MITSUBISHI

Mitsubishi Industrial Robot

SQ Series

RV-18SQ-S/18SQC-S

Special Specifications Manual
(CR3Q-709M/CR3Q-709 Controller)

This robot is manufactured with a special specification. When ordering, the details of the specification will be discussed and then determined. The Production Specifications will be submitted separately.

MELFA
BFP-A8767

⚠ Safety Precautions

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

⚠ CAUTION

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

⚠ CAUTION

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

⚠ WARNING

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

⚠ CAUTION

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

⚠ WARNING

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

⚠ CAUTION

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

⚠ CAUTION

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

⚠ CAUTION

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

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

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

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

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

⚠ CAUTION Use the USB devices confirmed by manufacturer. In other case, it might have care difficulty by the effect of temperature, noise and so on. When using it, measures against the noise, such as measures against EMI and the addition of the ferrite core, may be necessary. Please fully confirm of the operation by the customer

■ Revision history

Date of print	Specifications No.	Details of revisions
2009-09-15	BFP-A8767	First print

■ Introduction

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

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

Note that in this specification document the specifications related to the robot arm is described "2 Robot arm" on page 7 , the specifications related to the controller"3 Controller" on page 33 , and software functions and a command list "4 Software" on page 68 separately.

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

*RV-18SQ-S
*RV-18SQC-S

Contents

Contents

1 General configuration

1.1 Structural equipment

Structural equipment consists of the following types.

1.1.1 Standard structural equipment

The following items are enclosed as a standard.

(1) Robot arm
(2) Controller
(3) Machine cable
(4) Robot arm installation bolts
(5) Arm fixing bolts
(6) Safety manual, Instruction manual, CD-ROM (Instruction manual)
(7) Guarantee card

1.1.2 Special specifications

For the special specifications, some standard configuration equipments and specifications have to be changed before factory shipping. Confirm the delivery date and specify the special specifications at the order.

1.1.3 Options

User can install options after their delivery.

1.1.4 Maintenance parts

Materials and parts for the maintenance use.

1.2 Model type name of robot

1.2.1 How to identify the robot model

RV-18SQ C -Sxx
（a） （b） （c）

(a). RV-18SQ.....Indicates the RV-18SQ series.

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

(c). -SXX.....[1] Indicates a special model number. In order, limit special specification.

1.2.2 Combination of the robot arm and the controller

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

Protection specification	Robot arm	Arm length	Controller
Stardard specification	RV-18SQ-S	standard arm	CR3Q-709M[Note1)]
Clean specification	RV-18SQC-S	standard arm	CR3Q-709

Note1)Protection specification. (IP54)

1.3 Indirect export

The display in English is available by setting parameter LNG as "ENG."

1.4 Instruction manuals

The instruction manuals supplied in CD-ROM, except for the Safety Manual. This CD-ROM (electronic manual) includes instruction manuals in both Japanese and English versions.

1.4.1 Functions

This robot is special specification. Some functions are restricted and cannot be used.
The restricted functions are shown below.

Table 1-2 : Restricted functions

(1) MELFA-BASIC Ⅴ	
	1) Optimum acceleration/deceleration rate specification （Oadl）
	2) Compliance specification （Cmp Pos、Cmp Tool、Cmp Off）
(2) RT ToolBox 2 （optional）	
	1) Position recovery support
	2) Resetting maintenance forecast
(3) Other control functions	
	1) Deflection compensation

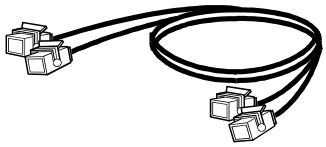
1.5 Contents of the structural equipment

1.5.1 Robot arm

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

Vertical six-axis
multiple-jointed type
(RV-18SQ-S/18SQC-S)

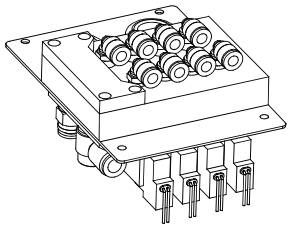
Machine cable
(Standard product: 7m attachment)



Machine cable extension
(attached to the standard 7 m cable)
- Fix type: 1S- □□ CBL-02
- Flex type: 1D- □□ LCBL-02

Note1) □□ refer the length.
Refer to Table 1-2 for datails.
Note2) Connect the extension cables to the arm side of the standard 7 m (for fixing) cable to extend.

Solenoid valve set
(Special hand output cable is attached)
<Sink type/Source type>
- 1 set: 1S-VD01-01/1S-VD01E-01
- 2 set: 1S-VD02-01/1S-VD02E-01
- 3 set: 1S-VD03-01/1S-VD03E-01
- 4 set: 1S-VD04-01/1S-VD04E-01

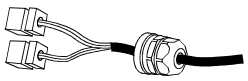


Stopper for changing the operating range of the J1 axis
- Stopper part: 1S-DH-01

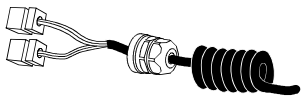
*Installed by customer.

Pneumatic hand customer-manufactured parts

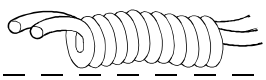
Hand output cable
- 1S-GR35S-01 (4sets)



Hand input cable
- 1S-HC25C-01



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



[Caution]
- Standard configuration equipment
- Special specifications
- Option
- Prepared by customer

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

1.5.2 Controller

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

Controller ・CR3Q-709M/709

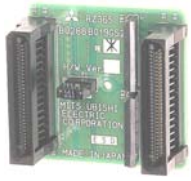
Robot CPU unit
・Q172DRCPU *1)

Drive unit
・DU3-709M/709

Caster type
Drive unit DU3-709*-S01

Cable
・2Q-TUCBL 10M
(TU Cable for robot)
・2Q-DISPCBL10M
(DISP Cable for robot)
・2Q-EMICBL 10M
(EMI Cable for robot)
・MR-J3BUS10M-A10M
(SSCNET Ⅲ Cable for robot)

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



*3)

*3) Corresponding to the sink or source to be used, setting of the drive unit is necessary.

Teaching pendant (T/B) ・R32TB/R56TB *2)

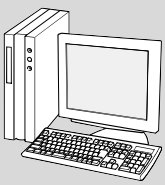
<R32TB>

<R56TB>

Personal computer cable
Prepared by customer
RS-232,USB, Ethernet

*)Refer to Table 1-3 for USB cable.

Personal computer
Prepared by customer



RT Tool Box2
(MS-Windows2000/XP/Vista)
・3D-11C-WINJ(CD-ROM)
RT Tool Box2 mini
(MS-Windows2000/XP/Vista)
・3D-12C-WINJ(CD-ROM)

Instruction Manual (printed)
・5S-QY00-PE01

*1)
The base board, the power supply unit, and sequencer CPU are required for installation of the robot CPU unit.
Prepared by customer

*2)
The previous R28TB can be used if the relay connector box is used.
And, since the R28TB operation method is the same as before, refer to the instructions manual which on hand.

[Caution]
Standard configuration equipment
Options
Special specifications
Prepared by customer

Fig.1-2 : Structural equipment

1.6 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

Item	Type	Specifications	Classification Note1)	Descripsion
Stopper for changing the operating range of the J1 axis	1S-DH-01	Stopper part One each of the following can be selected. + side: +135, +90, or +45 deg. − side: −135, −90, or −45 deg. ±170 deg. are used for the standard specification.	○	This must be installed by the customer.
Extended machine cable	1S- □□ CBL-02	For fixing (Set of power, signal and ground)	○	5, 10, 15m
	1D- □□ LCBL-02	For bending (Set of power, signal and ground)	○	5, 10, 15m
Solenoid valve set	1S-VD01-01/ 1S-VD01E-01	1 set (Sink type)/(Source type)	○	A solenoid valve set for the pneumatic hand
	1S-VD02-01/ 1S-VD02E-01	2 set (Sink type)/(Source type)	○	
	1S-VD03-01/ 1S-VD03E-01	3 set (Sink type)/(Source type)	○	
	1S-VD04-01/ 1S-VD04E-01	4 set (Sink type)/(Source type)	○	
Hand output cable	1S-GR35S-01	Robot side: connector. Hand side: wire.	○	The cable is connected to the hand output connector by the customer.
Hand input cable	1S-HC25C-01	Robot side: connector. Hand side: wire.	○	The cable is connected to the sensor by the customer.
Hand curl tube	1N-ST0602C	For solenoid valve 1set.:Φ6x2	○	Curl type air tube
	1N-ST0604C	For solenoid valve 2set.:Φ6x4	○	
	1N-ST0606C	For solenoid valve 3set.:Φ6x6	○	
	1N-ST0608C	For solenoid valve 4set.:Φ6x8	○	
Teaching pendant	R32TB	Cable length 7m	○	With 3-position deadman switch
	R32TB-15	Cable length 15m	○	
	R56TB	Cable length 7m	○	
	R56TB-15	Cable length 15m	○	
Pneumatic hand interface	2A-RZ365	DO: 8 point(Sink type)	○	It is necessary when the hand output signal of the robot arm is used.
	2A-RZ375	DO: 8 point(Source type)	○	
RT ToolBox2 (Personal computer Support software)	3D-11C-WINE	CD-ROM	○	MS-Windows2000/XP/Vista (With the simulation function)
RT ToolBox2 mini (Personal computer Support software mini)	3D-12C-WINE	CD-ROM	○	MS-Windows2000/XP/Vista
TU cable for robot	2Q-TUCBL □ M	Cable length 05、10、20、30m	○	For communication between robot CPU and DU.
DISP cable for robot	2Q-DISPCBL □ M	Cable length 05、10、20、30m	○	For communication between robot CPU and DU.
EMI cable for robot	2Q-EMICBL □ M	Cable length 05、10、20、30m	○	For a robot CPU emergency stop input.
SSCNET Ⅲ cable for robot	MR-J3BUS □ M-A	Cable length 05、10、20m	○	For the servo communication between robot CPU and DU .
	MR-J3BUS30M-B	Cable length 30m	○	
Caster specifications controller	CR3Q-709/709M	Specifications with casters	□	The controller height will be h =615
Instruction Manual	5S-QY00-PE01	RV-18SQ-S/18SQC-S	○	A set of the instructions manual bookbinding editions

Note1) ○ : option, □ : special specifications.

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

Table 1-3 : Recommendation article of the USB cable

Name	Type name	Supplier
USB cable (USB A type-USB B type)	USB2-30	ELECOM CO., LTD.
	AU230	BUFFALO KOKUYO SUPPLY INC.
USB cable (USB A type-USB mini B type)	KU-AMB530	SANWA SUPPLY INC.
	USB-M53	ELECOM CO., LTD.
	GT09-C20USB-5P	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. Otherwise, it becomes the cause of malfunction.

⚠Caution Use the USB devices confirmed by manufacturer. In other case, it might have care difficulty by the effect of temperature, noise and so on. When using it, measures against the noise, such as measures against EMI and the addition of the ferrite core, may be necessary. Please fully confirm the operation by customer

2 Robot arm

2.1 Standard specifications

Table 2-1 : Standard specifications of robot

Item		Unit	Specifications	
Type			RV-18SQ-S	RV-18SQC-S
Type of robot			6-axis standard arm	
			Standard	Clean (Special Specifications)
Degree of freedom			6	
Installation posture			On floor	On floor
Structure			Vertical, multiple-joint type	
Drive system			AC servo motor (brake provided on all axes)	
Position detection method			Absolute encoder	
Arm length	Shoulder shift	mm	150	
	Upper arm		400	
	Fore arm		530	
	Elbow shift		80	
	Wrist length		97	
Motor capacity	Waist (J1)	W	1,350	
	Shoulder (J2)		1,350	
	Elbow (J3)		480	
	Wrist twist (J4)		240	
	Wrist pitch (J5)		200	
	Wrist roll (J6)		100	
Operating range	Waist (J1)	Degree	340(-170 to +170)	
	Shoulder (J2)		230(-100 to +130)	
	Elbow (J3)		290(-130 to +160)	
	Wrist twist (J4)		320(-160 to +160)	
	Wrist pitch (J5)		240(-120 to +120)	
	Wrist roll (J6)		720(-360 to +350)	
Speed of motion	Waist (J1)	Degree/s	60	
	Shoulder (J2)		60	
	Elbow (J3)		60	
	Wrist twist (J4)		99	
	Wrist pitch (J5)		115	
	Wrist roll (J6)		156	
Maximum resultant velocity Note1)		mm/sec	Approx. 2,300	
Load	Maximum Note2)	kg	18 (176.4)	
	Rating	(N)	12 (117.6)	
Pose repeatability Note3)		mm	± 0.10	
Ambient temperature		℃	0 to 40	
mass		kg	Approx. 95	
Allowable moment load	Wrist twist (J4)	N・m	49	
	Wrist pitch (J5)		49	
	Wrist roll (J6)		11	
Allowable inertia	Wrist twist (J4)	kg・m^2	1.4	
	Wrist pitch (J5)		1.4	
	Wrist roll (J6)		0.14	
Arm reachable radius froot p-axis center point		mm	1,086	
Tool wiring Note4)			Hand input 8 point / hand output 8 point	
			Six spare wires : AWG#28(0.1mm^2) (shielded)	Four spare wires : AWG#22(0.3mm^2)
Tool pneumatic pipes			Primary side: Φ6 x 2, Secondary side: Φ6 × 8	
Supply pressure		MPa	0.49 ± 10%	
Protection specification Note5)			J1 to J3 axis : IP54, J4 to J6 axis : IP65	
Degree of cleanliness Note6)			—	10(0.3μm) Internal suction requirement
Painting color			Light gray (Equivalent to Munsell: 0.08GY7.64/0.81)	

Note1) This is the value on the mechanical interface surface when all axes are combined.

Note2) The maximum load capacity is the mass with the mechanical interface posture facing downword at the ± 10° limit. The workpiece's center of gravity position is 183mm or less from the mechanical interface surface of the J6 axis.

Note3) The pose repeatability details are given in Page 9, "2.2.1 Pose repeatability"

Note4) The air hand interface (option) is required when the tool (hand) output is used. Also, if the solenoid set (option) is used, eight points of hand outputs are used for other options. 。

Note5) The protection specification details are given in Page 11, "2.2.3 Protection specifications".

Note6) The clean specification details are given in Page 13, "2.2.4 Clean specifications". A down flow(0.3m/s or more) in the clean room is the necessary conditions for the cleanliness.

2.1.1 The counter-force applied to the installation surface

The counter-force applied to the installation surface for the strength design of the robot installation surface is shown.

Table 2-2 : Value of each counter-force

Item	Unit	Value
Falls moment: M_L	N•m	１，５３０
Torsion moment: M_T	N•m	１，５３０
Horizontal translation force: F_H	N	１，３００
Vertical translation force: F_V	N	２，３００

2.2 Definition of specifications

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

2.2.1 Pose repeatability

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

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

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

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

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

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

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

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

2.2.2 Rated load (mass capacity)

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

(1) The tooling should have the value less or equal than the smaller of the tolerable inertia and the tolerable moment found in Page 7, "Table 2-1 : Standard specifications of robot"

(2) Fig. 2-1shows 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 7, "Table 2-1 : 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 mechanical interface surface, or vibration can result, with tooling that is not rigid or that is long.

[Caution] Even within the allowable range previously mentioned, an overload alarm may be generated if an ascending operation continues at a micro-low speed. In such a case, it is necessary to increase the ascending speed.

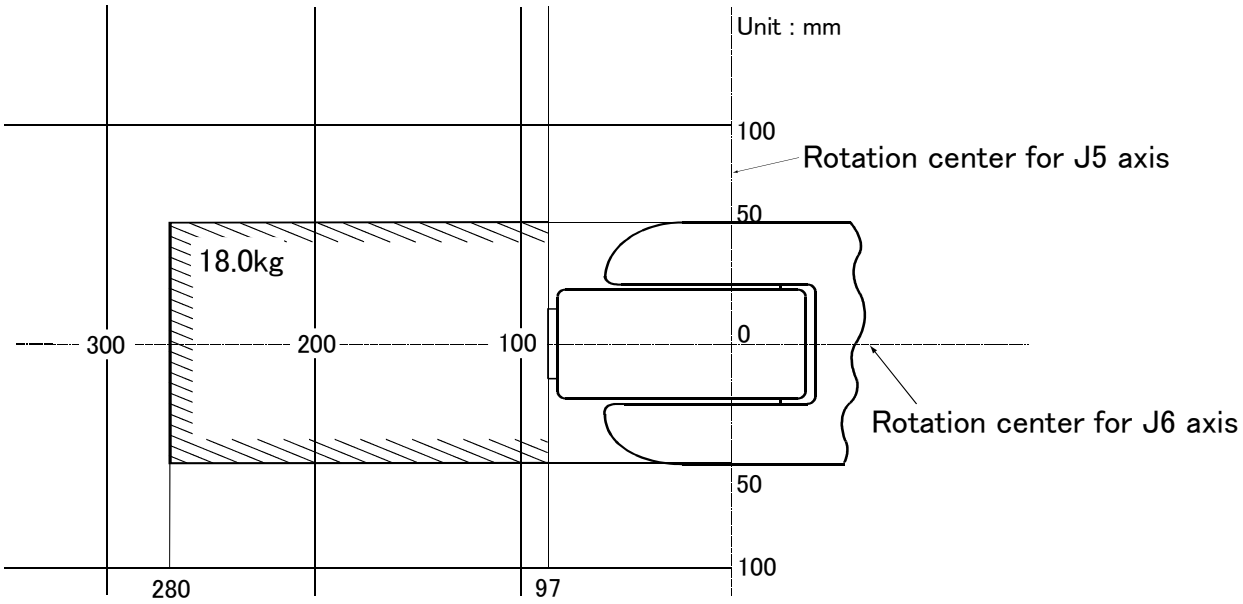


Fig.2-1 : Position of center of gravity for loads (for loads with comparatively small volume):RV-18SQ-S Series

2.2.3 Protection specifications

(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 .

Even oil mist environment can be used in addition to the general environment.

Table 2-3 : Protection specifications and applicable fields

Type	Protection specifications (IEC Standards value)	Classification	Applicable field	Remarks
RV-18SQ-S	IP54 (J1 to J3 axis)	General-purpose environment specifications	General assembly Slightly dusty environment	
	IP65 (J4 to J6 axis)	Oil mist specifications	Machine tool (cutting) Machine shop with heavy oil mist Dusty work shop	Note that if the cutting machine contains abrasive materials, the robot machine line will be shortened.

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

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

Name	Maker	Relevant JIS	Main characteristics	Application
Emulcut FA-800	Kyodo Yushi Co., Ltd	Class A1 No. 2	Water soluble cutting oil ・Base oil..... 50-60% ・Surfactant and rust inhibitor..... 30-40% ・Additives..... 5% or less ・Water ..... The rest	Water soluble cutting oil Emulcut

【Information】

・The IEC IP54

The IEC IP54 standard refers to protection structure designed to prevent any harmful effects by fresh water scattering vertically onto the testing equipment in a radius of 180 degrees from a distance of 300 to 500 mm, with 10 ± 0.5 liters of water every minute, at a water pressure of 80 to 100kPa, covering the entire area of the robot with the exception of the installation section at 1 ㎡ per minute, for a total of 5 minutes or more.

・The IEC IP65

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

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.

(2) About the use with the bad environment

This robot has protection methods that conform to IEC's IP54 (for J1 to J3 axis) and IP65 (for J4 to J6 axis) standards (splashproof type). Recommended usage conditions.

1) The robot is designed for use in combination with machining device.
2) Use confirmed cutting oil (Table 2-3) In case of applying not confirmed oil, customer should attempt it for a while if it matches
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 2-5.

Table 2-5 : Specification of the dry air for pressurization

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

The warranty is invalid for any faults that occur when the robot is used under the following conditions.
Also, if the cover and/or other parts are damaged by interferences caused by the peripheral devices and the robot, the protection specification (seal performance, etc.) may be degraded. Therefore, please pay extra attention when handling the robot.
Refer to Page 82, "6.2 Working environment".

5) In surroundings that generate inflammable gases or corrosive gasses.
6) Atmosphere used excluding cutting oil shown in Table 2-4.
7) Environment where the robot is exposed to water, oil and/or chips for a long period of time.
8) In surroundings where chips fall directly on the robot.In surroundings where the minimum diameter of chips is less than 0.5mm.
9) Mist atmosphere exceeding the specification.
10) Pressurization by the dry air exceeding the specification of Table 2-5

2.2.4 Clean specifications

(1) Types of clean specifications

The robot arm with clean specification is made by order. Please check the delivery schedule.

Table 2-6 : Clean specifications

Clean specifications	Type	Degree of cleanliness	Internal suction
RV-18SQC-S	10(0.3 μ m)	Concentrated suction with vaccum generating valve.	The use of a vacuum generating valve is recommended.

Table 2-7 : Specifications of vacuum generation valve

Type	Maker	Air pressure
MEDT 14	KONEGAI CORPORATION	0.2 to 0.6 MPa

■ Precautions for use

1) When using a device that moves or rotates the robot arm, the down flow may not be secured because of the air flow. In this case, the degree of cleanliness cannot be ensured.
2) A ϕ 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 (Φ6 pneumatic hose) of the primary piping to exhaust the air.
   If the exhaust leaks into the robot arm, the degree of cleanliness could be affected.

2.3 Names of each part of the robot

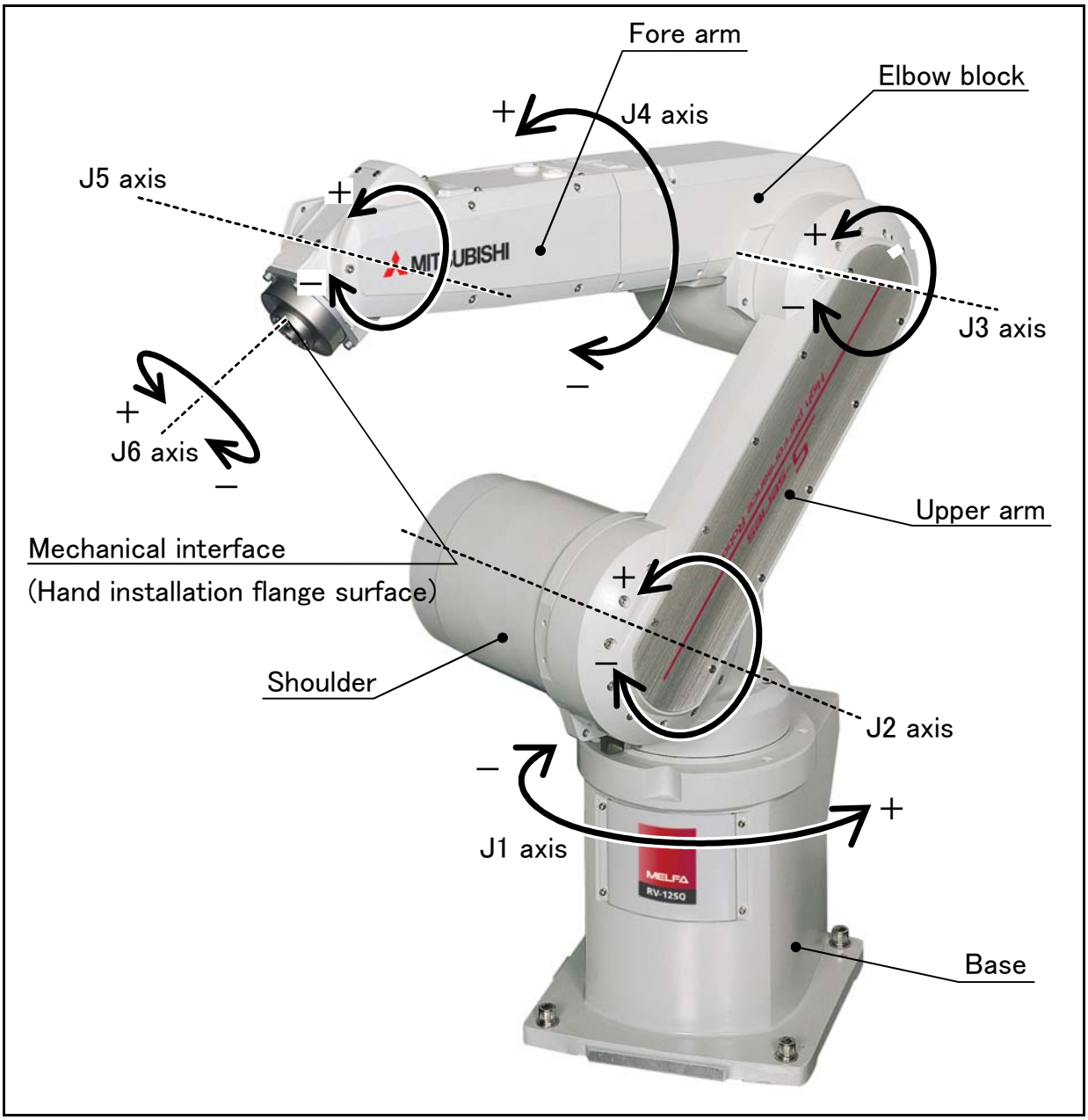


Fig.2-2 : Names of each part of the robot

2.4 Outside dimensions・Operating range diagram

(1) RV-18SQ-S/18SQC-S

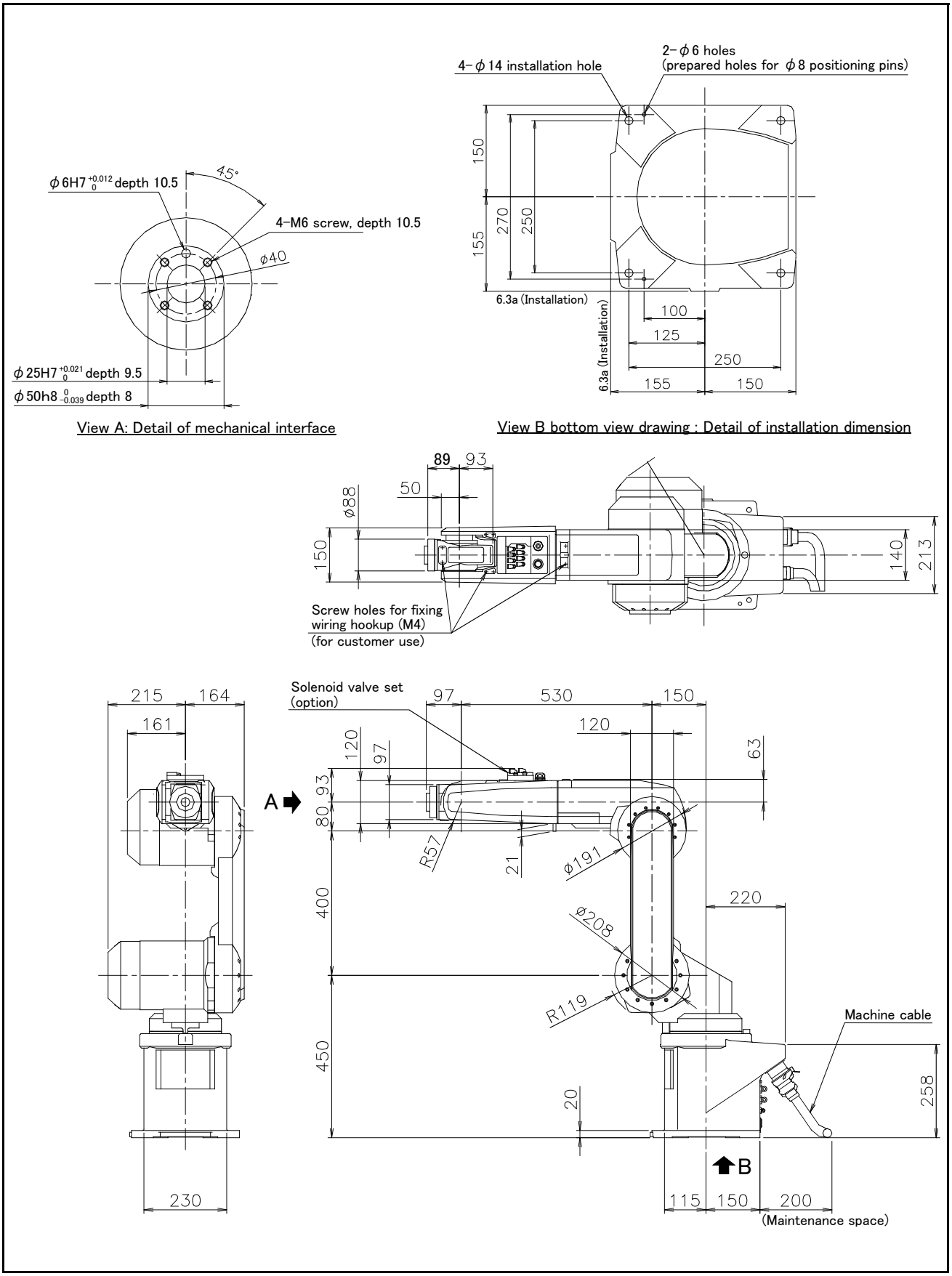
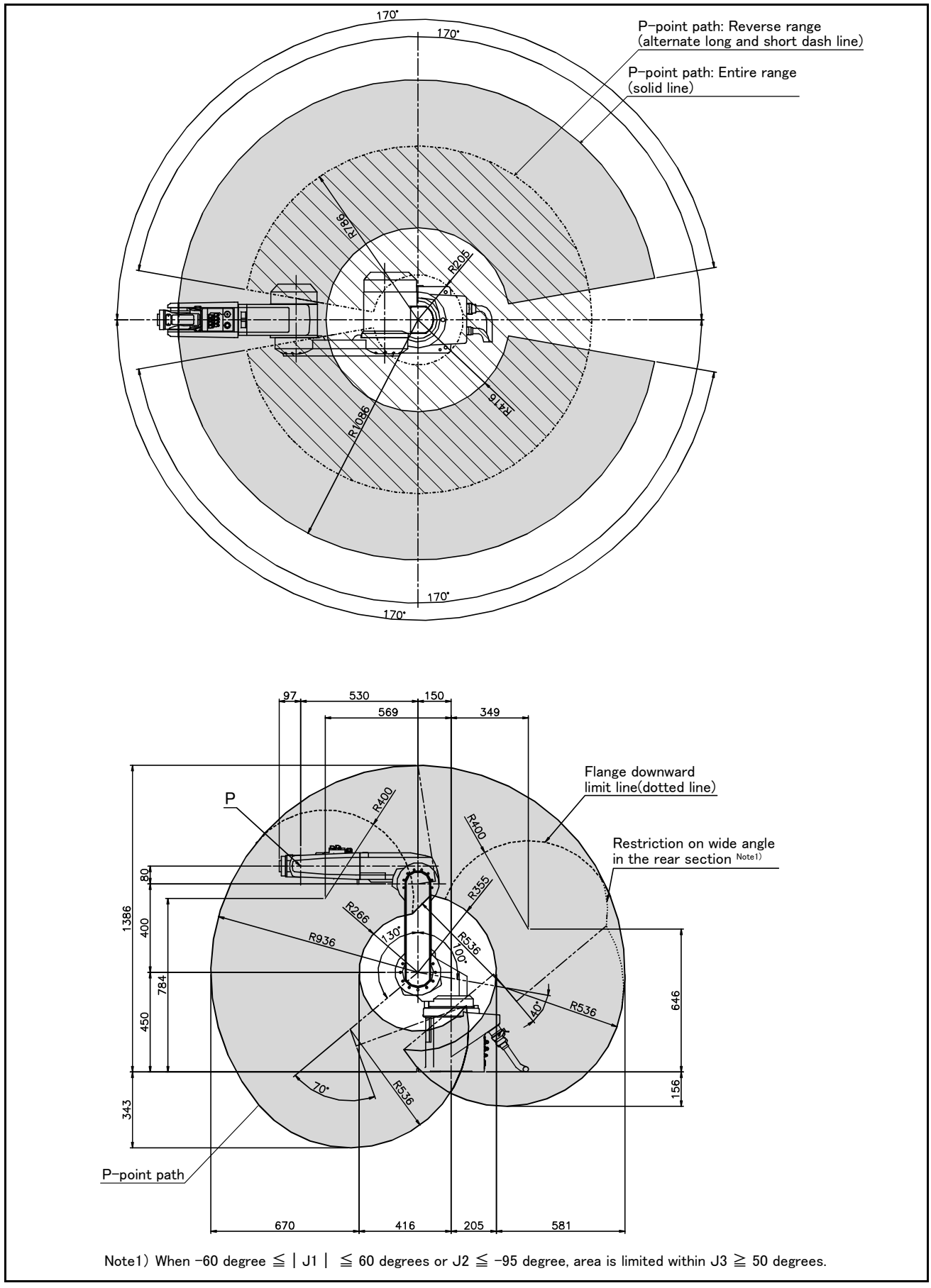


Fig.2-3 : Outside dimensions : RV-18SQ-S/18SQC-S



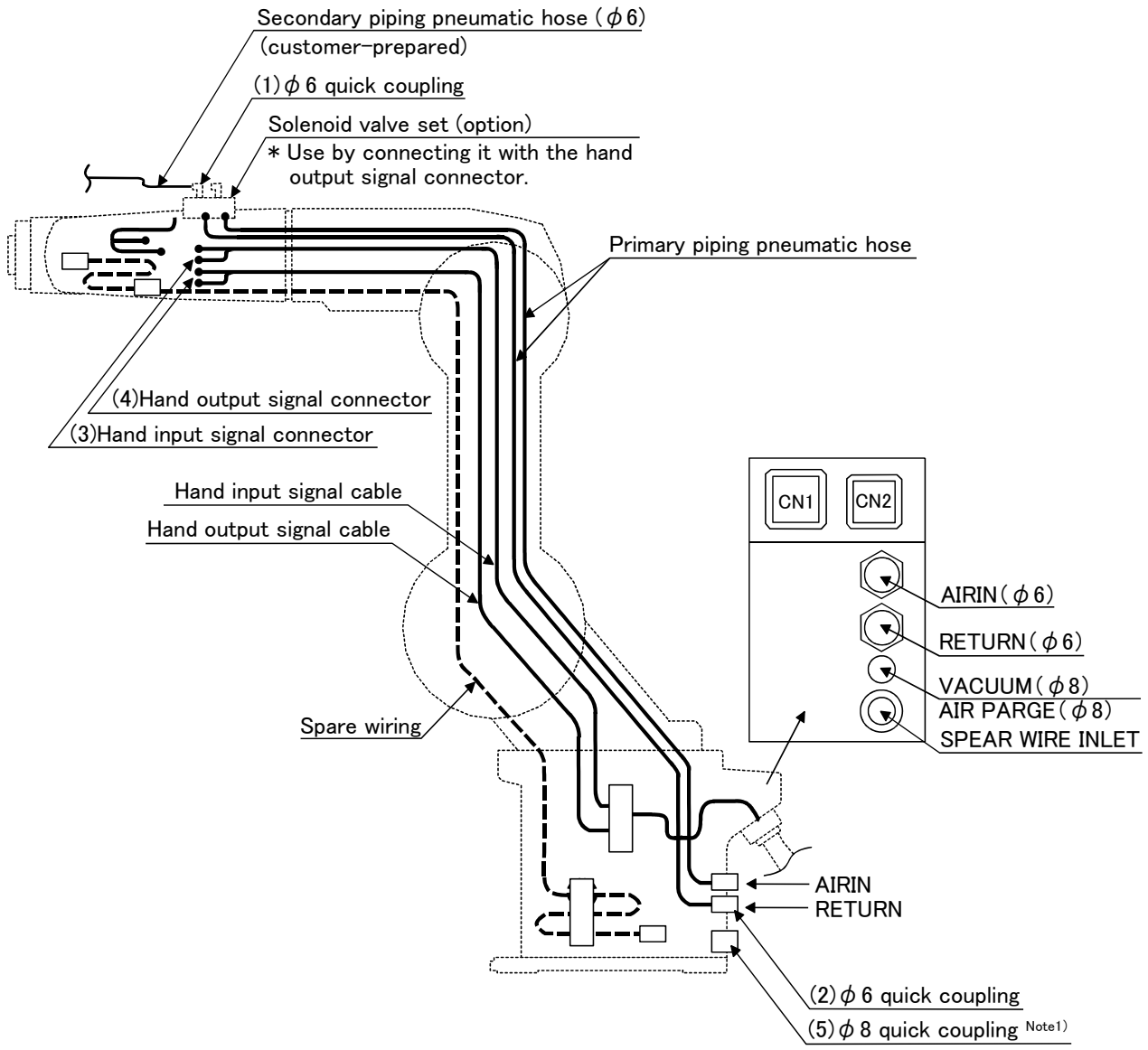
Note1) When −60 degree ≦ | J1 | ≦ 60 degrees or J2 ≦ −95 degree, area is limited within J3 ≧ 50 degrees.

Fig.2-4 : Operating range diagram : RV-18SQ-S/18SQC-S

2.5 Tooling

2.5.1 Wiring and piping for hand

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



Connector and pneumatic coupling

No	Name	Qty.	Robot side (Robot arm side)		Counter side (customer-prepared)		Manufacturer
			Connectors, couplings	Connector pins	Connector	Connector pins	
(1)	Coupling	8	KJL06-01S	—	—	—	SMC Corporation
(2)	Coupling	2	UKBL6	—	—	—	Koganei Corporation
(3)	Connector	2	1-1717834-3	1318108-1	1-1318115-3	1318112-1	Tyco Electronics AMP
(4)	Connector	2	1-1717834-4	1318108-1	1-1318115-4	1318112-1	Tyco Electronics AMP
(5)	Coupling Note1)	1	UKBL8	—	—	—	Koganei Corporation

Note1) For internal suction in the clean specification, or for AIR PARGE in protection specifications.

Fig.2-5 : Wiring and piping for hand

2.5.2 Internal air piping

(1) Standard type

1) The robot has two ϕ6 x 4 urethane hoses from the pneumatic entrance on the base section to the shoulder cover.
2) One hose is the primary piping for the pneumatic equipment. The remaining pipe is used for air exhaust.
3) The optional solenoid is provided with a maximum of eight couplings for the ϕ6 air hose.
4) The pneumatic inlet in the base section has a ϕ6 pneumatic coupling bridge.
5) Refer to Page 27, "(3) Solenoid valve set" for details on the electronic valve set (optional).
6) Protection performance can be improved by pressurizing the inside of the robot arm. Since the joint (AIR PURGE) of phi 8 is prepared at the rear of the base section, please supply the dry air for pressurization from this joint. Refer to Page 11, "2.2.3 Protection specifications" for the details of dry air.

(2) Clean type

1) The clean type basically includes the same piping as the standard type.
2) With the clean specification, a ϕ8 coupling is provided in the base section for suction inside the machine. For use, connect it to the suction port of the vacuum pump or the coupling on the "VACUUM" side of the vacuum generating valve. Moreover, to clean the exhaust from the vacuum pump or vacuum generator, use the exhaust filter (prepared by the customer).
3) Refer to Page 13, "2.2.4 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(0.2mm^2)x 2 : 8 cables) The cable terminals have connector bridges for eight hand inputs. The connector names are HC1 and HC2. The terminal section is connected to the connector in the fore-arm 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 air hand output can be used by installing the pneumatic hand interface (2A-RZ365/2A-RZ375) of the option in the controller. The hand output primary cable extends from the connector PCB of the base section to the inside of the forearm. (AWG#24(0.2mm^2)x 2 : 8 cables) The cable terminals have connector bridges for eight hand inputs. The connector names are HC1 and HC2. The terminal section is connected to the connector in the forearm section.
2) The hand check signal of the pneumatic hand is input by connecting this connector.
To extend the wiring to the outside of the arm, a separate cable (optional "hand input cable "1S-HC25C-01 " IP65 is recommended) is required.

2.5.5 Spare Wiring

(1) Standard type

As spare wiring, four pairs of AWG#27(0.1mm^2) 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

Pin	Color
A1	Red
A2	Brown
A3	Breen
A4	Brack
B1	Orange
B2	White
B3	Yellow
B4	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.

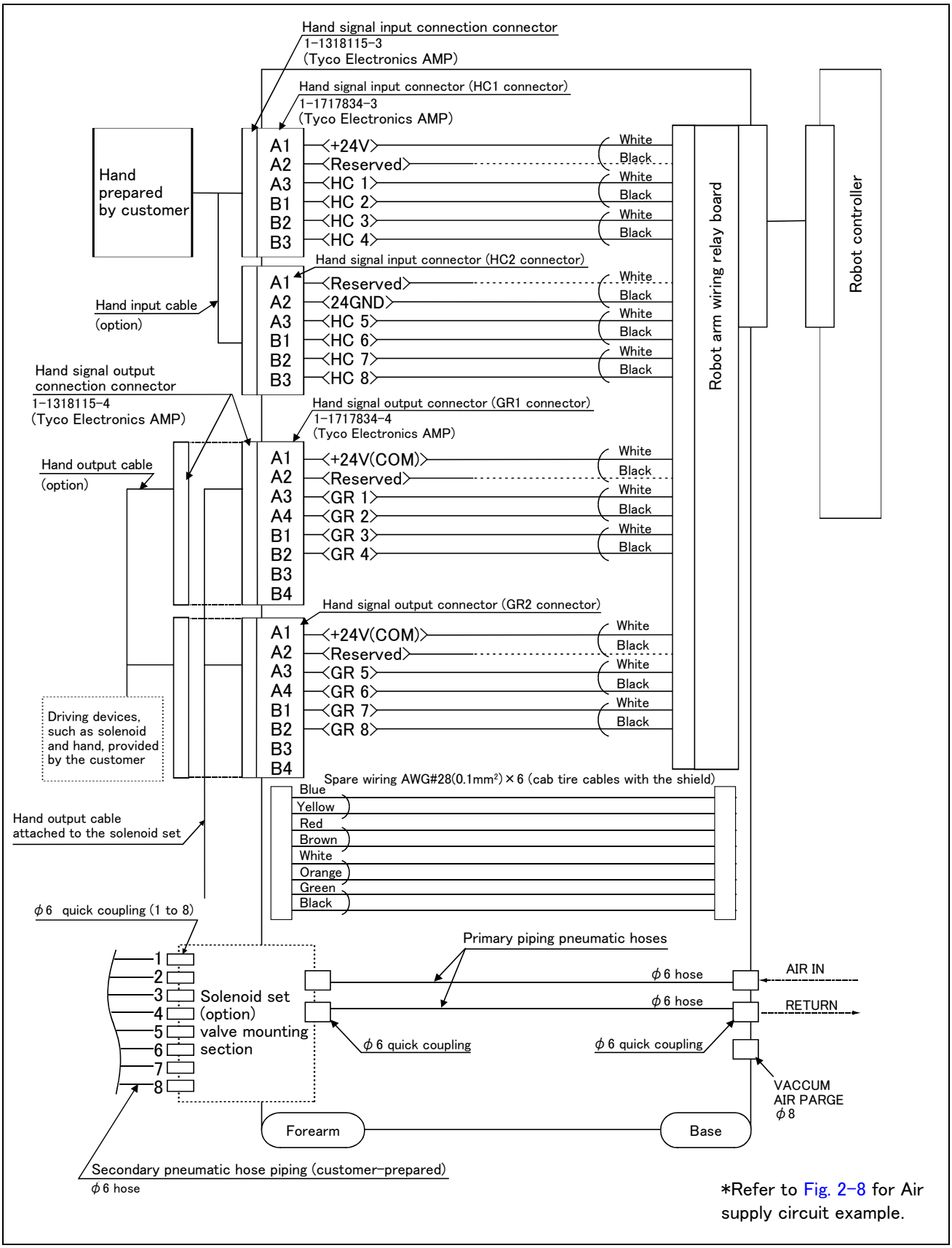


Fig.2-6 : Wiring and piping system diagram for hand and example the solenoid valve installation(Sink type)

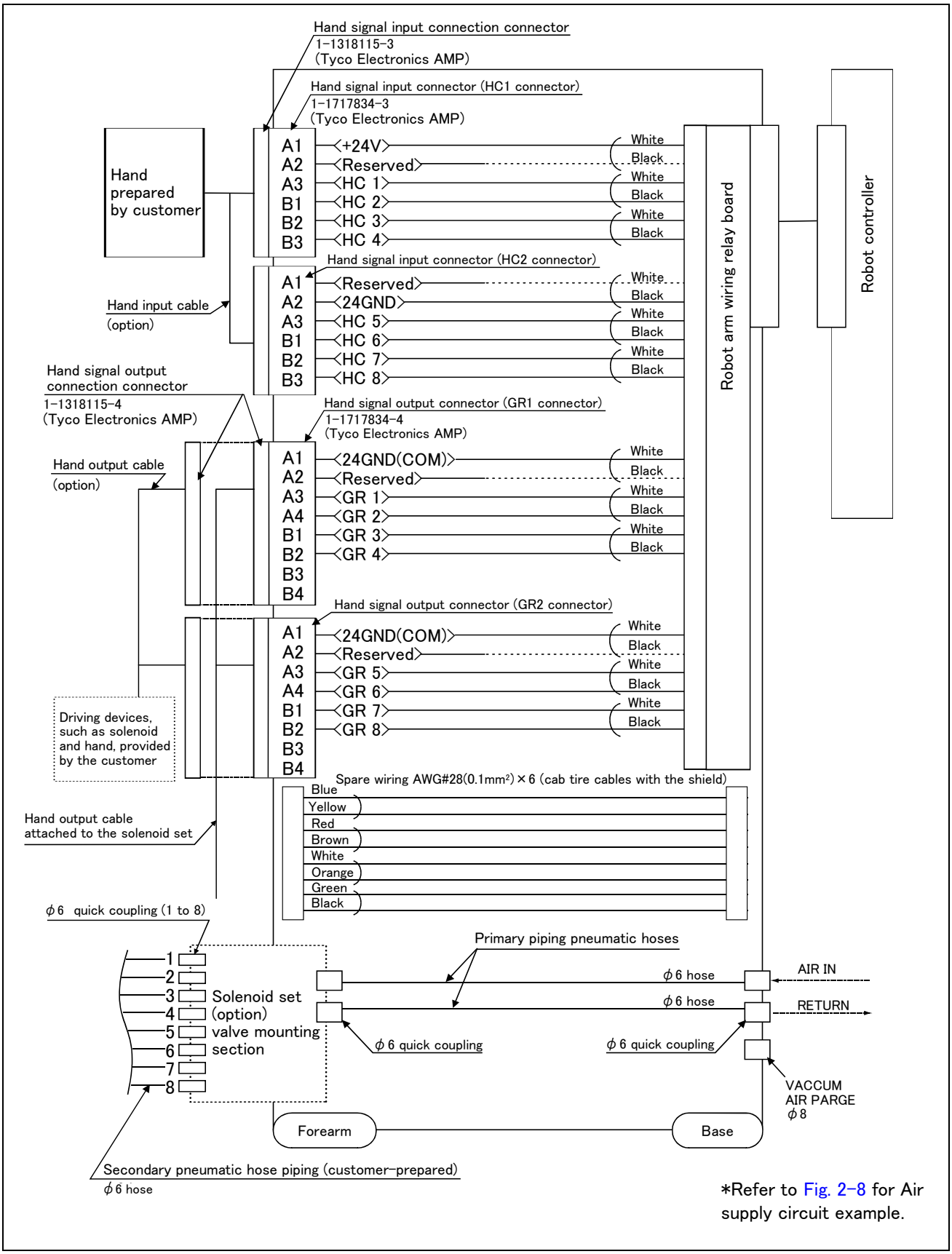


Fig.2-7 : Wiring and piping system diagram for hand and example the solenoid valve installation(Source type)

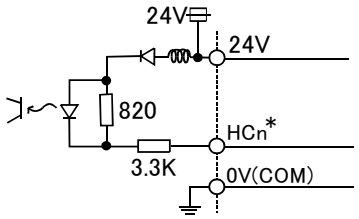
2.5.7 Electrical specifications of hand input/output

Table 2-8 : Electrical specifications of input circuit

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

Internal circuit

<Sink type>



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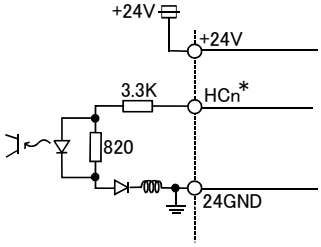


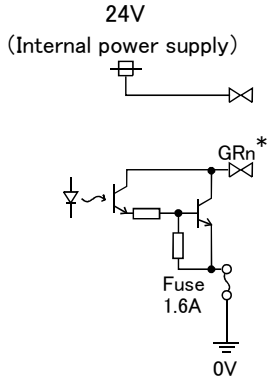
* HCn = HC1 ~ HC8

Table 2-9 : Electrical specifications of output circuit

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

Internal circuit

<Sink type>



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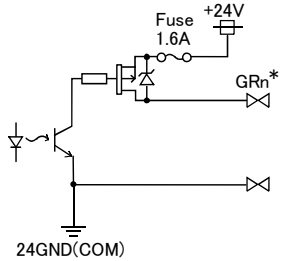


* GRn = GR1 ~ GR8

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

2.5.8 Air supply circuit example for the hand

Fig. 2-8 shows an example of pneumatic supply circuitry for the hand.

(1) Place diodes parallel to the solenoid coil.

(2) When the factory pneumatic pressure drops, as a result of the hand clamp strength weakening, there can be damage to the work. To prevent it, install a pressure switch to the source of the air as shown in Fig. 2-8 and use the circuit described so that the robot stops when pressure drops. Use a hand with a spring-pressure clamp, or a mechanical lock-type hand, that can be used in cases where the pressure switch becomes damaged.

(3) The optional hand and solenoid valve are of an oilless type. If they are used, don't use any lubricator.

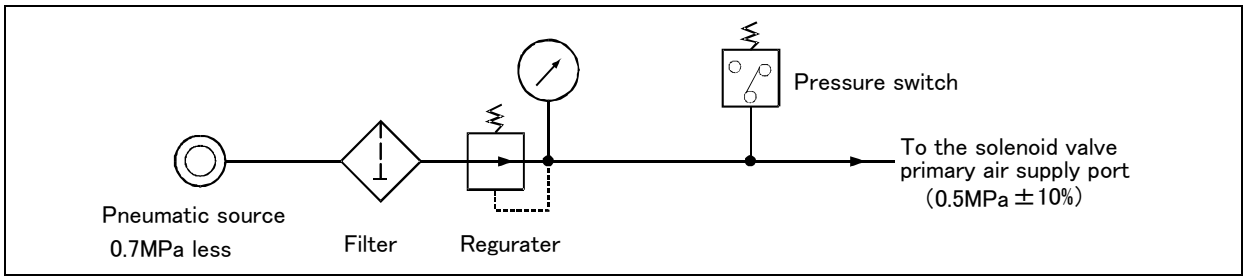


Fig.2-8 : Air supply circuit example for the hand

2.6 Options

■ What are options?

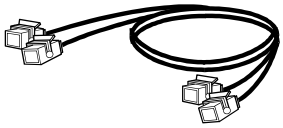
There are a variety of options for the robot designed to make the setting up process easier for customer needs. customer installation is required for the options. Options come in two types: ″set options″ and ″single options″.

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

(1) Machine cable extension

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

■ Outline



This cable is extended to the machine cable (5 m for fix type) that was supplied as standard.
A fixed type and flexible type are available.
The fix and flexible types are both configured of the motor signal cable and motor power cable.

■ Configuration

Table 2-10 : Configuration equipments and types

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

Note1)The numbers in the boxes □□ refer the length.

■ Specifications

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

Table 2-11 : Conditions for the flexed type cables

Item		Specifications
Minimum flexed radius		100R or more
Cable bare, etc., occupation rate		50% or less
Maximum movement speed		2000mm/s or less
Guidance of life count		7.5 million times
Environmental proof		Oil-proof specification sheath (for silicon grease, cable sliding lubricant type)
Cable configuration	Motor signal cable	ϕ7 x 6and ϕ1.7 x 1
	Motor power cable	ϕ7.5 x 2 and ϕ6 x 8

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

■ Cable configuration

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

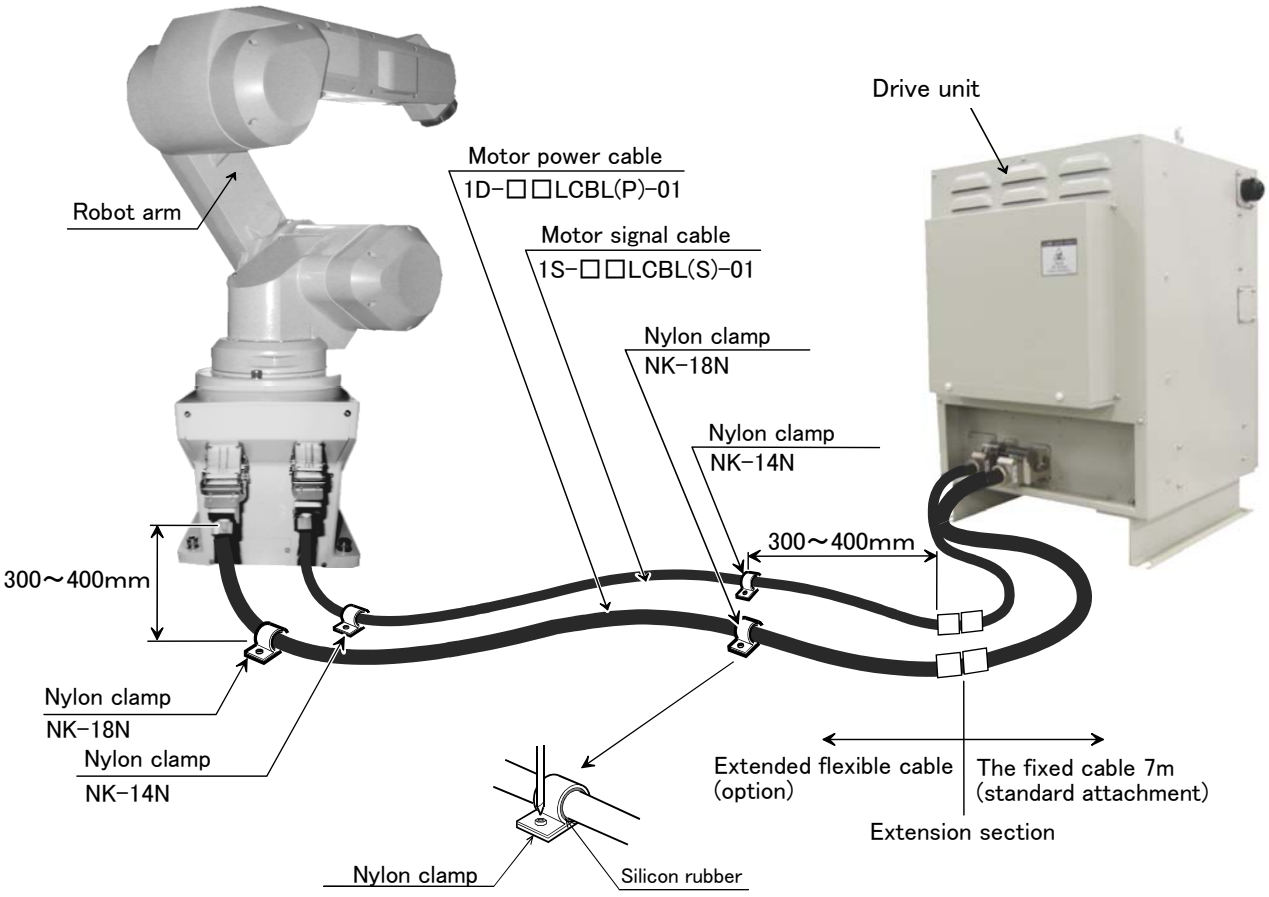
Table 2-12 : Cable configuration

Item	Motor signal cable 1S- □□ LCBL(S)-01			Motor power cable 1D- □□ LCBL(P)-01	
No. of cores	AWG#24(0.2mm^2)-4P	AWG#24(0.2mm^2)-7P	AWG#18(0.75mm^2)	AWG#17(1.25mm^2)-4C	AWG#19(0.75mm^2)-3C
Finish dimensions	Approx. ϕ6mm	Approx. ϕ8.5mm	Approx. ϕ1.7mm	Approx. ϕ7.5mm	Approx. ϕ6mm
No.of cables used	5 cables	1 cable	1 cable	2 cable	8 cable
No. in total	7 cables			10 cables	

■ Fixing the flexible cable

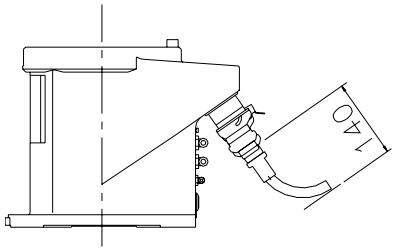
(1) Connect the connector to the robot arm .

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



⚠ CAUTION

Cover the extension terminal area with the cover etc. so that it may not be easily touched to the latch lever.



The cable shall bend and size shall be 140mm or more.

Fig.2-9 : Fixing the flexible cable

(2) Changing the operating range

■ Order type: J1 axis.....1S-DH -01

■ Outline

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

■ Configuration

Table 2-13 : Configuration devices

Part name	Type	Qty.	Remarks
Stopper for changing the operating range of J1	1S-DH-01	2 pcs.	Hexagon socket bolt: M10 x 20 plating (strength classification 10.9)

■ Specifications

Table 2-14 : Specifications

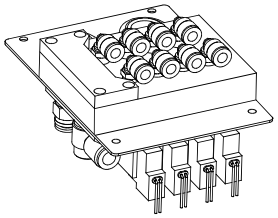
Axis		Standard	Changeable angle
J1	+ side	+170°	One point from +135° , +90° , +45°
	− side	−170°	One point from −135° , −90° , −45°

(1) The changeable angle shown in Table 2-14 indicates the operation range by the software.
The limit by the mechanical stopper is positioned 1 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-VD01-01(Sink type)/1S-VD01E-01(Source type)
Two sets: 1S-VD02-01(Sink type)/1S-VD02E-01(Source type)
Three sets: 1S-VD03-01(Sink type)/1S-VD03E-01(Source type)
Four sets: 1S-VD04-01(Sink type)/1S-VD04E-01(Source type)

■ Outline



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

■ Configuration

Table 2-15 : Configuration equipment

Part name	Type	Q'ty				Remark
		One set	Two sets	Three sets	Four sets	
Solenoid valve set (1 set)	1S-VD01-01/ 1S-VD01E-01	1 pc.	—	—	—	M4x8 four screws (installation screws). 1S-VD01-01/VD02-01/VD03-01/VD04-01 are the sink type. 1S-VD01E-01/VD02E-01/VD03E-01/VD04E-01 are the source type.
Solenoid valve set (2 sets)	1S-VD02-01/ 1S-VD02E-01	—	1 pc.	—	—	
Solenoid valve set (3 sets)	1S-VD03-01/ 1S-VD03E-01	—	—	1 pc.	—	
Solenoid valve set (4 sets)	1S-VD04-01/ 1S-VD04E-01	—	—	—	1 pc.	

■ Specifications

Table 2-16 : Valve specifications

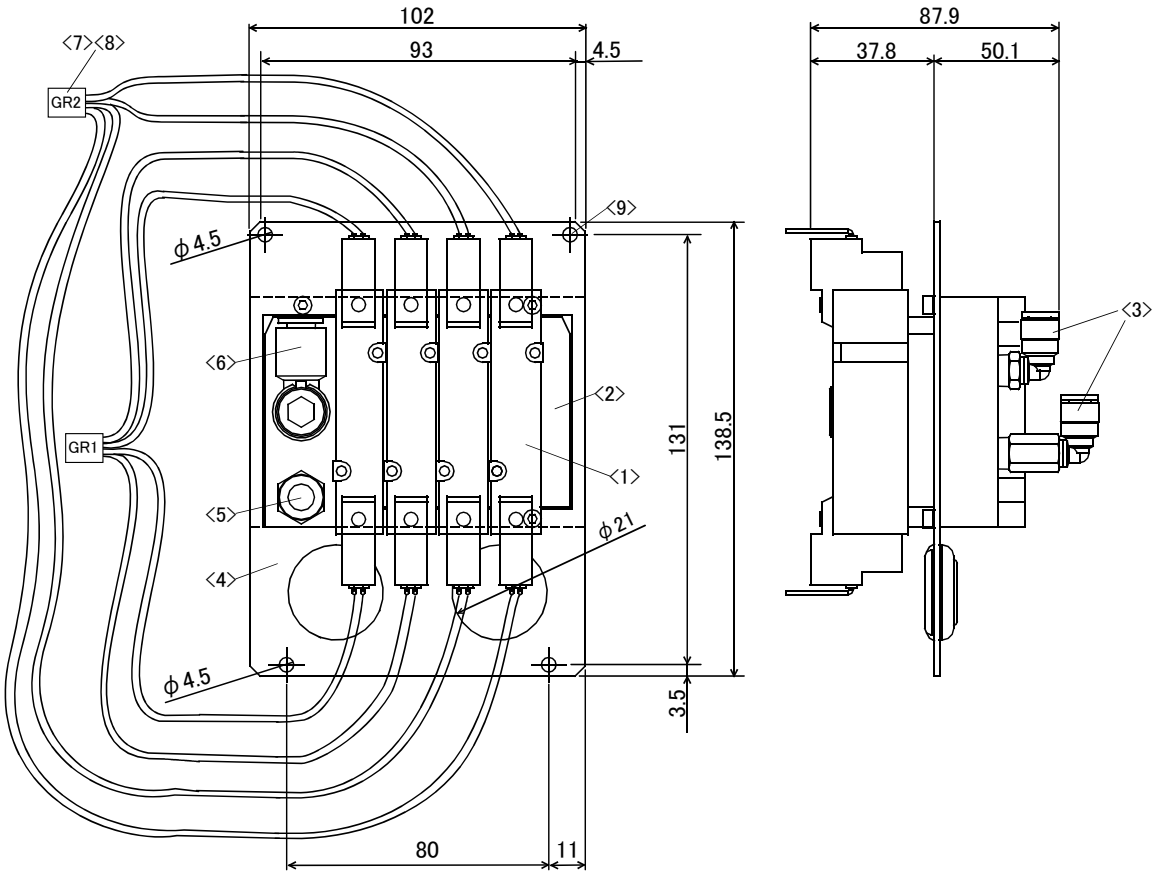
Item	Specifications
Number of positions	2
Port	5 Note1)
Valve function	Double solenoid
Operating fluid	Clean air Note2)
Operating method	Internal pilot method
Effective sectional area (CV value)	0.64mm
Oiling	Unnecessary
Operating pressure range	0.1 to 0.7MPa
Guaranteed proof of pressure	1.0MPa or more
Response time	22msec or less (at 0.5 MPa)
Max. operating frequency	5c/s
Ambient temperature	−5 to 50 ℃ (However, there must be no condensation.)

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

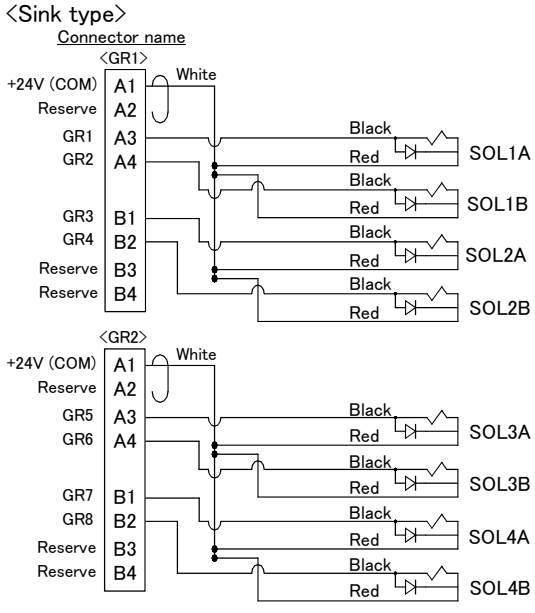
⚠ CAUTION Note2) The air to be provided must be clean, i.e., filtered with a mist separator or air filter. Failing to do so may lead to malfunctions.

Table 2-17 : Solenoid specifications

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



<Sink type>



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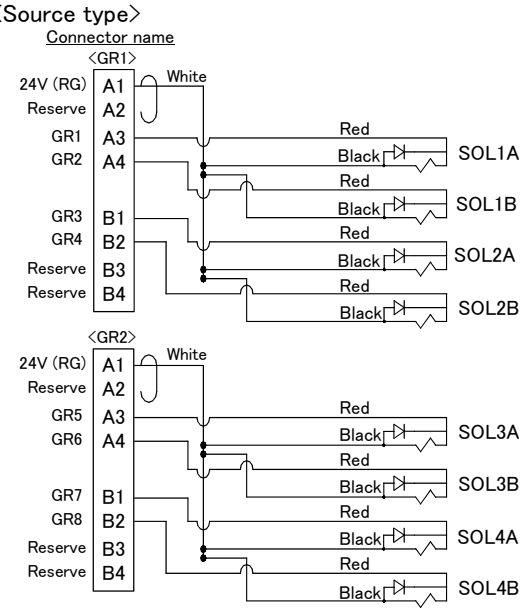
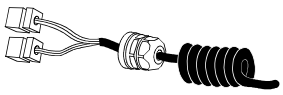


Part no.	Part name	1 sets	2 sets	3 sets	4 sets	Specifications
<1>	Solenoid valve	1	2	3	4	
<2>	Manifold block	1	1	1	1	
<3>	Quick coupling	2	4	6	8	φ6
<4>	Block plate	1	1	1	1	
<5>	Quick coupling	1	1	1	1	φ6
<6>	Quick coupling	1	1	1	1	φ6
<7>	Connector	1	1	2	2	1-1318115-4
<8>	Contact	6	6	12	12	1318112-1
<9>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

(4) Hand input cable

■ Order type: 1S-HC25C-01

■ Outline



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

■ Configuration

Table 2-18 : Configuration equipment

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

■ Specifications

Table 2-19 : Specifications

Item	Specifications	Remarks
Size x cable core	AWG#24 (0.2mm^2) × 12	One-sided connector, one-sided cable bridging
Total length	800mm (Including the curl section, which is 300mmlong)	

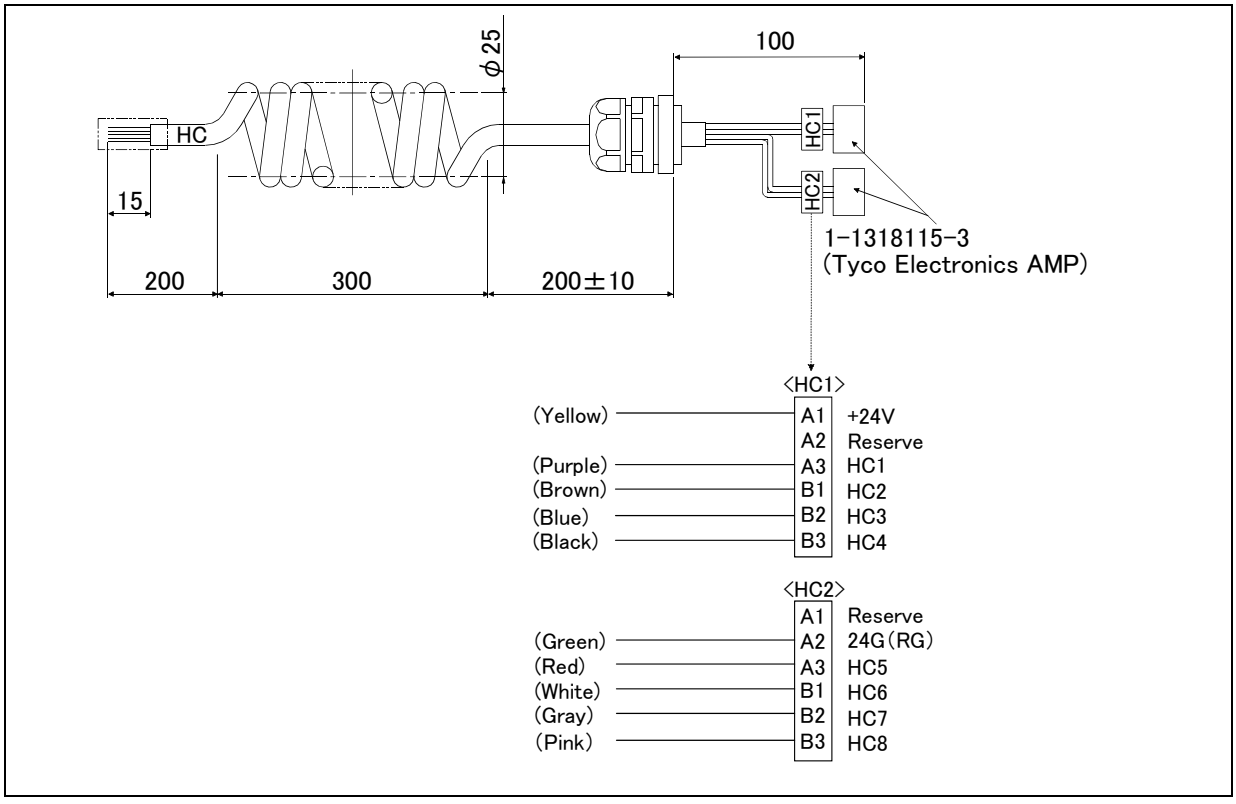


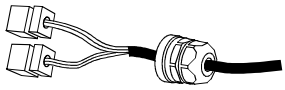
Fig.2-10 : Outside dimensional drawing and pin assignment

[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	Type	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	

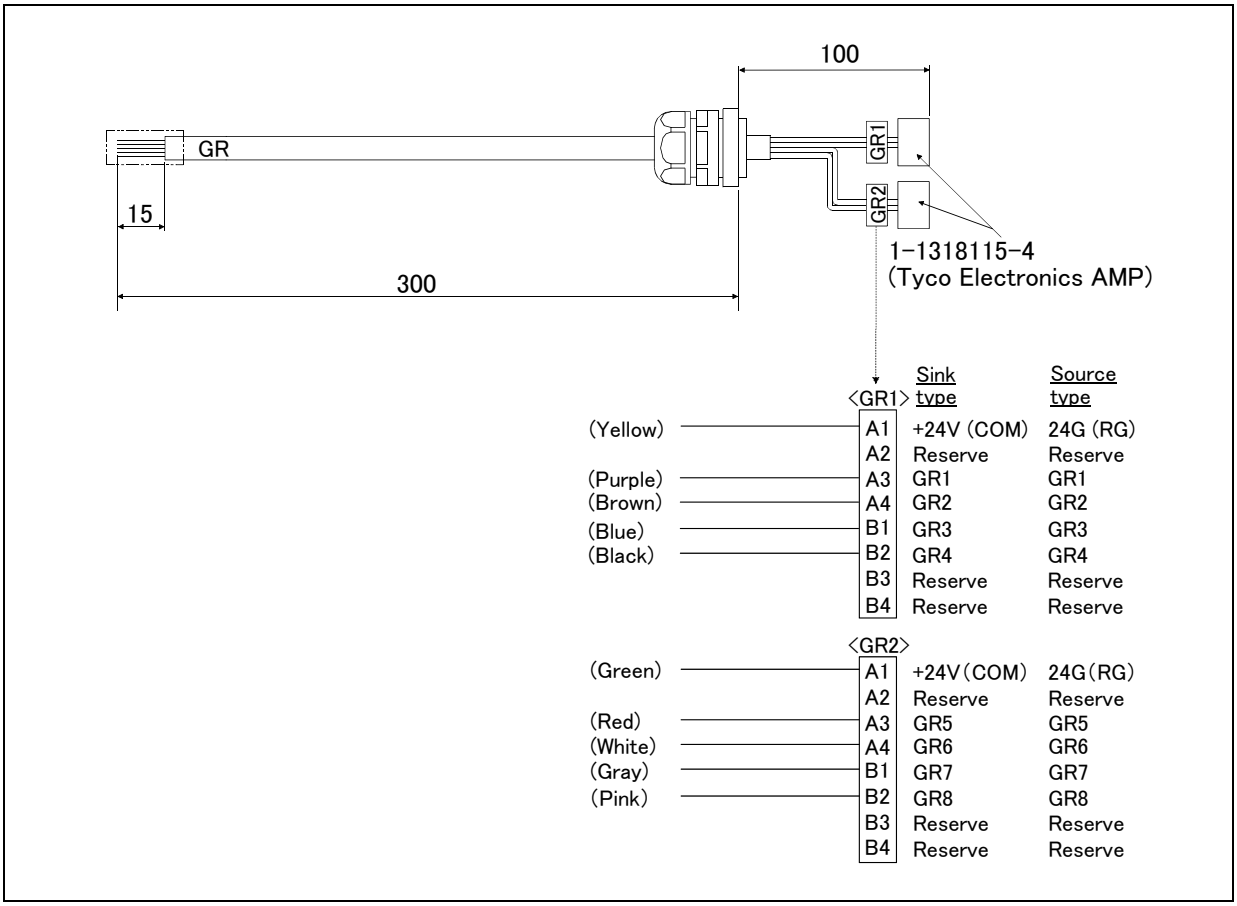
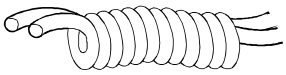


Fig.2-11 : Outline dimensional drawing and pin assignment

(6) Hand curl tube

■ Order type: Four set: :1N-ST0608C

■ Outline



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

■ Configuration

Table 2-22 : Configuration equipment

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

■ Specifications

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

Table 2-23 : Specifications

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

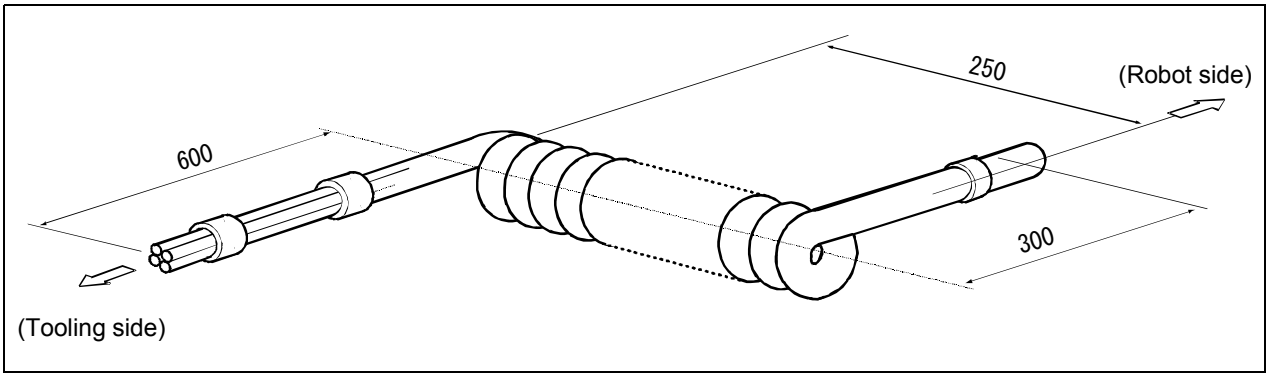


Fig.2-12 : Outline dimensional drawing

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

2.7 Maintenance parts

The consumable parts used in the robot arm are shown in Table 2-24. Purchase these parts from the designated maker or dealer when required. Some Mitsubishi-designated parts differ from the maker's standard parts. Thus, confirm the part name, robot arm and controller serial No. and purchase the parts from the dealer.

Table 2-24 : Consumable part list

No.	Part name	Type Note1)	Usage place	Qty.	Supplier
1	Grrase	SK-1A	Reduction gears of each axis	As needed	Mitsubishi Electric
2	Lithium battery	A6BAT	In the battery cover	5 pcs.	

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

3 Controller

3.1 Standard specifications

3.1.1 Standard specifications

Table 3-1 : Standard specifications of controller

Item			Unit	Specification	Remarks
Type				CR3Q-709M/CR3Q-709	CR3Q-709M : RV-18SQ-S series CR3Q-709 : RV-18SQC-S series
Number of control axis				Simultaneously 6(Maximum)	
CPU				６４ bit ＲＩＳＣ／ＤＳＰ	
Memory capacity	Programmed positions and No. of steps		point step	１３，０００ ２６，０００	
	Number of programs			２５６	
Robot language				ＭＥＬＦＡ－ＢＡＳＩＣＶ or ＭＥＬＦＡ－ＢＡＳＩＣＩＶ[Note1)]	
Teaching method				Pose teaching method ,MDI method	
External input and output	input and output		point	Input 0 point/Output 0 point	Multi-CPU share device Input 8192/Output 8192 (Max.)
		Dedicated input/output		Assign to the multi-CPU share device.	
	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-422		port	1	Only for the teaching pendant
	Ethernet		port	１ : Only for the teaching pendant	100BASE-TX
	Hand dedicated slot		slot	1	Dedicated for pneumatic hand interface
	Additional axis interface		Channel	1	SSCNET Ⅲ

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-RZ365/2A-RZ375) is installed.

Table 3-2 : Standard specifications of drive unit

Item		Unit	Specification	Remarks
Type			DU3-709M/DU3-709	DU3-709M: RV-18SQ-S series DU3-709: RV-18SQC-s series
External input and output	input and output	point	0/0	Multi-CPU share device Input 8192/Output 8192 (Max.)
	Dedicated input/output		Assign to the multi-CPU share device.	
	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[Note1)]
	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-422	port	1	Only for the teaching pendant
	Ethernet	port	1 : Only for the teaching pendant	100BASE-TX
	Hand dedicated slot	slot	1	Dedicated for pneumatic hand interface
Power source	Input voltage range	V	3-phase, AC １８０～２５３	[Note2)]
	Power capacity	kVA	3.0	Does not include rush current [Note3)] [Note4)]
	Power supply frequency	Hz	５０／６０	
Outline dimensions		mm	DU3-709M:450(W)x440(D)x625(H) DU3-709:450(W)x380(D)x625(H)	Excluding protrusions
Mass		kg	Approx.	
Construction			DU3-709M:Self-contained floor type, Closed type(IP54)[Note5)] DU-3-709 : Self-contained floor type, Opened type[Note6)]	
Operating temperature range		℃	０～４０	
Ambient humidity		%RH	４５～８５	Without dew drops
Grounding		Ω	100 or less	D class grounding earth[Note7)]
Paint color			Light gray	Munsell 0.08GY7.64/0.81

Note1) It is when an pneumatic hand interface (2A-RZ365/2A-RZ375) is installed.
Note2) Please use the controller with an input power supply voltage fluctuation rate of 10% or less.
Note3)The power capacity is the rating value for normal operation. The power capacity does not include the rush current when the power is turned ON. The power capacity is a guideline and the actual operation is affected by the input power voltage.The short circuit breaker should use the following.
*Operate by the current leakage under the commercial frequency domain (50-60Hz).
If sensitive to the high frequency ingredient, it will become the cause in which below the maximum leak current value carries out the trip.
Note4)If the earth leakage breaker is installed in the primary side power supply circuit of the drive unit, please select the earth leakage breaker of the specification of the amperage rating 20A and 10mA of sensed current. (The leak current of the controller is set to about 7.5mA)
Note5)The DU3-7xxM drive unit exchanges heat using the internal air circulation self-cooling method. Furthermore, the rear side sucks in the outside air and the top and bottom sections of the rear side discharges the inside air. And, has the protection structure which fitted IP54.
Note6)The DU3-7xx drive unit is a general environment specification.
Note7)The robot must be grounded by the customer.

Table 3-3 : Robot CPU unit standard specification

Item		Unit	Specification	Remarks
Type			Q172DRCPU	
Interface	Addition axis synchronization	port	1	
Power source	Power capacity (DC5V)	A	1．25	
Outline dimensions		mm	27.4 (W) x 98 (D) x 119.3 (H)	
Mass		kg	0．33	
Operating temperature range		℃	0～55	
Ambient humidity		%RH	5～95	Without dew drops

3.1.2 Protection specifications and operating supply

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 ± 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 ㎡ per minute, for a total of 5 minutes or more.

Refer to the section 82Page ″6.2Working environment″for details on the working environment.

3.2 Names of each part

3.2.1 Names of each part of the drive unit

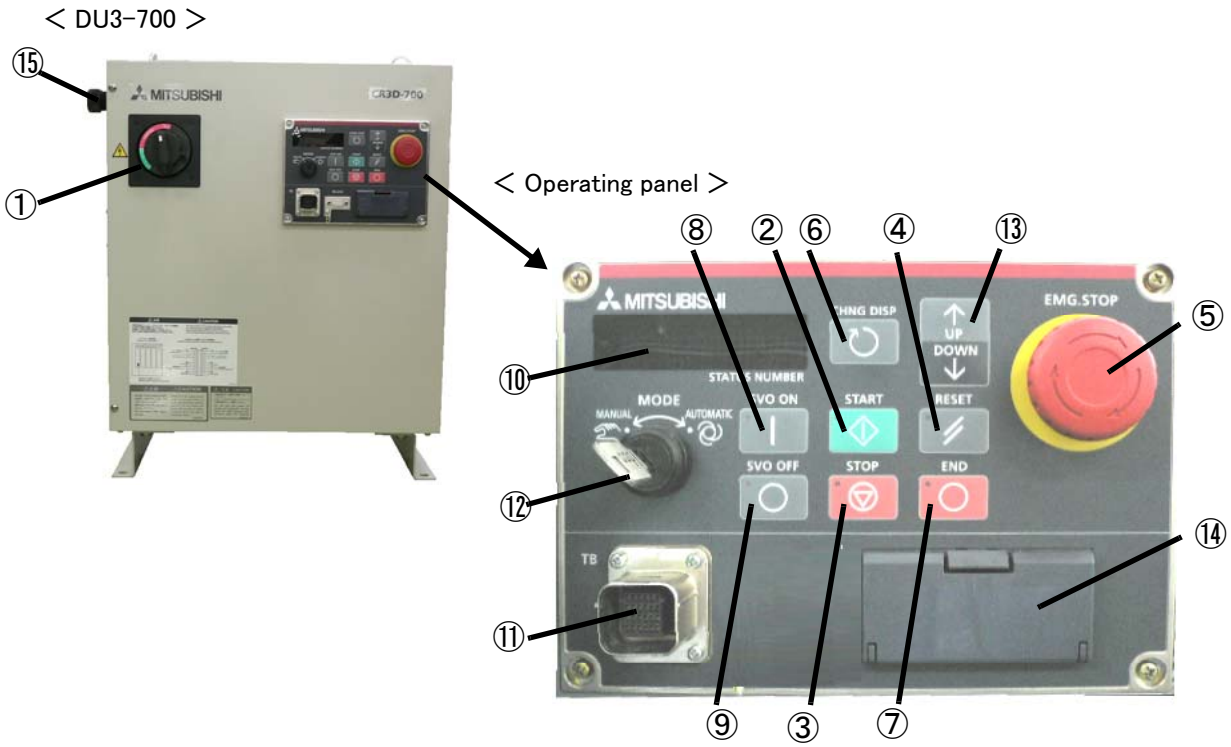


Fig.3-1 : Names of drive unit parts

① POWER switch.....This turns the control power ON/OFF. (With earth leakage breaker function) * 1)
② START button.....This executes the program and operates the robot. The program is run continuously.
③ STOP button.....This stops the robot immediately. The servo does not turn OFF.
④ RESET button.....This resets the error. This also resets the program's halted state and resets the program.
⑤ Emergency stop switch.....This stops the robot in an emergency state. The servo turns OFF.
⑥ CHNGDISP button.....This changes the details displayed on the display panel in the order of "Override" → "Program No." → "Line No.".
⑦ END button.....This stops the program being executed at the last line or END statement.
⑧ SVO.ON button.....This turns ON the servo power. (The servo turns ON.)
⑨ SVO.OFF button..... This turns OFF the servo power. (The servo turns OFF.)
⑩ STATUS NUMBER
(display panel).....The alarm No., program No., override value (%), etc., are displayed.
⑪ T/B connection connector .....This is a dedicated connector for connecting the T/B. When not using T/B, connect the attached dummy connector.
⑫ MODE key switch.....This changes the robot's operation mode.
AUTOMATIC.....operations from the controller or external equipment are valid. Operations for which the operation mode must be at the external device or T/B are not possible. It is necessary to set the parameter for the rights of operation to connection between the operation panel and external equipment. For details, please refer to "INSTRUCTION MANUAL/Detailed explanations of functions and operations" of the separate volume.
MANUAL.....When the T/B is valid, only operations from the T/B are valid. Operations for which the operation mode must be at the external device or controller are not possible.
⑬ UP/DOWN button.....This scrolls up or down the details displayed on the "STATUS. NUMBER" display panel.
⑭ Interface cover.....Unused in this drive unit. Please use closing this cover, because of to prevent deterioration of protection performance.
⑮ Power cable clamp.....Fix the primary power cable

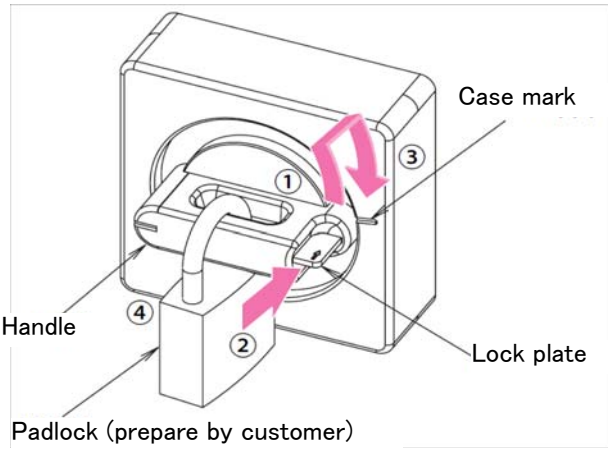
*1)The power switch of DU2-700/DU3-700 series can be locked by installing the padlock etc. Please prepare the padlock by the customer. Padlock specification is shown in "3.2.2Padlock specification"

[Note] The RS232 connection connector is not prepared by this controller. If you use it, please prepare sequencer CPU or the unit corresponding to the sequencer

3.2.2 Padlock specification

If the robot is not used, the power switch can be locked with the padlock so that power supply ON cannot be done easily. The specification is shown in the following.

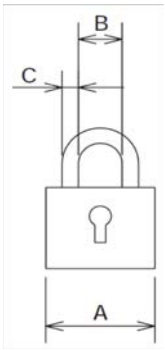
< CR3Q-700 >



Usage of lock function

① Turn the handle to the reset direction until the mark of the lock plate and the case mark is in match.
② Push in the lock plate.
③ Return the handle to the OFF position, with pushing the lock plate.
④ Lock the handle with the padlock.

The lock device which can be used

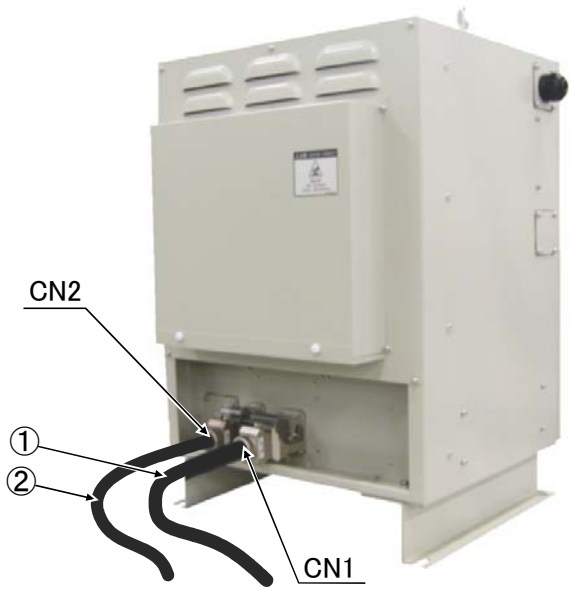


Dimension of the padlock

Dimension (mm)		
A	B	C
35(0.11)	19	5
40(0.13)	22 or 23	5.5

The maximum size of "C" which can be installed is 8mm.

Fig.3-2 : Operation lock of the power switch(CR3Q-700)

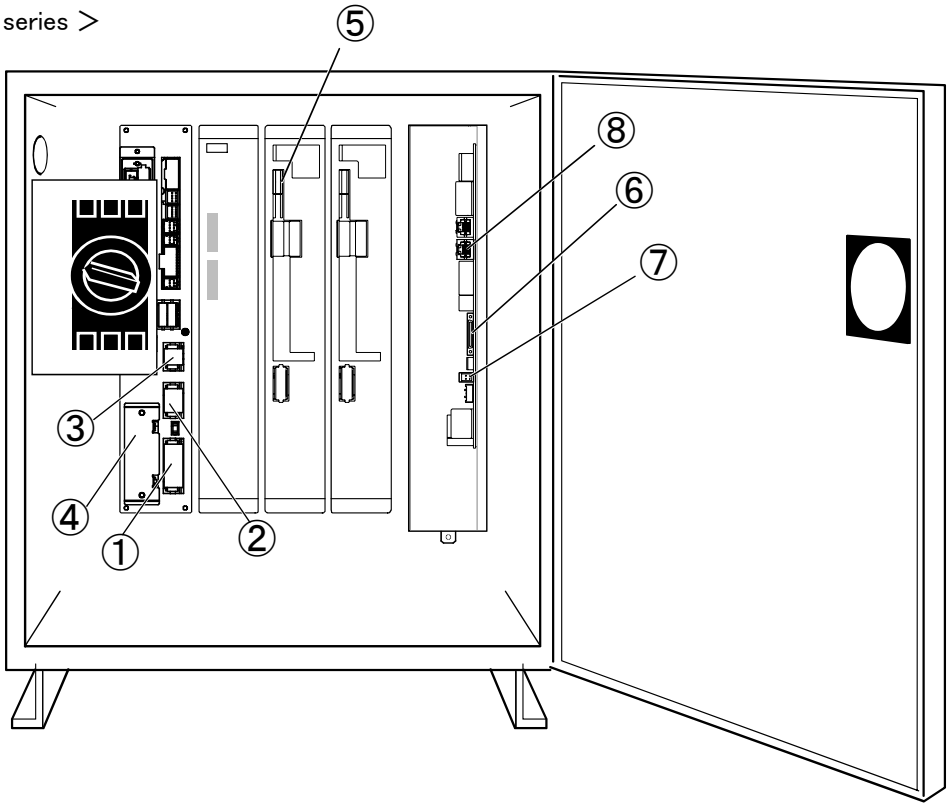


<figure is DU3-711M>

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

Fig.3-3 : Names of each part (Rear side DU3-700 series)

< DU3-700 series >



① Emergency stop input(EMGIN)..... Connect the emergency stop switch to the robot.
② Emergency stop output(EMGOUT)..... The robot's error condition is outputted.
③ Special stop input(SKIP)..... Stops the robot immediately.
④ Hand slot(HND)..... Install the pneumatic hand interface optional.
⑤ OPT1A、⑥ CON3、⑦ DCOUT、⑧ CNDISP..... Connecting with the robot CPU unit.

Fig.3-4 : Names of each part (Rear side DU3-700 series)

3.2.3 Names of each part of the robot CPU

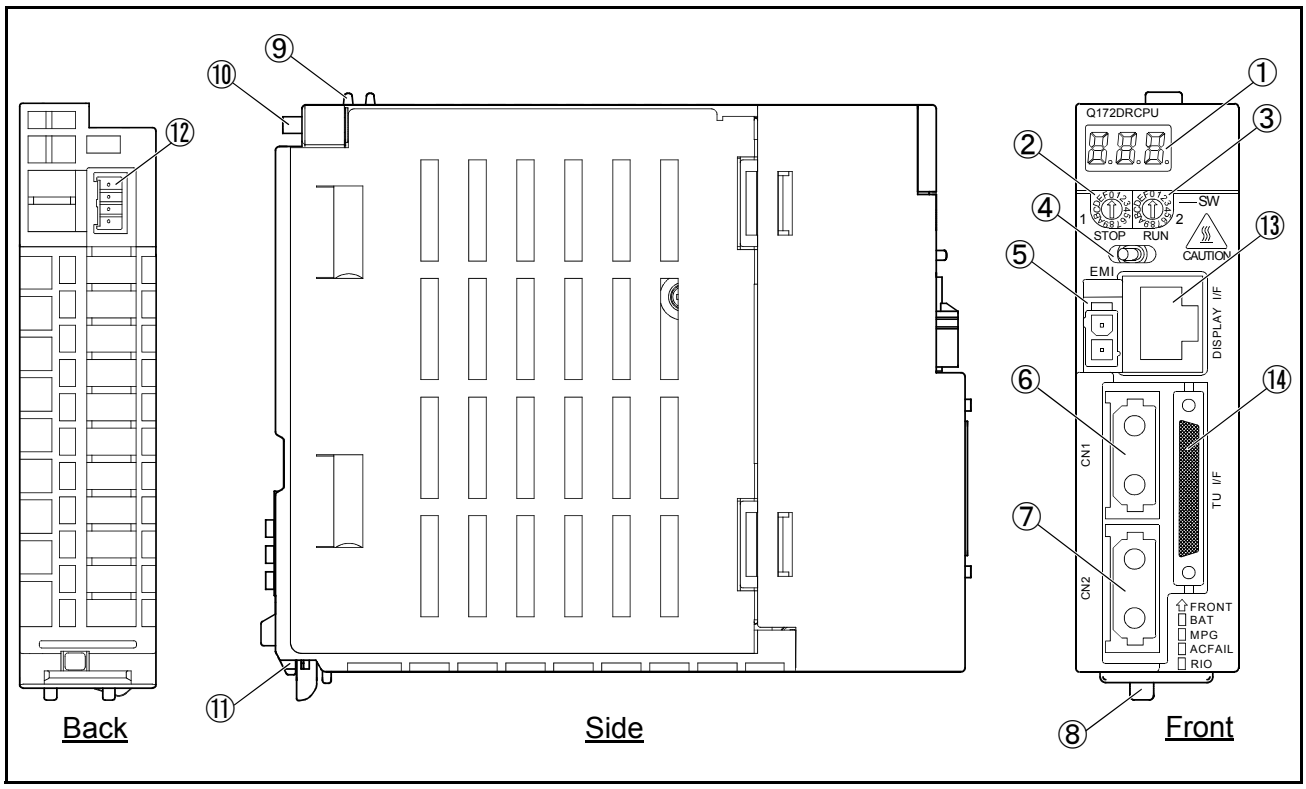


Fig.3-5 : Names of each part of the robot CPU

① Seven segments LED.....Indicates operational status and error information
② Rotary switch(SW1).....Set up operation mode. Always set it as "0."
③ Rotary switch(SW2).....Set up operation mode. Always set it as "0."
④ RUN/STOPswitch.....Unused
⑤ Emergency stop input(EMI)[Note1)] The input connector which makes the servo amplifier of all the axes the emergency stop at once.
EMI ON (open) : Emergency stop
EMI OFF (Supply DC24V.) : Emergency stop release
⑥ CN1 connector[Note2)].....Connect to the drive unit
⑦ CN2 connector[Note2)].....Connect to the servo amplifier of the addition axis(Eight axes)
⑧ Lever for unit installation.....Use this lever, when installing the unit in the base unit.
⑨ Hook for unit fixing[Note3)].....The hook which fixes the unit to the base unit (For the support at installation)
⑩ Unit fixing screw.....The screw for fixing to the base unit (M3 × 13)
⑪ The projection for unit fixing .....The projection for fixing to the base unit
⑫ Battery connector(BAT)[Note4)].....The connector for connection with battery holder unit Q170DBATC
⑬ The connector for the networks (DISPLAY I/F)
The connector of the LAN access for T/B (For R56TB).
⑭ RS422 connector(TU I/F).....The connector for RS422 connection with the drive unit

Note1)Please be sure to use the emergency stop input cable. The emergency stop cannot be canceled if it does not use. If it manufactures the emergency stop input cable in the customer, cable length should use 30m or less.
Note2)Please store in the duct or fix the cable section near robot CPU with the bunch wire rod so that prudence of the cable is not applied to CN1 and CN2 connector section.
Note3)It is equipment for the support when installing the unit in the basic base unit. Please be sure to fix the unit to the basic base unit with the attached fixing screw.
Note4)Please be sure to use the external battery. Unless the battery cable is connected surely, the program in SRAM with a built-in robot CPU, the parameter, origin position data, etc. are not held.

3.3 Outside dimensions/Installation dimensions

3.3.1 Outside dimensions

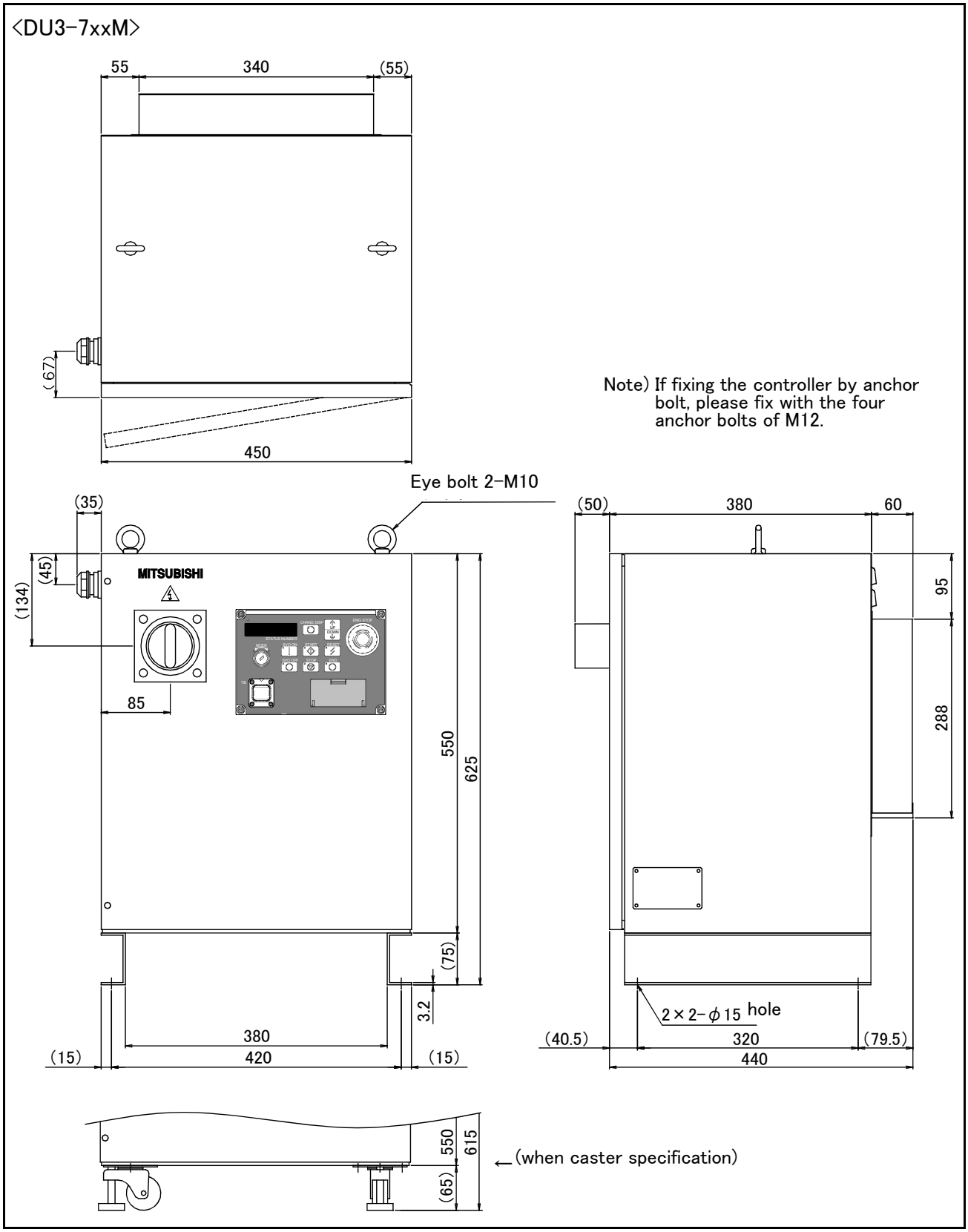


Fig.3-6 : Outside dimensions(DU3-7xxM)

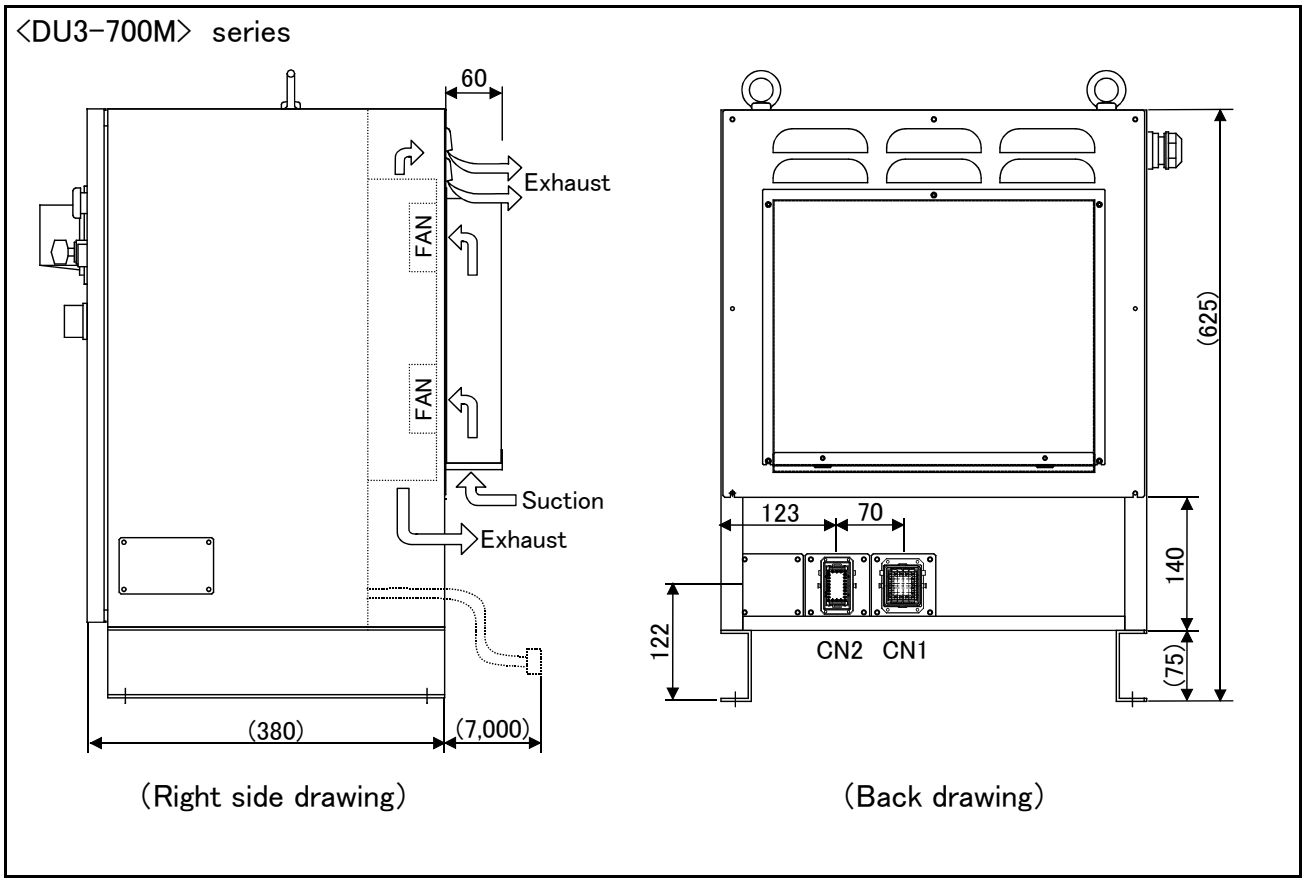


Fig.3-7 : Outside dimensions of controller (DU3-700M Supplement)

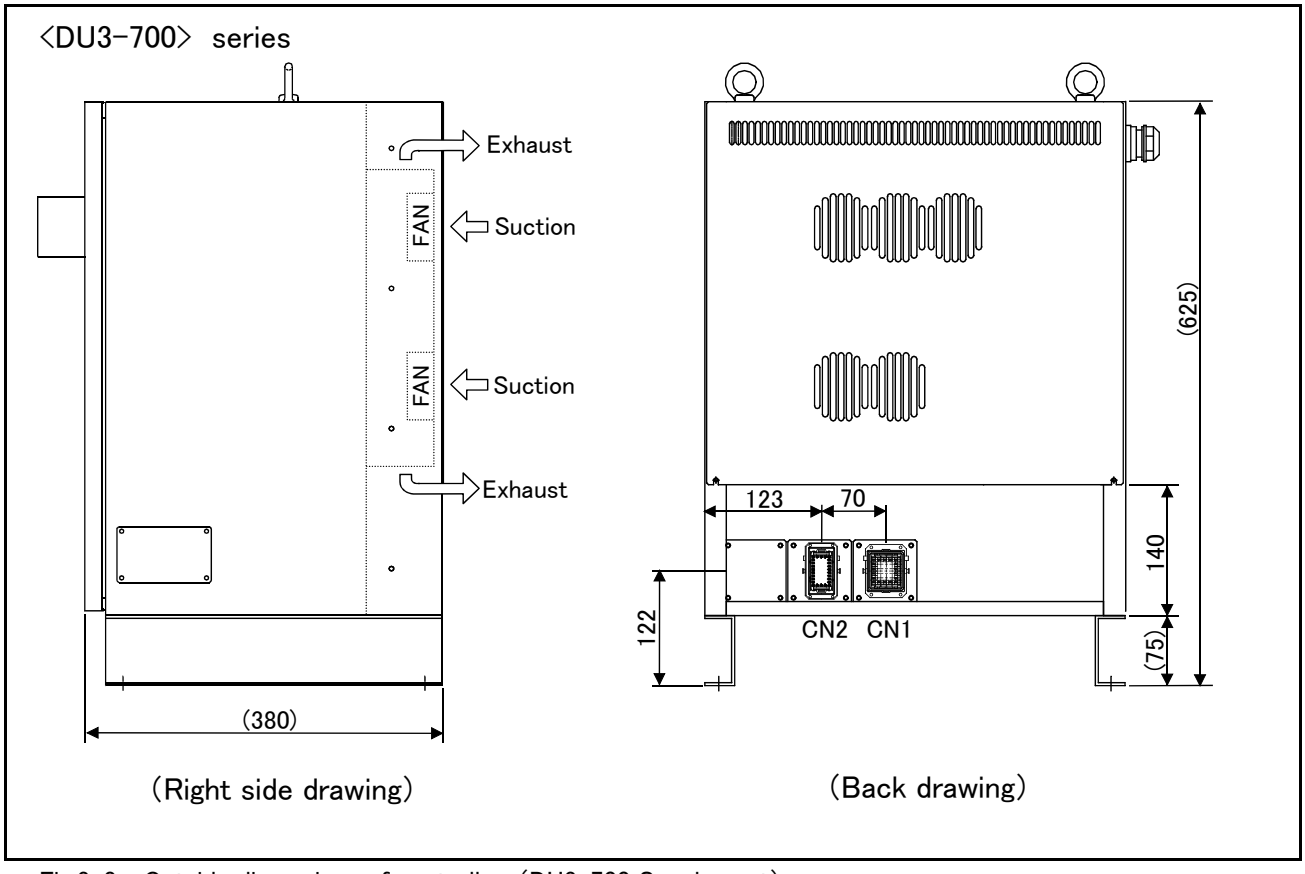
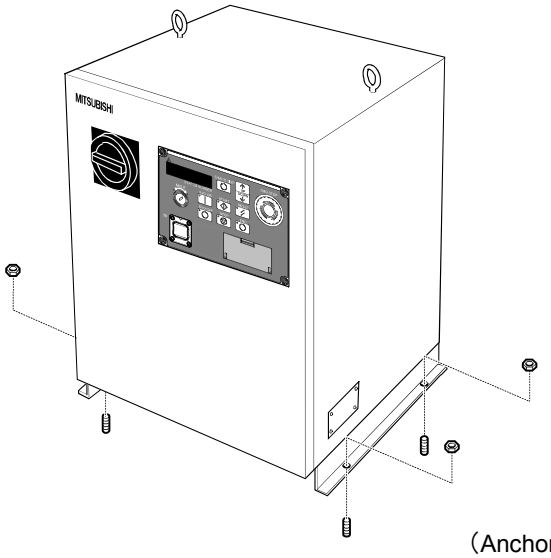


Fig.3-8 : Outside dimensions of controller (DU3-700 Supplement)

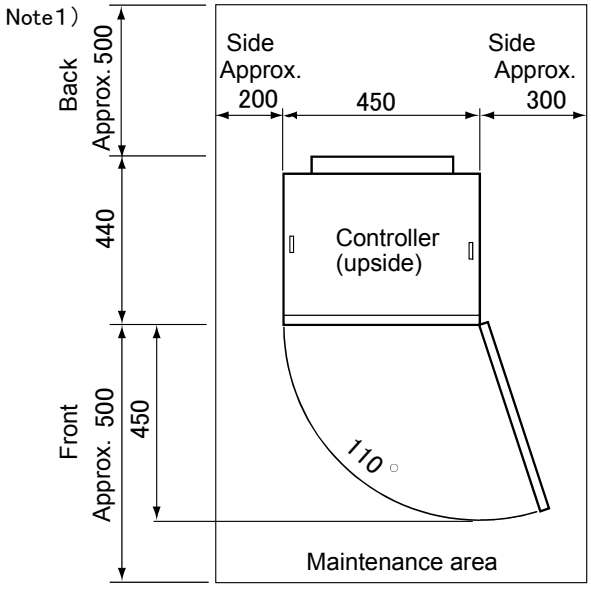
3.3.2 Installation dimensions

<DU3-700/700M> series



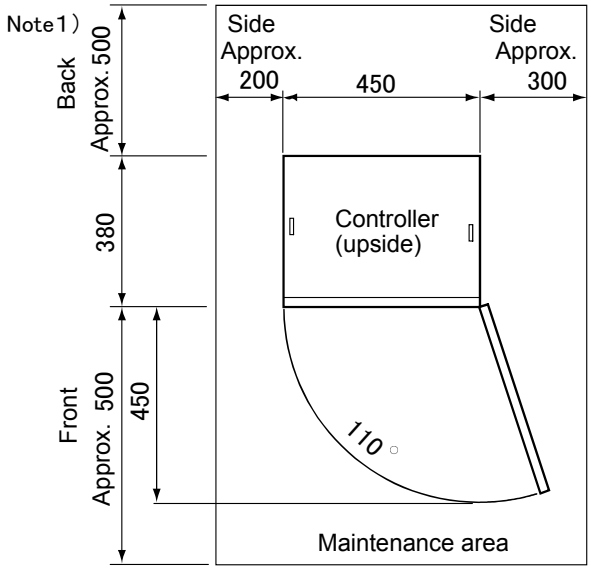
(Anchor bolt installation: 4 places)

<CR3D-700M> series



(View from upside)

<CR3D-700> series



(View from upside)

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

Fig.3-9 : Installation of controller (DU3-700/700M)

The controller has the openings parts for pulling out the cable as shown in Fig. 3-10.

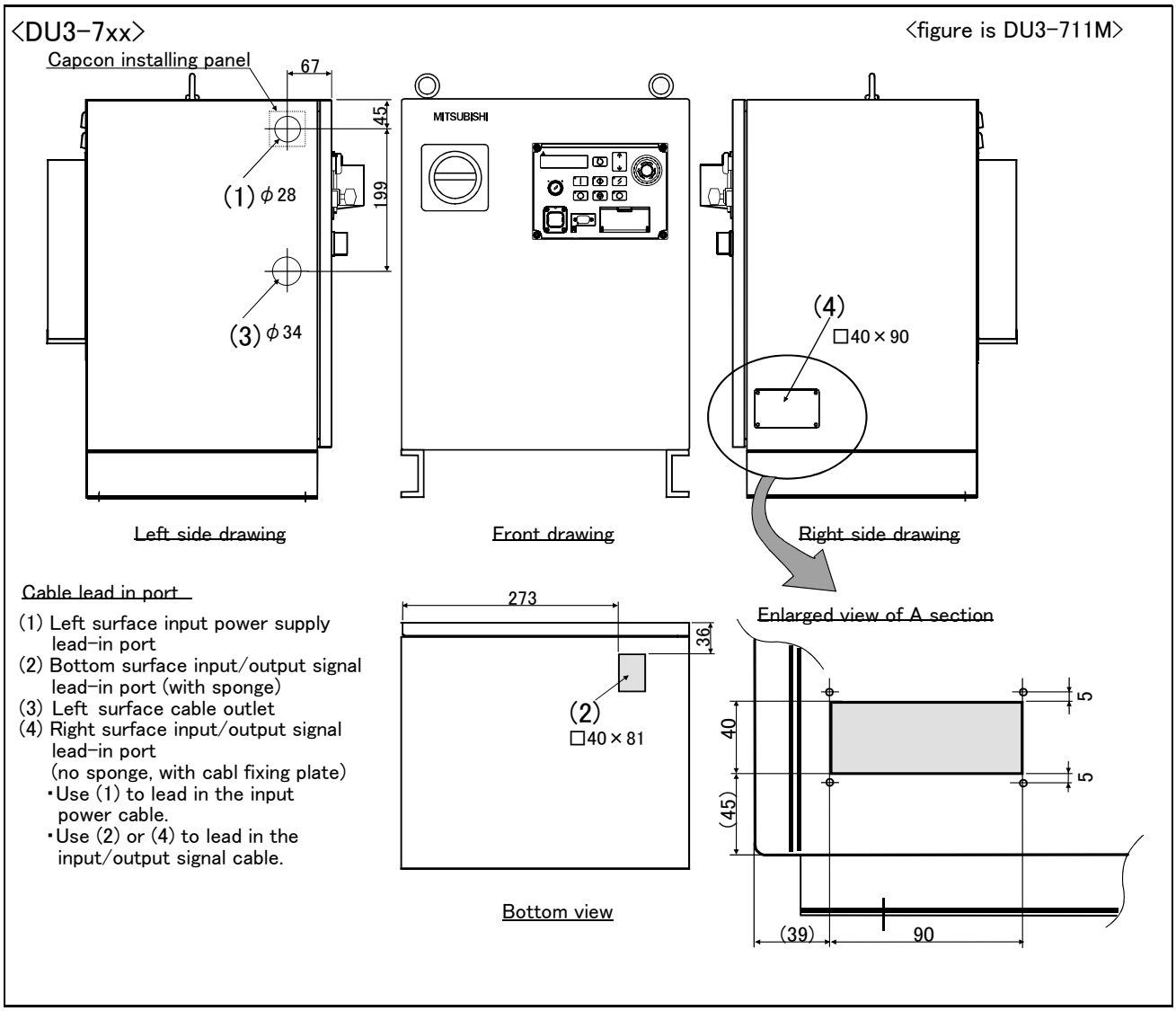


Fig.3-10 : Cable lead-in and dimension of the controller (DU3-7xx Series)

(1) Outside dimensions of robot CPU

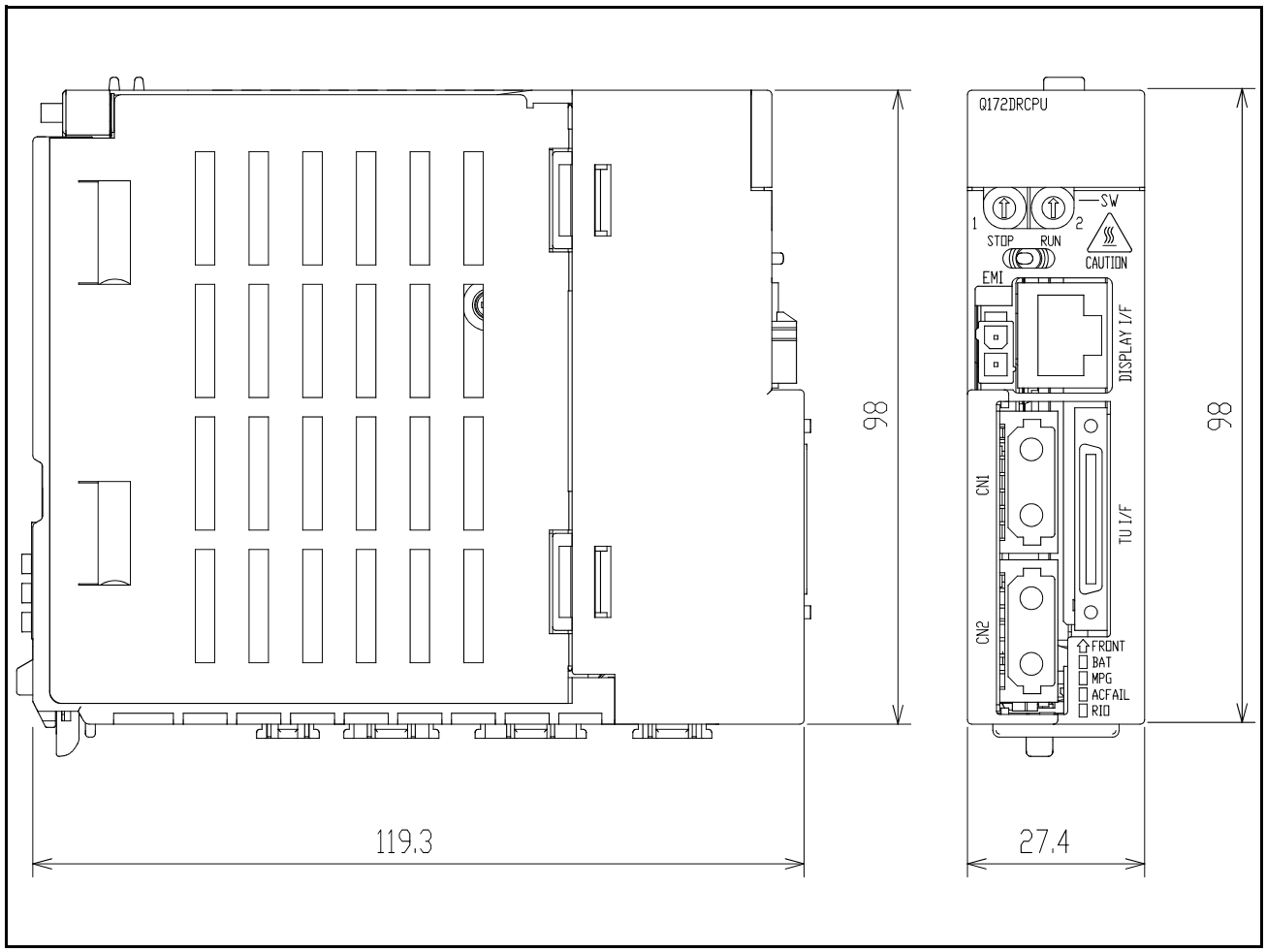


Fig.3-11 : Outside dimensions of robot CPU

3.4 External input/output

3.4.1 Types

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

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

(3) Hand input/output ..... These are inputs and outputs related to the hand that the customer can program. (The hand output is an option. The Page 62, "(2) Pneumatic hand interface" is required.)

Table 3-4 : Emergency stop/Door switch input

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

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

The hand output is an option. Refer to Page 62, "(2) Pneumatic hand interface" for details

3.5 Dedicated input/output

Show the main function of dedicated input/output in the Table 3-5. 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 3-5 : Dedicated input/output list

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

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

Note1) The level indicates the signal level.
L: Level signal → The designated function is validated when the signal is ON, and is invalidated when the signal is OFF.
E: Edge signal → The designated function is validated when the signal changes from the OFF to ON state, and the function maintains the original state even when the signal then turns OFF.
Note2) Four elements are set in the order of input signal start No., end No., output signal start No. and end No.
Note3) Up to eight points can be set successively in order of start output signal No. and end output signal No.

3.6 Emergency stop input and output etc.

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

Table 3-6 : Special input/output terminal

Item	Name	Function
Input	Emergency stop	Applies the emergency stop. Dual emergency line
Input	Special stop input	Applies the stop. (Refer to Page 51, "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 opening, AUTO mode: contactor is closing
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. 3-13.

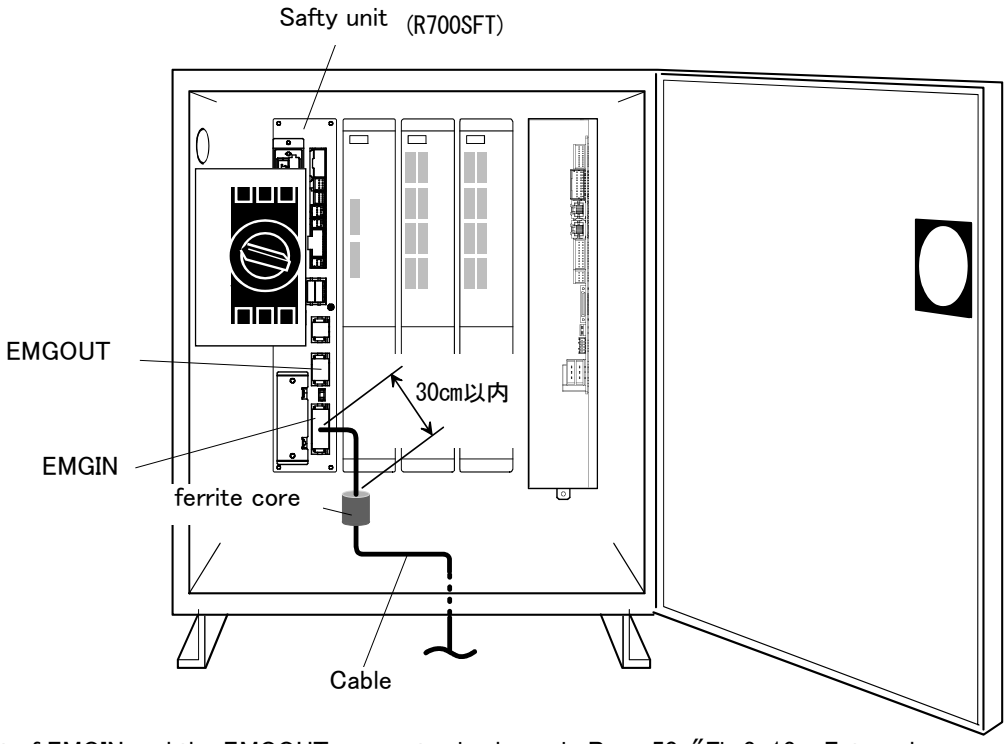
3.6.1 Connection of the external emergency stop

The external emergency stop input and door switch input and enabling device input are opened at shipment as shown in Fig. 3-13.
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.

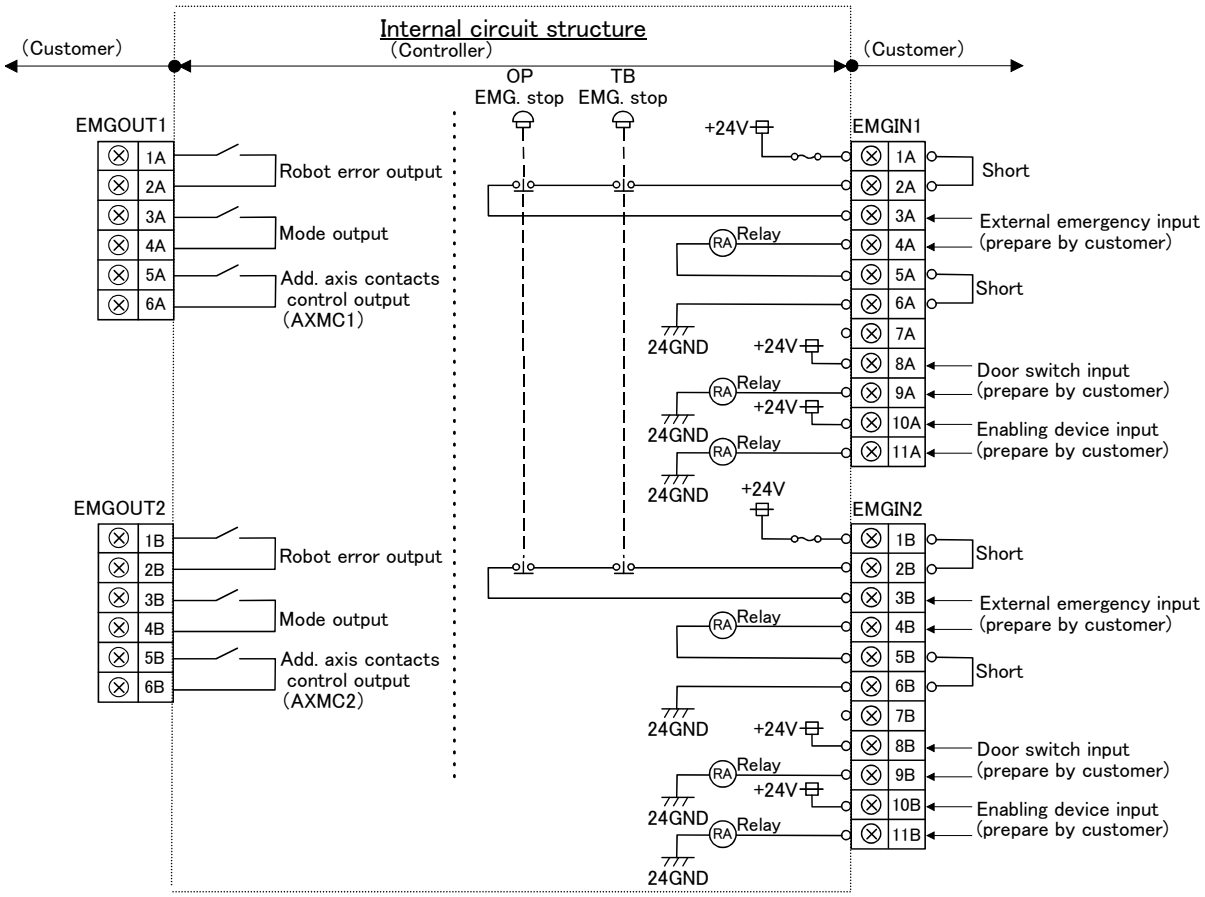
[Caution] When wiring the emergency stop switch (double emergency line type), wire both contacts to the two terminal blocks on the controller. If both contacts are wired to only one of the terminal blocks, errors cannot be cancelled using the door switch. The cable uses the shielded cable and installs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

<DU3-700/700M>

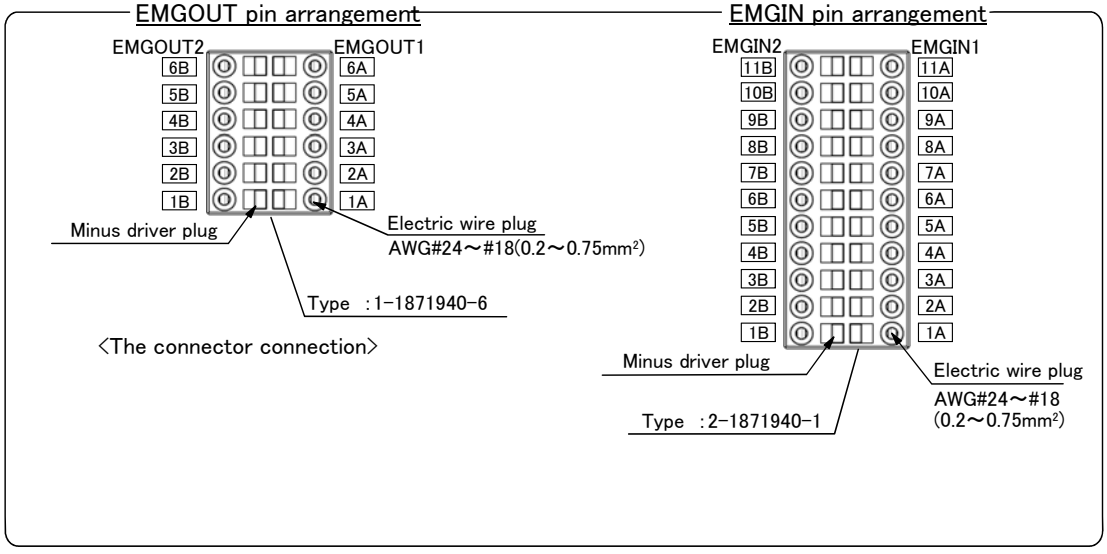


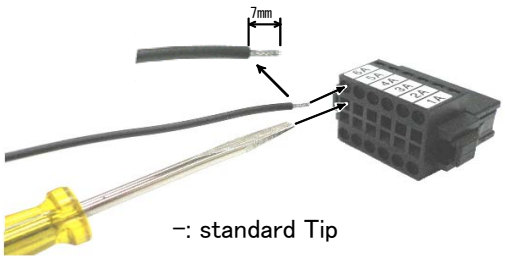
Pin allotment of EMGIN and the EMGOUT connector is shown in Page 50, "Fig.3-13 : External emergency stop connection".

Fig.3-12 : Emergency stop cable connection(DU3-700)



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





1) Remove the Sticker on the connector.
2) Remove the wire skin 7mm.
3) Push the back spring with the small standard Tip.
4) Insert the wire to the back.
5) Remove the small standard Tip.
*recommended Tip size is 1.4-2.4mm.
(The driver plug area of the connector is 2.5mm)

Fig.3-13 : External emergency stop connection

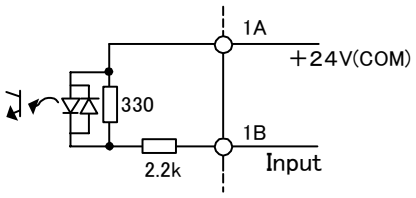
⚠CAUTION Please be sure to install the emergency stop switch and it is connection to the controller, to stop the robot immediately at emergency

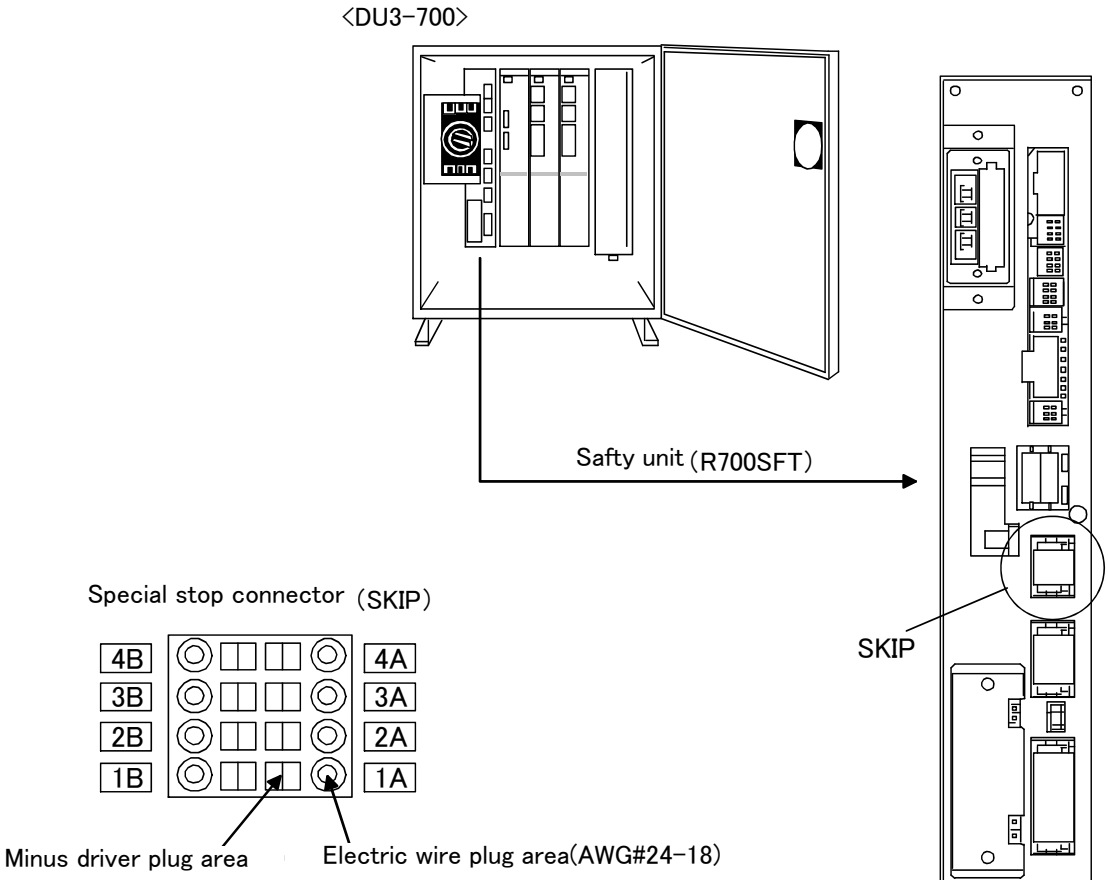
⚠CAUTION Be careful of the short circuit at cable connection.
And, don't give plating solder to the electric wire. Loose connection may occur.

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 52, "Fig.3-14 : Connection of the special-stop-input".

Table 3-7 : Special stop input electric specification

Item		Specifications	Internal circuit
Type		DC input	
No. of input point		1	
Insulation method		Phto-coupler insulation	
Rated inpit voltage		DC24V	
Rated input current		approx. 11mA	
Working voltage range		DC 21.6 ～ 26.4V (Ripple rate within 5 %)	
ON voltage/ON current		DC 8V or more / 2mA or more	
OFF voltage/OFF current		DC 4V or less / 1mA or less	
Input resistance		approx. 2.2 k Ω	
Response time	OFF → ON	1ms or less	
	ON → OFF	1ms or less	
Common method		1 point per common	
External wire connection method		Connector	



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

Fig.3-14 : 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. 3-13, and wire so that the contact closes when the door is closed. Details of this function according to the robot status are shown below.

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

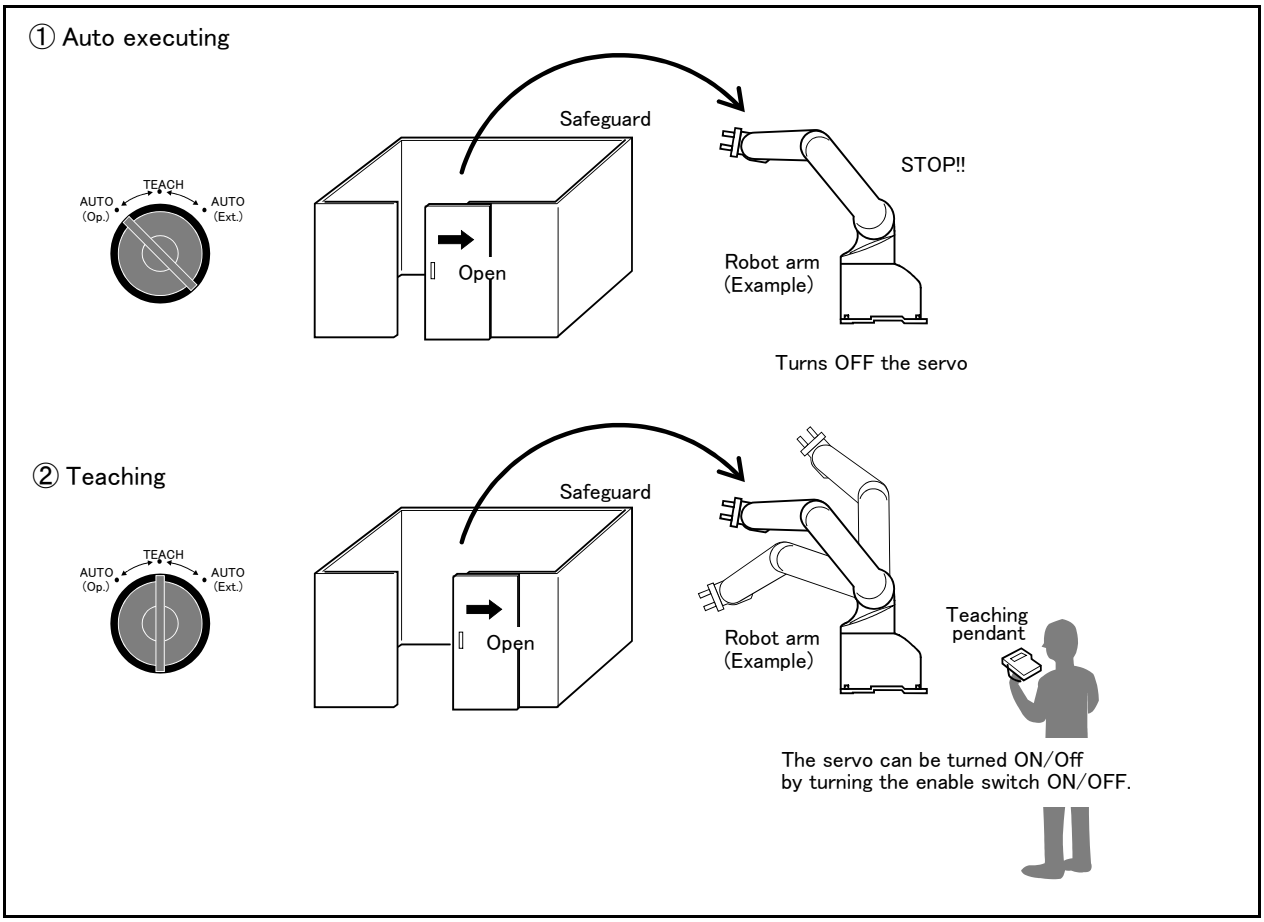


Fig.3-15 : Door switch function

3.6.4 Enabling device function

When the abnormalities occur in teaching operations etc., the robot's servo power can be immediately cut only by switch operation of the enabling device[Note1)] (servo-off), and the safety increases. To use the robot safely, please be sure to connect the enabling device.

- When door is opening.....Please do teaching by two-person operations. One person has T/B, the other has enabling device. Turn on the servo power, in the condition that both of switches are pushed. (Enable switch of T/B and enabling device) Then the jog operation will be available. You can off the servo power only by releasing the switch of the enabling device. And, care that the servo-on and releasing the brake cannot be done in the condition that the switch of the enabling device is released.
- When door is closing.....You can turn on the servo power by operation of only T/B

Note1)Recommendation products: HE1G-L20MB (IDEC)

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.

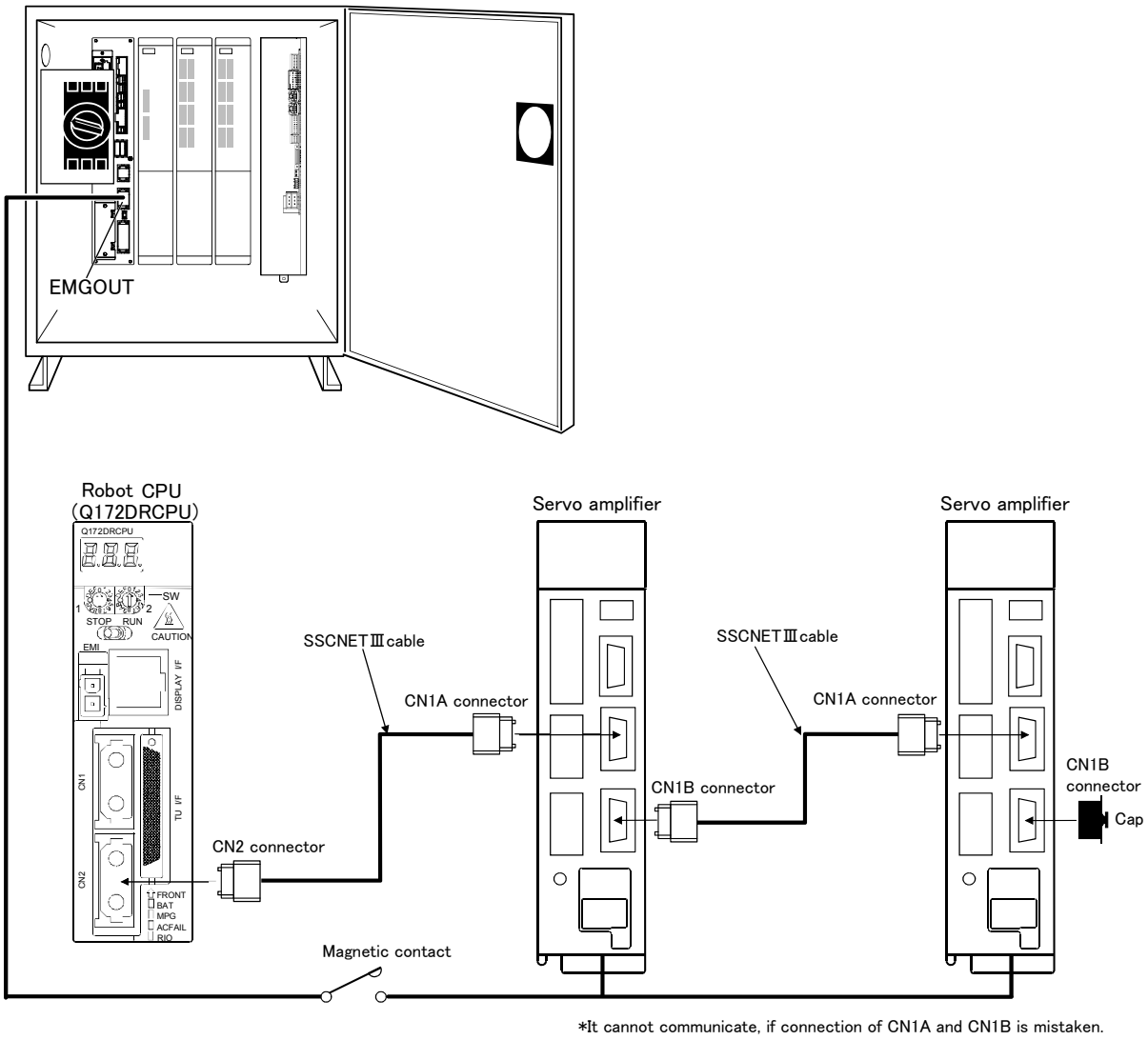
3.7.1 Wiring of the Additional Axis Interface

Table 3-8 shows the connectors for additional axes inside the controller and Fig. 3-16 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 56, "3.8 Magnet contactor control connector output (AXMC) for addition axes".

Table 3-8 : Dedicated Connectors inside the Controller

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

<DU3-700/700M>



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

Fig.3-16 : Example of addition axis connection (DU3-700/700M)

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

When an additional axis is used, the servo ON/OFF status of the additional axis can be synchronized with the servo ON/OFF status of the robot itself by using the output contact (AXMC) provided on the rear or inside of the controller and configuring a circuit so that the power to the servo amplifier for the additional axis can be turned off when this output is open.

Fig. 3-17 shows an example of its circuit, and Fig. 3-18 show the layout drawings of the output contact (AXMC1). When you are using an additional axis, please perform appropriate circuit connections by referring to these drawings.

Refer to the separate "Additional axis interface Instruction Manual" for details on the additional axis function.

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

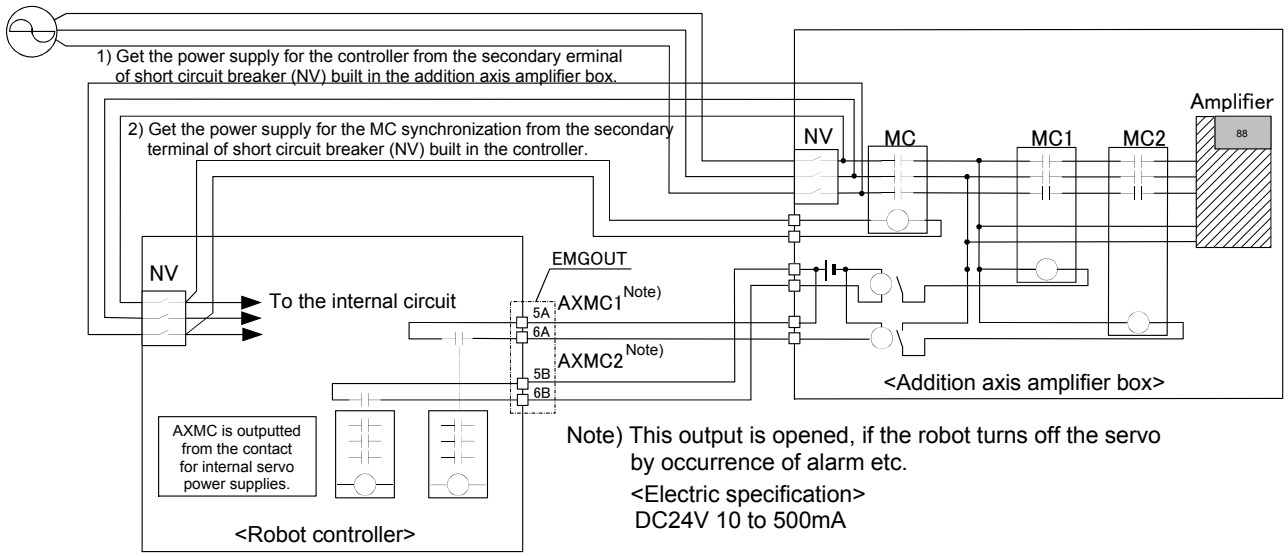


Fig.3-17 : Example of circuit for addition axes of Magnet contactor control output

<DU3-700/700M>

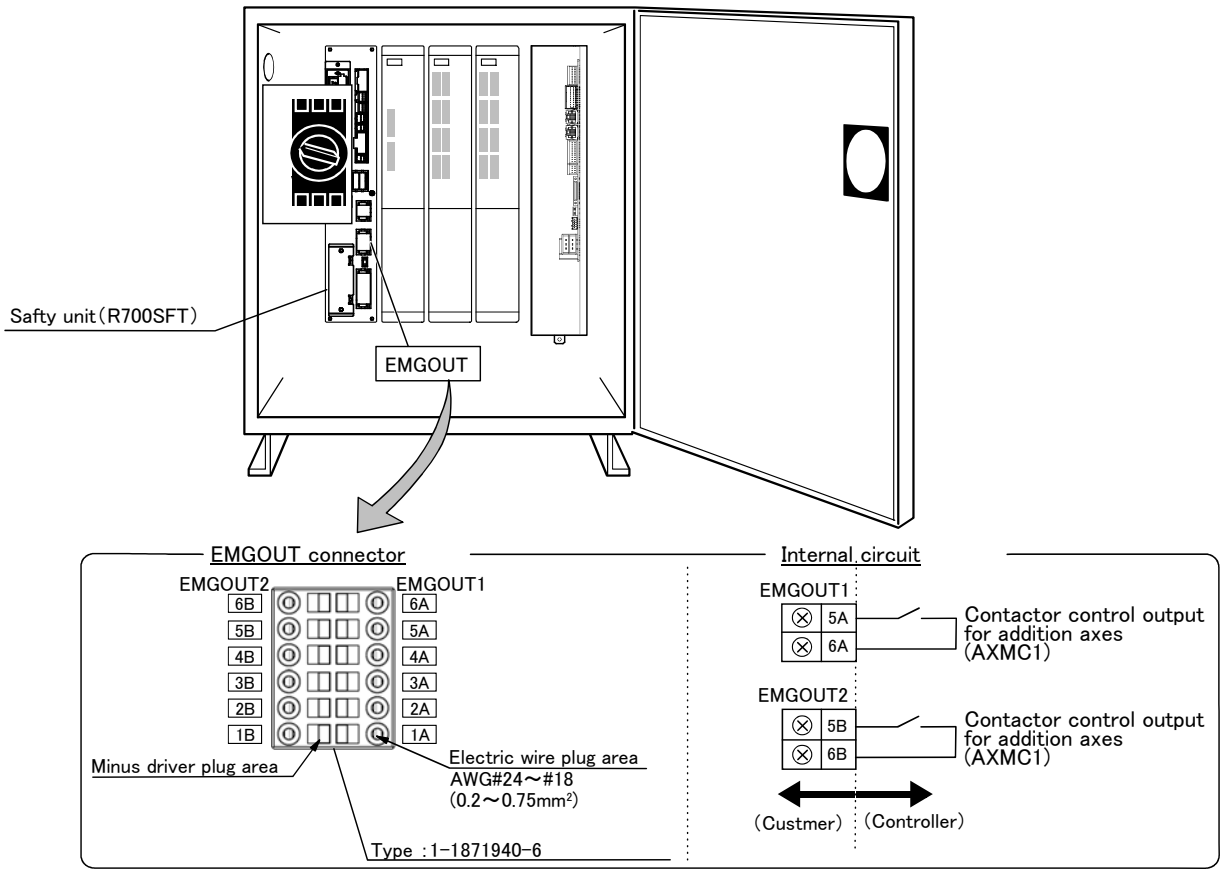


Fig.3-18 : EMGOUT connector (DU3-700/700M)

3.9 Options

■ What are options?

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

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

(1) Teaching pendant (T/B)

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

■ Outline

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

■ Configuration

Table 3-9 : Configuration device

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

■ Specifications

Table 3-10 : Specifications

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

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

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

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

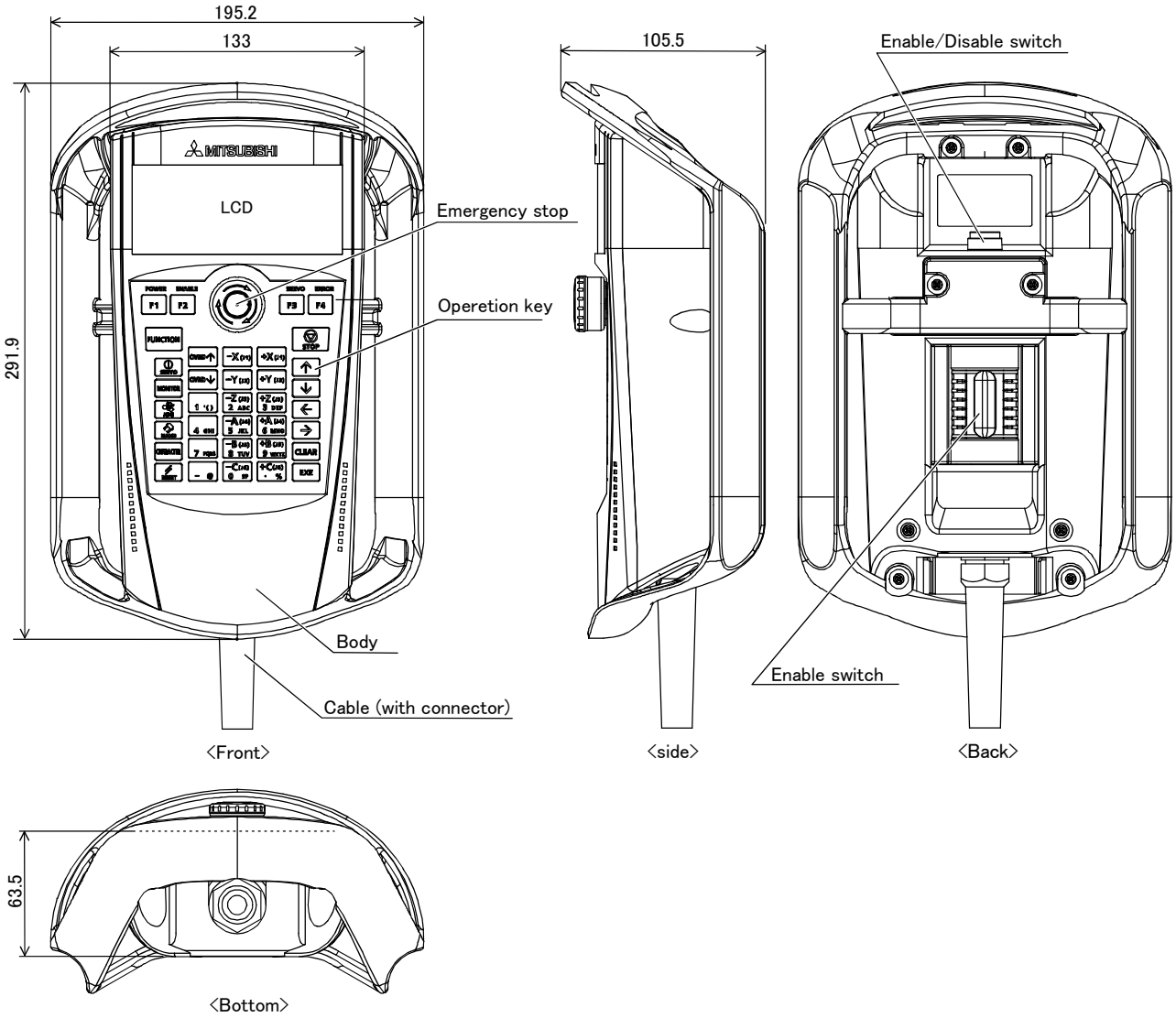
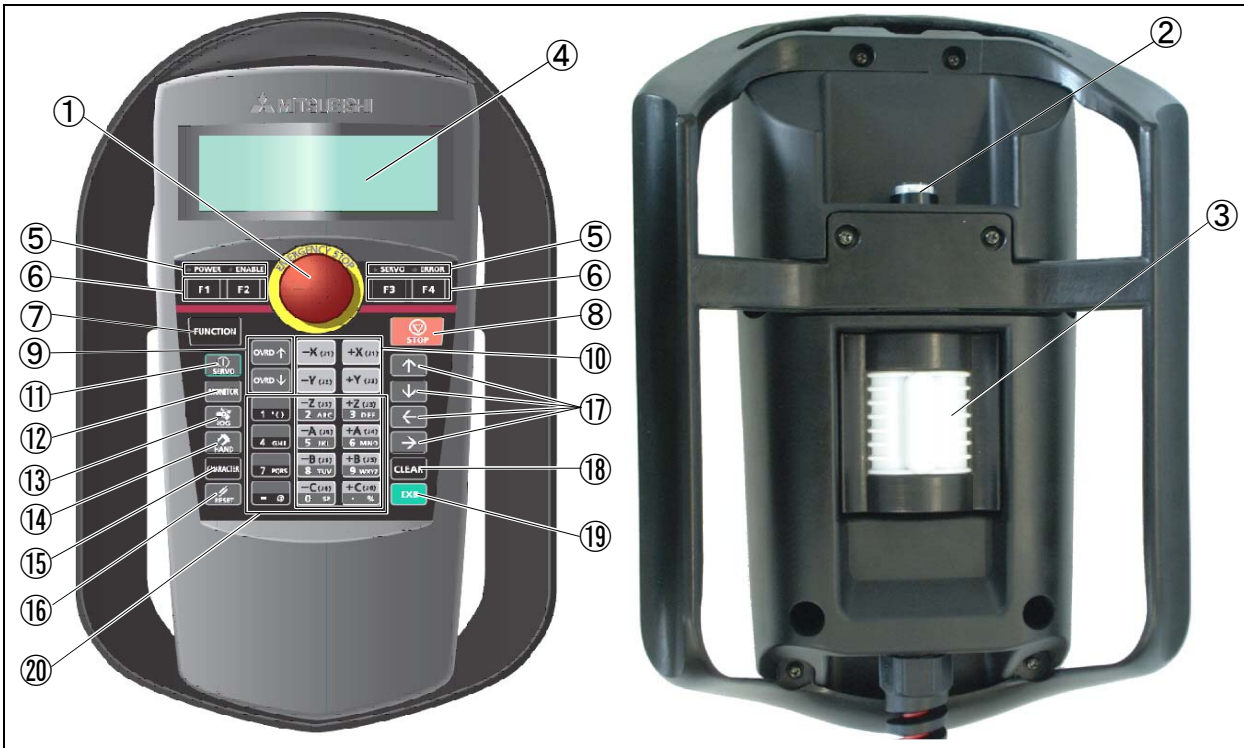


Fig.3-19 : Outside dimensions of teaching pendant

■ Installation method

The teaching pendant is connected to the T/B connector on the front of the controller.

■ Key layout and main functions



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

Fig.3-20 : Teaching pendant key layout and main functions

(2) Pneumatic hand interface

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

■ Outline

This interface is required to use the robot arm's hand output signals. 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. .

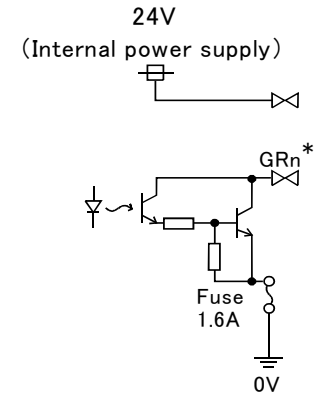
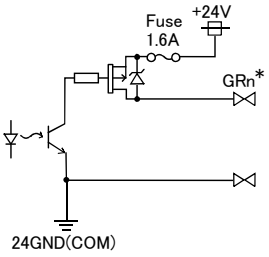
■ Configuration

Table 3-11 : Configuration device

Part name	Type	Qty.	Remarks
Pneumatic hand interface	2A-RZ365(Sink type)	Either one pc.	Output 8 points expansion.
	2A-RZ375(Source type)		

■ Specifications

Table 3-12 : Specifications

Item		Specification	Internal circuit
Type		Transistor output	<Sink type>  <Source type>  * GRn = GR1 ~ GR8
No. of output points		8	
Insulation method		Photo coupler insulation	
Rated load voltage		DC24V	
Rated load voltage range		DC21.6 to 26.4VDC	
Max. current load		0.1A/ 1 point (100%)	
Current leak with power OFF		0.1mA or less	
Maximum voltage drop with power ON		DC0.9V(TYP.)	
Response time	OFF-ON	2ms or less (hardware response time)	
	ON-OFF	2 ms or less (resistance load) (hardware response time)	
Fuse rating		Fuses 1.6A (each one common)	
Common method		8 points, 1 common	

■ Installation method

This is mounted in the controller.

Attach the pneumatic hand interface (2A-RZ365/2A-RZ375) 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.

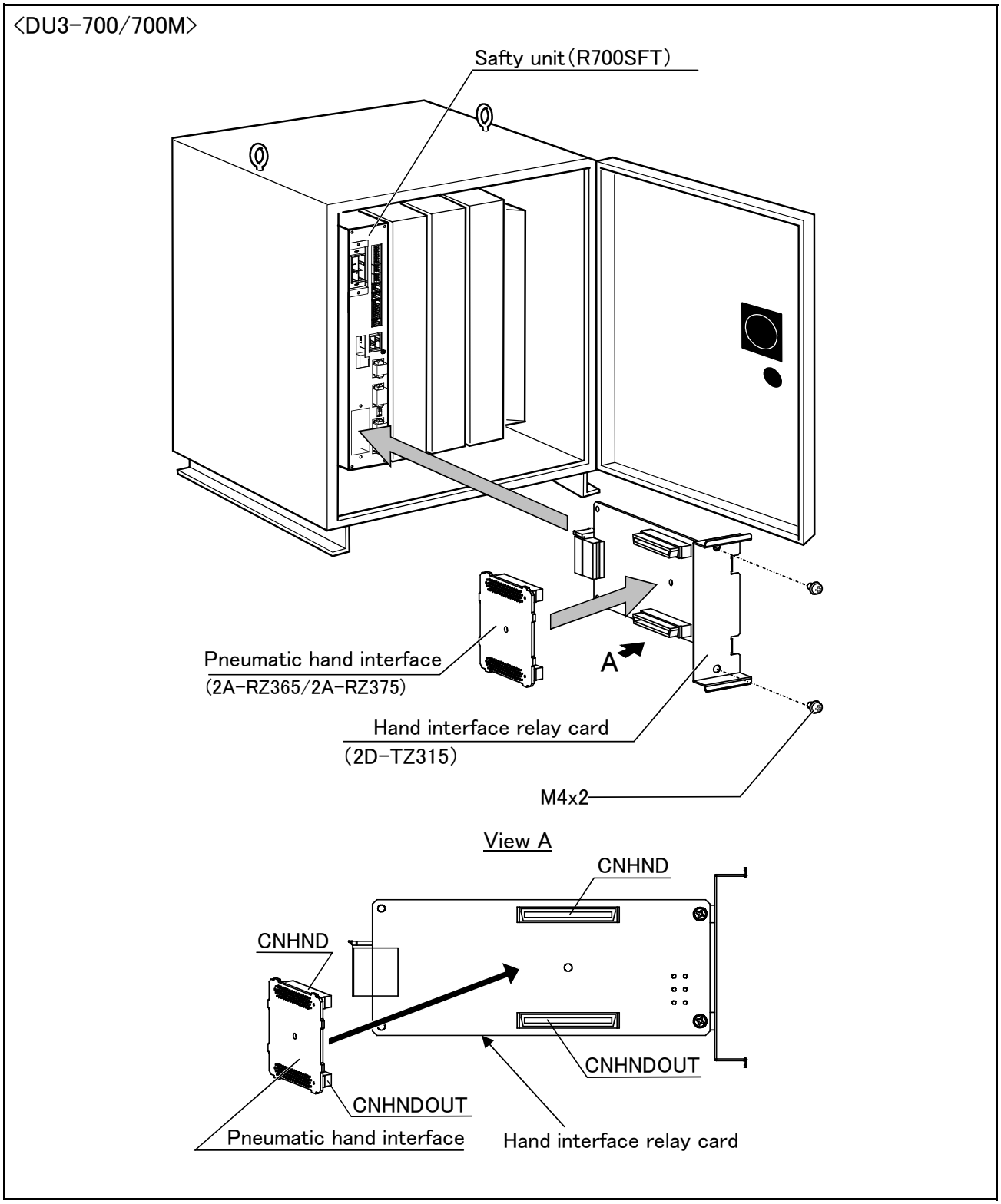


Fig.3-21 : Installation of the pneumatic hand interface (DU3-700/700M)

(3) 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
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 3-13 : Product configuration

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

■ Features

(1) Simple operation with guidance method and menu method
The Windows standard is used for windows operation, so the controller initialization and startup operations can be carried out easily by following the instructions given on the screen. Even a beginner can easily carry out the series of operations from program creation to execution.

(2) Increased work efficiency with ample support functions
The work efficiency is greatly improved with the multi-window method that carries out multiple steps and displays in parallel. The renumbering function, and copy, search, syntax check and step execution are especially sufficient, and are extremely useful when editing or debugging the program.
With the simulation function support, the program can be debugged and the tact checked before starting the machine at the site. This allows the on-site startup work efficiently to be greatly improved.

■ Functions

Table 3-14 : Functions

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

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

RT ToolBox2 (3D-11C-WINE)

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

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

(4) Instruction Manual(bound edition)

■ Order type : ● 5S-QY00-PE01 (RV-18SQ-S/18SQC-S)

■ Outline

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

■ Configuration

Table 3-15 : Product configuration(RV-18SQ-S/18SQC-S series)

Name	Type	Specifications
Instruction Manual	5S-QY00-PE01	
Safety Manual	BFP-A5948	Items relating to safety in handling the robot
Standard Specifications	BFP-A8767	Specification of the robot arm and controller
Robot Arm Setup & Maintenance	BFP-A8768	Installation method of the robot arm, jog operation, and maintenance and inspection procedures
Controller Setup, Basic Operation and Maintenance		Installation method of the controller, basic operation, and maintenance and inspection procedures
Detailed Explanation of Functions and Operations	BFP-A8586	Functions of the controller and T/B, operation method, and explanation of MELFA-BASIC Ⅴ
Troubleshooting	BFP-A8588	Causes of errors occurred and their countermeasures
Additional axis function	BFP-A8663	Function of the additinal axis, operation method.

3.10 Maintenance parts

The consumable parts used in the controller are shown in Table 3-16. 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 3-16 : Contloller consumable parts list

No.	Name	Type Note1)	Qty.	Usage place	Supplier
CR3Q-700 controller					
1	Lithium battery	Q6BAT	1	Robot CPU unit	Mitsubishi Electric System Service;Co.,Ltd
2	Fan (40 square)		5	Amplifier unit Converter unit	
3	Fan (90 square)		1	Control unit	
4	Filter		1	Controller rear	

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

4 Software

4.1 List of commands

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

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

Type	Class	Function	Input format (example)
Position and operation control	Joint interpolation	Moves to the designated position with joint interpolation.	Mov P1
	Linear interpolation	Moves to the designated position with linear interpolation.	Mvs P1
	Circular interpolation	Moves along a designated arc (start point → passing point → start point (end point)) with 3-dimensional circular interpolation (360 degrees).	Mvc P1,P2,P1
		Moves along a designated arc (start point → passing point → end point) with 3-dimensional circular interpolation.	Mvr P1,P2,P3
		Moves along the arc on the opposite side of a designated arc (start point → reference point → end point) with 3-dimensional circular interpolation.	Mvr2 P1,P9,P3
		Moves along a set arc (start point → end point) with 3-dimensional circular interpolation.	Mvr3 P1,P9,P3
	Speed designation	Designates the speed for various interpolation operations with a percentage (0.1% unit).	Ovrd 100
		Designate the speed for joint interpolation operation with a percentage (0.1% unit).	JOvrd 100
		Designates the speed for linear and circular interpolation with a numerical value (mm/s unit).	Spd 123.5
		Designates the acceleration/deceleration time as a percentage in respect to the predetermined maximum acceleration/deceleration. (1% unit)	Accel 50,80
	Operation	Performance of movement is upgraded corresponding to the application.	MvTune 4
		Adds a process unconditionally to the operation.	Wth
		Adds a process conditionally to the operation.	Wthif
		Designates smooth operation.	Cnt 1,100,200
		Designates the positioning completion conditions with a No. of pulses.	Fine 200
		Designates the positioning completion conditions with a joint interpolation.	Fine 0.5, J, 2
		Designates the positioning completion conditions with a distance in a straight line	Fine 1, P
		Turns the servo power ON/OFF for all axes.	Servo OFF
		Limits the operation of each axis so that the designated torque is not exceeded.	Torq 4,10
	Position control	Designates the base conversion data.	Base P1
		Designates the tool conversion data.	Tool P1
	Pallet	Defines the pallet.	Def Plt 1,P1,P2,P3,P4,5,3,1
		Operates the pallet grid point position.	Plt 1,M1
	Singular point passage	Move to a specified position using linear interpolation passing through a singular point.	Mvs P1 TYPE 0,2
Program control	Branching	Branches unconditionally to the designated place.	GoTo 120
		Branches according to the designated conditions.	If M1=1 Then GoTo 100 Else GoTo 20 End If
		Repeats until the designated end conditions are satisfied.	For M1=1 TO 10 Next M1
		Repeats while the designated conditions are satisfied.	While M1<10 Wend
		Branches corresponding to the designated expression value.	On M1 GOTO 100,200,300
		Executes program block corresponding to the designated expression value..	Select Case 1 Break Case 2 Break End Select
		Moves the program process to the next line.	Skip
	Impact detection	Set to enable/disable the impact detection.	ColChk ON/OFF
		Set the detection level of the impact detection.	ColLvl 100,80,,,,,,

Type	Class	Function	Input format (example)
Program control	Subroutine	Executes the designated subroutine. (Within program)	GoSub 200
		Returns from the subroutine.	Return
		Executes the designated program.	CallP "P10",M1,P1
		Defines the program argument executed with the CALLP command.	FPrm M10,P10
		Executes the subroutine corresponding to the designated expression value.	On M1 GOSUB 100,200,300
	Interrupt	Defines the interrupt conditions and process.	Def Act 1, M1=1 GOTO 100
		Enables/disables the interrupt.	Act 1=1
		Defines the start line of the program to be executed when an interrupt is generated from the communication line.	On Com(1) GOSUB 100
		Enables the interrupt from the communication line.	Com(1) ON
		Disables the interrupt from the communication line.	Com(1) OFF
		Stops the interrupt from the communication line.	Com(1) STOP
	Wait	Designates the wait time, and the output signal pulse output time. (0.01s unit)	Dly 0.5
		Waits until the variable becomes the designated value.	Wait M_IN(1)=1
	Stop	Stops the program execution.	Hlt
		Generates an error. During program execution, continue, stop or servo OFF can be designated.	Error 9000
	End	Ends the program execution.	End
Hand	Hand open	Opens the designated hand.	HOpen 1
	Hand close	Closes the designated hand.	HClose 1
Input/output	Assignment	Defines the input/output variables.	Def IO PORT1=BIT,0
	Input	Retrieves the general-purpose input signal.	M1=M_IN (1)
	Output	Calls out the general-purpose output signal.	M_Out(1) =0
Parallel execution	Mechanism designation	Acquires the mechanism with the designated mechanism No.	GetM 1
		Releases the mechanism with the designated mechanism No.	RelM 1
	Selection	Selects the designated program for the designated slot.	XLoad 2,"P102"
	Start/stop	Carries out parallel execution of the designated program.	XRun 3,"100",0
		Stops parallel execution of the designated program.	XStp 3
		Returns the designated program's execution line to the head and enters the program selection enabled state.	XRst 3
Others	Definition	Defines the integer type or real number type variable.	Def Inte KAISUU
		Defines the character string variable.	Def Char MESSAGE
		efines the layout variable. (Up to 3-dimensional possible)	Dim PDATA(2,3)
		Defines the joint variable.	Def Jnt TAIHI
		Defines the position variable.	Def Pos TORU
		Defines the function.	Def FN TASU(A,B)=A+B
	Clear	Clears the general-purpose output signal, variables in program, variables between programs, etc.	Clr 1
	File	Opens a file.	Open "COM1:" AS #1
		Closes a file.	Close #1
		Inputs data from a file.	Input# 1,M1
		Outputs data to a file.	Print# 1,M1
	Comment	Describes a comment.	Rem "ABC"
	Label	Indicates the branching destination.	*SUB1

4.2 List of parameters

show the main parameter in the Table 4-2.

Table 4-2 : List of parameters

Parameter		Details
Standard tool coordinates.	MEXTL	Set the default value for the tool data. Unit: mm or deg.
Standard base coordinates	MEXBS	Set the relation of the world coordinate system and robot coordinate system. Unit: mm or deg.
XYZ operation range	MEPAR	Designate the overrun limit value for the world coordinate system.
JOINT operation range	MEJAR	Set the overrun limit value for each joint axis.
Free plane limit		This is the overrun limit set with the free plane. Create a plane with the three coordinates x1, y1, z1 to x3, y3, z3, and set the outer side of the plane as the outside operation range (error). The following three types of parameters are used.
	SFC1P : SFC8P	Eight types of free plane limits can be set in SFC1P to SFC8P. There are nine elements, set in the order of x1, y1, z1, x2, y2, z2, x3, y3, z3.
	SFC1ME : SFC8ME	Designate which mechanism to use eight types of set free plane limits. The mechanism No. to use is set with 1 to 8.
	SFC1AT : SFC8AT	Set the validity of the eight types of set free plane limits. (Valid 1/Valid 2/invalid = 1/-1/0)
User-defined area		An area (cube) defined with two XYZ coordinate points can be designated and that area set as the outside operation range. Furthermore, a signal can be output when the axis enters that area. Up to 32 types of area can be designated.
	AREA1CS : AREA32CS	Specify the coordinate system of the user definition area *. 0: Base coordinate system (conventional compatibility) 1: Robot coordinate system
	AREA1P1 : AREA32P1	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 : AREA32P2	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 : AREA32ME	Designate which mechanism to use the eight types of set area. The mechanism No. to use is set with 1 to 8
	AREA1AT : AREA32AT	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.
Additional axis function	Explains the specifications, functions and operations of the additional axis control.

6 Safety

6.1 Safety

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

6.1.1 Self-diagnosis stop functions

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

Table 6-1 : Self-diagnosis stop functions

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

Table 6-2 : List of stop functions

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

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

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

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

[Caution] The external emergency stop input is prepared as a b contact for safety proposes. Thus, if the emergency stop input circuit is opened when the robot is started up, the robot will not operate. Refer to Page 76, "6.1.7 Examples of safety measures"for details.

6.1.3 Precautions for using robot

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

(1) Robot installation

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

(2) Prevention of contact with operator

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

(3) Work procedures

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

(4) Training

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

(5) Daily inspection and periodic inspection

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

6.1.4 Safety measures for automatic operation

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

6.1.5 Safety measures for teaching

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

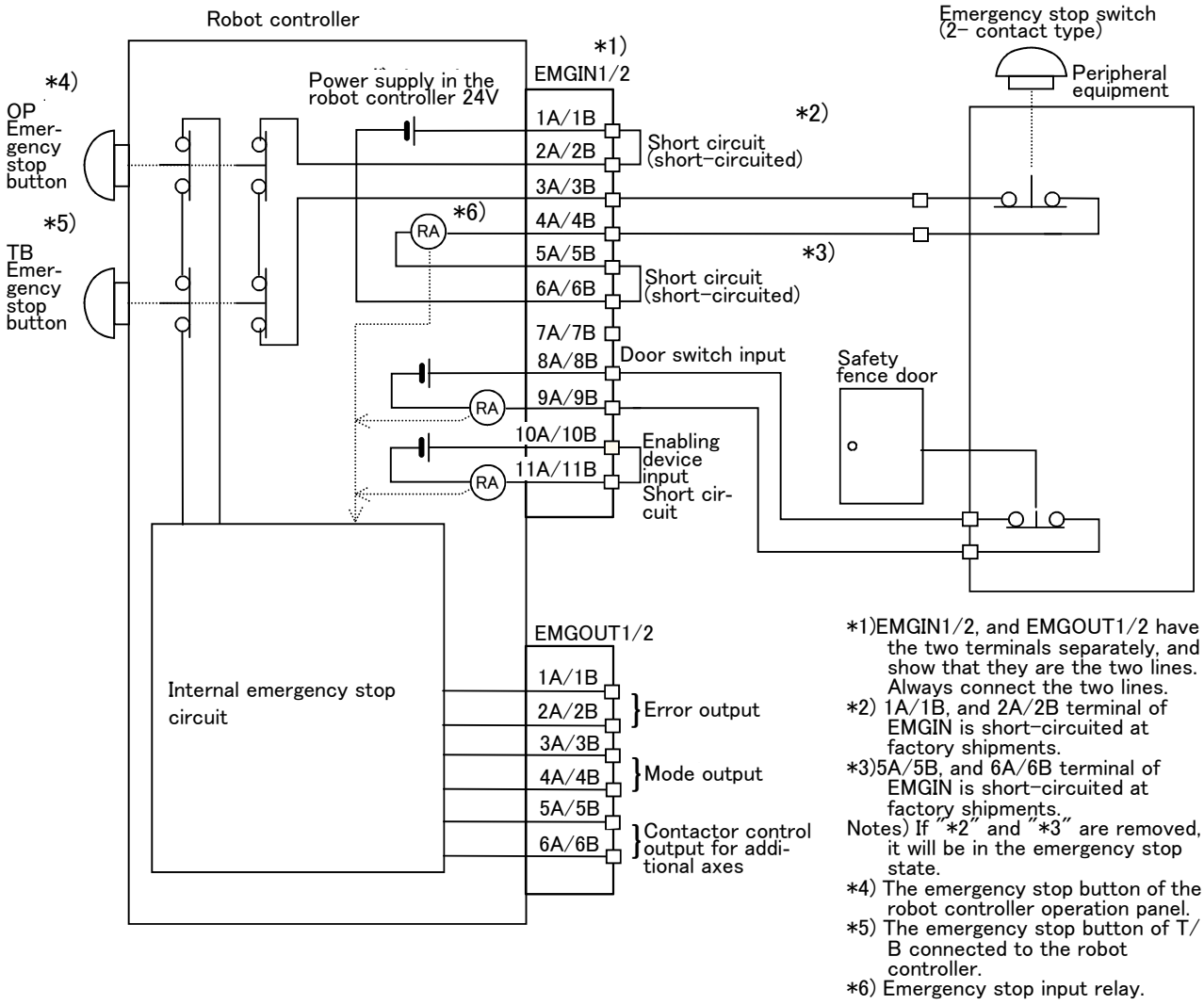
6.1.6 Safety measures for maintenance and inspections, etc.

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

6.1.7 Examples of safety measures

Two emergency-stop input circuits are prepared on the user wiring terminal block of the controller. Create a circuit as shown below for safety measures. In addition, the figure shows the normal state which is not in the emergency stop state.

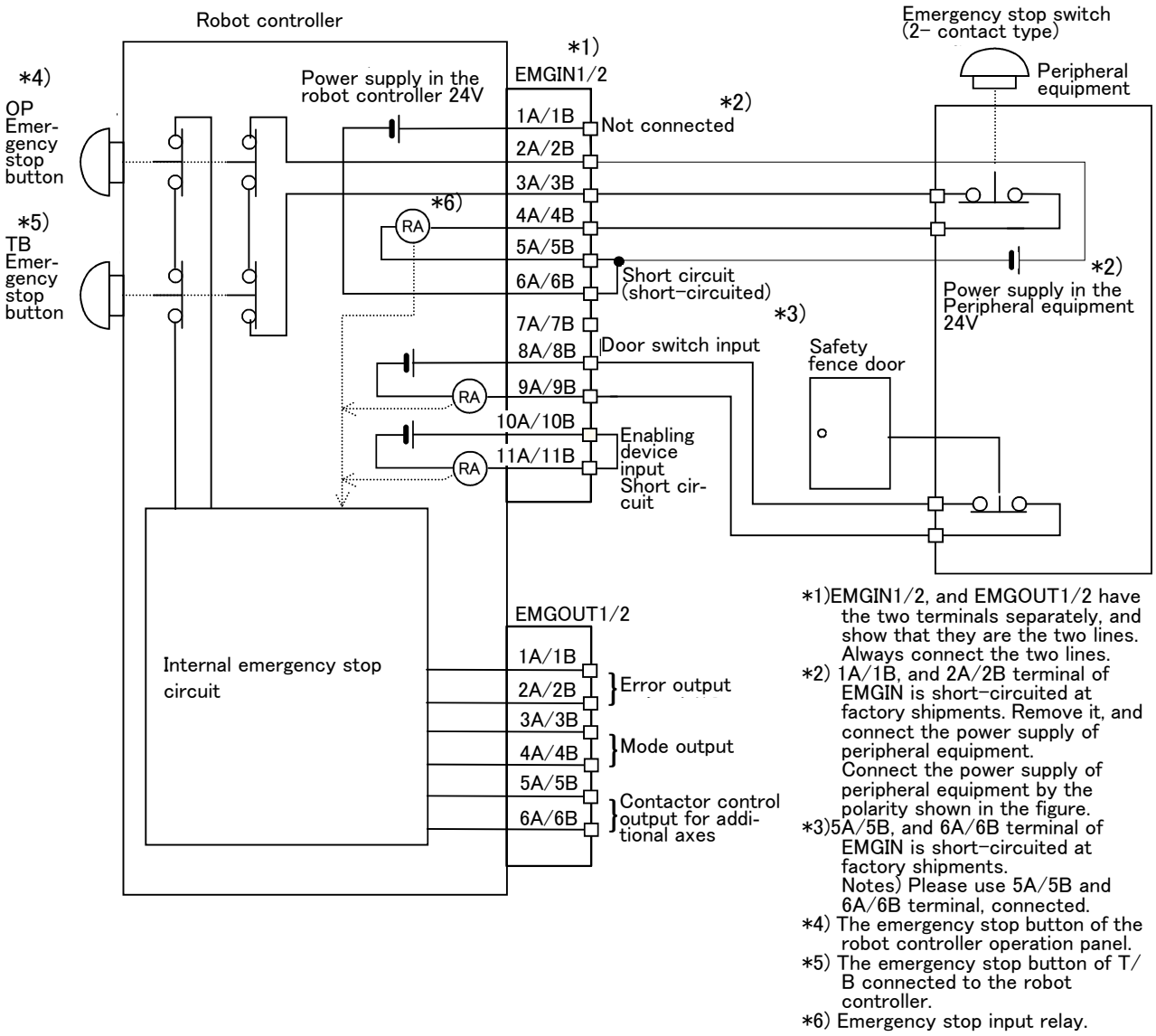
<Wiring example 1>: Connect the emergency stop switch of peripheral equipment to the robot controller.
The power supply for emergency stop input uses the power supply in the robot controller.
<Operation of the emergency stop>
If the emergency stop switch of peripheral equipment is pushed, the robot will also be in the emergency stop state.



[Caution] Since we have omitted the information in part because of explanation, there is the section different from the product. Also refer to Page 50, "Fig.3-13 : External emergency stop connection".

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

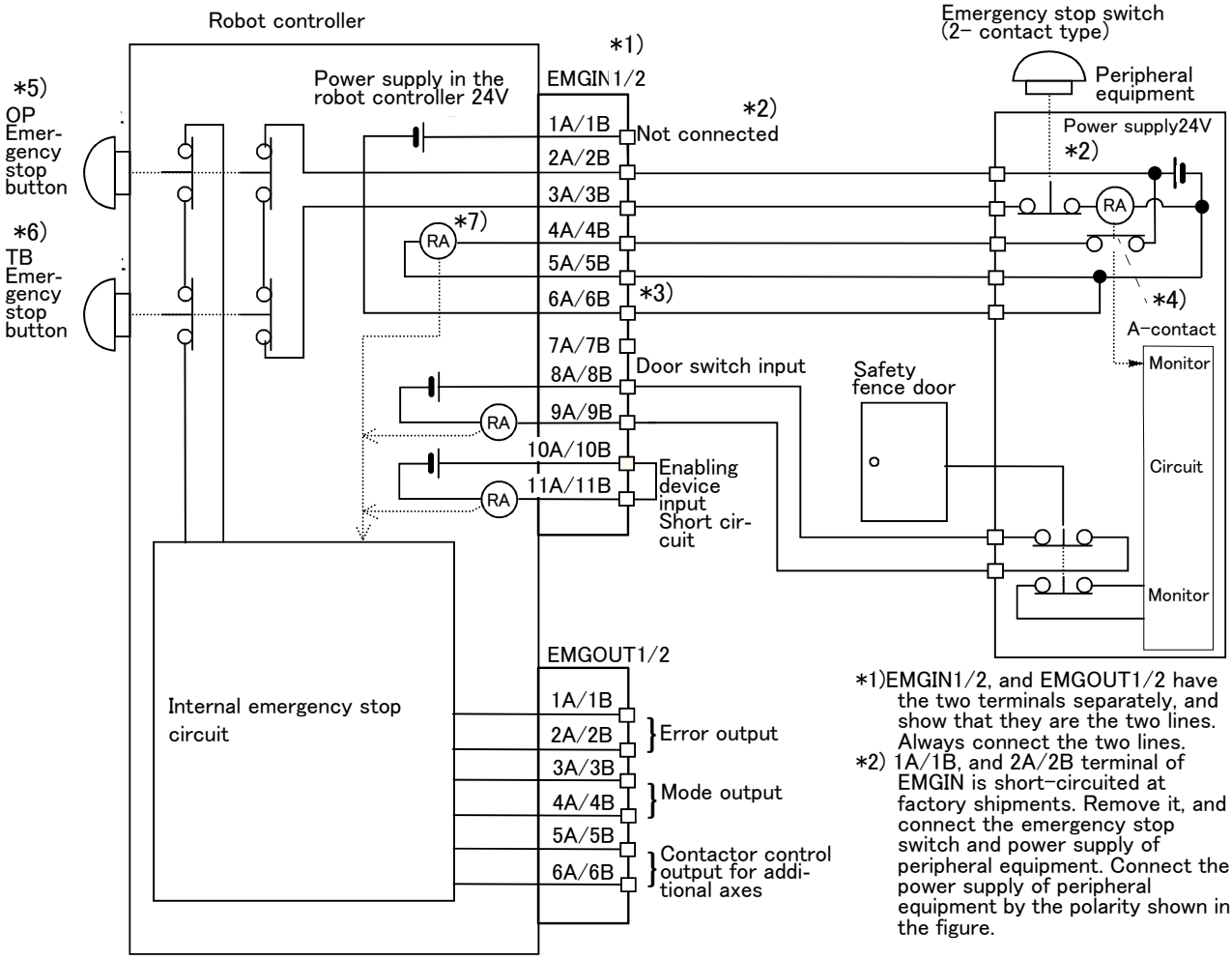
<Wiring example 2>: Connect the emergency stop switch of peripheral equipment to the robot controller.
The power supply for emergency stop input uses the power supply of peripheral equipment.
<Operation of the emergency stop>
If the emergency stop switch of peripheral equipment is pushed, the robot will also be in the emergency stop state.



[Caution] Since we have omitted the information in part because of explanation, there is the section different from the product. Also refer to Page 50, "Fig.3-13 : External emergency stop connection".

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

<Wiring example 3>: Connect the emergency stop switch of peripheral equipment to the robot controller.
The power supply for emergency stop input uses the power supply of peripheral equipment. Monitor the emergency stop state by the peripheral equipment side.
<Operation of the emergency stop>
If the emergency stop switch of peripheral equipment is pushed, the robot will also be in the emergency stop state. And, if the emergency stop switch of OP or T/B is pushed in the state of the power of robot controller OFF, peripheral equipment state can be the emergency stop also.

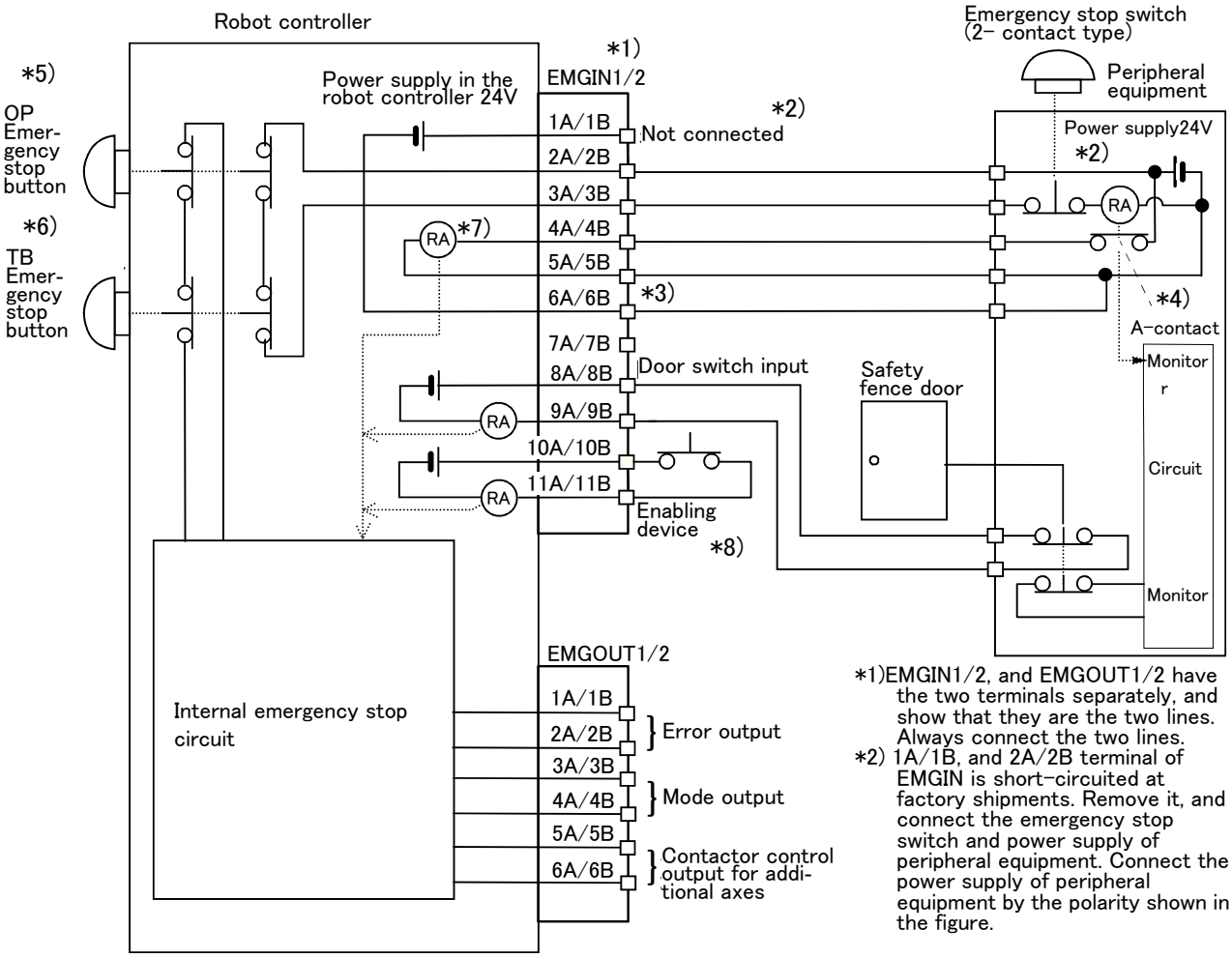


*3)5A/5B, and 6A/6B terminal of EMGIN is short-circuited at factory shipments. Remove it and connect with the power supply ground of peripheral equipment.
*4) Please use a A contact type of the relay with the compulsive guide.
*5) The emergency stop button of the robot controller operation panel.
*6) The emergency stop button of T/B connected to the robot controller.
*7) Emergency stop input relay.

[Caution] Since we have omitted the information in part because of explanation, there is the section different from the product. Also refer to Page 50, "Fig.3-13 : External emergency stop connection".

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

<Wiring example 4>: Connect the emergency stop switch, door switch, and enabling device of peripheral equipment to the robot controller. The power supply for emergency stop input uses the power supply of peripheral equipment. Monitor the emergency stop state by the peripheral equipment side.
<Operation of the emergency stop>
If the emergency stop switch of peripheral equipment is pushed, the robot will also be in the emergency stop state. And, if the emergency stop switch of OP or T/B is pushed in the state of the power of robot controller OFF, peripheral equipment state can be the emergency stop also.



*1)EMGIN1/2, and EMGOUT1/2 have the two terminals separately, and show that they are the two lines. Always connect the two lines.
*2) 1A/1B, and 2A/2B terminal of EMGIN is short-circuited at factory shipments. Remove it, and connect the emergency stop switch and power supply of peripheral equipment. Connect the power supply of peripheral equipment by the polarity shown in the figure.

*3)5A/5B, and 6A/6B terminal of EMGIN is short-circuited at factory shipments. Remove it and connect with the power supply ground of peripheral equipment.
*4) Please use a A contact type of the relay with the compulsive guide.
*5) The emergency stop button of the robot controller operation panel.
*6) The emergency stop button of T/B connected to the robot controller.
*7) Emergency stop input relay.
*8) Refer to Page 53, "3.6.4 Enabling device function"for the enabling device.

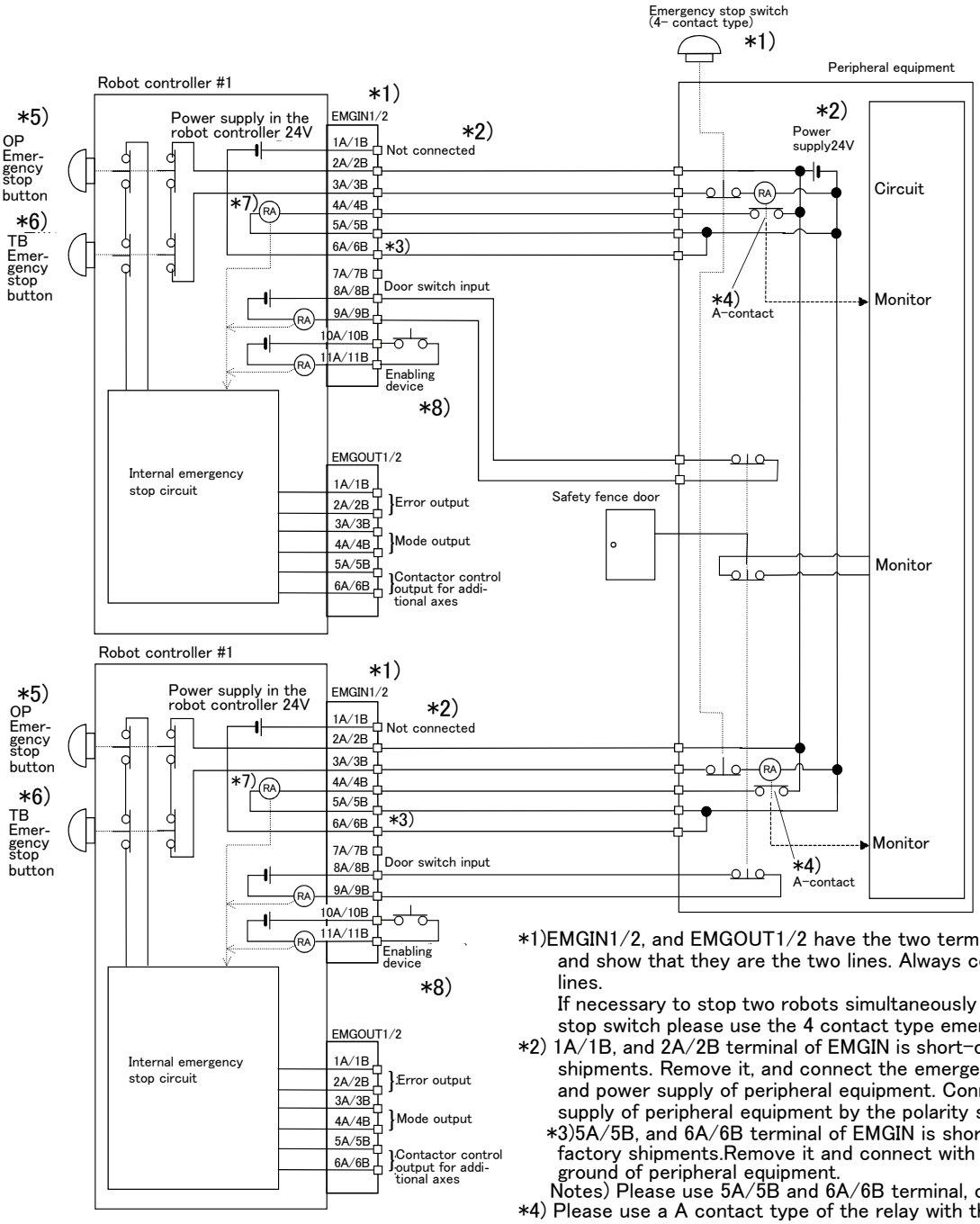
[Caution] Since we have omitted the information in part because of explanation, there is the section different from the product. Also refer to Page 50, "Fig.3-13 : External emergency stop connection".

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

<Wiring example 5>: Connect the emergency stop switch of peripheral equipment, and the door switch to two robot controllers, and it interlocks. Connect the enabling device to the robot controller.The power supply for emergency stop input uses the power supply of peripheral equipment. Monitor the emergency stop state by the peripheral equipment side.

<Operation of the emergency stop>

If the emergency stop switch of peripheral equipment is pushed, the robot will also be in the emergency stop state. And, if the emergency stop switch of OP or T/B is pushed in the state of the power of robot controller OFF, peripheral equipment state can be the emergency stop also.



*1)EMGIN1/2, and EMGOUT1/2 have the two terminals separately, and show that they are the two lines. Always connect the two lines.
If necessary to stop two robots simultaneously by one emergency stop switch please use the 4 contact type emergency stop switch.

*2) 1A/1B, and 2A/2B terminal of EMGIN is short-circuited at factory shipments. Remove it, and connect the emergency stop switch and power supply of peripheral equipment. Connect the power supply of peripheral equipment by the polarity shown in the figure.

*3)5A/5B, and 6A/6B terminal of EMGIN is short-circuited at factory shipments.Remove it and connect with the power supply ground of peripheral equipment.
Notes) Please use 5A/5B and 6A/6B terminal, connected.

*4) Please use a A contact type of the relay with the compulsive guide.

*5) The emergency stop button of the robot controller operation panel.

*6) The emergency stop button of T/B connected to the robot controller.

*7) Emergency stop input relay.

*8) Refer to Page 53, "3.6.4 Enabling device function" for the enabling device.

[Caution] Since we have omitted the information in part because of explanation, there is the section different from the product. Also refer to Page 50, "Fig.3-13 : External emergency stop connection".

Fig.6-5 : Example of safety measures (Wiring example 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 to Fig. 6-5. Note that there are limits to the No. of switch contacts, capacity and cable length, so refer to the following and install.

- Switch contact.....Prepare a 2-contact type.
- Switch contact capacity.....Use a contact that operates with a switch contact capacity of approx. 1mA to 100mA/24V. Note1)
- Cable length.....The length of the wire between the switch and terminal block must be max. 15m or less. Please use the shield line, in case of the cable may receive the noise etc. by other equipment, such as servo amplifier. And, since the ferrite core is attached as noise measures parts, please utilize.

Note1)The minimum load electric current of the switch is more than 5mA/24V.

6.2 Working environment

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

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

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

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

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

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

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

6.3 Precautions for handling

(1) This robot has brakes on all axes. The precision of the robot may drop, looseness may occur and the reduction gears may be damaged if the robot is moved with force with the brakes applied.
(2) Avoid moving the robot arm by hand. When unavoidable, gradually move the arm. If moved suddenly, the accuracy may drop due to an excessive backlash, or the backed up data may be destroyed.
(3) Note that depending on the posture, even when within the movement range, the wrist section could interfere with the base section. Take care to prevent interference during jog. Note1)
(4) The robot arm is configured of precision parts such as bearings. Grease is used for lubricating these parts. When cold starting at low temperatures or starting operation after long-term stoppage, the position accuracy may drop or servo alarms may occur. If these problems occur, perform a 5 to 10 minute running-in operation at a low speed (about a half of normal operating speed).
(5) The robot arm and controller must be grounded with Class D grounding to secure the noise resistance and to prevent electric shocks.
(6) The items described in these specifications are conditions for carrying out the periodic maintenance and inspections described in the instruction manual.
(7) When using the robot arm on a mobile axis or elevating table, the machine cables enclosed as standard configuration may break due to the fixed installation specifications. In this case, use the machine cable extension (for flexed)" factory shipment special specifications or options.
(8) If this robot interferes with the workpiece or peripheral devices during operation, the position may deviate, etc. Take care to prevent interference with the workpiece or peripheral devices during operation.
(9) Do not attach a tape or a label to the robot arm and the controller. If a tape or a label with strong adhesive power, such as a packaging tape, is attached to the coated surfaces of the robot arm and controller, the coated surface may be damaged when such tape or label is peeled off.
(10) If the robot is operated with a heavy load and at a high speed, the surface of the robot arm gets very hot. It would not result in burns, however, it may cause secondary accidents if touched carelessly.
(11) Do not shut down the input power supply to stop the robot. If the power supply is frequently shut down during a heavy load or high-speed operation, the speed reducer may be damaged, backlash may occur, and the program data may be destroyed.
(12) If the J1, J2 and J3 axes collide with the mechanical stopper during the automatic operation of the robot, it is necessary to replace the resin part of the mechanical stopper unit. For the replacement of the resin parts, please contact Mitsubishi or Mitsubishi's dealer.
If the resin part is not replaced, the mechanism unit and the speed reducer may be damaged significantly when the axes collide with the mechanical stopper next or subsequent time.
(13) During the robot's automatic operation, a break is applied to the robot arm when the input power supply is shut down by a power failure, for instance. When a break is applied, the arm may deviate from the operation path predetermined by automatic operation and, as a result, it may interfere with the mechanical stopper depending on the operation at shutdown. In such a case, take an appropriate measure in advance to prevent any dangerous situation from occurring due to the interference between the arm and peripheral devices.
Example) Installing a UPS (uninterruptible power supply unit) to the primary power source in order to reduce interference.
(14) Do not conduct an insulated voltage test. If conducted by mistake, it may result in a breakdown. If conducting an insulation test, although it is not covered by warranty, set the leakage current to 100 mA. If a leakage current of 10 mA is set, a low measurement value will be shown due to the leakage current of the built-in AC line filter.
(15) Fretting may occur on the axis which moving angle or moving distance move minutely, or not moves. 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 make no fretting recommends to move these axes about once every day the 30 degree or more, or the 30mm or more.

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

7 Appendix

Appendix 1 : Specifications discussion material

■ Customer information

Company name		Name	
Address		Telephone	

■ Purchased mode

Specification	Type
Standard specification	☐ RV-18SQ-S
Clean specification	☐ RV-18SQC-S

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

Item		Standard specifications	Special shipping specifications
Controller	Structure	☐ Floor type CR3D-709M(IP54) : RV-18SQ-S CR3D-709(Clean) : RV-18SQC-S	☐ Caster type CR3D-709M(IP54) : RV-18SQ-S CR3D-709(Clean) : RV-18SQC-S

■ Options (Installable after shipment)

Item		Type	Provision, and specifications when provided.
Robot arm	Operating range change	1S-DH-01	☐ Not provided ☐ Provided
	Machine cable extention	1S- ☐☐ CBL-02	☐ Not provided ☐ 5m fixing ☐ 10m fixing ☐ 15m fixing
		1S- ☐☐ LCBL-02	☐ Not provided ☐ 5m bending ☐ 10m bending ☐ 15m bending
	Solenoid valve set	1S-VD0 ☐ -01	☐ Not provided ☐ 1 set ☐ 2 sets ☐ 3 sets ☐ 4 stes
		1S-VD0 ☐ E-01	☐ Not provided ☐ 1 set ☐ 2 sets ☐ 3 sets ☐ 4 stes
	Hand input cable	1S-HC25C-01	☐ Not provided ☐ Provided
	Hand output cable	1S-GR35S-01	☐ Not provided ☐ Provided
	Hand curl tube	1N-ST060 ☐ C	☐ Not provided ☐ 1 set ☐ 2 sets ☐ 3 sets ☐ 4 stes
Controller	Simple teaching pendant	R32TB- ☐☐	☐ Not provided ☐ 7m ☐ 15m
	Highly efficient teaching pendant	R56TB- ☐☐	☐ Not provided ☐ 7m ☐ 15m
	Pneumatic hand interface	2A-RZ365/2A-RZ375	☐ Not provided ☐ 2A-RZ365(Sink) ☐ 2A-RZ375(Source)
	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
	Network vision sensor	4D-2CG5***-PKG	☐ Not provided ☐ Provided
	Instructions manual	5S-QY00-PE01	☐ Not provided ☐ Provided ( ) set

■ Maintenance parts (Consumable parts)

Maintenance parts	☐ Backup batteries A6BAT ( ) pcs. ☐ Backup batteries Q6BAT ( ) pcs. ☐ Grease ( ) cans

■ Robot selection check list

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

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