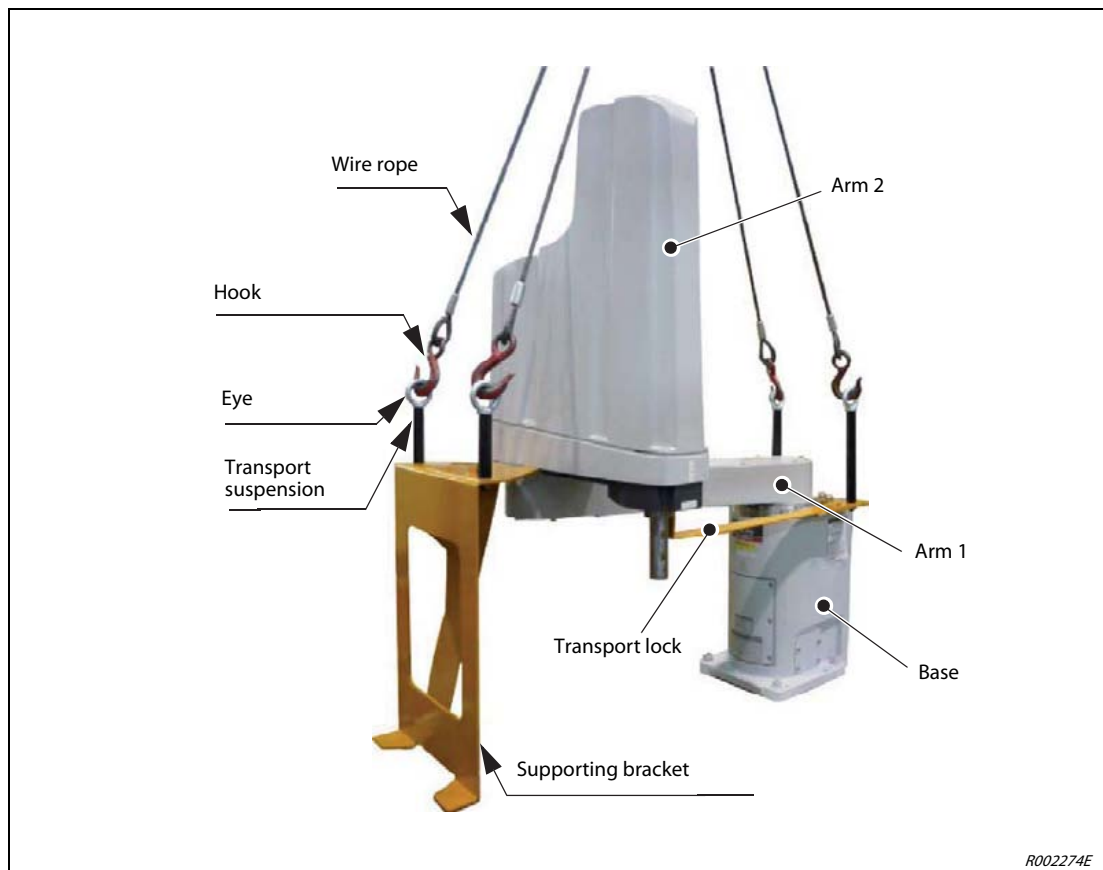
**CAUTION:**

- **To avoid faults, the wire rope of the crane must be attached as shown in Fig. 3-13.**
- **Always use four supporting ropes to transport the robot with a crane.**

NOTE

Keep the transport and support brackets as well as the transport locks and their fixing screws in a safe place for any later transport.

- ① Fix the crane hook onto the four eyes of the transport suspension. Make sure that the hooks are seated firmly in the eyes.
- ② You can now transport the robot. During transport, the wire ropes and the robot arm or the arm covers must not touch each other. Protect endangered areas using cloths or similar material.
- ③ Only release the wire rope after installing the robot and remove the attached transport locks, suspensions and brackets.



R002274E

Fig. 3-13: Fix the transport suspensions

**CAUTION:**

Also observe the above-mentioned steps when transporting the robot at a later time – e.g. when changing the installation location. If the robot is transported without the attached transport locks and supporting brackets, or if it is transported in operating position, then dangerous situations might arise due to a shifting of the centre of gravity during transport.

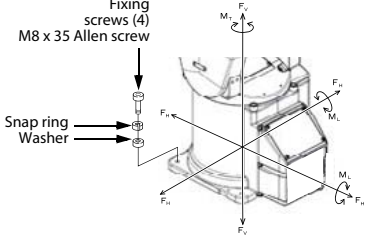
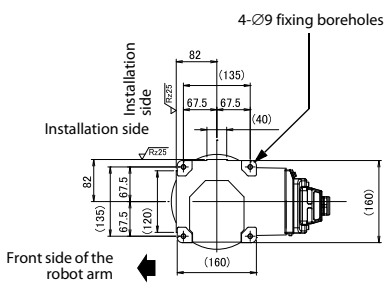
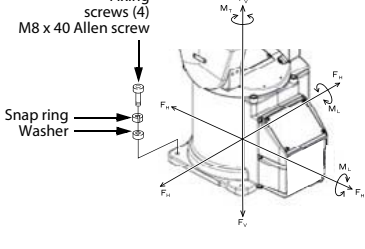
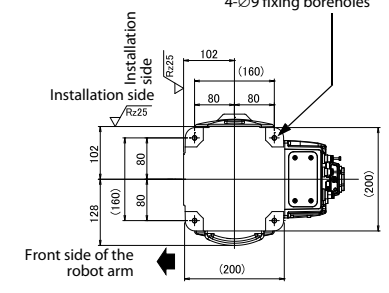
3.3 Set up the robot arm

3.3.1 Set up the articulated arm robot

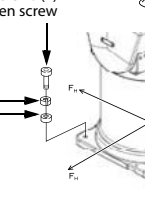
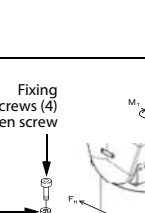
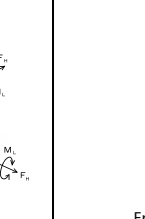
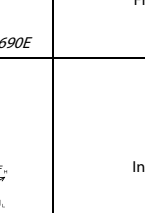
RV-2FR/4FR/7FR/7FRLLM/13FR/20FR

The table below shows how to set up and fix the articulated arm robots RV-2FR/4FR/7FR/7FRLLM/13FR/20FR.

- ① The base area of the robot arm has been levelled by machine.
If the base area is too uneven then this may result in robot arm malfunctions.
Fix the robot arm above the assembly boreholes on the four outer edges of the base area using the supplied Allen head screws.
- ② Align the robot arm horizontally.
- ③ The average surface finish of the assembly surface should be $R_a = 6.3 \mu\text{m}$. If the surface is too rough then this may result in deviations in the position of the robot arm.
- ④ To avoid position deviations, the peripheral equipment that the robot accesses as well as the robot arm itself should be installed on a common assembly platform/area.
- ⑤ The base area must be designed so that no distortion can occur, even from the loads and vibrations emanating from the robot itself.
- ⑥ Only remove the transport locks after setting up the robot arm.
- ⑦ If the robot is mounted on the ceiling then the MEGDIR parameter must be changed. Additional information on this parameter is contained in the operation and programming instructions of the controllers.
- ⑧ High loads and strains occur on the base area when operating the robot at high speeds. Make sure that the base area is suitable for the high forces and moments, as listed in Tab. 3-2.

Robot arm	Fixture	View from below
RV-2FR	 <p>Fixing screws (4) M8 x 35 Allen screw</p> <p>Snap ring Washer</p> <p>$F_x, F_y, F_z, M_x, M_y, M_z$</p> <p>R002690E</p>	 <p>4-$\varnothing 9$ fixing boreholes</p> <p>Installation side</p> <p>Front side of the robot arm</p> <p>R002691E</p>
RV-4FR	 <p>Fixing screws (4) M8 x 40 Allen screw</p> <p>Snap ring Washer</p> <p>$F_x, F_y, F_z, M_x, M_y, M_z$</p> <p>R002690E</p>	 <p>4-$\varnothing 9$ fixing boreholes</p> <p>Installation side</p> <p>Front side of the robot arm</p> <p>R002692E</p>

Tab. 3-1: Set up the robot arm (1)

Robot arm	Fixture	View from below
RV-7FR	 <p>Fixing screws (4) M8 x 40 Allen screw</p> <p>Snap ring Washer</p> <p>Force vectors: $F_x, F_y, F_z, M_x, M_y, M_z$</p>	 <p>4-$\varnothing 9$ fixing boreholes</p> <p>Installation side</p> <p>Front side of the robot arm</p>
RV-7FRLLM/13FR/20FR	 <p>Fixing screws (4) M12 x 55 Allen screw</p> <p>Snap ring Washer</p> <p>Force vectors: $F_x, F_y, F_z, M_x, M_y, M_z$</p>	 <p>4-$\varnothing 14$ fixing boreholes</p> <p>Installation side</p> <p>Front side of the robot arm</p> <p>2-$\varnothing 8$ positioning boreholes</p>

Tab. 3-1: Set up the robot arm (2)

Load	RV-2FR	RV-4FR	RV-7FR	RV-7FRLLM/ 13FR/20FR
Moment of tilt M_L [Nm]	240	410	900	2060
Torsional moment M_T [Nm]	150	400	900	2060
Translational forces on horizontal plane F_H [N]	700	700	1000	1750
Translational forces on vertical plane F_V [N]	820	1200	1700	2900

Tab. 3-2: Reaction forces on the base area of the robot



CAUTION:

- ***When installing the robot, make sure that there is enough space remaining at the rear of the robot arm to connect the cable used and to replace the backup battery, and also space for J1 axis belt in the right side.***
- ***And don't install the robot arm in the position where direct rays or the heat of lighting hits. The skin temperature of the robot arm may rise, and the error may occur.***

3.3.2 Set up the SCARA robot

RH-1FRHR5515

The table below shows how to set up and fix the SCARA robot RH-1FRHR5515.

- ① The base area of the robot arm has been levelled by machine.
If the base area is too uneven then this may result in robot arm malfunctions.
Fix the robot arm above the assembly boreholes on the four outer edges of the base area using the supplied Allen head screws.
- ② Align the robot arm horizontally.
- ③ The average surface finish of the assembly surface should be $R_a = 6.3 \mu\text{m}$. If the surface is too rough then this may result in deviations in the position of the robot arm.
- ④ To avoid position deviations, the peripheral equipment that the robot accesses as well as the robot arm itself should be installed on a common assembly platform/area.
- ⑤ The base area must be designed so that no distortion can occur, even from the loads and vibrations emanating from the robot itself.
- ⑥ Only remove the transportation tool and the transport locks after setting up the robot arm.
- ⑦ High loads and strains occur on the base area when operating the robot at high speeds. Make sure that the base area is suitable for the high forces and moments, as listed in Tab. 3-4.

Robot arm	Fixture	View from below
RH-1FRHR5515	<p>R002698E</p>	<p>R002699E</p>

Tab. 3-3: Set up the robot arm

Load	RH-1FRHR5515
Moment of tilt M_L [Nm]	610
Torsional moment M_T [Nm]	807
Translational forces on horizontal plane F_H [N]	1575
Translational forces on vertical plane F_V [N]	712

Tab. 3-4: Reaction forces on the base area of the robot



CAUTION:

- When installing the robot, make sure that there is enough space remaining at the rear of the robot arm to connect the cable used and to replace the backup battery.
- And don't install the robot arm in the position where direct rays or the heat of lighting hits. The skin temperature of the robot arm may rise, and the error may occur.

RH-3FRHR

The table below shows how to set up and fix the robot arm. Proper installation of the robot arm is an important requirement for failure-free operation.

- ① The base area of the robot arm has been levelled by machine.
If the base area is too uneven then this may result in robot arm malfunctions.
Fix the robot arm above the assembly boreholes on the four outer edges of the base area using the supplied Allen head screws.
- ② Align the robot arm horizontally.
- ③ The average surface finish of the assembly surface should be $R_a = 6.3 \mu\text{m}$. If the surface is too rough then this may result in deviations in the position of the robot arm.
- ④ To avoid position deviations, the peripheral equipment that the robot accesses as well as the robot arm itself should be installed on a common assembly platform/area.
- ⑤ The base area must be designed so that no distortion can occur, even from the loads and vibrations emanating from the robot itself.
- ⑥ Only remove the transport lock and transporting jigs after setting up the robot arm.
- ⑦ High loads and strains occur on the base area when operating the robot at high speeds. Make sure that the base area is suitable for the high forces and moments, as listed in Tab. 3-5.

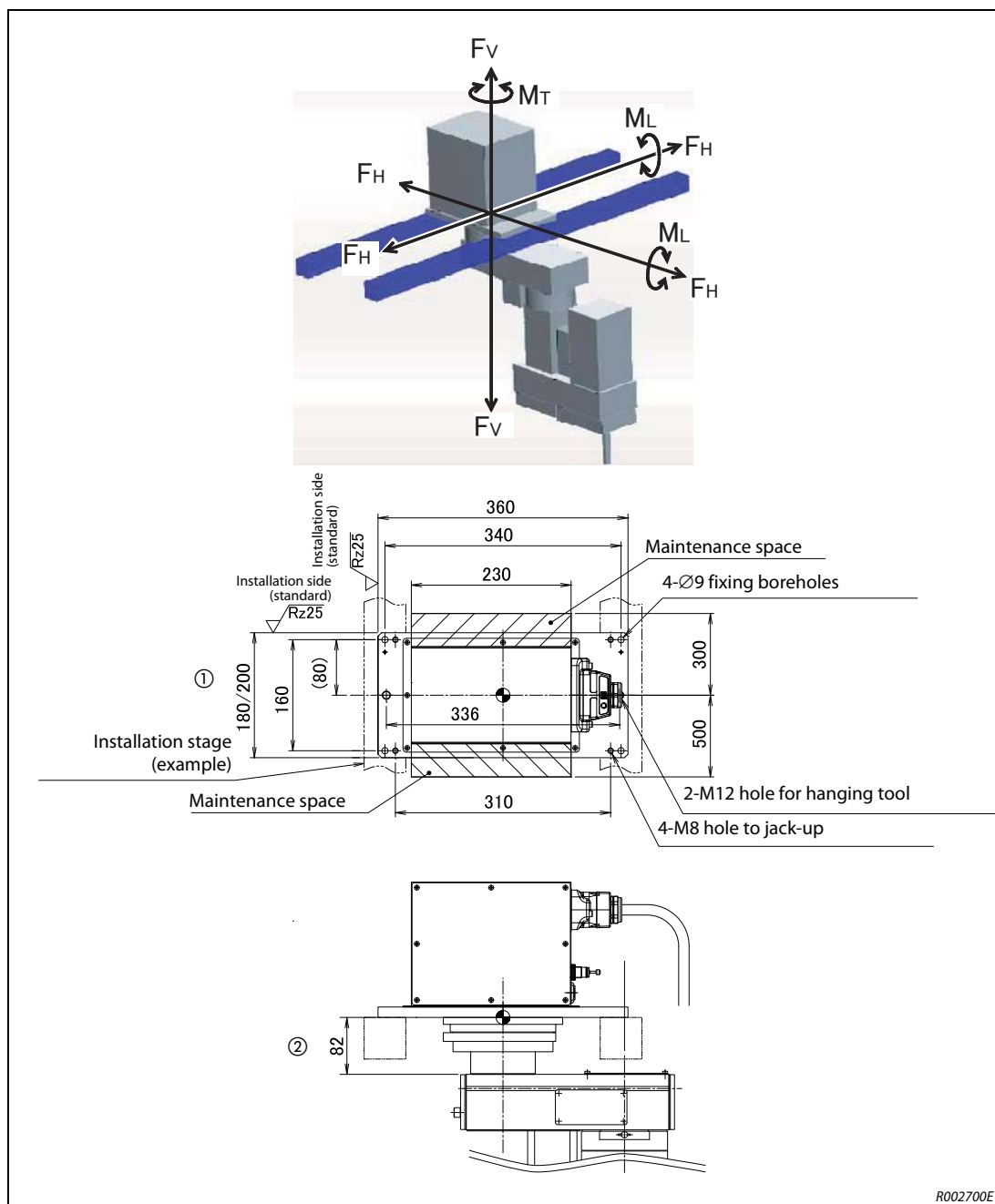


Fig. 3-14: Set up the robot arm

- ① General environment type: 180 mm
Clean/waterproof specification: 200 mm
- ② The interference of installation bolt and No.1 arm may occur depending on the size of installation stage. Take care against interference of installation bolt, such as inserting the installation bolt from the bottom.

Load	RH-3FRHR
Moment of tilt M_L [Nm]	380
Torsional moment M_T [Nm]	410
Translational forces on horizontal plane F_H [N]	920
Translational forces on vertical plane F_V [N]	570

Tab. 3-5: Reaction forces on the base area of the robot

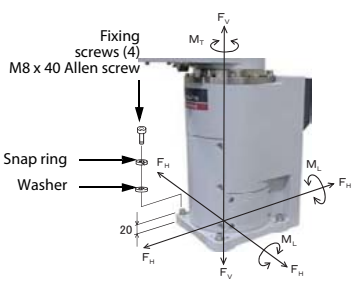
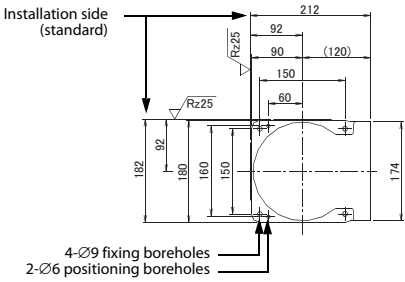
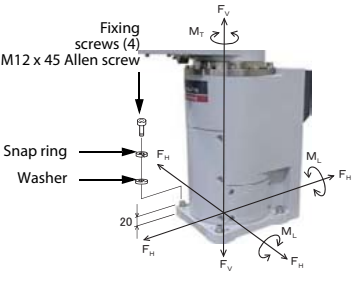
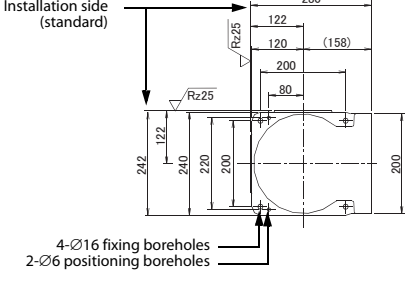
**CAUTION:**

- *When installing the robot, make sure that there is enough space remaining at the rear of the robot arm to connect the cable used and at side to replace the backup battery.*
- *And don't install the robot arm in the position where direct rays or the heat of lighting hits. The skin temperature of the robot arm may rise, and the error may occur.*

RH-3/6/12/20FRH

The table below shows how to set up and fix the SCARA robots RH-3/6/12/20FRH.

- ① The base area of the robot arm has been levelled by machine.
If the base area is too uneven then this may result in robot arm malfunctions.
Fix the robot arm above the assembly boreholes on the four outer edges of the base area using the supplied Allen head screws.
- ② Align the robot arm horizontally.
- ③ The average surface finish of the assembly surface should be $Ra = 6.3 \mu m$. If the surface is too rough then this may result in deviations in the position of the robot arm.
- ④ To avoid position deviations, the peripheral equipment that the robot accesses as well as the robot arm itself should be installed on a common assembly platform/area.
- ⑤ The base area must be designed so that no distortion can occur, even from the loads and vibrations emanating from the robot itself.
- ⑥ Only remove the transport locks, suspensions and supporting brackets after setting up the robot arm.
- ⑦ High loads and strains occur on the base area when operating the robot at high speeds. Make sure that the base area is suitable for the high forces and moments, as listed in Tab. 3-7.

Robot arm	Fixture	View from below
RH-3/6FRH	 <p>Fixing screws (4) M8 x 40 Allen screw</p> <p>Snap ring</p> <p>Washer</p> <p>20</p> <p>F_V, M_T, F_H, M_L</p> <p>R002695E</p>	 <p>Installation side (standard)</p> <p>212, 92, 90, 150, 60, 182, 180, 160, 150, 174</p> <p>4-$\varnothing 9$ fixing boreholes 2-$\varnothing 6$ positioning boreholes</p> <p>R002696E</p>
RH-12/20FRH	 <p>Fixing screws (4) M12 x 45 Allen screw</p> <p>Snap ring</p> <p>Washer</p> <p>20</p> <p>F_V, M_T, F_H, M_L</p> <p>R002695E</p>	 <p>Installation side (standard)</p> <p>280, 122, 120, 200, 80, 242, 240, 220, 200, 200</p> <p>4-$\varnothing 16$ fixing boreholes 2-$\varnothing 6$ positioning boreholes</p> <p>R002697E</p>

Tab. 3-6: Set up the robot arm

Load	RH-3FRH	RH-6FRH	RH-12/20FRH
Moment of tilt M_L [Nm]	240	1640	3190
Torsional moment M_T [Nm]	255	710	1840
Translational forces on horizontal plane F_H [N]	810	1653	2240
Translational forces on vertical plane F_V [N]	380	2318	2500

Tab. 3-7: Reaction forces on the base area of the robot



CAUTION:

- **When installing the robot, make sure that there is enough space remaining at the rear of the robot arm to connect the cable used and to replace the backup battery.**
- **And don't install the robot arm in the position where direct rays or the heat of lighting hits. The skin temperature of the robot arm may rise, and the error may occur.**

3.4 Handling the robot controller

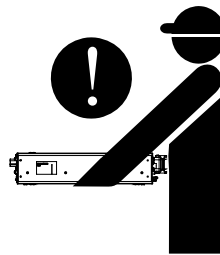
This section describes the handling and set up of the controller.

3.4.1 Transport the controller



CAUTION:

Carry the controller as shown in the illustration below. Lift it by holding firmly below the front or rear edges. Do not attempt to lift the unit by the switches or connectors.



CR800 controller

R002755E

Fig. 3-15: Transport the CR800 controller

3.4.2 Installing the CR800 controller

The illustration below shows the installed CR800 controller. Please observe these important instructions:

- The controller and drive unit can be installed vertically or horizontally.
- The lateral clearances must not be less than shown in Fig. 3-16.
- Take steps to ensure that the maximum permitted ambient temperature of 40 °C is never exceeded when installing the units in switch-gear cabinets.

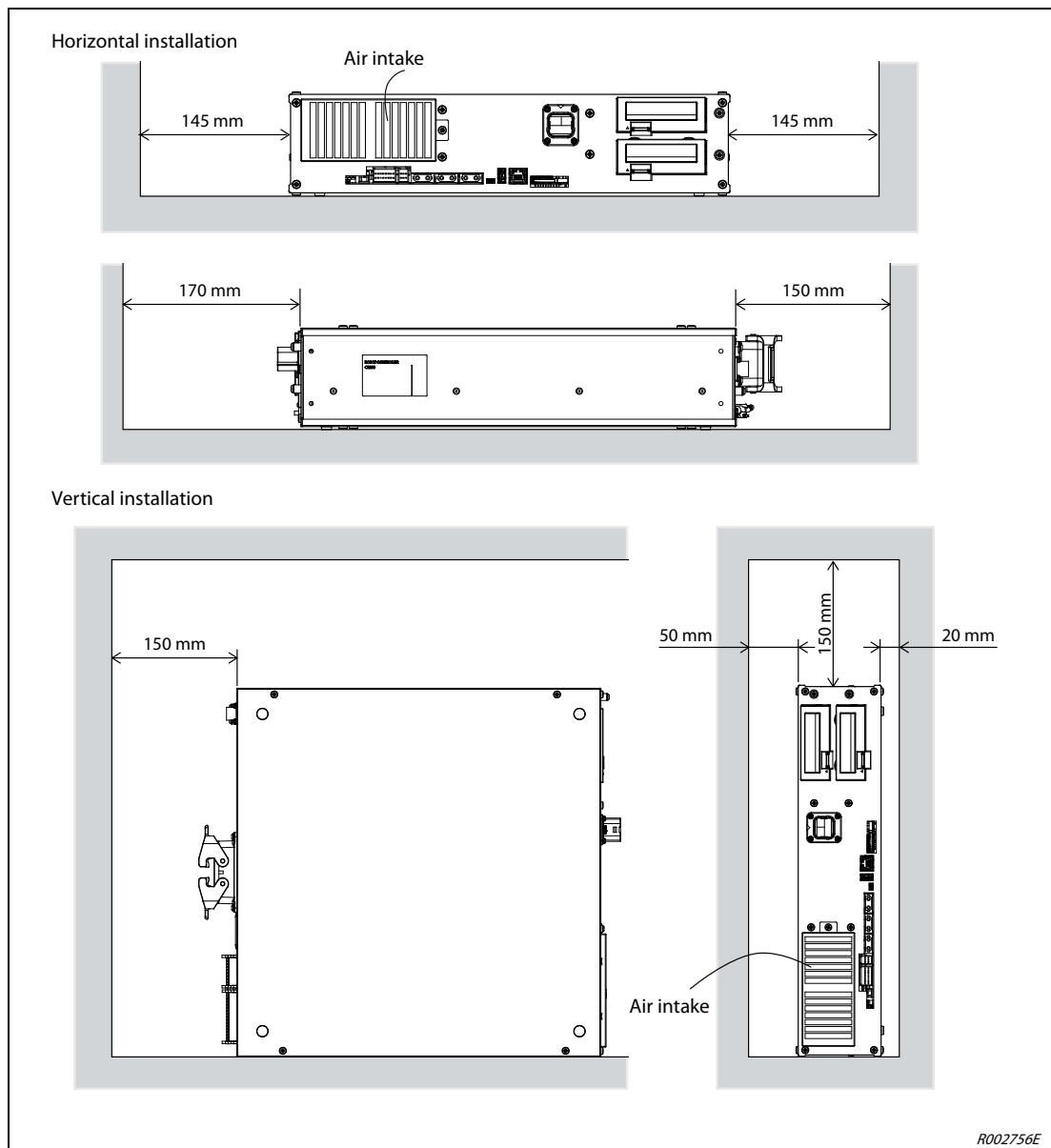


Fig. 3-16: Installation of the CR800 controller

3.5 Installation of robot CPU R16RTCPU

Notes on installation

- Always install the rack horizontally because only this ensures that there is enough ventilation.

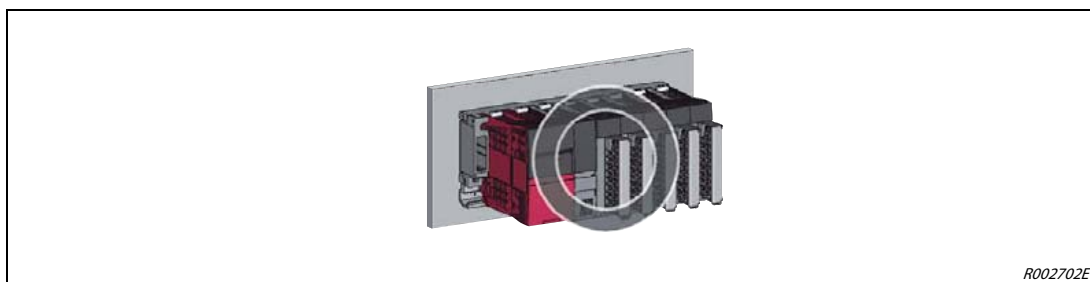


Fig. 3-17: Correct assembly of the rack

- The units must not be assembled lying flat or vertically, because this would prevent sufficient ventilation.

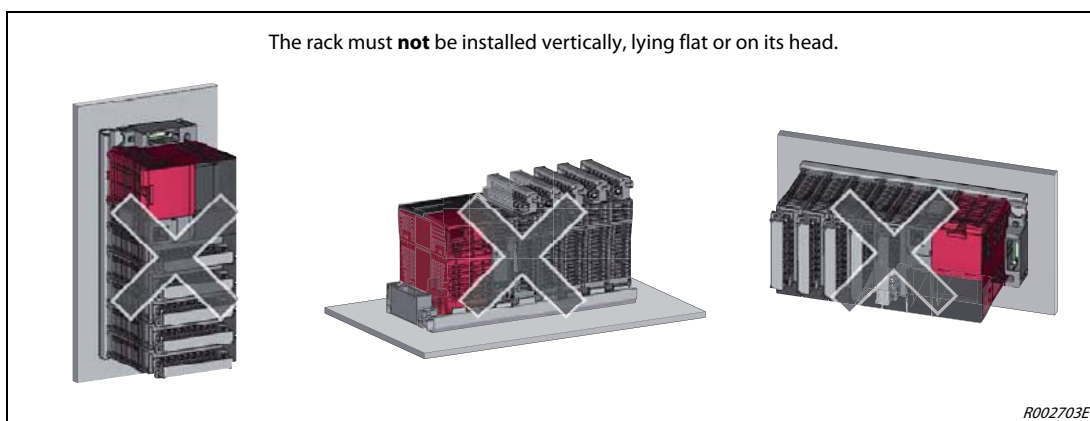


Fig. 3-18: Incorrect assembly of the rack

- The racks should be installed on an even surface to prevent deformation.
- The robot CPU must be installed far removed from electromagnetic switching devices which may cause vibrations and disturbances.
- If there is a device in the control cabinet that generates severe disturbances and heat, and this device is installed in front of the robot CPU, then a distance of at least 100 mm must be maintained between this device and the CPU. The device could be installed, e.g. on the inside of the control cabinet. If the robot CPU and such a device are assembled next to each other then they must have a minimum clearance of 50 mm.

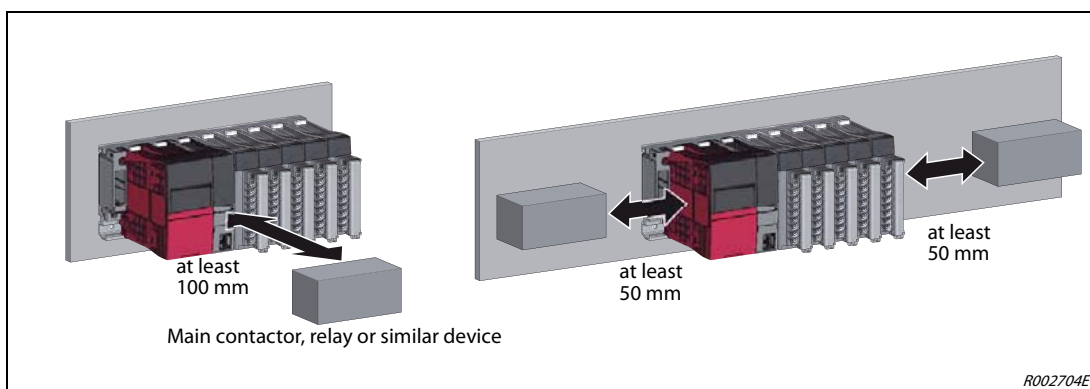


Fig. 3-19: Arrangement of modules in the control cabinet

3.5.1 Installation and removal of modules

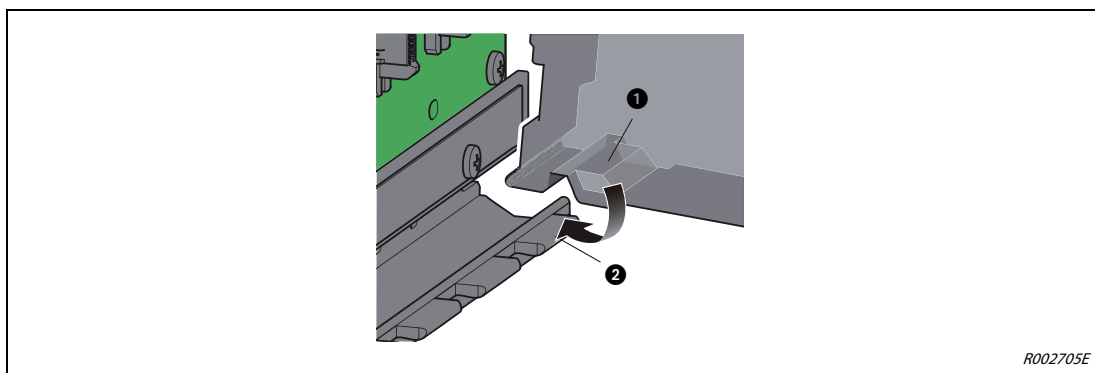
This section shows you how to assemble modules onto the rack such as, e.g. power supply unit, a PLC or a robot CPU.

**CAUTION:**

- *The mains voltage must always be switched off before installing a module.*
- *If the concave part of the module is not placed correctly onto the guide of the base unit, the PINs on the module plug might become bent.*

Installation

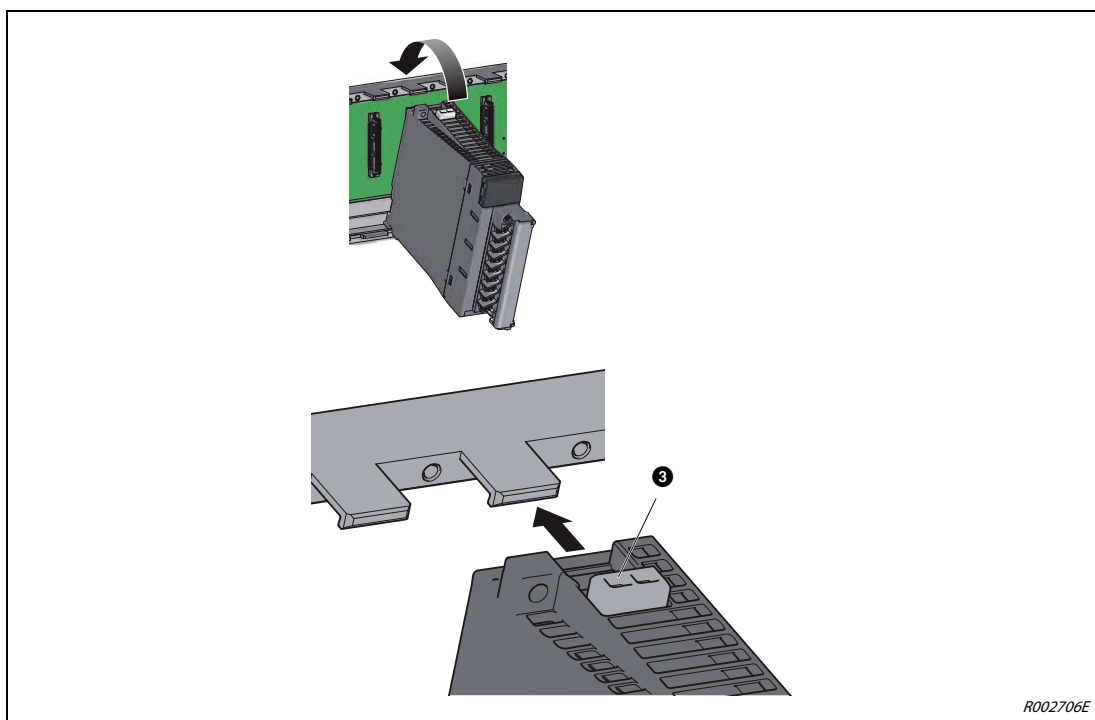
- ① Switch off the mains voltage!
- ② When a cap is attached to the unit connector of the base unit, remove it.
- ③ Place the concave part ① of an unit onto the guide ② of the base unit.



R002705E

Fig. 3-20: Installation of the modules

- ④ Push in the unit until the module fixing hook ③ snaps into place.
- ⑤ Fix the unit on the base unit with the screws (M3 x 12).



R002706E

Fig. 3-21: Locking the modules

Removal

**CAUTION:**

- *The mains voltage must always be switched off before removing a module.*
- *When removing a module, make sure that any fixing screw is release and that fixing hook on the module is not longer snapped in. Otherwise, the mounting devices on the module may be damaged.*

- ① Remove unit fixing screws.
- ② Support the unit with both hands and securely press the unit fixing hook ① with your finger.

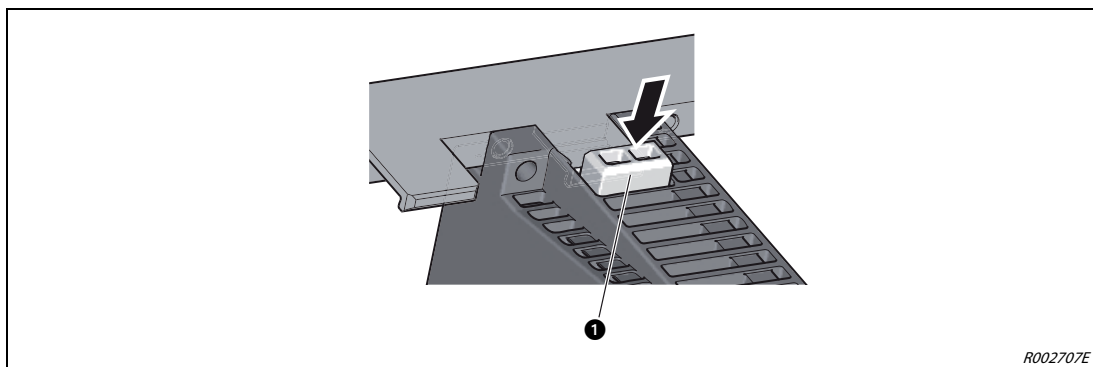


Fig. 3-22: Unlocking the modules

- ③ Pull the unit straight supporting it at its bottom while pressing the unit fixing hook ①.
- ④ While lifting the unit, remove the concave part ② from the guide ③ of the base unit.

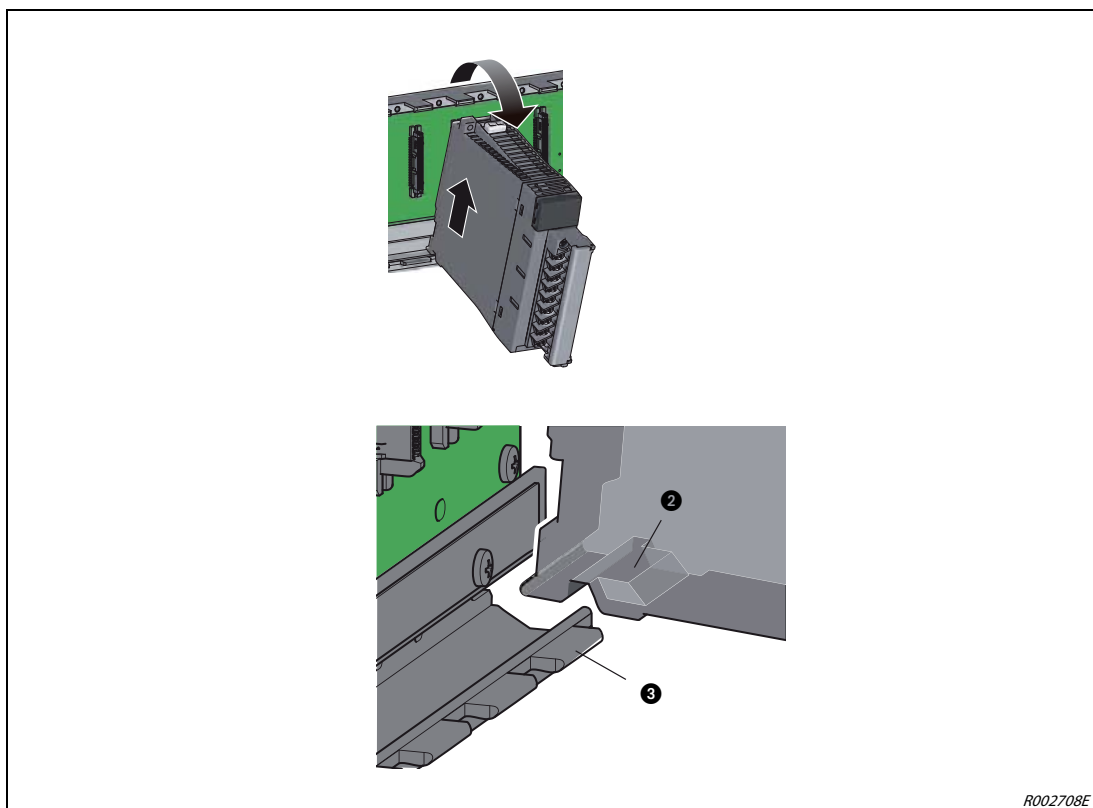
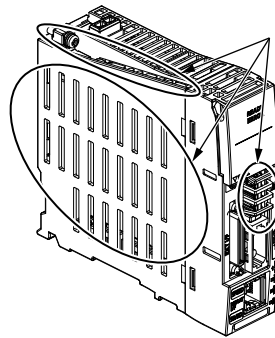


Fig. 3-23: Removal of the modules

**CAUTION:**

When removing the robot CPU, please note that the unit surface may be very hot. There is a possible risk of burns.



Metal parts become hot.

3.6 Grounding the robot system

General instructions on grounding the robot system

Three ways of grounding are shown in Fig. 3-24.

- Separate grounding is the best solution.
 - The robot arm is grounded at an M4 threaded hole (see Tab. 3-8) on the base area.
 - The controller is grounded together with the mains line (feed) connection.
To ground the controller, proceed as described in Section 4.2.
- If possible, the grounding of the robot arm must be separated from other units/devices.
- The minimum cross-section of the grounding cable must be 4,2 mm².
- The grounding cable is not included in the scope of delivery of the robot system.
- The grounding cable should be kept as short as possible.

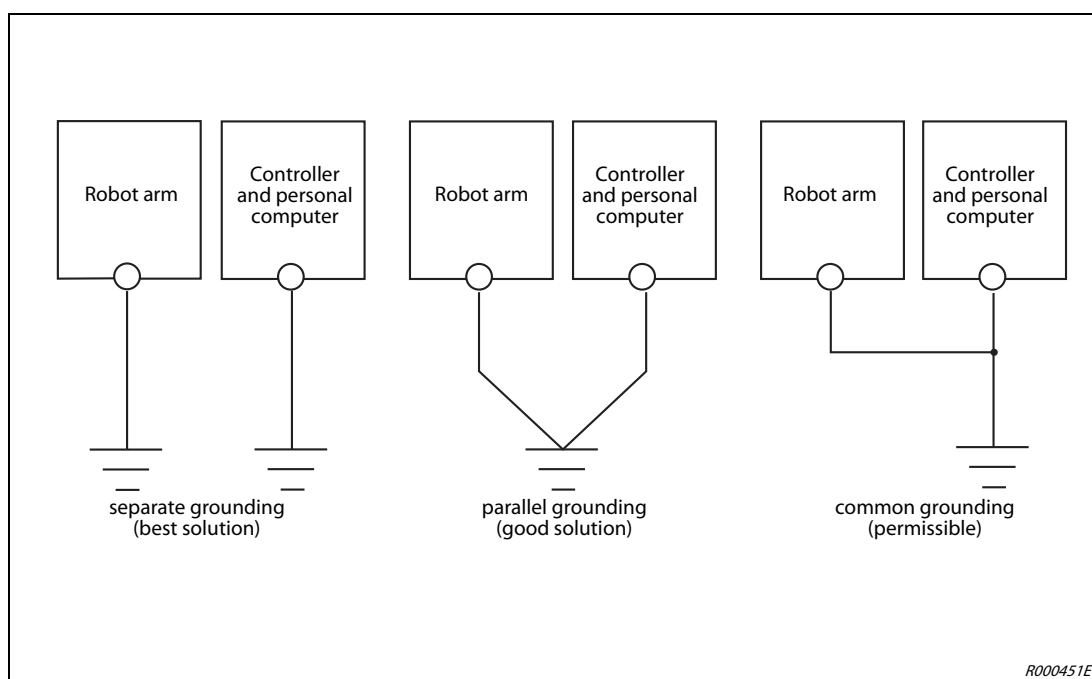
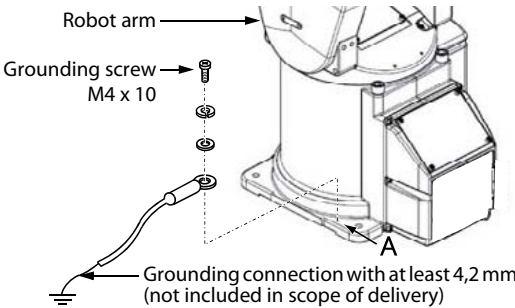
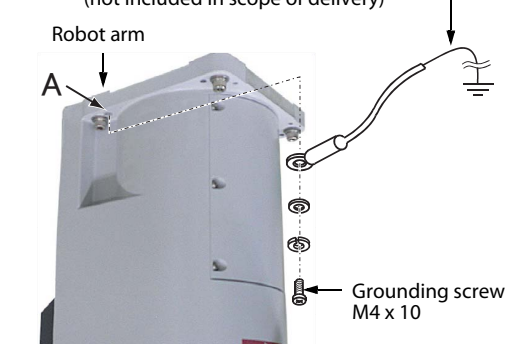
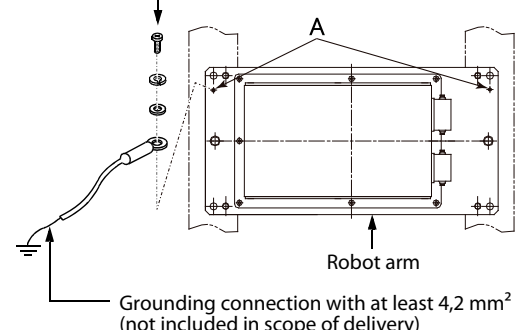
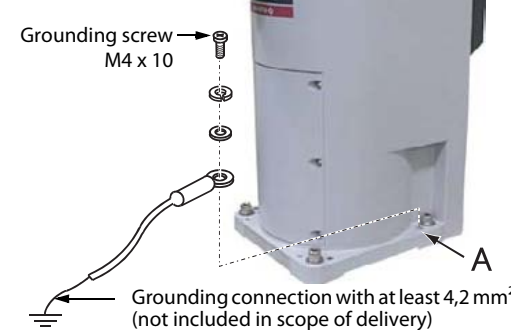


Fig. 3-24: Grounding the robot system

Grounding the robot arm

- ① Use a grounding cable with a minimum cross-section of 4,2 mm².
- ② Check the area around the grounding screw (A) for deposits and remove any using a file.
- ③ Fix the grounding cable with the grounding screw (M4 x 10) to the grounding connection of the robot arm (see here Tab. 3-8).

Vertical articulated robot arm RV-2/4/7/13/20FR	SCARA robot RH-1FRHR
 <p>Robot arm</p> <p>Grounding screw M4 x 10</p> <p>Grounding connection with at least 4,2 mm² (not included in scope of delivery)</p> <p>A</p> <p>R002710E</p>	 <p>Grounding connection with at least 4,2 mm² (not included in scope of delivery)</p> <p>Robot arm</p> <p>A</p> <p>Grounding screw M4 x 10</p> <p>R002711E</p>
SCARA robot RH-3FRHR	SCARA robot RH-3/6/12/20FRH
 <p>Grounding screw M4 x 10</p> <p>A</p> <p>Robot arm</p> <p>Grounding connection with at least 4,2 mm² (not included in scope of delivery)</p> <p>R002712E</p>	 <p>Robot arm</p> <p>Grounding screw M4 x 10</p> <p>A</p> <p>Grounding connection with at least 4,2 mm² (not included in scope of delivery)</p> <p>R002284E</p>

Tab. 3-8: Grounding the robot arm

4 Connection

This chapter explains how to connect the connection cable, the mains connection, the connection of the EMERGENCY-STOP switch and the connection of the Teaching Box.

4.1 Connection of the connection cable

4.1.1 Connect the robot arm to the CR800 controller

The following figure shows the connection of the connection cable between the robot arm and the CR800 controller.

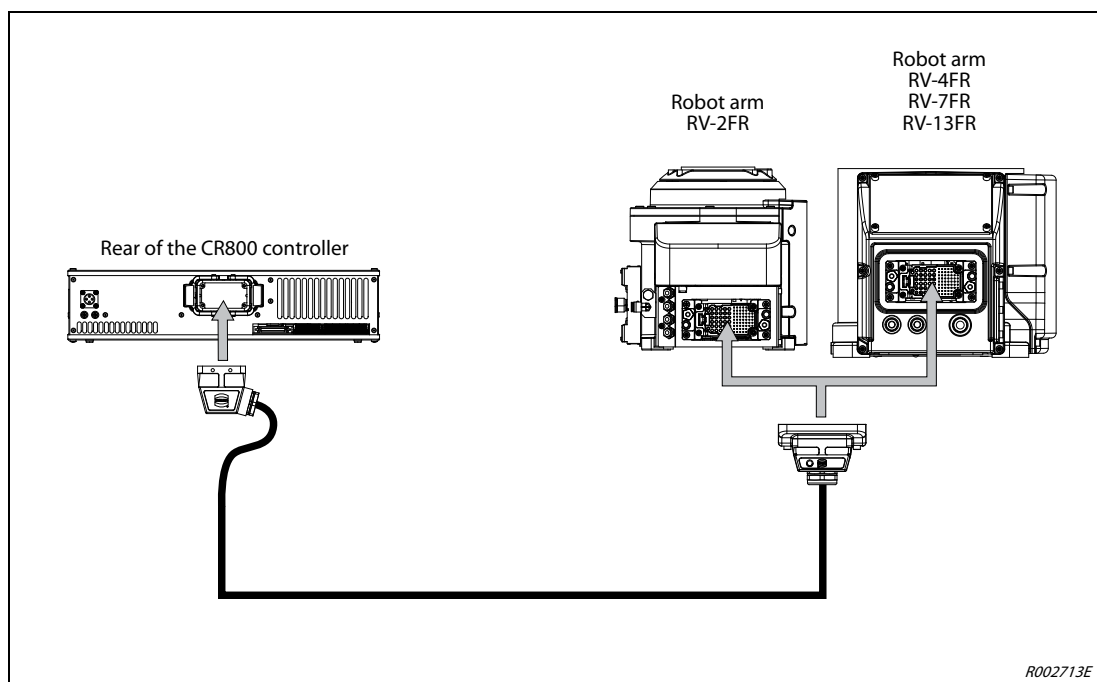


Fig. 4-1: Connection of the connection cable (CR800)

● Connection on the robot arm side

- ① Make sure that the CR800 controller is switched off.
- ② Connect the machine cable to CN1 connector on the robot arm.

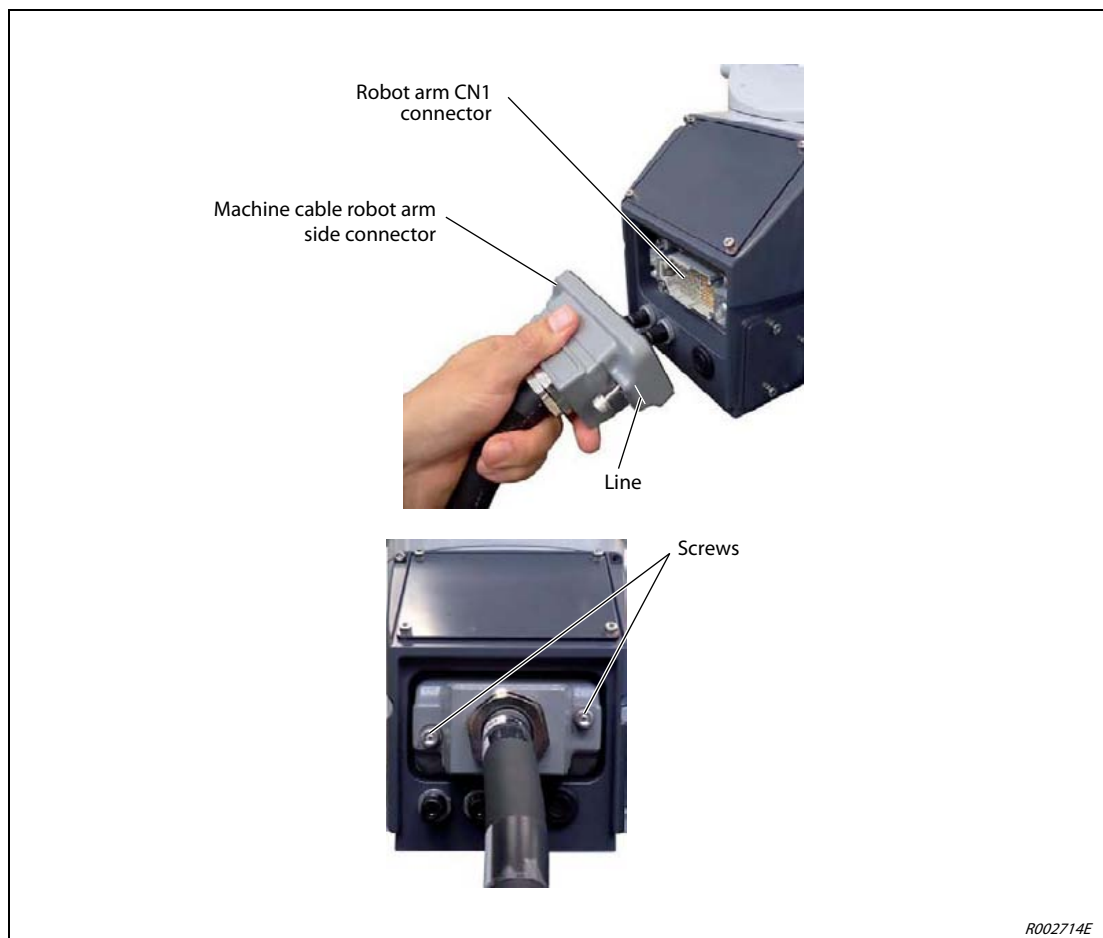


Fig. 4-2: Connecting the machine cable on the robot arm side

- ③ Insert the connector until the connector edge is aligned with the CONBOX surface and tighten two bolts.

NOTE

Refer to page 4-7 for the connection on the controller side.



CAUTION:

The standard connection cable between the robot arm and the controller is only suitable for fixed laying. It must not be used within a dragchain.

RH-1FRHR5515

The following figure shows the connection of the connection cable between the robot arm and the CR800 controller.

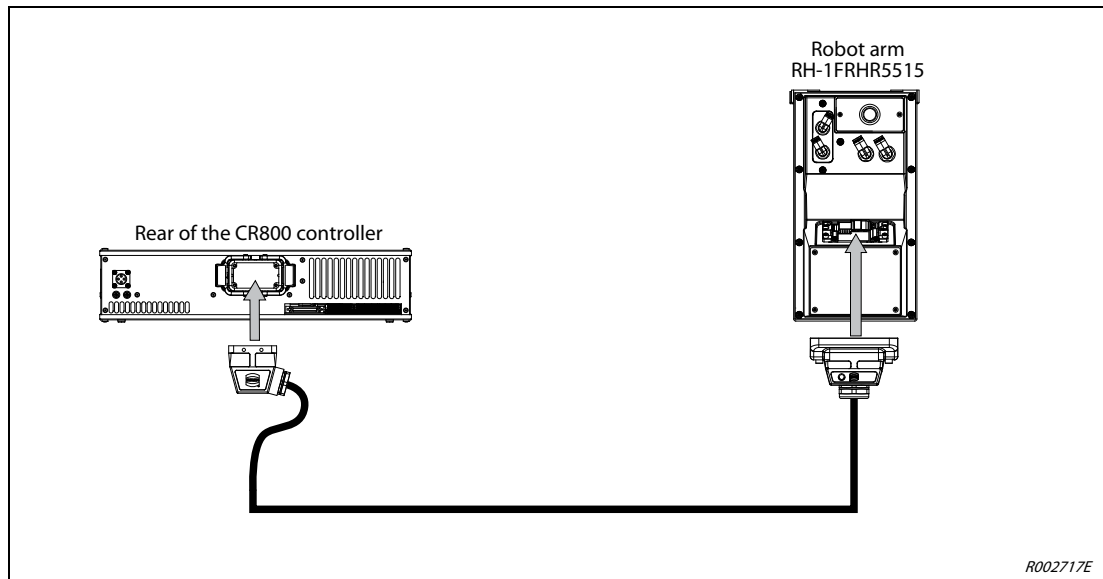


Fig. 4-3: Connection of the connection cable (CR800)

● Connection on the robot arm side

- ① Make sure that the CR800 controller is switched off.
- ② Connect the machine cable to CN1 connector on the robot arm.



Fig. 4-4: Connecting the machine cable on the robot arm side

- ③ Insert the connector until the connector edge is aligned with the CONBOX surface and tighten two bolts.

NOTE

Refer to page 4-7 for the connection on the controller side.



CAUTION:

The standard connection cable between the robot arm and the controller is only suitable for fixed laying. It must not be used within a dragchain.

RH-3FRHR and RH-3FRH/6FRH/12FRH/20FRH

The following figure shows the connection of the connection cable between the robot arm and the CR800 controller.

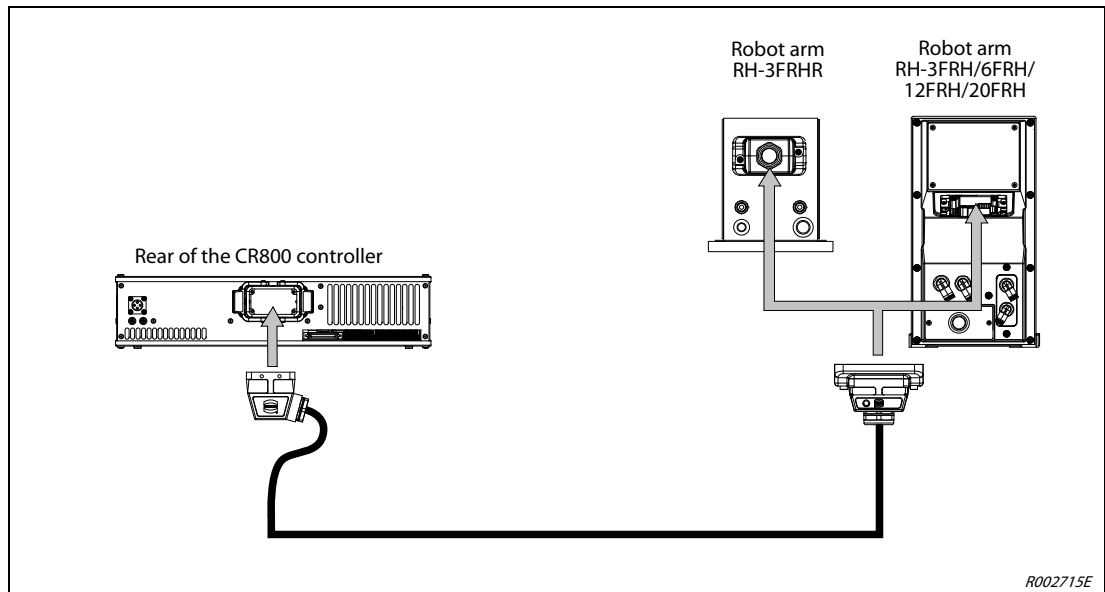


Fig. 4-5: Connection of the connection cable (CR800)

● Connection on the robot arm side

- ① Make sure that the power of the CR800 controller is switched off.
- ② Connect the machine cable to CN1 connector on the robot arm.



Fig. 4-6: Connecting the machine cable on the robot arm side

- ③ Insert the connector until the connector edge is aligned with the CONBOX surface and tighten two bolts.

NOTE

Refer to page 4-7 for the connection on the controller side.



CAUTION:

The standard connection cable between the robot arm and the controller is only suitable for fixed laying. It must not be used within a dragchain.

● Connection on the controller side

- ① Make sure that the power of the CR800 controller is switched off.
- ② Connect the controller side connector of the machine cable to CN1 connector on the rear side of the controller
- ③ To fix the inserted connector, close the latches of the CN1 connector.

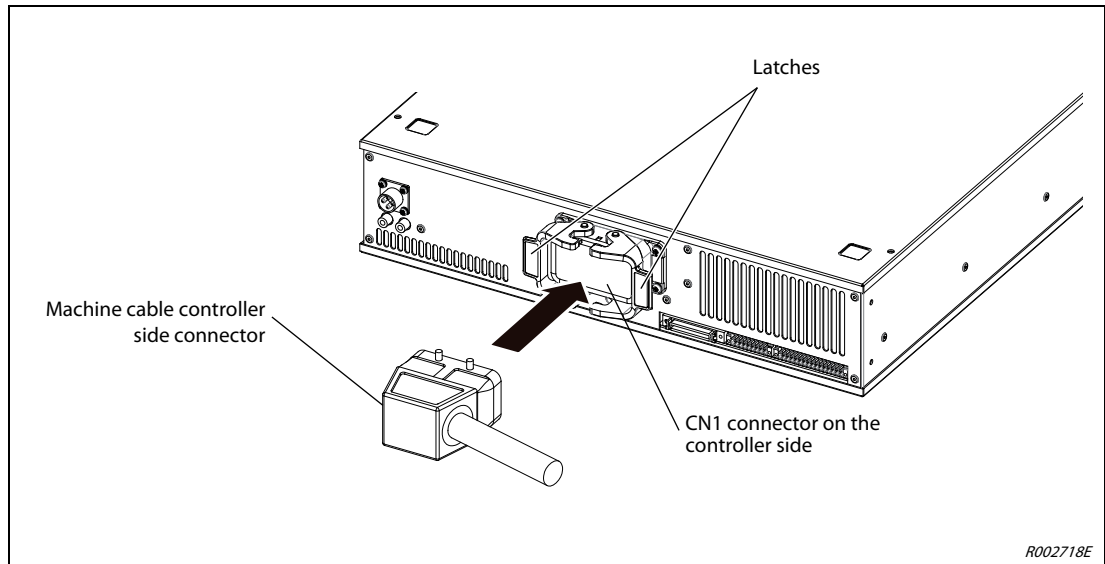


Fig. 4-7: Connection of the connection cable on the controller side

4.1.2 Connection of robot CPU to the drive unit

CR800 drive unit



CAUTION:

- **Always place the protective cap on the SSCNETIII/H connection when no cable is connected. Otherwise, soiling may lead to an impairment in the transmission and to malfunctions.**
- **Do not remove the SSCNETIII/H cable as long as the power supply of the CPU system or the drive unit is switched on.**
Never look directly into the light emitted from the robot CPU or the SSCNETIII/H connections of the drive unit, or into the open end of the SSCNETIII/H cable. The light emitted from these complies with the IEC60825-1 standard of laser class 1 and may result in an irritation to the eyes if viewed directly.

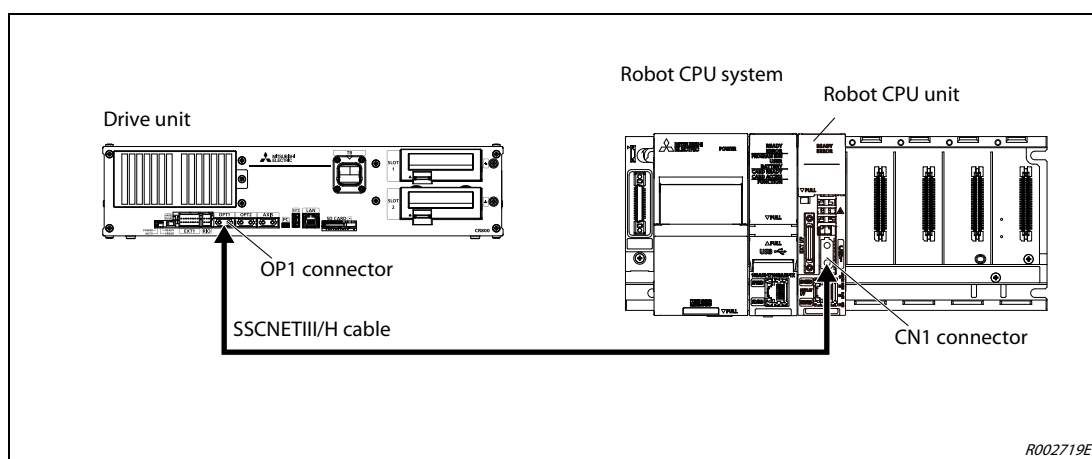


Fig. 4-8: Connection of robot CPU and CR800 drive unit

R002719E

4.2 Mains connection and grounding

Refer to Section 3.6 on how to ground the robot arm.



CAUTION:

- **Only carry out connection work at the controller when the main switch for the power supply is switched off and protected against being switched back on.**
- **Please install the earth leakage breaker in the primary side power supply of the controller because of leakage protection.**

4.2.1 CR800 controller

- ① Make sure that the mains voltage and the power switch of the controller are switched off.
- ② Prepare the mains line (feed) and the grounding cable. Use cable with a minimum cross-section of 2 mm².
- ③ Connect the ACIN cable to the breaker. Connect the power terminals of the ACIN cable to the secondary side terminals of the earth leakage breaker. Also, ground the FG terminal of the cable.
- ④ Connect the ACIN cable to the ACIN connector on the rear of the controller.
- ⑤ Connect one end of the grounding cable to the PE (protective earth) terminal on the controller and ground the other end.
- ⑥ Connect the primary power cable to the primary side terminal of the earth leakage breaker.

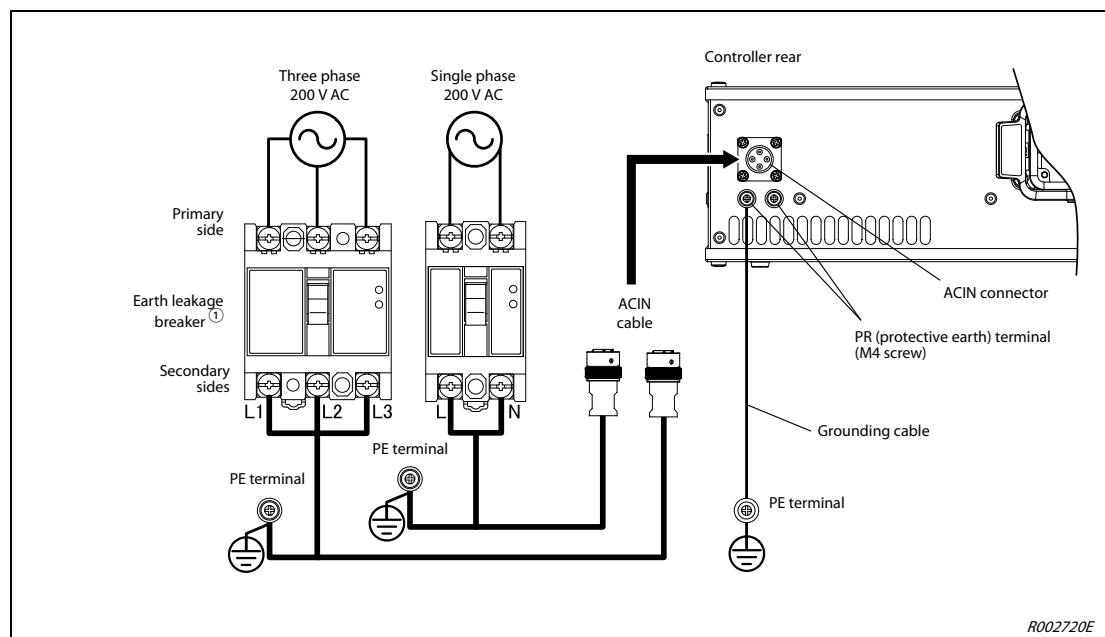


Fig. 4-9: Connection of mains line and grounding on CR800 controller

- ① Recommended earth leakage breaker:
Single phase: NV30FAU-2P-10A-AC100-240V-30mA, (Terminal cover: TCS-05FA2)
Three phase: NV30FAU-3P-10A-AC100-240V-30mA, (Terminal cover: TCS-05FA3)

4.3 EMERGENCY-STOP connection

Connection for EMERGENCY-STOP pushbutton is using the plug on the rear of the unit for the CR800 controller.

The EMERGENCY-STOP inputs are normally blank (see Fig. 4-10). The EMERGENCY-STOP pushbutton, the door closing contact and the enable switch (enabling) unit must be connected by the user.

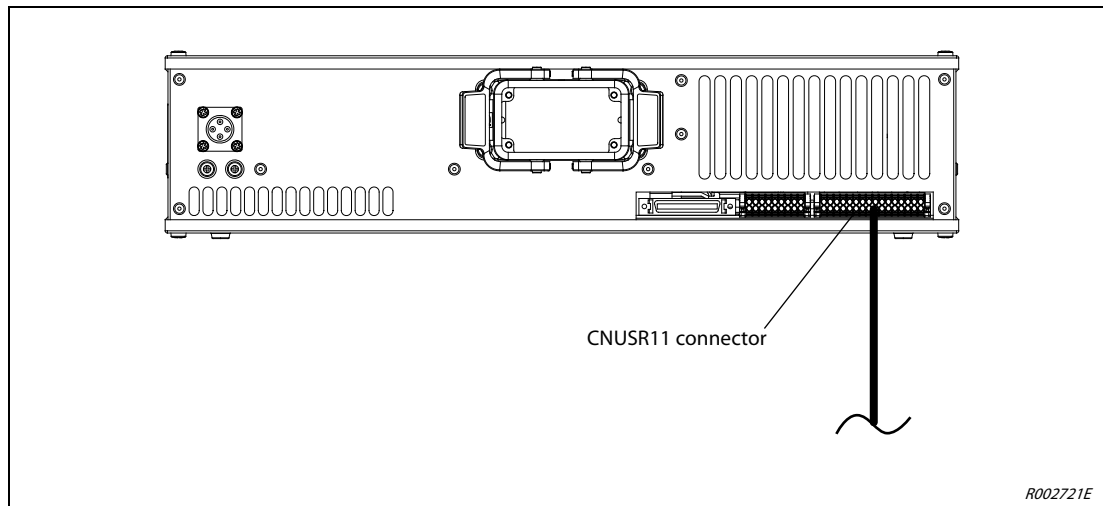


Fig. 4-10: Connection for EMERGENCY-STOP circuit

4.3.1 CR800 controller


CAUTION:

Do not carry out a surge voltage test.

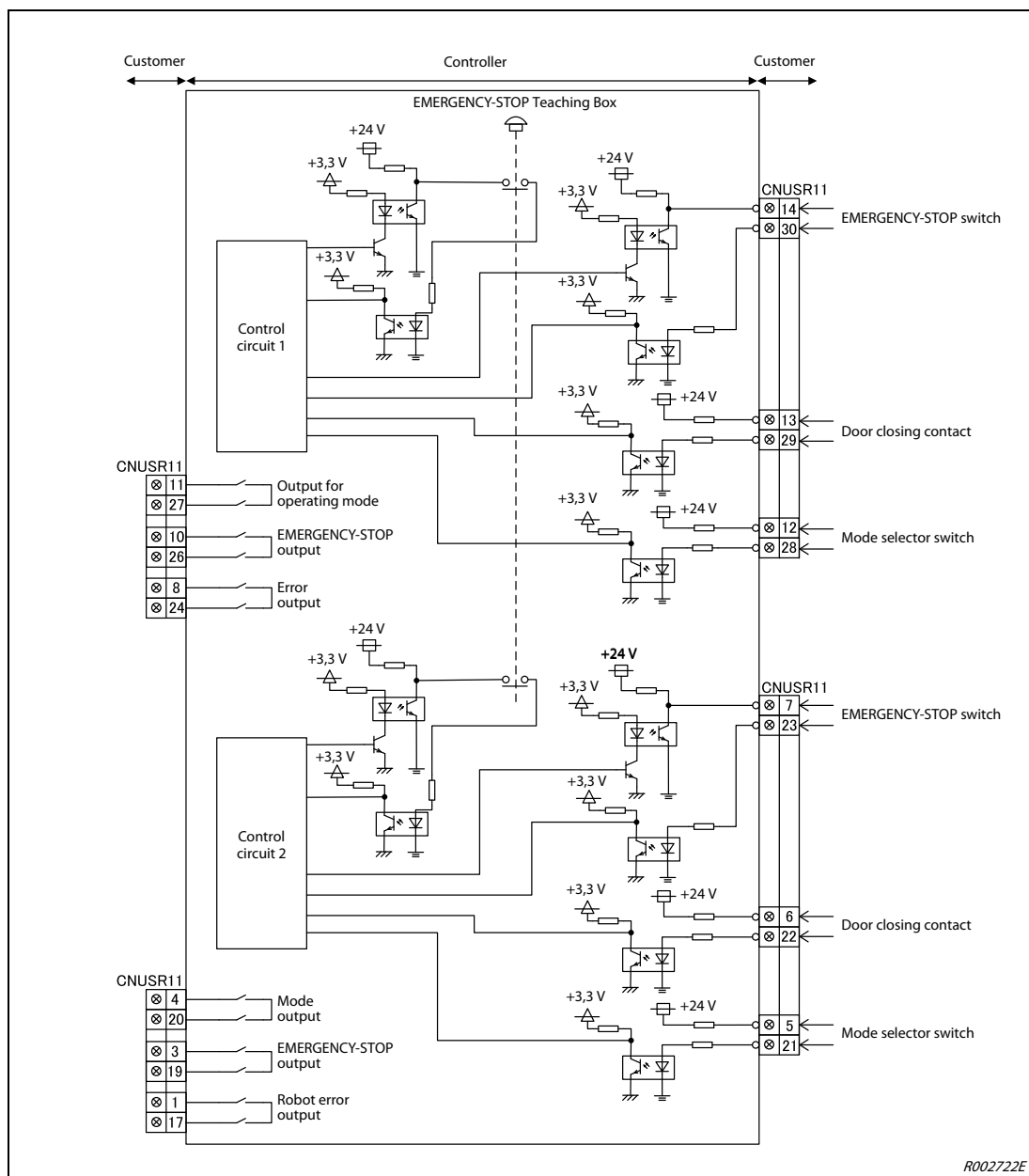


Fig. 4-11: Internal wiring of EMERGENCY-STOP circuit (CR800)


CAUTION:

Connect the EMERGENCY-STOP switch at an easily accessible location near the robot. If the robot behaves erratically then you must stop it immediately.

Connection to the connectors CNUSR11/12

In this plug connection the cable is screw-fastened to the connector. Please use an 0.2 to 1.5 mm² connector cable.

- ① Prepare the user wiring connector (attachment).
- ② Remove approx. 7 mm of the line shielding.
- ③ Insert the cable all the way in the insertion hole while pressing down the latch on the user wiring connector with a flatblade screwdriver.
- ④ When all the required wirings have been completed, fit the user wiring connector (CNUSR11/ CNUSR12) into the corresponding connector (CNUSR11/CNUSR12 port) on the controller.
- ⑤ When the user wiring connector has properly fitted, the levers on both sides of the connector rise and the connector is fixed. (To dismount the connector, lower the levers.)

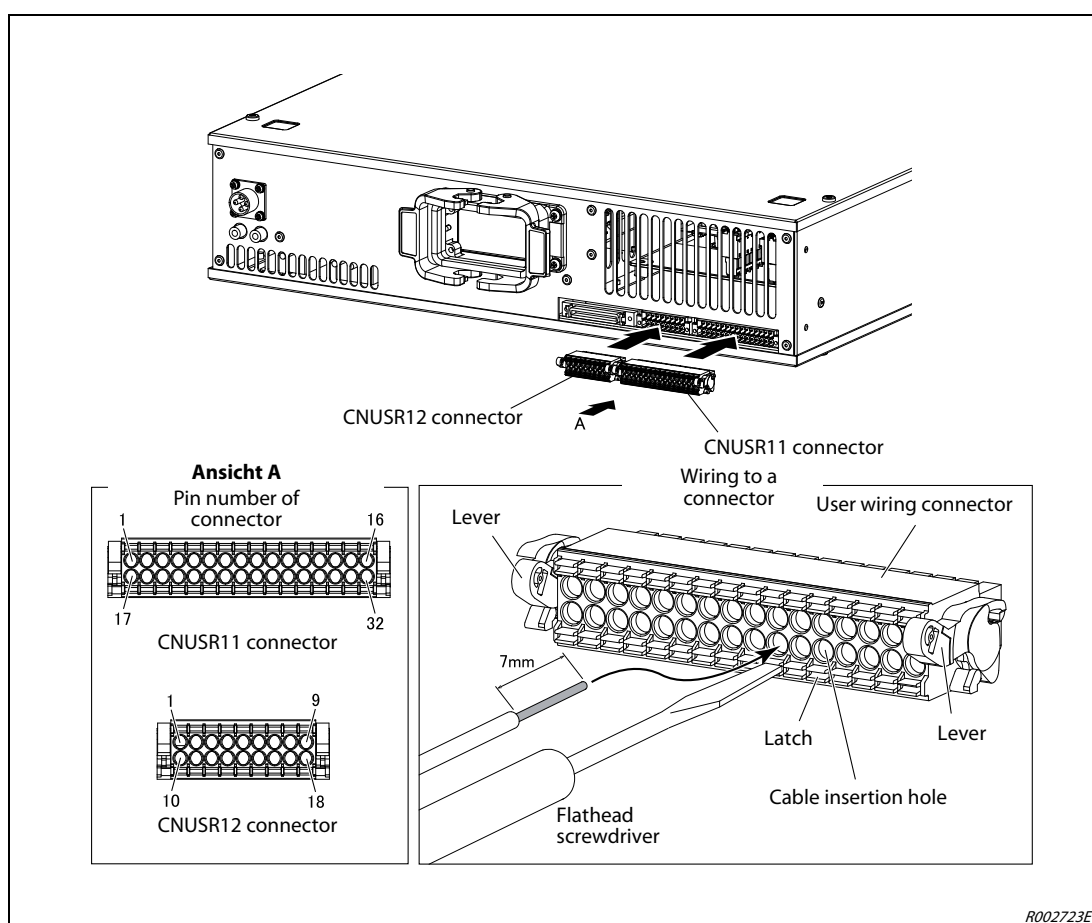


Fig. 4-12: Connection to the connectors CNUSR11/12



CAUTION:

The connector on the controller side that connects to the user wiring connector is CNUSR11 or CNUSR12. Be careful not to connect to CNUSR13 as the robot will not operate properly.

4.4 Safety circuits

4.4.1 CR800 controller

Example 1

Connect the EMERGENCY-STOP switch of peripheral equipment to the controller. The power supply for EMERGENCY-STOP input uses the power supply in the controller.

Operation of the EMERGENCY-STOP:

If the EMERGENCY-STOP switch of peripheral equipment is pushed, the robot will also be in the EMERGENCY-STOP state.

NOTE

To facilitate clarity, some information has been omitted from the figure; the figure therefore deviates from the actual conditions of the product.

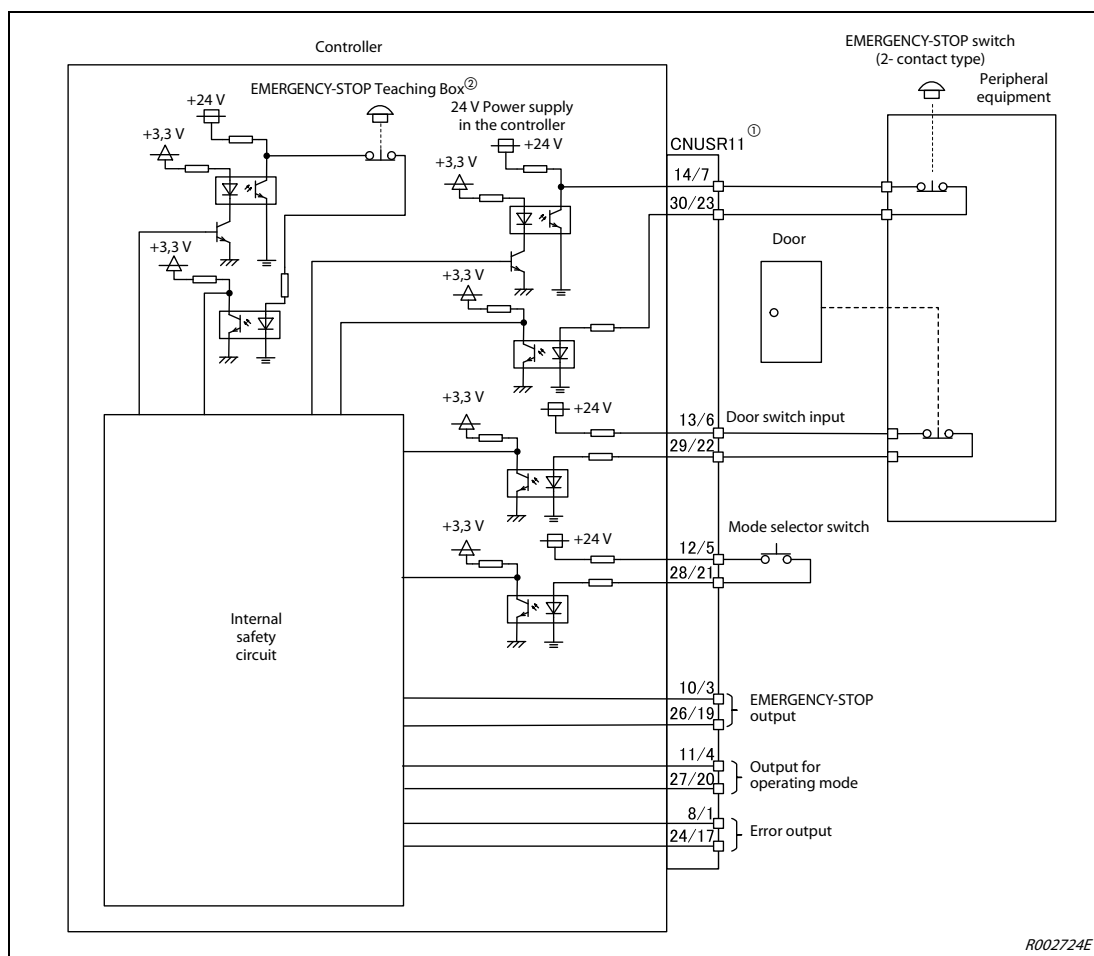


Fig. 4-13: Configuration of a safety circuit (Example 1)

- ① The CNUSR11 connector is a two-level terminal block, indicating that there are two circuits (channels). Two terminals (cable insertion holes) need to be used for one circuit.
- ② The EMERGENCY-STOP button of the Teaching Box is connected with the controller.

Example 2

Connect the EMERGENCY-STOP switch, door switch, and enabling device of peripheral equipment to the controller. The power supply for EMERGENCY-STOP input uses the internal power supply of the controller. Monitor the EMERGENCY-STOP state by the peripheral equipment side.

Operation of the EMERGENCY-STOP:

If the EMERGENCY-STOP switch of peripheral equipment is pushed, the robot will also be in the EMERGENCY-STOP state. And, if the EMERGENCY-STOP switch of Teaching Box is pushed in the state of the power of controller OFF, peripheral equipment state can be the EMERGENCY-STOP also.

NOTE

To facilitate clarity, some information has been omitted from the figure; the figure therefore deviates from the actual conditions of the product.

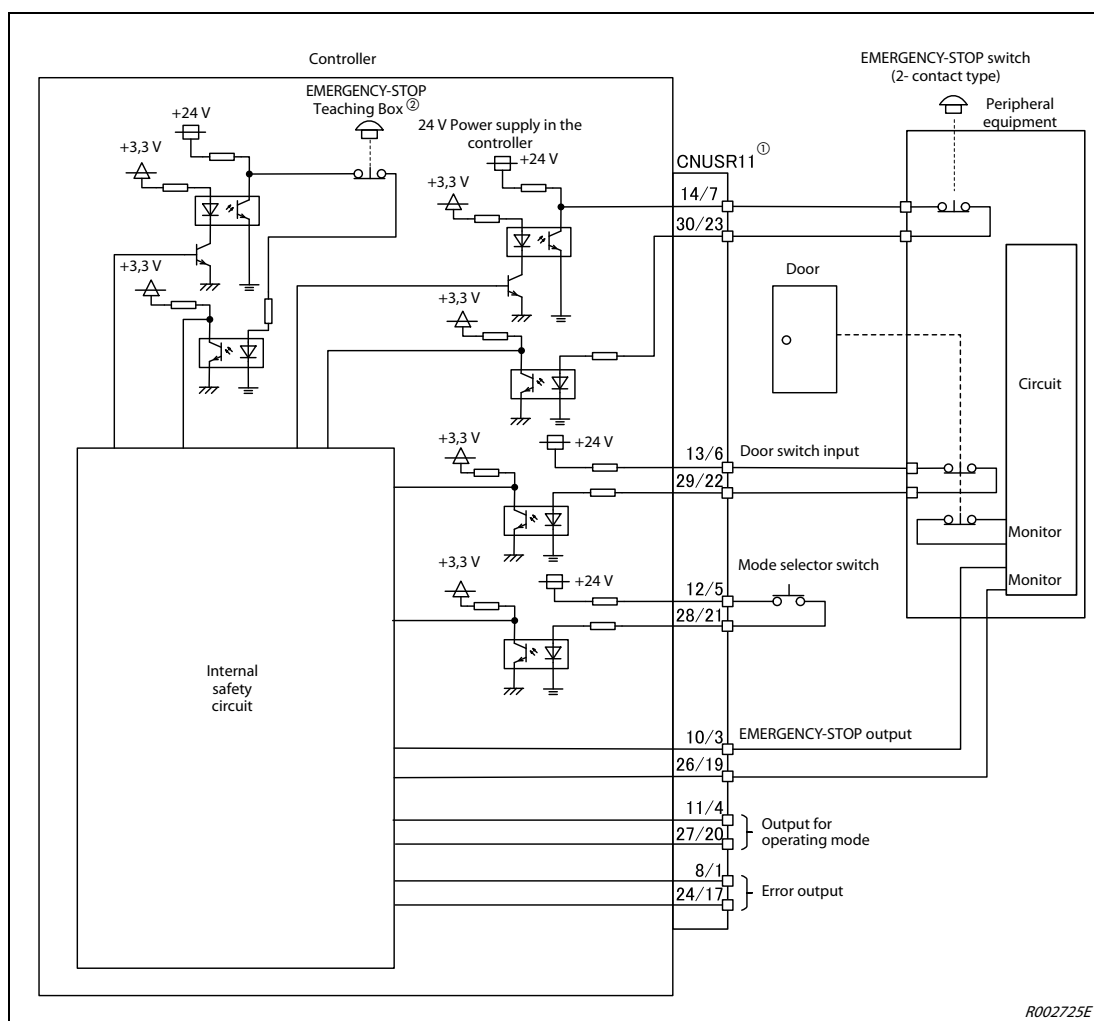


Fig. 4-14: Configuration of a safety circuit (Example 2)

- ① The CNUSR11 is a two-level terminal block, indicating that there are two circuits (channels). Two terminals (cable insertion holes) need to be used for one circuit.
- ② The EMERGENCY-STOP button of the Teaching Box is connected with the controller.

Example 3

Connect the EMERGENCY-STOP switch of peripheral equipment, and the door switch to two controllers, and it interlocks. Connect the enabling switch to the robot controllers. The power supply for EMERGENCY-STOP input uses the internal power supply of the controller. Monitor the EMERGENCY-STOP state by the peripheral equipment side.

Operation of the EMERGENCY-STOP:

If the EMERGENCY-STOP switch of peripheral equipment is pushed, the robot will also be in the EMERGENCY-STOP state. And, if the EMERGENCY-STOP switch of Teaching Box is pushed in the state of the power of the controller is OFF, peripheral equipment state can be the EMERGENCY-STOP also.

NOTE

To facilitate clarity, some information has been omitted from the figure; the figure therefore deviates from the actual conditions of the product.

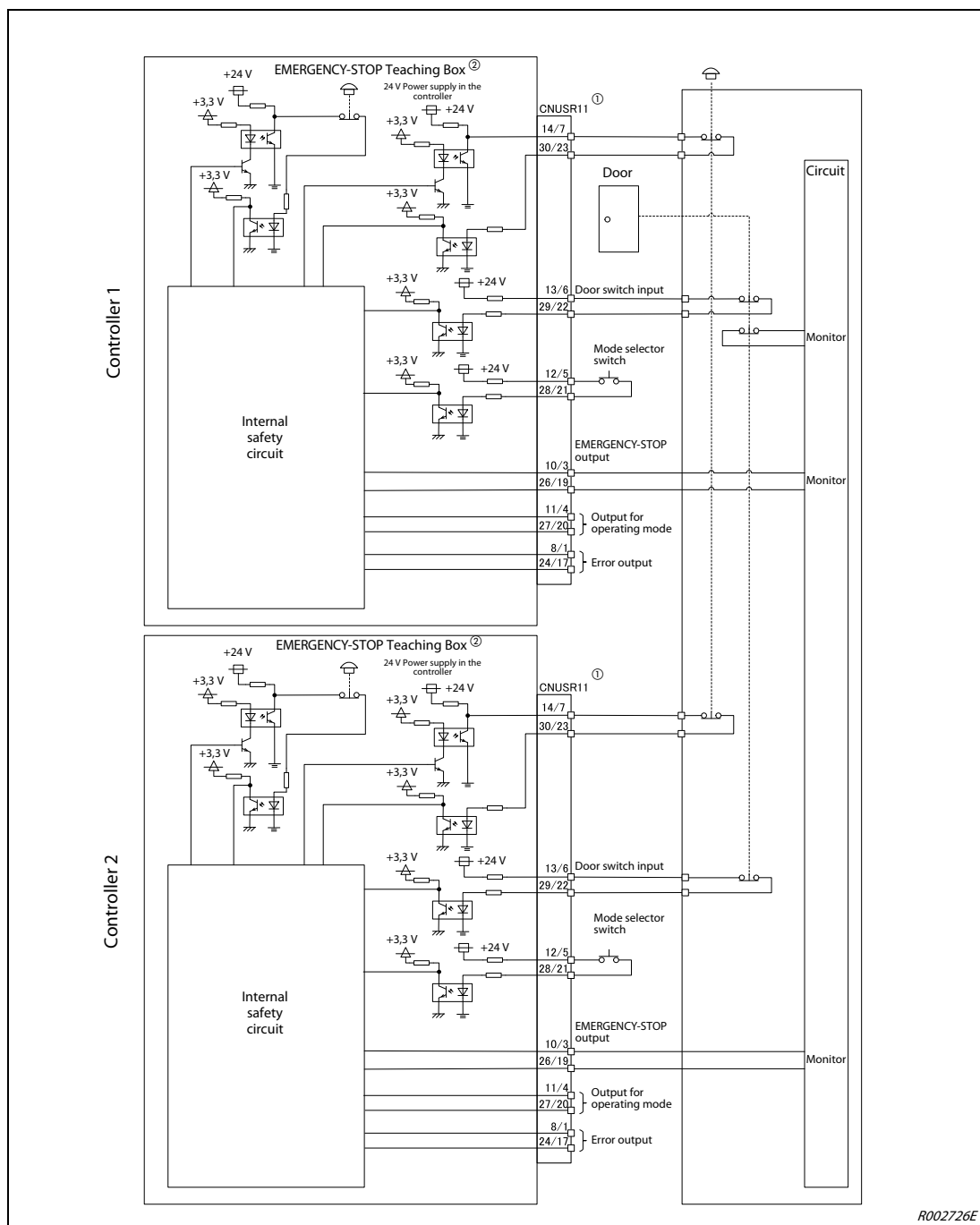


Fig. 4-15: Configuration of a safety circuit (Example 3)

- ① The CNUSR11 is a two-level terminal block, indicating that there are two circuits (channels). Two terminals (cable insertion holes) need to be used for one circuit.
- ② The EMERGENCY-STOP button of the Teaching Box is connected with the controller.

Example 4

Connect the controller to the safety relay. Use the controller's EMERGENCY-STOP button command as an input to the safety relay.

NOTE

To facilitate clarity, some information has been omitted from the figure; the figure therefore deviates from the actual conditions of the product.

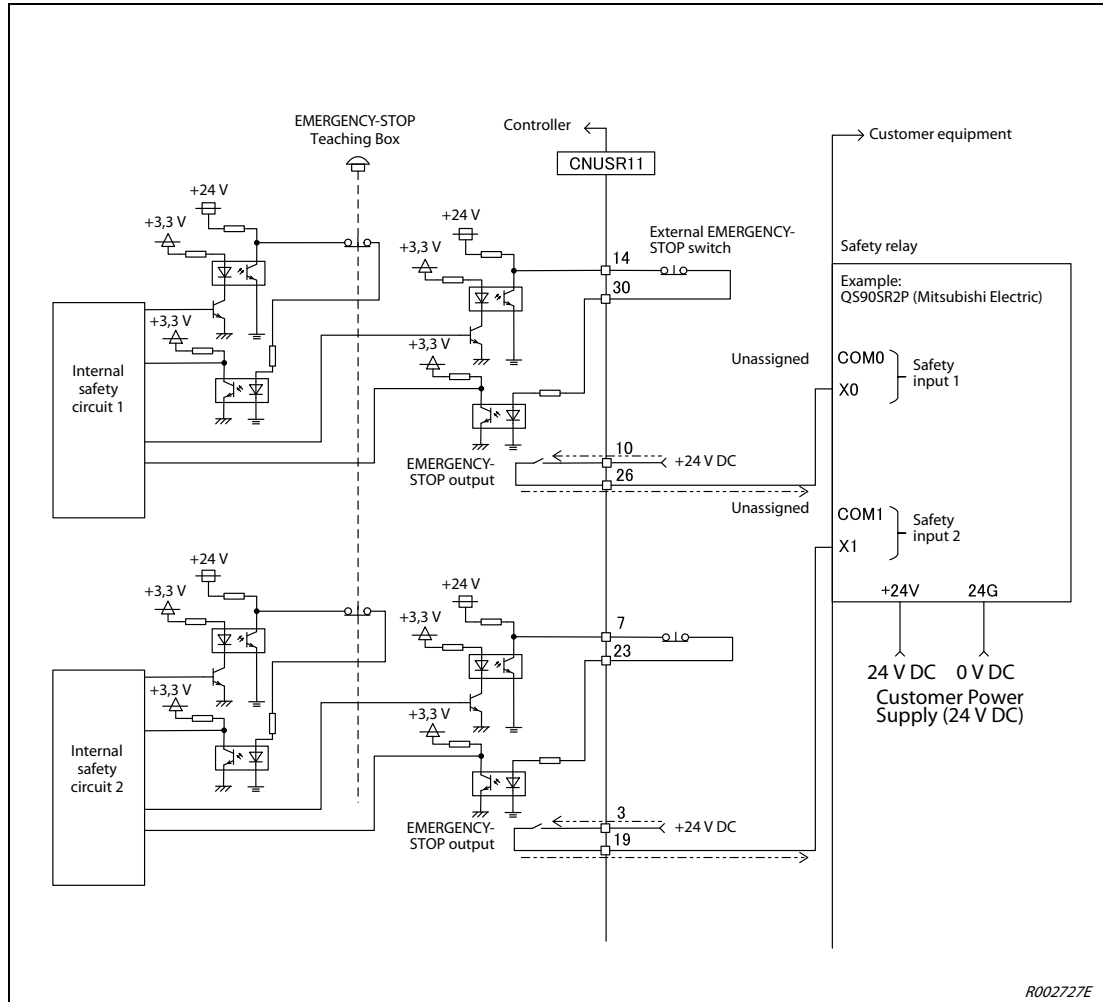


Fig. 4-16: Configuration of a safety circuit (Example 4)



CAUTION:

- The performance of this product must be compliant with the requirements of ISO 13849-1 Category 4. The product cannot be used in the condition comparable to Category 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. QS90SR2SP (Manufacture: Mitsubishi Electric Corporation)).
- 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 3 and 10 terminal of CNUSR11 connector to 24 V.

4.5 Mode changeover switch connection

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.

MANUAL..... When 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.

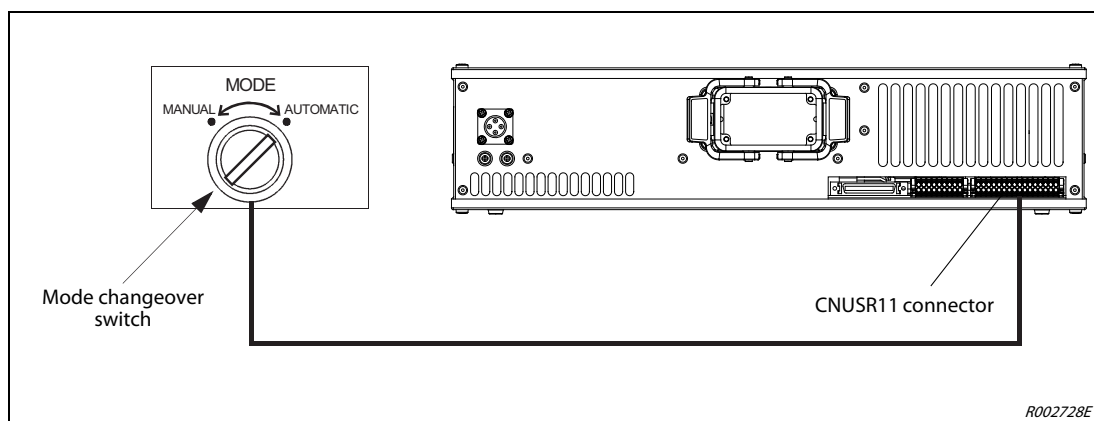


Fig. 4-17: Connection of the Mode changeover switch

Pin number and Function (Connector: CNUSR11)		Change mode ^①	
Pin-No.	Function	MANUAL	AUTOMATIC
21	1st line KEY input	Open	Close
5	Power supply +24 V of pin number 21		
28	2nd line KEY input	Open	Close
12	Power supply +24 V of pin number 28		

Tab. 4-1: Function of the key switch interface

① The mode changes by both opening or both closing between 21-5 pin and between 28-12 pin. Maintain the current mode except it.

NOTE

The contact capacity of each input/output terminal is 24 V DC/100 mA. 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 24 V 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.

4.6 Teaching Box connection

This section describes how to connect the Teaching Box with the supply voltage turned off. If the connection is established or terminated with the supply voltage turned on then an error message is issued.

However, it allows you to remove the T/B from the controller without occurrence of alarm by pulling out the T/B connector within five seconds while the 3-position enable switch of the T/B is being pulled up lightly (in the position 2).



CAUTION:

Do not pull or bend the connection cable excessively! This could otherwise damage the cable.

Connection of the Teaching Box

- ① Switch off the controller.
- ② Connect the Teaching Box cable to the Teaching-Box connection of the controller. The lock must point upwards. You hear a click when the connection is correct.

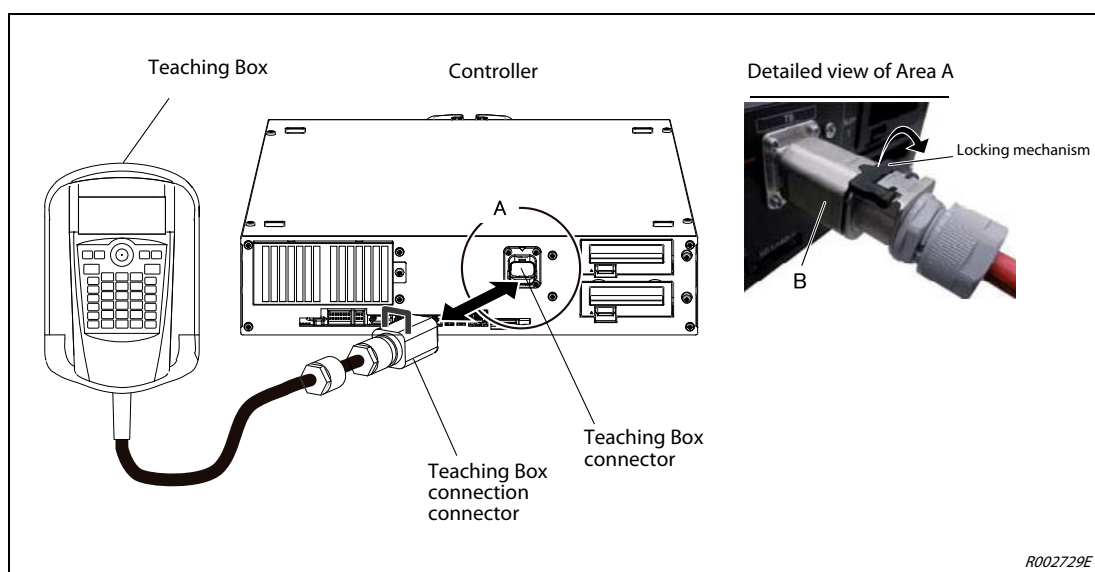


Fig. 4-18: Teaching Box connection

Release the connection between the controller and the Teaching Box

- ① Switch off the controller.
- ② Lift the lock upwards on the Teaching Box plug connector. Take hold of the plug in Area B and pull it upwards and out.
- ③ Install the dummy plug if you want to operate the robot without connecting the Teaching Box.

5 Startup

5.1 Switch on the robot system

5.1.1 Work flow

This section provides you step-by-step instructions on how to switch on the control voltage and the Teaching Box.

5.1.2 Prepare the system for maintenance mode

The preparations to be made for calling-up the maintenance menu are described in the following section.

Step 1: Switch on the supply voltage

**DANGER:**

Make sure that there is no-one within the movement area of the robot arm.

Controller CR800

- ① Turn ON the switch of the earth leakage breaker of the controller.
- ② The controller power turns on, and the power lamp lights up.

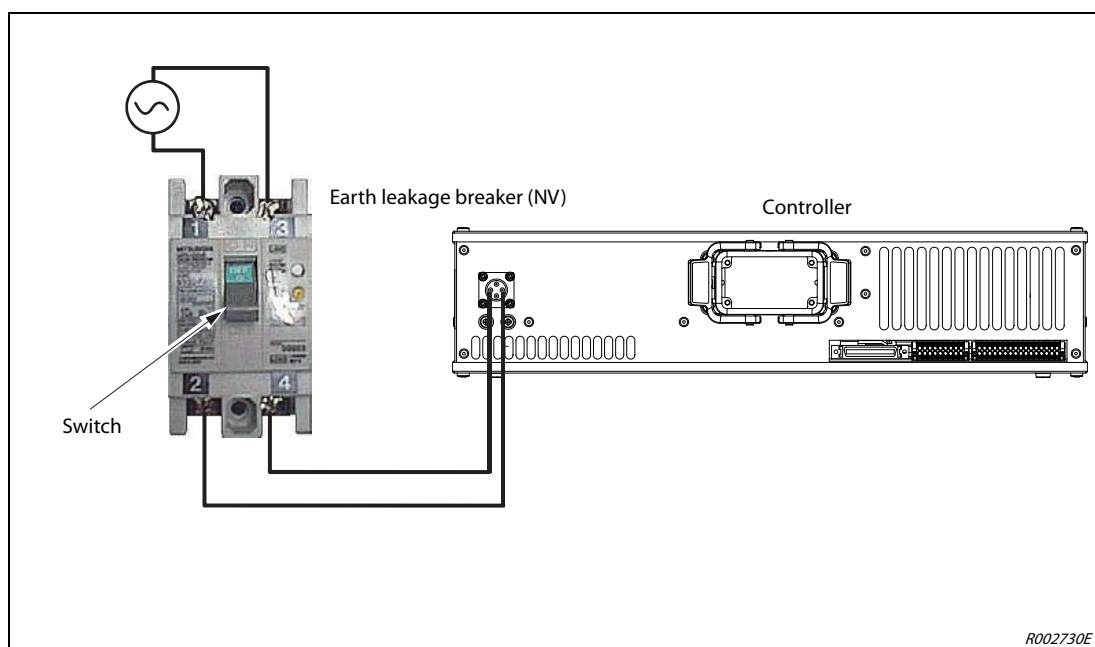


Fig. 5-1: Switch on the power supply

Step 2: Switch on the Teaching Box

- ① Set the [MODE] switch of the controller to "MANUAL".
- ② Set the [ENABLE/DISABLE] switch of the Teaching Box to "ENABLE".
- ③ The main menu appears on the display.

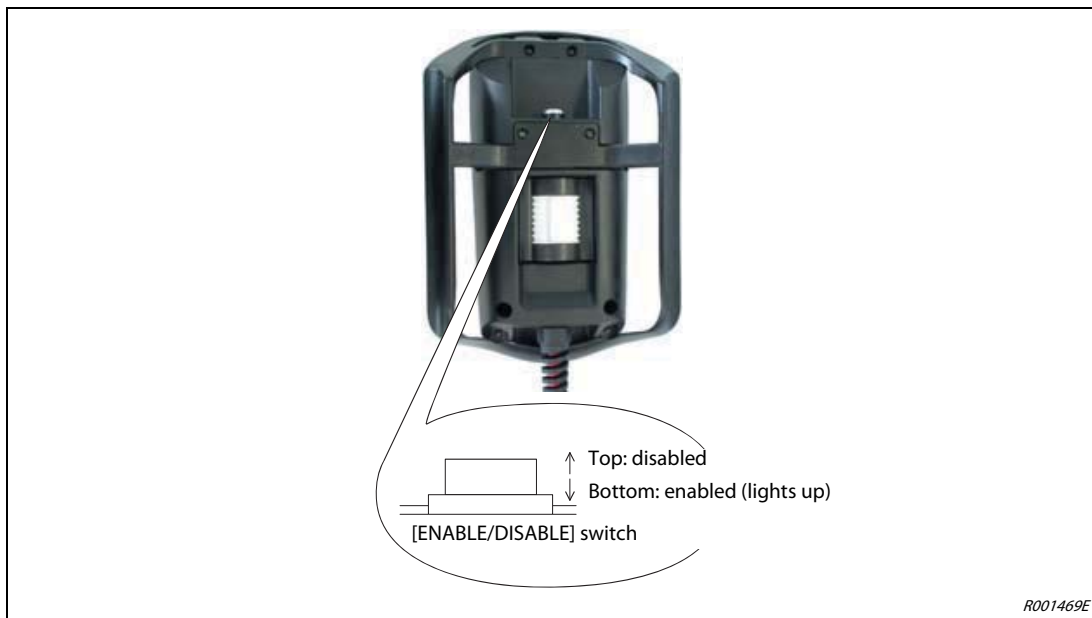


Fig. 5-2: Switch on the Teaching Box

**CAUTION:**

To gain sole control of the robot system, you must set the [ENABLE/DISABLE] switch of the Teaching Box to the "ENABLE" position. The control functions at the controller are disabled in this state. For safety reasons, all EMERGENCY-STOP and STOP switches on the system are always active.

5.1.3 Changing controller type

This section shows how to change a controller's type.

Changing from CR800-D to CR800-R

- ① Start up as CR800-D. (Connection with robot is necessary.)

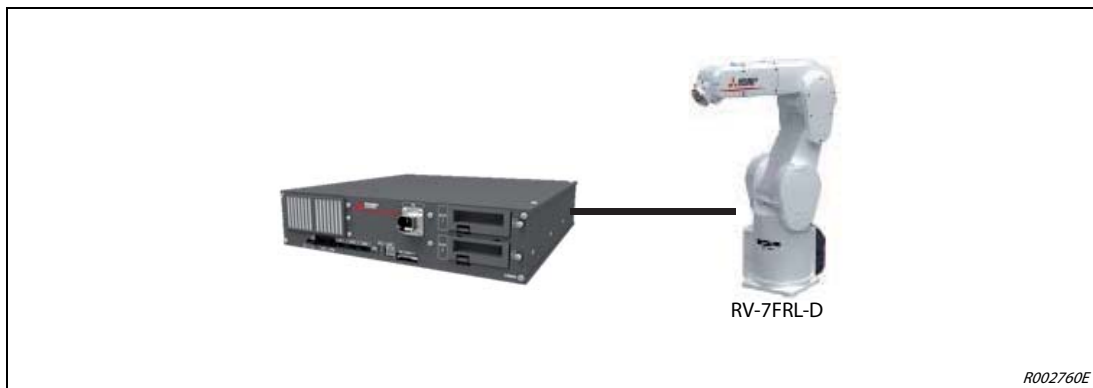


Fig. 5-3: Connect the robot to the controller CR800-D

- ② Change the setting value of parameter (IQRMODE) from 0 to 1. Power turn off.

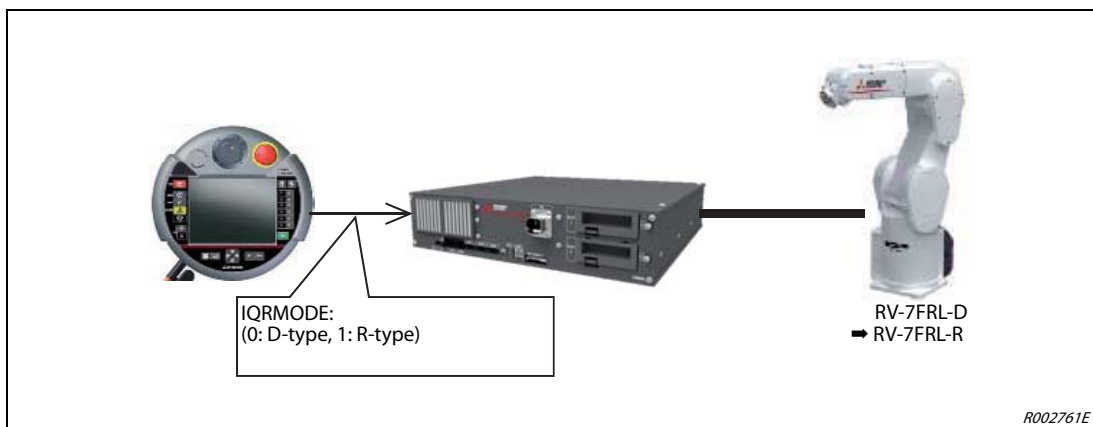


Fig. 5-4: Change parameter IQRMODE from 0 to 1

- ③ Set R16RTCPU SW is 4, and connect R16RTCPU to CR800. Power turn on.



Fig. 5-5: Set SW to 4

- ④ Set R16RTCPU SW is 0. Power turn off and turn on.



Fig. 5-6: Set SW to 0

- ⑤ The model information and the origin information are automatically set. (Programs and parameters are initialized.)

Changing from CR800-R to CR800-D

- ① Start up as CR800-R. (Connection with robot is necessary.)



Fig. 5-7: Connect the robot to the controller CR800-R

- ② Change the setting value of parameter (IQRMODE) from 1 to 0. Power turn off.

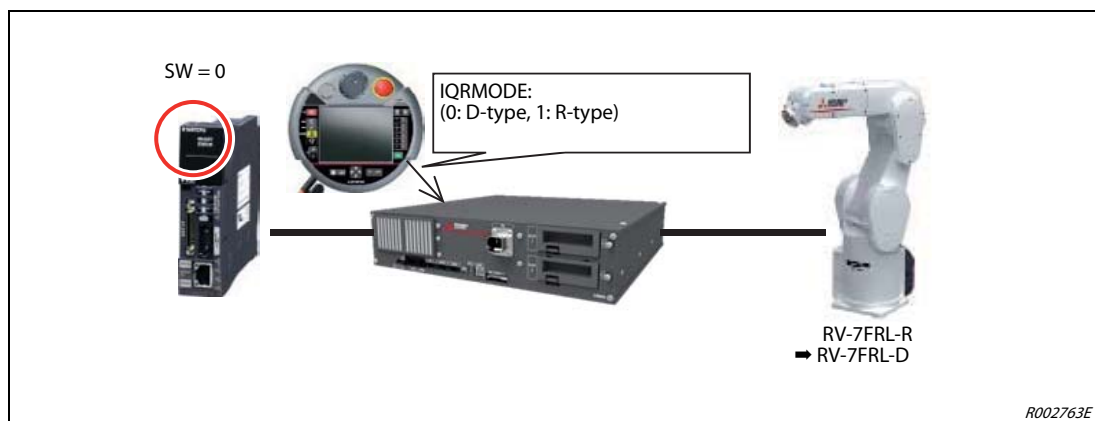


Fig. 5-8: Change parameter IQRMODE from 1 to 0

- ③ Remove R16RTCPU.

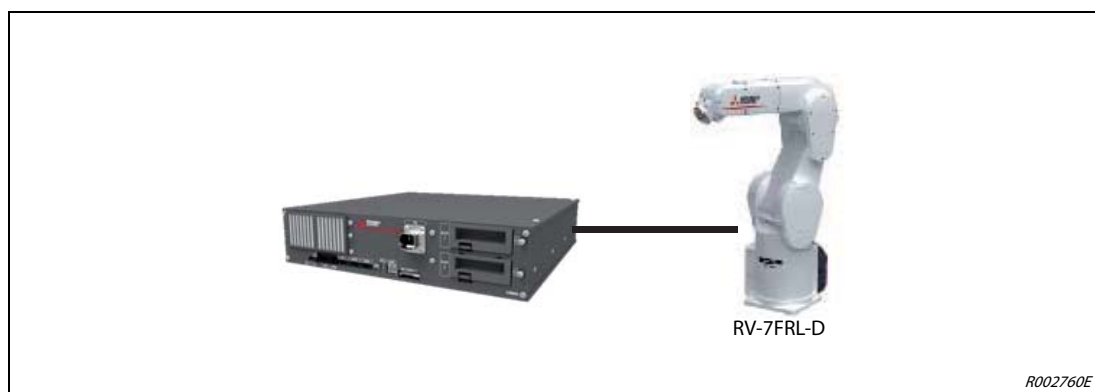


Fig. 5-9: Remove R16RTCPU.

- ④ The model information and the origin information are automatically set. (Programs and parameters are initialized.)

6 Operation of Teaching Box (R32TB)

This section describes the operation of the Teaching Box and the functions of the individual menus.

6.1 Menu tree

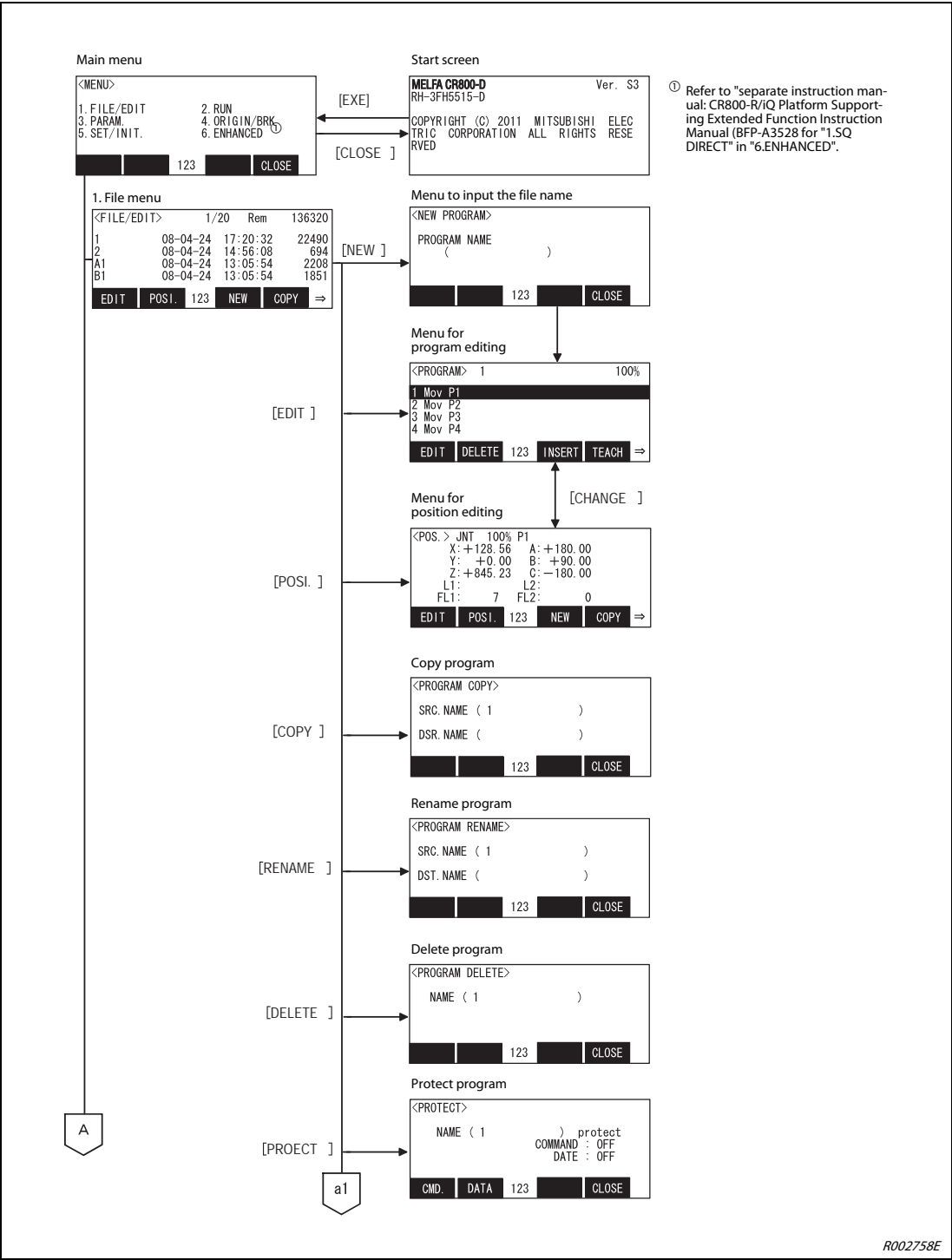
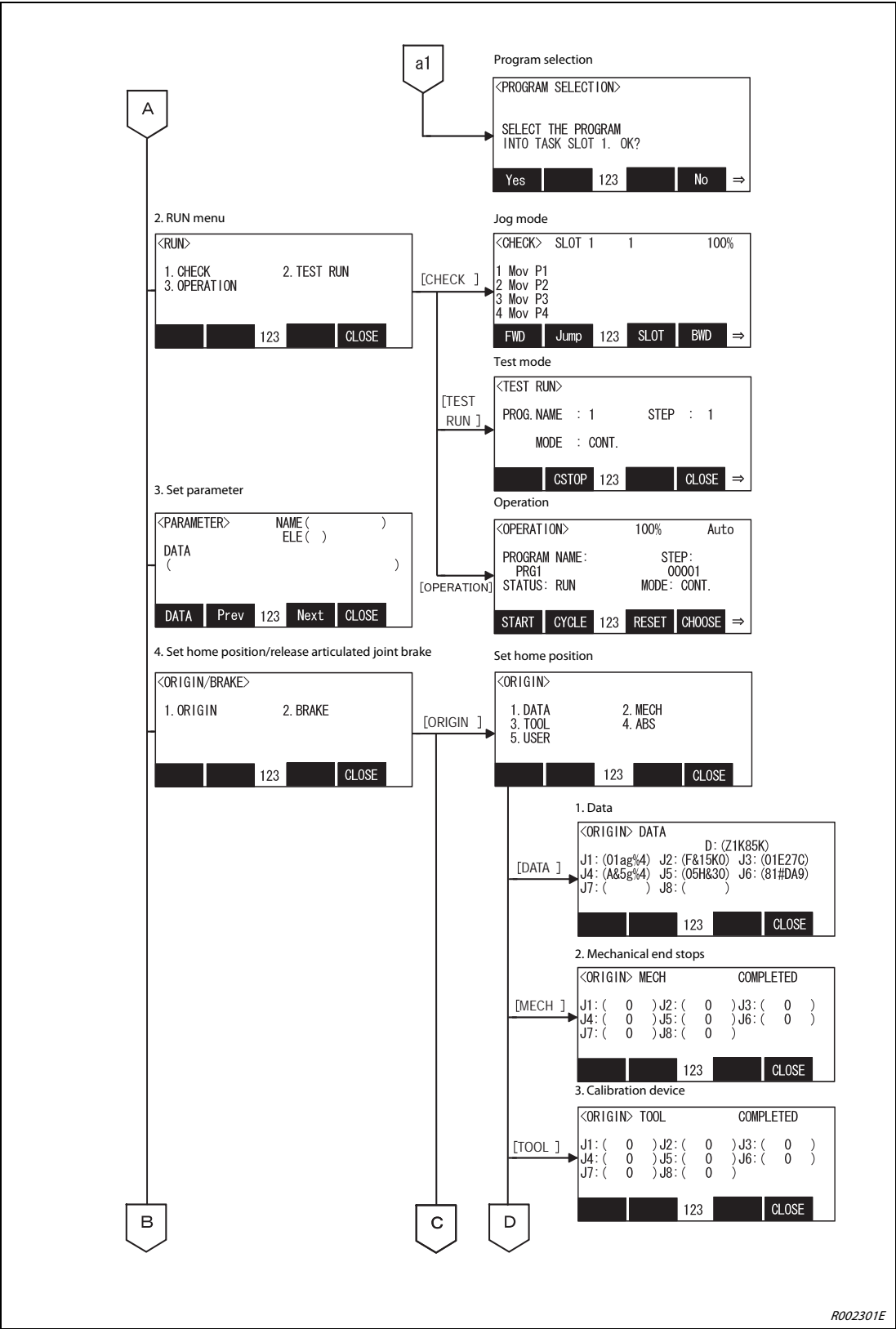
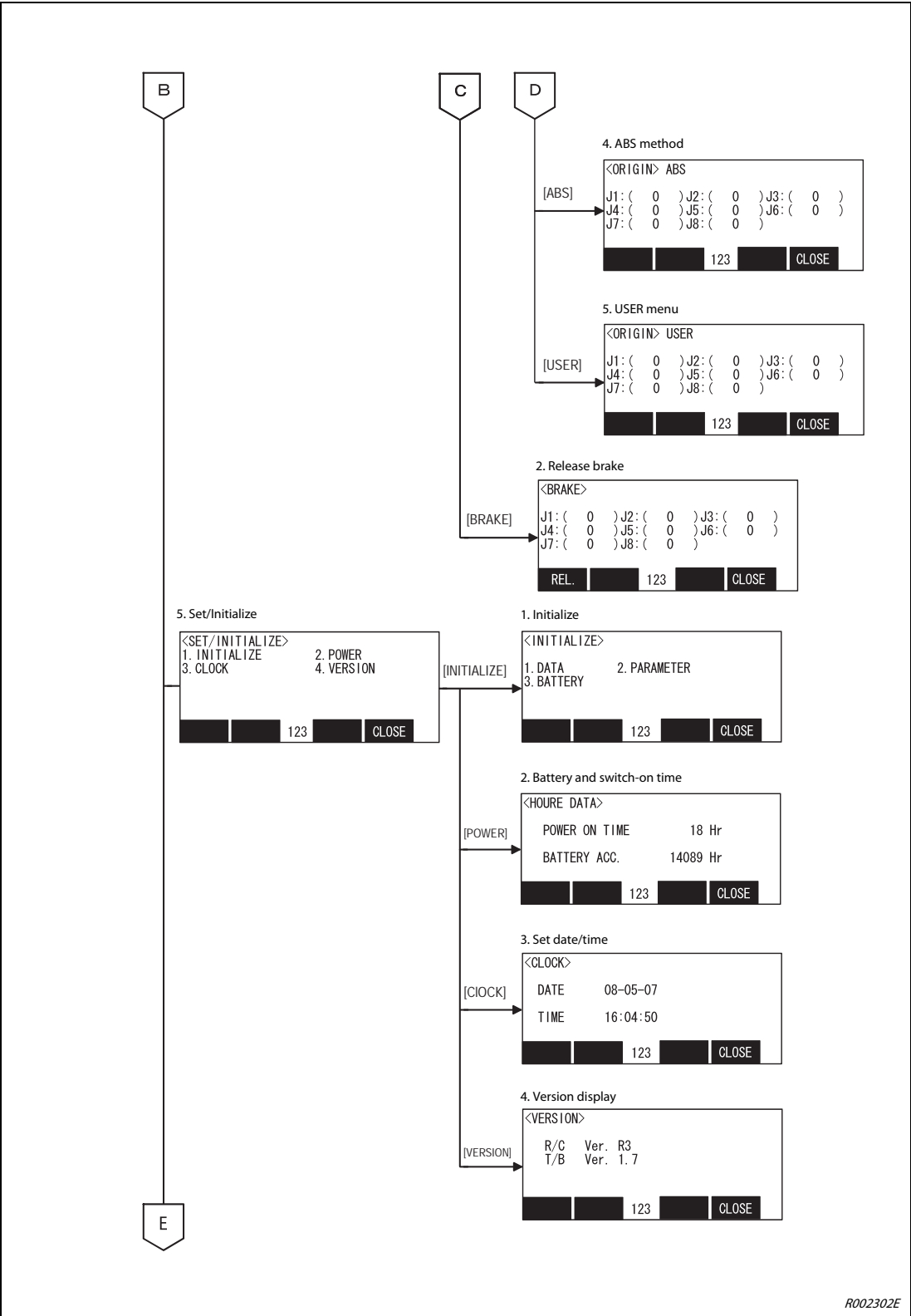


Fig. 6-1: Menu tree (1)



R002301E



R002302E

Fig. 6-1: Menu tree (3)

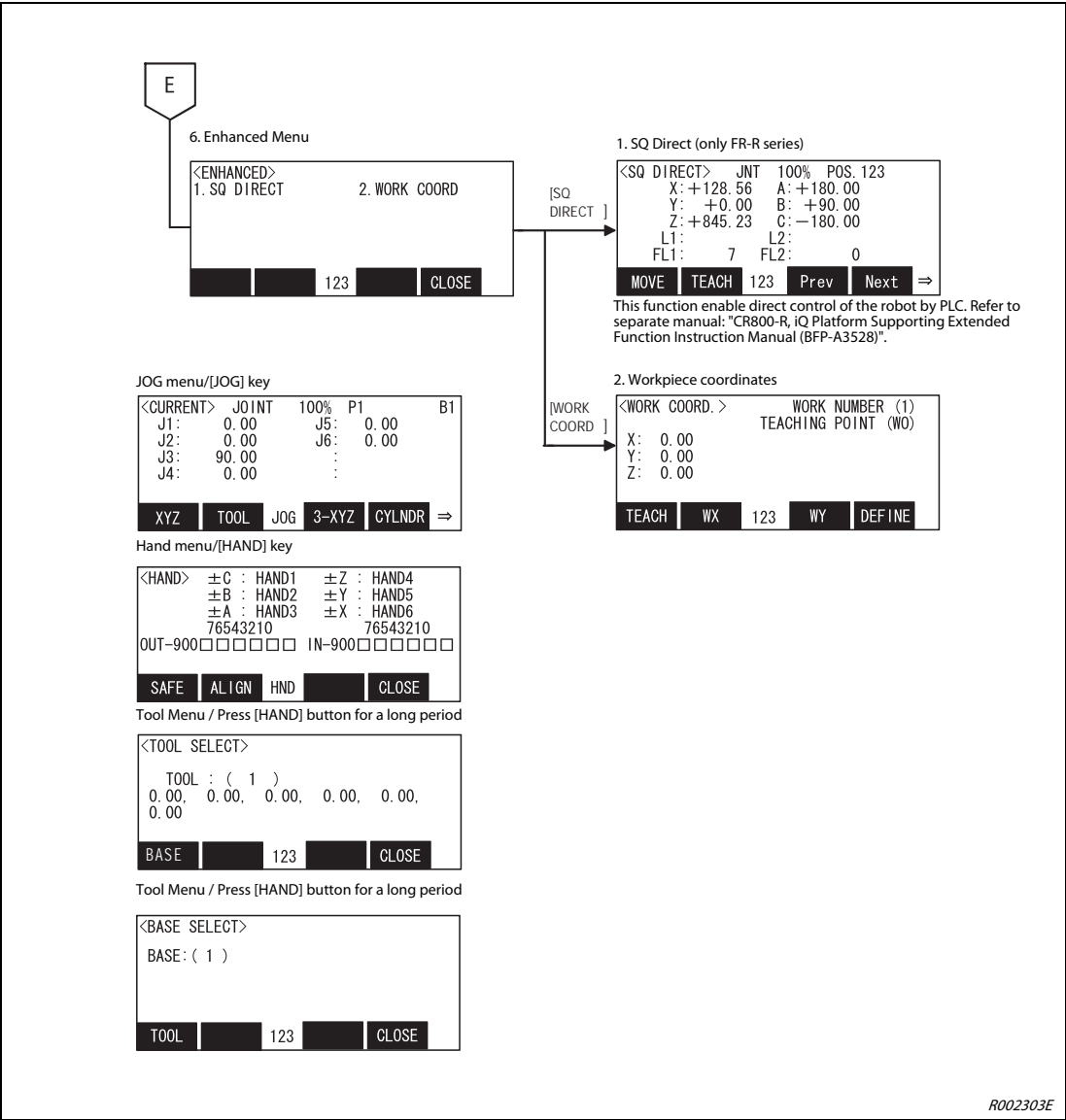


Fig. 6-1: Menu tree (4)

6.2 Enter a character

Every time you press the [CHARACTER] key, the write mode switches between entry of numbers and letters. The current mode is displayed at the bottom in the middle of the display.

Enter numbers

Numbers are entered in number mode using the keys on which the appropriate number as well as the minus sign and the full stop are shown at the bottom left.

Example ▾

"51" is entered as the program name.
To do this, press the [CHARACTER] key and keys [5] and [1].

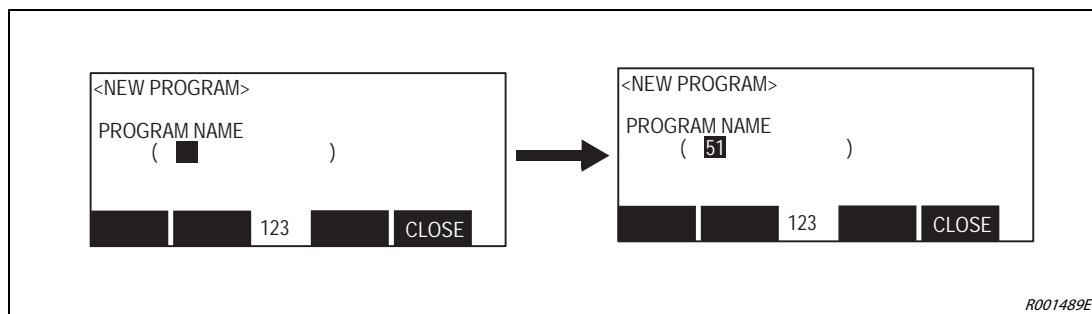


Fig. 6-2: Enter numbers



Enter letters

Letters are entered in letter mode using the keys on which the appropriate number indicated on the bottom right. Change the character by pressing the key repeatedly. For instance, pressing the [ABC] key repeatedly allows you to select from the following characters: "A" ... "B" ... "C" ... "a" ... "b" ... "c". When selecting letters assigned to the same key, you can move the cursor along a position by using the arrow key [→].

Example ▾

How to enter letters "ABY".
Press the following keys: 1 x [ABC], [→], 2 x [ABC], 3 x [WXYZ].

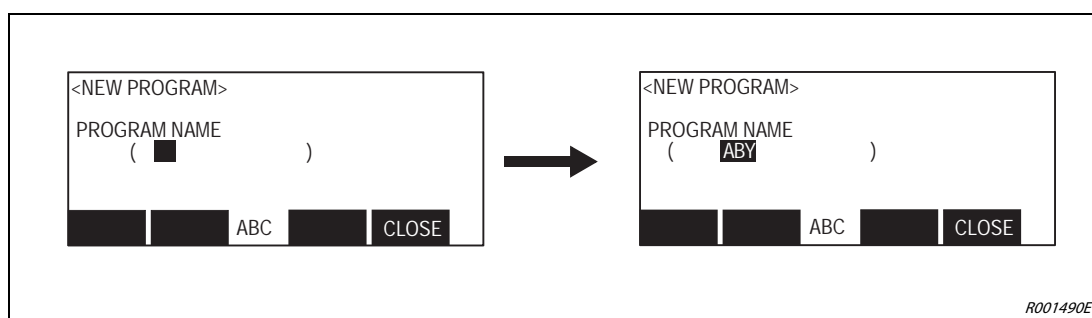


Fig. 6-3: Enter letters



The following characters are assigned to the keys:

- [' ()] key: ' → (→) → " → ^ → : → ; → ¥ → ?
- [@ =] key: @ → = → + → - → * → / → < → >
- [, %] key: , → % → # → \$ → ! → & → _ → .

Clear a character

Clear an incorrectly entered character by placing the cursor on the character and pressing the [CLEAR] key.

Example ▾

Letter "B" of string "ABY" is to be changed to an "M", resulting in the new string "AMY".
Move the cursor with the [←] key to the "B" character and press the following keys: [CLEAR], 1 x [MNO], 3 x [WXYZ].

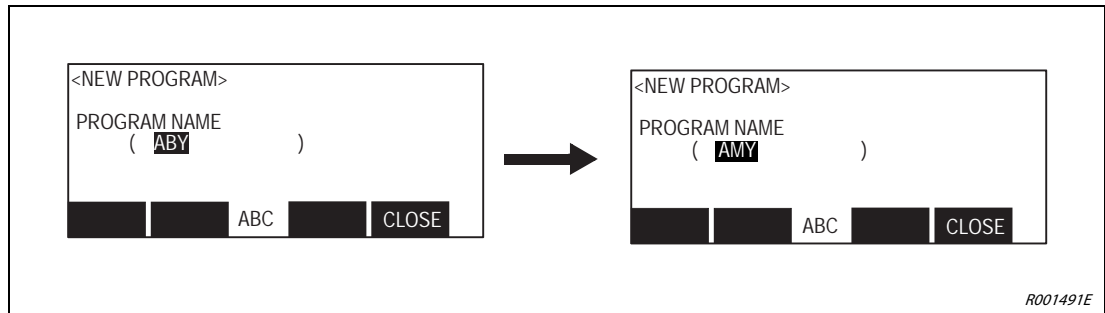


Fig. 6-4: Clear a character

**NOTE**

Pressing the [CLEAR] key for a longer period clears all the characters in the brackets.

6.3 Select a menu item

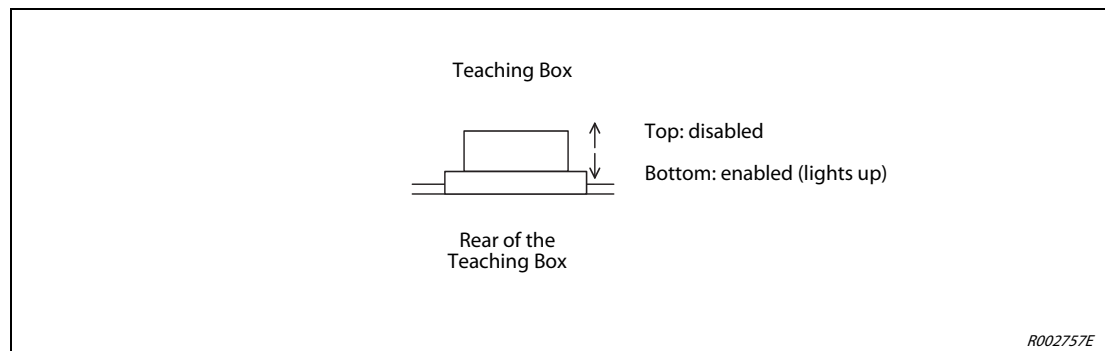
There are two ways to call up a menu:

- Select a menu by entering a number
- Select the menu with the cursor and press the [EXE] key

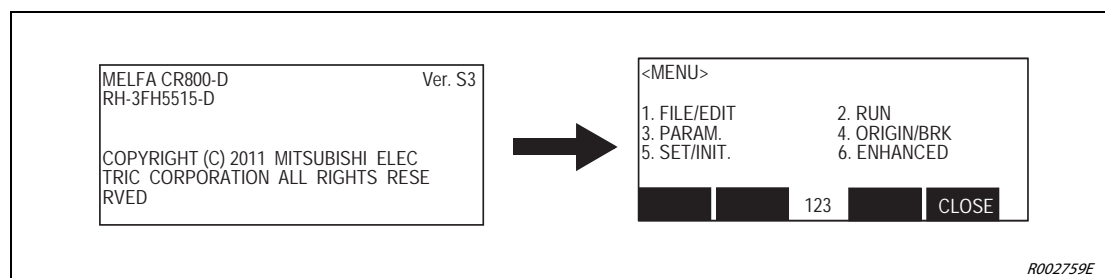
Running

Both possibilities are displayed in the following example by selecting menu item "1. FILE/EDIT".

- ① Set the [MODE] switch of the controller to "MANUAL". Activate the Teaching Box by setting the [ENABLE/DISABLE] switch of the Teaching Box to "ENABLE".

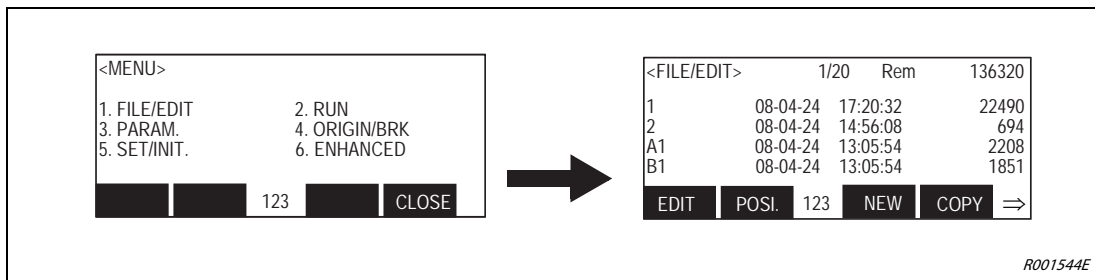


- ② The start screen appears after switching on. After the start screen appears, press [EXE] key to call up the main menu.



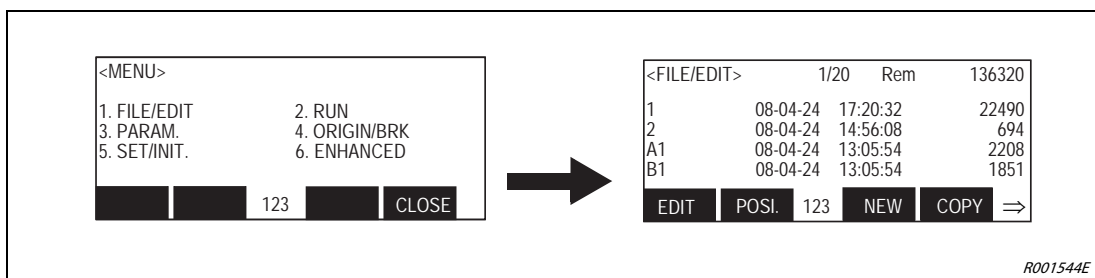
- Select a menu by entering a number

- ① Select the "FILE/EDIT" menu by entering "1". The "FILE/EDIT" menu is displayed.



- Select the menu with the cursor and press the [EXE] key

- ① With the arrow keys, move the cursor to the "FILE/EDIT" menu item and confirm with the [EXE] key. The "FILE/EDIT" menu is displayed.

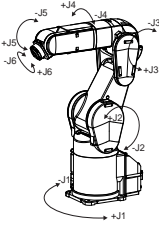
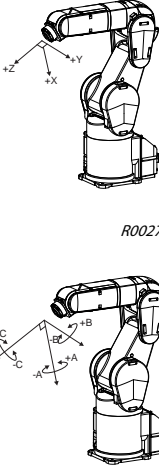
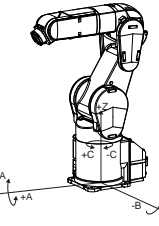


6.4 Move robot in JOG mode

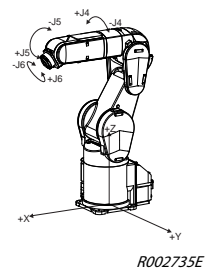
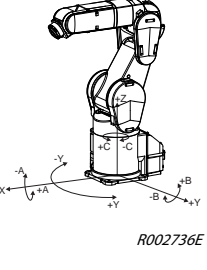
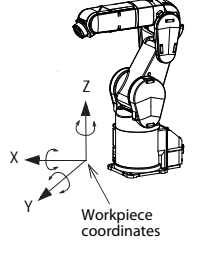
The robot can be moved in steps by the JOG mode. This section describes the JOG mode based on a 6-axis vertical articulated arm robot. Axis configuration depends on the robot type used. A detailed description on the individual types of robot is contained in the technical manual of the respective robot.

6.4.1 JOG modes

There are 5 JOG modes:

Operating mode	Mode	Description
Articulated joint JOG mode  R002731E	<ul style="list-style-type: none"> Set the [MODE] switch of the Teaching Box to "ENABLE". Keep the three-step switch in the middle position. Then press the [SERVO] key. (The servo power supply is switched on). Press [JOG]- and the [F1] key to switch to articulated joint JOG mode. To move the articulated joints, press appropriate keys J1 to J6. 	<p>The axes of the robot can be moved individually in articulated joint JOG mode. This allows axes J1 and J6 and auxiliary axes J7 and J8 to be set independently. The number of axes depends on the type of robot. Auxiliary axes J7 and J8 are controlled by keys [J1] and [J2].</p>
Tool JOG mode  R002732E R002733E	<p>Execute the three points listed above.</p> <ul style="list-style-type: none"> Press the function key to switch to the tool JOG mode. To move the axes, press appropriate key X, Y, Z, A, B, C. 	<p>The position of the tipped tool can be moved along the axes in the tool coordinate system in tool JOG mode.</p> <p>The tipped tool is moved linearly. The position of the robot can be rotated by keys A, B and C around axes X, Y and Z of the tool coordinate system without changing the position of the tipped tool. The middle point of the tool must be set by parameter MEXTL.</p> <p>The tool coordinate system in which the position of the tipped tool is determined depends on the robot type. In case of vertical articulated arm robots, the direction from the gripper flange to the tipped tool is defined as +Z. In case of SCARA robots, the direction upwards from the assembly area is defined as +Z.</p>
XYZ JOG mode  R002734E	<p>Execute the three points listed above.</p> <ul style="list-style-type: none"> Press the function key to switch to the XYZ JOG mode. 	<p>The position of the tipped tool can be moved along the axes in the XYZ coordinate system in XYZ JOG mode.</p> <p>The position of the robot can be rotated by keys A, B and C around axes X, Y and Z of the XYZ coordinate system without changing the position of the tipped tool. The middle point of the tool must be set by parameter MEXTL.</p>

Tab. 6-1: JOG modes (1)

Operating mode	Mode	Description
3-axis XYZ JOG mode 	Execute the three points listed above. <ul style="list-style-type: none"> Press the function key twice to switch to the 3-axis XYZ JOG mode. 	The position of the tipped tool can be moved along the axes in the XYZ coordinate system in 3-axis XYZ JOG mode. In contrast to XYZ JOG mode, the position of the robot is changed as in articulated joint mode by rotating axes J4, J5 and J6. With a fixed position of the tipped tool, the position is interpolated over axes X, Y, Z, J4, J5 and J6, i.e. the position is not constant. The middle point of the tool must be set by parameter MEXTL.
Circle JOG mode 	Execute the three points listed above. <ul style="list-style-type: none"> Press the function key three times to switch to the circle JOG mode. 	The position of the tipped tool can be rotated in circles around the zero point in circle JOG mode. A change in the X-axis coordinate moves the tipped tool radially, starting from the middle point of the robot. A change in the Y-axis coordinate has the effect of the same movement as control of the J1 axis in articulated joint JOG mode. A change in the Z-axis coordinate has the effect of a manual movement in the Z direction as in XYZ JOG mode. If the coordinates of the A, B or C axis are changed then the hand gripper is rotated as in XYZ JOG mode. The axes of robot type RH can be controlled.
Workpiece jog mode 	Execute the three points listed above. <ul style="list-style-type: none"> Press the function key three times to switch to workpiece JOG mode. To move the axes, press appropriate key X, Y, Z, A, B, C. 	In workpiece jog mode, the position of the tipped tool can be moved along the axes of the workpiece coordinate system. Buttons A, B and C rotate the position of the robot around the X, Y and Z axes of the workpiece coordinate system without changing the position of the tipped tool. You must set the tool middle point with the MEXTL parameter. NOTE: Workpiece coordinate system: You must set the workpiece coordinate system before using JOG mode. (There are eight parameters (WKnCORD, n = 1 - 8) for setting the coordinate system.) If the workpiece coordinate system is not defined, the robot will move in XYZ JOG mode. For details please consult the robot's technical manual.

Tab. 6-1: JOG modes (2)

NOTE

If the monitoring point of the hand in tool JOG mode, XYZ JOG mode or circle JOG mode approaches a singular point then a warning sign appears on the Teaching Box and a warning signal is issued. The function can be deactivated by parameter MESNGLSW. A detailed description of the parameter and the function "Error message on reaching a singular point" is contained in the operating and programming instructions.

7 Troubleshooting and maintenance instructions

7.1 Faults in automatic mode

**DANGER:**

- *Operation must be stopped immediately if you observe slight deviations when operating the robot or the auxiliary equipment. If immediate shutdown would result in concomitant dangers and hazards, then you must select a suitable time.*
- *If the robot stops for no apparent reason when in automatic mode then the operator must never approach the robot. If the robot nevertheless needs to be accessed, then the EMERGENCY-STOP function must be previously triggered or the power supply must be switched off. Make sure than no new dangers/hazards can arise from switching off the power supply.*
- *If a program is restarted after a reset, you must make sure that from the very start of running this program no dangerous/hazardous states can arise from the auxiliary equipment (e.g. check of position on restart, necessity to initialise the auxiliary equipment, etc.)*
- *If a program has been changed after a cancellation then it must be tested at least once before restarting of automatic mode is permitted.*

7.2 Troubleshooting

If a fault occurs, proceed as follows:

- Similar as during maintenance work, troubleshooting can be carried out from outside the protective enclosure or within the protective enclosure with the power supply switched off or from within the protective enclosure when automatic mode is deactivated.
If troubleshooting has to be carried out from within the protective enclosure then set the [MODE] switch of the controller to "MANUAL" and the [Enable/Disable] switch of the Teaching Box to "Enable".
- If a robot alarm occurs then first check the error code number or the error status. Take a note of this useful troubleshooting information and read the appropriate section in the operating and programming instructions.
- If the robot itself is affected and it is not possible for the user to remedy the cause of the error/fault then you must immediately contact your MITSUBISHI ELECTRIC sales agent.

7.3 Error diagnosis

When an error occurs, a 5-digit error code is shown on the display "STATUS.NUMBER" (e. g. C0010). The LED on the RESET pushbutton lights up.

A 4-digit error number appears on the display of the Teaching Box. The first character of the error number is not shown. For example the display shows "0010" for "C0010" and plain text.

A list of the messages that have previously occurred can be called up in the monitor menu of the "ERROR LOG" of the Teaching Box. The error must first be reset for this.

The error numbers, the errors causes and the countermeasures are listed in the operating and programming instructions. If an error can not be remedied by the countermeasures listed then please contact your sales partner.

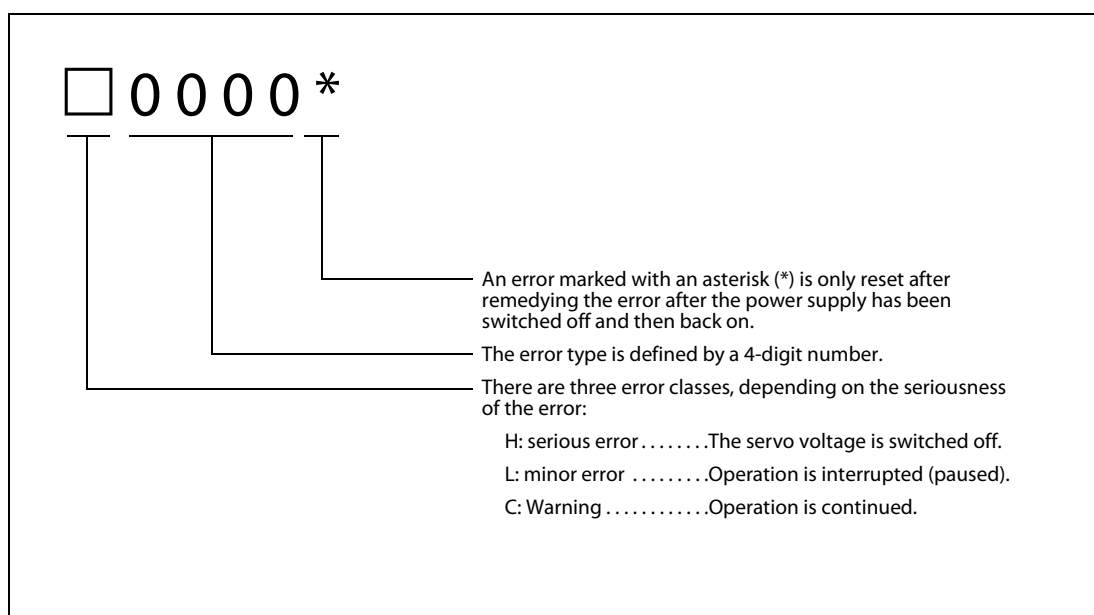


Fig. 7-1: Design of an error message

NOTE

The last position of the error number may be an axis number.
Example: Error number H0931 means overcurrent of axis J1 motor.

7.4 Replace the fuses

An error message is issued if a fuse on the interface card for the pneumatically operated gripper hand, or on the control board, is defective. The error message contains information on which fuse has to be replaced.

7.4.1 Fuse and error messages

Error code	Description	Fuse
H0083	Fuse of power supply or pneumatic gripper hand defective	F3 (rated current: 1,6 A), type LM16

Tab. 7-1: Fuses

7.4.2 Fuse of power supply of pneumatic gripper hand

If you see error message "H0083" replace fuse (rated current: 1.6 A).

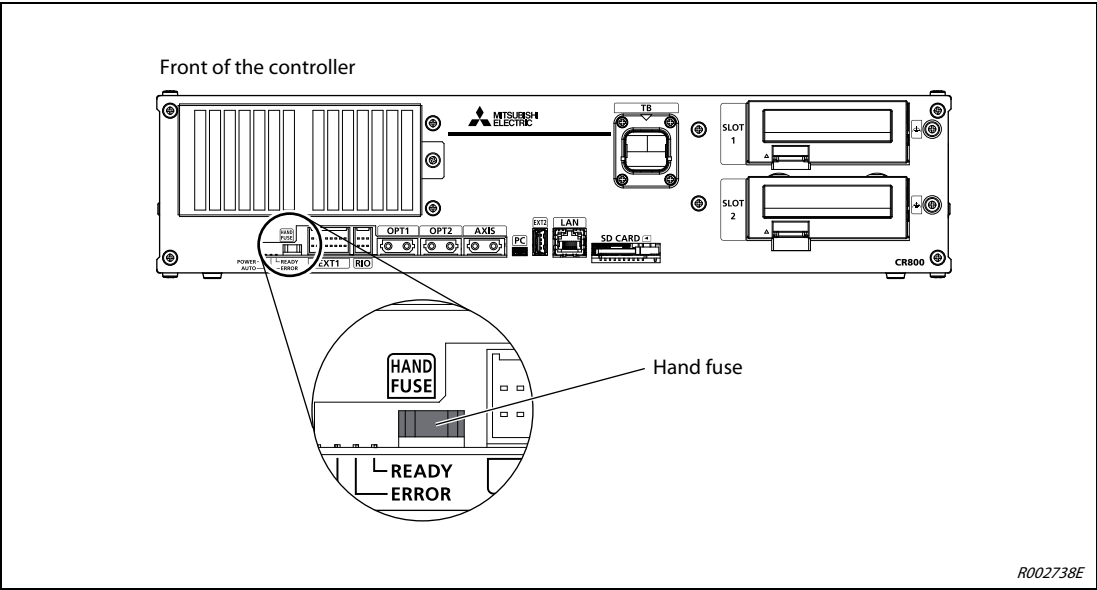


Fig. 7-2: Hand fuse exchange place

7.5 Instructions on maintenance

**CAUTION:**

All maintenance work on the robot must only be carried in full compliance to the following safety directives!

- Use the "Maintenance Forecast" function of the RT ToolBox3 robot programming software to determine the expected maintenance intervals.
- Maintenance work should be carried on outside of the protective area when possible.
- If the maintenance work has to be carried out from within the protective area then the power supply must be switched off at the main switch and must be protected by a padlock against being switched back on. However, switching off must never result in dangerous or hazardous states.
- You must make sure that the daily and periodic inspections are carried out compliant to the instructions in the technical manual. With regard to the robot system, the inspection and maintenance program of the manufacturer must be observed. If there is any special maintenance work that can not be easily carried out by the user then you must contact the service providers of MITSUBISHI ELECTRIC.
- When carrying out maintenance work at the controller unit, also check the function of the cooling fan, e.g. by making sure that there is an air current.
- If the robot brakes are released then the robot arm (articulated arm robot) or the J3 axis (SCARA robot) must be supported manually to ensure that they do not fall uncontrolled into the end stop. You require the support of a second person for this.
- Small amounts of grease may exit from the robot arm. If this can result in soiling or environmental pollution then the robot should be checked regularly for loss of grease. If you determine that grease is exiting at the robot then wipe it off from the surface with a cleaning cloth to ensure that the floor and the vicinity around the robot are not soiled.
- To be able to easily carry out maintenance work, make sure there is sufficient space and lighting.
- The robot must not be retrofitted or changed using unauthorized parts. Only ever use original spare parts and accessories. Parts and accessories not approved by the manufacturer must never be used. Make sure that no safety functions can be modified.
- Before switching back on the power supply, make sure that no dangerous or hazardous conditions can be caused by this.
- After completion of maintenance work, all safety equipment that has been temporarily deactivated must be reactivated (e. g., door contact switch of the safety enclosure, etc).
- Do not check the insulation resistor during maintenance work.
- The batteries must not be shorted, charged, heated up, burnt or disassembled.

A Appendix

A.1 Dimensions

A.1.1 Working areas of the robot

The following figure shows the external dimensions and the range of motion of the robot arm RV-2FR(B).

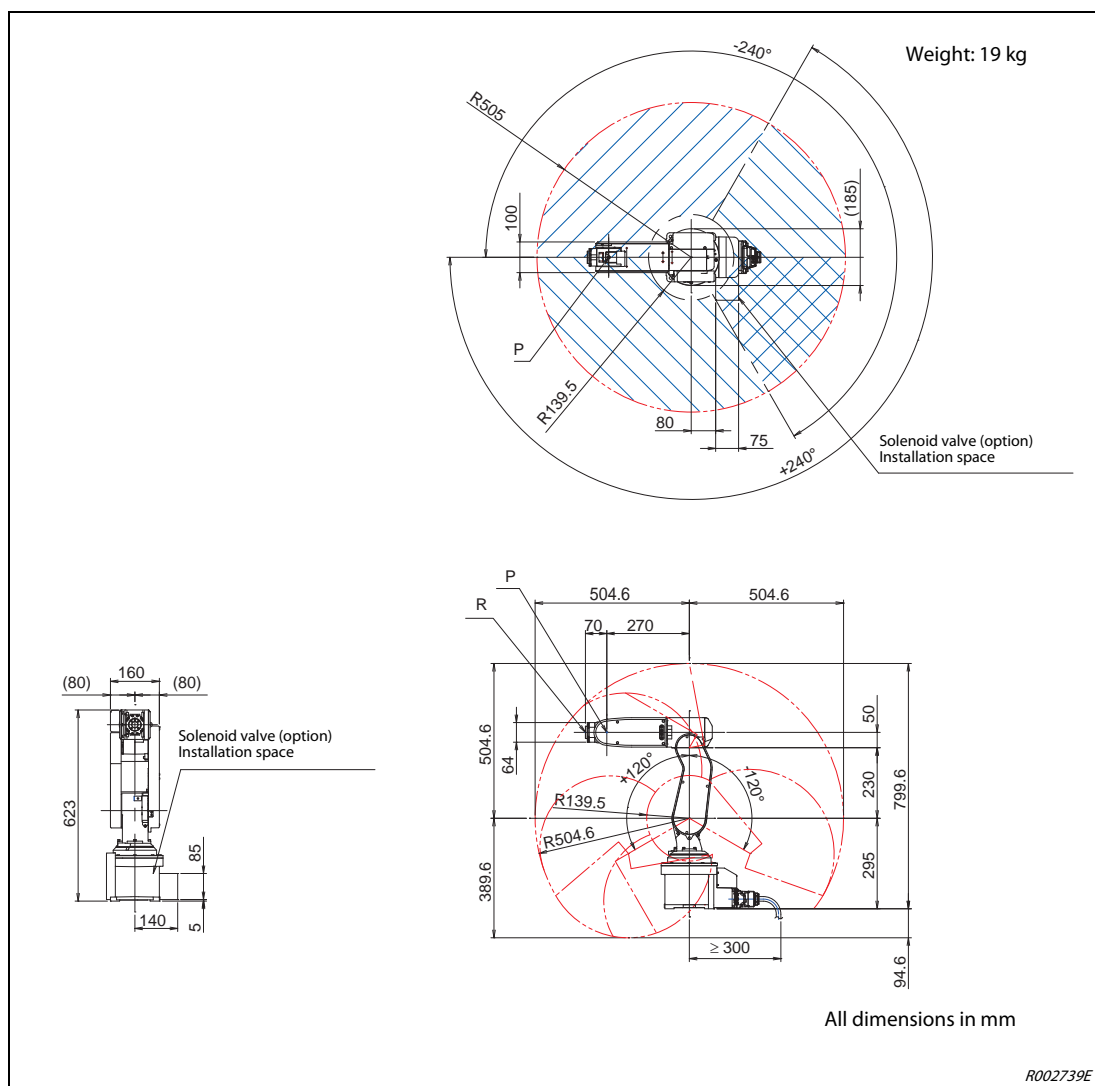


Fig. A-1: External dimensions and range of motion of robot arm RV-2FR(B)

NOTE

The working area stipulated refers to the P point of the robot arm without gripper hand.

The following figure shows the external dimensions and the range of motion of the robot arm RV-2FRL(B).

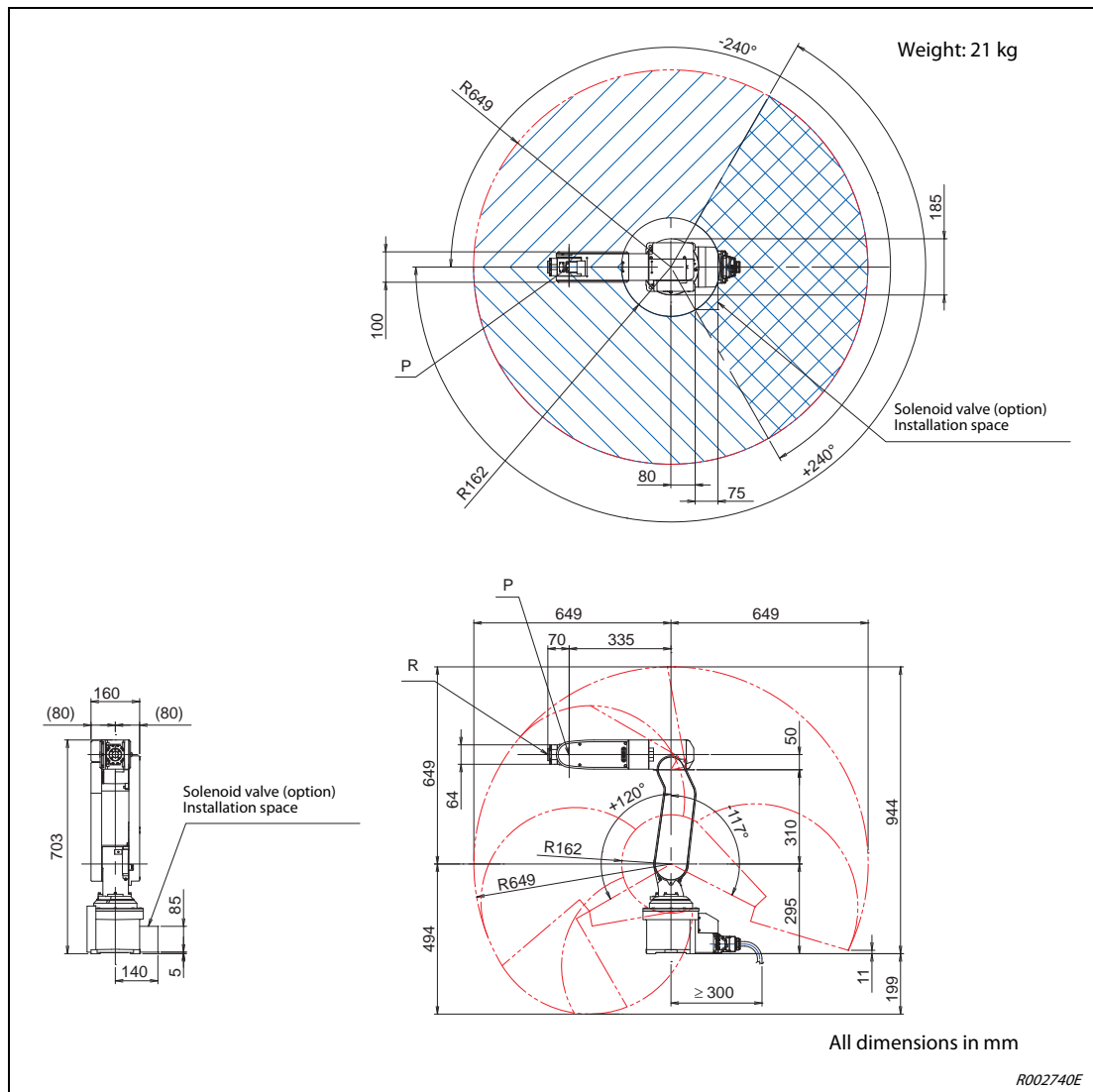


Fig. A-2: External dimensions and range of motion of robot arm RV-2FRL(B)

NOTE

The working area stipulated refers to the P point of the robot arm without gripper hand.

The following figure shows the external dimensions and the range of motion of the robot arm RV-4FRM.

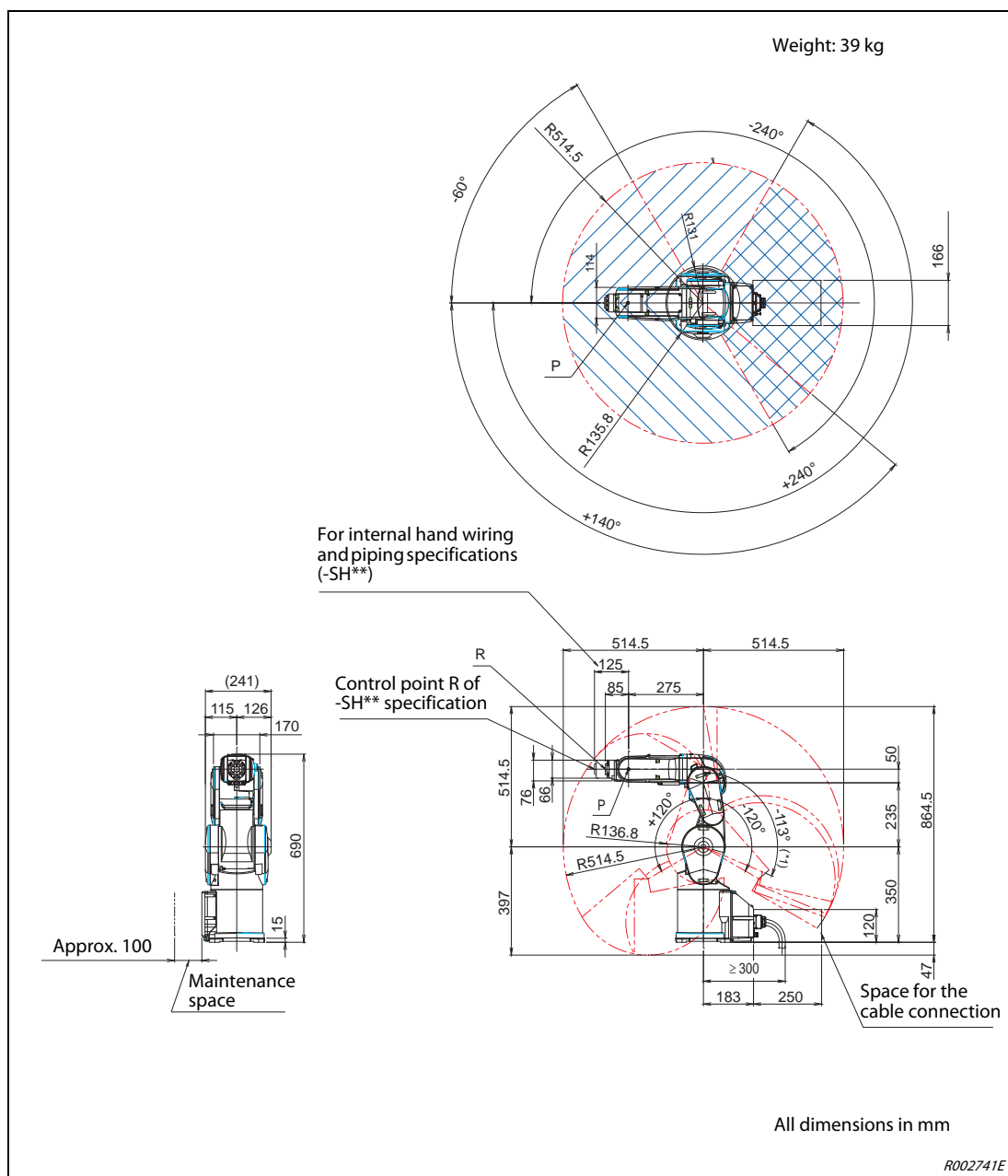


Fig. A-3: External dimensions and range of motion of robot arm RV-4FRM

NOTE

The working area stipulated refers to the P point of the robot arm without gripper hand.

The following figure shows the external dimensions and the range of motion of the robot arm RV-4FRLM.

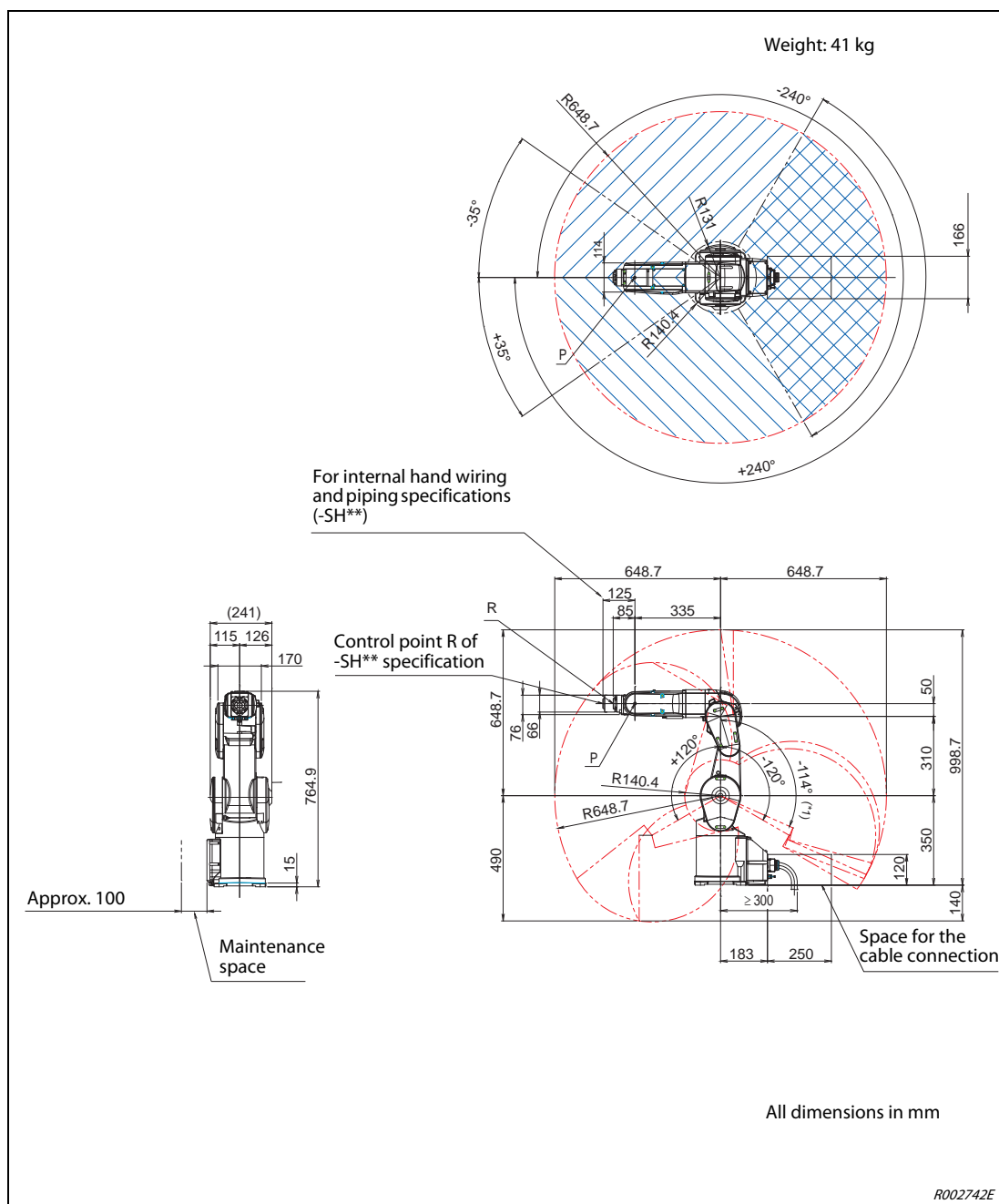


Fig. A-4: External dimensions and range of motion of robot arm RV-4FRLM

NOTE

The working area stipulated refers to the P point of the robot arm without gripper hand.

The following figure shows the external dimensions and the range of motion of the robot arm RV-7FRM.

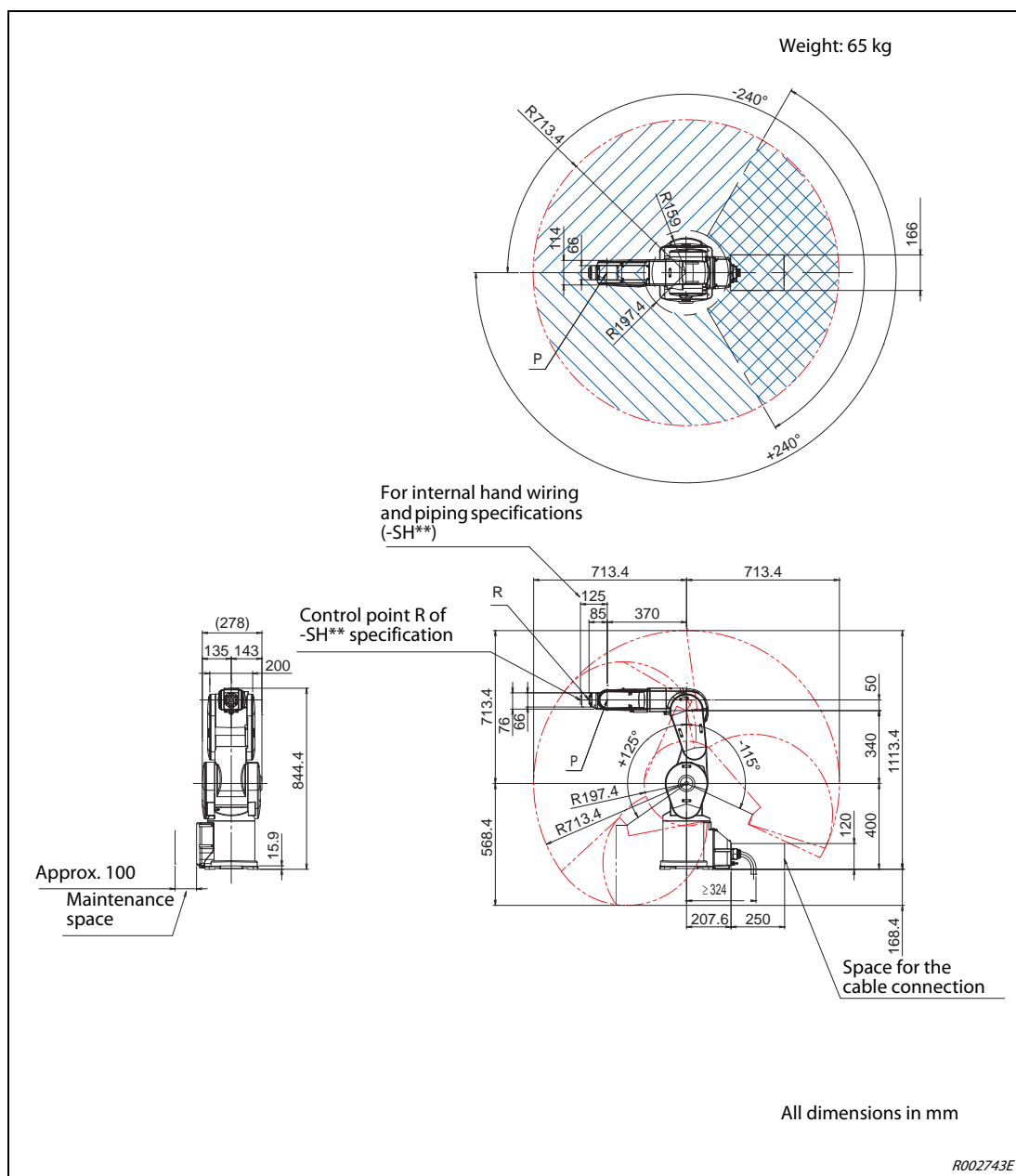


Fig. A-5: External dimensions and range of motion of robot arm RV-7FRM

NOTE

The working area stipulated refers to the P point of the robot arm without gripper hand.

The following figure shows the external dimensions and the range of motion of the robot arm RV-7FRLM.

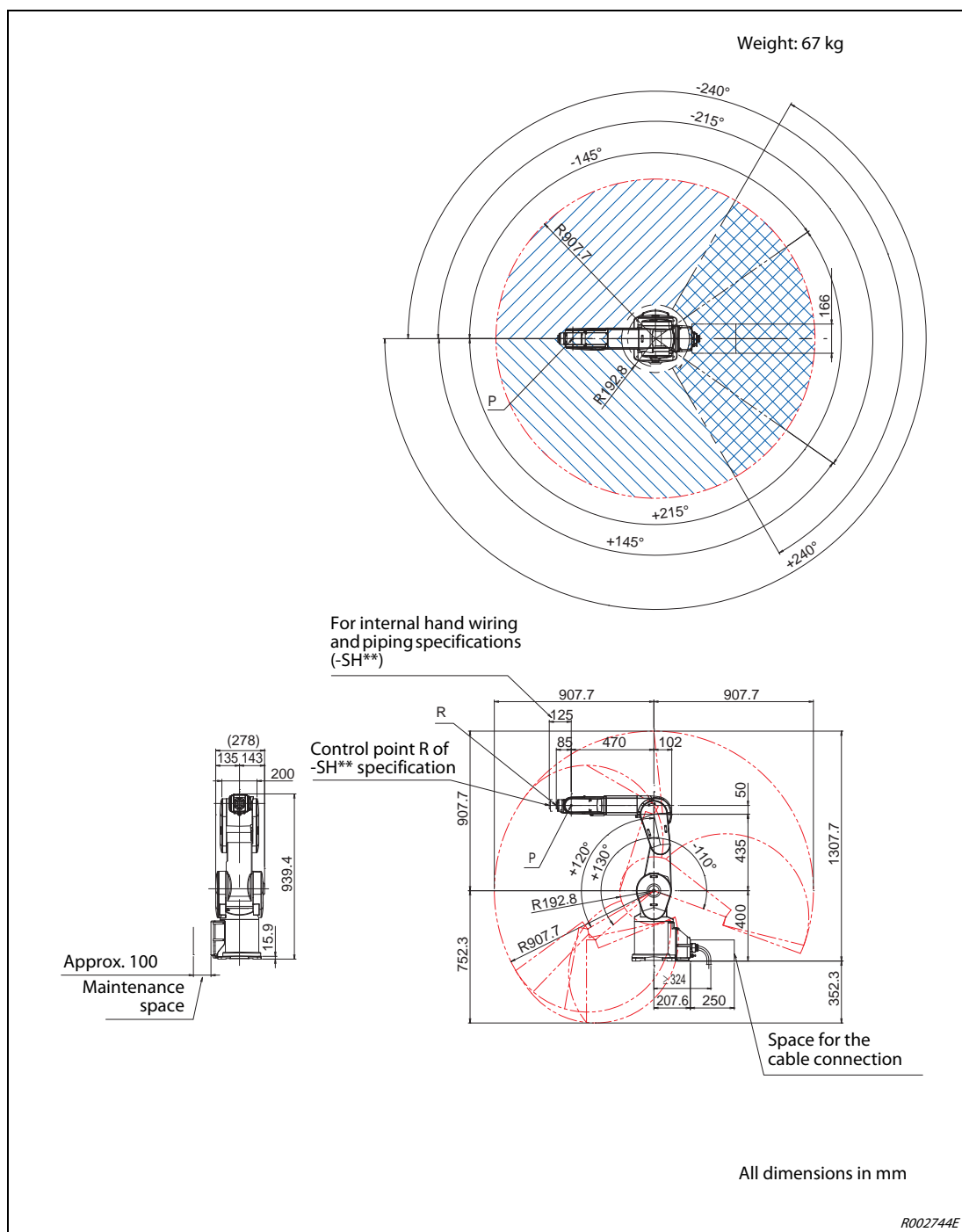


Fig. A-6: External dimensions and range of motion of robot arm RV-7FRLM

NOTE

The working area stipulated refers to the P point of the robot arm without gripper hand.

The following figure shows the external dimensions and the range of motion of the robot arm RV-7FRLLM.

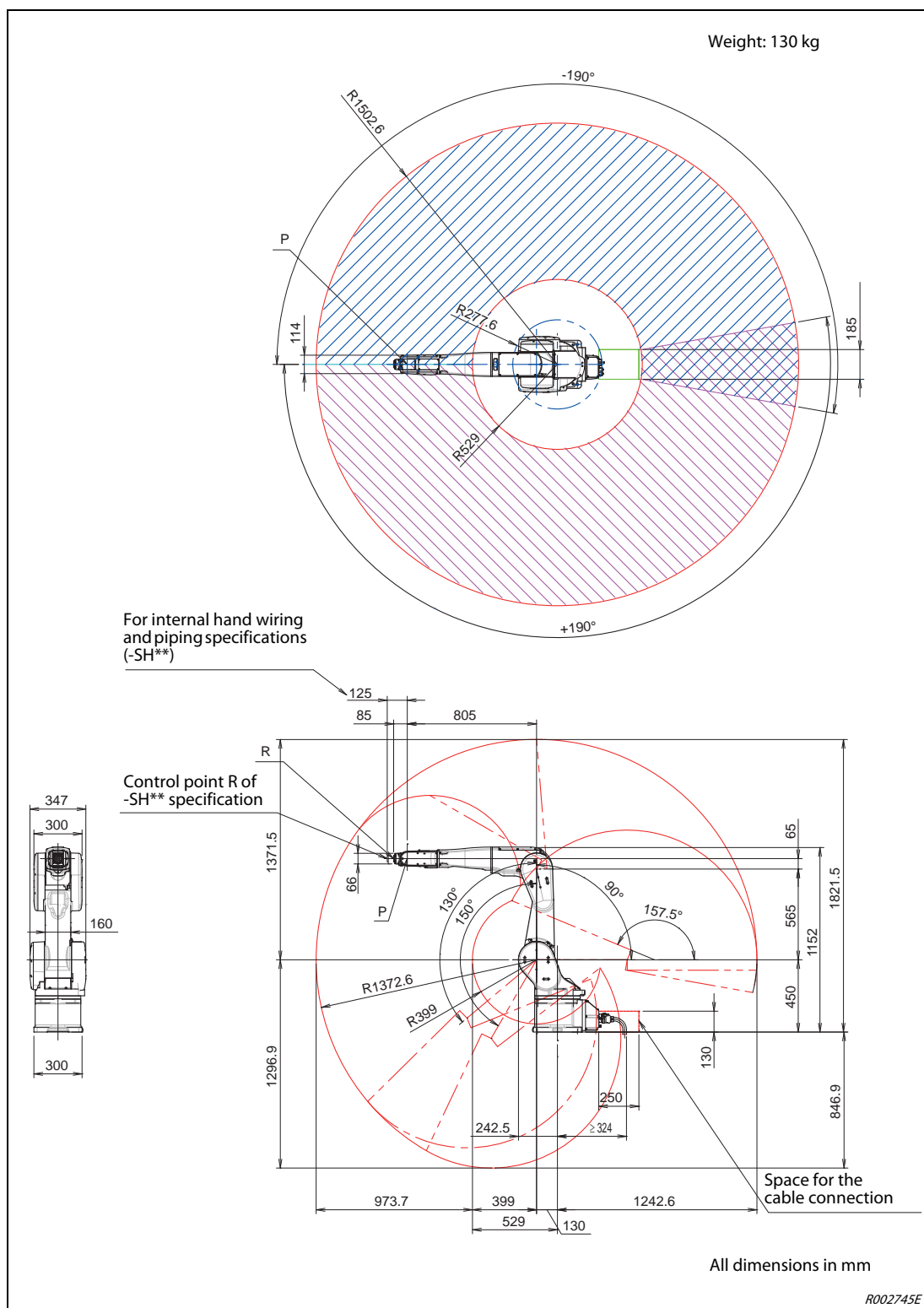


Fig. A-7: External dimensions and range of motion of robot arm RV-7FRLLM

NOTE

The working area stipulated refers to the P point of the robot arm without gripper hand.

The following figure shows the external dimensions and the range of motion of the robot arm RV-13FRM.

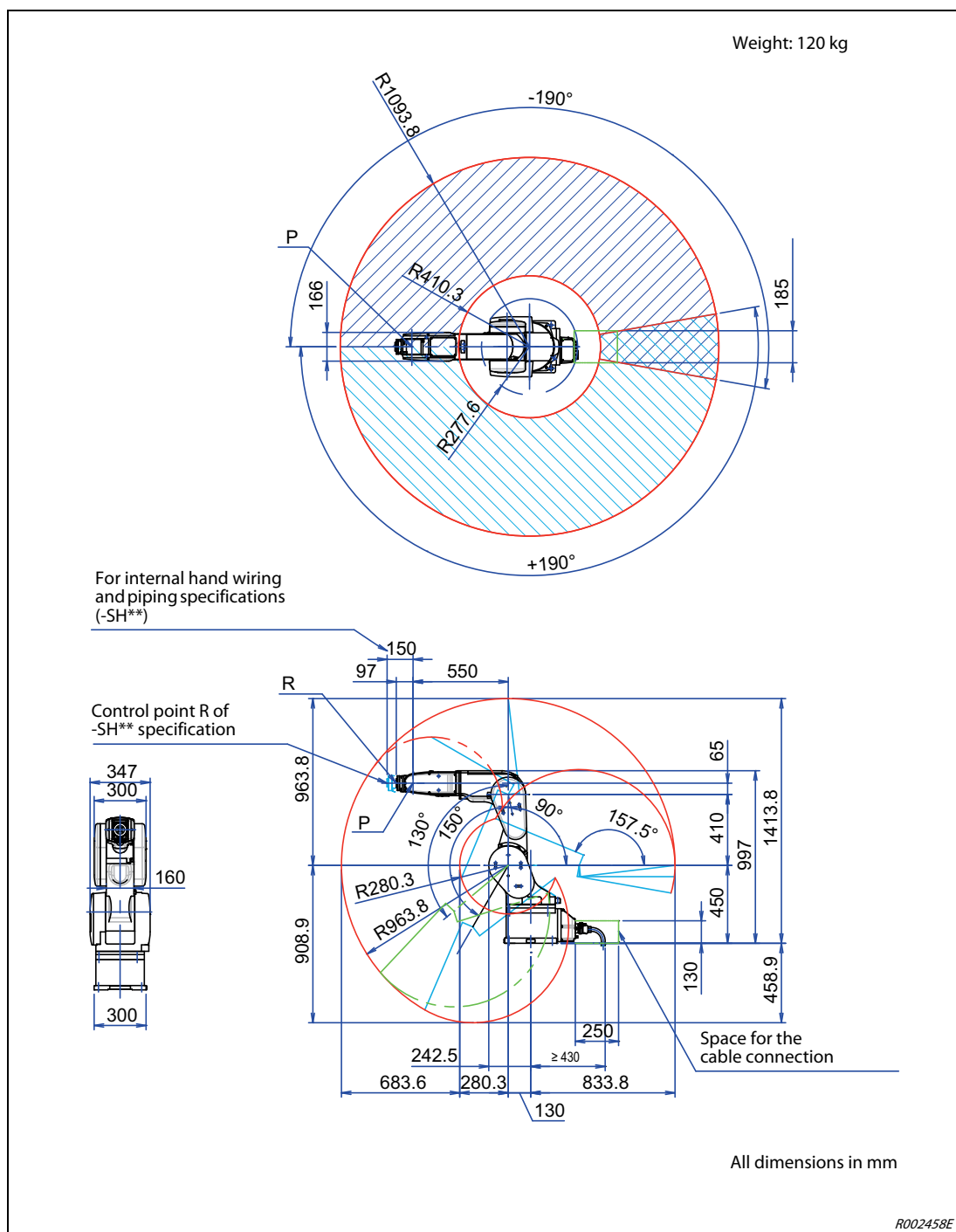


Fig. A-8: External dimensions and range of motion of robot arm RV-13FRM

NOTE

The working area stipulated refers to the P point of the robot arm without gripper hand.

The following figure shows the external dimensions and the range of motion of the robot arm RV-13FRLM.

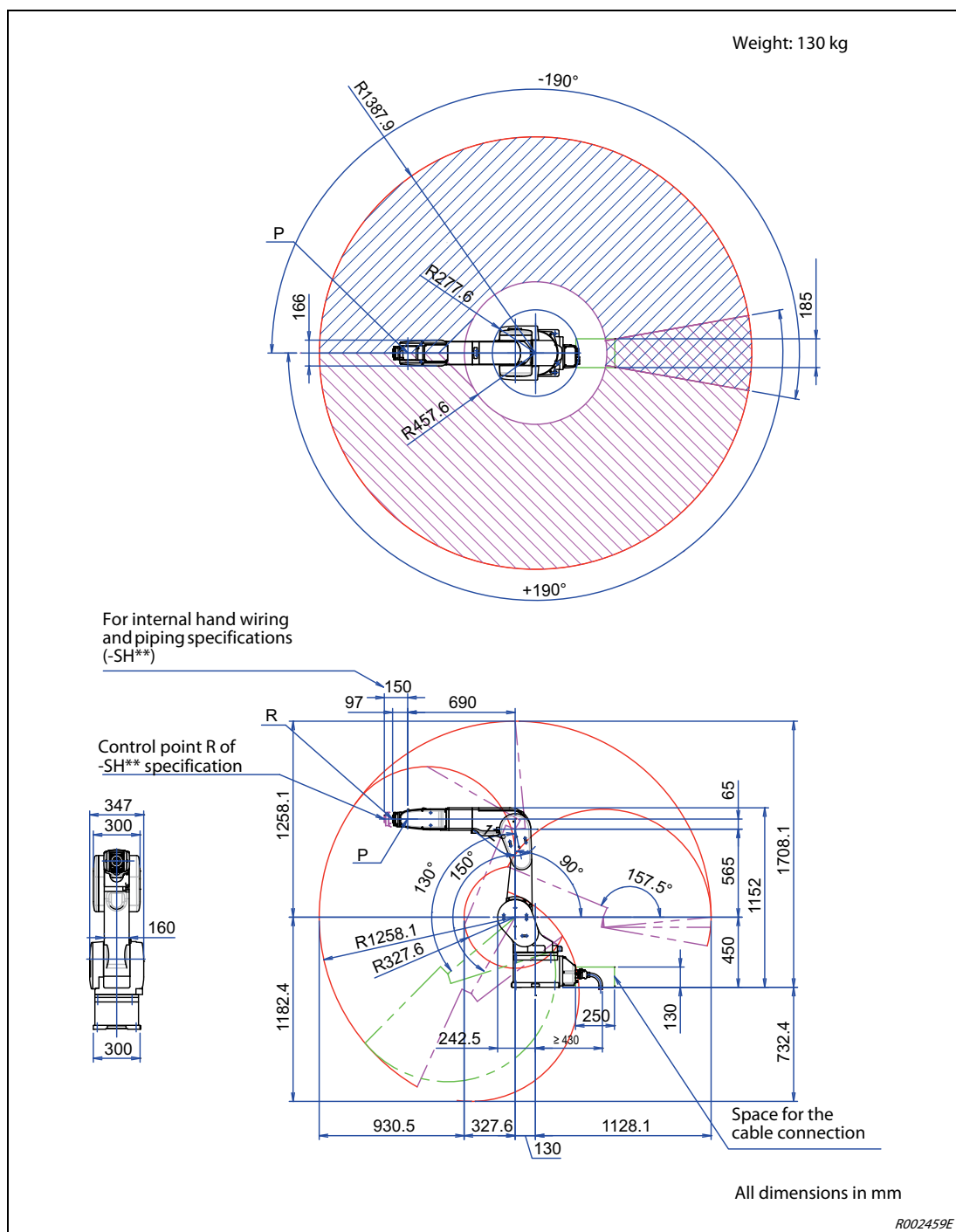


Fig. A-9: External dimensions and range of motion of robot arm RV-13FRLM

NOTE

The working area stipulated refers to the P point of the robot arm without gripper hand.

The following figure shows the external dimensions and the range of motion of the robot arm RV-20FRM.

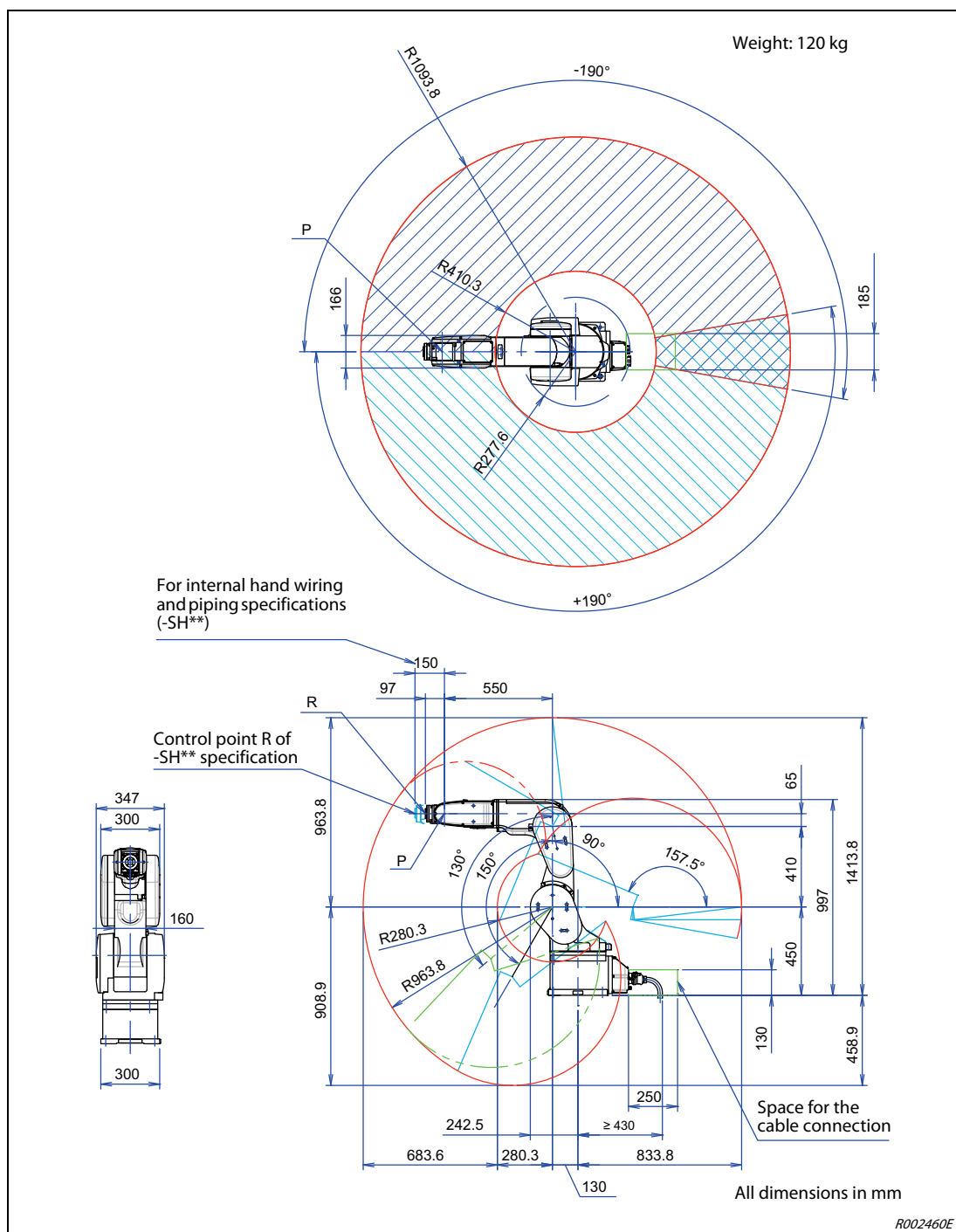


Fig. A-10: External dimensions and range of motion of robot arm RV-20FRM

NOTE

The working area stipulated refers to the P point of the robot arm without gripper hand.

The following figure shows the external dimensions and the range of motion of the robot arm RH-1FRHR5515.

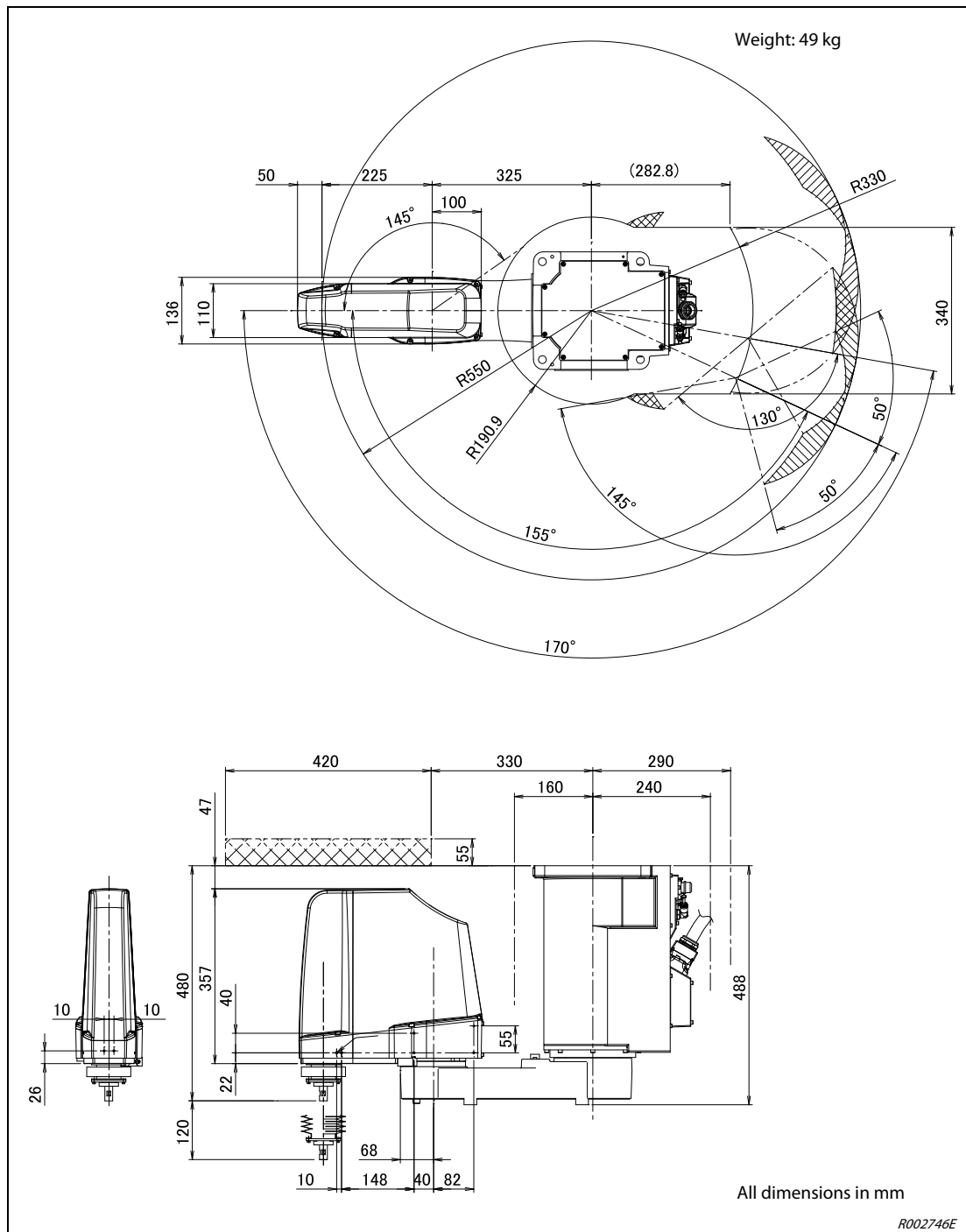


Fig. A-11: External dimensions and range of motion of robot arm RH-1FRHR

The following figure shows the external dimensions and the range of motion of the robot arm RH-3FRHR3515/3512.

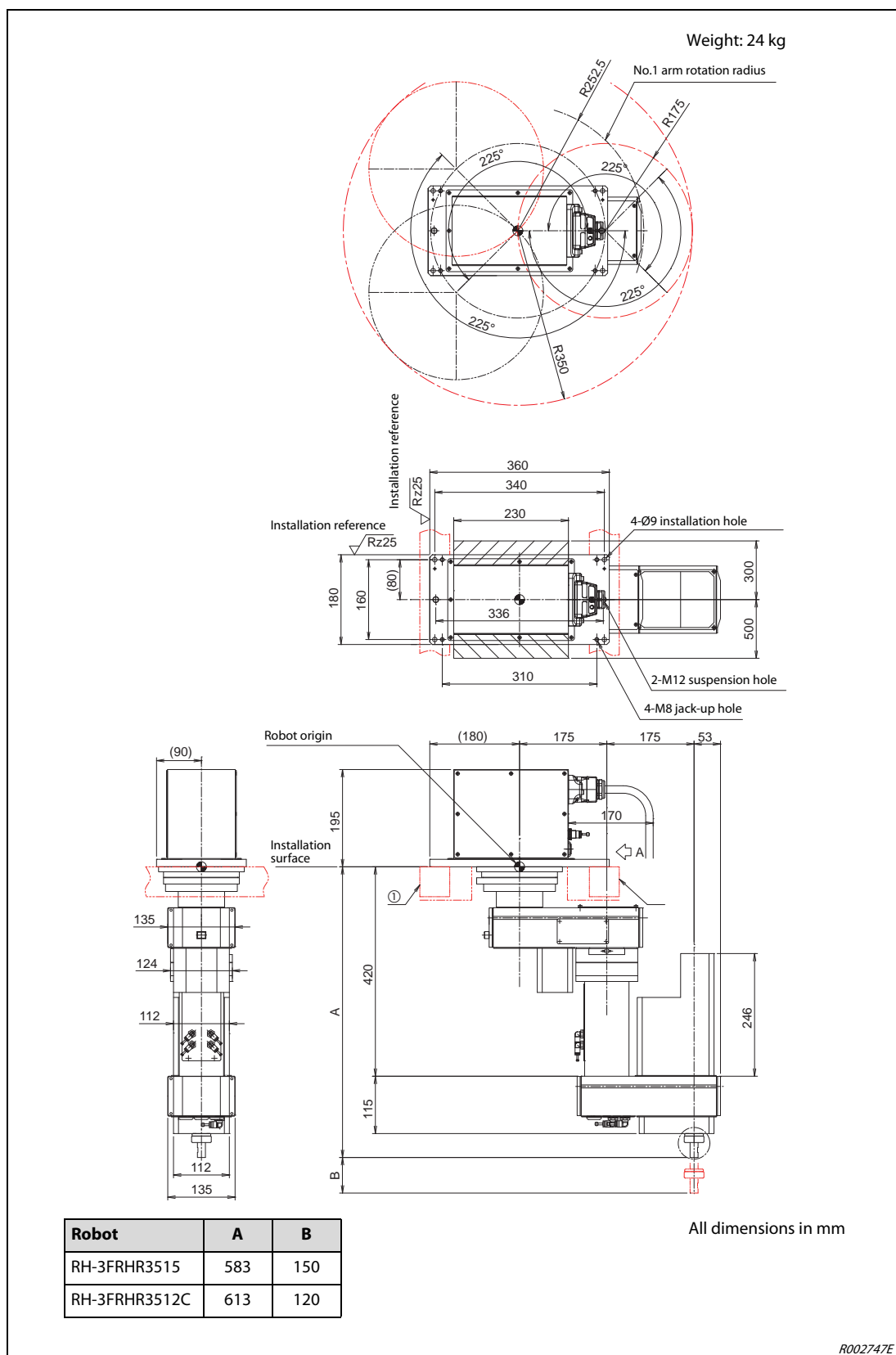


Fig. A-12: External dimensions and range of motion of robot arm RH-3FRHR3515/12

① Installation platform is prepared by customer.

The following figure shows the external dimensions and the range of motion of the robot arms RH-3FRH35/45/55.

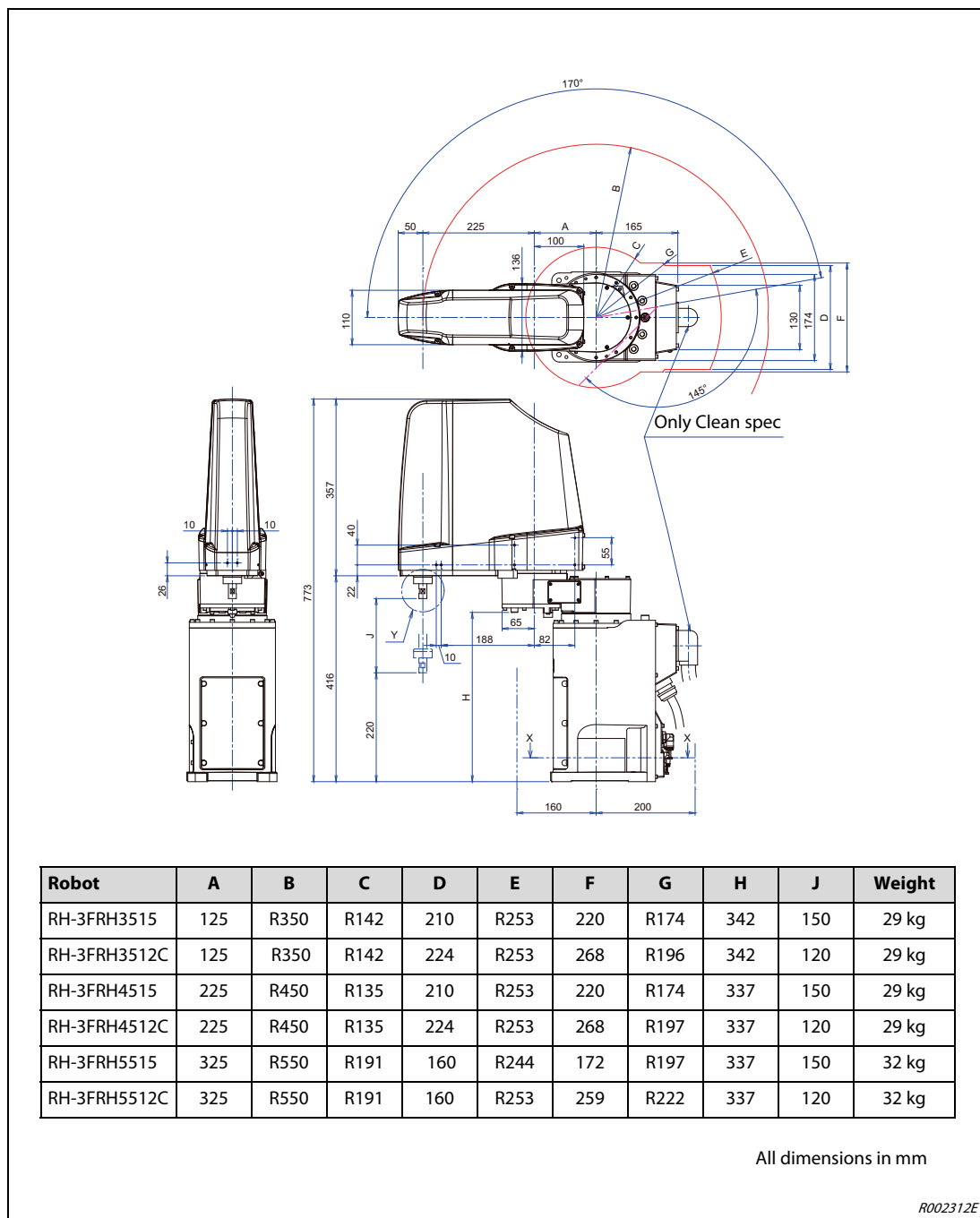


Fig. A-13: External dimensions and range of motion of robot arms RH-3FRH35/45/55

The following figure shows the external dimensions and the range of motion of the robot arms RH-6FRH35/45/55.

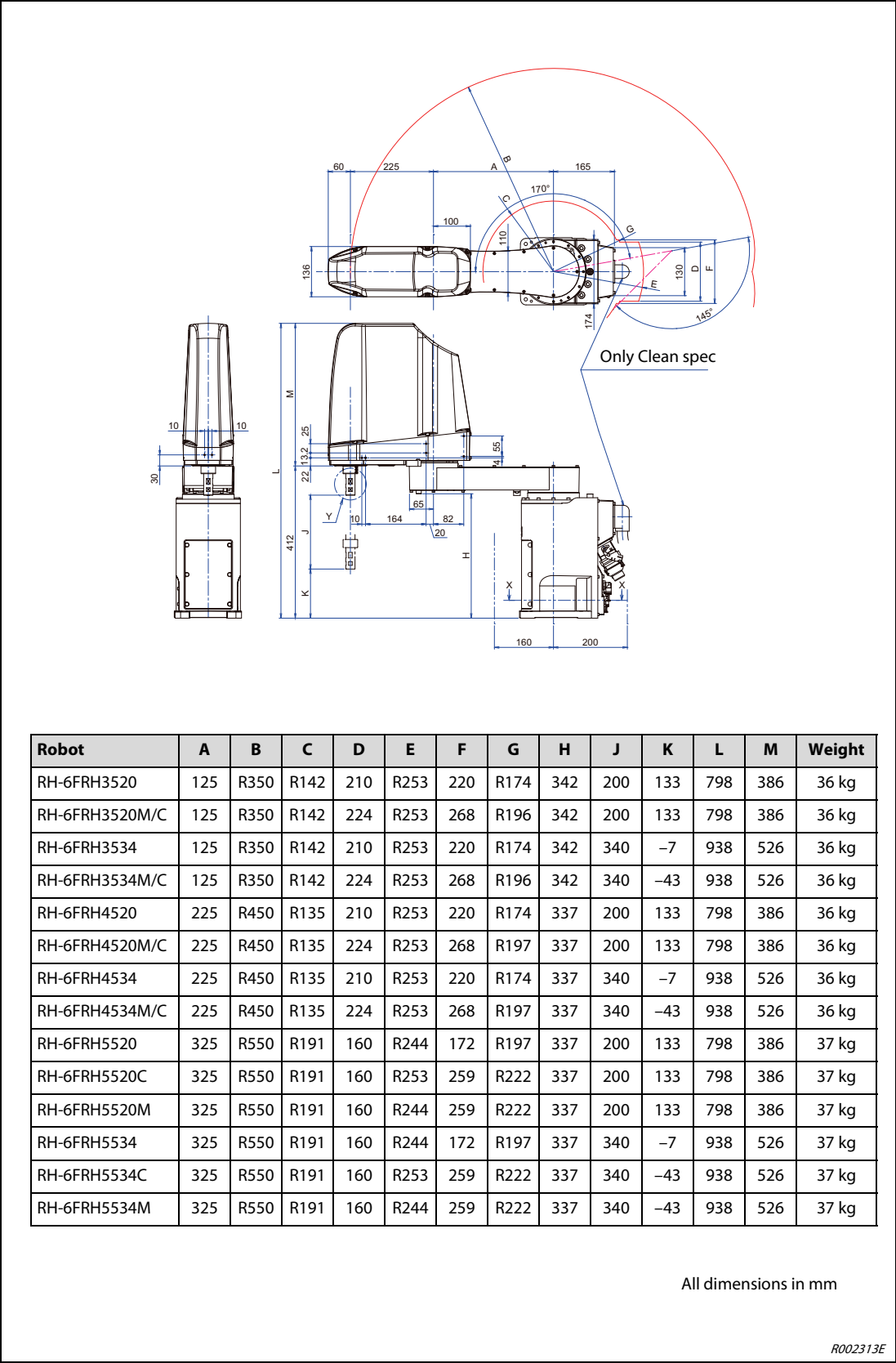


Fig. A-14: External dimensions and range of motion of robot arms RH-6FRH35/45/55

The following figure shows the external dimensions and the range of motion of the robot arms RH-12FRH55/70/85 und RH-20FRH85/100.

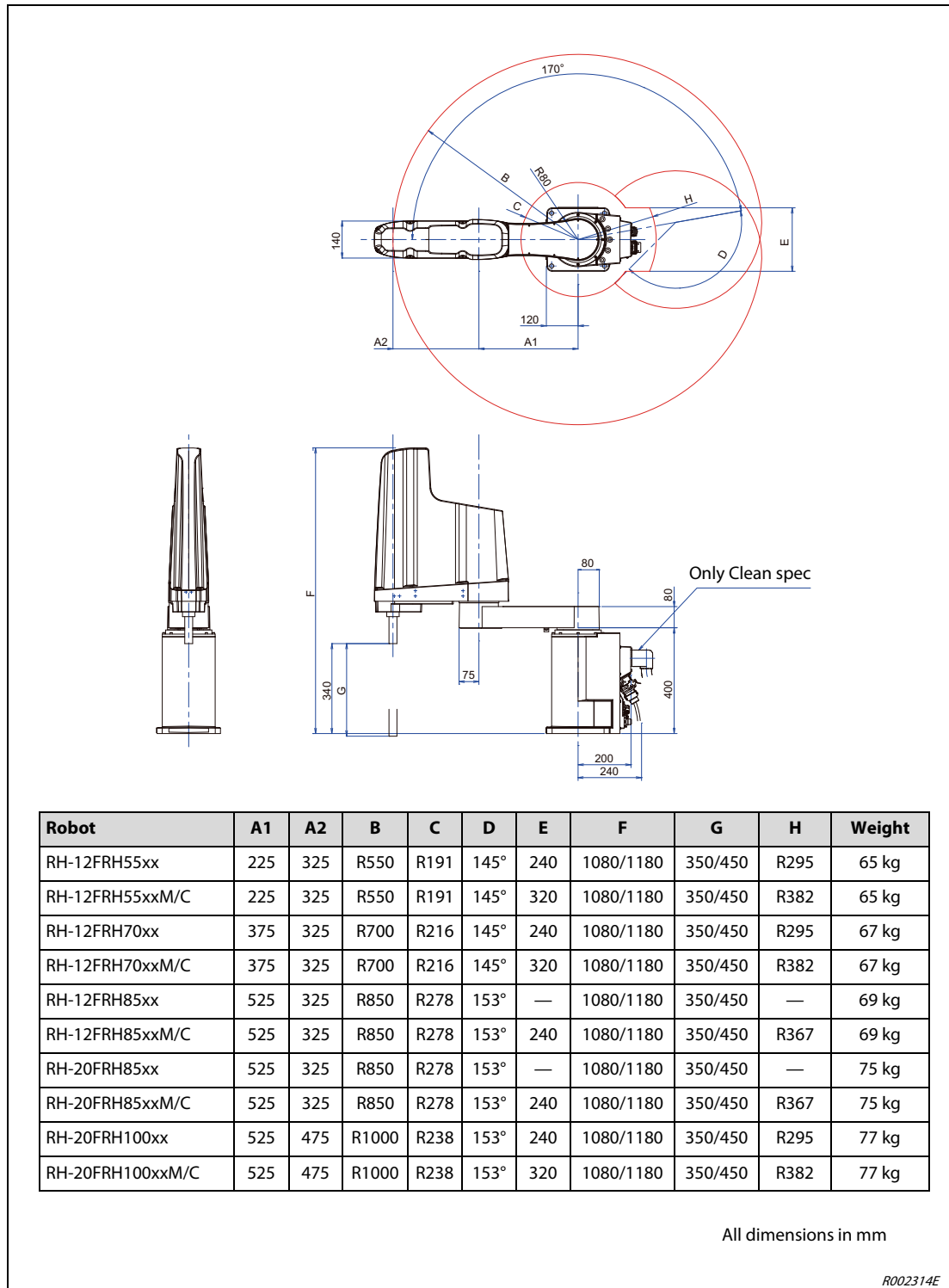


Fig. A-15: External dimensions and range of motion of robot arm RH-12FRH55/70/85 and RH-20FRH85/100

A.1.2 Dimensions of the controller and the CPU

CR800 controller

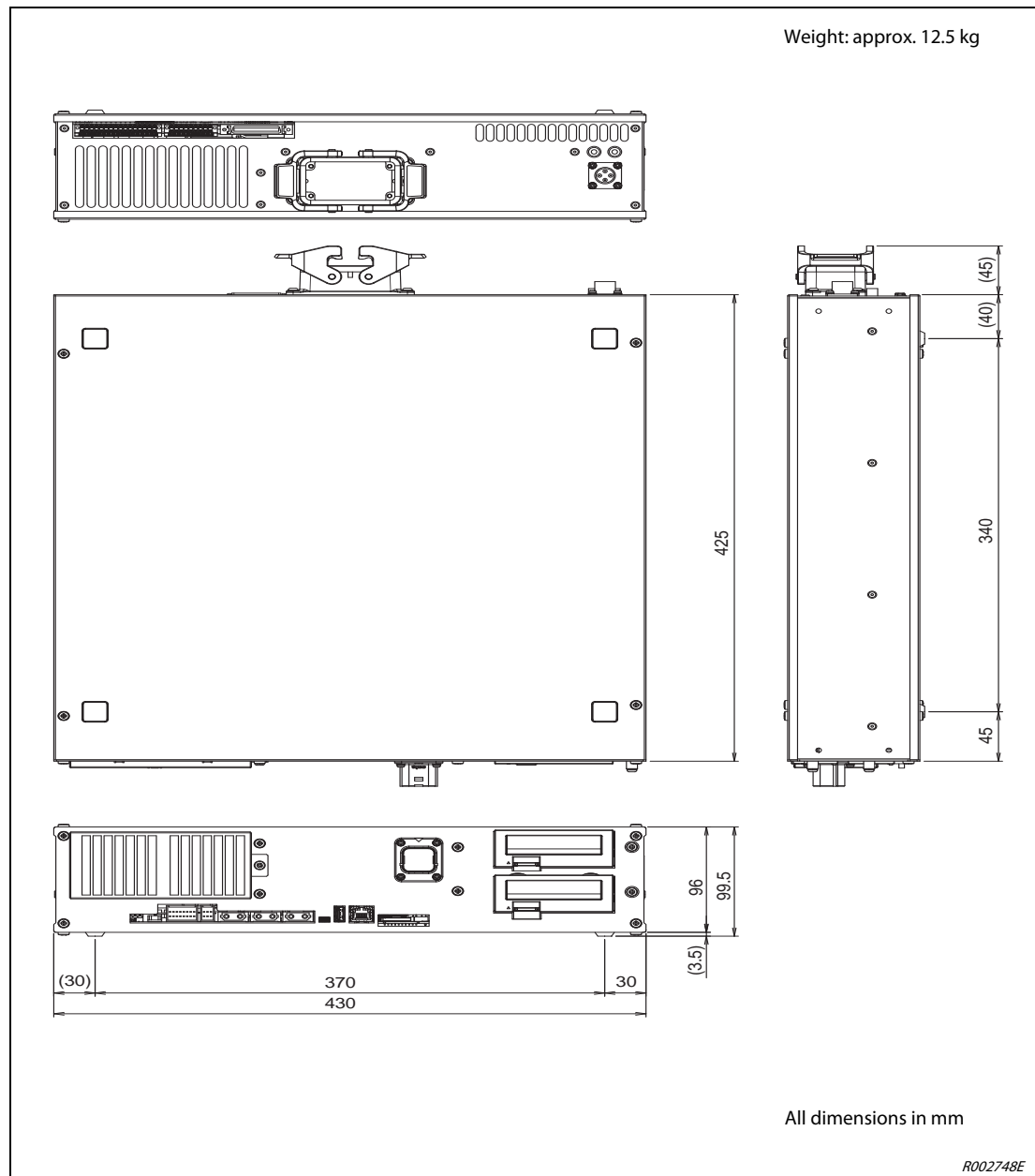


Fig. A-16: Dimensions of the CR800 controller

Robot CPU R16RTCPU

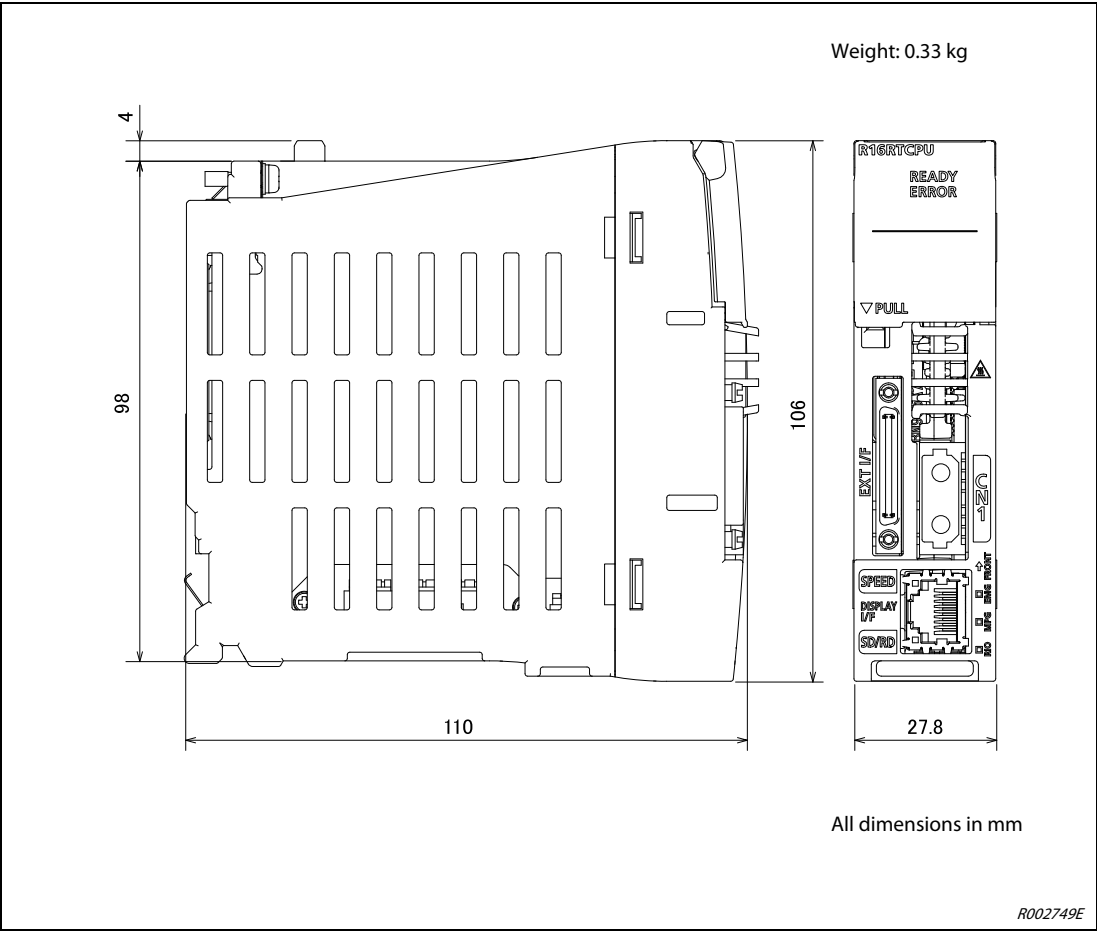


Fig. A-17: Dimensions of robot CPU R16RTCPU

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