

MELFA

Industrial robots

Installation description

RV-F-D/RH-FH-D

RV-F-Q/RH-FH-Q



Short operating instructions
Industrial robot RV-F-D/RH-FH-D, RV-F-Q/RH-FH-Q
Article No.: 272766

Version	Changes/Additions/Corrections
A 01/2014 pdp – gb	—

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 F 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 F 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 250mm/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.



ATTENTION:

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 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.



ATTENTION:

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 control unit 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 control unit. 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 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 SSCNET-III connection of F-Q-Series devices. Otherwise, impurities may impair transmission behaviour and result in malfunction.*
- *Do not remove the SSCNET-III cable from F-Q-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 SSCNET-III connections of the drive unit, or into the open end of the SSCNET-III 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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All rights reserved • We accept no liability for the correctness of the information that describes the product features or the technical data.

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

This manual is a translation of the original German manual from MITSUBISHI ELECTRIC B.V.

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

This manual applies to the following robots and control units:

Series	Model	Construction	Handling weight [kg]	Control unit
F-D	RV-2FB-D	Vertical articulated arm	2	CR750-D
	RV-4FM-D		4	
	RV-4FLM-D		4	
	RV-7FM-D		7	
	RV-7FLM-D	7	SCARA	
	RH-3FH-D	3		
	RH-6FH-D	6		
	RH-12FH-D	12		
RH-20FH-D	20			
F-Q	RV-2FB-Q	Vertical articulated arm	2	CR750-Q
	RV-4FM-Q		4	
	RV-4FLM-Q		4	
	RV-7FM-Q		7	
	RV-7FLM-Q	7	SCARA	
	RH-3FH-Q	3		
	RH-6FH-Q	6		
	RH-12FH-Q	12		
RH-20FH-Q	20			

Tab. 1-1: Overview of robot models and control units

1.1 Name of model

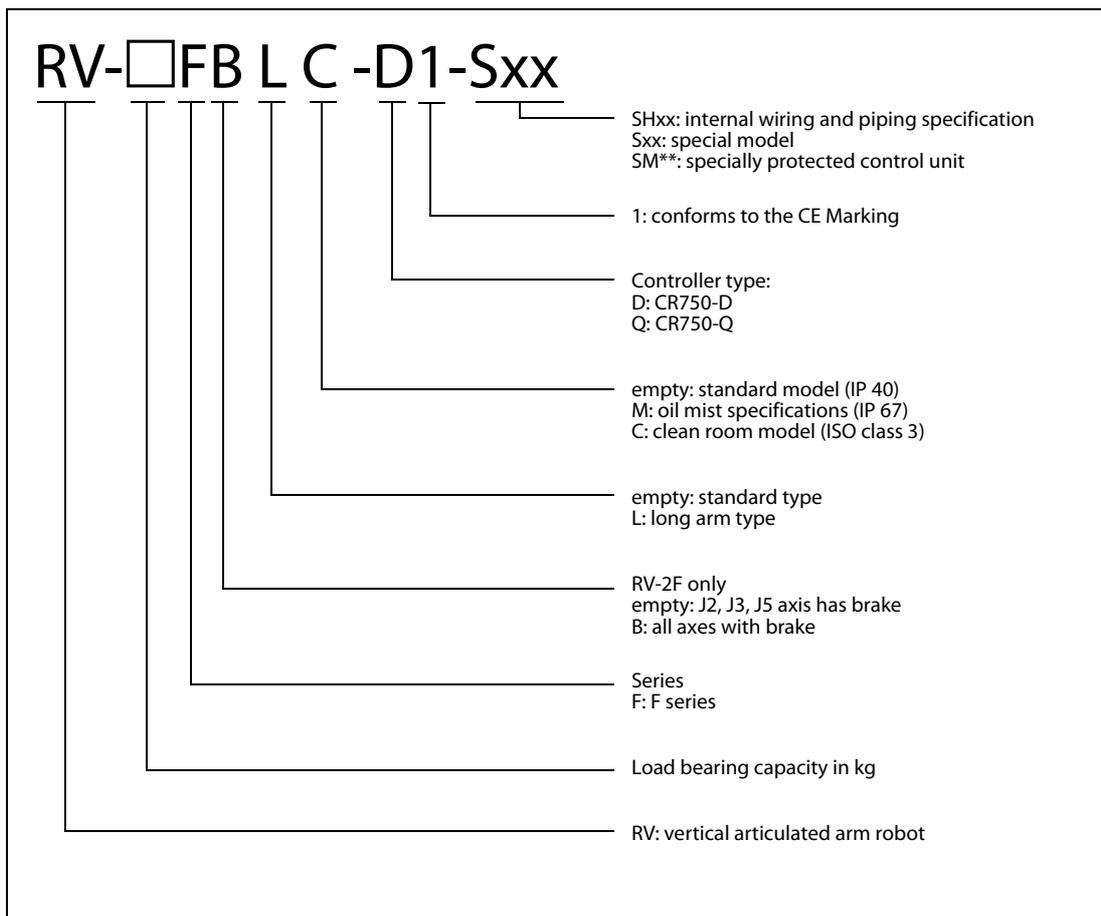


Fig. 1-1: Model name of vertical articulated arm robot

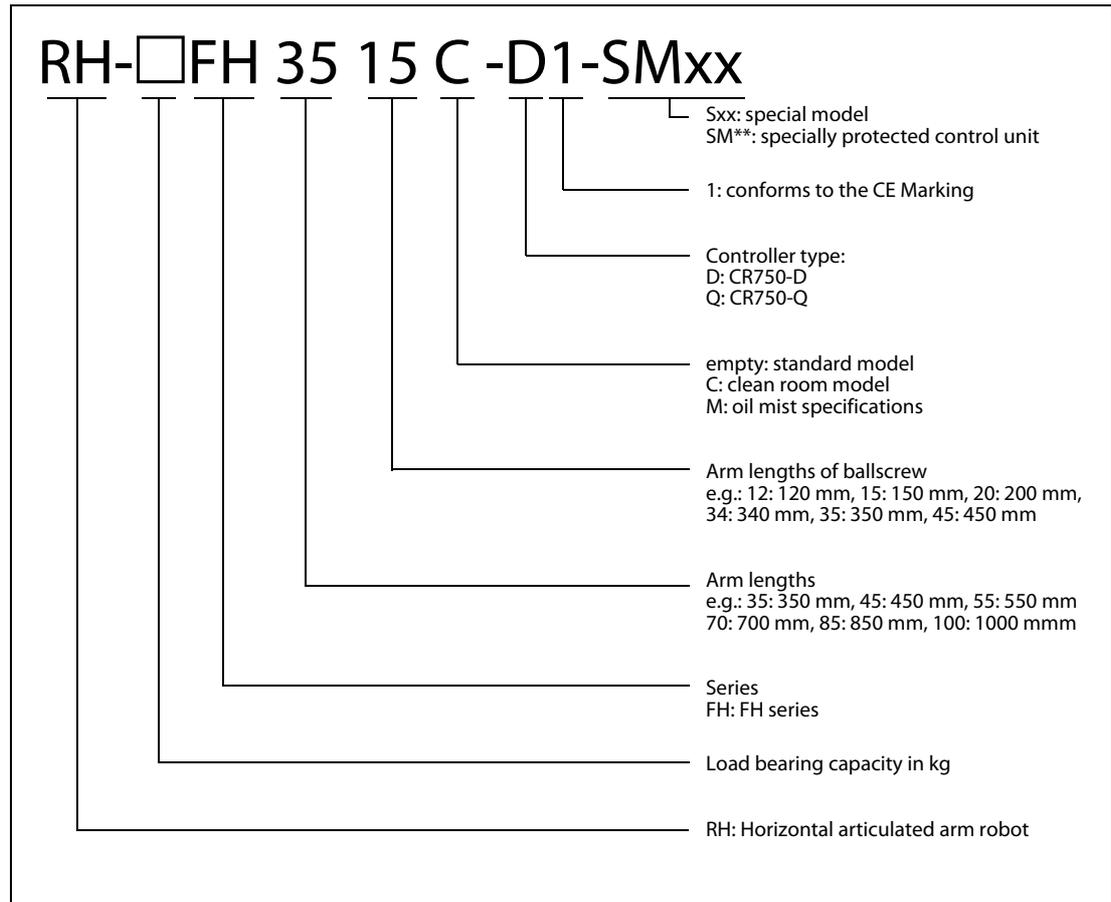


Fig. 1-2: Name of model of the horizontal articulated arm robot (SCARA)

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**

**ATTENTION:**

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.

**ATTENTION:**

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 control unit 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-2FB/RH-3FH), 1.0 kVA (RV-4FM/4FLM, RH-6FH), 1.5 kVA (RH-12/20FH) or 2.0 kVA (RV-7FM/7FLM).

- 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

- Performance Level (PL): d
- Category: 3

2 System overview

All devices and system parts belonging to the industrial robots from the MELFA F 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 F-D series

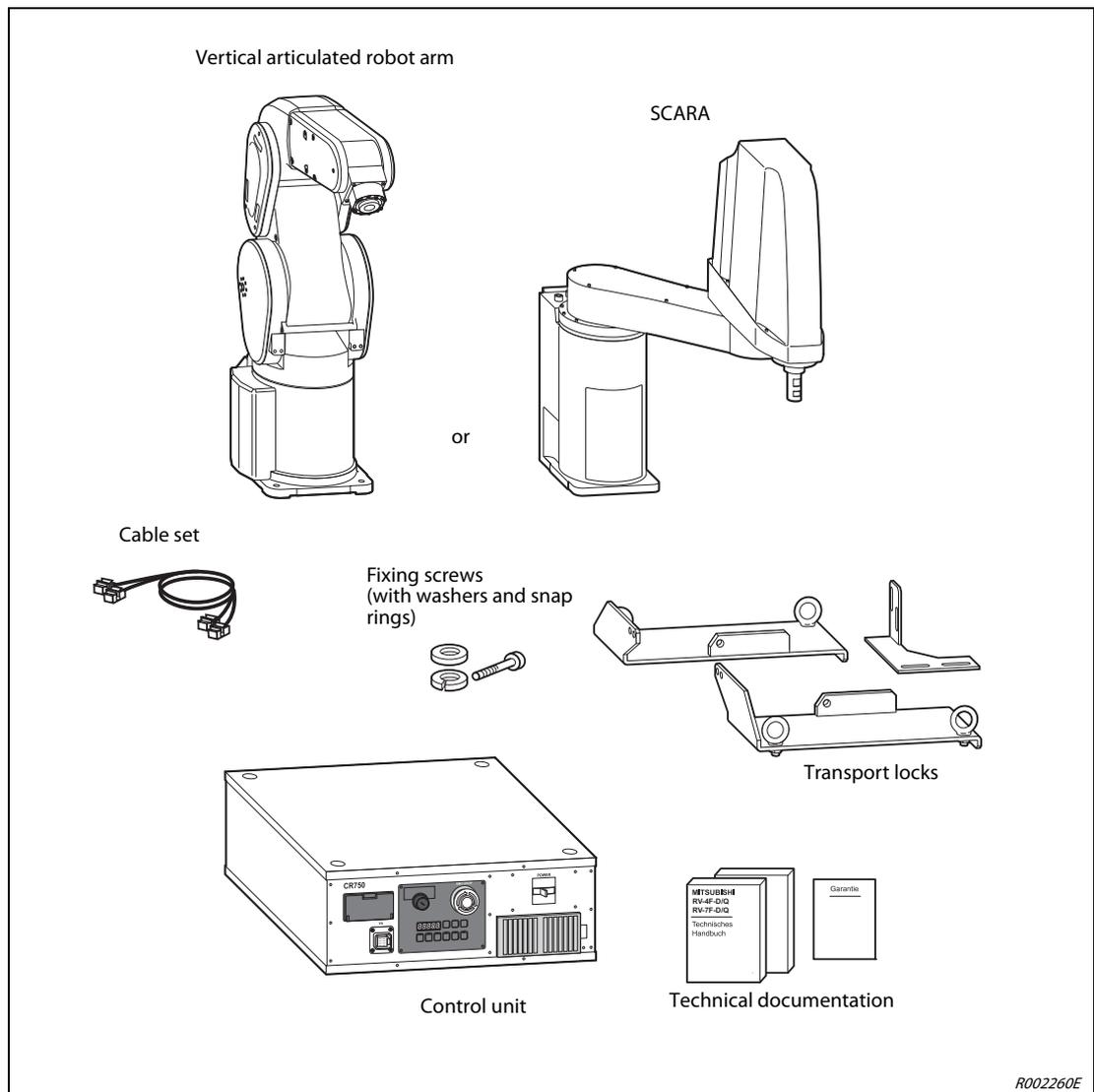


Fig. 2-1: Scope of delivery of robot systems RV-F-D and RH-FH-D

2.1.2 F-Q series

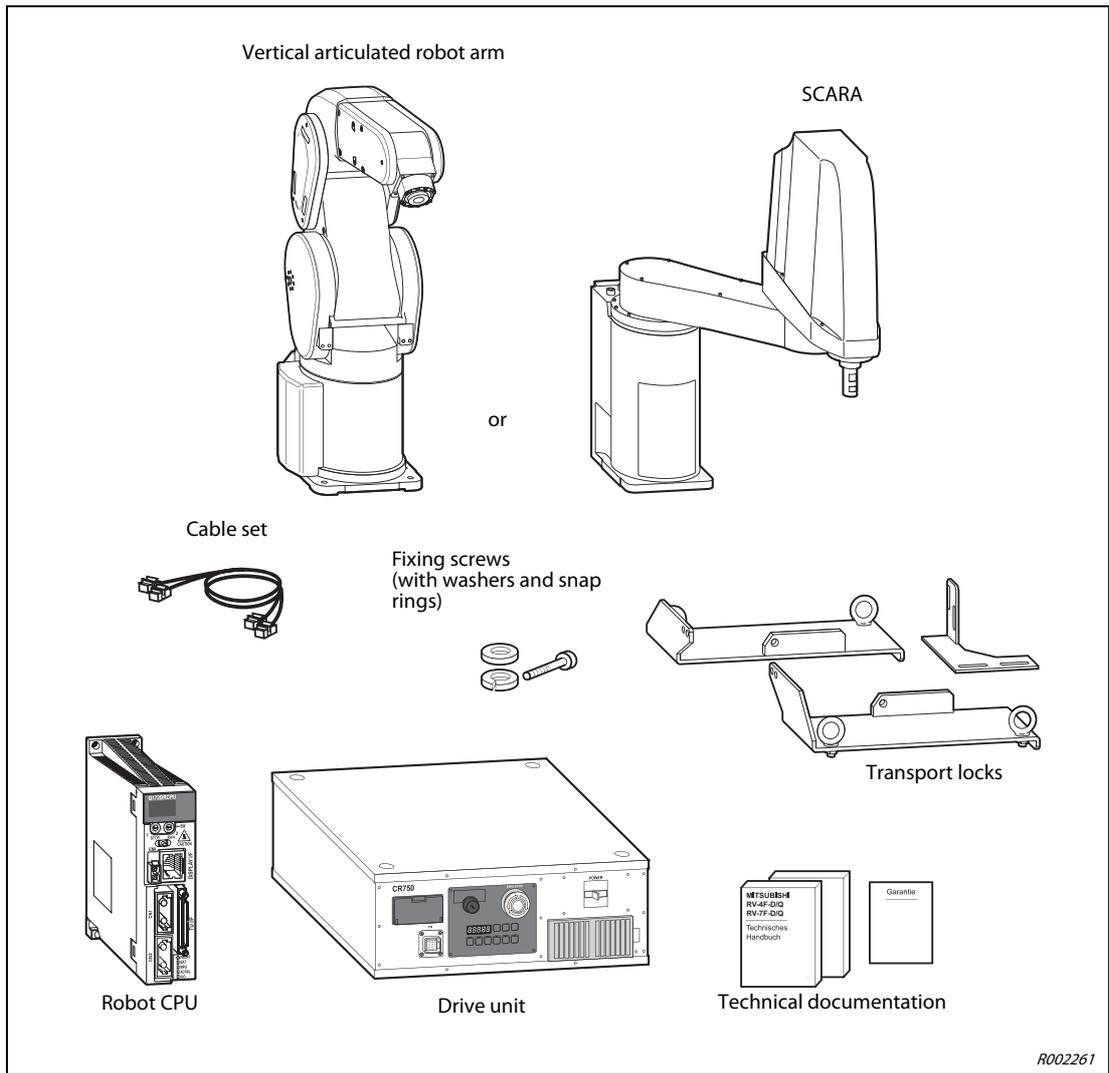


Fig. 2-2: Scope of delivery of robot systems RV-F-Q and RH-FH-Q

2.2 System configuration

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

2.2.1 F-D series

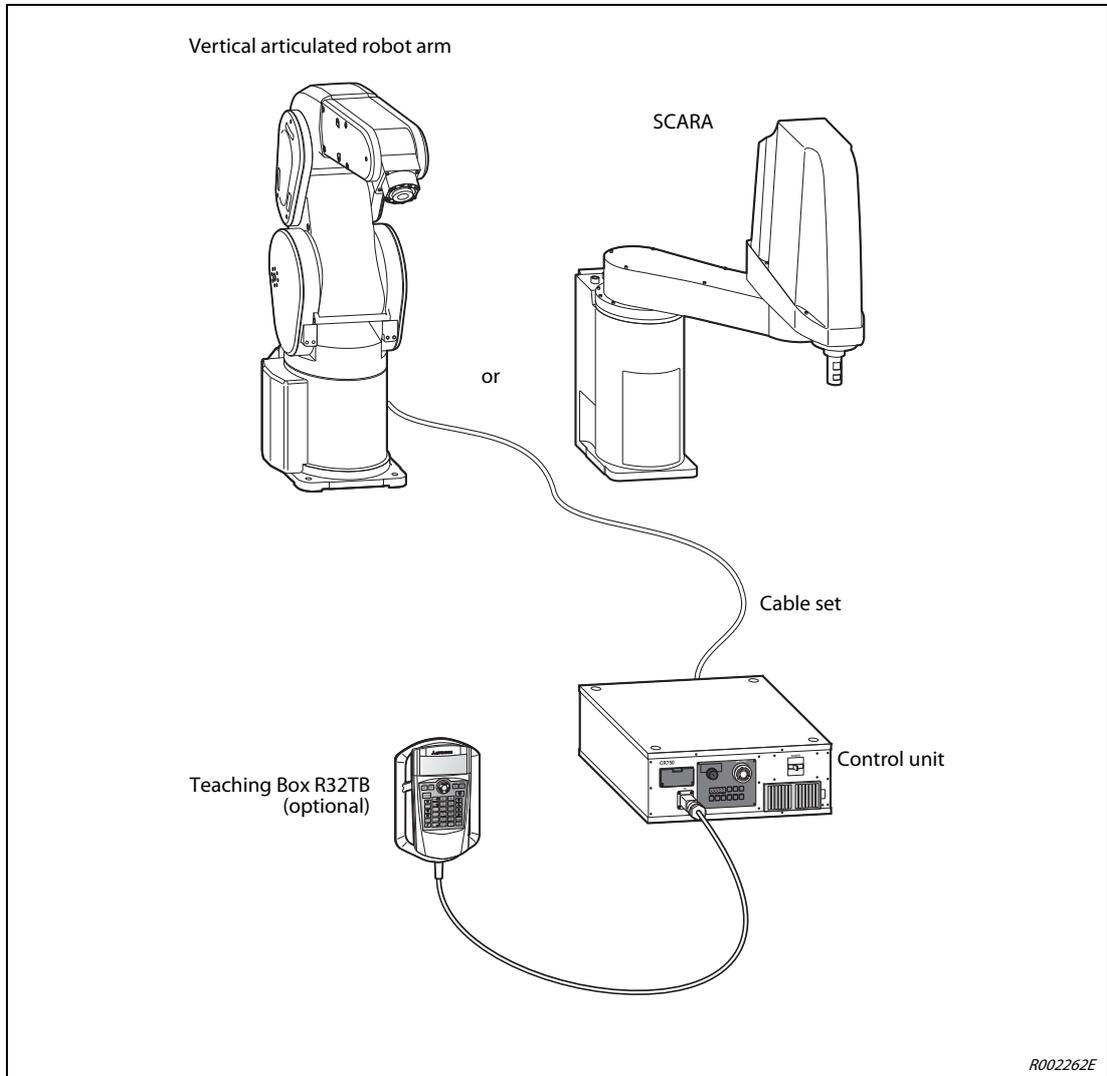


Fig. 2-3: Configuration of an F-D series robot system

NOTE

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

2.2.2 F-Q series

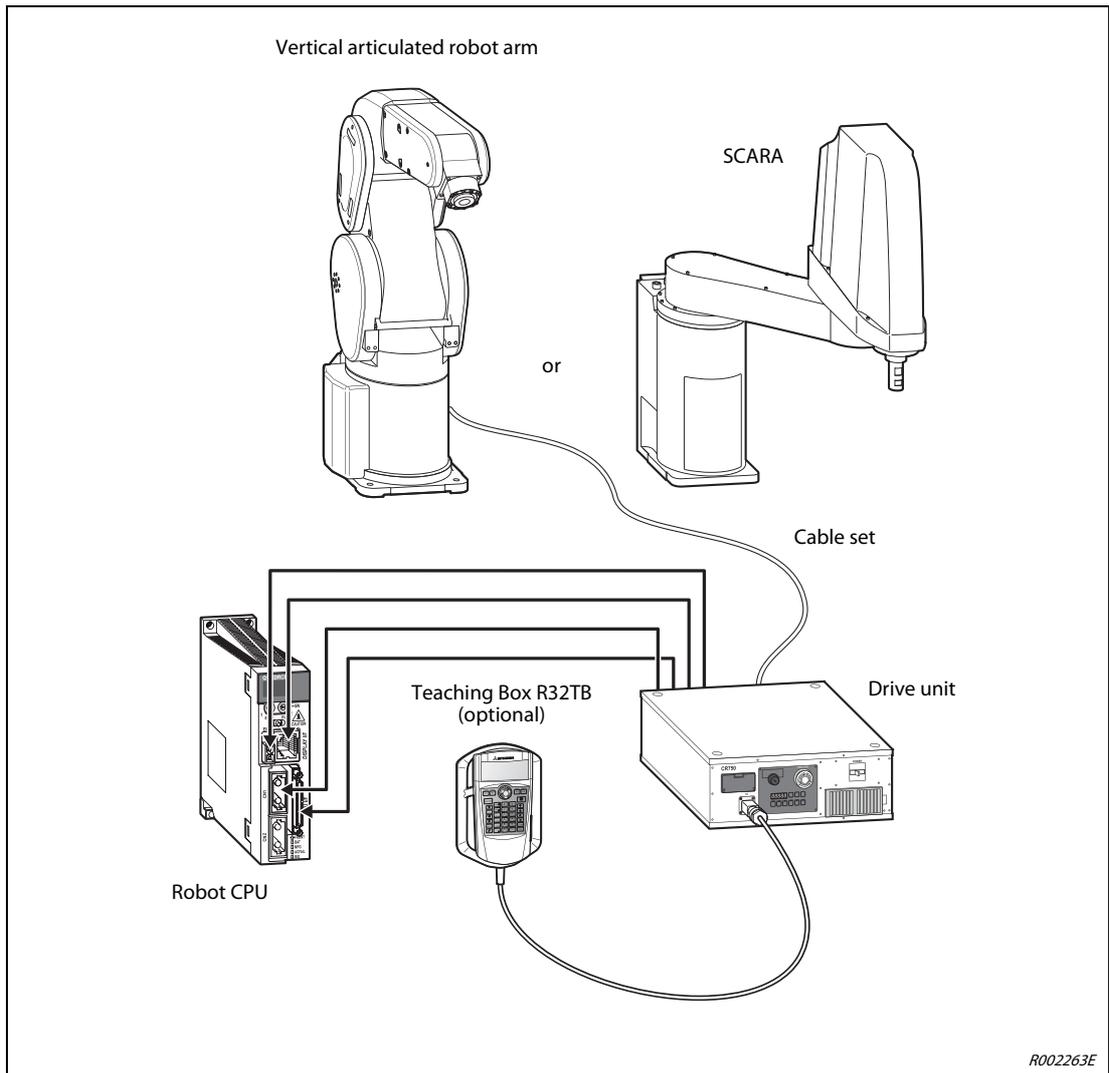


Fig. 2-4: Configuration of an F-Q series robot system

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

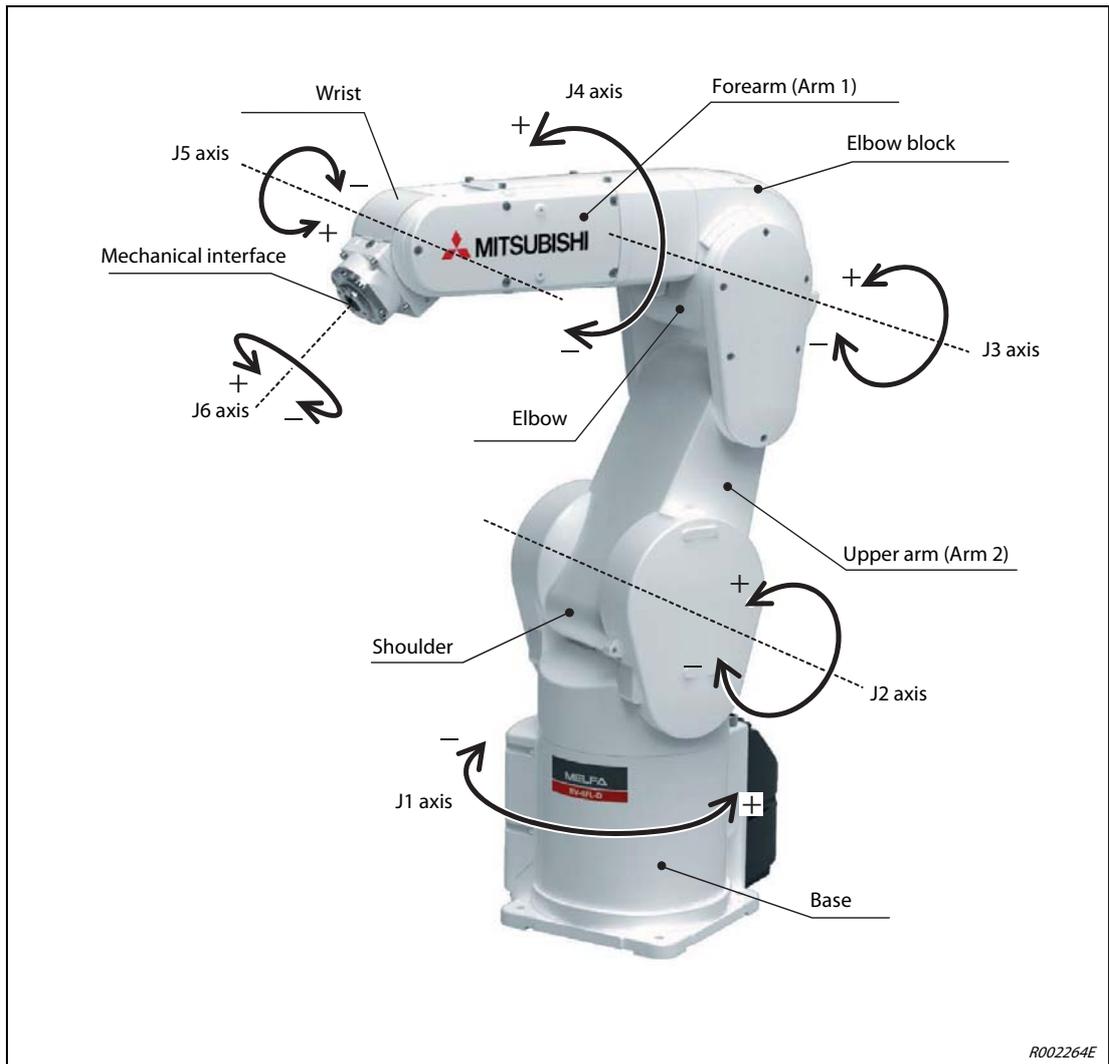


Fig. 2-5: Components of the robot arm on the vertical articulated arm robot

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

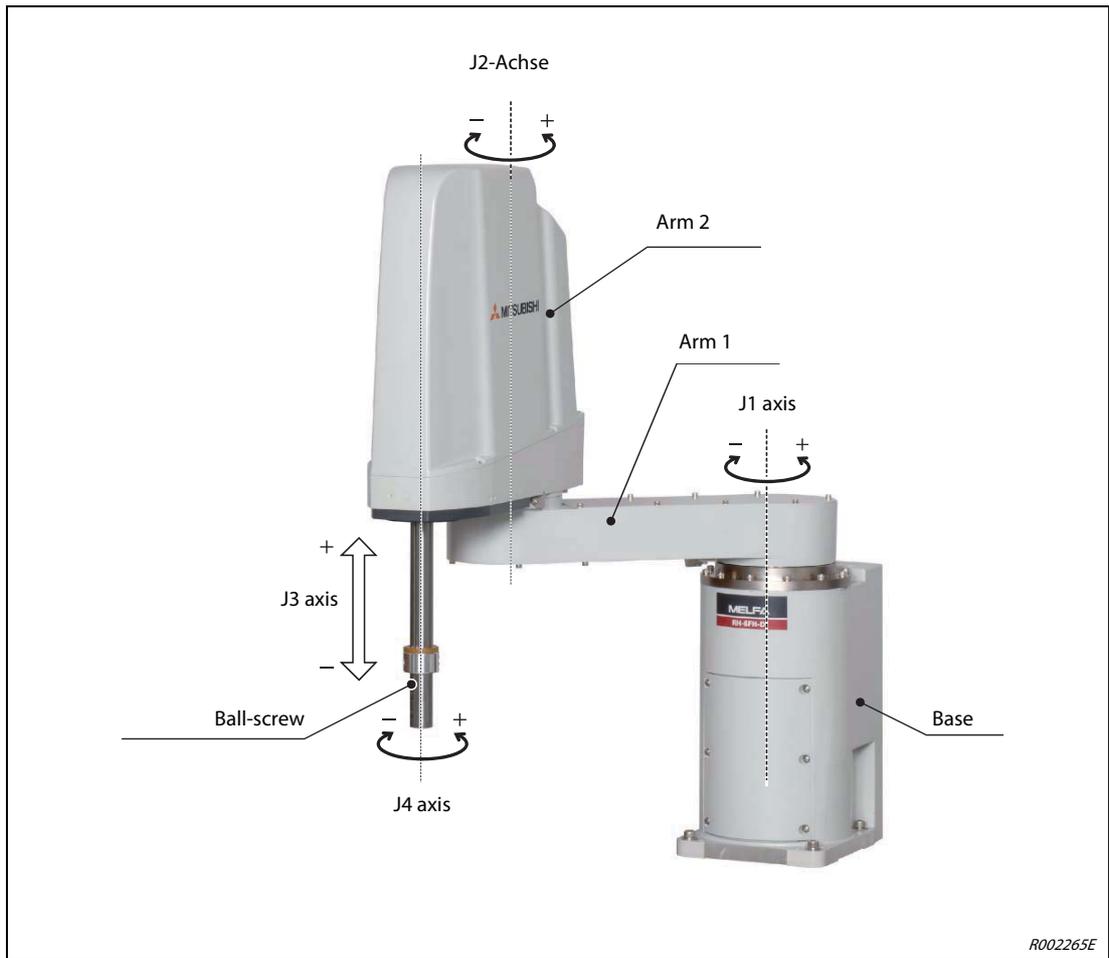


Fig. 2-6: Components of the robot arm in the SCARA

2.3 Control units

2.3.1 Front side

The following figure shows the front view of the control unit CR750.

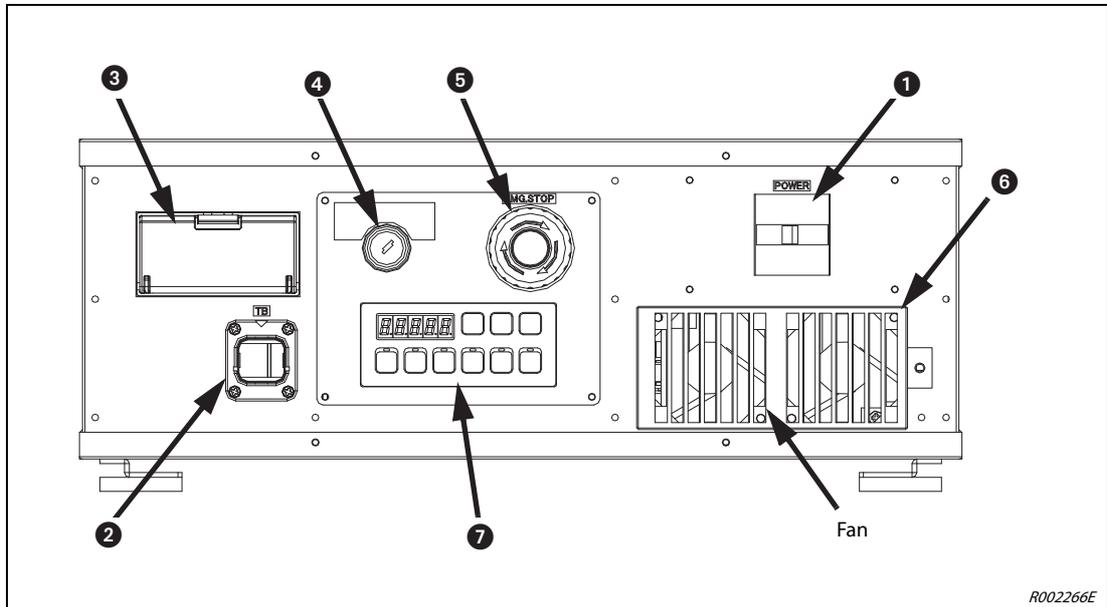


Fig. 2-7: Front view of the control unit

No.	Name	Function	
①	[Power] switch	This turns the control power ON/OFF	
②	T/B connection	Port to connect the Teaching Box. Install the dummy plug in the port (do this with the control unit turned off) if you do not plan to connect the Teaching Box.	
③	Port cover	USB port and battery	
④	[MODE] selector switch	AUTOMATIC	Operation can be carried out via the control unit or external devices. Operation via external signals or the Teaching Box is deactivated. (Exclude the start of automatic operation.)
		MANUAL	If the Teaching Box is enabled then the robot can only be operated by the Teaching Box. Operation cannot be carried out using external signals or the control unit.
⑤	[EMG.STOP] pushbutton switch	The pushbutton switch is used for the EMERGENCY-STOP of the robot system. After pressing the pushbutton switch, the servo power supply is switched off immediately and the moving robot arm stops instantaneously. The pushbutton is unlocked by turning it to the right and then jumps back out.	
⑥	Filter cover	There is an air filter inside the cover.	
⑦	Operation panel	The operation panel for servo ON/OFF, START/STOP the program etc. (refer to page 2-8)	

Tab. 2-2: Overview of components on the front side of the control unit

2.3.2 Control panel

The following figure shows the control panel of control unit CR750.

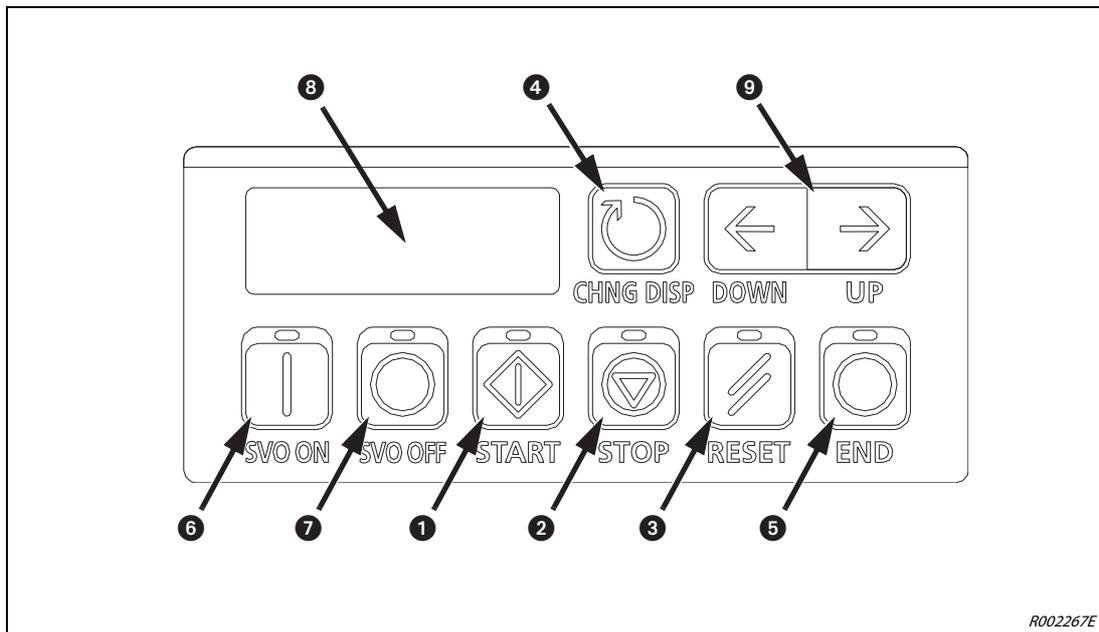


Fig. 2-8: Control panel

No.	Name	Function
①	[START] key	Start a program and operate the robot The program is processed continuously
②	[STOP] key	Cancel the running program and stop the robot This function is the same as the function of the [STOP] key on the Teaching Box.
③	[RESET] key	Acknowledges an error code Sets the hold state of the program and resets the program
④	[CHNG DISP] key	Changes the display on the control unit in the following order: Program number → Line number → Override → User information → Manufacturer information
⑤	[END] key	Stops the running program after END instruction
⑥	[SVO ON] key	Switches on the servo power supply
⑦	[SVO OFF] key	Switches off the servo power supply
⑧	[STATUS NUMBER] display	Displays alarm, program number and override value (%) etc.
⑨	[UP/DOWN] key	Scrolls within the display

Tab. 2-3: Overview of control and signal elements

NOTE | Keys ①, ②, ③, ⑤, ⑥ and ⑦ have integrated control displays.

2.3.3 Components of the CR750 control unit

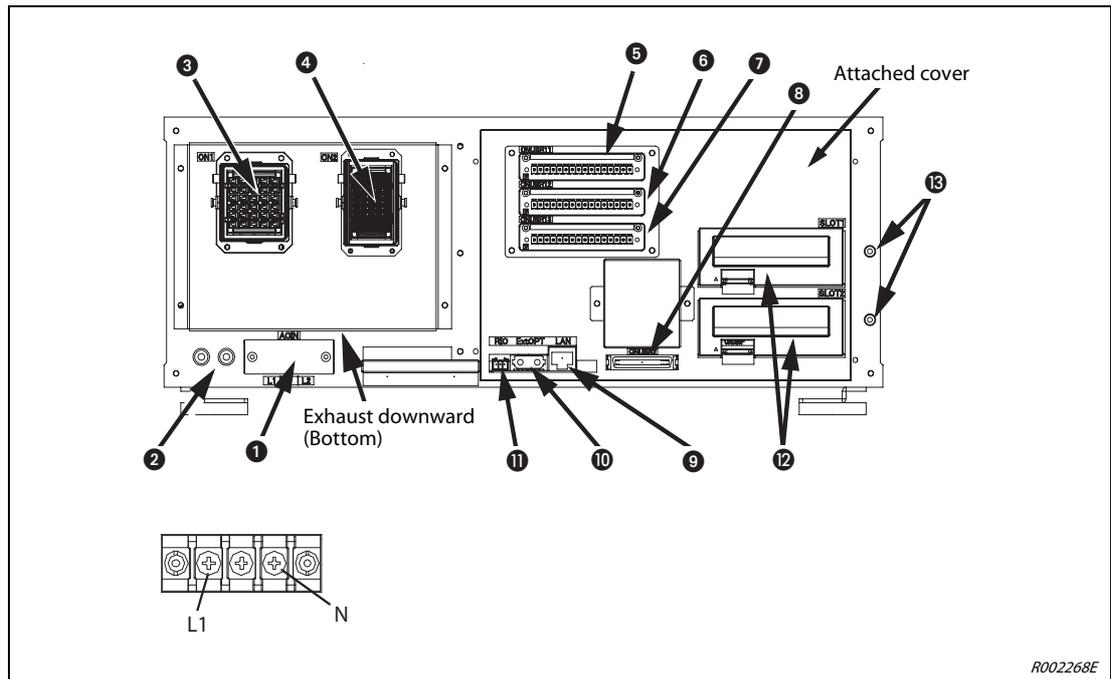


Fig. 2-9: Rear of control unit

No.	Name	Function
1	ACIN terminal	AC power source input
2	Grounding screw (M4 × 2)	Grounding connector
3	Connection fro servo power supply cable (CN1)	Robot power supply
4	Connection for signal cable (CN2)	Robot control cable
5	Connector CNUSR11	Input/output connection dedicated for robot (a plug connector attached)
6	Connector CNUSR12	
7	Connector CNUSR13	
8	Connector CNUSR2	
9	Connector LAN	LAN connection
10	Connector ExtOPT	Connect the cable for addition axis control
11	Connector RIO	Port to connect an additional parallel input/output ports
12	Option slot SLOT1 Option slot SLOT2	Slots for optional plug-in cards (Install the cover, when not using.)
13	Grounding screw (M3 × 2)	Grounding connector

Tab. 2-4: Components on the rear of the control unit

2.3.4 Components of the CR750 drive unit

The CR750-Q control unit is comprised of the robot CPU Q172DRCPU and the CR750 drive unit.

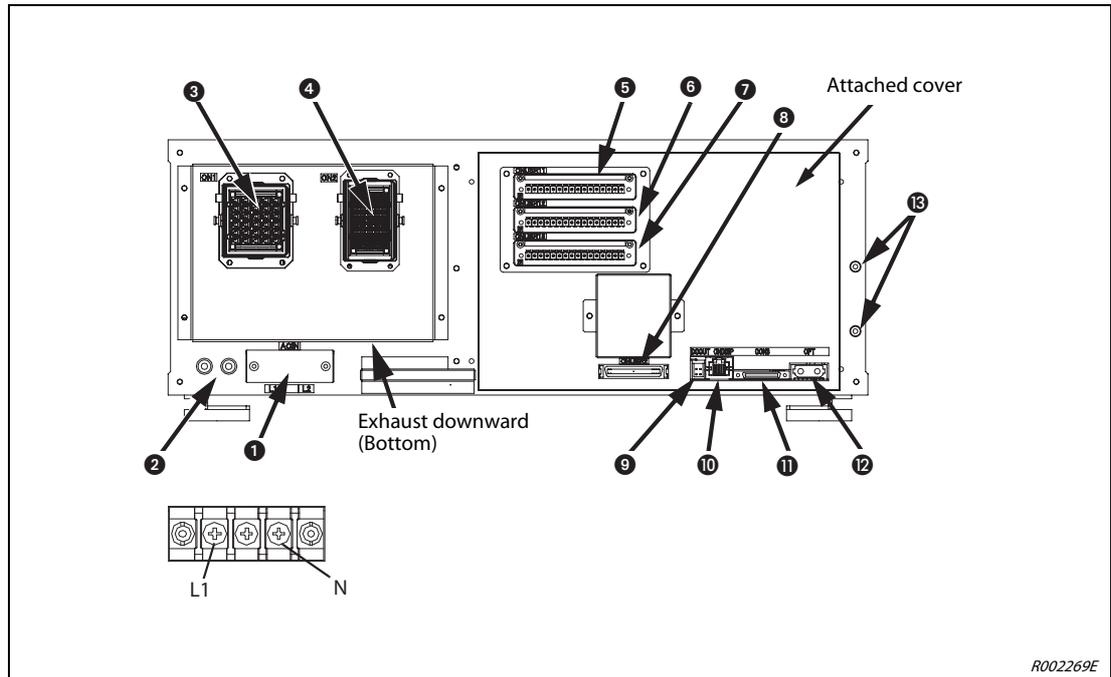


Fig. 2-10: Rear of drive unit

No.	Name	Function
①	ACIN terminal	AC power source input
②	Grounding screw (M4 × 2)	Grounding connector
③	Connection for servo power supply cable (CN1)	Robot power supply
④	Connection for signal cable (CN2)	Robot control cable
⑤	Connector CNUSR1	Input/output connection dedicated for robot (a plug connector attached)
⑥	Connector CNUSR12	
⑦	Connector CNUSR13 (not used)	
⑧	Connector CNUSR2	
⑨	Connector DCOUT	Emergency stop
⑩	Connector CNDISP	LAN of T/B connection
⑪	Connector CON3	RS422 of T/B connection
⑫	Connector OPT	SSCNETIII connection
⑬	Grounding screw (M3 × 2)	Grounding connector

Tab. 2-5: Components on the rear of the drive unit

2.4 Robot CPU (F-Q series only)

The control units of the F-Q series have an external CPU, which can be added to an already existing iQ system.

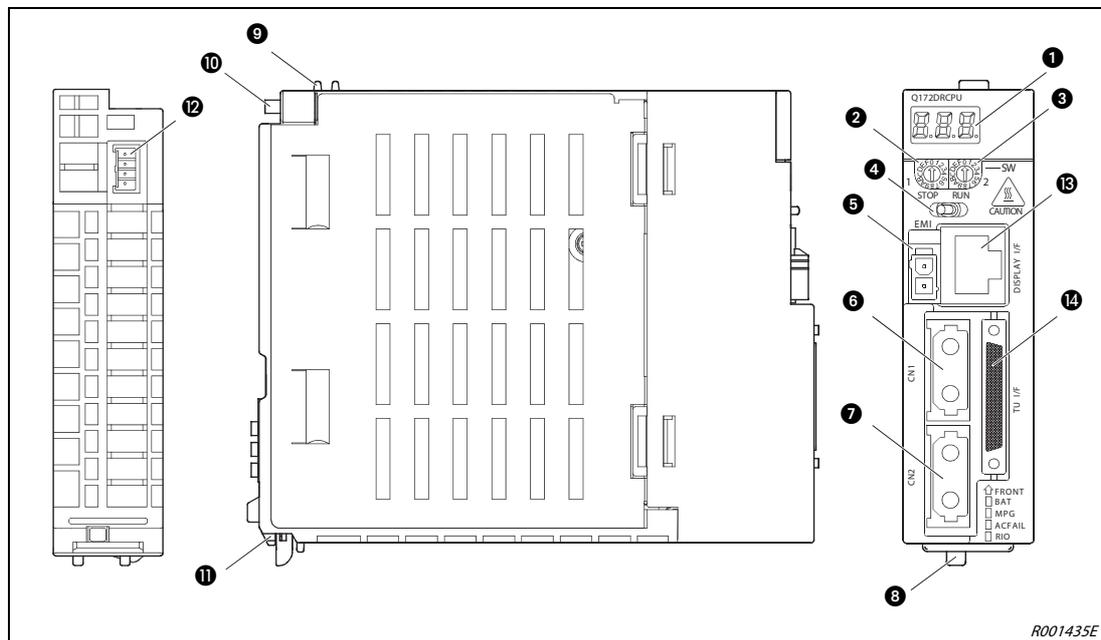


Fig. 2-11: Robot CPU Q172DRCPU

No.	Name	Function
①	7-segment LED display	Status and alarm display
②	Code switch SW1	Setting the operating mode
③	Code switch SW2	Must be set to "0".
④	[RUN/STOP] selector switch	Not used
⑤	EMI ①	EMERGENCY-STOP input All servo motors can be stopped simultaneously via this input. EMI ON (stop): EMERGENCY-STOP enabled EMI OFF (connect 24 V DC): EMERGENCY-STOP disabled
⑥	CN1 ②	Connection of control unit
⑦	CN2 ②	Connection of an additional axis (up to 8 axes)
⑧	Lock	The locking lever releases the plug when installed in the rack.
⑨	Catch ③	Used to fix the CPU to the rack
⑩	Fixing screw	Screw to fix the CPU to the rack (M3 x 13)
⑪	Catch	Used to fix the CPU to the rack
⑫	Battery connection ④	Connection for Q170DBATC battery unit
⑬	DISPLAY I/F	Connection for the Teaching Box (R56TB)
⑭	TU I/F	Connection for an RS422 connection to the control unit

Tab. 2-6: Overview of robot CPU components

- ① Always make sure to connect the EMI line, otherwise the EMERGENCY-OFF state is always enabled. The maximum permissible cable length is 30 m.
- ② Lay the cable in a cable channel or fix the cable near to the CPU to ensure a secure connection with plugs CN1 and CN2.
- ③ The catch is only used to simplify the installation process. Fix the CPU using the fixing screw on the rack.
- ④ Use an external battery as otherwise the program in the SRAM, the parameters, the home position data etc. will be lost.

2.5 Teaching Box

2.5.1 R28TB

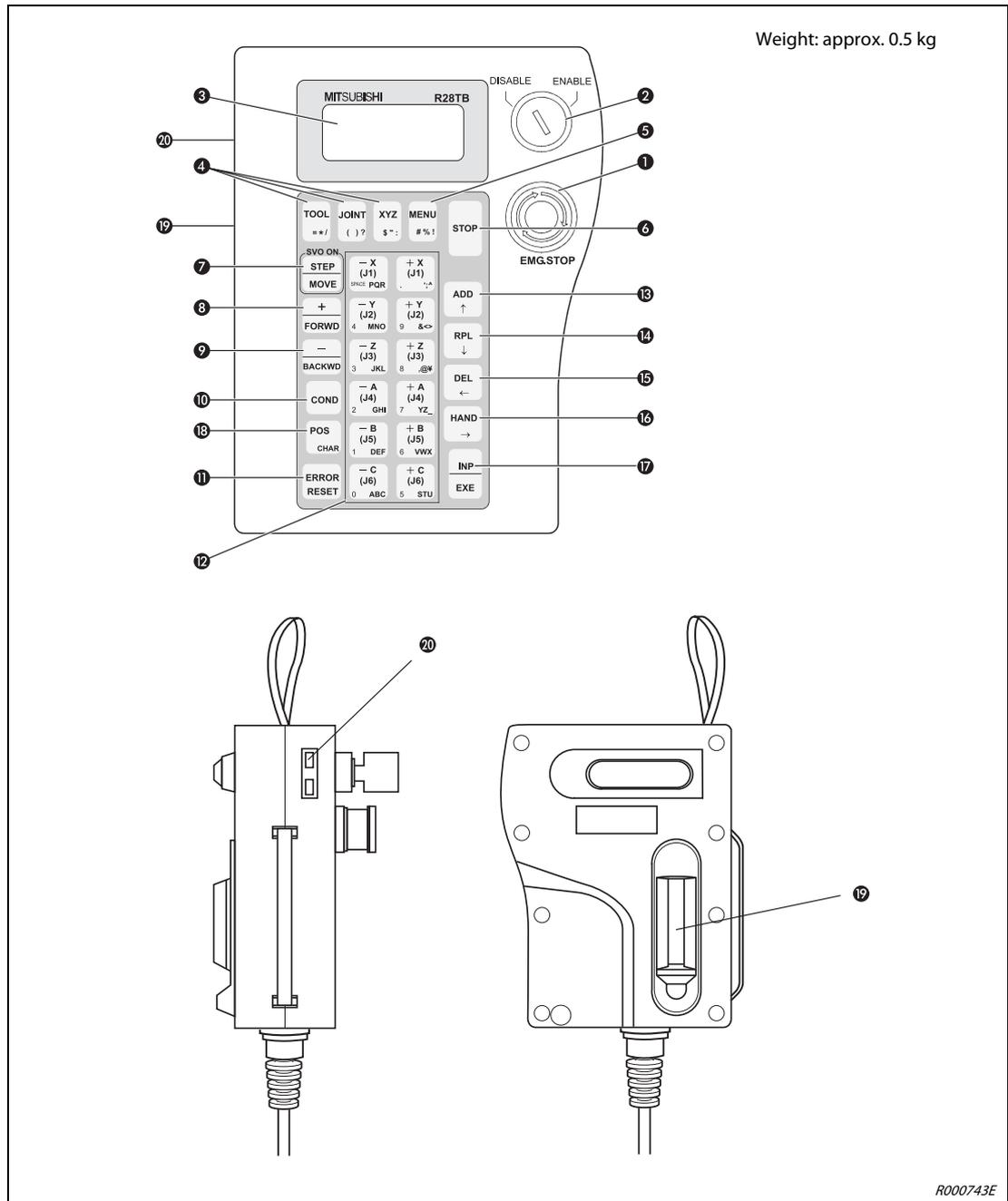


Fig. 2-12: Views of Teaching Box R28TB

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 control unit nor externally.
③	LCD display	The LCD display has 4 lines, each with 16 characters The state of the program or of the robot arm is displayed here
④	[TOOL] key	Select the tool-jog mode
	[JOINT] key	Select the articulated joint-jog mode
	[XYZ] key	Select the XYZ-jog- or circular-jog mode
⑤	[MENU] key	Returns to the main menu
⑥	[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 control unit. This key function is always available, independent of the position of the [ENABLE/DISABLE] selector switch.
⑦	[STEP/MOVE] key	Execute jog-mode together with jog keys ⑫ and the 3-step enable switch Instruction steps are executed together with the [INP/EXE] key. The servo power supply is switched off
⑧	[+/FORWD] key	Forward steps are executed together with the [INP/EXE] key. The next program line in edit mode is displayed. Press the key together with the [STEP/MOVE] key to increase override.
⑨	[-/BACKWD] key	Reverse steps are executed together with the [INP/EXE] key. The previous program line in edit mode is displayed. Press the key together with the [STEP/MOVE] key to decrease override.
⑩	[COND] key	Edit the program
⑪	[ERROR RESET] key	Acknowledges an error code A program is reset when used together with the [INP/EXE] key.
⑫	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.
⑬	[ADD/↑] key	Enter positions or move cursor upwards
⑭	[RPL/↓] key	Change positions or move cursor downwards
⑮	[DEL/←] key	Delete positions or move cursor to the left
⑯	[HAND/→] key	Used together with keys [+C/(J6)] or [-C/(J6)] to move the first gripper hand Used together with keys [+B/(J5)] or [-B/(J5)] to move the second gripper hand Used together with keys [+A/(J4)] or [-A/(J4)] to move the third gripper hand Move the cursor to the right
⑰	[INP/EXE]	Enter data or move on a step
⑱	[POS/CHAR] key	Switches between numbers and letters, e. g. when editing position data
⑲	Three-step switch	The three-step enable switch must be actuated to switch on the servo drive when the Teaching Box is switched on.
⑳	Contrast adjustment	Brightness setting on the LCD display

Tab. 2-7: Overview of Teaching Box R28TB controls

2.5.2 R32TB



Fig. 2-13: 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 control unit 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 control unit. 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. 2-8: Overview of Teaching Box R32TB (1) control

No.	Name	Function
①	[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. 2-8: Overview of Teaching Box R32TB (2) control

2.5.3 R46TB and R56TB

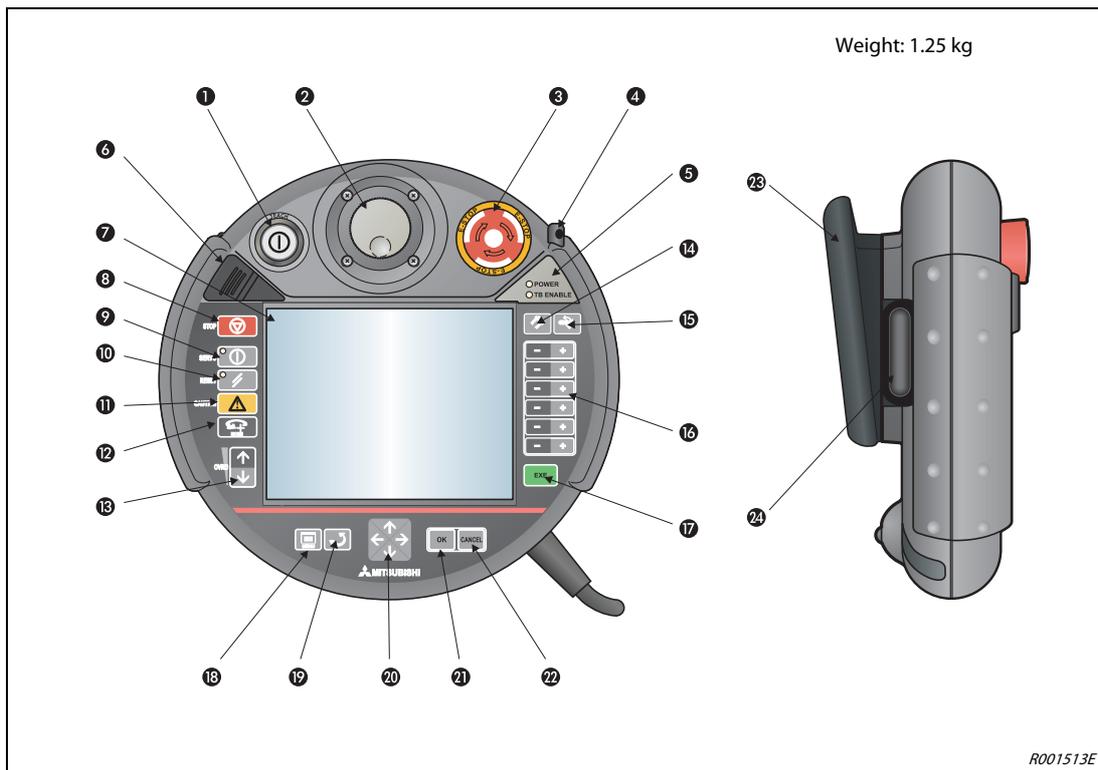


Fig. 2-14: Views of Teaching Boxes R46TB and R56TB

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 control unit 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. 2-9: Overview of controls on Teaching Boxes R46TB and 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. 2-9: Overview of controls on Teaching Boxes R46TB and 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



ATTENTION:

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-2FB

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 ③.
- ④ Set the robot arm upright together with the inner packaging, as shown in ④.
- 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.

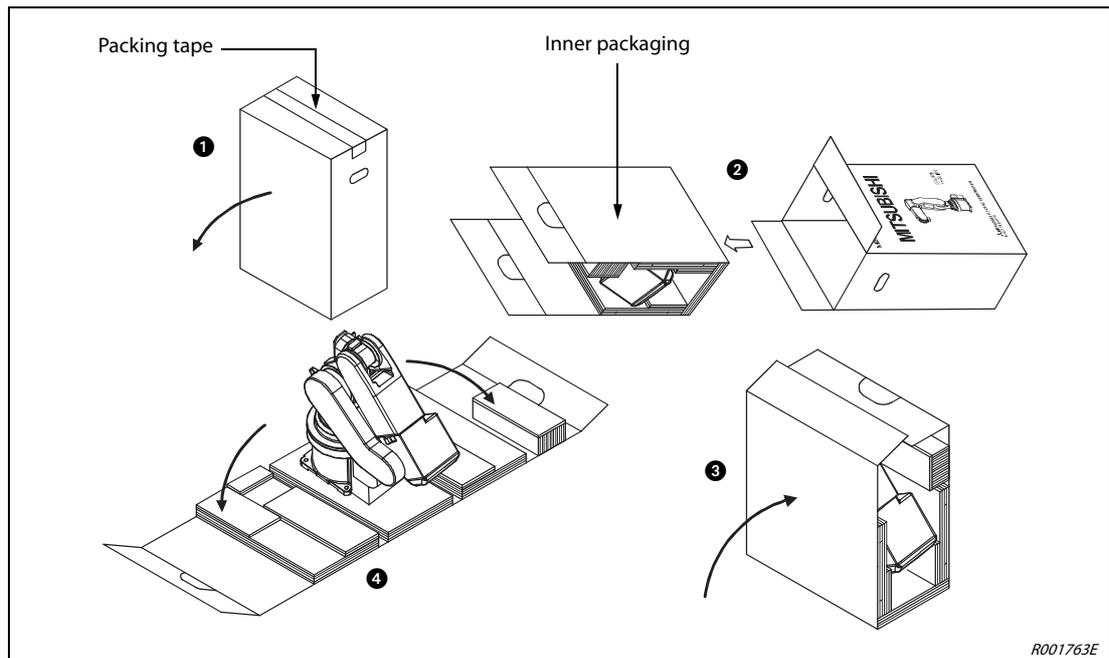


Fig. 3-1: Unpack articulated arm robot RV-2FB

RV-4FM/4FLM and RV-7FM/7FLM

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.

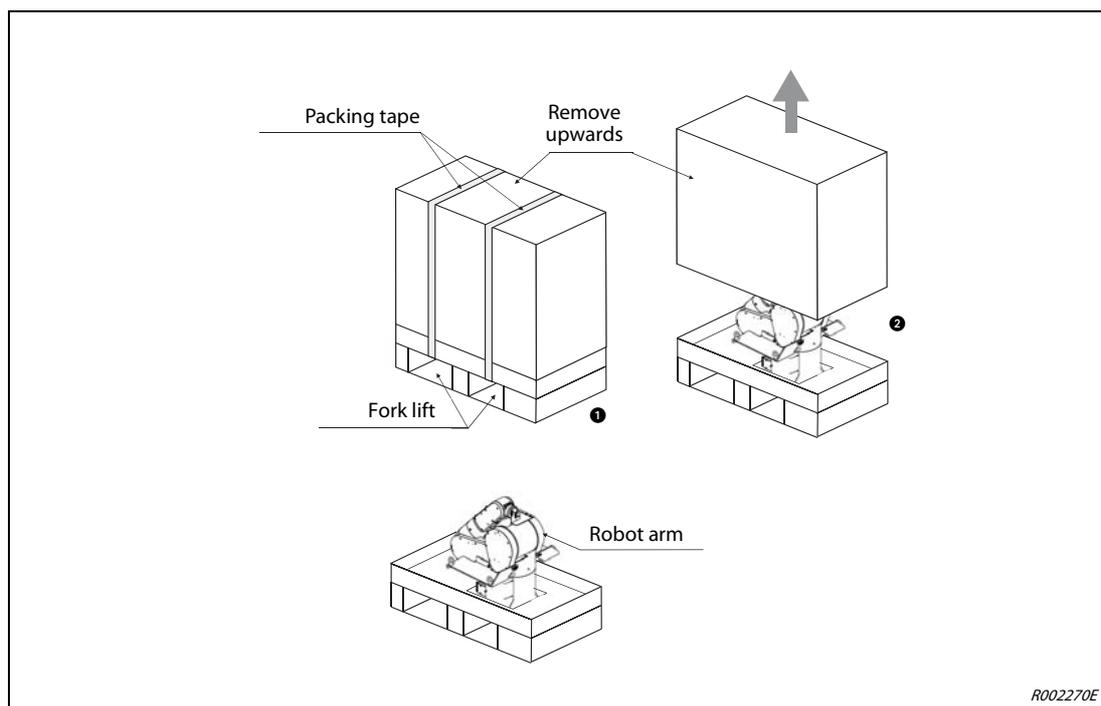


Fig. 3-2: Unpack articulated arm robot RV-4FM/4FLM and RV-7FM/7FLM

3.1.2 Unpack SCARA robot

RH-3/6/12/20FH

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.

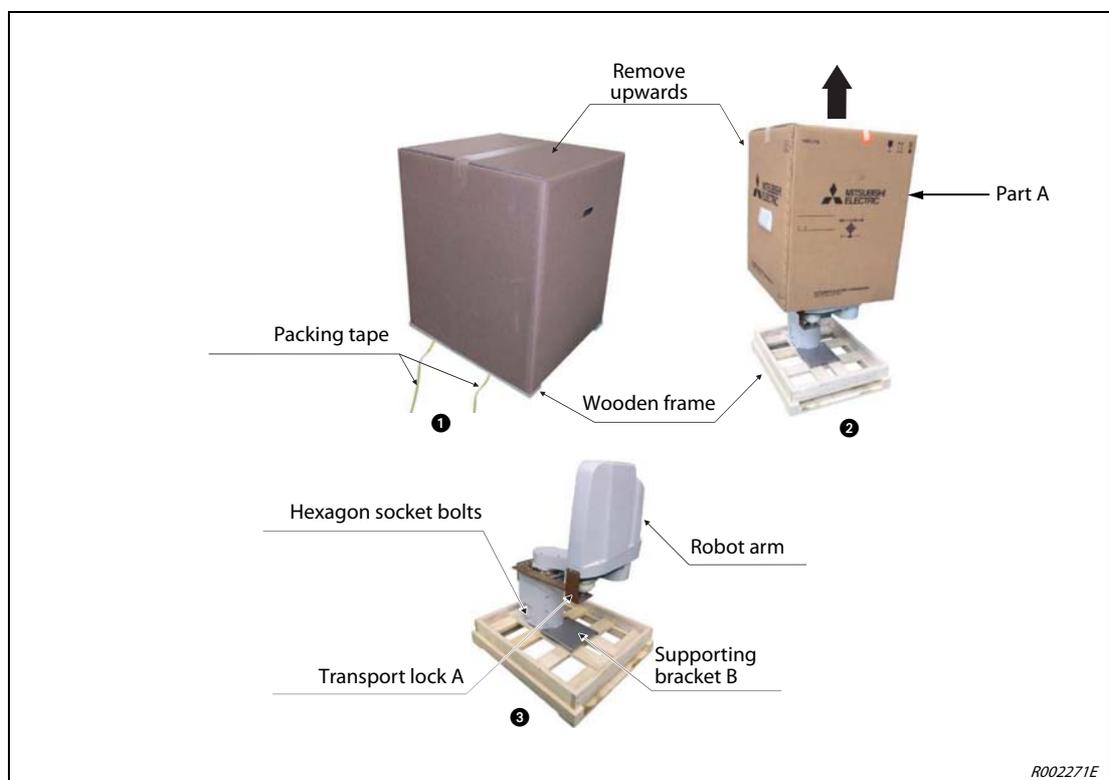


Fig. 3-3: Unpack the SCARA robots RH-3/6/12/20FH



ATTENTION:

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-2FB



ATTENTION:

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.

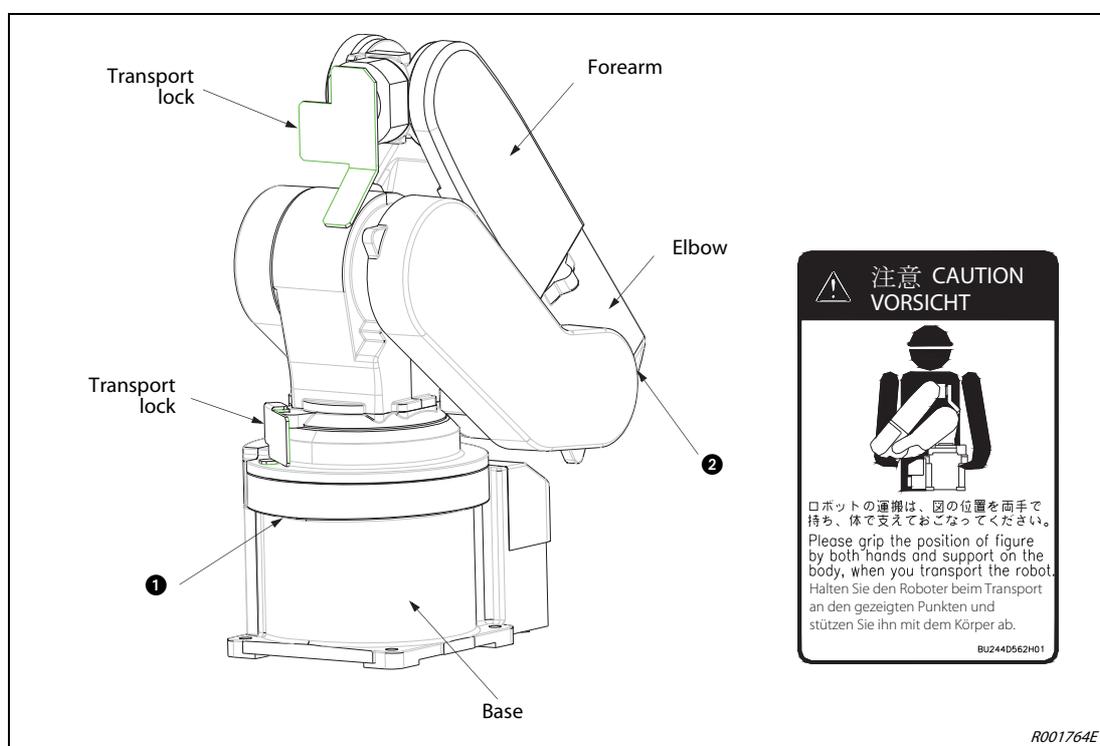


Fig. 3-4: Transporting the RV-2FB robot arm

- 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.



ATTENTION:

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

3.2.2 RV-4FM/4FLM and RV-7FM/7FLM

**ATTENTION:**

- *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.

**ATTENTION:**

To avoid faults, the wire rope of the crane must be attached as shown in Fig. 3-5.

- 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.

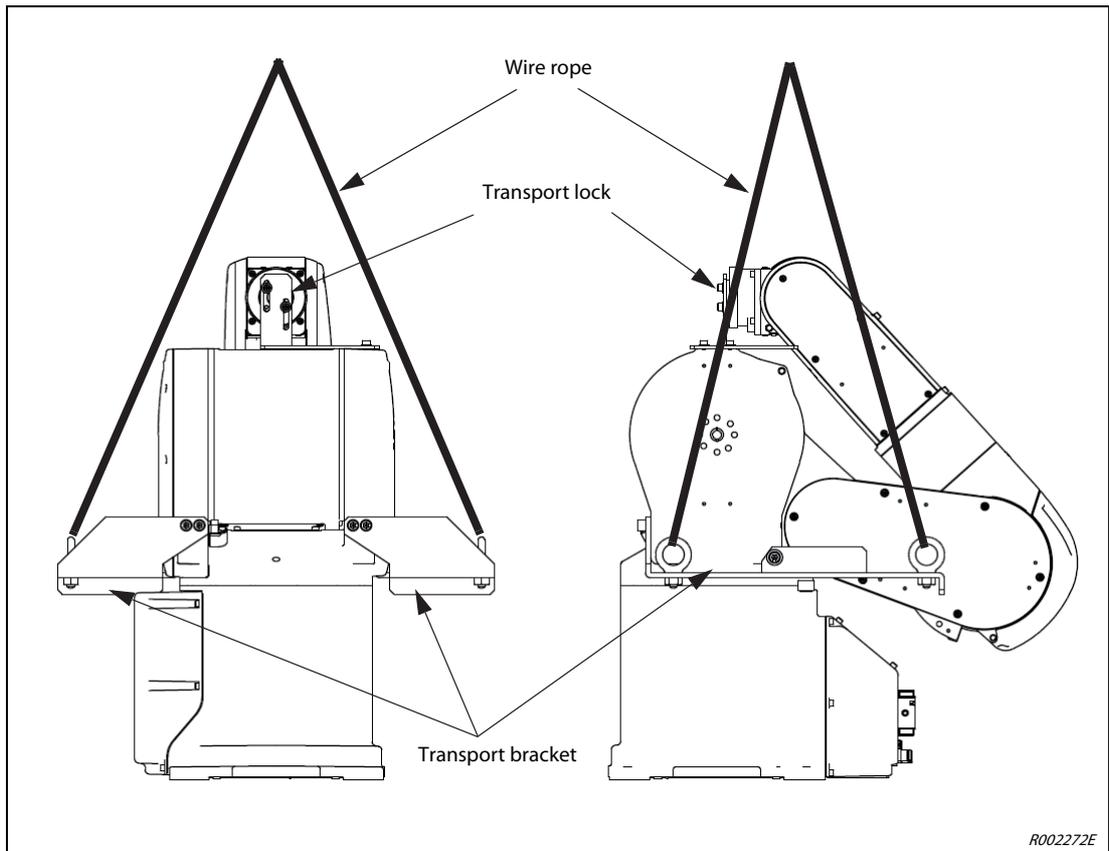


Fig. 3-5: Fix the transport bracket

3.2.3 RH-3FH/6FH



ATTENTION:

- **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 fixing plate A of arm 2 and point ② on arm 2 and another person should hold the fixing plate A of base at point ③ (see Fig. 3-6). Never carry the robot at the sides or at its covers because these may become loose and can destroy the robot arm.

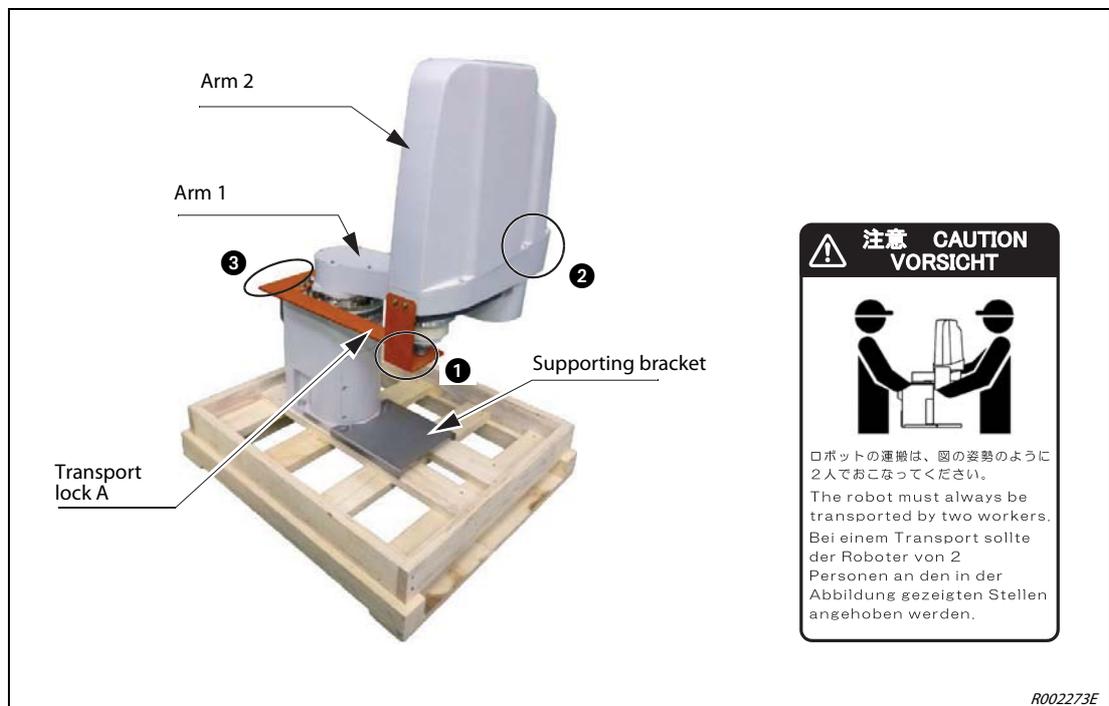


Fig. 3-6: Holding points on robot arm

- 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.

3.2.4 RH-12FH/20FH



ATTENTION:

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

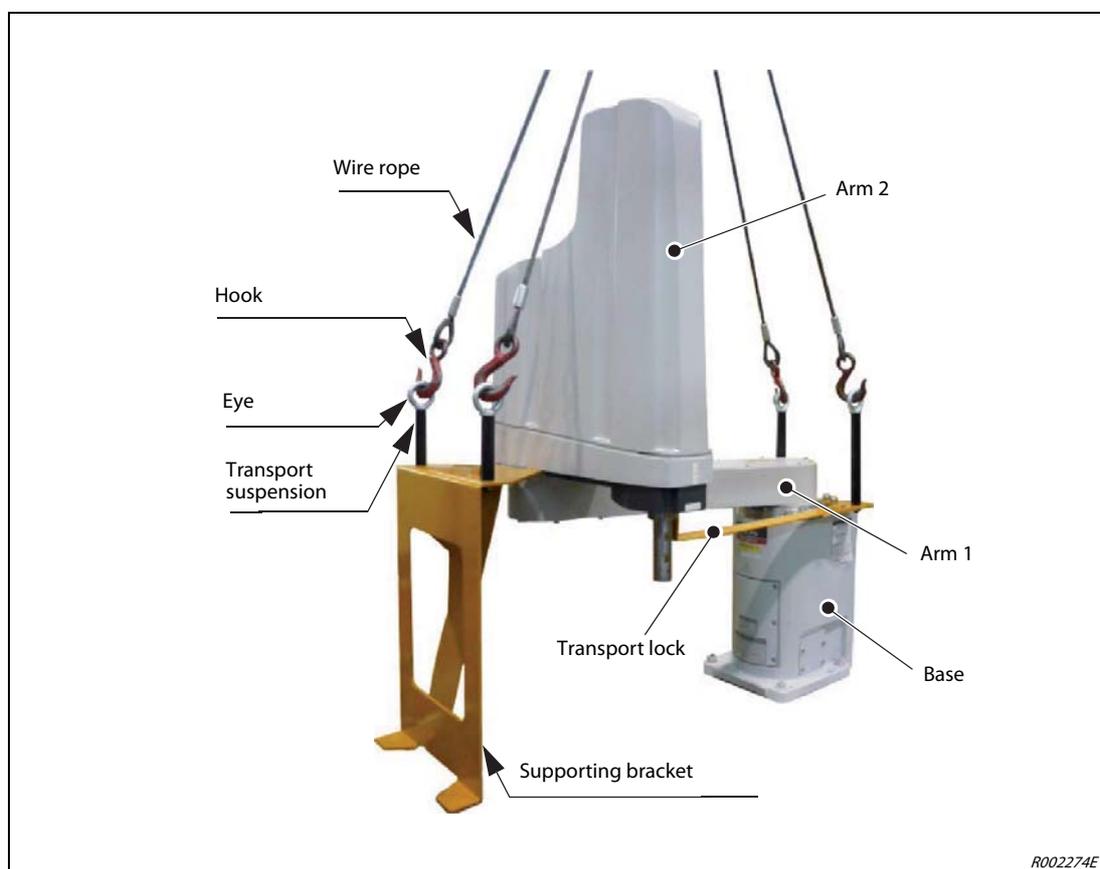


Fig. 3-7: Fix the transport suspensions



ATTENTION:

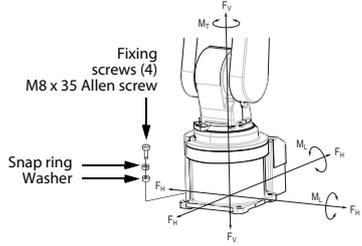
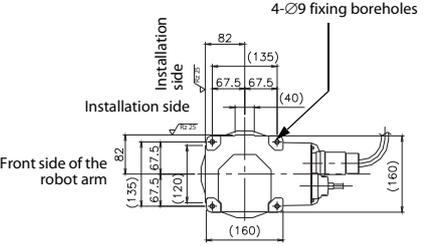
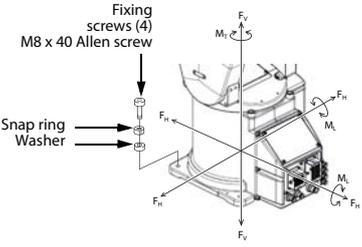
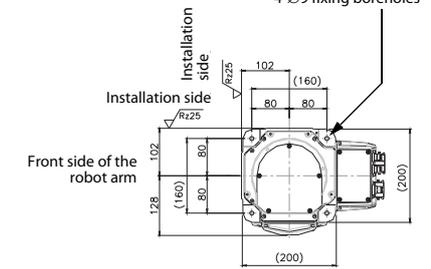
Also observe the above-mentioned steps when transporting the robot at a later time – e.g. when changing the installation location. If the robot is transported without the attached transport locks and supporting brackets, or if it is transported in operating position, then dangerous situations might arise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

3.3 Set up the robot arm

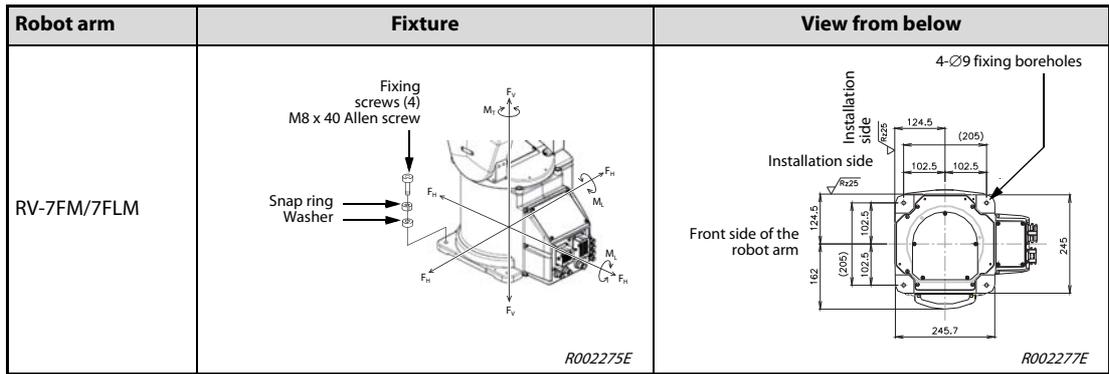
3.3.1 Set up the articulated arm robot

The table below shows how to set up and fix the articulated arm robot.

- 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 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 control units.
- 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-2FB	 <p style="text-align: right;"><i>R001765E</i></p>	 <p style="text-align: right;"><i>R001766E</i></p>
RV-4FM/4FLM	 <p style="text-align: right;"><i>R002275E</i></p>	 <p style="text-align: right;"><i>R002276E</i></p>

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



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

Load	RV-2FB	RV-4FM/4FLM	RV-7FM/7FLM
Moment of tilt M_L [Nm]	240	900	900
Torsional moment M_T [Nm]	150	900	900
Translational forces on horizontal plane F_H [N]	700	1000	1000
Translational forces on vertical plane F_V [N]	800	1700	1700

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



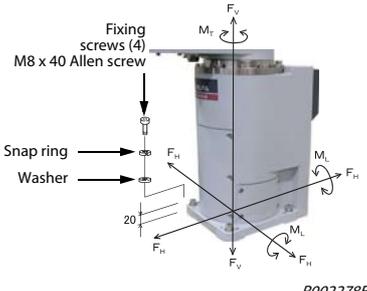
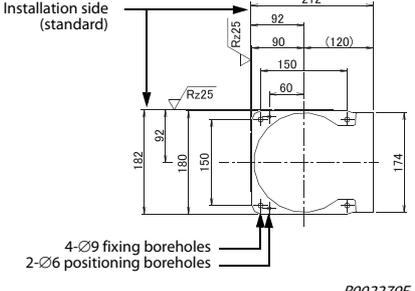
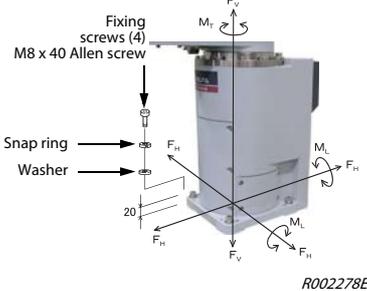
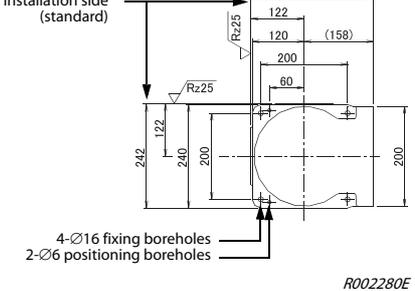
ATTENTION:

- **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

The table below shows how to set up and fix the SCARA robot.

- 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. 3-4.

Robot arm	Fixture	View from below
RH-3/6FH	 <p style="text-align: right;"><i>R002278E</i></p>	 <p style="text-align: right;"><i>R002279E</i></p>
RH-12/20FH	 <p style="text-align: right;"><i>R002278E</i></p>	 <p style="text-align: right;"><i>R002280E</i></p>

Tab. 3-3: Set up the robot arm

Load	RH-3FH	RH-6FH	RH-12/20FH
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	5500

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



ATTENTION:

- **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 control unit

This section describes the handling and set up of the control unit.

3.4.1 Transport the CR750 control unit and the CR750 drive unit



ATTENTION:

Carry the control unit or drive unit 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.



Fig. 3-8: Transport the CR750 control unit and the CR750 drive unit

3.4.2 Installing the CR750 control unit and the CR750 drive unit

The illustration below shows the installed CR750 control unit and CR750 drive unit. Please observe these important instructions:

- The control unit and drive unit can be installed vertically or horizontally. Only the horizontal installation option is described in this manual. Please contact your MITSUBISHI sales partner for information on vertical installation of the control unit and/or drive unit if necessary.
- Make sure that there is a lateral clearance of at least 145 mm and a clearance to the rear of at least 250 mm.
- Take steps to ensure that the maximum permitted ambient temperature of 40 °C is never exceeded when installing the units in switch-gear cabinets.

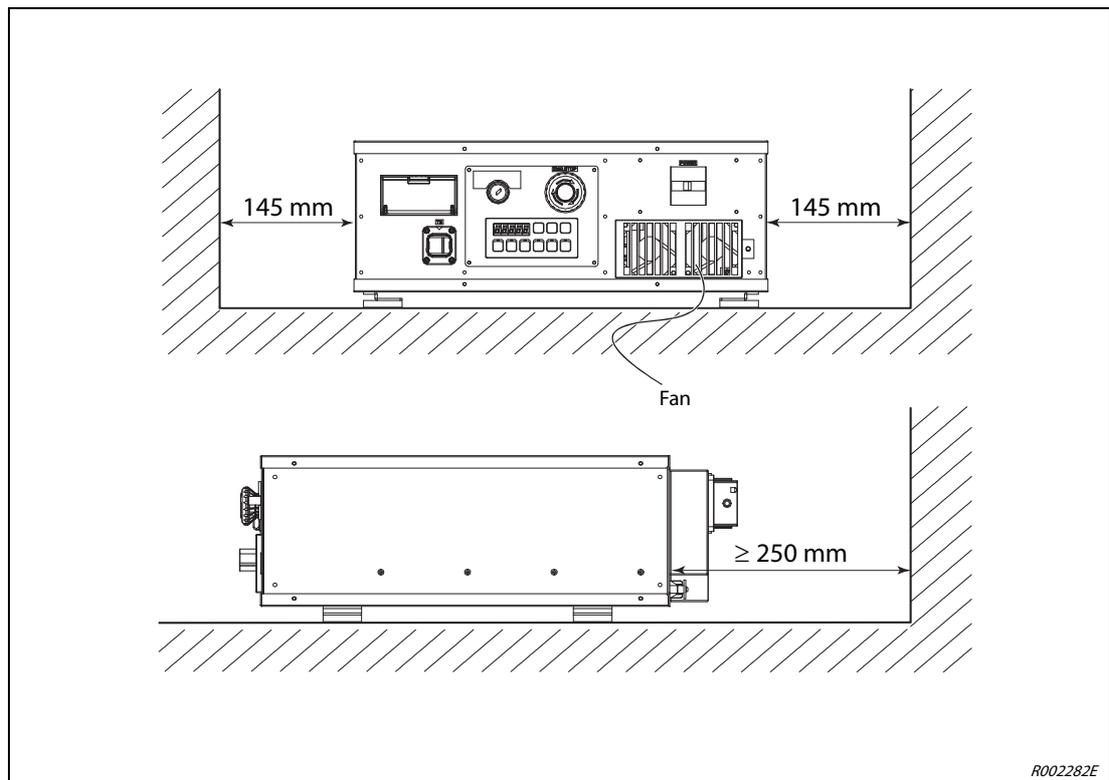


Fig. 3-9: Installation of the CR750 control unit and the CR750 drive unit

3.5 Installation of robot CPU Q172DRCPU

Notes on installation

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

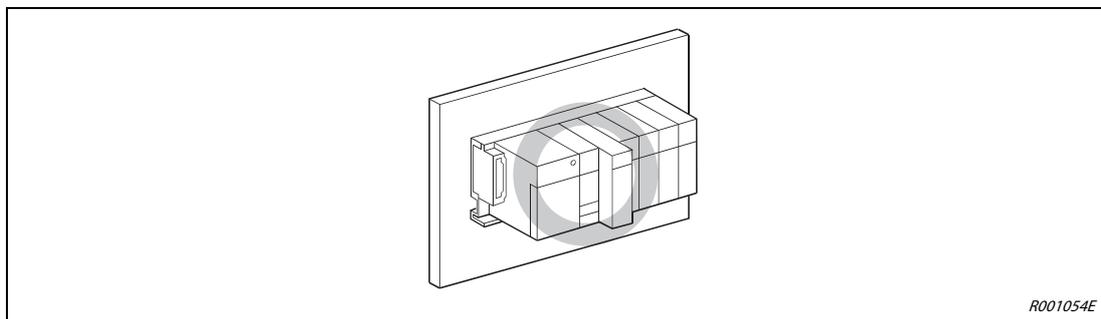


Fig. 3-10: Correct assembly of the rack

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

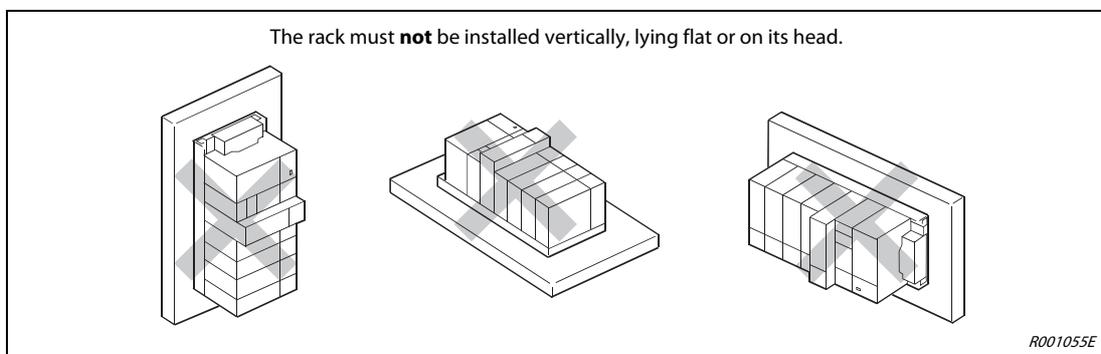


Fig. 3-11: Incorrect assembly of the rack

- 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.

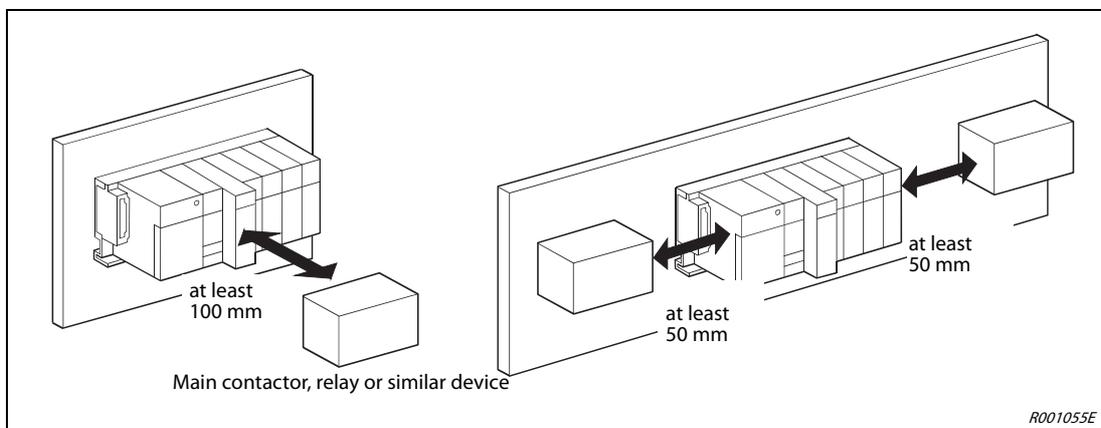


Fig. 3-12: Arrangement of modules in the control cabinet

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.



ATTENTION:

- *The mains voltage must always be switched off before installing a module.*
- *If the module is not placed correctly over the catch on the rack then the PINs on the module plug might become bent.*

Installation

- Switch off the mains voltage!
- Place the module with the lower catch into the guide on the rack.
- Then press the module onto the rack until it is lying fully onto the rack.
- Additionally secure the module with a screw (M3 x 12) if vibrations are to be expected. This screw is not supplied with the module. The robot CPU must always be secured with a fixing screw.

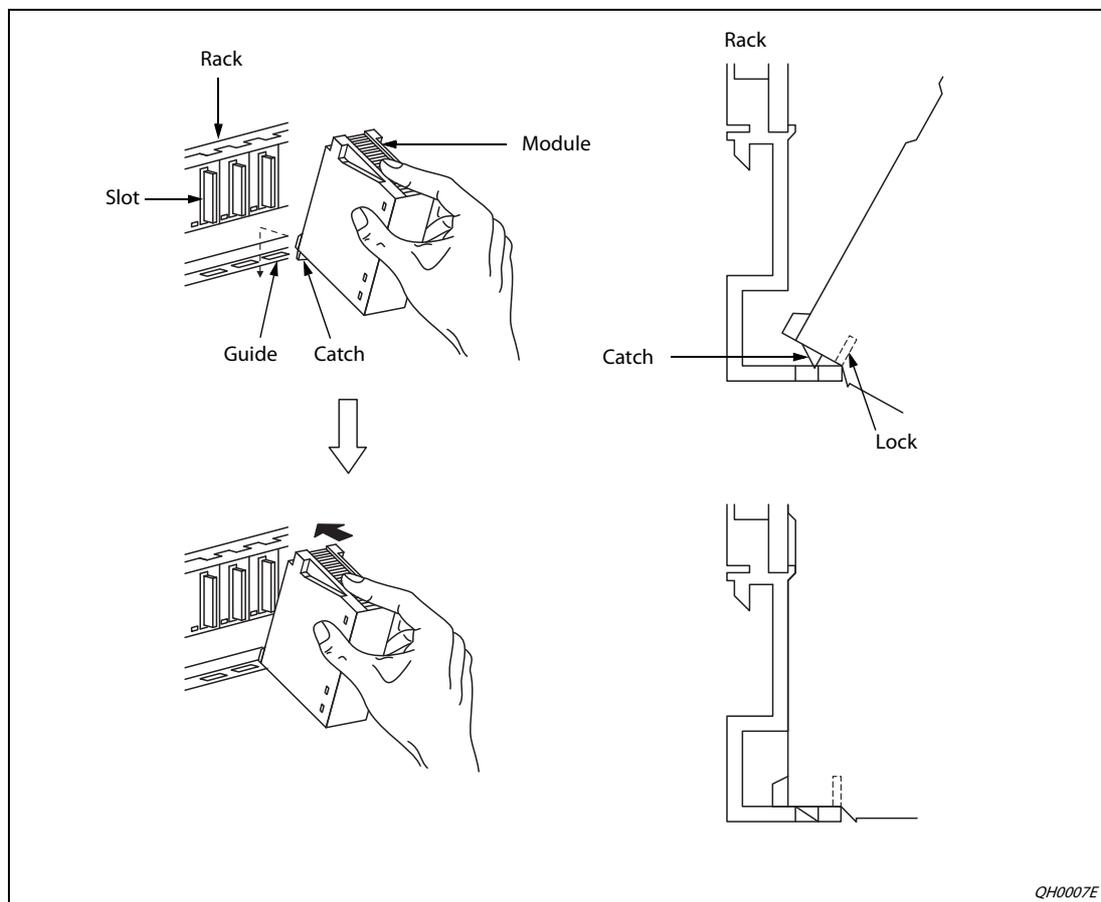


Fig. 3-13: Installation of the module

QH0007E

Removal

**ATTENTION:**

- *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 the catch on the module is not longer inserted into the guide. Otherwise, the mounting devices on the module may be damaged.*

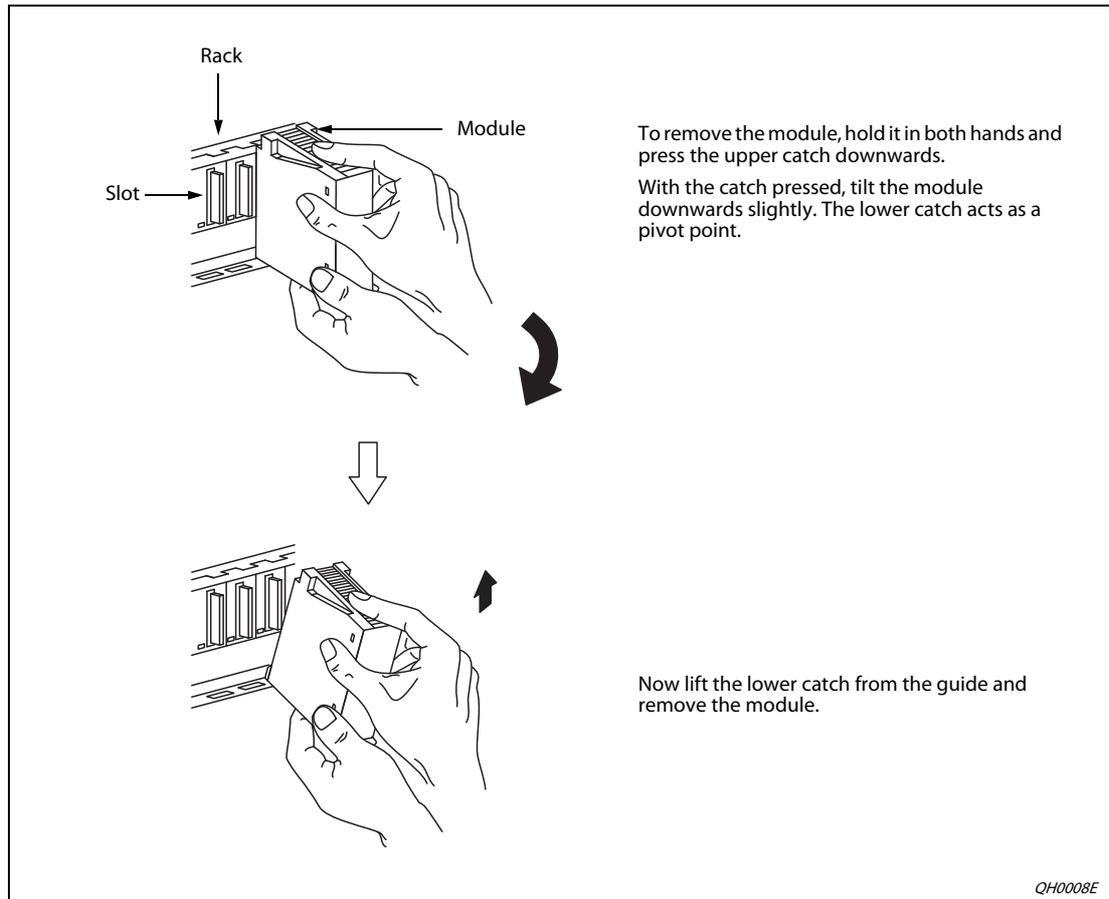


Fig. 3-14: Removal of the module

**ATTENTION:**

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

3.6 Grounding the robot system

General instructions on grounding the robot system

Three ways of grounding are shown in Fig. 3-15.

- Separate grounding is the best solution.
 - The robot arm is grounded at an M4 threaded hole (see Fig. 3-16) on the base area.
 - The control unit is grounded together with the mains line (feed) connection. To ground the control unit, 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.

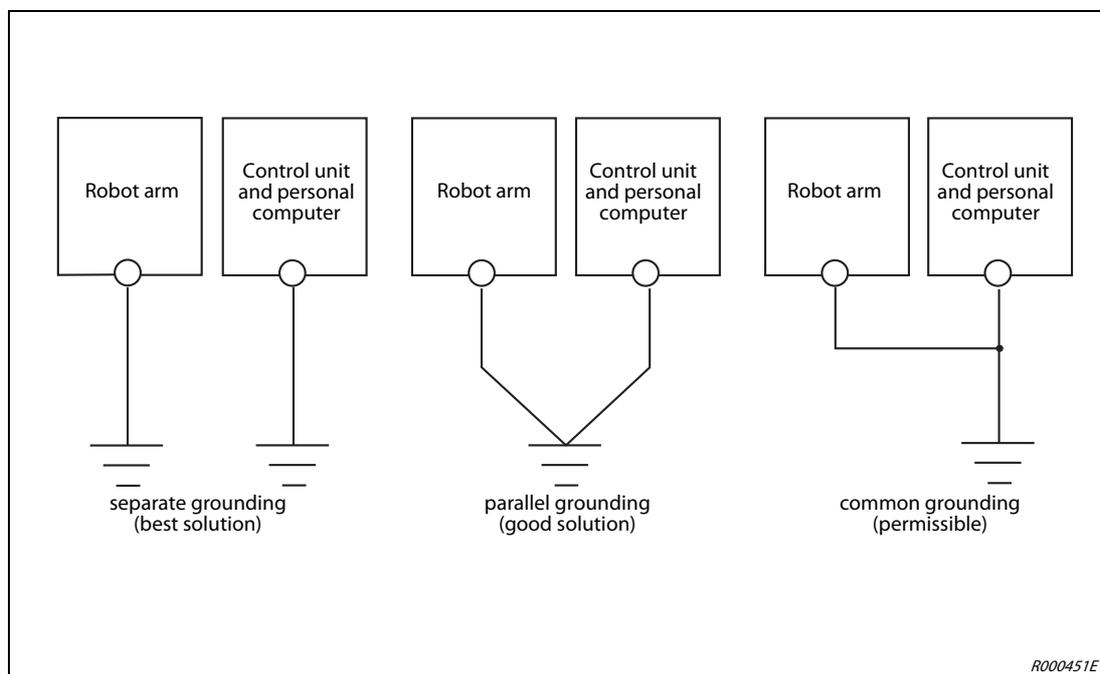


Fig. 3-15: Grounding the robot system

Grounding the robot arm

- ① Use a grounding cable with a minimum cross-section of $4,2 \text{ mm}^2$.
- 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 Fig. 3-16).

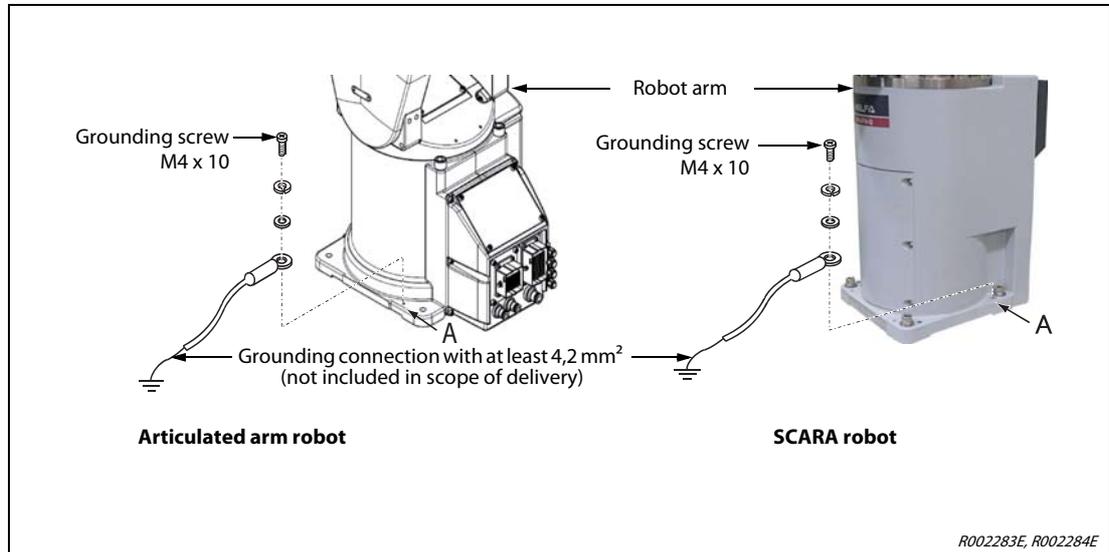


Fig. 3-16: Grounding the robot arm

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 control unit

The following figure shows the connection of the connection cable between the robot arm and the control unit.

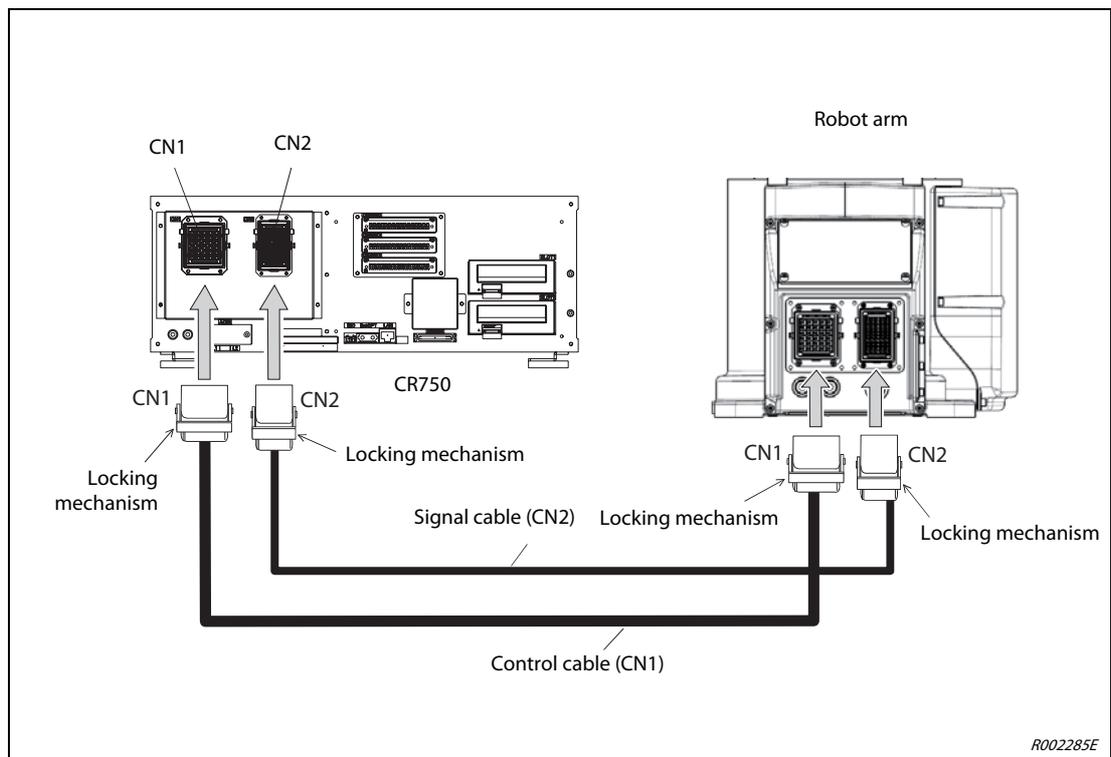


Fig. 4-1: Connection of the connection cable

- ① Make sure that the control unit or the drive unit is switched off. The [POWER] switch must be in the "OFF" position.
- ② Connect the power and control cable to the robot arm and the control unit or the drive unit. To do this, push the lock forwards and plug the plug into the jack. Avoid excessive pulling or bending of cable. This could damage the cable.

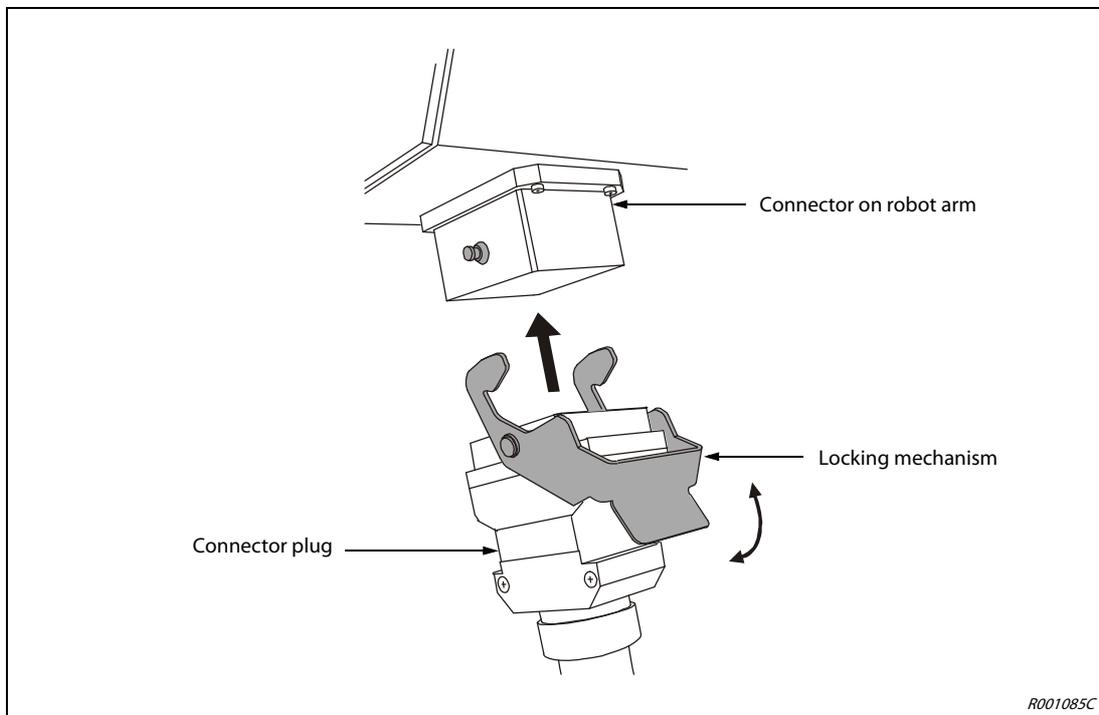


Fig. 4-2: Detailed view of the locking mechanism

- ③ Press the locking mechanism on the plug downwards. The plug can not be pulled out in this position. To release the connection, press the locking mechanism upwards. The plug can be removed in this position.

NOTE

The shape of the plugs is different for control cable and power cable. If connected incorrectly, the plug may be damaged.



ATTENTION:

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

4.1.2 Connection of robot CPU to the drive unit



ATTENTION:

- **Always place the protective cap on the SSCNET-III connection when no cable is connected. Otherwise, soiling may lead to an impairment in the transmission and to malfunctions.**
- **Do not remove the SSCNET-III 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 SSCNET-III connections of the drive unit, or into the open end of the SSCNET-III 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.

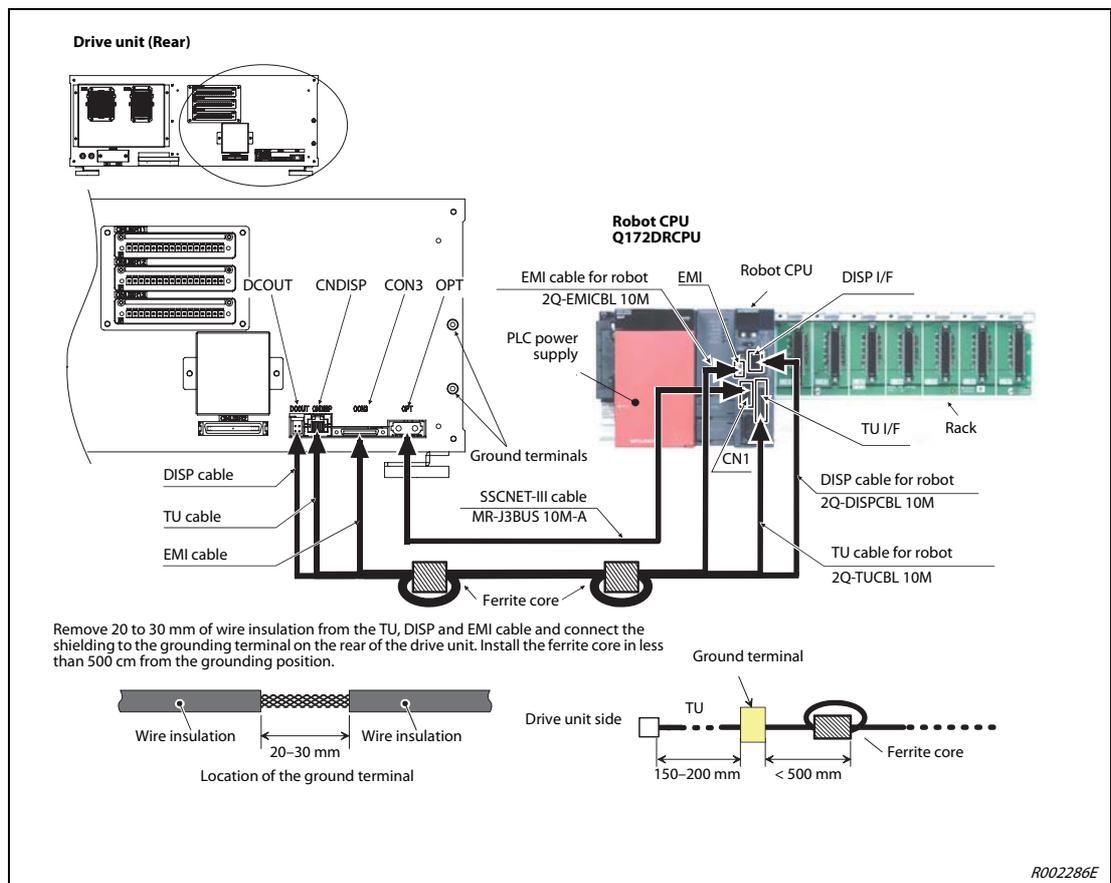


Fig. 4-3: Connection of robot CPU to CR750 drive unit

NOTE

Connect the shielding of the TU cable to the grounding cable on the housing of the drive unit to prevent electromagnetic disturbances.

4.2 Mains connection and grounding

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



ATTENTION:

Only carry out connection work at the control unit or the drive unit when the main switch for the power supply is switched off and protected against being switched back on.

4.2.1 CR750 control unit and CR750 drive unit

- ① Make sure that the mains voltage and the power switch of the control unit or drive unit are switched off.
- ② Remove the cover of the terminal block ACIN.
- ③ Prepare the mains line (feed) and the grounding cable. Use cable with a minimum cross-section of 2.5 mm².
- ④ Connect the power supply cable to terminals L1 and L2 of the terminals block. Connect the grounding cable with the grounding cable marked PE to the housing of the control unit.
- ⑤ Reinstall the cover on the terminal block ACIN.

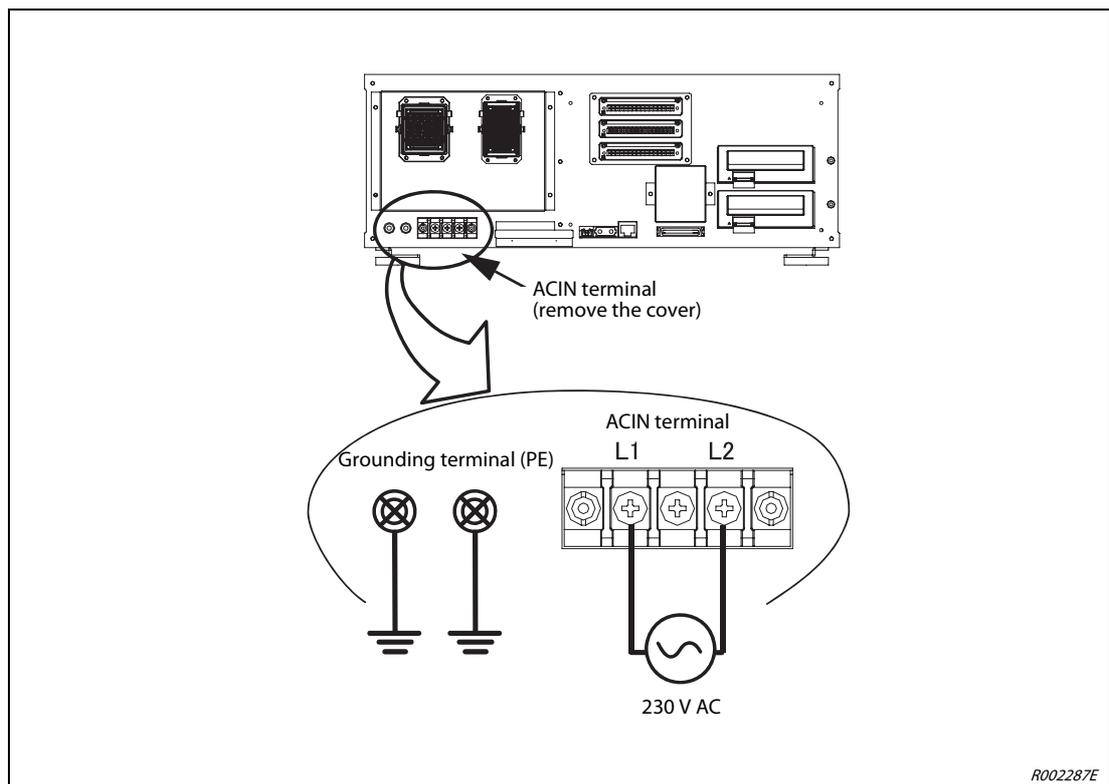


Fig. 4-4: Connection of mains line and grounding on CR750 control unit and on CR750 drive unit

4.3 EMERGENCY-STOP connection

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

The EMERGENCY-STOP inputs are normally blank (see Fig. 4-5). The EMERGENCY-STOP pushbutton, the door closing contact and the enable switch (enabling) unit must be connected by the user.

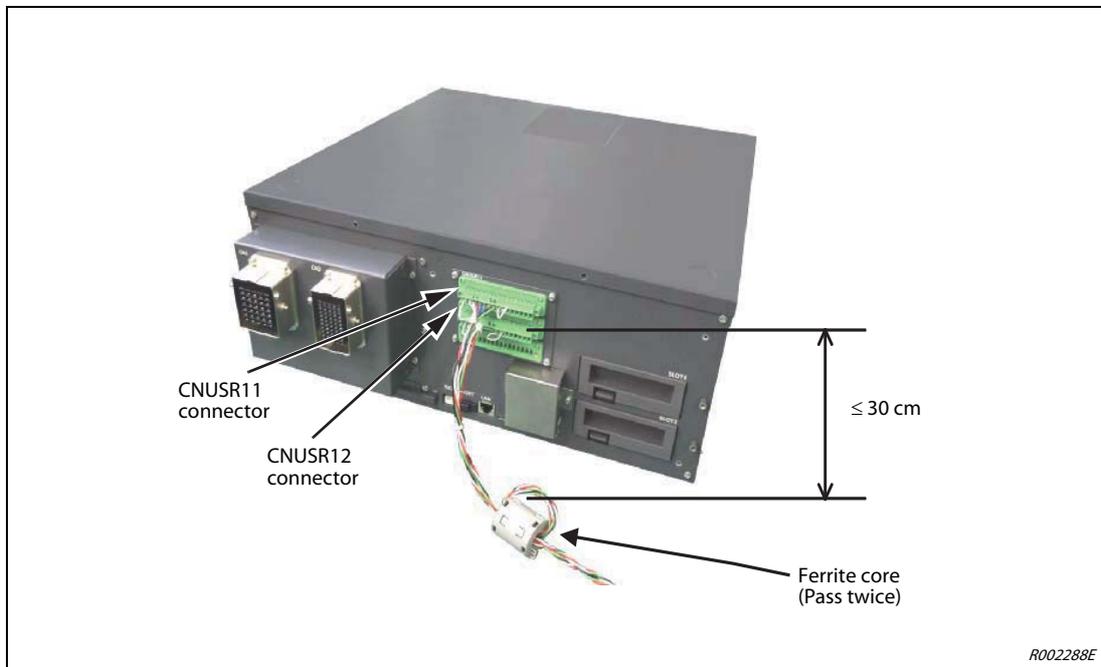


Fig. 4-5: Connection for EMERGENCY-STOP circuit



ATTENTION:
Do not carry out a surge voltage test.

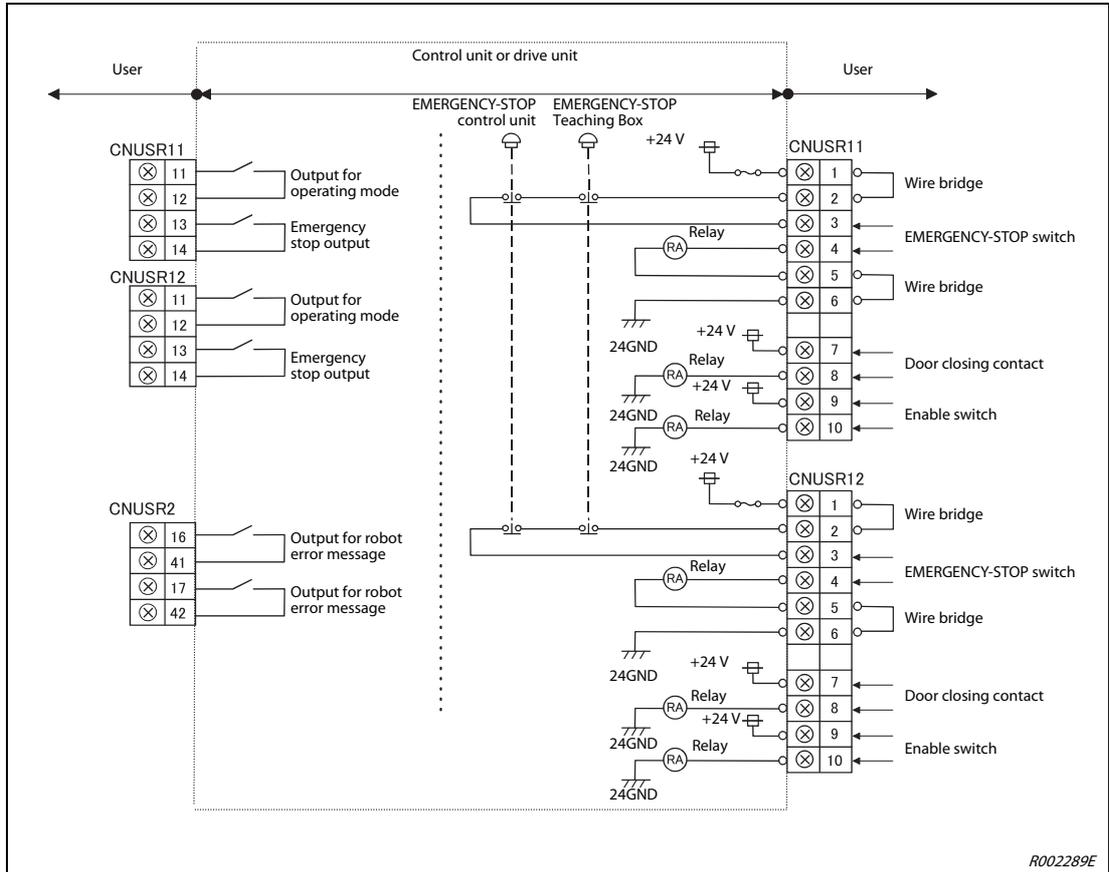


Fig. 4-6: Internal wiring of EMERGENCY-STOP circuit



ATTENTION:
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 0.14 to 1.5 mm² connector cable.

- ① Loosen the cable fixing screw at the point where the cable is to be inserted. Please use a screwdriver head with a width of 2.5 mm to loosen the screw.
- ② Remove approx. 7 mm of the line shielding.
- ③ Be sure to fix the inserted cable securely by fastening a cable fixing screw (tightening torque of 0.22 to 0.25 Nm).
- ④ After the necessary cables have been fixed, connect the connector to the connector (CNUSR11/12) that corresponds with the controller. Connect so that the cable fixing screw is on top, and make sure to fix securely by fastening connector fixing screws in two places. A screwdriver head with a width of 2.5 mm should be used to fix screws (tightening torque of 0.22 to 0.25 Nm).

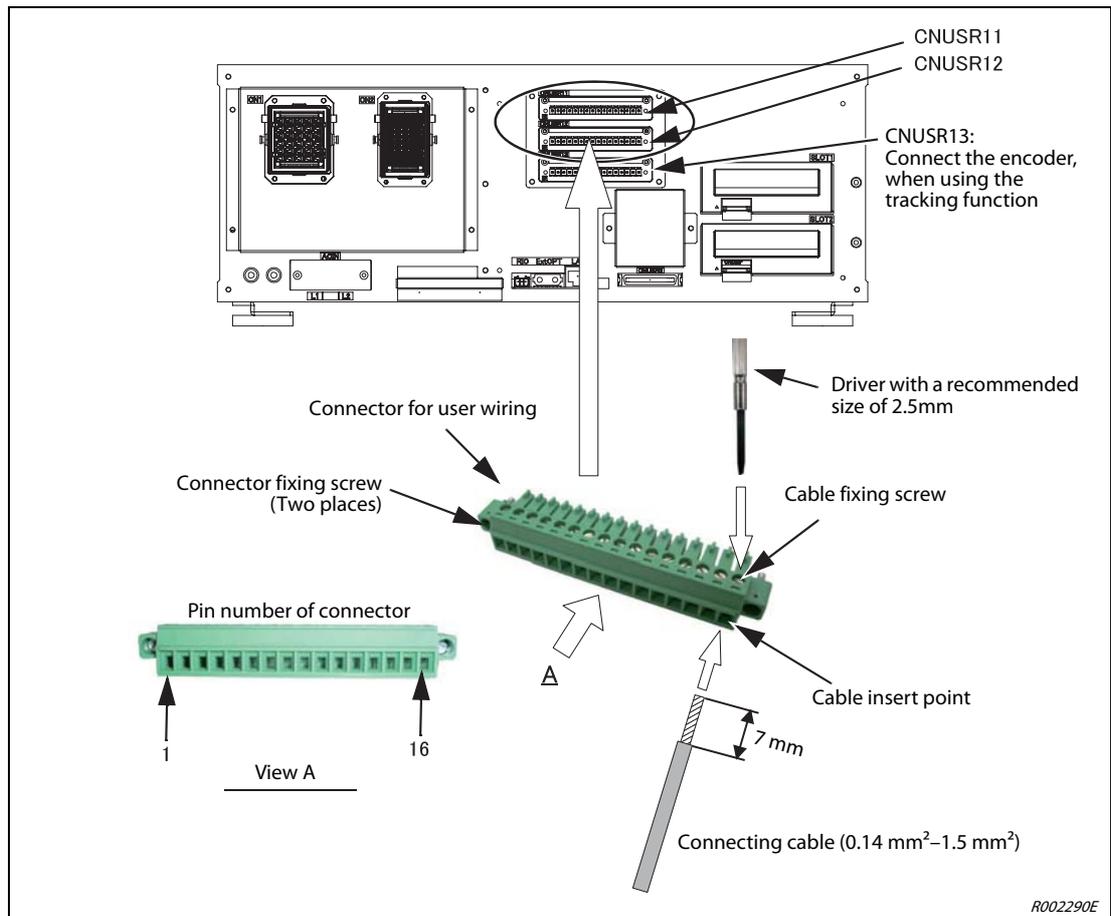


Fig. 4-7: Connection to the connectors CNUSR11/12



ATTENTION:

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

Connection to the connector CNUSR2

In this plug connection the cable is soldered to the connector. Please use an 0.05 bis 0.2 mm² connector cable.

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

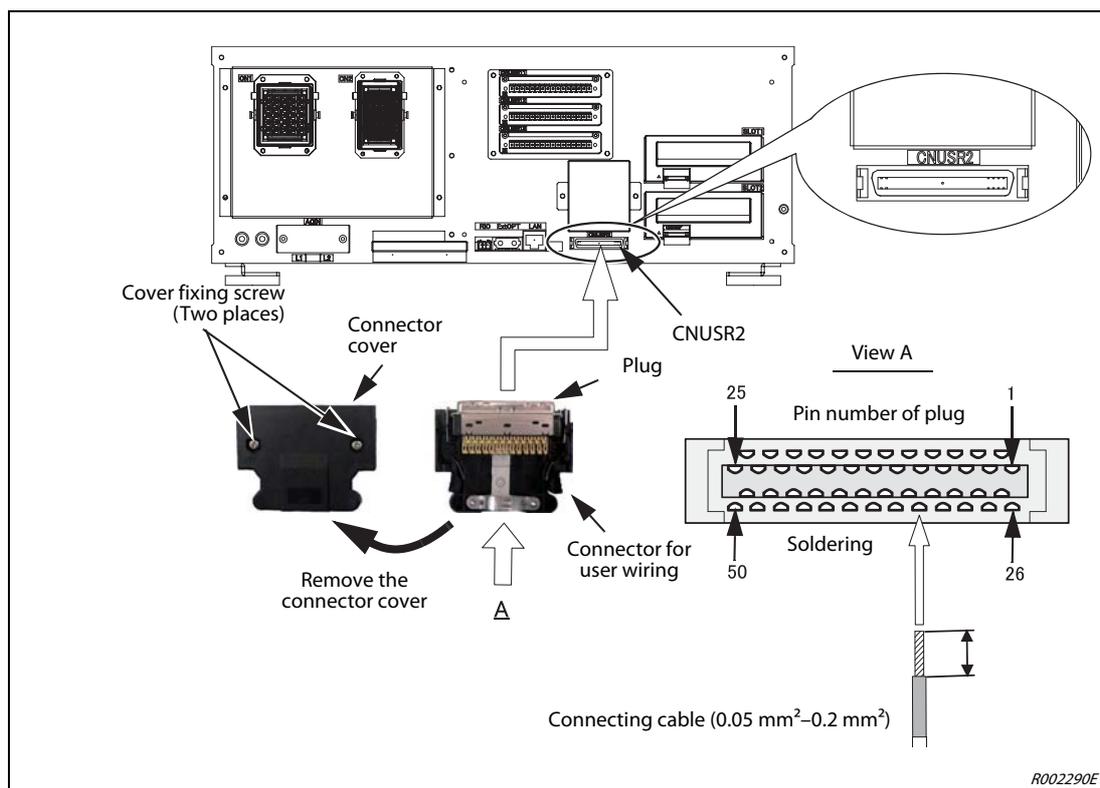


Fig. 4-8: Connection to the connector CNUSR2



ATTENTION:

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

4.4 Safety circuits

Example 1

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

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.

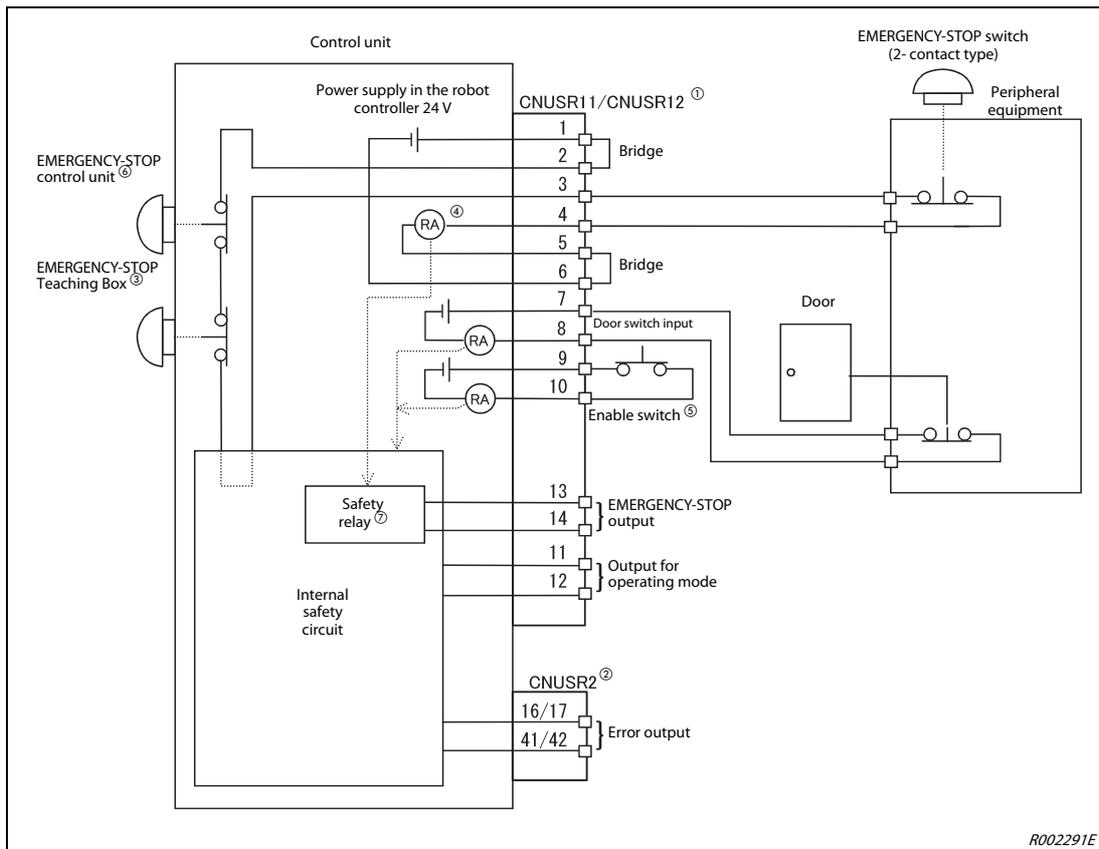


Fig. 4-9: Configuration of a safety circuit (Example 1)

- ① Each of the connectors, CNUSR11 and CNUSR12, are assigned with the same pin number, creating two systems for each terminal. It is absolutely necessary to connect the two systems.
- ② You can see in the diagram that connector CNUSR2 has two terminals and two systems (16/17 indicates two terminals at pin number 16 and pin number 17). It is absolutely necessary to connect the two systems.
- ③ The EMERGENCY-STOP button of the Teaching Box is connected with the controller.
- ④ EMERGENCY-STOP input relay.
- ⑤ Refer to Standard specification manual for the enable switch.
- ⑥ The EMERGENCY-STOP button of the robot controller.
- ⑦ The EMERGENCY-STOP input detection relay is used the controller's internal safety relay control. If the emergency stop input detection relay is switched OFF, emergency stop is detected and the safety relay is also switched OFF.

Example 2

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

Operation of the emergency stop:

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

NOTE

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

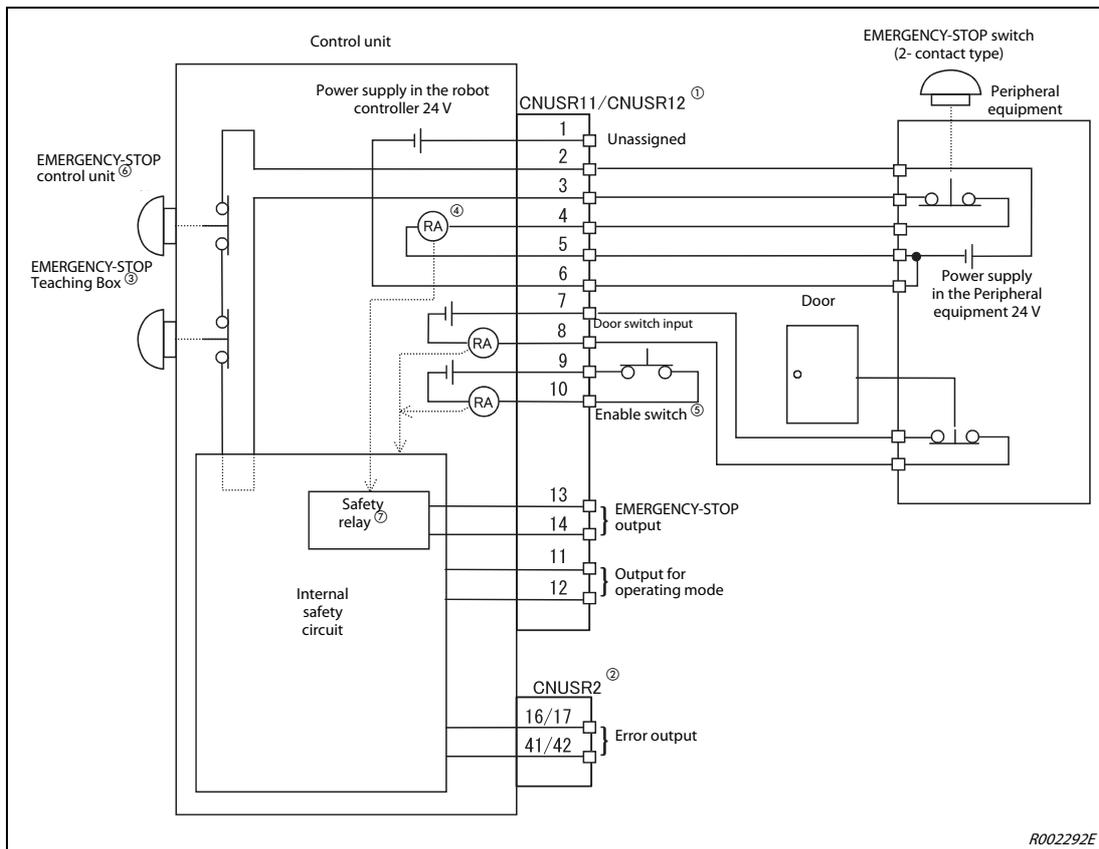


Fig. 4-10: Configuration of a safety circuit (Example 2)

- ① Each of the connectors, CNUSR11 and CNUSR12, are assigned with the same pin number, creating two systems for each terminal. It is absolutely necessary to connect the two systems.
- ② You can see in the diagram that connector CNUSR2 has two terminals and two systems (16/17 indicates two terminals at pin number 16 and pin number 17). It is absolutely necessary to connect the two systems.
- ③ The EMERGENCY-STOP button of the Teaching Box is connected with the controller.
- ④ EMERGENCY-STOP input relay.
- ⑤ Refer to Standard specification manual for the enable switch.
- ⑥ The EMERGENCY-STOP button of the robot controller.
- ⑦ The EMERGENCY-STOP input detection relay is used the controller's internal safety relay control. If the emergency stop input detection relay is switched OFF, emergency stop is detected and the safety relay is also switched OFF.

Example 3

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

Operation of the EMERGENCY-STOP:

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

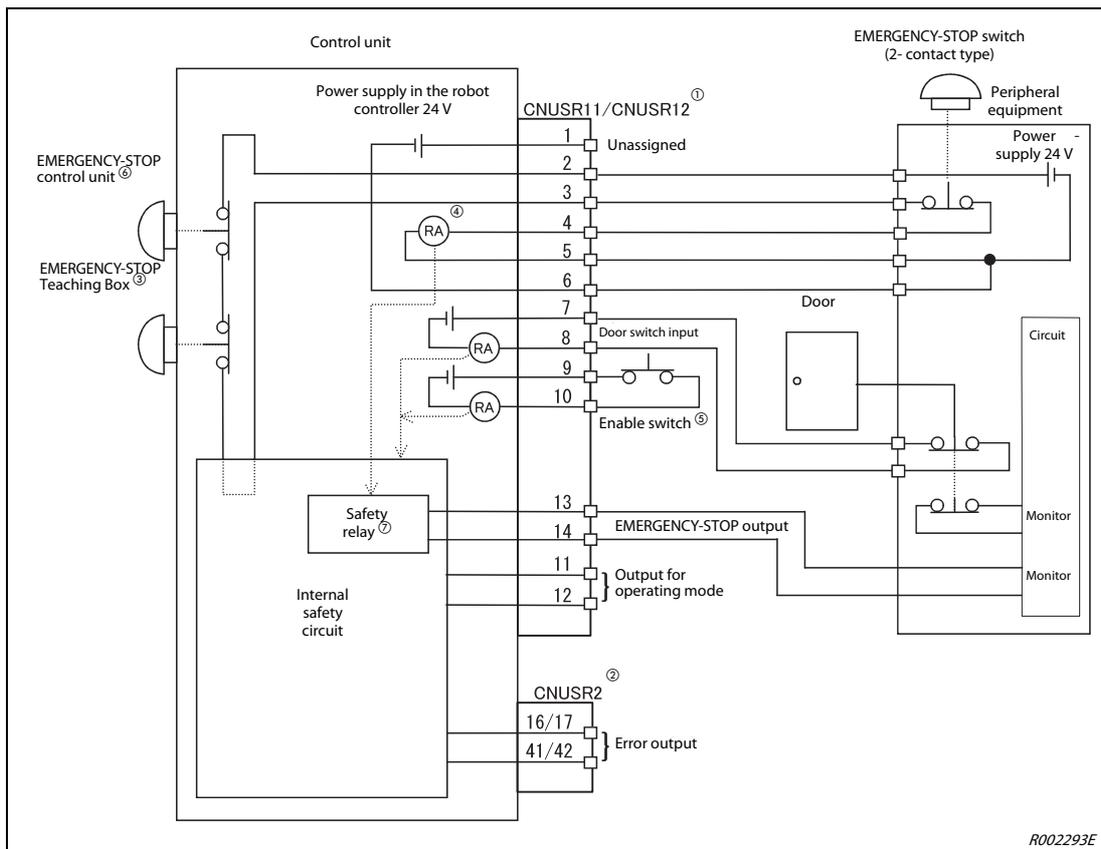


Fig. 4-11: Configuration of a safety circuit (Example 3)

- ① Each of the connectors, CNUSR11 and CNUSR12, are assigned with the same pin number, creating two systems for each terminal. It is absolutely necessary to connect the two systems.
- ② You can see in the diagram that connector CNUSR2 has two terminals and two systems (16/17 indicates two terminals at pin number 16 and pin number 17). It is absolutely necessary to connect the two systems.
- ③ The EMERGENCY-STOP button of the Teaching Box is connected with the controller.
- ④ EMERGENCY-STOP input relay.
- ⑤ Refer to Standard specification manual for the enable switch.
- ⑥ The EMERGENCY-STOP button of the robot controller.
- ⑦ The EMERGENCY-STOP input detection relay is used the controller's internal safety relay control. If the emergency stop input detection relay is switched OFF, emergency stop is detected and the safety relay is also switched OFF.

Example 4

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 controller. The power supply for EMERGENCY-STOP input uses the power supply of peripheral equipment. Monitor the EMERGENCY-STOP state by the peripheral equipment side.

Operation of the EMERGENCY-STOP:

If the EMERGENCY-STOP switch of peripheral equipment is pushed, the robot will also be in the EMERGENCY-STOP state. And, if the EMERGENCY-STOP switch of control unit or 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.

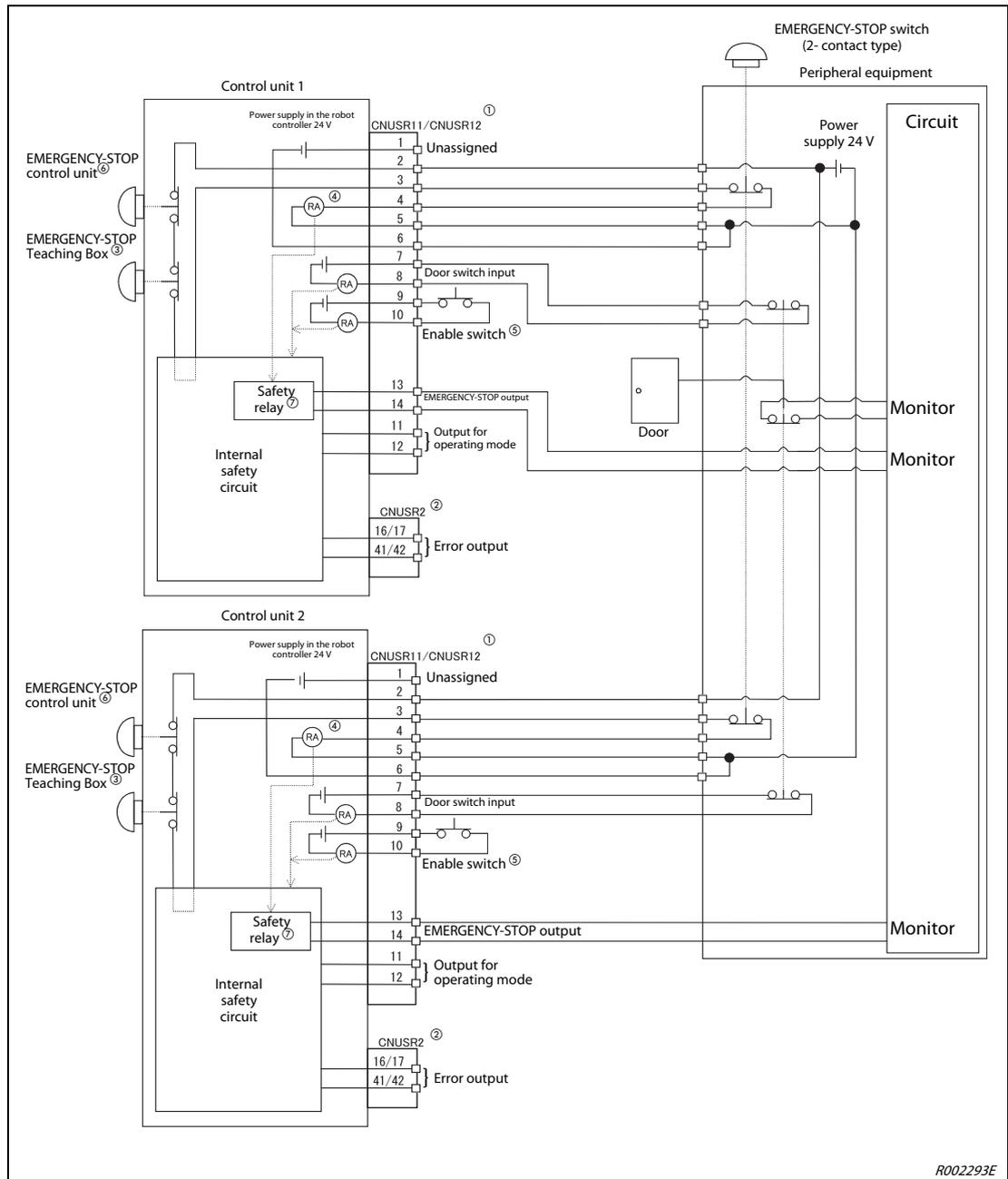


Fig. 4-12: Configuration of a safety circuit (Example 4)

- ① Each of the connectors, CNUSR11 and CNUSR12, are assigned with the same pin number, creating two systems for each terminal. It is absolutely necessary to connect the two systems.
- ② You can see in the diagram that connector CNUSR2 has two terminals and two systems (16/17 indicates two terminals at pin number 16 and pin number 17). It is absolutely necessary to connect the two systems.
- ③ The EMERGENCY-STOP button of the Teaching Box is connected with the controller.
- ④ EMERGENCY-STOP input relay.
- ⑤ Refer to Standard specification manual for the enable switch.
- ⑥ The EMERGENCY-STOP button of the robot controller.
- ⑦ The EMERGENCY-STOP input detection relay is used the controller's internal safety relay control. If the emergency stop input detection relay is switched OFF, emergency stop is detected and the safety relay is also switched OFF.

Example 5

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.

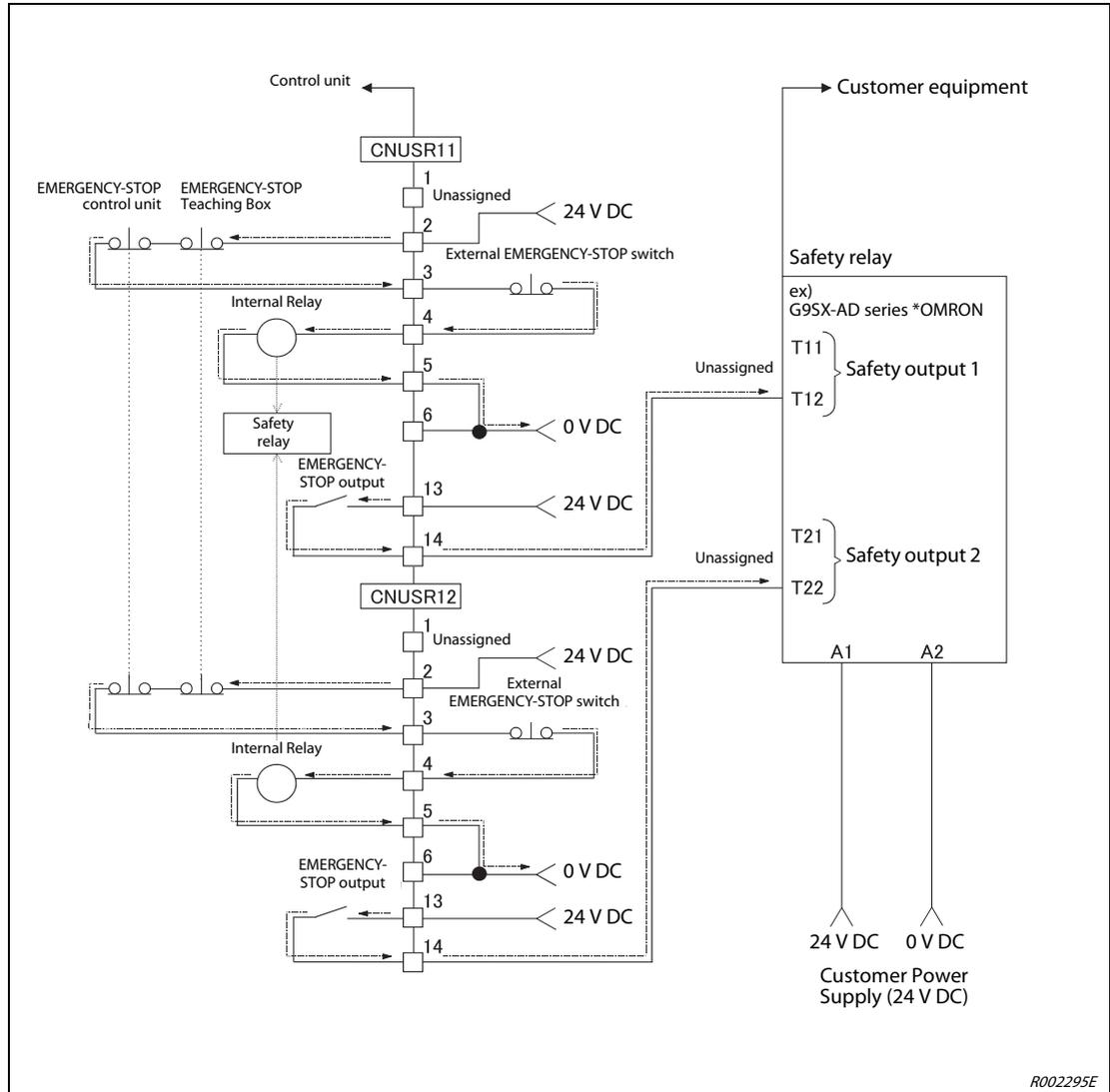


Fig. 4-13: Configuration of a safety circuit (Example 5)

**ATTENTION:**

- *This product has category 3 functionality and therefore the robot's whole unit cannot be set to category 4.*
- *The controller's internal circuit has polarity. Please adhere to the polarity as detailed in the wiring examples, particularly for EMERGENCY-STOP button output when using user equipment. Connect the positive side of the user equipment (24 V DC) to the terminal 2 of CNUSR11/12, then connect the EMERGENCY-STOP button (or contact points) in the user equipment to across the terminals 3 and 4 of CNUSR11/12, and ultimately connect the negative side (0 VDC).*
- *When installing a safety relay to use it as an input point of the controller's EMERGENCY-STOP button command, use a safety relay that is activated by an input from one of the two systems (i.e. Omron's G9S Series).*
- *The EMERGENCY-STOP input detection relay (internal relay) uses the controller's internal safety relay control. If the EMERGENCY-STOP input detection relay is switched OFF, emergency stop is detected and the safety relay is also switched OFF.*
- *When connecting EMERGENCY-STOP button output to an external safety relay, please take note of the polarity and make sure that the electrical current flows in the same direction as indicated by the dotted arrows in the two places in the diagram. If the polarity is setup incorrectly, this function will not operate correctly. Please connect the terminal 13 of CNUSR11/12 to 24 V.*

4.5 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.

Use the dummy plug if you want to operate the robot without connecting the Teaching Box.



ATTENTION:

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

Connection of the Teaching Box

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

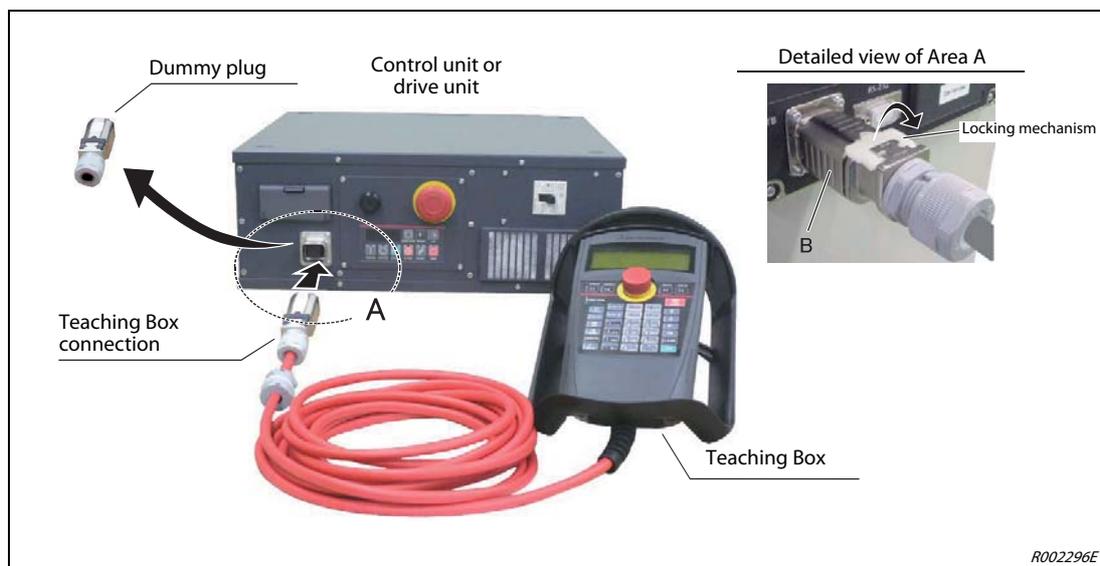


Fig. 4-14: Teaching Box connection

Release the connection between the control unit or drive unit and the Teaching Box

- ① Switch off the control unit or the drive unit.
- 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 Calibrate 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. It then describes how to adjust and save the home position.

**ATTENTION:**

To ensure perfect function of the robot the home position must first be set and must always be carried out after unpacking or reconfiguring (robot arm or control unit).

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.

- ① Switch the [POWER] switch on the front side of the control unit or the drive unit to the "ON" position.
- ② The control LEDs on the control unit flash briefly and the STATUS NUMBER display lights up.

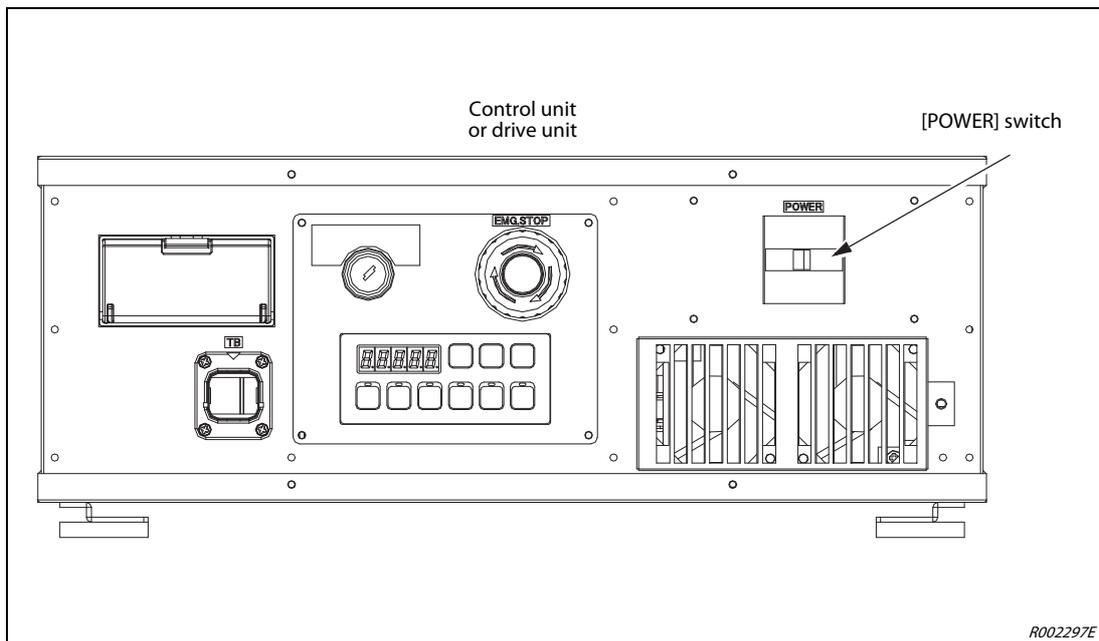


Fig. 5-1: Switch on the power supply

NOTE

As long as the serial number has not been input into parameter RB SERIAL, error message C150 is issued after you switch on the control unit or drive unit with the robot CPU Q172DR CPU. In this case, enter the serial number of the robot arm in the RB SERIAL parameter. How to enter the serial number in the parameter is described in step 3.

Step 2: Switch on the Teaching Box

- ① Set the [MODE] switch of the control unit or the drive unit to "MANUAL".

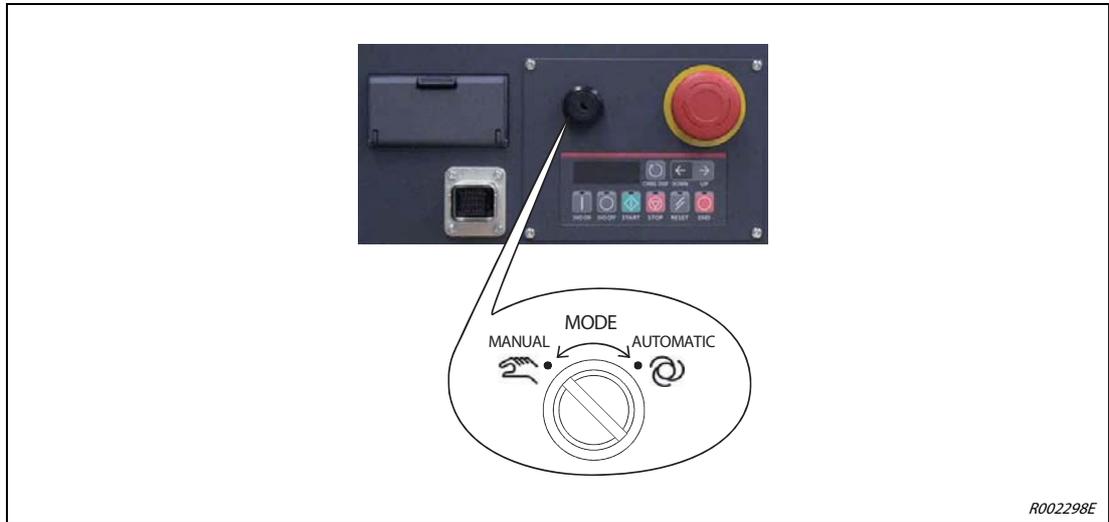


Fig. 5-2: Set [MODE] switch to "MANUAL"

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

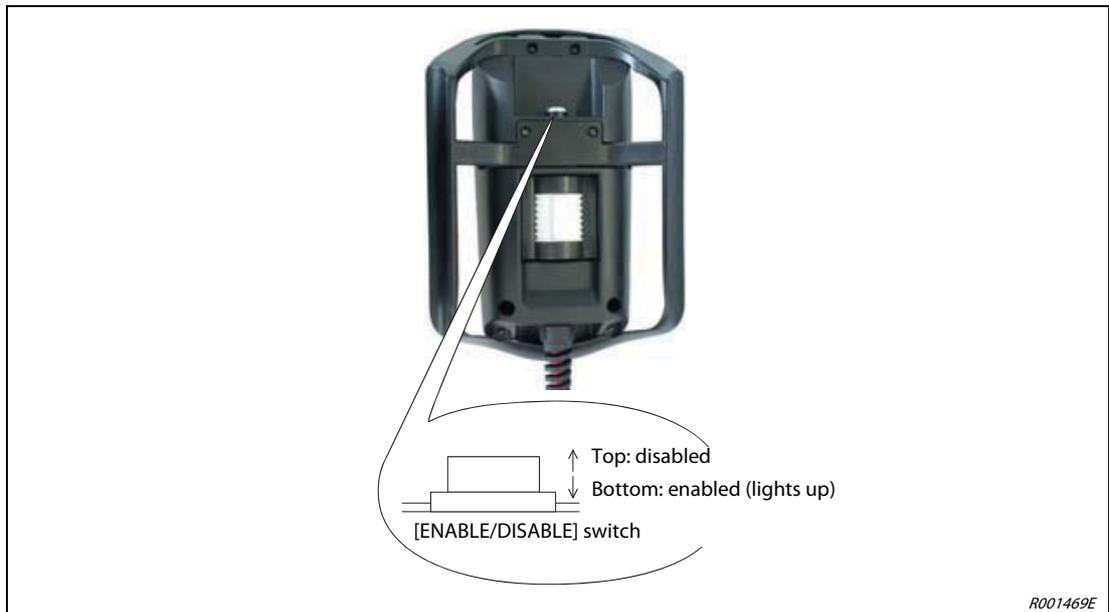


Fig. 5-3: Switch on the Teaching Box



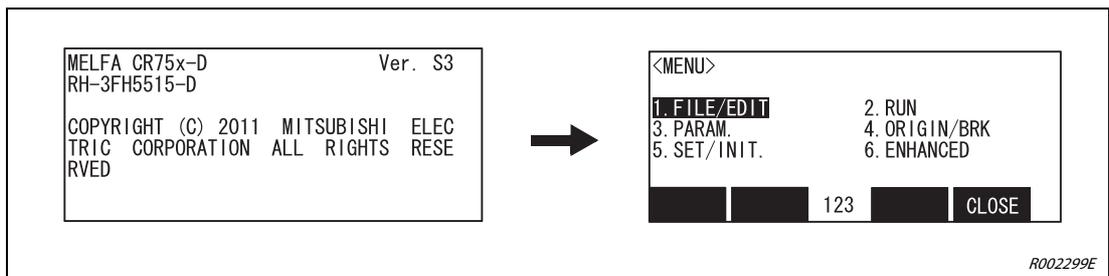
ATTENTION:

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 control unit are disabled in this state. For safety reasons, all EMERGENCY-STOP and STOP switches on the system are always active.

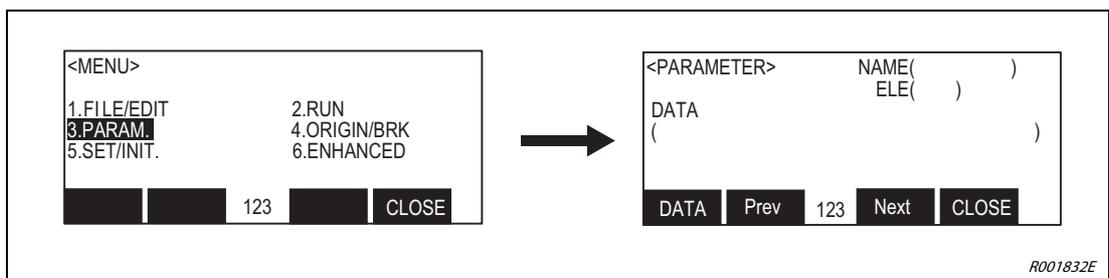
Step 3: Enter the serial number

As long as the serial number has not been input into parameter RB SERIAL, error message C150 is issued after you switch on the control unit or drive unit with the robot CPU Q172DRCPU. In this case, enter the serial number of the robot arm in the RB SERIAL parameter. The serial number is located on the type plate on the rear of the robot arm.

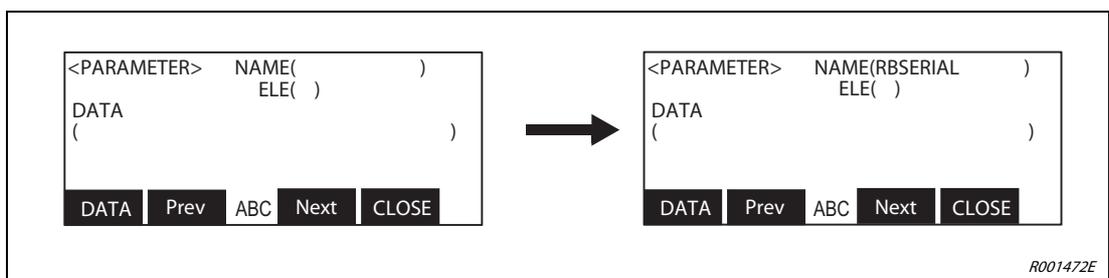
- ① Press the [RESET] key on the Teaching Box to reset the error.
- ② Then press the [EXE] key. The main menu appears.



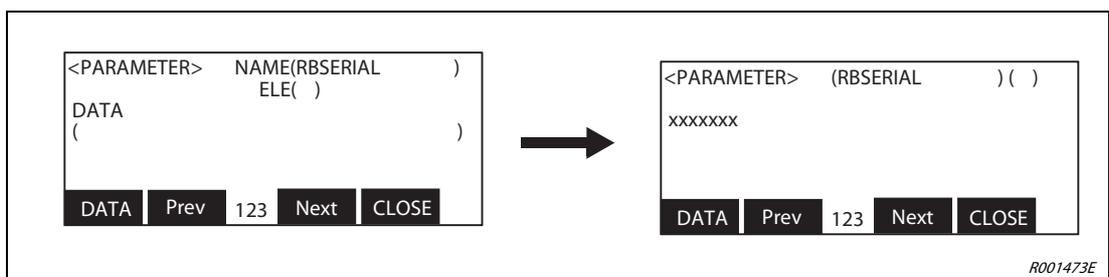
- ③ Press key [3] to call up the parameter menu.



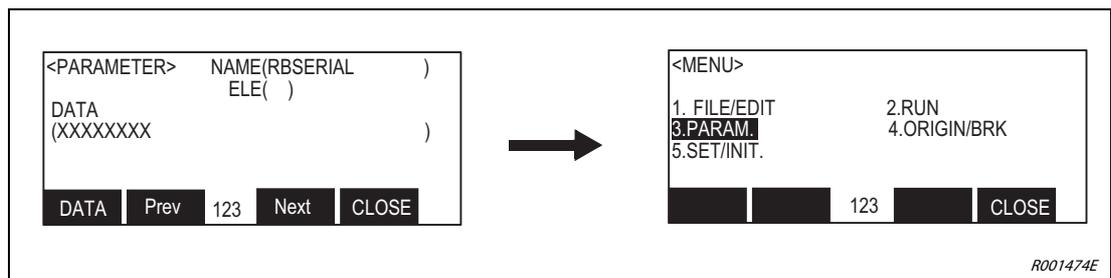
- ④ Enter "RB SERIAL" in the "NAME" box.



- ⑤ Press the key for "DATA" [F1] and enter the serial number of the robot arm. Press the [EXE] key to confirm the entry. A beep is issued and the value is stored.



- ⑥ Press the key [F4] for the "CLOSE" box. The main menu appears on the display.



5.1.3 Set the home position (zero point)

The home position is set after delivery of the robot by means of data entry. The data from the manufacturer for the stipulated home position is on the product insert in the robot arm box. The data is also contained on a sticker on the robot:

- for RV-2FB on the inside of the J1 motor cover
- for RV-4FM/4FLM and RV-7FM/7FLM on the inside of the CONBOX cover
- for RH-3/6/12/20FH on the inside of battery compartment cover

A detailed description on how to remove a cover is contained in the technical manual of the respective robot.



ATTENTION:

The data used for the home setting of the zero point is in the "Default" column of the product insert. If the new setting of the home position of the robot arm has been carried out (e. g. when replacing a motor) using another method (e.g. after calibration device), then the last data to have been entered are valid.

● Origin data history table Serial No. ES804008				
Date	Default
D	V!#S29			
J1	06DTYY			
J2	2?HL9X			
J3	1CP55V			
J4	T6!M\$Y			
J5	Z2!J%Z			
J6	A12%Z0			
Method	E	E · N · SP	E · N · SP	E · N · SP

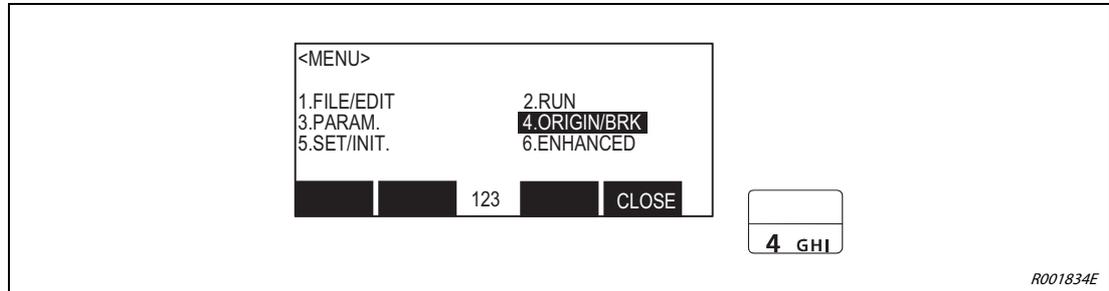
Adjustment method
 E: with calibration device
 N: no function
 SP: no function

Fig. 5-4: Product insert with the home position data (example data)

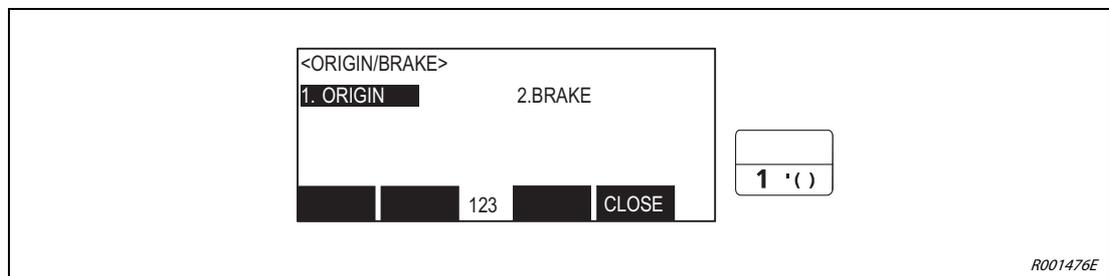
First make the settings as described in the instructions in section 5.1.2. Then select the "Setting by data entry" menu. To do so, proceed as follows:

Step 1: Select the setting (adjustment) method

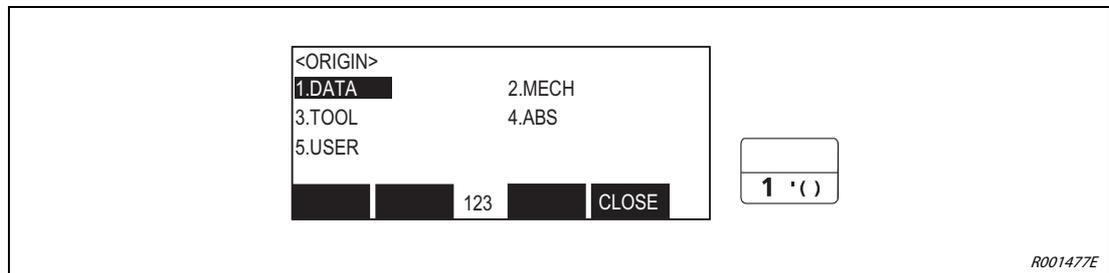
- ① Press key [4] to call up the "ORIGIN/BRK" menu.



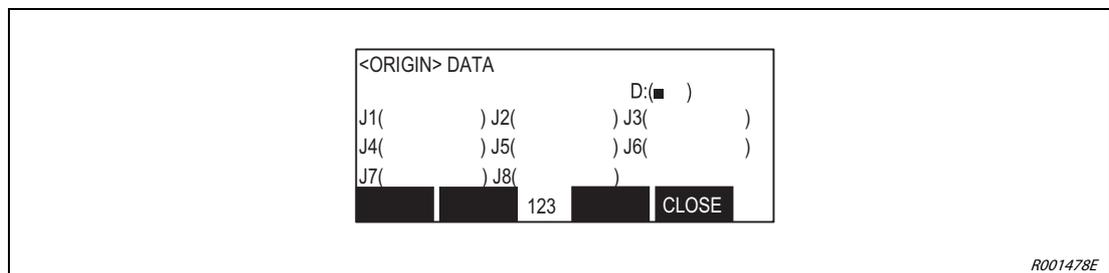
- ② Press key [1] to call up the "ORIGIN" menu.



- ③ Press key [1] to select the "DATA" method for the setting.



- ④ The home position setting menu is displayed.



Step 2: Enter the home position

The menu for entering the home position is displayed after the power supply to the servo drive is switched off. The entry fields shown correspond to the fields on the product insert.

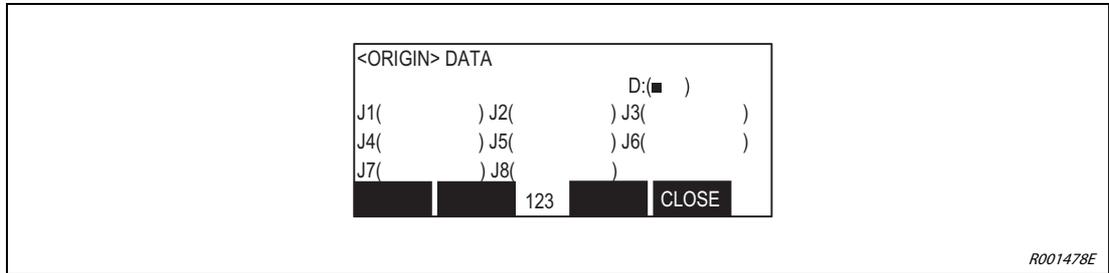


Fig. 5-5: Menu for setting the home position

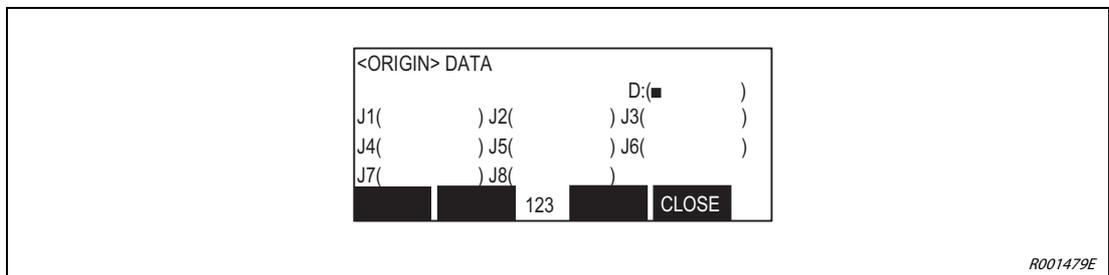
NOTES

You can move the cursor on the display of the Teaching Box using keys [↑], [↓], [←] and [→]. Enter characters by pressing the [CHARACTER] key and the key for the character together. The next character is displayed by repeatedly pressing the character key. Numbers are entered at the numeric keypad. You can delete incorrect entries by pressing the [CLEAR] key.

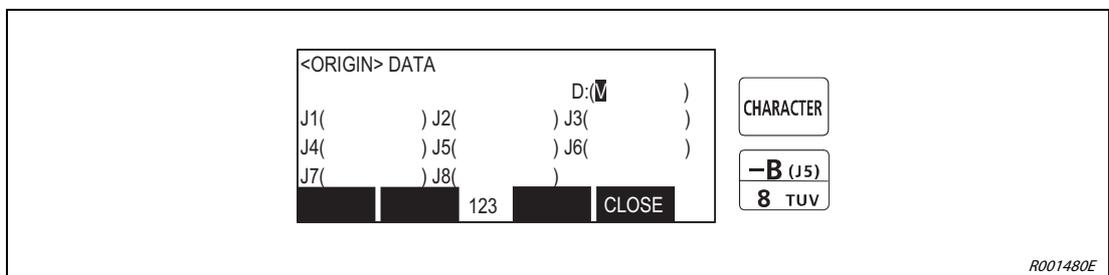
Alarm No. 1760 is displayed if incorrect home position data is entered. Press the [RESET] key and re-enter the home position data.

The following is an example of how to enter the home position data provided by the manufacturer.

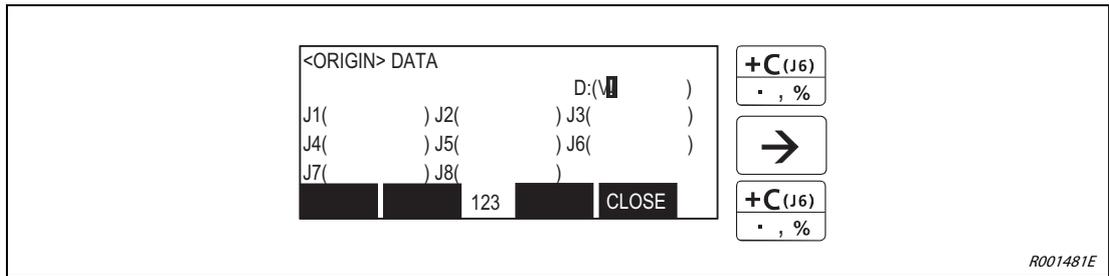
- ① Make sure that the cursor is in the "D" field.



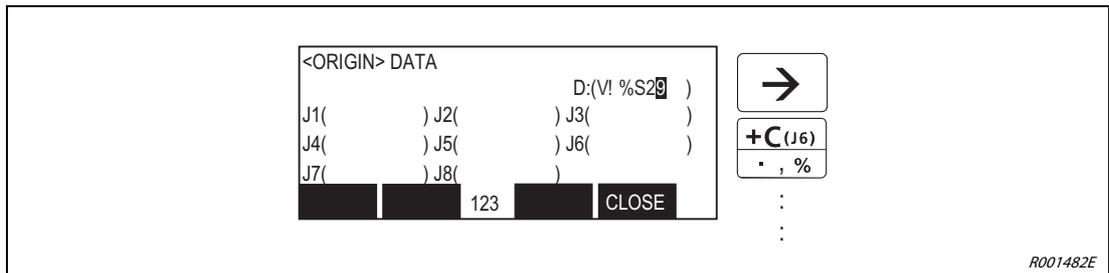
- ② The string "V!%S29" must be entered in the "D" field.
First enter "V". To do this, keep the [CHARACTER] key pressed and then press the [TUV] key 3 times. A "V" appears.



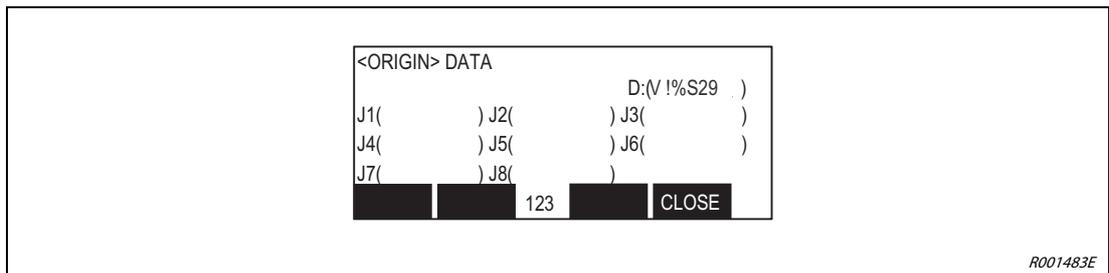
- ③ Enter "!". To do this, keep the [CHARACTER] key pressed and then press the [, %] key 5 times. A "!" appears.



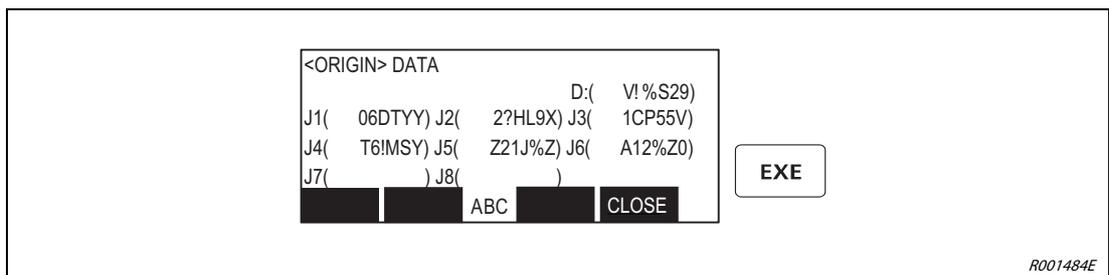
- ④ Enter the remaining characters in the same way. Press the [↓], key to move the cursor to the data entry position for the J1 articulated joint.



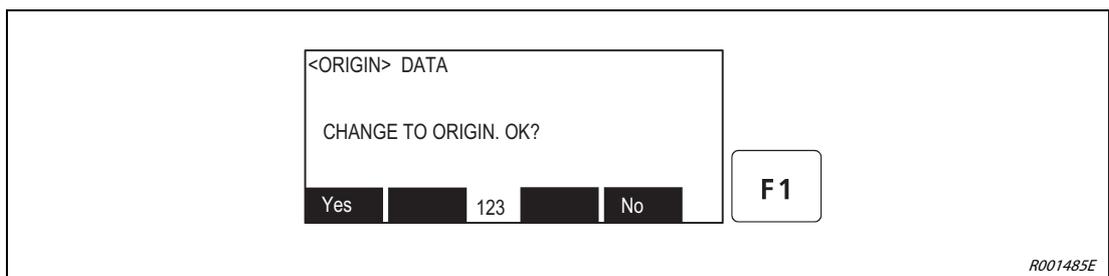
- ⑤ Data for the J1 to J6 articulated joints is entered in the same way as described above.



- ⑥ Press the [EXE] after entering all data. An acknowledgement screen pops up.



- ⑦ Press the [F1] key to complete the entry of the home position.



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

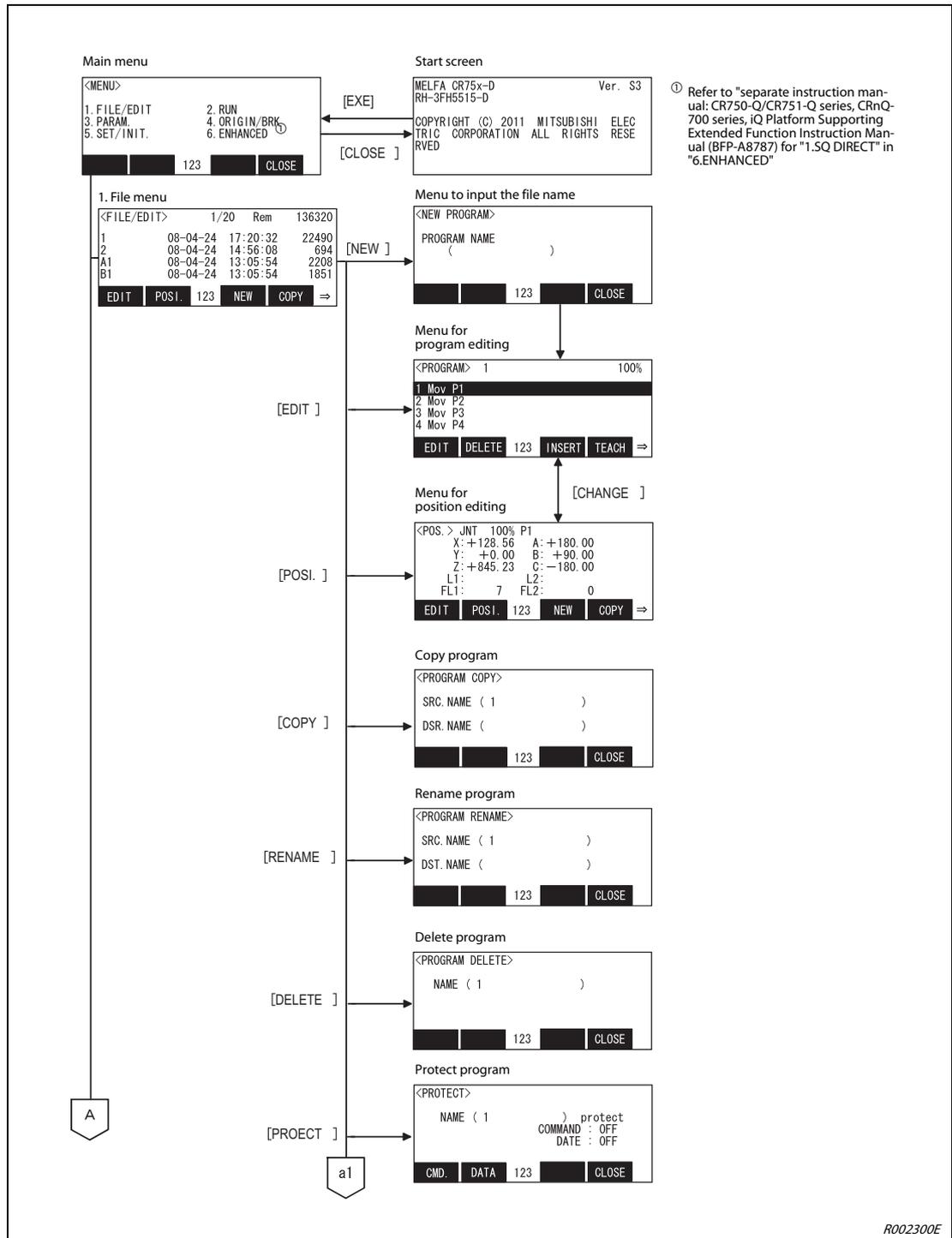
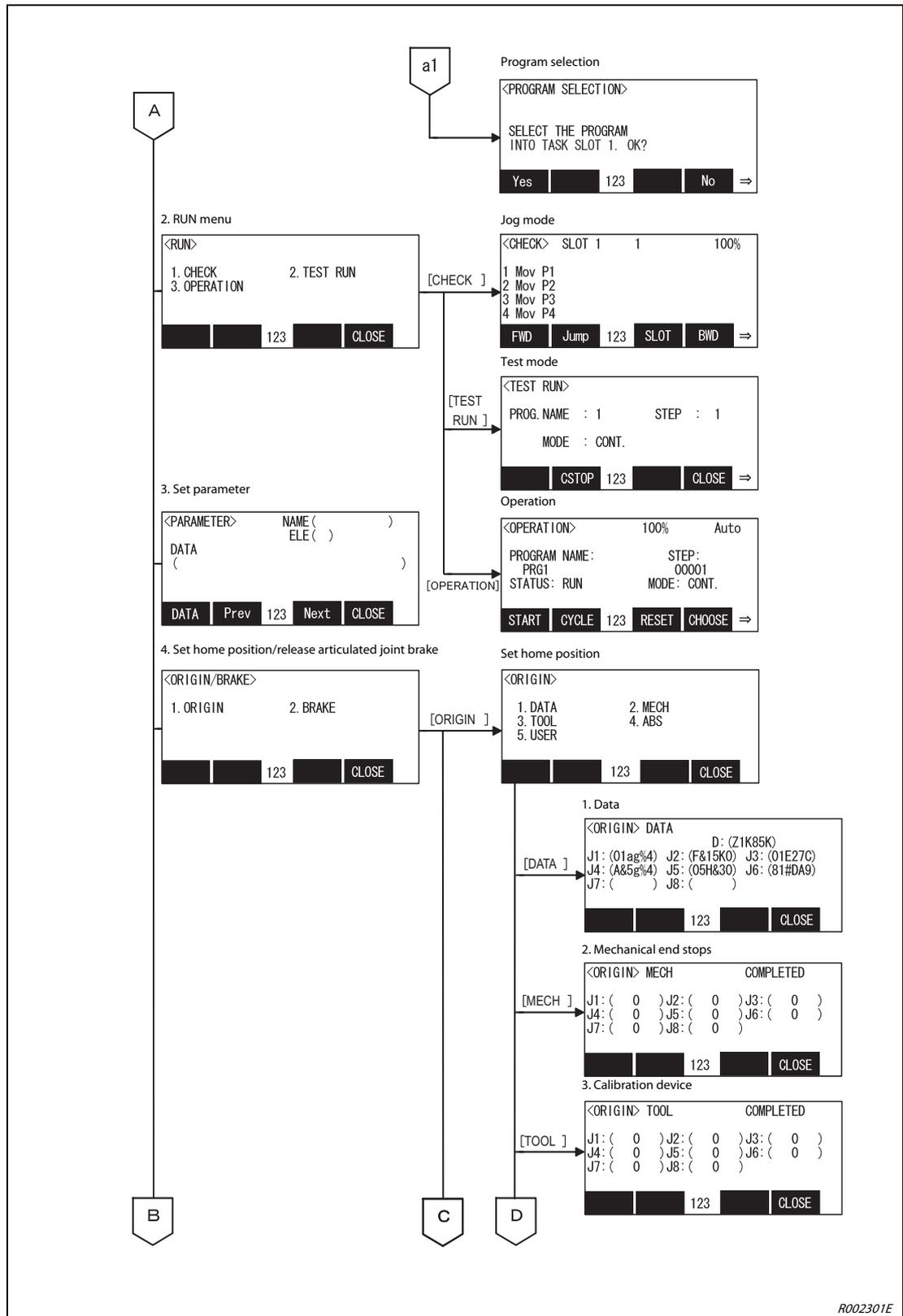
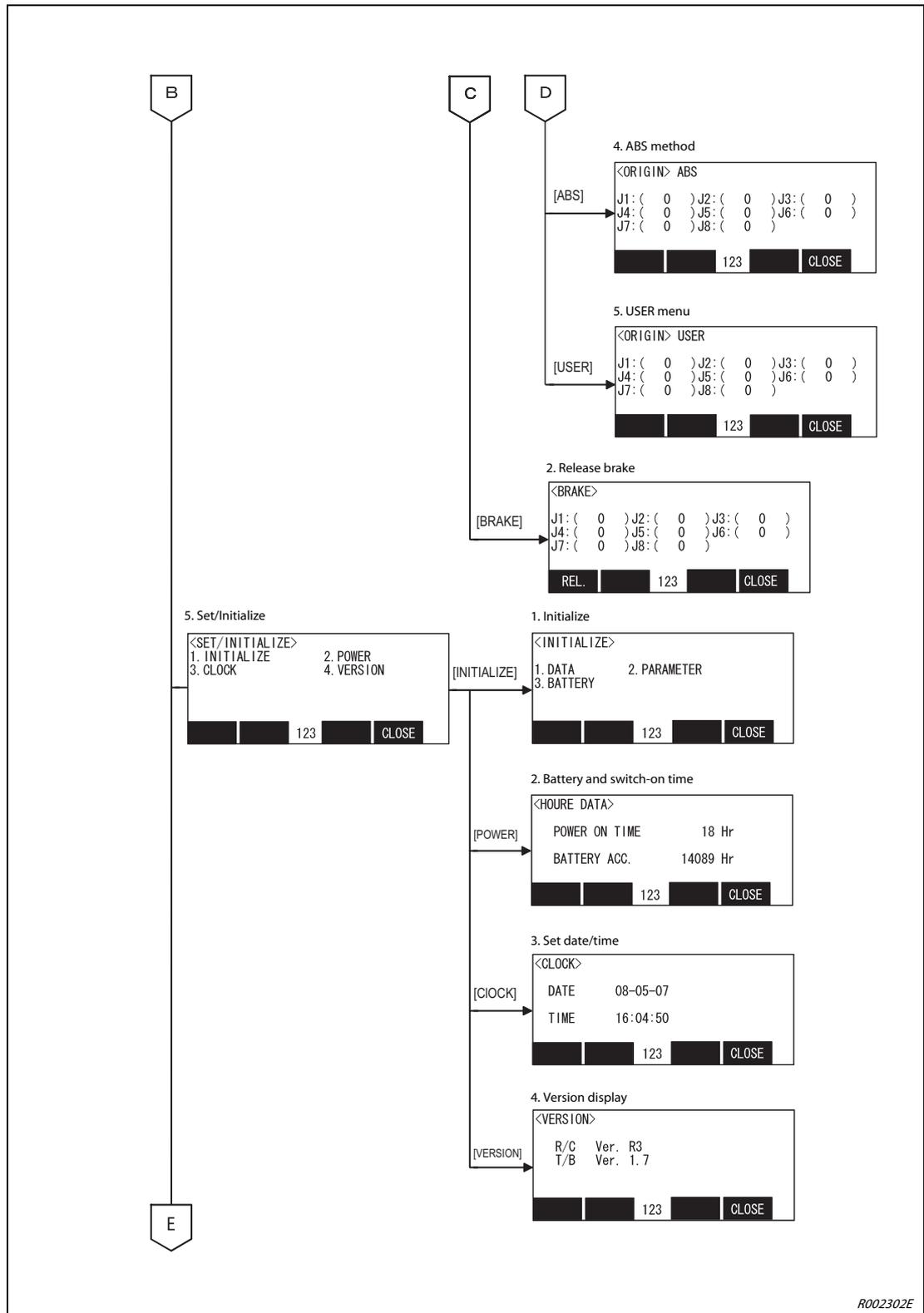


Fig. 6-1: Menu tree (1)



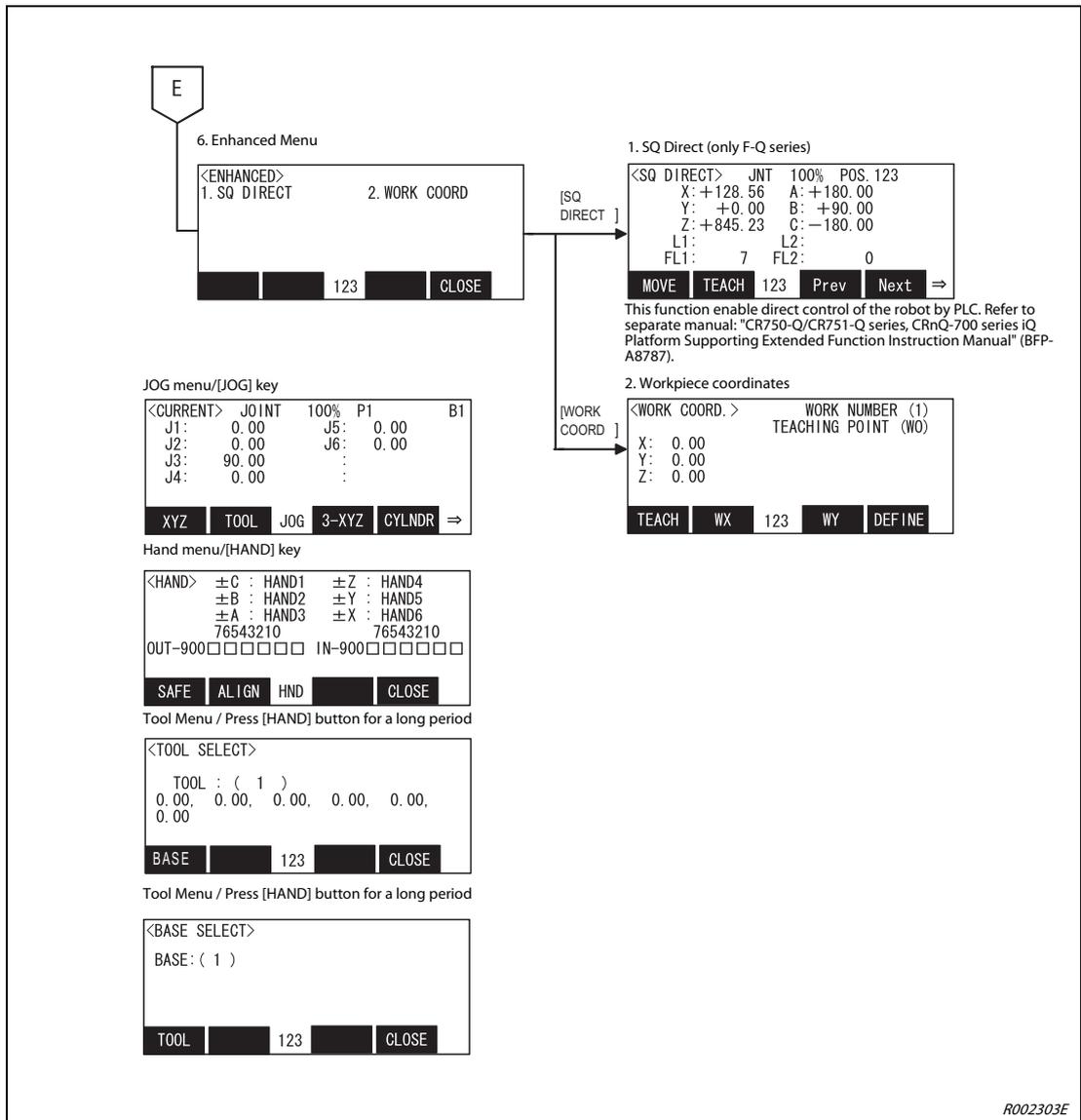
R002301E

Abb. 6-1: Menu tree (2)



R002302E

Abb. 6-1: Menu tree (3)



R002303E

Abb. 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].

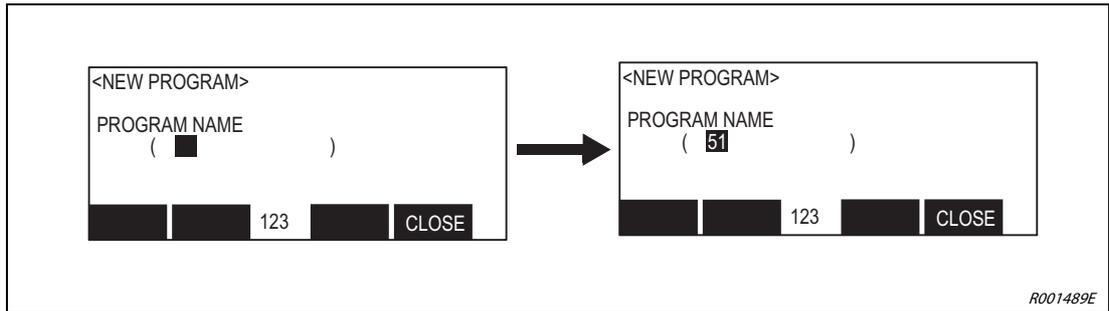


Fig. 6-2: Enter numbers



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].

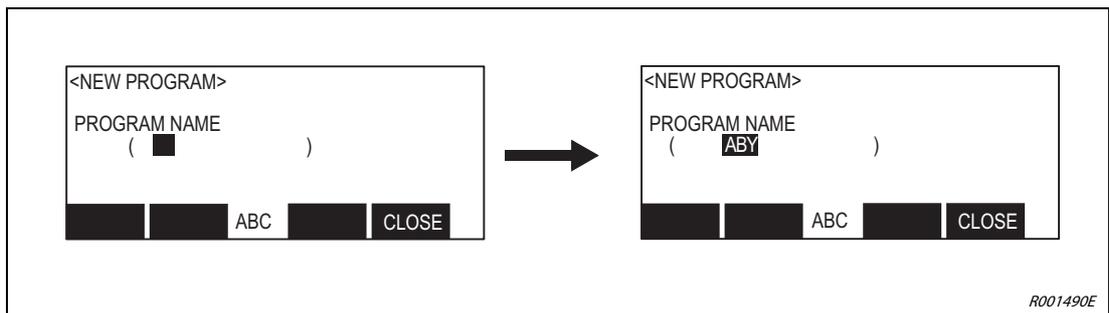


Fig. 6-3: Enter letters



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].

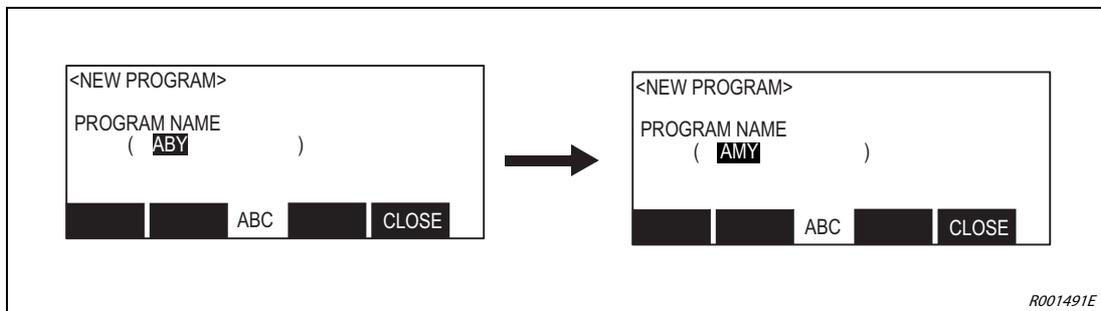


Fig. 6-4: Clear a character



NOTE

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

6.3 Select a menu item

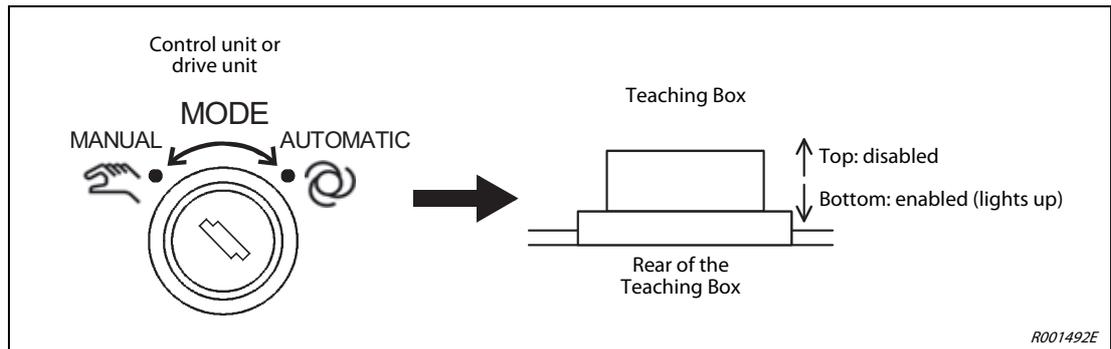
There are two ways to call up a menu:

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

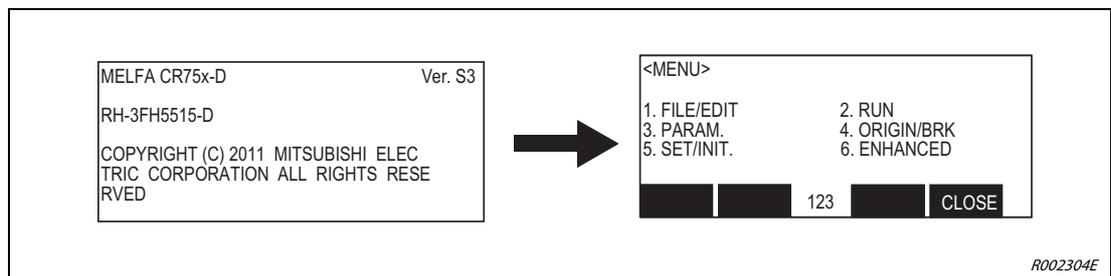
Running

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

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

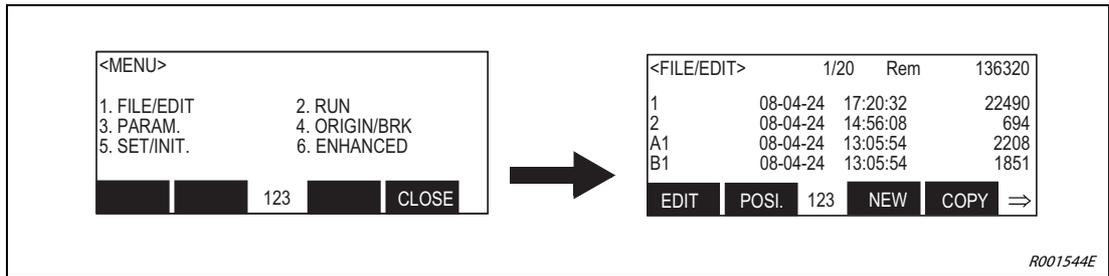


- ② The start screen appears after switching on. After the start screen appears, press [EXE] key to call up the main menu.



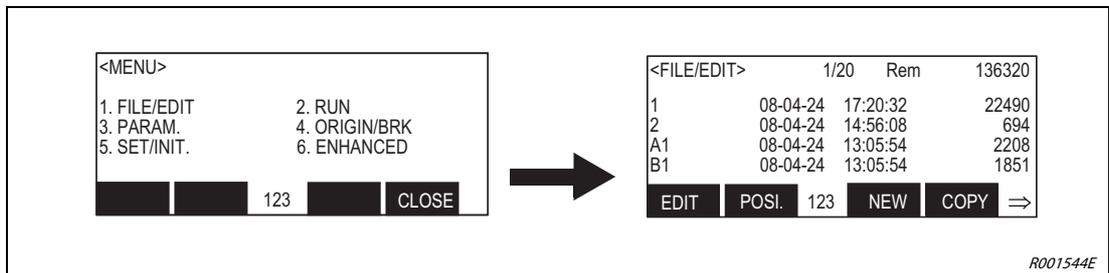
- Select a menu by entering a number

- 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.

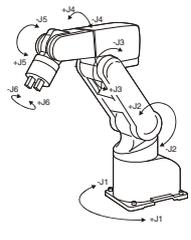
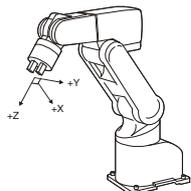
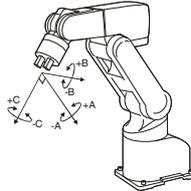
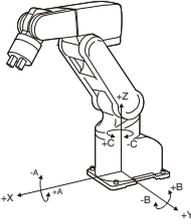


6.4 Move robot in JOG mode

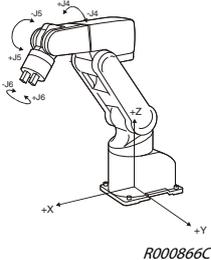
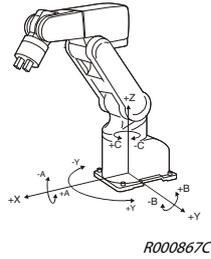
The robot can be moved in steps by the JOG mode. This section describes the JOG mode based on a 6-axis vertical articulated arm robot. Axis configuration depends on the robot type used. A detailed description on the individual types of robot is contained in the technical manual of the respective robot.

6.4.1 JOG modes

There are 5 JOG modes:

Operating mode	Mode	Description
Articulated joint JOG mode 	<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. 	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].
Tool JOG mode  	Execute the three points listed above. <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. 	The position of the tipped tool can be moved along the axes in the tool coordinate system in tool JOG mode. 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. 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.
XYZ JOG mode 	Execute the three points listed above. <ul style="list-style-type: none"> Press the function key to switch to the XYZ JOG mode. 	The position of the tipped tool can be moved along the axes in the XYZ coordinate system in XYZ JOG mode. 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.

Tab. 6-1: JOG modes (1)

Operating mode	Mode	Description
 <p>R000866C</p>	<p>Execute the three points listed above.</p> <ul style="list-style-type: none"> Press the function key twice to switch to the 3-axis XYZ JOG mode. 	<p>The position of the tipped tool can be moved along the axes in the XYZ coordinate system in 3-axis XYZ JOG mode.</p> <p>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 too, the position is interpolated over axes X, Y, Z, J4, J5 and J6, i.e. the position is not constant.</p> <p>The middle point of the tool must be set by parameter MEXTL.</p>
 <p>R000867C</p>	<p>Execute the three points listed above.</p> <ul style="list-style-type: none"> Press the function key three times to switch to the circle JOG mode. 	<p>The position of the tipped tool can be rotated in circles around the zero point in circle JOG mode.</p> <p>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.</p> <p>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.</p>
 <p>R001546E</p>	<p>Execute the three points listed above.</p> <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. 	<p>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.</p> <p>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.</p> <p>This function is available in the following software versions: TB: from version 1.3 since SD series: from version P8 since SQ series: from version N8</p>

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 control unit 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 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.

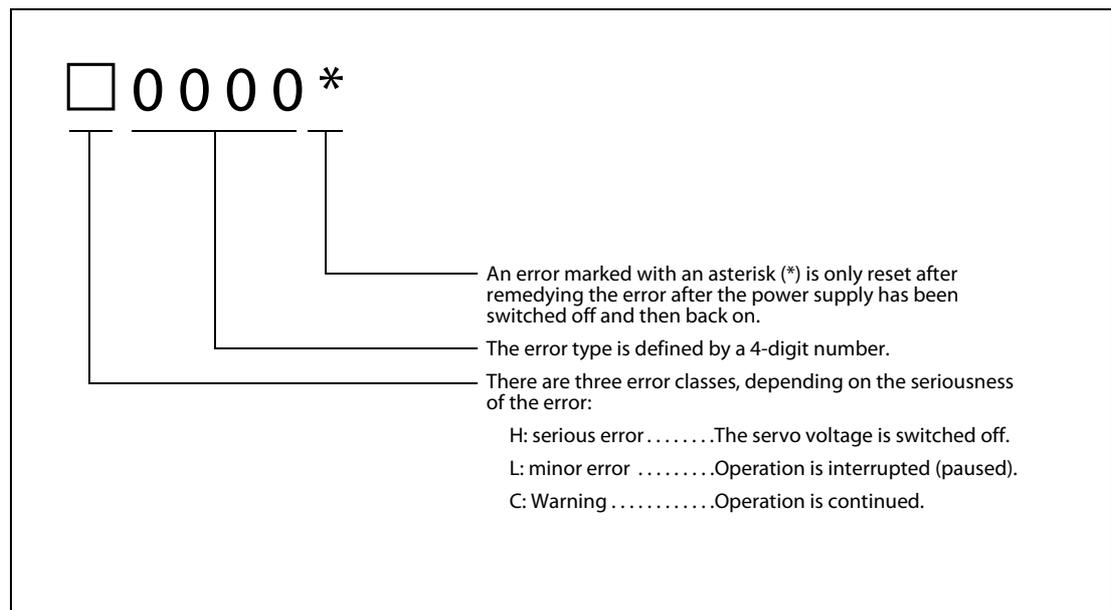


Fig. 7-1: Design of an error message

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	Board/Module	Fuse
H0083	Fuse of power supply or pneumatic gripper hand defective	YZ801	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 F3 (rated current: 1.6 A) on card YZ801. Remove the six top cover fixing screws (M3), and remove the top cover.

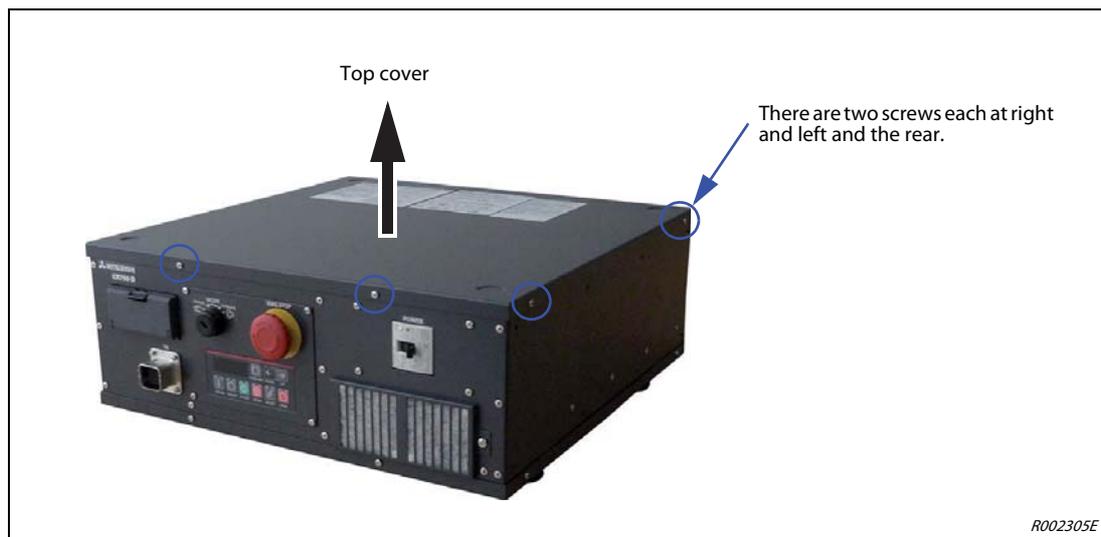


Fig. 7-2: Removing the top cover

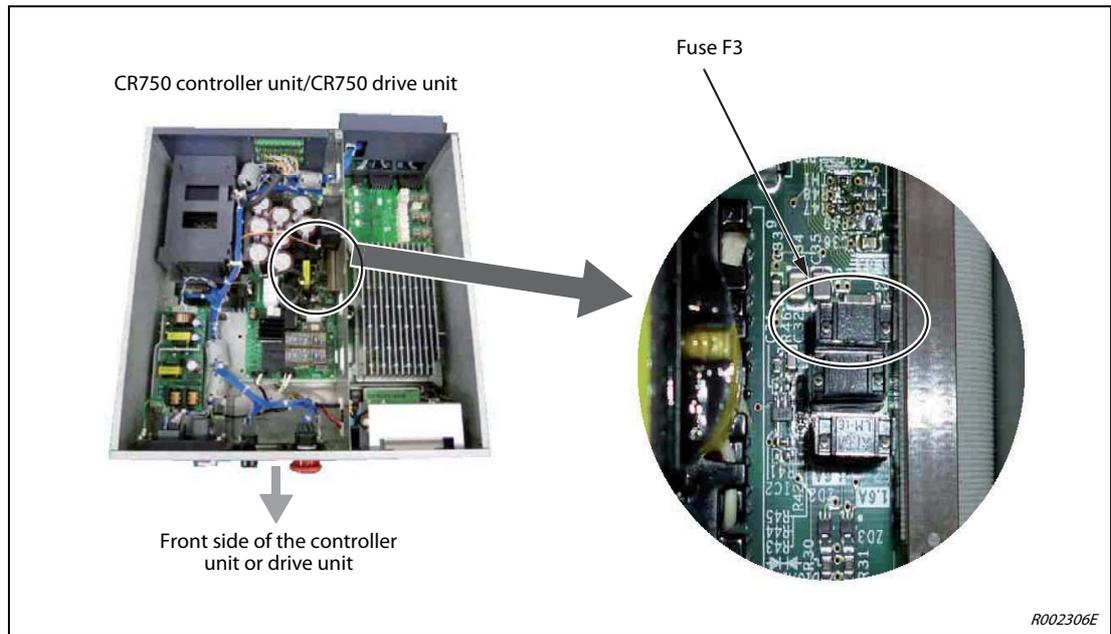


Fig. 7-3: Fuse of power supply for pneumatic gripper hand

7.5 Instructions on maintenance

**ATTENTION:**

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 ToolBox2 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 range of motion of the robot arm RV-2FB.

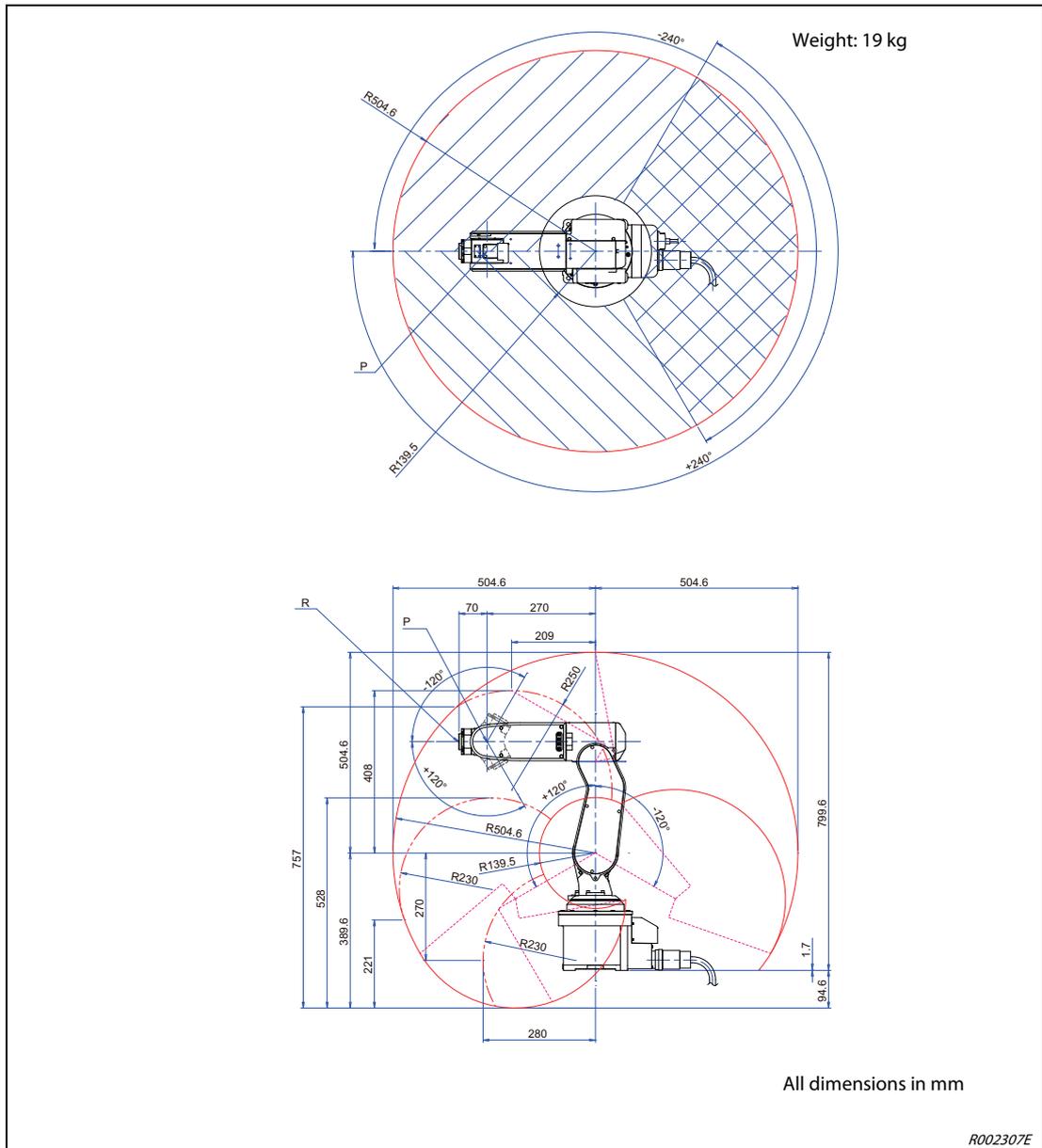


Fig. A-1: Range of motion of robot arm RV-2FB

NOTE

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

The following figure shows the range of motion of the robot arm RV-4FM.

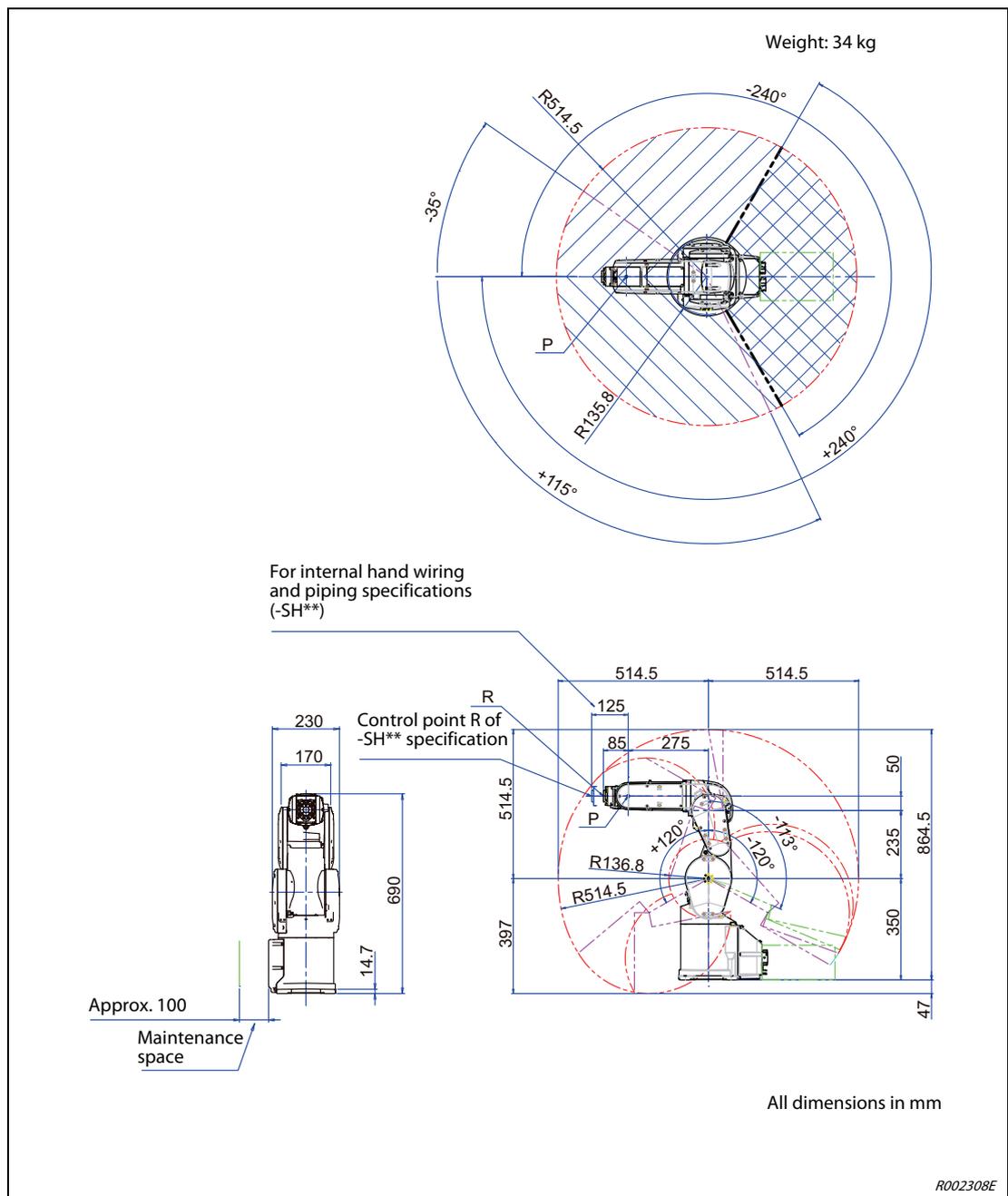


Fig. A-2: Range of motion of robot arm RV-4FM

NOTE

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

The following figure shows the range of motion of the robot arm RV-4FLM.

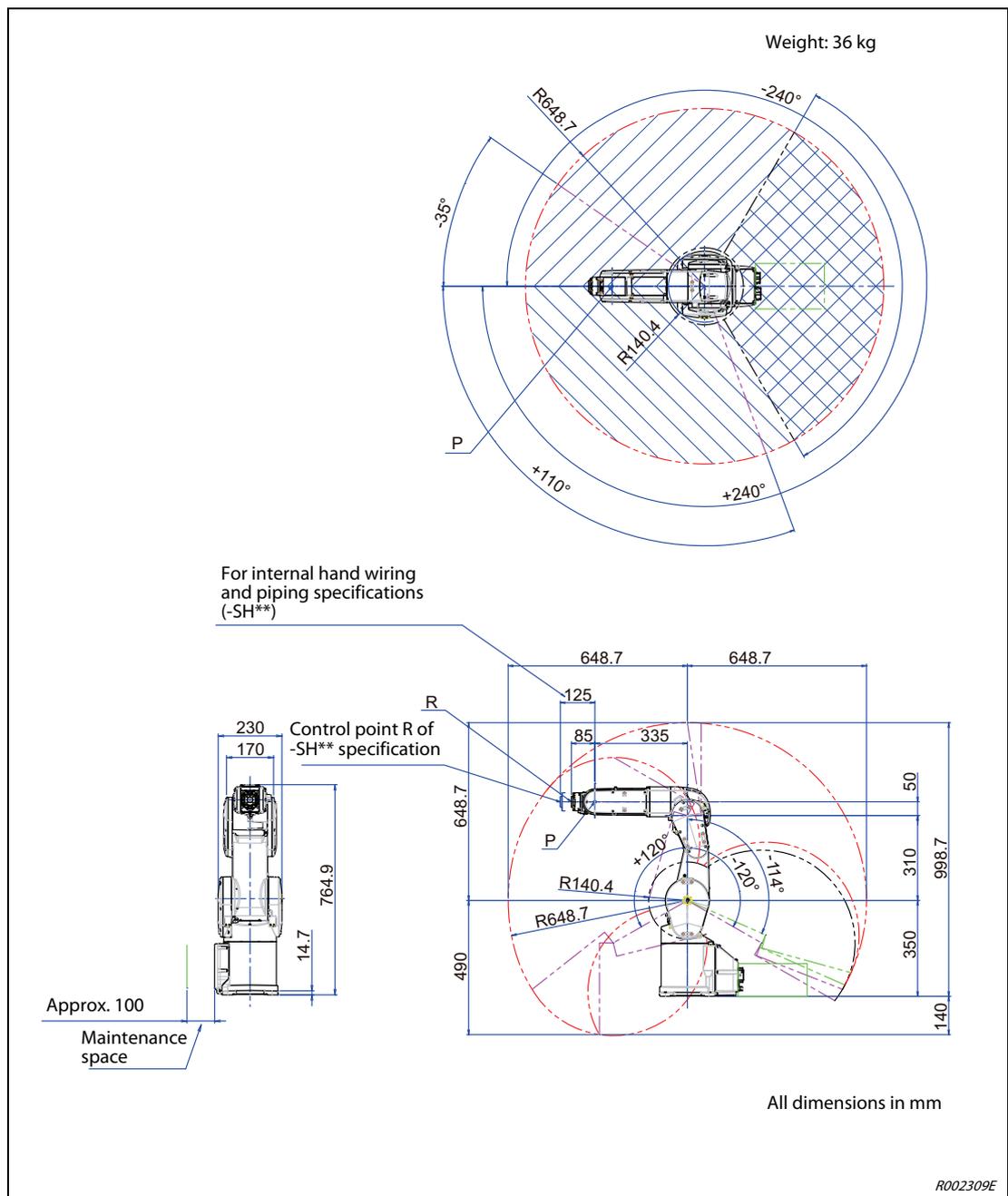


Fig. A-3: Range of motion of robot arm RV-4FLM

NOTE

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

The following figure shows the range of motion of the robot arm RV-7FM.

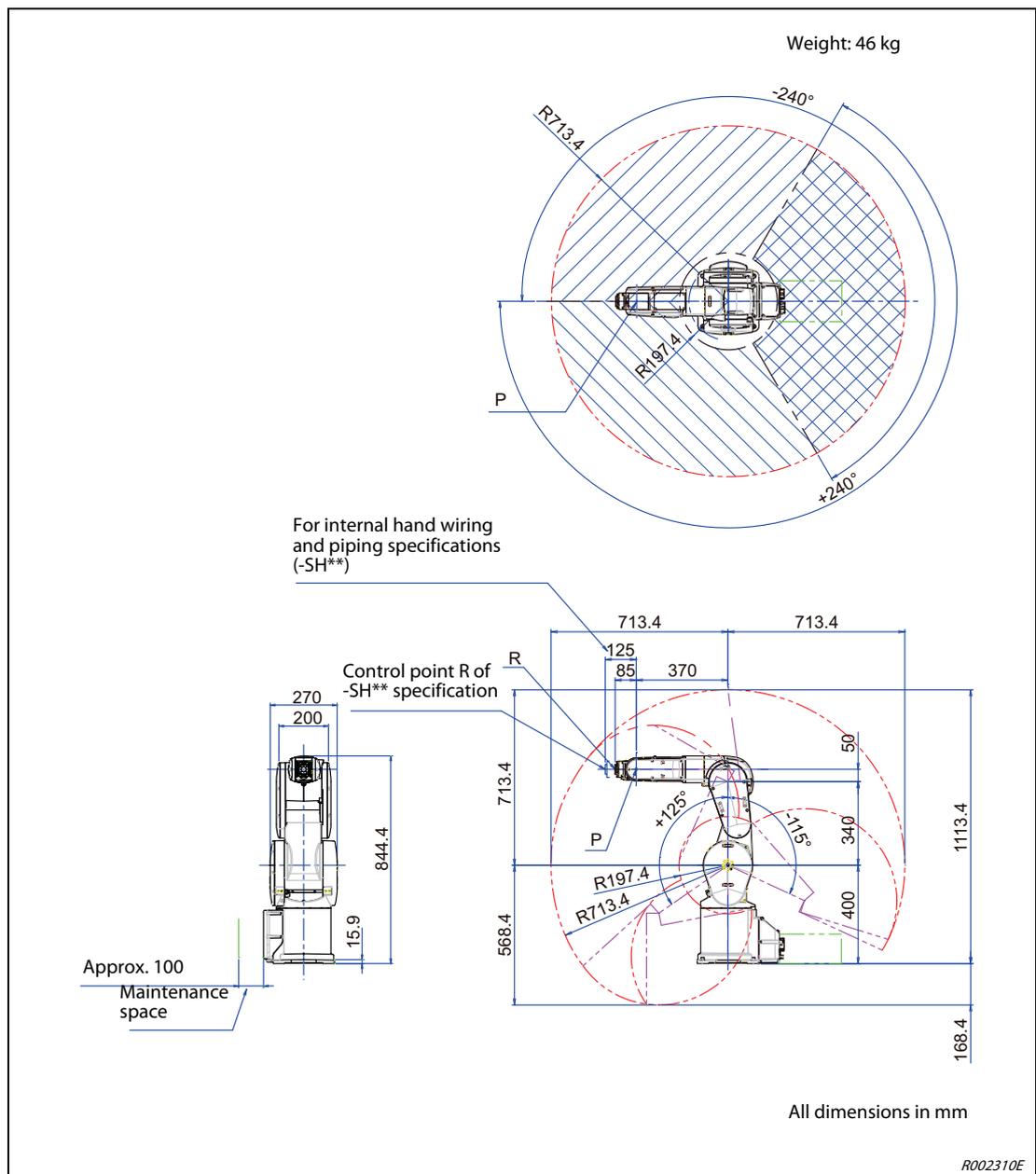


Fig. A-4: Range of motion of robot arm RV-7FM

NOTE

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

The following figure shows the range of motion of the robot arm RV-7FLM.

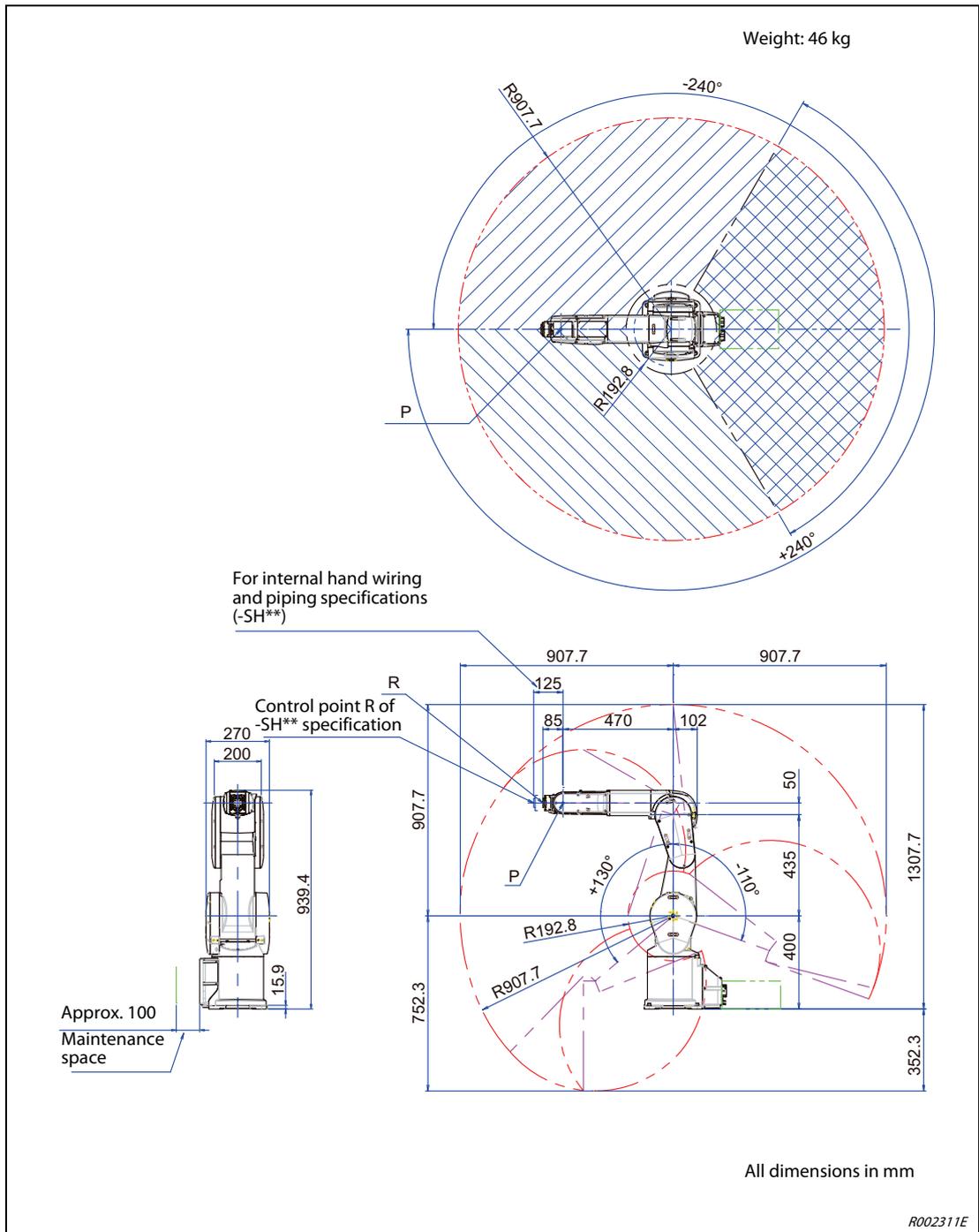


Fig. A-5: Range of motion of robot arm RV-7FLM

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 robot arms RH-3FH35/45/55.

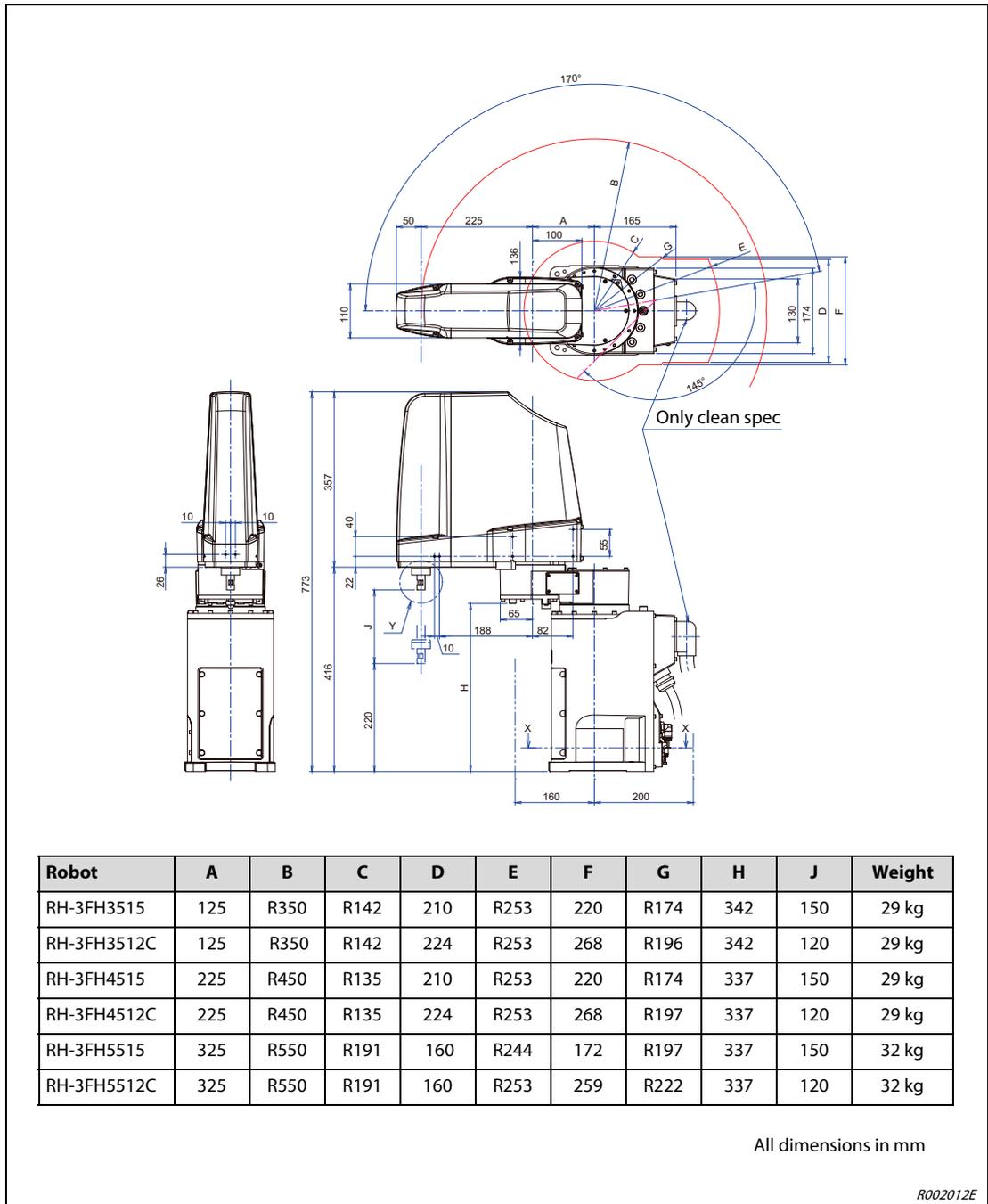


Fig. A-6: External dimensions and range of motion of robot arms RH-3FH35/45/55

The following figure shows the external dimensions and the range of motion of robot arms RH-6FH35/45/55.

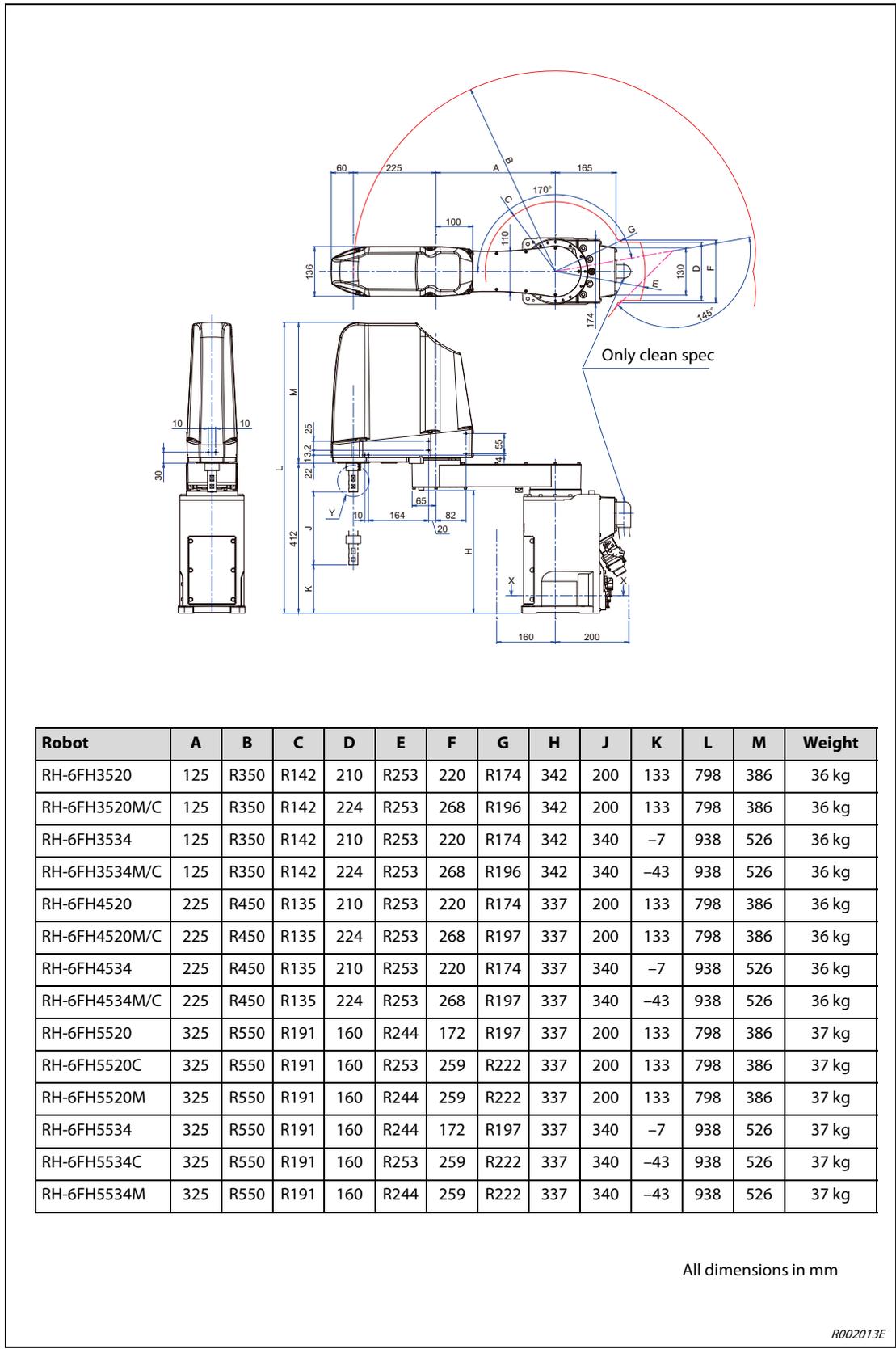


Fig. A-7: External dimensions and range of motion of robot arms RH-6FH35/45/55

The following figure shows the external dimensions and the range of motion of robot arms RH-12FH55/70/85 and RH-20FH85/100.

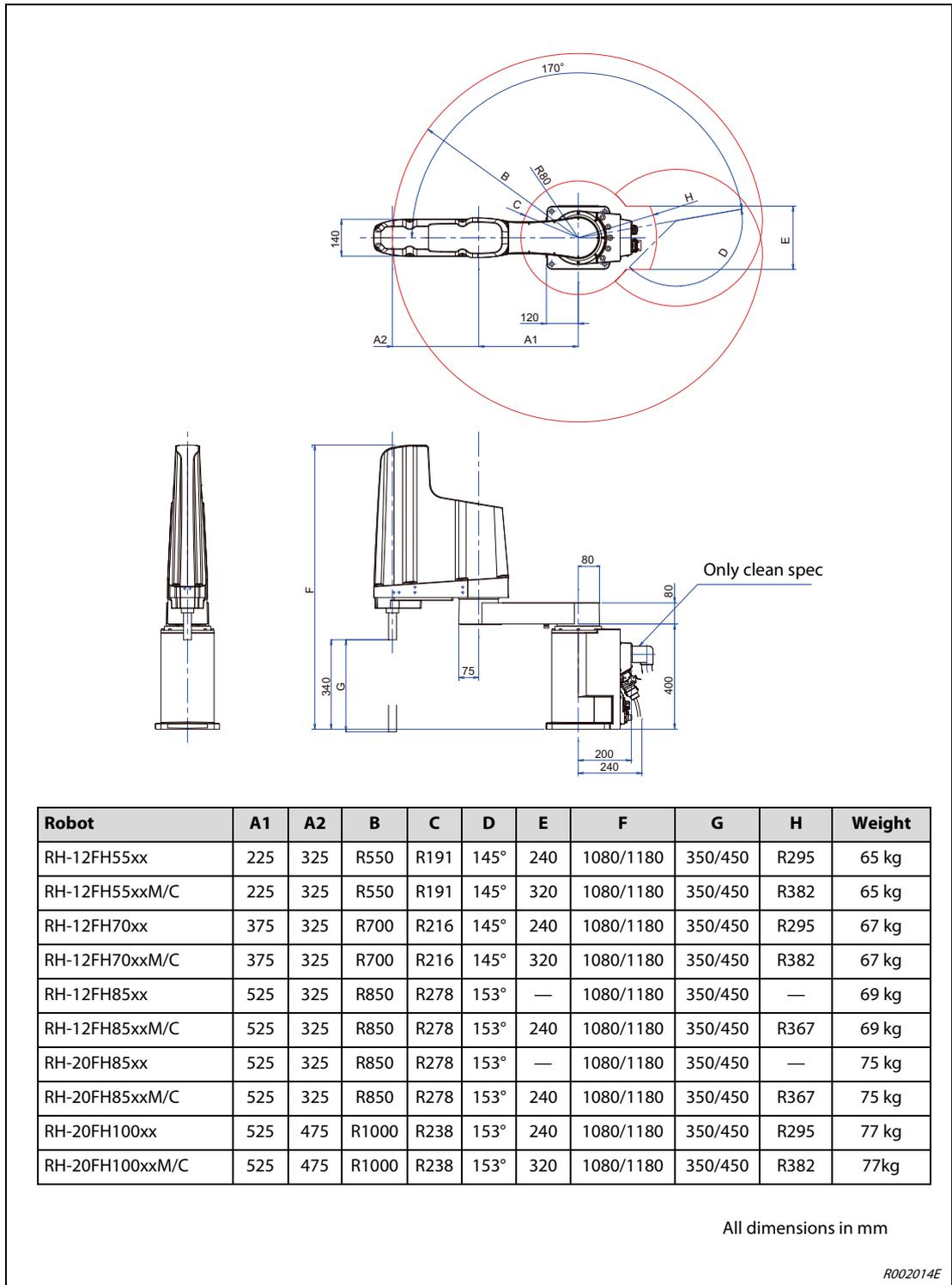


Fig. A-8: External dimensions and range of motion of robot arms RH-12FH55/70/85 and RH-20FH85/100

A.1.2 Dimensions of the control unit, the drive unit and the CPU

CR750 control unit and CR750 drive unit

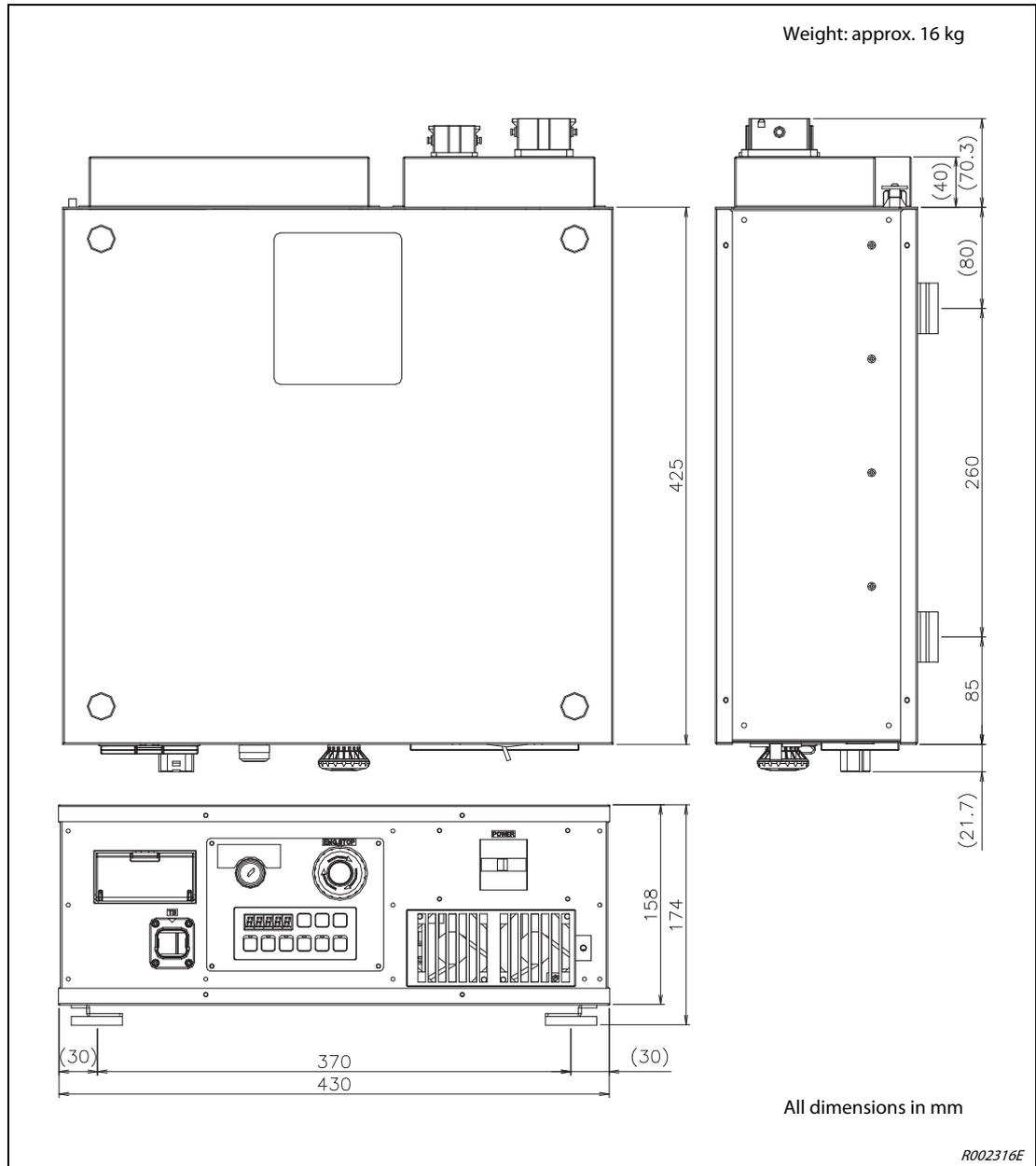


Fig. A-9: Dimensions of the CR750 control unit and the CR750 drive unit

Robot CPU Q172DRCPU

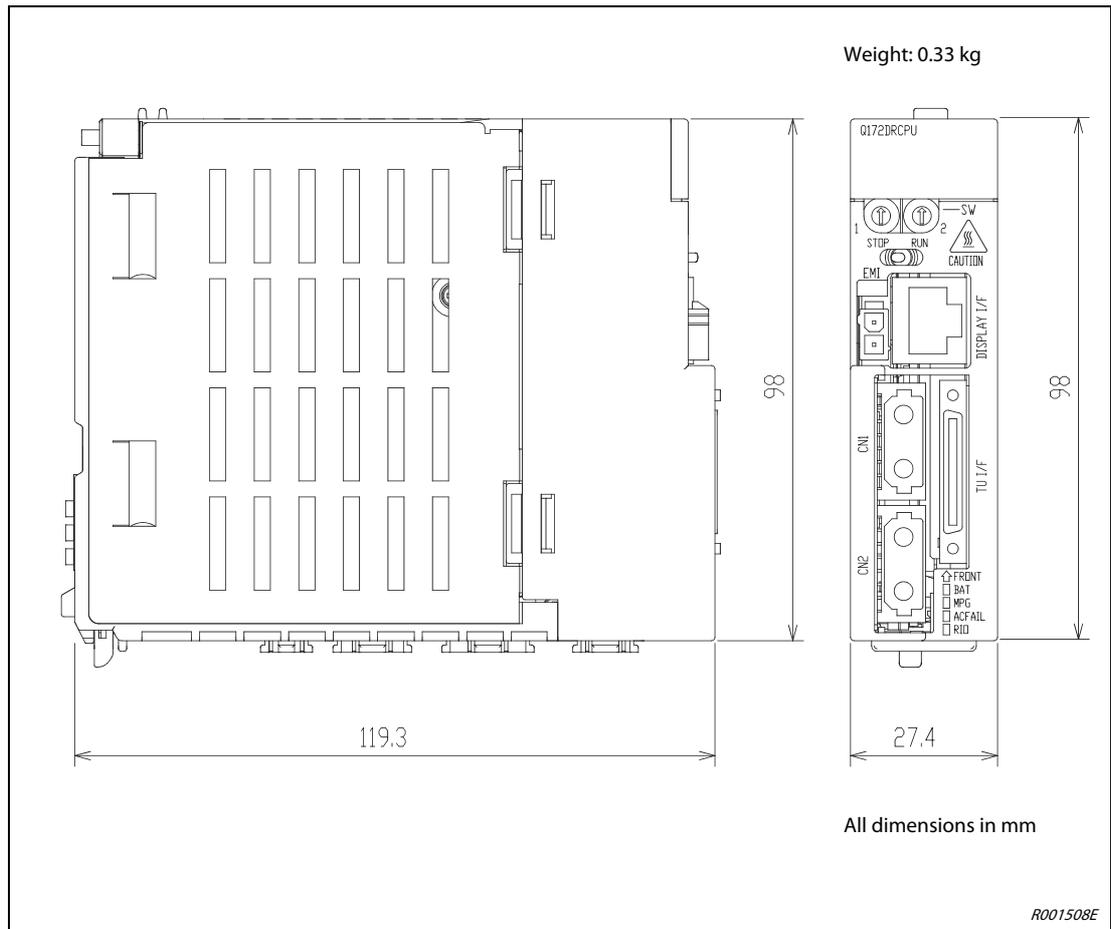


Fig. A-10: Dimensions of robot CPU Q172DRCPU

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Product Service

EC-Statement of Compliance

No. E6 12 11 25554 047

Holder of Certificate: Mitsubishi Electric CorporationTokyo BILD., 2-7-3 Marunouchi,
Chiyoda-ku
Tokyo
100-8310 JAPAN**Name of Object:** Industrial, Scientific and Medical
equipment
Industrial Robot**Model(s):** F series
(See Attachment for Nomenclature)**Description of Object:** Rated Voltage: 230 VAC
Rated Power: 1.7 kW
Protection Class: I**Tested according to:** EN 61000-6-4/A1:2011
EN 61000-6-2:2005

This EC-Statement of Compliance is issued according to the Directive 2004/108/EC relating to electromagnetic compatibility. It confirms that the listed apparatus complies with such aspects of the essential requirements of the EMC directive as specified by the manufacturer or his authorized representative in the European Community and applies only to the sample and its technical documentation submitted to TÜV SÜD Product Service GmbH for testing and certification. See also notes overleaf.

Technical report no.: 73539409**Date,** 2012-11-26 (Johann Roidt)

TÜV SÜD Product Service GmbH is Notified Body to the Directive 2004/108/EC of the European Parliament and of the council with the identification number 0123.

Page 1 of 6

Attachment

Statement No.

E6 12 11 25554 047



Product Service

Nomenclature

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

A1:RH-3FH,RH6FHseries 1.7kW

RH-x FH xx xx x - x x x-Sxx

(1) (2) (3)(4) (5) (6) (7) (8) (9) (10) (11)

(1)**RH**: Horizontal Robot

(2) Maximum Payload specification:

3 : 3kg

6 : 6kg

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

(4)**H** :4 joints

(5) Robot Arm length(No1 and No2 arm) specification:

35 : 350 mm arm

45 : 450 mm arm

55 : 550 mm arm

(6) Z stroke length specification:

12 : 120 mm arm

15 : 150 mm arm

20 : 200 mm arm

34 : 340 mm arm

(7) Dimension and Ambient specification:

M : Oil mist model(IP65)

C : Clean room model(ISO5)

[none] : Basic model(IP54)

(8) Type of Robot controller cabinet

[none] :CR750 controller

1 :CR751 controller

(9)Robot controller type:

D :Stand alone type

Q :iQ platform type

(10)Standard:

0: normal type

1:CE marking model

2:CE marking and UL model

(11)Optional Specification:

1 :normal type

SM :added cabinet box over Robot controller for oil mist resist

Sxx :Mechanical option

Attachment

Statement No.

E6 12 11 25554 047



Product Service

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

RH-x FH xx xx x - x x x-Sxx
(1) (2) (3) (4) (5) (6) (7) (8) (9) (10) (11)

(1) **RH**: Horizontal Robot

(2) Maximum Payload specification:

12 : 12kg

20 : 20kg

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

(4) **H** : 4 joints

(5) Robot Arm length(No1 and No2 arm) specification:

55 : 550 mm arm

70 : 700 mm arm

85 : 850 mm arm

100 : 1000 mm arm

(6) Z stroke length specification:

35 : 350 mm arm

45 : 450 mm arm

(7) Dimension and Ambient specification:

M : Oil mist model(IP65)

C : Clean room model(ISO3)

N : Special spec. For EU(IP54)

[none] : Basic model(IP20)

(8) Type of Robot controller cabinet

[none] :CR750 controller

1 :CR751 controller

(9)Robot controller type:

D :Stand alone type

Q :iQ platform type

(10)Standard:

0: normal type

1:CE marking model

2:CE marking and UL model

(11)Optional Specification:

1 :normal type

SM :added cabinet box over Robot controller for oil mist resist

Sxx :Mechanical option

Attachment

Statement No.

E6 12 11 25554 047



Product Service

A3:RV-2Fseries 1.7kW

RV-x F x - x x x-Sxx

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

(1)RV: Vertical Robot

(2) Maximum Payload specification:

2 : 2kg

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

(4)Robot Joint type

B :All axes have brake units.

[none] :J4 axis doesn't have brake unit.

(5) Type of Robot controller cabinet

[none] :CR750 controller

1 :CR751 controller

(6)Robot controller type:

D :Stand alone type

Q :iQ platform type

(7)Standard:

0: normal type

1:CE marking model

2:CE marking and UL model

(8)Optional Specification:

1 :normal type

SM :added cabinet box over Robot controller for oil mist resist

Sxx :Mechanical option

Attachment

Statement No.

E6 12 11 25554 047



Product Service

A4:RV-4F,7Fseries 1.7kW

RV-x F x x - x x x-Sxx

(1) (2) (3) (4) (5) (6) (7) (8) (9)

(1) **RV**: Vertical Robot

(2) Maximum Payload specification:

4 : 4kg

7 : 7kg

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

(4) Robot arm length:

L : Long arm model

[none] : normal model

(5) Dimension and Ambient specification:

M : Oil mist model(IP67)

C : Clean room model(ISO3)

[none] : Basic model(IP40)

(6) Type of Robot controller cabinet

[none] :CR750 controller

1 :CR751 controller

(7)Robot controller type:

D :Stand alone type

Q :iQ platform type

(8)Standard:

0: normal type

1:CE marking model

2:CE marking and UL model

(9)Optional Specification:

1 :normal type

SM :added cabinet box over Robot controller for oil mist resist

SH :Internal tube and wires are extended to J6 axis.

Sxx :Mechanical option

Attachment

Statement No.

E6 12 11 25554 047



Product Service

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

CR750- xx x x x - x - x Sxx
 (1) (2) (3) (4) (5) (6) (7) (8)

(1) **CR750**: CR750 controller

(2) Maximum Payload specification:

03 : 3kg

06 : 6kg

12 : 12kg

20 : 20kg

02 : 2kg

04 : 4kg

07 : 7kg

(3) Robot type

H : Horizontal robot

V : Vertical robot

(4) Robot controller type

D : stand alone

Q : iQ platform type

(5) Standard

1 : CE marking model

2 : CE marking and UL model

(6) Operation Panel

[none] : No panel type

1 : Panel type

(7) Power input connector type

[none] : normal type

P2 : Added cable with a connector and a terminal

P3 : Added cable with a connector and a terminal block

(8) Optional Specification

[none] : normal

SM : Added Cabinet box over robot controller for oil mist resist

Sxx : mechanical option



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

We,

Manufacturer: MITSUBISHI ELECTRIC Corporation Nagoya Works
 Address 1-14 Yada-Minami 5-Chome Higashi-Ku, Nagoya 461-8670, Japan

(Place of Declare):

Declare under our sole responsibility that the Product

Description: Industrial Robot
 Type of Model: F series
 Notice: Details of Serial No. are as per attached sheet(P7).
 Restrictive use: For industrial environment only

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

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

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

< Partly completed Machinery >

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

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

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

Tomoyuki Kobayashi
 (signature)

[Tomoyuki Kobayashi]

Senior Manager
 Robot Manufacturing Department
 MITSUBISHI ELECTRIC Corporation Nagoya Works

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

[Signature]
 (signature)

[Hartmut Putz]

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

■ Declaration Type of models

RH-xFH xxxxx-xxx-Sxx

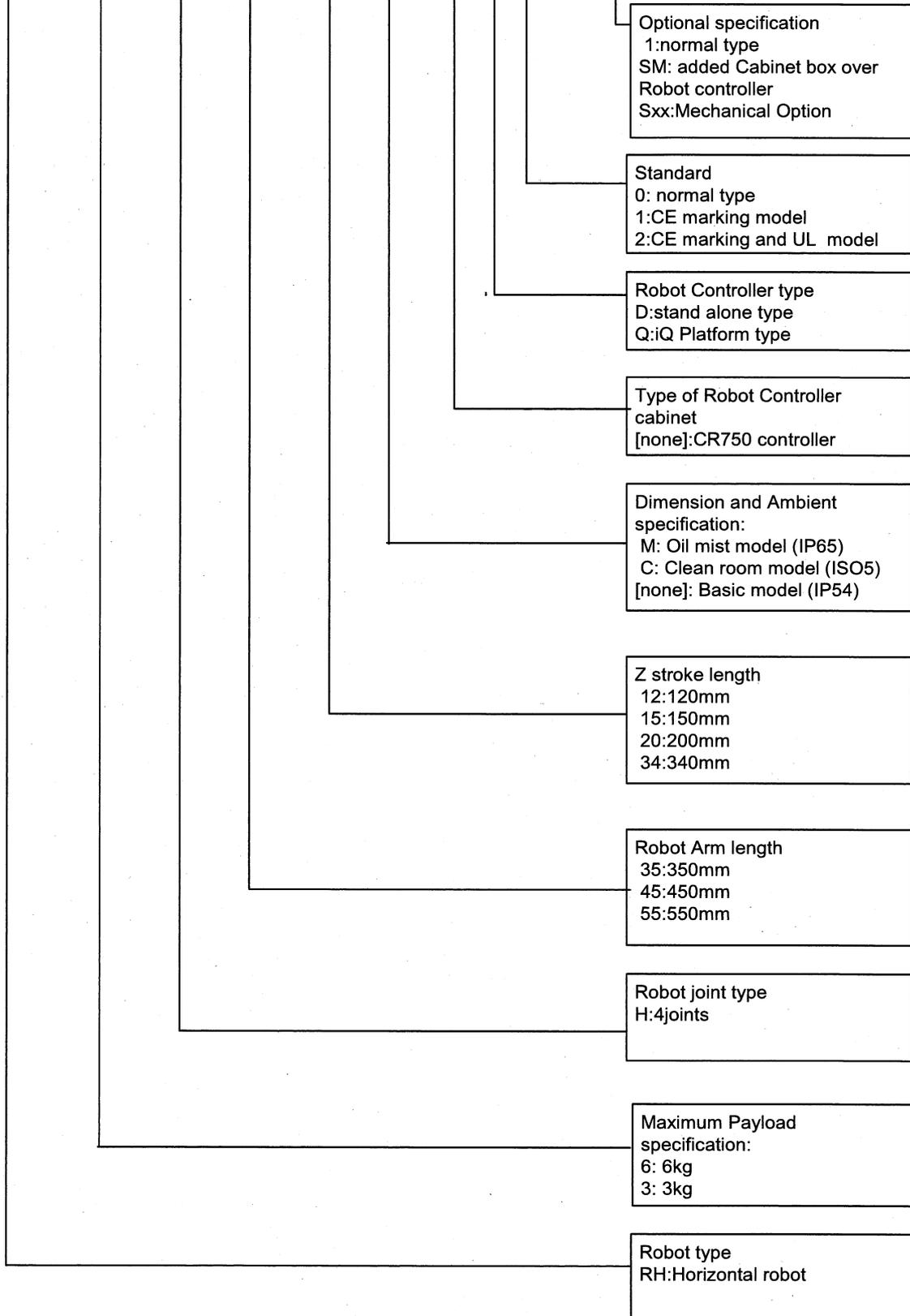


Fig.1-1 Nomenclature of F series robot (RH type Robot)

RH-xFH xxxxx - xxx - Sxx

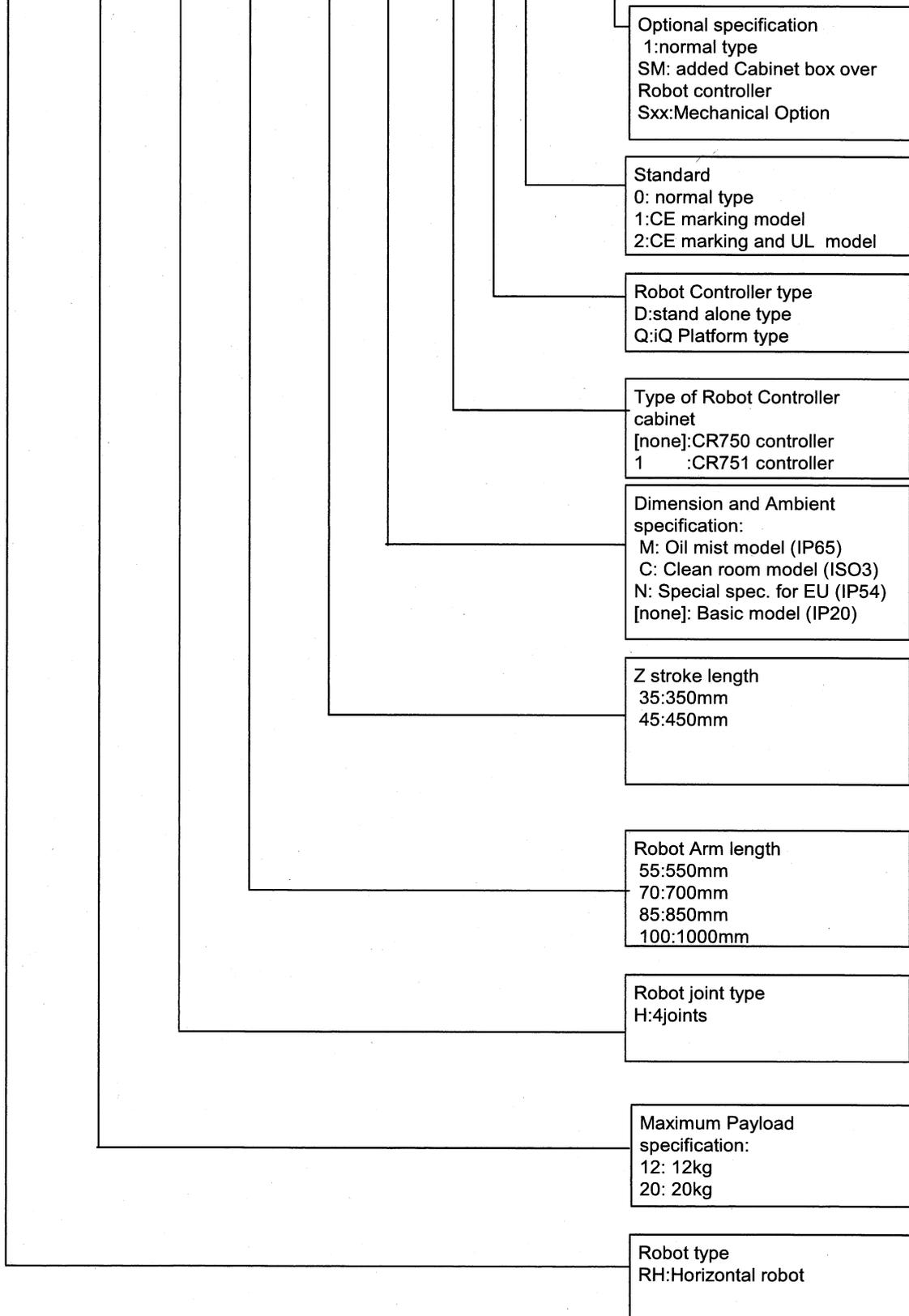


Fig.1-2 Nomenclature of F series robot of RH-12FH,20FH

RV-xF x-xxx-Sxx

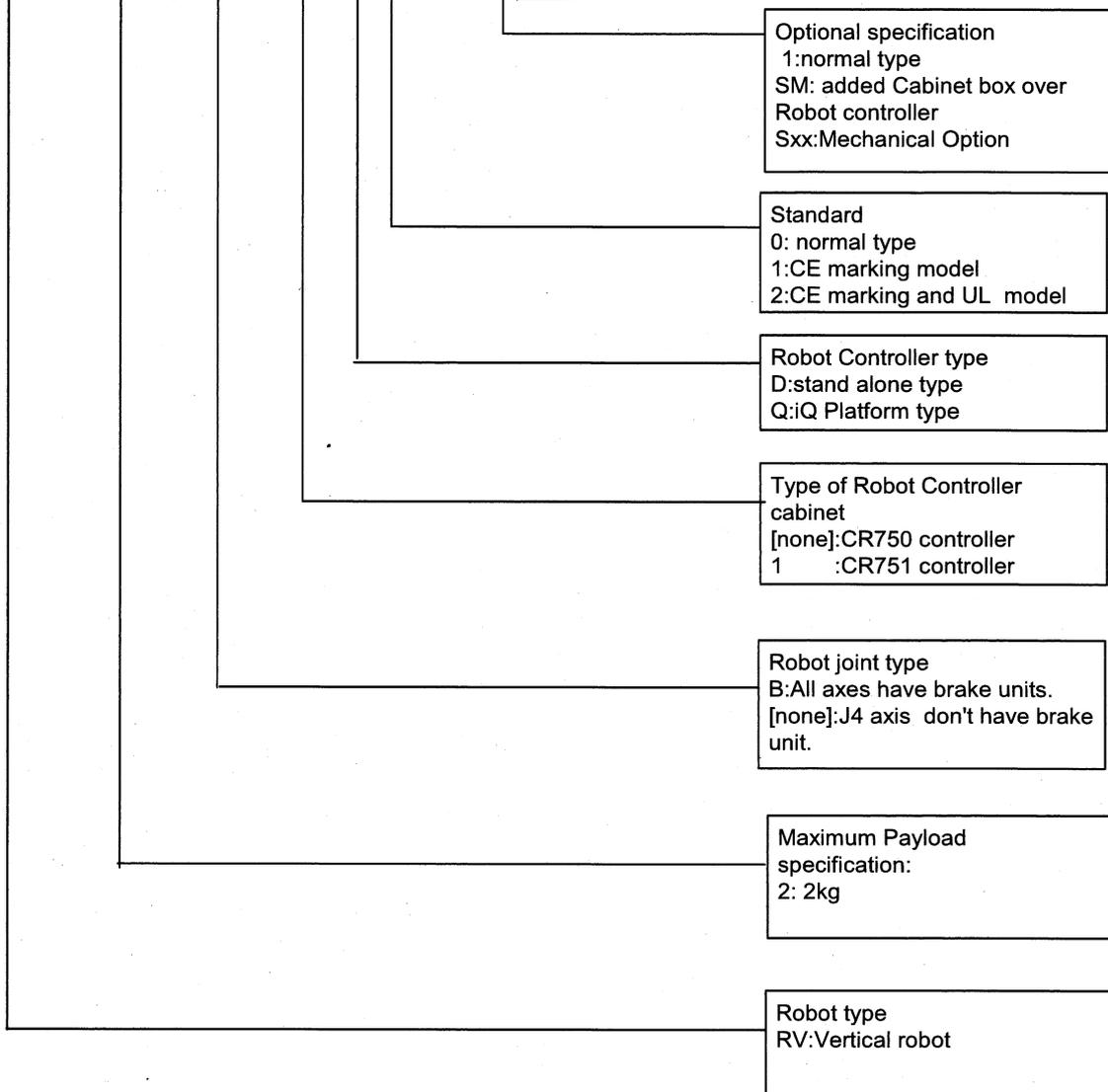


Fig.1-3 Nomenclature of F series robot of RV-2F

RV-xFx x-xxx-Sxx

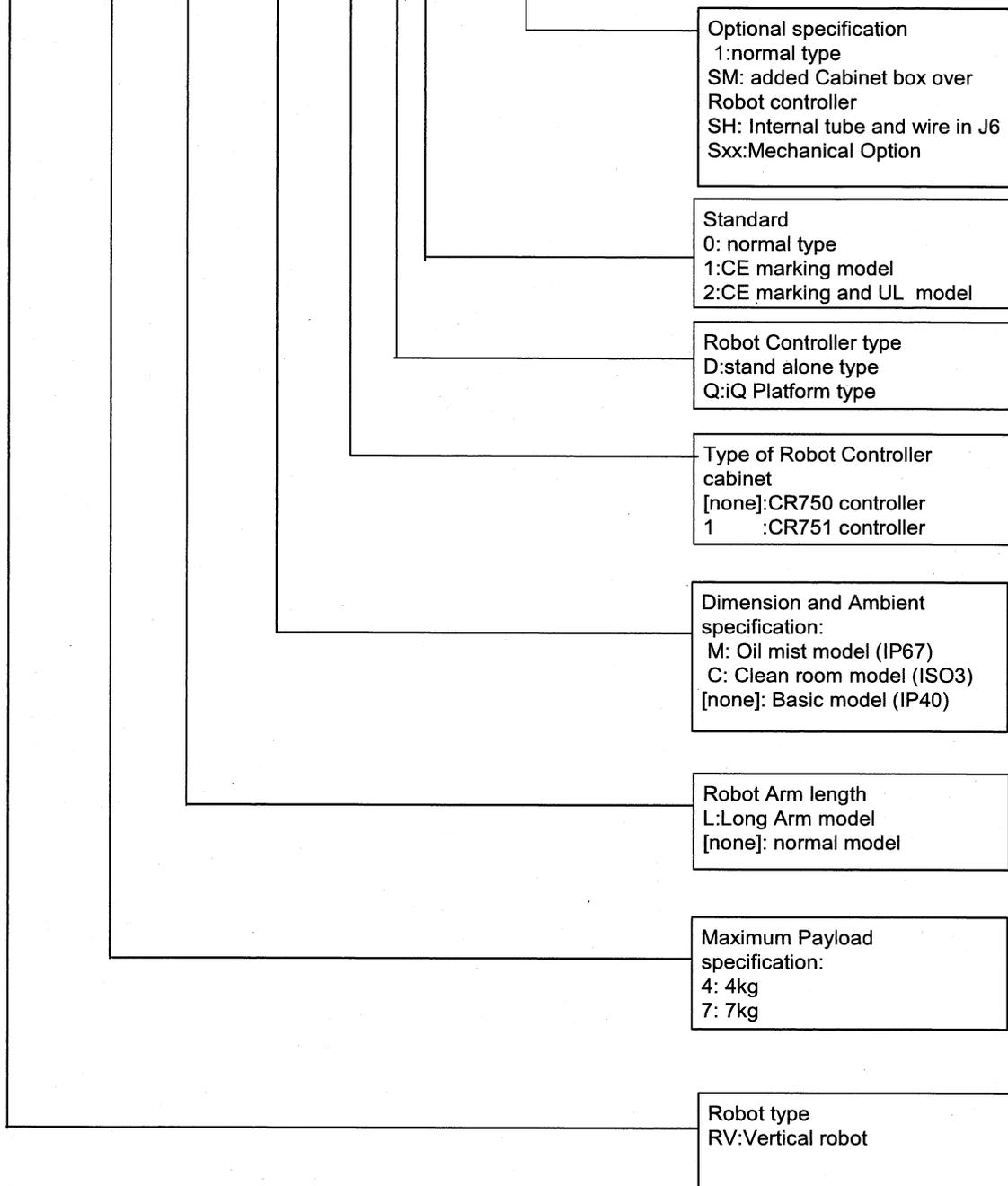


Fig.1-4 Nomenclature of F series robot of RV-4F,7F

CR750 - xx x x x - x-x - Sxx

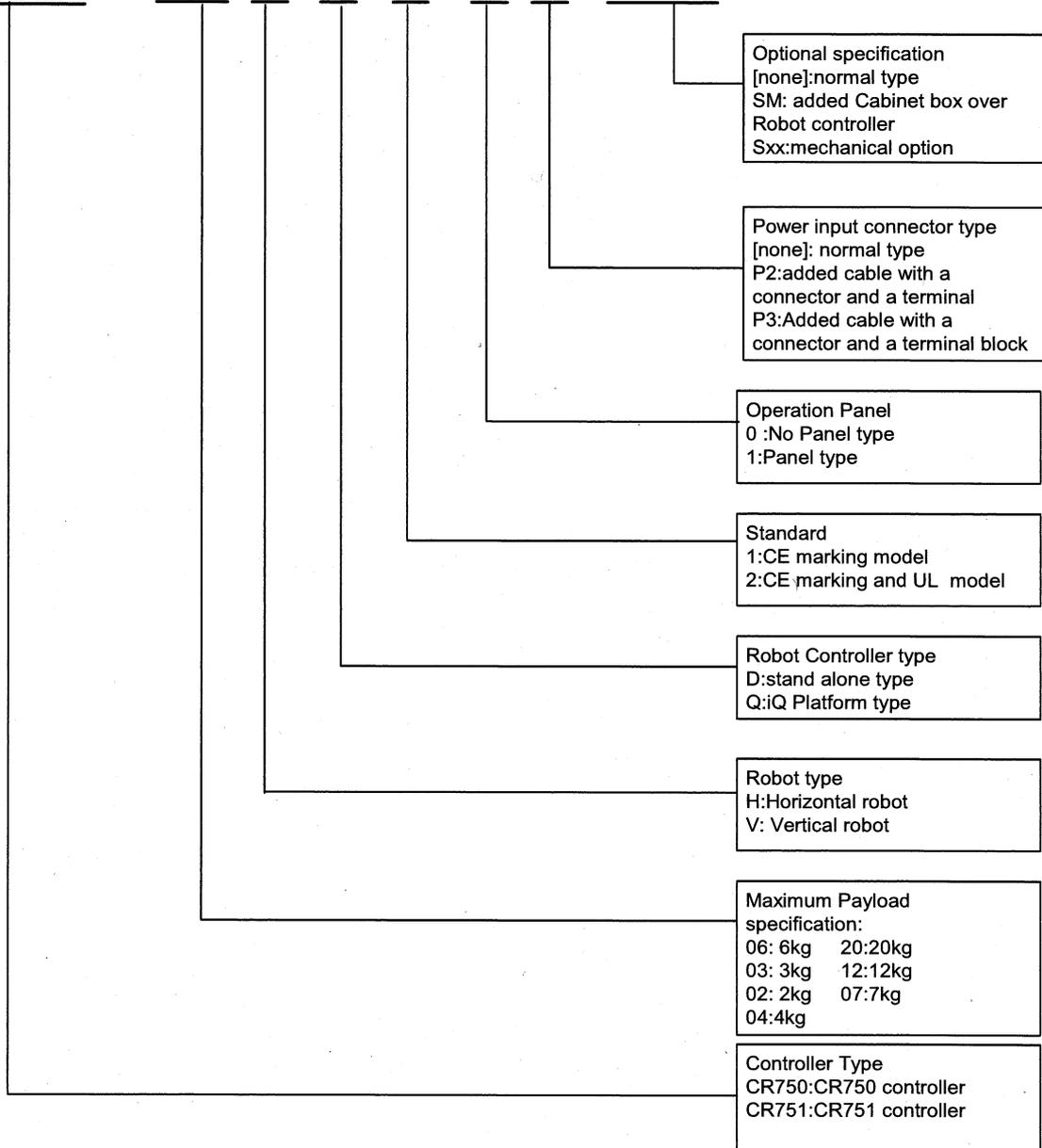


Fig.2-1 Nomenclature of F series robot controller

■ Details of serial number

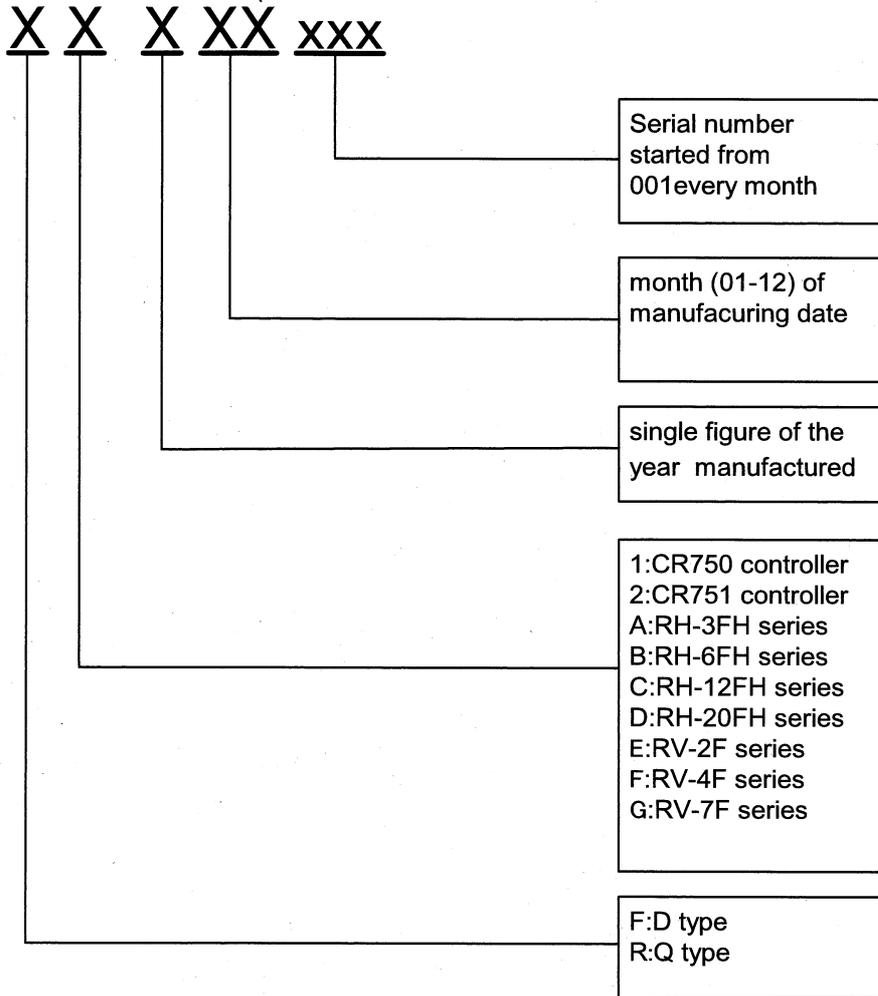


Fig.3.1 Nomenclature of serial number about F series Robot and robot controller

Revision history

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

사용자안내문 User's Guide

기종별 Type of Equipment	사용자안내문 User's Guide
<p>A 급 기기 (업무용 방송통신기자재)</p> <p>Class A Equipment (Industrial Broadcasting & Communication Equipment)</p>	<p>이 기기는 업무용(A 급) 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.</p> <p>This equipment is Industrial (Class A) electromagnetic wave suitability equipment and seller or user should take notice of it, and this equipment is to be used in the places except for home.</p>
<p>B 급 기기 (가정용 방송통신기자재)</p> <p>Class B Equipment (For Home Use Broadcasting & Communication Equipment)</p>	<p>이 기기는 가정용(B 급) 전자파적합기기로서 주로 가정에서 사용하는 것을 목적으로 하며, 모든 지역에서 사용할 수 있습니다.</p> <p>This equipment is home use (Class B) electromagnetic wave suitability equipment and to be used mainly at home and it can be used in all areas.</p>

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