MITSUBISHI ELECTRIC

MELFA

Industrial Robots

Specifications Manual

RV-12S Series
(CR3-535M Controller)

MITSUBISHI ELECTRIC   INDUSTRIAL AUTOMATION

Supplemental Instruction
(For CE specification: CR3-535M-S12)

This document additionally explains to the Mitsubishi Industrial Robot "RV-12S series Standard Specifications Manual (CR3-535M Controller)" (BFP-A8320). Therefore, check the content, and use it together with your Standard Specifications Manual.

Supplemental details
In the case of CE specification, the transformer box has been installed in the bottom of the controller because corresponding to primary supply voltage 3-phase AC360 to 480V.   The cable connection between this box and the controller is complete.   The primary power cable connection by the customer is same as the standard specification.   Connect to the primary side of earth leakage breaker.
The difference between the CE specification and standard specification is shown below.

1. Specification

Table：CE specification of controller

Item		Unit	Specification	Remarks
Type			CR3-535M-S12	CR3-TR52 has been installed in the bottom of the CR3-535M controller. Note1)
Power source	Input voltage range	V	3-phase, AC360 to 480	
	Power capacity	kVA	3.0	Note2)
Outline dimensions		mm	450 (W) x 380 (D) x 975 (H)	

Note1）The CR3-TR52 is the transfer box installed in the bottom of CR3-535M controller.
Note2）Approximately 7.5mA of leakage current flows.
　　　　If a no-fuse circuit breaker is installed on the primary side of the robot, select one with at least 15A and set the leakage current to at least 10mA.
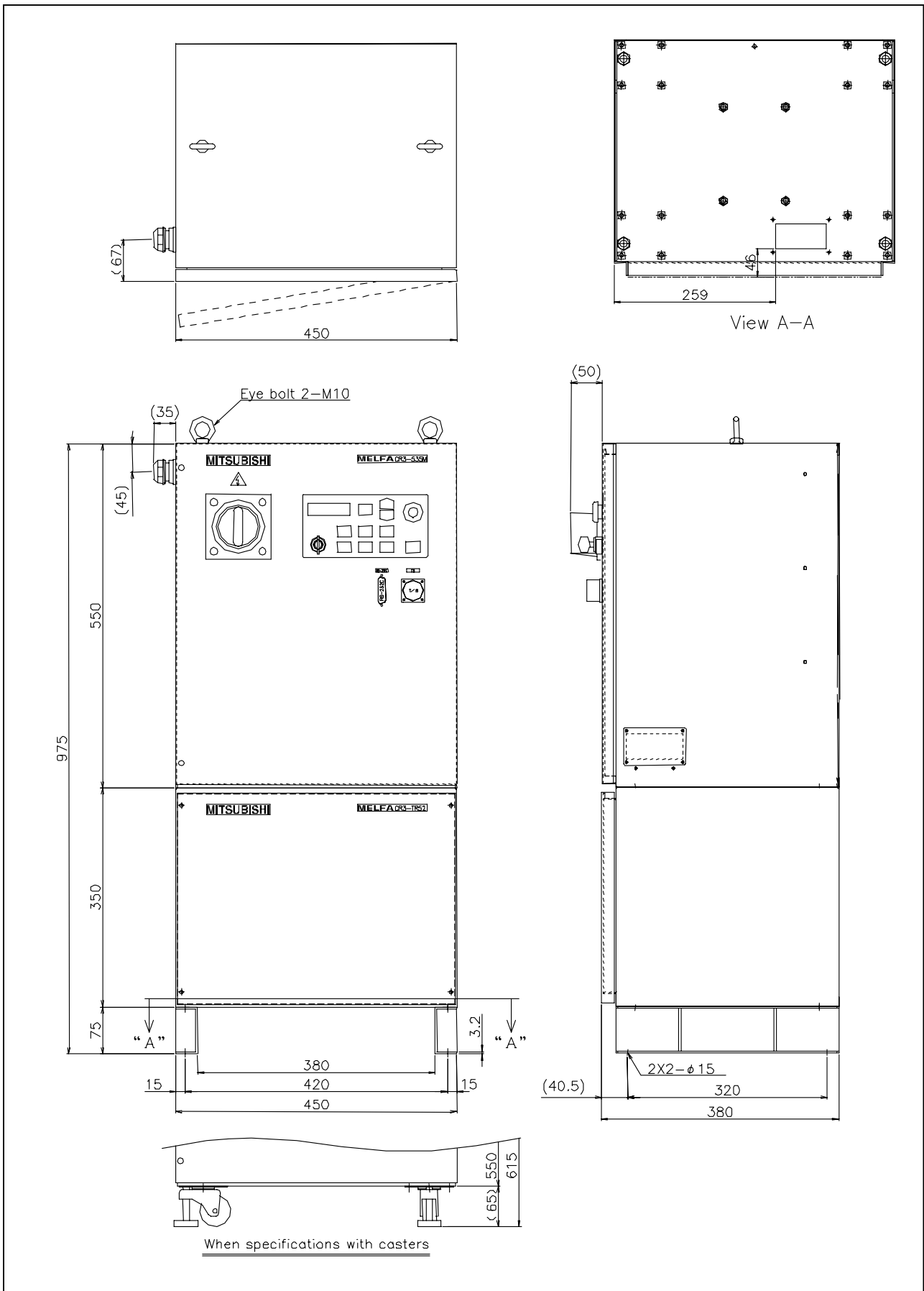
2. Outside dimensions

Fig. : Outside dimensions of controller (CR3-535M-S12)

BFP-A8320-01

⚠ Safety Precautions

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

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

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

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

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

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

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

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

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

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

⚠ CAUTION — Use the robot within the environment given in the specifications. Failure to do so could lead to a drop or reliability or faults. (Temperature, humidity, atmosphere, noise environment, etc.)

⚠ CAUTION — Transport the robot with the designated transportation posture. Transporting the robot in a non-designated posture could lead to personal injuries or faults from dropping.

⚠ CAUTION — Always use the robot installed on a secure table. Use in an instable posture could lead to positional deviation and vibration.

⚠ CAUTION — Wire the cable as far away from noise sources as possible. If placed near a noise source, positional deviation or malfunction could occur.

⚠ CAUTION — Do not apply excessive force on the connector or excessively bend the cable. Failure to observe this could lead to contact defects or wire breakage.

⚠ CAUTION — Make sure that the workpiece weight, including the hand, does not exceed the rated load or tolerable torque. Exceeding these values could lead to alarms or faults.

⚠ WARNING — Securely install the hand and tool, and securely grasp the workpiece. Failure to observe this could lead to personal injuries or damage if the object comes off or flies off during operation.

⚠ WARNING — Securely ground the robot and controller. Failure to observe this could lead to malfunctioning by noise or to electric shock accidents.

⚠ CAUTION — Indicate the operation state during robot operation. Failure to indicate the state could lead to operators approaching the robot or to incorrect operation.

⚠ WARNING — When carrying out teaching work in the robot's movement range, always secure the priority right for the robot control. Failure to observe this could lead to personal injuries or damage if the robot is started with external commands.

⚠ CAUTION — Keep the jog speed as low as possible, and always watch the robot. Failure to do so could lead to interference with the workpiece or peripheral devices.

⚠ CAUTION — After editing the program, always confirm the operation with step operation before starting automatic operation. Failure to do so could lead to interference with peripheral devices because of programming mistakes, etc.

⚠ CAUTION — Make sure that if the safety fence entrance door is opened during automatic operation, the door is locked or that the robot will automatically stop. Failure to do so could lead to personal injuries.

⚠ CAUTION — Never carry out modifications based on personal judgments, or use non-designated maintenance parts.
Failure to observe this could lead to faults or failures.

⚠ WARNING — When the robot arm has to be moved by hand from an external area, do not place hands or fingers in the openings. Failure to observe this could lead to hands or fingers catching depending on the posture.

⚠ CAUTION — Do not stop the robot or apply emergency stop by turning the robot controller's main power OFF.
If the robot controller main power is turned OFF during automatic operation, the robot accuracy could be adversely affected.

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

■ Revision history

Date of print	Specifications No.	Details of revisions
2003-09-22	BFP-A8320Za	First print.
2003-10-14	BFP-A8320	Formal style

■ Introduction

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

However, to comply with the target application, a work system having a well-balanced robot arm, peripheral devices or robot and hand section must be structured.
When creating these standard specifications, we have edited them so that the Mitsubishi robot's characteristics and specifications can be easily understood by users considering the implementation of robots. However, if there are any unclear points, please contact your nearest Mitsubishi branch or dealer.
Mitsubishi hopes that you will consider these standard specifications and use our robots.

In this manual, the specifications regarding the robot arm are given in Page 5, "2 Robot arm" and following, and the specifications regarding the controller are given in Page 32, "3 Controller" and following. Refer to the corresponding sections for details on the specifications, options and maintenance parts, etc.

The contents of this manual correspond to the following robot types.
    〈Type〉   ・RV-12S
                     ・RV-12SC
                     ・RV-12SL
                     ・RV-12SLC

Note:
・No part of this manual may be reproduced by any means or in any form, without prior consent from Mitsubishi.
・The contents of this manual are subject to change without notice.
・The specifications values are based on Mitsubishi standard testing methods.
・The information contained in this document has been written to be accurate as much as possible. Please interpret that items not described in this document "cannot be performed.".
  Please contact your nearest dealer if you find any doubtful, wrong or skipped point.

Contents

1 General configuration

1.1 Structural equipment

Structural equipment consists of the following types.

1.1.1 Standard structural equipment

The following items are enclosed as a standard.
　(1) Robot arm
　(2) Controller
　(3) Machine cable(Attached to the controller)
　(4) Robot arm installation bolts
　(5) Safety manual, CD-ROM (Instruction manual)
　(6) Guarantee card

1.1.2 Shipping special specifications

Part of the standard structural equipment is changed at the time of factory shipment. Consequently, kindly confirm the delivery date.

To make changes to the specifications after shipment, service work must be performed at the work site or the robot must be returned for service.

1.1.3 Options

Installation is possible after shipment. Customer needs to perform the installation work.

1.1.4 Maintenance parts

Consumable parts and spare parts for maintenance use.
For items not listed, contact the dealer where you made your purchase.

1.2 Contents of the structural equipment

1.2.1 Robot arm

The list of structural equipment is shown in Fig. 1-1.

Vertical six-axis
multiple-jointed type
(RV-12S/12SL/12SC/12SLC)

Machine cable extension
(attached to the standard 7 m cable)
・Fixed type: 1S- □□ CBL-01
・Flexed type: 1S- □□ LCBL-01

Note1) □□ refer the length.
        Refer to Table 1-1 for datails.
Note2) Connect the extension cables to
        the arm side of the standard 7 m
        (for fixing) cable to extend.

Solenoid valve set
(Hand output cable is attached)
〈Sink type〉
・1 set: 1S-VD01-01
・2 set: 1S-VD02-01
・3 set: 1S-VD03-01
・4 set: 1S-VD04-01
〈Source type〉
・1 set: 1S-VD01-01E
・2 set: 1S-VD02-01E
・3 set: 1S-VD03-01E
・4 set: 1S-VD04-01E

Stopper for changing the operating range
of the J1 axis
・Stopper part: 1S-DH-01
＊This must be installed by the customer.

Pneumatic hand customer-manufactured parts

Hand output cable
・1S-GR35S-01 (4sets)

Hand input cable
・1S-HC25C-01

Hand curl tube
・4 set, 8pc.: 1N-ST0608C

[Caution]

Standard configuration
equipment

Special shipping
specifications

Option

Prepared by customer

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

1.3 Controller

The devices shown below can be installed on the controller.

Controller
・CR3-535M

Teaching pendant (T/B)
・R28TB

Caster type controller

Pneumatic hand interface
・2A-RZ365 (Sink)
・2A-RZ375 (Source)

Parallel I/O unit
・2A-RZ361 (Sink)
・2A-RZ371 (Source)

External I/O cable
・2A-CBL05(5m)
・2A-CBL15(15m)

PLC(Programmable Logic Controller)
External device

Prepared by customer

Note1)
Extended serial interface
・2A-RZ581E

Note1)
CC-Link interface
・2A-HR575E

Note1)
Ethernet interface
・2A-HR533E

Extension memory cassette
・2A-HR432

Personal computer cable
・RS-MAXY-CBL

Personal computer
Prepared by customer

Personal computer support software
・3A-01C-WINE(CD-ROM)
(MS-Windows95/98/2000/NT4.0/Me/XP)
Personal computer support software mini
・3A-02C-WINE(CD-ROM)
(MS-Windows95/98/2000/NT4.0/Me/XP)

Instruction Manual
(bound edition)

[Caution]

☐ Standard configuration equipment

⌐·⌐·⌐ Special shipping specifications

⌐ ⌐ ⌐ Option

▨ Prepared by customer

Note1)There are some restrictions on the number of optional interfaces and their combinations.
Refer to the separate "Controller setup, basic operation, and mainte-nance" for details.

Fig.1-2 : Structural equipment(Controller)

1.4 Contents of the Option equipment and special specification

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

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

Item	Type	Specifications	Classification Note1)	Description
Stopper for changing the operating range of the J1 axis	1S-DH-01	Stopper part + side: +135, +90, or +45 deg. - side: -135, -90, or -45 deg. One each of the following can be selected: ± 170 deg. are used for the standard specification.	○	This must be installed by the customer.
Extended machine cable	1S- □□ CBL-01	For fixing (Two sets for power and signal)	□	10, 15m
	1S- □□ LCBL-01	For bending (Two sets for power and signal)	□	5, 10, 15m
Solenoid valve set	1S-VD01-01	1 set (Sink type)	○	A solenoid valve set for the pneumatic hand
	1S-VD02-01	2 set (Sink type)	○	
	1S-VD03-01	3 set (Sink type)	○	
	1S-VD04-01	4 set (Sink type)	○	
	1S-VD01-01E	1 set (Source type)	○	
	1S-VD02-01E	2 set (Source type)	○	
	1S-VD03-01E	3 set (Source type)	○	
	1S-VD04-01E	4 set (Source type)	○	
Hand output cable	1S-GR35S-01	Length 350mm with robot side connector. One terminal is not treated.	○	The cable is connected to the hand output connector by the customer.
Hand input cable	1S-HC25C-01	One terminal is not treated.	○	The cable is connected to the sensor by the customer.
Hand curl tube	1N-ST0608C	For solenoid valve 4set.: φ 6x8	○	Curl type air tube
Teaching pendant	R28TB	Cable length 7m	○	With 3-position deadman switch/ IP 65
	R28TB-15	Cable length 15m (special specification)	○	
Pneumatic hand interface	2A-RZ365	DO: 8 point (Sink type)	○	
	2A-RZ375	DO: 8 point (Source type)	○	
Parallel I/O interface	2A-RZ361	DO: 32 point (Sink type)/ DI : 32 point (Sink type)	○	The unit for expansion the external input/output. Electrical isolated Type (100mA/Point)
	2A-RZ371	DO: 32 point (Source type)/ DI : 32 point (Source type)	○	
External I/O cable	2A-CBL05	5m	○	Use to connect the external peripheral device to the parallel input/output unit
	2A-CBL15	15m	○	
Personal computer cable	RS-MAXY-CBL	RS-232C cable 3m for PC-AT compatible model	○	
Personal computer Support software	3A-01C-WINE	CD-ROM	○	MS-Windows95/98/2000/NT4.0/Me/XP (With the simulation function)
Personal computer Support software mini	3A-02C-WINE	CD-ROM	○	MS-Windows95/98/2000/NT4.0/Me/XP
Extended serial interface	2A-RZ581E	RS-232C x 1 RS-232C or RS-422 x 1	○	
CC-Link interface	2A-HR575E	Local station (The local station alone is supported.)	○	for MELSEC PLC with CC-Link connection.
Ethernet interface	2A-HR533E	ETHERNET x 1	○	
Extended memory cassette	2A-HR432	Teaching point number: 25,400 Steps number: 50,800 Program number: 100	○	The battery backup function is provided. Together with 2,500 points of standard teaching positions, the total number of teaching positions is 27,900 points.
Instruction Manual (bound edition)	BFP-A5948	Safety Manual	○	Items relating to safety in handling the robot
	BFP-A8320	Standard Specifications	○	Specification of the robot arm and controller
	BFP-A8321	Robot Arm Setup & Maintenance	○	Installation method of the robot arm, jog operation, and maintenance and inspection procedures
	BFP-A8324	Controller Setup, Basic Operation and Maintenance	○	Installation method of the controller, basic operation, and maintenance and inspection procedures
	BFP-A5945	Detailed Explanation of Functions and Operations	○	Functions of the controller and T/B, operation method, and explanation of MELFA-BASIC Ⅳ
	BFP-A5946	Troubleshooting	○	Causes of errors occurred and their countermeasures
	BFP-A8081	Extended serial interface	○	Functions and operation method of the extension serial interface
	BFP-A8079	CC-Link interface	○	Functions and operation method of the CC-Link interface
	BFP-A8080	ETHERNET interface	○	Functions and operation method of the ETHERNET interface
	BFP-A5949	Personal computer Support software	○	Functions and operation method of the personal computer Support software

Note1) In the classification column, ○ refers to an option,and □ to a Sipping special specifications.

2 Robot arm
2.1 Standard specifications
2.1.1 Standard specifications

Table 2-1 : Tab Standard specifications of robot

Item		Unit	Specifications			
Type			RV-12S	RV-12SC	RV-12SL	RV-12SLC
Type of robot			6-axis standard arm		6-axis long arm	
			Standard	Clean (Special Specifications)	Standard	Clean (Special Specifications)
Degree of freedom			6			
Installation posture			On floor, hanging	On floor	On floor, hanging	On floor
Structure			Vertical, multiple-joint type			
Drive system			AC servo motor (brake provided on all axes)			
Position detection method			Absolute encoder			
Arm length	Shoulder shift	mm	150		150	
	Upper arm		400		560	
	Fore arm		530		670	
	Elbow shift		80		80	
	Wrist length		97		97	
Operating range	Waist (J1)	Degree	340(-170 to +170)			
	Shoulder (J2)		230(-100 to +130)			
	Elbow (J3)		290(-130 to +160)			
	Wrist twist (J4)		320(-160 to +160)			
	Wrist pitch (J5)		240(-120 to +120)			
	Wrist roll (J6)		720(-360 to +360)			
Speed of motion	Waist (J1)	Degree/s	276		230	
	Shoulder (J2)		230		172	
	Elbow (J3)		267		200	
	Wrist twist (J4)		352			
	Wrist pitch (J5)		375			
	Wrist roll (J6)		660			
Maximum resultant velocity [Note1]		mm/sec	Approx. 9,600		Approx. 9,500	
Load	Maximum [Note2]	kg	12			
	Rating		10			
Pose repeatability [Note3]		mm	± 0.05			
Ambient temperature		℃	0 to 40			
mass		kg	Approx. 93		Approx. 98	
Allowable moment load	Wrist twist (J4)	N・m	19.3			
	Wrist pitch (J5)		19.3			
	Wrist roll (J6)		11			
Allowable inertia	Wrist twist (J4)	kg・m²	0.4			
	Wrist pitch (J5)		0.4			
	Wrist roll (J6)		0.14 [Note4]			
Arm reachable radius froot p-axis center point		mm	1,086		1,385	
Tool wiring [Note5]			Hand input 8 point / hand output 8 point			
			Six spare wires : AWG#28(0.1mm²) (shielded)	Four spare wires : AWG#22(0.3mm²)	Six spare wires : AWG#28(0.1mm²) (shielded)	Four spare wires : AWG#22(0.3mm²)
Tool pneumatic pipes			Primary side: Φ6 × 2 , Secondary side: Φ6 × 8			
Supply pressure		MPa	0.49 ± 10%			
Protection specification[Note6]			J1 to J3 axis : IP54 J4 to J6 axis : IP65	–	J1 to J3 axis : IP54 J4 to J6 axis : IP65	–
Degree of cleanliness[Note7]			–	10(0.3μm) Internal suction requirement	–	10(0.3μm) Internal suction requirement
Painting color			Light gray (Equivalent to Munsell: 0.08GY7.64/0.81)			

Note1) This is the value on the hand flange surface when all axes are combined.
Note2) The maximum load capacity is the mass with the flange posture facing downword at the ± 10° limit.
Note3) The pose repeatability details are given in Page 6, "2.2.1 Pose repeatability and distance accuracy"
Note4) Up to 0.28kg・m² can be supported by performing variable acceleration/deceleration control and also by setting the load inertia.
Note5) The air hand interface (option) is required when the tool (hand) output is used. Also, if the solenoid set (option) is used, eight points of hand outputs are used for other options. 。
Note6) The protection specification details are given in Page 9, "2.2.5 Protection specifications and working environment".
Note7) The clean specification details are given in Page 10, "2.2.6 Clean specifications" .A down flow(0.3m/s or more) in the clean room is the necessary conditions for the cleanliness.

2.2 Definition of specifications

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

2.2.1 Pose repeatability and distance accuracy

This robot, the pose repeatability and distance accuracy are defined and calculated in Table 2-2.

(1) The pose accuracy in terms of coordinates (XYZ) for the standard point which is obtained repeatedly under the same conditions and motions when the robot is on an operating course.

(2) The standard point is the intersection between the J6 axis and the flange surface for tooling installation.

Table 2-2 : Specified accuracy

Item	Specified conditionds
Pose repeatability	The value equal to the average of the maximum value and the minimum value of the group of attained poses, with (+) or (−) added.
Distance accuracy	The distance from the teaching point to the point that is equal to the average of the maximum value and the minimum value of the group of attained poses.
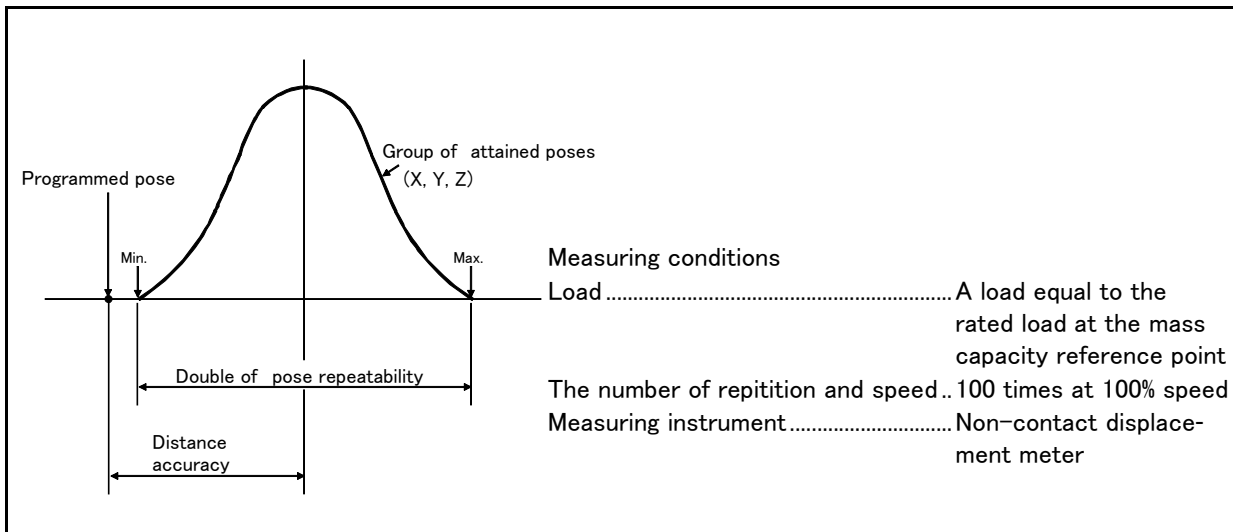
Fig.2-1 : Specified accuracy

[Caution] The position accuracies described in the specification are based on the measurements of accuracies under the same conditions. Therefore, the accuracies under the following specification conditions may not meet the specification values.

⟨1⟩ When the power is turned OFF during operation or the robot operation is stopped, even on the same path

⟨2⟩ When repeating with and without work

⟨3⟩ When the operating temperature varies

⟨4⟩ When the position accuracies are required immediately after starting the robot and after the robot is warmed up

⟨5⟩ When the speed while teaching and the speed while executing differ

⟨6⟩ Coordinates, position accuracies and so forth by setting numerical values

2.2.2 Rated load (mass capacity)

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

(1) The tooling should have the value less or equal than the smaller of the tolerable inertia and the tolerable moment found in Page 5, "Table 2-1 : Tab Standard specifications of robot"

(2) Fig. 2-2shows the distribution dimensions for the center of gravity in the case where the volume of the load is relatively small. Use this figure as a reference when designing the tooling.

(3) When the load is not mass, but force, you should design the tooling so that it does not exceed the value for allowable moment described in Page 5, "Table 2-1 : Tab Standard specifications of robot"

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

[Caution] The overhang amount of the load for the specified moment and inertia in this section is the dynamic limit value determined by the motor driving each axis and by the capacity of the reduction gears. Consequently, accuracy cannot be guaranteed for the entire tooling area. Since accuracy is based on the center point of the mechanical interface surface, position accuracy can diminish as you go away from the flange surface, or vibration can result, with tooling that is not rigid or that is long.

[Caution] Even within the allowable range previously mentioned, an overload alarm may be generated if an ascending operation continues at a micro-low speed. In such a case, it is necessary to increase the ascending speed.
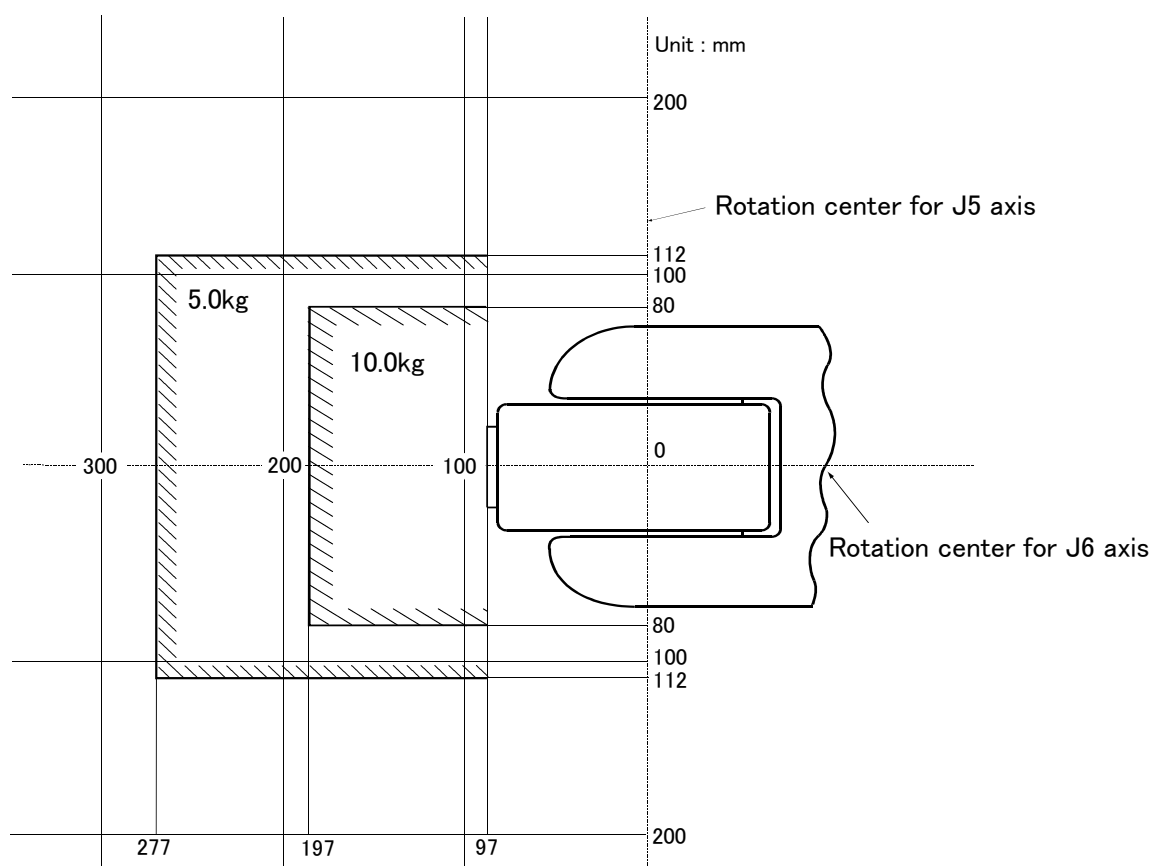
Fig.2-2 : Position of center of gravity for loads (for loads with comparatively small volume):RV-12S/12SL Series

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

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

To achieve that, it is necessary to correctly set the actual load data (mass and size of hand and work) to be used. However, vibration and errors such as excessive margin of error and overload may occur, depending on the robot operation pattern or ambient temperature. In such a case, change the setting value to the +20% range. If a setting is performed in such a way that it falls below the mounted load, the life span of the mechanism elements used in the robot may be shortened. In the case of a work requiring a high degree of accuracy, set up the load correctly and use the robot by lowering the ratios of the acceleration and deceleration speeds.

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

Set up the capacity and size of the hand with the "HNDDAT*" parameter (optimum acceleration/deceleration setting parameter), and set up the capacity and size of the work with the "WRKDAT*" parameter. Numbers 1 to 8 can be used for the asterisk (*) part. Designate the "HNDDAT*" and "WRKDAT*" parameters to be used using the "LOADSET" command in a program.

For more details, refer to the separate "Instruction Manual/Detailed Explanation of Functions and Operations."

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

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

1) Lower the robot's operating speed by approximately 5% from high speed using the OVRD instruction.
2) Change and move the teaching points of the robot.
3) Change the hand mass and hand inertia.

2.2.5 Protection specifications and working environment

(1) Types of protection specifications

The robot arm has protection specifications that comply with the IEC Standards. The protection specifications and applicable fields are shown in Table 2-3.
Even oil mist environment can be used in addition to the general environment.

Table 2-3 : Protection specifications and applicable fields

Type	Protection specifications (IEC Standards value)	Classification	Applicable field	Remarks
RV-12S RV-12SL	IP54 (J1 to J3 axis)	General-purpose environment specifications	General assembly Slightly dusty environment	
	IP65 (J4 to J6 axis)	Oil mist specifications	Machine tool (cutting) Machine shop with heavy oil mist Dusty work shop	Note that if the cutting machine contains abrasive materials, the machine line will be shortened.

The IEC IP symbols define the degree of protection against solids and fluids, and do not indicate a protective structure against the entry of oil or water.

The evaluation regarding oil mist specifications has been confirmed with Mitsubishi's standard testing methods using the cutting oils shown in Table 2-4

Table 2-4 : Tested cutting oil for oil mist specifications

Name	Maker	Relevant JIS	Main characteristics	Application
Emulcut FA-800	Kyodo Yushi Co., Ltd	Equivalent to Class W1 No. 1	Water soluble cutting oil · Base oil ....50-60% · Surfactant and rust inhibitor ....30-40% · Additives..5% or less · Water ....The rest	Water soluble cutting oil Emulcut

【Information】
· The IEC IP54
  The IEC IP54 standard refers to protection structure designed to prevent any harmful effects by fresh water scattering vertically onto the testing equipment in a radius of 180 degrees from a distance of 300 to 500 mm, with 10 ± 0.5 liters of water every minute, at a water pressure of 80 to 100kPa , covering the entire area of the robot with the exception of the installation section at 1 ㎡ per minute, for a total of 5 minutes or more.
· The IEC IP65
  Protection against water infiltration as specified in IP65 indicates a protective structure that is not harmfully affected when 12.5 ± 5% liters of water is supplied from a test device at a position approx. 3m away in various directions and a water pressure of 30kPa at the nozzle section. The water is filled one minute per $1m^2$ of test device surface area for a total of three minutes.

(2) About the use with the bad environment

This robot has protection methods that conform to IEC's IP54 (for J1 to J3 axis) and IP65 (for J4 to J6 axis) standards (splashproof type). Recommended usage conditions.
   1) The robot is designed for use in combination with machining device.
   2) Please examine cutting oil referring to Table 2-4 used by a standard examination of our company.
   3) Take measures so that water, oil, and chips do not directly fall on the robot.

The warranty is invalid for any faults that occur when the robot is used under the following conditions.
Also, if the cover and/or other parts are damaged by interferences caused by the peripheral devices and the robot, the protection specification (seal performance, etc.) may be degraded. Therefore, please pay extra attention when handling the robot.
Refer to Page 90, "6.2 Working environment".
   1) In surroundings that generate inflammable gases or corrosive gasses.
   2) Atmosphere used excluding cutting oil shown in Table 2-4
   3) In surroundings where water, oil, and chips fall directly on the robot.
   4) In surroundings where chips fall directly on the robot.In surroundings where the minimum diameter of chips is less than 0.5mm.
   5) Mist atmosphere exceeding the specification.

2.2.6 Clean specifications
(1) Types of clean specifications
The robot arm with clean specification is made by order. Please check the delivery schedule.

Table 2-5 : Clean specifications

Clean specifications	Type	Degree of cleanliness	Internal suction
RV-12SC-SA RV-12SLC-SA	10(0.3 μ m)	Concentrated suction with vaccum generating valve.	The use of a vacuum generating valve is recommended.

Table 2-6 : Specifications of vacuum generation valve

Type	Maker	Air pressure
MEDT 14	Koganei	0.2 to 0.6 MPa

■ Precautions for use

1) When using a device that moves or rotates the robot arm, the down flow may not be secured because of the air flow. In this case, the degree of cleanliness cannot be ensured.

2) A Φ8 coupling is provided in the base section of the robot arm for suction inside the robot arm. When using the robot, connect this coupling with the vacuum generating valve and vacuum pump (furnished by the customer).

＊Install the vacuum generating valve downstream of the downflow or install a filter in the exhaust air section so that the exhaust air from the vacuum generating valve does not affect cleanness.
Recommended filter: Exhaust filter EF300-02, Koganei Corporation

＊If any vacuum pump is prepared by the customer, assure on the vacuum side flow rate 30 liters/min.(ANR) or more .

3) When using the Mitsubishi standard option solenoid valve set, use the spare piping (Φ6 pneumatic hose) of the primary piping to exhaust the air.
If the exhaust leaks into the robot arm, the degree of cleanliness could be affected.

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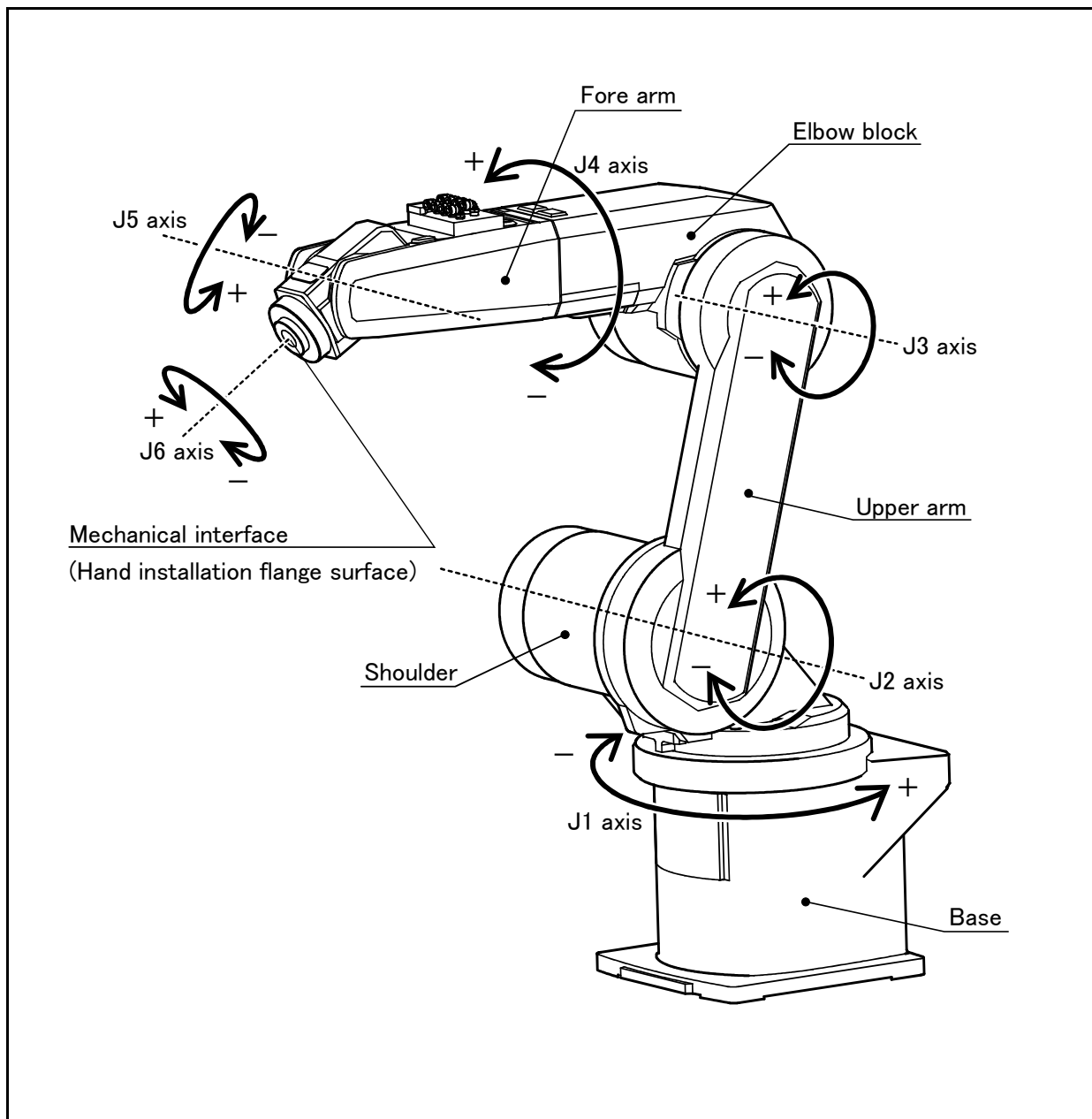
Fig.2-3 : Names of each part of the robot

2.4 Outside dimensions・Operating range diagram
(1) RV-12S/12SC

Fig.2-4 : Outside dimensions : RV-12S/12SC

P-point path: Reverse range (alternate long and short dash line)
P-point path: Entire range (solid line)

Flange downward limit line(dotted line)
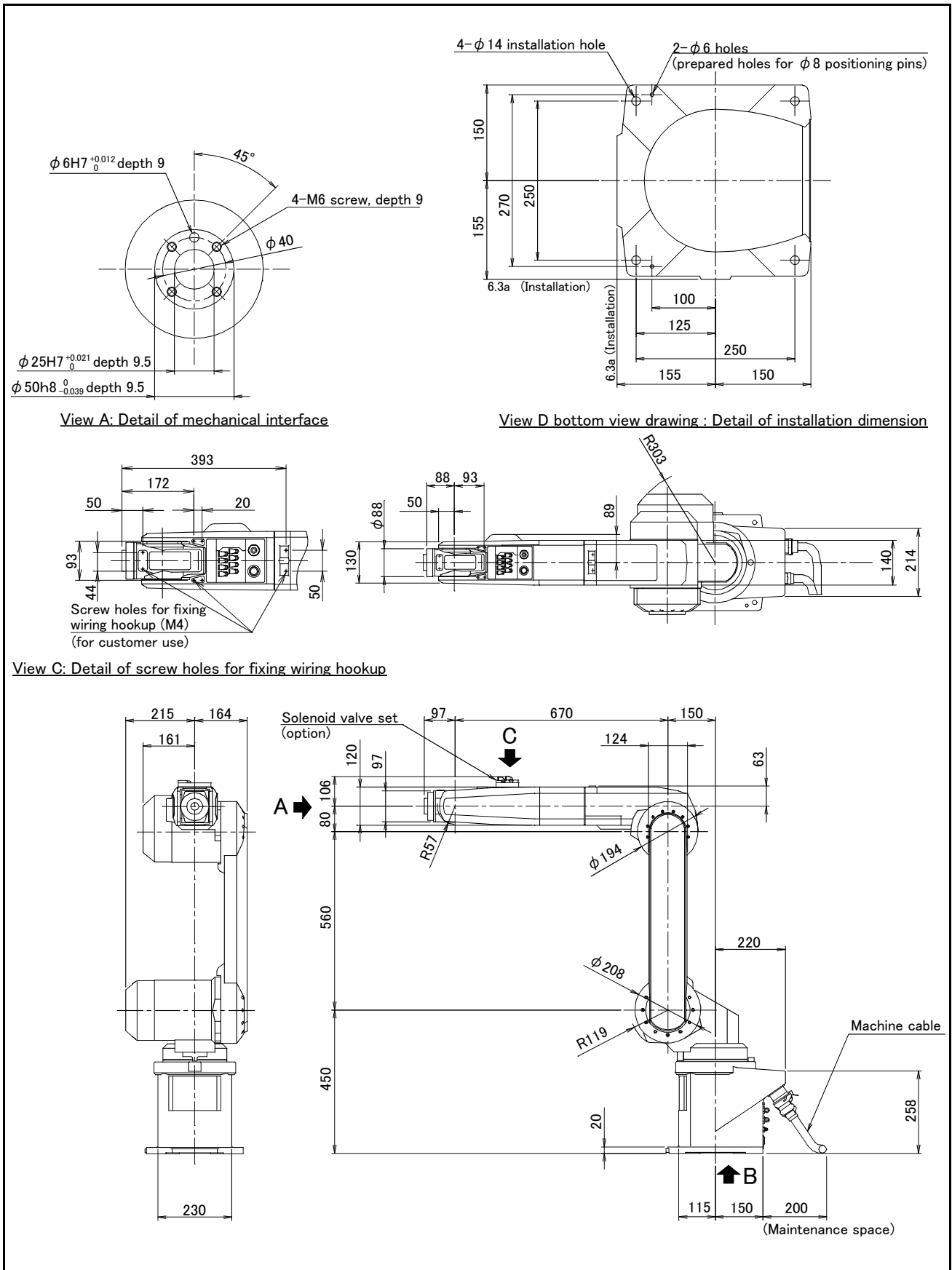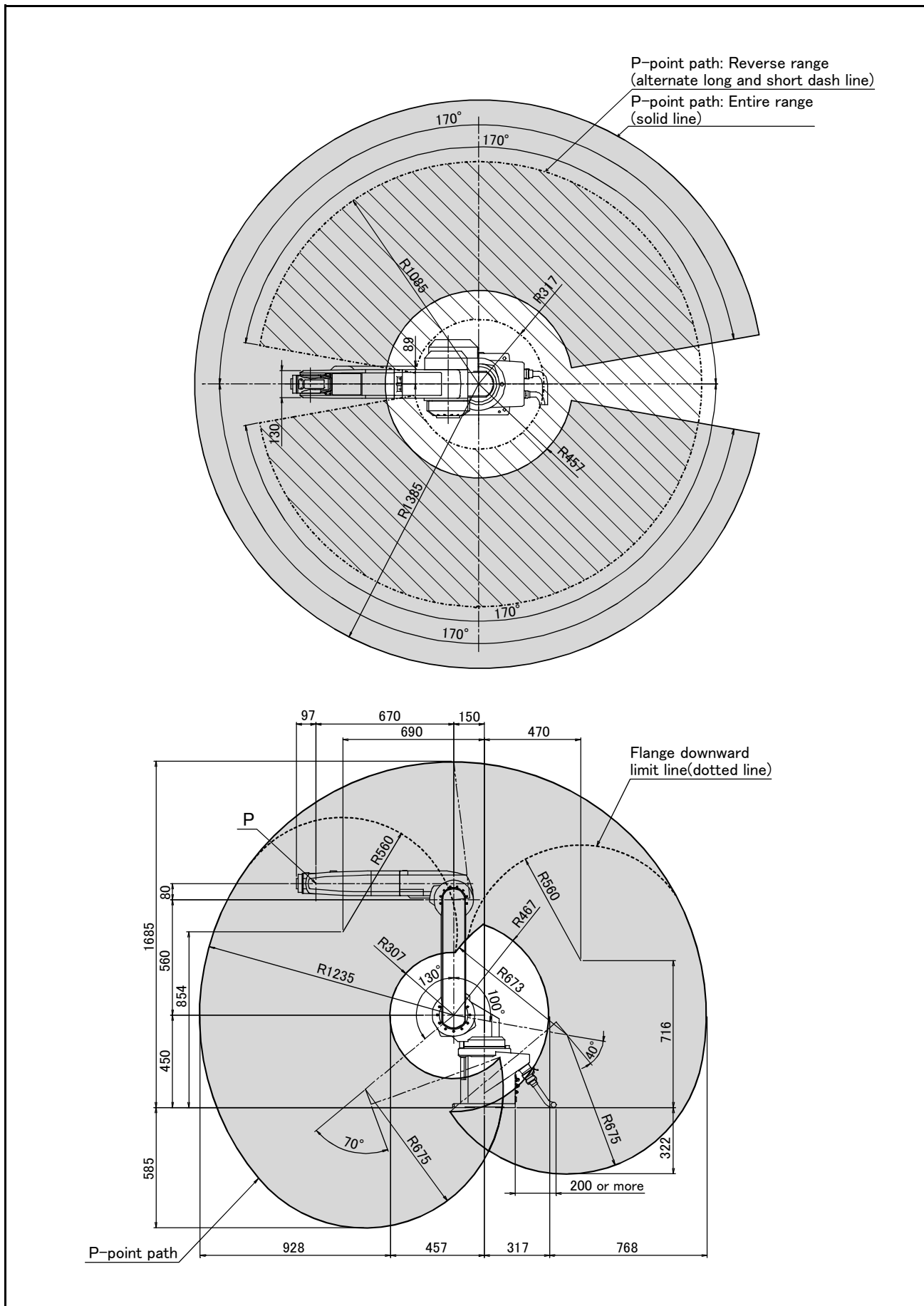
Fig.2-5 : Operating range diagram : RV-12S/12SC

(2) RV-12SL/12SLC

View A: Detail of mechanical interface

View D bottom view drawing : Detail of installation dimension

View C: Detail of screw holes for fixing wiring hookup
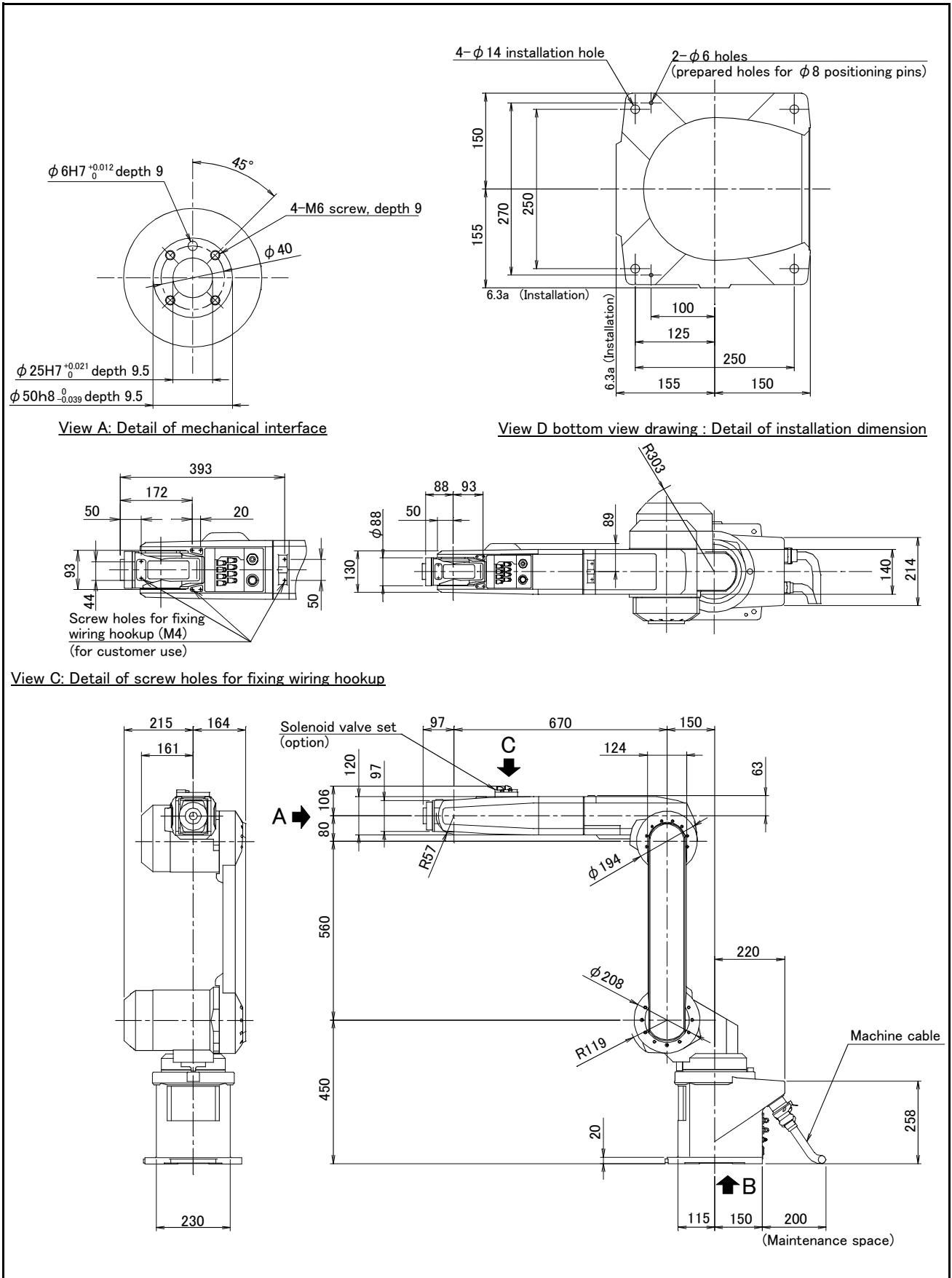
Fig.2-6 : Outside dimensions : RV-12SL/12SLC
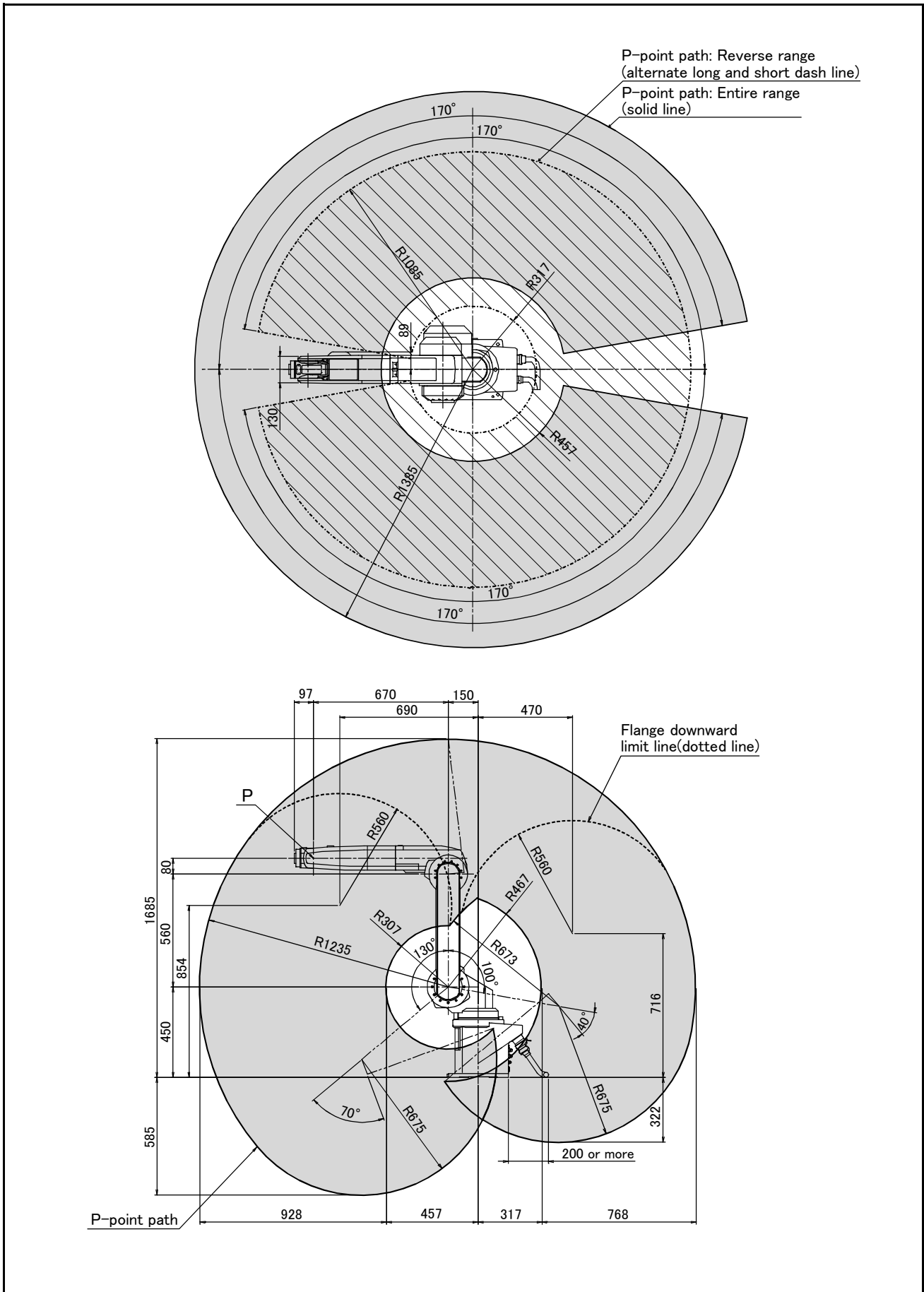
Fig.2-7 : Operating range diagram : RV-12SL/12SLC

2.5 Tooling

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

Connector and pneumatic coupling

No	Name	Qty.	Robot side (Robot arm side)		Counter side (customer-prepared)		Manufacturer
			Connectors, couplings	Connector pins	Connector	Connector pins	
(1)	Coupling	8	KJL06-01S	—	—	—	SMC Corporation
(2)	Coupling	2	UKBL6	—	—	—	Koganei Corporation
(3)	Connector	2	1-1318115-3	1318112-1	1-1318119-3	1318108-1	Tyco Electronics AMP K.K.
(4)	Connector	2	1-1318115-4	1318112-1	1-1318119-4	1318108-1	Tyco Electronics AMP K.K.
(5)	Coupling Note1)	1	UKBL8	—	—	—	Koganei Corporation

Note1) For dust suction in the clean specification

Fig.2-8 : Wiring and piping for hand

2.5.2 Internal air piping
(1) Standard type
1) The robot has two ϕ6 x 4 urethane hoses from the pneumatic entrance on the base section to the shoulder cover.
2) One hose is the primary piping for the pneumatic equipment. The remaining pipe is used for air exhaust.
3) The optional solenoid is provided with a maximum of eight couplings for the ϕ6 air hose.
4) The pneumatic inlet in the base section has a ϕ6 pneumatic coupling bridge.
5) Refer to Page 26, "(1) Solenoid valve set" for details on the electronic valve set (optional).

(2) Clean type
1) The clean type basically includes the same piping as the standard type.
2) With the clean specification, a ϕ8 coupling is provided in the base section for suction inside the machine. For use, connect it to the suction port of the vacuum pump or the coupling on the "VACUUM" side of the vacuum generating valve. Moreover, to clean the exhaust from the vacuum pump or vacuum generator, use the exhaust filter (prepared by the customer). Table 2-7 shows the specifications of the vacuum generating valve.
3) To use the vacuum pump, assure a flow rate of 30 liters/min. or more.
4) Use clean air as the air supplied to the vacuum generator.

Table 2-7 : Vacuum generating valve specifications

Type	Maker	Air pressure
MEDT14	Koganei	0.2 to 0.6 MPa

2.5.3 Internal wiring for the pneumatic hand output cable(Standard type/Clean type)
1) When the controller uses the optional pneumatic hand interface (2A-RZ365), the hand output signal works as the pneumatic hand cable.
2) The hand output primary cable extends from the connector PCB of the base section to the inside of the forearm. (AWG#24($0.2mm^2$)x 2 : 8 cables) The cable terminals have connector bridges for eight hand outputs. The connector names are GR1 to GR8.
To extend the wiring to the outside of the arm, a separate cable (optional "hand output cable 1S-GR35S-01" IP65 is recommended) is required.

2.5.4 Internal wiring for the hand check input cable(Standard type/Clean type)
1) The hand output primary cable extends from the connector PCB of the base section to the inside of the forearm. (AWG#24($0.2mm^2$)x 2 : 8 cables) The cable terminals have connector bridges for eight hand inputs. The connector names are HC1 and HC2. The terminal section is connected to the connector in the forearm section.
2) The hand check signal of the pneumatic hand is input by connecting this connector.
To extend the wiring to the outside of the arm, a separate cable (optional "hand input cable 1S-HC25C-01" IP65 is recommended) is required.

2.5.5 Spare Wiring
(1) Standard type
As spare wiring, three pairs of AWG#28($0.1mm^2$) cab tire cables (total of six cores) are preinstalled between the base section and the forearm side section.
Both ends of the wire terminals are unprocessed. Use them under the following circumstances:
- ● For folding as the hand output cable when installing the solenoid valve in outside the robot.
- ● For when installing six or more hand I/O points for the sensor in the hand section
(Connects to the parallel I/O general purpose input.)

(2) Clean type
As spare wiring, four cables of AWG#22($0.3mm^2$) are preinstalled between the base section and the forearm side section.

2.5.6 Wiring and piping system diagram for hand

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

Hand input signal connection connector
1-1318 119-3
(Tyco Electronics AMP K.K.)

Hand input signal connector
1-1318 115-3
(Tyco Electronics AMP K.K.)

Hand prepared by customer

		White
A1	<+24V>	
A2	<Reserved>	Black
A3	<HC 1>	White
B1	<HC 2>	Black
B2	<HC 3>	White
B3	<HC 4>	Black

Hand input cable (option)

A1	<Reserved>	White
A2	<24G(RG)>	Black
A3	<HC 5>	White
B1	<HC 6>	Black
B2	<HC 7>	White
B3	<HC 8>	Black

Hand input signal connection connector
1-1318 119-4
(Tyco Electronics AMP K.K.)

Hand output signal connector
1-1318 115-4
(Tyco Electronics AMP K.K.)

Hand output cable (option)

A1	<+24V(COM)>	White
A2	<Reserved>	Black
A3	<GR 1>	White
A4	<GR 2>	Black
B1	<GR 3>	White
B2	<GR 4>	Black
B3	<Reserved>	White
B4	<Reserved>	Black

Driving devices, such as solenoid and hand, provided by the customer

A1	<+24V(COM)>	White
A2	<Reserved>	Black
A3	<GR 5>	White
A4	<GR 6>	Black
B1	<GR 7>	White
B2	<GR 8>	Black
B3	<Reserved>	White
B4	<Reserved>	Black

Robot arm wiring relay board

Robot controller

Spare wiring AWG#28(0.1mm²)×6

White
Black
White
Black
White
Black

Hand output cable attached to the solenoid set

φ6 quick coupling (1 to 8)

1
2
3
4
5
6
7
8

Solenoid set (option) valve mounting section

Primary piping pneumatic hoses

φ6 hose — AIR IN
φ6 hose — RETURN

φ6 quick coupling

φ6 quick coupling

Forearm

Base

Secondary pneumatic hose piping (customer-prepared)
φ6 hose

*Refer to Fig. 2-11 for Air supply circuit example.

Fig.2-9 : Wiring and piping system diagram for hand and example the solenoid valve installation(Standard type)
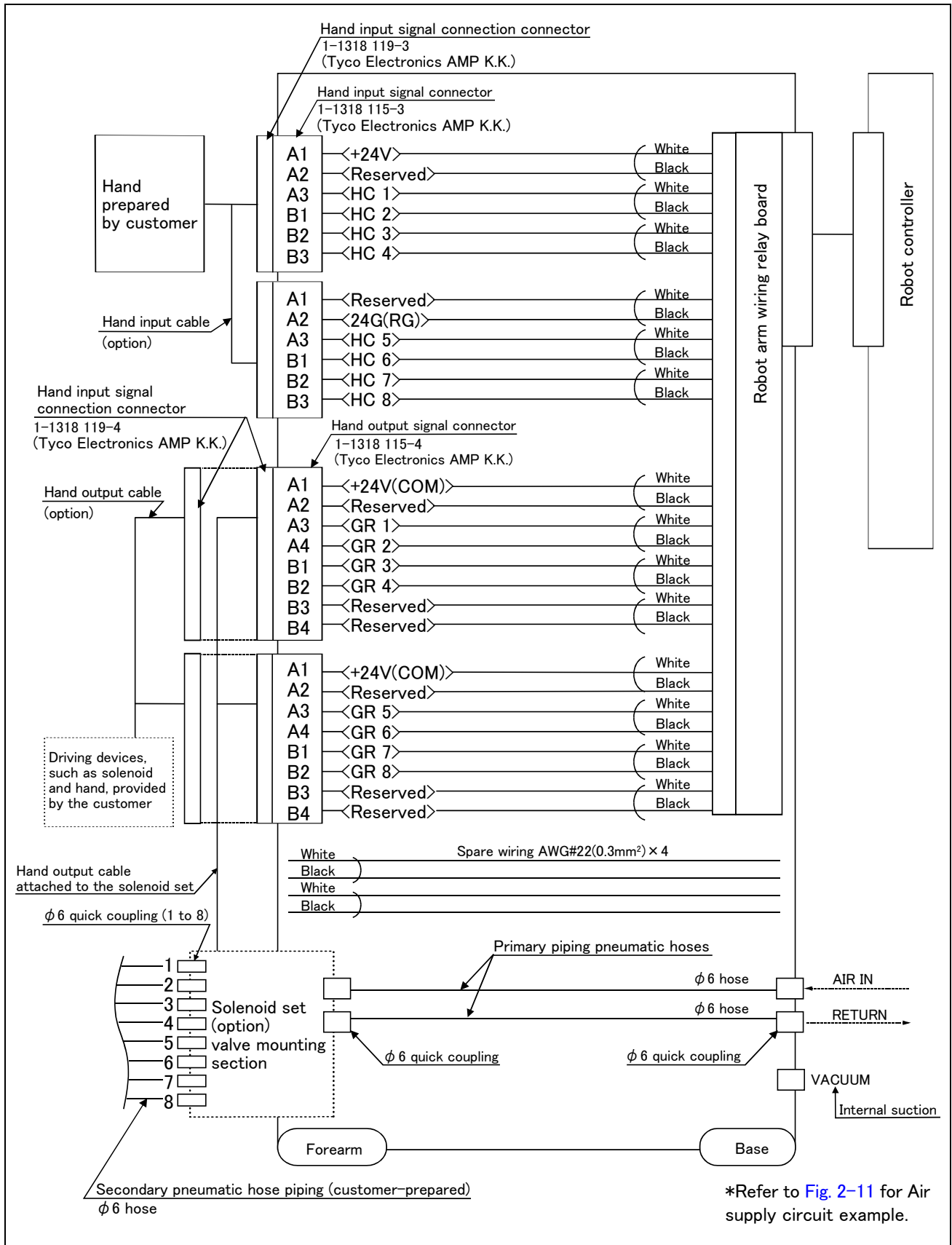
Fig.2-10 : Wiring and piping system diagram for hand and example the solenoid valve installation(Clean type)

2.5.7 Electrical specifications of hand input/output

Table 2-8 : Electrical specifications of input circuit
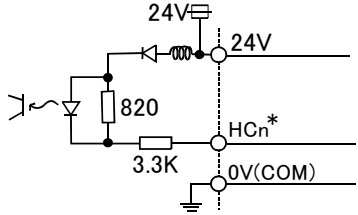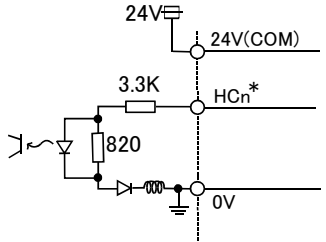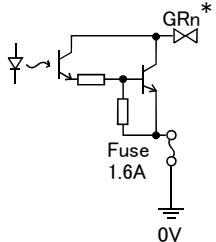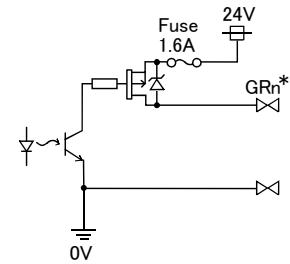
Item		Specifications	Internal circuit
Type		DC input	**\<Sink type\>**
No. of input points		8	
Insulation method		Photo-coupler insulation	
Rated input voltage		12VDC/24VDC	
Rated input current		Approx. 3mA/approx. 7mA	
Working voltage range		DC10.2 to 26.4V(ripple rate within 5%)	
ON voltage/ON current		8VDC or more/2mA or more	
OFF voltage/OFF current		4VDC or less/1mA or less	
Input resistance		Approx. 3.3kΩ	**\<Source type\>**
Response time	OFF-ON	10ms or less(DC24V)	
	ON-OFF	10ms or less(DC24V)	
			* HCn = HC1 ～ HC8

Table 2-9 : Electrical specifications of output circuit

Item		Specification	Internal circuit
Type		Transistor output	**\<Sink type\>**
No. of output points		8	24V
Insulation method		Photo coupler insulation	(Internal power supply)
Rated load voltage		DC24V	
Rated load voltage range		DC21.6 to 26.4VDC	
Max. current load		0.1A/ 1 point (100%)	
Current leak with power OFF		0.1mA or less	
Maximum voltage drop with power ON		DC0.9V(TYP.)	
Response time	OFF-ON	2ms or less (hardware response time)	
	ON-OFF	2 ms or less (resistance load) (hardware response time)	
Fuse rating		1.6A (each one common) Cannot be exchanged	**\<Source type\>**
			* GRn = GR1 ～ GR8

Note) An optional air hand interface (2A-RZ365/RZ375) is required to use hand output.

2.5.8 Air supply circuit example for the hand

Fig. 2-11 shows an example of pneumatic supply circuitry for the hand.

(1) Place diodes parallel to the solenoid coil.

(2) When the factory pneumatic pressure drops, as a result of the hand clamp strength weakening, there can be damage to the work. To prevent it, install a pressure switch to the source of the air as shown in Fig. 2-11 and use the circuit described so that the robot stops when pressure drops. Use a hand with a spring-pressure clamp, or a mechanical lock-type hand, that can be used in cases where the pressure switch becomes damaged.

(3) The optional hand and solenoid valve are of an oilless type. If they are used, don't use any lubricator.
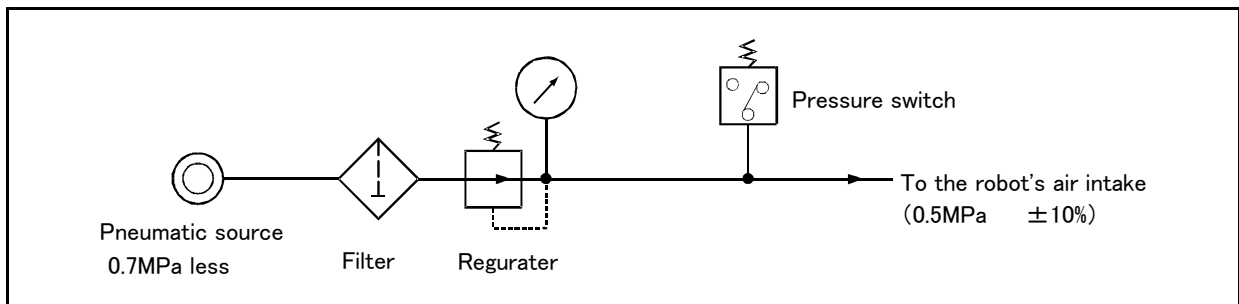
Fig.2-11 : Air supply circuit example for the hand

2.6 Shipping special specifications, options, and maintenance parts

2.6.1 Shipping special specifications

■ What are sipping special specifications?
Shipping special specifications are changed at the time of shipment from the factory. Consequently, customer need to confirm the delivery date.
To make changes to the specifications after shipment, service work must be performed at the work site or the robot must be returned for service.

■ How to order
（1）Confirm beforehand when the factory special specifications can be shipped, because they may not be immediately available.
（2）Order before the factory shipping date.
（3）Specified method ･･････ Specify the part name, model, and robot model type.

(1) Machine cable extension

■ Order type :　　● Fixed type　　　　1S-10CBL-01
　　　　　　　　　● Flexed type　　　　1S-15CBL-01　　Note) The numbers in the boxes □□ refer the length.

■ Outline
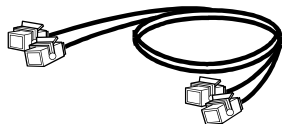
This cable is exchanged with the standard machine cable (5m) accessory to extend the distance between the controller and the robot arm.
A fixed type and flexible type are available.
Exchanges after shipment will be charged (for packaging, shipping costs).
The fixing and flexible types are both configured of the motor signal cable and motor power cable .

■ Configuration
Table 2-10 : Configuration equipments and types

Part name		Type	Qty.	Remarks
Fixed	Set of signal and power cables	1S- □□ CBL-01	1 set	10m, or 15m each
	Motor signal cable	1S- □□ CBL(S)-01	1 cable	
	Motor power cable	1S- □□ CBL(P)-01	1 cable	
Flexed	Set of signal and power cables	1S- □□ LCBL-01	1 set	5m, 10m, or 15m each
	Motor signal cable	1S- □□ LCBL(S)-01	1 cable	
	Motor power cable	1S- □□ LCBL(P)-01	1 cable	
Nylon clamp		NK-24N	2 pcs.	
Nylon clamp		NK-16N	2 pcs.	
Silicon rubber			4 pcs.	

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

■ Specifications
The specifications for the fixed type cables are the same as those for standard cables.
Shows usage conditions for flexed type cables in Table 2-11.

Table 2-11 : Conditions for the flexed type cables

Item		Specifications
Minimum flexed radius		100R or more
Cable bare, etc., occupation rate		50% or less
Maximum movement speed		2000mm/s or less
Guidance of life count		7.5 million times
Environmental proof		Oil-proof specification sheath (for silicon grease, cable sliding lubricant type)
Cable configuration	Motor power cable	ϕ 8.9 x 3 and ϕ 6.5 x 6
	Motor signal cable	ϕ 7 x 6 and ϕ 1.7 x 1

[Caution] The guidance of life count may greatly differ according to the usage state (items related to Table 2-11 and to the amount of silicon grease applied in the cable conduit.
[Caution] This option can be installed on clean-type, but its cleanliness is not under warranty.

■ Cable configuration
The configuration of the flexible cable is shown in Table 2-12. Refer to this table when selecting the cable bare.

Table 2-12 : Cable configuration

Item	Motor signal cable 1S- □□ LCBL(S)-01		Motor power cable 1S- □□ LCBL(P)-01	
No. of cores	AWG#24 (0.2mm^2)-4P	AWG#18 (0.75mm^2)	AWG#16 (1.25mm^2)-4C	AWG#18 (0.75mm^2) -4C
Finish dimensions	Approx. ϕ 7mm	Approx. ϕ 1.7mm	Approx. ϕ 8.9mm	Approx. ϕ 6.5mm
No.of cables used	6 cables	1 cable	3 cable	6 cable
No. in total	7 cables		9 cables	

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

■ Fixing the flexible cable
(1) Connect the connector to the robot arm .
(2) Wind the silicon rubber around the cable at a position 300 to 400 mm from the robot arm and controller as shown in Fig. 2-12, and fix with the nylon clamp to protect the cable from external stress.
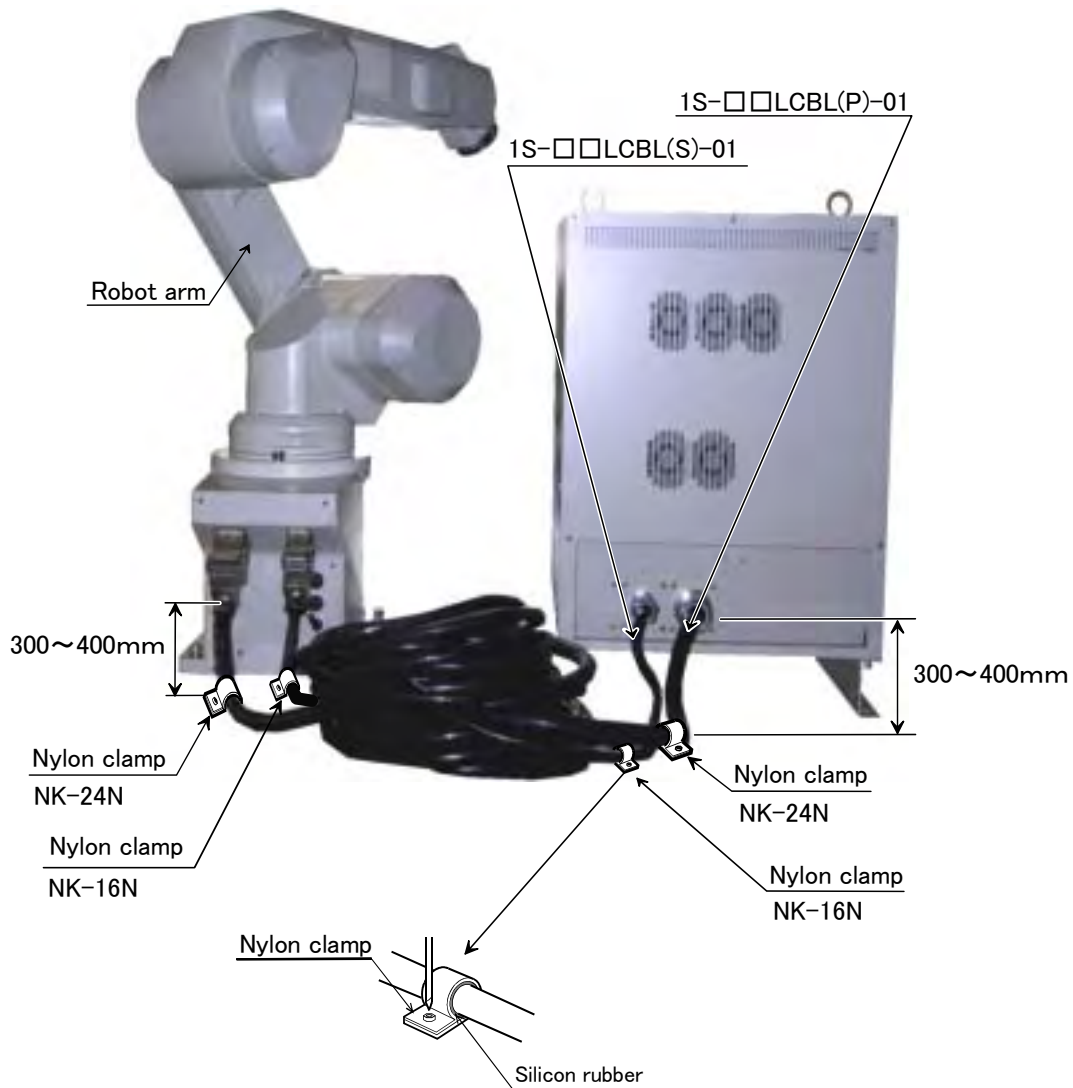
Fig.2-12 : Fixing the flexible cable

2.7 Options

■ What are options?

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

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

(1) Solenoid valve set

■ Order type: One set:　　1S-VD01-01(Sink type)/1S-VD01-01E(Source type)
　　　　　　　Two sets:　　1S-VD02-01(Sink type)/1S-VD02-01E(Source type)
　　　　　　　Three sets:　1S-VD03-01(Sink type)/1S-VD03-01E(Source type)
　　　　　　　Four sets:　　1S-VD04-01(Sink type)/1S-VD04-01E(Source type)

■ Outline
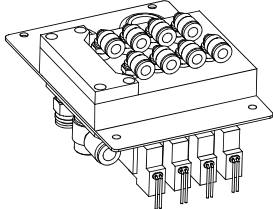
The solenoid valve set is an option that is used for controlling toolings when various toolings, such as the hand, are installed at the end of the arm. All have double solenoid specification, and either one or two or three sets can be selected. This solenoid valve set has a hand output cable attached to the solenoid valve. Also, for easy installation of this electromaagnetic set onto the robot, it comes equipped with a manifold, couplings, silencers, among other things.

When using the robot arm's hand output signal, the pneumatic hand interface option must be installed on the separate controller.

■ Configuration
　Table 2-13 : Configuration equipment

Part name	Type	Q'ty				Remark
		One set	Two sets	Three sets	Four sets	
Solenoid valve set (1 set)	1S-VD01-01/ 1S-VD01-01E	1 pc.	—	—	—	Connecting the Page 29, ″(3) Hand output cable″. M4x25 two screws and M4x10 two screws (Installation screws) 1S-VD01-01/VD02-01/VD03-01/VD04-01 are the sink type. 1S-VD01-01E/VD02-01E/VD03-01E/VD04-01E are the source type.
Solenoid valve set (2 sets)	1S-VD02-01/ 1S-VD02-01E	—	1 pc.	—	—	
Solenoid valve set (3 sets)	1S-VD02-01/ 1S-VD02-01E	—	—	1 pc.	—	
Solenoid valve set (4 sets)	1S-VD02-01/ 1S-VD02-01E	—	—	—	1 pc.	

■ Specifications
　Table 2-14 : Valve specifications

Item	Specifications
Number of positions	2
Port	5
Valve function	Double solenoid
Operating fluid	Clean air
Operating method	Internal pilot method
Effective sectional area (CV value)	0.64mm
Oiling	Unnecessary
Operating pressure range	0.1 to 0.7MPa
Guaranteed proof of pressure	1.0MPa or more
Response time	22msec or less (at 0.5 MPa)
Max. operating frequency	5c/s
Ambient temperature	−5 to 50 ℃ (However, there must be no condensation.)

　Table 2-15 : Solenoid specifications

Item	Specifications
Coil rated voltage	DC24V ± 10%
Power consumption	0.05W
Voltage protection circuit with power surge protection	Diode

Part no.	Part name	1 sets	2 sets	3 sets	4 sets	Specifications
(1)	Solenoid valve	1	2	3	4	
(2)	Manifold block	1	1	1	1	
(3)	Quick coupling	2	4	6	8	$\phi 6$
(4)	Block plate	1	0	0	0	
(5)	Quick coupling	1	1	1	1	$\phi 6$
(6)	Quick coupling	1	1	1	1	$\phi 6$
(10)	Connector	2	4	6	8	SMR-02V-B
(11)	Contact	4	8	12	16	SYM-001T-0.6
(12)	Installation screw	4	4	4	4	M4 × 8

〈Sink type〉

		Connector name	
SOL1A	Black / Red	1 Hand1ON / 2 +24V	GR1
SOL1B	Black / Red	1 Hand1OFF / 2 +24V	GR2
SOL2A	Black / Red	1 Hand2ON / 2 +24V	GR3
SOL2B	Black / Red	1 Hand2OFF / 2 +24V	GR4
SOL3A	Black / Red	1 Hand3ON / 2 +24V	GR5
SOL3B	Black / Red	1 Hand3OFF / 2 +24V	GR6
SOL4A	Black / Red	1 Hand3OFF / 2 +24V	GR7
SOL4B	Black / Red	1 Hand3OFF / 2 +24V	GR8

〈Source type〉

		Connector name	
SOL1A	Black / Red	1 Hand1ON / 2 24G	GR1
SOL1B	Black / Red	1 Hand1OFF / 2 24G	GR2
SOL2A	Black / Red	1 Hand2ON / 2 24G	GR3
SOL2B	Black / Red	1 Hand2OFF / 2 24G	GR4
SOL3A	Black / Red	1 Hand3ON / 2 24G	GR5
SOL3B	Black / Red	1 Hand3OFF / 2 24G	GR6
SOL4A	Black / Red	1 Hand3ON / 2 24G	GR7
SOL4B	Black / Red	1 Hand3OFF / 2 24G	GR8

Fig.2-13 : Outline dimensional drawing

(2) Hand input cable

■ Order type: 1S-HC25C-01

■ Outline
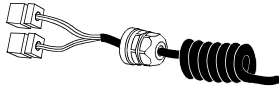
The hand input cable is used for customer-designed pneumatic hands.
It is necessary to use this to receive the hand's open/close confirmation signals and grasping confirmation signals, at the controller.
One end of the cable connects to the connector for hand input signals, which is in the wrist section of the hand. The other end of the cable connects to the sensor inside the hand customer designed.

■ Configuration
Table 2-16 : Configuration equipment

Part name	Type	Qty.	Remarks
Hand input cable	1S-HC25C-01	1 cable	

■ Specifications
Table 2-17 : Specifications

Item	Specifications	Remarks
Size x cable core	AWG#24 (0.2mm^2) × 12	One-sided connector, one-sided cable bridging
Total length	800mm (Including the curl section, which is 300mmlong)	
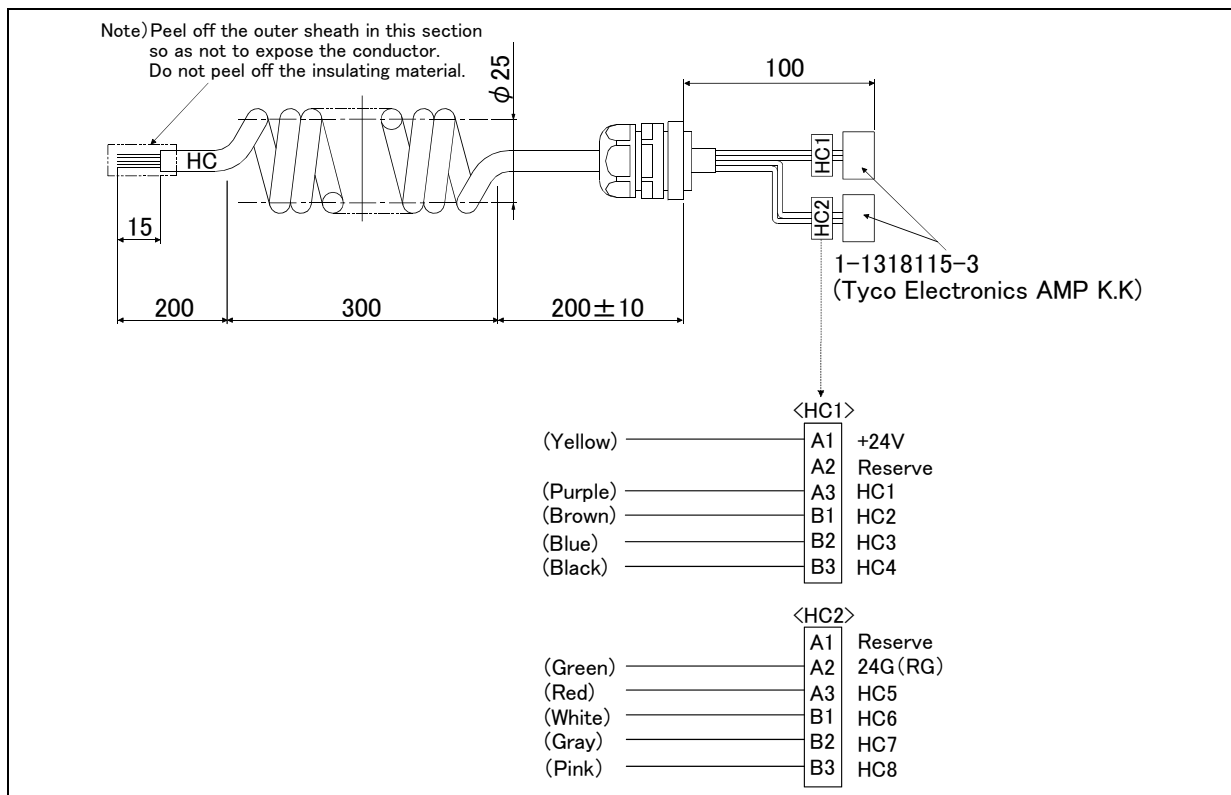
Fig.2-14 : Outside dimensional drawing and pin assignment

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

(3) Hand output cable

■ Order type: Four sets:1S-GR35S-01

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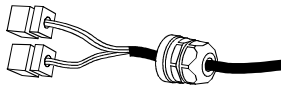
The hand output cable (solenoid valve connection cable) is an option that is used when an solenoid valve other than one of the solenoid valve set options, is used. One end of the cable has a connector that connects to the input terminal inside the robot. The other end of the cable is connected.

■ Configuration
Table 2-18 : Configuration equipment

Part name	Type	Qty.	Remarks
Hand output cable	1S-GR35S-01	1 cable	For four sets

■ Specifications
Table 2-19 : Specifications

Item	Specifications	Remarks
Size x Cable core	AWG#24(0.2mm^2) x 12 cores	One side connector and one side cable connection
Total length	400mm	

Note)Peel off the outer sheath in this section so as not to expose the conductor. Do not peel off the insulating material.

100

GR

15

300

1-1318115-4
(Tyco Electronics AMP K.K)

		Sink type	Source type
⟨GR1⟩			
(Yellow)	A1	+24V (COM)	24G (RG)
	A2	Reserve	Reserve
(Purple)	A3	GR1	GR1
(Brown)	A4	GR2	GR2
(Blue)	B1	GR3	GR3
(Black)	B2	GR4	GR4
	B3	Reserve	Reserve
	B4	Reserve	Reserve
⟨GR2⟩			
(Green)	A1	+24V (COM)	24V (RG)
	A2	Reserve	Reserve
(Red)	A3	GR5	GR5
(White)	A4	GR6	GR6
(Gray)	B1	GR7	GR7
(Pink)	B2	GR8	GR8
	B3	Reserve	Reserve
	B4	Reserve	Reserve

Fig.2-15 : Outline dimensional drawing and pin assignment

(4) Hand curl tube

■ Order type: Four set: :1N-ST0608C

■ Outline

The hand curl tube is a curl tube for the pneumatic hand.
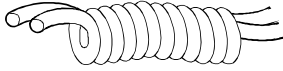
■ Configuration
Table 2-20 : Configuration equipment

Part name	Type	Qty.	Remarks
Hand curl tube (Four set: 8 pcs.)	1N-ST0608C	1 pc.	ϕ6 tube, 8pcs.

■ Specifications
This option can be installed on clean-type, but its cleanliness is not under warranty.

Table 2-21 : Specifications

Item	Specifications
Material	Urethane
Size	Outside diameter: ϕ6 x Inside diameter: ϕ4

| No.	Name	Type	Maker	Q'ty	Remarks
(1)	Curl tube	UT8-06 special	Junkosya Co., Ltd.	1	ϕ6 x 8 tubes
(2)	Insulock tie	T18R	Kyoritsu Dengyo	1	
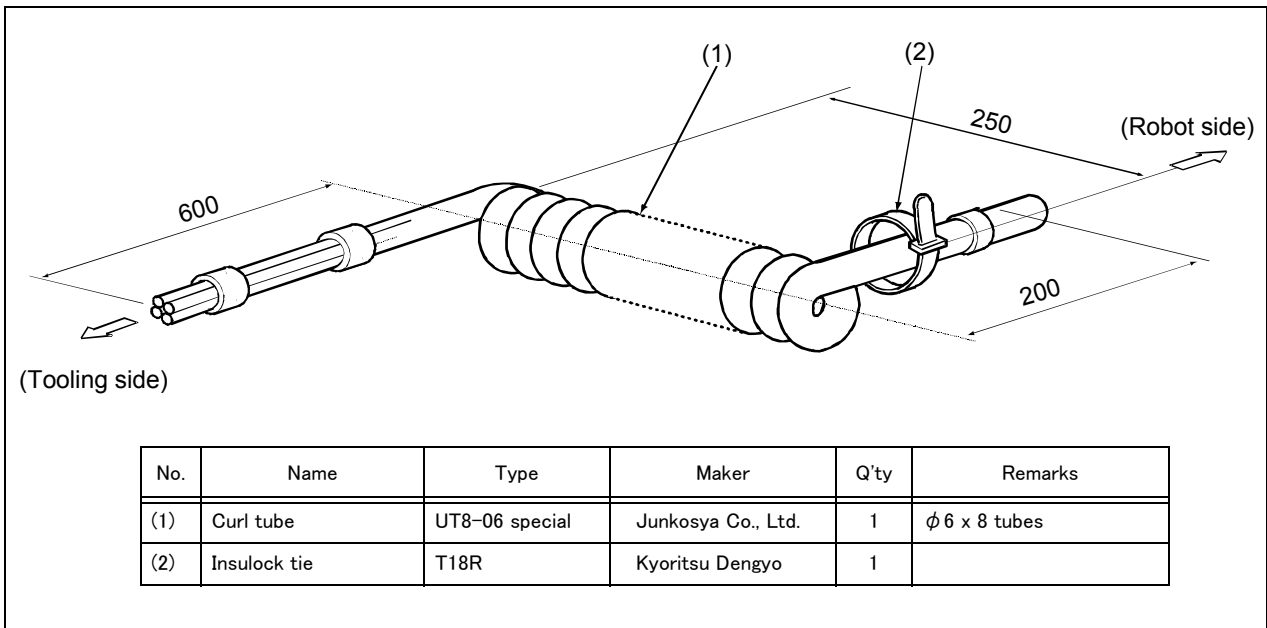
Fig.2-16 : Outline dimensional drawing

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

2.8 Maintenance parts

The consumable parts used in the robot arm are shown in Table 2-22. Purchase these parts from the designated maker or dealer when required. Some Mitsubishi-designated parts differ from the maker's standard parts. Thus, confirm the part name, robot arm and controller serial No. and purchase the parts from the dealer.

Table 2-22 : Consumable part list

No.	Part name	Type	Usage place	Qty.	Supplier
1	Grrase	SK-1A	Reduction gears of each axis	As needed	Mitsubishi Electric System & Service;Co.,Ltd.
2	Lithium battery	A6BAT	In the battery cover	5	

3 Controller

3.1 Standard specifications

3.1.1 Standard specifications

Table 3-1 : Standard specifications of controller

Item		Unit	Specification	Remarks
Type			CR3-535M	
Number of control axis			Simultaneously 6(Maximum)	
CPU			64 bit RISC, and DSP	
Memory capacity	Programmed positions and No. of steps	point step	2,500 5,000	
	Number of programs		88	
Robot language			MELFA-BASIC Ⅳ	
Teaching method			Pose teaching method ,MDI method	
External input and output	input and output	point	32/32	Max. 256/256[Note1)]
	Dedicated input/output	point	Assigned with general-purpose input/output	"STOP" 1 point is fixed
	Hand open/close input/output	point	Input 8 point/Output 0 point	Up to 8 output points can be added as an option[Note2)]
	Emergency stop input	point	1	Dual emergency line
	Door switch input	point	1	Dual door switch line
	Emergency stop output	point	1	Dual emergency line
Interface	RS-232C	port	1	For expansion such as the personal cpmputer, Vision sensor
	RS-422	port	1	Dedicated for T/B
	Hand dedicated slot	slot	1	Dedicated for pneumatic hand interface
	Expansion slot	slot	2	
	Memory expand slot	slot	1	Memory option
	Robot input/output link	channel	1	Used for general-purpose input/output (Max. 256/256)
Power source	Input voltage range	V	3-phase, AC180 to 253	
	Power capacity	KVA	3.0	Does not include rush current Note3) Note4)
Outline dimensions		mm	450(W)x380(D)x625(H)	Excluding protrusions[Note5)]
Mass		kg	Approx. 60	
Construction			Self-contained floor type, Closed type (IP54)	Note6)
Operating temperature range		deg.	0 to 40	
Ambient humidity		%RH	45 to 85	Without dew drops
Grounding		Ω	100 or less	D class grounding earth[Note7)]
Paint color			Light gray	Munsell 0.08GY7.64/0.81

Note1) It is the value when seven maximums expand (224/224) the Parallel I/O unit.
Note2) It is when an pneumatic hand interface (2A-RZ365 or 2A-RZ375) is installed.
Note3) The power capacity (3.0kVA) is the maximum rating value for normal operation. The power capacity does not include the rush current when the power is turned ON. The power capacity is a guideline and the actual operation is affected by the input power voltage. The power consumption in the specific operation pattern with the RV-12S/12SL series is approx. 4.5kw.
Note4) Approximately 7.5 mA of leakage current flows. If a no-fuse circuit breaker is installed on the primary side of the robot, select one with at least 20A and set the leakage current to at least 10 mA.
Note5) Becomes 615(H) at the caster specification.
Note6) This controller exchanges heat using the internal air circulation self-cooling method. Furthermore, the rear side sucks in the outside air and the top and bottom sections of the rear side discharges the inside air. This controller can also be used in the oil-mist environment.
Note7) The robot must be grounded by the customer.

3.1.2 Protection specifications and operating supply

A protection method complying with the IEC Standard IP54(Closed type) is adopted for the controller.

IEC's IP symbols refer only to the degree of protection between the solid and the fluids, and don't indicated that any special protection has been constructed for the prevention against oil and water.

3.2 Names of each part
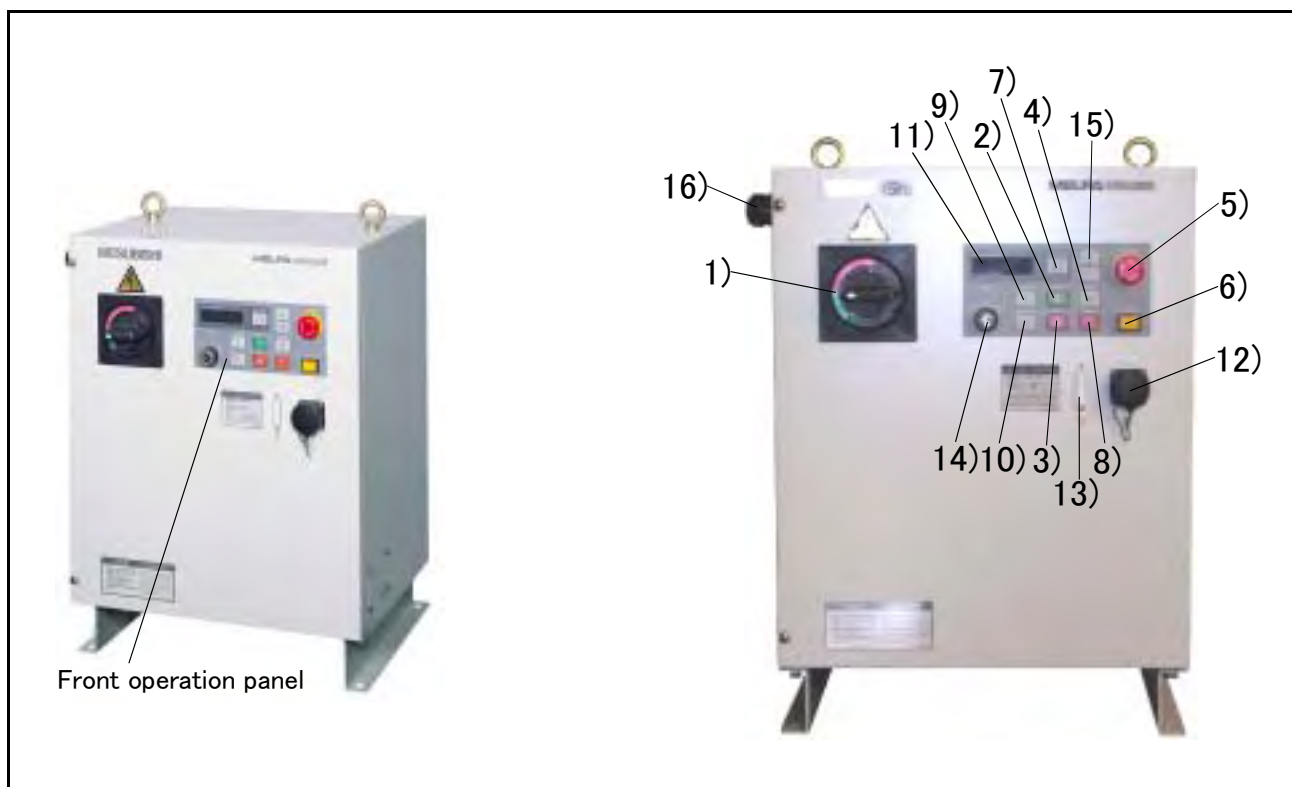
Fig.3-1 : Names of controller parts

1) POWER switch .... This turns the control power ON/OFF. (With earth leakage breaker function)
2) START button .... This executes the program and operates the robot. The program is run continuously.
3) STOP button .... This stops the robot immediately. The servo does not turn OFF.
4) RESET button .... This resets the error. This also resets the program's halted state and resets the program.
5) Emergency stop switch .... This stops the robot in an emergency state. The servo turns OFF.
6) T/B remove switch .... This is used to connect/disconnect the T/B without turning OFF the controller's control power.
7) CHNGDISP button .... This changes the details displayed on the display panel in the order of "Override" → "Program No." → "Line No.".
8) END button .... This stops the program being executed at the last line or END statement.
9) SVO.ON button .... This turns ON the servo power. (The servo turns ON.)
10) SVO.OFF button .... This turns OFF the servo power. (The servo turns OFF.)
11) STATUS NUMBER
   (display panel) .... The alarm No., program No., override value (%), etc., are displayed.
12) T/B connection connector .... This is a dedicated connector for connecting the T/B.
13) Personal computer
   connection connector .... This is an RS-232C specification connector for connecting the personal computer.
14) MODE key switch .... This changes the robot's operation mode. Note)
        AUTO (Op.) .... Only operations from the controller are valid. Operations for which the operation mode must be at the external device or T/B are not possible.
        TEACH .... When the T/B is valid, only operations from the T/B are valid. Operations for which the operation mode must be at the external device or controller are not possible.
        AUTO (Ext.) .... Only operations from the external device are valid. Operations for which the operation mode must be at the T/B or controller are not possible.
15) UP/DOWN button .... This scrolls up or down the details displayed on the "STATUS. NUMBER" display panel.
16) Power cable clamp .... Fix the primary power cable.
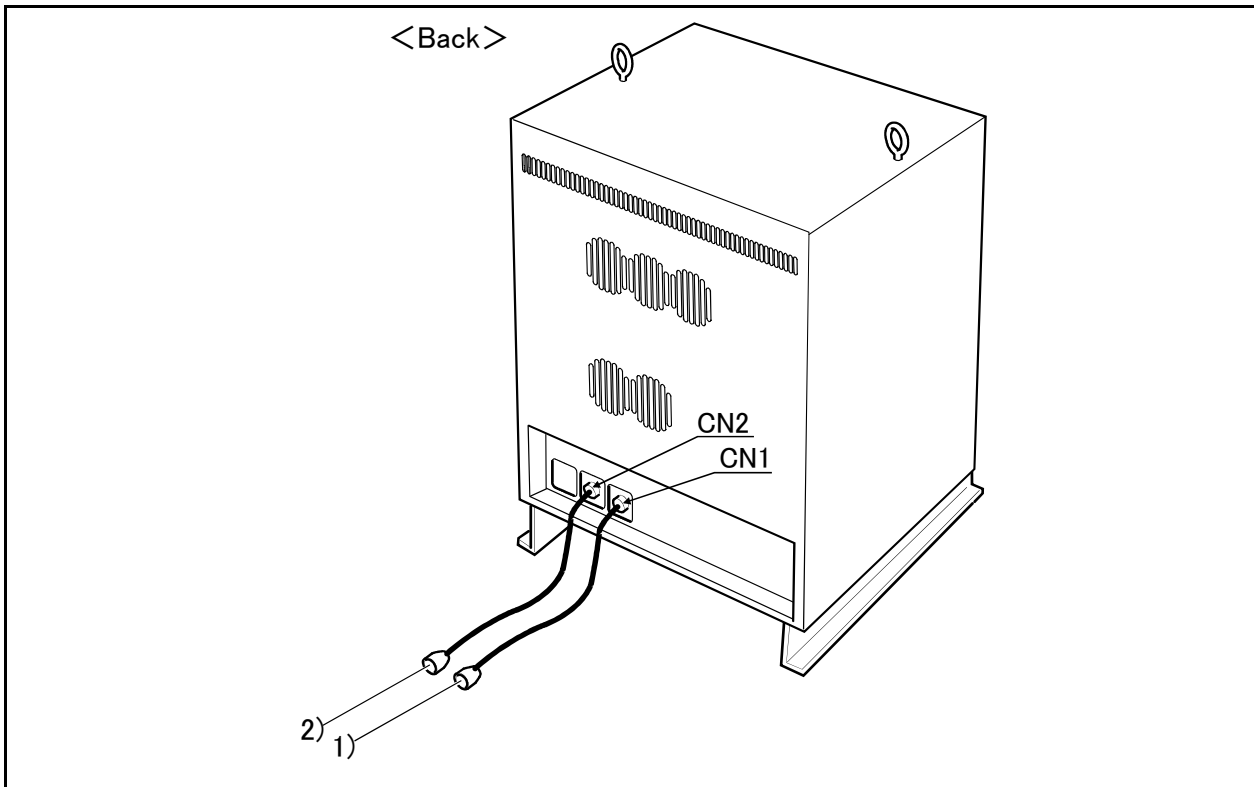
Fig.3-2 : Names of each controller part (Rear side)

1) Machine cable connector (for motor power)………. Connects to the robot arm base. (CN1 connector)
2) Machine cable connector (for motor signals)………. Connects to the robot arm base. (CN2 connector)
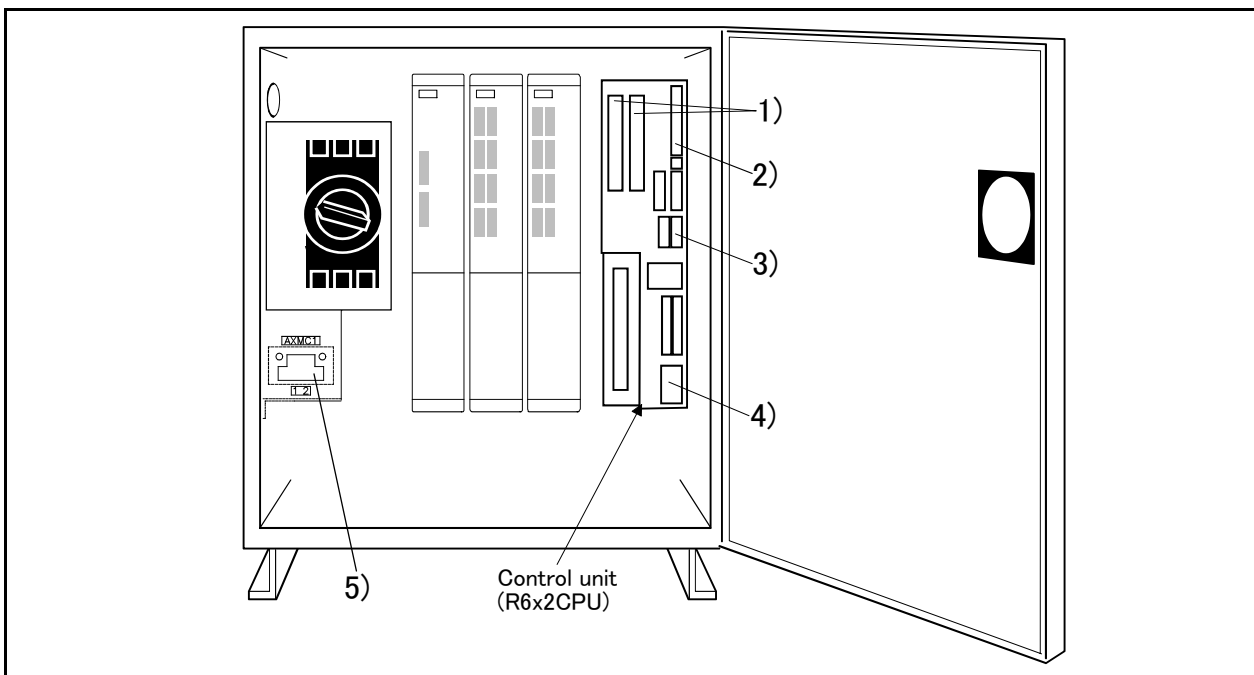
Fig.3-3 : Names of each controller part (interior)

1) External input/output signal connector.
2) Memory cassette entry
3) Network cable connector for parallel I/O unit expansion.
4) Emergency stop switch and door switch terminals.
5) Magnet contactor control connector for additional axis (AXMC1)

3.3 Outside dimensions/Installation dimensions

3.3.1 Outside dimensions

Fig.3-4 : Outside dimensions of controller

<CR3-535M>

(Right side drawing)   (Back drawing)
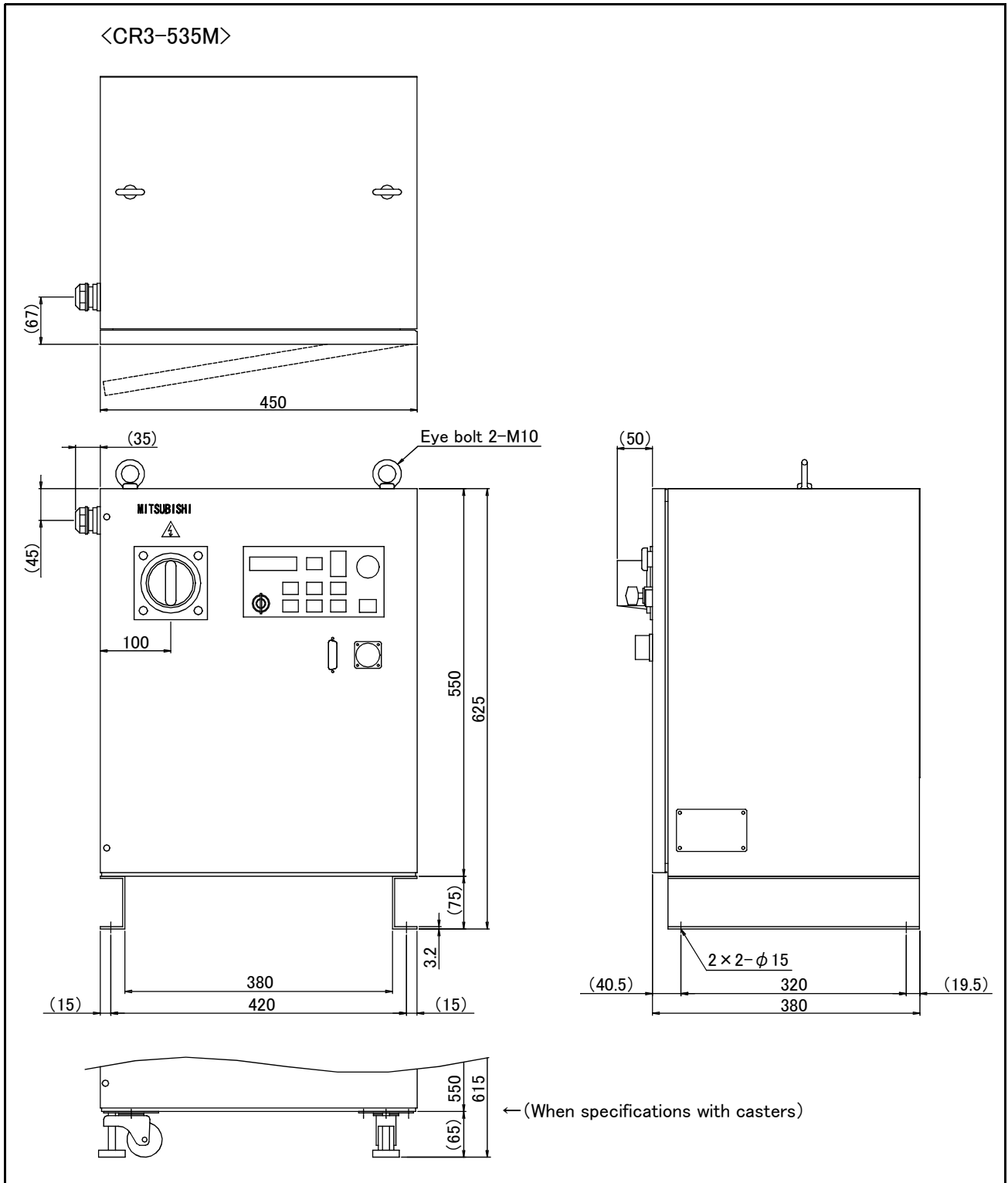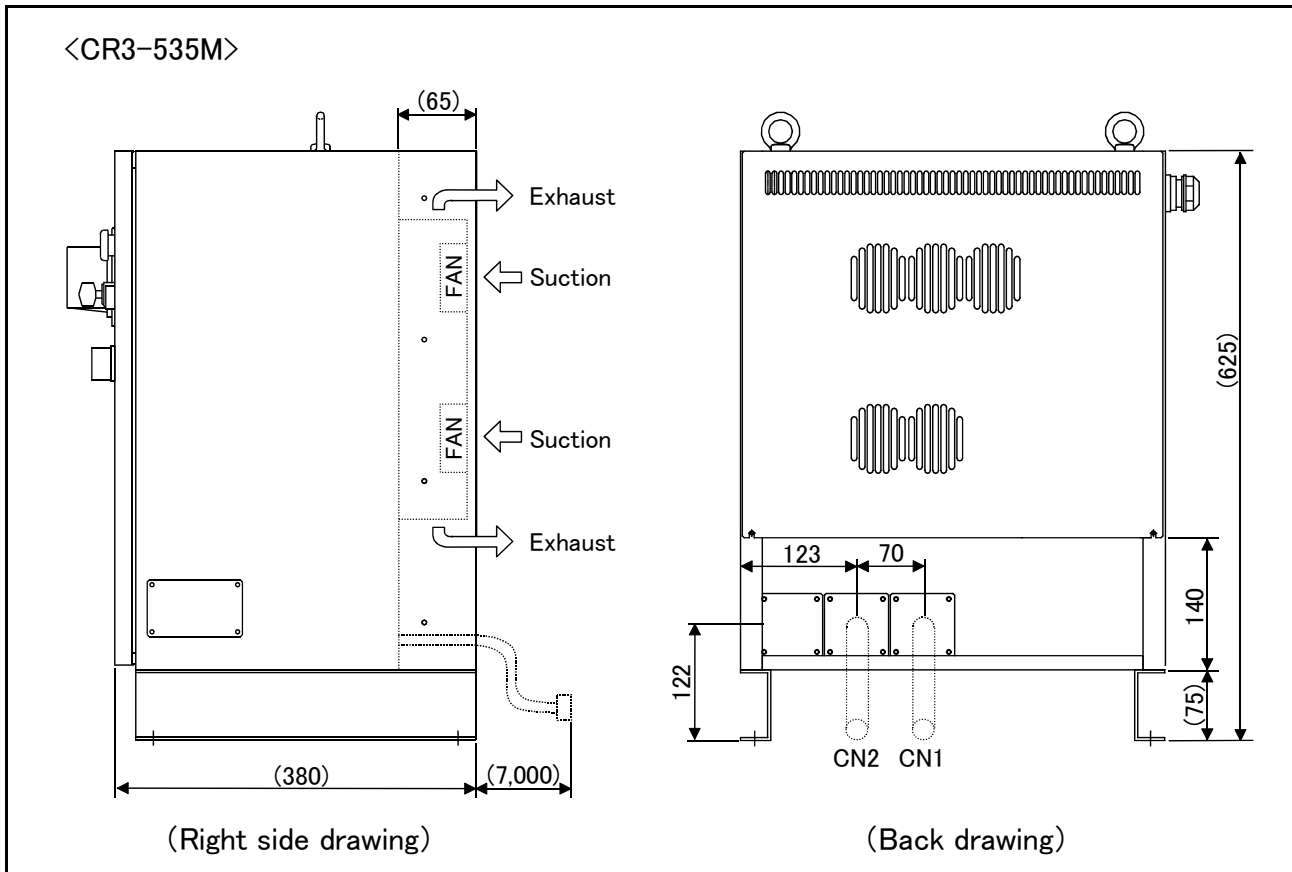
Fig.3-5 : Outside dimensions of controller (Supplement)

3.3.2 Installation dimensions

Note1) The controller sucks in the outside air and discharges the inside air after cooling (Fig. 3-5).
The space required for cooling is 100 mm minimum. Reserve approximately 500 mm of space behind the unit as the maintenance work area.
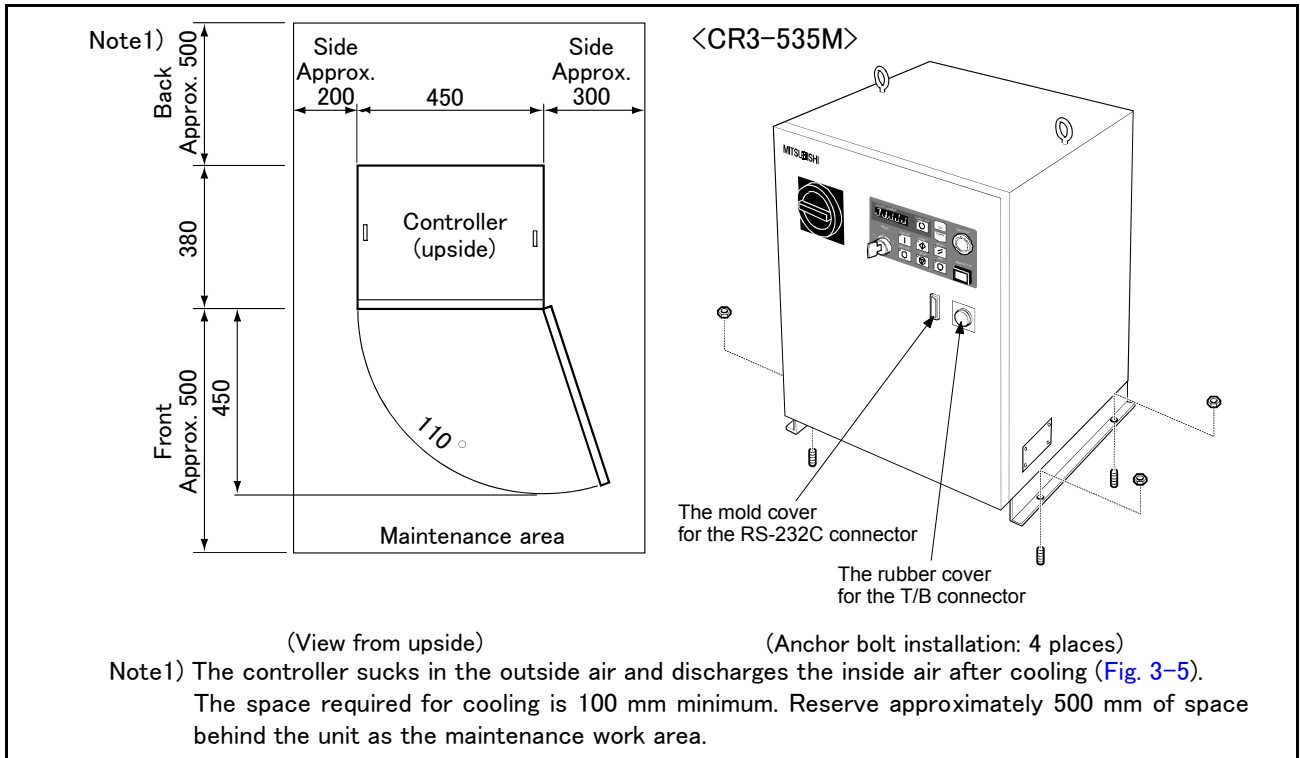
Fig.3-6 : Installation of controller

The controller has the openings (1) to (4) as shown in Fig. 3-7.

Cable lead in port

(1) Left surface input power supply lead-in port
(2) Bottom surface input/output signal lead-in port (with sponge)
(3) Left surface cable outlet
(4) Right surface input/output signal lead-in port
(no sponge, with cabl fixing plate)
・Use (1) to lead in the input power cable.
・Use (2) or (4) to lead in the input/output signal cable.

Fig.3-7 : Cable lead-in ports and dimensions

3.4 External input/output

3.4.1 Types

(1) Dedicated input/output..............................These inputs and outputs carry out the robot remote operation and status display.

(2) General-purpose input/output................These are inputs and outputs that the customer can program for peripheral device control.

(3) Hand input/output.......................................These are inputs and outputs related to the hand that the customer can program. (The hand output is an option. The Page 53, "(2) Pneumatic hand interface" is required.)

Class	Name	No. of input/output points		Connection format
		Input	Output	
Standard	Emergency stop	1	1	Terminal block
Standard	Door switch	1		
Standard	Parallel input/output	Occupies 32 general-purpose points/(6) dedicated points in general-purpose	Occupies 32 general-purpose points/(4) dedicated points in general-purpose	Connector

3.4.2 Explanation

The parallel input/output unit uses connector bridging. Purchase the "External I/O cable" for connection with external devices.

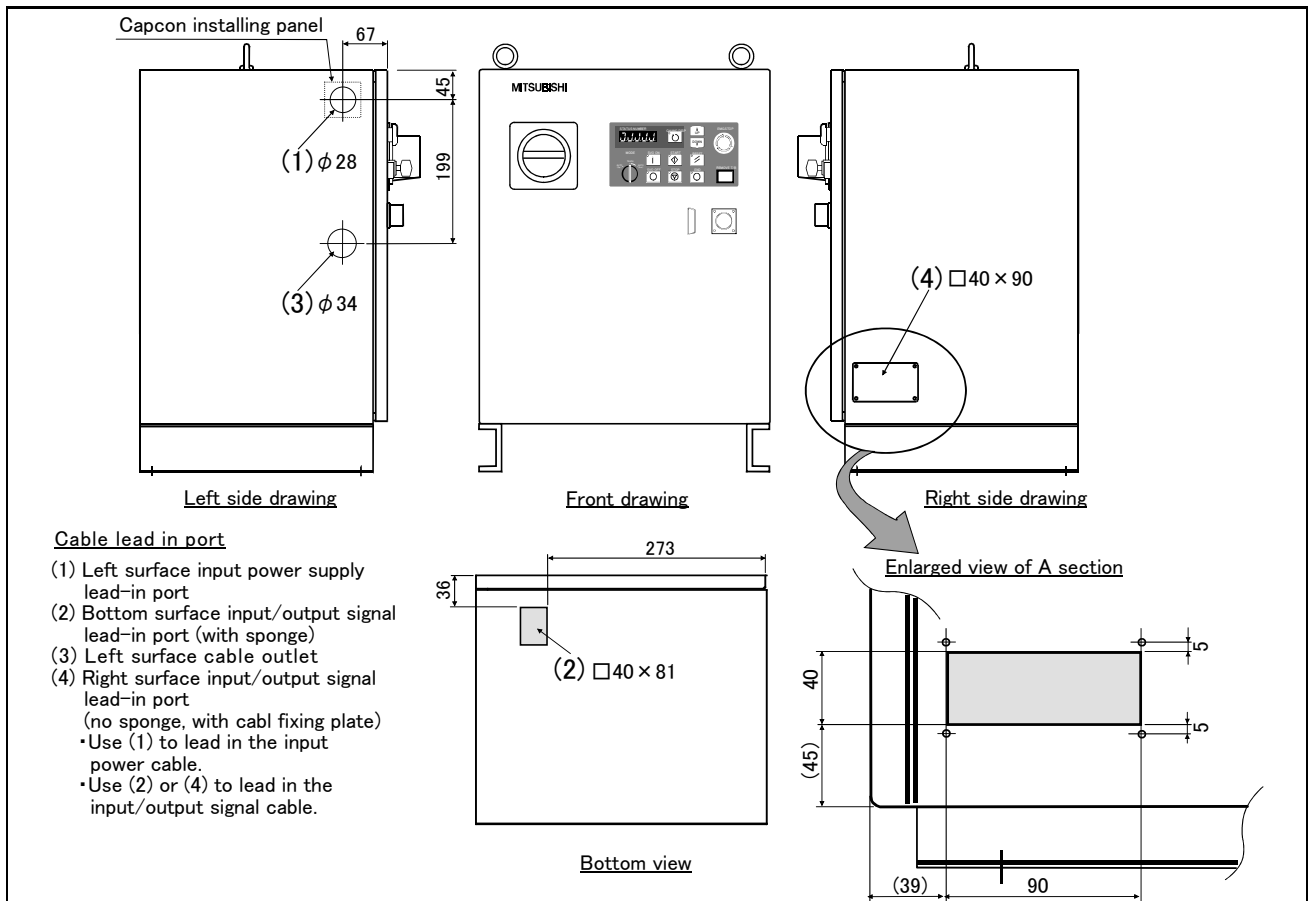The hand output is an option. Refer to Page 53, "(2) Pneumatic hand interface" for details

The parallel input/output unit can be expanded outside of the controller.
The expansion parallel input/output unit is connected with the control unit in the controller using a robot I/O link cable. Parallel input and output units can be expand as an option to seven maximums. With allows up to input 256 points and output 256 points of maximums can be used including 32 points input and 32 points output of standard.

Refer to Page 55, "(3) Parallel I/O unit" for details on the parallel input/output unit.

3.5 Dedicated input/output

Show the main function of dedicated input/output in the Table 3-2. Refer to attached instruction manual "Detailed explanations of functions and operations" in the product for the other functions . Each parameter indicated with the parameter name is used by designated the signal No., assigned in the order of input signal No. and output signal No. If the number of dedicated inputs and general-purpose input points used exceeds the standard No. of input/output points, install the parallel input /output unit (1st to 7th station: option).

Table 3-2 : Dedicated input/output list

Parameter name	Input		Level Note1)	Output	
	Name	Function		Name	Function
TEACHMD	None			Teaching mode output signal	Outputs that the teaching mode is entered.
ATTOPMD	None			Automatic mode output signal	Outputs that the automatic mode is entered.
ATEXTMD	None			Remote mode output signal	Outputs that the remote mode is entered.
RCREADY	None			Controller power ON complete signal	Outputs that external input signals can be received.
AUTOENA	Automatic operation enabled input signal	Allows automatic operation.	L	Automatic operation enabled output signal	Outputs the automatic operation enabled state.
START	Start input signal	Starts all slots.	E	Operating output signal	Outputs that the slot is operating.
STOP	Stop input signal	Stops all slots. The input signal No. is fixed to 0. Note) Use the emergency stop input for stop inputs related to safety.	L	Wait output signal	Outputs that the slot is temporarily stopped.
SLOTINIT	Program reset input signal	Resets the wait state.	E	Program selection enabled output signal	Outputs that the slot is in the program selection enabled state.
ERRRESET	Error reset input signal	Resets the error state.	E	Error occurring output signal	Outputs that an error has occurred.
CYCLE	Cycle stop input signal	Carries out cycle stop.	E	In cycle stop operation output signal	Outputs that the cycle stop is operating.
SRVOFF	Servo ON enabled input signal	Sets all mechanisms to servo ON enabled.	L	Servo ON enabled output signal	Outputs the servo ON enabled state. (Echo back)
SRVON	Servo ON input signal	Turns the servo ON for all mechanisms.	E	In servo ON output signal	Outputs the servo ON state.
IOENA	Operation rights input signal	Requests the operation rights for the external signal control.	L	Operation rights output signal	Outputs the operation rights valid state for the external signal control.
MELOCK	Machine lock input signal	Sets/resets the machine lock state for all mechanisms.	E	In machine lock output signal	Outputs the machine lock state.
SAFEPOS	Evasion point return input signal	Requests the evasion point return operation.	E	In evasion point return output signal	Outputs that the evasion point return is taking place.
OUTRESET	General-purpose output signal reset	Resets the general-purpose output signal.	E	None	
EMGERR	None			Emergency stop output signal	Outputs that an emergency stop has occurred.
S1START : S32START	Start input	Starts each slot.	E	In operation output	Outputs the operating state for each slot.
S1STOP : S32STOP	Stop input	Stops each slot.	L	In wait output	Outputs that each slot is temporarily stopped.
PRGSEL	Program selection input signal	esignates the setting value for the program No. with numeric value input signals.	E	None	
OVRDSEL	Override selection input signal	esignates the setting value for the override with the numeric value input signals.	E	None	

Parameter name	Input		Note1)	Output	
	Name	Function	Level	Name	Function
IODATA Note2)	Numeric value input (start No., end No.)	Used to designate the program name, override value., mechanism value.	L	Numeric value output (start No., end No.)	Used to output the program name, override value., mechanism No.
PRGOUT	Program No. output request	Requests output of the program name.	E	Program No. output signal	Outputs that the program name is being output to the numeric value output signal.
LINEOUT	Line No. output request	Requests output of the line No.	E	Line No. output signal	Outputs that the line No. is being output to the numeric value output signal.
OVRDOUT	Override value output request	Requests the override output.	E	Override value output signal	Outputs that the override value is being output to the numeric value output signal.
ERROUT	Error No. output request	Requests the error No. output.	E	Error No. output signal	Outputs that the error No. is being output to the numeric value output signal.
JOGENA	Jog valid input signal	Validates jog operation with the external signals	E	Jog valid output signal	Outputs that the jog operation with external signals is valid.
JOGM	Jog mode input 2-bit	Designates the jog mode.	L	Jog mode output 2-bit	Outputs the current jog mode.
JOG+	Jog feed + side for 8-axes	Requests the + side jog operation.	L	None	
JOG-	Jog feed - side for 8-axes	Requests the - side jog operation.	L	None	
HNDCNTL1 : HNDCNTL3	None			Mechanism 1 hand output signal status : Mechanism 3 hand output signal status	Mechanism 1: Outputs the status of general-purpose outputs 900 to 907. Mechanism 2: Outputs the status of general-purpose outputs 910 to 917. Mechanism 3: Outputs the status of general-purpose outputs 920 to 927.
HNDSTS1 : HNDSTS3	None			Mechanism 1 hand input signal status : Mechanism 3 hand input signal status	Mechanism 1: Outputs the status of hand inputs 900 to 907. Mechanism 2: Outputs the status of hand inputs 910 to 917. Mechanism 3: Outputs the status of hand inputs 920 to 927.
HNDERR1 : HNDERR3	Mechanism 1 hand error input signal : Mechanism 3 hand error input signal	Requests the hand error occurrence.	L	Mechanism 1 hand error output signal : Mechanism 3 hand error output signal	Outputs that a hand error is occurring.
AIRERR1 : AIRERR3	Pneumatic pressure error 1 input signal : Pneumatic pressure error 3 input signal	Request the pneumatic pressure error occurrence.	L	Pneumatic pressure error 1 output signal. : Pneumatic pressure error 3 output signal.	Outputs that a pneumatic pressure error is occurring.
M1PTEXC : M3PTEXC	None		L	Maintenance parts replacement time warning signal	Outputs that the maintenance parts have reached the replacement time.
USER-AREA Note3)	None			User-designated area 8-points	Outputs that the robot is in the user-designated area.

Note1) The level indicates the signal level.

       L: Level signal → The designated function is validated when the signal is ON, and is invalidated when the signal is OFF.

       E: Edge signal → The designated function is validated when the signal changes from the OFF to ON state, and the function maintains the original state even when the signal then turns OFF.

Note2) Four elements are set in the order of input signal start No., end No., output signal start No. and end No.

Note3) Up to eight points can be set successively in order of start output signal No. and end output signal No.

3.6 Emergency stop input/output

Input from the "emergency stop input" terminal, which is located inside the CR3-535M controller, or on the rear of the CR2B-572 controller.

Table 3-3 : Dedicated input terminals in controller

Class	Name	Details
Input	Emergency stop	Applies the emergency stop (Dual emergency line.)
Input	Door switch	The servo turns OFF.
Output	Emergency stop	This output indicates that the emergency stop input or the door switch input is turned on.

3.6.1 Connection of the external emergency stop

The external emergency stop input and door switch input are short-circuited with a short cable at shipment as shown in Fig. 3-8.
Connect the external emergency stop switch and door switch with the following procedure.

1) Prepare the "emergency stop switch" and "door switch".
2) Remove the two short pieces 1 and 2.
3) Securely connect the external emergency stop's contacts across "1)-2), and the door switch's contacts across 3)-4)" on the terminal block.

[Caution] When wiring the emergency stop switch (duble emergency line type), wire both contacts to the two terminal blocks on the controller. If both contacts are wired to only one of the terminal blocks, errors cannot be cancelled using the door switch.
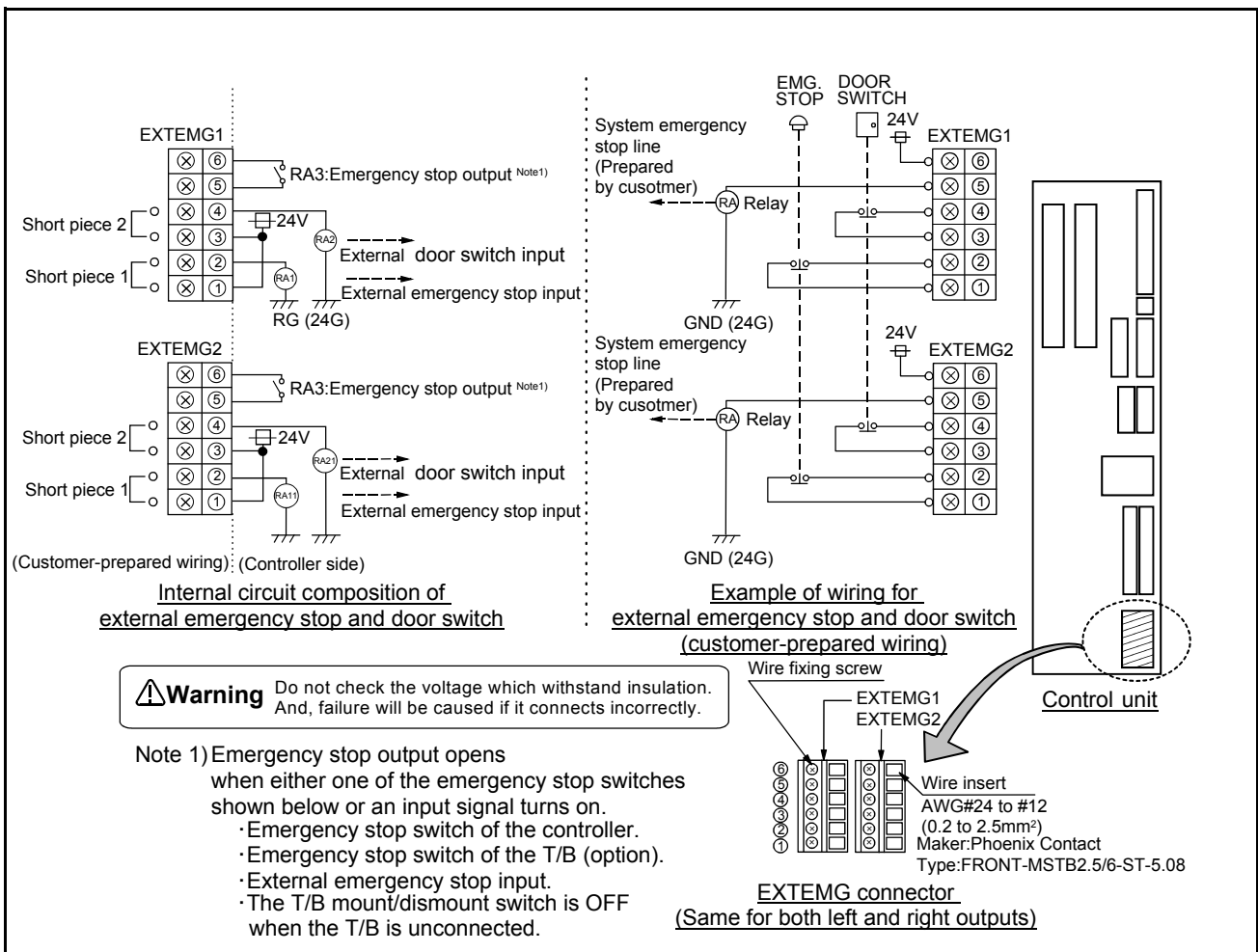

Fig.3-8 : Connection of the external emergency stop

[Note] Refer to Page 88, "6.1.7 Examples of safety measures" together, and carry out wiring to the emergency stop.

3.6.2 Door switch function

This function retrieves the status of the switch installed on the door of the safety fence, etc., and stops the robot when the door is opened. This differs from an emergency stop in that the servo turns OFF when the door is opened and an error does not occur. Follow the wiring example shown in Fig. 3-8, and wire so that the contact closes when the door is closed. Details of this function according to the robot status are shown below.

• During automatic operation ....When the door is opened, the servo turns OFF and the robot stops. An error occurs.
The process of the restoration : Close the door, reset the alarm, turn on the servo, and restart
• During teaching ....Even when the door is opened, the servo can be turned ON and the robot moved using the teaching pendant.
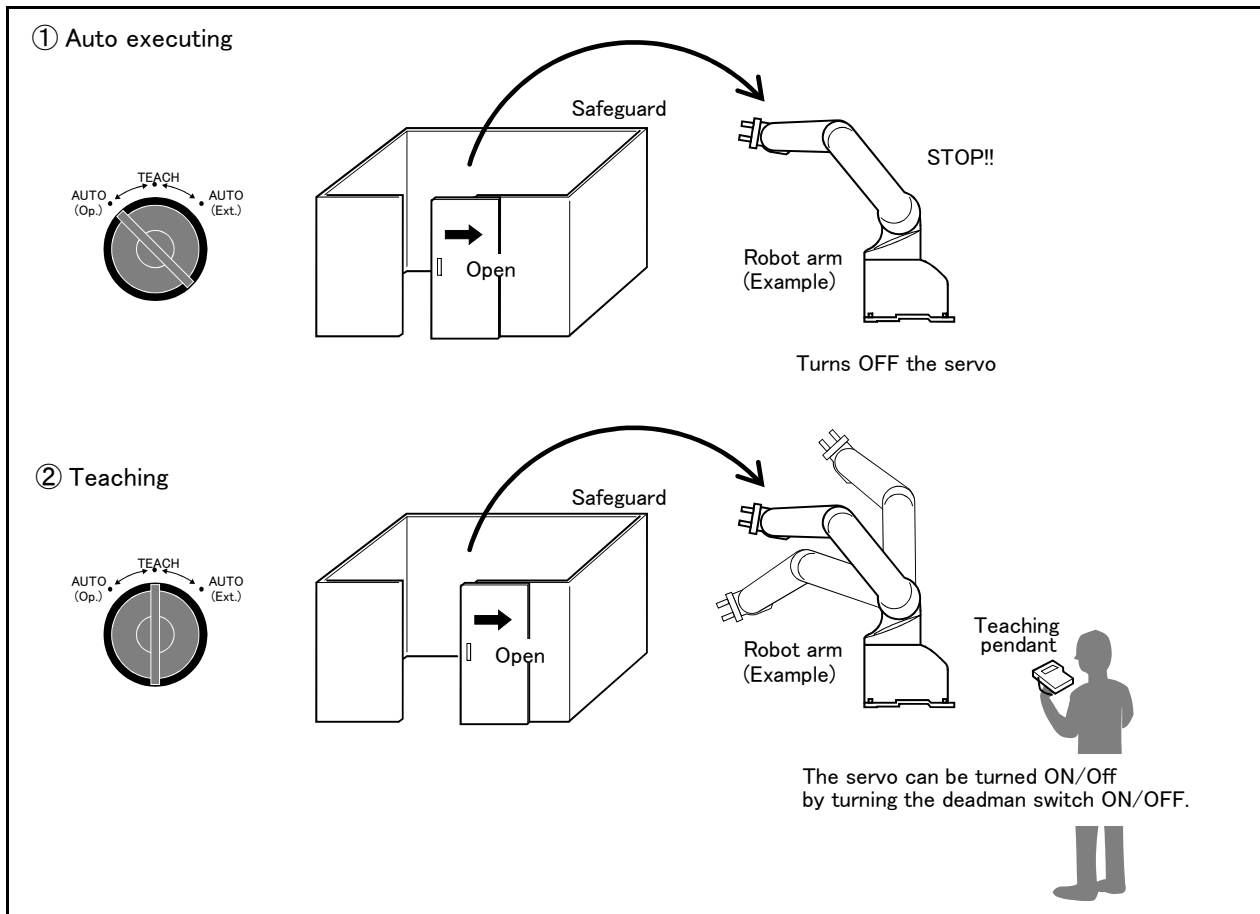

Fig.3-9 : Door switch function

3.7 Additional Axis Function

This controller is equipped with an additional axis interface for controlling an additional axis when a traveling axis or rotary table is added to the robot. A maximum of eight axes of servo motors can be controlled at the same time by connecting a general-purpose servo amplifier (MR-J2S-B, MR-J2M series) that supports Mitsubishi's SSC Net.
Refer to the separate "Additional axis interface Instruction Manual" for details on the additional axis function.

3.7.1 Wiring of the Additional Axis Interface

Table 3-4 shows the connectors for additional axes inside the controller and Fig. 3-5 shows a connection example (configuration example). The magnet contactor control connector for additional axes, AXMC1, is designed to accommodate circuit connection with improved safety in Mitsubishi's industrial robot systems connecting additional axes. Please implement the appropriate circuit connection by refere to Page 45, "3.8 Magnet contactor control connector output (AXMC) for addition axes".

Table 3-4 : Dedicated Connectors inside the Controller

Name	Connector name	Details
Connector for additional axes	CN1B [Note1)]	This connector is used to connect between general-purpose servo amplifiers and the controller.
Magnet contactor control connector for additional axes	AXMC1	This contact output is used to turn ON/OFF the motor power by connecting to general-purpose servo amplifiers.

Note1) The CN1A connector has already been in use.
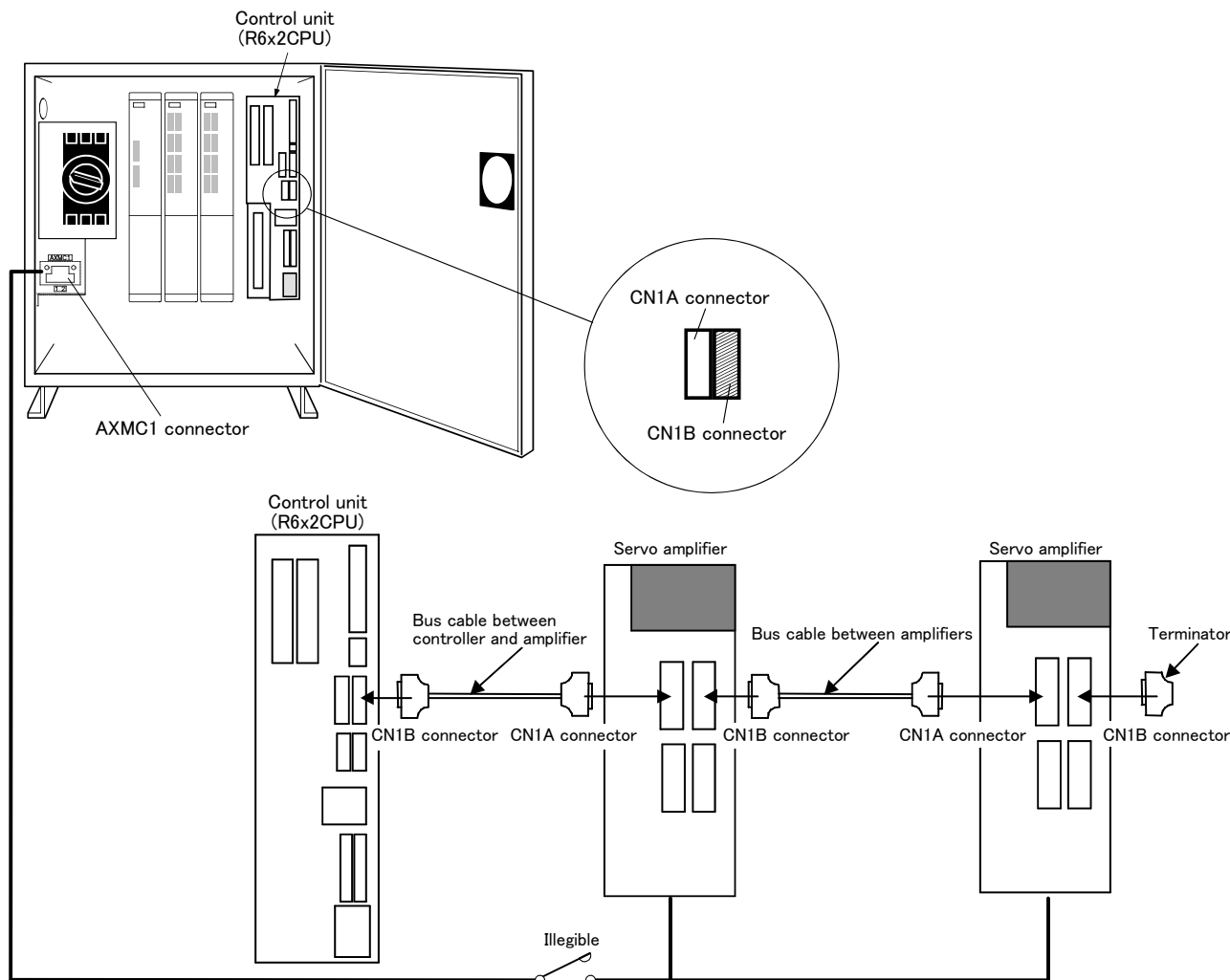
Table 3-5 : Connection Example of Additional Axis Interface Connection (Configuration Example)

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

When an additional axis is used, the servo ON/OFF status of the additional axis can be synchronized with the servo ON/OFF status of the robot itself by using the output contact (AXMC1) provided on the inside of the controller and configuring a circuit so that the power to the servo amplifier for the additional axis can be turned off when this output is open. Fig. 3-10 shows an example of its circuit, and and Fig. 3-11 show the layout drawings of the output contact (AXMC1). When you are using an additional axis, please perform appropriate circuit connections by referring to these drawings.

Refer to Page 44, "3.7 Additional Axis Function" for details.

Fig.3-10 : Example of circuit for addition axes of Magnet contactor control output

Fig.3-11 : Arrangement figure of the AXMC1 connector

3.9 Parallel input/output unit

- A parallel input/output unit is mounted as a standard in the controller's control unit.
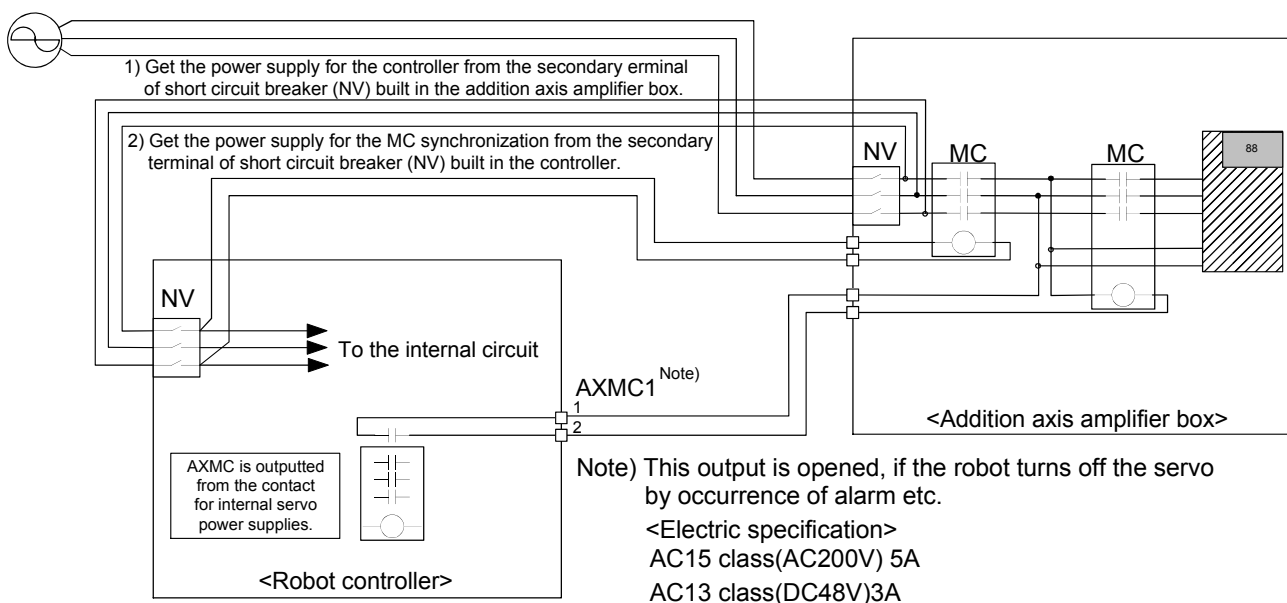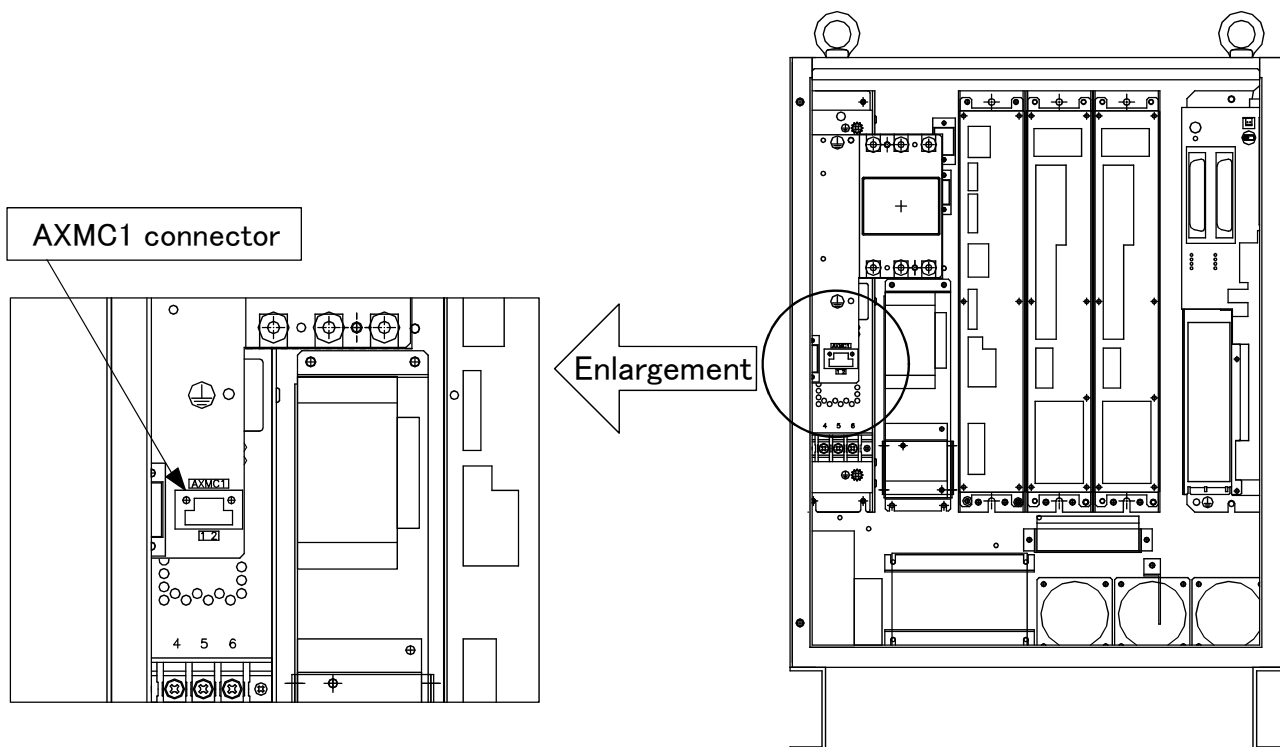- The external input/output circuit specifications are shown in Table 3-6 and Table 3-7.
- The correspondence of the external input/output connector pin No. and the colors of the connected "external input/output cable" wires (separate option) is as shown in Page 48, "Table 3-8" and Table 3-9. Refer to Page 63, "(4) External I/O cable" for details of external I/O cable.
- Pin Nos. described as both general-purpose signal and dedicated signal can be shared.
- The other dedicated input/output signals that are not assigned can be assigned to required general-purpose input/output pins when creating the program.
- If the standard inputs and outputs are insufficient, install the parallel input/output unit connection option outside the controller.

Table 3-6 : Electrical specifications of input circuit

Item		Specifications	Internal circuit
Type		DC input	⟨Sink type⟩
No. of input points		32	
Insulation method		Photo-coupler insulation	
Rated input voltage		12VDC/24VDC	
Rated input current		Approx. 3mA/approx. 7mA	
Working voltage range		10.2VDC to 26.4VDC(ripple rate within 5%)	
ON voltage/ON current		8VDC or more/2mA or more	
OFF voltage/OFF current		4VDC or less/1mA or less	
Input resistance		Approx. 3.3kΩ	
Response time	OFF-ON	10ms or less(DC24V)	
	ON-OFF	10ms or less(DC24V)	⟨Source type⟩
Common method		8 points per common	
External wire connection method		Connector	

Table 3-7 : Electrical specifications of output circuit

Item		Specifications	Internal circuit
Type		Transistor output	⟨Sink type⟩
No. of output points		32	
Insulation method		Photo-coupler insulation	
Rated load voltage		DC12V/DC24V	
Rated load voltage range		DC10.2 ～ 30V(peak voltage 30VDC)	
Max. load current		0.1A/point (100%)	
Leakage current at OFF		0.1mA or less	
Max. voltage drop at ON		DC0.9V(TYP.)	
Response time	OFF-ON	2ms or less (hardware response time)	
	ON-OFF	2ms or less (Resistance load) (hardware response time)	⟨Source type⟩
Fuse rating		Fuse 3.2A (one per common) Replacement not possible	
Common method		4 points per common (common terminal: 4 points)	
External wire connection method		Connector	
External power supply	Voltage	DC12/24V(DC10.2 ～ 30V)	
	Current	60mA (TYP. 24VDC per common) (base drive current)	

[Caution] When connecting the phototransistor output to the input circuit, be sure to allocate an input current of approximately 7 mA at 24 VDC. Especially when using a photo diode and a phototransistor (sensor) away from each other, it is recommended to verify the current that can be carried in the design stage.

Fig.3-12 : Connection with a Mitsubishi PLC (Example of sink type)
*The input/output circuit external power supply (24 VDC) must be prepared by the customer.

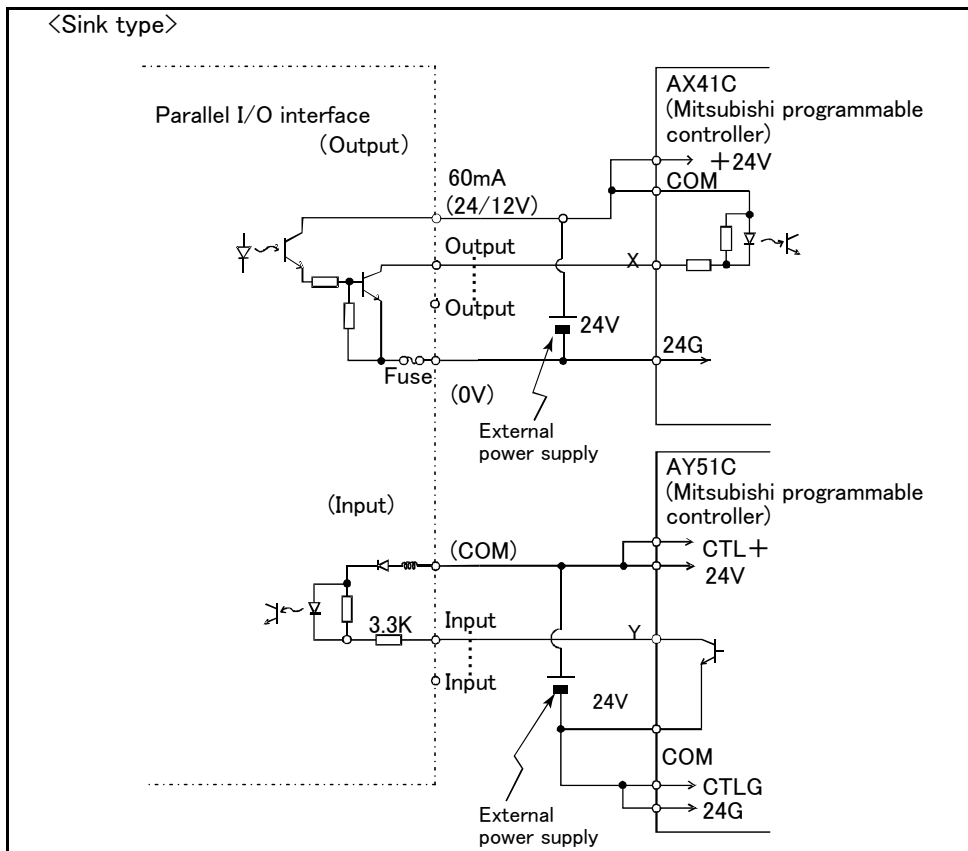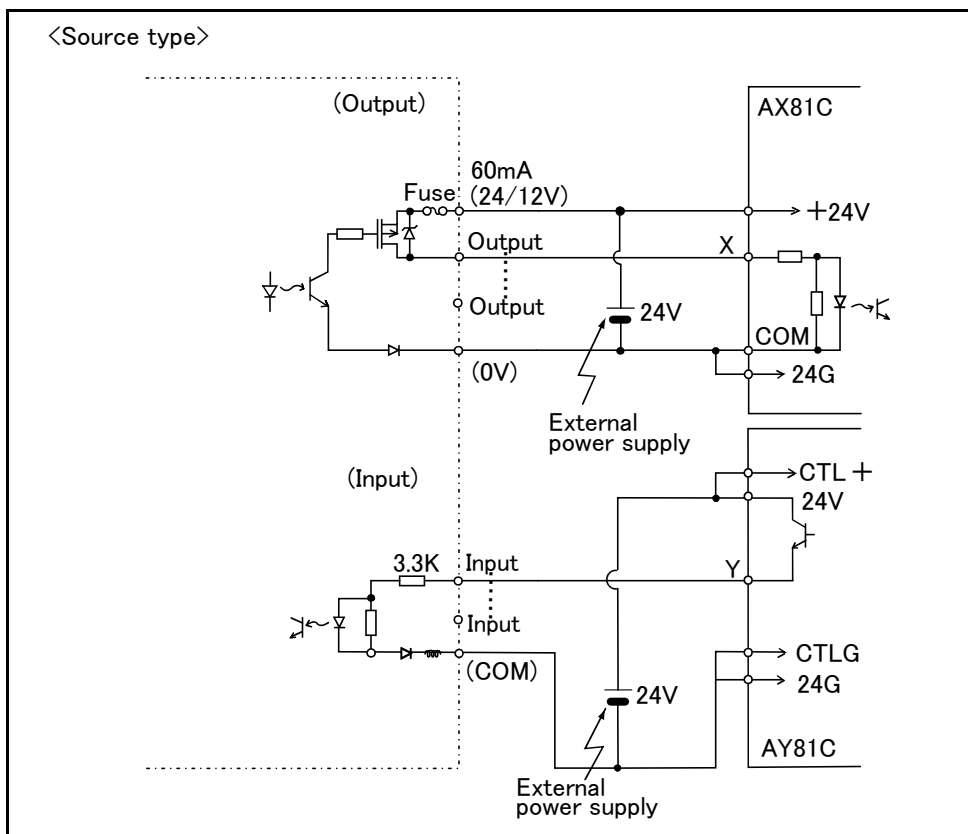Fig.3-13 : Connection with a Mitsubishi PLC (Example of source type)
*The input/output circuit external power supply (24 VDC) must be prepared by the customer.

Table 3-8 : Standard parallel I/O interface CN100pin No. and signal assignment list (2A-CBL □□)

Pin No.	Line color	Function name		Pin No.	Line color	Function name	
		General-purpose	Dedicated/power supply, common			General-purpose	Dedicated/power supply, common
1	Orange/Red A		FG	26	Orange/Blue A		FG
2	Gray/Red A		0V:For pins 4-7	27	Gray/Blue A		0V:For pins 29-32
3	White/Red A		12V/24V:For pins 4-7	28	White/Blue A		12V/24V:For pins 29-32
4	Yellow/Red A	General-purpose output 0	Running	29	Yellow/Blue A	General-purpose output 4	
5	Pink/Red A	General-purpose output 1	Servo on	30	Pink/Blue A	General-purpose output 5	
6	Orange/Red B	General-purpose output 2	Error	31	Orange/Blue B	General-purpose output 6	
7	Gray/Red B	General-purpose output 3	Operation rights	32	Gray/Blue B	General-purpose output 7	
8	White/Red B		0V:For pins 10-13	33	White/Blue B		0V:For pins 35-38
9	Yellow/Red B		12V/24V:For pins 10-13	34	Yellow/Blue B		12V/24V:For pins 35-38
10	Pink/Red B	General-purpose output 8		35	Pink/Blue B	General-purpose output 12	
11	Orange/Red C	General-purpose output 9		36	Orange/Blue C	General-purpose output 13	
12	Gray/Red C	General-purpose output 10		37	Gray/Blue C	General-purpose output 14	
13	White/Red C	General-purpose output 11		38	White/Blue C	General-purpose output 15	
14	Yellow/Red C		COM0:For pins 15-22 [Note1]	39	Yellow/Blue C		COM1:For pins 40-47 [Note1]
15	Pink/Red C	General-purpose input 0	Stop(All slot) [Note2]	40	Pink/Blue C	General-purpose input 8	
16	Orange/Red D	General-purpose input 1	Servo off	41	Orange/Blue D	General-purpose input 9	
17	Gray/Red D	General-purpose input 2	Error reset	42	Gray/Blue D	General-purpose input 10	
18	White/Red D	General-purpose input 3	Start	43	White/Blue D	General-purpose input 11	
19	Yellow/Red D	General-purpose input 4	Servo on	44	Yellow/Blue D	General-purpose input 12	
20	Pink/Red D	General-purpose input 5	Operation rights	45	Pink/Blue D	General-purpose input 13	
21	Orange/Red E	General-purpose input 6		46	Orange/Blue E	General-purpose input 14	
22	Gray/Red E	General-purpose input 7		47	Gray/Blue E	General-purpose input 15	
23	White/Red E		Reserved	48	White/Blue E		Reserved
24	Yellow/Red E		Reserved	49	Yellow/Blue E		Reserved
25	Pink/Red E		Reserved	50	Pink/Blue E		Reserved

Note1)Sink type:24V/12V(COM), Source type:0V(COM)
Note2)The assignment of the dedicated input signal "STOP" is fixed.

Table 3-9 : Standard parallel I/O interface CN300pin No. and signal assignment list (2A-CBL □□)

Pin No.	Line color	Function name		Pin No.	Line color	Function name	
		General-purpose	Dedicated/power supply, common			General-purpose	Dedicated/power supply, common
1	Orange/Red A		FG	26	Orange/Blue A		FG
2	Gray/Red A		0V:For pins 4-7	27	Gray/Blue A		0V:For pins 29-32
3	White/Red A		12V/24V:For pins 4-7	28	White/Blue A		12V/24V:For pins 29-32
4	Yellow/Red A	General-purpose output 16		29	Yellow/Blue A	General-purpose output 20	
5	Pink/Red A	General-purpose output 17		30	Pink/Blue A	General-purpose output 21	
6	Orange/Red B	General-purpose output 18		31	Orange/Blue B	General-purpose output 22	
7	Gray/Red B	General-purpose output 19		32	Gray/Blue B	General-purpose output 23	
8	White/Red B		0V:For pins 10-13	33	White/Blue B		0V:For pins 35-38
9	Yellow/Red B		12V/24V:For pins 10-13	34	Yellow/Blue B		12V/24V:For pins 35-38
10	Pink/Red B	General-purpose output 24		35	Pink/Blue B	General-purpose output 28	
11	Orange/Red C	General-purpose output 25		36	Orange/Blue C	General-purpose output 29	
12	Gray/Red C	General-purpose output 26		37	Gray/Blue C	General-purpose output 30	
13	White/Red C	General-purpose output 27		38	White/Blue C	General-purpose output 31	
14	Yellow/Red C		COM0:For pins 15-22 [Note1]	39	Yellow/Blue C		COM1:For pins 40-47 [Note1]
15	Pink/Red C	General-purpose input 16		40	Pink/Blue C	General-purpose input 24	
16	Orange/Red D	General-purpose input 17		41	Orange/Blue D	General-purpose input 25	
17	Gray/Red D	General-purpose input 18		42	Gray/Blue D	General-purpose input 26	
18	White/Red D	General-purpose input 19		43	White/Blue D	General-purpose input 27	
19	Yellow/Red D	General-purpose input 20		44	Yellow/Blue D	General-purpose input 28	
20	Pink/Red D	General-purpose input 21		45	Pink/Blue D	General-purpose input 29	
21	Orange/Red E	General-purpose input 22		46	Orange/Blue E	General-purpose input 30	
22	Gray/Red E	General-purpose input 23		47	Gray/Blue E	General-purpose input 31	
23	White/Red E		Reserved	48	White/Blue E		Reserved
24	Yellow/Red E		Reserved	49	Yellow/Blue E		Reserved
25	Pink/Red E		Reserved	50	Pink/Blue E		Reserved

Note1)Sink type:24V/12V(COM), Source type:0V(COM)

・The signals assigned as dedicated inputs can be used as general-purpose inputs during program execution. Note that for safety proposes, these should not be shared with the general-purpose inputs other than for numeric value inputs. The signals assigned as dedicated outputs cannot be used in the program. An alarm will occur during operation if used.
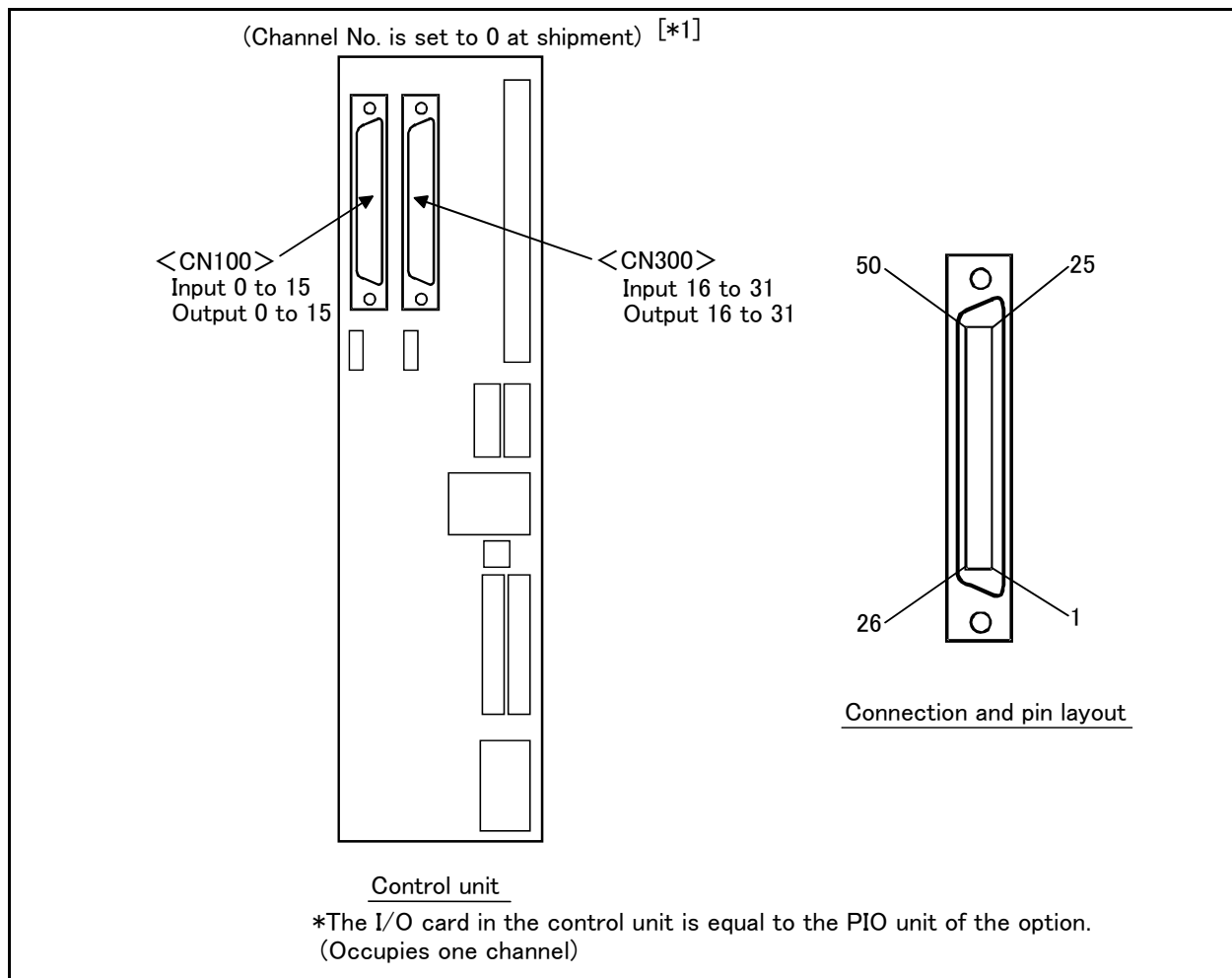

Fig.3-14 : Parallel input/output unit（in the control unit）connection and pin layout

(1) Teaching pendant (T/B)

■ Order type: R28TB   :Cable length 7m
                R28TB-15 :Cable length 15m
                     Note) There is a cable length 15m as special spcification. Confirm the delivery date.

■ Outline

This is used to create, edit and control the program, teach the operation position and for jog feed, etc.
For safety proposes, a 3-position deadman switch is mounted.[Note1]

If there are several robots, one teaching pendant can be used by connecting it to the respective robot.

■ Configuration
     Table 3-10 : Configuration device

■ Specifications
     Table 3-11 : Specifications

Items	Specifications	Remarks
Outline dimensions	95(W) x 236(H) x 34(D) (refer to outline drawing)	
Body color	Light gray (reference Munsell color: 7.65Y7.64/0.73)	
Mass	Approx. 0.5kg (only arm, excluding cable)	
Connection method	Connection with controller and round connector (30-pin)	
Interface	RS-422	
Display method	LCD method: 16 characters x 4 lines, LCD illumination: with backlight	
Operation section	28 keys	
Protection specifications	IP65	Note2)

Note2) The manual operation section of the teaching pendant has a protection method that complies with the IEC Standards IP65 (protection type).

[Reference] IProtection against water infiltration as specified in IP65 indicates a protective structure that is not harmfully affected when $12.5 \pm 5\%$ liters of water is supplied from a test device at a position approx. 3m away in various directions and a water pressure of 30kPa at the nozzle section. The water is filled one minute per $1m^2$ of test device surface area for a total of three minutes.
.

Note1) <3-position deadman switch>
In ISO/10218 (1992) and JIS-B8433 (1993), this is defined as an "enable device". These standards specify that the robot operation using the teaching pendant is enabled only when the "enable device" is at a specified position.
With the Mitsubishi Electric industrial robot, the above "enable device" is configured of an "Enable/Disable switch" and "Deadman switch".
The 3-position deadman switch has three statuses. The following modes are entered according to the switch state.

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

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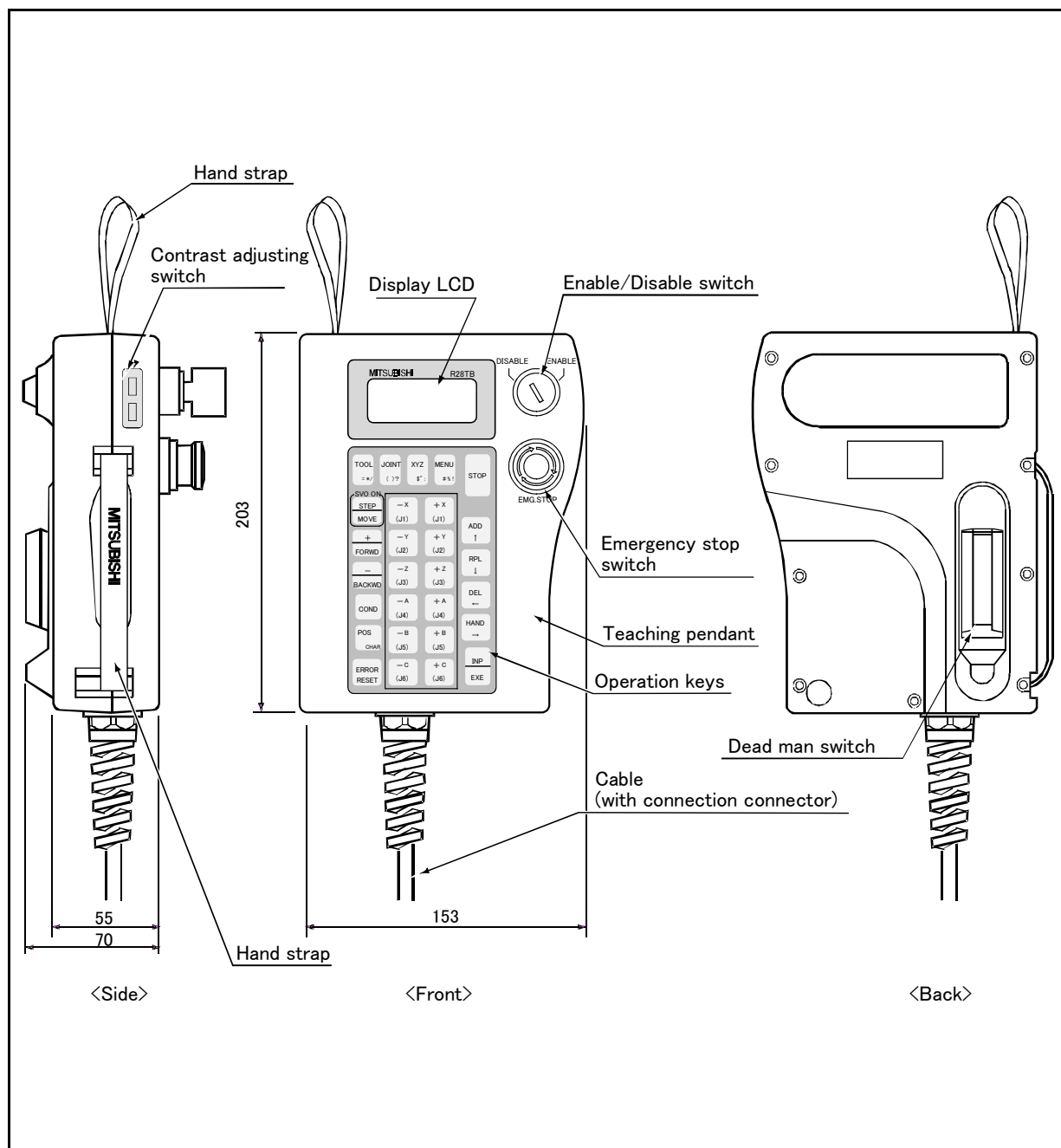   Safety is secured as the servo power is turned OFF simultaneously with the input of the emergency stop.

Fig.3-15 : Outside dimensions of teaching pendant

■ Installation method
The teaching pendant is connected to the T/B connector on the front of the controller.
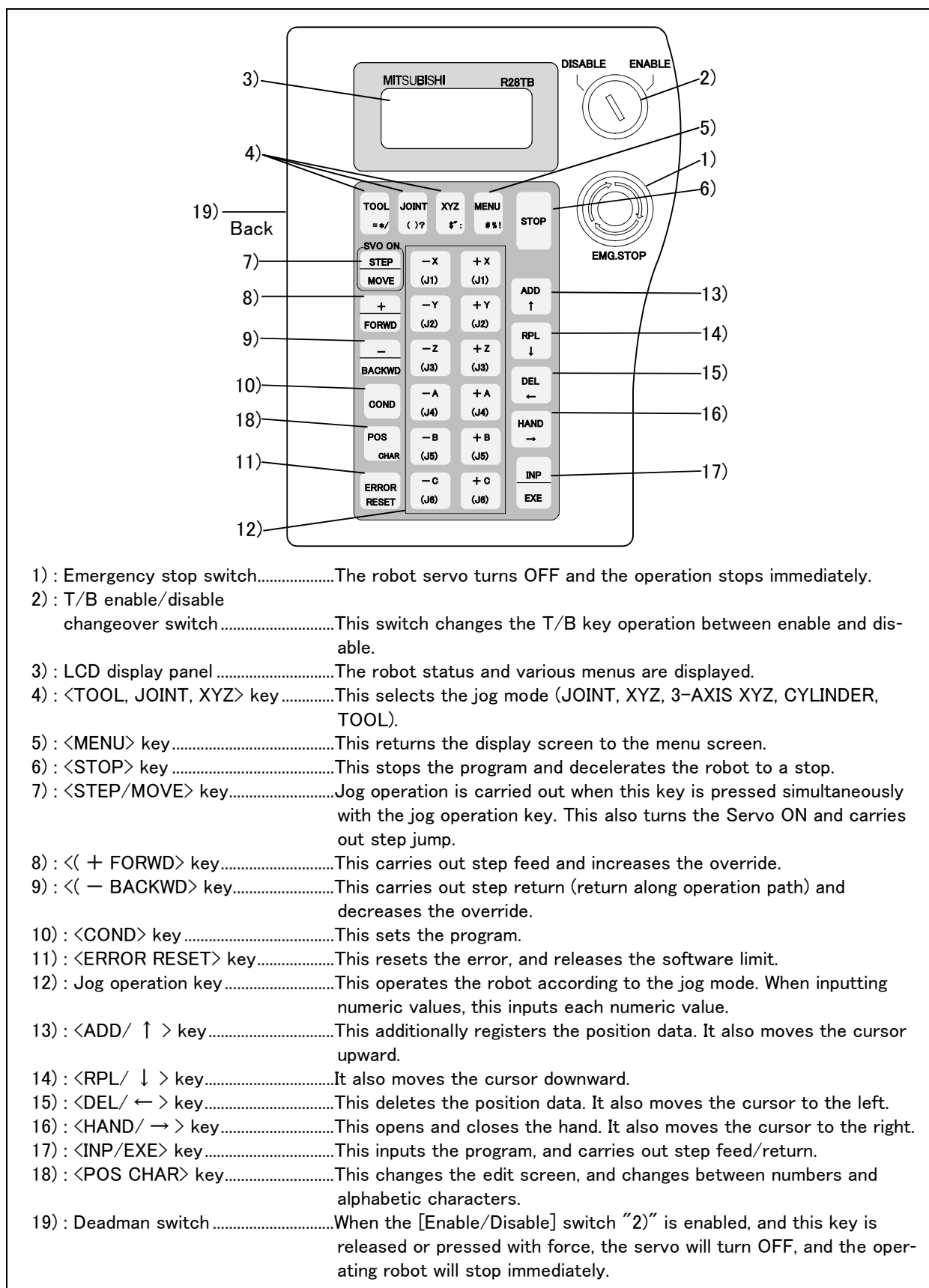
■ Key layout and main functions

1) : Emergency stop switch..................The robot servo turns OFF and the operation stops immediately.
2) : T/B enable/disable
    changeover switch.........................This switch changes the T/B key operation between enable and dis-
    able.
3) : LCD display panel............................The robot status and various menus are displayed.
4) : 〈TOOL, JOINT, XYZ〉 key.............This selects the jog mode (JOINT, XYZ, 3-AXIS XYZ, CYLINDER,
    TOOL).
5) : 〈MENU〉 key.......................................This returns the display screen to the menu screen.
6) : 〈STOP〉 key...This stops the program and decelerates the robot to a stop.
7) : 〈STEP/MOVE〉 key..........................Jog operation is carried out when this key is pressed simultaneously
    with the jog operation key. This also turns the Servo ON and carries
    out step jump.
8) : 〈＋FORWD〉 key............................This carries out step feed and increases the override.
9) : 〈－BACKWD〉 key.........................This carries out step return (return along operation path) and
    decreases the override.
10) : 〈COND〉 key.......................................This sets the program.
11) : 〈ERROR RESET〉 key....................This resets the error, and releases the software limit.
12) : Jog operation key.........................This operates the robot according to the jog mode. When inputting
    numeric values, this inputs each numeric value.
13) : 〈ADD/ ↑ 〉 key...............................This additionally registers the position data. It also moves the cursor
    upward.
14) : 〈RPL/ ↓ 〉 key...............................It also moves the cursor downward.
15) : 〈DEL/ ← 〉 key...............................This deletes the position data. It also moves the cursor to the left.
16) : 〈HAND/ → 〉 key...........................This opens and closes the hand. It also moves the cursor to the right.
17) : 〈INP/EXE〉 key................................This inputs the program, and carries out step feed/return.
18) : 〈POS CHAR〉 key..........................This changes the edit screen, and changes between numbers and
    alphabetic characters.
19) : Deadman switch............................When the [Enable/Disable] switch "2" is enabled, and this key is
    released or pressed with force, the servo will turn OFF, and the oper-
    ating robot will stop immediately.

Fig.3-16 : Teaching pendant key layout and main functions

(2) Pneumatic hand interface

■ Order type: 2A-RZ365(Sink type)
         2A-RZ375(Source type)

■ Outline

This interface is required to use the robot arm's hand output signals.
・Up to eight hand output points can be used with this interface.
・The eight hand input points can be used without this interface.
・When using more than eight hand input/output points, install the "Parallel I/O unit".
   Refer to Page 55, "Parallel I/O unit" for detail.

■ Configuration
   Table 3-12 : Configuration device

Part name	Type	Qty.	Remarks
Pneumatic hand interface	2A-RZ365/ 2A-RZ375	1pc.	Output 8 point expansion. 2A-RZ365 is the sink type. 2A-RZ375 is the source type.

■ Specifications
   Table 3-13 : Specifications

Item		Specification	Internal circuit
Type		Transistor output	<Sink type>
No. of output points		8	
Insulation method		Photo coupler insulation	
Rated load voltage		DC24V	
Rated load voltage range		DC21.6 to 26.4VDC	
Max. current load		0.1A/ 1 point (100%)	
Current leak with power OFF		0.1mA or less	
Maximum voltage drop with power ON		DC0.9V(TYP.)	
Response time	OFF-ON	2ms or less (hardware response time)	
	ON-OFF	2 ms or less (resistance load) (hardware response time)	
Fuse rating		Fuses 1.6A (each one common)	
Common method		8 points, 1 common	
External cable connection method		Connector (Connected from RZst181)	
Supply voltage		DC5V (Supplied from RZ181)	

■ Installation method
This is mounted on the control unit (RZ181 card) in the controller.
Securely insert the pneumatic hand interface (2A-RZ365) into the CNHNDOUT/CNHND connector on the control unit.
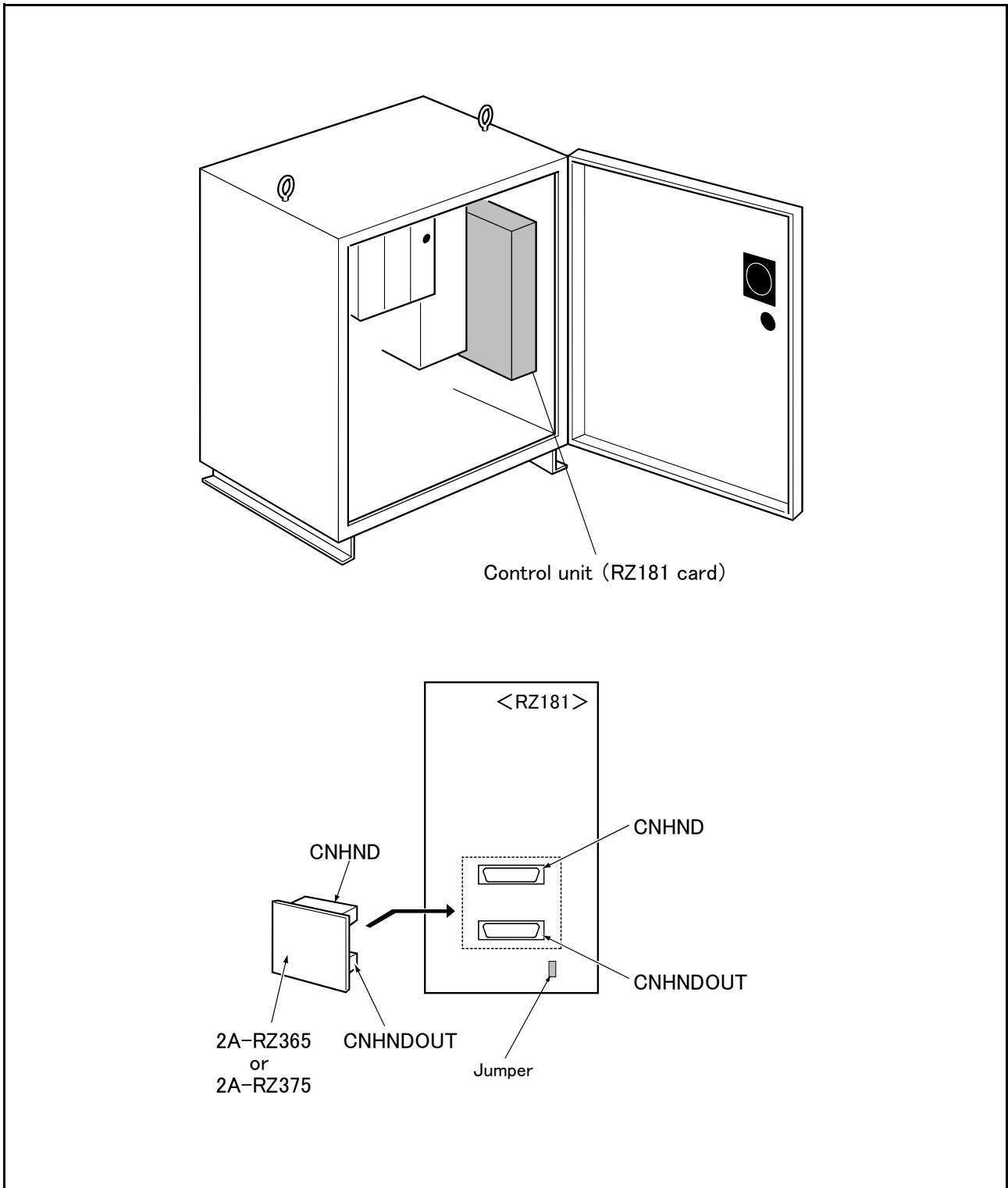
Control unit (RZ181 card)

＜RZ181＞

CNHND

CNHND

CNHNDOUT

2A-RZ365
or
2A-RZ375

CNHNDOUT

Jumper

Fig.3-17 : Installation of pneumatic hand interface

(3) Parallel I/O unit

■ Order type:　2A-RZ361(Sink type)
　　　　　　　　2A-RZ371(Source type)

■ Outline

This is used to expand the external inputs and outputs. One one equal with this unit is built into the control unit among controllers the standard.
・The connection cable is not included. Prepare the optional external input/output cable (2A-CBL05 or 2A-CBL15).

■ Configuration

Table 3-14：Configuration device

Part name	Type	Qty.	Remarks
Parallel I/O unit	2A-RZ361/ 2A-RZ371	1	Input/output 32 points/32 points 2A-RZ361 is the sink type. 2A-RZ371 is the source type.
Robot I/O link connection connector	NETcable-1	2 sets	Connector with pins. The cable must be prepared and wired by the customer.
Power connection connector	DCcable-2	1 sets	Connector with pins. The cable must be prepared and wired by the customer.
Terminator	R-TM	1	150Ω(1/4W)

■ Specifications
　1) Up to eight stations can be connected to this unit. (One station occupies one unit.)
　　One unit is built into the controller as a standard, so up to seven units can be installed as expansions.
　2) The power supply (24V) must be prepared by the customer and connected with the power connection cable (DCcable-2)
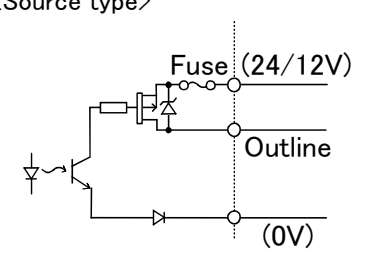　　A separate 24V power supply is required for the input/output circuit wiring.
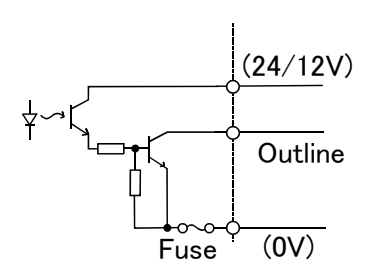
The detailed specifications of the input/output circuit are the same as the parallel input/output unit mounted as a standard. Refer to Page 46, "3.9 Parallel input/output unit" for details.

Table 3-15：Electrical specifications of input circuits

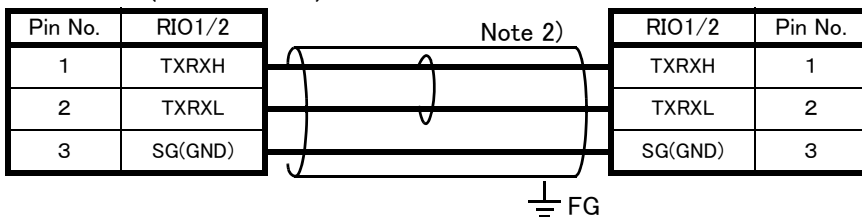| Item		Specification	Internal circuit
Type		DC input	<Sink type>
Number of input points		32	
Insulation method		Photo coupler insulation	
Rated input voltage		DC12V/DC24V	24V/12V (COM)
Rated input current		Approx 3mA/7mA	
Working voltage range		DC10.2 to 26.4V(Ripple factor should be less than 5%.)	820
ON voltage/ON current		8VDC or more/ 2mA or more	
OFF voltage/ OFF current		4VDC or less/ 1mA or less	3.3K　Input
Input resistance		Approx. 3.3kΩ	
Response time	OFF-ON	10ms or less (24VDC)	<Source type>
	ON-OFF	10ms or less (24VDC)	3.3K　Input
Common method		8 point 1 common	820
External cable connection method		Connector	0V(COM)

Table 3-16 : Electrical specifications for the output circuits

Item		Specification	Internal circuit
Type		Transistor output	<Sink type>
No. of output points		32	
Insulation method		Photo-coupler insulation	
Rated load voltage		DC12V/DC24V	
Rated load voltage range		DC10.2 ～ 30V(peak voltage 30VDC)	
Max. load current		0.1A/point (100%)	
Leakage current at OFF		0.1mA or less	
Max. voltage drop at ON		DC0.9V(TYP.)	
Response time	OFF-ON	2ms or less (hardware response time)	
	ON-OFF	2ms or less (Resistance load) (hardware response time)	<Source type>
Fuse rating		Fuse 3.2A (one per common) Replacement not possible	
Common method		4 points per common (common terminal: 4 points)	
External wire connection method		Connector	
External power supply	Voltage	DC12/24V(DC10.2 ～ 30V)	
	Current	60mA (TYP. 24VDC per common) (base drive current)	

NETcable-1 (Network cable)

Pin No.	RIO1/2			RIO1/2	Pin No.
1	TXRXH			TXRXH	1
2	TXRXL			TXRXL	2
3	SG(GND)			SG(GND)	3

Note 2)

FG

DCcable-2 (Power cable)

Pin No.	DCIN	
1	24V	+ Note 1)
2	24G(RG)	24V Power −
3	FG(PE)	

Connected the frame ground or protect ground

R-TM (Terminator)

Pin No.	RIO1/2	150Ω
1	TXRXH	
2	TXRXL	
3	SG(GND)	
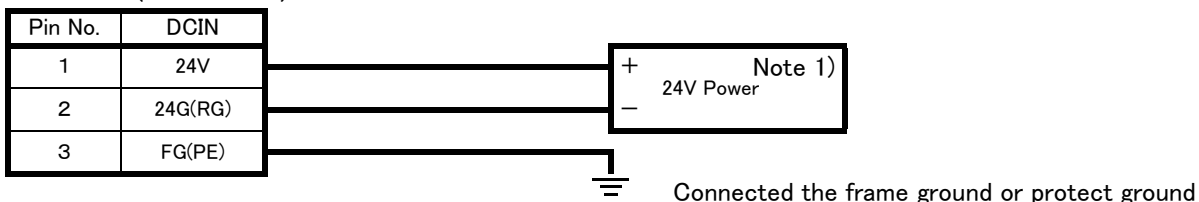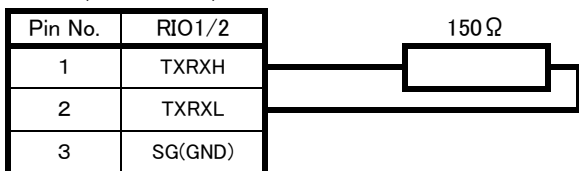
List of parts and manufacturer

Type	Connector type	Contact type	Resistant	Manufacturer
NETcable-1	1-178288-3 (2)	175218-3 (6)	—	AMP
DCcable-2	2-178288-3 (1)	175218-3 (3)	—	AMP
R-TM	1-178288-3 (1)	175218-3 (2)	150Ω(1/4W) (1)	Equivalent to KOA.

Note 1) The 24V power supply is prepared by customer (The power consumption is approx. 0.3A.)
Note 2) The cable for general purpose can be used to the network cable. However, use the twisted shield cable of AWG#22(0.3mm^2) or more.

Fig.3-18 : Spacifications for the connection cable

■ Installation method
The expansion parallel input/output unit is installed outside of the controller. Connect with the network connection cable (NETcable-1) from the RIO1 connector in the into of the controller.(Terminator is connected at the time of shipment)
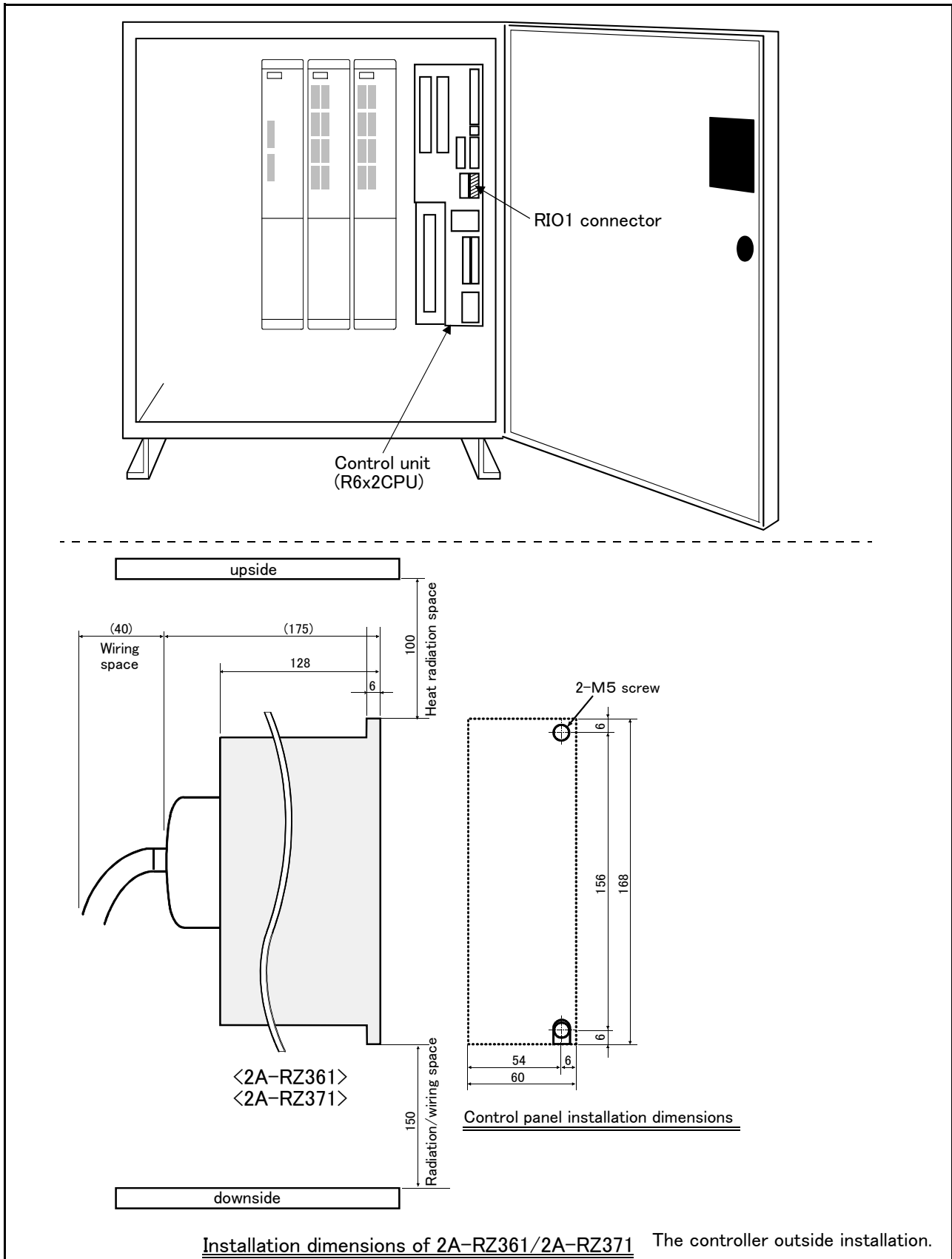

RIO1 connector

Control unit
(R6x2CPU)

upside

(40)
Wiring space

(175)

128

6

100
Heat radiation space

2-M5 screw

6

156
168

6

54
60

6

Radiation/wiring space
150

<2A-RZ361>
<2A-RZ371>

Control panel installation dimensions

downside

Installation dimensions of 2A-RZ361/2A-RZ371 The controller outside installation.

Fig.3-19 : Installing the parallel input/output unit

Control unit R6x2CPU

Parallel I/O unit 1 ... 6

Parallel I/O unit 7

Station No. setting
1 ... 6

Station No. setting
7

RIO1 connector (R6)

<CN100>

<CN300>

<CN100>

<CN300>

RIO1connector

RIO2 connector RIO1 connector

RIO2 connector

Note)
NETcable-1
cable

DCIN connector

FG

DCcable-2
cable

Note)
NETcable-1
cable

DCIN connector

FG

DCcable-2
cable

R-TM
terminator

Front

RIO1 connector

RIO2 connector

DCIN connector

I/O unit the bottom
Connecta layout

Connect the NET cable-1 to the RIO1 connector (R6) on the front of the control unit
(R6x2CPU) in the controller. Each unit is connected to from a daisy chain.
Always install a terminator (R-TM) to the last unit.
Note) Use a shield cable for NET cable-1 as a measure against noise.
    Always connect the shield to FG.
    The unit could malfunction because of noise if the shield cable is not used.

Fig.3-20 : Connection method of expansion parallel input/output unit

■ Parallel I/O interface (First expansion unit)
Table 3-17 : Connector CN100pin No. and signal assignment list (2A-CBL □□)

Pin No.	Line color	Function name		Pin No.	Line color	Function name	
		General-purpose	Dedicated/power supply, common			General-purpose	Dedicated/power supply, common
1	Orange/Red A		FG	26	Orange/Blue A		FG
2	Gray/Red A		0V:For pins 4-7	27	Gray/Blue A		0V:For pins 29-32
3	White/Red A		12V/24V:For pins 4-7	28	White/Blue A		12V/24V:For pins 29-32
4	Yellow/Red A	General-purpose output 32		29	Yellow/Blue A	General-purpose output 36	
5	Pink/Red A	General-purpose output 33		30	Pink/Blue A	General-purpose output 37	
6	Orange/Red B	General-purpose output 34		31	Orange/Blue B	General-purpose output 38	
7	Gray/Red B	General-purpose output 35		32	Gray/Blue B	General-purpose output 39	
8	White/Red B		0V:For pins 10-13	33	White/Blue B		0V:For pins 35-38
9	Yellow/Red B		12V/24V:For pins 10-13	34	Yellow/Blue B		12V/24V:For pins 35-38
10	Pink/Red B	General-purpose output 40		35	Pink/Blue B	General-purpose output 44	
11	Orange/Red C	General-purpose output 41		36	Orange/Blue C	General-purpose output 45	
12	Gray/Red C	General-purpose output 42		37	Gray/Blue C	General-purpose output 46	
13	White/Red C	General-purpose output 43		38	White/Blue C	General-purpose output 47	
14	Yellow/Red C		COM0:For pins 15-22 [Note1]	39	Yellow/Blue C		COM1:For pins 40-47 [Note1]
15	Pink/Red C	General-purpose input 32		40	Pink/Blue C	General-purpose input 40	
16	Orange/Red D	General-purpose input 33		41	Orange/Blue D	General-purpose input 41	
17	Gray/Red D	General-purpose input 34		42	Gray/Blue D	General-purpose input 42	
18	White/Red D	General-purpose input 35		43	White/Blue D	General-purpose input 43	
19	Yellow/Red D	General-purpose input 36		44	Yellow/Blue D	General-purpose input 44	
20	Pink/Red D	General-purpose input 37		45	Pink/Blue D	General-purpose input 45	
21	Orange/Red E	General-purpose input 38		46	Orange/Blue E	General-purpose input 46	
22	Gray/Red E	General-purpose input 39		47	Gray/Blue E	General-purpose input 47	
23	White/Red E		Reserved	48	White/Blue E		Reserved
24	Yellow/Red E		Reserved	49	Yellow/Blue E		Reserved
25	Pink/Red E		Reserved	50	Pink/Blue E		Reserved

Note1)Sink type:24V/12V(COM), Source type:0V(COM)

Table 3-18 : Connector CN300pin No. and signal assignment list (2A-CBL □□)

Pin No.	Line color	Function name		Pin No.	Line color	Function name	
		General-purpose	Dedicated/power supply, common			General-purpose	Dedicated/power supply, common
1	Orange/Red A		FG	26	Orange/Blue A		FG
2	Gray/Red A		0V:For pins 4-7	27	Gray/Blue A		0V:For pins 29-32
3	White/Red A		12V/24V:For pins 4-7	28	White/Blue A		12V/24V:For pins 29-32
4	Yellow/Red A	General-purpose output 48		29	Yellow/Blue A	General-purpose output 52	
5	Pink/Red A	General-purpose output 49		30	Pink/Blue A	General-purpose output 53	
6	Orange/Red B	General-purpose output 50		31	Orange/Blue B	General-purpose output 54	
7	Gray/Red B	General-purpose output 51		32	Gray/Blue B	General-purpose output 55	
8	White/Red B		0V:For pins 10-13	33	White/Blue B		0V:For pins 35-38
9	Yellow/Red B		12V/24V:For pins 10-13	34	Yellow/Blue B		12V/24V:For pins 35-38
10	Pink/Red B	General-purpose output 56		35	Pink/Blue B	General-purpose output 60	
11	Orange/Red C	General-purpose output 57		36	Orange/Blue C	General-purpose output 61	
12	Gray/Red C	General-purpose output 58		37	Gray/Blue C	General-purpose output 62	
13	White/Red C	General-purpose output 59		38	White/Blue C	General-purpose output 63	
14	Yellow/Red C		COM0:For pins 15-22 [Note1]	39	Yellow/Blue C		COM1:For pins 40-47 [Note1]
15	Pink/Red C	General-purpose input 48		40	Pink/Blue C	General-purpose input 56	
16	Orange/Red D	General-purpose input 49		41	Orange/Blue D	General-purpose input 57	
17	Gray/Red D	General-purpose input 50		42	Gray/Blue D	General-purpose input 58	
18	White/Red D	General-purpose input 51		43	White/Blue D	General-purpose input 59	
19	Yellow/Red D	General-purpose input 52		44	Yellow/Blue D	General-purpose input 60	
20	Pink/Red D	General-purpose input 53		45	Pink/Blue D	General-purpose input 61	
21	Orange/Red E	General-purpose input 54		46	Orange/Blue E	General-purpose input 62	
22	Gray/Red E	General-purpose input 55		47	Gray/Blue E	General-purpose input 63	
23	White/Red E		Reserved	48	White/Blue E		Reserved
24	Yellow/Red E		Reserved	49	Yellow/Blue E		Reserved
25	Pink/Red E		Reserved	50	Pink/Blue E		Reserved

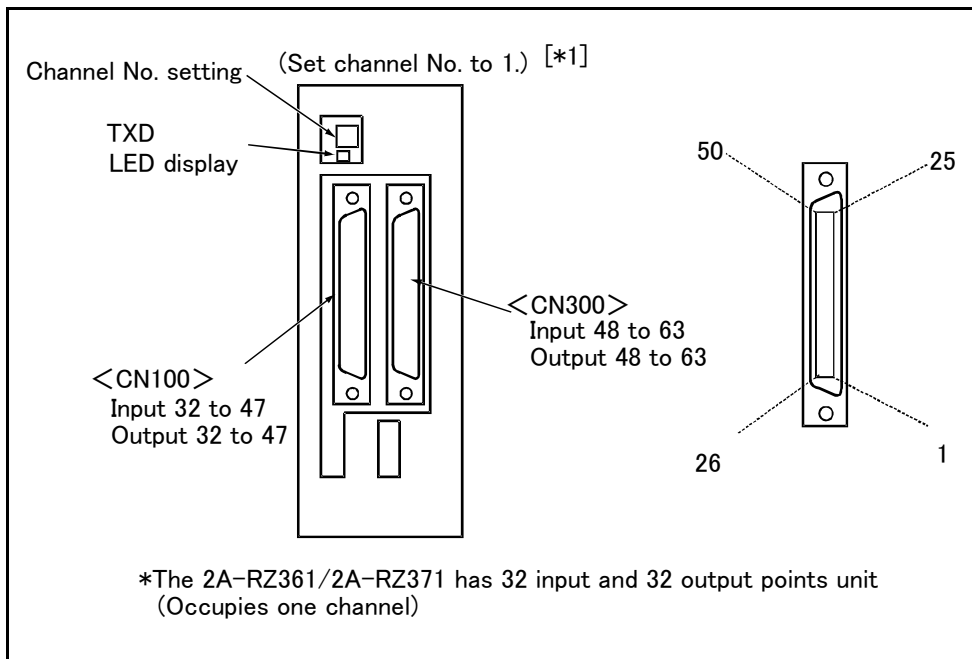Note1)Sink type:24V/12V(COM), Source type:0V(COM)

Fig.3-21 : Parallel input/output unit <2A-RZ361/2A-RZ371:First expansion> connection and pin layout

⚠ CAUTION [*1] For the 1st expansion unit, set the channel No. to "1".
The channel No. of 8 to F is used for the maker test. If any value of 8 to F is set, it may be dangerous since the robot unexpectedly moves. Don't set any value of 8 to F.

■ Parallel I/O interface (Second expansion unit)

Table 3-19 : Connector CN100pin No. and signal assignment list (2A-CBL □□)

Pin No.	Line color	Function name		Pin No.	Line color	Function name	
		General-purpose	Dedicated/power supply, common			General-purpose	Dedicated/power supply, common
1	Orange/Red A		FG	26	Orange/Blue A		FG
2	Gray/Red A		0V:For pins 4-7	27	Gray/Blue A		0V:For pins 29-32
3	White/Red A		12V/24V:For pins 4-7	28	White/Blue A		12V/24V:For pins 29-32
4	Yellow/Red A	General-purpose output 64		29	Yellow/Blue A	General-purpose output 68	
5	Pink/Red A	General-purpose output 65		30	Pink/Blue A	General-purpose output 69	
6	Orange/Red B	General-purpose output 66		31	Orange/Blue B	General-purpose output 70	
7	Gray/Red B	General-purpose output 67		32	Gray/Blue B	General-purpose output 71	
8	White/Red B		0V:For pins 10-13	33	White/Blue B		0V:For pins 35-38
9	Yellow/Red B		12V/24V:For pins 10-13	34	Yellow/Blue B		12V/24V:For pins 35-38
10	Pink/Red B	General-purpose output 72		35	Pink/Blue B	General-purpose output 76	
11	Orange/Red C	General-purpose output 73		36	Orange/Blue C	General-purpose output 77	
12	Gray/Red C	General-purpose output 74		37	Gray/Blue C	General-purpose output 78	
13	White/Red C	General-purpose output 75		38	White/Blue C	General-purpose output 79	
14	Yellow/Red C		COM0:For pins 15-22 [Note1]	39	Yellow/Blue C		COM1:For pins 40-47 [Note1]
15	Pink/Red C	General-purpose input 64		40	Pink/Blue C	General-purpose input 72	
16	Orange/Red D	General-purpose input 65		41	Orange/Blue D	General-purpose input 73	
17	Gray/Red D	General-purpose input 66		42	Gray/Blue D	General-purpose input 74	
18	White/Red D	General-purpose input 67		43	White/Blue D	General-purpose input 75	
19	Yellow/Red D	General-purpose input 68		44	Yellow/Blue D	General-purpose input 76	
20	Pink/Red D	General-purpose input 69		45	Pink/Blue D	General-purpose input 77	
21	Orange/Red E	General-purpose input 70		46	Orange/Blue E	General-purpose input 78	
22	Gray/Red E	General-purpose input 71		47	Gray/Blue E	General-purpose input 79	
23	White/Red E		Reserved	48	White/Blue E		Reserved
24	Yellow/Red E		Reserved	49	Yellow/Blue E		Reserved
25	Pink/Red E		Reserved	50	Pink/Blue E		Reserved

Note1)Sink type:24V/12V(COM), Source type:0V(COM)

Table 3-20 : Connector CN300pin No. and signal assignment list (2A-CBL □□)

Pin No.	Line color	Function name		Pin No.	Line color	Function name	
		General-purpose	Dedicated/power supply, common			General-purpose	Dedicated/power supply, common
1	Orange/Red A		FG	26	Orange/Blue A		FG
2	Gray/Red A		0V:For pins 4-7	27	Gray/Blue A		0V:For pins 29-32
3	White/Red A		12V/24V:For pins 4-7	28	White/Blue A		12V/24V:For pins 29-32
4	Yellow/Red A	General-purpose output 80		29	Yellow/Blue A	General-purpose output 84	
5	Pink/Red A	General-purpose output 81		30	Pink/Blue A	General-purpose output 85	
6	Orange/Red B	General-purpose output 82		31	Orange/Blue B	General-purpose output 86	
7	Gray/Red B	General-purpose output 83		32	Gray/Blue B	General-purpose output 87	
8	White/Red B		0V:For pins 10-13	33	White/Blue B		0V:For pins 35-38
9	Yellow/Red B		12V/24V:For pins 10-13	34	Yellow/Blue B		12V/24V:For pins 35-38
10	Pink/Red B	General-purpose output 88		35	Pink/Blue B	General-purpose output 92	
11	Orange/Red C	General-purpose output 89		36	Orange/Blue C	General-purpose output 93	
12	Gray/Red C	General-purpose output 90		37	Gray/Blue C	General-purpose output 94	
13	White/Red C	General-purpose output 91		38	White/Blue C	General-purpose output 95	
14	Yellow/Red C		COM0:For pins 15-22 [Note1]	39	Yellow/Blue C		COM1:For pins 40-47 [Note1]
15	Pink/Red C	General-purpose input 80		40	Pink/Blue C	General-purpose input 88	
16	Orange/Red D	General-purpose input 81		41	Orange/Blue D	General-purpose input 89	
17	Gray/Red D	General-purpose input 82		42	Gray/Blue D	General-purpose input 90	
18	White/Red D	General-purpose input 83		43	White/Blue D	General-purpose input 91	
19	Yellow/Red D	General-purpose input 84		44	Yellow/Blue D	General-purpose input 92	
20	Pink/Red D	General-purpose input 85		45	Pink/Blue D	General-purpose input 93	
21	Orange/Red E	General-purpose input 86		46	Orange/Blue E	General-purpose input 94	
22	Gray/Red E	General-purpose input 87		47	Gray/Blue E	General-purpose input 95	
23	White/Red E		Reserved	48	White/Blue E		Reserved
24	Yellow/Red E		Reserved	49	Yellow/Blue E		Reserved
25	Pink/Red E		Reserved	50	Pink/Blue E		Reserved

Note1)Sink type:24V/12V(COM), Source type:0V(COM)
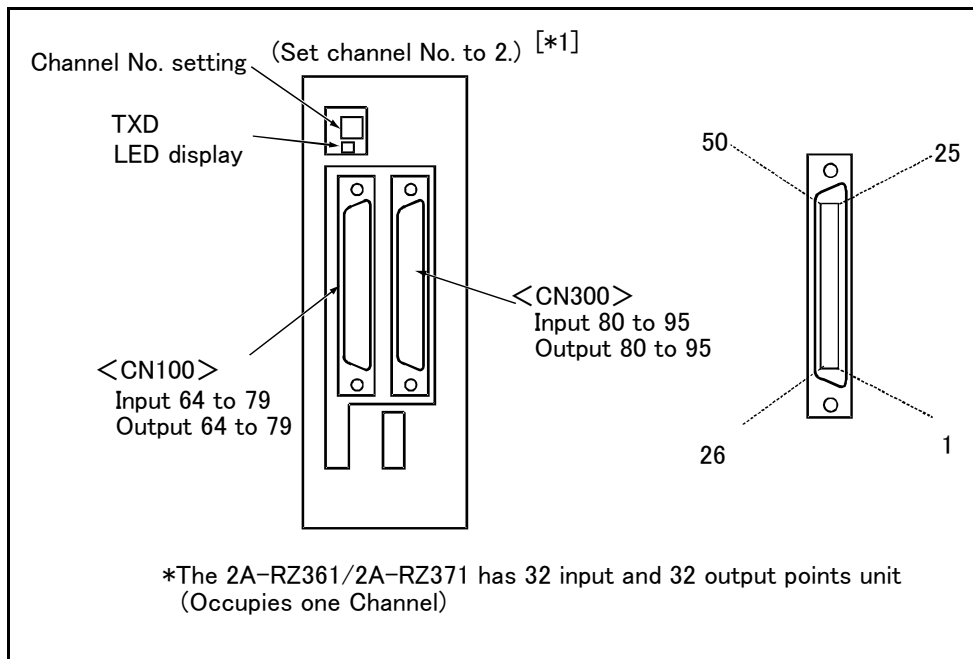
Fig.3-22 : Parallel input/output unit <2A-RZ361/2A-RZ371:Second expansion unit> connection and pin layout

⚠ CAUTION [*1] For the 2nd expansion unit, set the channel No. to "2".
The channel No. of 8 to F is used for the maker test. If any value of 8 to F is set, it may be dangerous since the robot unexpectedly moves. Don't set any value of 8 to F.

Table 3-21 lists the correspondence between the station numbers to be set and the I/O signal assignment. Refer to this table when the third and subsequent units are used.

Table 3-21 : Station Number Settings and I/O Signal Assignment

Unit No.	Station number setting	CN100	CN300
1st unit	1	Input: 32 ∼ 47 Output: 32 ∼ 47	Input: 48 ∼ 63 Output: 48 ∼ 63
2nd unit	2	Input: 64 ∼ 79 Output: 64 ∼ 79	Input: 80 ∼ 95 Output: 80 ∼ 95
3rd unit	3	Input: 96 ∼ 111 Output: 96 ∼ 111	Input: 112 ∼ 127 Output: 112 ∼ 127
4th unit	4	Input: 128 ∼ 143 Output: 128 ∼ 143	Input: 144 ∼ 159 Output: 144 ∼ 159
5th unit	5	Input: 160 ∼ 175 Output: 160 ∼ 175	Input: 176 ∼ 191 Output: 176 ∼ 191
6th unit	6	Input: 192 ∼ 207 Output: 192 ∼ 207	Input: 208 ∼ 223 Output: 208 ∼ 223
7th unit	7	Input: 224 ∼ 239 Output: 224 ∼ 239	Input: 240 ∼ 255 Output: 240 ∼ 255

(4) External I/O cable

■ Order type: 2A-CBL □□   Note）The numbers in the boxes □□ refer to the length.（05: 5m、15: 15m）

■ Outline

This is the dedicated cable used to connect an external peripheral device to the connector on the parallel input/output unit.

One end matches the connector on the parallel input/output unit, and the other end is free. Connect the peripheral device's input/output signal using the free end.

One cable correspond to the input 16 points and output 16 points.

Two cables are needed to connection of（input 32 points and output 32 points）with built-in standard.

■ Configuration

Table 3-22 : Configuration device

Part name	Type	Qty.	Remarks
External I/O cable	2A-CBL □□	1pc.	5m or 15m

■ Specifications

Table 3-23 : Specifications

Items	Specifications
Number of cables x cable size	50 pairs x AWG #28
Total length	5m or 15m

■ Connector pin numbers and cable colors

Table 3-24 : Connector pin numbers and cable colors

Pin no.	Cable colors	Pin no.	Cable colors	Pin no.	Cable colors	Pin no.	Cable colors	Pin no.	Cable colors
1	Orange/Red A	11	Orange/Red C	21	Orange/Red E	31	Orange/Blue B	41	Orange/Blue D
2	Gray/Red A	12	Gray/Red C	22	Gray/Red E	32	Gray/Blue B	42	Gray/Blue D
3	White/Red A	13	White/Red C	23	White/Red E	33	White/Blue B	43	White/Blue D
4	Yellow/Red A	14	Yellow/Red C	24	Yellow/Red E	34	Yellow/Blue B	44	Yellow/Blue D
5	Pink/Red A	15	Pink/Red C	25	Pink/Red E	35	Pink/Blue B	45	Pink/Blue D
6	Orange/Red B	16	Orange/Red D	26	Orange/Blue A	36	Orange/Blue C	46	Orange/Blue E
7	Gray/Red B	17	Gray/Red D	27	Gray/Blue A	37	Gray/Blue C	47	Gray/Blue E
8	White/Red B	18	White/Red D	28	White/Blue A	38	White/Blue C	48	White/Blue E
9	Yellow/Red B	19	Yellow/Red D	29	Yellow/Blue A	39	Yellow/Blue C	49	Yellow/Blue E
10	Pink/Red B	20	Pink/Red D	30	Pink/Blue A	40	Pink/Blue C	50	Pink/Blue E

■ Connections and outside dimensions
 The sheath of each signal cable (50 lines) is color indicated and marked with dots. Refer to the cable color specifications in "Table 3-24Connector pin numbers and cable colors" when making the connections.

(Eg.) Pin number: color indication
　　　　1　　: Orange ／ Red ／ A

　　　　　　　　　　　Type of dot mark (see figure below)
　　　　　　　　　　　Color of dot mark
　　　　　　　　　　　Color of sheath
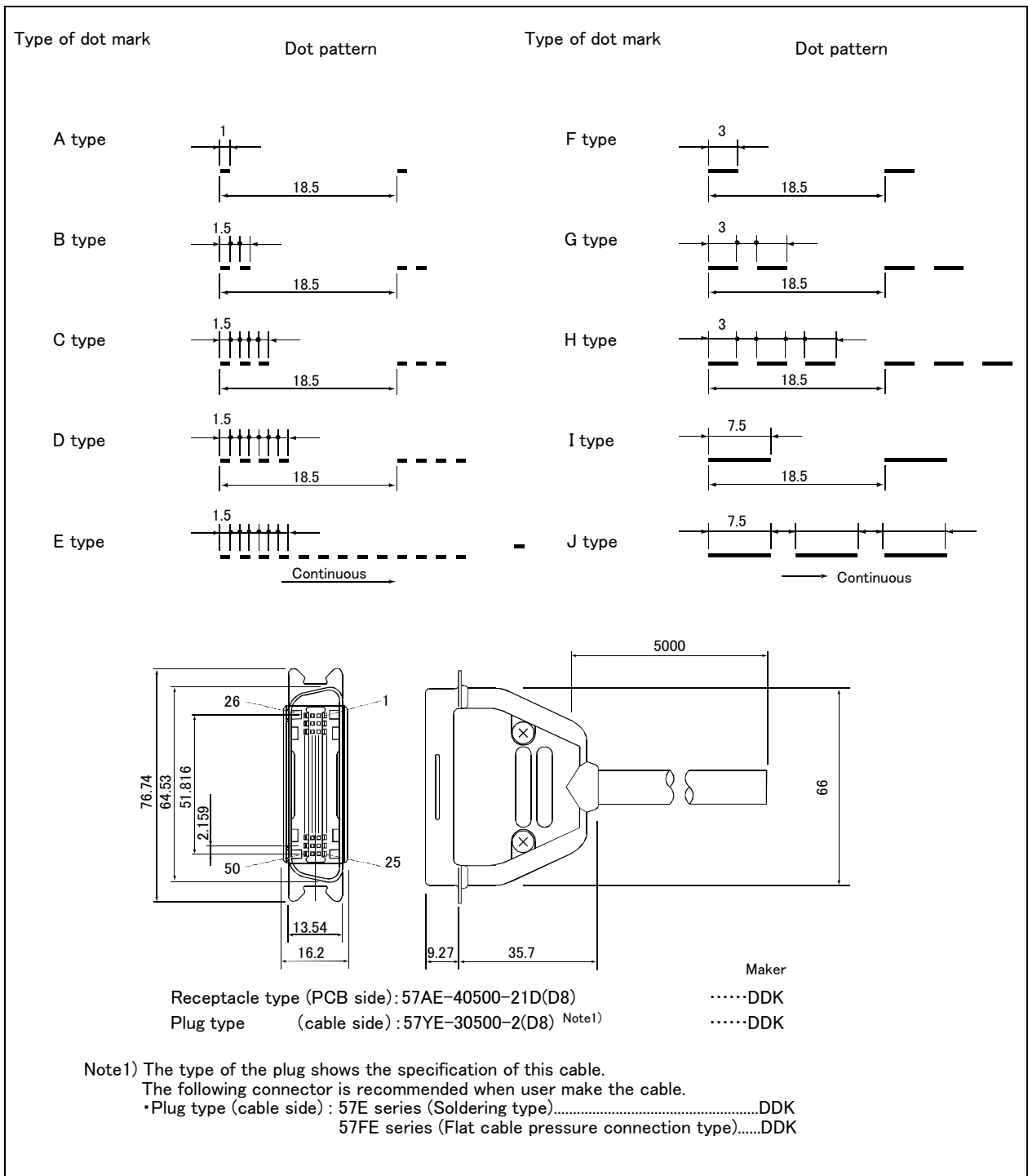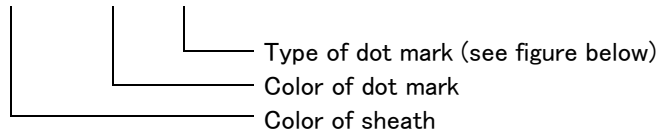
Fig.3-23 : Connections and outside dimensions

(5) Personal computer cable

■ Order type: ● For PC/AT : RS-MAXY-CBL

■ Outline

This is the RS-232C interface cable used for connecting the controller with a personal computer. The personal computer on hand may be usable with the above interface cable. Confirm the connection specifications when placing an order.

Personal computer cables for the PC/AT compatible model is available.

The cable for the NEC PC9821 (half-pitch 14-pin) must be manufactured by the customer.

■ Configuration

Table 3-25 : Configuration device

Part name	Type	Qty.	Remarks
Personal computer cable (for PC/AT)	RS-MAXY-CBL	1pc.	3m, D-SUB 9 pin[Note1]

Note1)The personal computer cable is the same as that for use with "Movemaster M1/M2/E/EN series".

■ Specifications

(1) For PC/AT

Controller side
(Signal name, pin No.)

RS-MAXY-CBL

Personal computer side
(Signal name, pin No.)

(FG) 1   1 (CD)
($\overline{SD}$) 2   2 ($\overline{RD}$)
($\overline{RD}$) 3   3 ($\overline{SD}$)
(RS) 4   4 (DTR)
(CS) 5   6 (DSR)
(DR) 6   8 (CTS)
(ER)20   7 (RTS)
(SG) 7   5 (GND)

(2) For PC98

Controller side
(Signal name, pin No.)

Personal computer side
25 pin connector
(Signal name, pin No.)

(FG) 1   1 (FG)
($\overline{SD}$) 2   2 ($\overline{SD}$)
($\overline{RD}$) 3   3 ($\overline{RD}$)
(RS) 4   4 (RS)
(CS) 5   5 (CS)
(DR) 6   6 (DR)
(ER)20   20 (ER)
(SG) 7   7 (SG)
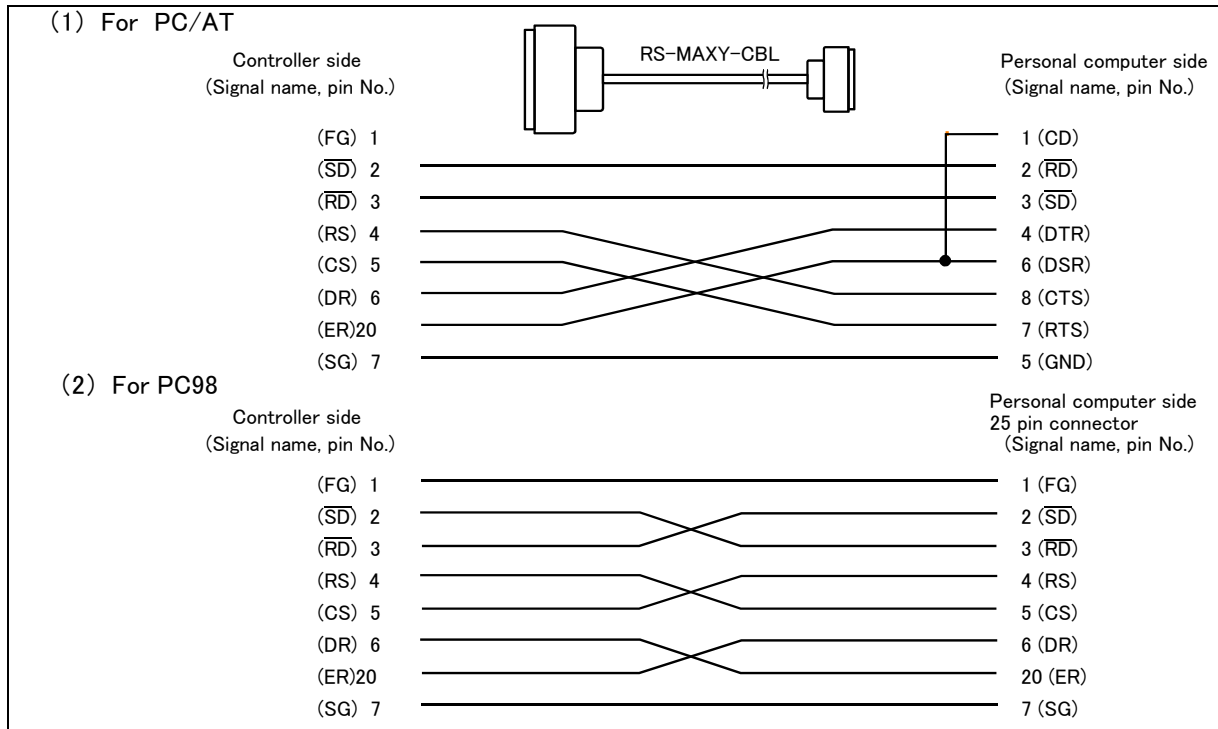
Fig.3-24 : Personal computer cabe connection

RS-MAXY-CBL

Robot side
Type:17JE-23250(D8A6) (DDK)

P/C side
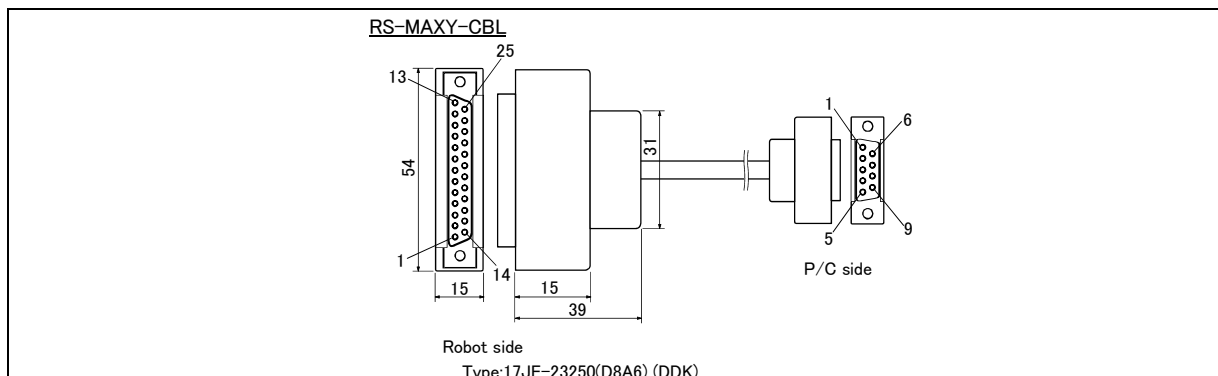
Fig.3-25 : Personal computer cabe connector

(6) Extended serial interface

■ Order type: ● 2A-RZ581

■ Outline

The extension serial interface is the option to add a serial communication function to the robot controller. One channel of RS-232C interface is provided in the front of the controller. By using the extension serial interface, more channels can be added in order to allow the use of a personal computer, vision sensor and PLC at the same time. Also, in addition to RS-232C communication, RS-422 communication, which is superior in noise resistance, is also supported.

Caution) The extension serial interface can only be used with the robot controller's main unit software version E1 or later.

■ Configuration

Table 3-26 : Configuration device

Part name	Type	Qty.	Remarks
Extended serial interface	2A-RZ581	1	
Instruction Manual	BFP-A8081	1	
Ferrite core	E04SR301334	1	Be sure to install this for noise countermeasure.

Table 3-27 : Procured by the customer

Part name	Type	Qty.	Remarks
Personal computer, vision sensor, etc.		From 1 unit.	Two channel per one board.
Communication cable (used when the length of the standard RS-232C cable is too short, or when RS-422 communication is implemented)	RS-232C or RS-422	From 1 cable.	

■ Specifications

Table 3-28 : Specifications

Item	Specifications	Remarks
Mountable optional slots	Slot 1 or 2	
Number of mountable interface cards	Maximum 2	
Number of channels	2	Channel 1: Dedicated to RS-232C Channel 2: Either RS-232C or RS-422
Communication data	ASCII data [Note1]	
Communication baud rate	2400 / 4800 / 9600 / 19200	This has been set to "9600" at shipment.
Parity	Notiong / Odd/ Even	This has been set to "even" at shipment.
Stop bit	1 / 2	This has been set to "2" at shipment.
End code	CR code/ CR code + LF code	This has been set to "CR code" at shipment.
Protocol	Nonprocedural / Procedural / Data link [Note2]	This has been set to "nonprocedural" at shipment.
Remarks	Capable of offering the same functions as provided by the standard RS-232C interface in the front of the controller	

Note1)Binary data communication is not supported.
Note2)Nonprocedural: Nonprocedural protocol with the personal computer support software
    Procedural: Procedural protocol with the personal computer support software
    Data link: Nonprocedural (ASCII data) protocol for data link between robot programs and a personalcomputer/PLC/vision sensor, etc.

■ Functions
(1) Controller communication function
　・This function allows to update and download programs as well as to monitor various statuses.
　・The personal computer support software (sold separately) is available as a robot controller programming support tool. Refer to (9), Page 74, "(10) Personal computer support software/Personal computer support software mini" of details.
(2) Data link function
　・The data link function allows to link numerical values and position data between robot programs and a personal computer using the MELFA-BASIC IV language (OPEN/PRINT/INPUT instruction).
　・Data can be exchanged one to one by specifying the COM number at the communication open destination.

■ Pin assignment
(1) RS-232C pin assignment
　　Refer to Page 65, "(5) Personal computer cable".

(2) RS-422 pin assignment
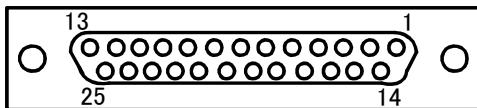
Fig.3-26 : D-SUB25 Pin Female Connector (RZ581 Board Side)

Pin no.	Abbreviated signal name	Signal name	Signal direction 2A-RZ581 ⇔ Device on other end
1	FG	Frame ground	
7, 9	SG	Signal ground	
13	TXD+(SDA)	Transmission data (+)	→
25	TXD-(SDB)	Transmission data (-)	→
11	DTR+(RSA)	Terminal ready (+)	→
23	DTR-(RSB)	Terminal ready (-)	→
12	RXD+(RDA)	Reception data (+)	←
24	RXD-(RDB)	Reception data (-)	←
10	DSR+(CSA)	Data set ready (+)	←
22	DSR-(CSB)	Data set ready (-)	←

(7) CC-Link interface

■ Order type: ● 2A-HR575

■ Outline

The CC-Link interface is the option to not only add bit data to the robot controller, but also to add CC-Link field network function that allows cyclic transmission of word data.

Caution) The CC-Link interface can only be used with the robot controller's main unit software version E1 or later.

■ Configuration

Table 3-29 : Configuration deviceon

Part name	Type	Qty.	Remarks
CC-Link interface	2A-HR575	1	
Instruction Manual	BFP-A8079	1	
Ferrite core	E04SR301334	1	Be sure to install this for noise countermeasure.

Table 3-30 : Procured by the customer

Part name	Type	Qty.	Remarks
Master station	QJ61BT11(Q series)	1	FX series products are not supported.
	AJ61QBT11(QnA series)		
	A1SJ61QBT11(QnAS series)		
	AJ61BT11(A series)		
	A1SJ61BT11(AnS series)		
	A80BD-J61BT11(personal computer board)		
Communication cable	−	1	Shielded 3-core twisted cable This cable may be manufactured by the customer.
Terminal resistor	−	1	110Ω or 130Ω is recommended.
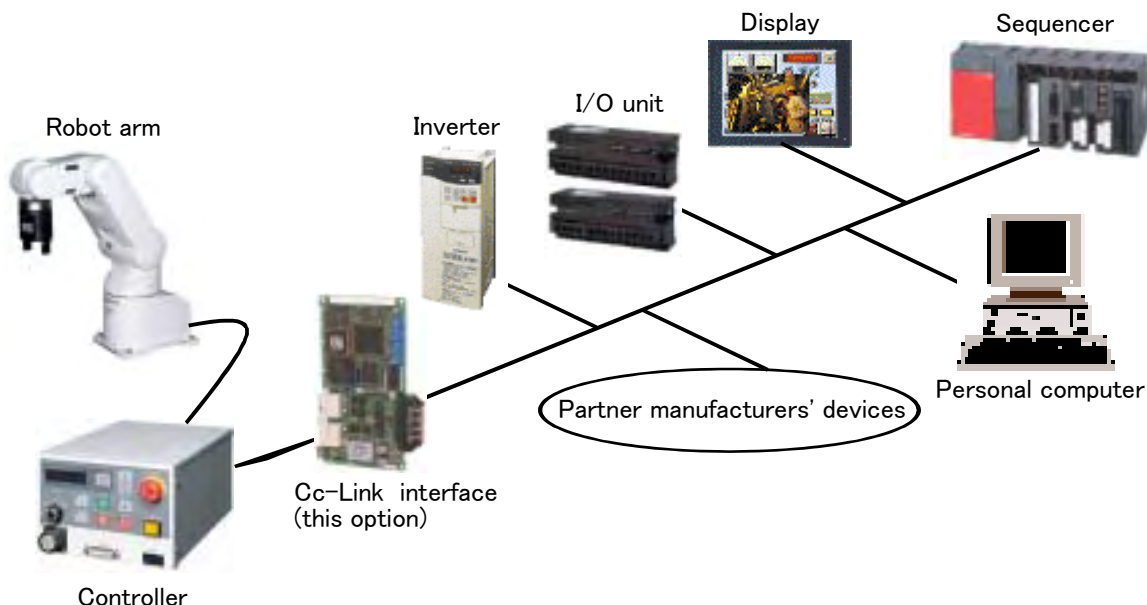
Fig.3-27 : Example of CC-Link Product Configuration

■ Specifications
　Table 3-31 : Specifications

Item			Specifications		Remarks
Communication function			Bit data and word data can be transmitted.		Word data are used by the registers.
Station type			Intelligent device station Note1)		
Support station			Local station		No master station function
Mountable option slot			Slot 2 only		
Number of mountable CC-Link interface cards			1		Multiple CC-Link interface cards cannot be inserted.
Number of stations			1 to 64 stations		When four stations are occupied, continuous station numbers are used. The station numbers are set by a DIP switch.
Transmission speed			10M/5M/2.5M/625K/156K bps		This is set by the rotary SW.
Number of occupied stations			One or four occupied stations can be set.		When four stations are occupied, continuous station numbers are used. The station numbers are set by a DIP switch.
Number of I/O points	Remote I/O	When one station is occupied	Input: 30 points	Output: 30 points	The last two points of 32 points cannot be used.
		When four stations are occupied	Input: 126 points	Output: 126 points	The last two points of 128 points cannot be used.
	Remote registers	When one station is occupied	Input: 4 registers	Output: 4 registers	One register consists of 16 bits.
		When four stations are occupied	Input: 16 registers	Output: 16 registers	

　Note1)The CC-Link interface supports neither the transient transmission function nor the FX series.

■ Functions
(1) Communication function
　　・ The number of usable points is 126 points maximum for bit control and 16 points maximum for word control.
　　・ Up to 2,048 points of input bit data can be monitored by a unit being connected. (Input only, output is disabled.)
　　・ Up to 256 points of input word data can be monitored by a unit being connected. (Input only, output is disabled.)

(2) Easy setup
　　・ The CC-Link interface card can be set by a rotary switch or DIP switch.
　　・No separate space is required to mount the CC-Link interface card as it is embedded in the robot controller (can only be mounted into slot 2).
　　・ Easy wiring since only four terminals need to be connected.
　　・ Dedicated commands have been added to MELFA-BASIC IV (robot programming language); thus, no complex interface programming is required.

(3) High-speed response
　　・The link scan time when connecting 64 stations is approximately 7.2 ms, achieving superior high-speed response performance.
　　・ A transmission speed can be selected from 10M, 5M, 2.5M, 625K and 156K bps according to the transmission distance.

(8) Ethernet interface

■ Order type: ● 2A-HR533

■ Outline

The Ethernet interface is the option to add an Ethernet communication function to the robot controller.

Caution) The Ethernet interface can only be used with the robot controller's main unit software version E2 or later.

■ Configuration
Table 3-32 : Configuration deviceon

Part name	Type	Qty.	Remarks
Ethernet interface	2A-HR533	1	
Instruction Manual	BFP-A8080	1	
Ferrite core	E04SR301334	1	Be sure to install this for noise countermeasure.

Table 3-33 : Procured by the customer

Part name	Type	Qty.	Remarks
Personal computer (A network interface is required.)	Windows 95/98/Me/NT 4.0/2000/XP compatible. Installed with TCP/IP network functions, including Linux OS (However, operation has not be verified.)	From 1 unit.	
Ethernet cable (Select either straight cable or cross cable depending on the connection mode.)	10BASE-T or 10BASE-5	From 1 cable.	

Table 3-34 : Items required as needed

Part name	Type	Qty.	Remarks
Hub (Required for use in LAN environment)	(Commercially sold)	1	
Windows compatible robot controller programming support tool for Mitsubishi CRn-500 series controllers	(Separately sold) Personal computer support software	1	
Windows compatible development tool	(Commercially sold) Microsoft Visual C++, Visual Basic, etc.	1	

■ Specifications
Table 3-35 : Specifications

Item	Specifications	Remarks
Mountable optional slots	Slot 1 only	
Number of mountable interface cards	1	
LAN interface	10BASE-T or 10BASE-5(changeover type)	
Transmission speed	10Mbps	
Connector specification	RJ-45	

A personal computer and the robot controller that communicates with that personal computer must be located on the same network. They cannot communication with each other crossing a firewall (from the Internet) or gateway (from another adjacent network, etc,). If such form of communication must be implemented, consider communicating via a server connected to the same network as that of the robot controller. Be cautious about safety and response performance in this case.

■ Functions

(1) Controller communication function
・ This function allows communication with the robot controller via Ethernet.
(Program upload/download, status monitoring, etc.)
The personal computer support software (sold separately) is available as a robot controller programming support tool.
・ This function allows communication with a maximum of 16 clients on other end.

(2) Data link function
・ The data link function allows to link numerical values and position data between robot programs and a personal computer using the MELFA-BASIC IV language (OPEN/PRINT/INPUT instruction).
・ Data can be exchanged one to one by specifying the COM number at the communication open destination.
・ This function allows to communicate with up to eight applications of clients on other end by changing COM numbers.
・ Either server mode or client mode can be selected as the TCP/IP function.
・ The customer needs to write application programs on the personal computer side.

(3) Real-time external control function
・The real-time external control function loads the position command data and performs operation in control cycle units of the robot. The joint, orthogonality and motor pulse can be specified as the position data. Also, this function monitors I/O signals and outputs signals at the same time.
・The data that can be monitored include the encoder feedback values, current command, and current feedback of the position data type mentioned above.
・ This function is valid only for the following models:
    RP-1AH/3AH/5AH series
    RV-1A series
    RV-2A/3AJ series
    RV-4A/5AJ/3AL/4AJL series
    RH-5AH/10AH/15AH series
    RV-6S/6SL/12S/12SL series
・ In order to control the robot, an application program on the personal computer side must be created by the customer. It must communicate one to one.

Table 3-36 : Software Versions and Functions of the Controller

Software version of the robot controller	Controller communication function	Data link function (server)	Data link function (server/client)	Real-time external control function
Versions A*, B*, C*, D* and E1	The Ethernet option is disabled.			
Versions E2 to E4	○	○	×	×
Versions F*, G* and H1 to H6	○	○	×	○
Versions H7 and later	○	○	○	○

○ ..... Can be used.
× ..... Cannot be used.

(9) Extension memory cassette

■ Order type: ● 2A-HR432

■ Outline

Used to increase the total number of teaching points in the robot program.

■ Configuration

Table 3-37 : Configuration device

Part name	Type	Qty.	Remarks
Extension memory cassette	2A-HR432	1	27,900 total teaching points With a battery backup feature

■ Specifications

Table 3-38 : Specifications

Items	Specifications	Remarks
External dimensions	Approx. 95(W)X65(D)X15(H) mm	Excluding the connection connector
Mass	Approx. 0.2 kg	
Connection method	Connection using a special connector	
Memory size [Note1)]	Teaching point number: 25,400 Steps number: 50,800 Program number: 100	The battery backup function is provided. Together with 2,500 points of standard teaching positions, the total number of teaching positions is 27,900 points.
Backup	Backup using the controller's internal battery	

Note1) As for the standard 2,500 points, after adding an expansion memory cassette, the information in all backup memory areas in the controller is copied into the expansion memory cassette. Therefore, please note that if the expansion memory cassette is removed after it has been added, there will be no program left in the controller.

[CAUTION]
· Inserting and removing the memory cassette
  A memory cassette cannot be inserted or removed while the control power is on. Please turn off the control power before handling the memory cassette to avoid destroying the memory information in the cassette.

· Memory backup
  Retaining the contents of memory in a memory cassette is not covered by the warrantee when the memory cassette is removed from the control unit. Nonetheless, memory is retained under the following conditions.
  (Conditions) If the power has been on for at least a half-hour before the power is turned off and the cassette is removed, the contents of memory can be retained for approximately one hour. (Not covered by the warrantee.)

■ Installation

The following describes a sample installation to the R6x2CPU.

1) Completely back up the memory information in the robot controller using the personal computer support software. (This must be performed as a preventive measure in case the contents of the internal memory are destroyed while inserting a memory cassette.)

2) Turn off the control power.

⚠ CAUTION   Turn off the primary power.
Failure to observe this could lead to electric shock accidents.

3) Open the controller front door.

4) Attach a memory cassette to the control unit.

・As shown in Fig. 3-28, insert the memory cassette all the way to the back with the " $\frac{\blacktriangle}{R}$ " facing up.

・Securely tighten the fixing screws.

Note) Be careful not to over-tighten the screws, as it may deform the memory cassette.

5) Turn on the control power.

Error C.0023 will occur when using the software version J1 edition.

Press the reset button to clear the error.

At this point, a new file system has been created in the memory cassette.

[CAUTION]

The programs that are stored in the control unit will be copied into the memory cassette; they will be deleted from the memory in the control unit. Please be careful not to remove the memory cassette, since if you remove it, there will be no program information residing in the controller (the information is in the memory cassette). Although the program information (****.MB4) is copied into the memory cassette, the parameter information (****.PRM) is still stored in the control unit.
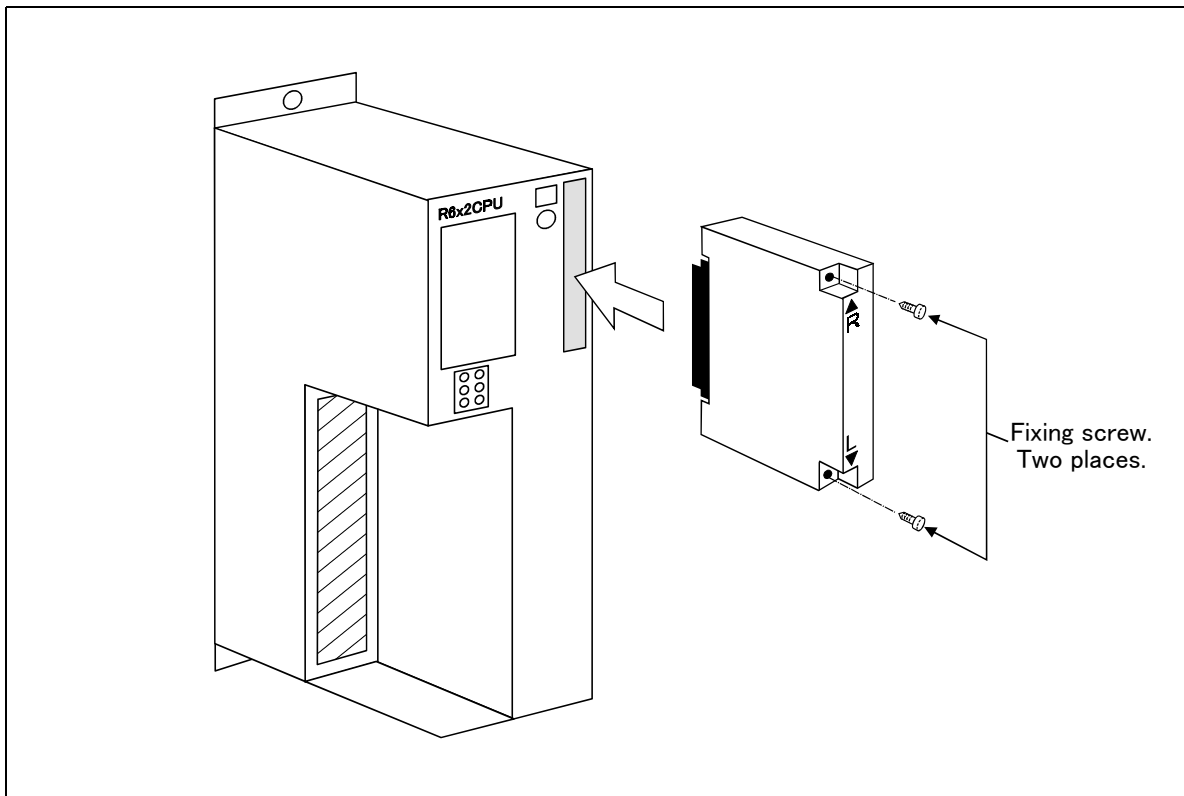
Fig.3-28 : Installation of extension memory cassette

(10) Personal computer support software/Personal computer support software mini

■ Order type :　● Personal computer support software
　　　　　　　　　　　*For windows CD-ROM 　　: 3A-01C-WINE
　　　　　　　　● Personal computer support software mini
　　　　　　　　　　　*For windows CD-ROM 　　: 3A-02C-WINE

■ Outline

This is handy software that fully uses the personal computer functions. It can be used in various stages from the robot specifications study (tact study, etc.) to the design support (creation and editing of programs), start up support (execution, control and debugging of program), and maintenance (remote maintenance.)
The "personal computer support software" which supports these function fully, and the "personal computer support software mini" which does not have the simulation function are available. Select according to the required application.

■ Configuration
　　Table 3-39 : Product configuration

Part name	Type	Medium	Remarks
Personal computer support software	3A-01C-WINE	CD-ROM	One operation manual included
Personal computer support software mini	3A-02C-WINE	CD-ROM	One operation manual included

■ Features
　　(1) Simple operation with guidance method and menu method
　　　　The Windows standard is used for windows operation, so the controller initialization and startup operations can be carried out easily by following the instructions given on the screen. Even a beginner can easily carry out the series of operations from program creation to execution.
　　(2) Increased work efficiency with ample support functions
　　　　The work efficiency is greatly improved with the multi-window method that carries out multiple steps and displays in parallel. The renumbering function, and copy, search, syntax check and step execution are especially sufficient, and are extremely useful when editing or debugging the program.
　　　　With the simulation function support, the program can be debugged and the tact checked before starting the machine at the site. This allows the on-site startup work efficiently to be greatly improved.
　　(3) Increased maintenance efficiency with remote maintenance function
　　　　With remote operations over a telephone line, the robot's operation status can be monitored without going to the site. Losses incurred while moving to the site can be reduced, and the time required to investigate the trouble and determine measures to be taken can be shortened.
　　(4) The maintenance forecast function increases the efficiency of maintenance work. Analyze the load condition while the robot is actually operating. Based on this analysis, calculate the time for maintenance, such as lubrication and belt replacement. By utilizing this information, the line stop time as well as the maintenance costs can be reduced.
　　　　Note) The maintenance forecast function is supported by Personal Computer Support Software Version E1 or later.
　　(5) The position recovery support function increases the recovery efficiency in the event of origin position displacement. This function compensates the origin settings and position data by just reproducing several previous teaching points when hand and/or arm displacement occurs, when replacing the motor and the belts, or when reloading the robot. This function can reduce the time required for recovery.
　　　　Note) The position recovery support function is supported by Personal Computer Support Software Version E1 or later.

■ Functions

Table 3-40 : Functions

Function		Functional existence[Note1]		Details
Compatible model		○	○	Personal computer running Microsoft Windows 95/98/NT 4.0
Program editing functions	Editing functions	○	○	・MELFA BASIC IV language compatible ・Multiple editing screen simultaneously display ・Command input, comment writing ・Position data editing ・File operation (writing to controller, floppy disk, personal computer) ・Search and replace function (using characters, line Nos., labels) ・Copy, cut, paste, insert (per character, line), undo (per command statement, position conversion) ・Line No. automatic generation, renumbering ・Batch syntax check ・Command template ・Position conversion batch editing ・Position variable template ・Print, print preview
	Control functions	○	○	・Program file control (list, copy, movement, delete, content comparison, name change, protect)
	Debugging functions	○	○	・Direct editing of program in controller ・Confirmation of robot program operation (step execution, direct execution) ・Tact time measurement[Note2]
Simulation function[Note3]		○	×	・Off-line simulation of robot program operation using CG (computer graphics) ・Tact time calculation
Monitor functions		○	○	・Robot operation monitor (robot operation state, stop signal, error monitor, program monitor (execution program, variables), general-purpose input/output signals (forced output possible), dedicated input/output signals, operation confirmation (operation range, current position, hand, etc.) ・Operation monitor (working time statistics, production information, robot version) ・Servo monitor (position, speed, current, load, power)
Maintenance function		○	○	・Parameter setting ・Batch, divided backup
Remote maintenance function		○	○	・Monitoring and maintenance of robot state at remote site using telephone line. (A separate modem is required for this function.)

Personal computer support software mini
(3A-02C-WINE)

Personal computer support software
(3A-01C-WINE)

Note1)The functions included with the personal computer support software and the personal computer support software mini are shown below. ○ : Function provided   × : Function not provided

Note2)When using the ″personal computer support software mini″, connect with the controller and measure.

Note3)A simulation function is available only with ″MELFA-BASIC IV ″.

3.10 Maintenance parts

The consumable parts used in the controller are shown in Table 3-41. Purchase these parts from your dealer when required. Some Mitsubishi-designated parts differ from the maker's standard parts. Thus, confirm the part name, robot arm and controller serial No. and purchase the parts from your dealer.

Table 3-41 : Contloller consumable parts list

No.	Part name	Type	Qty.	Usage place	Manufacturer
1	Lithium battery	ER6 BKO-NC2157H01	1	Control unit	Mitsubishi Electric System & Service;Co.,Ltd

4 Software

4.1 List of commands

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

Table 4-1 : The available new functions in MELFA-BASIC IV

Class	Command example	Function
Robot Status Variable	P_TOOL	keep current tool length
	M_SPD	keep current speed (linear/circular interpolation)
Built-in functions	ABS	Produces the absolute value
	VAL	Converts a character string into a numeric value
	ATN	Calculates the arc tangent
	STR$	Converts the numeric expression value into a decimal character string
	ZONE	Check current position area
Operation function	P1=P1*P2	Relative calculation of position data
	M1=M1*M2	Multiplication of numerical variable
	P1.X=10	Operation of the position element data
Conditional branching	SELECT CASE	More than one condition branch
	ON GOSUB	Condition branch by the value
	WHILE WEND	Repeat with condition
Optimum acceleration/ deceleration control	LOADSET	Load condition setting
	OADL	valid/invalid setting for the optimum acceleration/deceleration
Float control (compliance in the XYZ coordinate system)	CMP POS	Compliance control
	CMPG	Force control
Parallel execution (Multitask)	XRUN, XSTP, XRST, XLOAD, XCLR	Parallel executions of another task, the stops, the resets the clear, and, the loads
Conveyor trucking [Special specification]	TRKON, TRKOFF	Valid/invalid of the trucking
	TRBASE	Setting the base coordinate for the trucking

(1) MELFA-BASIC Ⅳ commands

Table 4-2 : List of MELFA-BASIC IV commands

Type	Class	Function	Input format (example)
Position and operation control	Joint interpolation	Moves to the designated position with joint interpolation.	MOV P1
	Linear interpolation	Moves to the designated position with linear interpolation.	MVS P1
	Circular interpolation	Moves along a designated arc (start point → passing point → start point (end point)) with 3-dimensional circular interpolation (360 degrees).	MVC P1,P2,P1
		Moves along a designated arc (start point → passing point → end point) with 3-dimensional circular interpolation.	MVR P1,P2,P3
		Moves along the arc on the opposite side of a designated arc (start point → reference point → end point) with 3-dimensional circular interpolation.	MVR2 P1,P9,P3
		Moves along a set arc (start point → end point) with 3-dimensional circular interpolation.	MVR3 P1,P9,P3
	Speed designation	Designates the speed for various interpolation operations with a percentage (0.1% unit).	OVRD 100
		Designate the speed for joint interpolation operation with a percentage (0.1% unit).	JOVRD 100
		Designates the speed for linear and circular interpolation with a numerical value (mm/s unit).	SPD 123.5
		Designates the acceleration/deceleration time as a percentage in respect to the predetermined maximum acceleration/deceleration. (1% unit)	ACCEL 50,80
		Automatically adjusts the acceleration/deceleration according to the parameter setting value.	OADL ON
		ets the hand and work conditions for automatic adjustment of the acceleration/deceleration.	LOADSET 1,1
	Operation	Adds a process unconditionally to the operation.	WTH
		Adds a process conditionally to the operation.	WTHIF
		Designates smooth operation.	CNT 1,100,200
		Designates the positioning completion conditions with a No. of pulses.	FINE 200
		Turns the servo power ON/OFF for all axes.	SERVO OFF
		Limits the operation of each axis so that the designated torque is not exceeded.	TORQ 4,10
	Position control	Designates the base conversion data.	BASE P1
		Designates the tool conversion data.	TOOL P1
	Pallet	Defines the pallet.	DEF PLT 1,P1,P2,P3,P4,5,3,1
		Operates the pallet grid point position.	PLT 1,M1

Type	Class	Function	Input format (example)
Program control	Branching	Branches unconditionally to the designated place.	GOTO 120
		Branches according to the designated conditions.	IF M1=1 THEN GOTO 100 ELSE GOTO 20 END IF
		Repeats until the designated end conditions are satisfied.	FOR M1=1 TO 10 NEXT
		Repeats while the designated conditions are satisfied.	WHILE M1<10 WEND
		Branches corresponding to the designated expression value.	ON M1 GOTO 100,200,300
		Executes program block corresponding to the designated expression value..	SELECT CASE 1 BREAK CASE 2 BREAK END SELECT
		Moves the program process to the next line.	SKIP
	Subroutine	Executes the designated subroutine. (Within program)	GOSUB 200
		Returns from the subroutine.	RETURN
		Executes the designated program.	CALLP "P10",M1,P1
		Defines the program argument executed with the CALLP command.	FPRM M10,P10
		Executes the subroutine corresponding to the designated expression value.	ON M1 GOSUB 100,200,300
	Interrupt	Defines the interrupt conditions and process.	DEF ACT 1, M1=1 GOTO 100
		Enables/disables the interrupt.	ACT 1=1
		Defines the start line of the program to be executed when an interrupt is generated from the communication line.	ON COM(1) GOSUB 100
		Enables the interrupt from the communication line.	COM(1) ON
		Disables the interrupt from the communication line.	COM(1) OFF
		Stops the interrupt from the communication line.	COM(1) STOP
	Wait	Designates the wait time, and the output signal pulse output time. (0.01s unit)	DLY 0.5
		Waits until the variable becomes the designated value.	WAIT M_IN(1)=1
	Stop	Stops the program execution.	HLT
		Generates an error. During program execution, continue, stop or servo OFF can be designated.	ERROR 9000
	End	Ends the program execution.	END
Hand	Hand open	Opens the designated hand.	HOPEN 1
	Hand close	Closes the designated hand.	HCLOSE 1
Input/output	Assignment	Defines the input/output variables.	DEF IO PORT1=BIT,0
	Input	Retrieves the general-purpose input signal.	M1=M_IN (1)
	Output	Calls out the general-purpose output signal.	M_OUT(1) =0
Parallel execution	Mechanism designation	Acquires the mechanism with the designated mechanism No.	GETM 1
		Releases the mechanism with the designated mechanism No.	RELM 1
	Selection	Selects the designated program for the designated slot.	XLOAD 2,"P102"
	Start/stop	Carries out parallel execution of the designated program.	XRUN 3,"100",0
		Stops parallel execution of the designated program.	XSTP 3
		Returns the designated program's execution line to the head and enters the program selection enabled state.	XRST 3

Type	Class	Function	Input format (example)
Others	Definition	Defines the integer type or real number type variable.	DEF INTE KAISUU
		Defines the character string variable.	DEF CHAR MESSAGE
		efines the layout variable. (Up to 3-dimensional possible)	DIM PDATA(2,3)
		Defines the joint variable.	DEF JNT TAIHI
		Defines the position variable.	DEF POS TORU
		Defines the function.	DEF FNTASU(A,B)=A+B
	Clear	Clears the general-purpose output signal, variables in program, variables between programs, etc.	CLR 1
	File	Opens a file.	OPEN ″COM1:″ AS #1
		Closes a file.	CLOSE #1
		Inputs data from a file.	INPUT# 1,M1
		Outputs data to a file.	PRINT# 1,M1
	Comment	Describes a comment.	REM ″ABC″
	Label	Indicates the branching destination.	*SUB1

4.2 List of parameters

(1) List of parameters
show the main parameter in the Table 4-3.

Table 4-3 : List of parameters

Parameter		Details
Standard tool coordinates.	MEXTL	Set the default value for the tool data. Unit: mm or deg.
Standard base coordinates	MEXBS	Set the relation of the world coordinate system and robot coordinate system. Unit: mm or deg.
XYZ operation range	MEPAR	Designate the overrun limit value for the world coordinate system.
JOINT operation range	MEJAR	Set the overrun limit value for each joint axis.
Free plane limit		This is the overrun limit set with the free plane. Create a plane with the three coordinates x1, y1, z1 to x3, y3, z3, and set the outer side of the plane as the outside operation range (error). The following three types of parameters are used.
	SFC1P : SFC8P	Eight types of free plane limits can be set in SFC1P to SFC8P. There are nine elements, set in the order of x1, y1, z1, x2, y2, z2, x3, y3, z3.
	SFC1ME : SFC8ME	Designate which mechanism to use eight types of set free plane limits. The mechanism No. to use is set with 1 to 8.
	SFC1AT : SFC8AT	Set the validity of the eight types of set free plane limits. (Valid 1/Valid 2/invalid = 1/-1/0)
User-defined area		An area (cube) defined with two XYZ coordinate points can be designated and that area set as the outside operation range. Furthermore, a signal can be output when the axis enters that area. Up to eight types of area can be designated.
	AREA1P1 : AREA8P1	Designated the 1st point of the area. There are eight elements, set in the order of x, y, z, a, b, c, L1, L2. (L1 and L2 are the additional axes.)
	AREA1P2 : AREA8P2	Designated the 2nd point of the area. There are eight elements, set in the order of x, y, z, a, b, c, L1, L2. (L1 and L2 are the additional axes.)
	AREA1ME : AREA8ME	Designate which mechanism to use the eight types of set area. The mechanism No. to use is set with 1 to 8
	AREA1AT : AREA8AT	Designate the area check type. (Invalid/zone/interference = 0/1/2) Zone: The dedicated output signal USRAREA turns ON. Interference: An error occurs..
Automatic return setting	RETPATH	Set to restart the program after returning to the interrupt position when resuming operation after an interruption.
Buzzer ON/OFF	BZR	Designate whether to the turn buzzer ON or OFF.
Jog setting	JOGJSP	Designate the joint jog and step operation speed. (Set dimension H/L amount, max. override.)
	JOGPSP	Designate the linear jog and step operation speed. (Set dimension H/L amount, max. override.)
Jog speed limit value	JOGSPMX	Limit the operation speed during the teaching mode. Max. 250[mm/s]
Hand type	HANDTYPE	Set the hand type of the single/double solenoid, and the signal No. (Single/double = S/D) Set the signal No. after the hand type. Example) D900
Stop input B contact designation	INB	Change the dedicated input (stop) between the A contact and B contact.
User-designated origin	USERORG	Designate the user-designated origin position.

Parameter		Details
Program selection memory	SLOTON	Select the program selected previously when initializing the slot. The non-selected state will be entered when not set.
Communication setting	CBAU232	Set the baud rate.
	CLEN232	Set the character length.
	CPRTY232	Set the parity.
	CSTOP232	Set the stop bit.
	CTERM232	Set the end code.
Slot table	SLT1 : SLT32	Make settings (program name, operation type, order of priority, etc.) for each slot during slot initialization.
No. of multi-tasks	TASKMAX	Designate the No. of programs to be executed simultaneously. (Max. 32)
Select the function of singular point adjacent alarm	MESNGLSW	Designate the valid/invalid of the singular point adjacent alarm. (Invalid/Valid = 0/1) When this parameter is set up "VALID", this warning sound is buzzing even if parameter: BZR (buzzer ON/OFF) is set up "OFF".
Display language.[Note1] 表示言語 [注 1)]	LNG	Change the language to display on the LCD display of teaching pendant. ティーチングボックスの表示 LCD などに表示する言語を切り替えます。

注 1)The procedure of Language as shown in "(2) Change the display language / 表示言語の切り替え".
注 1) 表示言語切り替え方法の詳細を "(2) Change the display language / 表示言語の切り替え" に示します。

（2）Change the display language / 表示言語の切り替え

The language to display on the LCD display of teaching pendant can be changed by "the display language parameter". (Japanese or English)

Show the details of the parameter in the Table 4-3. Refer to the separate "Instruction Manual/Detailed Explanation of Functions and Operations" for details on changing the parameter.

The parameter is set up based on the order specifications before shipment. Order to dealer when the instruction manual of the other language is necessity.

More, the caution seals that stuck on the robot arm and the controller are made based on the language of the order specification. Use it carefully when selecting the other language.

　表示言語設定パラメータによって、ティーチングボックスの表示 LCD などに表示する言語を切り替えることができます。（日本語、または英語）Table 4-3 にそのパラメータの詳細を示します。パラメータの変更方法は、別冊の「取扱説明書／機能と操作の詳細解説」を参照願います。

　なお、出荷時はご注文仕様に基づき弊社で設定いたします。別の言語の取扱説明書をご希望の場合はご用命願います。

　また、ロボット本体とコントローラに貼り付けてある注意シールは、ご注文仕様に基づいた言語で製作いたします。本パラメータを変更して言語を切り替えてご使用の場合はご注意願います。

Table 4-4 : Display language parameter / 表示言語設定パラメータ

Parameter パラメータ	Parameter name パラメータ名	No. of arrays No. of characters 配列数 文字数	Details explanation 内容説明	Default setting 出荷時 設定
Display language 表示言語設定	LNG	Character string 1 文字列 1	Set up the display language. "JPN" : Japanese "ENG" : English The following language is changed. （1）The display LCD of teaching pendant. （2）Personal computer support software. 　*alarm message of the robot. 　*Parameter explanation list. （3）Alarm message that read from the robot with external communication. (Standard RS232C, Extended serial I/F, Ethernet I/F) 表示言語を設定します。 "JPN" : 日本語表示 "ENG" : 英語表示 以下に示す表示言語が変更されます。 （1）ティーチングボックスの表示 LCD （2）パソコンサポートソフトウェア 　・ロボットのアラームメッセージ 　・パラメータ説明リスト （3）外部通信でロボットから読み出したアラームメッセージ　（標準 RS232C、増設シリアルインタフェース、イーサネットインタフェース）	1

5 Instruction Manual

5.1 The details of each instruction manuals

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

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

Safety Manual	Explains the common precautions and safety measures to be taken for robot handling, system design and manufacture to ensure safety of the operators involved with the robot.
Standard Specifications	Explains the product's standard specifications, factory-set special specifications, option configuration and maintenance parts, etc. Precautions for safety and technology, when incorporating the robot, are also explained.
Robot Arm Setup & Maintenance	Explains the procedures required to operate the robot arm (unpacking, transportation, installation, confirmation of operation), and the maintenance and inspection procedures.
Controller Setup, Basic Operation and Maintenance	Explains the procedures required to operate the controller (unpacking, transportation, installation, confirmation of operation), basic operation from creating the program to automatic operation, and the maintenance and inspection procedures.
Detailed Explanation of Functions and Operations	Explains details on the functions and operations such as each function and operation, commands used in the program, connection with the external input/output device, and parameters, etc.
Troubleshooting	Explains the causes and remedies to be taken when an error occurs. Explanations are given for each error No.
Extended serial interface	Explains the specifications, functions and operations of the expansion serial interface optional.

CC–Link interface	Explains the specifications, functions and operations of the CC–Link interface optional.
ETHERNET interface	Explains the specifications, functions and operations of the ETHERNET interface optional.
Personal computer Support software	Explains the specifications, functions and operations of the Personal computer Support software optional.

6 Safety

6.1 Safety

Measures to be taken regarding safety of the industrial robot are specified in the "Labor Safety and Sanitation Rules". Always follow these rules when using the robot to ensure safety.

6.1.1 Self-diagnosis stop functions

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

Table 6-1 : Self-diagnosis stop functions

No.	Function		Details	Remarks
1	Overload protection function		Activates when the total servo current time exceeds the specified value.	The drive circuit is shut off. The robot stops, and an alarm displays.
2	Overcurrent diagnosis function		Activates when an overcurrent flows to the motor circuit.	The drive circuit is shut off. The robot stops, and an alarm displays.
3	Encoder disconnection diagnosis function		Activates when the encoder cable is disconnected.	The drive circuit is shut off. The robot stops, and an alarm displays.
4	Deflection over diagnosis function		Activates when an error occurs between the command value and actual position, and the error exceeds the specified amount.	The drive circuit is shut off. The robot stops, and an alarm displays.
5	AC power voltage drop diagnosis function		Activates when the AC power voltage drops below the specified value.	The drive circuit is shut off. The robot stops, and an alarm displays.
6	CPU error detection function		Activates when an error occurs in the CPU.	The drive circuit is shut off. The robot stops, and an alarm displays.
7	Overrun prevention function	Software limit detection	This is the limit provided by the software to enable operation only in the operation range.	The drive circuit is shut off. The robot stops, and an alarm displays.
		Mechanical stopper	This is the mechanical stopper provided outside the software.	The robot mechanically stops, and function 1 or 2 activates.

Table 6-2 : List of stop functions

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

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

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

	Signal	Command	Functions	Usage method
Input	External emergency stop	(Input signal)	This servo power is shut off, and the robot stops immediately.	Externally installed emergency stop switch. Door switch on safety protection fence. Stopping at high-level error occurrence.
	Stop	STOP	The program execution is stopped, and the robot stops. The servo power is not shut off.	The robot is stopped when a peripheral device fault occurs. The servo power is not shut off.
	Servo OFF	SRVOFF	The servo power can be shut off.	The robot is stopped when a peripheral device fault occurs. The servo power is not shut off.
	Automatic operation enable	AUTOENA	Disables automatic operation when inactive.	Door switch on safety protection fence
Output	In servo ON	SRVON	The servo power ON/OFF state is output.	The servo power ON/OFF state is shown and alerted with the display lamps.
	Waiting	STOP	Outputs that the robot is temporarily stopped.	The temporary stop state is shown and alerted with the display lamps.
	In alarm	ERRRESET	Outputs when an alarm occurs in the robot.	The alarm state is shown and alerted with the display lamps.

[Caution] The external emergency stop input is prepared as a b contact for safety proposes. Thus, if the emergency stop input circuit is opened when the robot is started up, the robot will not operate. Refer to "Fig. 6-1 Example of safety measures" for details.

6.1.3 Precautions for using robot

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

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

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

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

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

(5) Daily inspection and periodic inspection
- lways inspect the robot before starting daily operations and confirm that there are no abnormalities.
- Set the periodic inspection standards in view of the robot's ambient environment and operation frequency, and perform periodic inspections.
- Make records when periodic inspections and repairs have been done, and store the records for three or more years.

6.1.4 Safety measures for automatic operation

(1) Install safety fences so that operators will not enter the operation area during operation and indicate that automatic operation is in progress with lamps, etc.
(2) Create signals to be given when starting operation, assign a person to give the signal, and make sure that the operator follows the signals.

6.1.5 Safety measures for teaching

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

6.1.6 Safety measures for maintenance and inspections, etc.

Turn the power OFF and take measures to prevent operators other than the relevant operator from pressing the start switch when performing inspections, repairs, adjustments, cleaning or oiling.
If operation is required, take measures to prevent hazards caused by unintentional or mistaken operations.
(1) Specify and follow items such as procedures related to maintenance work, etc.
(2) Take measures so that operation can be stopped immediately in case of trouble, and measures so that operation can be restarted.
(3) Take measures with the robot start switch, etc., to indicate that work is being done.
(4) Take measures so that the work supervisor can immediately stop the robot operation when trouble occurs.
(5) The operator must have completed special training regarding safety. (Training regarding industrial robots and work methods, etc.)
(6) Create signals to be used when several operators are working together.

6.1.7 Examples of safety measures

Two emergency stop input circuits are prepared on the user wiring terminal block of the controller. Create a circuit as shown below for safety measures
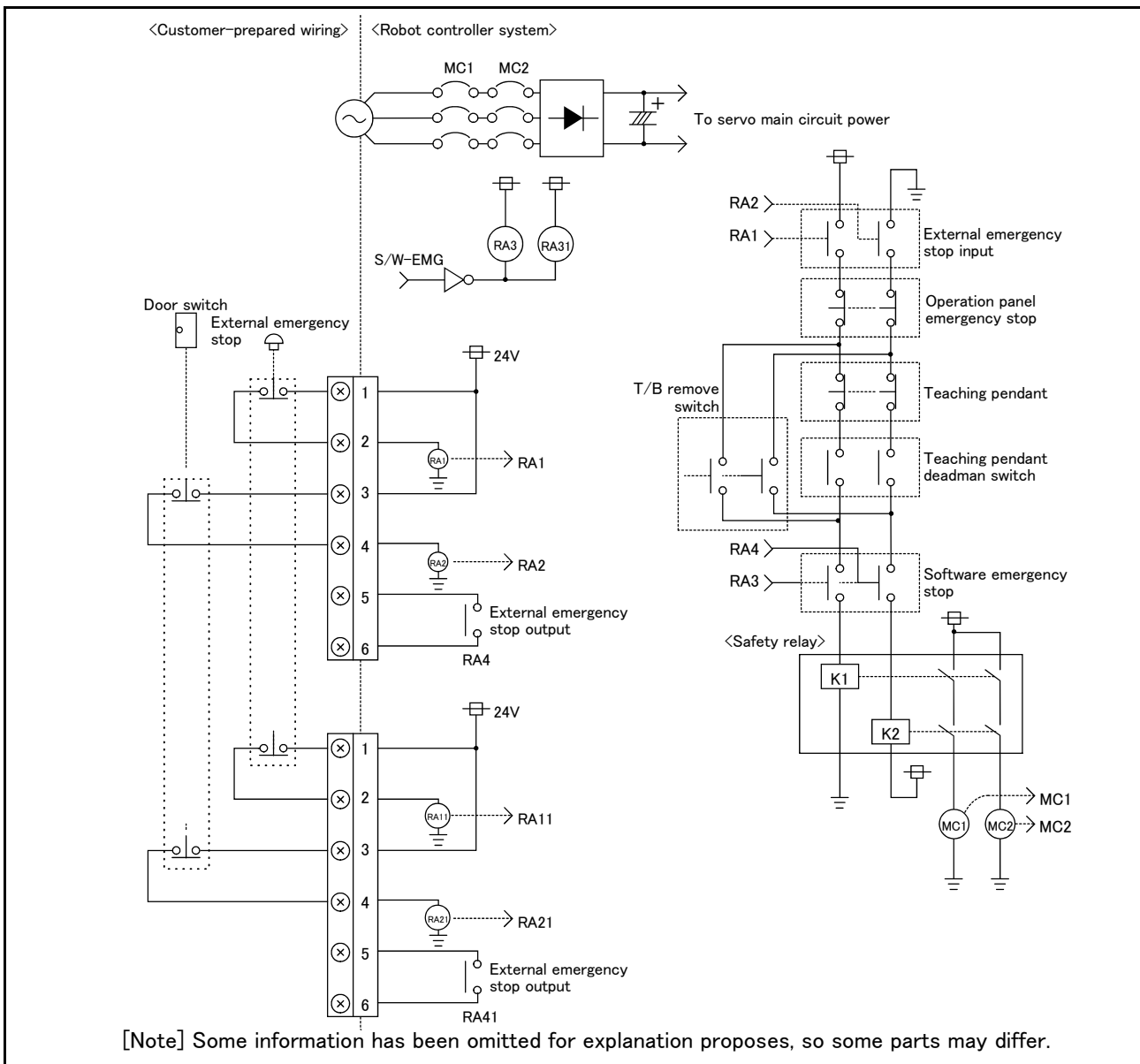
Fig.6-1 : Example of safety measures

(1) Use a 2-contact type switch for all switches.
(2) Install a limit switch on the safety fence's door. With a constantly open contact (a contact), wire to the door switch input terminal so that the switch turns ON (is conducted) when the door is closed, and turns OFF (is opened) when the door is open.
(3) Use a 2b contact manual-return type operator emergency stop switch.
(4) Classify the faults into minor faults (faults that are easily restored and that do not have a great effect) and major faults (faults that cause the entire system to stop immediately, and that require care in restoration), and wire accordingly.

[Caution] The emergency stop input(terminal block) on the user wiring in the controller can be used for safety measures as shown in Fig. 6-1. Note that there are limits to the No. of switch contacts, capacity and cable length, so refer to the following and install.
・Switch contact.......Prepare a 2-contact type.
・Switch contact capacity.......Use a contact that operates with a switch contact capacity of approx. 1mA to 100mA/24V.
・Cable length..............................The length of the wire between the switch and terminal block must be max. 15m or less.

[Reference] The specifications of the RA1 and RA2 coil shown in Fig. 6-1 are as follow.
・Rated voltage.............................DC24V ± 10%
・Rated excitation current......12.5mA ± 10%（at25 deg.）
＊ Note that these specifications are subject to change without prior notice for modification purposes.

The emergency stop circuit in the robot is a duplex type to ensure safety.

Thus, if a 1b contact type is used, faults such as fusing in the emergency stop circuit will not be detected, and could lead to fires.

If a 1b contact type is used and the emergency stop is input with only one side (across No. 1-2 or No. 5-6), the contact fusing alarm will occur, and resetting of the alarm will not be possible.

6.2 Working environment

Avoid installation in the following places as the equipment's life and operation will be affected by the ambient environment conditions. When using in the following conditions, the customer must pay special attention to the preventive measures.

(1) Power supply
・Where the voltage fluctuation will exceed the input voltage range.
・Where a momentary power failure exceeding 20ms may occur.
・Where the power capacity cannot be sufficiently secured.

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

(3) Temperature and humidity
・Where the atmospheric temperature exceeds 40 degree , lower than 0 degree.
・Where the relative humidity exceeds 85%, lower than 45%, and where dew may condense.
・Where the robot will be subject to direct sunlight or near heat generating sources such as heaters.

(4) Vibration
・Where excessive vibration or impact may be applied. (Use in an environment of 34m/s^2 or less during transportation and 5m/s^2 or less during operation.)

(5) Installation environment
・Where strong electric fields or magnetic fields are generated.
・Where the installation surface is rough. (Avoid installing the robot on a bumpy or inclined floor.)

6.3 Precautions for handling

(1) This robot has brakes on all axes. The precision of the robot may drop, looseness may occur and the reduction gears may be damaged if the robot is moved with force with the brakes applied.
(2) Avoid moving the robot arm by hand. When unavoidable, gradually move the arm. If moved suddenly, the accuracy may drop due to an excessive backlash, or the backed up data may be destroyed.
(3) Note that depending on the posture, even when within the movement range, the wrist section could interfere with the base section. Take care to prevent interference during jog. [Note1)]
(4) The robot arm is configured of precision parts such as bearings. Grease is used for lubricating these parts. When cold starting at low temperatures or starting operation after long-term stoppage, the position accuracy may drop or servo alarms may occur. If these problems occur, perform a 5 to 10 minute running-in operation at a low speed (about a half of normal operating speed).
(5) The robot arm and controller must be grounded with Class D grounding to secure the noise resistance and to prevent electric shocks.
(6) The items described in these specifications are conditions for carrying out the periodic maintenance and inspections described in the instruction manual.
(7) When using the robot arm on a mobile axis or elevating table, the machine cables enclosed as standard configuration may break due to the fixed installation specifications. In this case, use the machine cable extension (for flexed)″ factory shipment special specifications or options.
(8) If this robot interferes with the workpiece or peripheral devices during operation, the position may deviate, etc. Take care to prevent interference with the workpiece or peripheral devices during operation.
(9) Do not attach a tape or a label to the robot arm and the controller. If a tape or a label with strong adhesive power, such as a packaging tape, is attached to the coated surfaces of the robot arm and controller, the coated surface may be damaged when such tape or label is peeled off.
(10) If the robot is operated with a heavy load and at a high speed, the surface of the robot arm gets very hot. It would not result in burns, however, it may cause secondary accidents if touched carelessly.
(11) Do not shut down the input power supply to stop the robot. If the power supply is frequently shut down during a heavy load or high-speed operation, the speed reducer may be damaged, backlash may occur, and the program data may be destroyed.

Note1)Jog operation refers to operating the robot manually using the teaching pendant.

(12) If the J1, J2 and J3 axes collide with the mechanical stopper during the automatic operation of the robot, it is necessary to replace the resin part of the mechanical stopper unit. For the replacement of the resin parts, please contact Mitsubishi or Mitsubishi's dealer.
If the resin part is not replaced, the mechanism unit and the speed reducer may be damaged significantly when the axes collide with the mechanical stopper next or subsequent time.

(13) During the robot's automatic operation, a break is applied to the robot arm when the input power supply is shut down by a power failure, for instance. When a break is applied, the arm may deviate from the operation path predetermined by automatic operation and, as a result, it may interfere with the mechanical stopper depending on the operation at shutdown. In such a case, take an appropriate measure in advance to prevent any dangerous situation from occurring due to the interference between the arm and peripheral devices.
Example) Installing a UPS (uninterruptible power supply unit) to the primary power source in order to reduce interference.

(14) Do not conduct an insulated voltage test. If conducted by mistake, it may result in a breakdown. If conducting an insulation test, although it is not covered by warranty, set the leakage current to 100 mA. If a leakage current of 10 mA is set, a low measurement value will be shown due to the leakage current of the built-in AC line filter.

7 Appendix
Appendix 1 : Specifications discussion material

■ Customer information

Company name		Name	
Address		Telephone	

■ Purchased mode

Specification	Type	
Standard specification	☐ RV-12S	☐ RV-12SL
Clean specification	☐ RV-12SC	☐ RV-12SLC

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

Item		Standard specifications	Special shipping specifications
Robot arm	Machine cable	☐ 7m fixed type	☐ 10m fixed type ☐ 15m fixed type ☐ 5m flexed type ☐ 10m flexed type ☐ 15m flexed type
Controller	Controller structure	☐ Floor type	

■ Options (Installable after shipment)

Item			Provision, and specifications when provided.
Robot arm	Stopper for changing the operating range of the J1 axis	1A-DH-01	J1 axis + side: ☐ +135° ☐ +90° ☐ +45° J1 axis − side: ☐ −135° ☐ −90° ☐ −45°
	Solenoid valve set	1S-VD0 ☐ -01	☐ Not provided ☐ 1 set ☐ 2 set ☐ 3 set ☐ 4 set
	Hand input cable	1S-HC25C-01	☐ Not provided ☐ Provided
	Hand output cable	1S-GR35S-01	☐ Not provided ☐ Provided
	Hand curl tube	1N-ST0608C	☐ Not provided ☐ Provided
Controller	Teaching pendant	R28TB- ☐☐	☐ Not provided ☐ 7m ☐ 15m
	Pneumatic hand interface	2A-RZ365/2A-RZ375	☐ Not provided ☐ Provided
	Parallel I/O interface	2A-RZ361/2A-RZ371	☐ Not provided ☐ 1pc. ☐ 2pc. ☐ 3pc. ☐ 4pc. ☐ 5pc. ☐ 6pc. ☐ 7pc.
	External I/O cable	2A-CBL ☐☐	☐ Not provided ☐ 5m-1pc. ☐ 5m-2pc. ☐ 5m-3pc. ☐ 15m-1pc. ☐ 15m-2pc. ☐ 15m-3pc.
	CC-Link interface	2A-HR575E	☐ Not provided ☐ Provided
	Ethernet interface	2A-HR533E	☐ Not provided ☐ Provided
	Extended serial interface	2A-RZ581E	☐ Not provided ☐ Provided
	Extended memory cassette	2A-HR432	☐ Not provided ☐ Provided
	Personal computer cable	RS-MAXY-CBL	☐ Not provided ☐ Provided
	Personal computer support software	3A-01C-WINE	☐ Not provided ☐ Windows95/98/2000/NT4.0/Me/XP CD-ROM
	Personal computer support software mini	3A-02C-WINE	☐ Not provided ☐ Windows95/98/2000/NT4.0/Me/XP CD-ROM

Note1) Up to eight units, including the one unit mounted as a standard.

■ Maintenance parts (Consumable parts)

Maintenance parts	☐ Backup batteries A6BAT ( ) pcs. ☐ Backup batteries ER6 ( ) pcs. ☐ Grease ( ) cans

■ Robot selection check list

Work description	☐ Material handring ☐ Assembly ☐ Machining L/UL ☐ Sealing ☐ Testing and inspection ☐ Other ( )
Workpiece mass ( ) g	Hand mass ( ) g	Atmosphere ☐ General enveronment ☐ Clean ☐ Dust provided ☐ Other( )
Remarks	

Copy this page and use the copy.

EC Certificate of Conformity

No.: E9 03 09 25554 011

TÜV
PRODUCT SERVICE

concerning the EMC protection requirements in accordance with Article 10 of the Council Directive 89/336/EEC on electromagnetic compatibility for

Mitsubishi Electric Corporation
Mitsubishi Denki Bldg.
Marunouchi, Tokyo 100-8310
Japan

Item Identification:	Industrial Scientific and Medical Equipment RV-12S, RV-6S series (see Attachment 1 for Grouping)
Item Description:	Industrial Robot 400VAC/200VAC, 3.5kVA Protection class I
Project-/TCF No.:	TYOEMC16943A

This Certificate of Conformity was issued in accordance with Article 10.2 of the Council Directive 89/336 EEC on the harmonization of the laws of the Member States relating to electromagnetic compatibility. It was transposed into the "Gesetz über die elektromagnetische Verträglichkeit von Geräten vom 9. November 1992 (EMVG, § 5.2)" in Germany. This certificate does not contain any statements pertaining to the EMC protection requirements governed by other laws which serve to implement EC Directives other than the aforementioned Council Directive 89/336 EEC. This certificate or the technical report refers only to the tested sample or product family listed in the above mentioned Project-/TCF documentation.

This certificate does not permit the use of a TÜV PRODUCT SERVICE certification mark on the tested product.

Released with the above mentioned certificate number by the certification body of TÜV PRODUCT SERVICE.

Department:	EMCJP/Tomoki Takeuchi
Date:	26.09.2003

TÜV Product Service GmbH is Competent Body in accordance with EMC Directive 99/336/EEC (BMPT VFG. 91/1992).

TÜV PRODUCT SERVICE GMBH · Zertifizierstelle · Ridlerstrasse 65 · D-80339 München

Anlage 1 zum Zertifikat
Certificate Attachement 1

Zertifikat Nr./
Certificate No.   **E9 03 09 25554 011**

Grouping:

*RV-12S series: 400VAC/200VAC 3 phase

RV-12S, RV-12SL, RV-12SC, RV-12SLC

*RV-6S series (oil mist resistance type): 400VAC/200VAC 3 phase

RV-6S-SM, RV-6SL-SM, RV-6SC-SM, RV-6SLC-SM

*RV-6S series: 200VAC 1 phase

RV-6S, RV-6SL, RV-6SC, RV-6SLC

Total: 12

DECLARATION OF CONFORMITY

We

(Company) : MITSUBISHI ELECTRIC CORPORATION

MITSUBISHI DENKI BLDG., Marunouchi, Tokyo 100-0081, Japan

(Factory) : NAGOYA WORKS

1-14, Yadaminami 5, Higashiku, Nagoya 461-8670, Japan

explain in own responsibility, that the products:

Kind of equipment :

INDUSTRIAL ROBOT

Type-designation :

RV-12S ,RV-6S series

(See attached sheet to identify the type of model.)

are in compliance with following norms or documents:

1. Machinery Directive(98/37/EC)

(a) Type A : Fundamental safety standards

EN292-1/1991, EN292-2/1991, EN1050/1996

(b) Type B : Group safety standards

B1 : Safety aspects

EN60204-1/1997(partly unconformed), EN294/1992, EN349/1993,

EN457/1992, EN999/1998, EN954-1:1996

B2 : Safety related devices

EN418 : 1992

(c) Type C : Machine safety standards

EN775 : 1992

2. EMC Directive(89/336/EEC),Amendment(92/31/EEC)

(a) EN55011:1998+ A2:2001, Group1, Class A

(b) EN61000-6-2:2001

Manager   Nagoya, Japan / date:

Servo & Robot Systems Department in Nagoya Works

Tsutomu Kazama   Tsutomu   Kazama

Manufacture/Authorized representative   Place and date of issue name and signature

■ Declaration Type of models

A.RV-12S series

Model Name	Language	Robot Arm	Controller	Software Version
RV-12S	Japanese	BU240B014G51	TU117C306G12	J or later
	/English/German	BU240B014G61	TU117C307G12	
RV-12SL	Japanese	BU240B014G53	TU117C306G12	J or later
	/English/German	BU240B014G63	TU117C307G12	
RV-12SC	Japanese	BU240B014G53	TU117C308G12	J or later
	/English/German	BU240B014G63	TU117C308G12	
RV-12SLC	Japanese	BU240B014G54	TU117C309G12	J or later
	/English/German	BU240B014G64	TU117C309G12	

B. RV-6S series

Model Name	Language	Robot Arm	Controller	Software Version
RV-6S	Japanese	BU240B026G56	TU117C251G01	J or later
	/English/German	BU240B026G61	TU117C253G01	
RV-6SL	Japanese	BU240B026G58	TU117C251G01	J or later
	/English/German	BU240B026G63	TU117C253G01	
RV-6SC	Japanese	BU240B026G57	TU117C251G01	J or later
	/English/German	BU240B026G62	TU117C253G01	
RV-6SLC	Japanese	BU240B026G59	TU117C251G01	J or later
	/English/German	BU240B026G64	TU117C253G01	

C. RV-6S series oil mist type

Model Name	Language	Robot Arm	Controller	Software Version
RV-6S-SM	Japanese	BU240B026G56	TU117C316G12	J or later
	/English/German	BU240B026G61	TU117C317G12	
RV-6SL-SM	Japanese	BU240B026G58	TU117C316G12	J or later
	/English/German	BU240B026G63	TU117C317G12	
RV-6SC-SM	Japanese	BU240B026G57	TU117C316G12	J or later
	/English/German	BU240B026G62	TU117C317G12	
RV-6SLC-SM	Japanese	BU240B026G59	TU117C316G12	J or later
	/English/German	BU240B026G64	TU117C317G12	

BFP-A5735-13- ∗

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