



Mitsubishi Industrial Robot



CR751-D Controller

RH-3CH-Sxx/RH-6CH-Sxx

Special Specifications Manual

Safety Precautions

Always read the following precautions and the separate volume "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
-  **DANGER** 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 in the separate volume "Safety Manual" are given below.
Refer to "Safety Manual" for details.

- ⚠ DANGER** When automatic operation of the robot is performed using multiple control devices (GOT, programmable controller, push-button switch), the interlocking of operation rights of the devices, etc. must be designed by the customer.
- ⚠ 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.

 **DANGER**

Do not connect the Handy GOT when using the GOT direct connection function of this product. Failure to observe this may result in property damage or bodily injury because the Handy GOT can automatically operate the robot regardless of whether the operation rights are enabled or not.

 **DANGER**

Do not remove the SSCNET III cable while power is supplied to the controller. Do not look directly at light emitted from the tip of SSCNET III connectors or SSCNET III cables. Eye discomfort may be felt if exposed to the light. (Reference: SSCNET III employs a Class 1 or equivalent light source as specified in JIS C 6802 and IEC60825-1 (domestic standards in Japan).)

 **DANGER**

Attach the cap to the SSCNET III connector after disconnecting the SSCNET III cable. If the cap is not attached, dirt or dust may adhere to the connector pins, resulting in deterioration connector properties, and leading to malfunction.

 **CAUTION**

Make sure there are no mistakes in the wiring. Connecting differently to the way specified in the manual can result in errors, such as the emergency stop not being released.

In order to prevent errors occurring, please be sure to check that all functions (such as the controller operation panel emergency stop, teaching pendant emergency stop, customer emergency stop, and door switch) are working properly after the wiring setup is completed.

 **CAUTION**

Use the network equipments (personal computer, USB hub, LAN hub, etc) confirmed by manufacturer. The thing unsuitable for the FA environment (related with conformity, temperature or noise) exists in the equipments connected to USB. When using network equipment, 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. Guarantee and maintenance of the equipment on the market (usual office automation equipment) cannot be performed.

CAUTION

To maintain the security (confidentiality, integrity, and availability) of the robot and the system against unauthorized access, DoS*¹ attacks, computer viruses, and other cyberattacks from unreliable networks and devices via network, take appropriate measures such as firewalls, virtual private networks (VPNs), and antivirus solutions.

Mitsubishi Electric shall have no responsibility or liability for any problems involving robot trouble and system trouble by unauthorized access, DoS attacks, computer viruses, and other cyberattacks.

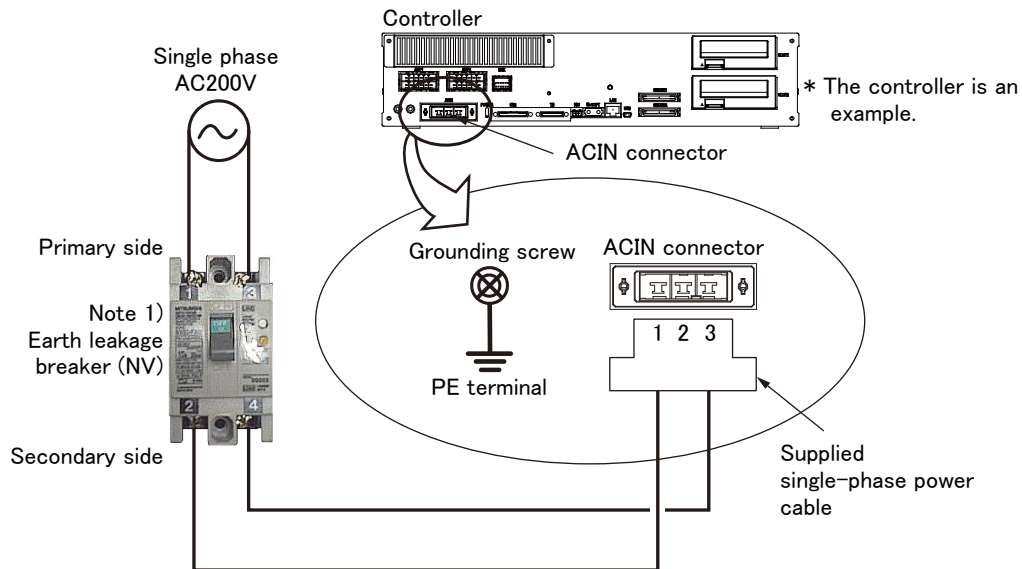
*1 DoS: A denial-of-service (DoS) attack disrupts services by overloading systems or exploiting vulnerabilities, resulting in a denial-of-service (DoS) state.

*CR751-D controller

Notes of the basic component are shown.

⚠ CAUTION

Please install the earth leakage breaker in the primary side supply power supply of the controller of CR751-D because of leakage protection.



Note 1) The earth leakage breaker is the customer preparation. Always use the cover below.
Recommendation: NV30FAU-2P-10 A-AC100-240 V-30 mA, (Cover: TCS-05FA2)

- 1) Please prepare the following: Leakage current breaker (with the terminal cover), cable for connecting the primary side power supply (AWG #14 (2 mm² or above), cables to ground the primary side power supply (AWG #12 (3.5 mm² or above).
The secondary side power cable (with the ACIN connector) for single phase power is supplied with the product to match the specifications.
- 2) Confirm that the primary side power matches the specifications.
- 3) Confirm that the primary side power is OFF and that the earth leakage breaker power switch is OFF.
- 4) Connect the secondary side power cable.
Refer to the figure above and connect the cable from the secondary side of the earth leakage breaker.
- 5) Connect this ACIN connector to the ACIN connector on the front of the controller.
- 6) Connect the primary side grounding cable to the PE terminal. (M4 screw)
- 7) Connect the primary side power cable to the primary side terminal of the earth leakage breaker.

CAUTION

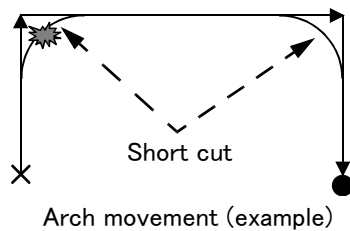
Be careful of interference with peripheral equipment.

Especially don't give a shock to the shaft (J3 axis). When you install the hand, be careful not to knock at the shaft end by the hammer etc. The shaft may be damaged.

Take care also of the following items.

(1) The robot's locus of movement may change with specified speed.

Especially as for the corner section, short cut distance may change. Therefore, when beginning automatic operation, moves at low speed at first, and you should gather speed slowly with being careful of interference with peripheral equipment.



(2) It can be confirmed whether the specified position exist in the defined area by using the instruction command "Zone". It can utilize as one of the methods for collision evasion. Refer to the "detailed description of the instructions manual/function, and operation" of the separate volume for the details of the instruction command.

■Revision history

Date of print	Specifications No.	Details of revisions
2016-06-20	BFP-A3447	• First print.
2016-10-11	BFP-A3447-A	<ul style="list-style-type: none"> • The description of Special Specifications was added. Bellows installed specification (S23) 5 kg load specification for RH-3CH (S51) • The machine cable (replacement type) was changed to an option. • D-cutout dimensions of shaft to outline drawing were added. • Erroneous initial value of HNDDAT was corrected. • The description of the effects of erroneously setting HNDDAT and WRKDAT was added.
2016-11-02	BFP-A3447-B	• CE marking specification (S15/S24/S52) were added.
2017-07-26	BFP-A3447-C	<ul style="list-style-type: none"> • S11 specification has been released in Japan. • RT ToolBox3 and RT ToolBox3 mini were supported. • Contact information of the authorized representative was updated. • Configuration device was corrected. (Table 3-29)
2017-08-29	BFP-A3447-D	• Description (3) in "2.5.5 Air supply circuit example for the hand" was deleted.
2017-09-13	BFP-A3447-E	• "2.7 About Overhaul" was modified.
2018-03-01	BFP-A3447-F	• Referenced Standard (Requirement of Chinese standardized law) was added.
2018-12-25	BFP-A3447-G	<ul style="list-style-type: none"> • Description of countermeasures against unauthorized access was added. • Added explanation of parallel I/O interface • Notes were added to section 3.6. • "3.9 Magnet contactor control connector output (AXMC) for addition axes" was modified. • Environmental conditions of electromagnetic noise was modified.
2019-10-09	BFP-A3447-H	<ul style="list-style-type: none"> • "3.2.1 Controller" was corrected. • "6.4.4 Concrete example for RH-3CH/6CH series" was corrected.
2020-01-24	BFP-A3447-J	<ul style="list-style-type: none"> • Revised the cautions for the basic system structure. • Added Note 4. (Table 3-1)
2020-10-30	BFP-A3447-K	<ul style="list-style-type: none"> • Amended the precautions regarding the prevention of unauthorized access. • Corrected the battery name. (ER6 → ER6V) • Corrected other mistakes and changed some sections.
2021-06-25	BFP-A3447-M	<ul style="list-style-type: none"> • Corrected examples of safety measures. (Fig. 6-1 to 6-4) • Corrected limitations when connecting the relay etc. (Fig. 6-6) • Added "Appendix 1: Classification of functions using external input/output signals".
2021-011-30	BFP-A3447-N	<ul style="list-style-type: none"> • Corrected the explanation of the parameter "SRVON". • Corrected other mistakes and changed some sections.
2022-01-31	BFP-A3447-P	<ul style="list-style-type: none"> • Revised "6.4 EMC installation guideline". • Corrected other mistakes and changed some sections.
2023-04-17	BFP-A3447-Q	<ul style="list-style-type: none"> • Changed the parallel I/O interface connector (supplied). • Changed the plug of the external I/O cable for the parallel I/O interface. • Corrected other mistakes and changed some sections.

■ Introduction

This series offers small-size industrial robots developed using Mitsubishi's latest technology. They are especially designed to handle and assemble mechanical parts. They are Mitsubishi's answer to the customer's need to achieve a compact manufacturing facility capable of highly flexible production, as necessitated by the diffusion of high-density product groups and the shorter product life cycles that have become common-place in recent years.

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 in [Page 8, "2 Robot arm"](#), the specifications related to the controller in [Page 45, "3 Controller"](#), and software functions and a command list in [Page 99, "4 Software"](#) separately.

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

Robot type	*RH-3CH-S11/S15
	*RH-3CH-S23/S24
	*RH-3CH-S51/S52
	*RH-6CH-S11/S15
	*RH-6CH-S23/S24

Note) Only RH-3CH-S11 and RH-6CH-S11 have been released in Japan.

- No part of this manual may be reproduced by any means or in any form, without prior consent from Mitsubishi.
- The contents of this manual are subject to change without notice.
- The specifications values are based on Mitsubishi standard testing methods.
- The information contained in this document has been written to be accurate as much as possible. Please interpret that items not described in this document "cannot be performed." or "alarm may occur".
Please contact your nearest dealer if you find any doubtful, wrong or skipped point.
- This specifications is original.
- Microsoft, Windows, Windows XP, Windows Vista, Windows 7, Windows 8, Windows 8.1, Windows 10 are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries.
- The official name of Windows® is Microsoft®Windows®Operating System.
- Windows®XP, Windows Vista®, Windows® 7, Windows® 8, and Windows® 8.1, and Windows® 10 are either product names of Microsoft Corporation in the United States.
- Ethernet is registered trademarks or trademarks of Xerox Corporation in the United States.
- All other company names and production names in this document are the trademarks or registered trademarks of their respective owners.
- Referenced Standard (Requirement of Chinese standardized law): This Product is designed and manufactured accordance with GB 11291.1.
- Illustrations in this Instruction Manual may differ from the actual products.

CONTENTS

	Page
1 General configuration	1-1
1.1 Structural equipment	1-1
1.1.1 Standard structural equipment	1-1
1.1.2 Special specifications	1-1
1.1.3 Options	1-1
1.1.4 Maintenance parts	1-1
1.2 Model type name of robot	1-2
1.2.1 How to identify the robot model	1-2
1.2.2 Combination of the robot arm and the controller	1-3
1.3 CE marking specifications	1-3
1.4 Indirect export	1-3
1.5 Instruction manuals	1-3
1.6 Contents of the structural equipment	1-4
1.6.1 Robot arm	1-4
1.6.2 Controller	1-5
1.7 Contents of the Option equipment and special specification	1-6
2 Robot arm	2-8
2.1 Standard specifications	2-8
2.1.1 Basic specifications	2-8
(1) RH-3CH-Sxx	2-8
(2) RH-6CH-Sxx	2-10
2.1.2 The counter-force applied to the installation surface	2-11
2.2 Definition of specifications	2-12
2.2.1 Pose repeatability	2-12
2.2.2 Mass capacity	2-13
2.2.3 Relationships Among Mass Capacity, Speed, and Acceleration/Deceleration Speed	2-15
(1) Setting Load Capacity and Size (Hand Conditions)	2-15
2.2.4 Vibrations at the Tip of the Arm during Low-Speed Operation of the Robot	2-15
2.2.5 Vibration of shaft (J3 axis) position and arm end	2-15
(1) Relationship Between Mass Capacity and Speed	2-16
(2) Relationship Between Height of Shaft (J3 Axis) and Acceleration/Deceleration Speed	2-16
(3) Relationship Between Offset Amount and Maximum Speed	2-18
(4) Time to reach the position repeatability	2-19
2.2.6 Collision detection	2-19
2.2.7 Protection specifications	2-20
(1) Types of protection specifications	2-20
2.3 Names of each part of the robot	2-21
2.4 Outside dimensions / Operating range diagram	2-22
2.4.1 Outside dimensions / Operating range diagram	2-22
(1) Normal environmental specification	2-22
2.4.2 Outside dimensions of machine cables	2-34
(1) RH-3CH-Sxx/RH-6CH-Sxx (fixed type)	2-34
(2) RH-3CH-Sxx/RH-6CH-Sxx (flexed type)	2-34
2.5 Tooling	2-35
2.5.1 Wiring and piping for hand	2-35
2.5.2 Internal wiring and piping	2-36
(1) General environment	2-36
2.5.3 Internal wiring for the hand output cable	2-36
2.5.4 About the Installation of Tooling Wiring and Piping (Examples of Wiring and Piping)	2-36
2.5.5 Air supply circuit example for the hand	2-38
2.6 Options	2-39
(1) Machine cable (Fixed type)	2-40
(2) Machine cable (flexed type)	2-41
2.7 About Overhaul	2-43
2.8 Maintenance parts	2-44

CONTENTS

	Page
3 Controller	3-45
3.1 Standard specifications	3-45
3.1.1 Basic specifications	3-45
3.1.2 Protection specifications and operating supply	3-46
3.2 Names of each part	3-47
3.2.1 Controller	3-47
3.3 Outside dimensions/Installation dimensions	3-49
3.3.1 Outside dimensions	3-49
3.3.2 Installation dimensions	3-50
3.4 External input/output	3-52
3.4.1 Types	3-52
3.5 Dedicated input/output	3-53
3.6 Emergency stop input and output etc.	3-56
3.6.1 Connection of the external emergency stop	3-56
3.6.2 Special stop input (SKIP)	3-60
3.6.3 Door switch function	3-61
3.6.4 Enabling device function	3-61
(1) When door is opening	3-61
(2) When door is closing	3-61
(3) Automatic Operation/Jog Operation/Brake Release and Necessary Switch Settings	3-62
3.7 Mode changeover switch input	3-63
(1) Specification of the key switch interface	3-63
(2) Connection of the mode changeover switch input	3-65
3.8 Additional axis function	3-66
3.8.1 Wiring of the additional axis interface	3-66
3.9 Magnet contactor control connector output (AXMC) for addition axes	3-69
3.10 Options	3-71
(1) Teaching pendant (T/B)	3-72
(2) Parallel I/O interface	3-75
(3) External I/O cable	3-80
(4) Parallel I/O unit	3-82
(5) External I/O cable	3-90
(6) CC-Link interface	3-92
(7) MELSOFT RT ToolBox2/MELSOFT RT ToolBox2 mini	3-95
(8) Instruction Manual (hardcopy)	3-97
3.11 Maintenance parts	3-98
4 Software	4-99
4.1 Functions and specifications of RH-3CH-Sxx/RH-6CH-Sxx	4-99
4.1.1 Changed functions/specifications	4-99
4.1.2 Descriptions of changed functions/specifications	4-99
4.1.3 Origin position adjustment of J2 axis	4-103
4.2 List of commands	4-104
4.3 List of parameters	4-107
5 Instruction Manual	5-109
5.1 The details of each instruction manuals	5-109
6 Safety	6-110
6.1 Safety	6-110
6.1.1 Self-diagnosis stop functions	6-110
6.1.2 External input/output signals that can be used for safety protection measures	6-111
6.1.3 Precautions for using robot	6-111
6.1.4 Safety measures for automatic operation	6-112
6.1.5 Safety measures for teaching	6-112

CONTENTS

	Page
6.1.6 Safety measures for maintenance and inspections, etc.	6-112
6.1.7 Examples of safety measures	6-113
(1) External emergency stop connection [supplementary explanation]	6-118
6.2 Working environment	6-120
6.3 Precautions for handling	6-120
6.4 EMC installation guideline	6-122
6.4.1 Outlines	6-122
6.4.2 EMC	6-122
6.4.3 EMC measures	6-123
6.4.4 Concrete example for RH-3CH/6CH series	6-123
6.4.5 Component parts for EMC measures	6-124
(1) Ferrite core	6-124
(2) Line noise filter	6-124
7Appendix	Appendix-125
Appendix 1 : Classification of functions using external input/output signals	Appendix-125

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) Safety manual, CD-ROM (Instruction manual)
- (6) Guarantee card

1.1.2 Special specifications

For the special specifications, some standard configuration equipment 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

This robot has arranged the type name corresponding to load mass, arm length, and environment specification. Details are shown below, please select the robot suitable for the customer's use.

1.2.1 How to identify the robot model

RH - **◇** **CH** **□□** **△△** - **1** **D** **▲** - **Sxx**

(a) (b) (c) (d) (e) (f) (g) (h) (i)

- (a). RH.....Indicates the horizontal multiple-joint robot.
- (b). ◇.....Indicates the maximum load.
Example)
3: 3 kg
6: 6 kg
- (c). CH.....Indicates the CH series.
- (d). □□.....Indicates the arm length.
Example)
40: 400 mm
60: 600 mm
70: 700 mm
- (e). △△.....Indicates the vertical stroke length.
Example)
18: 180 mm stroke
20: 200 mm stroke
- (f). 1.....Indicates the controller series.
1: CR751 controller
- (g). D.....Indicates the controller type.
D: Stand alone type
- (h). ▲.....Technical standard of Conformity.
Example)
Omitted: No conformity of technical standard.
1: Conforms to the CE marking
- (i). - Sxx.....Indicates a special model. In order, limit special specification.
Example)
S11: Standard specification
S15: Standard specification complies with CE marking requirements
S23: Bellows-installed specification
S24: Bellows-installed specification complies with CE marking requirements
S51: 5 kg load specification (RH-3CH only)
S52: 5 kg load specification complies with CE marking requirements. (RH-3CH only)
S**: Other special specification

1.2.2 Combination of the robot arm and the controller

Table 1-1 : Combination of robot arm and controller

Robot arm	Arm length (mm)	Vertical stroke length (mm)	Controller
Stand-alone controller compatible			
RH-3CH4018-1D-S11	400	180	CR751-03CHD-0-S11
RH-3CH4018-1D-S23		130	CR751-03CHD-0-S23
RH-3CH4018-1D-S51		180	CR751-03CHD-0-S51
RH-6CH6020-1D-S11	600	200	CR751-06CHD-0-S11
RH-6CH6020-1D-S23		172	CR751-06CHD-0-S23
RH-6CH7020-1D-S11	700	200	CR751-06CHD-0-S11
RH-6CH7020-1D-S23		172	CR751-06CHD-0-S23

1.3 CE marking specifications

The robot shown in [Table 1-2](#) are the CE marking specification.

Table 1-2 : Robot models with CE marking specifications

Robot arm	Arm length (mm)	Vertical stroke length (mm)	Controller
Stand-alone controller compatible			
RH-3CH4018-1D1-S15	400	180	CR751-03CHD1-0-S15
RH-3CH4018-1D1-S24		130	CR751-03CHD1-0-S24
RH-3CH4018-1D1-S52		180	CR751-03CHD1-0-S52
RH-6CH6020-1D1-S15	600	200	CR751-06CHD1-0-S15
RH-6CH6020-1D1-S24		172	CR751-06CHD1-0-S24
RH-6CH7020-1D1-S15	700	200	CR751-06CHD1-0-S15
RH-6CH7020-1D1-S24		172	CR751-06CHD1-0-S24

1.4 Indirect export

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

1.5 Instruction manuals

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

1.6 Contents of the structural equipment

1.6.1 Robot arm

The list of structural equipment is shown in below.

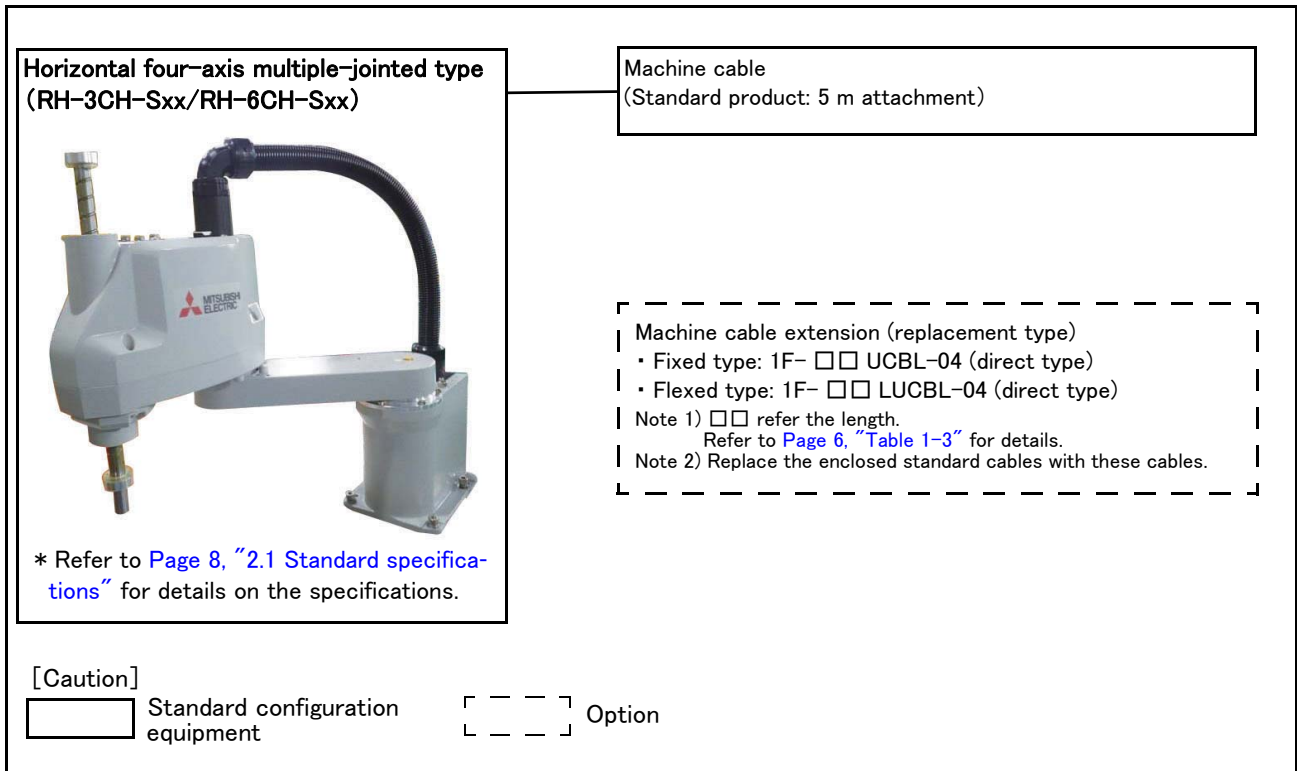


Fig.1-1 : Structural equipment

1.6.2 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. (Refer to Page 2, "1.2 Model type name of robot".)

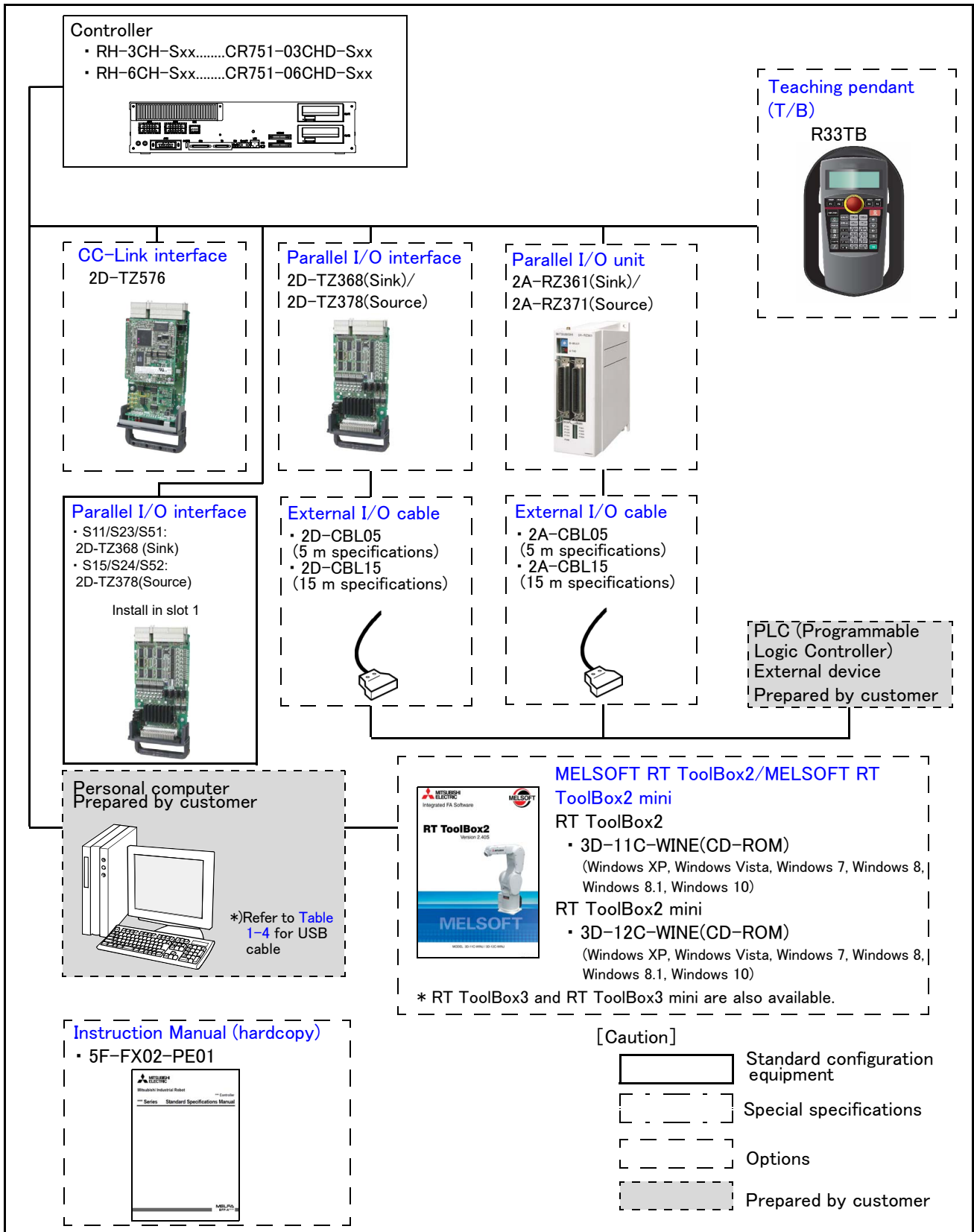


Fig.1-2 : Structural equipment

1.7 Contents of the Option equipment and special specification

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

Table 1-3 : List of the optional equipment and special specifications

Item	Model	Specifications	Category Note 1)	Remarks
Machine cables (replacement)	1F- □□ UCBL-04	Fixed type (set of 2 cables, one each for power and for signal)	○	3m, 10m, 15m, 20m (used as alternative cables to the standard 5m cables.)
	1F- □□ LUCBL-04	Flexed type (set of 2 cables, one each for power and for signal)	○	10m, 15m, 20m (used as alternative cables to the standard 5m cables.)
Bellows	Special model number -S23	Bellows-installed specification	□	Used to prevent scattering of the grease for the J3 shaft.
	Special model number -S24	Bellows-installed specification complies with CE marking requirements	□	
5 kg load specification (RH-3CH only)	Special model number -S51	5 kg load specification	□	RH-3CH with the maximum load mass of 5 kg.
	Special model number -S52	5 kg load specification complies with CE marking requirements	□	
Simple teaching pendant	R33TB	Cable length: 7m	○	ENABLE switch (three-position switch) is equipped. IP65 compatible
	R33TB-15	Cable length: 15m	○	
Parallel I/O interface	2D-TZ368 (sink type)/ 2D-TZ378 (source type)	Input/output: 32/32 points Insulated type output signal (0.1 A/24 V output per point) Insulated type input signal (9 mA/24 V input per point)	□	The card type external add-on I/O interface, attached to the controller at factory shipment. • S11/S23/S51: 2D-TZ368 installed • S15/S24/S52: 2D-TZ378 installed
External I/O cable (for parallel I/O interface)	2D-CBL05	5 m	○	A cable connected between the external I/O interface and peripheral equipment.
	2D-CBL15	15 m	○	
Parallel I/O unit	2A-RZ361 (sink type) / 2A-RZ371 (source type)	Input/output: 32/32 points Insulated type output signal (0.1A/24V output per point) Insulated type input signal (7mA/24V input per point)	○	A unit device for external I/O, attached on the outside of the controller for use.
External I/O cable (for parallel I/O unit)	2A-CBL05	5m	○	A cable connected between the external I/O unit and peripheral equipment.
	2A-CBL15	15m	○	
CC-Link interface	2D-TZ576	Supporting intelligent device stations and local network stations only.	○	Used for connecting to a MELSEC programmable controller through CC-Link network.
RT Tool Box2	3D-11C-WINE	CD-ROM	○	Windows XP, Windows Vista, Windows 7, Windows 8, Windows 8.1, and Windows 10-compatible software. English version (with the simulation function) * RT ToolBox3 is also available.
RT Tool Box2 mini	3D-12C-WINE	CD-ROM	○	Windows XP, Windows Vista, Windows 7, Windows 8, Windows 8.1, and Windows 10-compatible software. English version * RT ToolBox3 mini is also available.
Instruction manual (printed)	5F-FX02-PE01	A set of manuals of RH-3CH-Sxx/6CH-Sxx	○	

Note 1) In the category line, a circle (○) represents an option, and a square (□) represents the factory-shipped special specification.

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

Table 1-4 : Recommendation article of the USB cable

Name	Type name	Supplier
USB cable (USB A type-USB mini B type)	KU-AMB530	SANWA SUPPLY INC.
	USB-M53	ELECOM CO., LTD.
	GT09-C30USB-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 network equipments (personal computer, USB hub, LAN hub, etc) confirmed by manufacturer. The thing unsuitable for the FA environment (related with conformity, temperature or noise) exists in the equipments connected to USB. When using network equipment, 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. Guarantee and maintenance of the equipment on the market (usual office automation equipment) cannot be performed.

2 Robot arm

2.1 Standard specifications

2.1.1 Basic specifications

(1) RH-3CH-Sxx

Table 2-1 : Standard specifications of robot arm

Type			RH-3CH4018-S11/S15	RH-3CH4018-S23/S24	RH-3CH4018-S51/S52
Environment			Standard specification		
Installation posture			On floor		
Degree of freedom			4		
Structure			Horizontal, multiple-joint type		
Drive system			AC servo motor		
Position detection method			Absolute encoder		
Motor capacity	J1	W	200		
	J2	W	100		
	J3 (Z)	W	100		
	J4 (θ)	W	100		
Brake			J1, J2, J4 axes: no brake J3 axis: with brake		J1, J2 axes: no brake J3, J4 axes: with brake
Arm length	No. 1 arm	mm	225		
	No. 2 arm	mm	175		
Reach radius (No. 1 + No. 2)		mm	400		
Operating range	J1	deg	264(\pm 132)		
	J2	deg	282(\pm 141)		
	J3 (Z)	mm	180	130	180
	J4 (θ)	deg	720(\pm 360)		
Speed of motion ^{Note 1)}	J1	deg/sec	720		
	J2	deg/sec	720		
	J3	mm/sec	1100		
	J4	deg/sec	2600		
	J1+J2	mm/sec	7200		
Pose repeatability ^{Note 2)}	X-Y direction	mm	\pm 0.01		
	J3 (Z)	mm	\pm 0.01		
	J4 (θ)	deg	\pm 0.01		
Cycle time ^{Note 3)}		sec	0.44		
Load	Rating	kg (N)	1		
	Maximum	kg (N)	3	5	
Allowable inertia (during the large inertia mode ^{Note 4)})	Rating	kg · m ²	0.005		
	Maximum	kg · m ²	0.05 (0.075)		
J3(Z) axis pressing force ^{Note 5)}		N	100		
Maximum eccentricity (during the large inertia mode ^{Note 6)})		mm	150 (10)		
Mass		kg	14		
Tool wiring			15 points, D-SUB		
Tool pneumatic pipes			ϕ 6 × 2, ϕ 4 × 1		
Supply pressure		MPa	0.5 \pm 10%		
Protection specification ^{Note 7)}			IP20		
Ambient temperature ^{Note 8)}		°C	0 to 40		
Painting color			Light gray (reference Munsell color: 0.6B7.6/0.2)		
Machine cable		m	5		

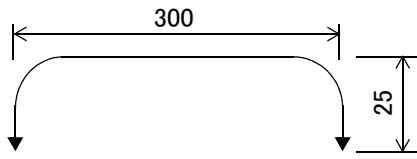
Note 1) The maximum speed is the value which applied MvTune2 (high-speed movement mode).

In addition, it is the value during load conditions in which the effects of automatic speed compensation due to load mass are not being imparted.

For the RH-3CH4018-S51/S52, it is the value when the large inertia mode is disabled.

Note 2) The pose repeatability details are given in [Page 12, "2.2.1 Pose repeatability"](#).

Note 3) The value with the movements and conditions below when the MvTune2 (high-speed movement mode) is applied.
· The cycle time may increase with the case where the positioning accuracy of the work etc. is necessary, or by the moving position.



<Conditions>

RH-3CH4018-S11/S15: carrying mass of 2 kg

RH-3CH4018-S23/S24: carrying mass of 1 kg

RH-3CH4018-S51/S52: carrying mass of 2 kg. The large inertia mode disabled.

(Unit: mm)

Note 4) The values in parentheses are the values when the large inertia mode is enabled.

Note 5) When the maximum load is installed, the downward pushing force generated at the tip of the load is obtained with J1, J2, and J4 axes stopped. The force shown above is the maximum value. When the force is applied for a long time, an overload error will be generated. Prevent errors from occurring.

Note 6) The values in parentheses are the values when the large inertia mode is enabled.

Note 7) The protection specification details are given in [Page 20, "2.2.7 Protection specifications"](#).

Note 8) Sets the robot's operating environmental temperature as parameter OLTMX. Corresponding to the environment, the continuous control action performance and the overload-protection function are optimized. (Refers to "Optimizing the overload level" described in "Chapter 5 Functions set with parameters" of separate instruction manual/ Detailed explanations of functions and operations for details.)

(2) RH-6CH-Sxx

Table 2-2 : Standard specifications of robot arm

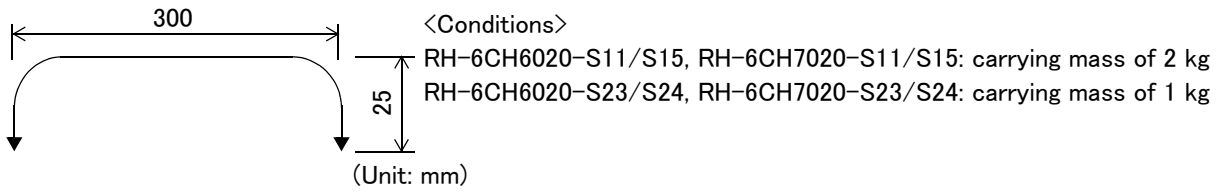
Type			RH-6CH6020 -S11/S15	H-6CH6020 -S23/S24	RH-6CH7020 -S11/S15	RH-6CH7020 -S23/S24
Environment			Standard specification			
Installation posture			On floor			
Degree of freedom			4			
Structure			Horizontal, multiple-joint type			
Drive system			AC servo motor			
Position detection method			Absolute encoder			
Motor capacity	J1	W	200			
	J2	W	200			
	J3 (Z)	W	100			
	J4 (θ)	W	100			
Brake			J1, J2 axes: no brake J3, J4 axes: with brake			
Arm length	No. 1 arm	mm	325		425	
	No. 2 arm	mm	275			
Reach radius (No. 1+ No. 2)		mm	600		700	
Operating range	J1	deg	264(± 132)			
	J2	deg	300(± 150)			
	J3 (Z)	mm	200	172	200	172
	J4 (θ)	deg	720(± 360)			
Speed of motion ^{Note 1)}	J1	deg/sec	420		360	
	J2	deg/sec	720			
	J3	mm/sec	1100			
	J4	deg/sec	2500			
	J1+J2	mm/sec	7800			
Pose repeatability ^{Note 2)}	X-Y resultant	mm	± 0.02			
	J3 (Z)	mm	± 0.01			
	J4 (θ)	deg	± 0.01			
Cycle time ^{Note 3)}		sec	0.41		0.43	
Load	Rating	kg (N)	2			
	Maximum	kg (N)	6			
Allowable inertia (during heavy load mode ^{Note 4)})	Rating	kg · m ²	0.01			
	Maximum	kg · m ²	0.12 (0.18)			
J3(Z) axis pressing force ^{Note 5)}		N	100			
Maximum eccentricity (during heavy load mode ^{Note 6)})		mm	150 (10)			
Mass		kg	17		18	
Tool wiring			15 points, D-SUB			
Tool pneumatic pipes			$\phi 6 \times 2, \phi 4 \times 1$			
Supply pressure		MPa	0.5 \pm 10%			
Protection specification ^{Note 7)}			IP20			
Ambient temperature ^{Note 8)}		°C	0 to 40			
Painting color			Light gray (Equivalent to Munsell color: 0.6B7.6/0.2)			
Machine cable		m	5			

Note 1) The maximum speed is the value which applied MvTune2 (high-speed movement mode).

In addition, it is the value during load conditions in which the effects of automatic speed compensation due to load mass are not being imparted.

Note 2) The pose repeatability details are given in [Page 12, "2.2.1 Pose repeatability"](#).

Note 3) The value with the movements and conditions below when the MvTune2 (high-speed movement mode) is applied.
 · The cycle time may increase with the case where the positioning accuracy of the work etc. is necessary, or by the moving position.



- Note 4) The values in parentheses are the values when the large inertia mode is enabled.
 Note 5) When the maximum load is installed, the downward pushing force generated at the tip of the load is obtained with J1, J2, and J4 stopped. The force shown above is the maximum value. When the force is applied for a long time, an overload error will be generated. Prevent errors from occurring.
 Note 6) The values in parentheses are the values when the large inertia mode is enabled.
 Note 7) The protection specification details are given in [Page 20, "2.2.7 Protection specifications"](#).
 Note 8) Sets the robot's operating environmental temperature as parameter OLTMX. Corresponding to the environment, the continuous control action performance and the overload-protection function are optimized. (Refers to "Optimizing the overload level" described in "Chapter 5 Functions set with parameters" of separate instruction manual/ Detailed explanations of functions and operations for details.)

2.1.2 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 2-3 : Value of each counter-force

	Unit	RH-3CH-Sxx	RH-6CH6020-Sxx	RH-6CH7020-Sxx
Falls moment: M_L	N·m	220	410	500
Torsion moment: M_T	N·m	180	260	370
Horizontal translation force: F_H	N	820	800	960
Vertical translation force: F_V	N	320	640	670

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 B 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 and a position within the actual space

2.2.2 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 allowable moment of inertia found in [Page 8, "2.1.1 Basic specifications"](#).

(2) [Fig. 2-1](#) and [Fig. 2-3](#) shows the distribution dimensions for the center of gravity in the case where the volume of the load is relatively small. Use this figure as a reference when designing the tooling.

Please use the robot in the allowable moment of inertia of maximum moment of inertia shown in [Fig. 2-1](#) and [Fig. 2-3](#).

[Caution] Depending on the operating speed and operating posture of the robot, vibration, overload, and overcurrent alarms may occur even if the mass and inertia of the hand, workpiece, etc. are within the permissible range above. In such cases, please reduce acceleration and deceleration (Accel command) speeds and movement speed (Ovrd command). Although the standard value to reduce is 50% for each command, please adjust corresponding to the movement posture. Refer to separate "Instruction Manual/Detailed Explanation of Functions and Operations" for details of each command.

Furthermore, these sorts of events will occur more readily if, for example, the hand/workpiece parameters are not set correctly, or the optimum acceleration/deceleration setting is disabled.

[Caution] Refer to [Page 15, "2.2.3 Relationships Among Mass Capacity, Speed, and Acceleration/Deceleration Speed"](#), and set the values of the mass, magnitude, and distance to the centroid of a tool and a workpiece to parameters.

If parameters are not set exactly, the lifetime of reduction gears, a belt, etc. is affected.

[Caution] The overhang amount of the load, such as the mass capacity and the allowable moment of inertia defined in this section, are dynamic limit values determined by the capacity of the motor that drives axes or the capacity of the speed reducer. Therefore, it does not guarantee the accuracy on all areas of tooling. Guaranteed accuracy is measured from the center point of the mechanical interface surface. Please note that if the point of operation is kept away from the mechanical interface surface by long and low-rigid tooling, the positioning accuracy may deteriorate or may cause vibration.

Note that the allowable offset value (Z direction) from the lower edge of the shaft to the position of center of gravity is 100 mm.

[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.

[Caution] This robot will restrict speed automatically by internal controls when the load center-of-gravity position separates from the shaft center. Refer to [Page 15, "2.2.3 Relationships Among Mass Capacity, Speed, and Acceleration/Deceleration Speed"](#) in detail.

The allowance distance (allowance offset amount) from the center of the shaft to the center of gravity for loads is 150 mm.

[Caution] When the large inertia mode is enabled, it is possible to use large hands (or workpieces) that exceed the allowable inertia for the standard load mode, but if the inertia exceeds the allowable inertia for the standard load mode, the permissible value for the distance from the center of the shaft to the center of gravity of the load (the offset amount) is 10 mm.

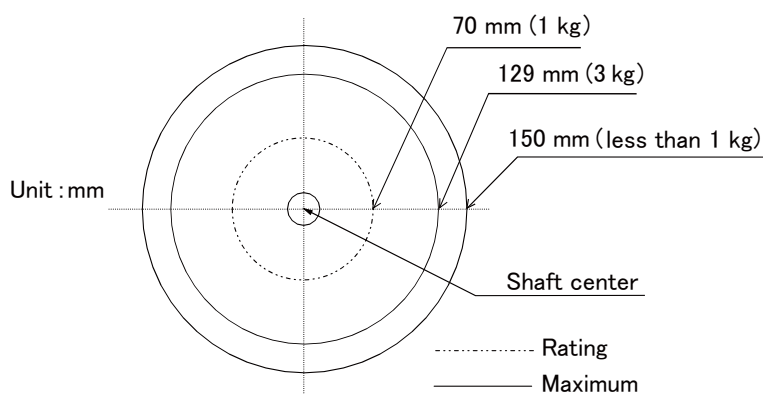


Fig.2-1 : Position of the center of gravity for loads (for loads with comparatively small volume): RH-3CH-S11/S15/S23/S24

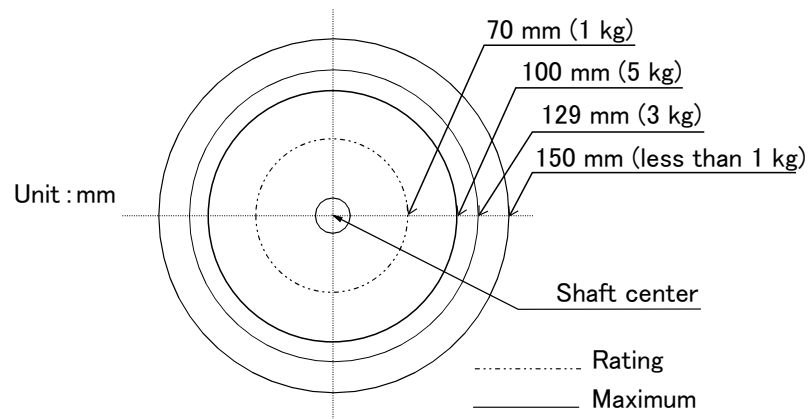


Fig.2-2 : Position of the center of gravity for loads (for loads with comparatively small volume): RH-3CH-S51/S52

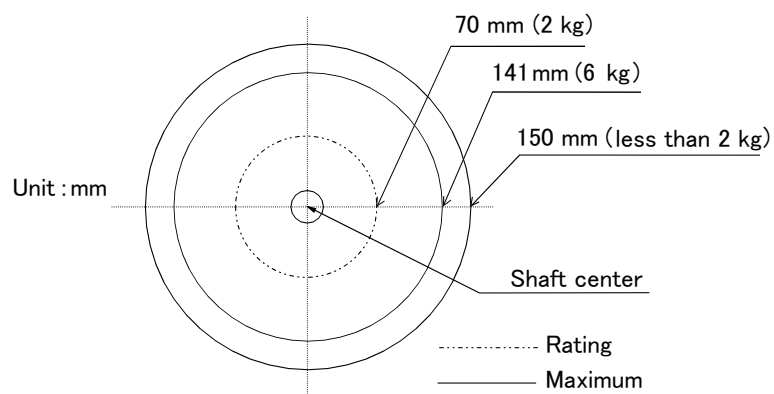


Fig.2-3 : Position of the center of gravity for loads (for loads with comparatively small volume): RH-6CH-Sxx

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

This robot automatically sets the optimum acceleration and deceleration speeds and maximum speed, according to the load capacity and size that have been set, and operates using these automatically set speeds. To achieve that, it is necessary to correctly set the actual load data (mass and size of hand and work) to be used. However, vibration, overheating and errors such as excessive margin of error and overload may occur, depending on the robot operation pattern or ambient temperature.

In this case, reduce the speed and the acceleration and deceleration rate before continuing to use. This is done by accessing the robot program and adjusting the speed settings (Ovrd) and the acceleration and deceleration settings (Accel).

If a setting is performed in such a way that it falls below the mounted load, the life span of the mechanism elements used in the robot may be shortened. In the case of a work requiring a high degree of accuracy, set up the load correctly and use the robot by lowering the ratios of the acceleration and deceleration speeds.

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

Set up the capacity and size of the hand with the "HNDDAT*" parameter (optimum acceleration/deceleration setting parameter), and set up the capacity and size of the work with the "WRKDAT*" parameter. Numbers 0 to 8 can be used for the asterisk (*) part. Designate the "HNDDAT*" and "WRKDAT*" parameters to be used using the "LoadSet" command in a program.

For more details, refer to the separate "Instruction Manual/Detailed Explanation of Functions and Operations." It is the same meaning as "LoadSet 0.0" if not using the "LoadSet".

<Factory default settings>

	Hand mass kg	size X mm	size Y mm	size Z mm	center-of-gravity position X mm	center-of-gravity position Y mm	center-of-gravity position Z mm
RH-3CH-S11/S15/S23/S24 series							
HNDDAT*	3.0	82.0	82.0	60.0	0.0	0.0	20.0
WRKDAT*	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	Hand mass kg	size X mm	size Y mm	size Z mm	center-of-gravity position X mm	center-of-gravity position Y mm	center-of-gravity position Z mm
RH-3CH-S51/S52 series							
HNDDAT*	5.0	82.0	82.0	60.0	0.0	0.0	20.0
WRKDAT*	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	Hand mass kg	size X mm	size Y mm	size Z mm	center-of-gravity position X mm	center-of-gravity position Y mm	center-of-gravity position Z mm
RH-6CH-Sxx series							
HNDDAT*	6.0	82.0	82.0	60.0	0.0	0.0	20.0
WRKDAT*	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Note) The position of the center of gravity is located at the center of the surface at the bottom of the shaft. Set the X, Y and Z center of gravity positions for the tool coordinate directions (the Z center of gravity position will be a plus for downward directions).

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

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

- 1) Change the robot's operating speed by using the Ovrd command.
- 2) Change and move the teaching points of the robot.
- 3) Change the hand mass and hand inertia.

2.2.5 Vibration of shaft (J3 axis) position and arm end

Vibrations at the tip of the arm may increase substantially during operation under the shaft position near the low end or the high end of the robot, depending on the combination of hand mass and hand inertia. This problem occurs according to that inertia, because the distance from the shaft support section to the shaft end becomes

long. When this vibration affects the robot's operations, please change operating speed etc. like the above [Page 15, "2.2.4 Vibrations at the Tip of the Arm during Low-Speed Operation of the Robot"](#).

(1) Relationship Between Mass Capacity and Speed

A function to optimize the maximum speed of each axis according to the setting value of the load capacity will be activated (Refer to [Fig. 2-4](#)).

However, this function does not work with the load mass of 2 kg or less.

When the load mass is changed to exceed 2 kg, the maximum speed is compensated according to the load mass.

[CAUTION] Depending on the operation pattern, the speed and/or acceleration/deceleration at the front edge may not be parallel with the speed and the rate of change of acceleration/deceleration specified in a program.

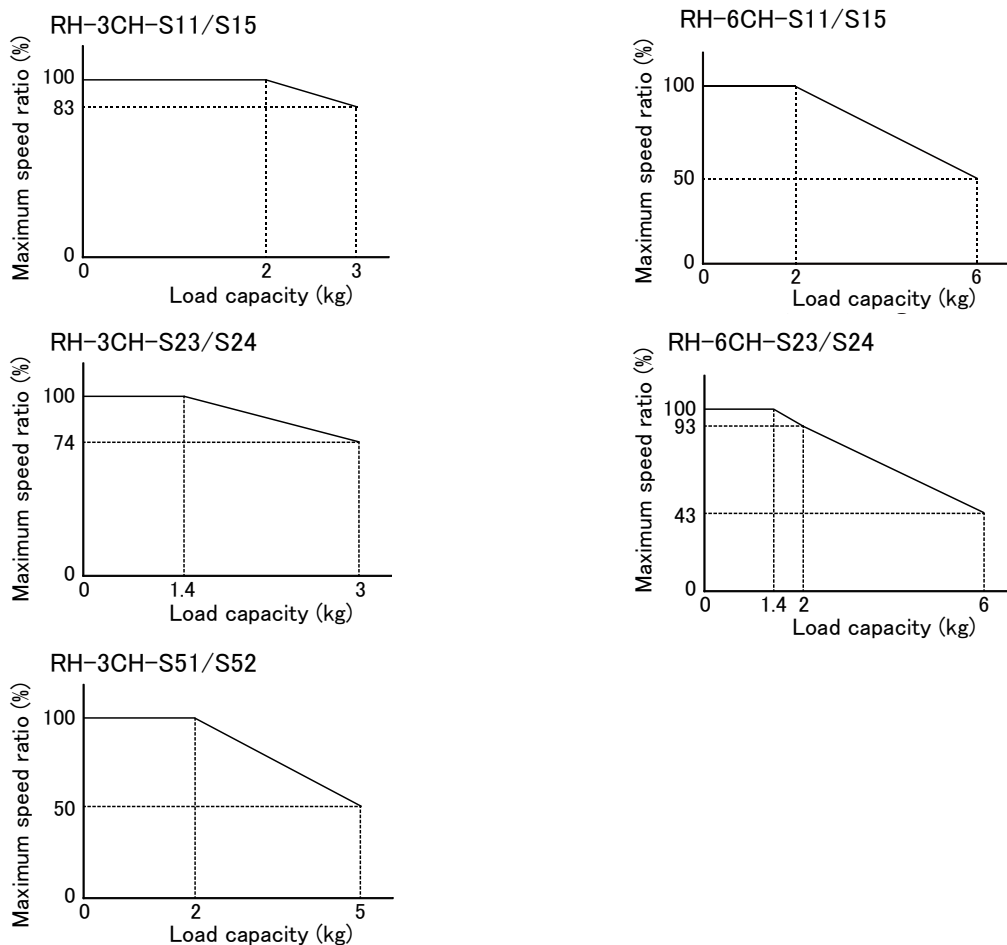


Fig.2-4 : Automatic compensation of speed

(2) Relationship Between Height of Shaft (J3 Axis) and Acceleration/Deceleration Speed

A function to optimize the acceleration/deceleration speed according to the height of the shaft (Refer to [Fig. 2-5](#), [Fig. 2-6](#)) will be activated. This function is invalid if the shaft (axis J3) operates at a position above P3 in [Fig. 2-5](#).

Acceleration/deceleration is compensated for at a position below P3 in [Fig. 2-5](#) if the position of the center of gravity of the load is located at the front edge of the shaft.

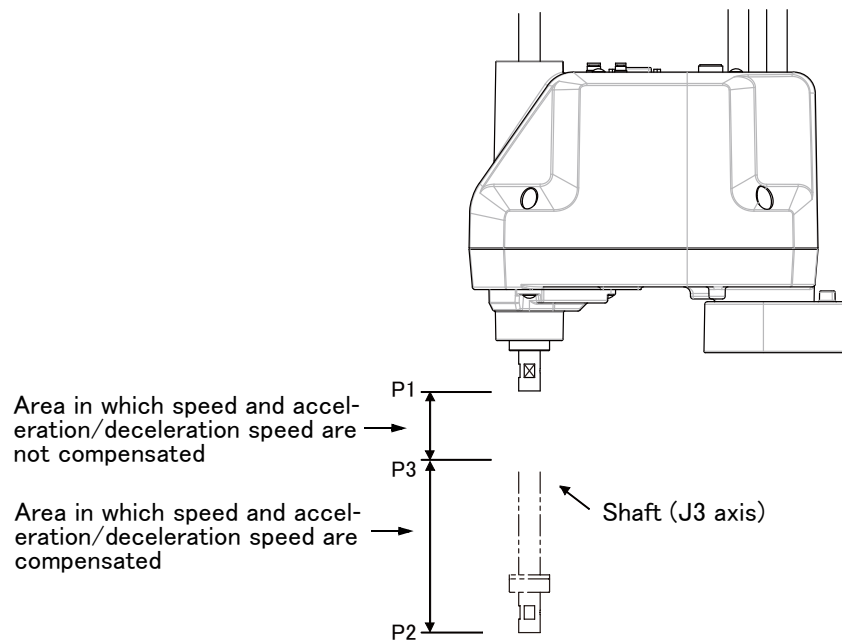
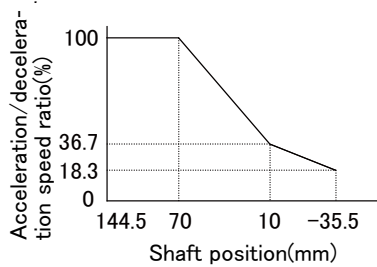


Fig.2-5 : Area in which acceleration/deceleration speed is compensated

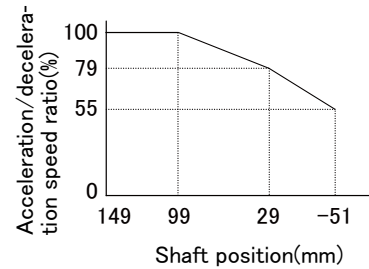
Table 2-4 : Area in which acceleration/deceleration speed is compensated

Type	J3 axis stroke (mm)			Compensation area (P2 to P3)
	Stroke length	P1(Upper end)	P2(Lower end)	
RH-3CH-S11/S15/S51/S52	180	144.5	-35.5	-35.5 to 70
RH-3CH-S23/S24	130	94.5	-35.5	-35.5 to 70
RH-6CH-S11/S15	200	149	-51	-51 to 99
RH-6CH-S23/S24	172	119	-53	-53 to 99

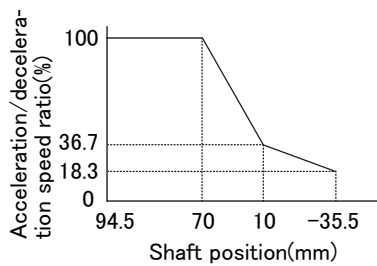
RH-3CH-S11/S15/S51/S52



RH-6CH-S11/S15



RH-3CH-S23/S24



RH-6CH-S23/S24

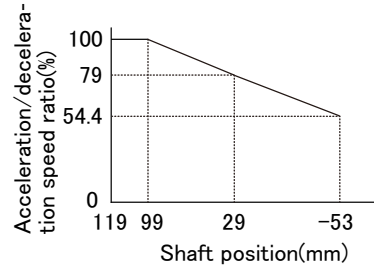


Fig.2-6 : Automatic compensation of acceleration/deceleration speed

(3) Relationship Between Offset Amount and Maximum Speed

A function to optimize the maximum speed of each axis according to the offset amount will be activated. (Refer to Fig. 2-7.)

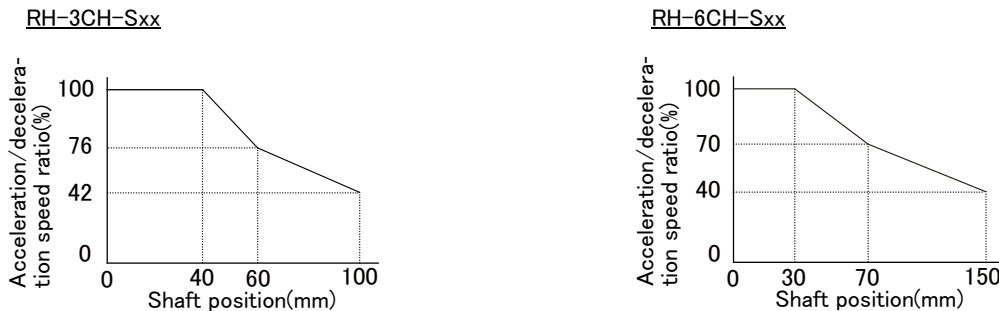


Fig.2-7 : Relationship Between Offset Amount and Maximum Speed

[Supplementary explanation 1]: The setting which shortens execution time

The execution time can be improved by using the following methods.

- 1) Perform continuous path operation using the Cnt command.
- 2) Control the optimum acceleration/deceleration using the Oadl command.
- 3) Control the optimum speed using the Spd command.

[Supplementary explanation 2]: The setting which improves continuous control action performance in a short wait time

The continuous control action performance can be improved by setting a smaller value in the optimum acceleration/deceleration adjustment rate parameter (JADL). In this robot, the acceleration/deceleration speed is initialized for quick moves (setting of A in the Fig. 2-8).

If quick moves (short moving time) are required, such as L/UL work on machined parts, the acceleration/deceleration speed can be increased by initial setting (setting of A in the Fig. 2-8).

However, please note that some setting values of acceleration/deceleration speed tend to cause overload and overheat errors. In such a case, extend the wait time, reduce the acceleration/deceleration speed, or decrease the moving speed. This setting is suited for continuous operations that have a short tact time, such as palletizing work.

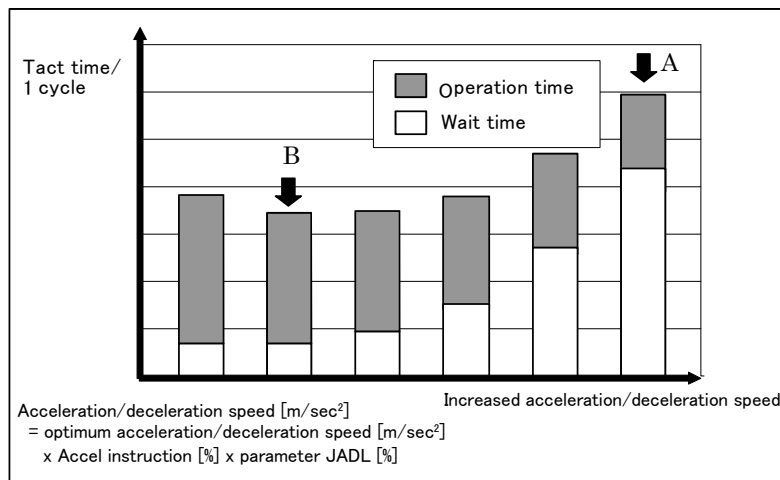


Fig.2-8 : Relationship between Acceleration/deceleration Speed and Tact Time (Conceptual Drawing)

(4) Time to reach the position repeatability

When using this robot, the time to reach the position repeatability may be prolonged due to the effect of residual vibration at the time of stopping. If this happens, take the following measures:

- 1) Change the operation position of the Z axis to the location near the top as much as possible.
- 2) Increase the operation speed prior to stopping.
- 3) When positioning the work near the bottom edge of the Z axis, if no effectiveness is achieved in step "2" above, perform operation ① (robot path: O → A → C). In the case of operation ② (robot path: O → B → C), residual vibration may occur. (Refer to Fig. 2-9.)

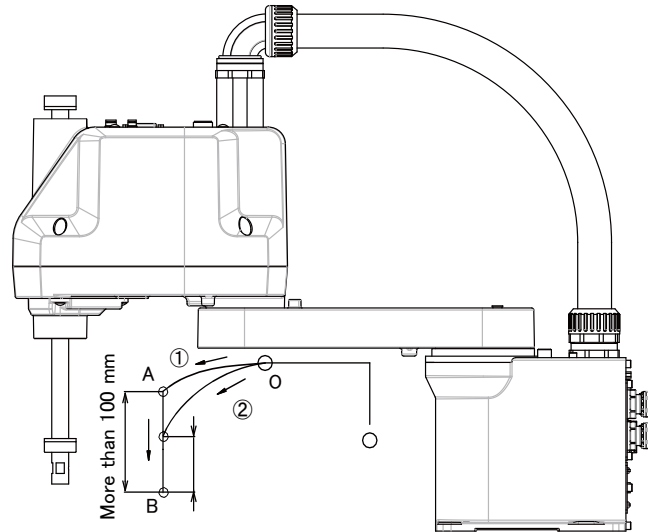


Fig.2-9 : Recommended path when positioning at the bottom edge of the Z axis

2.2.6 Collision detection

This series have the "collision detection function" which detects the abnormalities by the collision of the robot arm, and the initial setting has set this function as the enable to suppress damage to the minimum.

Although the enable/disable of this function can be changed by parameter: COL and command: ColChk, you should use in valid condition of this function for protection of the robot and of the peripheral equipment.

The abnormalities are detected by the robot's kinetics model, presuming torque necessary for movement at any time. Therefore, the setting parameter (HNDDAT*, WRKDAT*) of the hand and the work piece conditions should be right. And, it may be detected as the collision in movement as speed and motor torque are changed rapidly. (for example, the movement near the place of the origin by linear interpolation, the reversal movement, the cold condition, the operation after long term stoppage)

In such a case, by adjusting the value of the setting parameter (COLLVL, COLLVLJG) of the collision detection level according to actual use environment, the sensitivity of collision detection can be optimized and the damage risk can be reduced further. And, in the operation after the low temperature or long term stoppage, please operate by accustoming at low speed (warm-up), or use the warm-up operation mode.

Refer to the separate instruction manual "Detailed explanations of functions and operations" for details of related parameter.

Table 2-5 : Factory-shipments condition

	JOG operation	Automatic
RH-3CH-Sxx/RH-6CH-Sxx	Valid	Invalid

2.2.7 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 [Table 2-6](#).

Table 2-6 : Protection specifications and applicable fields

Type	Protection specifications (IEC Standards value)	Classification	Applicable field	Remarks
RH-3CH-Sxx	Robot arm: IP20	General-purpose environment specifications	General assembly Slightly dusty environment	
RH-6CH-Sxx				

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.

The IEC standard is described by the following "Information" And, the corrosion of the rust etc. may occur to the robot with the liquids.

【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 $3.1 \text{ kg} \pm 10\%$, from going through the opening in the outer sheath of the supplied equipment.

2.3 Names of each part of the robot

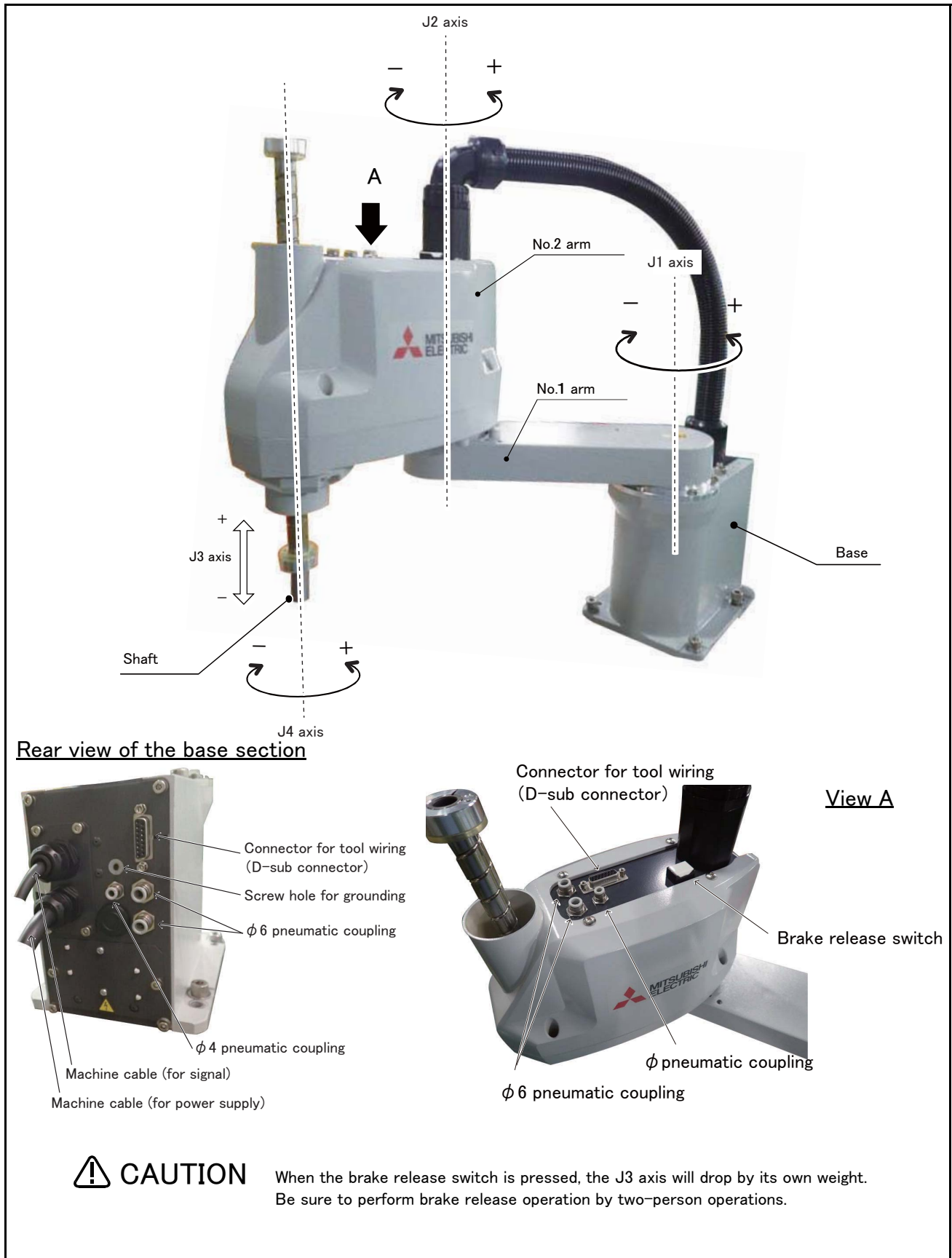


Fig.2-10 : Names of each part of the robot

2.4 Outside dimensions / Operating range diagram

2.4.1 Outside dimensions / Operating range diagram

(1) Normal environmental specification

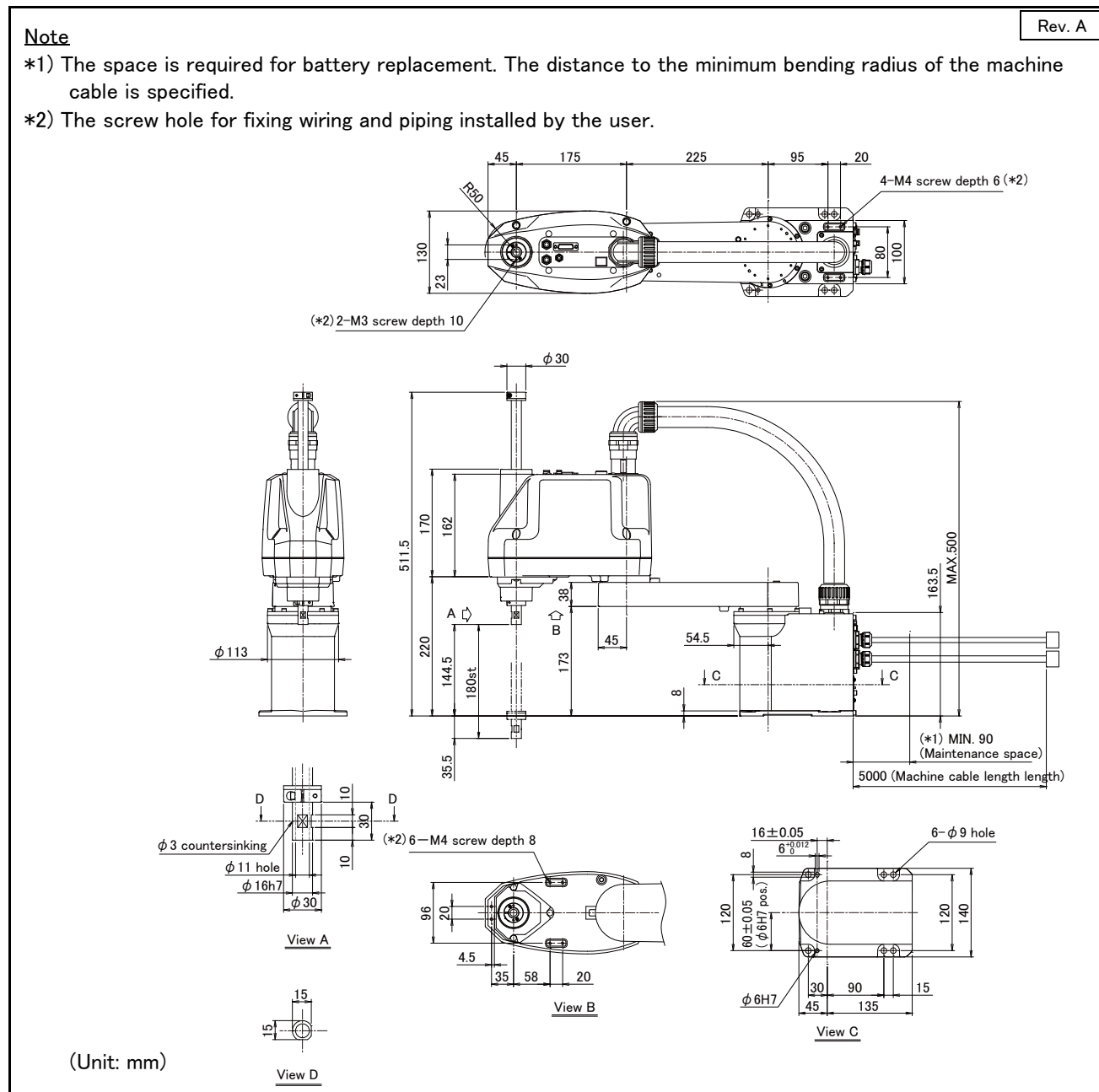


Fig.2-11 : Outside dimensions of RH-3CH4018-S11/S15/S51/S52

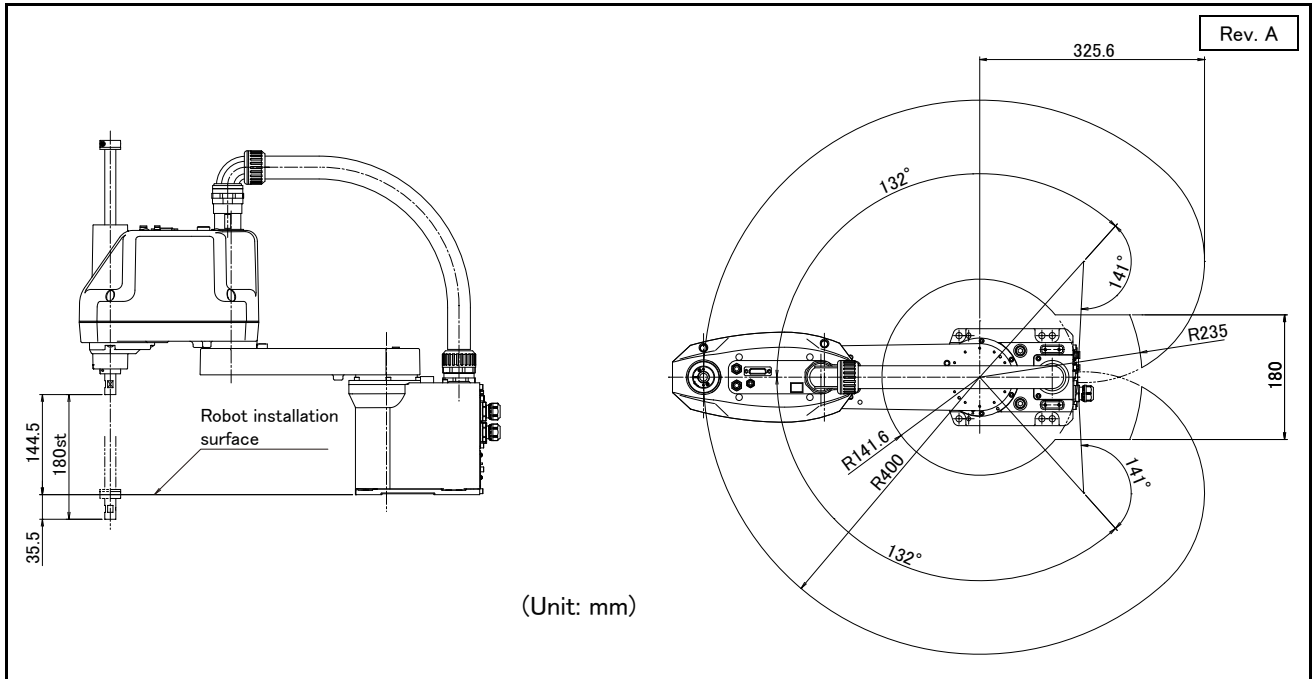
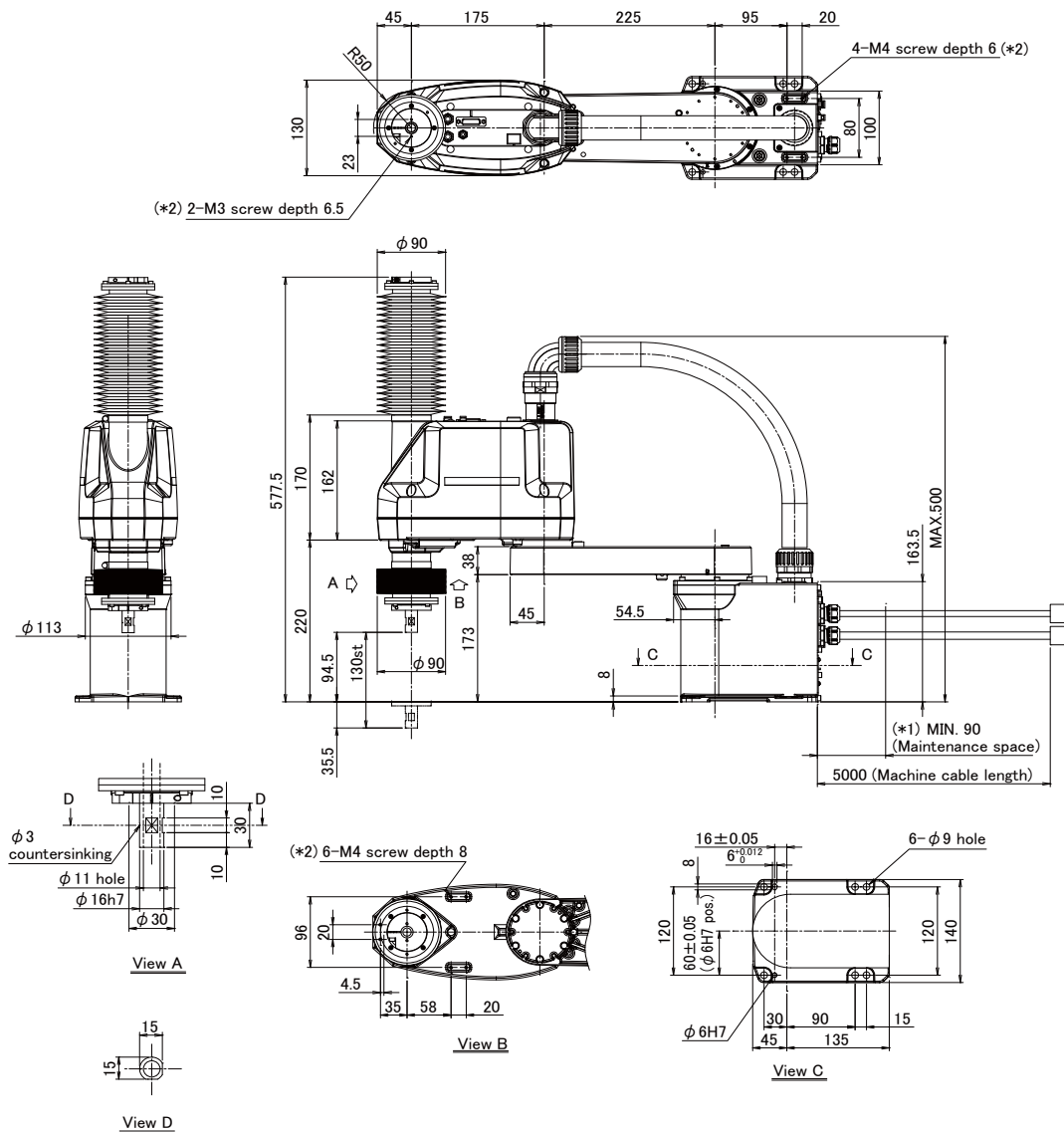


Fig.2-12 : Operating range diagram of RH-3CH4018-S11/S15/S51/S52

Rev. *

Note

- *1) The space is required for battery replacement. The distance to the minimum bending radius of the machine cable is specified.
- *2) The screw hole for fixing wiring and piping installed by the user.



(Unit: mm)

Fig.2-13 : RH-3CH4018-S23/S24

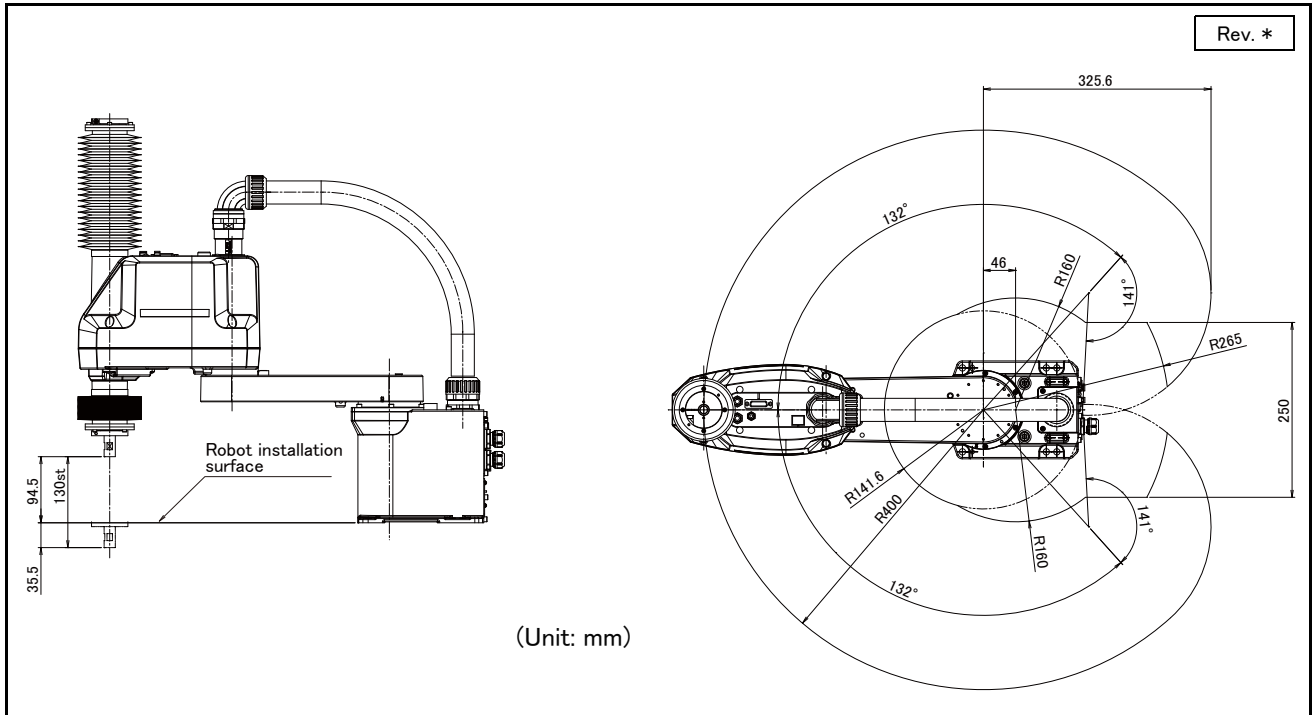


Fig.2-14 : Operating range diagram of RH-3CH4018-S23/S24

Rev. A

Note

- *1) The space is required for battery replacement. The distance to the minimum bending radius of the machine cable is specified.
- *2) The screw hole for fixing wiring and piping installed by the user.

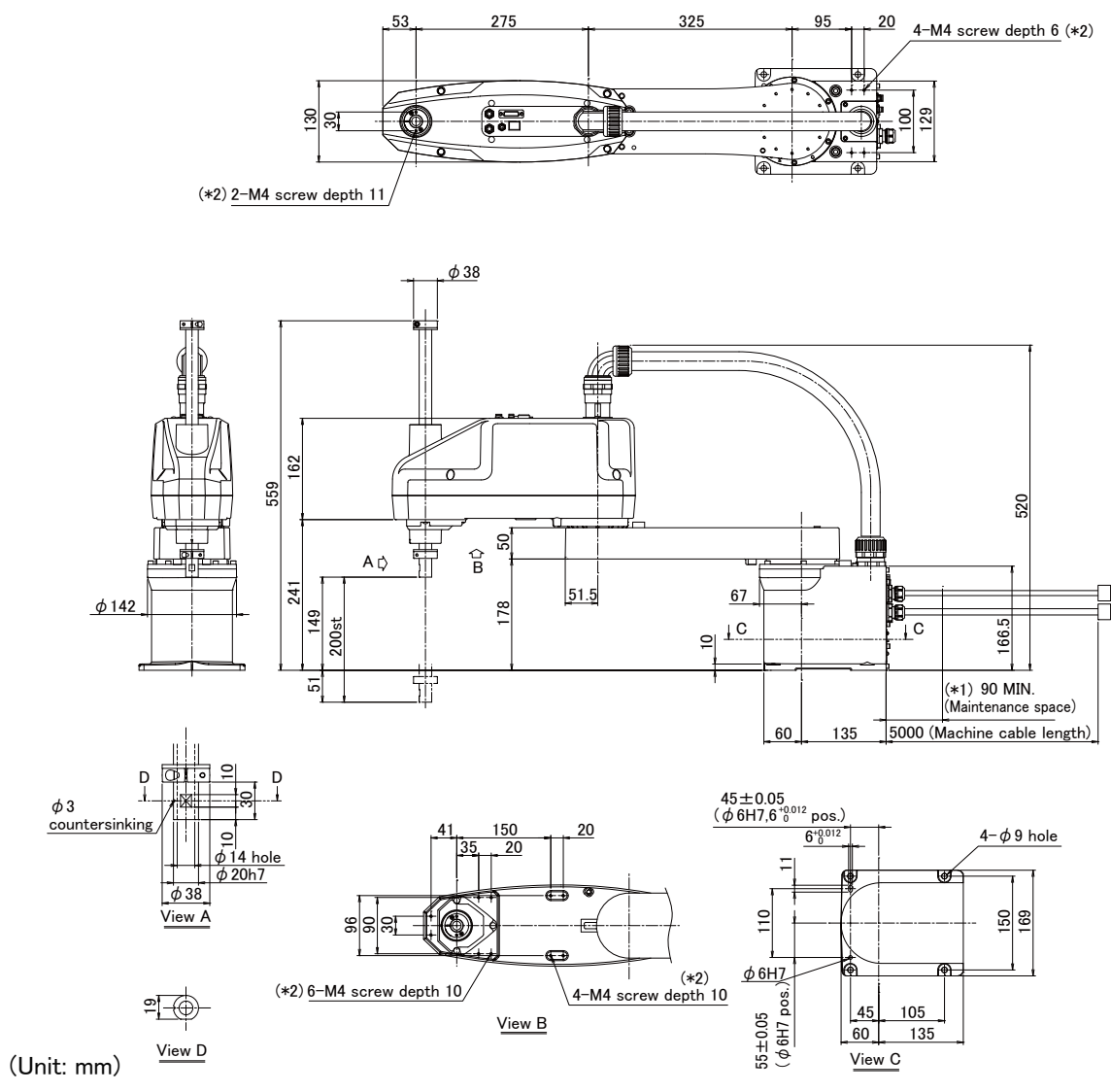


Fig.2-15 : Operating range diagram of RH-6CH6020-S11/S15

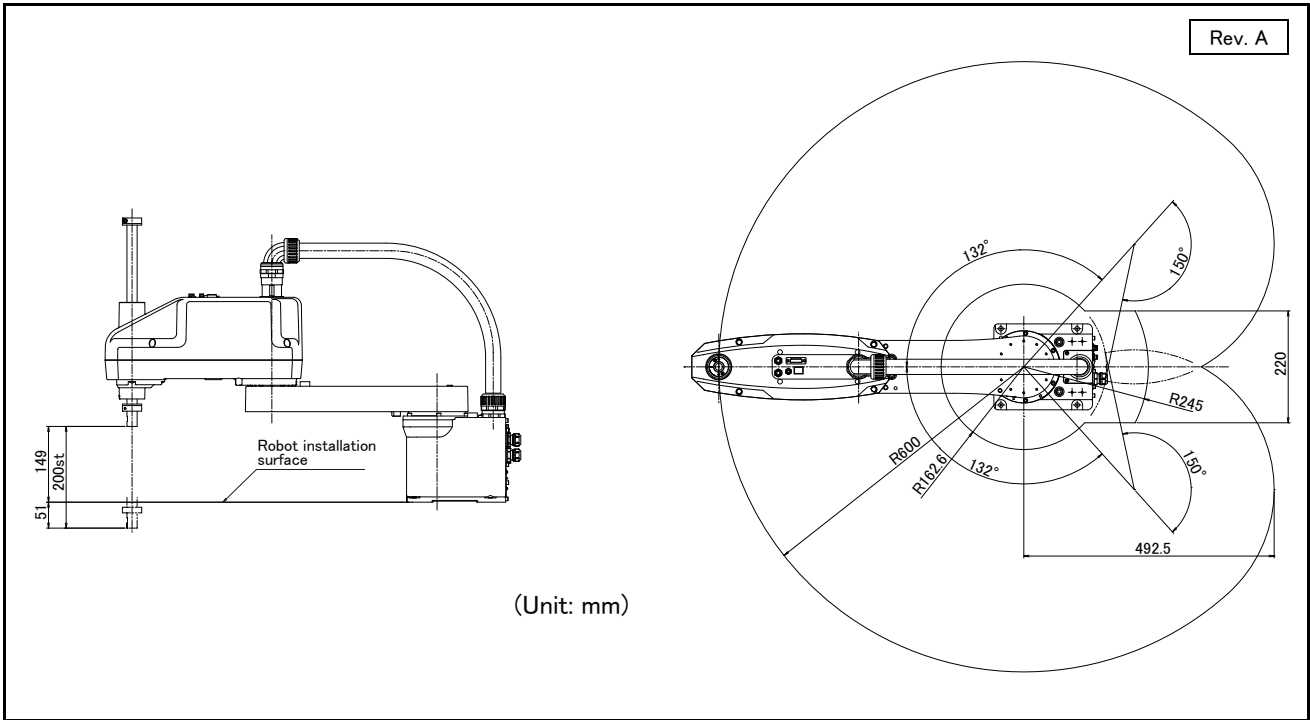


Fig.2-16 : Operating range diagram of RH-6CH6020-S11/S15

Rev. *

Note

- *1) The space is required for battery replacement. The distance to the minimum bending radius of the machine cable is specified.
- *2) The screw hole for fixing wiring and piping installed by the user.

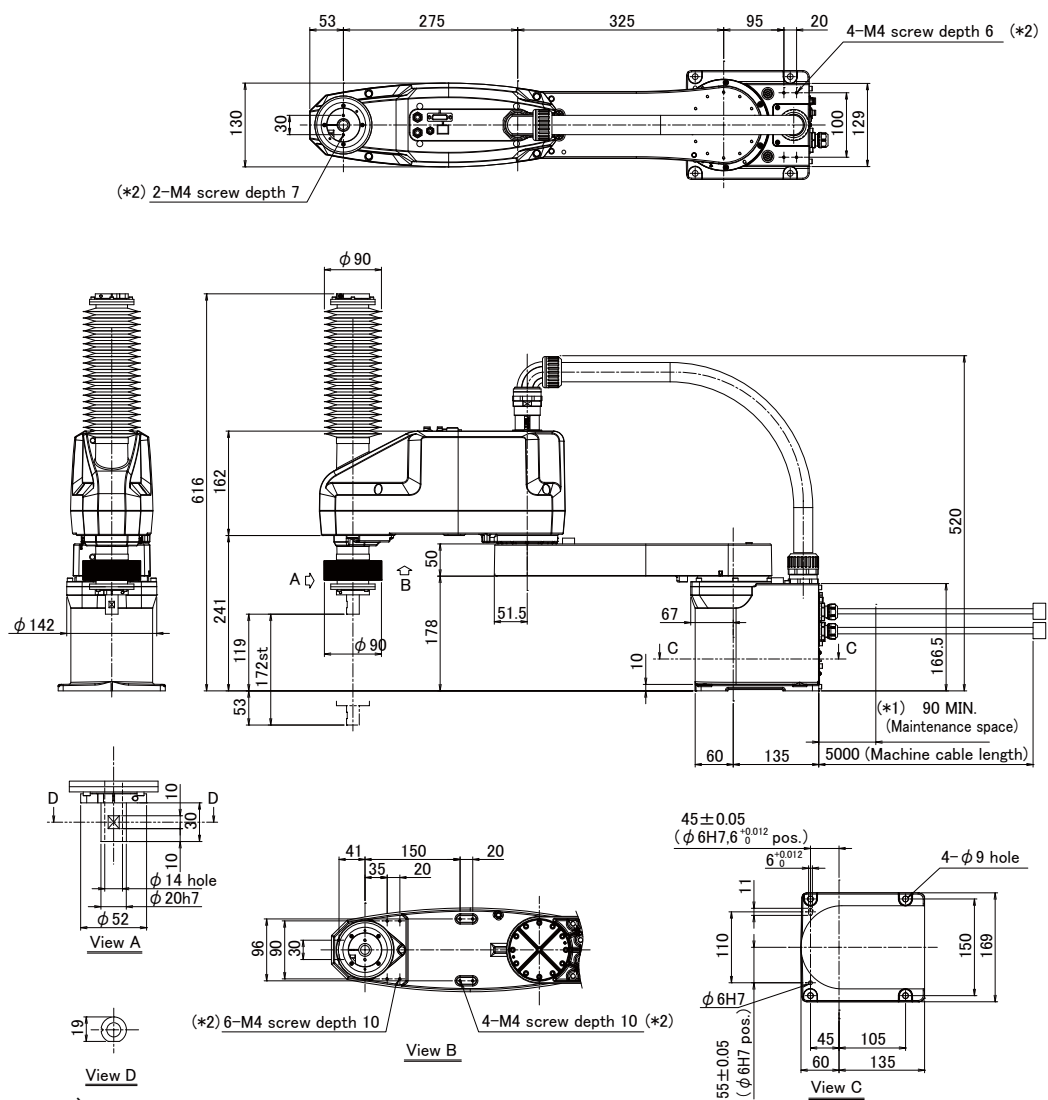


Fig.2-17 : Operating range diagram of RH-6CH6020-S23/S24

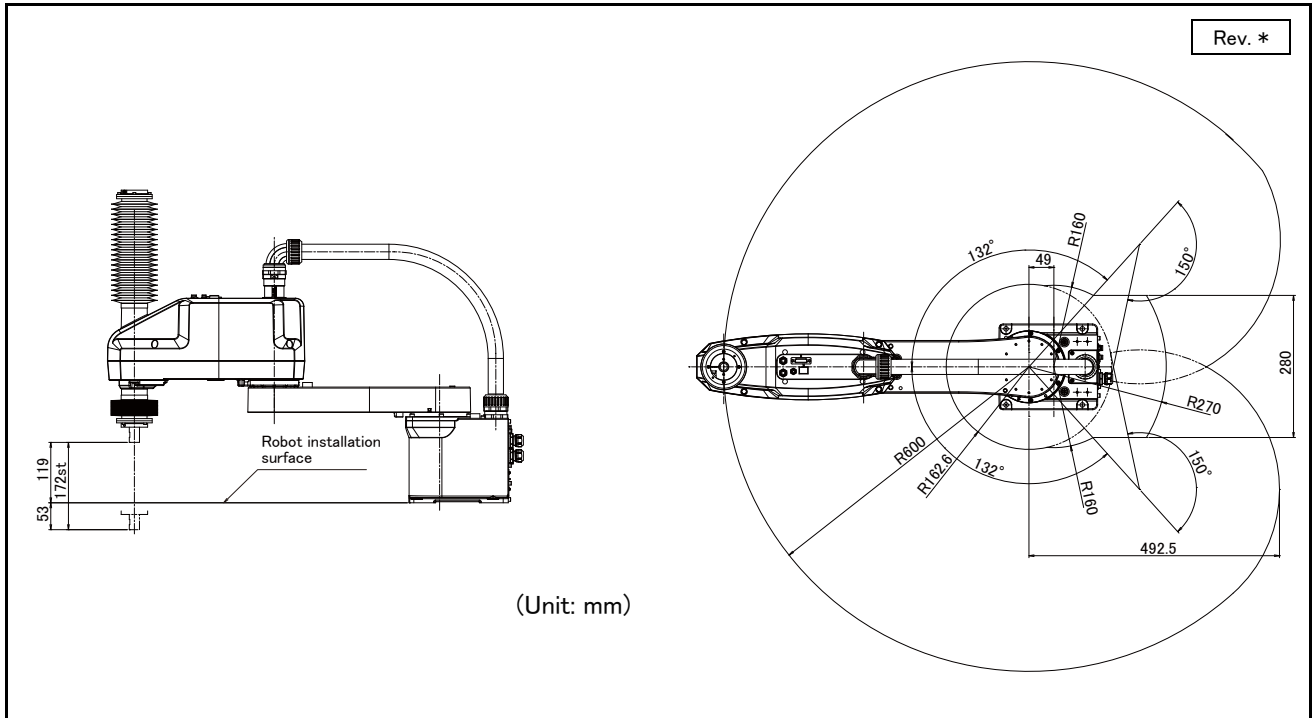
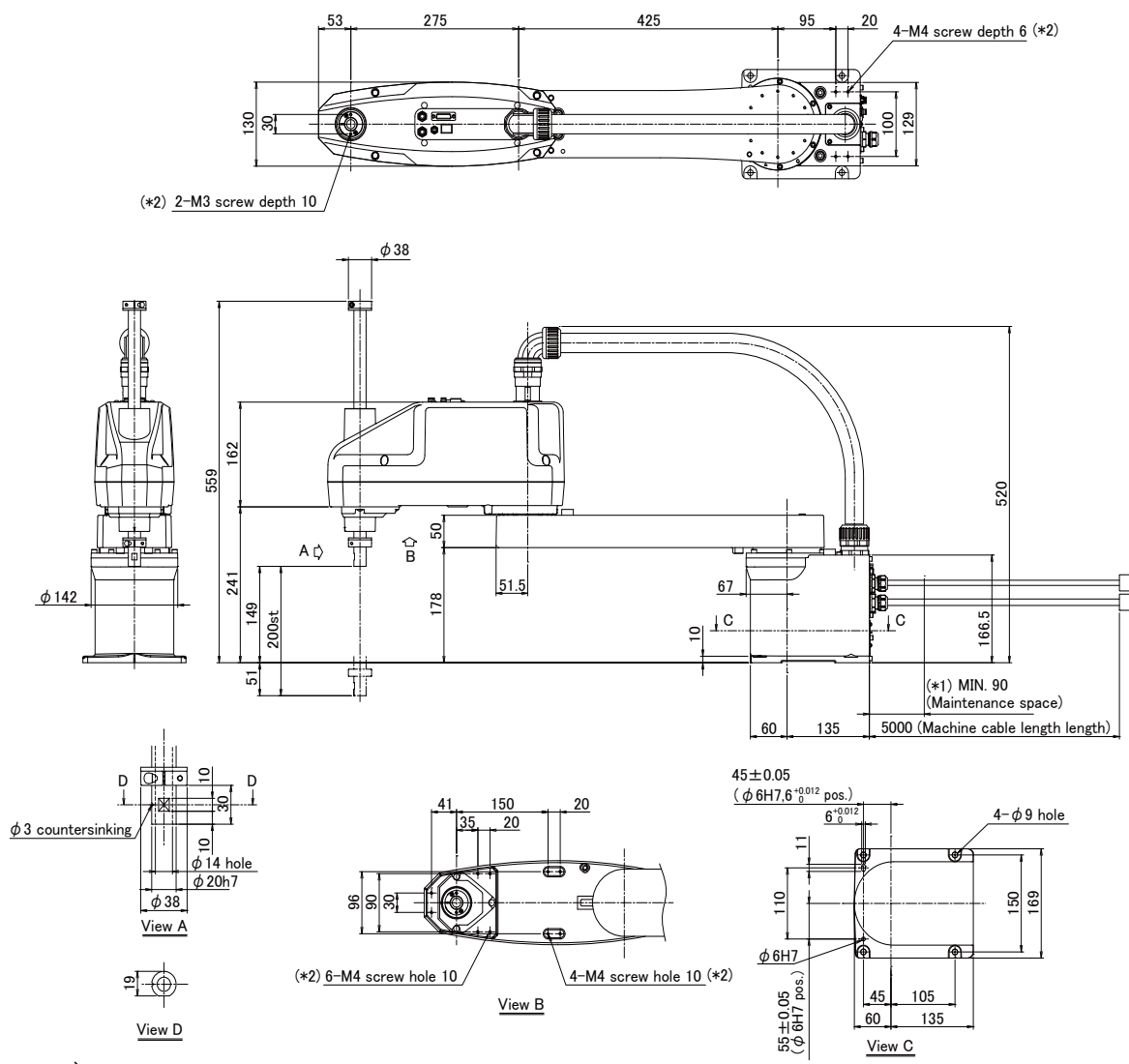


Fig.2-18 : Operating range diagram of RH-6CH6020-S23/S24

Rev. A

Note

- *1) The space is required for battery replacement. The distance to the minimum bending radius of the machine cable is specified.
- *2) The screw hole for fixing wiring and piping installed by the user.



(Unit: mm)

Fig.2-19 : Operating range diagram of RH-6CH7020-S11/S15

Rev. A

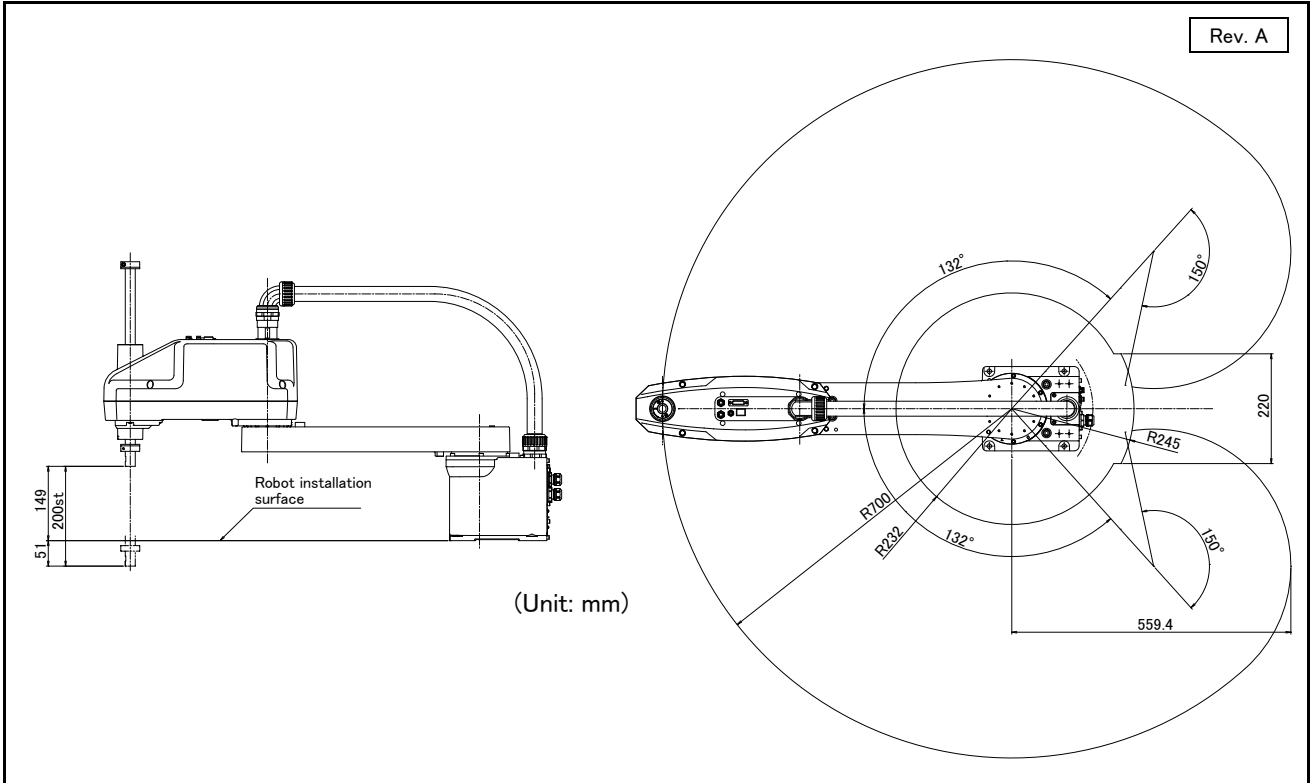
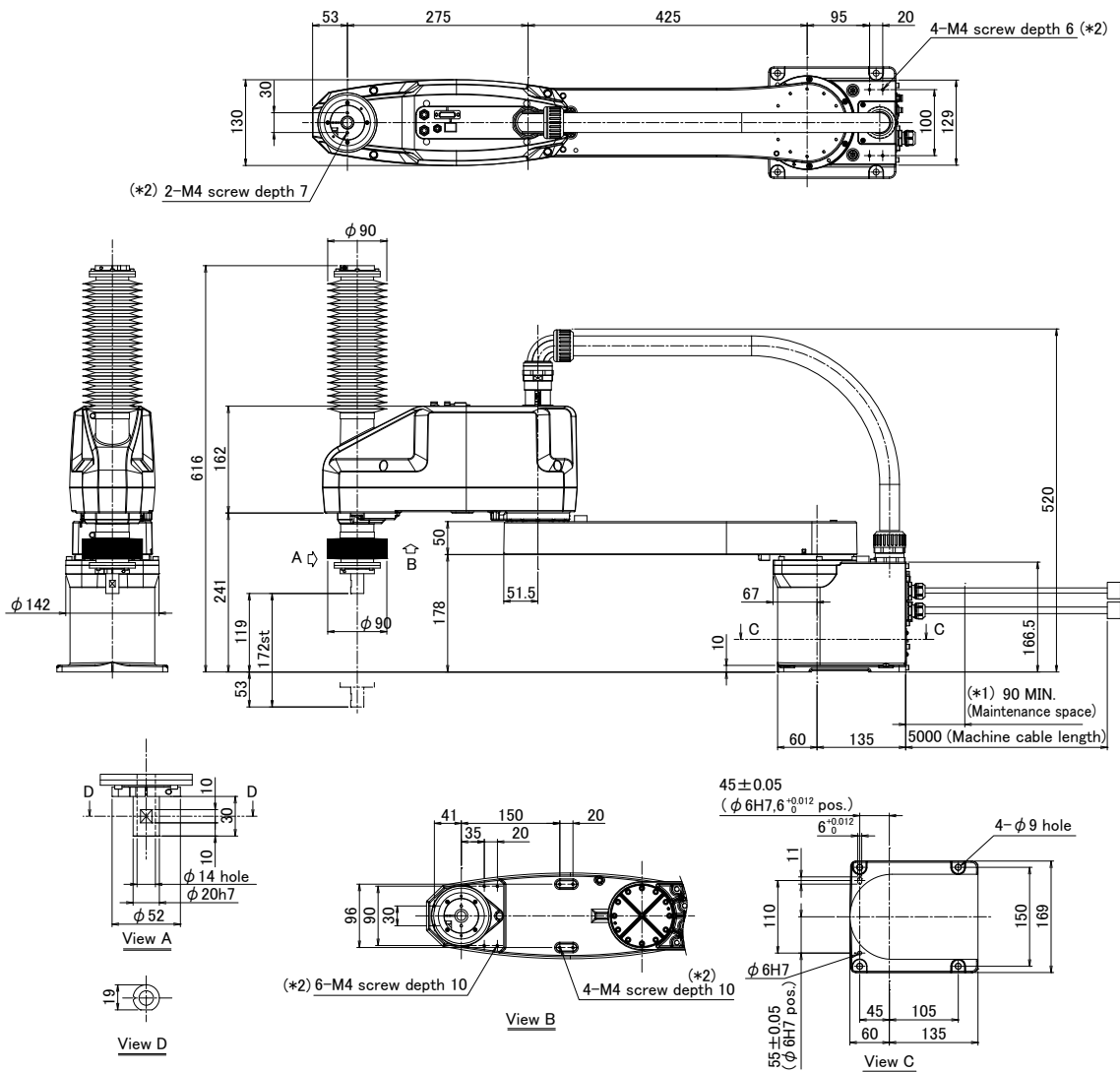


Fig.2-20 : Operating range diagram of RH-6CH7020-S11/S15

Rev. *

Note

- *1) The space is required for battery replacement. The distance to the minimum bending radius of the machine cable is specified.
- *2) The screw hole for fixing wiring and piping installed by the user.



(Unit: mm)

Fig.2-21 : Operating range diagram of RH-6CH7020-S23/S24

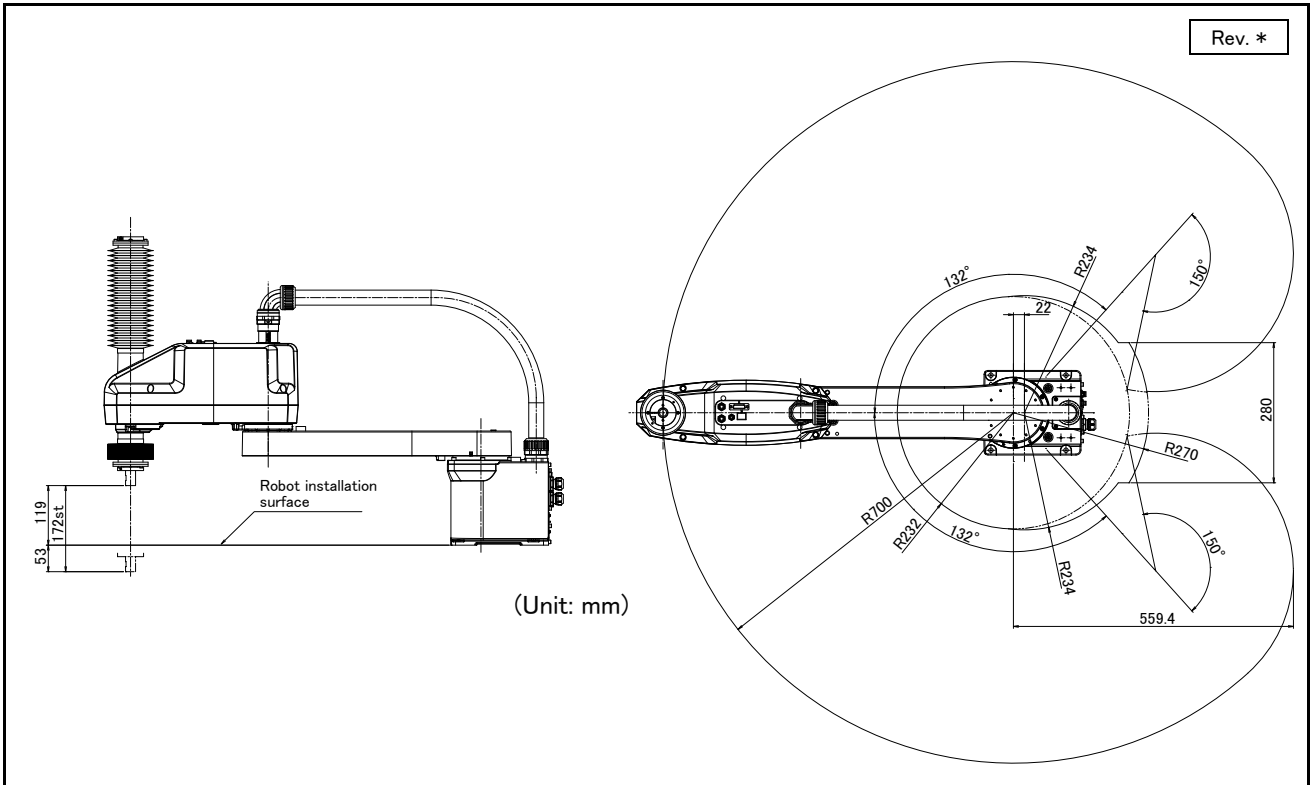
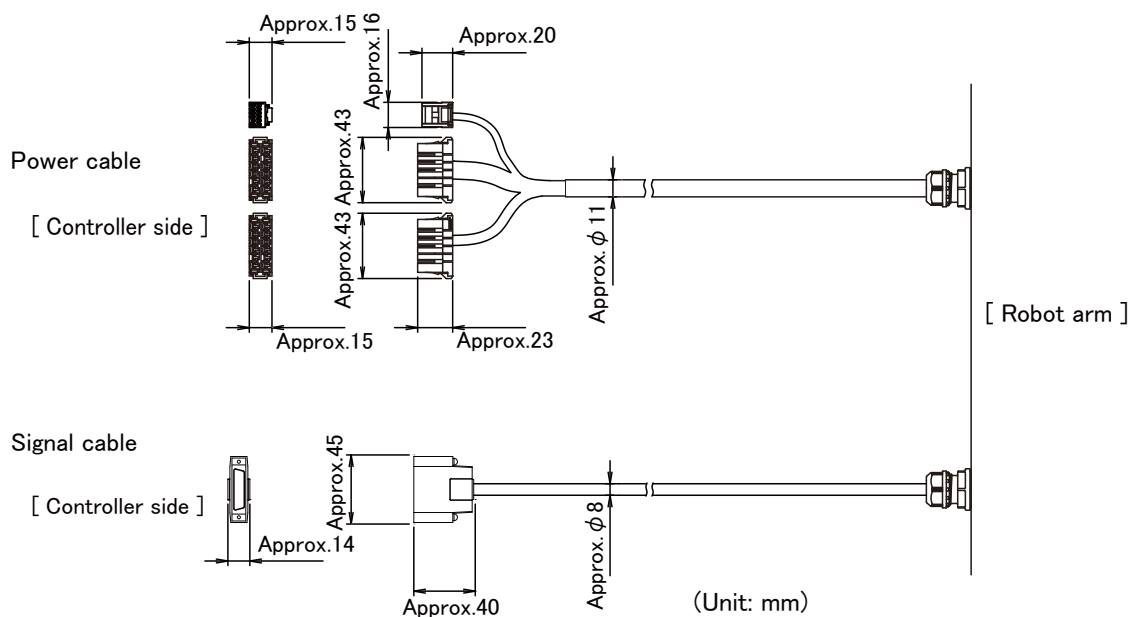
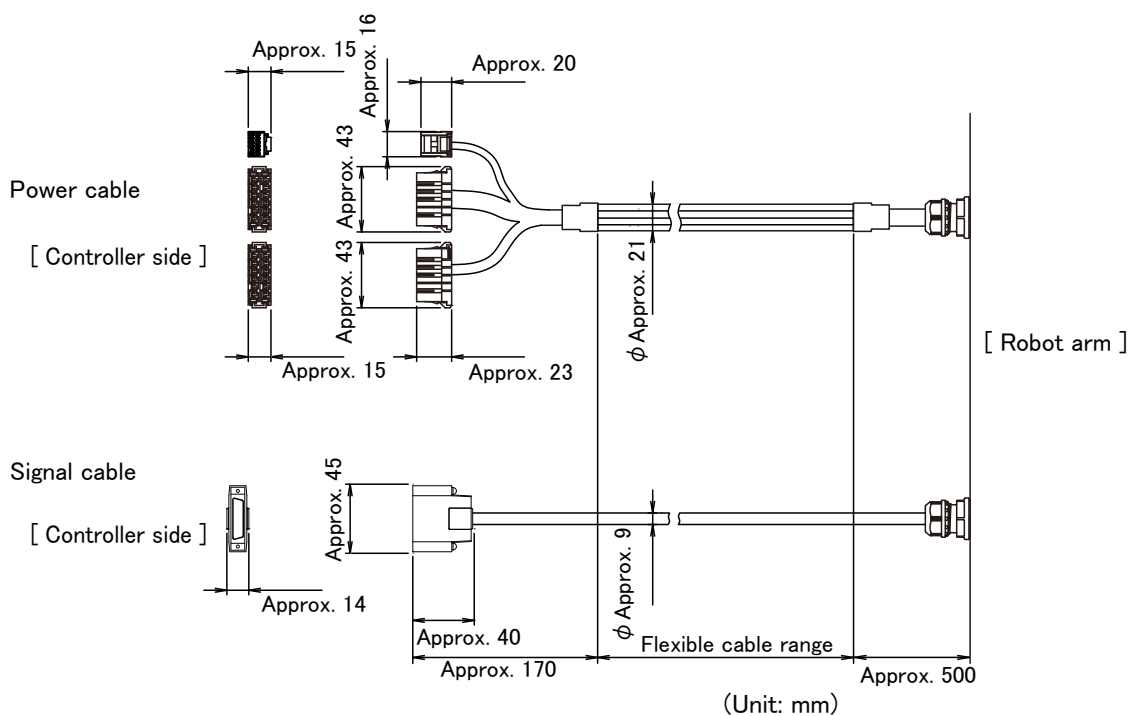


Fig.2-22 : Operating range diagram of RH-6CH7020-S23/S24

2.4.2 Outside dimensions of machine cables
 (1) RH-3CH-Sxx/RH-6CH-Sxx (fixed type)



(2) RH-3CH-Sxx/RH-6CH-Sxx (flexed type)



2.5 Tooling

2.5.1 Wiring and piping for hand

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

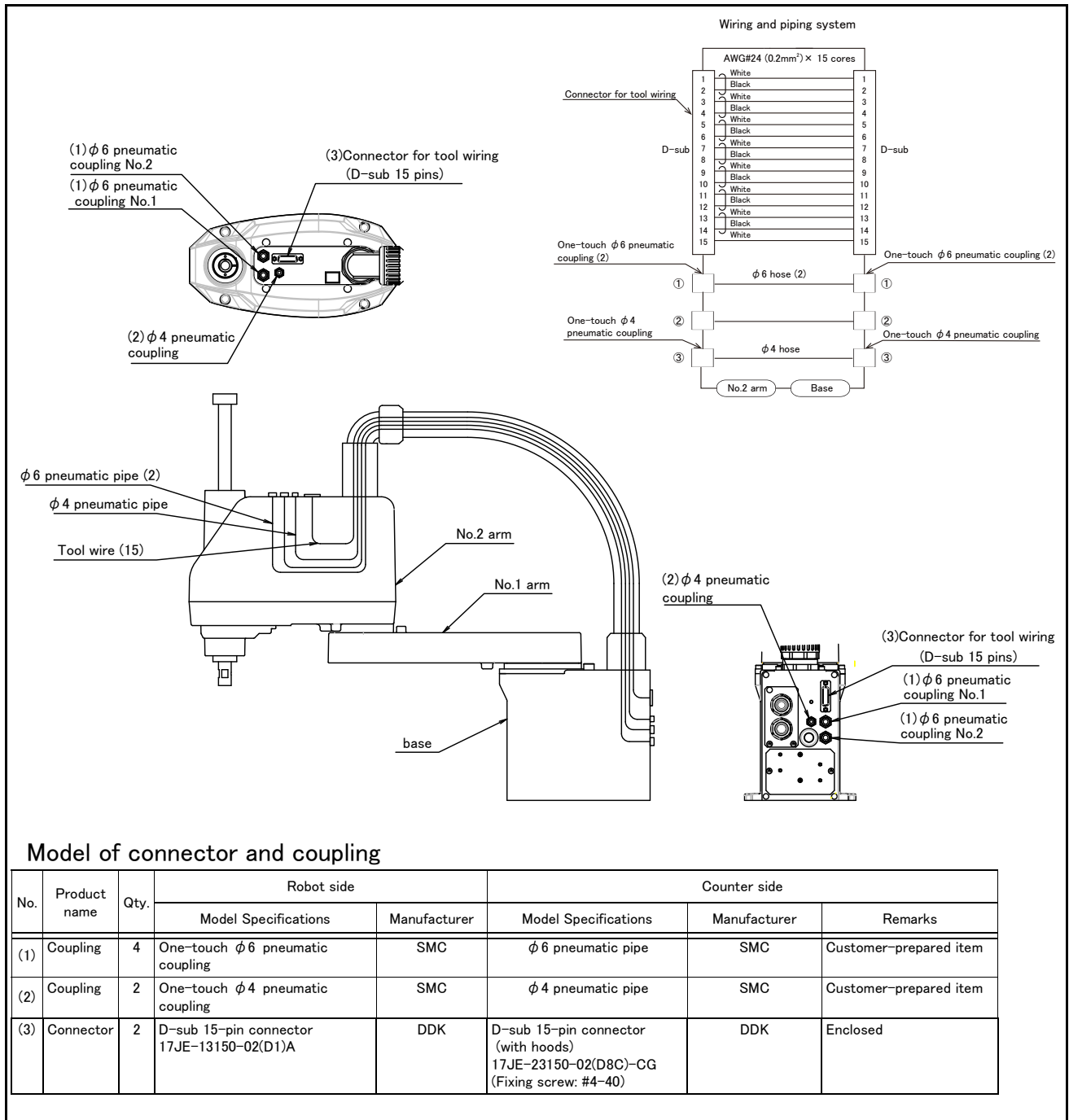


Fig.2-23 : Wiring and piping for hand

2.5.2 Internal wiring and piping

(1) General environment

- 1) In the robot, two lengths of $\phi 6$ pneumatic hose and a length of $\phi 4$ pneumatic hose are piped as the primary piping between the pneumatic inlet on the base and the top part of the No.2 arm.
- 2) The pneumatic inlet ports on both the base and the No.2 arm equip $\phi 6$ pneumatic couplings and $\phi 4$ pneumatic couplings as a bridge.

2.5.3 Internal wiring for the hand output cable

- 1) In the robot, a cable for the hand is wired between the base and the top part of the No.2 arm (AWG #24 (0.2 mm^2) \times 15 cores).The cable ends in connectors as a bridge of data.

2.5.4 About the Installation of Tooling Wiring and Piping (Examples of Wiring and Piping)

The customer is required to provide tooling wiring, piping and metal fixtures.
 Screw holes are provided on the robot arm for the installation of tooling wiring, piping and metal fixtures. (Refer to the Fig. 2-24.)
 The length of wiring and piping and the installation position on the robot must be adjusted according to the work to be done by the robot. Please use the following example as reference.

<Precautions>

- After performing wiring and piping to the robot, operate the robot at low speed to make sure that each part does not interfere with the robot arm and the peripheral devices.
- If you install metal fixtures and a solenoid valve using the screw holes on the No.2 arm portion, add the mass of the metal fixtures and the solenoid valve to mass of a hand then set the HNDDAT parameter. Moreover, Fix the parts, such as a solenoid valve, firmly to prevent the parts getting shaky during operation of a robot.

RH-3CH-S11/S15/S51/S52

RH-3CH-S23/S24

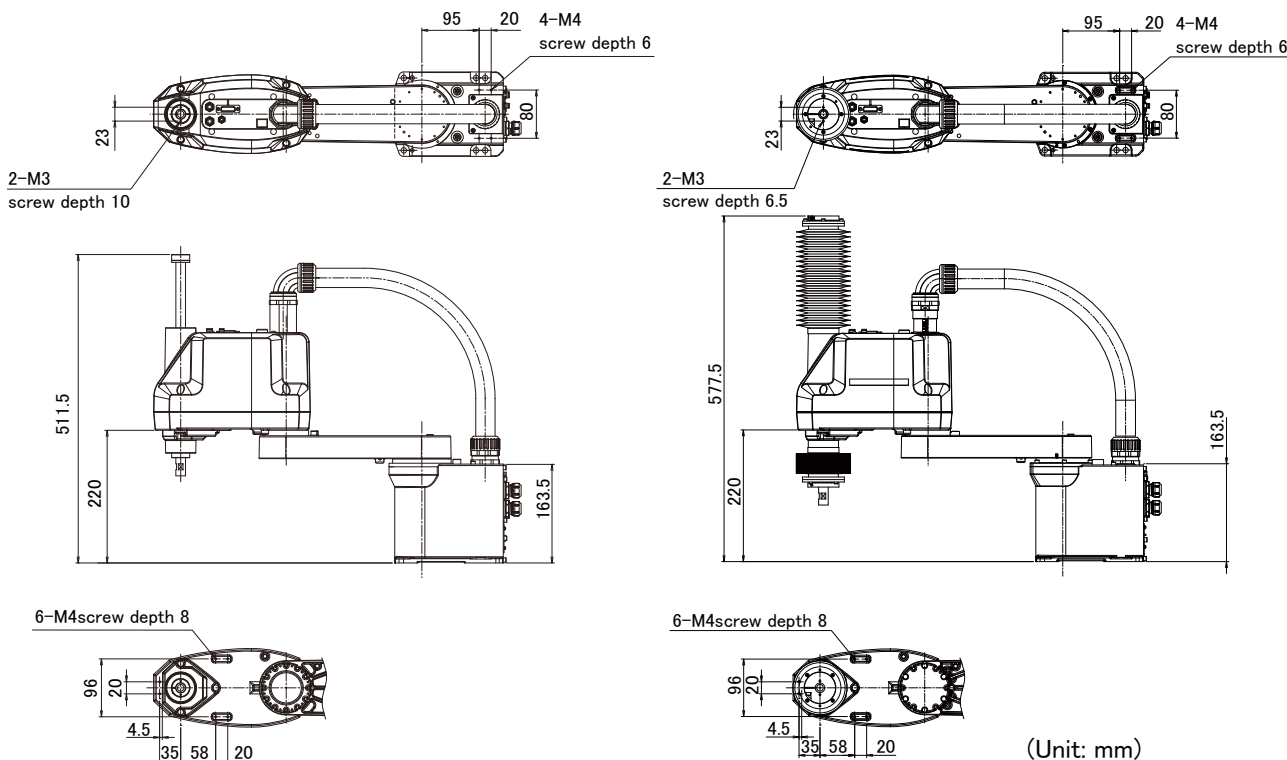


Fig.2-24 : Location of screw holes for fixing wiring/piping (RH-3CH-Sxx)

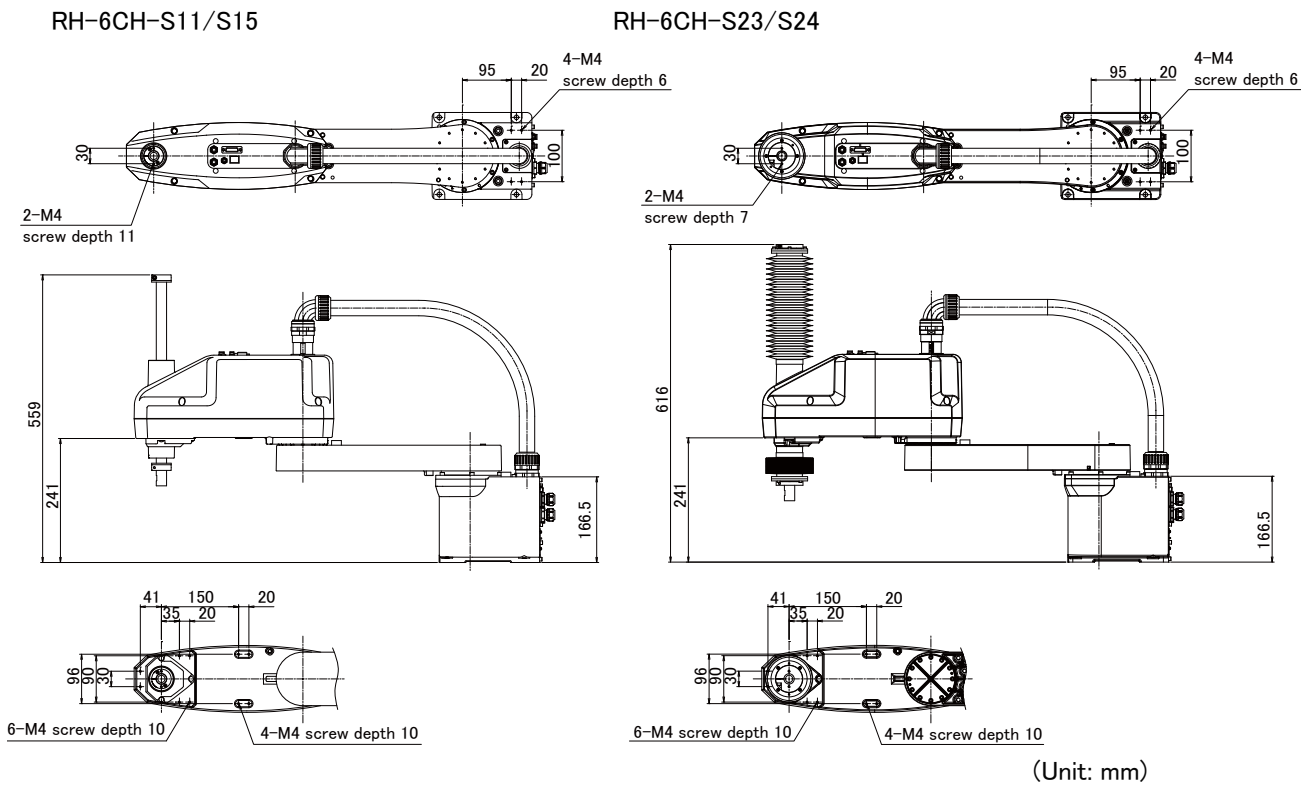


Fig.2-25 : Location of screw holes for fixing wiring/piping (RH-6CH-Sxx)

2.5.5 Air supply circuit example for the hand

Fig. 2-26 shows an example of the pneumatic circuit of air supply for the hand.

- (1) Make sure that a surge voltage protection circuit such as a diode is connected to the solenoid coil in parallel.
- (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. 2-26 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) If the air supply temperature (primary piping) used for the tool etc. is lower than ambient air temperature, the dew condensation may occur on the coupling or the hose surface.

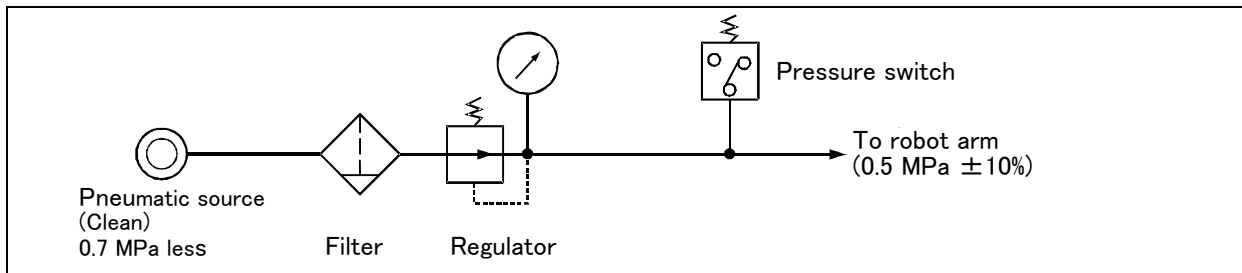


Fig.2-26 : Air supply circuit example for the hand

2.6 Options

■ What are options?

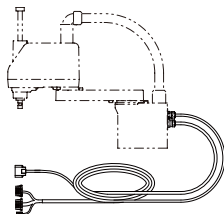
A variety of options are available to enable customers to perform setup simply and easily. These options are intended to be attached by the customer.

(1) Machine cable (Fixed type)

■ Order type : ● 1F- □□ UCBL-04

Note) □□ represents the cable length.

■ Outline



Replace the enclosed 5 m standard machine cables (fixed type) with these cables to reduce or extend the distance between the controller and the robot arm. The cables consist of a signal cable and a power cable.

■ Configuration

Table 2-7 : Configuration equipment and types

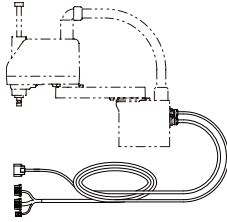
Part name		Type ^{Note 1)}	Qty.	Remarks
Fixed	Set of signal and power cables	1F- □□ UCBL-04	1 set	3 m, 10 m, 15 m, or 20 m each
	Motor signal cable		(1 cable)	
	Motor power cable		(1 cable)	
Cable ties		T18R	3 pcs.	Incl. 2 spare pcs.

Note 1) □□ represents the cable length.

(2) Machine cable (flexed type)

Order type: ● IF- □□ LUCBL-04 Note) □□ represents the cable length.

Outline



These cables consist of flexed cables, and used for extending the distance between the controller and the robot arm. Replace the enclosed standard cables (5 m) with these cables.
The cables consist of a signal cable and a power cable.

Configuration

Table 2-8 : Configuration equipment and types

Part name	Type ^{Note 1)}	Qty.	Remarks
Flexed Set of signal and power cables	1F- □□ LUCBL-04	1 set	10 m, 15 m, or 20 m each
	Motor signal cable	(1 cable)	
	Motor power cable	(1 cable)	
Nylon clamp	NK-10N	2 pcs.	For signal cable
Nylon clamp	NK-16N	2 pcs.	For power cable
Silicon rubber		4 pcs.	
Cable ties	T18R	3 pcs.	Incl. 2 spare pcs.

Note 1) □□ represents the cable length.

Specifications

Shows usage conditions for flexed type cables in Table 2-9.

Table 2-9 : Conditions for the flexed type cables

Item	Specifications	
Minimum flexed radius	100 mm or more	
Cableveyor, etc., occupation rate	50% or less	
Maximum movement speed	2,000 mm/s or less	
Guidance of life count	7.5 million times (With silicone grease coating)	
Environmental proof	IP20	
Cable configuration	Motor signal cable	φ 8.5 × 1
	Motor power cable	φ 9 × 1, φ 6.5 × 4, φ 6.2 × 1

[Caution] The guidance of life count may greatly differ according to the usage state items related to Table 2-9 and to the amount of silicon grease applied in the cableveyor.

Recommendation grease: G-501 (Supplier: Shin-Etsu Chemical Co., Ltd.)

[Caution] When a cableveyor is used, partitions are required to avoid overlapping or riding up of the cables. Also, adjust the cable length to eliminate tension or excessive looseness, and fix it securely.

Cable configuration

The configuration of the flexed cable is shown in Table 2-10. Refer to this table when selecting the cableveyor. The configuration is the same between the length difference in the cable, and extension type / direct type.

Table 2-10 : Cable configuration (Flexed type)

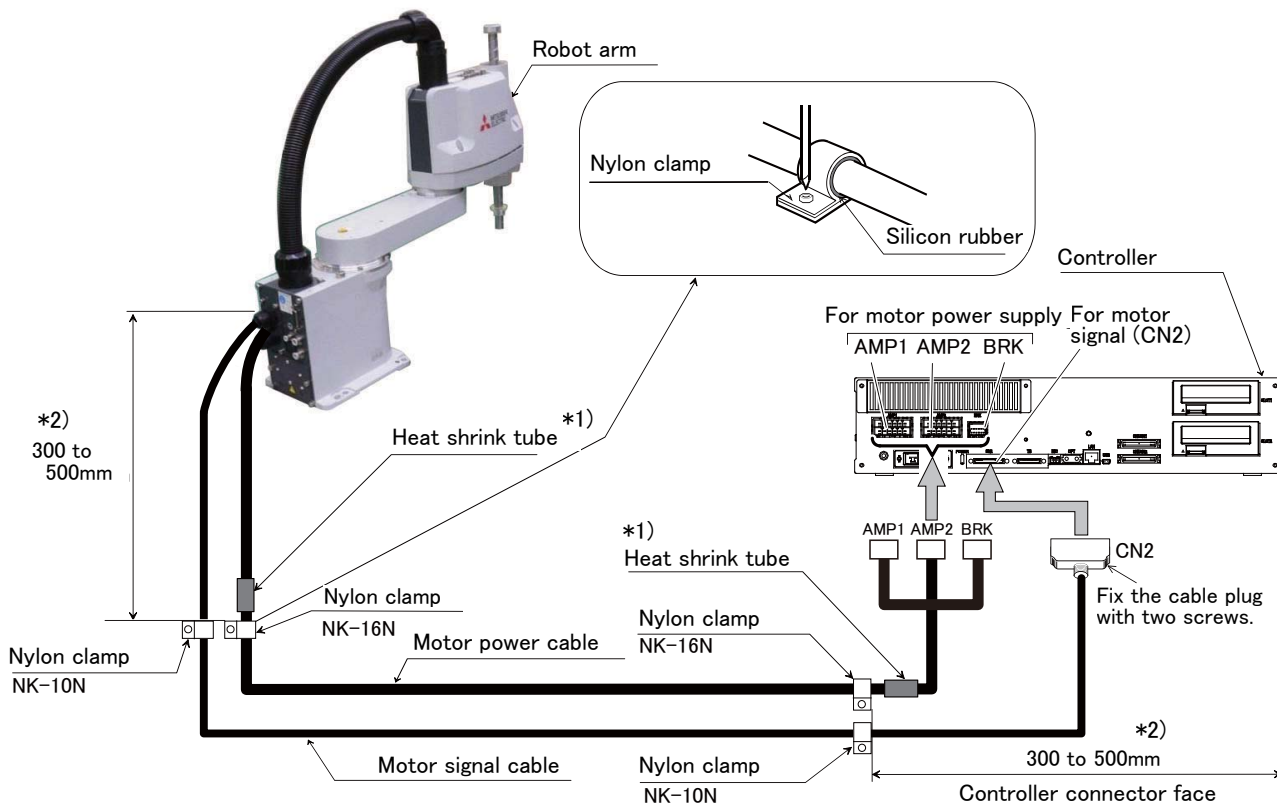
Item	Motor signal cable	Motor power cable		
		AWG#16 (1.25 mm ²)-4C	AWG#18 (0.75 mm ²)-3C	AWG#24 (0.2 mm ²)-4P
No. of cores	AWG#24 (0.2 mm ²)-4P			
Finish dimensions	Approx. φ 8.5 mm	Approx. φ 9 mm	Approx. φ 6.5 mm	Approx. φ 6.2 mm
No. of cables used	1 cable	1 cable	4 cables	1 cable
No. in total	7 cables			

■ Fixing the flexed cable

- (1) Connect the connector to the robot arm.

The connection method to a robot arm is the same as a standard machine cable. Refer to the separate volume "Robot Arm Setup & Maintenance" and connect.

- (2) For protection of wires from external stress, see Fig. 2-27. to wrap the cable with the supplied silicon rubber and fix the cable with nylon clamps in the area between the heat shrink tubes on the robot and the controller sides (flexed cable area).



*1) The area allowing bending the servo motor power cable is between the heat shrink tubes on the robot arm and the controller sides. Refer to Page 34, "(2) RH-3CH-Sxx/RH-6CH-Sxx (flexed type)" for details of the area allowing bending cables.

*2) Motor power cable and motor signal cable should be fixed at the same position.

Fig.2-27 : Fixing the flexed cable

2.7 About Overhaul

Robots which have been in operation for an extended period of time can suffer from wear and other forms of deterioration. In regard to such robots, we define overhaul as an operation to replace parts running out of specified service life or other parts which have been damaged, so that the robots may be put back in shape for continued use. As a rule of thumb, it is recommended that overhaul be carried out before the total amount of servo-on time reaches the specified time (24,000 hours for the robot arm and 36,000 hours for the controller) (See Fig. 2-28.). However, the degree of the equipment's wear and deterioration presumably varies depending on their operating conditions. Especially for operation with high load and frequency, the maintenance cycle may be shorter. For details on the part selection for replacement and the timing of overhaul, contact your dealer.

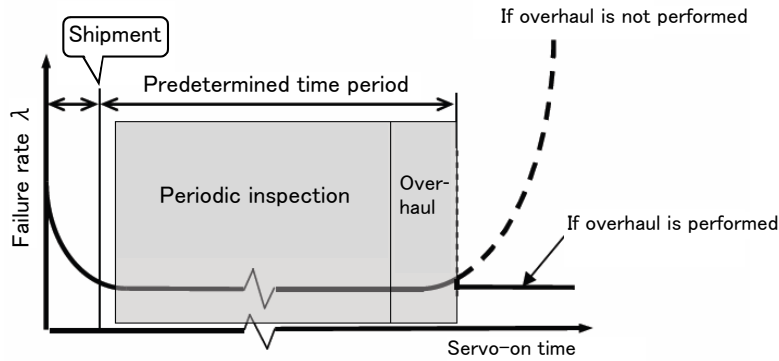


Fig.2-28 : Periodic inspection/overhaul periods

2.8 Maintenance parts

The consumable parts used in the robot arm are shown in [Table 2-11](#). 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 2-11 : Consumable part list

No.	Part name	Type ^{Note 1)}	Usage place	Qty.	Supplier
1	Grease		Reduction gears of each axis	As needed	Mitsubishi Electric
2			Ball screw/spline	As needed	
3	Lithium battery	ER6V	Front part of the base section	2	
4	Timing belt		J3 axis	1	Mitsubishi Electric
5			J4 axis motor side	1	
6			J4 axis shaft side	1	
7	Felt		Ball screw/spline	1	

Note 1) 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 Basic specifications

Table 3-1 : Specifications of controller

Item	Unit	Specification	Remarks	
Type		CR751-03CHD-Sxx CR751-06CHD-Sxx	Note 1)	
Number of control axis		Simultaneously 4		
Memory capacity	Programmed positions	point	39,000	
	No. of steps	step	78,000	
	Number of program		512	
Robot language		MELFA-BASIC IV, V		
Teaching method		Pose teaching method, MDI method ^{Note 2)}		
External input and output	Input and output	point	32/32	2D-TZ368 is attached at the time of shipment.
	Dedicated input/output		Assigned with general-purpose input/output	The signal number of "STOP" input signals is fixing.
	Emergency stop input	point	1	Duplicated
	Door switch input	point	1	Duplicated
	Enabling device input	point	1	Duplicated
	Emergency stop output	point	1	Duplicated
	Mode output	point	1	Duplicated
	Robot error output	point	1	Duplicated
	Addition axis synchronization	point	1	Duplicated
Mode changeover switch input	point	1	Duplicated	
Interface	RS-422	port	1	Only for T/B
	Ethernet	port	1	10BASE-T/100BASE-Tx
	USB	port	1	Ver.2.0 FullSpeed Only device function
	Additional axis interface	Channel	1	SSCNET III (Connects with MR-J3-BS, MR-J4-B series)
	Tracking interface	Channel	2	
	Option slot	slot	2	The following interfaces are installed in slot 1 which is a dedicated option interface slot. ^{Note 3)} <ul style="list-style-type: none"> • S11/S23/S51: 2D-TZ368 • S15/S24/S52: 2D-TZ378
Power source ^{Note 4)}	Input voltage range	V	Single phase AC200 to 253	
	Power capacity	kVA	0.5	Does not include rush current. ^{Note 5)}
	Power supply frequency	Hz	50/60	
Outline dimensions ^{Note 6)}	mm	430(W) × 425(D) × 98(H)	Excluding protrusions	
Mass	kg	Approx. 12		
Construction		Self-contained floor type, Opened type. Installation vertically or horizontally	IP20 ^{Note 7)}	
Operating temperature range	°C	0 to 40		
Ambient humidity	%RH	45 to 85	Without dew drops	
Grounding	Ω	100 or less	100 Ω or less (class D grounding) ^{Note 8)}	
Paint color		Dark gray	Equivalent to Munsell: 3.5PB3.2/0.8	

Note 1) For details of the operation procedure, basic operations, and maintenance and inspection items of the controller, refer to the information on the CR751-03HD in the separate volume "Controller Setup, Basic Operation and Maintenance".

Note 2) Pose teaching method: The method to register the current position of the robot arm.

MDI method: The method to register by inputting the numerical value Immediate.

Note 3) Two connectors (FCN-360 BKO-C11465H03) are included for the 2D-TZ368 and 2D-TZ378.

The cable must be prepared and wired by the customer. Refer to Fig. 3-22 for the pin layout.

- Note 4) For information on connecting the power supply to the controller, refer to the separate Instruction Manual "Controller Setup, Basic Operation, and Maintenance".
The ACIN connector and the ACIN terminal are not included with the controller. Use the supplied single-phase power cable for connection to a power supply.
- Note 5) The power capacity is the rating value for normal operation. The power capacity does not include the rush current when the power is turned ON. The power capacity is a guideline and the actual operation is affected by the input power voltage. The power consumption in the specific operation pattern with the RH-6FH is approx. 0.3kW. The short circuit breaker should use the following.
* Operate by the current leakage under the commercial frequency domain (50 to 60 Hz). If sensitive to the high frequency ingredient, it will become the cause in which below the maximum leak current value carries out the trip.
- Note 6) Refer to [Page 49, "3.3.1 Outside dimensions"](#) for details.
- Note 7) This controller is standard specification. (Refer to [Page 46, "3.1.2 Protection specifications and operating supply"](#).)
- Note 8) The robot must be grounded by the customer.

3.1.2 Protection specifications and operating supply

A protection method complying with the IEC Standard IP20 (Opened type) is adopted for the controller. The IEC IP symbols refer only to the degree of protection between the solid and the fluids, and don't indicated that any special protection has been constructed for the prevention against oil and water.

【Information】

- The IEC IP20

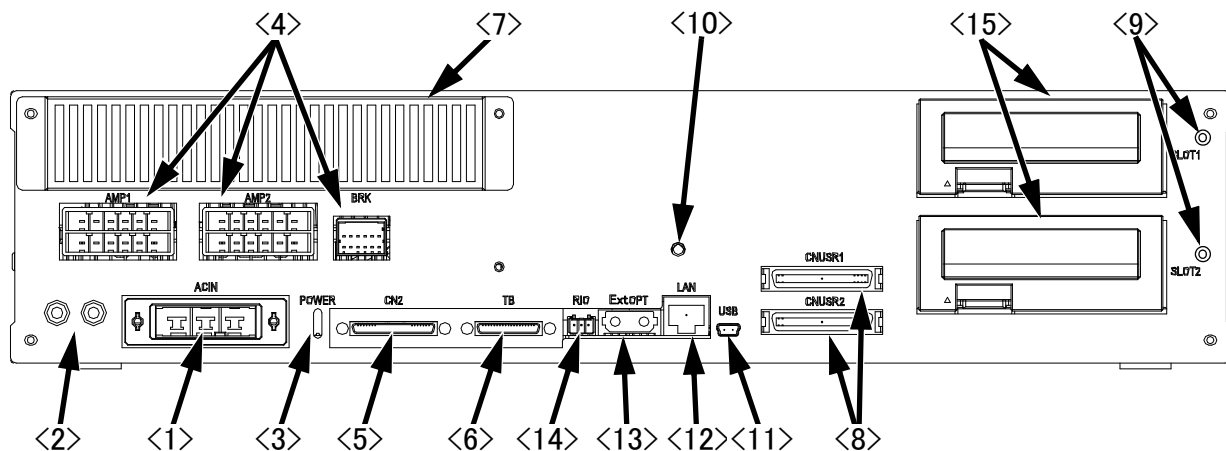
It indicates the protective structure that prevents an iron ball $12^{+0.05}_0$ mm diameter, which is being pressed with the power of $3.1 \text{ kg} \pm 10\%$, from going through the opening in the outer sheath of the supplied equipment.

Refer to [Page 120, "6.2 Working environment"](#) for details on the working environment.

3.2 Names of each part

3.2.1 Controller

Controller (Front side)



Controller (Rear side)

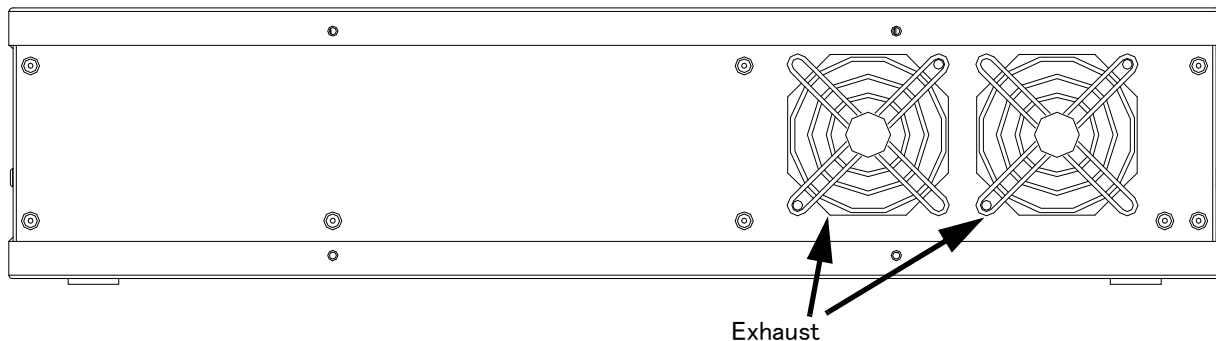


Fig.3-1 : Names of controller parts (CR751)

- <1> ACIN connectorThe connector for AC power source (single phase, 200 VAC) input. (a socket housing and a terminal are attached).
Refer to the separate volume "Controller Setup, Basic Operation and Maintenance" for how to connect a power cable.
- <2> PE terminalThe screw for grounding of the cable. (2 M4 screws)
- <3> POWER lampLamp of control power source
- <4> Machine cable connector (for motor power supply)
AMP1, AMP2: Motor power supply, BRK: Motor brake
- <5> Machine cable connector (for motor signal)
CN2: Motor signal
- <6> T/B connection connector (TB).....This is a dedicated connector for connecting the R33TB. When not using T/B, connect the attached dummy plug.
- <7> Filter coverThere is an air filter and battery inside this cover.
- <8> CNUSR connectorThe connector for input/ output connection dedicated for robot.
(CNUSR1, CNUSR2) (a plug connector attached)
Refer to the separate volume "Controller Setup, Basic Operation and Maintenance" for the connection method and the further description of pin assign.
- <9> Grounding terminalThe grounding terminal for connecting cables of option card. (2 M3 screws)
- <10> Power supply charge lamp (CRARGE)
The lamp is to ensure safe timing (prevent electric shocks) when removing the cover (users are not normally required to remove the cover).
This lamp is illuminated (red) when electrical energy accumulates on the controller's power supply circuit board due to the robot's servo being ON.

After turning the control power OFF and allowing a few minutes to pass, the lamp will go out.

- <11> USB connecting connector (USB) For USB connection
- <12> LAN connector (LAN).....For LAN connection
- <13> ExtOPT connector (ExtOPT).....Connect the cable for addition axis control.
- <14> RIO connector (RIO).....Connect the extension parallel input/output unit.
- <15> Option slot.....Install the interface optional. (Install the cover, when not using.)
(SLOT1, SLOT2)

Caution

Use the network equipments (personal computer, USB hub, LAN hub, etc) confirmed by manufacturer. The thing unsuitable for the FA environment (related with conformity, temperature or noise) exists in the equipments connected to USB. When using network equipment, 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. Guarantee and maintenance of the equipment on the market (usual office automation equipment) cannot be performed.

3.3 Outside dimensions/Installation dimensions

3.3.1 Outside dimensions

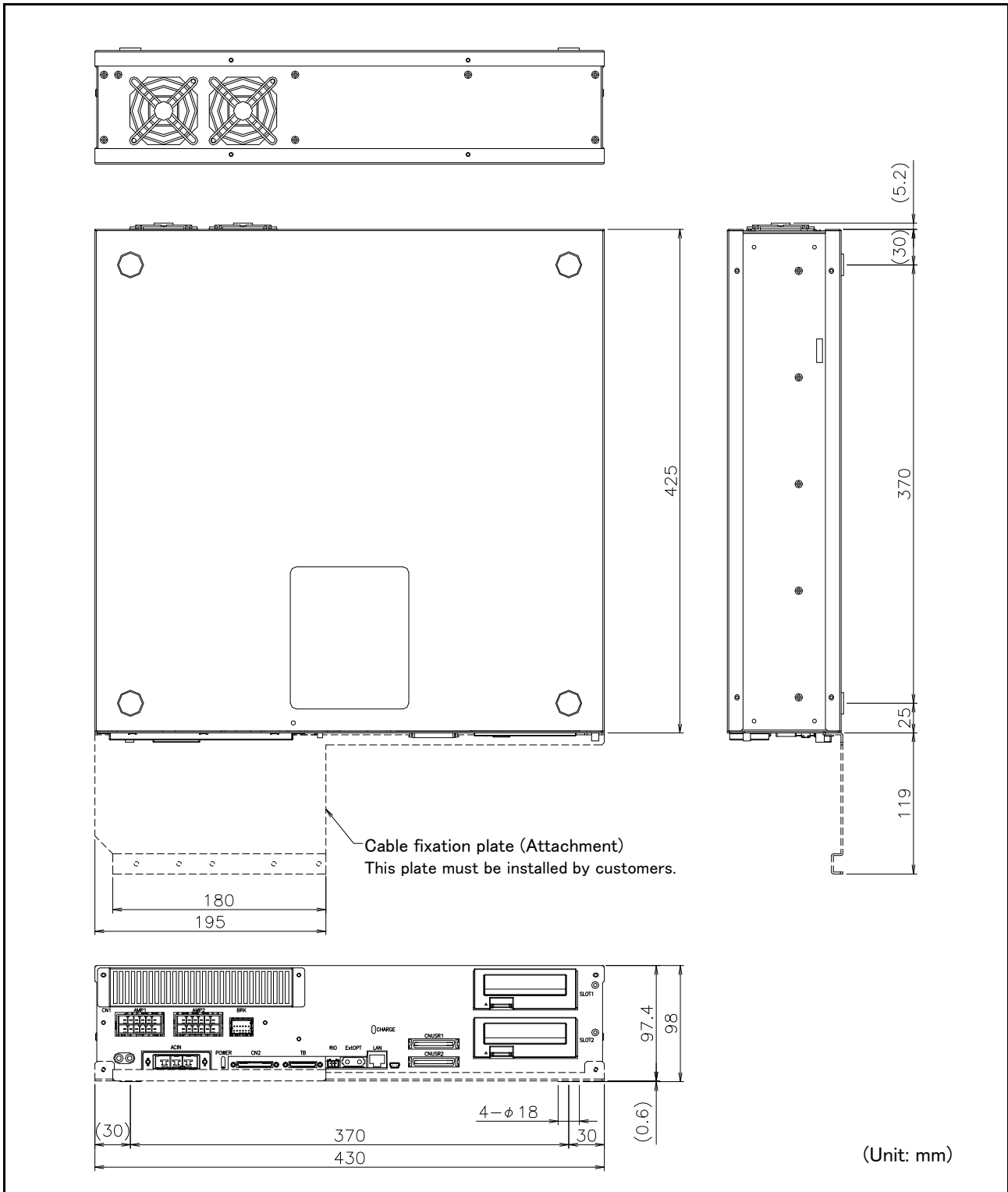
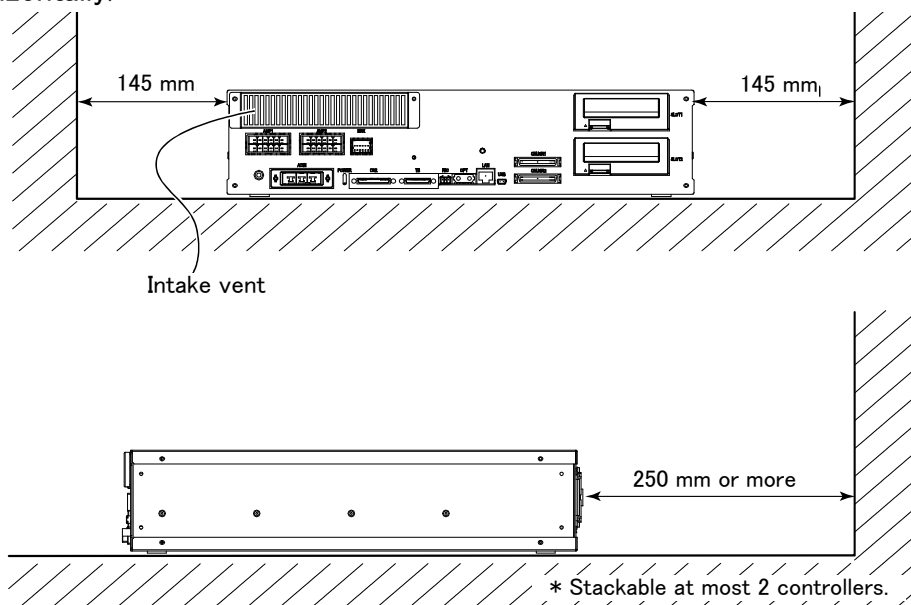


Fig.3-2 : Outside dimensions of controller (CR751)

3.3.2 Installation dimensions

<Placed horizontally>



<Placed vertically>

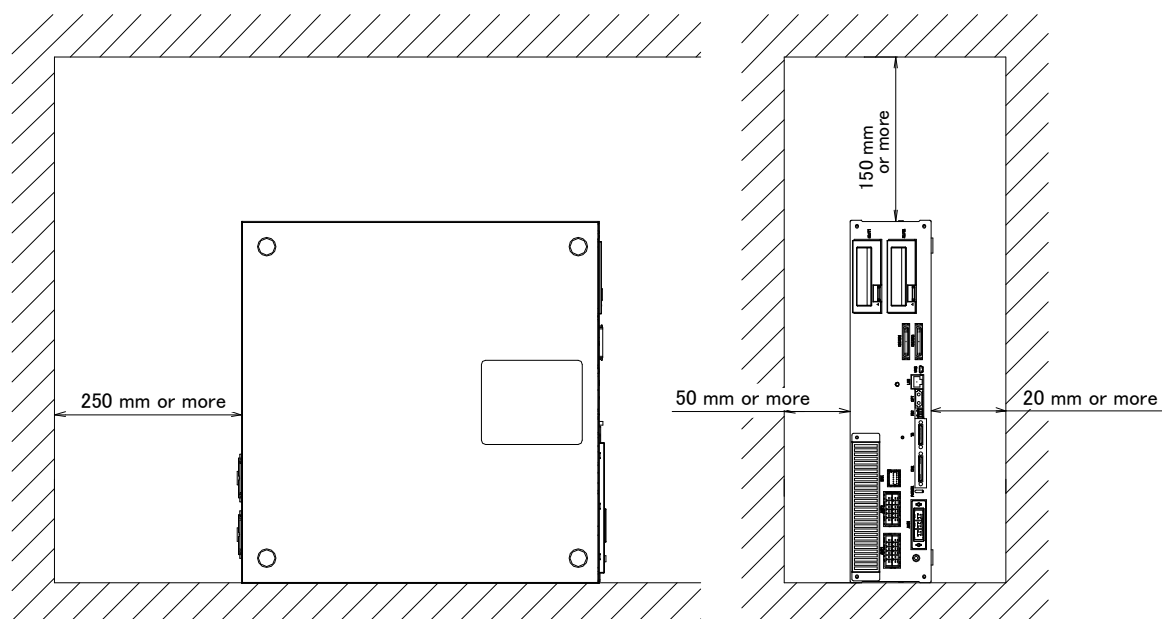


Fig.3-3 : Installation of controller (CR751)

CAUTION

Fixing installation section sure for prevention from the fall, when using the controller placing vertically. The reference figure of the metal plate for fixing is shown in Fig. 3-4. You should install the metal plate for fixation to the controller with M4 – 8 or the shorter screw. The screw projection length inside the controller (side board thickness is 1.2 mm) surely makes 6.8 mm or less.

CAUTION

When storing the controller in a cabinet, etc., take special care to the heat radiating properties and ventilation properties so that the ambient temperature remains within the specification values. And, don't install the controller in the position where direct rays or the heat of lighting hits. The skin temperature of the controller may rise, and the error may occur.

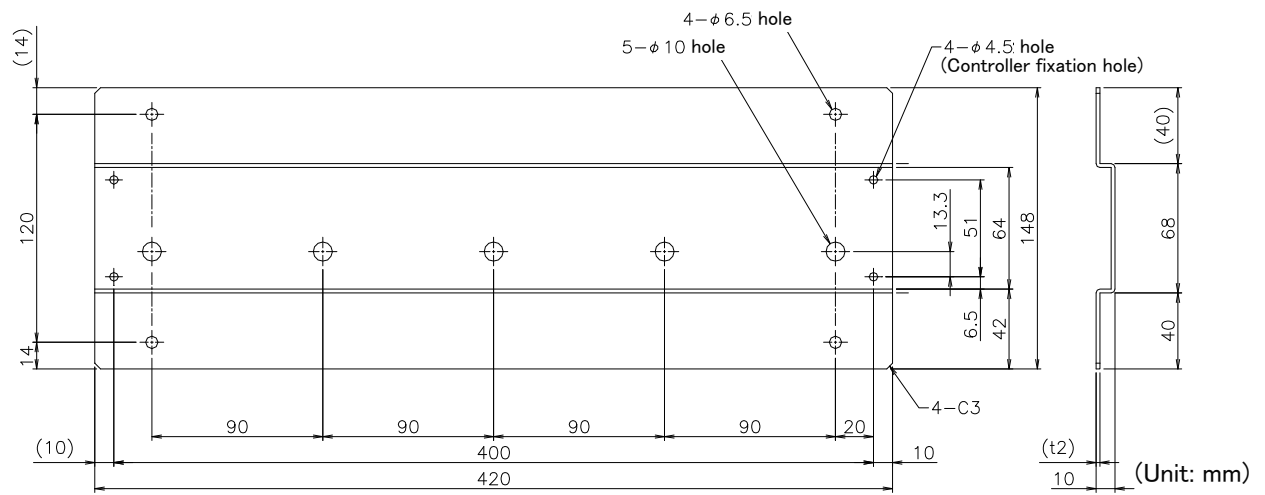


Fig.3-4 : Metal plate for fixation to placing vertically (Reference for CR751)

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.
- (4) Emergency stop/Door switch input.....Information on wiring the emergency stop and wiring used to ensure safety can be found on [Page 56, "3.6 Emergency stop input and output etc."](#) and on [Page 113, "6.1.7 Examples of safety measures"](#).

<For Reference>

Linking our GOT (graphic operation terminal) 1000 series (GT15) display equipment to the robot controller over the Ethernet permits you to control robot controller's input/output from the GOT.

3.5 Dedicated input/output

Show the main function of dedicated input/output in the [Table 3-2](#). Refer to attached instruction manual "Detailed explanations of functions and operations" in the product for the other functions. Each parameter indicated with the parameter name is used by designated the signal No., assigned in the order of input signal No. and output signal No.

Table 3-2 : Dedicated input/output list

Parameter name	Input <small>Note 1)</small>			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. Notes) Specification is the same as the STOP parameter.
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	For multiple mechanisms, it powers on the servos of all the mechanisms.	E	In servo ON output signal	Outputs the servo ON state. For multiple mechanisms, the output is performed when at least one of the mechanisms is in 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 Note 1)			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 Note 2)	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	
HNDCTRL1 : HNDCTRL3	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 ^{Note 3)}	None			User-designated area 8-points	Outputs that the robot is in the user-designated area.

Note 1) 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.

Note 2) Four elements are set in the order of input signal start No., end No., output signal start No. and end No.

Note 3) 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 3-3 : 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 60, "3.6.2 Special stop input (SKIP)")
Input	Door switch	Servo-off. Dual line, normal close (Page 61, "3.6.3 Door switch function")
Input	Enabling device	Servo-off. Dual line, normal close (Page 61, "3.6.4 Enabling device function")
Output	Robot error output	Contact is opening during error occurrence.
Output	Emergency stop output	The point of contact opens under occurrence of emergency stop of external input signal, emergency stop of OP, emergency stop of T/B.
Output	Mode output	MANUAL mode: contactor is opening, AUTOMATIC 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. (Page 69, "3.9 Magnet contactor control connector output (AXMC) for addition axes")

*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 24 VDC/10 to 100 mA. Don't connect the equipment except for this range. The use exceeding contact capacity causes failure.
In the customer's system, do not ground the + side of 24V power supply prepared by customer for connect to the controller. (related with emergency stop and parallel input/output) If it connects with the controller under the condition that the + side is grounded, it will lead to failure of controller.

[Note] If a stop signal or servo OFF signal is input simultaneously with a door switch open/emergency stop input, the error, H056n "Servo sys. error (A/D)" may occur.
When a door switch open/emergency stop is input, the robot turns off the servo after it stops. It is unnecessary to input a stop signal or servo OFF signal. To input a stop signal or servo OFF signal with a door switch open/emergency stop input, wait for 100ms or more after a door switch open/emergency stop input.

Pin number assignment of each terminal and the circuit diagram are shown in [Fig. 3-6](#).

3.6.1 Connection of the external emergency stop

The input terminals for the external emergency stop, door switch, and enabling device are opened (unconnected) as shown in [Fig. 3-6](#). Connect the external emergency stop switch and door switch with the following procedure. And, the example of the connection and notes of the emergency stop are described in [Page 113, "6.1.7 Examples of safety measures"](#) Refer to it together

[Caution] The emergency stop circuit is duplicated inside the controller. The emergency stop switch uses a double contact-type switch, so please be sure to fix both of the contacts to the connector pins as shown below in order to ensure the wiring is duplicated. An error will continue to occur in the event that only one of the pins is connected.

- 1) Please prepare the emergency stop switch, door switch and enabling device.
 - a) External emergency switch
 - CR751 controllerCNUSR1 connector "between 2 and 27" and "between 7 and 32".
 - b) Door switch
 - CR751 controllerCNUSR1 connector "between 4 and 29" and "between 9 and 34".
 - c) Enabling device
 - CR751 controllerCNUSR1 connector "between 5 and 30" and "between 10 and 35".

[Caution] Be sure to use a shield cable for the emergency stop wiring cable. And when operating in an environment that is easily affected by noise, be sure to fix the attached ferrite core (model number: E04SR301334, manufacturer: Seiwa Electric Mfg. Co., Ltd.). Be sure to place the ferrite core more than 30 cm from the connecting terminal section.

⚠ CAUTION Make sure there are no mistakes in the wiring. Connecting differently to the way specified in the manual can result in errors, such as the emergency stop not being released. In order to prevent errors occurring, please be sure to check that all functions (such as the teaching box emergency stop, customer emergency stop, and door switch) are working properly after the wiring setup is completed.

⚠ CAUTION You should always connect doubly connection of the emergency stop, the door switch, and the enabling switch. In connection of only one side, if the relay of customer use should break down, it may not function correctly. The robot output contacts (error output, emergency stop output, mode output, addition axis contactor control output) are duplicated output contacts that are wired in series. As with emergency stop switches and door switches, ensure that all connections to customer devices are duplicated to achieve redundancy.

⚠ CAUTION Please make sure to wire the multiple emergency stop switches so that they each function independently. Check and make sure that the emergency stop doesn't only function under an AND condition (when multiple emergency stop switches are ON at the same time).

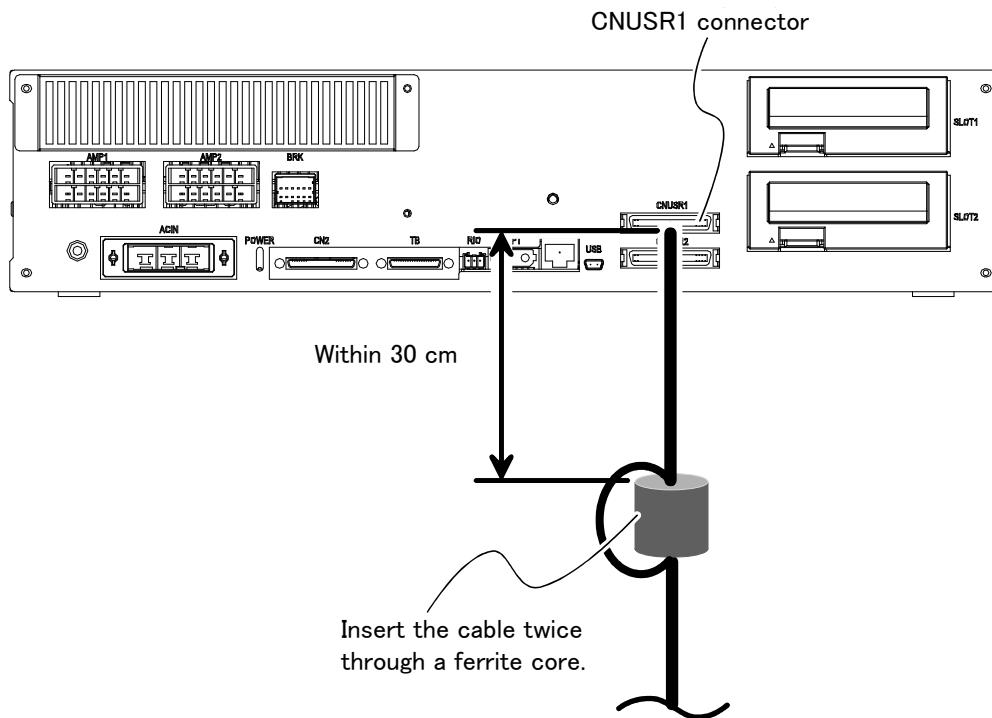


Fig.3-5 : Emergency stop cable connection (CR751)

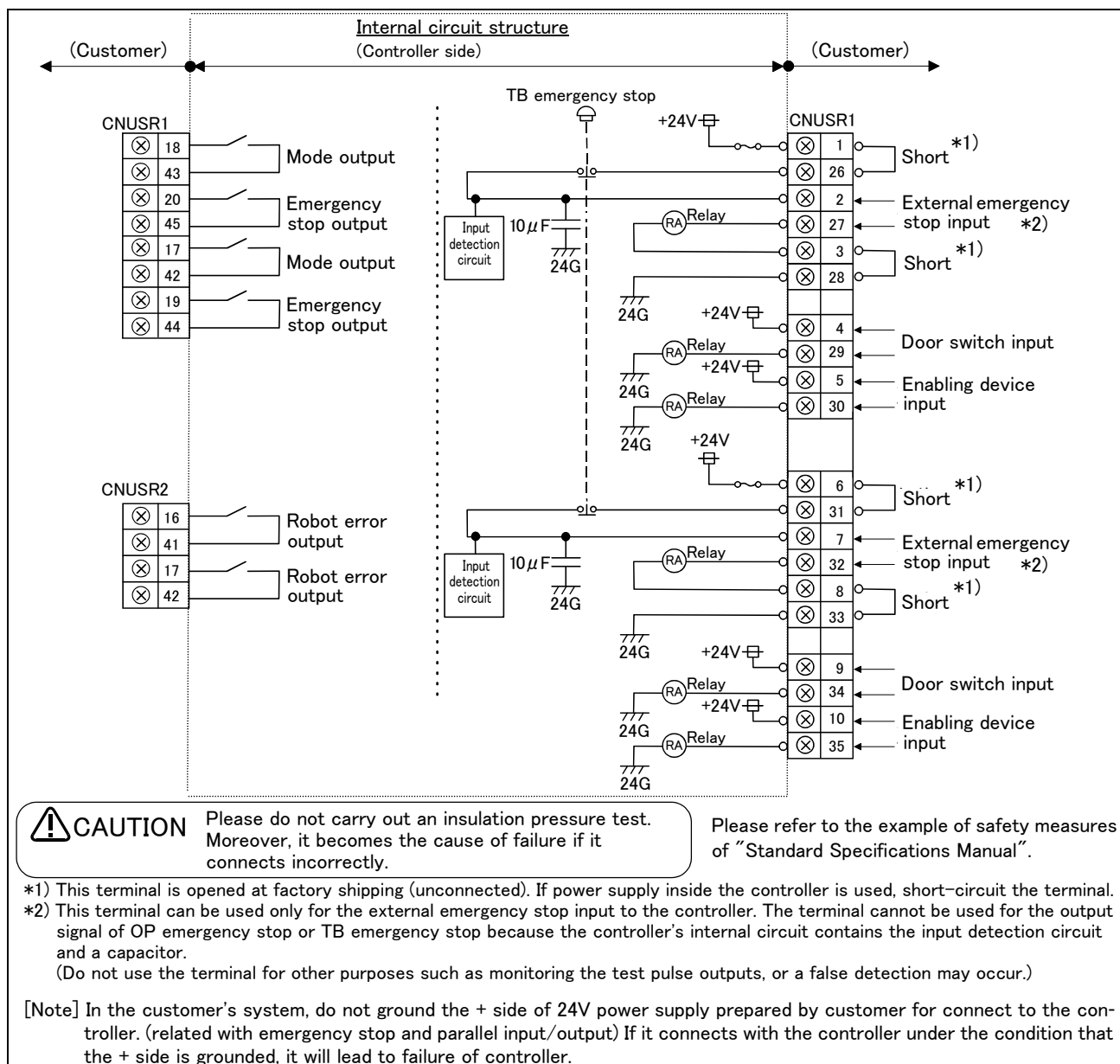


Fig.3-6 : External emergency stop connection (CR751)

CAUTION

Place the emergency stop switch in an easily operable position, and be sure to wire it to the emergency stop correctly by referencing to [Page 113, "6.1.7 Examples of safety measures"](#).

This is a necessary measure in order to ensure safe operation so that the robot can be stopped immediately by pressing the emergency stop switch in the event that the robot malfunctions.

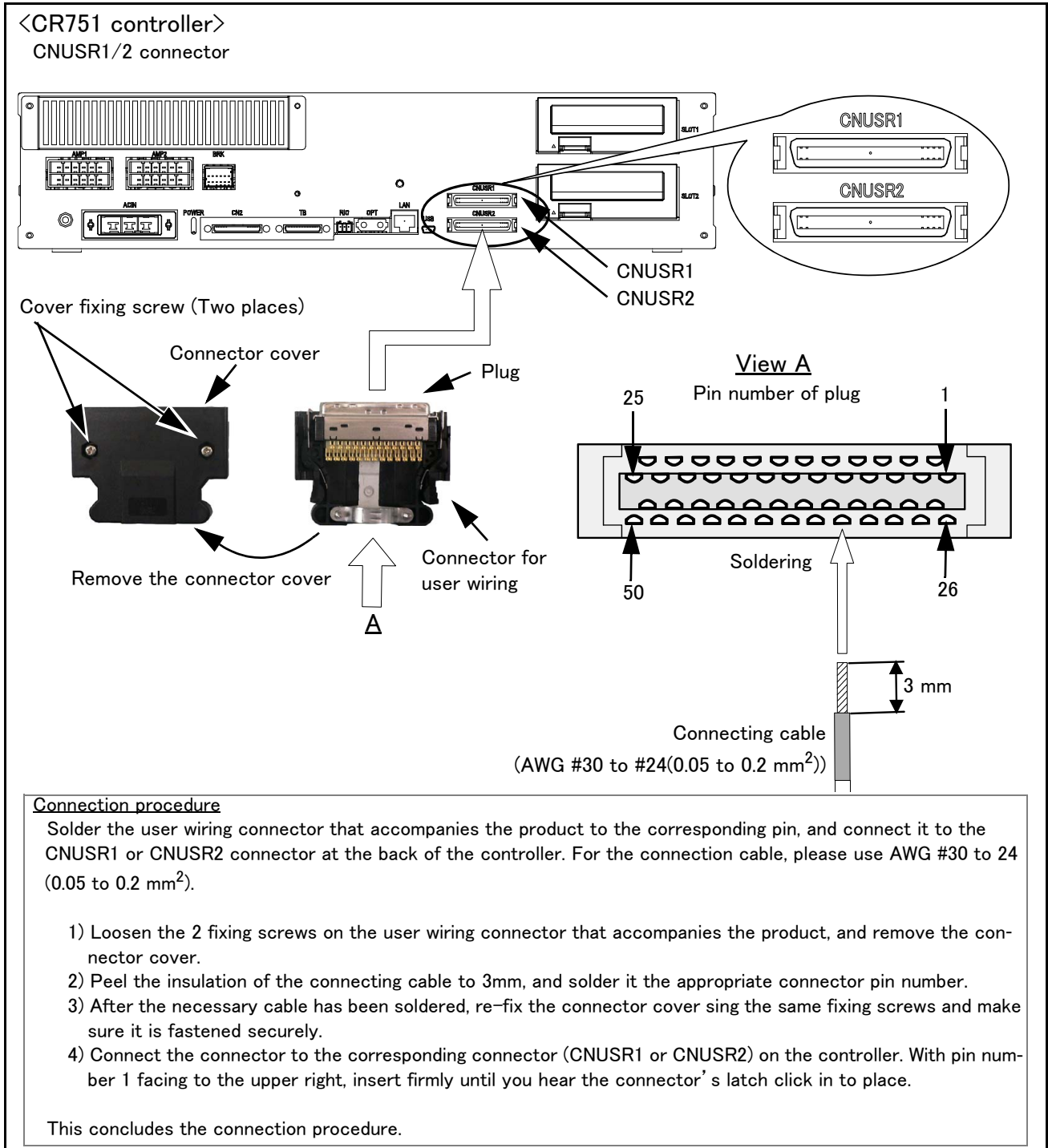


Fig.3-7 : Method of wiring for external emergency stop connection (CR751 (CNUSR1/2))

⚠ CAUTION

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

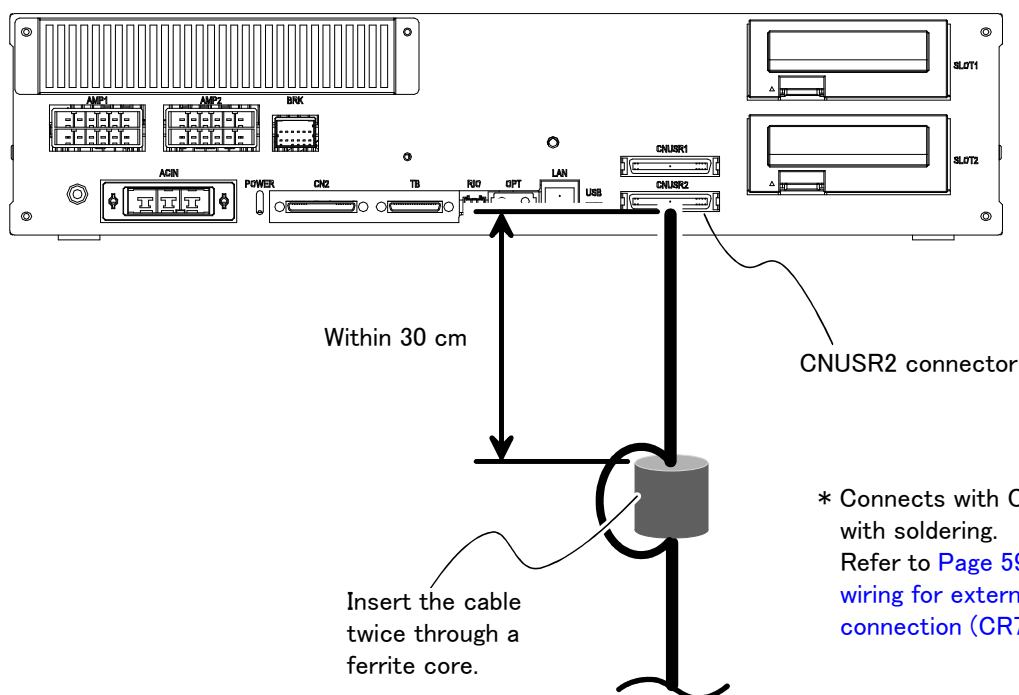
The connectors on the controller side are CNUSR1 (upper side) and CNUSR2 (lower side). Make sure that there is no mistake when connecting to the target connectors. Connecting incorrectly will result in the robot breaking down or malfunctioning.

3.6.2 Special stop input (SKIP)

The skip is the input signal to stop the robot. The pins No.9 and 34 of the connector (CNUSR2) on the controller as shown in Fig. 3-8.

Table 3-4 : Special stop input electric specification

Item		Specifications	Internal circuit
Type		DC input	
No. of input point		1	
Insulation method		Photo-coupler insulation	
Rated input voltage		24 VDC	
Rated input current		Approx. 11 mA	
Working voltage range		21.6 to 26.4 VDC (Ripple rate within 5%)	
ON voltage/ON current		8 VDC or more / 2 mA or more	
OFF voltage/OFF current		4 VDC or less / 1 mA or less	
Input resistance		Approx. 2.2 k Ω	
Response time	OFF \rightarrow ON	1 ms or less	
	ON \rightarrow OFF	1 ms or less	
Common method		1 point per common	
External wire connection method		Connector	



Note) In the customer's system, do not ground the + side of 24 V power supply prepared by customer for connect to the controller. (related with emergency stop and parallel input/output) If it connects with the controller under the condition that the + side is grounded, it will lead to failure of controller.

Fig.3-8 : Connection of the special-stop-input (CR751)

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 [Page 58 "Fig. 3-6: External emergency stop connection \(CR751\)"](#), and [Page 113, "6.1.7 Examples of safety measures"](#). Those figure explains the wire is contact closes when the door is closed. Details of this function according to the robot status are shown below.

*During automatic operationWhen the door is opened, the servo turns OFF and the robot stops. An error occurs. The process of the restoration: Close the door, reset the alarm, turn on the servo, and restart

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

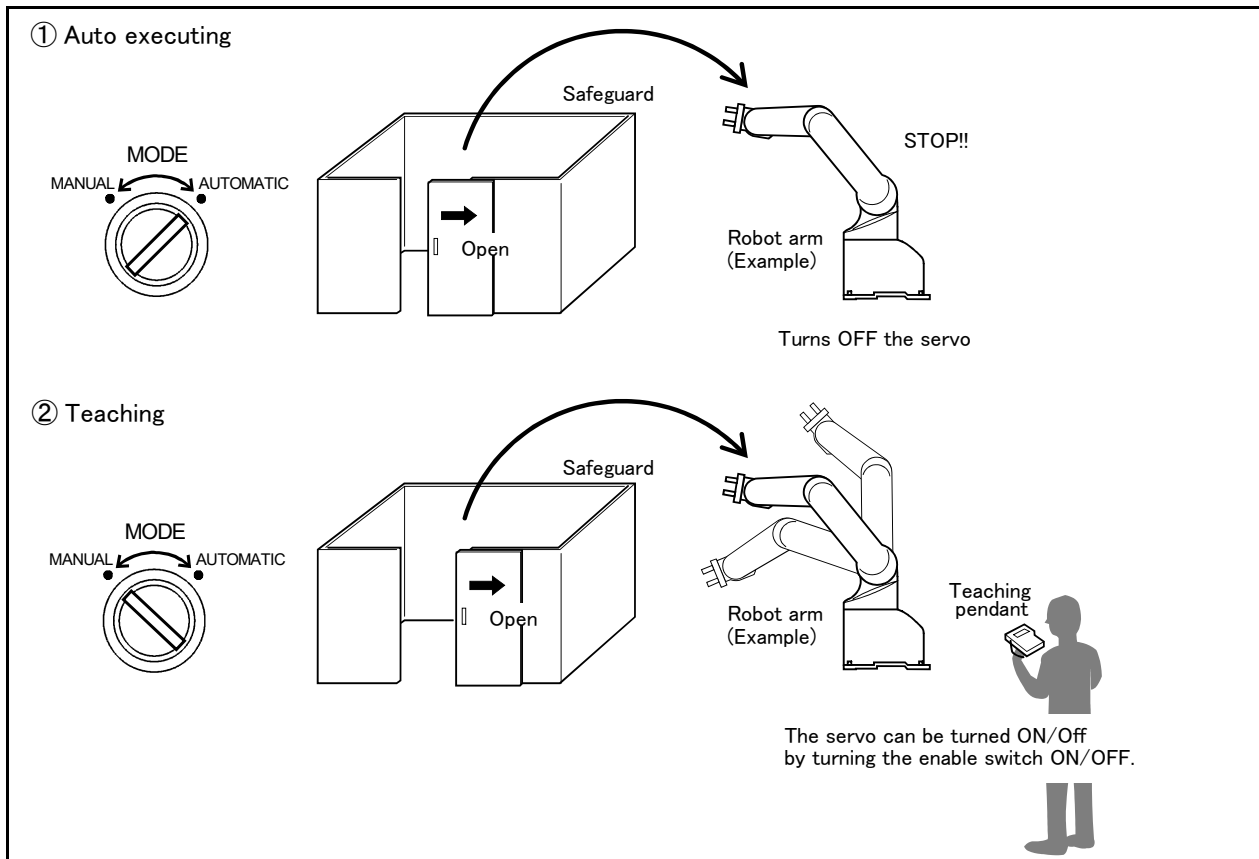


Fig.3-9 : Door switch function

3.6.4 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*1) (servo-off), and the safety increases. To use the robot safely, please be sure to connect the enabling device.

(1) 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.

(2) When door is closing

You can turn on the servo power by operation of only T/B. In this case perform jog operation outside the safeguard sure.

*1) Recommendation products: HE1G-L20MB (IDEC)

(3) Automatic Operation/Jog Operation/Brake Release and Necessary Switch Settings

The following is a description of various operations performed on the robot and switch settings that are required.

Table 3-5 : Various operations and necessary switch settings

No	Operation	Related switch settings ^{Note 1)}					Description
		Mode of controller	T/B enable/disable	T/B enable switch	Enabling device input terminal	Door switch input terminal	
1	Jog operation	Manual	Enable	ON	Close(ON)	—	If the enabling device input is set to Close (On), the state of door switch input does not matter.
2	Jog operation Note 2)	Manual	Enable	ON	Open(OFF)	Close (Door Close)	If the enabling device input is set to Open (Off), door switch input must be in a state of Close
3	Brake release Note 3)	Manual	Enable	ON	Close(ON)	—	Irrespective of the state of door switch input, enabling device input must be in a state of Close (On).
4	Automatic operation	Automatic	Disable	—	—	Close (Door Close)	Door switch input must always be in a state of Close (Door Close).

Note 1) “—” in the table indicates that the state of switch concerned does not matter.

Refer to the following for operation of each switch.

- Mode of controller:Page 63, “3.7 Mode changeover switch input”
- T/B enable/disable:.....Page 72, “(1) Teaching pendant (T/B)”
- T/B enable switch:Page 72, “(1) Teaching pendant (T/B)”
- Enabling device input terminal:.....Page 113, “6.1.7 Examples of safety measures”
- Door switch input terminal:Page 113, “6.1.7 Examples of safety measures”

Note 2) Jog operation, if door switch input is set for Close (Door Close), must be performed outside the safety barrier.

Note 3) It is imperative that brake release operation be carried out by two persons. One person turns on the enabling device (“Close” on the enabling device input terminal) while the other manipulates the T/B. Brake release can be effected only when both of the enabling switch device and the T/B enable switch are placed in intermediate position (lightly gripped position). At this point, the state of door switch input does not matter.

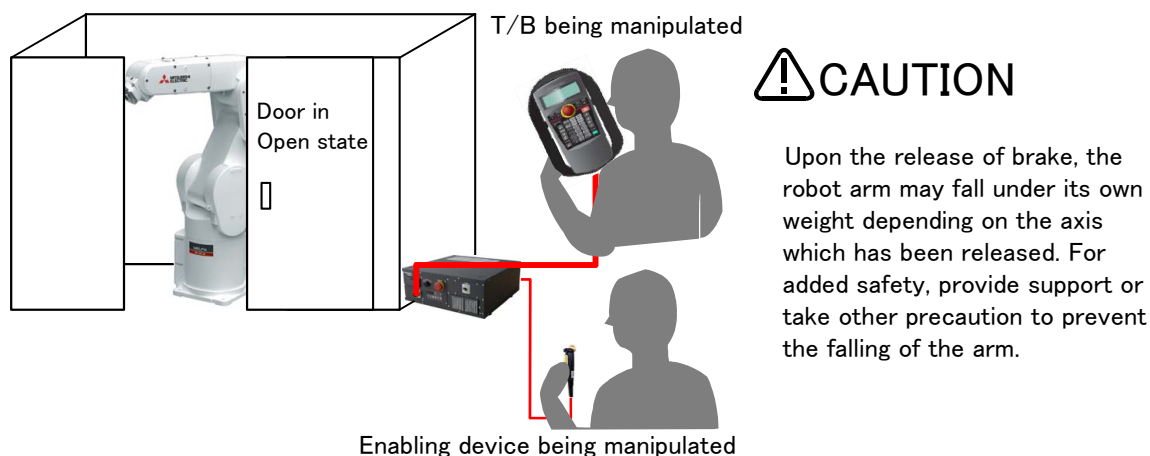


Fig.3-10 : Brake release operation

3.7 Mode changeover switch input

Connect the key switch of customer prepared and change the right of robot's operation by switch operation. The key switch can be installed in the operation panel of customer preparation.

<Right of operation (mode)>

AUTOMATIC.....The operation from external equipment becomes available. Operation which needs the right of operation from T/B cannot be performed. It is necessary to set the parameter for the rights of operation to connection with external equipment. Refer to the separate volume, "Instruction Manual/Detailed Explanation of Functions and Operations" for detail.

MANUALWhen T/B is available, only the operation from T/B becomes available. Operation which needs the right of operation from external equipment cannot be performed.

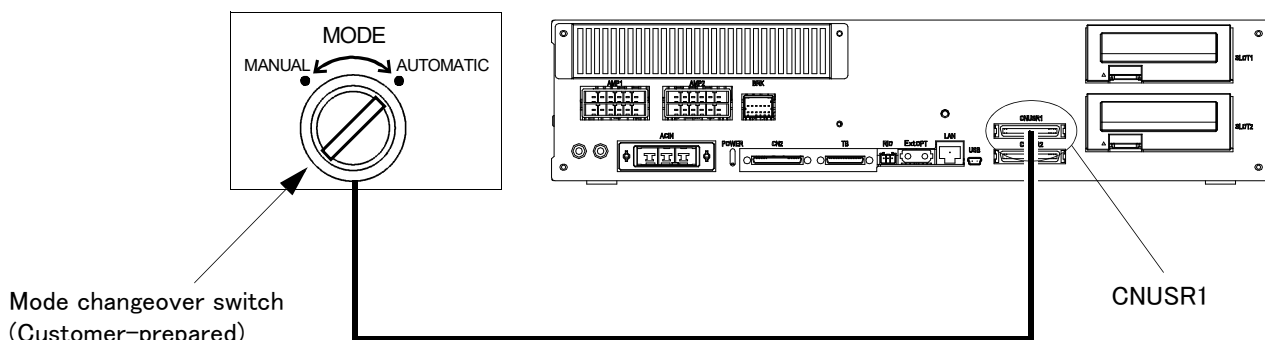


Fig.3-11 : Mode changeover switch image figure (CR751)

(1) Specification of the key switch interface

The function and specification of the key switch interface are shown below.

Table 3-6 : Function of the key switch interface

Pin number and Function (Connector: CNUSR1)		Change mode ^{Note 1)}	
Pin number	Function	MANUAL	AUTOMATIC
49	1st line KEY input	Open	Close
24	Internal power supply of 1st line KEY input +24V output		
50	2nd line KEY input	Open	Close
25	Internal power supply of 2nd line KEY input +24V output		

Note 1) The mode changes by both opening or both closing between 49-24 pin and between 50-25 pin. When input states differ between two lines, error H0044 (OP Mode key line is faulty) will occur.

[Note] For the input/output cable (CNUSR connector cable) that connects customer's system and the controller, prevent ground faults from occurring at the + side of the 24V power supply prepared by customer. A ground fault may lead to a failure of the protection device in the controller.

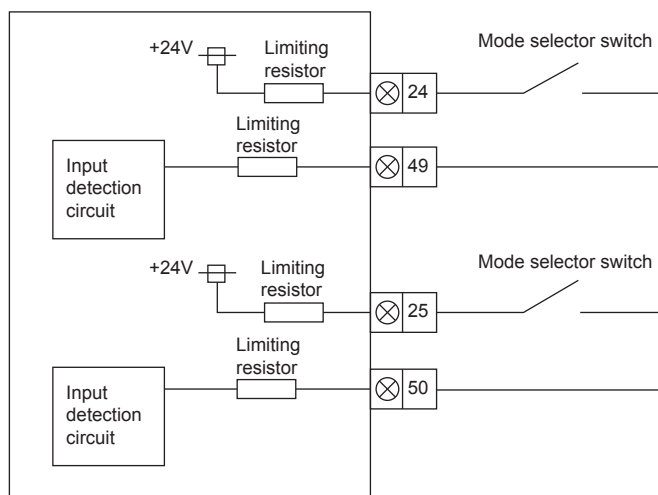


Fig.3-12 : Mode selector switch connection diagram

Table 3-7 : Specification of the mode changeover switch input

Item	Specification	Remarks
Rated voltage	24 VDC	Supply from the controller.
Current rating	Approx. 10 mA	Select the switch or button which operates normally in 24V/10mA.
Input resistance	Approx. 2.2 k Ω	
Response time (OFF→ON)	Approx. 15 ms	Example: The response time the program starts, after pushing the run button.
Common method	1 point per common	
Connection method	Connector	
Conformity electric wire size	AWG#24 to #30	0.2 to 0.05 mm ²
Manufacturer/Type	-	Manufacturer: 3M / 10150-3000PE, 10350-52Y0-008 (cover)

(2) Connection of the mode changeover switch input

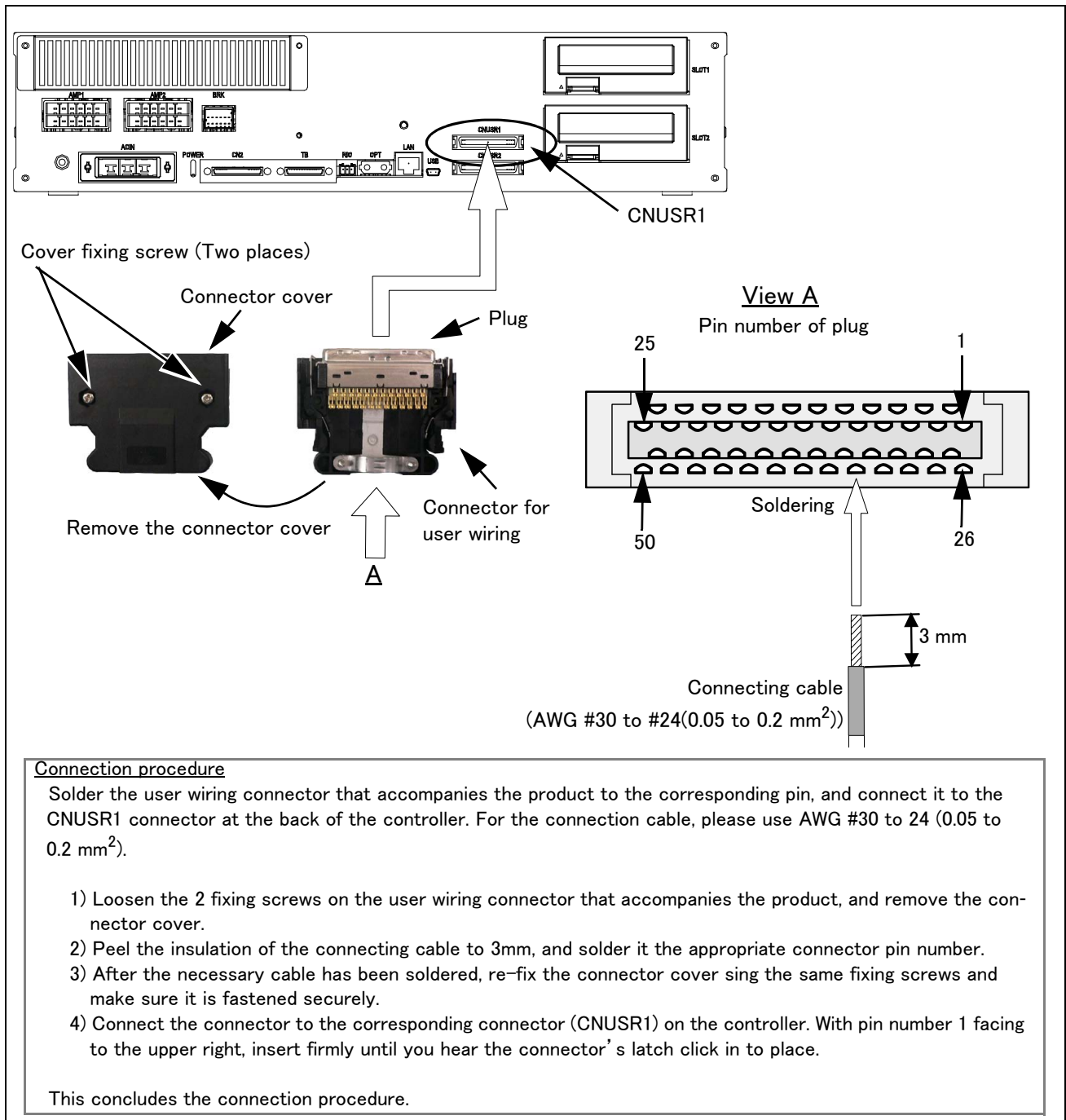


Fig.3-13 : Connection of the mode changeover switch input (CR751)

3.8 Additional axis function

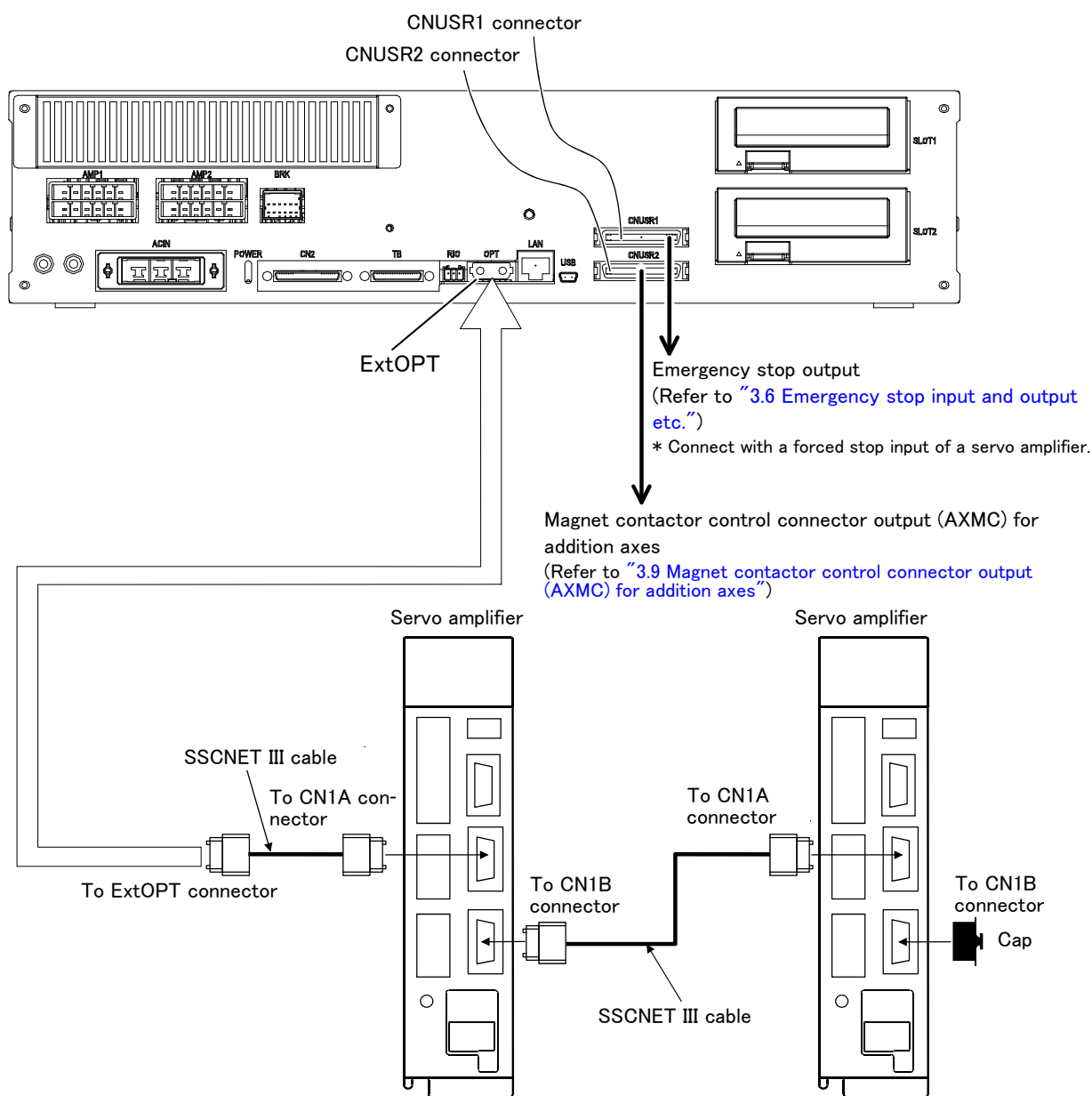
This controller is equipped with an additional axis interface for controlling an additional axis when a traveling axis or rotary table is added to the robot. A maximum of eight axes of servo motors can be controlled at the same time by connecting a general-purpose servo amplifier (MR-J3-B, MR-J4-B series) that supports Mitsubishi's SSCNET III. Refer to the separate "Additional axis function Instruction Manual" for details on the additional axis function.

3.8.1 Wiring of the additional axis interface

Table 3-8 provides information of a connector for additional axes inside the controller, and Fig. 3-14 shows a connection example (configuration example).

Table 3-8 : Dedicated connectors inside the controller

Name	Connector name	Details
Connector for additional axes	ExtOpt	The connector for connecting the general-purpose servo amplifier.



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

Fig.3-14 : Example of addition axis connection (CR751)

(1) Example of the installation of the noise filter

1) EMC filter (recommended)

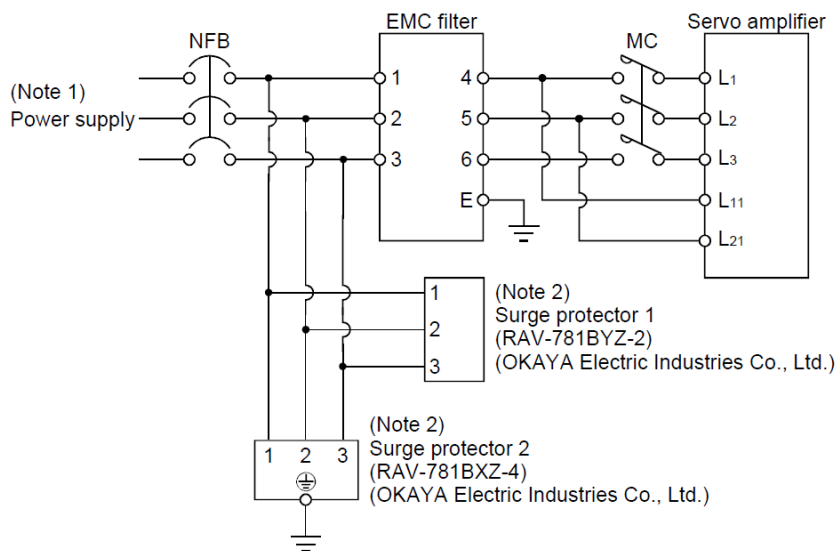
Please install the recommendation filter shown below according to the example of connection.

1) Combination with the servo amplifier

Servo amplifier	Recommended filter (Soshin Electric)		Mass [kg]([lb])
	Model	Leakage current [mA]	
MR-J3-10B to MR-J3-100B MR-J3-10B1 to MR-J3-40B1	(Note) HF3010A-UN	5	3 (6.61)
MR-J3-250B ▪ MR-J3-350B	(Note) HF3030A-UN		5.5 (12.13)
MR-J3-500B ▪ MR-J3-700B	(Note) HF3040A-UN	1.5	6.0 (13.23)
MR-J3-11KB to MR-J3-22KB	(Note) HF3100A-UN	6.5	15 (33.07)
MR-J3-60B4 ▪ MR-J3-100B4	TF3005C-TX	5.5	6 (13.23)
MR-J3-200B4 to MR-J3-700B4	TF3020C-TX		7.5 (16.54)
MR-J3-11KB4	TF3030C-TX		12.5 (27.56)
MR-J3-15KB4	TF3040C-TX		
MR-J3-22KB4	TF3060C-TX		

Note. A surge protector is separately required to use any of these EMC filters.

2) Connection example



Note 1) For 1-phase 200 to 230 VAC power supply, connect the power supply to L1, L2 and leave L3 open.
There is no L3 for 1-phase 100 to 120 VAC power supply.

Note 2) The example is when a surge protector is connected.

Fig.3-15 : Example of EMC noise filter installation

2) Line noise filter

This filter is effective in suppressing noises radiated from the power supply side and output side of the servo amplifier and also in suppressing high-frequency leakage current (zero-phase current) especially within 0.5 to 5 MHz band.

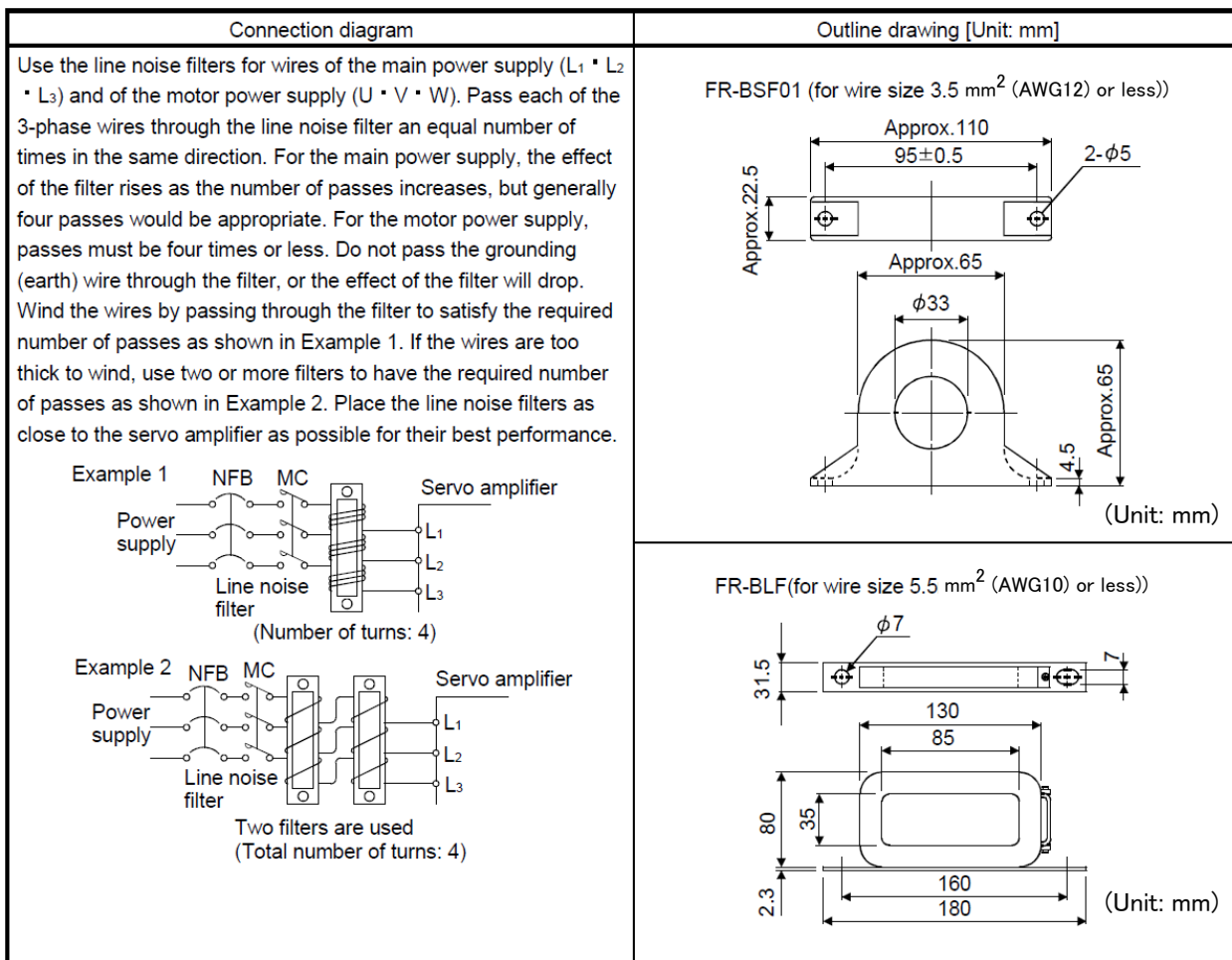


Fig.3-16 : Example of noise filter installation

3.9 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.

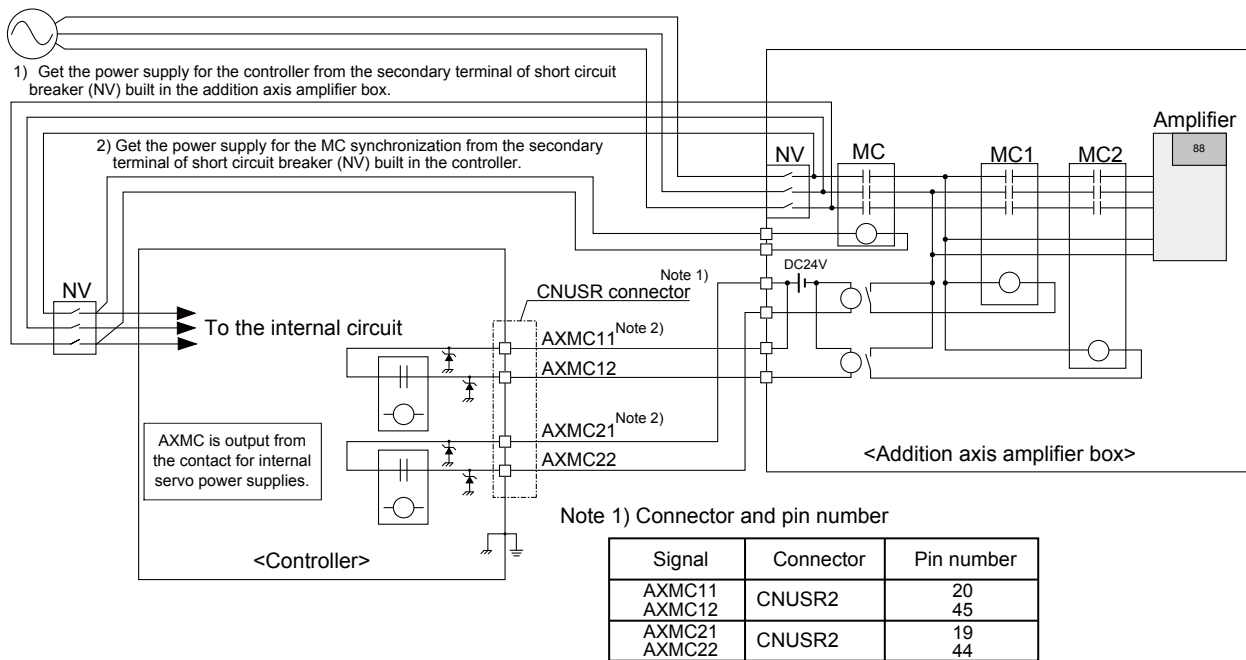
Fig. 3-17 shows a circuit example, and Fig. 3-18 shows an illustrative picture of its connection to the controller connector.

When you are using an additional axis, please perform appropriate circuit connections by referring to these drawings.

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

Refer to Page 66, "3.8 Additional axis function" for details on the additional axis function.

Note 1) 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.



Note 2) This output is opened, if the robot turns off the servo by occurrence of alarm etc.
<Electric specification>
DC24V/10mA to 100mA

[Note] For the input/output cable (CNUSR connector cable) that connects customer's system and the controller, prevent ground faults from occurring at the + side of the 24V power supply prepared by customer. A ground fault may lead to a failure of the protection device in the controller.

Bending or frictional forces may be applied to the input/output cable repeatedly depending on the system configuration or layout. In this case, use a flexible cable for the input/output cable. Note that a fixed cable may be broken, resulting in a ground fault.

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

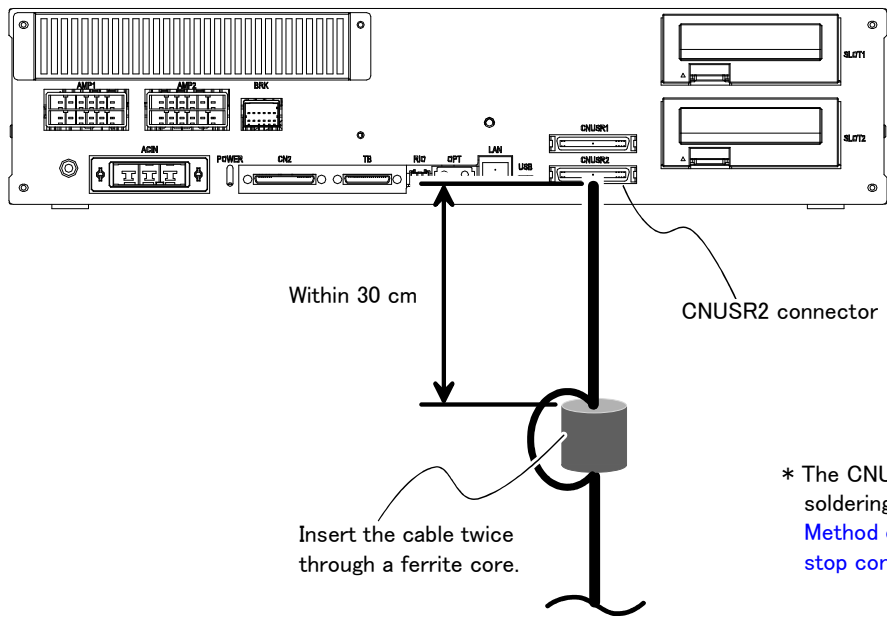


Fig.3-18 : AXMC terminal connector (CR751)

3.10 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 optionsA combination of single options and parts that together, form a set for serving some purpose.
2. Single optionsThat 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: ● R33TB: Cable length 7m
- R33TB-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.*1)

For multiple robots, one teaching pendant can be used by being connected to the target robot for each use. The power must be off before each connection.

■ Configuration

Table 3-9 : Configuration device

Part name	Type	Qty.	Mass (kg) ^{Note 1)}	Remarks
Teaching pendant	R33TB	Either one pc.	1.7	Cable length is 7 m. Hand strap is attached.
	R33TB-15		2.8	Cable length is 15 m. Hand strap is attached.

Note 1) Mass indicates one set.

■ 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 connector.	
Interface	RS-422	
Display method	LCD method: 24 characters x 8 lines, LCD illumination: with backlight	At 8x8 font
Operation section	36 keys	

*1) <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 "Enable switch".

The 3-position enable switch has three statuses. The following modes are entered according to the switch state.

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

*) Releasing or forcefully pressing the 3-position enable switch cuts power to the servos in the same way as when the emergency stop is input. This helps to ensure safety.

Operations such as editing programs and displaying the robot's status are possible while the 3-position enable switch is released or forcefully pressed (excludes operating the robot).

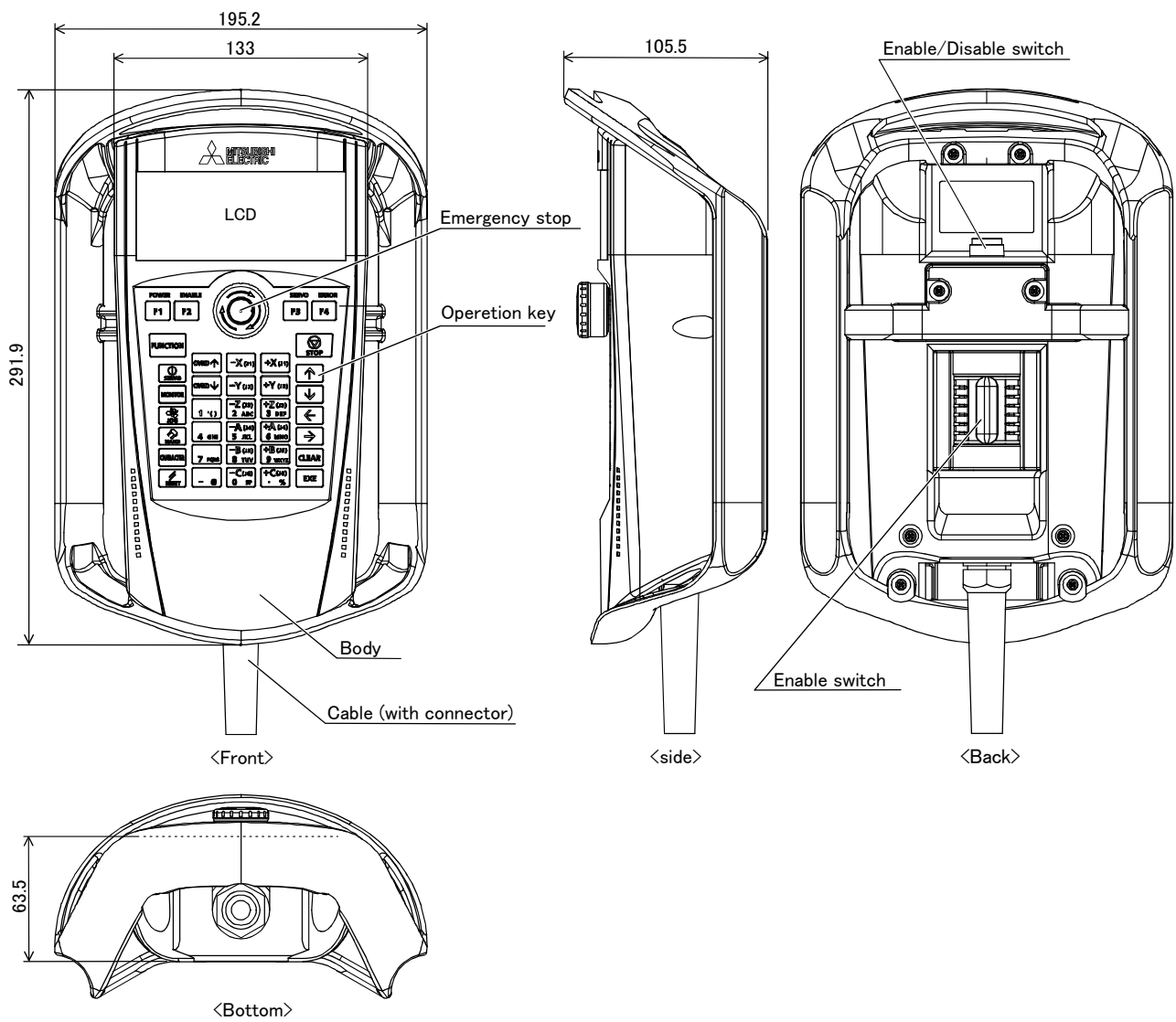


Fig.3-19 : Outside dimensions of teaching pendant

(Unit: mm)

■ Installation method

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

■ Key layout and main functions



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

(2) Parallel I/O interface

■ Order type : ● 2D-TZ368 (Sink type)/2D-TZ378 (Source type)

■ Outline



This is used to expand the external inputs and outputs

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

Notes)Although the combined use with the parallel input-and-output unit (2A-RZ361/2A-RZ371) of another option is also possible, please use the setup of the station number by the different number separately. The station number is automatically determined by the position of the option slot which installed this interface. (station number 0 to 1)

■ Configuration

Table 3-11 : Configuration device

Part name	Type	Qty.	Mass (kg) ^{Note 1)}	Remarks
Parallel I/O interface	2D-TZ368	Either one pc.	0.4	Input/output 32 points/32 points 2D-TZ368 is sink type. 2D-TZ378 is source type.
	2D-TZ378			

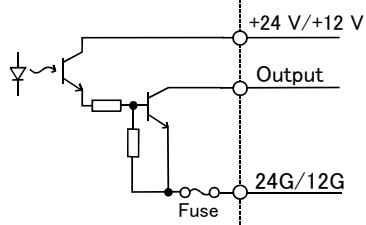
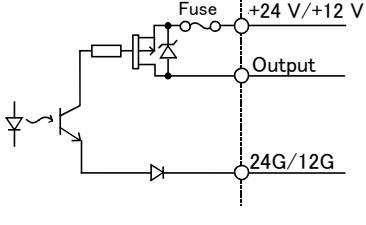
Note 1) Mass indicates one set.

■ Specifications

Table 3-12 : Electrical specifications of input circuits

Item	Specification		Internal circuit
Type	DC input		<p><Sink type></p> <p><Source type></p>
Number of input points	32		
Insulation method	Photo coupler insulation		
Rated input voltage	12 VDC	24 VDC	
Rated input current	Approx. 3 mA	Approx.9 mA	
Working voltage range	10.2 to 26.4 VDC (Ripple factor should be less than 5%)		
ON voltage/ON current	8 VDC or more/2 mA or more		
OFF voltage/ OFF current	4 VDC or less/1 mA or less		
Input resistance	Approx. 2.7 kΩ		
Response time	OFF-ON	10 ms or less (24 VDC)	
	ON-OFF	10 ms or less (24 VDC)	
Common method	32 points per common		
External cable connection method	Connector		

Table 3-13 : Electrical specifications for the output circuits

Item	Specification	Internal circuit	
Type	Transistor output	<p><Sink type></p>  <p><Source type></p> 	
No. of output points	32		
Insulation method	Photo-coupler insulation		
Rated load voltage	12/24 VDC		
Rated load voltage range	10.2 to 30 VDC (peak voltage 30 VDC)		
Max. load current	0.1 A/point (100%)		
Leakage current at OFF	Within 0.1 mA		
Max. voltage drop at ON	9 VDC (TYP.) ^{Note 1)}		
Response time	OFF-ON		10 ms or less (Resistance load) (hardware response time)
	ON-OFF		10 ms or less (Resistance load) (hardware response time)
Fuse rating	Fuse 1.6 A (one per common) Replacement possible (max. 3)		
Common method	16 points per common (common terminal: 2 points)		
External wire connection method	Connector		
External power supply	Voltage		12/24 VDC (10.2 to 30 VDC)
	Current		60 mA (TYP.24 VDC per common)(base drive current)

Note 1) The maximum voltage drop value at signal ON.

Refer to it for the equipment connected to the output circuit.



Caution

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

■ Installation method

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

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

SLOT 1: station number 0 (0 to 31)

SLOT 2: station number 1 (32 to 63)



Caution

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

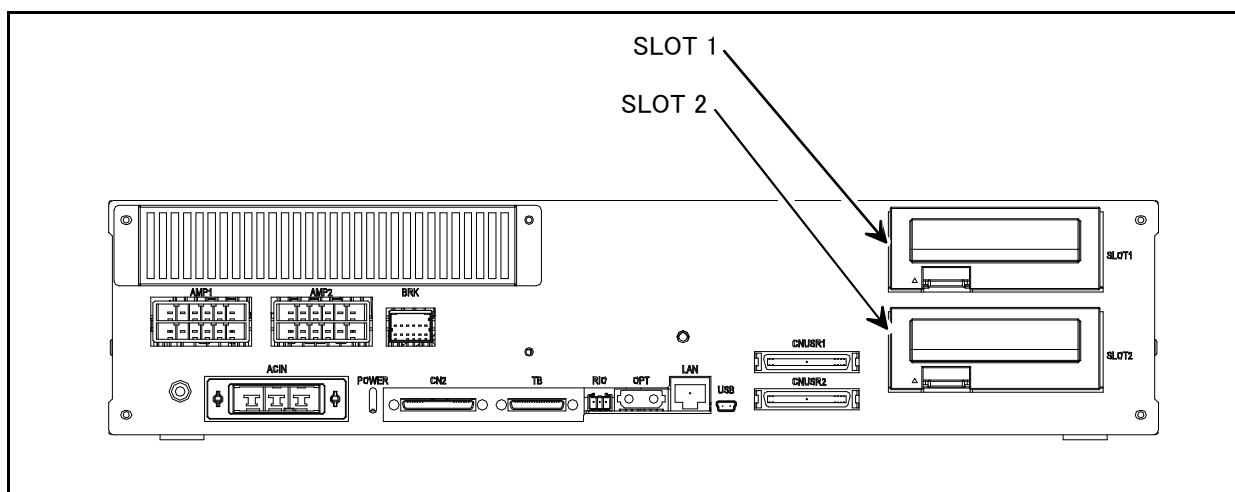


Fig.3-21 : Parallel I/O interface installation position (CR751)

■ Pin layout of connector

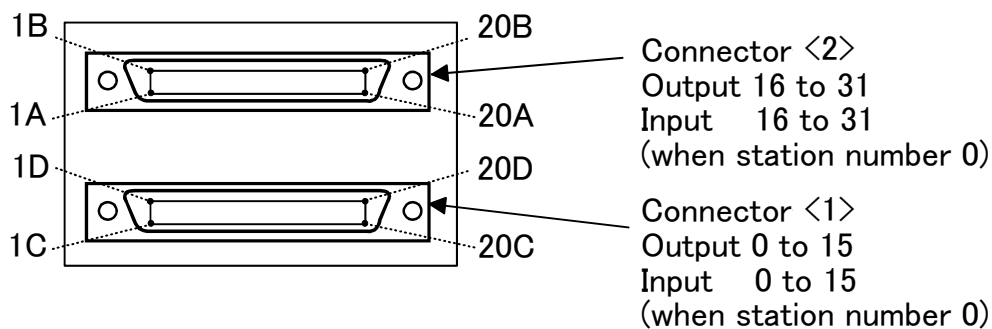


Fig.3-22 : Pin layout of connector

■ Connector pin No. and signal assignment

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

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

Slot number	Station number	Range of the general-purpose input-and-output signal	
		Connector <1>	Connector <2>
SLOT 1	0	Input : 0 to 15 Output : 0 to 15	Input : 16 to 31 Output : 16 to 31
SLOT 2	1	Input : 32 to 47 Output : 32 to 47	Input : 48 to 63 Output : 48 to 63

The connector pin number of the parallel input-and-output interface installed in SLOT 1 and signal number allocation are shown in Table 3-15 and Table 3-16. If it installs in other slots, please interpret and utilize.

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

Pin No.	Line color	Function name		Pin No.	Line color	Function name	
		General-purpose	Dedicated/power supply, common			General-purpose	Dedicated/power supply, common
1C	Orange/Red a	General-purpose input 15	24G/12G: For pins 5D-20D	1D	Orange/Black a	General-purpose output 15	+24 V/+12 V (COM):
2C	Gray/Red a		COM : For pins 5C-20C Note 1)	2D	Gray/Black a		Reserved
3C	White/Red a		Reserved	3D	White/Black a		Reserved
4C	Yellow/Red a		Reserved	4D	Yellow/Black a		Reserved
5C	Pink/Red a			5D	Pink/Black a		
6C	Orange/Red b	General-purpose input 14		6D	Orange/Black b	General-purpose output 14	
7C	Gray/Red b	General-purpose input 13		7D	Gray/Black b	General-purpose output 13	
8C	White/Red b	General-purpose input 12		8D	White/Black b	General-purpose output 12	
9C	Yellow/Red b	General-purpose input 11		9D	Yellow/Black b	General-purpose output 11	
10C	Pink/Red b	General-purpose input 10		10D	Pink/Black b	General-purpose output 10	
11C	Orange/Red c	General-purpose input 9	Operation rights input signal Note 2)	11D	Orange/Black c	General-purpose output 9	
12C	Gray/Red c	General-purpose input 8		12D	Gray/Black c	General-purpose output 8	
13C	White/Red c	General-purpose input 7		13D	White/Black c	General-purpose output 7	
14C	Yellow/Red c	General-purpose input 6		14D	Yellow/Black c	General-purpose output 6	
15C	Pink/Red c	General-purpose input 5		15D	Pink/Black c	General-purpose output 5	
16C	Orange/Red d	General-purpose input 4	Servo ON input signal Note 2)	16D	Orange/Black d	General-purpose output 4	Operation rights output signal Note 2)
17C	Gray/Red d	General-purpose input 3	Start input Note 2)	17D	Gray/Black d	General-purpose output 3	
18C	White/Red d	General-purpose input 2	Error reset input signal Note 2)	18D	White/Black d	General-purpose output 2	
19C	Yellow/Red d	General-purpose input 1	Servo OFF input signal Note 2)	19D	Yellow/Black d	General-purpose output 1	
20C	Pink/Red d	General-purpose input 0	Stop input Note 3)	20D	Pink/Black d	General-purpose output 0	

Note 1) Sink type: +24V/+12V(COM), Source type: 24G/12G

Note 2) The dedicated signal is assigned at shipping. It can change with the parameter.

Note 3) The dedicated input signal (STOP) is assigned at shipping. The signal number is fixing.

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

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

Note 1) Sink type: +24V/+12V(COM), Source type: 24G/12G

<Reference> The example of connection with our PLC

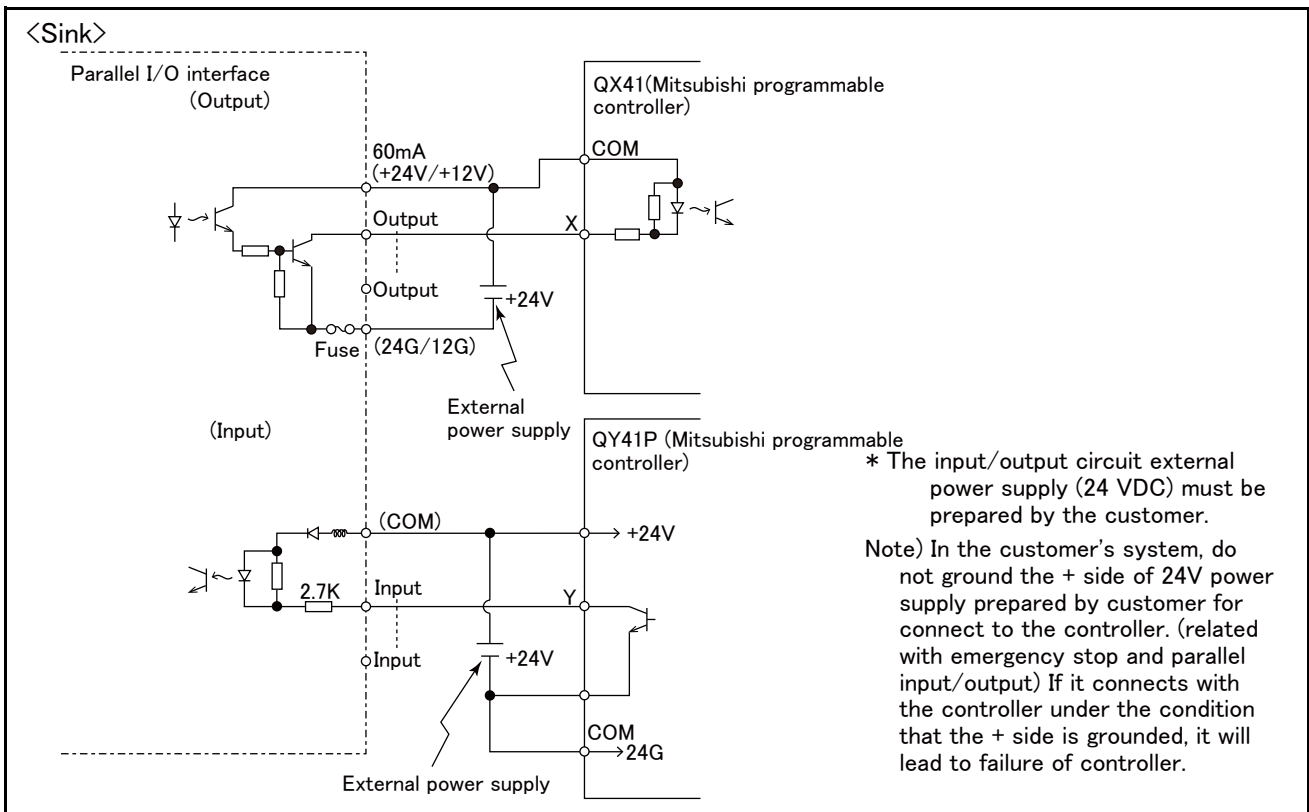


Fig.3-23 : Connection with a Mitsubishi PLC (Example of sink type)

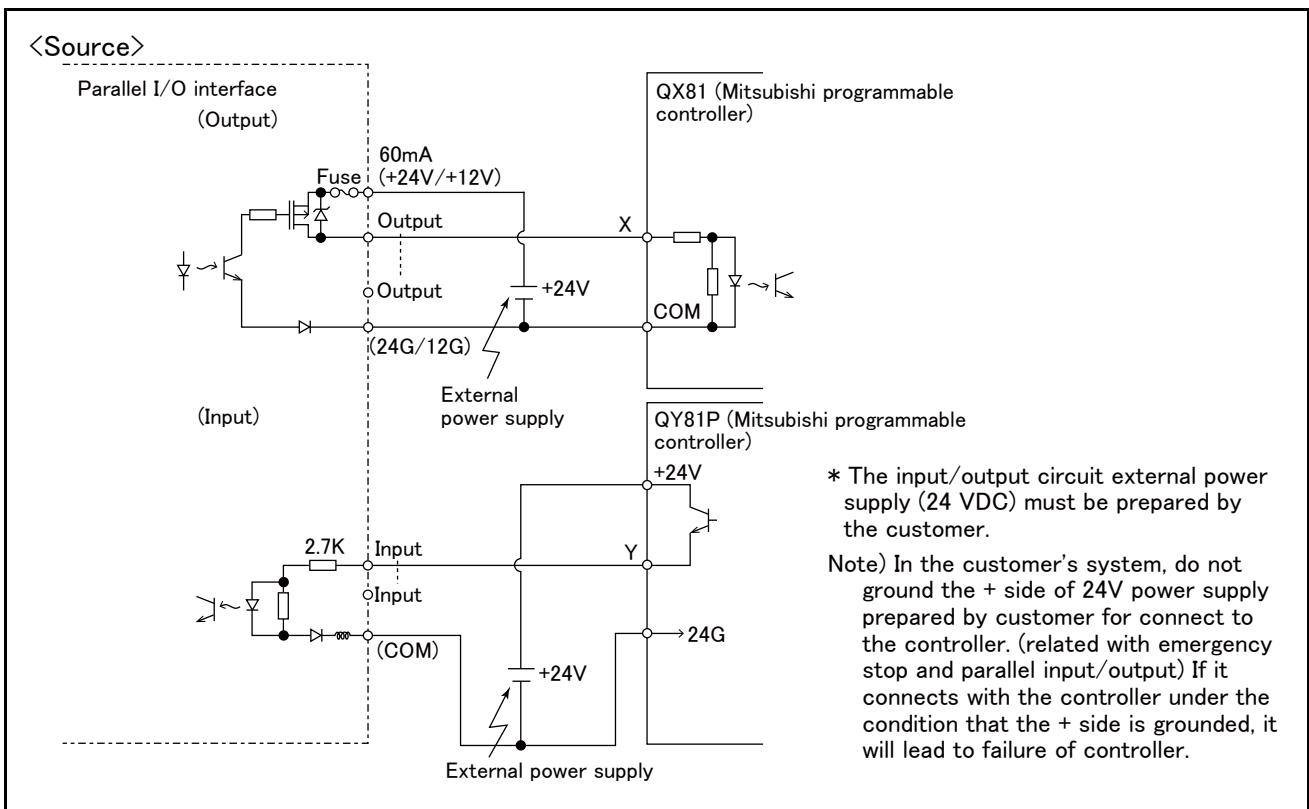


Fig.3-24 : Connection with a Mitsubishi PLC (Example of source type)

(3) External I/O cable

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

■ Outline



This is the dedicated cable used to connect an external peripheral device to the connector on the parallel I/O interface. For parallel I/O unit is another option 2A-CBL.**. One end matches the connector on the parallel input/output unit, and the other end is free. Connect the peripheral device's input/output signal using the free end. One cable correspond to the input 16 points and output 16 points. Two cables are needed to connection of (input 32 points and output 32 points) with built-in standard.

■ Configuration

Table 3-17 : Configuration device

Part name	Type	Qty.	Mass (kg) ^{Note 1)}	Remarks
External I/O cable	2D-CBL □□	1 pc.	0.7 (5 m) 1.84 (15 m)	5 m or 15 m

Note 1) Mass indicates one set.

■ Specifications

Table 3-18 : Specifications

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

■ Connector pin numbers and cable colors

Table 3-19 : Connector pin numbers and cable colors

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

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

■ Connections and outside dimensions

The sheath of each signal cable (40 lines) is color indicated and marked with dots. Refer to the cable color specifications in "Table 3-19: Connector pin numbers and cable colors" when making the connections.

(Eg.) Pin number: color indication

1 : Orange / Red / a

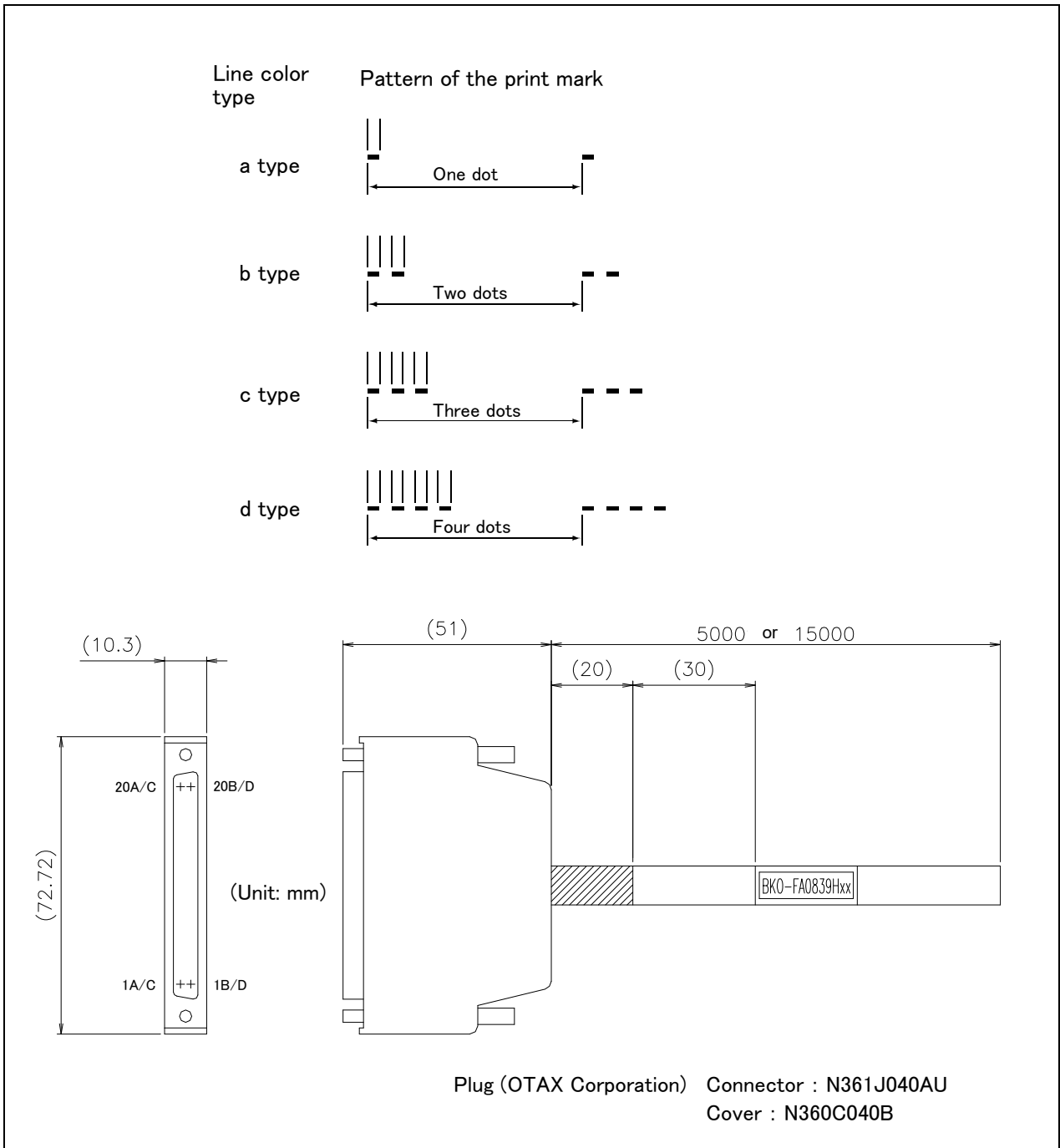
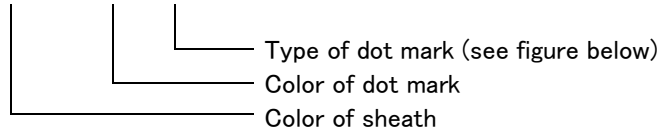


Fig.3-25 : Connections and outside dimensions

(4) Parallel I/O unit

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

- Outline



This is used to expand the external inputs and outputs. One one equal with this unit is built into the control unit among controllers the standard.

- The connection cable is not included. Prepare the optional external input/output cable (2A-CBL05 or 2A-CBL15).
- Use 2A-RZ361 if the external input/output signal logic is of the sink type and 2A-RZ371 for source type signal logic.

Notes) Although the combined use with the parallel I/O interface (2D-TZ368) of another option is also possible, please use the setup of the station number by the different number separately. The station number is automatically fixed by the position of the option slot which installed the parallel I/O interface in 0-1.

- Configuration

Table 3-20 : Configuration device

Part name	Type	Qty.	Mass (kg) ^{Note 1)}	Remarks
Parallel I/O unit	2A-RZ361	Either one pc.	0.7	Input/output 32 points/32 points 2A-RZ361 is the sink type. 2A-RZ371 is the source type.
	2A-RZ371		0.7	
Robot I/O link connection connector	NETcable-1	2 sets	-	Connector with pins. The cable must be prepared and wired by the customer.
Power connection connector	DCcable-2	1 set	-	Connector with pins. The cable must be prepared and wired by the customer.
Terminator	R-TM	1 pc.	-	100 Ω (1/4 W)

Note 1) Mass indicates one set.

- Specifications

- The parallel I/O interface (2D-TZ368) of another option, and the a maximum of eight pieces in all. (One station occupies one unit.)
- The power supply (24V) must be prepared by the customer and connected with the power connection cable (DCcable-2)
A separate 24 V power supply is required for the input/output circuit wiring.

Table 3-21 : Electrical specifications of input circuits

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

Table 3-22 : Electrical specifications for the output circuits

Item		Specification	Internal circuit
Type		Transistor output	<div style="display: flex; flex-direction: column; align-items: center;"> <div style="text-align: center; margin-bottom: 20px;"> <p><Sink type></p> </div> <div style="text-align: center;"> <p><Source type></p> </div> </div>
No. of output points		32	
Insulation method		Photo-coupler insulation	
Rated load voltage		12 VDC/24 VDC	
Rated load voltage range		10.2 to 30 VDC (peak voltage 30 VDC)	
Max. load current		0.1 A/point (100%)	
Leakage current at OFF		0.1 mA or less	
Max. voltage drop at ON		0.9 VDC (TYP.) ^{Note 1)}	
Response time	OFF-ON	2 ms or less (hardware response time)	
	ON-OFF	2 ms or less (Resistance load) (hardware response time)	
Fuse rating		Fuse 3.2 A (one per common) Replacement not possible	
Common method		8 points per common (common terminal: 4 points)	
External wire connection method		Connector	
External power supply	Voltage	12/24 VDC (10.2 to 30 VDC)	
	Current	60 mA (TYP. 24 VDC per common) (base drive current)	

Note 1) The maximum voltage drop value at signal ON.
 Refer to it for the equipment connected to the output circuit.

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

CAUTION Inputs the power supply for control (DCcable-2) then inputs the controller's power supply.

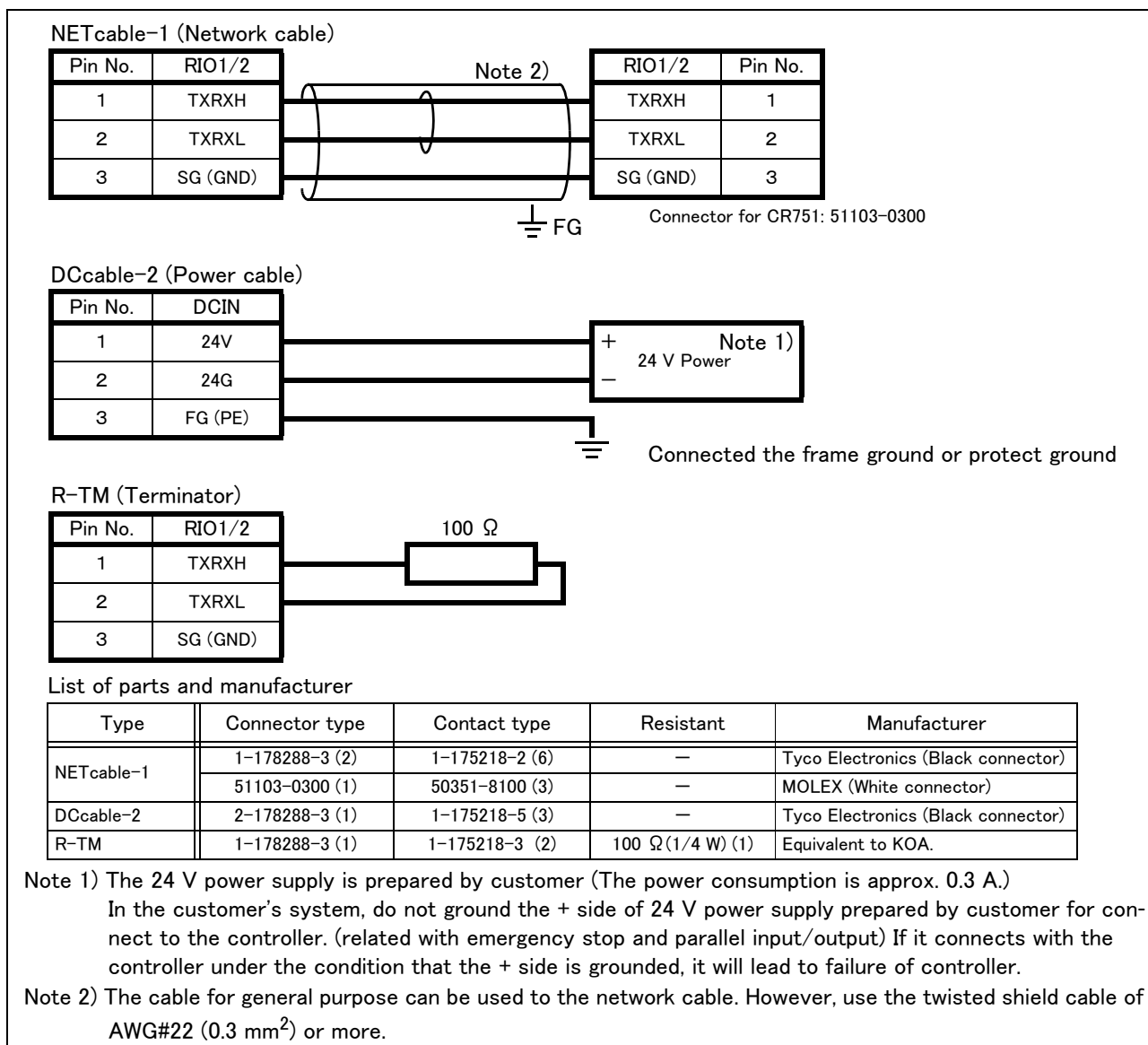


Fig.3-26 : Specifications for the connection cable

■ Installation method

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

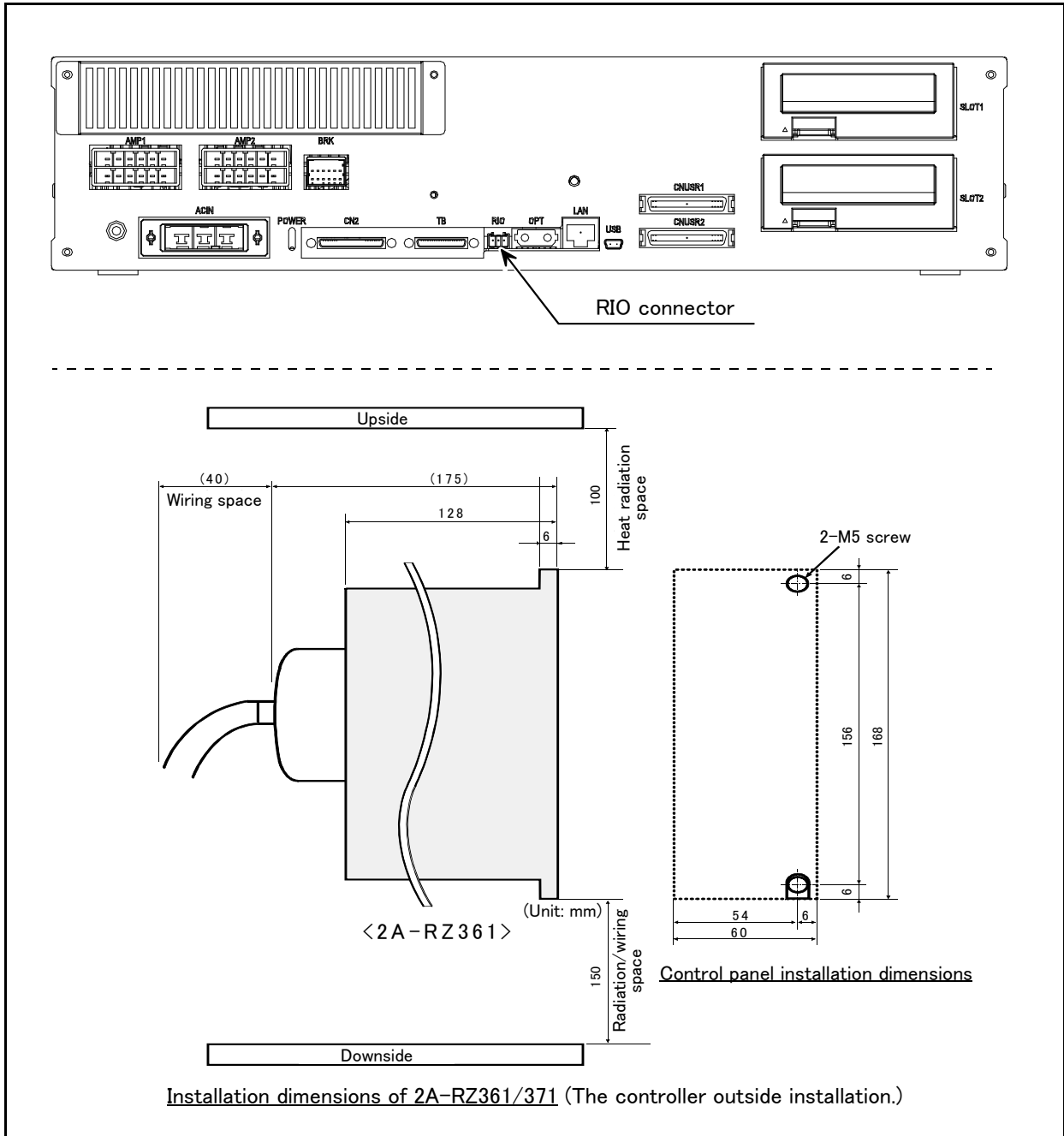


Fig.3-27 : Installing the parallel I/O unit (CR751)

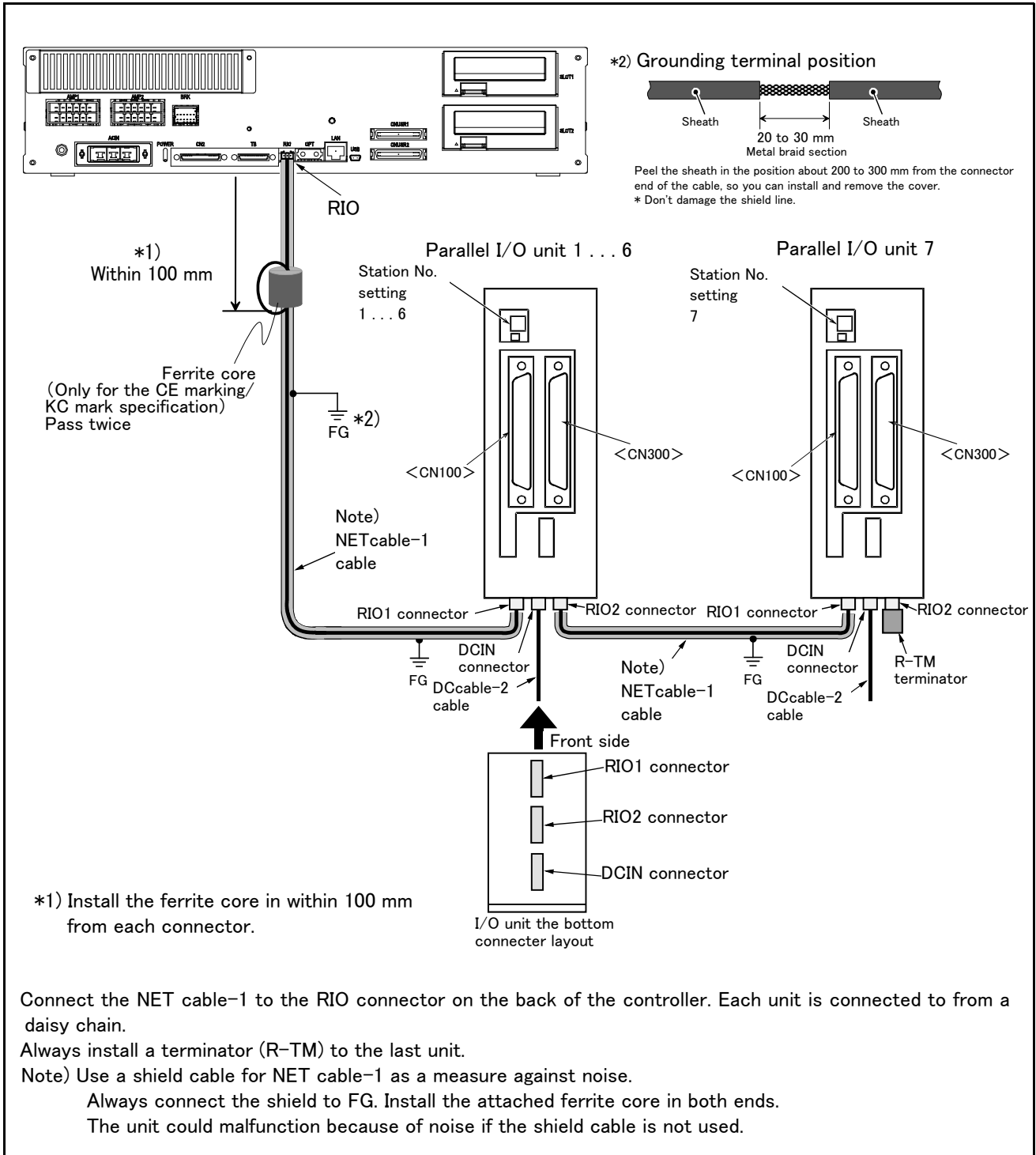
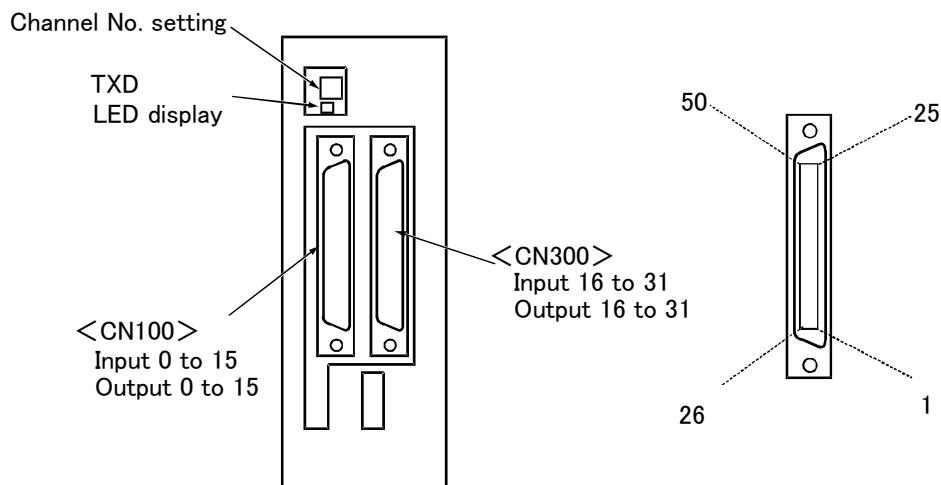


Fig.3-28 : Connection method of expansion parallel I/O unit (CR751)

■ Pin arrangement of the connector



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

Fig.3-29 : Pin arrangement of the parallel I/O unit

■ Assignment of pin number and signal

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

Table 3-23 : Assignment of pin number and signal

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

The connector pin number of the parallel I/O unit of the station number 0 and signal number assignment are shown in Table 3-24 and Table 3-25. If it is set as other station number, please interpret and utilize.

■ Parallel I/O interface (First expansion unit)

Table 3-24 : Connector CN100 pin No. and signal assignment list (2A-CBL □□)

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

Note 1) The dedicated signal is assigned at shipping. It can change with the parameter.

Note 2) Sink type: 12V/24V (COM), Source type: 0V (COM)

Note 3) The dedicated input signal (STOP) is assigned at shipping. The signal number is fixing.

Table 3-25 : Connector CN300 pin No. and signal assignment list (2A-CBL □□)

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

Note 1) Sink type: 12V/24 V (COM), Source type: 0V (COM)

<Reference> The example of connection with our PLC

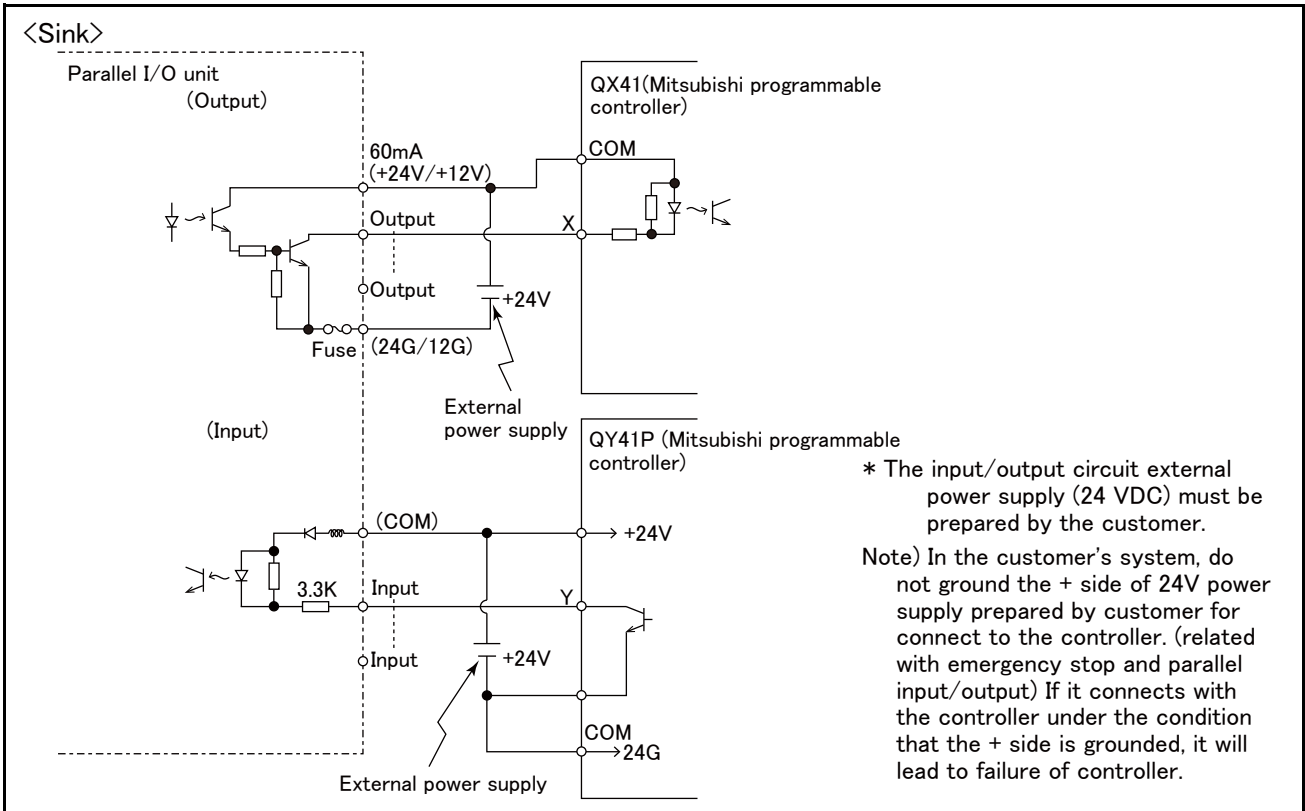


Fig.3-30 : Connection with a Mitsubishi PLC (Example of sink type)

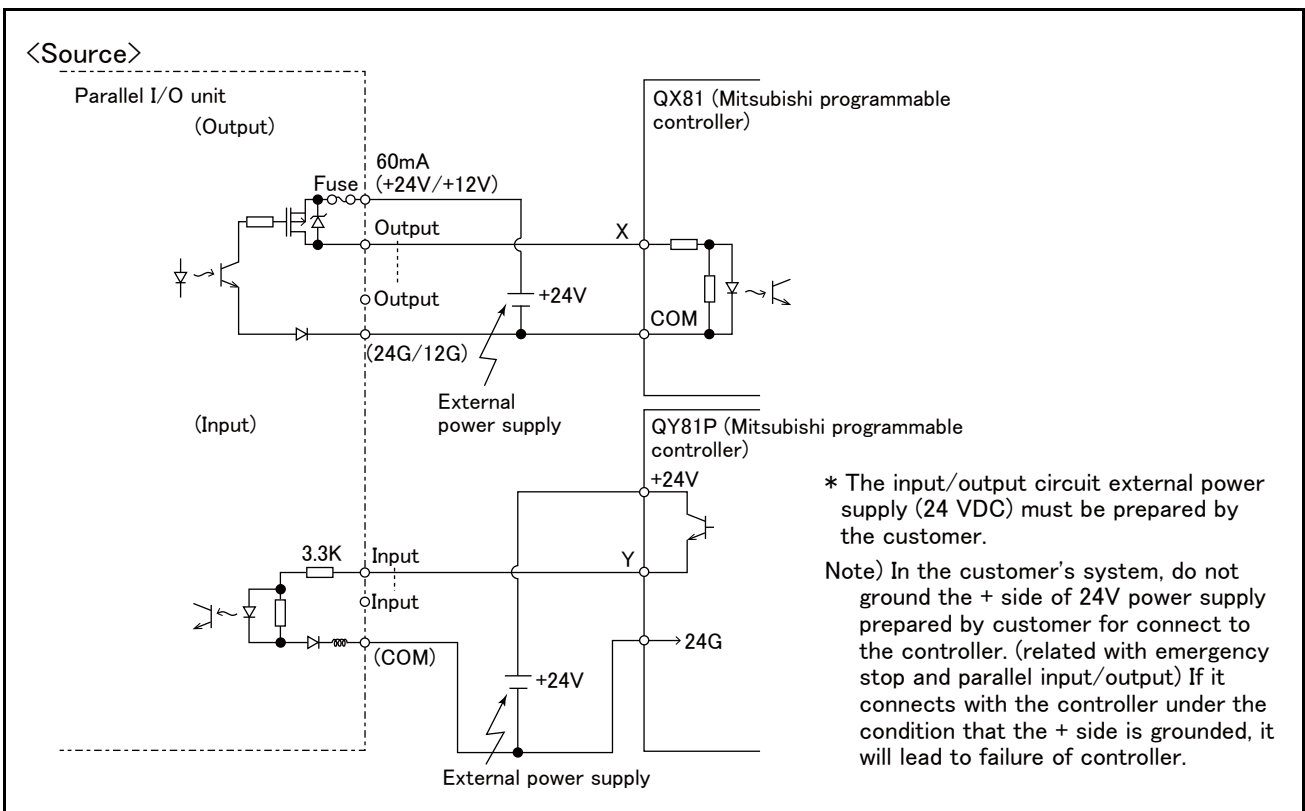


Fig.3-31 : Connection with a Mitsubishi PLC (Example of source type)

(5) External I/O cable

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

■ Outline



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

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

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

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

■ Configuration

Table 3-26 : Configuration device

Part name	Type	Qty.	Mass (kg) ^{Note 1)}	Remarks
External I/O cable	2A-CBL □□	1pc.	0.7 (5 m) 1.84 (15 m)	5 m or 15 m

Note 1) Mass indicates one set.

■ Specifications

Table 3-27 : Specifications

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

■ Connector pin numbers and cable colors

Table 3-28 : Connector pin numbers and cable colors

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

■ Connections and outside dimensions

The sheath of each signal cable (50 lines) is color indicated and marked with dots. Refer to the cable color specifications in "Table 3-28: Connector pin numbers and cable colors" when making the connections.

(Eg.) Pin number: color indication

1 : Orange / Red / A

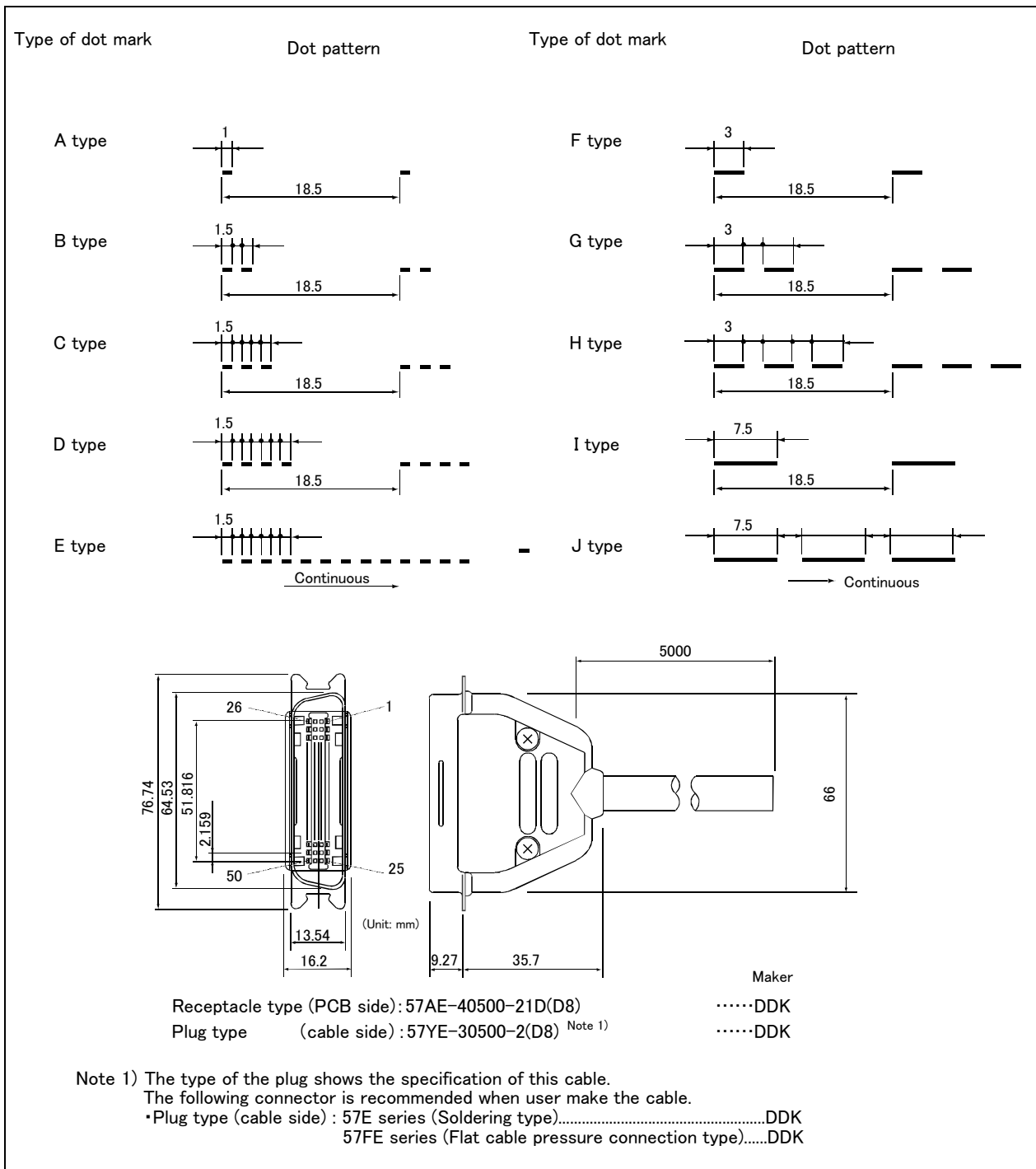
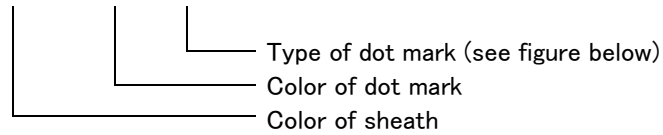


Fig.3-32 : Connections and outside dimensions

(6) CC-Link interface

■ Order type: ● 2D-TZ576

■ Outline



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

■ Configuration

Table 3-29 : Configuration device

Part name	Type	Qty.	Mass(kg) ^{Note 1)}	Remarks
CC-Link interface	TZ576	1	0.6	
Manual	BFP-A8634	1	-	CD-ROM
Ferrite core	E04SR301334	2	-	Be sure to install this for noise countermeasure.
Cable clamp	AL4	2	-	
	AL5	2	-	
On-line connector for communication	A6CON-LJ5P	1	-	
Terminal resistor	A6CON-TR11N	1	-	Resistance value: 100Ω
One-touch connector plug for communication	A6CON-L5P	2	-	

Note 1) Mass indicates one set.

Table 3-30 : Procured by the customer

Part name	Type	Qty.	Remarks
Master station	QJ61BT11(Q series)	1	FX series products are not supported.
	QJ61BT11N(Q series)		
	AJ61QBT11(QnA series)		
	A1SJ61QBT11(QnAS series)		
	AJ61BT11(A series)		
	A1SJ61BT11(AnS series)		
	A80BD-J61BT11(personal computer board)		
Communication cable	-	1	Shielded 3-core twisted cable This cable may be manufactured by the customer.

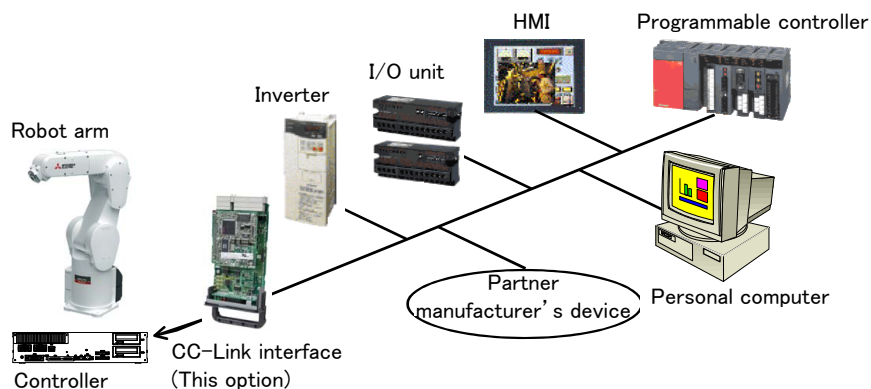


Fig.3-33 : Example of CC-Link Product Configuration

■ Specifications

Table 3-31 : Specifications

Item		Specifications				Remarks
Communication function		Bit data and word data can be transmitted.				Word data are used by the registers.
Station type		Intelligent device station ^{Note 1)}				
Support station		Local station				No master station function
The version corresponding to CC-Link		Ver.2				The extended cyclic setup is possible.
Mountable option slot		Slot 1, 2				
Number of mountable CC-Link interface cards		1				Multiple CC-Link interface cards cannot be inserted.
Number of stations		1 to 64 stations				When four stations are occupied, continuous station numbers are used. The station numbers are set by a DIP switch.
Transmission speed		10M/5M/2.5M/625K/156K bps				This is set by the rotary SW.
Station number		1 to 64				When two or more stations are occupied, continuous station numbers are used.
Number of occupied stations		1/2/3/4				
Extended cyclic setup		1/2/4/8				
Maximum link point		Remote I/O (RX, RY)	Each 896 points			The two last cannot be used.
		Remote register (RW _w , RW _r)	Each 128 register			
Extended cyclic setup		-	1 fold setup	2 fold setup	3 fold setup	4 fold setup
Link point per set	When one station is occupied	Remote I/O (RX, RY)	32 point	32 point	64 point	128 point
		Remote register (RW _w)	4 word	8 word	16 word	32 word
		Remote register (RW _r)	4 word	8 word	16 word	32 word
	When two stations is occupied	Remote I/O (RX, RY)	64 point	96 point	192 point	384 point
		Remote register (RW _w)	8 word	16 word	32 word	64 word
		Remote register (RW _r)	8 word	16 word	32 word	64 word
	When three stations is occupied	Remote I/O (RX, RY)	96 point	160 point	320 point	640 point
		Remote register (RW _w)	12 word	24 word	48 word	96 word
		Remote register (RW _r)	12 word	24 word	48 word	96 word
	When four stations is occupied	Remote I/O (RX, RY)	128 point	224 point	448 point	896 point
		Remote register (RW _w)	16 word	32 word	64 word	128 word
		Remote register (RW _r)	16 word	32 word	64 word	128 word
Number of the maximum occupancy station		4 stations				
The I/O first number of the robot controller.		No. 6000 -. The number corresponding to the station number by the setup of the parameter "CCFIX."				

Note 1) Not available for the transient transmission function and FX-series models that do not support intelligent devices.

■ Functions**(1) Communication function**

- The number of usable points is 896 points maximum for bit control and 128 points maximum for word control.

(2) Easy setup

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

(3) High-speed response

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

(7) MELSOFT RT ToolBox2/MELSOFT RT ToolBox2 mini

- Order type : ● MELSOFT RT ToolBox2
 *For windows CD-ROM : 3D-11C-WINE
- MELSOFT 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 3-32 : Product configuration

Part name	Type	Medium	Mass (kg) ^{Note 1)}	Remarks
RT ToolBox2	3D-11C-WINE	CD-ROM	0.2	
RT ToolBox2 mini	3D-12C-WINE	CD-ROM	0.2	

Note 1) Mass indicates one set.

■ Features

- (1) Simple operation with guidance method and menu method
 The Windows standard is used for windows operation, so the controller initialization and startup operations can be carried out easily by following the instructions given on the screen. Even a beginner can easily carry out the series of operations from program creation to execution.
- (2) Increased work efficiency with ample support functions
 The work efficiency is greatly improved with the multi-window method that carries out multiple steps and displays in parallel. The renumbering function, and copy, search, syntax check and step execution are especially sufficient, and are extremely useful when editing or debugging the program.
 With the simulation function support, the program can be debugged and the tact checked before starting the machine at the site. This allows the on-site startup work efficiently to be greatly improved.
- (3) The maintenance forecast function increases the efficiency of maintenance work. Analyze the load condition while the robot is actually operating. Based on this analysis, calculate the time for maintenance, such as lubrication and belt replacement. By utilizing this information, the line stop time as well as the maintenance costs can be reduced.
- (4) The position recovery support function increases the recovery efficiency in the event of origin position displacement. This function compensates the origin settings and position data by just reproducing several previous teaching points when hand and/or arm displacement occurs, when replacing the motor and the belts, or when reloading the robot. This function can reduce the time required for recovery.

■ Functions

Table 3-33 : Functions

Function		Functional existence ^{Note 1)}		Details
Compatible model		○	○	Personal computer running Windows XP, Windows Vista, Windows 7, Windows 8, Windows 8.1, or Windows 10. ^{Note 2)}
Program editing functions	Editing functions	○	○	<ul style="list-style-type: none"> ▪ 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	○	○	<ul style="list-style-type: none"> ▪ Program file control (list, copy, movement, delete, content comparison, name change, protect)
	Debugging functions	○	○	<ul style="list-style-type: none"> ▪ Direct editing of program in controller ▪ Confirmation of robot program operation (step execution, direct execution)
Simulation function		○	×	<ul style="list-style-type: none"> ▪ Off-line simulation of robot program operation using CG (computer graphics) ▪ Tact time calculation
Monitor functions		○	○	<ul style="list-style-type: none"> ▪ 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		○	○	<ul style="list-style-type: none"> ▪ Parameter setting ▪ Batch, divided backup

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

— MELSOFT RT ToolBox2 (3D-11C-WINE)

Note 1) The functions included with the RT ToolBox2 and the RT ToolBox2 mini are shown below.

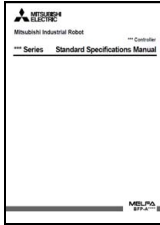
○ : Function provided × : Function not provided

Note 2) Recommend corresponding to CE Marking, an FCC standard, and a VCCI standard.

(8) Instruction Manual (hardcopy)

■ Order type: ● 5F-FX02-PE01: A set of manuals of RH-3CH-Sxx/6CH-Sxx

■ Outline



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

■ Configuration

Table 3-34 : Product configuration

Name	Type	Mass (Kg) ^{Note 1)}	Specifications
Instruction Manual	5F-FX02-PE01	2.6	The instructions manual set of "RH-3CH-Sxx/6CH-Sxx".
Safety Manual	BFP-A8006	-	Items relating to safety in handling the robot
Special Specifications Manual	BFP-A3447	-	Specification of the robot arm and controller
Robot Arm Setup & Maintenance	BFP-A3448	-	Installation method of the robot arm, jog operation, and maintenance and inspection procedures
Controller Setup, Basic Operation and Maintenance	BFP-A8867	-	Installation method of the controller, basic operation, and maintenance and inspection procedures
Detailed Explanation of Functions and Operations	BFP-A8869	-	Functions of the controller and T/B, operation method, and explanation of MELFA-BASIC V
Troubleshooting	BFP-A8871	-	Causes of errors occurred and their countermeasures
Additional axis function	BFP-A8663	-	Function of the additional axis, operation method.
Tracking Function Manual	BFP-A8664	-	Function of the Tracking, operation method.
GOT Direct Connection Extended Function	BFP-A8849	-	Explains of data configuration of shared memory, monitoring, and operating procedures, between the GOT and controller.

Note 1) Mass indicates one set.

3.11 Maintenance parts

The consumable parts used in the controller are shown in [Table 3-35](#). 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 3-35 : Controller consumable parts list

No.	Name	Type ^{Note 1)}	Qty.	Usage place	Supplier
1	Lithium battery	Q6BAT	1	Inside of the filter cover	Mitsubishi Electric
2	Filter	BKOFA0773H41	1	Inside the filter cover	

Note 1) Confirm the robot arm serial No., and contact the dealer or service branch of Mitsubishi Electric Co., for the type.

4 Software

4.1 Functions and specifications of RH-3CH-Sxx/RH-6CH-Sxx

4.1.1 Changed functions/specifications

Some functions of RH-3CH-Sxx/RH-6CH-Sxx controller and some functions/specifications of MELFA-BASIC V programming language are changed from the functions/specifications of RH-F series. Table 4-1 shows details on the changes.

Table 4-1 : List of changed functions/specifications

	Changed function/specification	Outline	Reference page
1	Definition change of component C in XYZ coordinate data	The numerical value range of component C is extended.	Page 99
2	Functionality change of some commands and a function in MELFA-BASIC V	In connection with No.1 above, the functionality of Mvs command, Def Plt command, and Zone function are changed.	Page 100
3	Addition of the parameter to select the component C indication method	A parameter to select the indication method between the one mentioned in No. 1 above and the conventional one.	Page 101
4	Method change for setting a user-defined area	In connection with No.1 above, the setting method is changed.	Page 101
5	Large inertia mode	Enabling the large inertia mode has the effect to suppress vibrations of the robot arm when the hand (or workpiece) with a large inertia is used.	Page 101

4.1.2 Descriptions of changed functions/specifications

■ Definition change of component C in XYZ coordinate data

The definition of component C in XYZ coordinate data is changed for RH-3CH-Sxx/RH-6CH-Sxx. Refer to the following descriptions for the details.

The format of the robot position data is divided into two categories: XYZ coordinate and JOINT coordinate. XYZ coordinate format data includes position data, posture data, and associated information (flags). For a horizontal, multiple-joint type robot, the data is displayed in format such as (X, Y, Z, , , C)(FL1, FL2). The component C represents rotational angle about the Z axis.

For conventional robots (ex. RH-F, RH-SD/SQ), the component C range is defined as $-180 \leq C \leq +180$ (Fig. 4-1). For RH-3CH-Sxx/RH-6CH-Sxx, it is defined more widely (Fig. 4-2). See Fig. 4-2 to find two diagrams of (a) Forward rotation, and (b) Reverse rotation.

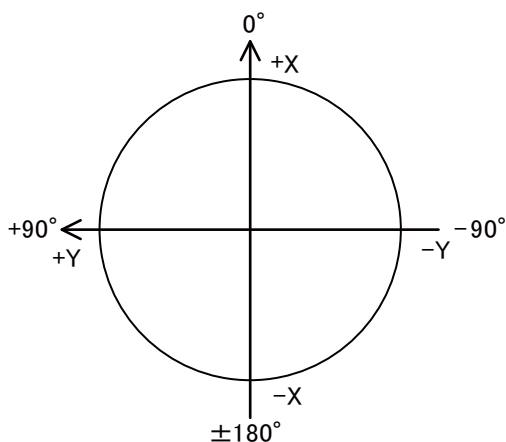


Fig.4-1 : Definition of component C for conventional robots (within ± 180)

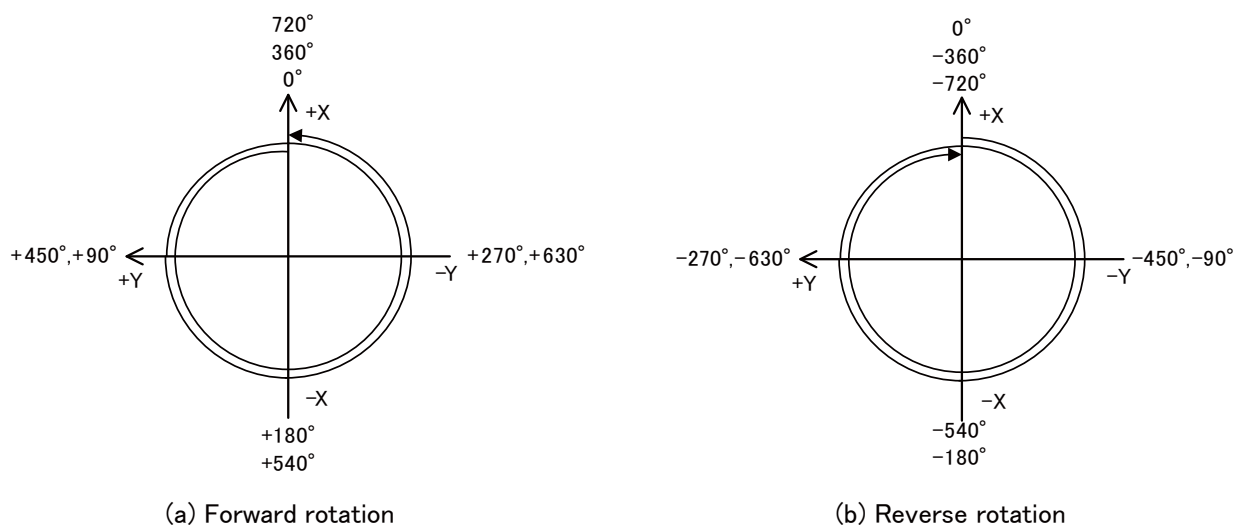


Fig.4-2 : Definition of component C for RH-3CH-Sxx/RH-6CH-Sxx (over ± 180)

As the component C covers a value less than -180 or more than $+180$, an actual rotational angle can be set for the rotational angle for linear interpolation or perfect circle/circular interpolation. To move the work at a target angle in the robot programming, the rotation direction was set by specifying an operation in the argument Type or changing the multi-rotation flag (FL2) for conventional robots but is set just by specifying an angle for RH-3CH-Sxx/RH-6CH-Sxx value of the FL2 is always 0.

Due to this change, the robot program used for the conventional robots may malfunction. In such cases, refer to [Page 100](#), " [Functionality change of some commands and a function in MELFA-BASIC V](#)" to change the robot programming.

Or the definition of component C can be converted back into the conventional definition by setting a related parameter to maintain compatibility among the robot program or robot operations. For information on how to adjust the parameter, refer to [Page 101](#), " [Parameter to select the component C indication method](#)".

■ Functionality change of some commands and a function in MELFA-BASIC V

Due to the definition change of component C in XYZ coordinate data, some commands and a function in MELFA-BASIC V are changed. [Table 4-2](#) shows details on the changes.

Table 4-2 : List of changed commands/function for RH-3CH-Sxx/RH-6CH-Sxx

Command/function	Descriptions
Mvs	<ul style="list-style-type: none"> - The initial value of "constant 1" specified in the argument Type differs according to the setting value of the parameter DISPCTYP. <ul style="list-style-type: none"> When DISPCTYP=0 (initial value): The initial value of "constant 1" is 1 (roundabout). When DISPCTYP=1: The initial value of "constant 1" is 0 (shortcut) (compatible with the conventional robots).
Zone	<ul style="list-style-type: none"> - When DISPCTYP=0 (initial value) for RH-3CH-Sxx/RH-6CH-Sxx, the posture angle (component C) is checked whether it satisfies the following formula: Position 2 \leq Position 1 \leq Position 3. <ul style="list-style-type: none"> Make sure to so define the posture angle as to satisfy the requirement of "Position 2 < Position 3". If the wrong requirement of "Position 3 < Position 2" is defined, check results are not returned correctly. When DISPCTYP=1, the posture angle is checked, as for the conventional robots, whether it is within the area covered by the robot arm's forward rotation from Position 2 to Position 3. - When the posture angle (component C) check is not performed, set the component C to sufficient large values, for example, -10000 for Position 2, and $+10000$ for Position 3.

■ Parameter to select the component C indication method

The definition of component C in XYZ coordinate data is changed for RH-3FCH-Sxx/RH-6CH-Sxx. However, in order to maintain operational compatibility with the conventional models (RH-F, RH-SD/SQ, etc.), it is possible to use the definition of component C in XYZ coordinate data for the conventional models by setting the parameter. Table 4-3 describes the parameter.

Table 4-3 : Parameter added for RH-3CH-Sxx/RH-6CH-Sxx

Parameter	Parameter name	Number of arrays Number of characters	Description	Factory default setting
Multi-rotation indication method	DISPCTYP	Integer 1	<p>Indication method for multi-rotation of component C in XYZ coordinate data.</p> <p>0: Invalid (The component C value is not rounded to the value within +/-180 degrees.)</p> <p>1: Valid (The component C value is rounded to the value within +/-180 degrees to maintain compatibility with the conventional models.)</p> <p>Turn off and on the controller's power supply after changing the setting of this parameter.</p> <p>For using robot programs for the conventional models (RH-F, RH-SD/SQ) after introducing RH-3CH-Sxx/RH-6CH-Sxx, change the parameter setting to "1" (valid).</p> <p>This parameter is valid only for the RH-CH, RH-FH, and RH-SD/SQ series. It is not used for the RH-FHR, RV-F, or RV-SD/SQ series.</p>	<p>RH-3CH-Sxx/ RH-6CH-Sxx 0</p> <p>Other models 1</p>

■ Method change for setting a user-defined area

The definition and evaluation of a user-defined area is changed for RH-3CH-Sxx/RH-6CH-Sxx.

- (1) When DISPCTYP=0 (initial value) for RH-3CH-Sxx/RH-6CH-Sxx, the posture angle (component C) is checked whether it satisfies the following formula: $AREAnP2 \leq \text{current position} \leq AREAnP3$.

Make sure to so define the posture angle as to satisfy the requirement of "AREAnP2 < AREAnP3". If the wrong requirement of "AREAnP3 < AREAnP2" is defined, check results are not returned correctly. When DISPCTYP=1, the posture angle is checked, as for the conventional robots, whether it is within the area covered by the robot arm's forward rotation from AREAnP2 to AREAnP3.

- (2) When the posture angle (component C) check is not performed, set the component C to sufficient large values, for example, -10000 for AREAnP2, and +10000 for AREAnP3.

■ Large inertia mode

Enabling the large inertia mode has the effect to suppress vibrations of the robot arm when the hand (or workpiece) with a large inertia is used. When the hand (or workpiece) with a large inertia is used, enable the large inertia mode. Table 4-4 shows the allowable inertia when the large inertia mode is enabled. Table 4-5 describes the parameter.

When the large inertia mode is enabled, if the inertia exceeds the allowable inertia for the standard load mode, the permissible value for the distance from the center of the shaft to the center of gravity of the load (the offset amount) is 10 mm.

Table 4-4 : List of the allowable inertia when the large inertia mode is enabled

Item	Unit	Inertia mode	RH-3CH-Sxx	RH-6CH-Sxx
Allowable inertia (Maximum)	kg m ²	Standard load mode	0.05	0.12
		Large inertia mode	0.075	0.18

Table 4-5 : Parameter added for RH-3CH-Sxx/RH-6CH-Sxx

Parameter	Parameter name	Number of arrays Number of characters	Description	Factory default setting
Inertia mode	PYLDMODE	Integer 1	<p>Specify whether the large inertia mode is enabled or disabled. 0: Standard load mode 1: Large inertia mode</p> <p>Enabling the large inertia mode has the effect to suppress vibrations of the robot arm when the hand (or workpiece) with a large inertia is used. When the hand (or workpiece) with a large inertia is used, enable the large inertia mode.</p> <p>This parameter is valid only for the RH-CH series. It cannot be used for other series.</p>	<p>RH-3CH-S51/S52 1</p> <p>Other models 0</p>

4.1.3 Origin position adjustment of J2 axis

When a calculated point is used for a robot's work point, the accuracy of J2 axis is important. This paragraph 4.1.3 "Origin position adjustment of J2 axis" gives the details of an origin position adjustment by the configuration flag (RIGHT/LEFT).

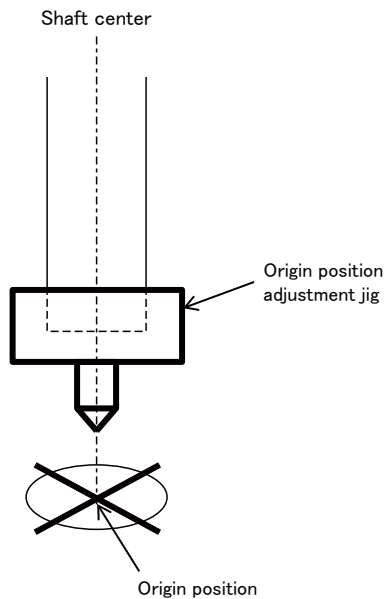


Fig.4-3 : Origin position adjustment

For the origin position adjustment, a reference point is an axis center of a shaft. When a center of the hand is offset from a center of the shaft, the hand must be removed before the origin position adjustment.

Origin position adjustment procedure

- 1) Designate any point as an origin position.
- 2) Match the center of the shaft with the origin position in a right hand coordinate system.
- 3) Perform teaching work to the joint variables JR.
- 4) Match the center of the shaft with the origin position in a left hand coordinate system.
- 5) Perform teaching work to the joint variables JL.
- 6) Execute the following commands in the order presented.

```
MDJNT_J2=(JR.J2+JL.J2)/2
JDJNT_Data=(0,0,0,0,0,0)
JDJNT_Data.J2=JDJNT_Data.J2-(MDJNT_J2)
PrmWrite 1,"DJNT",JDJNT_Data
```

- 7) Move J2 axis to 0 degrees, and check the robot position.

After the origin position adjustment, an adjusted value is stored in the parameter DJNT.
 For another origin position adjustment with retaining an earlier adjusted value after the first adjustment is finished, change "JDJNT_Data=(0,0,0,0,0,0)" into "PrmRead 1,"DJNT",JDJNT_Data" before command execution.
 As a repeat of command execution causes an accumulation of the adjusted values, clear the parameter DJNT back to 0 before another origin position adjustment.

4.2 List of commands

The available new functions in MELFA-BASIC V are given in [Table 4-6](#).

Table 4-6 : 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).
	Designate the speed for joint interpolation operation with a percentage (0.1% unit).		JOvrd 100
	Designates the speed for linear and circular interpolation with a numerical value (mm/s unit).		Spd 123.5
	Designates the acceleration/deceleration time as a percentage in respect to the predetermined maximum acceleration/deceleration. (1% unit)		Accel 50,80
	Automatically adjusts the acceleration/deceleration according to the parameter setting value.		Oadl ON
	Sets the hand and work conditions for automatic adjustment of the acceleration/deceleration.		Loadset 1,1
	Operation	Adds a process unconditionally to the operation.	Wth
		Adds a process conditionally to the operation.	WthIf
		Designates smooth operation.	Cnt 1,100,200
		Performance of movement is upgraded corresponding to the application.	MvTune 4
		Designates the positioning completion conditions with a No. of pulses.	Fine 200
		Designates the positioning completion conditions with a distance in a straight line	Fine 1, P
		Designates the positioning completion conditions with a joint interpolation.	Fine 0.5, J, 2
		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
	Float control	The robot arm rigidity is lowered and softened. (XYZ coordinate system)	Cmp Pos ,&B00000011
		The robot arm rigidity is lowered and softened. (JOINT coordinate system)	Cmp Jnt ,&B00000011
		The robot arm rigidity is lowered and softened. (TOOL coordinate system)	Cmp Tool ,&B00000011
		The robot arm rigidity is returned to the normal state.	Cmp Off
		The robot arm rigidity is designated.	CmpG 1.0,1.0,1.0,1.0,1.0,1.0,1.0
	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

Type	Class	Function	Input format (example)	
Program control	Branching	Branches unconditionally to the designated place.	GoTo 120	
		Branches according to the designated conditions.	If M1=1 Then GoTo *L100 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 *La1, *Lb2, *Lc3	
		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	
	Collision detection	Set to enable/disable the collision detection.	ColChk ON/OFF	
		Set the detection level of the collision detection.	ColLvl 100,80,.....	
	Subroutine	Executes the designated subroutine. (Within program)	GoSub *L200	
		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 *La1, *Lb2, *Lc3	
	Interrupt	Defines the interrupt conditions and process.	Def Act 1, M1=1 GoTo *L100	
		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 *L100	
		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.	ReIM 1	
	Selection	Selects the designated program for the designated slot.	XLoad 2,"P102"	
	Start/stop	Carries out parallel execution of the designated program.	XRun 3,"100",0	
		Stops parallel execution of the designated program.	XStp 3	
Returns the designated program's execution line to the head and enters the program selection enabled state.	XRst 3			

Type	Class	Function	Input format (example)
Others	Definition	Defines the integer type or real number type variable.	Def Inte KAISUU
		Defines the character string variable.	Def Char MESSAGE
		Defines 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

4.3 List of parameters

Show the main parameter in the [Table 4-7](#).

Table 4-7 : 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 3.
	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 32 types of set area. The mechanism No. to use is set with 1 to 3.
	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]
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) to either of normal open or normal close.

Parameter		Details
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	MESNGLS W	Designate the valid/invalid of the singular point adjacent alarm. (Invalid/Valid = 0/1) When this parameter is set up "VALID", this warning sound is buzzing even if parameter: BZR (buzzer ON/OFF) is set up "OFF".
Display language.	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.
Special Specifications Manual	Explains the product's specifications, factory-set special specifications, option configuration, maintenance parts, etc.
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.
Tracking Function Manual	Explains the control function and specifications of conveyor tracking
Extended Function Instruction Manual	Explains the detailed description of data configuration of shared memory, monitoring, and operating procedures, about the PLC(CR750-Q/CR751-Q controller) and the GOT (CR750-D/CR751-D controller).

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.
		Mechanical stopper	This is the mechanical stopper provided outside the software.

Table 6-2 : List of stop functions

Stop function	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	Connection point	Parameter	Functions	Usage method	
Input	External emergency stop Note 1)	Connector (CNUSR1)	-	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	Parallel I/O unit or interface	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	Emergency stop output	Connector (CNUSR1)	-	Outputs the input signal of external emergency stop or emergency stop switch of T/B turned on.	Display and warn the pilot lamp, the input signal of external emergency stop or the emergency stop switch of T/B turned on.
	In servo ON	Parallel I/O unit or interface	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	Connector (CNUSR2)	ERRRESET	Outputs when an alarm occurs in the robot.	The alarm state is shown and alerted with the display lamps.
		-			

Note 1) The external emergency stop input is prepared as a normal close 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 113, "6.1.7 Examples of safety measures" for details.
 And, refer to Page 62, "(3) Automatic Operation/Jog Operation/Brake Release and Necessary Switch Settings" for the function of the door switch input and the enabling device input.

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

- Always 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

The controller's dedicated I/O terminal connector has a duplicate emergency stop circuit. Fig. 6-1 to Fig. 6-5 shows examples of safety measures. 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.

[Caution] Since we have omitted the information in part because of explanation, there is the section different from the product. Also refer to Page 118, "(1) External emergency stop connection [supplementary explanation]".

[Note] · In the emergency-stop related wiring by the customer, if the coil (is not the contact points) of the relay prepared by the customer is connected to the controller, please be sure to implement the measure against the noise by the customer in the coil section. And, please also take the lifetime of noise suppression parts into consideration.

- Electric specification of the emergency-stop-related output terminal: 100mA/24V or less
- In the customer's system, do not ground the + side of 24V power supply prepared by customer for connect to the controller. (related with emergency stop and parallel input/output) If it connects with the controller under the condition that the + side is grounded, it will lead to failure of controller.

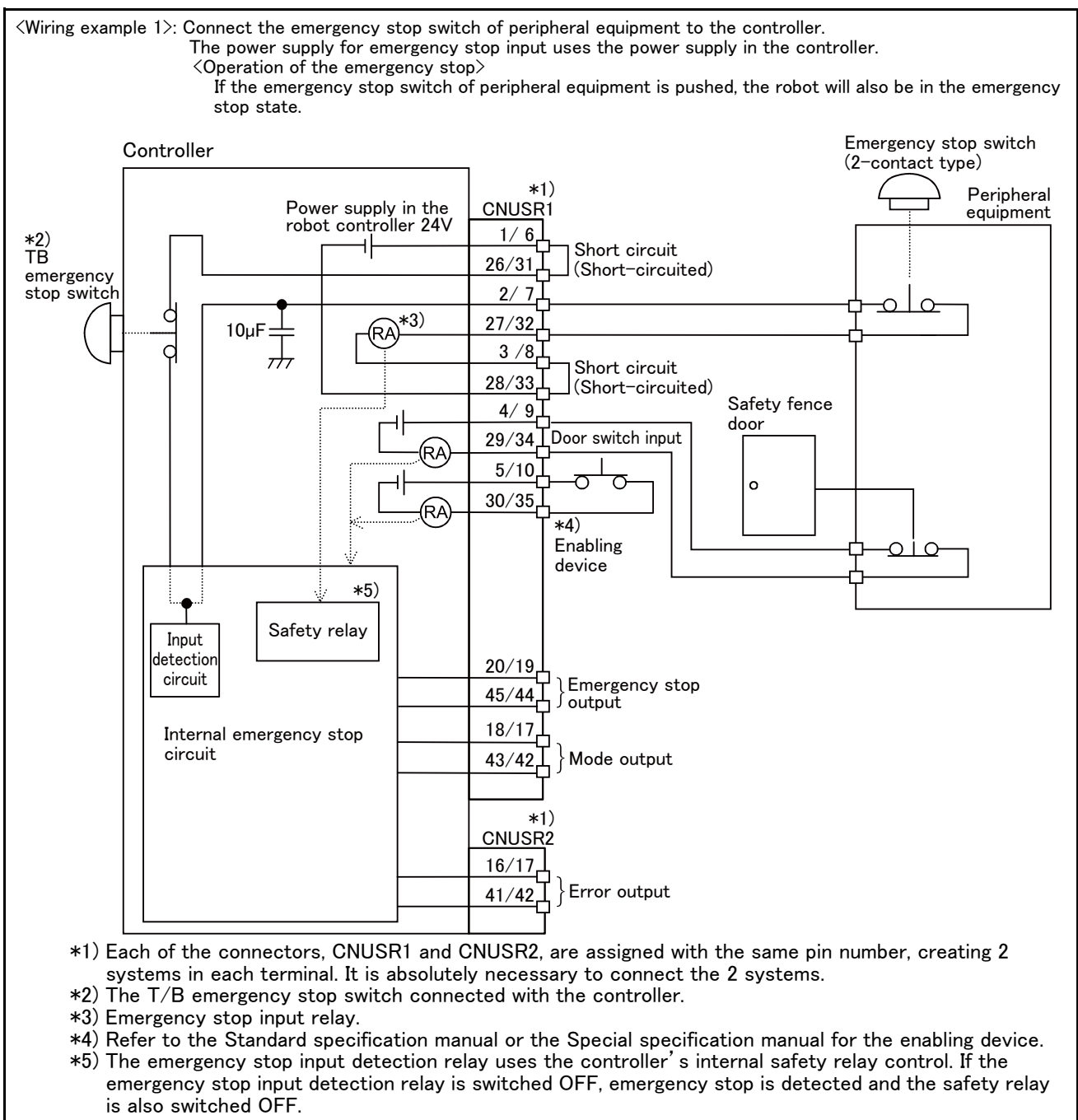
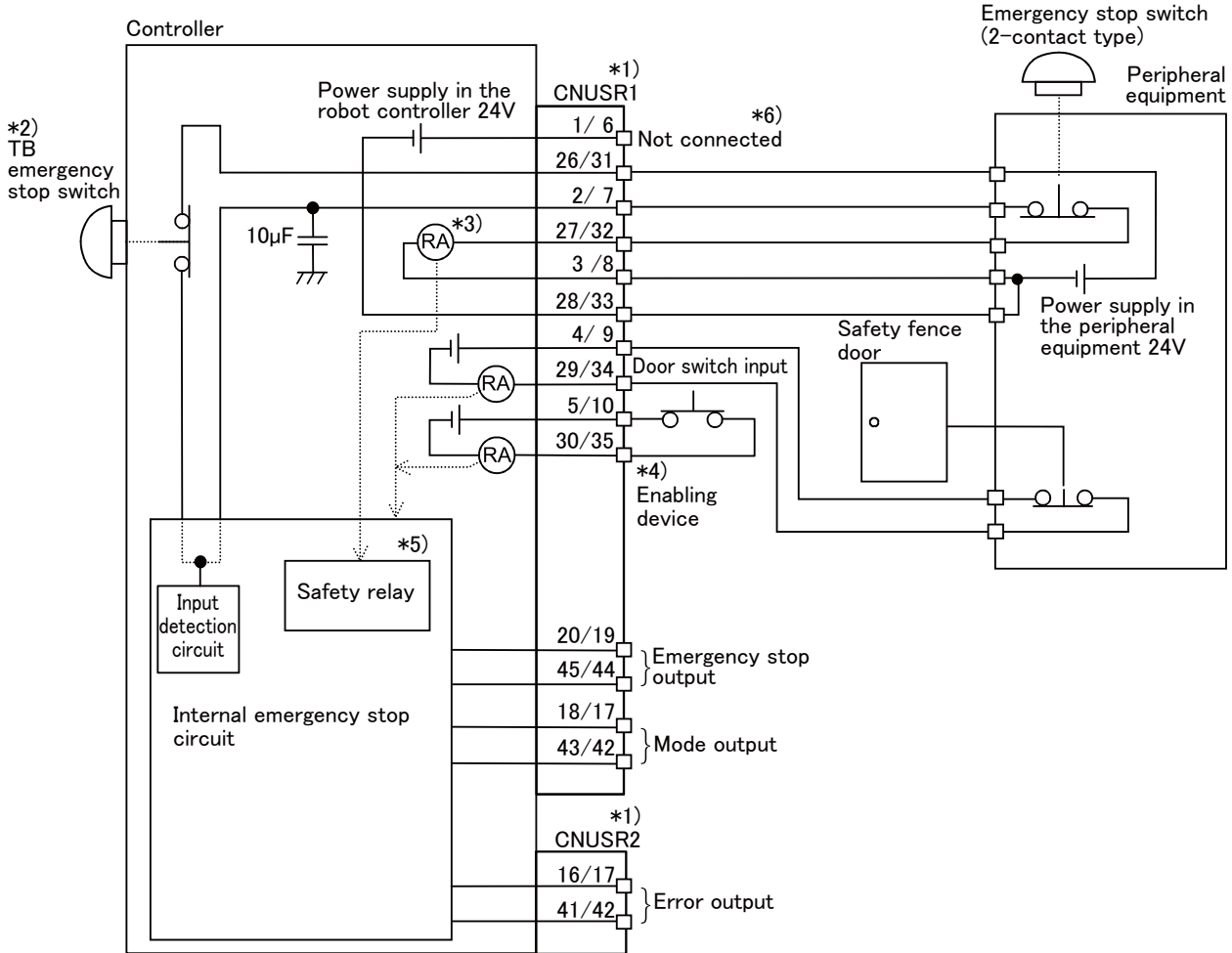


Fig.6-1 : Example of safety measures (CR751 wiring example 1)

<Wiring example 2>: Connect the emergency stop switch of peripheral equipment to the 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.



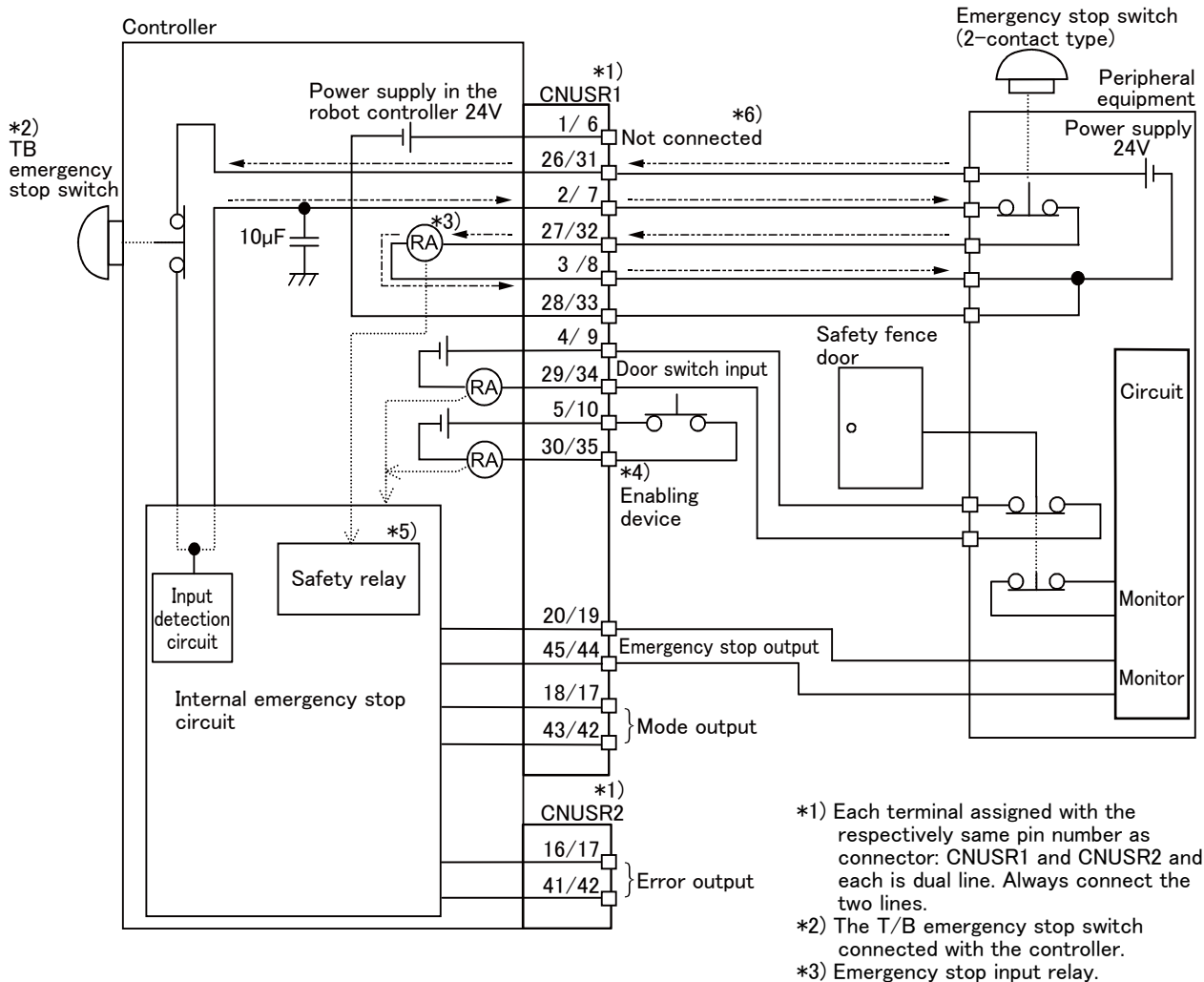
- *1) Each of the connectors, CNUSR1 and CNUSR2, are assigned with the same pin number, creating 2 systems in each terminal. It is absolutely necessary to connect the 2 systems.
- *2) The T/B emergency stop switch connected with the controller.
- *3) Emergency stop input relay.
- *4) Refer to the Standard specification manual or the Special specification manual for the enabling device.
- *5) The emergency stop input detection relay uses the controller's internal safety relay control. If the emergency stop input detection relay is switched OFF, emergency stop is detected and the safety relay is also switched OFF.
- *6) Connect the 24V power supply to 26/31 terminals.

Fig.6-2 : Example of safety measures (CR751 wiring example 2)

<Wiring example 3>: Connect the emergency stop switch, door switch, and enabling device of peripheral equipment to the 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 controller OFF, peripheral equipment state can be the emergency stop also.



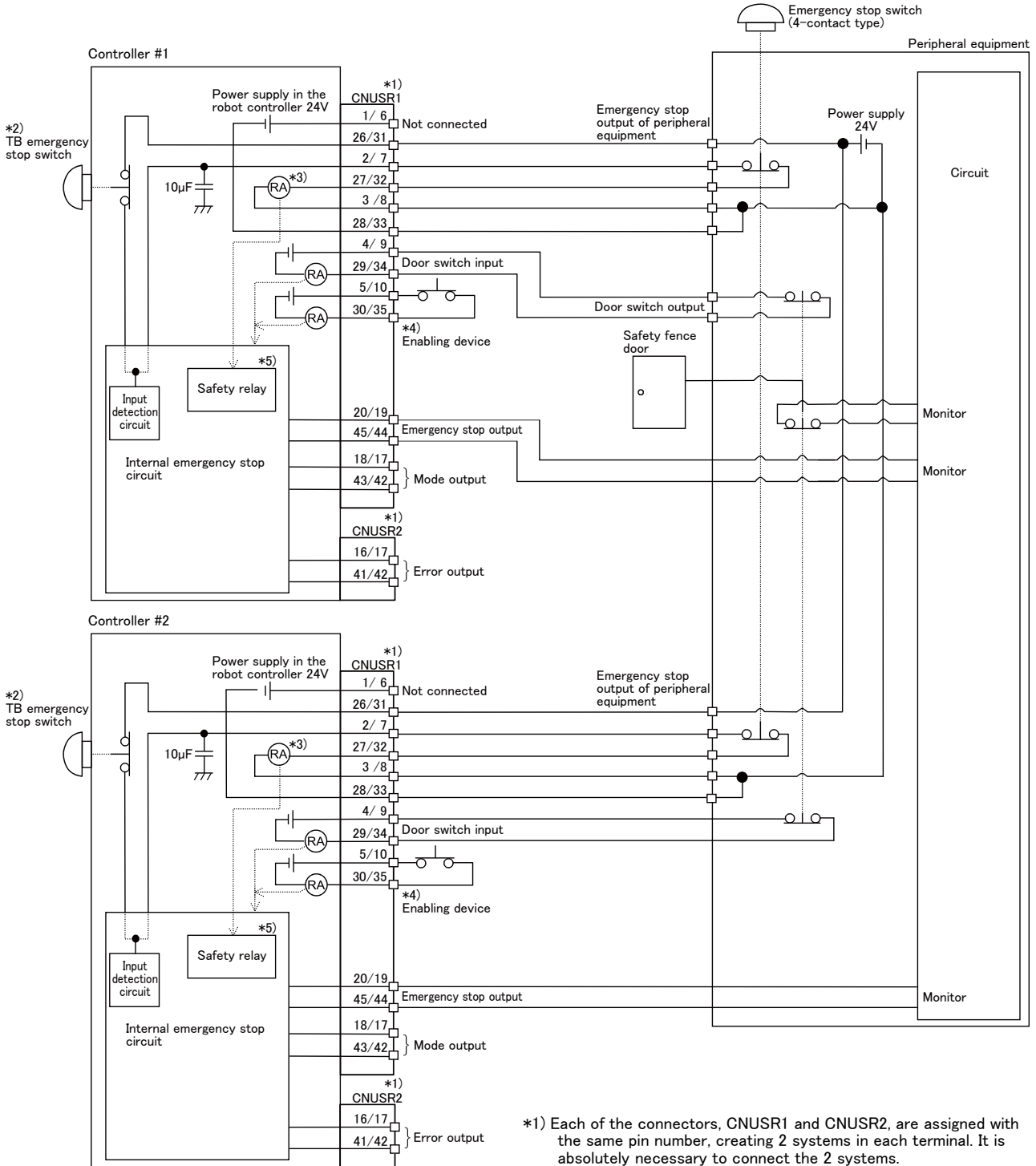
- *1) Each terminal assigned with the respectively same pin number as connector: CNUSR1 and CNUSR2 and each is dual line. Always connect the two lines.
- *2) The T/B emergency stop switch connected with the controller.
- *3) Emergency stop input relay.
- *4) Refer to the Standard specification manual or the Special specification manual for the enabling device.
- *5) The emergency stop input detection relay uses the controller's internal safety relay control. If the emergency stop input detection relay is switched OFF, emergency stop is detected and the safety relay is also switched OFF.
- *6) When using emergency stop switch output function, please take note of the polarity and make sure that the electrical current flows in the same direction as indicated by the dotted arrows in the two places in the diagram. If the polarity of the circuit is wrong, the emergency stop switch output may not work properly. Please connect the 24V power supply to 26/31 terminals.

Fig.6-3 : Example of safety measures (CR751 wiring example 3)

<Wiring example 4>: Connect the emergency stop switch of peripheral equipment, and the door switch to two 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 controller OFF, peripheral equipment state can be the emergency stop also.



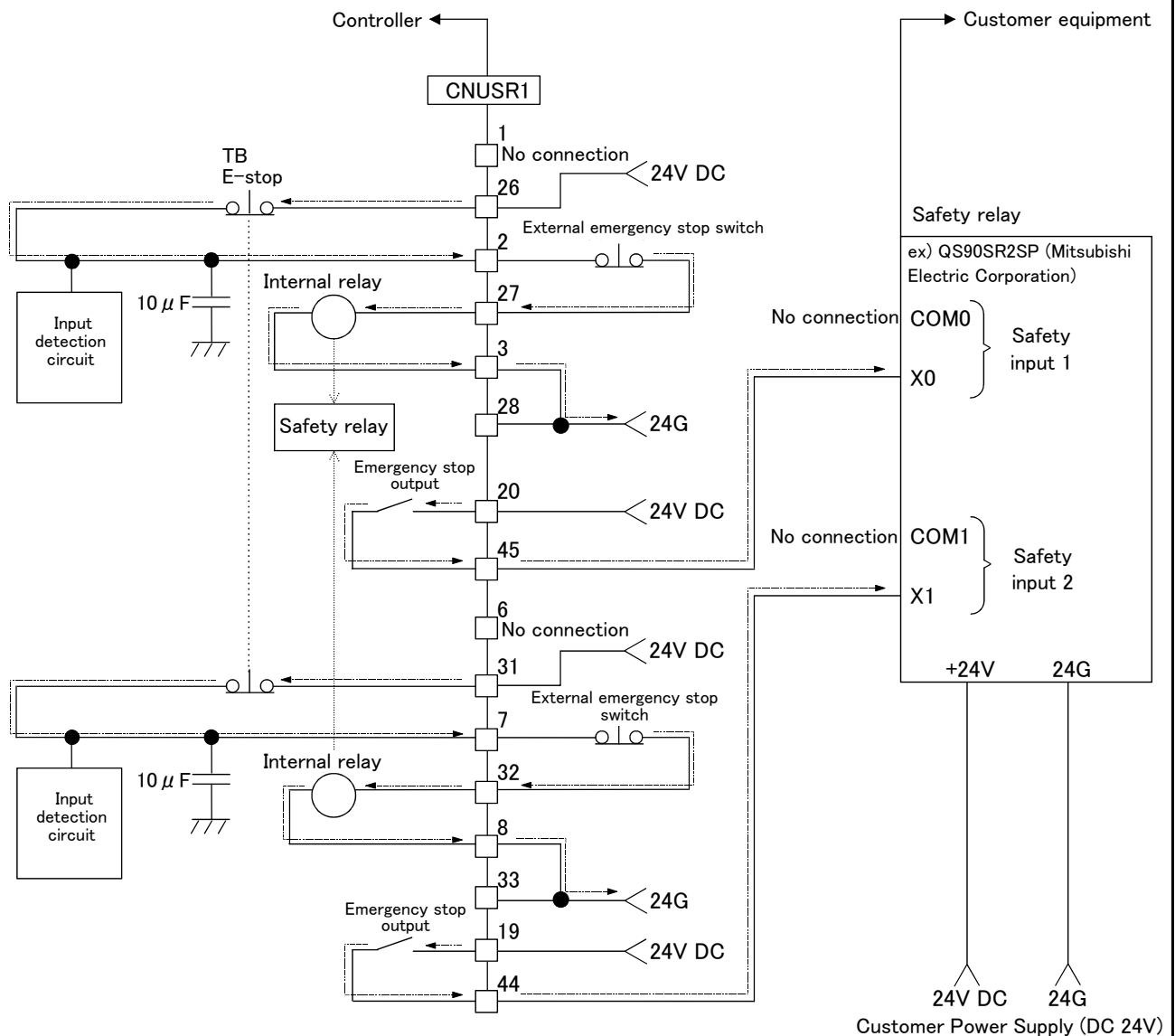
*1) Each of the connectors, CNUSR1 and CNUSR2, are assigned with the same pin number, creating 2 systems in each terminal. It is absolutely necessary to connect the 2 systems.
If necessary to stop two robots simultaneously by one emergency stop switch please use the 4 contact type emergency stop switch.

*2) The T/B emergency stop switch connected with the controller.

- *3) Emergency stop input relay.
- *4) Refer to the Standard specification manual or the Special specification manual for the enabling device.
- *5) The emergency stop input detection relay uses the controller's internal safety relay control. If the emergency stop input detection relay is switched OFF, emergency stop is detected and the safety relay is also switched OFF.

Fig.6-4 : Example of safety measures (CR751 wiring example 4)

<Wiring example 5>: Connect the controller to the safety relay
Use the controller's emergency stop switch to input safety relay.



[Caution]

- 1) This product has category 3 functionality and therefore the robot's whole unit cannot be set to category 4.
- 2) The controller's internal circuit has polarity. Please adhere to the polarity as detailed in the wiring examples, particularly for emergency stop switch output when using user equipment. Connect the positive side of the user equipment (24V DC) to the two terminals 26/31, then connect the emergency stop switch (or contact points) in the user equipment to the 2-27 and 7-32 terminals, and ultimately connect to the negative side (24G).
- 3) Setup a safety relay on the user equipment, and when using to input the emergency stop switch on the controller, please only use a safety relay that functions when connecting the input to the one end of the 2 systems (i.e. QS90SR2SP (Manufacture: Mitsubishi Electric Corporation)).
- 4) The emergency stop input detection relay (internal relay) uses the controller's internal safety relay control. If the emergency stop input detection relay is switched OFF, emergency stop is detected and the safety relay is also switched OFF.
- 5) When connecting emergency stop switch output to an exterior safety relay, please take note of the polarity and make sure that the electrical current flows in the same direction as indicated by the dotted arrows in the two places in the diagram. If the polarity is setup incorrectly this function will not operate correctly. Please connect 20/19 terminal to 24V.

Fig.6-5 : Example of safety measures (CR751 wiring example 5)

(1) External emergency stop connection [supplementary explanation]

- (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 (normal open), 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 of normal close which have two lines for the emergency stop switch.
- (4) Classify the faults into minor faults (faults that are easily restored and that do not have a great effect) and major faults (faults that cause the entire system to stop immediately, and that require care in restoration), and wire accordingly.

[Caution] The emergency stop input (terminal block) on the user wiring in the controller can be used for safety measures as shown in figure above. 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.*1)
 - Switch contact capacity.....Use a normal open contact that operates with a switch contact capacity of approx. 1mA to 100mA/24V. *1)
 - 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.
- The size of the wire that fits to use is shown below.
- CR751 controller..... CNUSR1/2 connector:
AWG #30 to #24 (0.05mm² to 0.2mm²)

Electric specification of the emergency stop related output circuit is 100mA/24V or less. Don't connect the equipment except for this range.

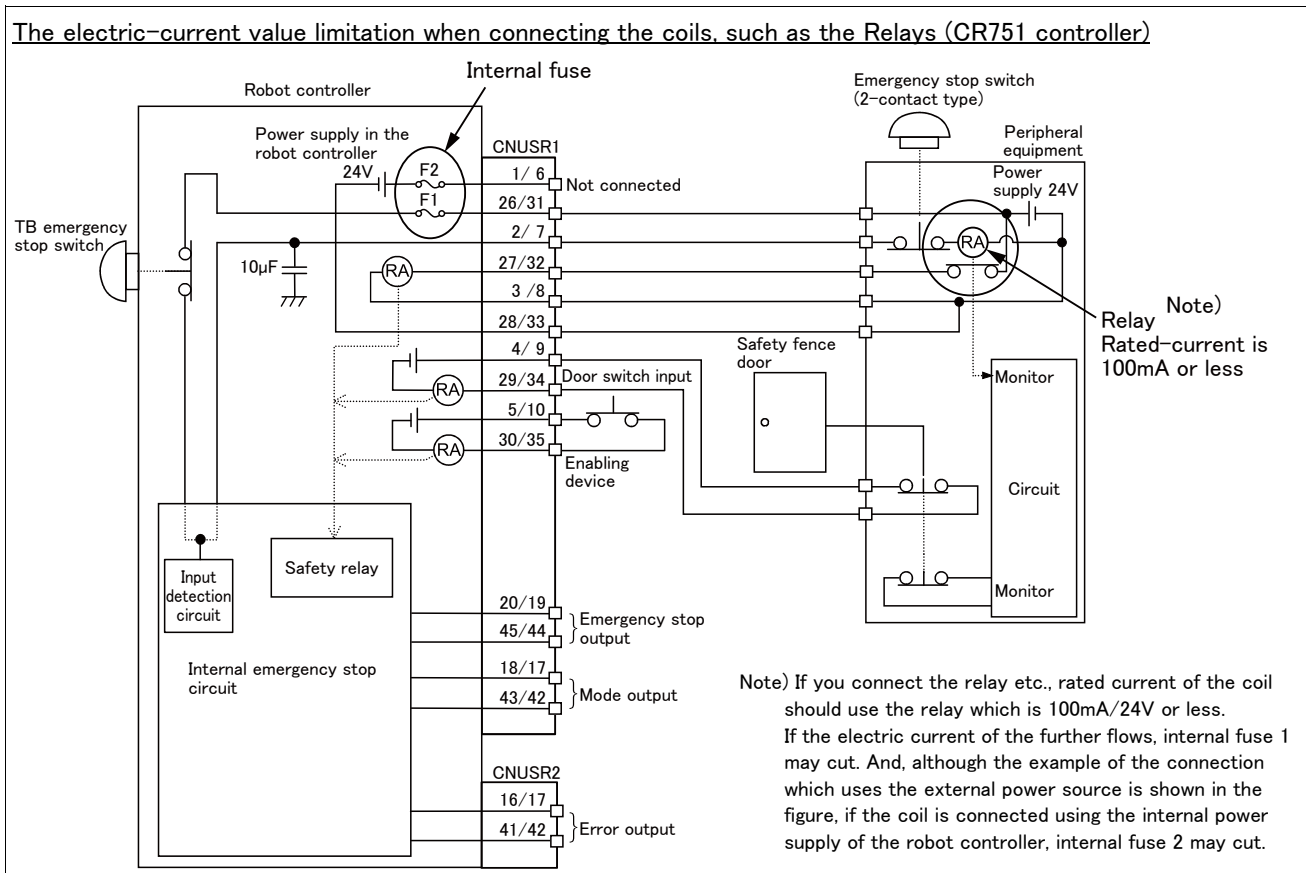


Fig.6-6 : Limitations when connecting the relay etc. (CR751)

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

[Supplementary explanation regarding emergency stop circuit]

The controller's internal circuit is as shown in the below diagram. Be sure to build a circuit that properly shuts off the emergency stop detection relay when the emergency stop switch is pressed.

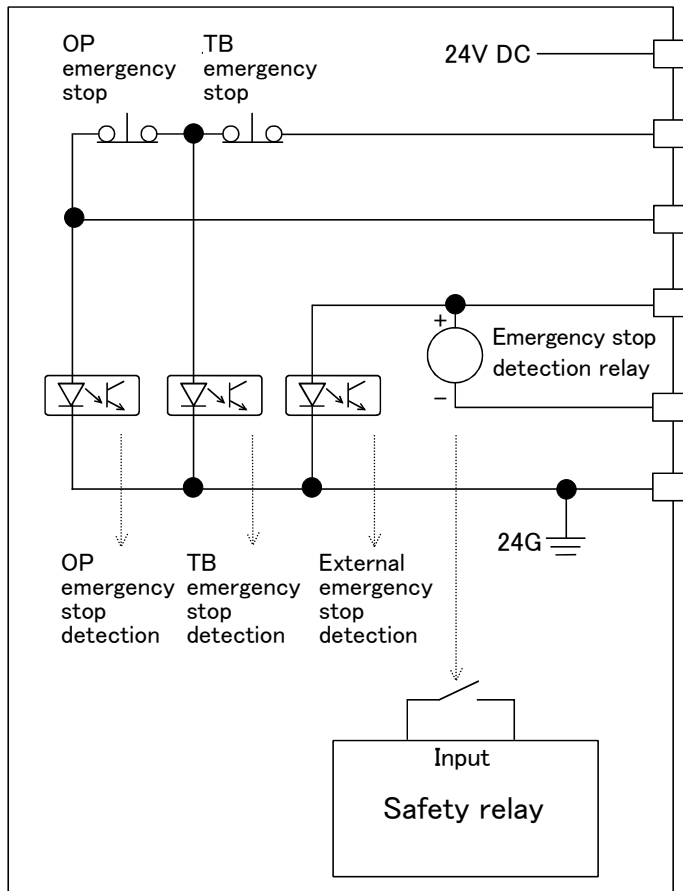


Fig.6-7 : Internal circuit of controller

⚠ CAUTION

Be sure to perform wiring correctly. If there are mistakes in the wiring, the robot may not stop when the emergency stop switch is pressed and there will be a risk of damage or personal injury occurring.

After wiring, be sure to press each of the installed emergency stop switches and check whether the emergency stop circuit works properly.

⚠ CAUTION

Be sure to duplicate connection of the emergency stop, door switch and enabling switch. If not duplicated, these functions may fail due to a broken relay used by customer, etc.

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 or overvoltage error may occur.

(2) Noise

- Where a surge voltage exceeding 2000V, 5kHz (equivalent to EN61000-4-4) 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 34 m/s² or less during transportation and 5 m/s² 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 J3 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 shaft section could interfere with the base section. Take care to prevent interference during jog. ^{*1)}
- (4) The robot arm consists of precision parts such as bearing. Lubricants such as grease are also applied on the moving parts to keep the mechanical accuracy. In a cold start under low temperature or in the first start after being stored for one month or longer, lubricants may not be spread enough. Such condition may lower the positioning accuracy, cause servo and overload alarms, and early wearing of the moving parts. To avoid such situation, perform warm-up operation of the machine at a low speed (at about 20% of normal operation speed). Move the robot arm from the lower to the upper limit of the movable range with the 30 degree joint angle or more for about 10 minutes. After that, speed up the operation gradually.
Please use the warm-up operation. (About the details of the warm-up operation, refer to the separate volume "Detailed Explanation of Functions and Operations".)
- (5) When the air hoses and cables are used inside the shaft (J3 axis), the grease for cable protection may ooze out or abrasion powders may be generated from the tip of the shaft while the robot is moving. However, movements and performance of the robot are not affected. Wipe off the grease or powders as required.

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

- (6) The robot arm and controller must be grounded with 100Ω or less (class D grounding) to secure the noise resistance and to prevent electric shocks.
- (7) The items described in these specifications are conditions for carrying out the periodic maintenance and inspections described in the instruction manual.
- (8) 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 machine cables (flexed type) with the factory default special specification.
- (9) 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.
- (10) Do not attach a tape or a label to the robot arm and the controller. If a tape or a label with strong adhesive power, such as a packaging tape, is attached to the coated surfaces of the robot arm and controller, the coated surface may be damaged when such tape or label is peeled off.
- (11) If the robot is operated with a heavy load and at a high speed, the surface of the robot arm gets very hot. It would not result in burns, however, it may cause secondary accidents if touched carelessly.
- (12) Do not shut down the input power supply to stop the robot. If the power supply is frequently shut down during a heavy load or high-speed operation, the speed reducer may be damaged, backlash may occur, and the program data may be destroyed.
- (13) During the robot's automatic operation, a break is applied to the robot arm when the input power supply is shut down by a power failure, for instance. When a break is applied, the arm may deviate from the operation path predetermined by automatic operation and, as a result, it may interfere with the mechanical stopper depending on the operation at shutdown. In such a case, take an appropriate measure in advance to prevent any dangerous situation from occurring due to the interference between the arm and peripheral devices.
Example) Installing a UPS (uninterruptible power supply unit) to the primary power source in order to reduce interference.
- (14) Do not conduct an insulated voltage test. If conducted by mistake, it may result in a breakdown.
- (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 20 mm or more.
- (16) The United Nations' Recommendations on the Transport of Dangerous Goods must be observed for trans-border transportation of lithium batteries by air, sea, and land. The lithium batteries (ER6V, Q6BAT) used in Mitsubishi industrial robots contain lithium and fall under the definition.
When the lithium batteries are shipped for storage, etc., they will be classified as Class 9: Miscellaneous dangerous substances and articles. Please contact your transportation company and must provide appropriate transport safety measures as the customer's consignor.
- (17) If the air supply temperature (primary piping) used for the tool etc. is lower than ambient air temperature, the dew condensation may occur on the coupling or the hose surface.
- (18) Collision detection function is valid condition for both of automatic and jog operation at shipping.
So, the robot stops immediately if the robot's tool or arm interferes with a peripheral device, minimizing damage. Therefore, please use in the valid condition.
- (19) When fumigants that contain halogen materials such as fluorine, chlorine, bromine, and iodine are used for disinfecting and protecting wooden packaging from insects, they cause malfunction when entering our products. Please take necessary precautions to ensure that remaining materials from fumigant do not enter our products, or treat packaging with methods other than fumigation (heat method). Additionally, disinfect and protect wood from insects before packing products.

6.4 EMC installation guideline

6.4.1 Outlines

Industrial robots are one of the components of automation systems as well as main components. This section introduces methods and parts to ensure electromagnetic compatibility (EMC) in automation systems.

We test for EMC in the environment described in this manual, but the noise level varies depending on device types, layout, control panel structure, and wiring, etc. Please make final checks for EMC.

6.4.2 EMC

This technical standard regulates the following two items.

- (1) Emission (EMI : Electromagnetic Interference).....The capacity not to generate the disturbance noise which has a bad influence outside.
- (2) Immunity (EMS : Electromagnetic Susceptibility).....The capacity which does not malfunction for the disturbance noise from the outside.

Each contents are shown below.

Item	Name	Contents	Testing technical-standard number
Emission (EMI)	Radiative noise disturbance	The electromagnetic noise etc. which are emitted to environs.	EN61000-6-2 : 2005 EN61000-6-4 : 2007 EN62061:2005(Annex E)
	Electrical-conduction noise disturbance	The electromagnetism noise etc. which flow out of the power-supply line.	
Immunity (EMS)	Electrostatic discharge immunity test	The noise from the electrified human body.	
	Radiated, radio-frequency, electromagnetic field immunity test susceptibility test	The electromagnetism noise from the transceiver, the broadcasting station, etc.	
	Electrical fast transient burst immunity test	The relay noise or the electromagnetism noise etc. which are caused in power-supply ON/OFF.	
	Immunity to conducted disturbances induced radio-frequency fields	The electromagnetism noise etc. which flow in through the power source wire and the grounding wire.	
	Power frequency magnetic field immunity test	The electromagnetism noise with a power supply frequency of 50/60 Hz etc.	
	Voltage dips, short interruptions and voltage variations immunity test	The noise in the variation of the source voltage of the power dispatching, etc.	
	Surge immunity test	The electromagnetism noise by the thunderbolt, etc.	

6.4.3 EMC measures

There are mainly following items in the EMC measures.

- (1) Store into the sealed metal board.
- (2) Grounding all the conductor that have floated electrically (makes the impedance low).
- (3) Wiring so that the power source wire and signal wire are separated.
- (4) Use the shield cable for the cable which wired outside of the metal board.
- (5) Install the noise filter.

To suppress the noise emitted out of the board, be careful of the following item.

- (1) Ensure grounding of the equipment.
- (2) Use the shield cable.
- (3) Separate the metal board electrically. Narrows the distance/hole.

The strength of electromagnetic noise emitted to environment is changed a lot by the shielding efficiency of cable and the distance of metal board, so it should be careful.

6.4.4 Concrete example for RH-3CH/6CH series

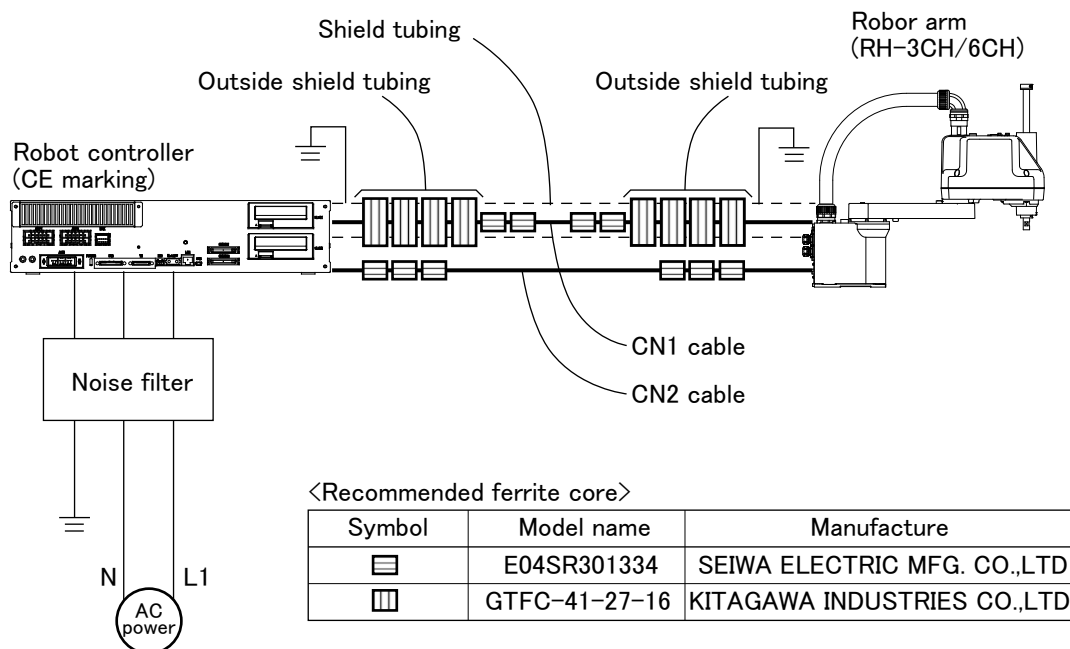


Fig.6-8 : EMC measures for RH-3CH/6CH

- 1) Install shield tubing on the CN1 cable and earth the both end of the shield tubing (robot controller side and robot arm side)

Recommended shield tubing

Manufacture: Zippertubing (Japan), Ltd.

Model name: MTFX-40

- 2) Attach ferrite cores to the CN1 cable and CN2 cable (see Fig. 6-8 for details).

- 3) Install noise filter to the power cable.

Recommended noise filter

Manufacture: OKAYA ELECTRIC INDUSTRIES CO., LTD

Model name: SUP-EL20-ER-6

6.4.5 Component parts for EMC measures

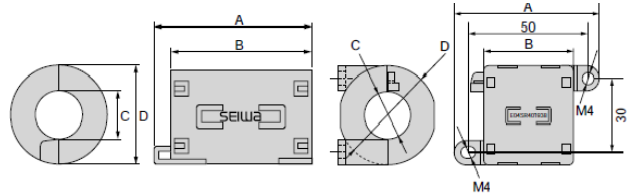
(1) Ferrite core

The ferrite core is mounted by the plastics case as one. It can attach by the one-touch, without cutting the cable. This has the effect in the common-mode noise. The measures against the noise are made not influential in the quality of the signal.

There are the following as an example.

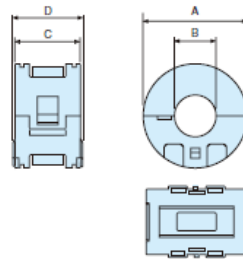
Maker: SEIWA ELECTRIC MFG. Co.,Ltd.

Type	Outside dimension (mm)				Diameter of the adaptation cable [max] (mm)
	A	B	C	D	
E04SR401938	61	38	19	40	19.0
E04SR301334	39	34	13	30	13.0



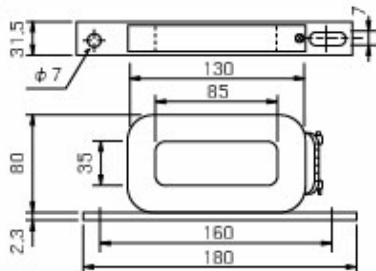
Maker: TAKACHI ELECTRONICS ENCLOSURE CO., LTD.

Type	Outside dimension (mm)				Diameter of the adaptation cable [max] (mm)
	A	B	C	D	
TFT-274015S	43.8	27.4	20.7	-	φ 26.5



(2) Line noise filter

Type : FR-BLF (Mitsubishi Electric Corp.)



7 Appendix

Appendix 1 : Classification of functions using external input/output signals

Before using the functions, note the following.

Table 7-1 : Classification of functions using external input/output signals

Classification	Function	Description
Safety signal	Emergency stop input	Detects emergency stop inputs. This function meets the requirements of category 3 and PL d.
	Door switch input	Receives the status of the switch installed on the door of the safety fence to detect the opening of the door.
	Enabling device input	This function checks the state of the switch on the enabling device.
Non-safety signal	Mode changeover switch input	Switches the controller mode between MANUAL and AUTOMATIC.
	Emergency stop output	Monitors whether the robot is in the emergency stop state.
	Mode output	Monitors whether the robot operates in MANUAL or AUTOMATIC mode.
	Robot error output	Monitors the error status of the robot.
	Magnet contactor control connector output for addition axes	Synchronizes the state of the additional axes (servo ON/OFF) with that of the robot arm. For details, refer to Page 69 , "3.9 Magnet contactor control connector output (AXMC) for addition axes".

mitsubishi electric corporation

HEAD OFFICE: TOKYO BLDG., 2-7-3, MARUNOUCHI, CHIYODA-KU, TOKYO 100-8310, JAPAN
NAGOYA WORKS: 1-14, YADA-MINAMI 5-CHOME, HIGASHI-KU, NAGOYA 461-8670, JAPAN