MITSUBISHI Mitsubishi Industrial Robot

RV-3SD/3SDJ Series

Standard Specifications Manual (CR1D-721/731 Controller)



🔨 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.

A 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

A 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

ANARNING

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

A 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

Installation of safety fence

ACAUTION

Establish a set signaling method to the related operators for starting work, and follow

this method.

Signaling of operation start

ACAUTION

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

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 poice

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.

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.

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.

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

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

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.

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.

NARNING When the robot arm has to be moved by hand from an external area, do not

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.

A 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.

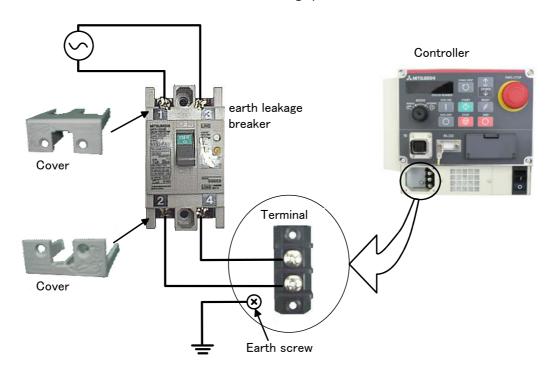
A CAUTION

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.

C.Notes of the basic component are shown. (CR1D-700 series)



Please install the earth leakage breaker in the primary side supply power supply of the controller because of leakage protection.



■ Revision history

Date of print	Specifications No.	Details of revisions			
2008-07-26	BFP-A8652	First print.			

■ Introduction

This series provides compact vertical multi-joint robots for use in machine processes and assemblies. This series is especially designed to answer the needs of users who want to create compact and highly flexible production facilities to cope with shortened product life cycles as well as the diffusion of small and high density product groups in recent years, such as personal computer related devices, information terminal devices and small car-mounted electronic devices. This series supports the oil mist environment as standard, offering variations of 5-axis type, 6-axis type and clean 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 6, the specifications related to the controller" 3 Controller" on page 30, and software functions and a command list "4 Software" on page 79 separately.

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

- *RV-3SD
- *RV-3SDC
- *RV-3SDJ
- *RV-3SDJC

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1 General configuration

1.1 Structural equipment

Structural equipment consists of the following types.

1.1.1 Standard structural equipment

The following items are enclosed as a standard.

- (1) Robot arm
- (2) Controller
- (3) Machine cable
- (4) Robot arm installation bolts
- (5) Earth leakage breaker(CR1D-700 only)
- (6) Arm fixing bolts
- (7) Safety manual, Instruction manual, CD-ROM (Instruction manual)
- (8) 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

$$\frac{RV\text{-}3SD}{\tiny \text{(a)}} \quad \underbrace{J}_{\tiny \text{(b)}} \quad \underbrace{C}_{\tiny \text{(c)}} \quad \underbrace{-Sxx}_{\tiny \text{(d)}}$$

- (a). RV-3SDIndicates the RV-3SD series.
- (b). J.....Indicates axis configuration.

Examples)

Blank: 6-axis type. J: 5-axis type.

(c). CIndicates environment specification.

Examples)

Blank: Standard Specifications C: Clean Specifications

- (d). <u>-SXX</u>.....[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
Standard appointment	RV-3SD	6-axis type	CR1D-721
Stardard specification	RV-3SDJ	5-axis type	CR1D-731
-SM ^{Note1)}	RV-3SD-SM	6-axis type	CR1D-721 + CR1D-MB
-2M	RV-3SDJ-SM	5-axis type	CR1D-731 + CR1D-MB

Note1) The controller protection box is attached. (IP54)

1.3 Indirect 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.

1.5 Contents of the structural equipment

1.5.1 Robot arm

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

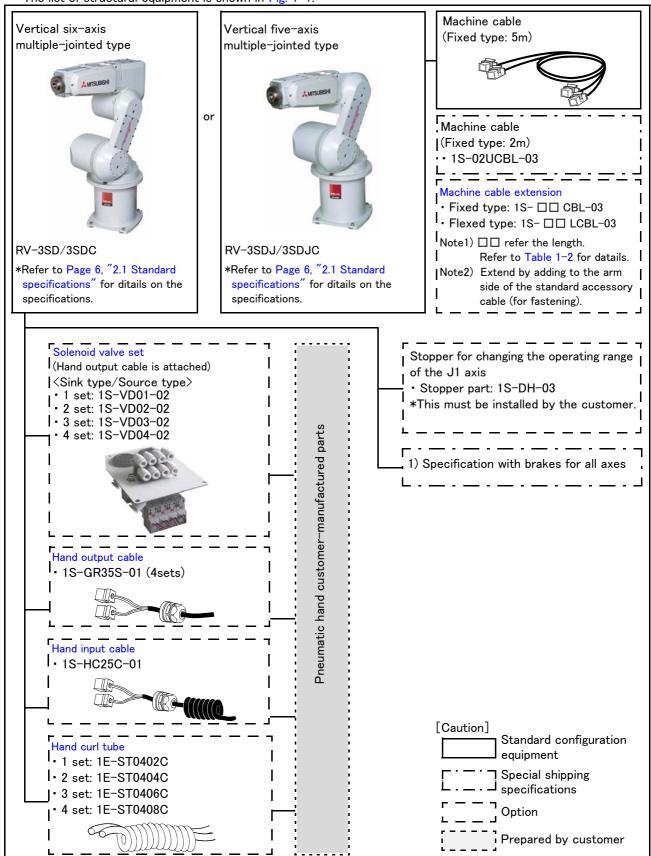


Fig.1-1: Structural equipment (Robot arm)

1.3.2 Controller

The devices shown below can be installed on the controller.

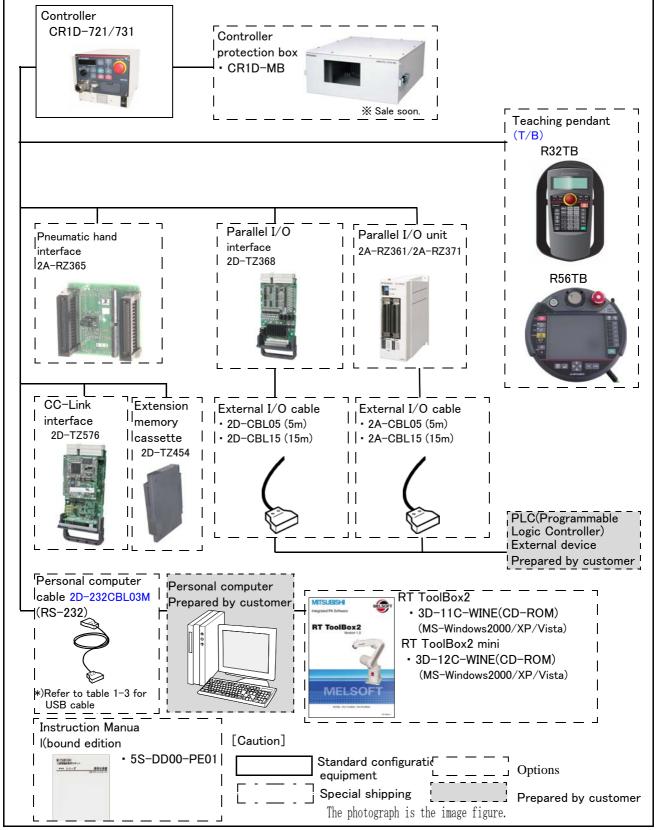


Fig.1-2: Structural equipment

1.4 Contents of the Option equipment and special specification

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

Table 1-2: The list of Option equipment and special specification

Table I Z . The list of	I Option equipment	and special specification	Olassic	T
Item	Туре	Specifications	Classificati on ^{Note1)}	Descripsion
Stopper for changing the operating range of the J1 axis	1S-DH-03	Stopper part + side: +120, +90, +60, or +30 deg. - side: -120, -90, -60, or -30 deg. One each of the following can be selected: ± 170 deg. are used for the standard specification.	0	
Machine cable(Replaced with shorter cable)	1S-02UCBL-03	For fixing (Two sets for power and signal)	0.0	Timi(Andust bablesisalsed plied in steach of ethe 5 m cable that is supplied as standard)
Extended machine cable	1S- □□ CBL-03	For fixing (Two sets for power and signal)	0	5, 10, 15m
	1D- □□ LCBL-03	For bending (Two sets for power and signal)		5, 10, 15m
Solenoid valve set	1S-VD01-02 1S-VD02-02	1 set (Sink type) 2 set (Sink type)	0	A solenoid valve set for the pneumatic hand
	1S-VD03-02 1S-VD04-02	3 set (Sink type) 4 set (Sink type)	0	·
Hand output cable	1S-GR35S-01	Robot side connector. One terminal is not treated.	0	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.	0	The cable is connected to the sensor by the customer.
Hand curl tube	1E-ST0402C	For solenoid valve 1set.:Φ4x2	0	
	1E-ST0404C	For solenoid valve 2set.:Φ4x4	0	Curl type air tube
	1E-ST0406C	For solenoid valve 3set.: Φ4x6	0	Curr type an tube
	1E-ST0408C	For solenoid valve 4set.:Φ4x8	0	
Teaching pendant	R32TB	Cable length 7m	0	
	R32TB-15	Cable length 15m	0	 With 3-position deadman switch
	R56TB	Cable length 7m	0	That o postaon addantan omeon
	R56TB-15	Cable length 15m	0	
Pneumatic hand interface	2A-RZ365	DO: 8 point (Sink type)	0	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)	0	The card type external input-and-output. Interface.Install to the slot of controller.
External I/O cable	2D-CBL05	5m	0	Use to connect the external peripheral device to
(For Parallel I/O Interface)	2D-CBL15	15m	0	the parallel input/output interface.
Parallel I/O Unit	2A-RZ361	DO: 32 point (Sink type)/ DI: 32 point (Sink type)	0	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)	0	(TOOMA/ POINT)
External I/O cable	2A-CBL05	5m	0	Use to connect the external peripheral device to
(For Parallel I/O Unit)	2A-CBL15	15m	0	the parallel input/output unit
Personal computer cable ^{Note2)}	2D-232CBL03M	RS-232C cable 3m for PC-AT compatible model	0	
RT ToolBox2 (Personal computer Sup- port software)	3D-11C-WINE	CD-ROM	0	MS-Windows2000/XP/Vista (With the simulation function)
RT ToolBox2 mini (Personal computer Sup- port software mini)	3D-12C-WINE	CD-ROM	0	MS-Windows2000/XP/Vista
CC-Link interface	2D-TZ576	Local station (The local station alone is supported.)	0	for MELSEC PLC with CC-Link connection.
Extended memory cassette	2D-TZ454	Teaching point number: 50,800 Steps number: 50,800 Program number: 512	0	The battery backup function is provided. The value combined with the standard
Controller protection box Note3)	CR1D-MB	IP54		The controller protection box is used to protect the controller from an oil mist or other operating environment
Instruction Manual	5S-DA00-PE01	RV-3SD/3SDJ series	0	A set of the instructions manual bookbinding editions

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

Note2)The recommendation products of the USB cable are shown in Table 1-2.

Note3)This is provided as standard for the specification with the controller protection box. Use this option to protect the controller from the oil mist when the controller will be installed in the environment such as the oil mist. This option only applies to the CR1D-7** controller.

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

Table 1-3: Recommendation article of the USB cable

Name	Туре	Maker
USB cable	USB2-30	ELECOM CO., LTD.
(USB A type-USB B type)	AU230	BUFFALO KOKUYO SUPPLY INC.
USB cable	KU-AMB530	SANWA SUPPLY INC.
(USB A type-USB mini B type)	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					
Туре			RV-3SD	RV-3SDC	RV-3D-SM	RV-3SDJ	RV-3SDJC	RV-3SDJ-SM
Type of robot				6-axis			5-axis	'
	Environment		Standard (oil mist)	Clean	With the con- troller protec- tion box	Standard (oil mist)	Clean	With the con- troller protec- tion box
Degree of free	edom			6			5	•
Installation po	sture			(On floor, hanging	,(against wall ^{Not}	e ¹⁾)	
Structure						ltiple-joint type		
Drive system				AC s	ervo motor (J1	to J3:and J5: witl	h brake)	
Position detec	ction method				Absolu	te encoder		
A 1 .1	Upper arm					245		
Arm length	Fore arm	mm		270			300	
	Waist (J1) Note1)				340 (-1	70 to +170)		
	Shoulder (J2)				225 (-9	90 to +135)		
Operating	Elbow (J3)	D		191 (-20 to +171))		237 (-100 to +137))
range	Wrist twist (J4)	Degree		320 (-160 to +160))		-	
	Wrist pitch (J5)				240 (-1	20 to +120)		
	Wrist roll (J6)				720 (-3	60 to +360)		
	Waist (J1)					250		
	Shoulder (J2)					187		
Speed of	Elbow (J3)	Degree/				250		
motion	Wrist twist (J4)	s		412			-	
	Wrist pitch (J5)		412					
	Wrist roll (J6)					660		
Maximum resu	ultant velocity Note2)	mm/sec		5,500			5,300	
Load	Maximum Note3)	le or				3.5		
	Rating	kg				3		
Pose repeatal	oility ^{Note4)}	mm	± 0.02					
Ambient temp	erature	°C	0 to 40					
Mass		kg		37			33	
A.II I- I -	Wrist twist (J4)			5.83			_	
Allowable moment load	Wrist pitch (J5)	N·m				5.83		
	Wrist roll (J6)			·	·	3.9		
Allowable	Wrist twist (J4)]		0.137				
inertia	Wrist pitch (J5)	kg·m²				0.137		
	Wrist roll (J6)				0.04	17 Note5)		
center point	radius froot p-axis	mm	mm 642 641		641			
Tool wiring ^{No}	te6)			Hand inp		utput 8 point, eight nm ²) with shielded)	spare wires	
Tool pneumatic pipes				Prim		(Base to fore arm s Φ4 × 8 (Optional		
Supply pressure		MPa			0.5	± 10%		
Protection sp	ecification ^{Note7)}		IP65 (all axes)	-	IP65 (all axes)	IP65 (all axes)	_	IP65 (all axes)
Degree of clea			$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		-			
Painting color			Light gray (Equivalent to Munsell: 0.08GY7.64/0.81)					

Note1) When used by mounting on the wall, a special specification that limits the operating range of the J1 axis will be used. The operating range is limited by changing the mechanical stopper position and also by setting parameters.

Note2) This is the value on the hand flange surface when all axes are combined.

Note3) The maximum load capacity is the mass with the flange posture facing downword at the $\pm~10^\circ~$ limit.

Note4) The pose repeatability details are given in Page 6, "2.2.1 Pose repeatability"

Note5) When the optimum acceleration/deceleration mode is in effect, up to twice the specification value indicated here can be set.

Note6) The air hand interface (option) is required when the tool (hand) output is used.

Note7) The protection specification details are given in Page 10, "2.2.5 Protection specifications and working environment". Note8) The clean specification details are given in Page 12, "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

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."

Note1)

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 6, "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 6, "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.

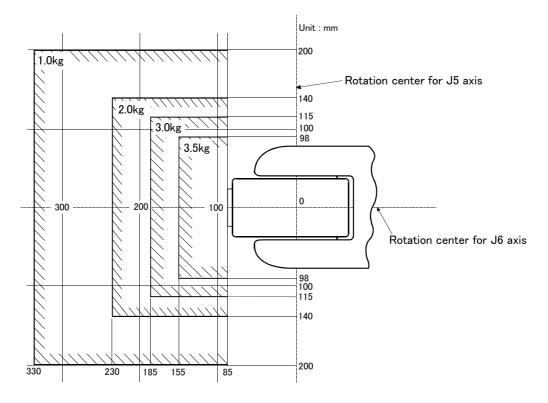


Fig.2-1: Position of center of gravity for loads (for loads with comparatively small volume)

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

Туре	Protection specifications (IEC Standards value)	Classification	Applicable field	Remarks
RV-3SD RV-3SDJ	Robot arm:IP65(all axes) Controller:IP20	General-purpose environment speci-	General assembly Slightly dusty environment	
RV-3SD-SM Note1) RV-3SDJ-SM	Robot arm:IP65(all axes) Controller:IP54	fications and 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.

Note1) The "-SM" specification (specification with the controller protection box) comes with the controller protection box (CR1D-MB) as standard.



Use the controller protection box (CR1D-MB) optional to protect the controller from the environment when the CR1D-7xx controller will be used in the environment such as the oil mist shown in the Table 2-2. A robot equipped with the controller protection box as standard is available (Note 1 in Table 2-2).

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	Kyodo Yushi Co., Ltd	Class A1 No. 2	Water soluble cutting oil	Water soluble cutting oil
FA-800			• Base oil	Emulcut
			• Surfactant and rust inhibitor 30-40%	
			• Additives 5% or less	
			WaterThe rest	

[Information]

• The IEC IP20

It indicates the protective structure that prevents an iron ball 12 $^{+0.05}_{0}$ mm diameter, which is being pressed with the power of 3.1 kg \pm 10%, from going through the opening in the outer sheath of the supplied equipment.

• 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 $\rm m^2$ 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 $12.5 \pm 5\%$ liters of water is supplied from a test device at a position approx. 3m away in various directions and a water pressure of 30kPa at the nozzle section. The water is filled one minute per 1m² of test device surface area for a total of three minutes.

(2) About the use with the bad environment

This robot has protection methods that conform to IEC's IP65(all axis) standards (splashproof type). It has protection structure designed to prevent harmful effects caused by splashing water coming from various directions, as the robot is operating. 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 from this joint. The specification of the dry air for pressurization is shown in Table 2-4.

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

Item	Dew point	Pressure
Specification	The atmospheric pressure dew point is -20 degree or less.	0 to 0.03MPa

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	Туре	Degree of cleanliness	Internal suction
RV-3SDC RV-3SDJC	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

Туре	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 \$\Phi\$8 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 (\$\Phi\$6 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

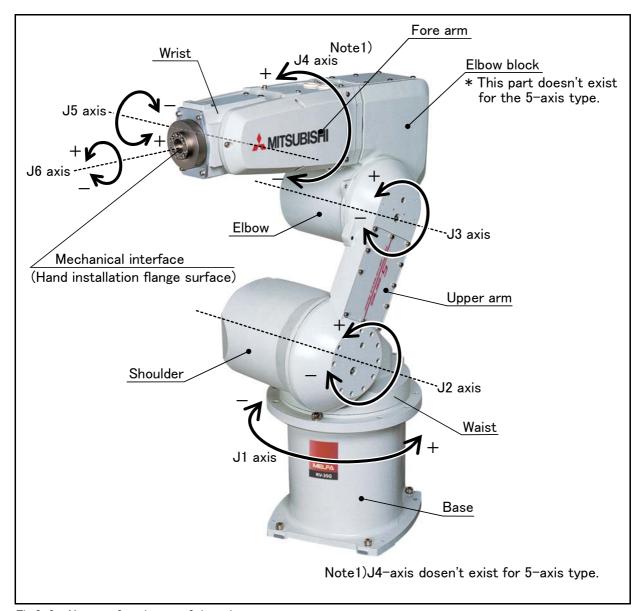
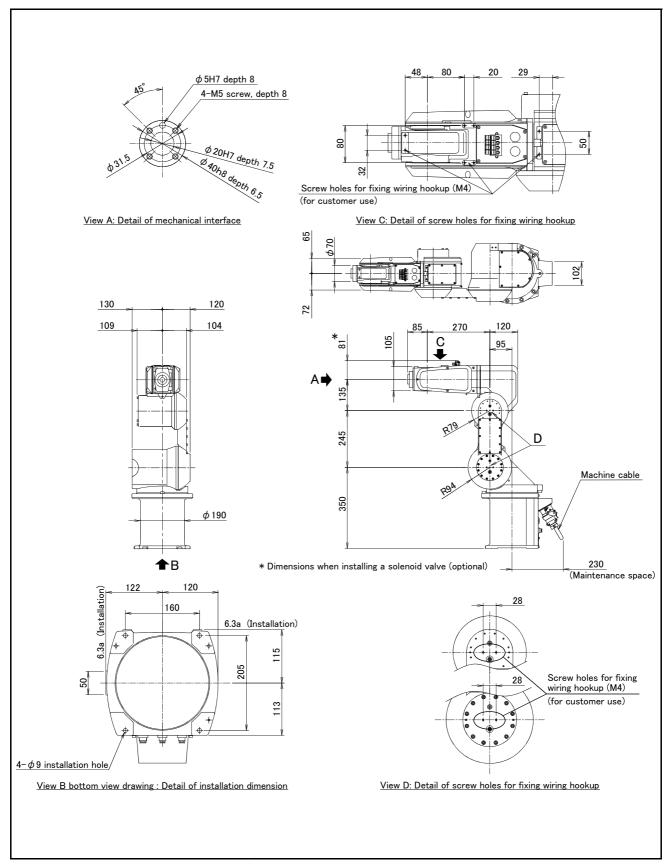


Fig.2-2: Names of each part of the robot

2.4 Outside dimensions • Operating range diagram

(1) RV-3SD/3SDC (6-axis type)



 $\label{eq:Fig.2-3} \textit{Fig.2-3}: \textit{Outside dimensions: RV-3SD/3SDC}$

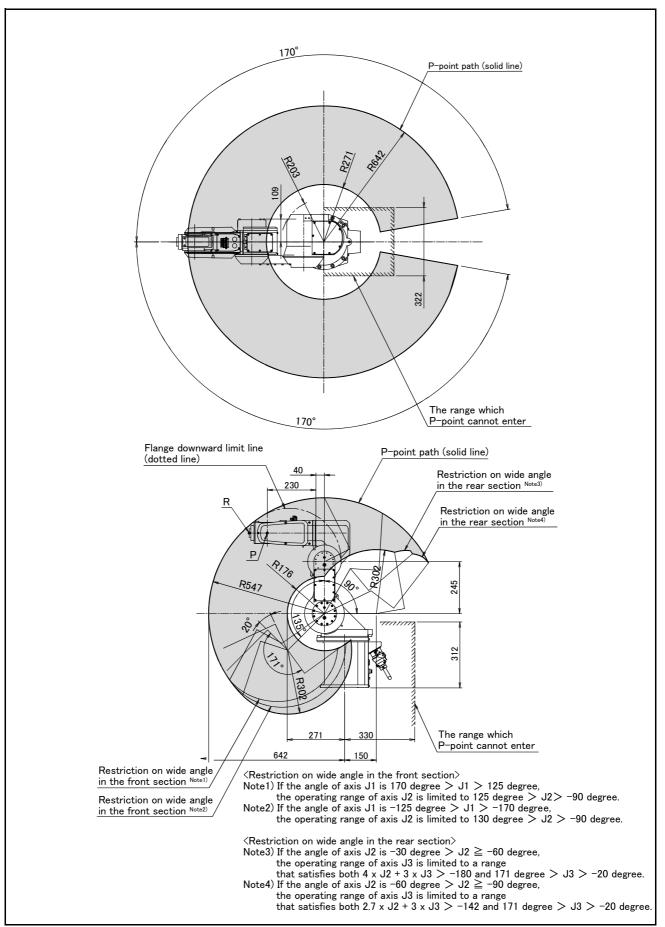


Fig.2-4: Operating range diagram: RV-3SD/3SDC

(2) RV-3SDJ/3SDJC (5-axis type)

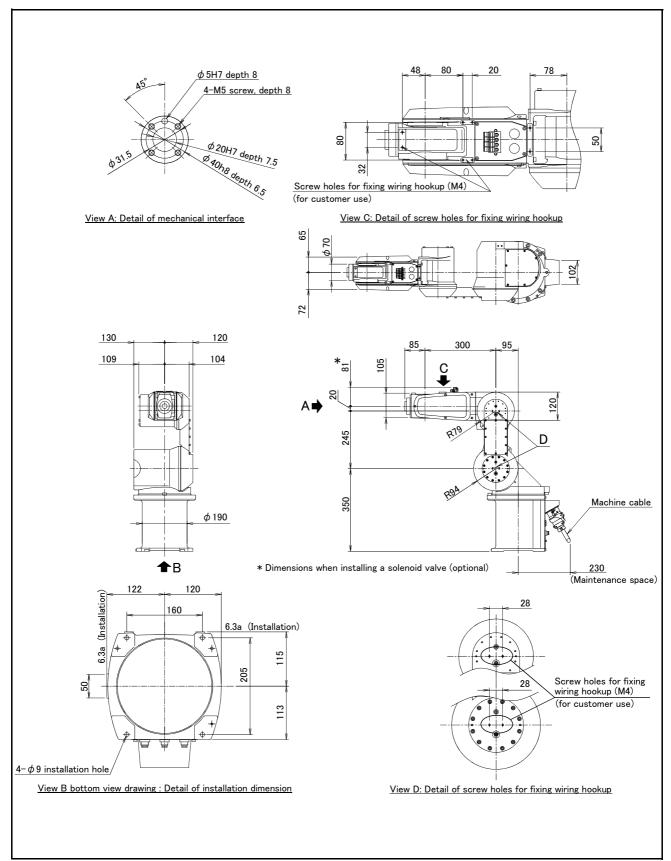


Fig.2-5: Outside dimensions: RV-3SDJ/3SDJC

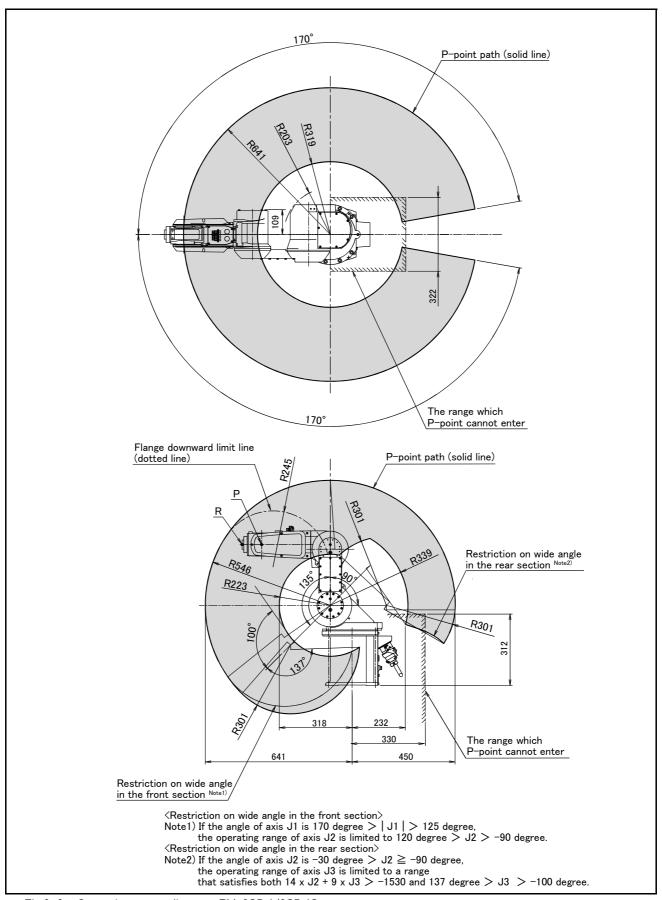


Fig.2-6: Operating range diagram: RV-3SDJ/3SDJC

2.5 Tooling

2.5.1 Wiring and piping for hand

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

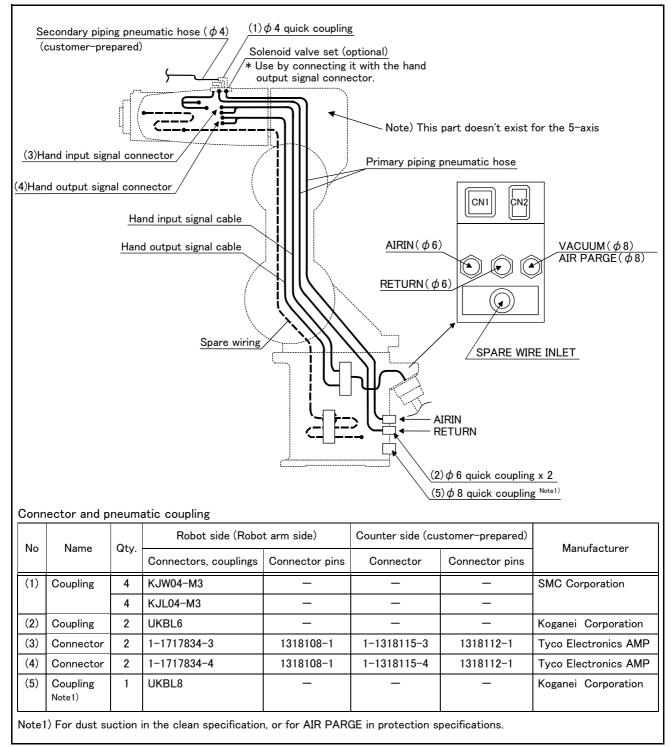


Fig.2-7: Wiring and piping for hand

2.5.2 Internal air piping

- (1) General-purpose envi-ronment/Oil mist specifications
 - 1) The robot has two ϕ 6 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 ϕ 4 air hose.
 - 4) The pneumatic inlet in the base section has a ϕ 6 pneumatic coupling bridge.
 - 5) Refer to Page 44, "(4) 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 21, "2.2.3 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 ϕ 8 coupling is provided in the base section for suction inside the machine. For use, connect it to the suction port of the vacuum pump or the coupling on the "VACUUM" side of the vacuum generating valve. Moreover, to clean the exhaust from the vacuum pump or vacuum generator, use the exhaust filter (prepared by the customer).
- 3) Refer to Page 12, "2.2.6 Clean specifications" for details of the vacuum for suction.
- 4) Use clean air as the air supplied to the vacuum generator.

2.5.3 Internal wiring for the hand check input cable

- 1) The hand output primary cable extends from the connector PCB of the base section to the inside of the forearm. (AWG#24(0.2mm²)x 2:8 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.

2.5.4 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(0.2mm²)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 AWG#24(0.2mm²) 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.)

Reference) Pin assignment of the connector, and the matching connector

Pin assignment

Color	
Red	
Brown	
Breen	
Brack	
Orange	
White	
Yellow	
Blue	

Robot side connector

Connection place	Connector	Contactor	Maker
Base portion	2-1318115-4	-	Tyco Electronics AMP K.K.
Fore arm portion	2-1717834-4	-	

Other party connector (recommendation)

Connection place	Connector	Contactor	Maker
Base portion	2-1717834-4	1318108-1	Tyco Electronics AMP K.K.
Fore arm portion	2-1318115-4	1318112-1	

2.5.6 iring and piping system diagram for hand Shows the wiring and piping configuration for a standard-equipped hand.

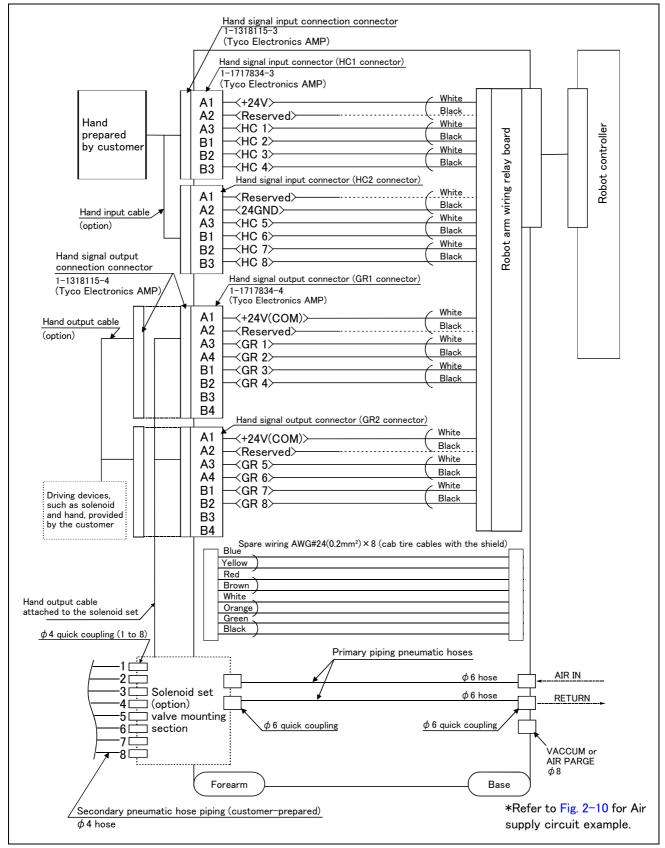


Fig.2-8: Wiring and piping system diagram for hand and example the solenoid valve installation(Sink type)

2.5.7 Electrical specifications of hand input/output

Table 2-7: Electrical specifications of input circuit

Item		Specifications	Internal circuit	
Туре		DC input	⟨Sink type⟩	
No. of input point	S	8	24\/□	
Insulation method	I	Photo-coupler insulation	24V= 	
Rated input volta	ge	12VDC/24VDC		
Rated input current		Approx. 3mA/approx. 7mA] → ↓	
Working voltage range		DC10.2 to 26.4V(ripple rate within 5%)	HCn*	
ON voltage/ON current		8VDC or more/2mA or more	3.3KOV(COM)	
OFF voltage/OFF current		4VDC or less/1mA or less		
Input resistance		Approx. 3.3kΩ		
Response time	OFF-ON	10ms or less(DC24V)	* HCn = HC1 ~ HC8	
	ON-OFF	10ms or less(DC24V)		
	•	•		

Table 2-8: Electrical specifications of output circuit

Item		Specification	Internal circuit
Туре		Transistor output	⟨Sink type⟩
No. of output points		8	24V
Insulation method		Photo coupler insulation	(Internal power supply)
Rated load voltage		DC24V	
Rated load voltage	range	DC21.6 to 26.4VDC	
Max. current load		0.1A/ 1 point (100%)	GRn*
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
Fuse rating		1.6A (each one common) Cannot be exchanged	1.6A
] <u></u>
			* GRn = GR1 ∼ GR8

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

2.5.8 Air supply circuit example for the hand

Fig. 2-9 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. 2-9 and use the circuit described so that the robot stops when pressure drops. Use a hand with a spring-pressure clamp, or a mechanical lock-type hand, that can be used in cases where the pressure switch becomes damaged.
- (3) The optional hand and solenoid valve are of an oilless type. If they are used, don't use any lubricator.
- (4) Supply clean air to the vacuum generation valve when you use clean type robot.

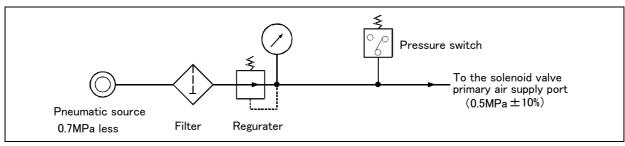


Fig.2-9: Air supply circuit example for the hand

2.6 Shipping special specifications, options, and maintenance parts

2.6.1 Shipping special specifications

■ What are sipping special specifications?

Shipping special specifications are changed at the time of shipment from the factory. Consequently, customer need to confirm the delivery date.

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

■ How to order

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

(1) Machine cable

Order type: Fixed type 1S-02UCBL-03 (2m)

Outline



This cable is exchanged for the machine cable (5 m for fixed type) that was supplied as standard to shorten the distance between the controller and the robot arm.

■ Configuration

Table 2-9: Configuration equipments and types

Part name		Туре	Qty.	Remarks
Fixed	Set of signal and power cables	1S-02UCBL-03	1 set	2m
	Motor signal cable	BKO-FA0741H02	(1 cable)	
	Motor power cable	BKO-FA0892H02	(1 cable)	

Note) Standard 5 m (for fixed type) is not attached.

[Caution] Orders made after purchasing a robot are treated as purchases of optional equipment. In this case, the machine cable (5 m for fixed type) that was supplied as standard is not reclaimed. Please keep it in storage.

2.7 Options

■ What are options?

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

- 1. Set optionsA combination of single options and parts that together, from a set for serving some purpose.
- 2. Single optionsThat 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-03

◆ Flexed type 1D- □□ LCBL-03 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 and motor power cable.

■ Configuration

Table 2-10: Configuration equipments and types

	Part name	Type	Qty.		Remarks
	T die Hamo	Туро	Fixed	Flexed	Romano
Fixed	Set of signal and power cables 1S- 🗆 CBL-03		1 set	-	5m, 10m, or 15m each
	Motor signal cable	1S- □□ CBL(S)-01	(1 cable)	-	
	Motor power cable	1S- □□ CBL(P)-02	(1 cable)	-	
Flexed	Set of signal and power cables	1D- □□ LCBL-03	-	1 set	5m, 10m, or 15m each
	Motor signal cable	1S- □□ LCBL(S)-01	-	(1 cable)	
	Motor power cable	1D- □□ LCBL(P)-02	-	(1 cable)	
Nylon clamp		NK-14N	-	2 pcs.	for motor signal cable
Nylon clamp		NK-18N	-	2 pcs.	for motor power cable
Silicon ru	ubber		-	4 pcs.	

■ 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., occup	ation rate	50% or less	
Maximum movement spe	eed	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		ϕ 6 x 5, ϕ 8.5 x 1and ϕ 1.7 x 1	
	Motor power cable	φ6 x 10	

[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 power cable 1D− □□ LCBL(P)-02		
No. of cores	AWG#24(0.2mm ²)-4P	AWG#24(0.2mm ²)-7P	AWG#18(0.75mm ²)	AWG#19(0.75mm ²) -3C
Finish dimensions	Approx. φ6mm	Approx. <i>φ</i> 8.5mm	Approx. <i>φ</i> 1.7mm	Approx. ϕ 6mm
No.of cables used	5 cables	1 cable	1 cable	10 cables
No. in total		10 cables		

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

■ Fixing the flexible cable

- (1) Connect the connector to the robot arm .
- (2) Wind the silicon rubber around the cable at a position 300 to 400 mm from the side of robot arm and extension section as shown in Fig. 2-10, and fix with the nylon clamp to protect the cable from external stress.

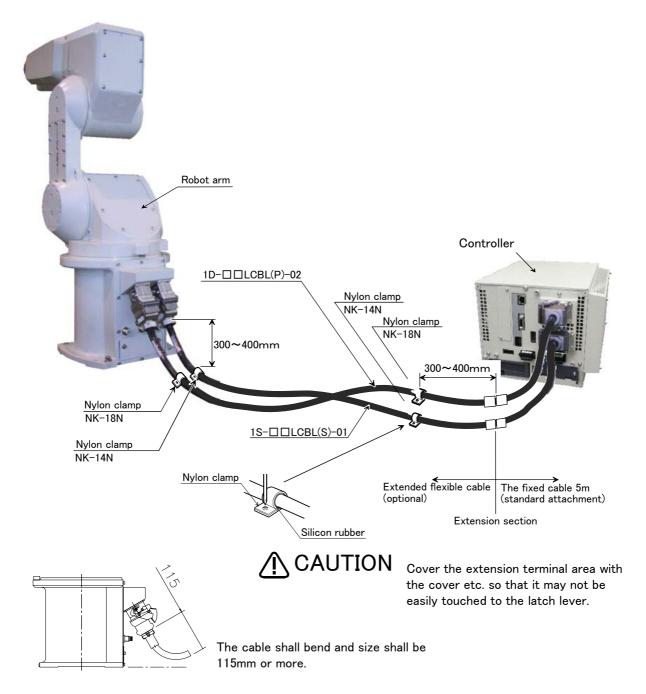


Fig.2-10: Fixing the flexible cable

(2) Changing the operating range

■ Order type: J1 axis.....1S-DH-03

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	Туре	Qty.	Remarks
Stopper for changing the operating range of J1	1S-DH-03	2 pcs.	Hexagon socket bolt: M10 x 20 plating (strength classification 10.9)

■ Specifications

Table 2-14: Specifications

A	cis .	Standard	Changeable angle
J1	+ side	+170°	One point from +120° , +90° , +60° , +30°
31	- side	-170°	One point from -120° , -90° , -60° , -30°

- (1) The changeable angle shown in Table 2-14indicates the operation range by the software.

 The limit by the mechanical stopper is positioned 2.5 degrees 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-VD01-02(Sink type)/1S-VD01E-02(Source type)

Two sets: 1S-VD02-02(Sink type)/1S-VD02E-02(Source type)Three sets: 1S-VD03-02(Sink type)/1S-VD03E-02(Source type)Four sets: 1S-VD04-02(Sink type)/1S-VD04E-02(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	Tura	Q'ty				Remark
Part name	Туре	One set	Two sets	Three sets	Four sets	Kemark
Solenoid valve set (1 set)	1S-VD01-02/ 1S-VD01E-02	1 pc.	-	_	_	M4x8 four screws (installation screws).
Solenoid valve set (2 sets)	1S-VD02-02/ 1S-VD02E-02	_	1 pc.	_	_	1S-VD01-02/VD02-02/VD03-02/VD04-02 are
Solenoid valve set (3 sets)	1S-VD02-02/ 1S-VD02E-02	_	_	1 pc.	_	the sink type. 1S-VD01E-02/VD02E-02/VD03E-02/VD04E-0
Solenoid valve set (4 sets)	1S-VD02-02/ 1S-VD02E-02	1	1	_	1 pc.	are the source type.

■ 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 °C (However, there must be no condensation.)	

Note1) Couplings of unused solenoid valves must be blocked with plugs. If they are not blocked, supplied air will blow out from the couplings, lowering the air pressure of the solenoid valves being used and making them nonfunctional

(recommended plugs: KQ2P-04 plugs made by SMC).



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	Diode
protection	

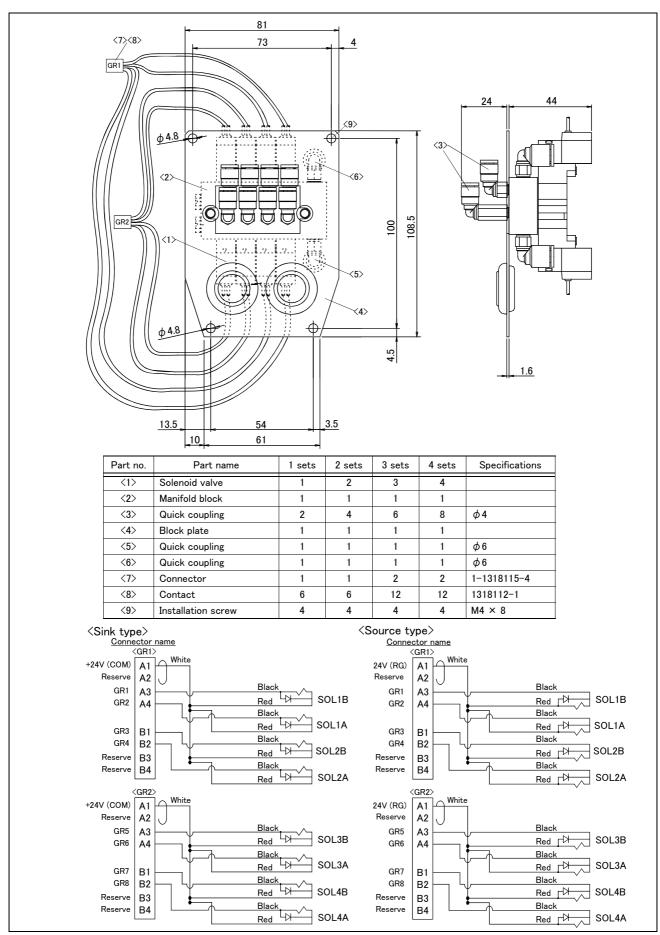


Fig.2-11: Outline dimensional drawing

(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	Туре	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)	

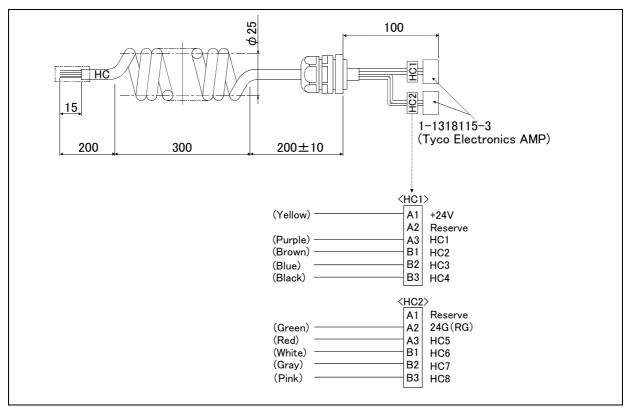


Fig.2-12: Outside dimensional drawing and pin assignment

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

(5) Hand output cable

■ Order type: 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	Туре	Qty.	Remarks
Hand output cable	1S-GR35S-01	1 cable	

■ 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	

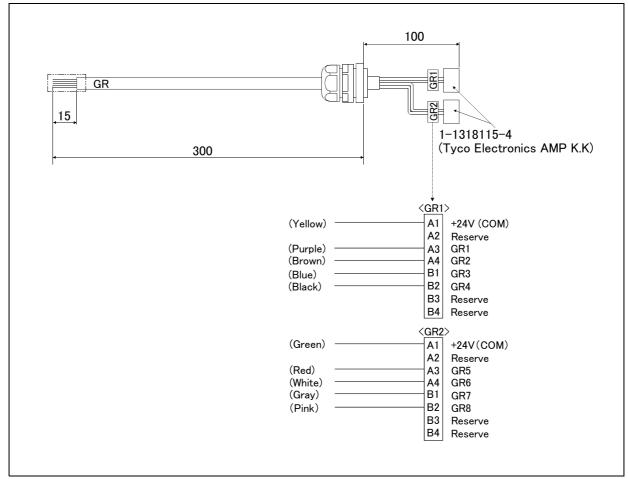


Fig.2-13: Outline dimensional drawing and pin assignment

(6) Hand curl tube

■ Order type: One set :1E-ST0402C

Two sets :1E-ST0404C
Three sets :1E-ST0406C
Four sets :1E-ST0408C

■ Outline



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

■ Configuration

Table 2-22 : Configuration equipment

Part name	Туре	Qty.	Remarks
Hans curl tube (One set: 2 pcs.)	1E-ST0402C	1 pc.	Φ4 tube, 2pcs.
Hans curl tube (Two set: 4 pcs.)	1E-ST0404C	1 pc.	Φ4 tube, 4pcs.
Hans curl tube (Three set: 6 pcs.)	1E-ST0406C	1 pc	Φ4 tube, 6pcs.
Hans curl tube (Four set: 8 pcs.)	1E-ST0408C	1 pc.	Φ4 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: ϕ 4 x Inside diameter: ϕ 2.5		

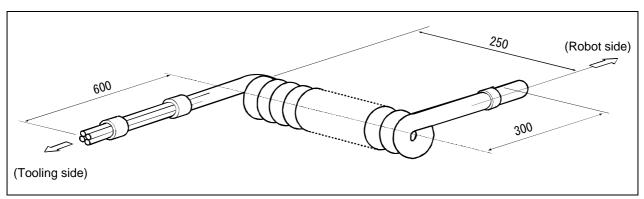


Fig.2-14: Outline dimensional drawing

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

2.8 Maintenance parts

The consumable parts used in the robot arm are shown in Table 2–24. 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
2	Lithium battery	A6BAT	In the battery cover A 5 pcs. Mitsut		WILLSUDISTII EIECTFIC

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 (CR1D-700 series)

Item		Unit	Specification	Remarks
Туре			CR1D-721/731	RV-3SD(6-axis) : CR1D-721 RV-3SDJ(5-axis) : CR1D-731
Number of control axis			Simultaneously 6/5	
Memory	Programmed positions and No.	point	13,000	
capacity	of steps	step	26,000	
	Number of programs		256	
Robot lang	uage		MELFA-BASIC V	
			or N. (1)	
			MELFA-BASIC IV ^{Note1)}	
Teaching m	nethod		Pose teaching method ,MDI method	
External	input and output	point	0/0	Max. 256/256 by option
input and	Dedicated input/output	point	Assigned with general-purpose input/output	
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 computer, 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	Input voltage range	V	1-phase, AC180 to 253	Note3)
source	Power capacity	KVA	1.0	Does not include rush current Note4)
Outline dimensions		mm	240(W) x 290(D) x 200(H)	Excluding protrusions
Mass		kg(lb)	Approx. 9(19.8)	
Construction			Self-contained floor type, Opened type	IP20 Note5)
Operating temperature range		deg.	0 to 40	
Ambient hu	ımidity	%RH	45 to 85	Without dew drops
Grounding		Ω	100 or less	D class grounding earth ^{Note6)}
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.
- Note5) This controller is a general environment specification. If the controller used in the clean environment, install to the place which does not have effect to cleanness.
- Note6) The robot must be grounded by the customer.

3.1.2 Protection specifications and operating supply

A protection method complying with the IEC Standard CR1D-721/731: IP20(Opened type), is adopted for the controller.

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

[Information]

• The IEC IP20

It indicates the protective structure that prevents an iron ball $12^{+0.05}_{0}$ mm diameter, which is being pressed with the power of 3.1 kg \pm 10%, from going through the opening in the outer sheath of the supplied equipment.

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



If the robot is used in an oil mist environment, use the optional contorller protection box (CR1D-MB) to protect the controller from the oil mist environment.

3.2 Names of each part

< CR1D-700 series >



< 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" \to "Program No." \to "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.
① 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.
(f) Power cable leading out	Lead out the power cable.

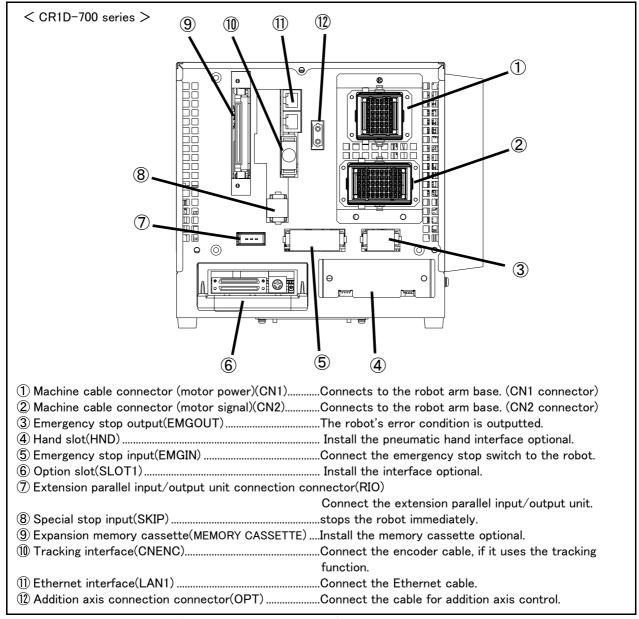


Fig.3-2: Names of each part (Rear side CR1D-700 series)

3.3 Outside dimensions/Installation dimensions

3.3.1 Outside dimensions

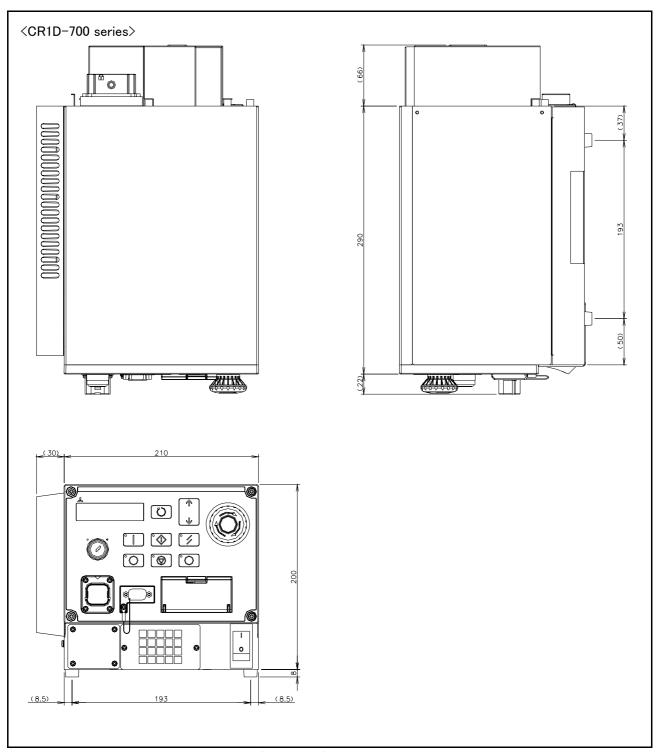


Fig.3-3: Outside dimensions of controller (CR1D-700)

3.3.2 Installation dimensions

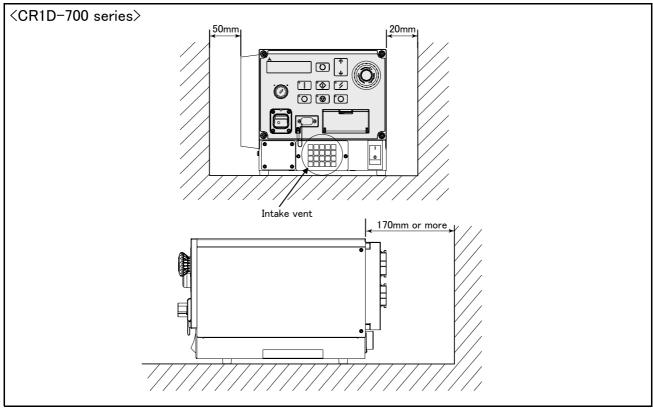


Fig.3-4: Installation of controller(CR1D-700 series)

The controller has the openings as shown in Fig. 3-5.

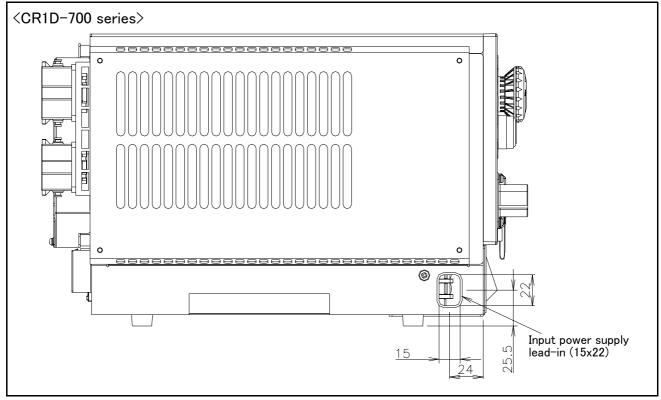


Fig.3-5 : Cable lead-in and dimension of the controller (CR1D-700 series)

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/outputThese are inputs and outputs related to the hand that the customer can program. (The hand output is an option. The Page 115, "(2) Pneumatic hand interface" is required.)

Table 3-2: Emergency stop/Door switch input

Nama	No. of input/	Connection	
Name	Input	Output	format
Emergency stop	1	1	Connector
Special stop switch	1	-	
Door switch	1	-	
Enabling device	1	-	1

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.

Table 3-3: Dedicated input/output list

Parameter		Input	Note1)		Output
name	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 opera- tion enabled input signal	Allows automatic operation.	L	Automatic operation enabled output signal	Outputs the automatic operation enabled state.
START	Start input signal	Starts all slots.	E	Operating output sig- nal	Outputs that the slot is operating.
STOP	Stop input signal	Stops all slots. The input signal No. is fixed to 0. Note) Use the emergency stop input for stop inputs related to safety.	L	Wait output signal	Outputs that the slot is temporarily stopped.
STOP2	Stop input signal	The program during operation is stopped. Unlike the STOP parameter, change of the signal number is possible. Notes) specification is the same as the STOP parameter.	L	Wait output signal	Outputs that the slot is temporarily stopped.
SLOTINIT	Program reset input signal	Resets the wait state.	Е	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.	Е	Error occurring output signal	Outputs that an error has occurred.
CYCLE	Cycle stop input signal	Carries out cycle stop.	Е	In cycle stop opera- tion 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 out- put signal	Outputs that an emergency stop has occurred.
S1START : S32START	Start input	Starts each slot.	E	In operation output	Outputs the operating state for each slot.
S1STOP : S32STOP	Stop input	Stops each slot.	L	In wait output	Outputs that each slot is temporarily stopped.

Parameter		Input	Note1)		Output
name	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. out- put request	Requests output of the program name.	E	Program No. output signal	Outputs that the program name is being output to the numeric value 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 out- put 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 sig- nal	Outputs that the error No. is being output to the numeric value output signal.
JOGENA	Jog valid input sig- nal	Validates jog operation with the external signals	E	Jog valid output sig- nal	Outputs that the jog operation with external signals is valid.
JOGM	Jog mode input 2- bit	Designates the jog mode.	L	Jog mode output 2- bit	Outputs the current jog mode.
JOG+	Jog feed + side for 8-axes	Requests the + side jog operation.	L		None
JOG-	Jog feed - side for 8-axes	Requests the - side jog operation.	L	. None	
HNDCNTL1 : HNDCNTL3		None		Mechanism 1 hand output signal status : Mechanism 3 hand output signal status	Mechanism 1: Outputs the status of general-purpose outputs 900 to 907. Mechanism 2: Outputs the status of general-purpose outputs 910 to 917. Mechanism 3: Outputs the status of general-purpose outputs 920 to 927.
HNDSTS1 : HNDSTS3		None		Mechanism 1 hand input signal status : Mechanism 3 hand input signal status	Mechanism 1: Outputs the status of hand inputs 900 to 907. Mechanism 2: Outputs the status of hand inputs 910 to 917. Mechanism 3: Outputs the status of hand inputs 920 to 927.
HNDERR1 : HNDERR3	Mechanism 1 hand error input signal : Mechanism 3 hand error input signal	Requests the hand error 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 50, "3.6.2 Special stop input(SKIP)")
Input	Door switch	Servo-off
Input	Enabling device	Servo-off
Output	Robot error output	Contactor is opening during error occurrence
Output	Mode output	MANUAL mode: contactor is closing, AUTO mode: contactor is opening
Output	Magnet contactor control connector output for addition axes	When an additional axis is used, the servo ON/OFF status of the additional axis can be synchronized with the robot arm.

^{*}At the time of the power supply OFF, the output point of contact is always open.

[Note] The contact capacity of each input/output terminal is DC24V/10mA - 500mA. Don't connect the equipment except for this range. The use exceeding contact capacity causes failure.

Pin number assignment of each terminal and the circuit diagram are shown in Fig. 3-7.

3.6.1 Connection of the external emergency stop

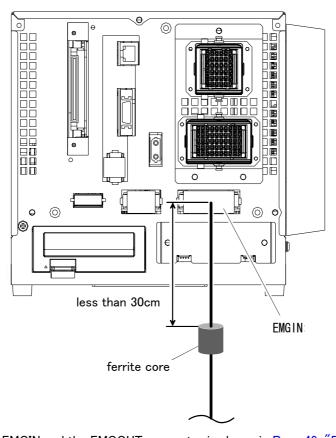
The external emergency stop input and door switch input and enabling device input are opened at shipment as shown in Fig. 3-7.

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.

<CR1D-700>



Pin allotment of EMGIN and the EMGOUT connector is shown in Page 49, "Fig.3-7: External emergency stop connection".

Fig.3-6: emergency stop cable connection(CR1D-700)

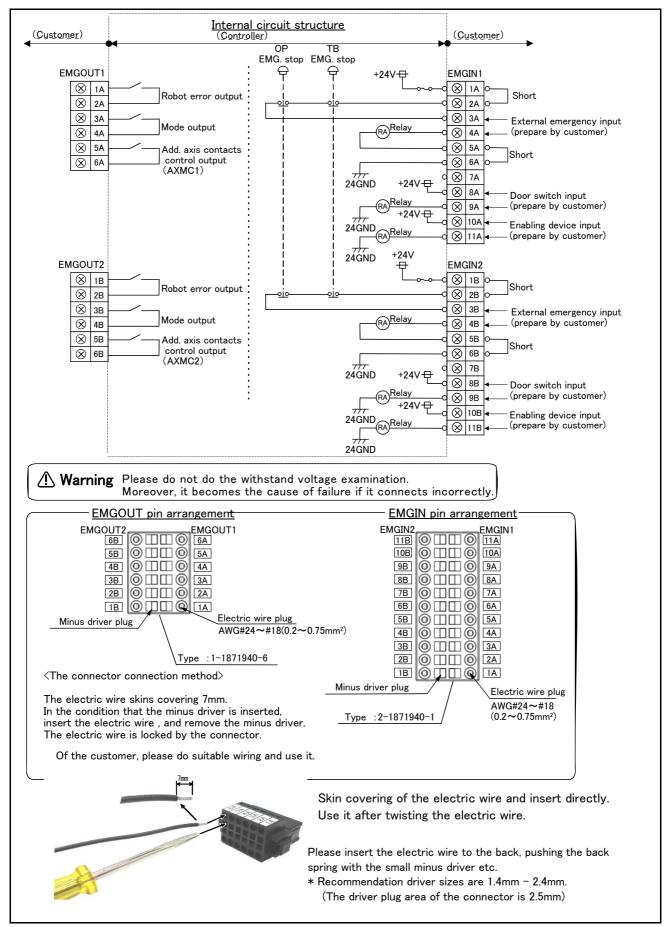


Fig.3-7: External emergency stop connection

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.



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.

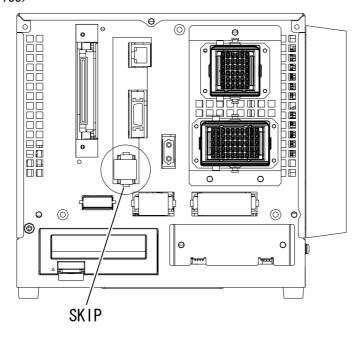
3.6.2 Special stop input(SKIP)

The skip is the input signal to stop the robot. Wire 1A-1B of the special stop connector (SKIP) shown in Page 51, "Fig.3-8: Connection of the special-stop-input".

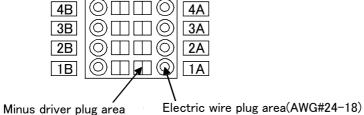
Table 3-5: Special stop input electric specification

Item		Specifications	Internal circuit		
Туре		DC input			
No. of input po	int	1			
Insulation meth	nod	Phto-coupler insulation			
Rated inpit volt	tage	DC24V			
Rated input cu	rrent	approx. 11mA	1A +24V(COM)		
Working voltage range		DC 21.6 ~ 26.4V (Ripple rate within 5 %)	330		
ON voltage/ON	V current	DC 8V or more / 2mA or more	1B 2.2k Input		
OFF voltage/O	FF current	DC 4V or less / 1mA or less	2.28		
Input resistanc	е	approx. 2.2 k Ω			
Response	OFF → ON	1ms or less			
time	ON → OFF	1ms or less			
Common method		1 point per common			
External wire connection method		Connector			

<CR1D-700>



Special stop connector (SKIP)



<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.3-8: 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. 3-7, 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 operationWhen the door is opened, the servo turns OFF and the robot stops. An error occurs.

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

• During teaching Even when the door is opened, the servo can be turned ON and the robot moved using the teaching pendant.

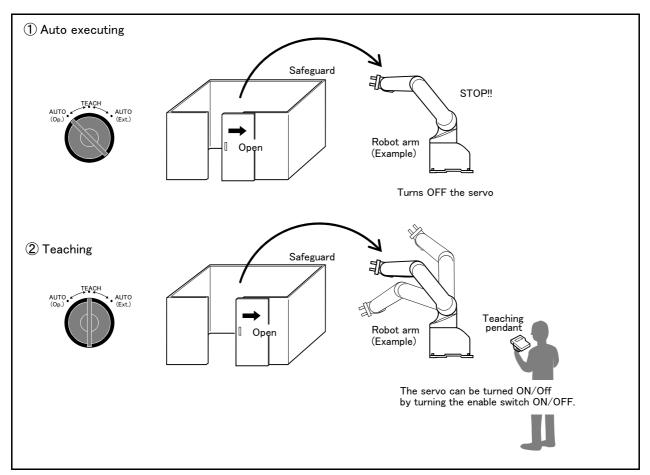


Fig.3-9: Door switch function

3.7 Additional Axis Function

This controller is equipped with an additional axis interface for controlling an additional axis when a traveling axis or rotary table is added to the robot. A maximum of eight axes of servo motors can be controlled at the same time by connecting a general-purpose servo amplifier (MR-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. 3–10 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 54, "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	ОРТ	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.

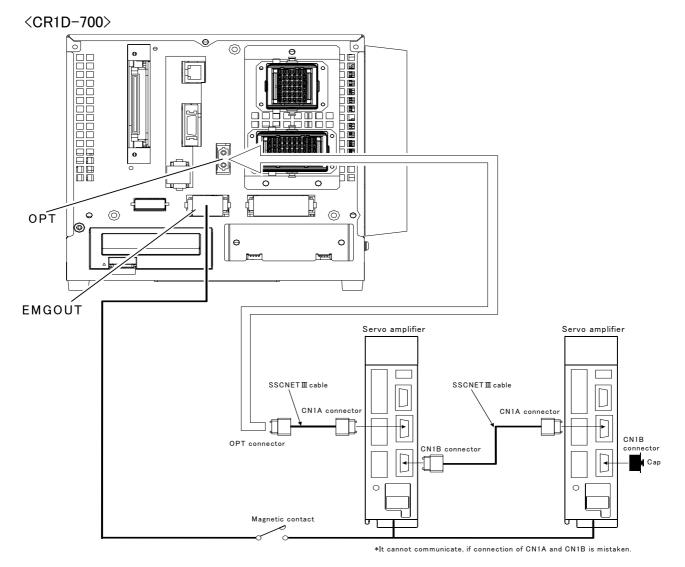


Fig.3-10: Example of addition axis connection (CR1D-700)

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. 3-11 shows an example of its circuit, and Fig. 3-12how the layout drawings of the output contact (AXMC1). When you are using an additional axis, please perform appropriate circuit connections by referring to these draw-

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.

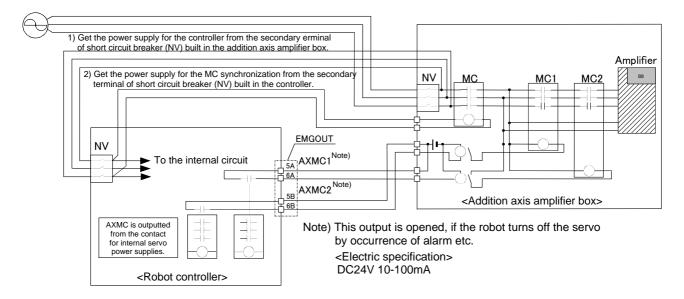


Fig.3-11: Example of circuit for addition axes of Magnet contactor control output

<CR1D-700> 9 0] 0 Бū 5 🖪 6 (P 0 0 (O) (O) (4) θ 0 EMGOUT EMGOUT connector Internal circuit EMGOUT2 EMGOUT1 Contactor control output for addition axes (AXMC1) ⊗ 6A EMGOUT2 Contactor control output for addition axes (AXMC1) ⊗ 5B Electric wire plug area AWG#24~#18 (0.2~0.75mm²) ⊗ 6B Minus driver plug area

(Custmer) (Controller)

Fig.3-12: EMGOUT connector (CR1D-700)

Type :1-1871940-6

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	Туре	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	Dark gray		
Mass	Approx. 0.9kg (only arm, excluding cable)	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.

[&]quot;Not pressed"......The robot does not operate. *)

[&]quot;Pressed lightly"......The robot can be operated and teaching is possible.

[&]quot;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.

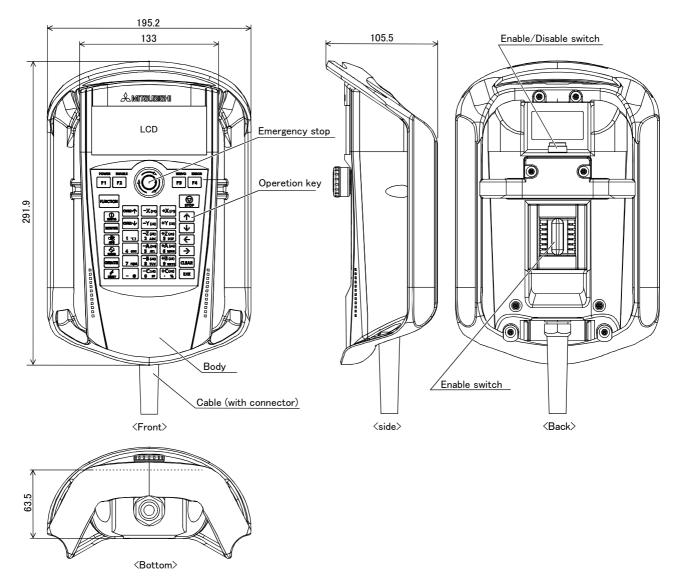


Fig.3-13: Outside dimensions of teaching pendant

■ Installation method

The teaching pendant is connected to the $\ensuremath{\mathsf{T/B}}$ connector on the front of the controller.

■ Key layout and main functions

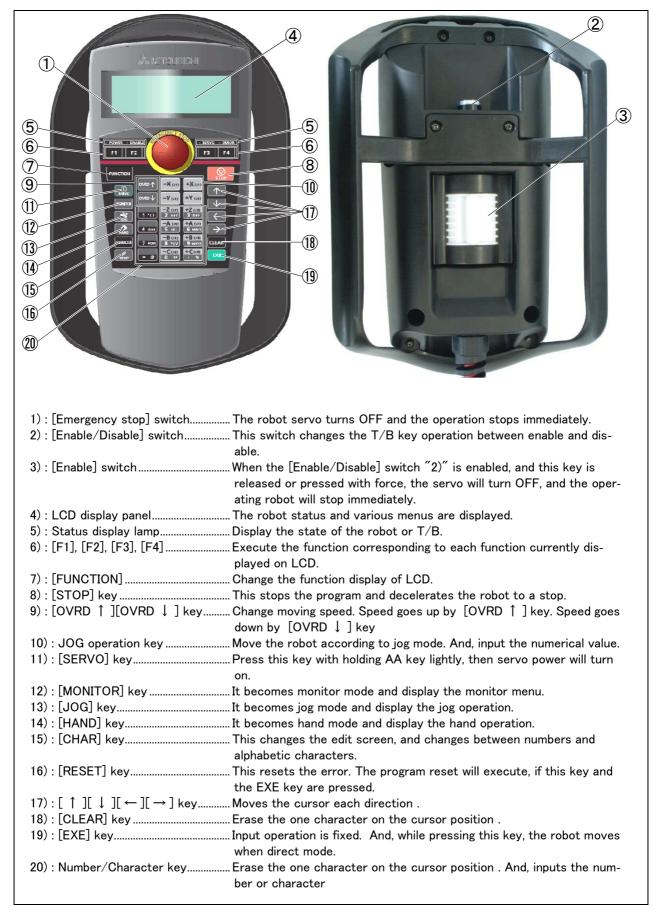


Fig.3-14: Teaching pendant key layout and main functions

(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	Туре	Qty.	Remarks	
Pneumatic hand interface	2A-RZ365	1pc.	. Output 8 points expansion.	

■ Specifications

Table 3-10 : Specifications

Item		Specification	Internal circuit
Туре		Transistor output	<sink type=""></sink>
No. of output points		8	24V
Insulation method		Photo coupler insulation	(Internal power supply)
Rated load voltage		DC24V	十二十二十二十二十二十二十二十二十二十二十二十二十二十二十二十二十二十二十二
Rated load voltage range		DC21.6 to 26.4VDC	
Max. current load		0.1A/ 1 point (100%)	GRn*
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)	1 6'1
	ON-OFF	2 ms or less (resistance load) (hardware response time)	Fuse S
Fuse rating		Fuses 1.6A (each one common)	1.6A ==
Common method		8 points, 1 common	
			0V
			* GRn = GR1 ~ GR8

■ 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.

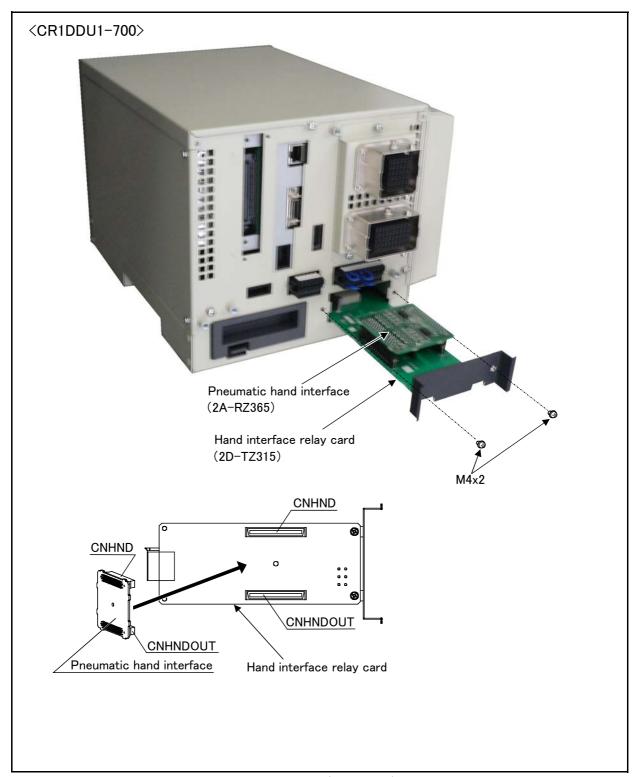


Fig.3-15: Installation of the pneumatic hand interface (CR1D-700)

(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	Туре	Qty.	Remarks
Parallel I/O interface 2D-TZ368		1 pc.	Input/output 32 points/32 points

■仕様

1) The CR1D-700 series controller can connect this one interface.

Table 3-12: Electrical specifications of input circuits

Item		Specification	Internal circuit
Туре		DC input	⟨Sink type⟩
Number of input points		32	+24V/+12V
Insulation method		Photo coupler insulation	(COM)
Rated input voltage		DC12V/DC24V	
Rated input current		Approx. 3mA/7mA	7 → 1820
Working voltage range		DC10.2 ~ 26.4V (Ripple factor should be less than 5%)	入力 2.7K
ON voltage/ON current		DC4V or more/1mA or more	<u> </u>
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
Туре		Transistor output	⟨Sink type⟩
No. of o	utput points	32	+24V/+12V
Insulation	on method	Photo-coupler insulation	1244//1124
Rated Id	oad voltage	DC12V/DC24V	】 ፟
Rated load voltage range		DC10.2 ~ 30V(peak voltage DC30V)	
Max. loa	d current	0.1A/point (100%)]
Leakage current at 0.1mA or I		0.1mA or less	Ea-X
Max. vo	Itage drop at	DC0.9V(TYP.)	
Respo	OFF-ON	10ms or less (hardware response time)	
nse time	ON-OFF	10ms or less(Resistance load) (hardware response time)	
Fuse rat	ting	Fuse 1.6A(one per common) Replacement possible (max. 3)	
Common method 8per common(8per common(common terminal : 4 points)	
Externa tion met	l wire connec- thod	Connector	
Exter-	Voltage	DC12/24V(DC10.2 ~ 30V)	
nal power supply	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)



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.

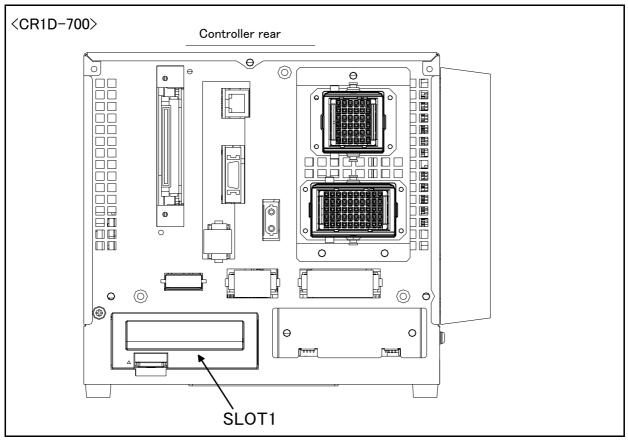


Fig.3-16: Parallel I/O interface installation position (CR1D-700)

■ Pin layout of connector

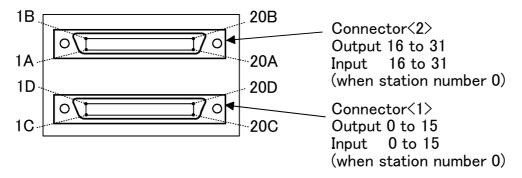


Fig.3-17: Pin layout of connector

■ 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-andoutput signal is fixed.

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

Slot number	Station	Range of the general-purpose input-and-output signal				
Slot number	number	Connector <1>	Connector <2>			
SLOT1	0	Input: 0 to 15 Output: 0 to 15	Input : 16 to 31 Output : 16 to 31			

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.

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

Pin	Line selen	Function	n name	Pin	Line relea	Function name	
No.	Line color	General-purpose	power supply, common	No.	Line color	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	2D	Gray/Black a		Reserved
			5C-20C				
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)

		bililoocol (2) pili dool	Brillione not and oxed		1, 0 00.0.0 (22	052 7 00101 (020	,
Pin Line color		Function name		Pin	Function name		
No.	Line color	General-purpose power supply, common No.		No.	Line color	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-	2B	Gray/Black a		Reserved
			20A				
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

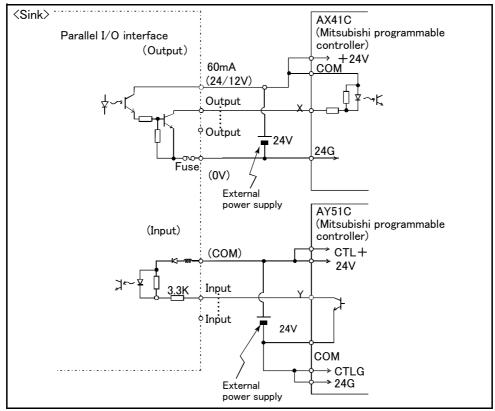


Table 3-17: Connection with a Mitsubishi PLC (Example of sink type)

^{*}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	Туре	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

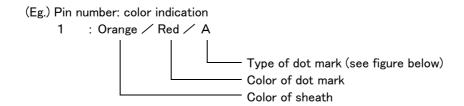
Table 3-20: Connector pin numbers and cable colors

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.



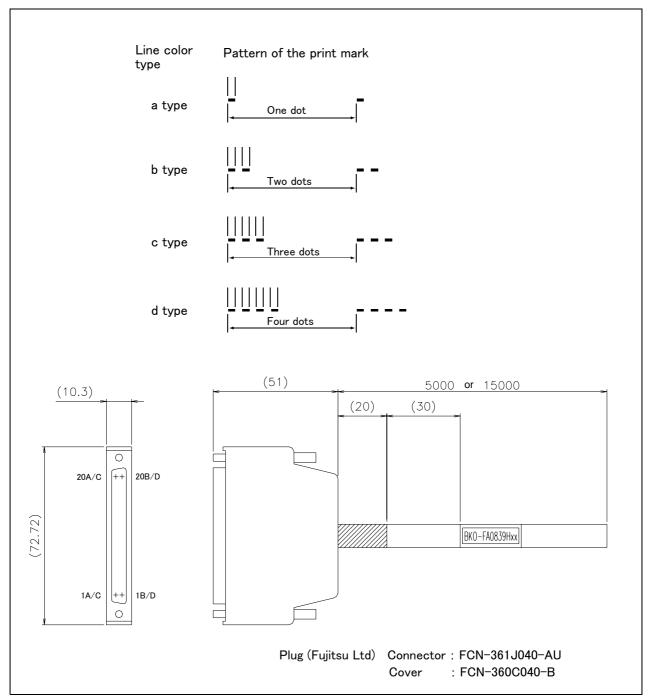


Fig.3-18: Connections and outside dimensions

(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.	100 Ω (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.

Item Specification Internal circuit DC input Туре <Sink type> Number of input points 32 24V/12V Insulation method Photo coupler insulation (COM) Rated input voltage 12VDC/24VDC Rated input current Approx 3mA/7mA 820 10.2 to 26.4VDC(Ripple factor should be less than 5%.) Working voltage range Input ON voltage/ON current 8VDC or more/ 2mA or more OFF voltage/ OFF current 4VDC or less/ 1mA or less Ö Input resistance Approx. 3.3kΩ <Source type> OFF-ON Response time 10ms or less (24VDC) ON-OFF 10ms or less (24VDC) 3.3K Common method 8 points per common Input External cable connection method Connector OV(COM)

Table 3-22: Electrical specifications of input circuits

Table 3-23: Electrical specifications for the output circuits

Item		Specification	Internal circuit	
Type Tran		Transistor output	⟨Sink type⟩	
No. of output poi	nts	32		
Insulation metho	d	Photo-coupler insulation		
Rated load voltag	ge	12VDC/24VDC	(24/12V)	
Rated load voltag	ge range	10.2 to 30VDC(peak voltage 30VDC)	4.2	
Max. load curren	t	0.1A/point (100%)	Outline	
Leakage current	at OFF	0.1mA or less		
Max. voltage drop at ON		0.9VDC(TYP.)		
OFF-ON		2ms or less (hardware response time)	Fuse (0V)	
Response time	ON-OFF	2ms or less (Resistance load) (hardware response time)	⟨Source type⟩	
Fuse rating		Fuse 3.2A (one per common) Replacement not possible	Fuse (24/12V)	
Common method		8 points per common (common terminal: 8 points)	r—FA i	
External wire connection method		Connector	Outline	
External power	Voltage	12VDC/24VDC(10.2 to 30VDC)	(0V)	
supply	Current	60mA (TYP. 24VDC per common) (base drive current)	(01)	



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.

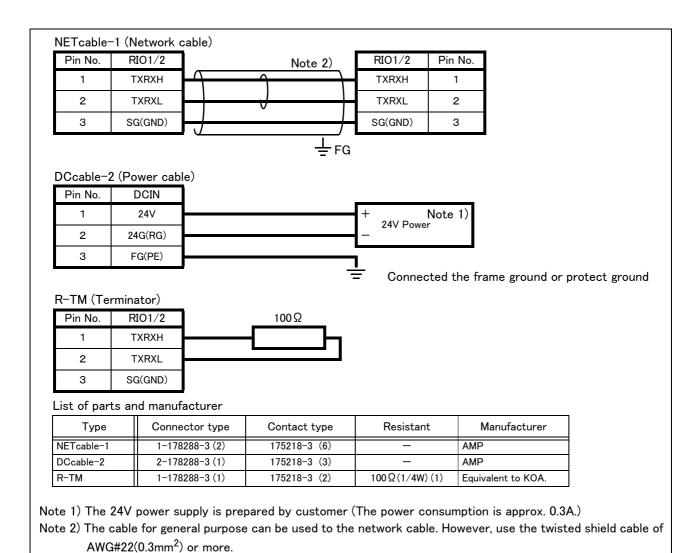


Fig.3-19: Spacifications for the connection cable

■ Installation method

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

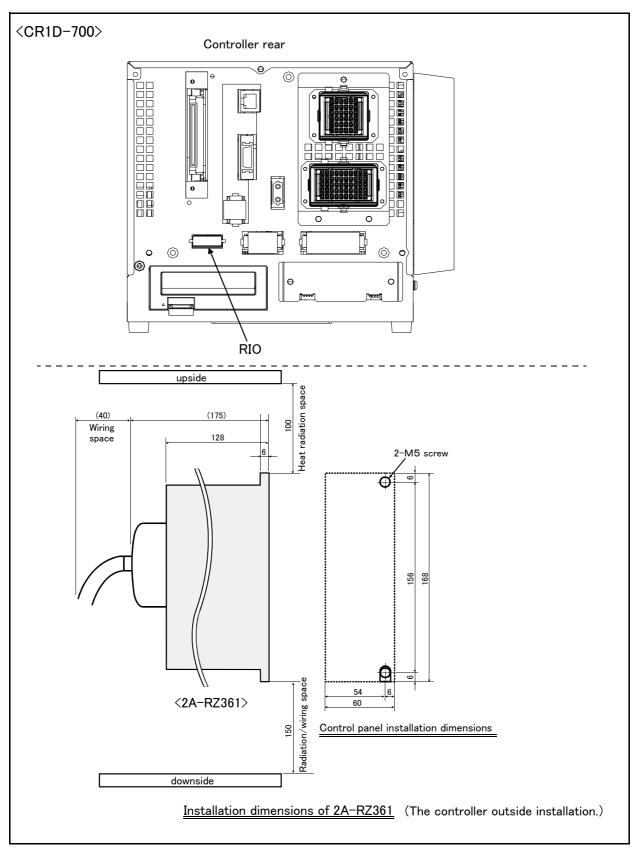


Fig.3-20 : Installing the parallel I/O unit (CR1D-700)

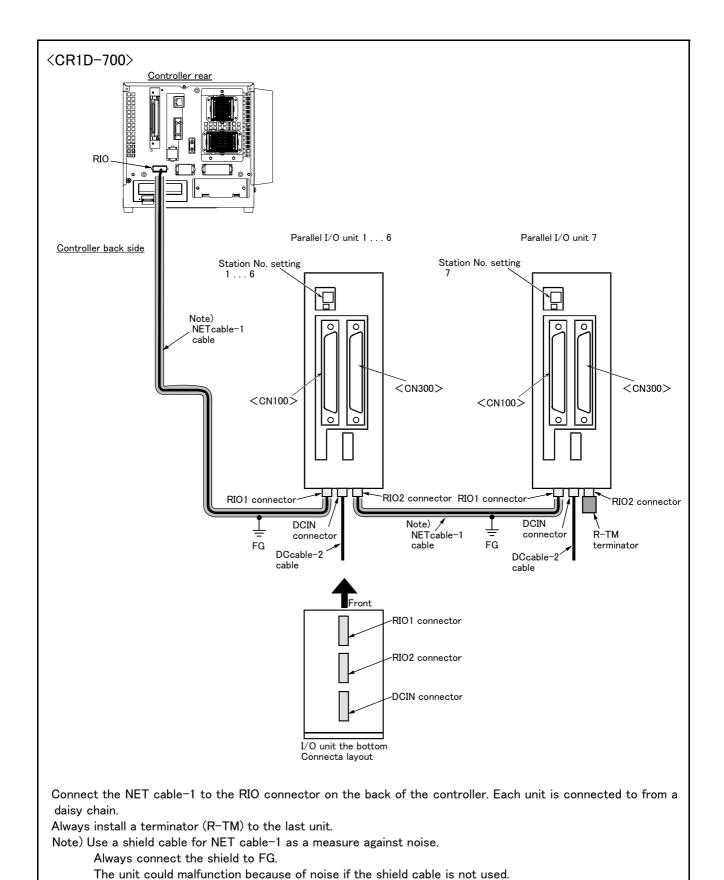
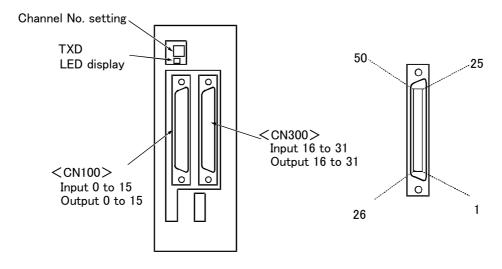


Fig.3-21 : Connection method of expansion parallel I/O unit (CR1D-700)

■ Pin arrangement of the connector



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

Fig.3-22 : 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		Function name		Pin	IISC (Z/C ODI	Functio	n name
No.	Line color	General-purpose	Dedicated/power supply, common	No.	l ine color	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 $\Box\Box$)

Pin		Functio	Function name			Functio	n name
No.	Line color	General-purpose	Dedicated/power supply, common	Pin No.	Line color	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	Туре	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

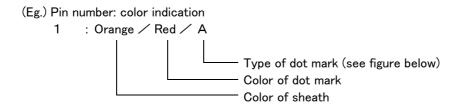
■ Connector pin numbers and cable colors

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.



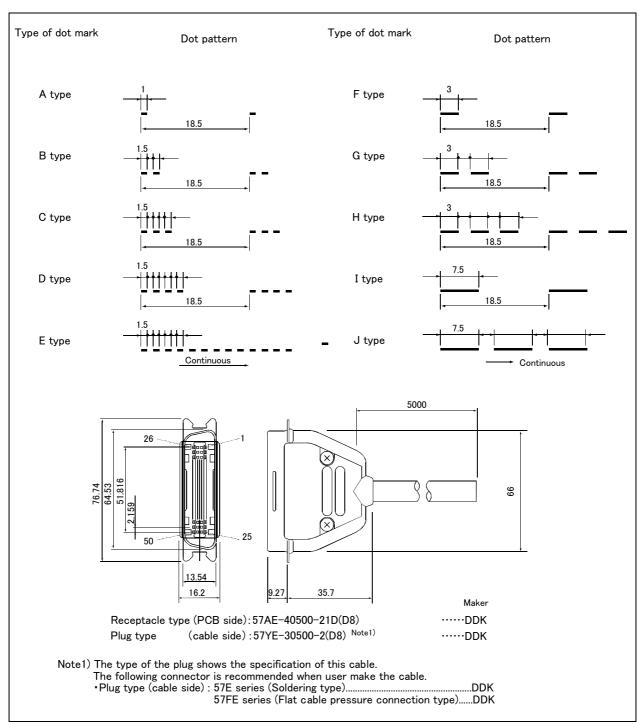


Fig.3-23: Connections and outside dimensions

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

■ Specifications

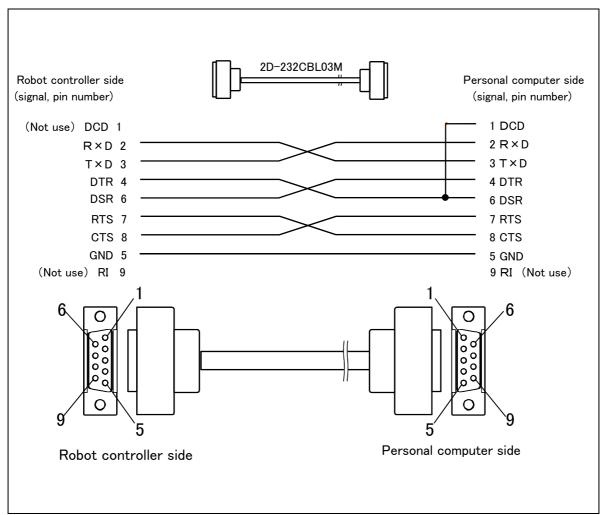


Fig.3-24: Personal computer cabe connection

(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	Туре	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	Туре	Qty.	Remarks	
	QJ61BT11(Q series)			
	AJ61QBT11(QnA series)			
	A1SJ61QBT11(QnAS series)			
Master station	AJ61BT11(A series)	1	FX series products are not supported.	
	A1SJ61BT11(AnS series)			
	A80BD-J61BT11(personal computer board)			
Communication cable	n cable –		Shielded 3-core twisted cable This cable may be manufactured by the customer.	
Terminal resistor	-	1	110 Ω or 130 Ω is recommended.	

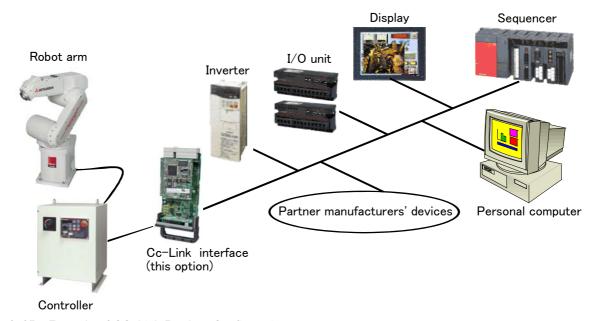


Fig.3-25: Example of CC-Link Product Configuration

■ Specifications

Table 3-33 : Specifications

	Item			Specif	ications		Remarks
Communica	ation function		Bit data	and word da	ta can be tra	ansmitted.	Word data are used by the registers.
Station typ	е		Int	elligent devi	ce station ^N	ote1)	
Support sta	ation			Local	station		No master station function
The version	n correspondin	g to CC-Link		V	er.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.
Transmissio	on speed		101	M/5M/2.5M	/625K/156K	bps	This is set by the rotary SW.
Station nur	mber			1 t	o 64		When four stations are occupied, continuous
Number of	occupied stati	ons	One or f	our occupie	d stations ca	an be set.	station numbers are used.
Extended c	yclic setup			1/2	2/4/8		1
Maximum li	nk point	Remote I/O (RX, RY).		Each 8	96 points		The two last cannot be used.
		Remote register (RWr, RWw)		Each 12	8 register		16 bits/register
Extended c	yclic setup	-	1 fold setup	2 fold setup	3 fold setup	4 fold setup	
Link point per set	When one station is	Remote I/O (RX, RY).	32 point	32 point	64 point	128 point	
	occupied	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	Remote I/O (RX, RY).	64 point	96 point	192 point	384 point	
	occupied	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	Remote I/O (RX, RY).	96 point	160 point	320 point	640 point	
	occupied	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	Remote I/O (RX, RY).	128 point	224 point	448 point	896 point	
	occupied	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."					

 ${\tt Note1)} The \ {\tt CC-Link} \ interface \ supports \ neither \ the \ transmission \ function \ nor \ the \ {\tt FX} \ series.$

■ 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	Туре	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	Туре	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

Fun	ction	Functional e	xistence ^{Note1)}	Details	
Compatible mode	l	0	0	Personal computer running Microsoft Windows2000/XP/Vista.	
Program editing functions	Editing functions	0	0	MELFA BASIC V language compatible Multiple editing screen simultaneously display Command input, comment writing Position data editing File operation (writing to controller, floppy disk, personal computer) Search and replace function (using characters, line Nos., labels) Copy, cut, paste, insert (per character, line), undo (per command statement, position conversion) Line No. automatic generation, renumbering Batch syntax check Command template Position conversion batch editing Position variable template Print, print preview	
Control functions		0	0	Program file control (list, copy, movement, delete, content comparison, name change, protect)	
	Debugging functions	0	0	Direct editing of program in controller Confirmation of robot program operation (step execution, direct execution) Tact time measurement Note2)	
Simulation function		0	×	Off-line simulation of robot program operation using CG (computer graphics) Tact time calculation	
Monitor func- tions		0	0	Robot operation monitor (robot operation state, stop signal, error monitor, program monitor (execution program, variables), general-purpose input/output signals (forced output possible), dedicated input/output signals, operation confirmation (operation range, current position, hand, etc.) Operation monitor (working time statistics, production information, robot version) Servo monitor (position, speed, current, load, power)	
Maintenance function		0	0	Parameter setting Batch, divided backup	
Remote mainte- nance function		0	0	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.

O: 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-DA00-PE01 (RV-3SD/3SDJ series)

Outline



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

■ Configuration

Table 3-38: Product configuration(RV-3SD/3SDJ series)

Name	Туре	Specifications
nstruction Manual		
Safety Manual	BFP-A5948	Items relating to safety in handling the robot
Standard Specifications	BFP-A8652	Specification of the robot arm and controller
Robot Arm Setup & Maintenance	I BEP-A8653	Installation method of the robot arm, jog operation, and maintenance and inspection procedures
Controller Setup, Basic Operation and Maintenance	BFP-A8660	Installation method of the controller, basic operation, and maintenance and inspection procedures
Detailed Explanation of Functions and Operations	BFP-A8661	Functions of the controller and T/B, operation method, and explanation of MELFA-BASIC V
Troubleshooting	BFP-A8662	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.	Name Type Note1)		Qty.	Usage place	Supplier		
CR1D-	CR1D-700 controller						
1	Lithium battery	Q6BAT	1	Front operation panel	Mitsubishi Electric Sys-		
2	Filter		1	Front of the controller	tem Service;Co.,Ltd		

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

Туре	Class	Function	Input format (example)		
	Joint interpolation	Moves to the designated position with joint interpolation.	Mov P1		
	Linear interpolation	Moves to the designated position with linear interpolation.	Mvs P1		
	Circular interpolation	Moves along a designated arc (start point \rightarrow passing point \rightarrow start point (end point)) with 3-dimensional circular interpolation (360 degrees).	Mvc P1,P2,P1		
		Moves along a designated arc (start point \rightarrow passing point \rightarrow end point) with 3-dimensional circular interpolation.	Mvr P1,P2,P3		
		Moves along the arc on the opposite side of a designated arc (start point \rightarrow reference point \rightarrow end point) with 3-dimensional circular interpolation.	Mvr2 P1,P9,P3		
		Moves along a set arc (start point \rightarrow end point) with 3-dimensional circular interpolation.	Mvr3 P1,P9,P3		
	Speed designation	Designates the speed for various interpolation operations with a percentage (0.1% unit).	Ovrd 100		
		Designate the speed for joint interpolation operation with a percentage (0.1% unit).	JOvrd 100		
ō		Designates the speed for linear and circular interpolation with a numerical value (mm/s unit).	Spd 123.5		
Position and operation control		Designates the acceleration/deceleration time as a percentage in respect to the predetermined maximum acceleration/deceleration. (1% unit)	Accel 50,80		
ation		Automatically adjusts the acceleration/deceleration according to the parameter setting value.	Oadl ON		
d ope		ets the hand and work conditions for automatic adjustment of the acceleration/deceleration.	LoadsetT 1,1		
аŬ	Operation	Adds a process unconditionally to the operation.	Wth		
on		Adds a process conditionally to the operation.	Wthif		
siti		Designates smooth operation.	Cnt 1,100,200		
Ъ		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.	Wthif Cnt 1,100,200 Fine 200 Servo OFF		
		Designates the tool conversion data.	Wth Wthif Cnt 1,100,200 Fine 200 Servo OFF Torq 4,10 Base P1 Tool P1 Cmp Pos ,&B00000011 Cmp Jnt ,&B00000011		
	Float control	The robot arm rigidity is lowered and softened. (XYZ coordinate system)	Cmp Pos ,&B00000011		
		The robot arm rigidity is lowered and softened. (JOINT coordinate system)	Cmp Jnt ,&B00000011		
		The robot arm rigidity is lowered and softened. (TOOL coordinate system)	Cmp Tool ,&B00000011		
		The robot arm rigidity is returned to the normal state.	Cmp Off		
		The robot arm rigidity is designated.	Cmpg 1.0,1.0,1.0,1.0,1.0,1.0,1.0,1.0		
	Pallet	Defines the pallet.	Def Plt 1,P1,P2,P3,P4,5,3,1		
		Operates the pallet grid point position.	Plt 1,M1		
	Singular point pas- sage	Move to a specified position using linear interpolation passing through a singular point.	Mvs P1 TYPE 0,2		

Туре	Class	Function	Input format (example)
	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
Program control		Repeats while the designated conditions are satisfied.	Next M1 While M1<10
00 0			Wend
grar		Branches corresponding to the designated expression value.	On M1 GOTO 100,200,300
Pro		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
	0.1	Set the detection level of the impact detection.	ColLvl 100,80,,,,,
	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
	T-+	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
<u>,</u>		Enables/disables the interrupt. Defines the start line of the program to be executed when an interrupt is	Act 1=1
ontr		generated from the communication line.	On Com(1) GOSUB 100
Program control		Enables the interrupt from the communication line.	Com(1) ON
gran		Disables the interrupt from the communication line.	Com(1) OFF
Prog		Stops the interrupt from the communication line.	Com(1) STOP
ш.	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
Ϊ̈́	Hand close	Closes the designated hand.	HClose 1
nt	Assignment	Defines the input/output variables.	Def IO PORT1=BIT,0
outp	Input	Retrieves the general-purpose input signal.	M1=M_IN (1)
Input/output	Output	Calls out the general-purpose output signal.	M_Out(1) =0
_	Mechanism designa-	Acquires the mechanism with the designated mechanism No.	GetM 1
Parallel execution	tion	Releases the mechanism with the designated mechanism No.	RelM 1
ecn	Selection	Selects the designated program for the designated slot.	XLoad 2,"P102"
ex ex	Start/stop	Carries out parallel execution of the designated program.	XRun 3,"100",0
alle		Stops parallel execution of the designated program.	XStp 3
Par		Returns the designated program's execution line to the head and enters the program selection enabled state.	XRst 3

Туре	Class	Function	Input format (example)			
	Definition	Defines the integer type or real number type variable.	Def Inte KAISUU			
		Defines the character string variable.	Def Char MESSAGE			
		efines the layout variable. (Up to 3-dimensional possible)	Dim PDATA(2,3)			
		Defines the joint variable.	Def Jnt TAIHI			
		Defines the position variable.	Def Pos TORU			
		Defines the function.	Def FN TASU(A,B)=A+B			
Others	Clear	Clears the general-purpose output signal, variables in program, variables	Clr 1			
₹		between programs, etc.	3li 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	ment Describes a comment.				
	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		Function Details		Details	Remarks
1	Overload pro	otection func-	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				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	0	0	0	This is the stop with the highest degree of emergency. The servo power is shut off, and the mechanical brakes (all axes) activate to stop the robot. To recover, reset the alarm, and turn the servo ON with the servo ON command.
Stop	0	0	0	This is a stop operation with a high degree of emergency. The robot immediately decelerates and stops. Note that the servo power is not shut off. Use this when using the collision evasion sensor, etc.

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

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

Signal		Command	Functions	Usage method
	External emer- gency 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
Input	Enabling device input			Enabling device. The safety switch during teaching work
In	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 opera- tion enable	AUTOENA	Disables automatic operation when inactive.	Door switch on safety protection fence
	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.
Output	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

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

6.1.4 Safety measures for automatic operation

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

6.1.5 Safety measures for teaching

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

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

6.1.6 Safety measures for maintenance and inspections, etc.

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

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

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

6.1.7 Examples of safety measures

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

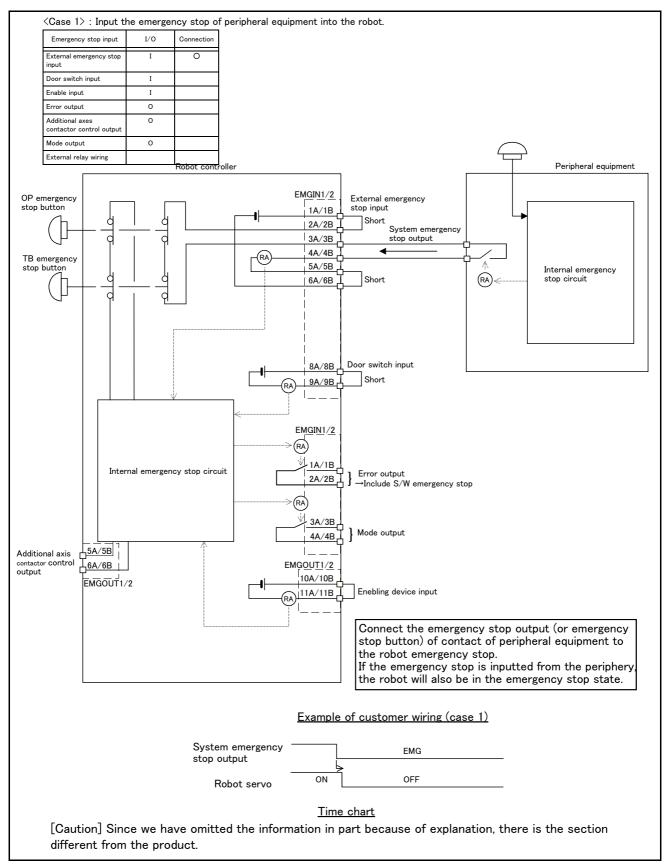


Fig.6-1: Example of safety measures (Case 1)

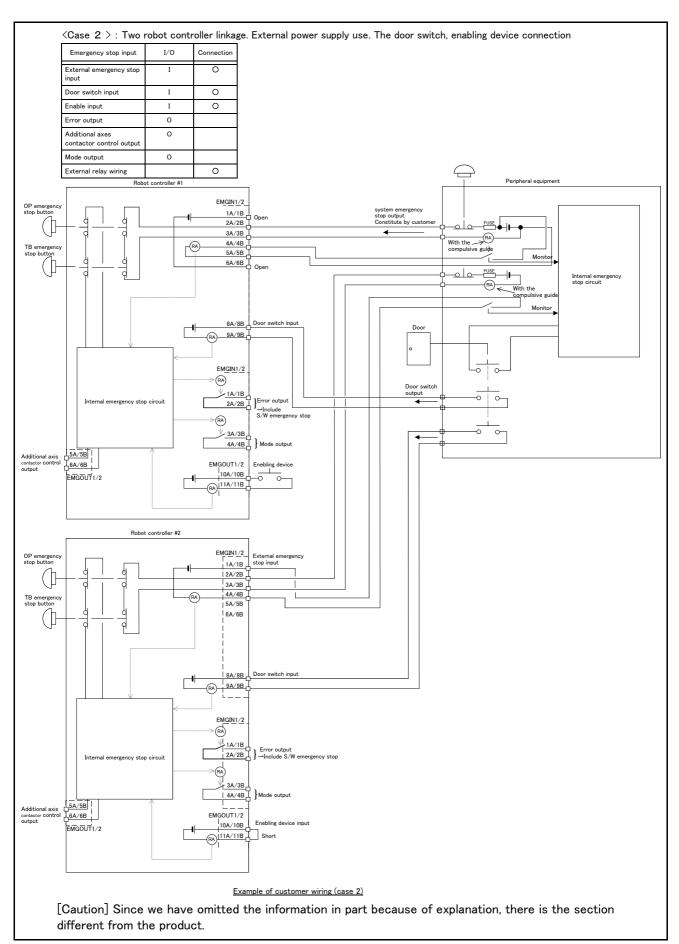


Fig.6-2: Example of safety measures (Case 2)

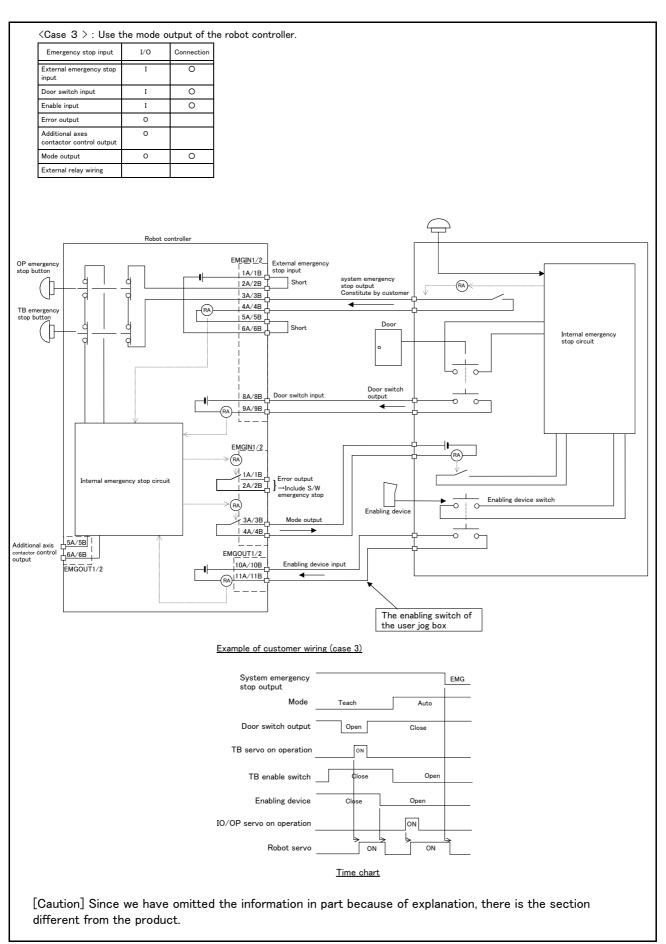


Fig.6-3: Example of safety measures (Case 3)

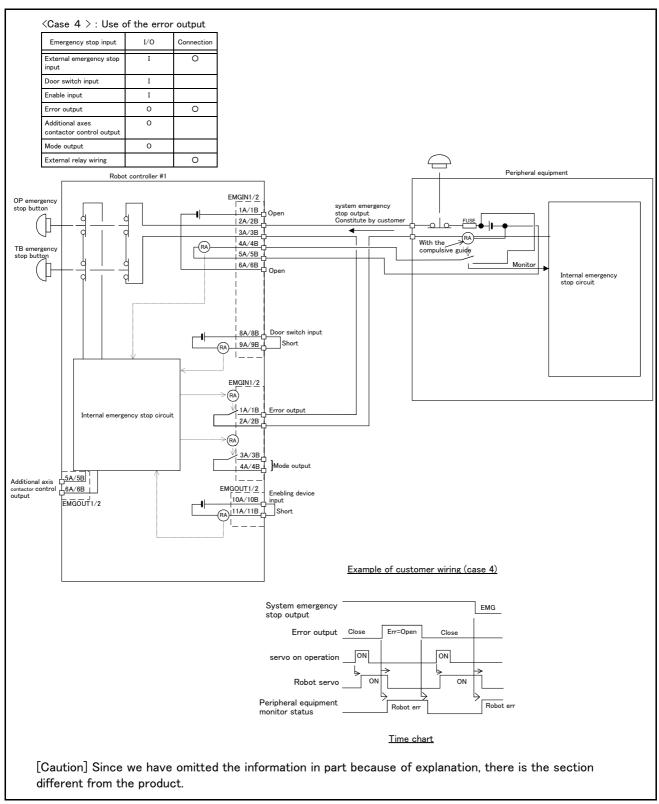


Fig.6-4: Example of safety measures (Case 4)

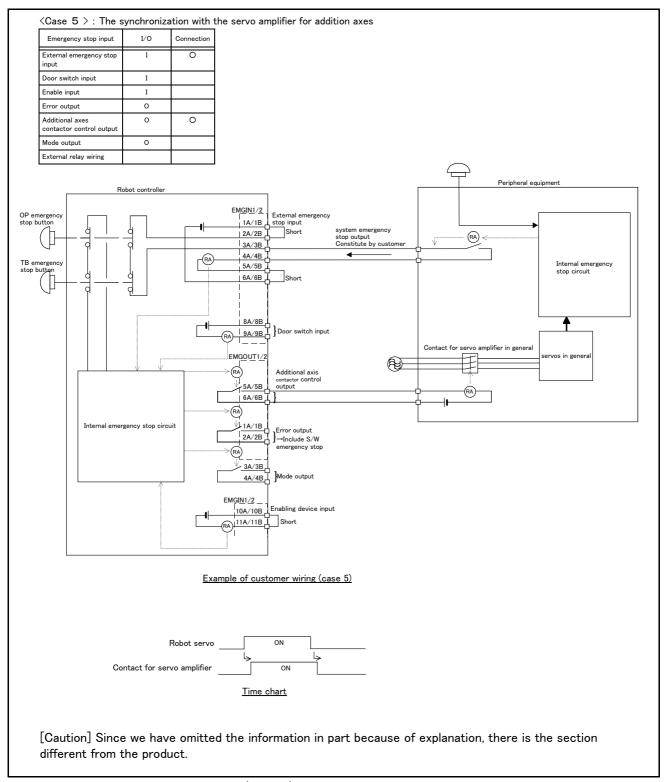


Fig.6-5: Example of safety measures (Case 5)

- (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.

bic length, so refer to the following and	a matan.
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.



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 J1 to J3 and J5 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. Note 1)
- (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) The hanging installation jig can be borrowed from the maker. Order to dealer when need.
- (10) Do not attach a tape or a label to the robot arm and the controller. If a tape or a label with strong adhesive power, such as a packaging tape, is attached to the coated surfaces of the robot arm and controller, the coated surface may be damaged when such tape or label is peeled off.
- (11) If the robot is operated with a heavy load and at a high speed, the surface of the robot arm gets very hot. It would not result in burns, however, it may cause secondary accidents if touched carelessly.
- (12) Do not shut down the input power supply to stop the robot. If the power supply is frequently shut down during a heavy load or high-speed operation, the speed reducer may be damaged, backlash may occur, and the program data may be destroyed.
- (13) 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 Name Company name Telephone Address Purchased mode Specification Type Standard specification ☐ RV-3SD ☐ RV-3SDJ Clean specification ☐ RV-3SDC ☐ RV-3SDJC With the controller protection ☐ RV-3SD-SM ☐ RV-3SDJ-SM box Note1) Note1) Controller protection box(CR1D-MB) is attached. Shipping special specifications (Settings can be made only at time of shipment) Standard specifications Special shipping specifications Item ☐ 5m fixed type ☐ 2m fixed type: 1S-02UCBL-03 Robot arm Machine cable □ 10m fixed type ☐ 15m fixed type \square 5m flexed type ☐ 10m flexed type ☐ 15m flexed type Options (Installable after shipment) Item Туре Provision, and specifications when provided. 1S-DH-03 J1 + side : ☐ +135° □ +90° □ +45° Operating range change J1 - side : □ -135° □ -90° □ -45° Machine cable extention 1S- 🗆 🗆 CBL-03 □ Not provided □ 5m fixing □ 10m fixing □ 15m fixing 1S- □□ LCBL-03 ☐ Not provided ☐ 5m bending ☐ 10m bending ☐ 15m bending 1S-VD0 □ -02 □ Not provided □ 1 set □ 2 sets □ 3 sets □ 4 stes Solenoid valve set 1S-HC25C-01 ☐ Not provided ☐ Provided Hand input cable 1S-GR35S-01 ☐ Not provided ☐ Provided Hand output cable 1E-ST040 □ C □ Not provided □ 1 set □ 2 sets □ 3 sets □ 4 stes Hand curl tube Simple teaching pendant R32TB- □ □ ☐ Not provided ☐ 7m □ 15m Highly efficient teaching pendant R56TB- □□ □ Not provided □ 7m □ 15m 2A-RZ365 ☐ Not provided ☐ Provided Pneumatic hand interface Parallel <u>I/O interface</u> 2D-TZ368 Not provided □ -1pc. □ -2pc. □ -3pc. External I/O cable 2D-CBI □□ \square Not provided \square 5m-()pc. \square 15m-1()pc. (For 2D-TZ368) Parallel I/O unit 2A-RZ361/2A-RZ371 ☐ Not provided ☐ Provided ()unit External I/O cable 2A-CBL □□ □ Not provided □ 5m-()pc. □ 15m-1()pc. (For 2A-RZ361/RZ371) CC-Link interface 2D-TZ576 \square Not provided \square Provided Expansion memory 2D-TZ454 ☐ Not provided ☐ Provided RT ToolBox2 3D-11C-WINE ☐ Not provided ☐ Windows2000/XP/Vista Englishi CD-ROM RT ToolBox2 mini 3D-12C-WINE ☐ Not provided ☐ Windows2000/XP/Vista Englishi CD-ROM Personal computer cable 2D-232CBL03M ☐ Not provided ☐ Provided Network vision sensor 4D-2CG5***-PKG ☐ Not provided ☐ Provided Instructions manual 5S-DA00-PE01 ☐ Not provided ☐ Provided (

	Maintenance parts (Consumable parts)											
	Maintenance pa	rts 🗆 B	ackup batteries A	6BAT () pcs.	☐ Backu	p batteries	Q6BAT	() pcs.	☐ Grease ()	cans	
ı	Robot selection	check li	st									
	Work description ☐ Material handring ☐ Assembly ☐ Machining L/UL ☐ Sealing ☐ Testing and inspection ☐ Other ())		
	Workpiece mass () g	Hand mass () g	Atmosph	iere 🗆 (General env	/eronment	☐ Clean	☐ Dust provided	☐ Other()
	Remarks			•	•			•	•			

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