MITSUBISHI

Mitsubishi Industrial Robot

RV-12SD Series

Standard Specifications Manual

(CR3D-701M/CR3D-701 Controller)

MELFA

BFP-A8656

⚠ Safety Precautions

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

⚠CAUTION

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

⚠CAUTION

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

⚠WARNING

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

⚠CAUTION

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

⚠WARNING

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

⚠CAUTION

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

⚠CAUTION

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

⚠CAUTION

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

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

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

⚠ CAUTION

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

⚠ CAUTION

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

■ Revision history

Date of print	Specifications No.	Details of revisions
2008-05-9	BFP-A8656	First print.

■ 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.

Note that in this specification document the specifications related to the robot arm is described "2 Robot arm" on page 3 , the specifications related to the controller"3 Controller" on page 30 , and software functions and a command list "4 Software" on page 79 separately.

Contents

Page

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
(4) Robot arm installation bolts
(5) Arm fixing bolts
(6) Safety manual, Instruction manual, CD-ROM (Instruction manual)
(7) 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 Model type combination of robot

The robot has decided the type corresponding to load, arm length, and environment specification. Please select the robot matched with the use.

1.2.1 How to identify the robot model

RV-12SD L C -Sxx
(a) (b) (c) (d)

(a). RV-12SD.....Indicates the RV-12SD series.

(b). L.....Indicates long arm type.
Examples)
Blank: Standard type.
L: Long arm type.

(c). C.....Indicates environment specification.
Examples)
Blank: Standard Specifications
C: Clean Specifications

(d). -SXX.....[1] Indicates a special model number.
[2] -SM**.....Indicates a specification with protection specification controller.

1.2.2 Combination of the robot arm and the controller

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

Protection specification	Robot arm	Arm length	Controller
Stardard specification	RV-12SD	standard arm	CR3D-701M[Note1)]
	RV-12SDL	Long arm	
Clean specification	RV-12SDC	standard arm	CR3D-701
	RV-12SDLC	Long arm	

Note1)protection specification. (IP54)

1.3 Combination of the robot arm and the controllerIndirect export

If you intend to export robots bought from us, be sure to choose robots whose language setting parameter (LNG) is set to English (ENG).

1.4 Instruction manuals

The instruction manuals supplied with the shipment are provided in electronic form in a CD-ROM, except for the Safety Manual. This CD-ROM (electronic manual) includes instruction manuals in both Japanese and English versions. Please note that the instruction manuals are the same for both language settings (parameter LNG).

1.5 Contents of the structural equipment

1.5.1 Robot arm

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

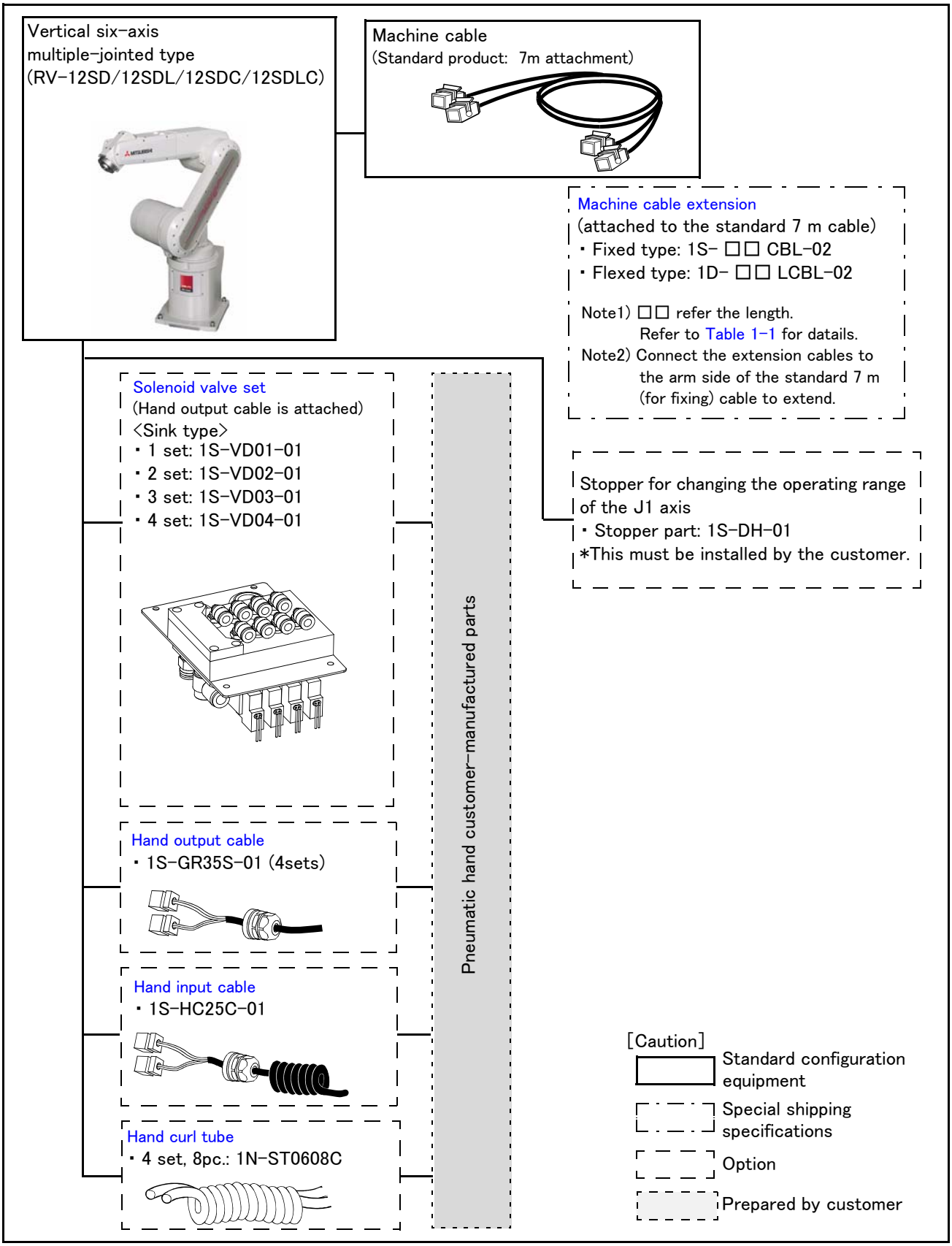


Fig.1-1 : Structural equipment (Robot arm)

1.3.1 Controller

The devices shown below can be installed on the controller.
The controllers that can be connected differ depending on the model of the robot arm.

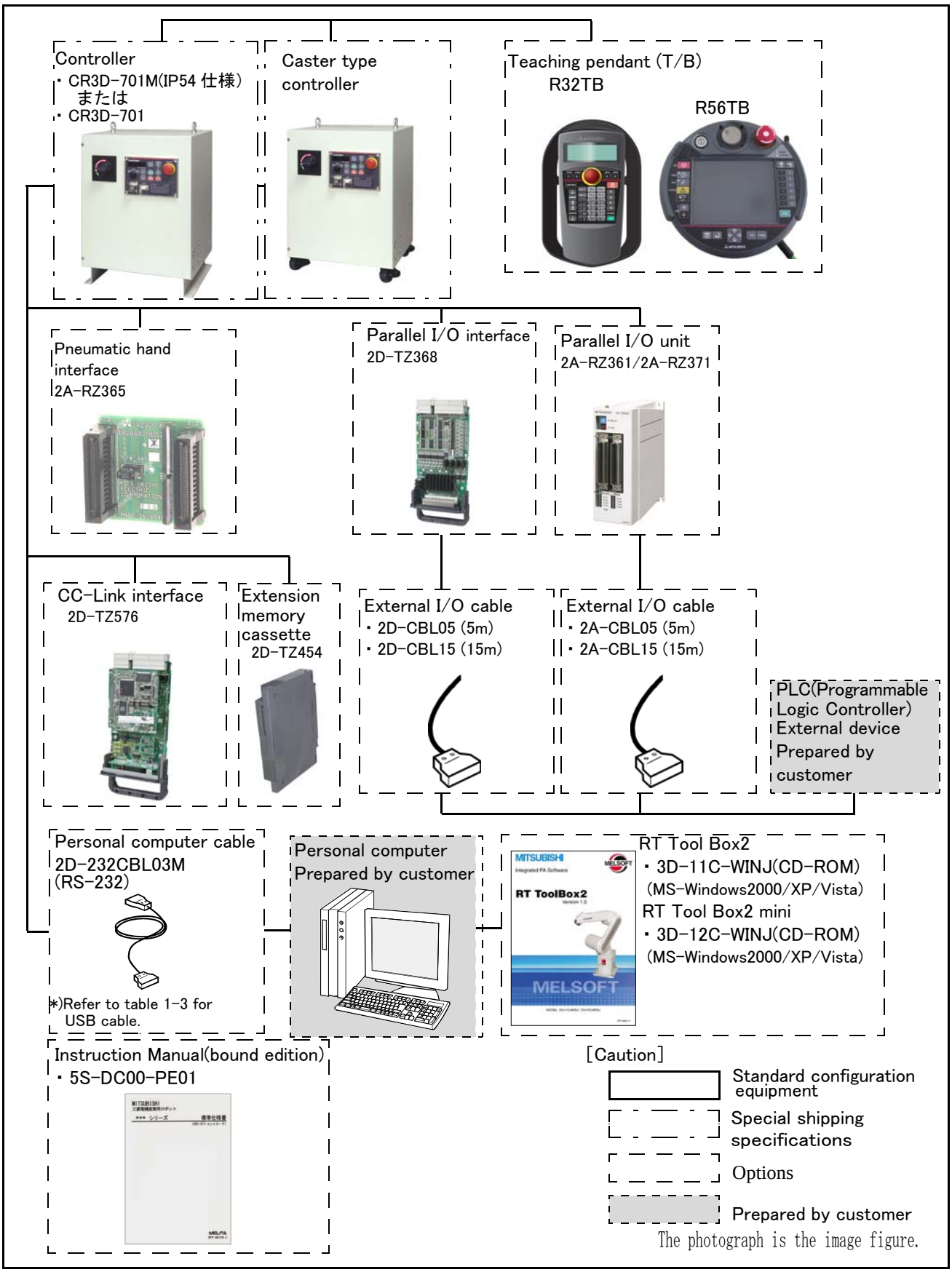


Fig.1-1 : Structural equipment

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)	Descripsion
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-02	For fixing (Three sets for power, signal and ground cable)	○	5, 10, 15m
	1S- □□ LCBL-02	For bending (Three sets for power, signal and ground cable)	○	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)	○	
Hand output cable	1S-GR35S-01	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	Robot side connector. One terminal is not treated.	○	The cable is connected to the sensor by the customer.
Hand curl tube	1N-ST0602C	For solenoid valve 1set.:Φ6x2	○	Curl type air tube
	1N-ST0604C	For solenoid valve 2set.:Φ6x4	○	
	1N-ST0606C	For solenoid valve 3set.:Φ6x6	○	
	1N-ST0608C	For solenoid valve 4set.:Φ6x8	○	
Teaching pendant	R32TB	Cable length 7m	○	With 3-position deadman switch
	R32TB-15	Cable length 15m	○	
	R56TB	Cable length 7m	○	
	R56TB-15	Cable length 15m	○	
Pneumatic hand interface	2A-RZ365	DO: 8 point (Sink type)	○	It is necessary when the hand output signal of the robot arm is used.
Parallel I/O Interface (Sink type)	2D-TZ368 (Sink type)	DO: 32 point (Sink type)/ DI : 32 point (Sink type) Insulated type output signal (100mA/point)	○	The card type external input-and-output. Interface.Install to the slot of controller.
External I/O cable (For Parallel I/O Interface)	2D-CBL05	5m	○	Use to connect the external peripheral device to the parallel input/output interface.
	2D-CBL15	15m	○	
Parallel I/O Unit	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 (For Parallel I/O Unit)	2A-CBL05	5m	○	Use to connect the external peripheral device to the parallel input/output unit
	2A-CBL15	15m	○	
Personal computer cable Note2)	2D-232CBL03M	RS-232C cable 3m for PC-AT compatible model	○	
RT ToolBox2 (Personal computer Support software)	3D-11C-WINE	CD-ROM	○	MS-Windows2000/XP/Vista (With the simulation function)
RT ToolBox2 mini (Personal computer Support software mini)	3D-12C-WINE	CD-ROM	○	MS-Windows2000/XP/Vista
CC-Link interface	2D-TZ576	Local station (The local station alone is supported.)	○	for MELSEC PLC with CC-Link connection.
Extended memory cassette	2D-TZ454	Teaching point number: 50,800 Steps number: 50,800 Program number: 512	○	The battery backup function is provided. The value combined with the standard
Caster specifications controller	CR3D-701/701M	Specifications with casters	□	The controller height will be h =615
Instruction Manual	5S-DC00-PE01	RV-12SD/12SDL series	○	A set of the instructions manual bookbinding editions

Note1)In the classification column, ○ refers to an option,and □ to a Shipping special specifications.
Note2)The recommendation products of the USB cable are shown in Table 1-1.

[Reference]:The recommendation products of the USB cable are shown below.

Table 1-2 : Recommendation article of the USB cable

製 品 名	形 名	メーカ名
USB cable (USB A type-USB B type)	USB2-30	ELECOM CO., LTD.
	AU230	BUFFALO KOKUYO SUPPLY INC.
USB cable (USB A type-USB mini B type)	KU-AMB530	SANWA SUPPLY INC.
	USB-M53	ELECOM CO., LTD.
	GT09-C20USB-SP	MITSUBISHI ELECTRIC SYSTEM & SERVICE CO., LTD.
	MR-J3USBCBL3M	MITSUBISHI ELECTRIC CO., LTD.
USB adapter (USB B type-USB mini B type)	AD-USBBFTM5M	ELECOM CO., LTD.

⚠Caution Be careful to the USB cable to apply neither the static electricity nor the noise.
Failure to observe this could lead to malfunc-tioning .

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-12SD	RV-12SDC	RV-12SDL	RV-12SDLC
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・m^2	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			
			Eight spare wires : AWG#27(0.1mm^2) (shielded)			
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(0.3 μm) Internal suction requirement	-	10(0.3 μm) 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"
Note4) Up to 0.28kg・m^2 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 7, "2.2.5 Protection specifications and working environment".
Note7) The clean specification details are given in Page 9, "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

For this robot, the pose repeatability is given in accordance with JIS 8432 (Pose repeatability). Note that the value is based on 100 measurements (although 30 measurements are required according to JIS).

[Caution] The specified "pose repeatability" is not guaranteed to be satisfied under the following conditions.

[1] Operation pattern factors
1) When an operation that approaches from different directions and orientations are included in relation to the teaching position during repeated operations
2) When the speed at teaching and the speed at execution are different

[2] Load fluctuation factor
1) When work is present/absent in repeated operations

[3] Disturbance factor during operation
1) Even if approaching from the same direction and orientation to the teaching position, when the power is turned OFF or a stop operation is performed halfway

[4] Temperature factors
1) When the operating environment temperature changes
2) When accuracy is required before and after a warm-up operation

[5] Factors due to differences in accuracy definition
1) When accuracy is required between a position set by a numeric value in the robot's internal coordinate system and a position within the actual space
2) When accuracy is required between a position generated by the pallet function Note1) and a position within the actual space

Note1)
The pallet function is a function that teaches only the position of the work used as reference (3 to 4 points) and obtains the remaining positions by calculations, for an operation that arranges works orderly or for an operation that unloads orderly arranged works. By using this function, for example, in the case of an operation that arranges works on grid points of 100 x 100, by teaching only three points of four corners, the remaining grid points are automatically generated; thus, it is not necessary to teach all 10,000 points. For more information about the pallet function, refer to the separate volume, "Instruction Manual/Detailed Explanation of Functions and Operations."

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 3, "Table 2-1 : Tab Standard specifications of robot"

(2) Fig. 2-1 shows the distribution dimensions for the center of gravity in the case where the volume of the load is relatively small. Use this figure as a reference when designing the tooling.

(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 3, "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.

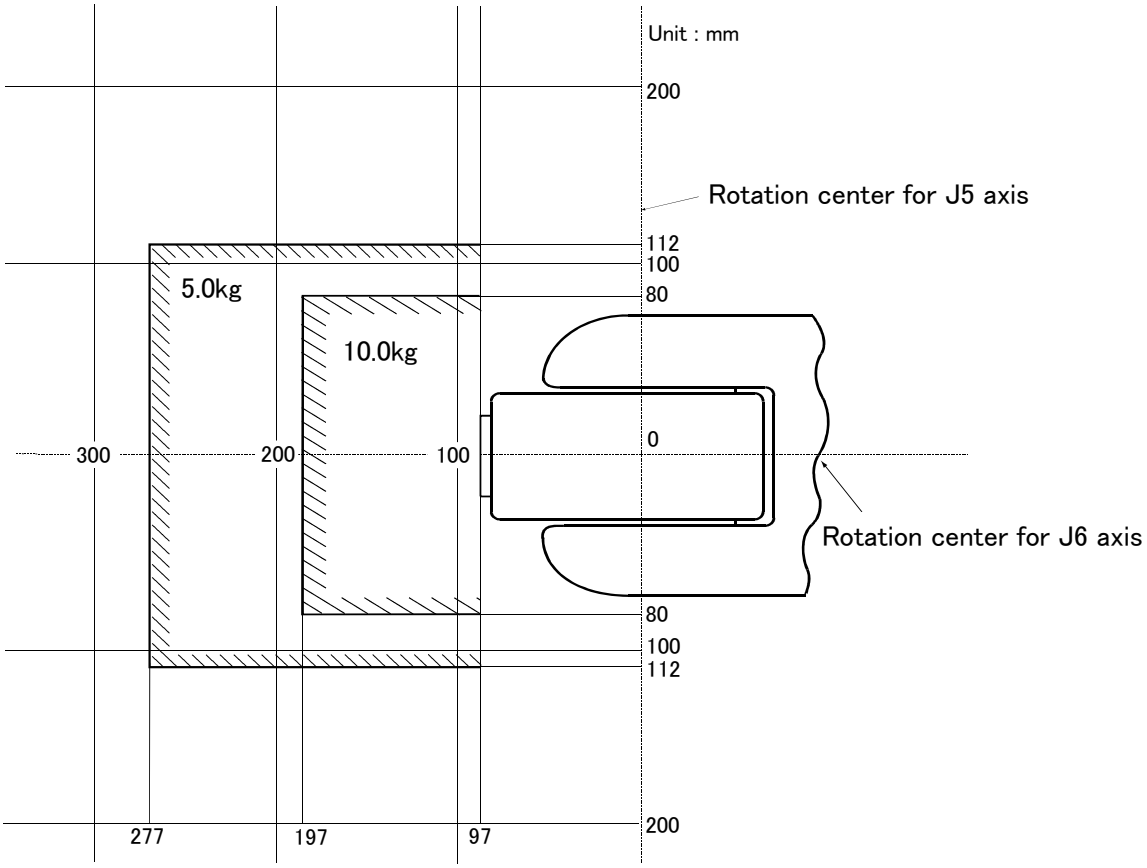


Fig.2-1 : Position of center of gravity for loads (for loads with comparatively small volume): RV-12SD/12SDLSeries

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

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

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

Set up the capacity and size of the hand with the "HNDDAT*" parameter (optimum acceleration/deceleration setting parameter), and set up the capacity and size of the work with the "WRKDAT*" parameter. Numbers 0 to 8 can be used for the asterisk (*) part. Designate the "HNDDAT*" and "WRKDAT*" parameters to be used using the "LOADSET" command in a program.
For more details, refer to the separate "Instruction Manual/Detailed Explanation of Functions and Operations."
It is the same meaning as "LOADSET 0.0" if not using the "LOADSET".

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

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

1) Lower the robot's operating speed by approximately 5% from high speed using the OVRD 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 2-2.
Even oil mist environment can be used in addition to the general environment.

Table 2-2 : Protection specifications and applicable fields

Type	Protection specifications (IEC Standards value)	Classification	Applicable field	Remarks
RV-12SD RV-12SDL	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 2-3

Table 2-3 : Tested cutting oil for oil mist specifications

Name	Maker	Relevant JIS	Main characteristics	Application
Emulcut FA-800	Kyodo Yushi Co., Ltd	Class A1 No. 2	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'sIP54 (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 2-3 used by a standard examination of our company.
3) Take measures so that the robot will not be exposed to water, oil and/or chips for a long period of time.
4) Protection performance can be improved by pressurizing the inside of the robot arm. Since the joint (AIR PURGE) of phi 8 is prepared at the rear of the base section, please supply the dry air for pressurization from The specification of the dry air for pressurization is shown in Table 2-4.

Table 2-4 : Specification of the dry air for pressurization

Specification	The atmospheric pressure dew point is -20 degree or less.	0 to 0.01MPa

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 91, "6.2 Working environment".

1) In surroundings that generate inflammable gases or corrosive gasses.
2) Atmosphere used excluding cutting oil shown in Table 2-3
3) Environment where the robot is exposed to water, oil and/or chips for a long period of time.
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.
6) Pressurization by the dry air exceeding the specification of Table 2-4

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-12SDC-SA RV-12SDLC-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	KONEGAI CORPORATION	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

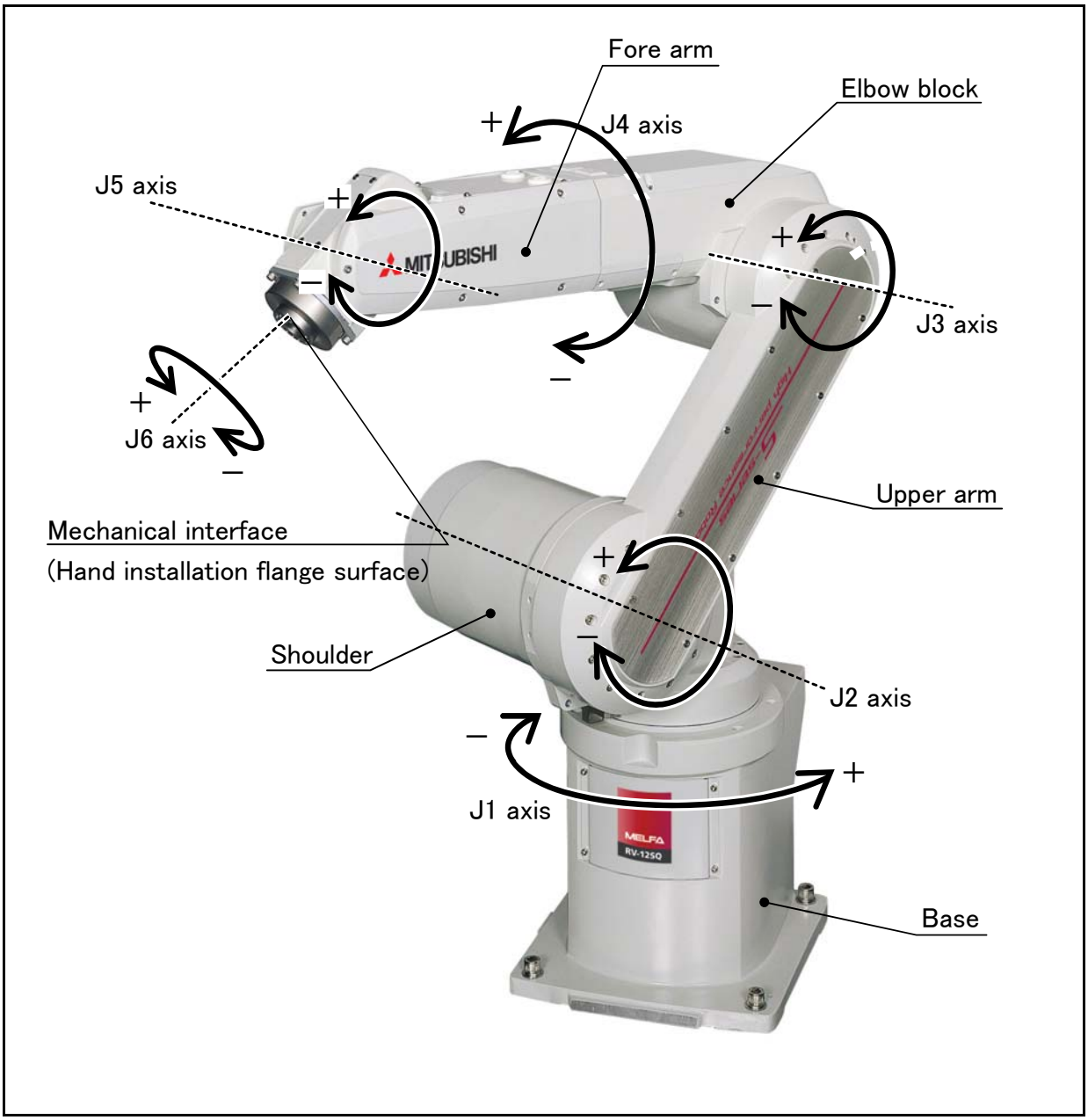
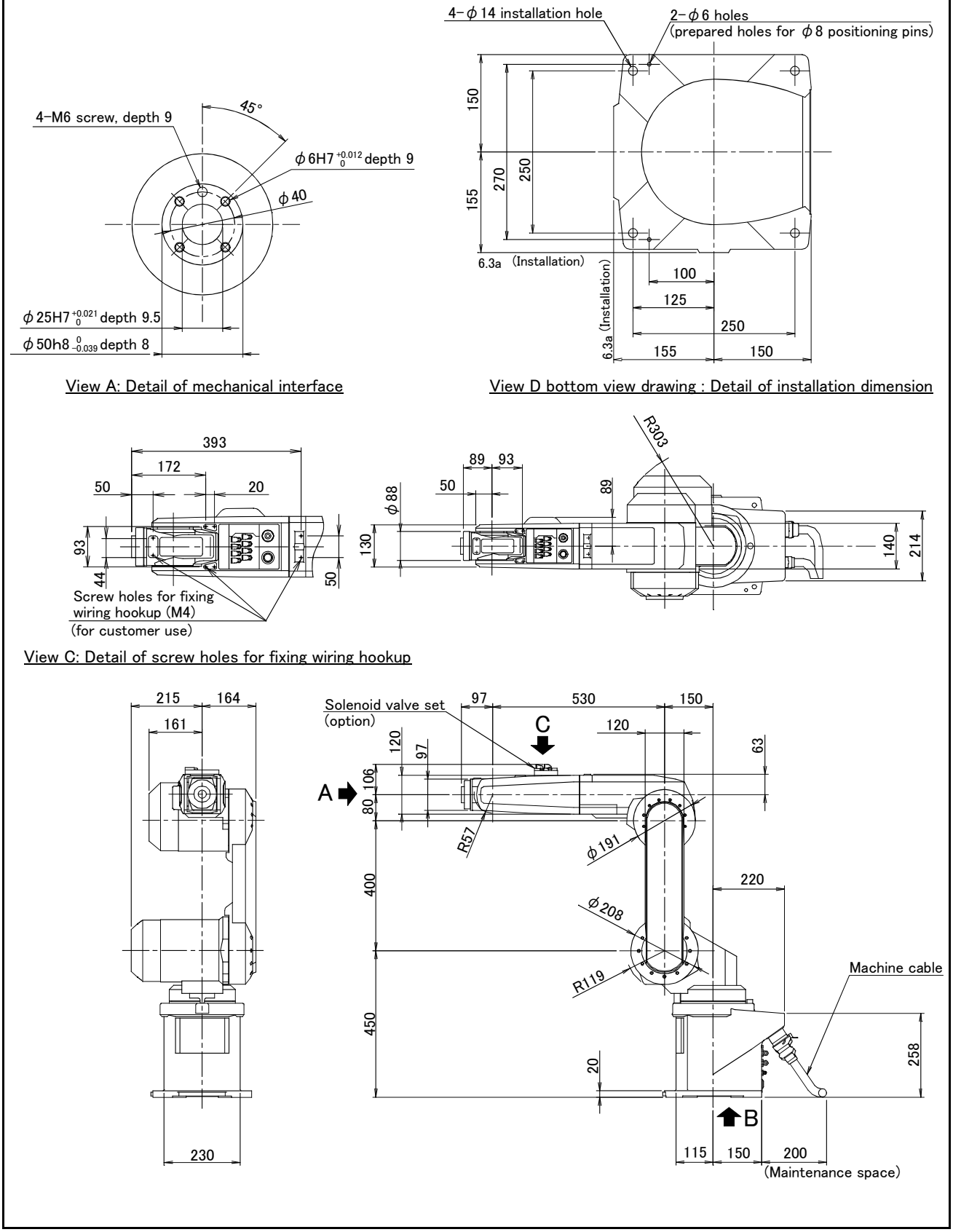


Fig.2-2 : Names of each part of the robot

2.4 Outside dimensions・Operating range diagram

(1) RV-12SD/12SDC

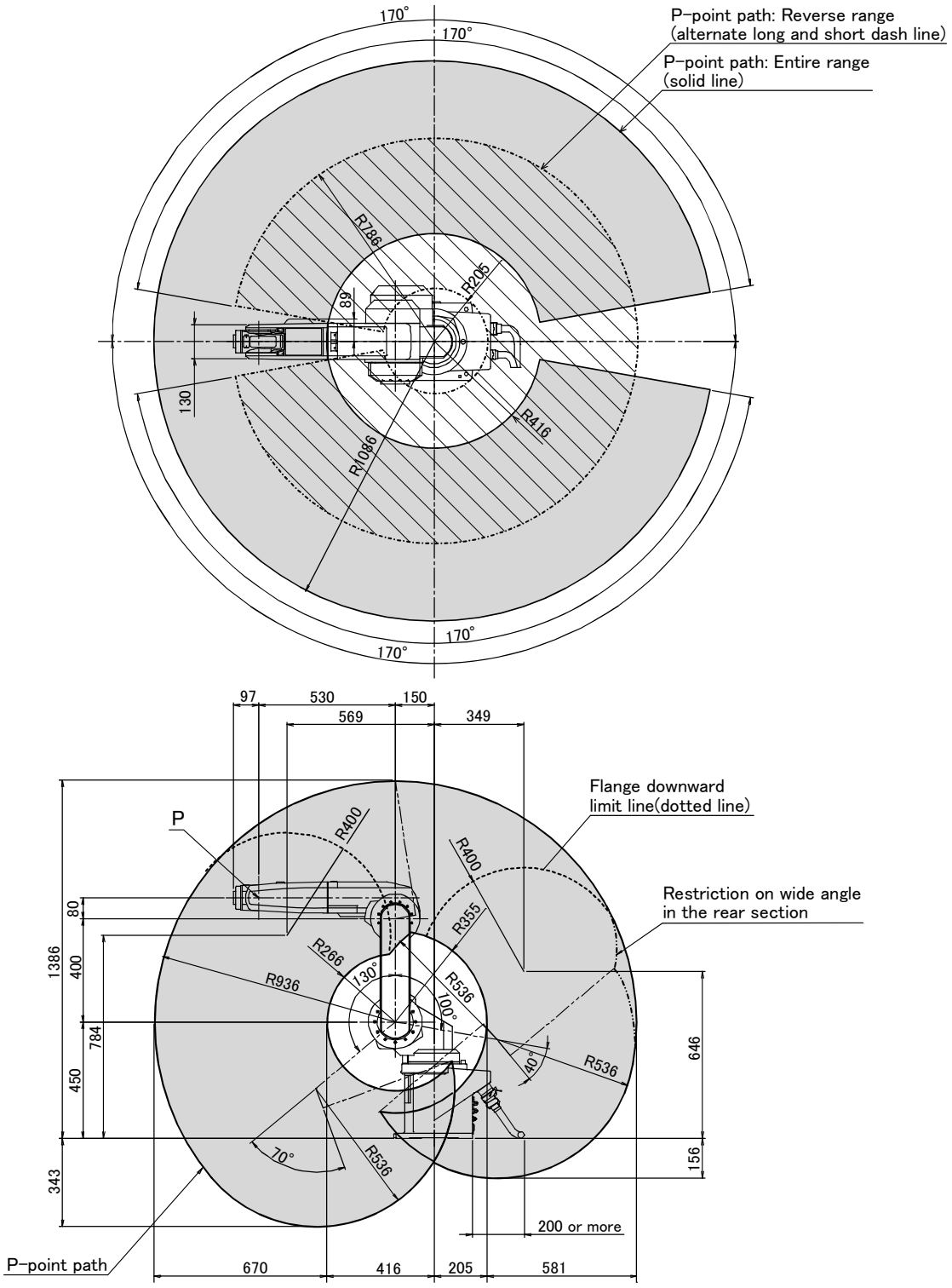


View A: Detail of mechanical interface

View D bottom view drawing : Detail of installation dimension

View C: Detail of screw holes for fixing wiring hookup

Fig.2-3 : Outside dimensions : RV-12SD/12SDC



Rear surface area wide angle, narrow angle limit
*If the angle of axis J1 is −75deg <= J1 <= 75deg and the angle of axis J2 is −25deg <= J2 < 2deg,
then operating range is limited to J2 + J3 * 2 >= −258deg.
*If the angle of axis J1 is −75deg <= J1 <= 75 deg and the angle of axis J2 is −80deg <= J2 < −25deg,
then operating range is limited to J2 + J3 >= −141.5deg.
*If the angle of axis J1 is −75deg <= J1 <= 75 deg and the angle of axis J2 is J2 < −80deg,
then operating range is limited to 6.4 * J2 + J3 >= 573.5deg.
*If the angle of axis J1 is J1 <= −75 degree or J1 > 75 degree and the angle of axis J2 is −80deg <= J2 < 2 degree,
then operating range is limited to J2 + J3 * 2 >= −258 degree.
*If the angle of axis J1 is J1 <= −75deg or J1 > 75deg and the angle of axis J2 is J2 < −80deg ,
then operating range is limited to 2.4 * J2 + J3 >= −281 degree.

Fig.2-4 : Operating range diagram : RV-12SD/12SDC

(2) RV-12SDL/12SDLC

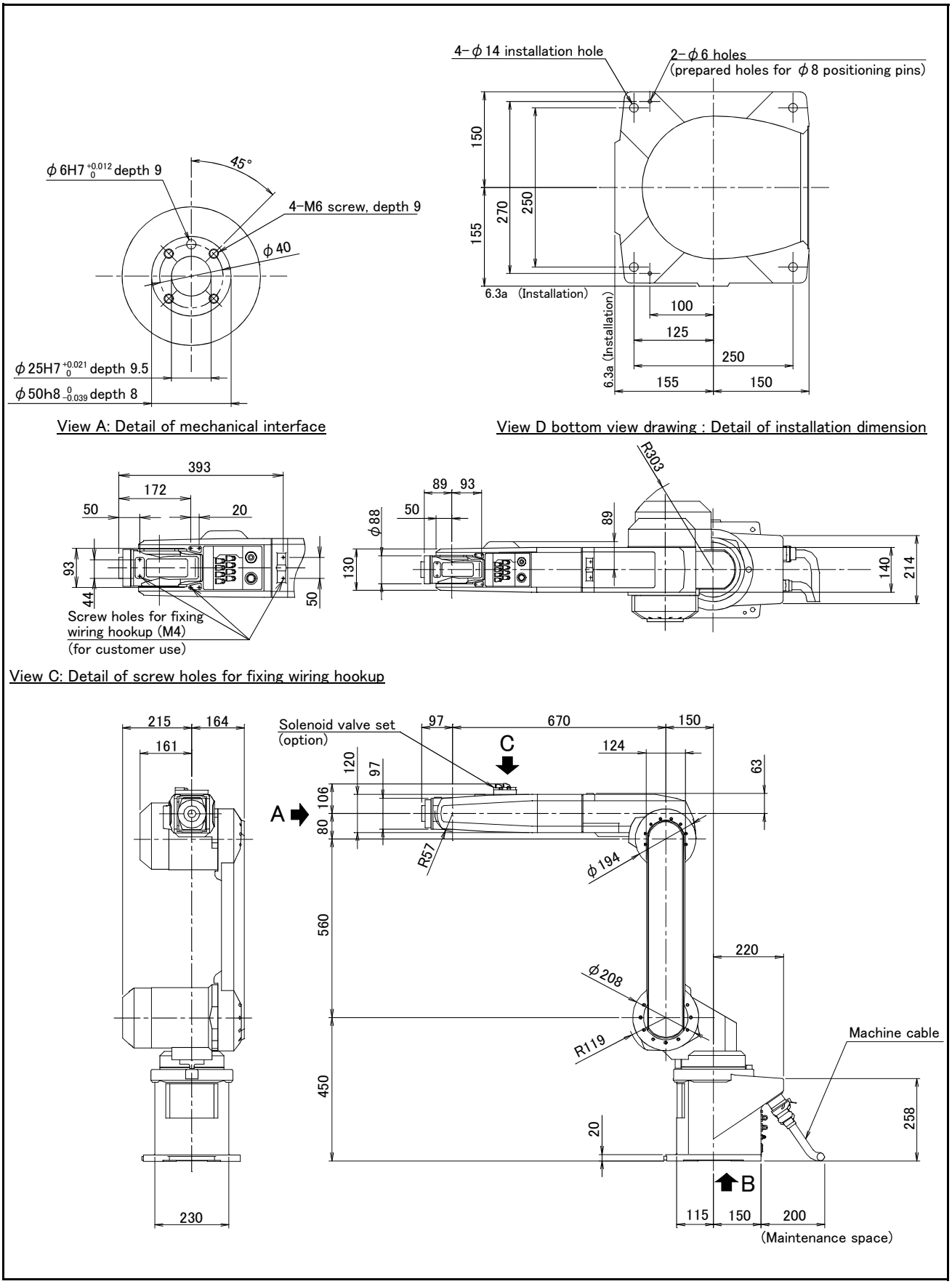
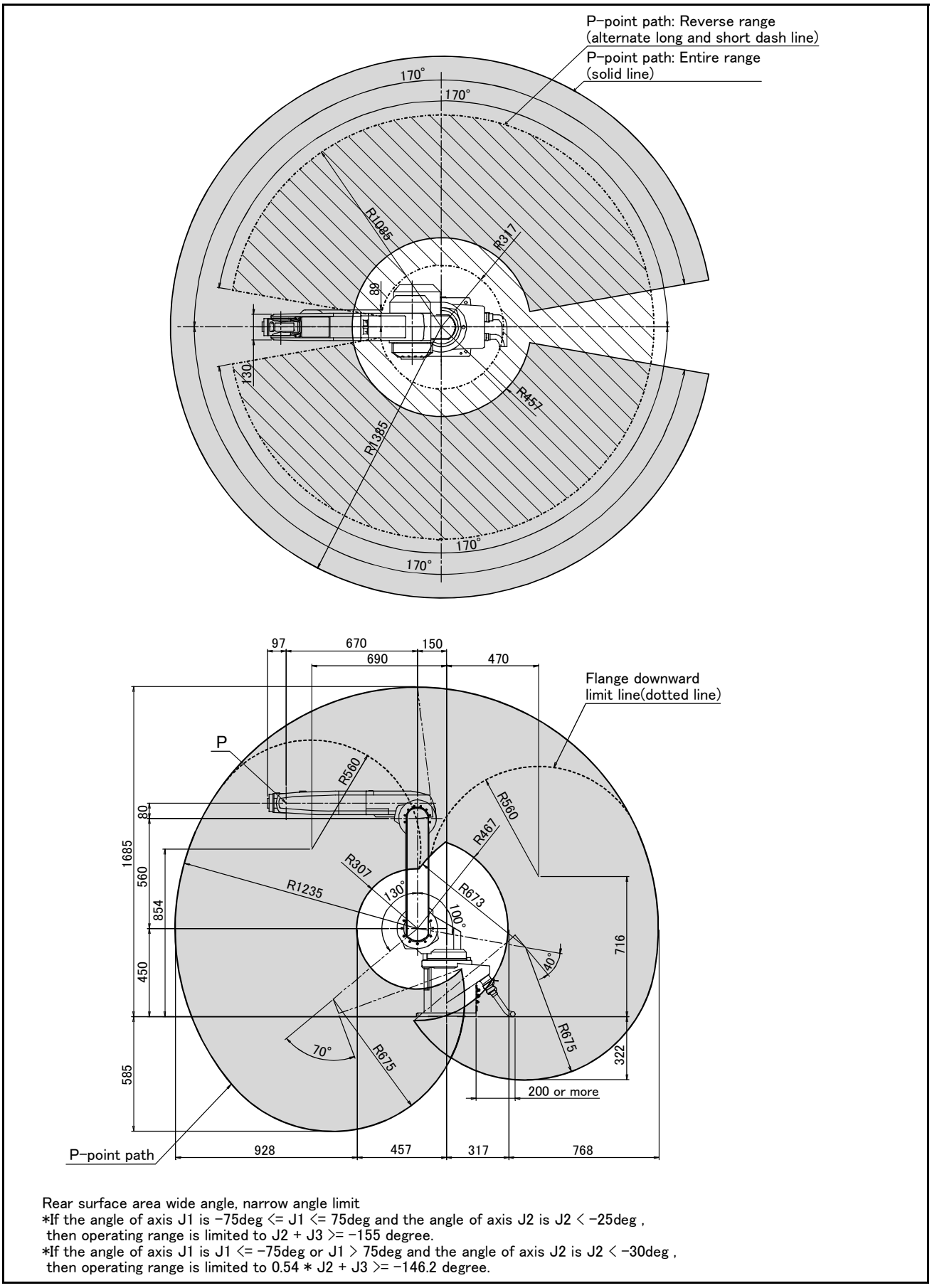


Fig.2-5 : Outside dimensions : RV-12SDL/12SDLC



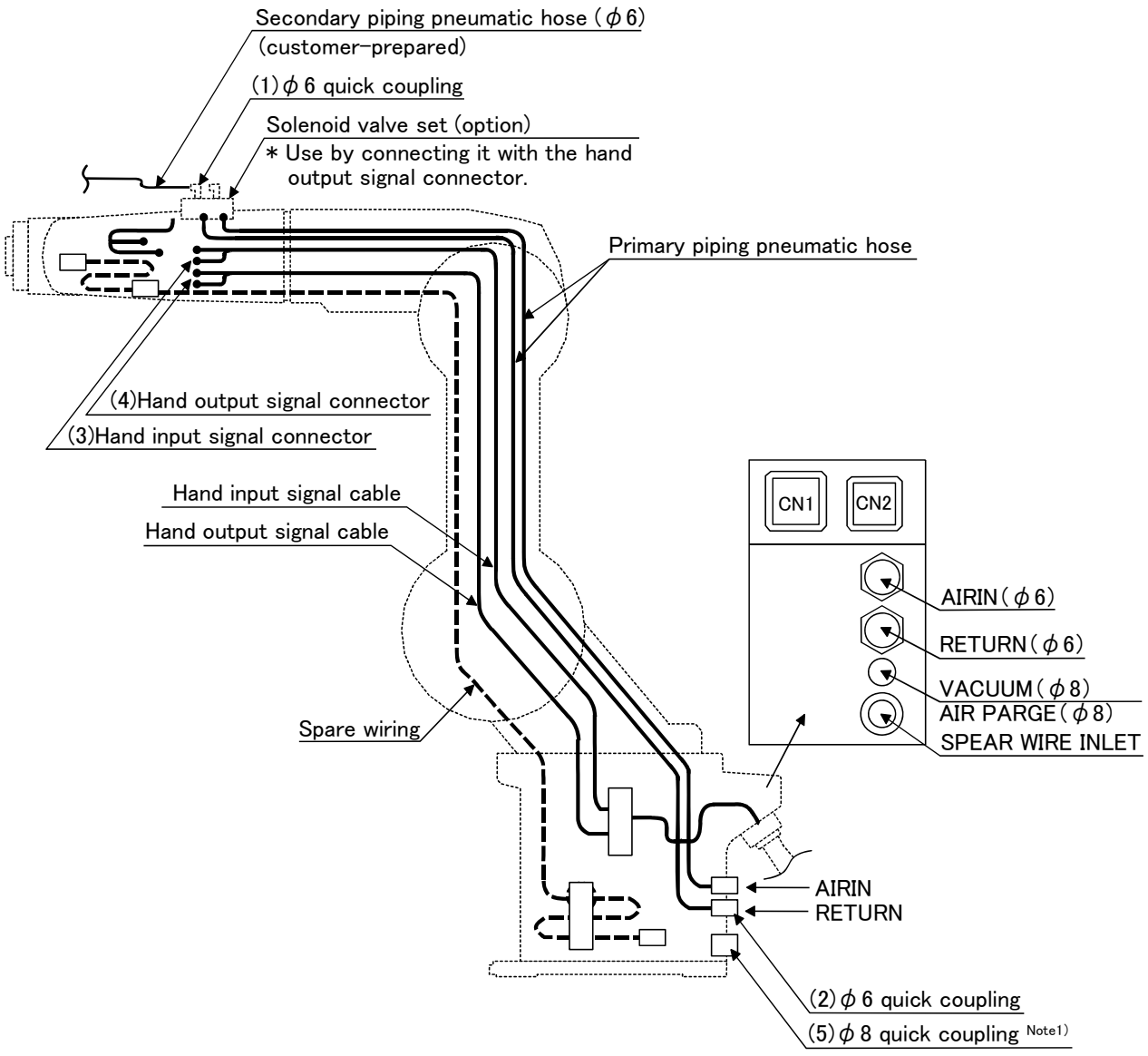
Rear surface area wide angle, narrow angle limit
*If the angle of axis J1 is −75deg <= J1 <= 75deg and the angle of axis J2 is J2 < −25deg ,
then operating range is limited to J2 + J3 >= −155 degree.
*If the angle of axis J1 is J1 <= −75deg or J1 > 75deg and the angle of axis J2 is J2 < −30deg ,
then operating range is limited to 0.54 * J2 + J3 >= −146.2 degree.

Operating range diagram : RV-12SDL/12SDLC

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	1-1717834-3	1318108-1	1-1318115-3	1318112-1	Tyco Electronics AMP
(4)	Connector	2	1-1717834-4	1318108-1	1-1318115-4	1318112-1	Tyco Electronics AMP
(5)	Coupling Note1)	1	UKBL8	—	—	—	Koganei Corporation

Note1) For dust suction in the clean specification

Fig.2-6 : 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 24, "(3) Solenoid valve set" for details on the electronic valve set (optional).
6) Protection performance can be improved by pressurizing the inside of the robot arm. Since the joint (AIR PURGE) of phi 8 is prepared at the rear of the base section, please supply the dry air for pressurization from this joint. Refer to Page 7, "2.2.5 Protection specifications and working environment" for the details of dry air.

(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	KONEGAI CORPORATION	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/RZ375), 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 and GR2.
   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, four pairs of cab tire cables (total of eight cores) are preinstalled between the base section and the forearm side section. The connector is attached to both ends. Customer can be use. Refer to the separate "Instruction Manual/ROBOT ARM SETUP & MAINTENANCE" for details.

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.)

2.5.6 Wiring and piping system diagram for hand

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

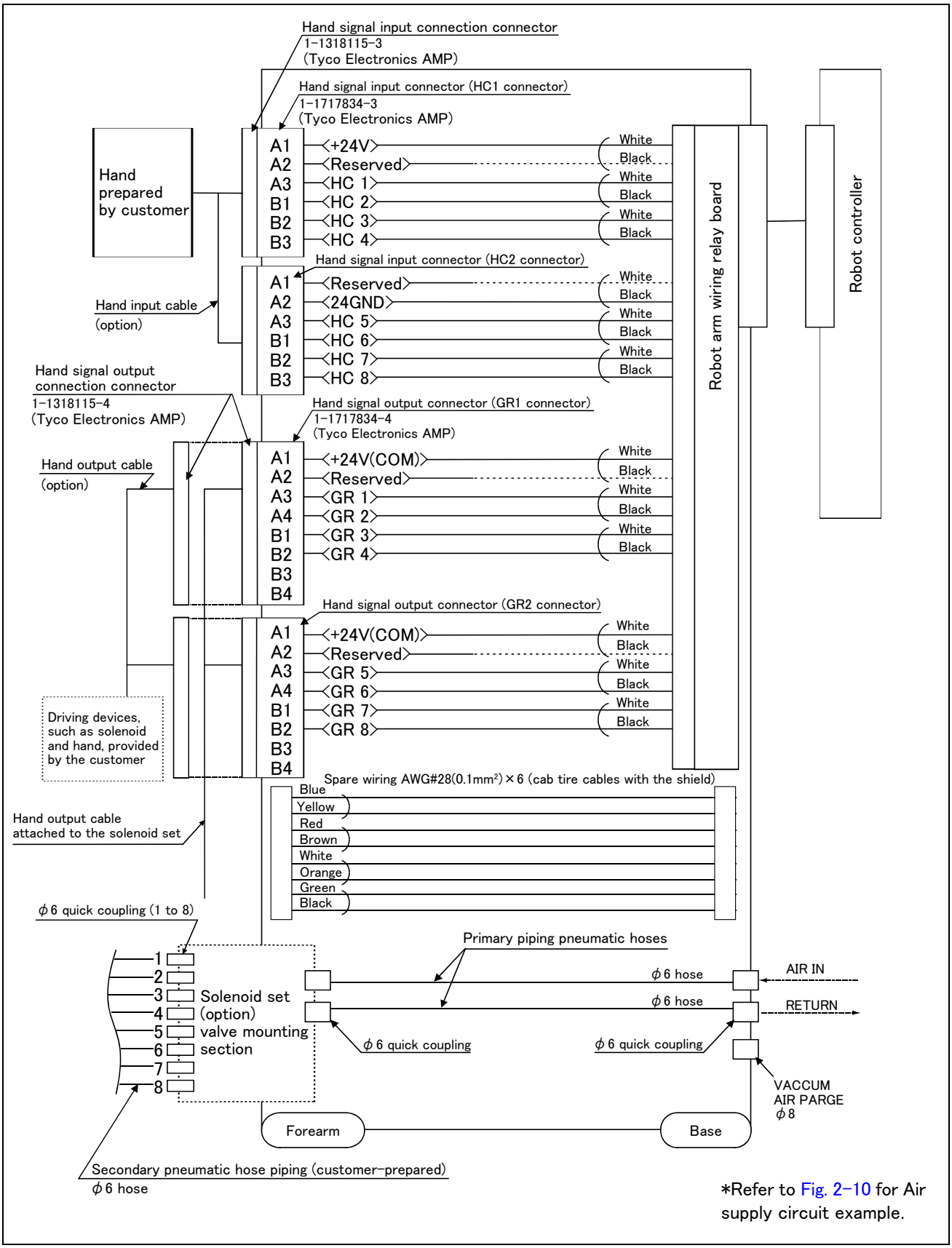


Fig.2-7 : Wiring and piping system diagram for hand and example the solenoid valve installation(Sink type)

2.5.7 Electrical specifications of hand input/output

Table 2-8 : Electrical specifications of input circuit

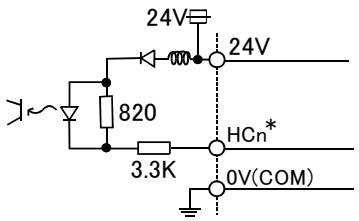
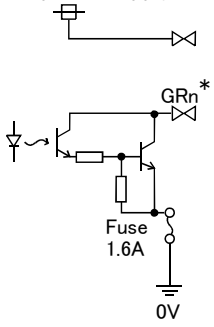
Item		Specifications	Internal circuit
Type		DC input	<Sink type>  * HCn = HC1 ~ HC8
No. of input points		8	
Insulation method		Photo-coupler insulation	
Rated input voltage		12VDC/24VDC	
Rated input current		Approx. 3mA/approx. 7mA	
Working voltage range		DC10.2 to 26.4V(ripple rate within 5%)	
ON voltage/ON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

Table 2-9 : Electrical specifications of output circuit

Item		Specification	Internal circuit
Type		Transistor output	<Sink type>  * GRn = GR1 ~ GR8
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		1.6A (each one common) Cannot be exchanged	

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

2.5.8 Air supply circuit examplefor the hand

Fig. 2-8 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. 2-8 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.

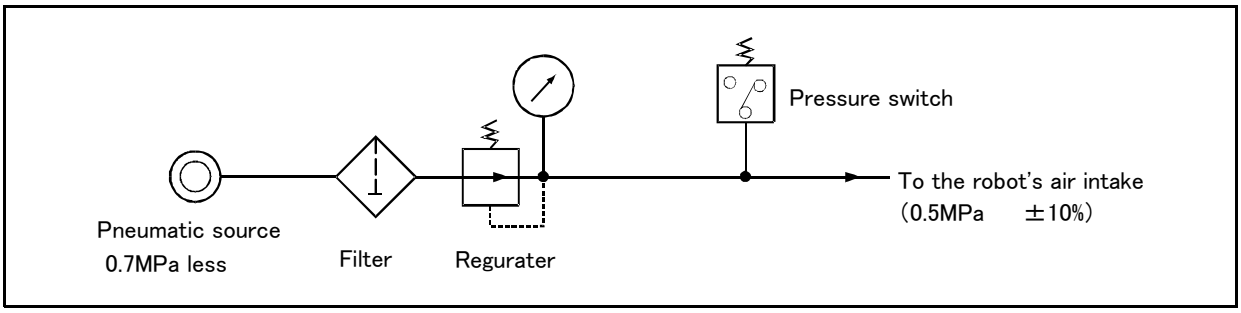


Fig.2-8 : Air supply circuit example for the hand

2.6 Options

■ What are options?

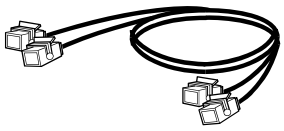
There are a variety of options for the robot designed to make the setting up process easier for customer needs. customer installation is required for the options. Options come in two types: ″set options″ and ″single options″.

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

(1) Machine cable extension

■ Order type : ● Fixed type 1S- □□ CBL-02
● Flexed type 1S- □□ LCBL-02 Note) The numbers in the boxes □□ refer the length.

■ Outline



This cable is exchanged for the machine cable (5 m) that was supplied as standard 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,motor power cable and ground cable.

■ Configuration

Table 2-10 : Configuration equipments and types

Part name		Type	Qty.		Remarks
			Fixed	Flexed	
Fixed	Set of signal and power cables	1S- □□ CBL-02	1 set	–	5m, 10m, or 15m each[Note1)]
	Motor signal cable	1S- □□ CBL(S)-01	(1 cable)	–	
	Motor power cable	1S- □□ CBL(P)-01	(1 cable)	–	
	Ground cable	BU284D339G △△	(1 cable)	–	12m, 17m or 22m each[Note2)]
Flexed	Set of signal and power cables	1S- □□ LCBL-02	–	1 set	5m, 10m, or 15m each[Note1)]
	Motor signal cable	1S- □□ LCBL(S)-01	–	(1 cable)	
	Motor power cable	1S- □□ LCBL(P)-01	–	(1 cable)	
	Ground cable	BU284D663G △△	–	(1 cable)	12m, 17m or 22m each[Note2)]
Nylon clamp		NK-14N	–	2 pcs.	for motor signal cable
Nylon clamp		NK-18N	–	2 pcs.	for motor power cable and ground cable
Silicon rubber			–	4 pcs.	

Note1)The numbers in the boxes □□ refer the length.
Note2)The numbers in the boxes △△ refer the length.
△ = Length of standard 7 m + extension (5m, 10m, or 15m each)

■ 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 signal cable	φ7 x 6and φ1.7 x 1
	Motor power cable	φ8.9 x 3 and φ6.5 x 6
	Ground cable	φ7.5 × 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		Ground cable BU284D663G △△
No. of cores	AWG#24 (0.2mm^2)-4P	AWG#24 (0.2mm^2)-7P	AWG#18 (0.75mm^2)	AWG#16 (1.25mm^2)-4C	AWG#18 (0.75mm^2)-3C	AWG#18 (0.75mm^2)-6C
Finish dimensions	Approx. ϕ6mm	Approx. ϕ8.5mm	Approx. ϕ1.7mm	Approx. ϕ8.9mm	Approx. ϕ6.5mm	Approx. ϕ7.5mm
No.of cables used	5 cables	1 cable	1 cable	2 cable	8 cable	1 cable
No. in total	7 cables			10 cables		1 cable

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

■ Fixing the flexible cable

(1) Connect the connector to the robot arm .

(2) Wind the silicon rubber around the cable at a position 300 to 400 mm from the side of robot arm and extension section as shown in Fig. 2-9, and fix with the nylon clamp to protect the cable from external stress.

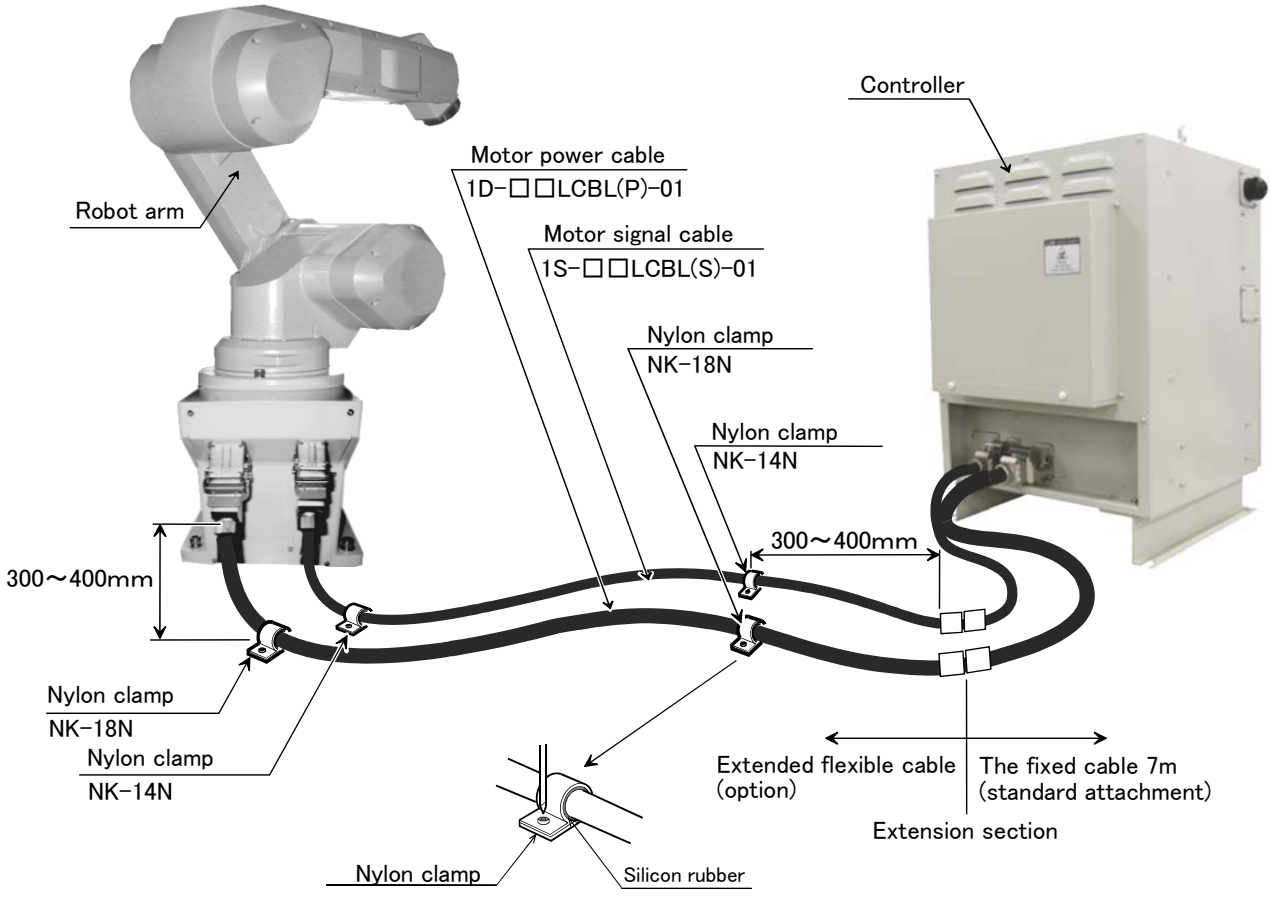


Fig.2-9 : Fixing the flexible cable

(2) Changing the operating range

■ Order type: 1S-DH -01

■ Outline

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

■ Configuration

Table 2-13 : Configuration devices

Part name	Type	Qty.	Remarks
Stopper for changing the operating range	1S-DH-01	2 pcs.	Hexagon socket bolt: M12 x 20 plating (strength classification 10.9)

■ Specifications

Table 2-14 : Specifications

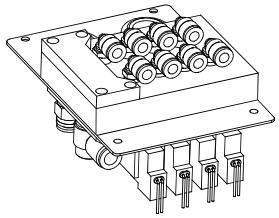
Axis		Standard	Changeable angle
J1	+ side	+170 degree	One point from +135° , +90° , +45°
	− side	−170 degree	One point from −135° , −90° , −45°

(1) The changeable angle shown in Table 2-14indicates the operation range by the software.
The limit by the mechanical stopper is positioned 1degrees outward from that angle, so take care when designing the layout.
(2) The changeable angle can be set independently on the + side and − side.
(3) The operating range is changed with robot arm settings and parameter settings. Refer to the separate "Instruction Manual/ROBOT ARM SETUP & MAINTENANCE" or "Instruction Manual/Detailed Explanation of Functions and Operations" for details.

(3) Solenoid valve set

■ Order type: One set: 1S-VD01-01(Sink type)/1S-VD01E-01(Source type)
Two sets: 1S-VD02-01(Sink type)/1S-VD02E-01(Source type)
Three sets: 1S-VD03-01(Sink type)/1S-VD03E-01(Source type)
Four sets: 1S-VD04-01(Sink type)/1S-VD04E-01(Source type)

■ Outline



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 2-15 : 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-VD01E-01	1 pc.	—	—	—	M4x8 four screws (installation screws). 1S-VD01-01/VD02-01/VD03-01/VD04-01 are the sink type. 1S-VD01E-01/VD02E-01/VD03E-01/VD04E-01 are the source type.
Solenoid valve set (2 sets)	1S-VD02-01/ 1S-VD02E-01	—	1 pc.	—	—	
Solenoid valve set (3 sets)	1S-VD02-01/ 1S-VD02E-01	—	—	1 pc.	—	
Solenoid valve set (4 sets)	1S-VD02-01/ 1S-VD02E-01	—	—	—	1 pc.	

■ Specifications

Table 2-16 : Valve specifications

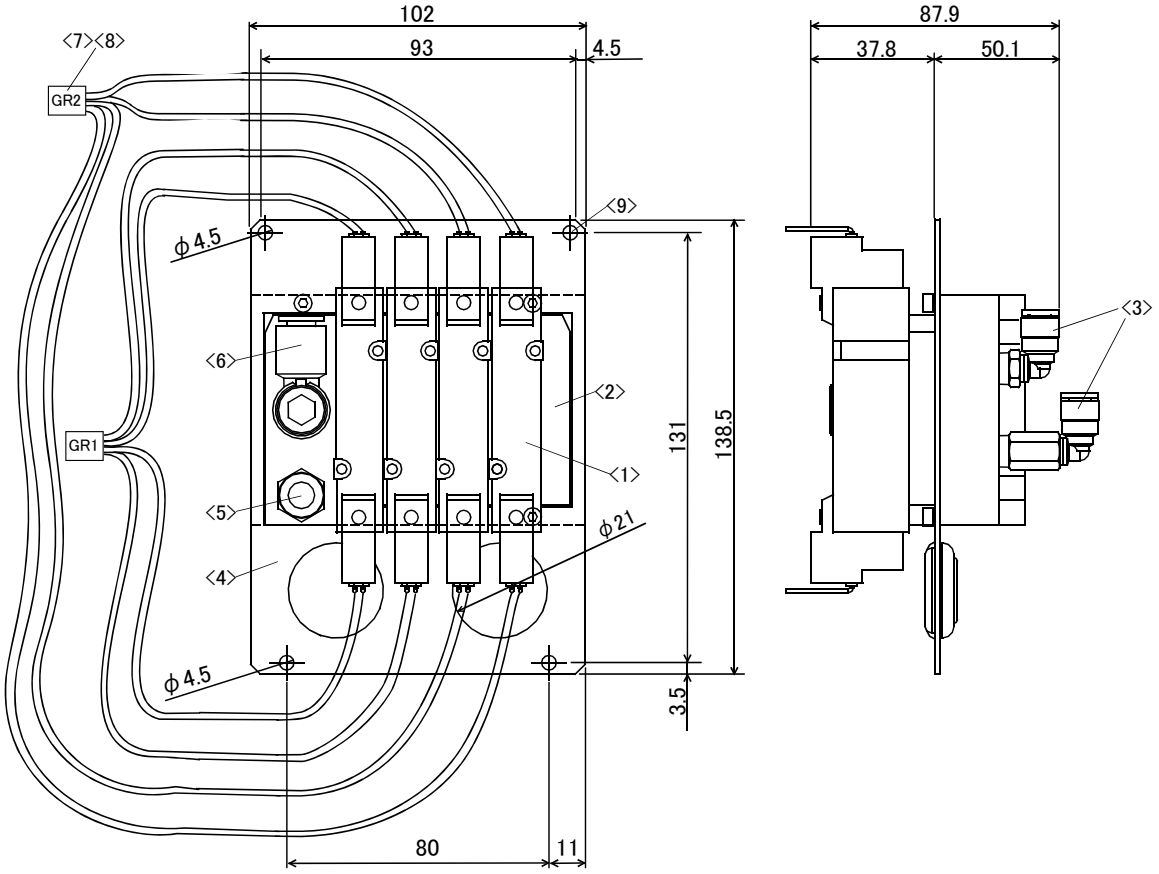
Item	Specifications
Number of positions	2
Port	5 Note1))
Valve function	Double solenoid
Operating fluid	Clean air Note2)
Operating method	Internal pilot method
Effective sectional area (CV value)	0.64mm
Oiling	Unnecessary
Operating pressure range	0.1 to 0.7MPa
Guaranteed proof of pressure	1.0MPa or more
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.)

Note1) Couplings of unused solenoid valves must be blocked with plugs. If they are not blocked, supplied air will blow out from the couplings, lowering the air pressure of the solenoid valves being used and making them nonfunctional
(recommended plugs: KQ2P-04 plugs made by SMC).

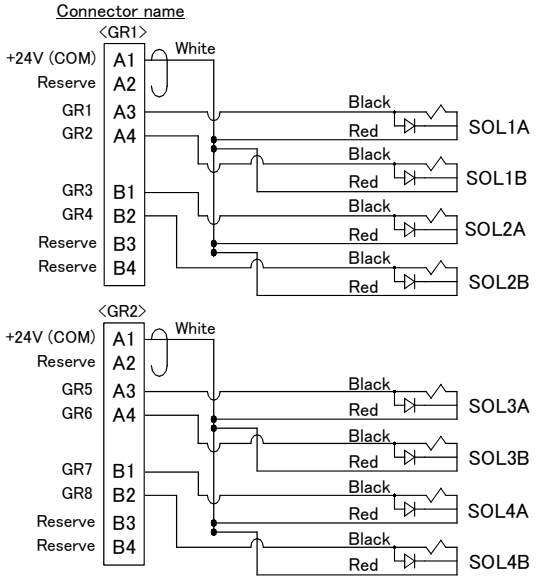
⚠ CAUTION Note2) The air to be provided must be clean, i.e., filtered with a mist separator or air filter. Failing to do so may lead to malfunctions.

Table 2-17 : Solenoid specifications

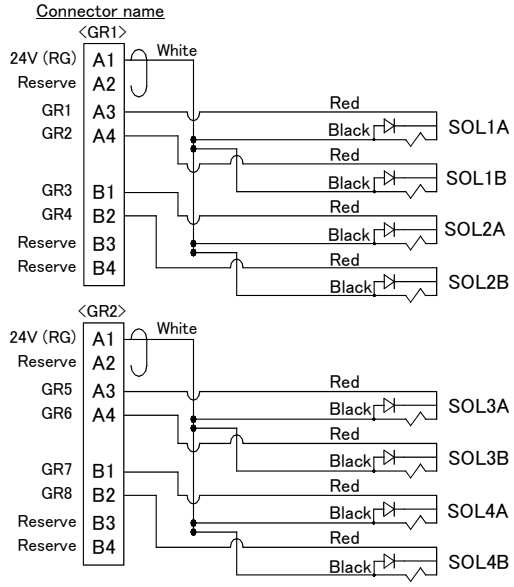
Item	Specifications
Coil rated voltage	DC24V ± 10%
Power consumption	0.55W
Voltage protection circuit with power surge protection	Diode



<Sink type>



<Source type>



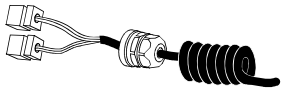
Part no.	Part name	1 sets	2 sets	3 sets	4 sets	Specifications
<1>	Solenoid valve	1	2	3	4	
<2>	Manifold block	1	1	1	1	
<3>	Quick coupling	2	4	6	8	φ6
<4>	Block plate	1	1	1	1	
<5>	Quick coupling	1	1	1	1	φ6
<6>	Quick coupling	1	1	1	1	φ6
<7>	Connector	1	1	2	2	1-1318115-4
<8>	Contact	6	6	12	12	1318112-1
<9>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

Fig.2-10 : Outline dimensional drawing

(4) 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 2-18 : Configuration equipment

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

■ Specifications

Table 2-19 : 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)	

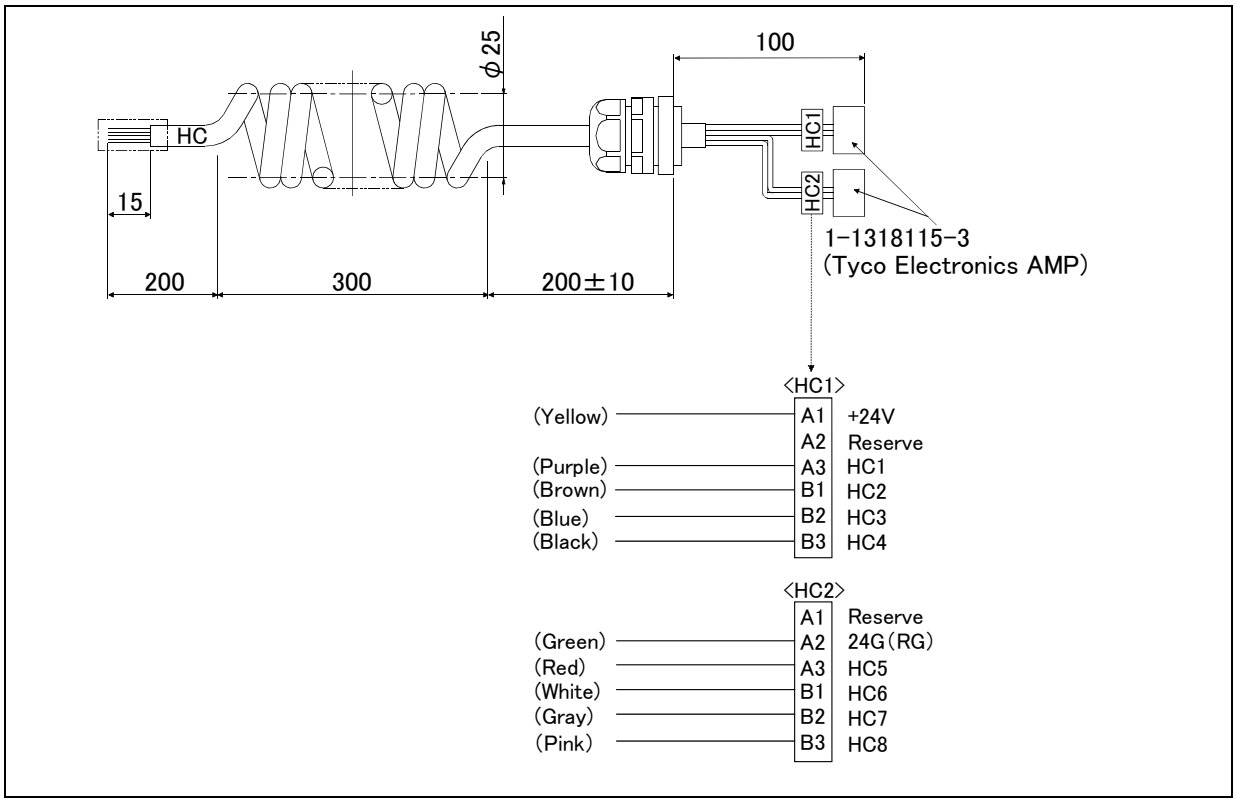


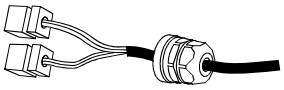
Fig.2-11 : Outside dimensional drawing and pin assignment

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

(5) Hand output cable

■ Order type: 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 2-20 : Configuration equipment

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

■ Specifications

Table 2-21 : 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	

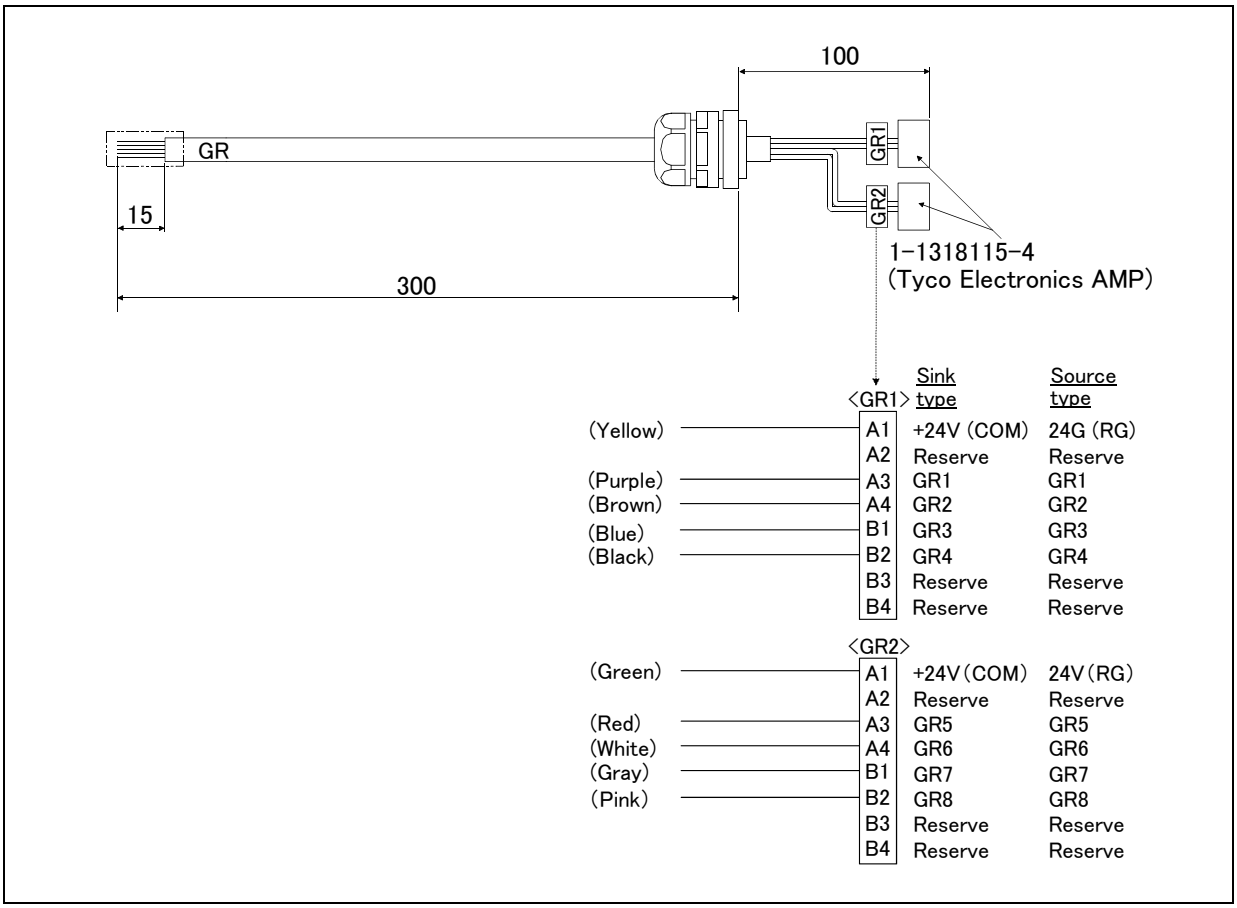


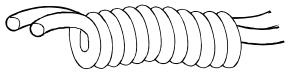
Fig.2-12 : Outline dimensional drawing and pin assignment

(6) Hand curl tube

■ Order type: Four set: :1N-ST0608C

■ Outline

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



■ Configuration

Table 2-22 : 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 2-23 : Specifications

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

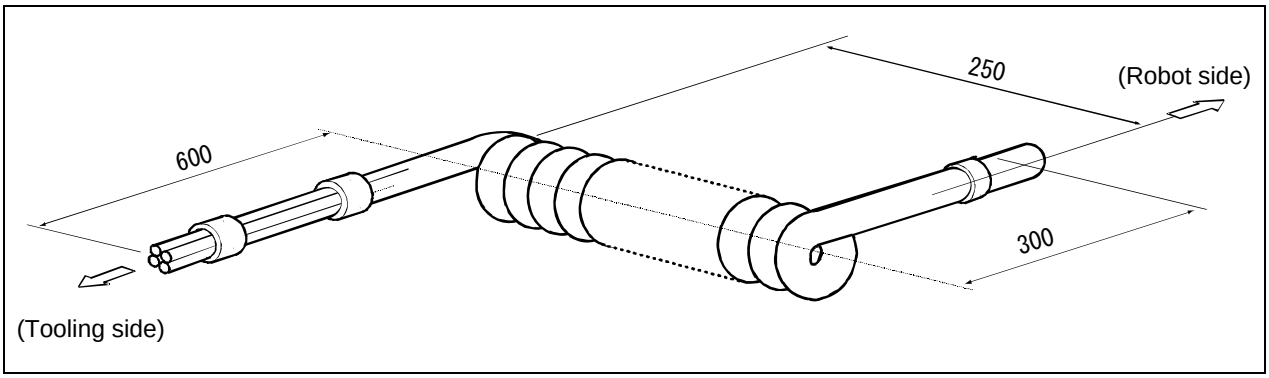


Fig.2-13 : Outline dimensional drawing

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

2.7 Maintenance parts

The consumable parts used in the robot arm are shown in Table 2-24. 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 2-24 : Consumable part list

No.	Part name	Type Note1)	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 pcs.	

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

3 Controller

3.1 Standard specifications

3.1.1 Standard specifications

Table 3-1 : Standard specifications of controller

Item		Unit	Specification	Remarks
Type			CR3D-701/701M	CR3D-701:RV-12SDC series CR3D-701M:RV-12SD series
Number of control axis			Simultaneously 6(Maximum)	
Memory capacity	Programmed positions and No. of steps	point step	13,000 26,000	
	Number of programs		256	
Robot language			MELFA-BASIC Ⅴ or MELFA-BASIC Ⅳ Note1)	
Teaching method			Pose teaching method ,MDI method	
External input and output	input and output	point	0/0	Max. 256/256 by option
	Dedicated input/output	point	Assigned with general-purpose input/output	
	Special stop input	point	1	
	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
	Enabling device input	point	1	Dual enabling switch line
	Emergency stop output	point	1	
	Mode output	point	1	
	Robot error output	point	1	
	Addition axis synchronization	point	1	
Interface	RS-232C	port	1	For expansion such as the personal cpmputer, Vision sensor
	Ethernet	port	1: For T/B, 1: For customers	10BASE-T/100BASE-Tx
	USB		1	Ver. 2.0 Only device function
	Hand dedicated slot	slot	1	Dedicated for pneumatic hand interface
	Option slot	slot	3	
	Additional axis interface	Channel	1	SSCNET Ⅲ
Power source	Input voltage range	V	3-phase, AC180 to 253	Note3)
	Power capacity	KVA	3.0	Does not include rush current Note4) Note5)
Outline dimensions		mm	CR3D-701: 450(W) x 380(D) x 625(H) CR3D-701M: 450(W) x 440(D) x 625(H)	Excluding protrusions Note6)
Mass		kg	Approx. 60	
Construction			Self-contained floor type, Closed type (IP54)	
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)The program of MELFA-BASICIV can be used by MELFA-BASICV, if program is converted by RT ToolBox2 (option).

Note2) It is when an pneumatic hand interface (2A-RZ365) is installed.

Note3) Please use the controller with an input power supply voltage fluctuation rate of 10% or less.

Note4) The power capacity is the rating value for normal operation. The power capacity does not include the rush current when the power is turned ON. The power capacity is a guideline and the actual operation is affected by the input power voltage. The power consumption in the specific operation pattern with the RV-12SD/12SDL series is approx. 4.5kW.

Note5)If the earth leakage breaker is installed in the primary side power supply circuit of the controller, please select the earth leakage breaker of the specification of the amperage rating 20A and 10mA of sensed current. (The leak current of the controller is set to about 7.5mA)

The short circuit breaker should use the following.

*Operate by the current leakage under the commercial frequency domain (50-60Hz).

If sensitive to the high frequency ingredient, it will become the cause in which below the maximum leak current value carries out the trip.

Note6)Becomes 615(H) at the caster specification.

Note7) The robot must be grounded by the customer.

3.1.2 Protection specifications and operating supply

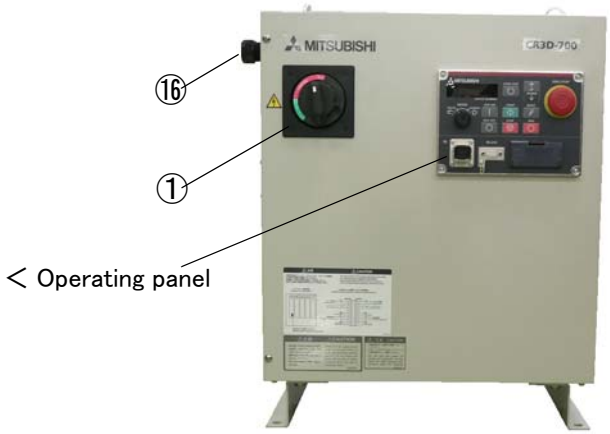
A protection method complying with the IEC Standard IP54(Closed type) is adopted for the controller.

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

Refer to the section Page 91, "6.2 Working environment" for details on the working environment.

3.2 Names of each part

＜ CR3D-700 ＞



＜ Operating panel ＞

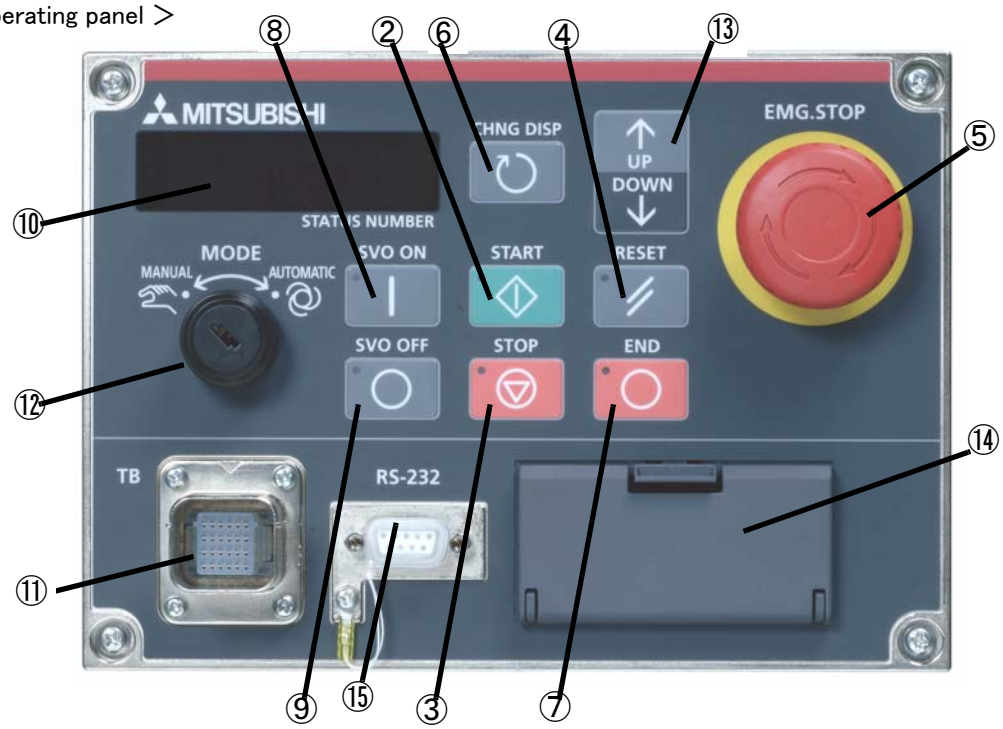


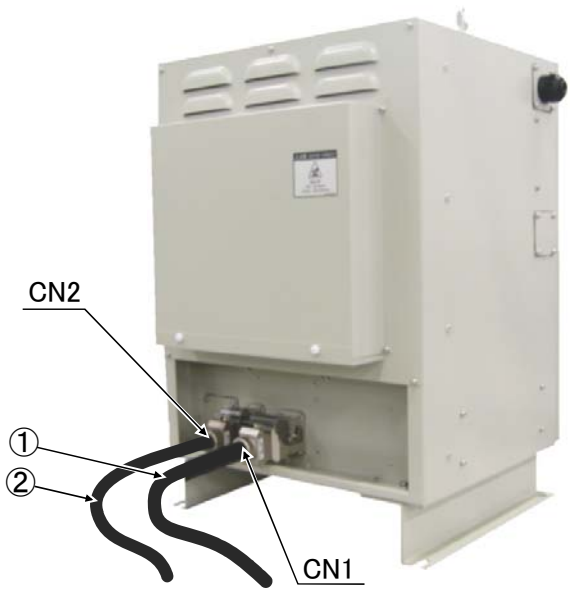
Fig.3-1 : Names of controller parts

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 CHNGDISP button..... This changes the details displayed on the display panel in the order of "Override" → "Program No." → "Line No.".
⑦ END button..... This stops the program being executed at the last line or END statement.
⑧ SVO.ON button..... This turns ON the servo power. (The servo turns ON.)
⑨ SVO.OFF button..... This turns OFF the servo power. (The servo turns OFF.)
⑩ STATUS NUMBER (display panel)..... The alarm No., program No., override value (%), etc., are displayed.
⑪ T/B connection connector ..... This is a dedicated connector for connecting the T/B. When not using T/B, connect the attached dummy connector.

⑫ MODE key switch..... This changes the robot's operation mode.
AUTOMATIC.....operations from the controller or external equipment are valid. Operations for which the operation mode must be at the external device or T/B are not possible. It is necessary to set the parameter for the rights of operation to connection between the operation panel and external equipment. For details, please refer to "INSTRUCTION MANUAL/Detailed explanations of functions and operations" of the separate volume.
MANUAL.....When the T/B is valid, only operations from the T/B are valid. Operations for which the operation mode must be at the external device or controller are not possible.
⑬ UP/DOWN button..... This scrolls up or down the details displayed on the "STATUS. NUMBER" display panel.
⑭ Interface cover .....USB interface and battery are mounted.
⑮ RS-232 connector..... This is an RS-232C specification connector for connecting the personal computer.
⑯ Power cable clamp ..... Fix the primary power cable.

1) Machine cable (for motor power)..... Connects to the robot arm base. (CN1 connector)
2) Machine cable (for motor signal)..... Connects to the robot arm base. (CN2 connector)

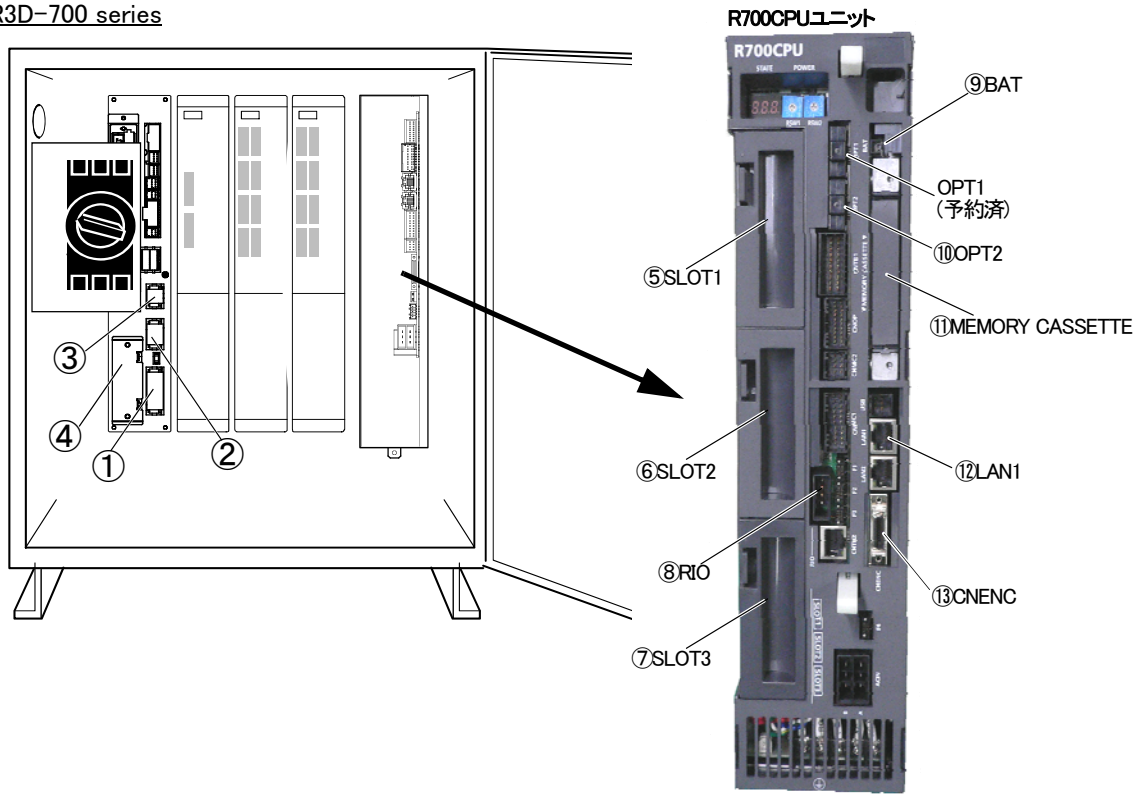
< CR3D-700 series >



① Machine cable connector (motor power)(CN1)..... Connects to the robot arm base. (CN1 connector)
② Machine cable connector (motor signal)(CN2)..... Connects to the robot arm base. (CN2 connector)

Fig.3-2 : Names of each part (Rear side CR3D-700 series)

CR3D-700 series



① Emergency stop input(EMGIN)..... Connect the emergency stop switch to the robot.
② Emergency stop output(EMGOUT) ..... The robot's error condition is outputted.
③ Special stop input(SKIP)..... stops the robot immediately.
④ Hand slot(HND)..... Install the pneumatic hand interface optional.
⑤⑥⑦ Option slot(SLOT1, SLOT2, SLOT3)..... Install the interface optional.
⑧ Extension parallel input/output unit connection connector(RIO)
Connect the extension parallel input/output unit.
⑨ Battery connection connector(BAT)..... Connect the battery
⑩ Addition axis connection connector(OPT)..... Connect the cable for addition axis control.
⑪ Expansion memory cassette(MEMORY CASSETTE).... Install the memory cassette optional.
⑫ Ethernet interface(LAN1)..... Connect the Ethernet cable.
⑬ Tracking interface(CNENC)..... Connect the encoder cable, if it uses the tracking function.

図 3-3 : Names of each part (interior CR3D-700 series)

3.3 Outside dimensions/Installation dimensions

3.3.1 Outside dimensions

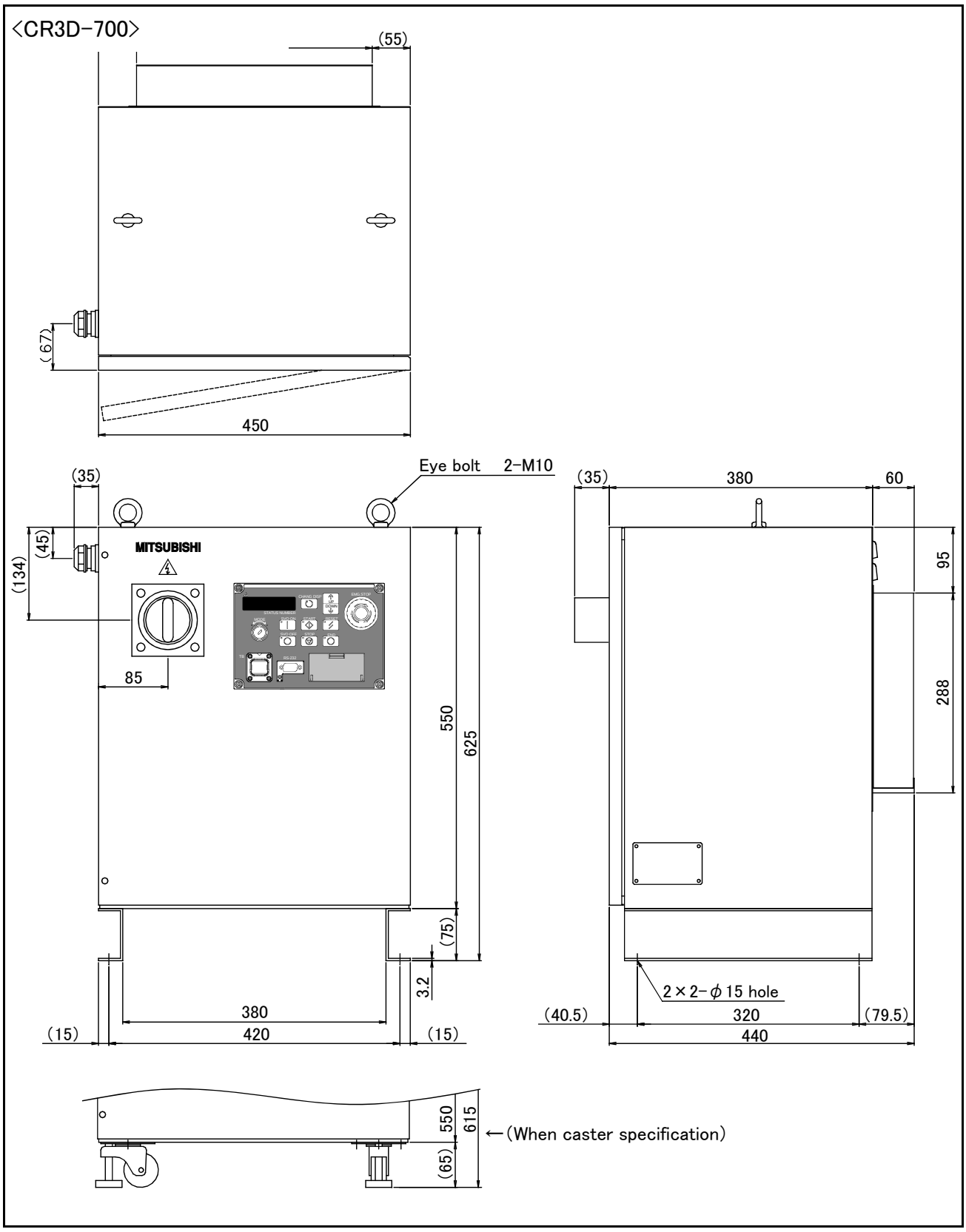


図 3-4 : Outside dimensions of controller(CR3D-700)

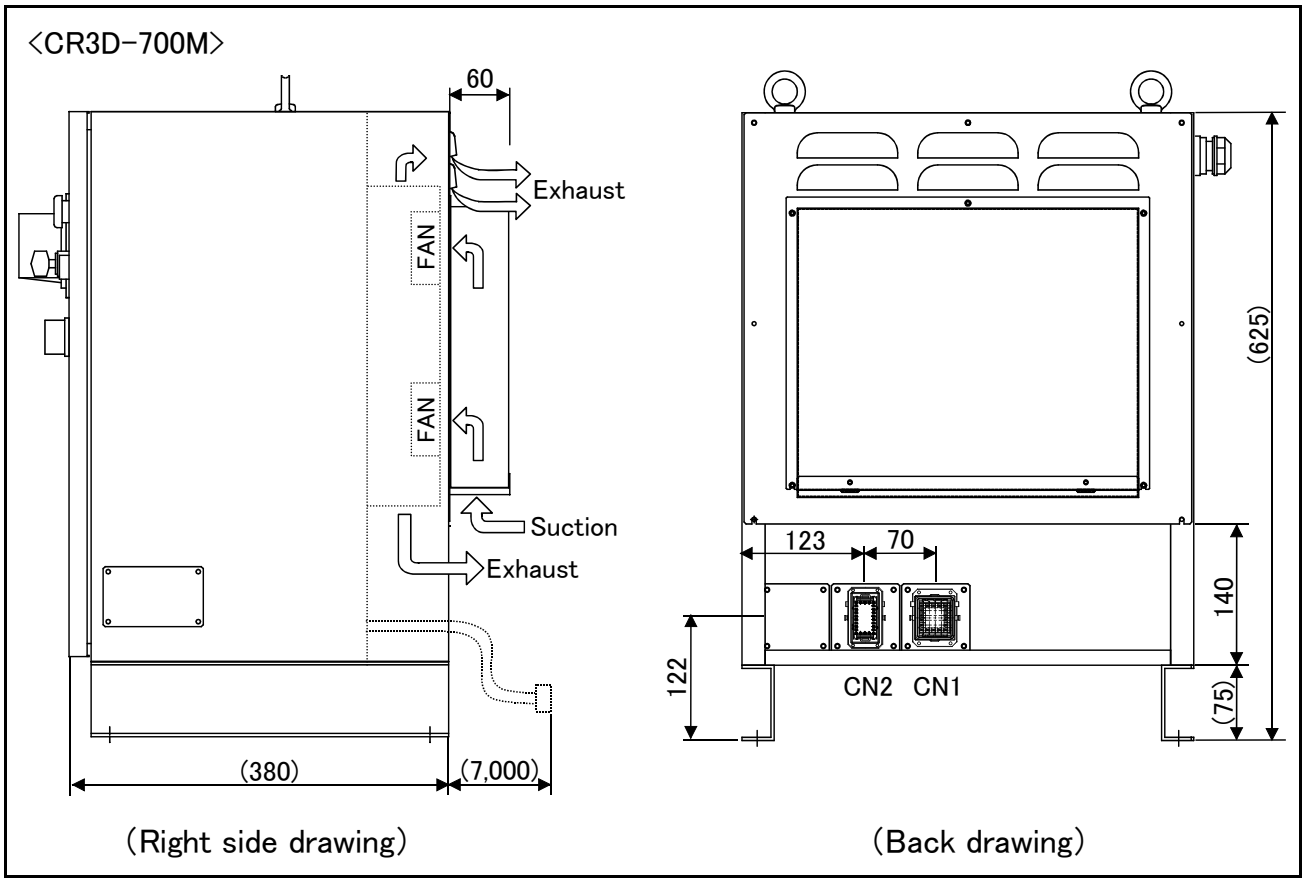


Fig.3-5 : Outside dimensions of controller (CR3D-700M Supplement)

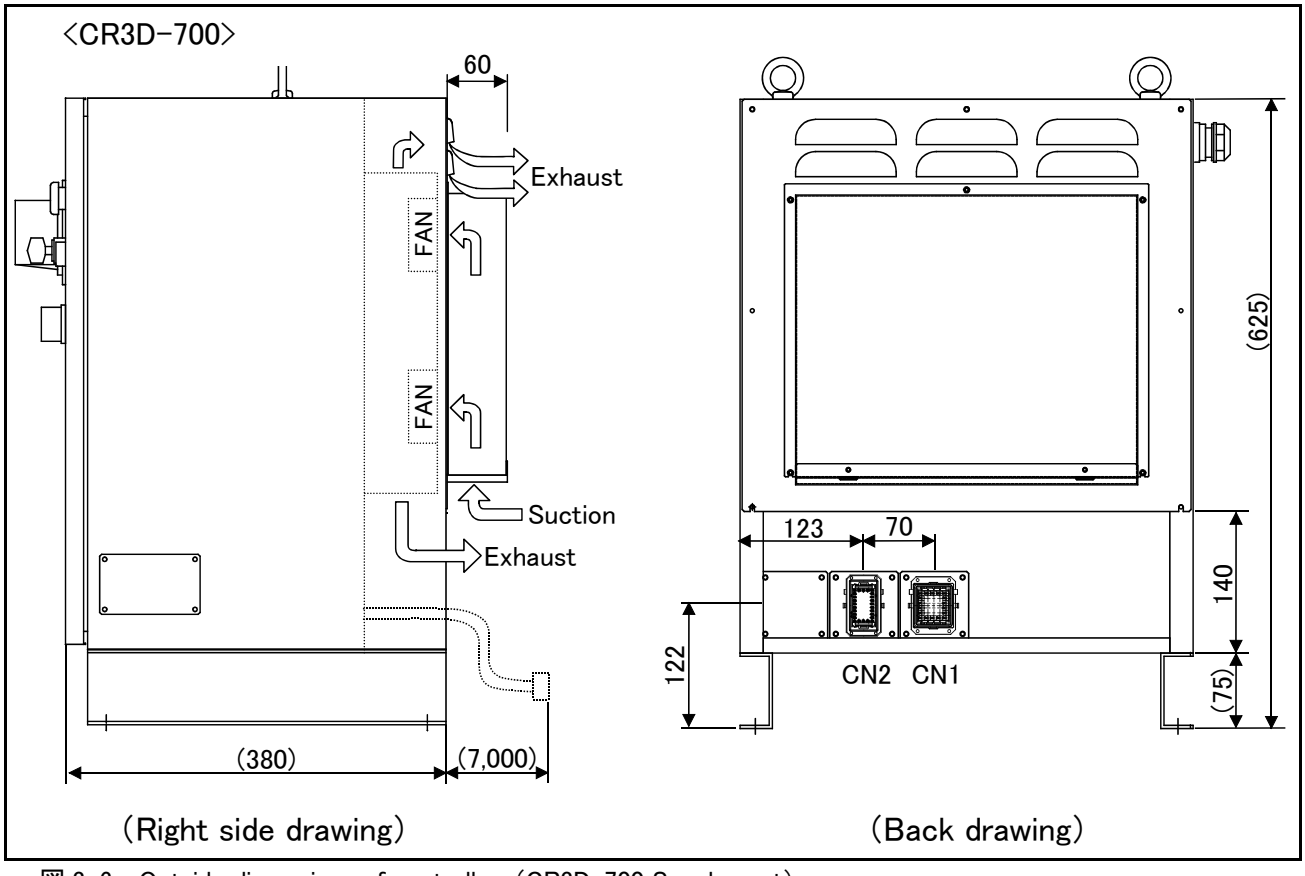
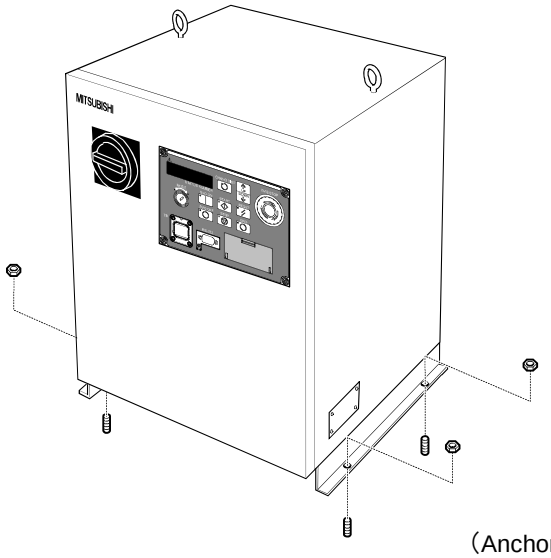


図 3-6 : Outside dimensions of controller (CR3D-700 Supplement)

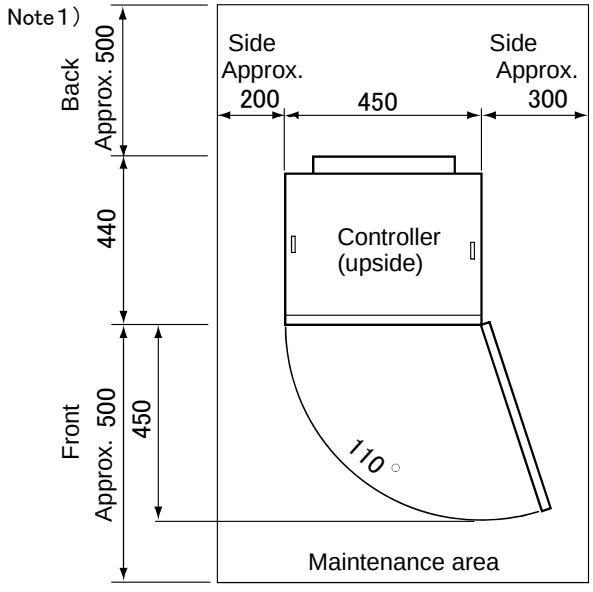
3.3.2 Installation dimensions

<CR3D-700/700M>



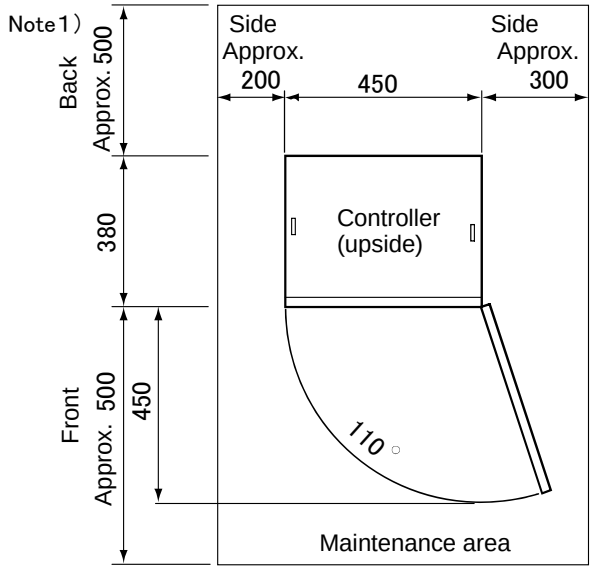
(Anchor bolt installation: 4 places)

<CR3D-700M>



(View from upside)

<CR3D-700>



(View from upside)

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

Fig.3-7 : Installation of controller (CR3D-700/700M)

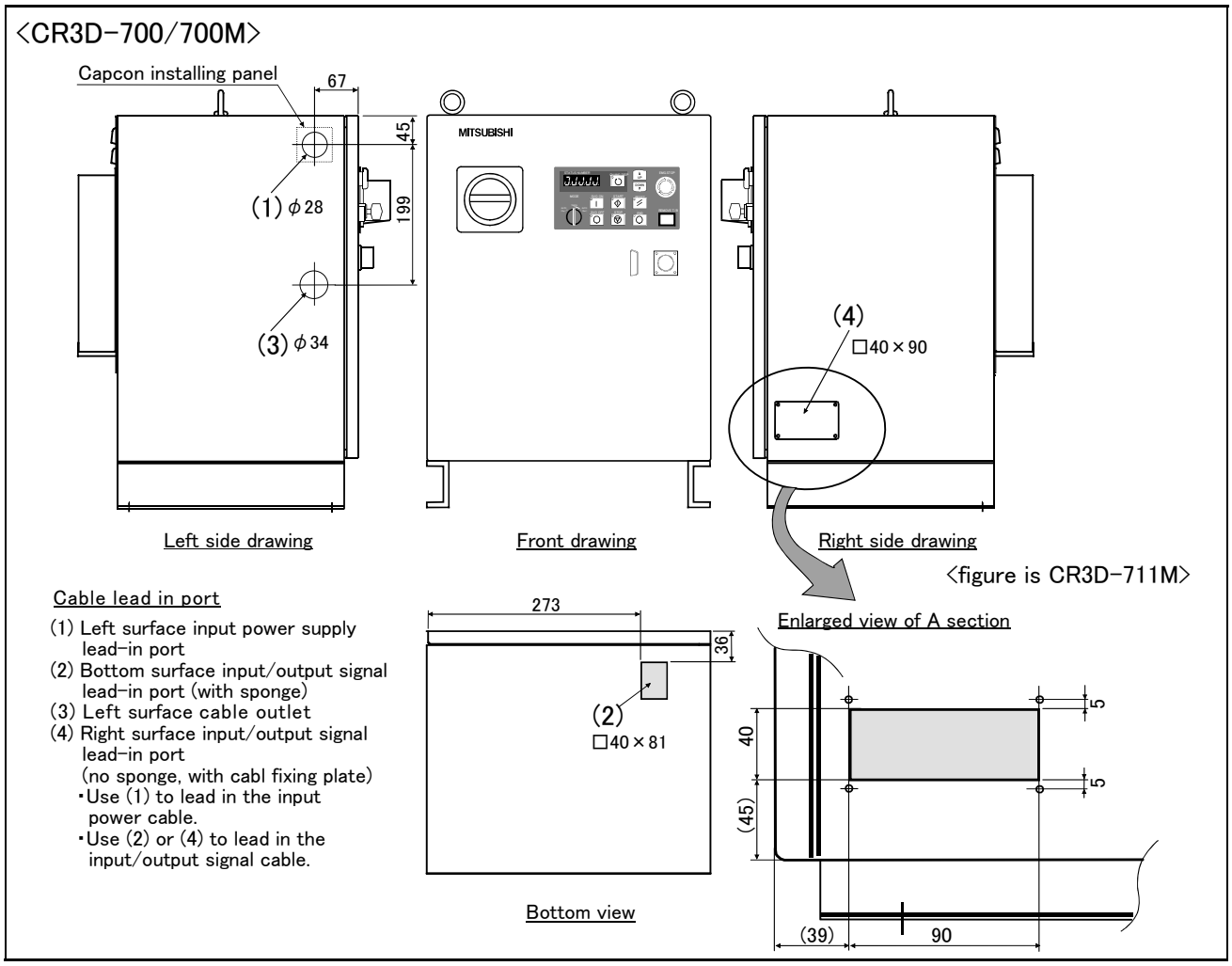


図 3-8 : Cable lead-in and dimension of the controller （CR3D-700/700M）

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.

Table 3-2 : Emergency stop/Door switch input

Name	No. of input/output points		Connection format
	Input	Output	
Emergency stop	1	1	Connector
Special stop input	1	-	
Door switch	1	-	
Enabling device input	1	-	
Dedicated input/output	Assigned with HLS input/output		

The wiring for the safe security of the emergency stop etc. is shown after

The hand output is an option. Refer to Page 57, "(2) Pneumatic hand interface" for details

3.5 Dedicated input/output

Show the main function of dedicated input/output in the Table 3-3. Refer to attached instruction manual "Detailed explanations of functions and operations" in the product for the other functions. Each parameter indicated with the parameter name is used by designated the signal No., assigned in the order of input signal No. and output signal No. 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 3-3 : Dedicated input/output list

Parameter name	Input		Note1)	Output	
	Name	Function	Level	Name	Function
TEACHMD	None			Teaching mode output signal	Outputs that the teaching mode is entered.
ATTOPMD	None			Automatic mode output signal	Outputs that the automatic mode is entered.
ATEXTMD	None			Remote mode output signal	Outputs that the remote mode is entered.
RCREADY	None			Controller power ON complete signal	Outputs that external input signals can be received.
AUTOENA	Automatic operation enabled input signal	Allows automatic operation.	L	Automatic operation enabled output signal	Outputs the automatic operation enabled state.
START	Start input signal	Starts all slots.	E	Operating output signal	Outputs that the slot is operating.
STOP	Stop input signal	Stops all slots. The input signal No. is fixed to 0. Note) Use the emergency stop input for stop inputs related to safety.	L	Wait output signal	Outputs that the slot is temporarily stopped.
STOP2	Stop input signal	The program during operation is stopped. Unlike the STOP parameter, change of the signal number is possible. Notes) specification is the same as the STOP parameter.	L	Wait output signal	Outputs that the slot is temporarily stopped.
SLOTINIT	Program reset input signal	Resets the wait state.	E	Program selection enabled output signal	Outputs that the slot is in the program selection enabled state.
ERRRESET	Error reset input signal	Resets the error state.	E	Error occurring output signal	Outputs that an error has occurred.
CYCLE	Cycle stop input signal	Carries out cycle stop.	E	In cycle stop operation output signal	Outputs that the cycle stop is operating.
SRVOFF	Servo ON enabled input signal	Turns the servo OFF for all mechanisms.	L	Servo ON enabled output signal	Outputs servo-on disable status. (Echo back)
SRVON	Servo ON input signal	Turns the servo ON for all mechanisms.	E	In servo ON output signal	Outputs the servo ON state.
IOENA	Operation rights input signal	Requests the operation rights for the external signal control.	L	Operation rights output signal	Outputs the operation rights valid state for the external signal control.
MELOCK	Machine lock input signal	Sets/resets the machine lock state for all mechanisms.	E	In machine lock output signal	Outputs the machine lock state.
SAFEPOS	Evasion point return input signal	Requests the evasion point return operation.	E	In evasion point return output signal	Outputs that the evasion point return is taking place.
OUTRESET	General-purpose output signal reset	Resets the general-purpose output signal.	E	None	
EMGERR	None			Emergency stop output signal	Outputs that an emergency stop has occurred.
S1START : S32START	Start input	Starts each slot.	E	In operation output	Outputs the operating state for each slot.
S1STOP : S32STOP	Stop input	Stops each slot.	L	In wait output	Outputs that each slot is temporarily stopped.

Parameter name	Input		Note1)	Output	
	Name	Function	Level	Name	Function
PRGSEL	Program selection input signal	Designates the setting value for the program No. with numeric value input signals.	E	None	
OVRDSEL	Override selection input signal	Designates the setting value for the override with the numeric value input signals.	E	None	
IODATA Note2)	Numeric value input (start No., end No.)	Used to designate the program name, override value., mechanism value.	L	Numeric value output (start No., end No.)	Used to output the program name, override value., mechanism No.
PRGOUT	Program No. output request	Requests output of the program name.	E	Program No. output signal	Outputs that the program name is being output to the numeric value output signal.
LINEOUT	Line No. output request	Requests output of the line No.	E	Line No. output signal	Outputs that the line No. is being output to the numeric value output signal.
OVRDOUT	Override value output request	Requests the override output.	E	Override value output signal	Outputs that the override value is being output to the numeric value output signal.
ERROUT	Error No. output request	Requests the error No. output.	E	Error No. output signal	Outputs that the error No. is being output to the numeric value output signal.
JOGENA	Jog valid input signal	Validates jog operation with the external signals	E	Jog valid output signal	Outputs that the jog operation with external signals is valid.
JOGM	Jog mode input 2-bit	Designates the jog mode.	L	Jog mode output 2-bit	Outputs the current jog mode.
JOG+	Jog feed + side for 8-axes	Requests the + side jog operation.	L	None	
JOG-	Jog feed - side for 8-axes	Requests the - side jog operation.	L	None	
HNDCNTL1 : HNDCNTL3	None			Mechanism 1 hand output signal status : Mechanism 3 hand output signal status	Mechanism 1: Outputs the status of general-purpose outputs 900 to 907. Mechanism 2: Outputs the status of general-purpose outputs 910 to 917. Mechanism 3: Outputs the status of general-purpose outputs 920 to 927.
HNDSTS1 : HNDSTS3	None			Mechanism 1 hand input signal status : Mechanism 3 hand input signal status	Mechanism 1: Outputs the status of hand inputs 900 to 907. Mechanism 2: Outputs the status of hand inputs 910 to 917. Mechanism 3: Outputs the status of hand inputs 920 to 927.
HNDERR1 : HNDERR3	Mechanism 1 hand error input signal : Mechanism 3 hand error input signal	Requests the hand error occurrence.	L	Mechanism 1 hand error output signal : Mechanism 3 hand error output signal	Outputs that a hand error is occurring.
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 and output etc.

Do wiring of the external emergency stop, the special stop input, the door switch, and the enabling device from the "special input/output" terminal connector.

Table 3-4 : Special input/output terminal

区分	名称	内容
Input	Emergency stop	Applies the emergency stop. Dual emergency line
Input	Special stop input	Applies the stop. (Refer to Page 45, "3.6.2 Special stop input(SKIP)")
Input	door switch	Servo-off
Input	enabling device	Servo-off
Output	Emergency stop	It outputs that the emergency stop is inputting.

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

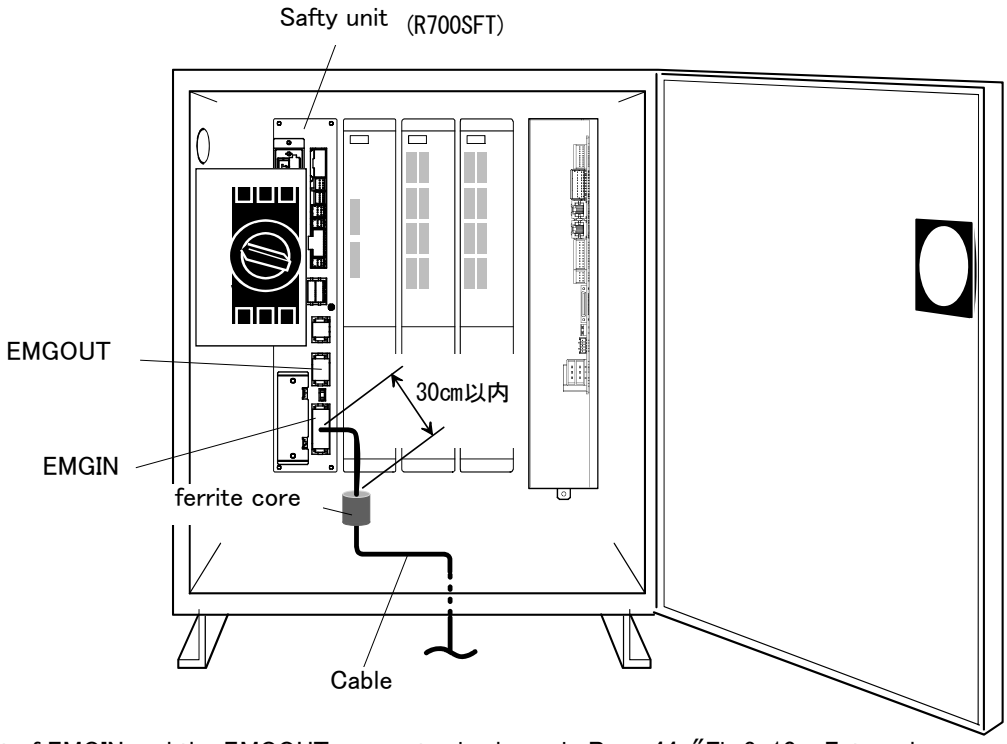
3.6.1 Connection of the external emergency stop

The external emergency stop input and door switch input and enabling device input are opened at shipment as shown in Fig. 3-10.
Connect the external emergency stop switch and door switch with the following procedure.

1) Prepare the "emergency stop switch", "enabling device" and "door switch".
2) Securely connect the external emergency stop's contacts across 3A-4A, 3B-4B, and the door switch's contacts across 8A-9A, 8B-9B, and the enabling device switch's contacts across 10A-11A, 10B-11B, on the terminal block.

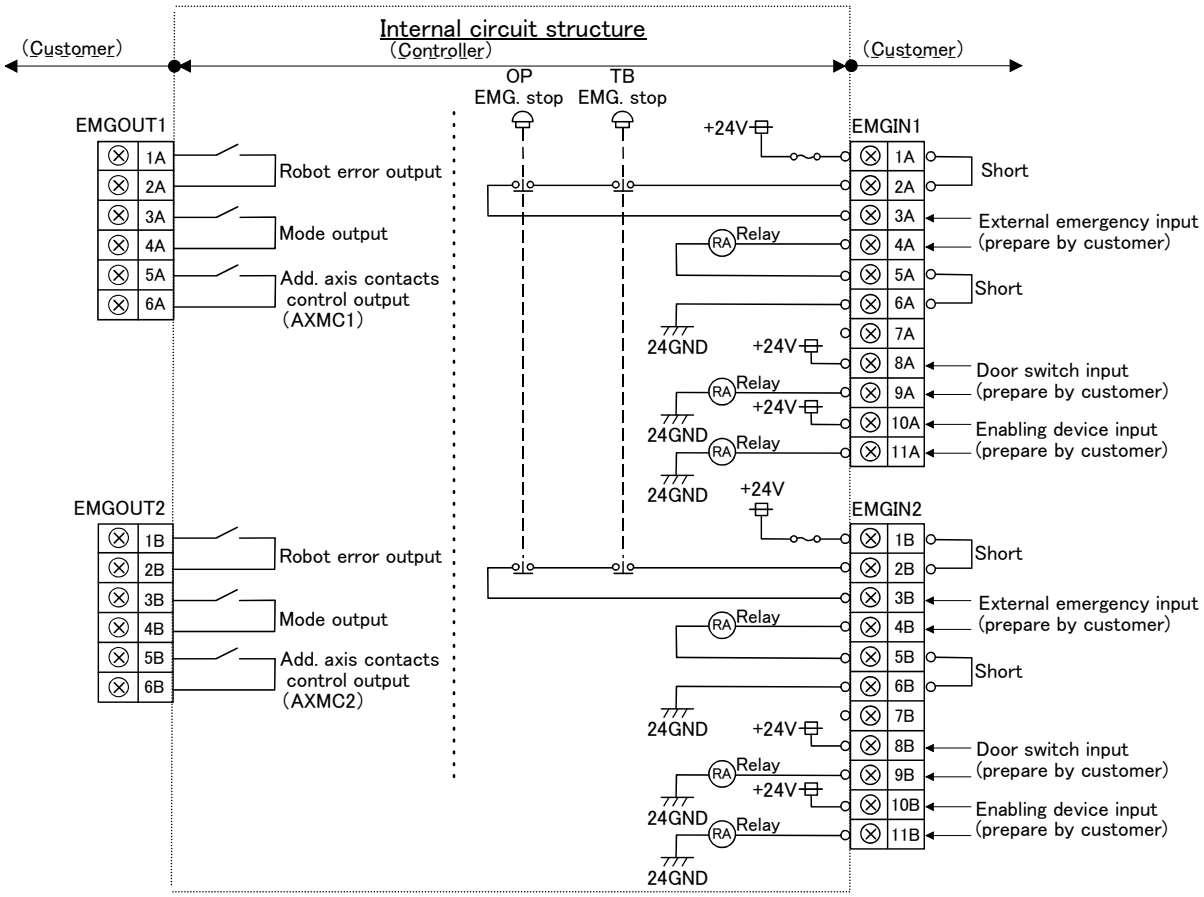
[Caution] When wiring the emergency stop switch (double emergency line type), wire both contacts to the two terminal blocks on the controller. If both contacts are wired to only one of the terminal blocks, errors cannot be cancelled using the door switch. The cable uses the shielded cable and installs the ferrite core. Install the ferrite core in less than 30cm from the contact button.

<CR3D-700/700M>

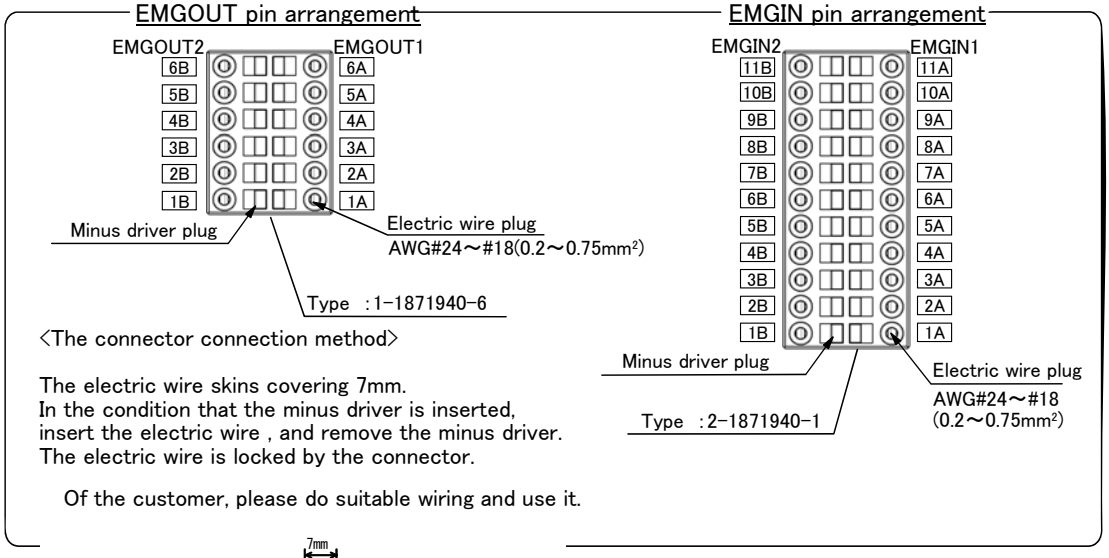


Pin allotment of EMGIN and the EMGOUT connector is shown in Page 44, "Fig.3-10 : External emergency stop connection".

Fig.3-9 : Emergency stop cable connection(CR3D-700)



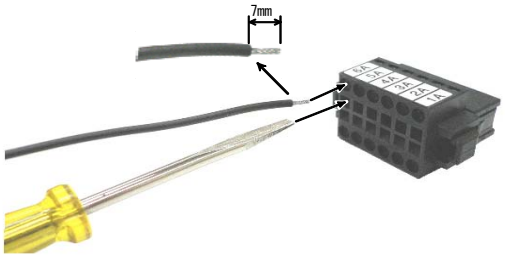
Warning Please do not do the withstand voltage examination.
Moreover, it becomes the cause of failure if it connects incorrectly.



<The connector connection method>

The electric wire skins covering 7mm.
In the condition that the minus driver is inserted,
insert the electric wire , and remove the minus driver.
The electric wire is locked by the connector.

Of the customer, please do suitable wiring and use it.



Skin covering of the electric wire and insert directly.
Use it after twisting the electric wire.

Please insert the electric wire to the back, pushing the back spring with the small minus driver etc.
* Recommendation driver sizes are 1.4mm – 2.4mm.
(The driver plug area of the connector is 2.5mm)

Fig.3-10 : External emergency stop connection

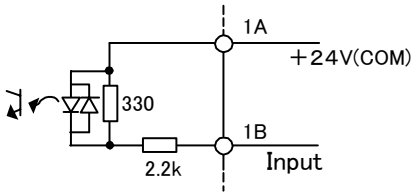
⚠CAUTION Please install the emergency stop switch to the place which is easy to operate it, and when the robots are the abnormalities, stop the robot immediately.

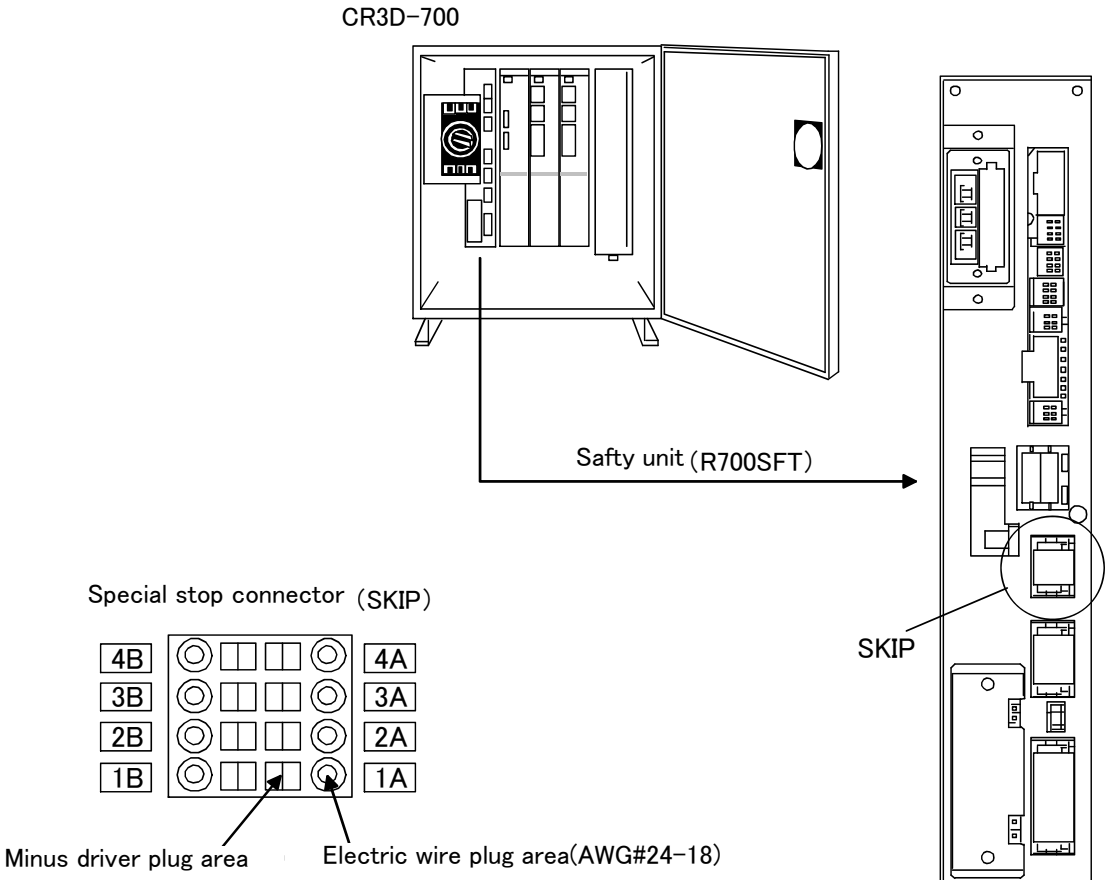
⚠CAUTION Be careful of the short circuit with the next terminal at the time of connection of the electric wire to the EMGIN connector.
Moreover, since solder plating to the electric wire section may wake up loose connection, please do not carry out.

3.6.2 Special stop input(SKIP)

The skip is the input signal to stop the robot. Wire 1A-1B of the special stop connector (SKIP) shown in Page 46, "Fig.3-11 : Connection of the special-stop-input".

Table 3-5 : Special stop input electric specification

Item		Specifications	Internal circuit
Type		DC input	
No. of input point		1	
Insulation method		Phto-coupler insulation	
Rated inpit voltage		DC 24 V	
Rated input current		approx. 11 mA	
Working voltage range		DC 21.6～26.4 V (Ripple rate within 5%)	
ON voltage/ON current		DC 8 V or more ／ 2 mA or more	
OFF voltage/OFF current		DC 4 V or less ／ 1 mA or less	
Input resistance		approx. 2.2 kΩ	
Response time	OFF → ON	1 ms or less	
	ON → OFF	1 ms or less	
Common method		1 point per common	
External wire connection method		Connector	



<The connector connection method>
The electric wire skins covering 7mm.
In the condition that the minus driver is inserted, insert the electric wire, and remove the minus driver.
The electric wire is locked by the connector.

Fig.3-11 : Connection of the special-stop-input

3.6.3 Door switch function

This function retrieves the status of the switch installed on the door of the safety fence, etc., and stops the robot when the door is opened. This differs from an emergency stop in that the servo turns OFF when the door is opened and an error does not occur. Follow the wiring example shown in Fig. 3-10, 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.

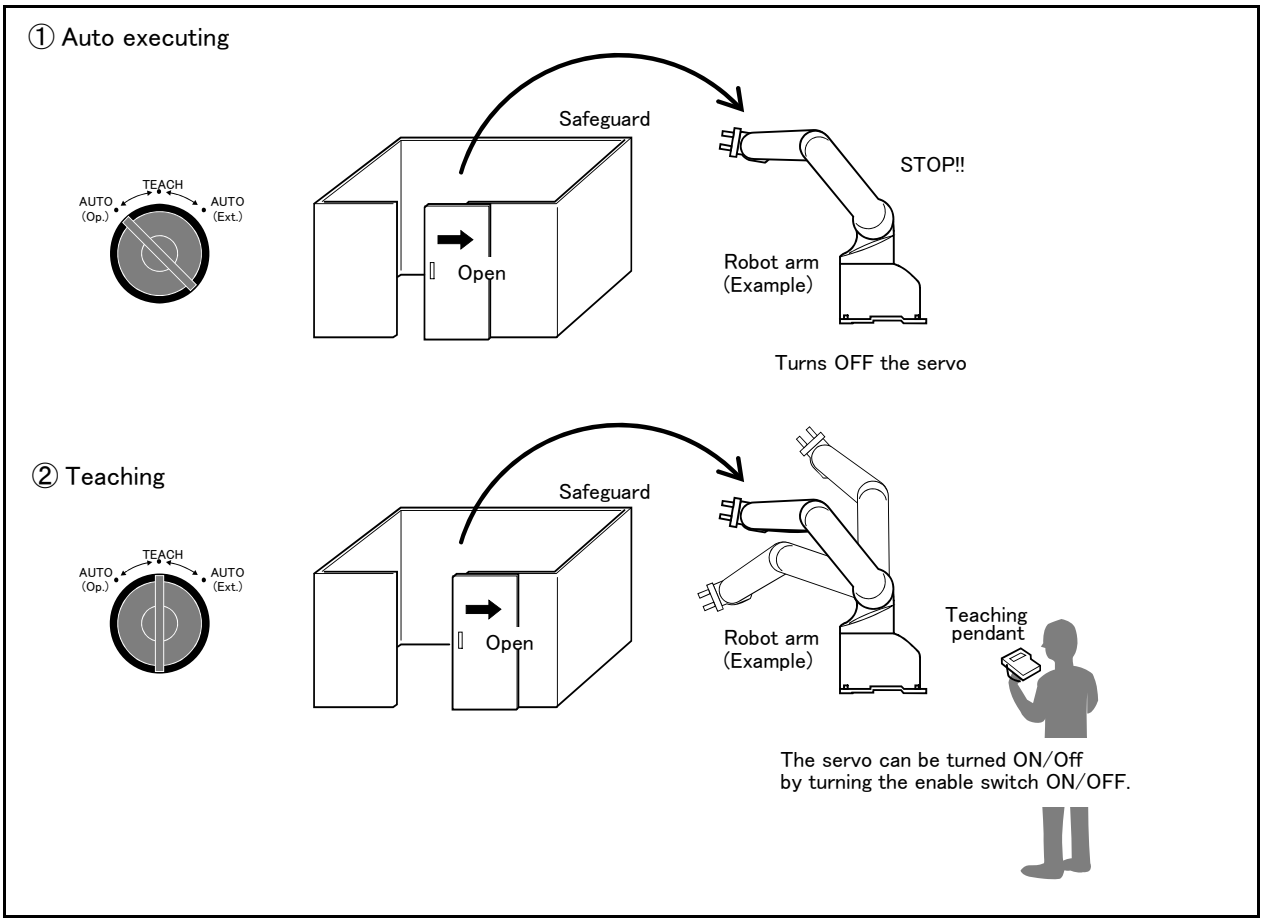


Fig.3-12 : Door switch function

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-J3-B series) that supports Mitsubishi's SSC Net Ⅲ .
Refer to the separate "Additional axis interface Instruction Manual" for details on the additional axis function.

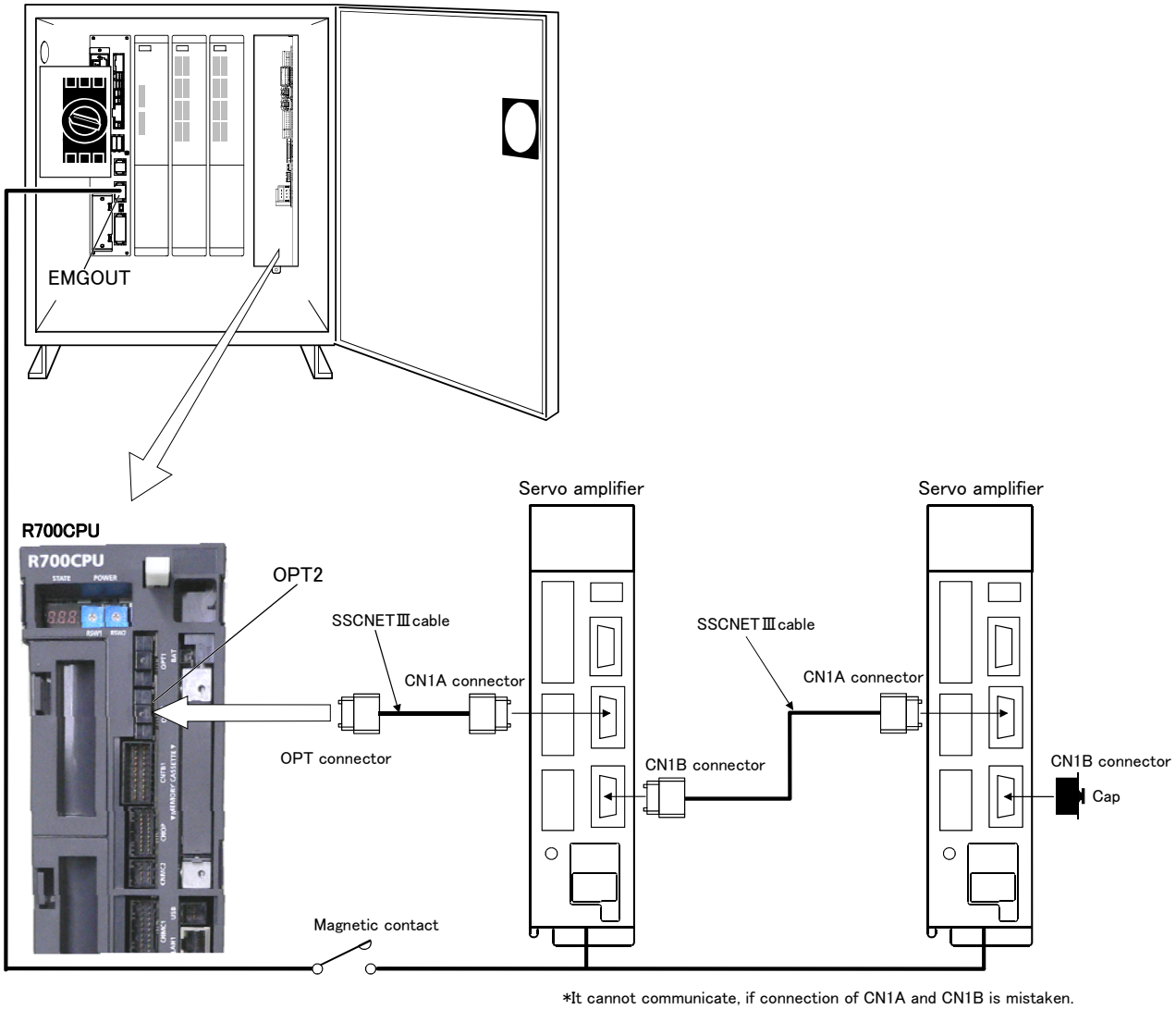
3.7.1 Wiring of the Additional Axis Interface

Table 3-6 shows the connectors for additional axes inside the controller and Fig. 3-13 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 50, "3.8 Magnet contactor control connector output (AXMC) for addition axes".

Table 3-6 : Dedicated Connectors inside the Controller

Name	Connector name	Details
Connector for additional axes	OPT2	This connector is used to connect between general-purpose servo amplifiers and the controller.
Magnet contactor control connector for additional axes	EMGOUT	This contact output is used to turn ON/OFF the motor power by connecting to general-purpose servo amplifiers.

<CR3D-700/700M>



*It cannot communicate, if connection of CN1A and CN1B is mistaken.

Fig.3-13 : Example of addition axis connection (CR3-700/700M)

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 (AXMC) provided on the rear or 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. 3-14 shows an example of its circuit, and Fig. 3-15 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 the separate "Additional axis interface Instruction Manual" for details on the additional axis function.

Note1) you use the addition axis function as a user mechanism who became independent of the robot arm, please do not connect this output signal. Servo-on of the user mechanism may be unable.

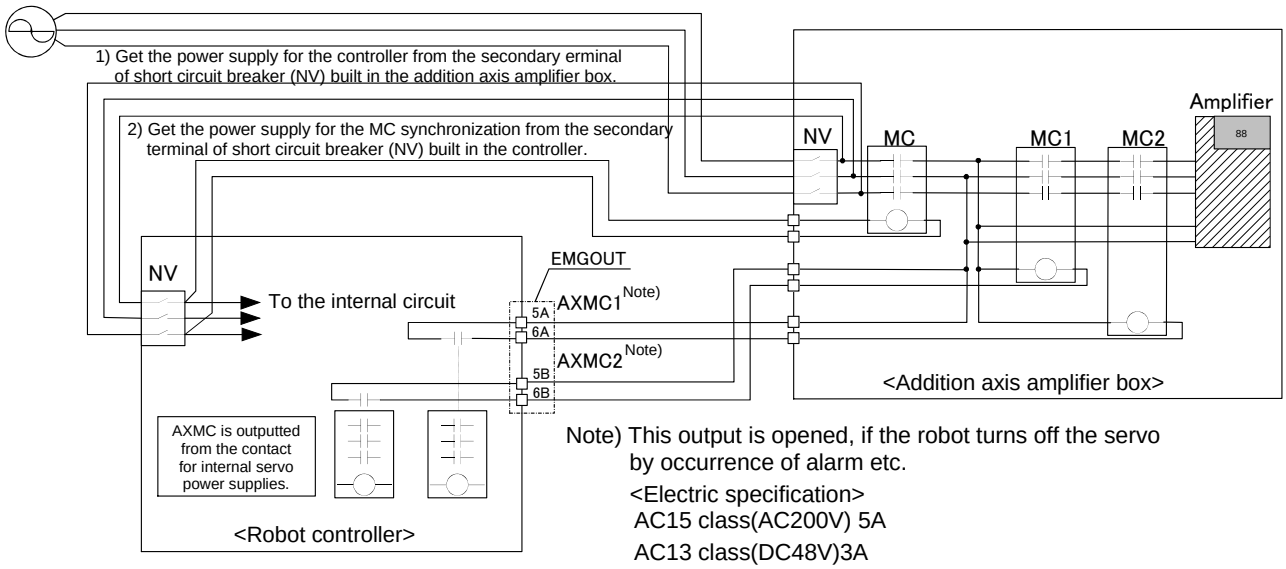


Fig.3-14 : Example of circuit for addition axes of Magnet contactor control output

<CR3D-700/700M>

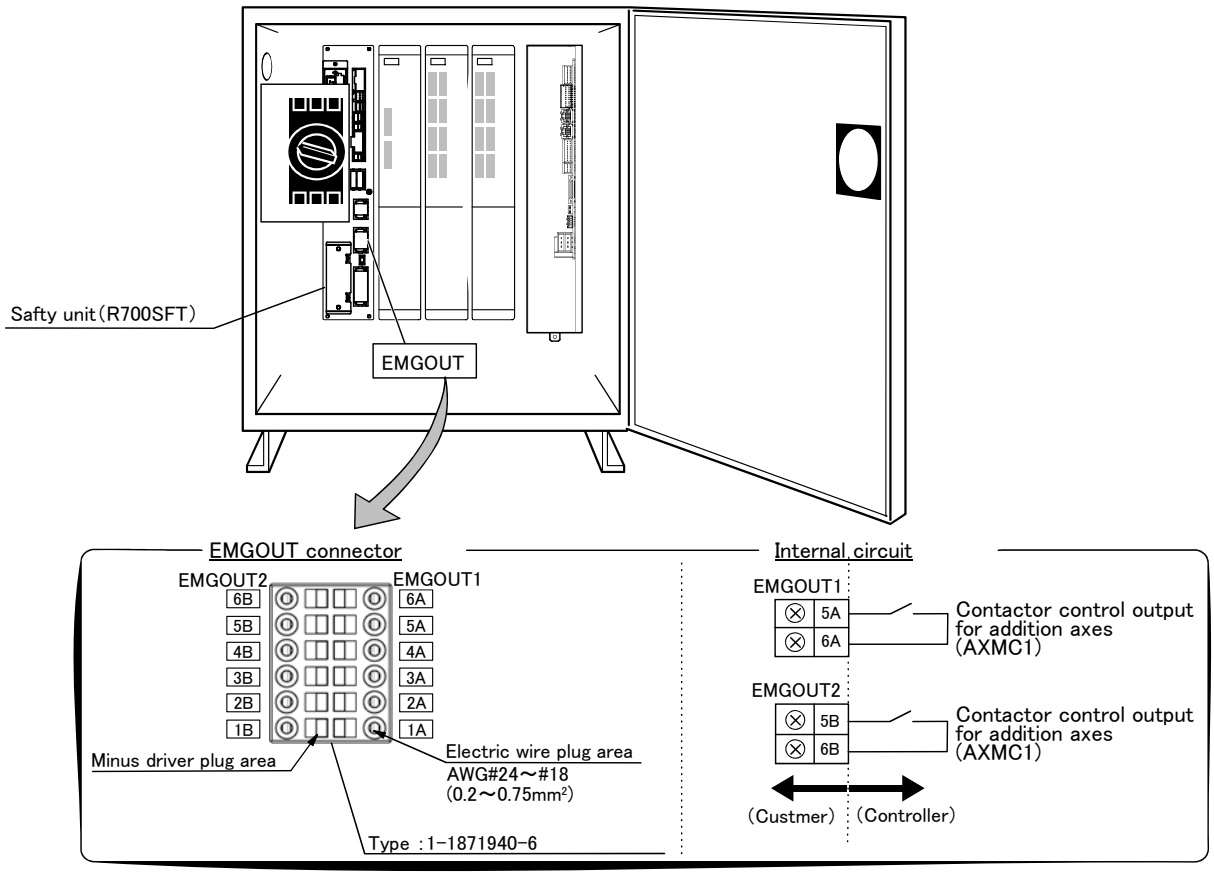


図 3-15 : EMGOUT connector （CR3D-700/700M）

3.9 Options

■ What are options?

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

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

(1) Teaching pendant (T/B)

■ Order type: R32TB :Cable length 7m
R32TB-15 :Cable length 15m

■ Outline

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

■ Configuration

Table 3-7 : Configuration device

Part name	Type	Qty.	Remarks
Teaching pendant	R32TB	Either one pc.	Cable length is 7m. Hand strap is attached.
	R32TB-15		Cable length is 15m. Hand strap is attached.

■ Specifications

Table 3-8 : Specifications

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

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

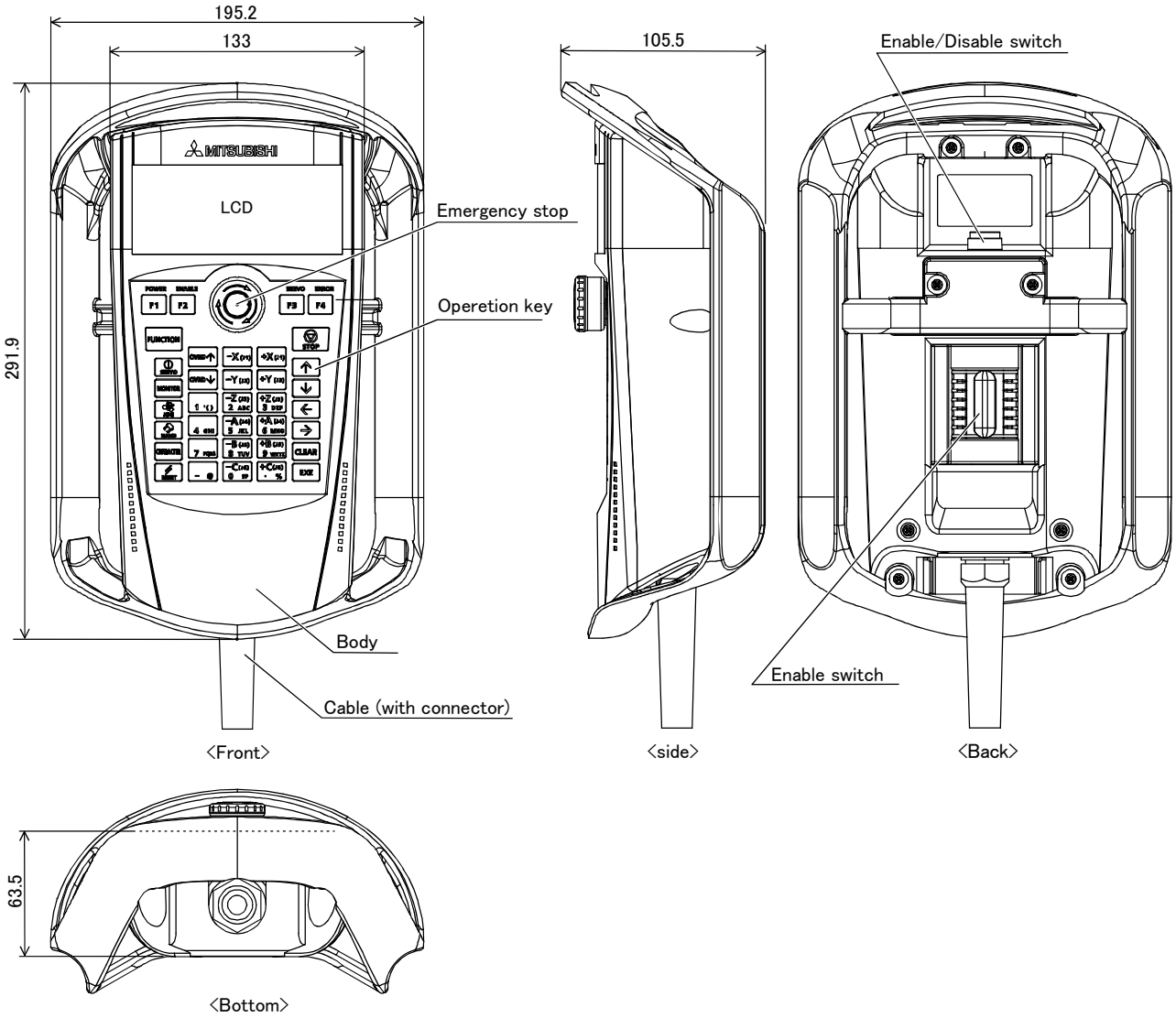
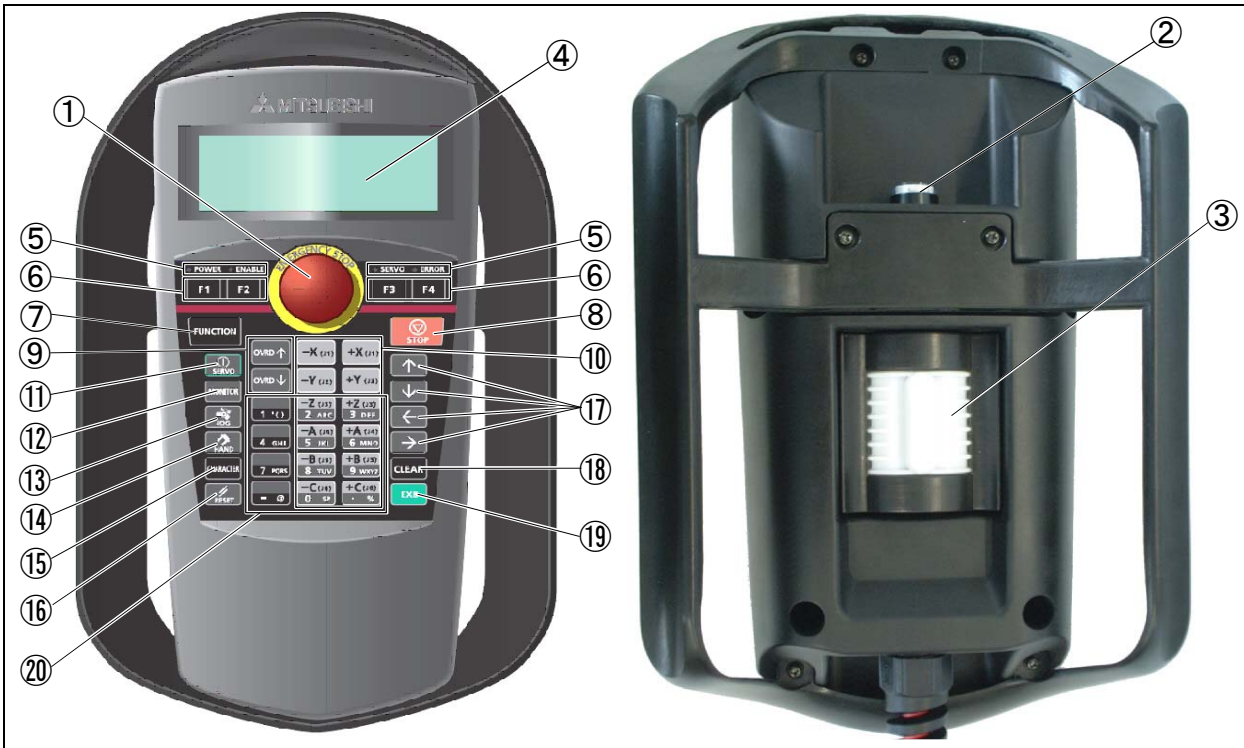


Fig.3-16 : Outside dimensions of teaching pendant

■ 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) : [Enable/Disable] switch..... This switch changes the T/B key operation between enable and disable.
3) : [Enable] switch..... When the [Enable/Disable] switch "2)" is enabled, and this key is released or pressed with force, the servo will turn OFF, and the operating robot will stop immediately.
4) : LCD display panel..... The robot status and various menus are displayed.
5) : Status display lamp..... Display the state of the robot or T/B.
6) : [F1], [F2], [F3], [F4]..... Execute the function corresponding to each function currently displayed on LCD.
7) : [FUNCTION]..... Change the function display of LCD.
8) : [STOP] key..... This stops the program and decelerates the robot to a stop.
9) : [OVRD ↑][OVRD ↓] key..... Change moving speed. Speed goes up by [OVRD ↑] key. Speed goes down by [OVRD ↓] key
10) : JOG operation key..... Move the robot according to jog mode. And, input the numerical value.
11) : [SERVO] key..... Press this key with holding AA key lightly, then servo power will turn on.
12) : [MONITOR] key..... It becomes monitor mode and display the monitor menu.
13) : [JOG] key..... It becomes jog mode and display the jog operation.
14) : [HAND] key..... It becomes hand mode and display the hand operation.
15) : [CHAR] key..... This changes the edit screen, and changes between numbers and alphabetic characters.
16) : [RESET] key..... This resets the error. The program reset will execute, if this key and the EXE key are pressed.
17) : [↑][↓][←][→] key..... Moves the cursor each direction .
18) : [CLEAR] key..... Erase the one character on the cursor position .
19) : [EXE] key..... Input operation is fixed. And, while pressing this key, the robot moves when direct mode.
20) : Number/Character key..... Erase the one character on the cursor position . And, inputs the number or character

Fig.3-17 : Teaching pendant key layout and main functions

(2) Pneumatic hand interface

■ Order type: 2A-RZ365(Sink type)

■ Outline

This interface is required to use the robot arm's hand output signals. This interface is pre-installed on the controller.

- Up to eight hand output points can be used with this interface.
- The eight hand input points can be used without this interface.
- The previous pneumatic hand interface can be used. .

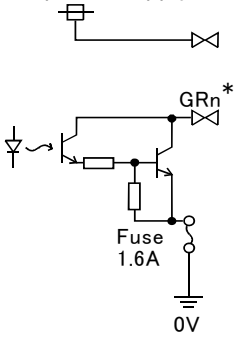
■ Configuration

Table 3-9 : Configuration device

Part name	Type	Qty.	Remarks
Pneumatic hand interface	2A-RZ365	1pc.	Output 8 points expansion.

■ Specifications

Table 3-10 : Specifications

Item		Specification	Internal circuit
Type		Transistor output	<Sink type> 24V (Internal power supply)  * GRn = GR1 ～ GR8
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	

■ Installation method

This is mounted in the controller.

Attach the pneumatic hand interface (2A-RZ365) to the CNHNDOUT/CNHND connector of the hand interface relay card (2D-TZ315) securely. Refer to separate "Instruction Manual/ Controller setup, basic operation, and maintenance" for details on the installing method.

<CR3D-700/700M>

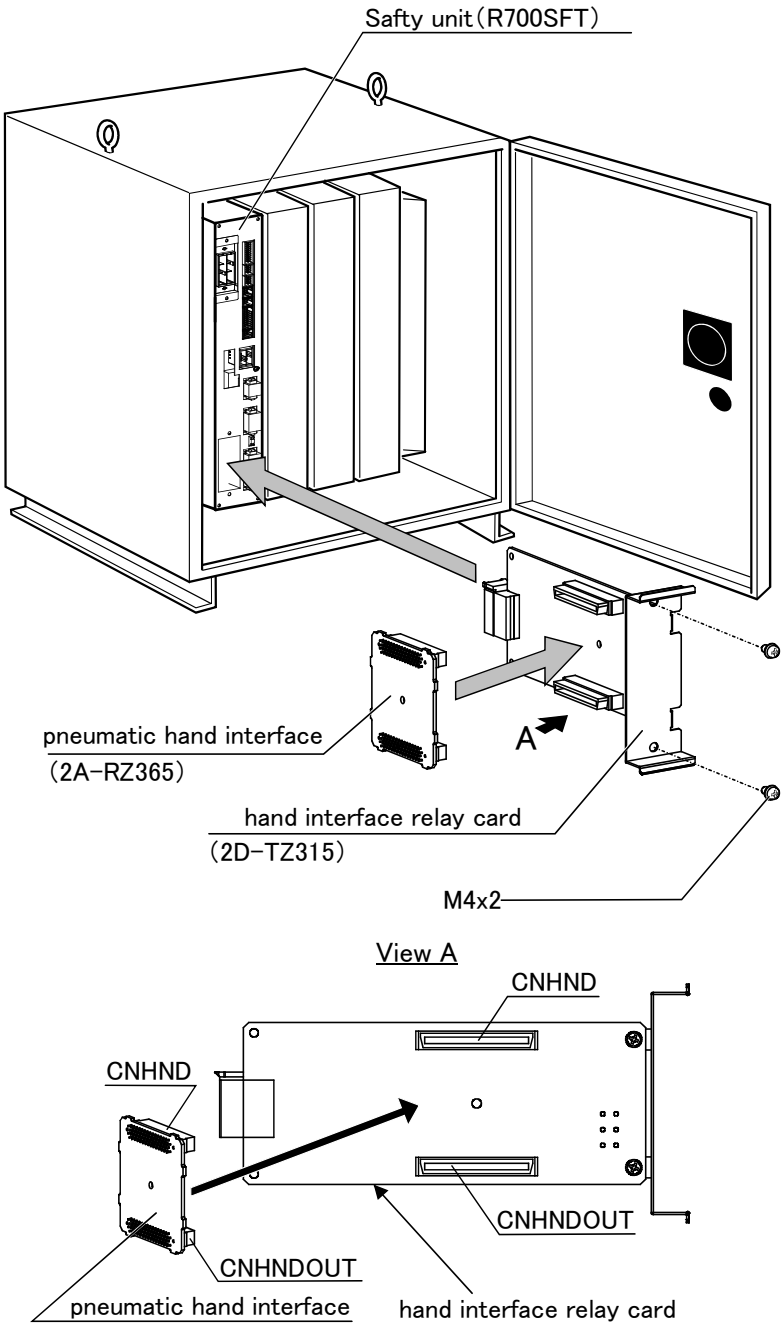


Fig.3-18 : Installation of the pneumatic hand interface (CR3D-700/700M)

(3) Parallel I/O interface

■ Order type ： ● 2D-TZ368 (Sink type)

■ Outline

This is used to expand the external inputs and outputs

・The connecting cable with external equipment is not attached. Since we are preparing the external input-and-output cable (2D-CBL05 or 2D-CBL15) as the option, please use.

Notes)Although the combined use with the parallel input-and-output unit (2A-RZ361/2A-RZ371) of another option is also possible, please use the setup of the station number by the different number separately. The station number is automatically determined by the position of the option slot which installed this interface. (station number 0 to 2)

■ Configuration

Table 3-11 : Configuration device

Part name	Type	Qty.	Remarks
Parallel I/O interface	2D-TZ368	1 pc.	Input/output 32 points/32 points

■仕様

1) The CR3D-700 series controller can connect this three interfaces.

Table 3-12 : Electrical specifications of input circuits

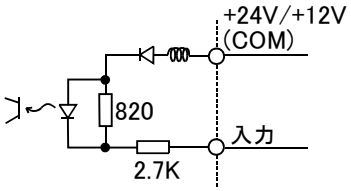
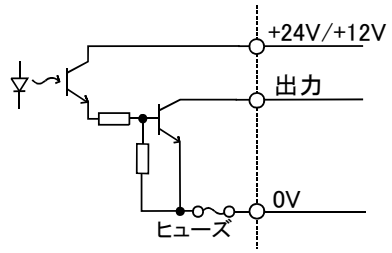
Item		Specification	Internal circuit
Type		DC input	<Sink type> 
Number of input points		32	
Insulation method		Photo coupler insulation	
Rated input voltage		DC12V/DC24V	
Rated input current		Approx. 3mA/7mA	
Working voltage range		DC10.2 ～ 26.4V (Ripple factor should be less than 5%)	
ON voltage/ON current		DC4V or more/1mA or more	
OFF voltage/ OFF current		DC0.1V or less/0.02mA or less	
Input resistance		Approx. 2.7kΩ	
Response time	OFF-ON	10ms or less(DC24V)	
	ON-OFF	10ms or less(DC24V)	
Common method		8points per common	
External cable connection method		Connector	

Table 3-13 : 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 DC30V)	
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	10ms or less (hardware response time)	
	ON-OFF	10ms or less(Resistance load) (hardware response time)	
Fuse rating		Fuse 1.6A(one per common) Replacement possible (max. 3)	
Common method		8per common(common terminal : 4 points)	
External wire connection method		Connector	
External power supply	Voltage	DC12/24V(DC10.2 ～ 30V)	
	Current	60mA(TYP.DC24V per common)(base drive current)	

⚠ Caution The protection fuse of the output circuit prevents the failure at the time of the load short circuit and incorrect connection. The load connected of the customer should be careful not to exceed maximum rating current. The internal transistor may be damaged if maximum rating current is exceeded.

■ Installation method

The expansion parallel input/output interface is installed in the controller. Refer to separate "Instruction Manual/ Controller setup, basic operation, and maintenance" for details on the installing method.

If it installs in the option SLOT of the controller, the station number will be assigned automatically.

SLOT1: station number 0(0 to 31)
SLOT2: station number 1(32 to 63)
SLOT3: station number 2(64 to 95)

⚠ Caution If it uses together with parallel input-and-output unit 2 A-RZ361/2 A-RZ371, please do not overlap with the station number of the parallel input-and-output interface.

<CR3D-700/700M>

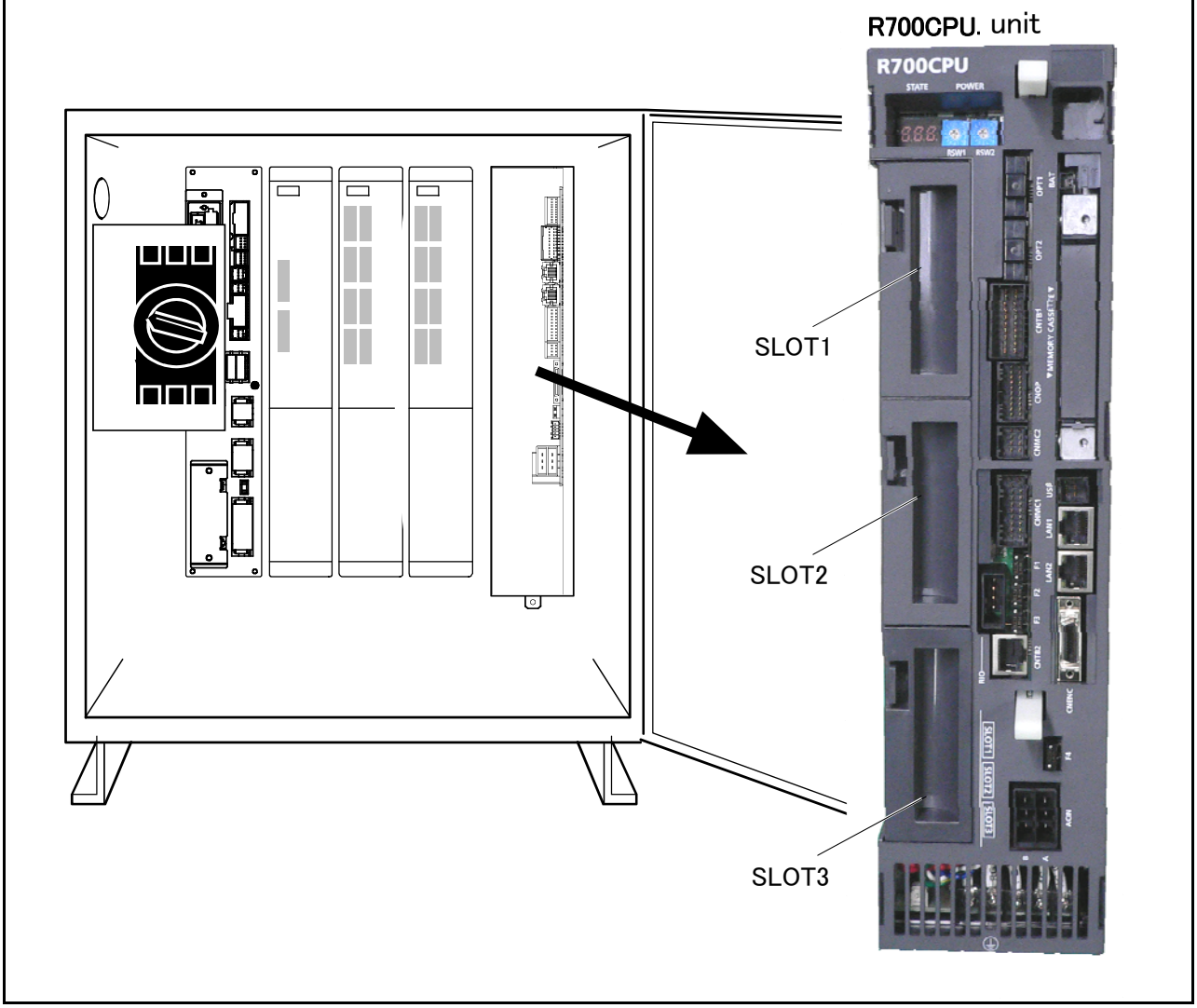


Fig.3-19 : Parallel I/O interface installation position (CR3D-700/700M)

■ Pin layout of connector

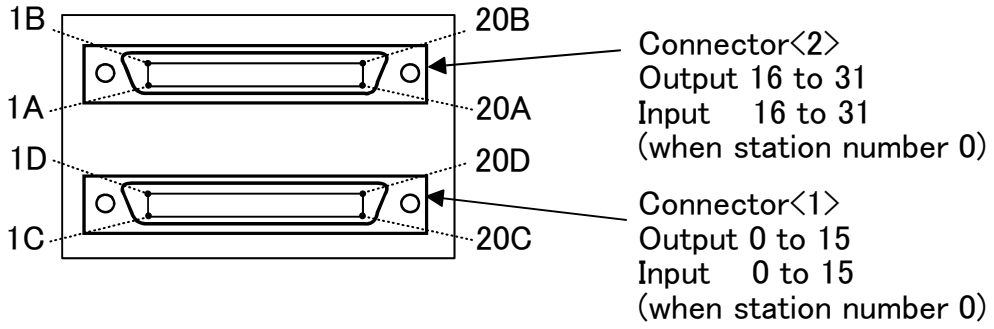


Fig.3-20 : Pin layout of connector

■ Connector pin No. and signal assignment

The station number is fixed by the slot to install and the allocation range of the general-purpose input-and-output signal is fixed.

Table 3-14 : The slot number and the station number

Slot number	Station number	Range of the general-purpose input-and-output signal	
		Connector <1>	Connector <2>
SLOT1	0	Input : 0 to 15 Output : 0 to 15	Input : 16 to 31 Output : 16 to 31
SLOT2	1	Input : 32 to 47 Output : 32 to 47	Input : 48 to 63 Output : 48 to 63
SLOT3	2	Input : 64 to 79 Output : 64 to 79	Input : 80 to 95 Output : 80 to 95

The connector pin number of the parallel input-and-output interface installed in SLOT1 and signal number allocation are shown in Table 3-15 and Table 3-16. If it installs in other slots, please interpret and utilize.

Table 3-15 : Connector<1> pin assignment list and external I/O cable (2D-CBL**) color(SLOT1)

Pin No.	Line color	Function name		Pin No.	Line color	Function name	
		General-purpose	power supply, common			General-purpose	power supply, common
1C	Orange/Red a		0V : For pins 5D-20D	1D	Orange/Black a		12V/24V : For pins 5D-20D
2C	Gray/Red a		12V/24V : For pins 5C-20C	2D	Gray/Black a		Reserved
3C	White/Red a		Reserved	3D	White/Black a		Reserved
4C	Yellow/Red a		Reserved	4D	Yellow/Black a		Reserved
5C	Pink/Red a	General-purpose input 15		5D	Pink/Black a	General-purpose output 15	
6C	Orange/Red b	General-purpose input 14		6D	Orange/Black b	General-purpose output 14	
7C	Gray/Red b	General-purpose input 13		7D	Gray/Black b	General-purpose output 13	
8C	White/Red b	General-purpose input 12		8D	White/Black b	General-purpose output 12	
9C	Yellow/Red b	General-purpose input 11		9D	Yellow/Black b	General-purpose output 11	
10C	Pink/Red b	General-purpose input 10		10D	Pink/Black b	General-purpose output 10	
11C	Orange/Red c	General-purpose input 9		11D	Orange/Black c	General-purpose output 9	
12C	Gray/Red c	General-purpose input 8		12D	Gray/Black c	General-purpose output 8	
13C	White/Red c	General-purpose input 7		13D	White/Black c	General-purpose output 7	
14C	Yellow/Red c	General-purpose input 6		14D	Yellow/Black c	General-purpose output 6	
15C	Pink/Red c	General-purpose input 5		15D	Pink/Black c	General-purpose output 5	
16C	Orange/Red d	General-purpose input 4		16D	Orange/Black d	General-purpose output 4	
17C	Gray/Red d	General-purpose input 3		17D	Gray/Black d	General-purpose output 3	
18C	White/Red d	General-purpose input 2		18D	White/Black d	General-purpose output 2	
19C	Yellow/Red d	General-purpose input 1		19D	Yellow/Blackc d	General-purpose output 1	
20C	Pink/Red d	General-purpose input 0		20D	Pink/Black d	General-purpose output 0	

Table 3-16 : Connector<2> pin assignment list and external I/O cable (2D-CBL**) color(SLOT1)

Pin No.	Line color	Function name		Pin No.	Line color	Function name	
		General-purpose	power supply, common			General-purpose	power supply, common
1A	Orange/Red a		0V : For pins 5B-20B	1B	Orange/Black a		12V/24V : For pins 5B-20B
2A	Gray/Red a		12V/24V : For pins 5A-20A	2B	Gray/Black a		Reserved
3A	White/Red a		Reserved	3B	White/Black a		Reserved
4A	Yellow/Red a		Reserved	4B	Yellow/Black a		Reserved
5A	Pink/Red a	General-purpose input 31		5B	Pink/Black a	General-purpose output 31	
6A	Orange/Red b	General-purpose input 30		6B	Orange/Black b	General-purpose output 30	
7A	Gray/Red b	General-purpose input 29		7B	Gray/Black b	General-purpose output 29	
8A	White/Red b	General-purpose input 28		8B	White/Black b	General-purpose output 28	
9A	Yellow/Red b	General-purpose input 27		9B	Yellow/Black b	General-purpose output 27	
10A	Pink/Red b	General-purpose input 26		10B	Pink/Black b	General-purpose output 26	
11A	Orange/Red c	General-purpose input 25		11B	Orange/Black c	General-purpose output 25	
12A	Gray/Red c	General-purpose input 24		12B	Gray/Black c	General-purpose output 24	
13A	White/Red c	General-purpose input 23		13B	White/Black c	General-purpose output 23	
14A	Yellow/Red c	General-purpose input 22		14B	Yellow/Black c	General-purpose output 22	
15A	Pink/Red c	General-purpose input 21		15B	Pink/Black c	General-purpose output 21	
16A	Orange/Red d	General-purpose input 20		16B	Orange/Black d	General-purpose output 20	
17A	Gray/Red d	General-purpose input 29		17B	Gray/Black d	General-purpose output 19	
18A	White/Red d	General-purpose input 18		18B	White/Black d	General-purpose output 18	
19A	Yellow/Red d	General-purpose input 17		19B	Yellow/Blackc d	General-purpose output 17	
20A	Pink/Red d	General-purpose input 16		20B	Pink/Black d	General-purpose output 16	

<Reference> The example of connection with our PLC

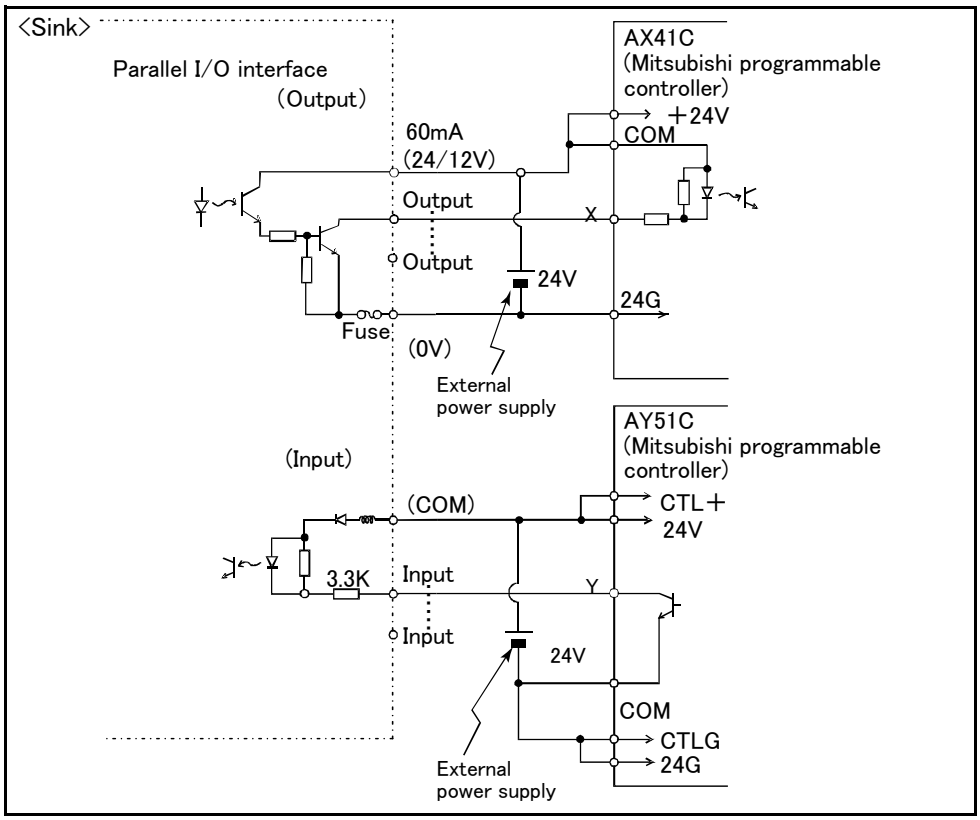


Table 3-17 : Connection with a Mitsubishi PLC (Example of sink type)

*The input/output circuit external power supply (24 VDC) must be prepared by the customer.

(4) External I/O cable

■ Order type : ● 2D-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 I/O interface. For parallel I/O unit is another option 2A-CBL.**.
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 3-18 : Configuration device

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

■ Specifications

Table 3-19 : Specifications

Items	Specifications
Number of cables x cable size	AWG #28 x 20P (40 pairs)
Total length	5m、15m

■ Connector pin numbers and cable colors

Table 3-20 : Connector pin numbers and cable colors

Pin no.	Cable colors	Pin no.	Cable colors	Pin no.	Cable colors	Pin no.	Cable colors
1A/C	Orange/Red a	11A/C	Orange/Red c	1B/D	Orange/Black a	11B/D	Orange/Black c
2A/C	Gray/Red a	12A/C	Gray/Red c	2B/D	Gray/Black a	12B/D	Gray/Black c
3A/C	White/Red a	13A/C	White/Red c	3B/D	White/Black a	13B/D	White/Black c
4A/C	Yellow/Red a	14A/C	Yellow/Red c	4B/D	Yellow/Black a	14B/D	Yellow/Black c
5A/C	Pink/Red a	15A/C	Pink/Red c	5B/D	Pink/Black a	15B/D	Pink/Black c
6A/C	Orange/Red b	16A/C	Orange/Red d	6B/D	Orange/Black b	16B/D	Orange/Black d
7A/C	Gray/Red b	17A/C	Gray/Red d	7B/D	Gray/Black b	17B/D	Gray/Black d
8A/C	White/Red b	18A/C	White/Red d	8B/D	White/Black b	18B/D	White/Black d
9A/C	Yellow/Red b	19A/C	Yellow/Red d	9B/D	Yellow/Black b	19B/D	Yellow/Black d
10A/C	Pink/Red b	20A/C	Pink/Red d	10B/D	Pink/Blackb	20B/D	Pink/Blackd

Notes) Pin number of connector<1> are 1C, 2C, ...20C, 1D, 2D, ...20D, connector<2> are 1A, 2A, ...20A, 1B, 2B, ...20B.

■ Connections and outside dimensions

The sheath of each signal cable (40 lines) is color indicated and marked with dots. Refer to the cable color specifications in "Table 3-29: Connector pin numbers and cable colors" when making the connections.

(Eg.) Pin number: color indication

1 : Orange ／ Red ／ A

- A — Type of dot mark (see figure below)
- Red — Color of dot mark
- Orange — Color of sheath

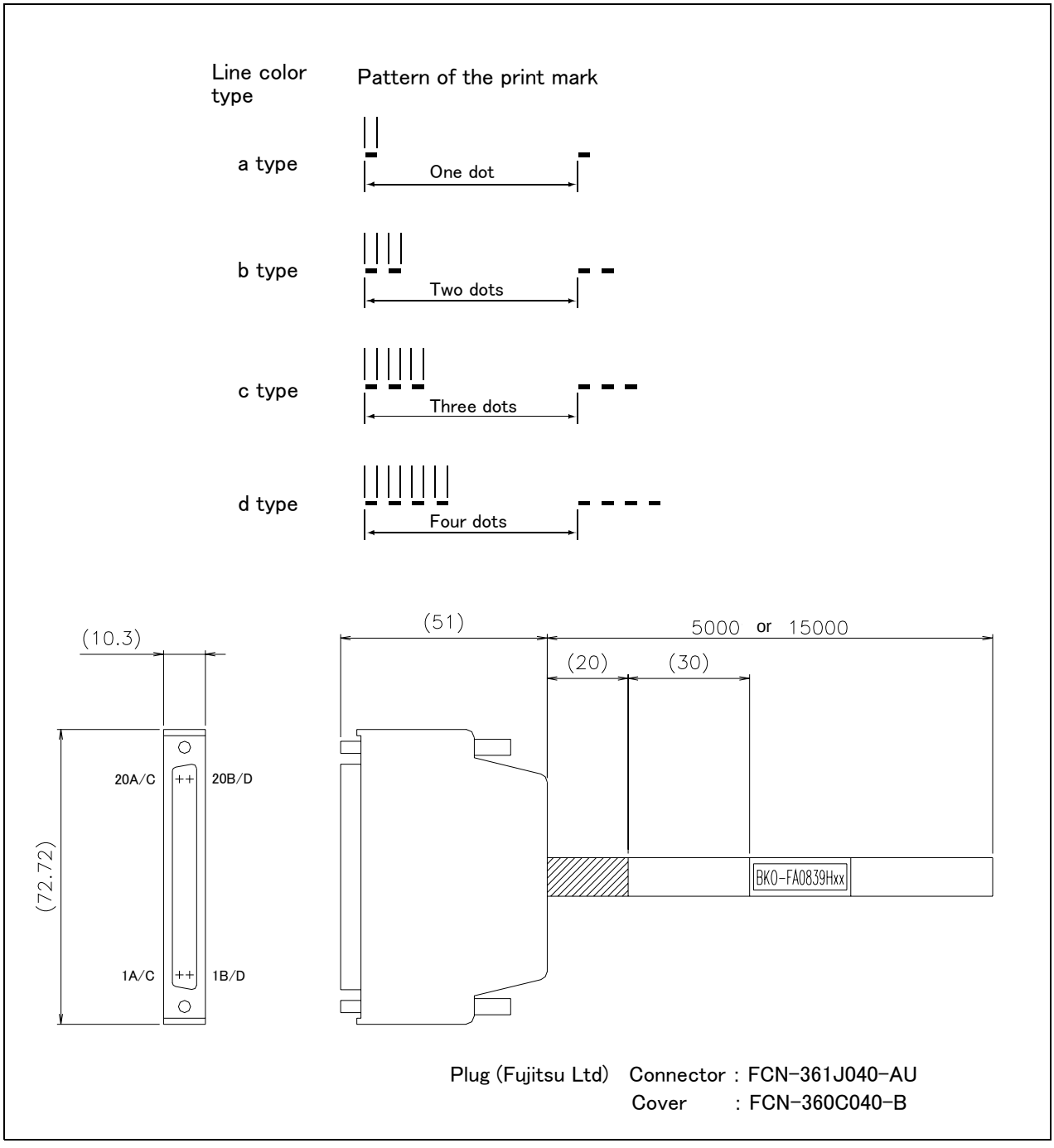


Fig.3-21 : Connections and outside dimensions

(5) 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).
- Use 2A-RZ361 if the external input/output signal logic is of the sink type and 2A-RZ371 for source type signal logic.

Notes) Although the combined use with the parallel I/O interface (2D-TZ368) of another option is also possible, please use the setup of the station number by the different number separately. The station number is automatically fixed by the position of the option slot which installed the parallel I/O interface in 0-2.

■ Configuration

Table 3-21 : Configuration device

Part name	Type	Qty.	Remarks
Parallel I/O unit	2A-RZ361/ 2A-RZ371	1 pc.	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 set	Connector with pins. The cable must be prepared and wired by the customer.
Terminator	R-TM	1 pc.	100Ω(1/4W)

■ Specifications

1) The parallel I/O interface (2D-TZ368) of another option, and the a maximum of eight pieces in all. (One station occupies one unit.)
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.

Table 3-22 : Electrical specifications of input circuits

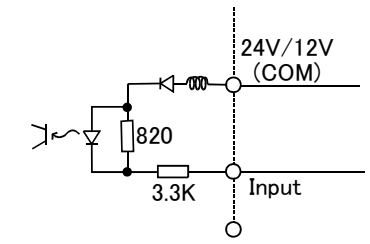
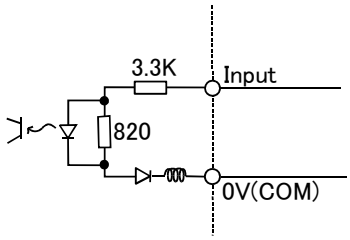
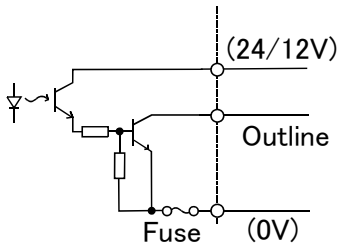
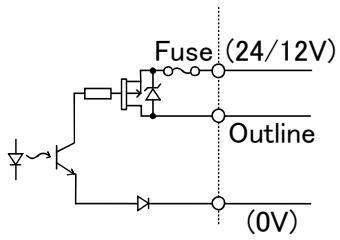
Item		Specification	Internal circuit
Type		DC input	<Sink type>  <Source type> 
Number of input points		32	
Insulation method		Photo coupler insulation	
Rated input voltage		12VDC/24VDC	
Rated input current		Approx 3mA/7mA	
Working voltage range		10.2 to 26.4VDC(Ripple factor should be less than 5%.)	
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 (24VDC)	
	ON-OFF	10ms or less (24VDC)	
Common method		8 points per common	
External cable connection method		Connector	

Table 3-23 : Electrical specifications for the output circuits

Item		Specification	Internal circuit
Type		Transistor output	<Sink type>  <Source type> 
No. of output points		32	
Insulation method		Photo-coupler insulation	
Rated load voltage		12VDC/24VDC	
Rated load voltage range		10.2 to 30VDC(peak voltage 30VDC)	
Max. load current		0.1A/point (100%)	
Leakage current at OFF		0.1mA or less	
Max. voltage drop at ON		0.9VDC(TYP.)	
Response time	OFF-ON	2ms or less (hardware response time)	
	ON-OFF	2ms or less (Resistance load) (hardware response time)	
Fuse rating		Fuse 3.2A (one per common) Replacement not possible	
Common method		8 points per common (common terminal: 8 points)	
External wire connection method		Connector	
External power supply	Voltage	12VDC/24VDC(10.2 to 30VDC)	
	Current	60mA (TYP. 24VDC per common) (base drive current)	

⚠ CAUTION The output circuit protective fuses prevent failure in case of load short-circuit and improper connections. Please do not connect loads that cause the current to exceed the maximum rated current. If the maximum rated current is exceeded, the internal transistors may be damaged.

NETcable-1 (Network cable)

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

Note 2)

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

FG

DCcable-2 (Power cable)

Pin No.	DCIN
1	24V
2	24G(RG)
3	FG(PE)

+ Note 1)
24V Power
−

Connected the frame ground or protect ground

R-TM (Terminator)

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

100Ω

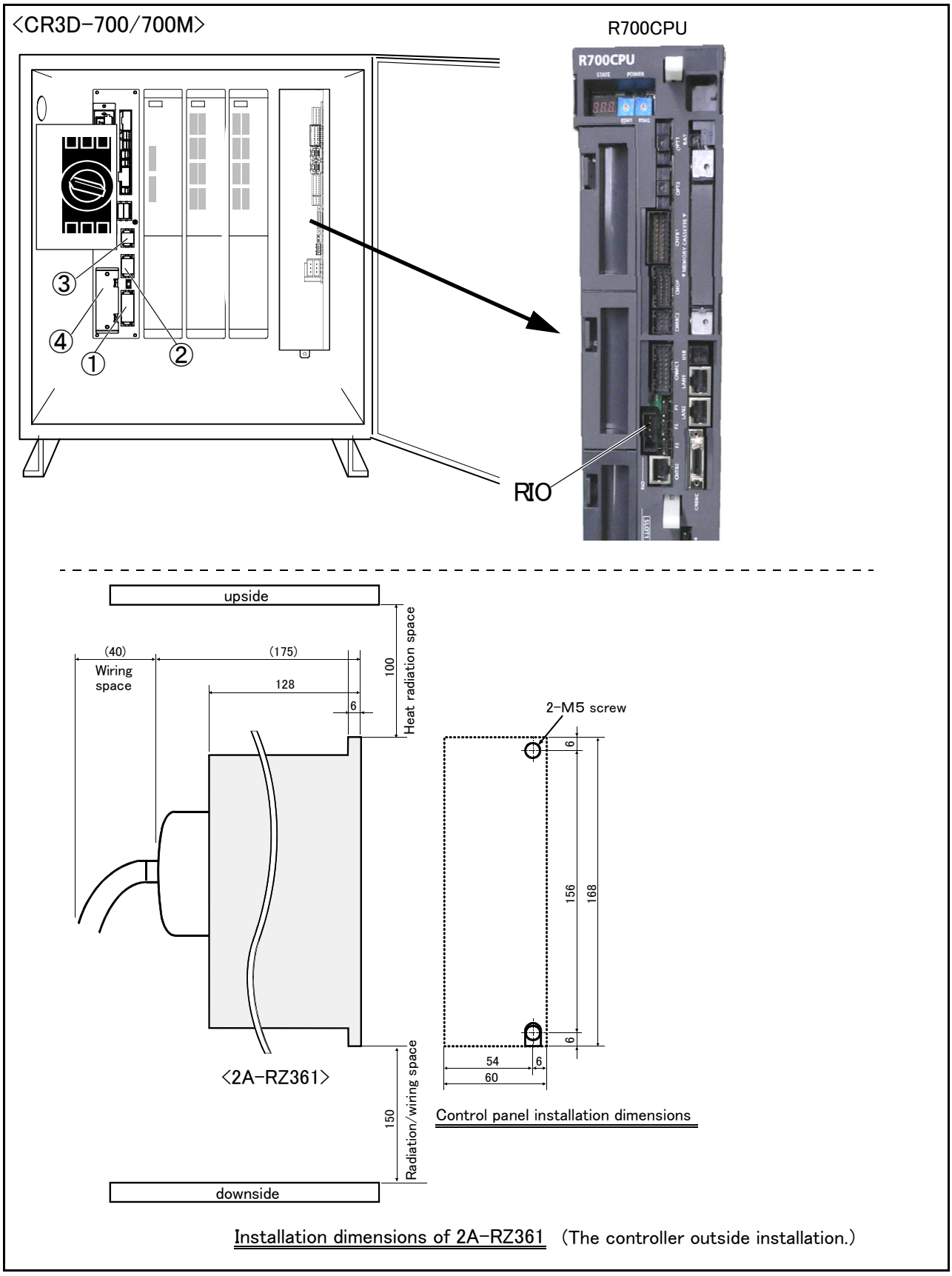
List of parts and manufacturer

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)	100Ω(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.3-22 : Spacifications for the connection cable

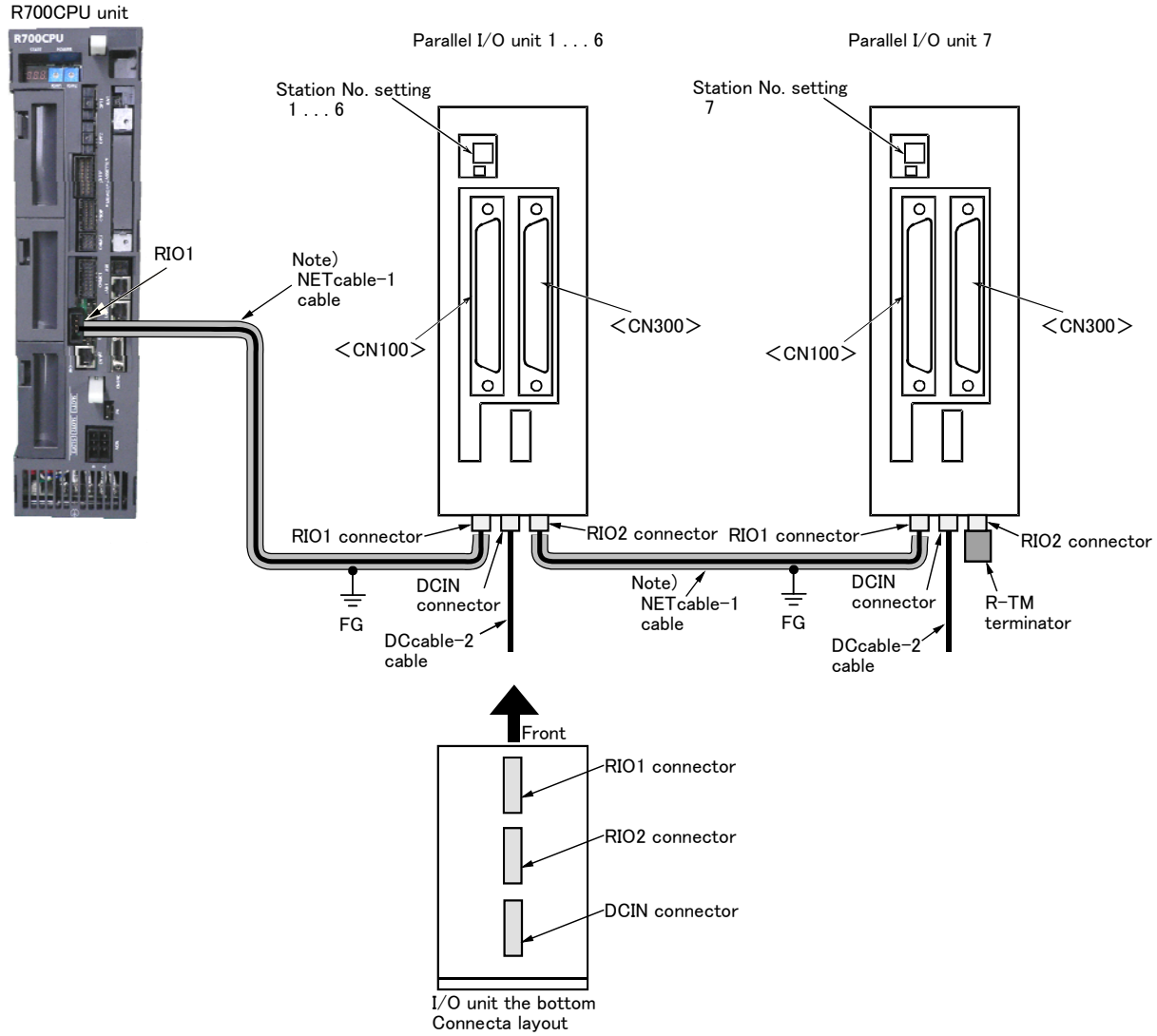
■ Installation method



Installation dimensions of 2A-RZ361 (The controller outside installation.)

Fig.3-23 : Installing the parallel I/O unit (CR3D-700/700M)

<CR3D-700/700M>



Connect the NET cable-1 to the RIO connector on the back of the controller. Each unit is connected to from a daisy chain.

Always install a terminator (R-TM) to the last unit.

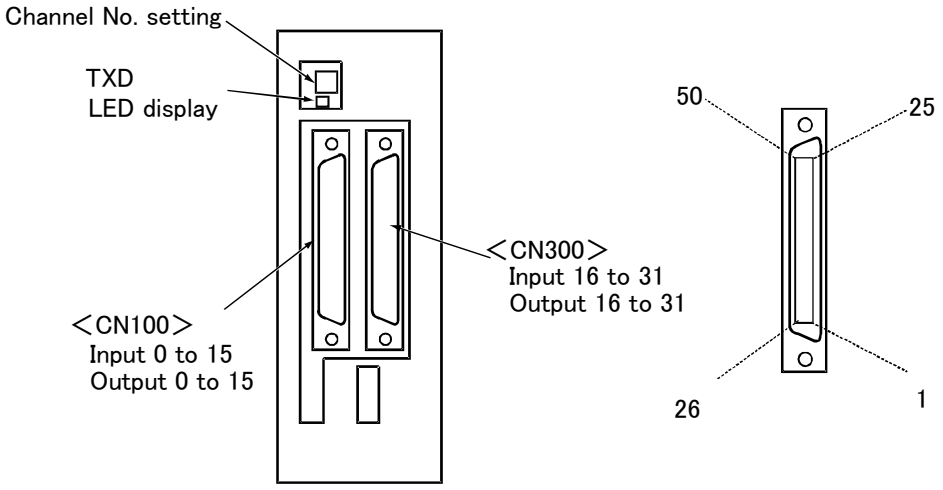
Note) Use a shield cable for NET cable-1 as a measure against noise.

Always connect the shield to FG.

The unit could malfunction because of noise if the shield cable is not used.

Fig.3-24 : Connection method of expansion parallel I/O unit （CR3D-700/700M）

■ Pin arrangement of the connector



*2A-RZ361/2 A-RZ371 are 32/32 input-and-output units. (One-station occupancy)

Fig.3-25 : Pin arrangement of the parallel I/O unit

■ Assignment of pin number and signal

The assignment range of the general-purpose input-and-output signal is fixed by the setup of the station number.

Table 3-24 : Assignment of pin number and signal

Unit Number	Station number	CN100	CN300
1st set	0	Input : 0 to 15 Output : 0 to 15	Input : 16 to 31 Output : 16 to 31
2nd set	1	Input : 32 to 47 Output : 32 to 47	Input : 48 to 63 Output : 48 to 63
3rd set	2	Input : 64 to 79 Output : 64 to 79	Input : 80 to 95 Output : 80 to 95
4th set	3	Input : 96 to 111 Output : 96 to 111	Input : 112 to 127 Output : 112 to 127
5th set	4	Input : 128 to 143 Output : 128 to 143	Input : 144 to 159 Output : 144 to 159
6th set	5	Input : 160 to 175 Output : 160 to 175	Input : 176 to 191 Output : 176 to 191
7th set	6	Input : 192 to 207 Output : 192 to 207	Input : 208 to 223 Output : 208 to 223
8th set	7	Input : 224 to 239 Output : 224 to 239	Input : 240 to 255 Output : 240 to 255

The connector pin number of the parallel I/O unit of the station number 0 and signal number assignment are shown in Table 3-25 and Table 3-26. If it is set as other station number, please interpret and utilize.

■ Parallel I/O interface (First expansion unit)

Table 3-25 : 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, 10-13	27	Gray/Blue A		0V:For pins 29-32, 35-38
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		29	Yellow/Blue A	General-purpose output 4	
5	Pink/Red A	General-purpose output 1		30	Pink/Blue A	General-purpose output 5	
6	Orange/Red B	General-purpose output 2		31	Orange/Blue B	General-purpose output 6	
7	Gray/Red B	General-purpose output 3		32	Gray/Blue B	General-purpose output 7	
8	White/Red B		0V:For pins 4-7, 10-13	33	White/Blue B		0V:For pins 29-32, 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	39	Yellow/Blue C		COM1:For pins 40-47 Note1)
15	Pink/Red C	General-purpose input 0		40	Pink/Blue C	General-purpose input 8	
16	Orange/Red D	General-purpose input 1		41	Orange/Blue D	General-purpose input 9	
17	Gray/Red D	General-purpose input 2		42	Gray/Blue D	General-purpose input 10	
18	White/Red D	General-purpose input 3		43	White/Blue D	General-purpose input 11	
19	Yellow/Red D	General-purpose input 4		44	Yellow/Blue D	General-purpose input 12	
20	Pink/Red D	General-purpose input 5		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

Table 3-26 : 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, 10-13	27	Gray/Blue A		0V:For pins 29-32, 35-38
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 4-7, 10-13	33	White/Blue B		0V:For pins 29-32, 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:(12V/24V(COM)) For pins 15-22	39	Yellow/Blue C		COM1:(12V/24V(COM)) For pins 40-47
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

(6) 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 3-27 : Configuration device

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

■ Specifications

Table 3-28 : 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 3-29 : 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

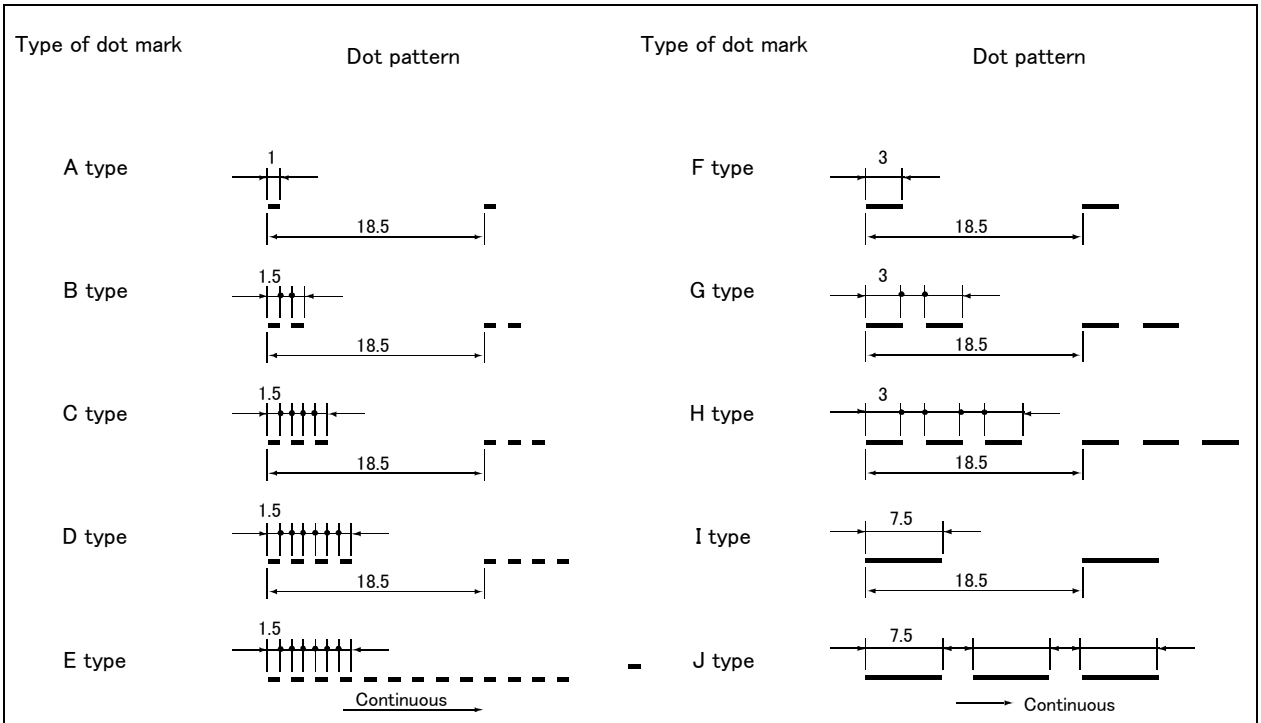
■ Connections and outside dimensions

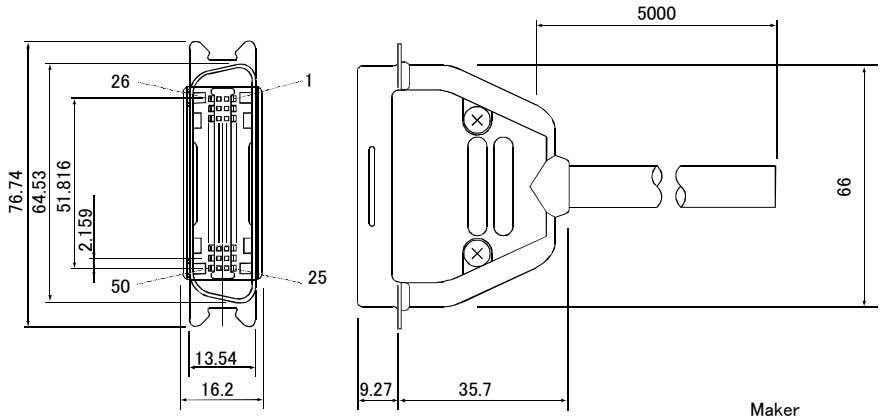
The sheath of each signal cable (50 lines) is color indicated and marked with dots. Refer to the cable color specifications in "Table 3-29: Connector pin numbers and cable colors" when making the connections.

(Eg.) Pin number: color indication

1 : Orange ／ Red ／ A

- A: Type of dot mark (see figure below)
- Red: Color of dot mark
- Orange: Color of sheath





		Maker
Receptacle type (PCB side)	57AE-40500-21D(D8)	……DDK
Plug type (cable side)	57YE-30500-2(D8) Note1)	……DDK

Note1) The type of the plug shows the specification of this cable.
The following connector is recommended when user make the cable.
・Plug type (cable side) : 57E series (Soldering type).....DDK
57FE series (Flat cable pressure connection type).....DDK

Fig.3-26 : Connections and outside dimensions

(7) Personal computer cable

■ Order type: ● For PC/AT : 2D-232CBL03M

■ Outline

This is the RS-232 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.

■ Configuration

Table 3-30 : Configuration device

Part name	Type	Qty.	Remarks
Personal computer cable (for PC/AT)	2D-232CBL03M	1pc.	3m, D-SUB 9 pin

■ Specifications

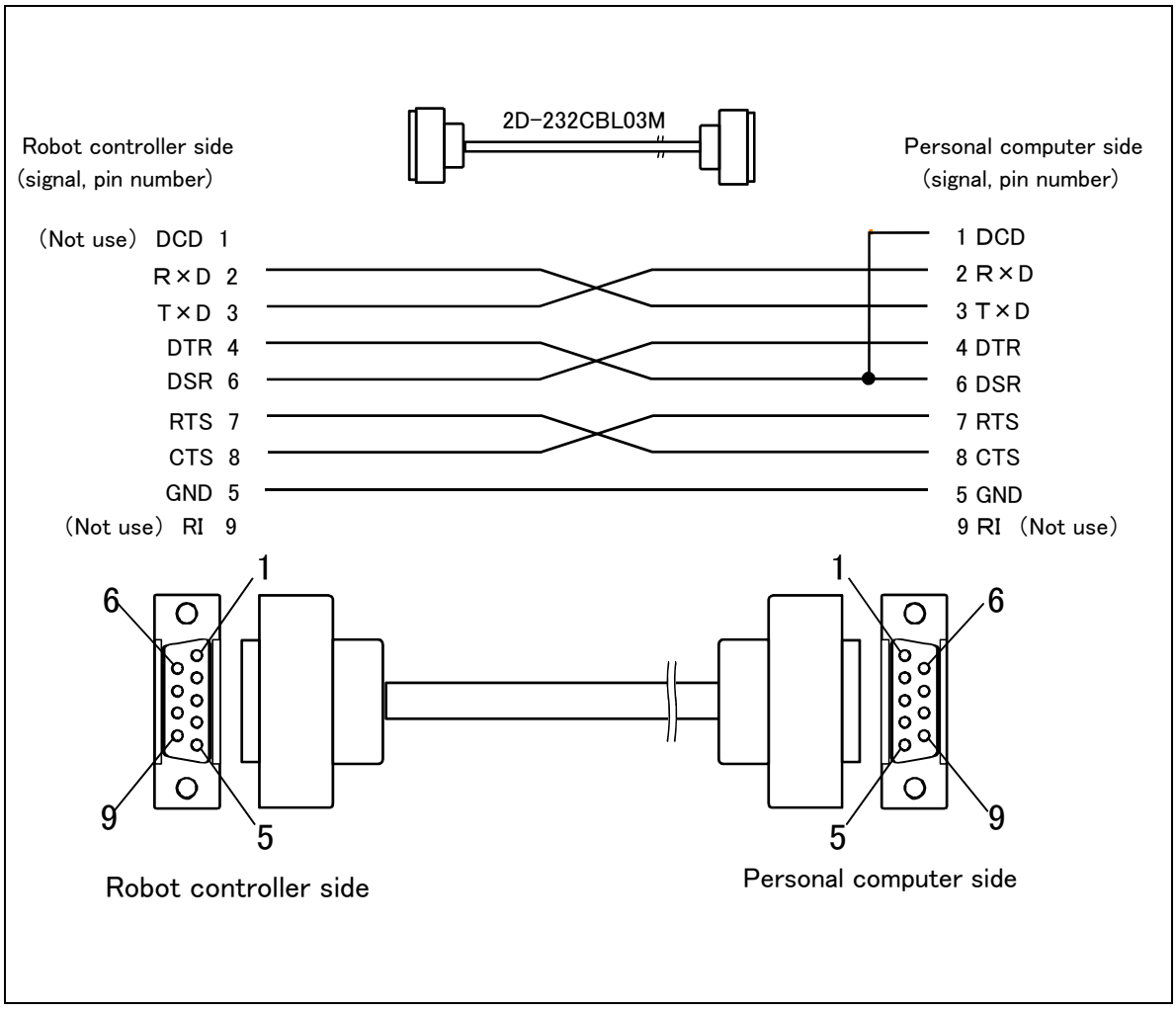


Fig.3-27 : Personal computer cabe connection

(8) CC-Link interface

■ Order type: ● 2D-TZ576

■ Outline

The CC-Link interface is the optioninterface 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.

■ Configuration

Table 3-31 : Configuration deviceon

Part name	Type	Qty.	Remarks
CC-Link interface	2D-TZ576	1	
Ferrite core	E04SR301334	2	Be sure to install this for noise countermeasure.

Table 3-32 : 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.

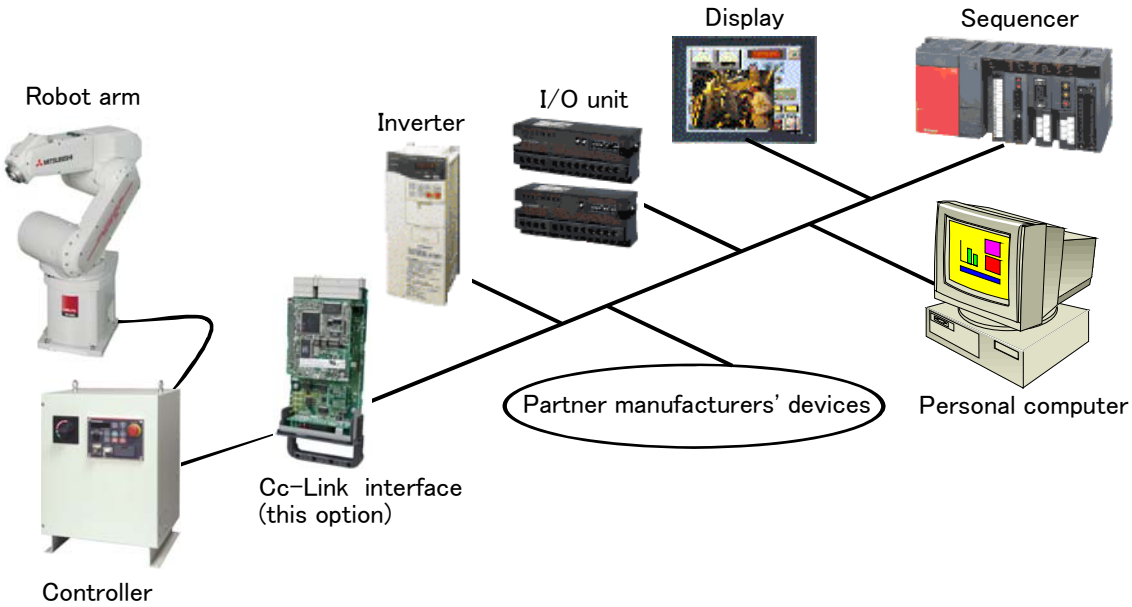


Fig.3-28 : Example of CC-Link Product Configuration

■ Specifications

Table 3-33 : 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
The version corresponding to CC-Link			Ver.2				The extended cyclic setup is possible.
Mountable option slot			Slot 1, 2, 3				
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.
Station number			1 to 64				When four stations are occupied, continuous station numbers are used.
Number of occupied stations			One or four occupied stations can be set.				
Extended cyclic setup			1/2/4/8				
Maximum link point		Remote I/O (RX, RY).	Each 896 points				The two last cannot be used.
		Remote register (RWr, RWw)	Each 128 register				16 bits/register
Extended cyclic setup		–	1 fold setup	2 fold setup	3 fold setup	4 fold setup	
Link point per set	When one station is occupied	Remote I/O (RX, RY).	32 point	32 point	64 point	128 point	
		Remote register (RWw)	4 word	8 word	16 word	32 word	
		Remote register (RWr)	4 word	8 word	16 word	32 word	
	When two stations is occupied	Remote I/O (RX, RY).	64 point	96 point	192 point	384 point	
		Remote register (RWw)	8 word	16 word	32 word	64 word	
		Remote register (RWr)	8 word	16 word	32 word	64 word	
	When three stations is occupied	Remote I/O (RX, RY).	96 point	160 point	320 point	640 point	
		Remote register (RWw)	12 word	24 word	48 word	96 word	
		Remote register (RWr)	12 word	24 word	48 word	96 word	
	When four stations is occupied	Remote I/O (RX, RY).	128 point	224 point	448 point	896 point	
		Remote register (RWw)	16 word	32 word	64 word	128 word	
		Remote register (RWr)	16 word	32 word	64 word	128 word	
Number of the maximum occupancy station			4 stations				
The I/O first number of the robot controller.			No. 6000 –. The number corresponding to the station number by the setup of the parameter "CCFIX."				

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.

(9) Extension memory cassette

■ Order type: ● 2D-TZ454

■ Outline

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

■ Configuration

Table 3-34 : Configuration device

Part name	Type	Qty.	Remarks
Extension memory cassette	2D-TZ454	1	

■ Specifications

Table 3-35 : Specifications

Items	Specifications	Remarks
External dimensions	Approx. 94(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: 37,800 Steps number: 75,600 Program number: 256	The sum total value combined with the standard are Teaching point number: 50,800 Steps number: 101,600 Program number: 512
Backup	Backup using the controller's internal battery	

Note1) As for the standard 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.

(10) RT ToolBox2/RT ToolBox2 mini

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

■ Outline

This is handy software that fully uses the personal computer functions. It can be used in various stages from the robot specifications study (tact study, etc.) to the design support (creation and editing of programs), start up support (execution, control and debugging of program), and maintenance (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.

■ Configuration

Table 3-36 : Product configuration

Part name	Type	Medium	Remarks
RT ToolBox2	3D-11C-WINE	CD-ROM	
RT ToolBox2 mini	3D-12C-WINE	CD-ROM	

■ 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.

(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.

■ Functions

Table 3-37 : Functions

Function		Functional existence[Note1)]		Details
Compatible model		○	○	Personal computer running Microsoft Windows2000/XP/Vista.
Program editing functions	Editing functions	○	○	・MELFA BASIC Ⅴ language compatible ・Multiple editing screen simultaneously display ・Command input, comment writing ・Position data editing ・File operation (writing to controller, floppy disk, personal computer) ・Search and replace function (using characters, line Nos., labels) ・Copy, cut, paste, insert (per character, line), undo (per command statement, position conversion) ・Line No. automatic generation, renumbering ・Batch syntax check ・Command template ・Position conversion batch editing ・Position variable template ・Print, print preview
	Control functions	○	○	・Program file control (list, copy, movement, delete, content comparison, name change, protect)
	Debugging functions	○	○	・Direct editing of program in controller ・Confirmation of robot program operation (step execution, direct execution) ・Tact time measurement[Note2)]
Simulation function		○	×	・Off-line simulation of robot program operation using CG (computer graphics) ・Tact time calculation
Monitor functions		○	○	・Robot operation monitor (robot operation state, stop signal, error monitor, program monitor (execution program, variables), general-purpose input/output signals (forced output possible), dedicated input/output signals, operation confirmation (operation range, current position, hand, etc.) ・Operation monitor (working time statistics, production information, robot version) ・Servo monitor (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.)

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

RT ToolBox2
(3D-11C-WINE)

Note1)The functions included with the RT ToolBox2 and the RT ToolBox2 mini are shown below.
○ : Function provided × : Function not provided

Note2)When using the RT ToolBox2 mini, connect with the controller and measure.

(11) Instruction Manual(bound edition)

■ Order type : ● 5S-DC00-PE01 : RV-12SD/12SDL series
■ Outline

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

■ Configuration

表 3-38 : Product configuration(RV-12SD-SM/12SDL-SM series)

Name		Type	Specifications
Instruction Manual		5S-DC00-PE01	
	Safety Manual	BFP-A5948	Items relating to safety in handling the robot
	Standard Specifications	BFP-A8599	Specification of the robot arm and controller
	Robot Arm Setup & Maintenance	BFP-A8600	Installation method of the robot arm, jog operation, and maintenance and inspection procedures
	Controller Setup, Basic Operation and Maintenance	BFP-A8601	Installation method of the controller, basic operation, and maintenance and inspection procedures
	Detailed Explanation of Functions and Operations	BFP-A8586	Functions of the controller and T/B, operation method, and explanation of MELFA-BASIC Ⅴ
	Troubleshooting	BFP-A8588	Causes of errors occurred and their countermeasures

3.10 Maintenance parts

The consumable parts used in the controller are shown in Table 3-39. 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 3-39 : Contloller consumable parts list

No.	Part name	Type Note1)	Usage place	Qty.	Supplier
CR3D-700 controller					
1	Lithium battery	Q6BAT	1	Front operation panel	Mitsubishi Electric System Service;Co.,Ltd
2	Fan (40 square)		5	Amplifier unit Converter unit	
3	Fan (90 square)		1	Control unit	
4	Filter		1	Controller rear	

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

4 Software

4.1 List of commands

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

Table 4-1 : List of MELFA-BASIC Ⅴ commands

Type	Class	Function	Input format (example)
Position and operation control	Joint interpolation	Moves to the designated position with joint interpolation.	Mov P1
	Linear interpolation	Moves to the designated position with linear interpolation.	Mvs P1
	Circular interpolation	Moves along a designated arc (start point → passing point → start point (end point)) with 3-dimensional circular interpolation (360 degrees).	Mvc P1,P2,P1
		Moves along a designated arc (start point → passing point → end point) with 3-dimensional circular interpolation.	Mvr P1,P2,P3
		Moves along the arc on the opposite side of a designated arc (start point → reference point → end point) with 3-dimensional circular interpolation.	Mvr2 P1,P9,P3
		Moves along a set arc (start point → end point) with 3-dimensional circular interpolation.	Mvr3 P1,P9,P3
	Speed designation	Designates the speed for various interpolation operations with a percentage (0.1% unit).	Ovrd 100
		Designate the speed for joint interpolation operation with a percentage (0.1% unit).	JOvrd 100
		Designates the speed for linear and circular interpolation with a numerical value (mm/s unit).	Spd 123.5
		Designates the acceleration/deceleration time as a percentage in respect to the predetermined maximum acceleration/deceleration. (1% unit)	Accel 50,80
	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
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 M1
		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
	Impact detection	Set to enable/disable the impact detection.	ColChk ON/OFF
		Set the detection level of the impact detection.	ColLvl 100,80,,,,,,

Type	Class	Function	Input format (example)
Program control	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
Others	Definition	Defines the integer type or real number type variable.	Def Inte KAISUU
		Defines the character string variable.	Def Char MESSAGE
		efines the layout variable. (Up to 3-dimensional possible)	Dim PDATA(2,3)
		Defines the joint variable.	Def Jnt TAIHI
		Defines the position variable.	Def Pos TORU
		Defines the function.	Def FN TASU(A,B)=A+B
	Clear	Clears the general-purpose output signal, variables in program, variables between programs, etc.	Clr 1
	File	Opens a file.	Open "COM1:" AS #1
		Closes a file.	Close #1
		Inputs data from a file.	Input# 1,M1
		Outputs data to a file.	Print# 1,M1
	Comment	Describes a comment.	Rem "ABC"
	Label	Indicates the branching destination.	*SUB1

4.2 List of parameters

show the main parameter in the Table 4-2.

Table 4-2 : List of parameters

Parameter		Details
Standard tool coordinates.	MEXTL	Set the default value for the tool data. Unit: mm or deg.
Standard base coordinates	MEXBS	Set the relation of the world coordinate system and robot coordinate system. Unit: mm or deg.
XYZ operation range	MEPAR	Designate the overrun limit value for the world coordinate system.
JOINT operation range	MEJAR	Set the overrun limit value for each joint axis.
Free plane limit		This is the overrun limit set with the free plane. Create a plane with the three coordinates x1, y1, z1 to x3, y3, z3, and set the outer side of the plane as the outside operation range (error). The following three types of parameters are used.
	SFC1P : SFC8P	Eight types of free plane limits can be set in SFC1P to SFC8P. There are nine elements, set in the order of x1, y1, z1, x2, y2, z2, x3, y3, z3.
	SFC1ME : SFC8ME	Designate which mechanism to use eight types of set free plane limits. The mechanism No. to use is set with 1 to 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]

Parameter		Details
Hand type	HANDTYPE	Set the hand type of the single/double solenoid, and the signal No. (Single/double = S/D) Set the signal No. after the hand type. Example) D900
Stop input B contact designation	INB	Change the dedicated input (stop) between the A contact and B contact.
User-designated origin	USERORG	Designate the user-designated origin position.
Program selection memory	SLOTON	Select the program selected previously when initializing the slot. The non-selected state will be entered when not set.
Communication setting	CBAU232	Set the baud rate.
	CLEN232	Set the character length.
	CPRTY232	Set the parity.
	CSTOP232	Set the stop bit.
	CTERM232	Set the end code.
Slot table	SLT1 : SLT32	Make settings (program name, operation type, order of priority, etc.) for each slot during slot initialization.
No. of multi-tasks	TASKMAX	Designate the No. of programs to be executed simultaneously. (Max. 32)
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".
Specification of singular point passage jog mode	FSPJOGMD	Specify an operation mode for singular point passage jog.
Display language.	LNG	Change the language to display on the LCD display of teaching pendant.

5 Instruction Manual

5.1 The details of each instruction manuals

The contents and purposes of the documents enclosed with this product are shown below. Use these documents according to the application.
Instruction manuals enclosed in dashed lines in the list below are for optional products.
For special specifications, a separate instruction manual describing the special section may be enclosed.

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

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	Terminal (EMG IN)	This servo power is shut off, and the robot stops immediately.	Externally installed emergency stop switch. Door switch on safety protection fence. Stopping at high-level error occurrence.
	Door switch			The door switch of the safe protection fence
	Enabling device input			Enabling device. The safety switch during teaching work
	Stop	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 (Case 1)" 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.

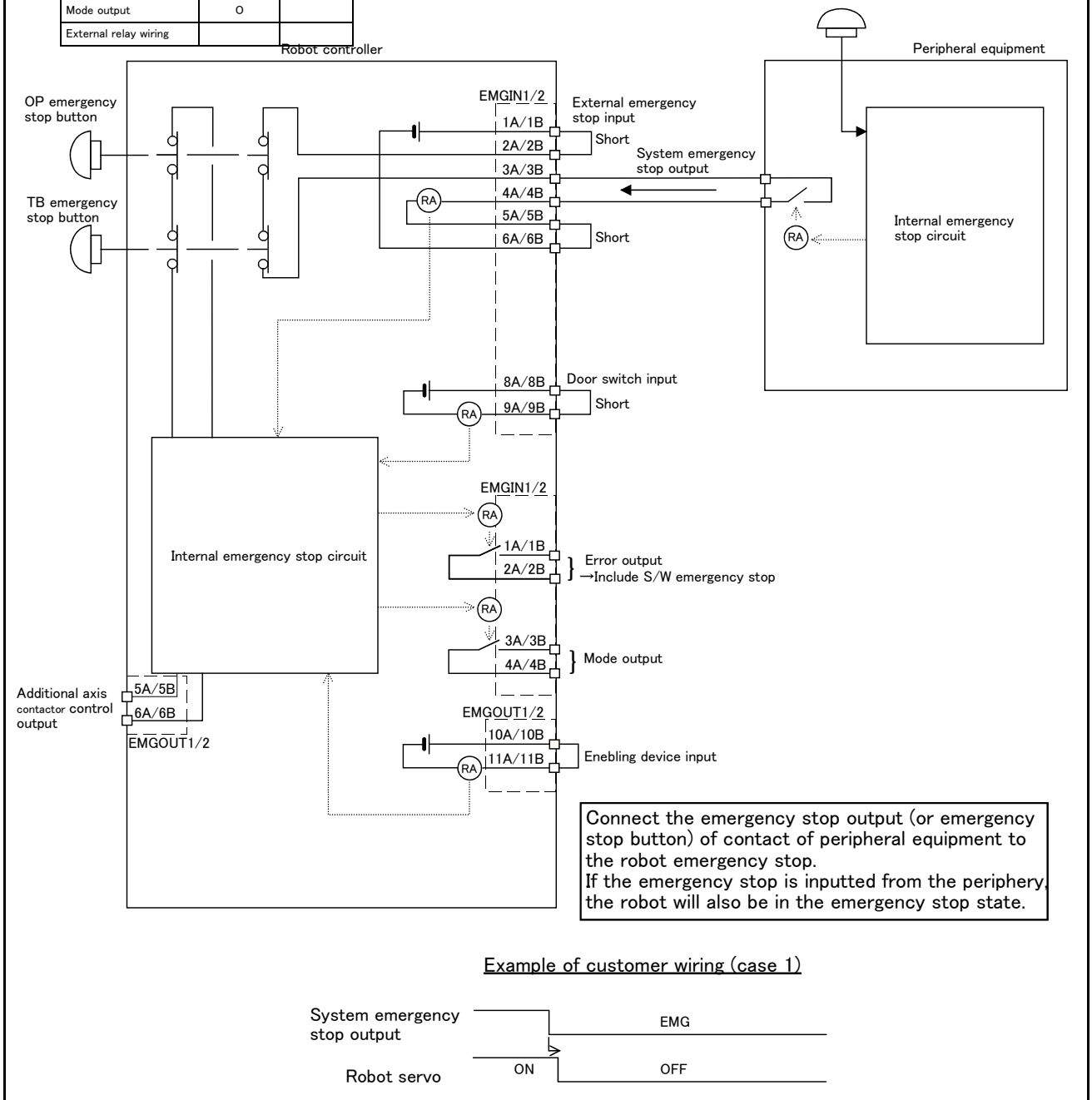
Turn the power OFF and take measures to prevent operators other than the relevant operator from pressing the start switch when performing inspections, repairs, adjustments, cleaning or oiling.
If operation is required, take measures to prevent hazards caused by unintentional or mistaken operations.
(1) 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

<Case 1> : Input the emergency stop of peripheral equipment into the robot.

Emergency stop input	I/O	Connection
External emergency stop input	I	○
Door switch input	I	
Enable input	I	
Error output	O	
Additional axes contactor control output	O	
Mode output	O	
External relay wiring		



Example of customer wiring (case 1)

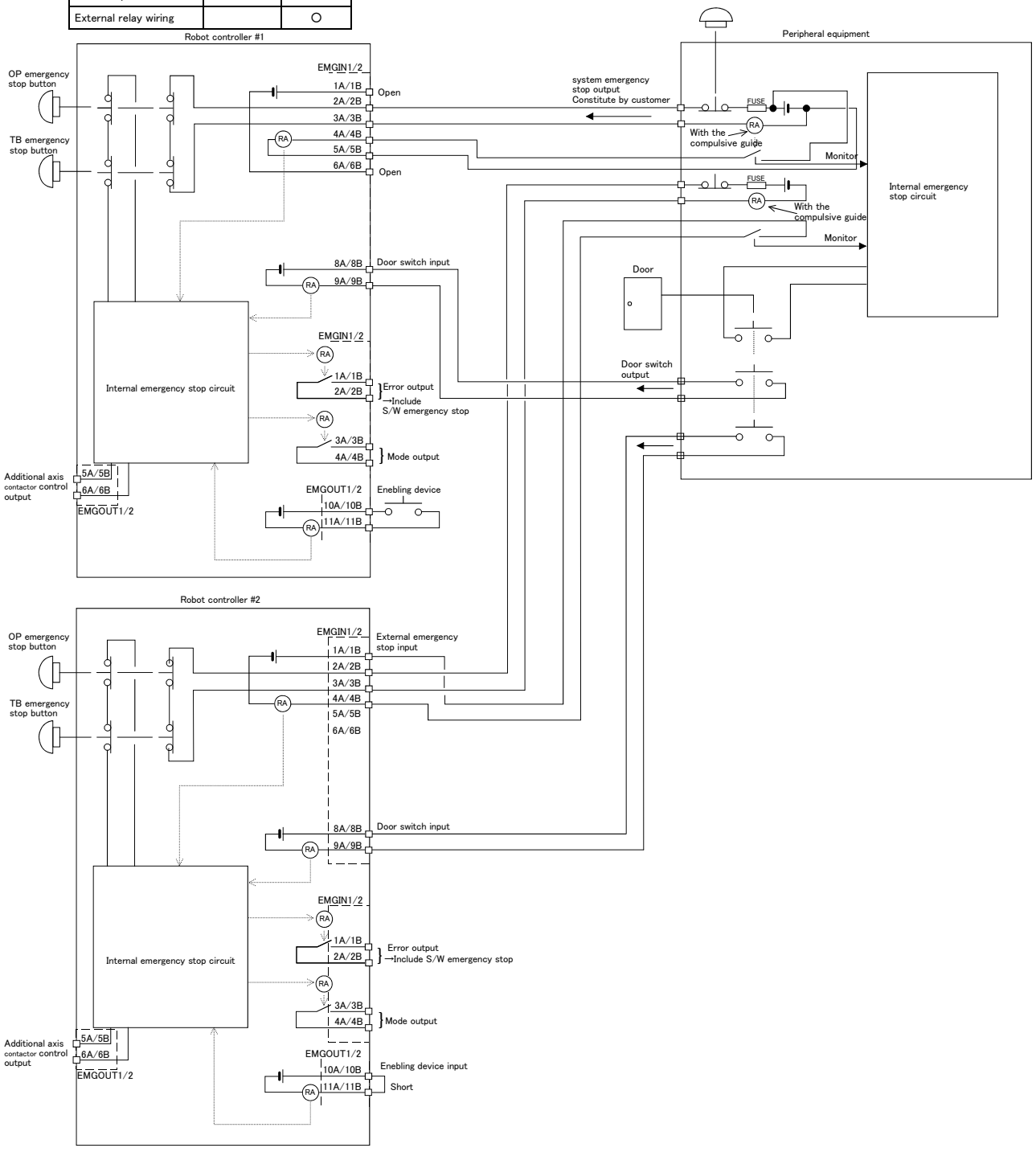
Time chart

[Caution] Since we have omitted the information in part because of explanation, there is the section different from the product.

Fig.6-1 : Example of safety measures （Case 1）

<Case 2> : Two robot controller linkage. External power supply use. The door switch, enabling device connection

Emergency stop input	I/O	Connection
External emergency stop input	I	○
Door switch input	I	○
Enable input	I	○
Error output	O	
Additional axes contactor control output	O	
Mode output	O	
External relay wiring		○



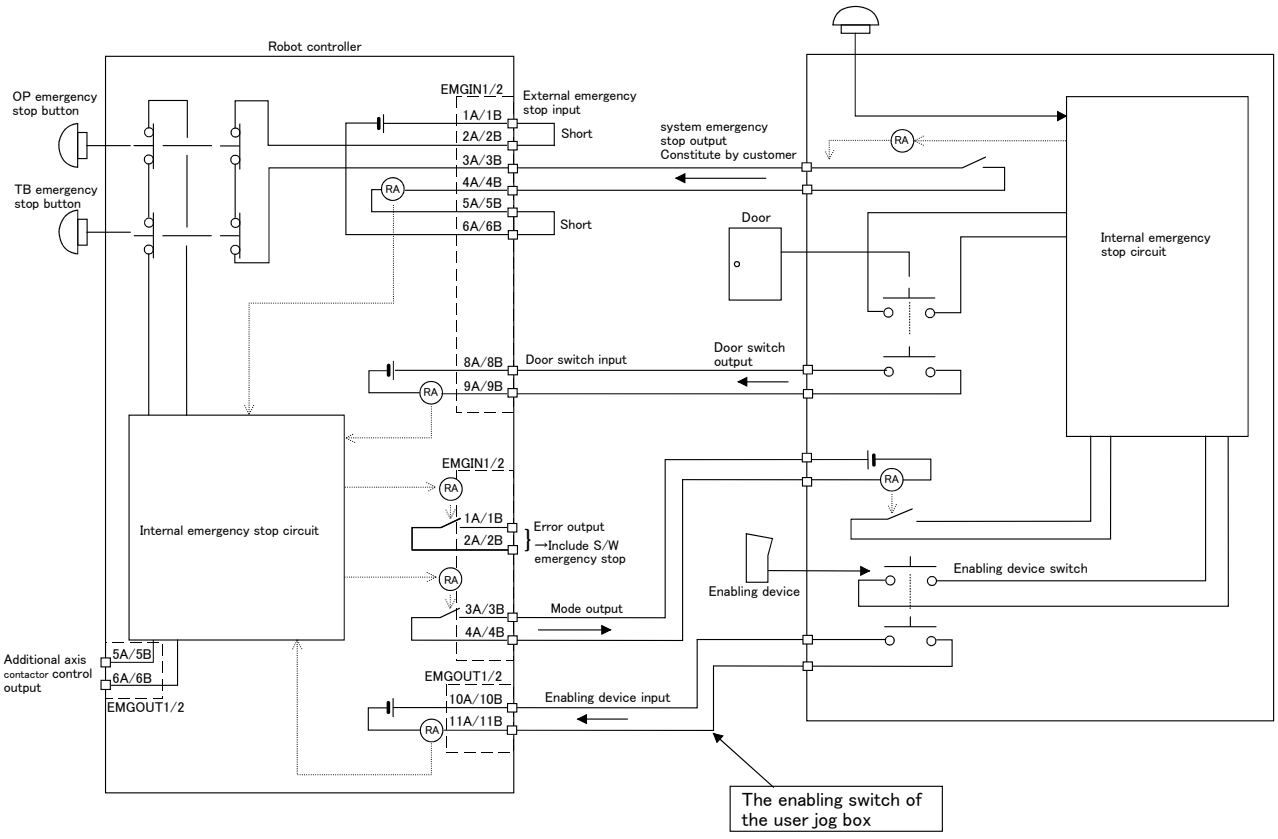
Example of customer wiring (case 2)

[Caution] Since we have omitted the information in part because of explanation, there is the section different from the product.

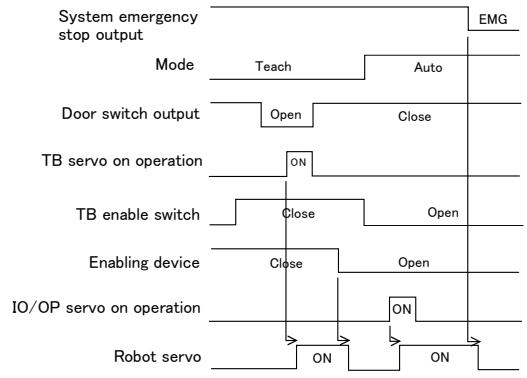
Fig.6-2 : Example of safety measures (Case 2)

<Case 3> : Use the mode output of the robot controller.

Emergency stop input	I/O	Connection
External emergency stop input	I	O
Door switch input	I	O
Enable input	I	O
Error output	O	
Additional axes contactor control output	O	
Mode output	O	O
External relay wiring		



Example of customer wiring (case 3)



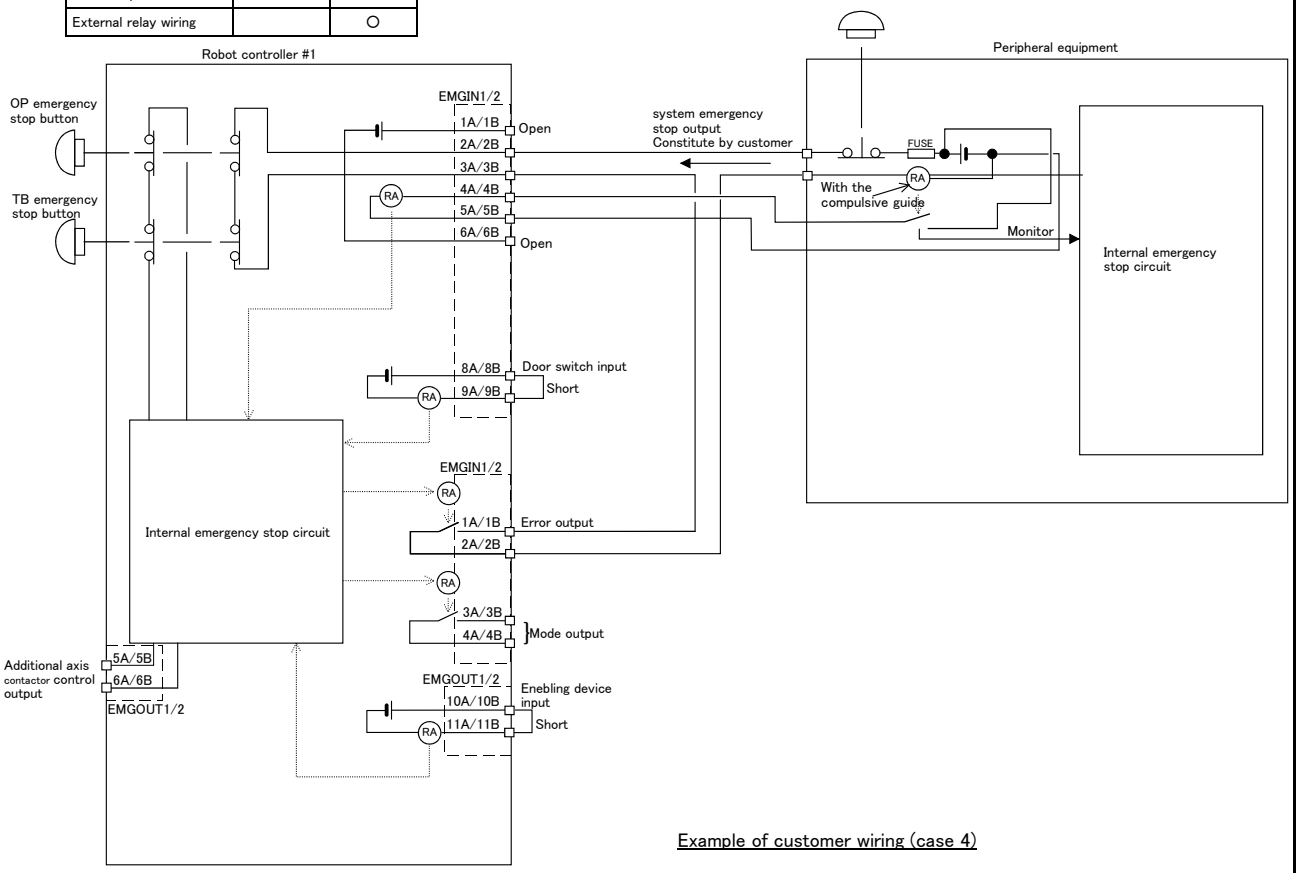
Time chart

[Caution] Since we have omitted the information in part because of explanation, there is the section different from the product.

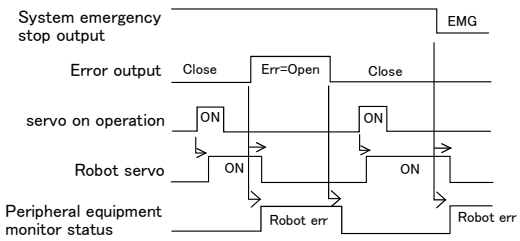
Fig.6-3 : Example of safety measures (Case 3)

<Case 4> : Use of the error output

Emergency stop input	I/O	Connection
External emergency stop input	I	○
Door switch input	I	
Enable input	I	
Error output	O	○
Additional axes contactor control output	O	
Mode output	O	
External relay wiring		○



Example of customer wiring (case 4)



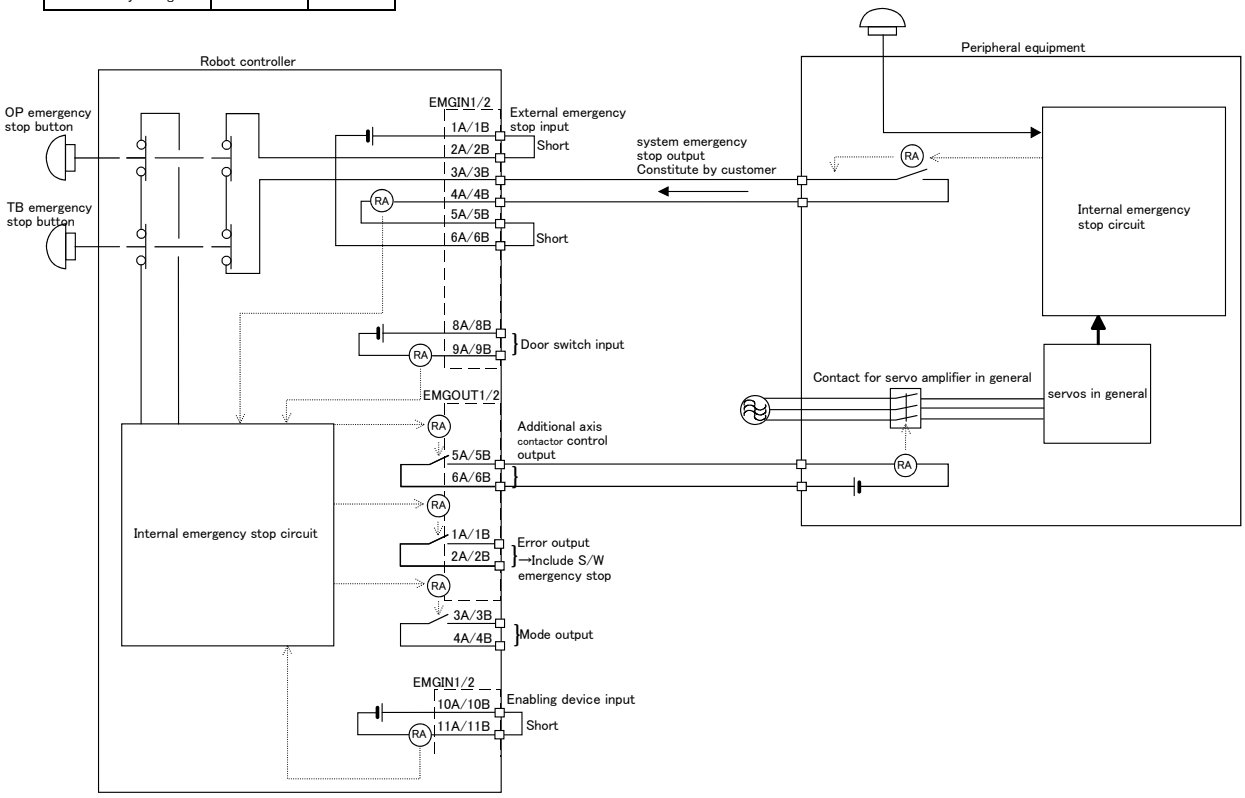
Time chart

[Caution] Since we have omitted the information in part because of explanation, there is the section different from the product.

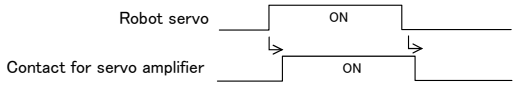
Fig.6-4 : Example of safety measures (Case 4)

<Case 5> : The synchronization with the servo amplifier for addition axes

Emergency stop input	I/O	Connection
External emergency stop input	I	O
Door switch input	I	
Enable input	I	
Error output	O	
Additional axes contactor control output	O	O
Mode output	O	
External relay wiring		



Example of customer wiring (case 5)



Time chart

[Caution] Since we have omitted the information in part because of explanation, there is the section different from the product.

Fig.6-5 : Example of safety measures (Case 5)

(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 manual-return type 2b-contact for the emergency stop button.
(4) Classify the faults into minor faults (faults that are easily restored and that do not have a great effect) and major faults (faults that cause the entire system to stop immediately, and that require care in restoration), and wire accordingly.

[Caution] The emergency stop input(terminal block) on the user wiring in the 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.
- Emergency stop output capacity.....Set it within 300 mA/24 VDC.
  Connecting an external device outside of the above range will cause a controller failure.

6.2 Working environment

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

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

⚠CAUTION Please use the controller with an input power supply voltage fluctuation rate of 10% or less. In the case of 200 VAC input, for example, if the controller is used with 180 VAC during the day and 220 VAC during the night, turn the servo off once and then on again. If this is not performed, an excessive regeneration error may occur.

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

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

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

(5) Installation environment
- Where strong electric fields or magnetic fields are generated.
- Where the installation surface is rough. (Avoid installing the robot on a bumpy or inclined floor.)
- Where there is heavy powder dust and oil mist present.

6.3 Precautions for handling

(1) This robot has brakes on 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.
(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.
(15) The fretting may occur on the axis which moving angle is the 30 degree or less, or moving distance is the 30mm or less, or not moves. The fretting is that the required oil film becomes hard to be formed if the moving angle is small, and wear occurs. The axis which not moved is moving slightly by vibration etc. To prevent the fretting, recommends to move these axes about once every day the 30 degree or more, or the 30mm or more.

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

7 Appendix

Appendix 1 : Specifications discussion material

■ Customer information

Company name		Name	
Address		Telephone	

■ Purchased mode

Specification	Type	
Standard specification	☐ RV-12SD	☐ RV-12SDL
Clean specification	☐ RV-12SDC	☐ RV-12SDLC

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

Item		Standard specifications	Special shipping specifications
Controller	Structure	☐ Floor type CR3D-701M(IP54) : RV-12SD/12SDL CR3D-701(Clean) : RV-12SDC/12SDLC	☐ Caster type CR3D-701M(IP54) RV-12SD/12SDL CR3D-701(Clean) RV-12SDC/12SDLC

■ Options (Installable after shipment)

Controller	Simple teaching pendant	R32TB- ☐☐	☐ Not provided ☐ 7m ☐ 15m
	Highly efficient teaching pendant	R56TB- ☐☐	☐ Not provided ☐ 7m ☐ 15m
	Pneumatic hand interface	2A-RZ365	☐ Not provided ☐ Provided
	Parallel I/O interface	2D-TZ368	☐ Not provided ☐ -1pc. ☐ -2pc. ☐ -3pc.
	External I/O cable	2D-CBL ☐☐ (2D-TZ368)	☐ Not provided ☐ 5m-( )pc. ☐ 15m-1( )pc.
	Parallel I/O unit	2A-RZ361/2A-RZ371	☐ Not provided ☐ Provided ( )unit
	External I/O cable	2A-CBL ☐☐ (2A-RZ361/RZ371 用)	☐ Not provided ☐ 5m-( )pc. ☐ 15m-1( )pc.
	CC-Link interface	2D-TZ576	☐ Not provided ☐ Provided
	Expansion memory	2D-TZ454	☐ Not provided ☐ Provided
	RT ToolBox2	3D-11C-WINE	☐ Not provided ☐ Windows2000/XP/Vista Englishi CD-ROM 版
	RT ToolBox2 mini	3D-12C-WINE	☐ Not provided ☐ Windows2000/XP/Vista Englishi CD-ROM 版
	Personal computer cable	2D-232CBL03M	☐ Not provided ☐ Provided
	Network vision sensor	4D-2CG5***-PKG	☐ Not provided ☐ Provided
	Instructions manual	5S-DC00-PJ01	☐ Not provided ☐ Provided ( ) set

Maintenance parts (Consumable parts)

Maintenance parts	☐ Backup batteries A6BAT ( ) pcs. ☐ Backup batteries Q6BAT ( ) 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 enverонment ☐ Clean ☐ Dust provided ☐ Other( )
Remarks		

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