











Mitsubishi Electric Industrial Robot

CR800-D Controller


RV-8CRL Standard Specifications Manual


Safety Precautions


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


-  **CAUTION** All teaching work must be carried out by an operator who has received special training. (This also applies to maintenance work with the power source turned ON.)
Enforcement of safety training
-  **CAUTION** For teaching work, prepare a work plan related to the methods and procedures of operating the robot, and to the measures to be taken when an error occurs or when restarting. Carry out work following this plan. (This also applies to maintenance work with the power source turned ON.)
Preparation of work plan
-  **WARNING** Prepare a device that allows operation to be stopped immediately during teaching work. (This also applies to maintenance work with the power source turned ON.)
Setting of emergency stop switch
-  **CAUTION** During teaching work, place a sign indicating that teaching work is in progress on the start switch, etc. (This also applies to maintenance work with the power source turned ON.)
Indication of teaching work in progress
-  **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 given in the separate "Safety Manual" are given below.
Refer to the actual "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 multiple CPU system or the servo amplifier. Do not look directly at light emitted from the tip of SSCNET III connectors or SSCNET III cables of the Motion CPU or the servo amplifier. 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** 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 teaching box 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.

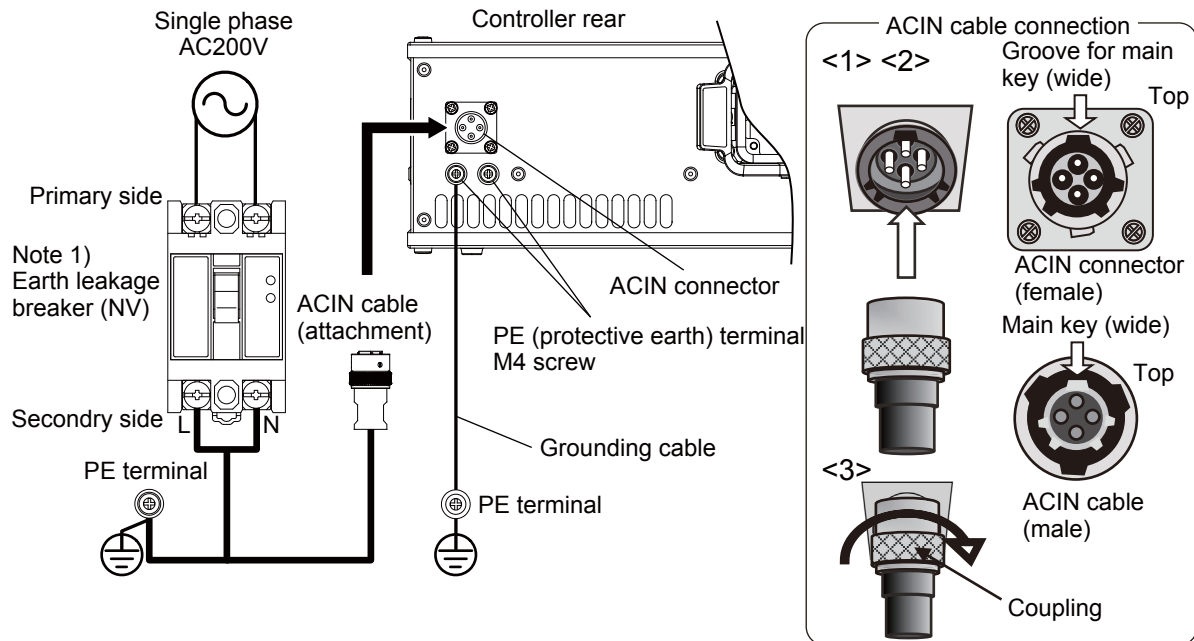
*1 DoS: A denial-of-service (DoS) attack disrupts services by overloading systems or exploiting vulnerabilities, resulting in a denial-of-service (DoS) state.

*CR800 controller

Notes of the basic component are shown.



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



Note 1) Always use the terminal cover for the earth leakage breaker.

1) Prepare the following items.

| Part name | Specifications | Remarks |
|--------------------------------|--|--|
| Earth leakage breaker | The following is recommended product. Single phase: NV30FAU-2P-10A-AC100-240V-30mA (Terminal cover: TCS-05FA2) | Prepared by customer. |
| Cable for primary power supply | AWG14 (2mm ²) or above | Prepared by customer. Tightening torque for terminal fixing screw is 2 to 3N•m. |
| Grounding cable | AWG14 (2mm ²) or above | Prepared by customer. Tightening torque for terminal fixing screw is 2 to 3N•m. |
| ACIN cable | Terminal: M5, cable length: 3m | Supplied with the product. |

- 2) Confirm that the primary power matches the specifications.
- 3) Confirm that the primary power is OFF and that the earth leakage breaker power switch is OFF.
- 4) Connect the ACIN cable to the breaker.
Connect the power terminals of the ACIN cable to the secondary side terminals of the earth leakage breaker. Also, ground the FG terminal of the cable.
- 5) Connect the ACIN cable to the ACIN connector on the rear of the controller.
 - <1> Face the main key on the ACIN cable plug upwards. (Refer to the "ACIN cable connection" illustration.)
 - <2> Align the main key of the ACIN cable plug with the grooves on the ACIN connector. Push the plug into the connector as far as it will go.
The plug may be damaged if it is not correctly aligned with the connector.
 - <3> Tighten the coupling on the ACIN cable, turning it to the right until it locks.
- 6) Connect one end of the grounding cable to the PE (protective earth) terminal on the controller and ground the other end (2-point grounding) in order to comply with the requirements of EN 61800-5-1 for the touch current of 3.5 mA AC or more.
- 7) Connect the primary power cable to the primary side terminal of the earth leakage breaker.

■Revision history

| Date of print | Specifications No. | Details of revisions |
|---------------|--------------------|---|
| 2019-06-24 | BFP-A3678 | <ul style="list-style-type: none"> • First print. |
| 2019-07-26 | BFP-A3678-A | <ul style="list-style-type: none"> • Added "External magnetic field" to "2.1 Standard specifications". • Added the procedure for enabling the safety diagnosis function (STO function). |
| 2019-10-31 | BFP-A3678-B | <ul style="list-style-type: none"> • Added additional information to the specifications of the S15. • The safety option (4F-SF002-01) is now available. • Deleted cycle time information. • Added "6.4 EMC installation guideline". • Added the model name of the sensor attachment adapter used for the force sensor set (4F-FS002H-W1000). • Revised "2.2.6 Protection specifications". • Amended the following: "Fig. 3-28: Specifications for the connection cable" "(4) MELSOFT RT ToolBox3/MELSOFT RT ToolBox3 mini/MELSOFT RT ToolBox3 Pro" • Added a figure to "2.1.2 The counter-force applied to the installation surface". |
| 2020-01-24 | BFP-A3678-C | <ul style="list-style-type: none"> • Corrected "Fig. 2-1: Positions of the centers of gravity for loads with relatively small volume". |
| 2020-10-30 | BFP-A3678-D | <ul style="list-style-type: none"> • Amended the precautions regarding the prevention of unauthorized access. • Added an example of a protective circuit. (Fig. 3-5) • Removed Windows XP and Windows Vista from the supported operating systems for RT ToolBox3, RT ToolBox3 mini, and RT ToolBox3 Pro. • Added information to the specifications of the earth leakage breaker. • Added precautions for vertical installation of the robot controller. • Corrected the battery name. (ER6 → ER6V) • Corrected other mistakes and changed some sections. |
| 2021-01-22 | BFP-A3678-E | <ul style="list-style-type: none"> • Revised "6.4 EMC installation guideline". |
| 2021-01-29 | BFP-A3678-F | <ul style="list-style-type: none"> • Updated contents for the optional product "MELFA-3D Vision 3.0 (3F-53U-WINM)". • Deleted the optional product "MELFA-3D Vision 2.0 (4F-3DVS2-PKG3)" and associated parts. |
| 2021-02-19 | BFP-A3678-G | <ul style="list-style-type: none"> • Added support for the Function expansion card option (2F-DQ510, 2F-DQ511, 2F-DQ520, 2F-DQ521). • Added support for RT ToolBox3 maintenance forecast function. |
| 2021-04-01 | BFP-A3678-H | <ul style="list-style-type: none"> • Elaborated on explanations on the STO function. |
| 2021-09-30 | BFP-A3678-J | <ul style="list-style-type: none"> • Corrected the explanation of the parameter "SRVON". • Added illustrations showing the installation position of ferrite cores. (Fig. 3-6) • Revised "(7) Parallel I/O interface". • Revised "(9) Parallel I/O unit". • Corrected the explanation of noise in "6.2 Working environment". • Corrected other mistakes and changed some sections. |
| | | |

■ Introduction

This series provides compact vertical multi-joint robots for use in machine processes and assemblies.

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 [Page 9, "2 Robot arm"](#), the specifications related to the controller [Page 30, "3 Controller"](#), and software functions and a command list [Page 95, "4 Software"](#) separately.

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

<Robot type>

- RV-8CRL

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1 General configuration

1.1 Structural equipment

Structural equipment consists of the following types.

1.1.1 Standard structural equipment

The following items are enclosed as a standard.

- 1) Robot arm
- 2) Controller
- 3) Machine cable
- 4) Robot arm installation bolts
- 5) CD-ROM (Instruction manual)

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. The customer needs to arrange for the installation.

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

RV - ◇ CR L - D - Sxx

(a) (b) (c) (d) (e) (f)

(a) RV Indicates the vertical multi-joint robot.

(b) ◇ Indicates the maximum load.
8: 8kg

(c) CR Indicates the CR series.

(d) L Indicates long arm type.

(e) D Indicates the controller type.
D: Stand alone type

(f) -Sxx Indicates a special model. In order, limit special specification.
S15: The parallel I/O interface installed on the controller is source type (2D-TZ378). It was originally sink type (2D-TZ368).

1.2.2 Combination of the robot arm and the controller

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

| Robot arm | | | | | Controller |
|-----------|-----------------------------|------------|----------|--------------------|------------|
| Type name | Protection specification | Arm length | Brake | Axial constitution | |
| RV-8CRL | IP rating ^{Note1)} | Long arm | All axes | 6-axis type | CR800-CVD |


Note1) This robot arm's protective structure is IP65. The protective structure of all the controllers is IP20 (open type). To protect a controller, use the optional controller protection box (IP54).

1.3 Contents of the structural equipment

1.3.1 Robot arm

The list of structural equipment is shown in below.

6-axis vertical multi-joint robot (RV-8CRL)



* Refer to [Page 9, "2.1 Standard specifications"](#) for details on the specifications.

Machine cable
(Fixed type: 5m)

Machine cable (replaceable type)

- Fixed type: 1F-□□UCBL-43
- Flexed type: 1F-□□LUCBL-43

Note 1)□□ refer the length.
Refer to [Table 1-2](#) for details.

Note 2) Replace the enclosed standard cable with this cable.

[Caution]

Standard configuration equipment

Option

Fig.1-1: Structural equipment

1.3.2 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".)

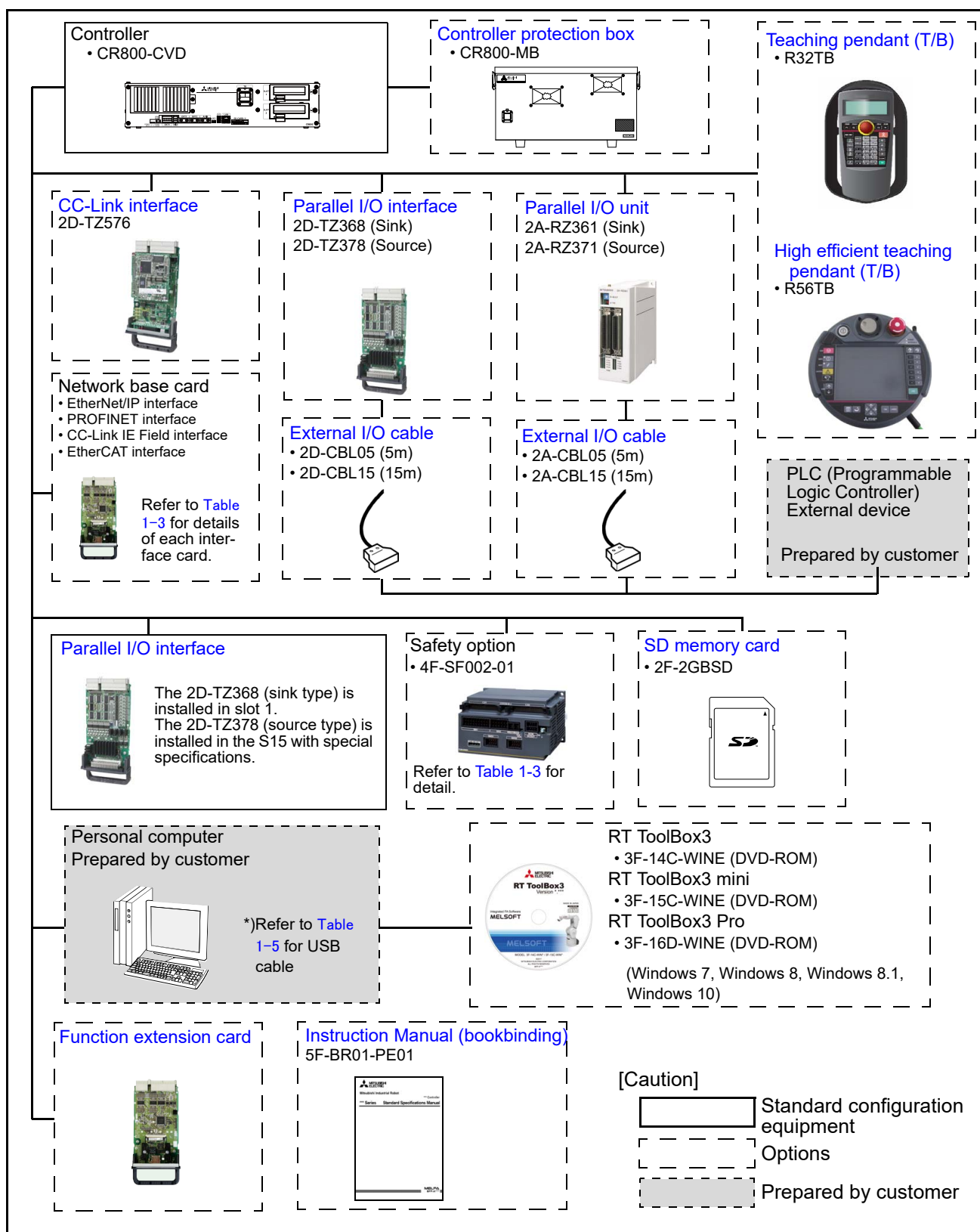


Fig.1-2: Structural equipment

1.3.3 Function extension device

These devices (option) are used to extend the function of the robot.

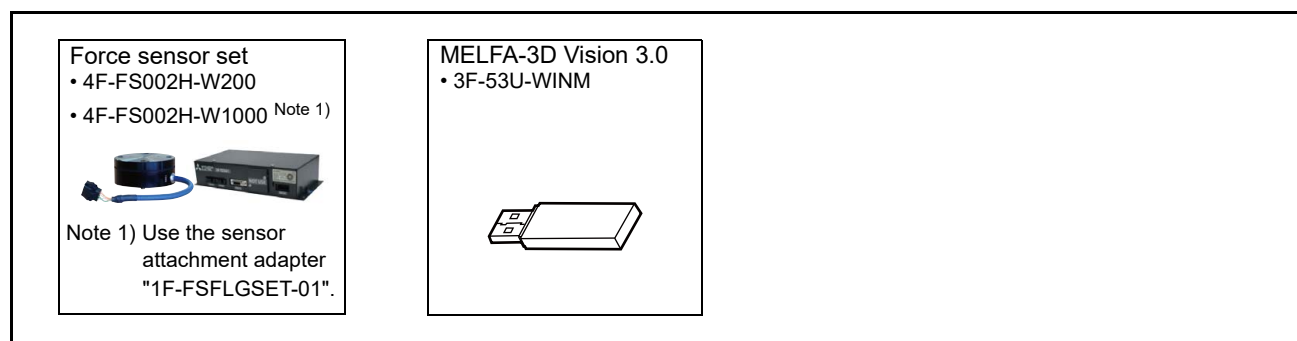


Fig.1-3: Function extension device

1.4 Contents of the Option equipment and special specification

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

1.4.1 List of the robot arm option equipment and special specification

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

| Item | Type | Specifications | Classification Note1) | Description |
|-------------------------------------|---------------|----------------|--------------------------|--|
| Machine cable (replaceable type) | 1F-□□UCBL-43 | For fixing | ○ | "□□" in type shows the length of the cables as follows. 10=10m, 15=15m, 20=20m (The standard cable is 5 m long.) |
| | 1F-□□LUCBL-43 | For flexing | ○ | "□□" in type shows the length of the cables as follows. 10=10m, 15=15m, 20=20m (The standard cable is 5 m long.) |

Note1) ○: option.

1.4.2 List of the controller option equipment and special specification

Table 1-3: The list of the controller option equipment and special specification

| Item | Type | Specifications | Classification Note1) | Description |
|--|---|--|--------------------------|---|
| Simple teaching pendant | R32TB | Cable length 7m | ○ | With 3-position enable switch IP65 |
| | R32TB-15 | Cable length 15m | ○ | |
| Highly efficient teaching pendant | R56TB | Cable length 7m | ○ | |
| | R56TB-15 | Cable length 15m | ○ | |
| Parallel I/O Interface | 2D-TZ368(Sink type)/ 2D-TZ378(Source type) | DO: 32 point DI: 32 point Insulated type output signal (0.1A/24V /point) Insulated type input signal (9mA/ 24V /point) | ○ | The card type external input-and-output. Interface. Install to the slot of controller. The 2D-TZ368 (sink type) is installed in SLOT1 of the robot controller from the factory. The 2D-TZ378 (source type) is installed in the S15 with special specifications. |
| External I/O cable (For Parallel I/O Interface) | 2D-CBL05 | 5m | ○ | Use to connect the external peripheral device to the parallel input/output interface. |
| | 2D-CBL15 | 15m | ○ | |
| Parallel I/O Unit | 2A-RZ361(Sink type)/2A-RZ371(Source type) | DO: 32 point/ DI: 32 point Insulated type output signal (0.1A/24V /point) Insulated type input signal (7mA/ 24V /point) | ○ | The unit for expansion the external input/output. |
| External I/O cable (For Parallel I/O Unit) | 2A-CBL05 | 5m | ○ | Use to connect the external peripheral device to the parallel input/output unit |
| | 2A-CBL15 | 15m | ○ | |
| CC-Link interface | 2D-TZ576 | Only Intelligent device station, Local station | ○ | For MELSEC PLC with CC-Link connection. |
| Network base card (EtherNet/IP interface) | 2D-TZ535 | Communication interface for mounting the Anybus CompactCom module manufactured by HMS. The customer needs to prepare the EtherNet/IP module (AB6314) manufactured by HMS. | ○ | Refer to separate volume "Network Base Card Instruction Manual" for details. |
| Network base card (PROFINET interface) | 2D-TZ535-PN | Communication interface for mounting the Anybus CompactCom module manufactured by HMS. The customer needs to prepare the PROFINET IO module (AB6489-B) manufactured by HMS. | ○ | Refer to separate volume "Network Base Card Instruction Manual" for details. |
| Network base card (CC-Link IE Field interface) | 2F-DQ535 | Communication interface for mounting the Anybus CompactCom module manufactured by HMS. The customer needs to prepare the CC-Link IE Field module (AB6709) manufactured by HMS. | ○ | Refer to separate volume "Network Base Card Instruction Manual" for details. |

| Item | Type | Specifications | Classification Note1) | Description |
|---|--------------|--|--------------------------|--|
| Network base card (EtherCAT interface) | 2F-DQ535-EC | Communication interface for mounting the Anybus CompactCom module manufactured by HMS. The customer needs to prepare the EtherCAT module (AB6607) manufactured by HMS. | ○ | Refer to separate volume "Network Base Card Instruction Manual" for details. |
| Function extension card | 2F-DQ510 | MELFA Smart Plus card pack (A-type) | ○ | Item to enable the software extension function MELFA Smart Plus. Software version of controller: Ver. A5p or later. |
| | 2F-DQ520 | MELFA Smart Plus card pack (AB-type) | ○ | |
| | 2F-DQ511 | MELFA Smart Plus card (A-type) | ○ | |
| | 2F-DQ521 | MELFA Smart Plus card (B-type) | ○ | |
| SD memory card | 2F-2GBSD | Memory card capacity 2GB. | ○ | - |
| Safety option | 4F-SF002-01 | Item to support the safety I/O. | ○ | Refer to separate volume "Robot Safety Option Instruction Manual" for details. |
| Controller protection box | C800-MB | IP54 | ○ | The controller protection box is used to protect the controller from an oilmist or other operating environment. |
| RT ToolBox3 | 3F-14C-WINE | DVD-ROM | ○ | Windows 7, Windows 8, Windows 8.1, Windows 10 Supporting English. (With the simulation function) |
| RT ToolBox3 mini | 3F-15C-WINE | DVD-ROM | ○ | Windows 7, Windows 8, Windows 8.1, Windows 10 Supporting English. |
| RT ToolBox3 Pro | 3F-16D-WINE | DVD-ROM | ○ | Windows 7, Windows 8, Windows 8.1, Windows 10 Supporting English. |
| Instruction Manual | 5F-BR01-PE01 | RV-8CRL | ○ | - |

Note1) ○: option.

1.4.3 Function extension device

Table 1-4: The list of function extension device

| Item | Type name | Specifications | Classification Note1) | Remarks |
|---------------------|-----------------------------------|---|--------------------------|---|
| Force sensor set | 4F-FS002H-W200 | A set of devices necessary for force sense control function, such as a force sensor, an interface unit, and support software. | ○ | Refer to separate volume "Force Sense Function Instruction Manual" for details. |
| | 4F-FS002H-W1000 ^{Note2)} | | | |
| MELFA-3D Vision 3.0 | 3F-53U-WINM | Software that connects a compact 3D vision sensor for robots to measure and recognize parts. | ○ | Refer to separate volume "MELFA-3D Vision 3.0 Instruction Manual" for details. |

Note1) ○: option.

Note2) Use the sensor attachment adapter "1F-FSFLGSET-01".

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

Table 1-5: Recommendation article of the USB cable

| Name | Type name | Supplier | Outside dimensions |
|---|----------------|--|--------------------------|
| USB cable (USB A type-USB mini B type) | GT09-C30USB-5P | MITSUBISHI ELECTRIC SYSTEM & SERVICE CO., LTD. | Fig. 1-4 |
| | MR-J3USBCBL3M | MITSUBISHI ELECTRIC CO., LTD. | Fig. 1-5 |

⚠ 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.

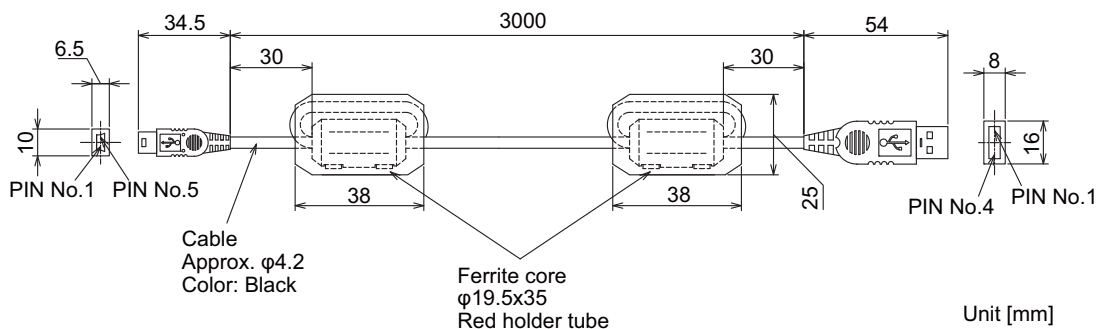


Fig.1-4: USB cable (GT09-C30USB-5P)

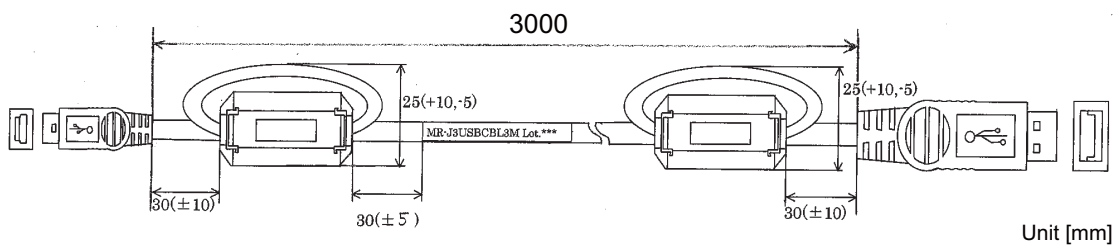


Fig.1-5: USB cable (MR-J3USBCBL3M)

2 Robot arm

2.1 Standard specifications

2.1.1 Basic specifications

Table 2-1: Standard specifications of RV-8CRL robot

| Item | | Unit | Specifications |
|--|---------------------------|-------------------|--|
| Type | | | RV-8CRL |
| Environment | | | Oil mist specification |
| Degree of freedom | | | 6 |
| Installation posture | | | On floor, hanging, (against wall ^{Note1)}) |
| Structure | | | Vertical, multiple-joint type |
| Drive system | | | AC servo motor (brake provided on all axes) |
| Position detection method | | | Absolute encoder |
| Motor capacity | Waist (J1) | W | 600 |
| | Shoulder (J2) | | 750 |
| | Elbow (J3) | | 400 |
| | Wrist twist (J4) | | 100 |
| | Wrist pitch (J5) | | 100 |
| | Wrist roll (J6) | | 100 |
| Operating range | Waist (J1) | Degree | ±170 |
| | Shoulder (J2) | | ±110 |
| | Elbow (J3) | | +0 to +165 |
| | Wrist twist (J4) | | ±200 |
| | Wrist pitch (J5) | | ±120 |
| | Wrist roll (J6) | | ±360 |
| Speed of motion | Waist (J1) | Degree/s | 288 |
| | Shoulder (J2) | | 321 |
| | Elbow (J3) | | 360 |
| | Wrist twist (J4) | | 337 |
| | Wrist pitch (J5) | | 450 |
| | Wrist roll (J6) | | 720 |
| Maximum reach radius (P point) | | mm | 931 |
| Maximum resultant velocity ^{Note2)} | | mm/sec | 10,500 |
| Load | Rating | kg | 7 |
| | Maximum ^{Note3)} | kg | 8 |
| Pose repeatability ^{Note4)} | | mm | ±0.02 |
| Ambient temperature ^{Note5)} | | °C | 0 to 40 |
| Mass | | kg | 41 |
| Allowable moment load | Wrist twist (J4) | N·m | 16.2 |
| | Wrist pitch (J5) | | 16.2 |
| | Wrist roll (J6) | | 6.86 |
| Allowable inertia | Wrist twist (J4) | kg·m ² | 0.45 |
| | Wrist pitch (J5) | | 0.45 |
| | Wrist roll (J6) | | 0.10 |
| Tool wiring | | - | D-sub 15 pins |
| Tool pneumatic pipes | | - | φ6×2 |
| Supply pressure | | MPa | 0.54 |
| Protection specification ^{Note6)} ^{Note7)} ^{Note8)} | | - | IP65 |
| Painting color | | - | Light gray (Equivalent to Munsell: 0.6B7.6/0.2, PANTONE: 428C) |
| External magnetic field | | mT | Less than 10 |

Note1) When used by mounting on the wall, a special specification that limits the operating range of the J1 axis will be used. Please give an order separately.

Note2) This is the value on the mechanical interface surface when all axes are combined.

Note3) Allowable load when the mechanical interface faces downward at an inclination within ±10° to the vertical direction.

Note4) The pose repeatability details are given in [Page 11, "2.2.1 Pose repeatability"](#)

Note5) 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.)

Note6) The protection specification details are given in [Page 14, "2.2.6 Protection specifications"](#).

Note7) The protection performance may not be ensured depending on the oil characteristics. Please consult the dealer.

Note8) If the controller is used in oil mist or similar environments, use the controller protection box to protect the controller from the environment.

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.

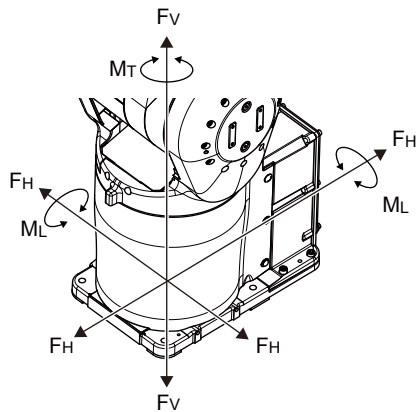


Table 2-2: Value of each counter-force

| Item | Unit | Value |
|-------------------------------------|------|-------|
| Falls moment: M_L | N•m | 900 |
| Torsion moment: M_T | N•m | 900 |
| Horizontal translation force: F_H | N | 1,000 |
| Vertical translation force: F_V | N | 1,700 |

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 Rated load (mass capacity)

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

- (1) The tooling should have the value less or equal than the smaller of the allowable inertia and the allowable moment found in [Page 9, "2.1.1 Basic specifications"](#).
The examples of inertia calculation methods are described in [Page 113, "Appendix 1: Inertia calculation method"](#).
- (2) [Fig. 2-1](#) shows the distribution dimensions for the positions of the centers of gravity for loads with relatively small volume. Refer to the figure for designing tooling.
- (3) Even if the load is force, not the mass, design the tooling so that moment does not exceed the allowable moment. Refer to [Page 9, "2.1 Standard specifications"](#) for details of allowable moment value.

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

[Caution] The overhang amount of the load, 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.

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

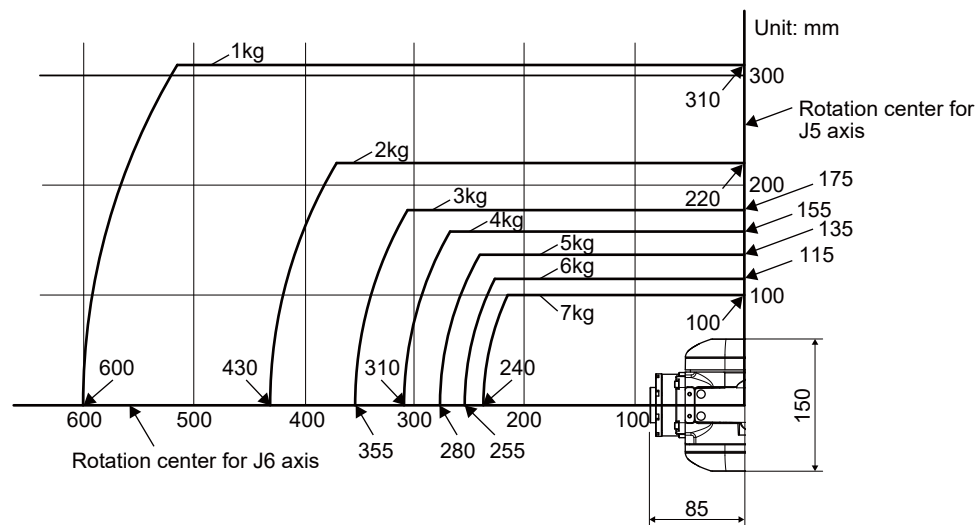


Fig.2-1: Positions of the centers of gravity for loads with relatively small volume

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

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

To achieve that, it is necessary to correctly set the actual load data (mass and size of hand and work) to be used. However, vibration, overheating and errors such as excessive margin of error and overload may occur, depending on the robot operation pattern or ambient temperature. In such a case, change the setting value to the +20% range.

If a setting is performed in such a way that it falls below the mounted load, the life span of the mechanism elements used in the robot may be shortened.

(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 settings>

| | Hand mass | Size X | Size Y | Size Z | Center-of-grav- ity position X | Center-of-grav- ity position Y | Center-of-grav- ity position Z |
|-----------|-----------|--------|--------|--------|-----------------------------------|-----------------------------------|-----------------------------------|
| | [kg] | [mm] | [mm] | [mm] | [mm] | [mm] | [mm] |
| HNDDAT* = | 8.0 | 100.0 | 100.0 | 100.0 | 0.0 | 0.0 | 155.0 |
| WRKDAT* = | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

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

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

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

2.2.5 Collision detection

This series have the "collision detection function" which detects the abnormalities by the collision of the robot arm, however initial setting is in invalid condition.

The enable/disable of this function can be changed by parameter: COL and command: ColChk, this function is effective for protect 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 2-3: Factory-shipments condition

| | JOG operation | Automatic |
|---------|---------------|-----------|
| RV-8CRL | Invalid | Invalid |

2.2.6 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 2-4](#).

Table 2-4: Protection specifications and applicable fields

| Type | Protection specifications (IEC Standards value) | Classification | Applicable field | Remarks |
|--------------------|--|-------------------------|---|---|
| RV-8CRL | IP65 | Oil mist specifications | Machine tool (cutting) | Note that if the cutting machine is using abrasive materials, the robot's life will be shortened. |
| RV-7FRLM (example) | IP67 | | Machine shop with heavy oil mist Dusty work shop | |



CAUTION Use the controller protection box to protect the controller from the environment when the controller will be used in the environment such as the oil mist shown in the [Table 2-4](#).

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 IP65

Protection against water infiltration as specified in IP65 indicates a protective structure that is not harmfully affected when 12.5±5% liters of water is supplied from a test device at a position approx. 3m away in various directions and a water pressure of 30kPa at the nozzle section. The water is filled one minute per 1m² of test device surface area for a total of three minutes.

- The IEC IP67

Protection against water infiltration as specified in IP67 indicates a protective structure that is not harmfully affected, even if the test device dives underwater for the 30 minutes. The diving depth is shown below. When the height of the test device is less than 850 mm, the position of the lowest part is 1 m from the water surface.

When the height of the test device is 850 mm or more, the position of the highest part is 150 mm from the water surface.

(2) About the use with the bad environment

This robot has protection methods that conform to IEC IP65 standards.

Usage conditions are shown below.

- 1) The robot is designed for use in combination with machining device.
- 2) We have confirmed that the robot arm meets the protection specifications by testing it using our specified cutting oil. However, the parts of the controller may be damaged by the cutting oil. When using the controller in an oil mist environment, always use the controller protection box. Our warranty does not cover damages or failure resulting from the robot being operated in any environment where other cutting oils than those listed in the table are used (except cutting oils with respect to which the robot's compatibility with the protection specification is verified through our operability evaluation) or where the robot body may be directly splashed with water, oil or dust in quantities larger than stated in the protection specification.
- 3) Take measures so that the robot will not be exposed to water, oil and/or chips for a long period of time.

Also, entrained water droplets lead to the formation of rust on the robot, but would not usually affect the robot's ability to operate normally.

The warranty is invalid for any faults that occur when the robot is used under the following conditions.

Also, if the cover and/or other parts are damaged by interferences caused by the peripheral devices and the robot, the protection specification (seal performance, etc.) may be degraded. Therefore, please pay extra attention when handling the robot.

Refer to [Page 109, "6.2 Working environment"](#).

- 1) In surroundings that generate inflammable gases or corrosive gasses.
- 2) Atmosphere of the mist containing polish liquid etc.
- 3) Atmosphere in which the water, the oil, and the dust exceeding protection specification fall on the robot arm directly.

2.3 Names of each part of the robot

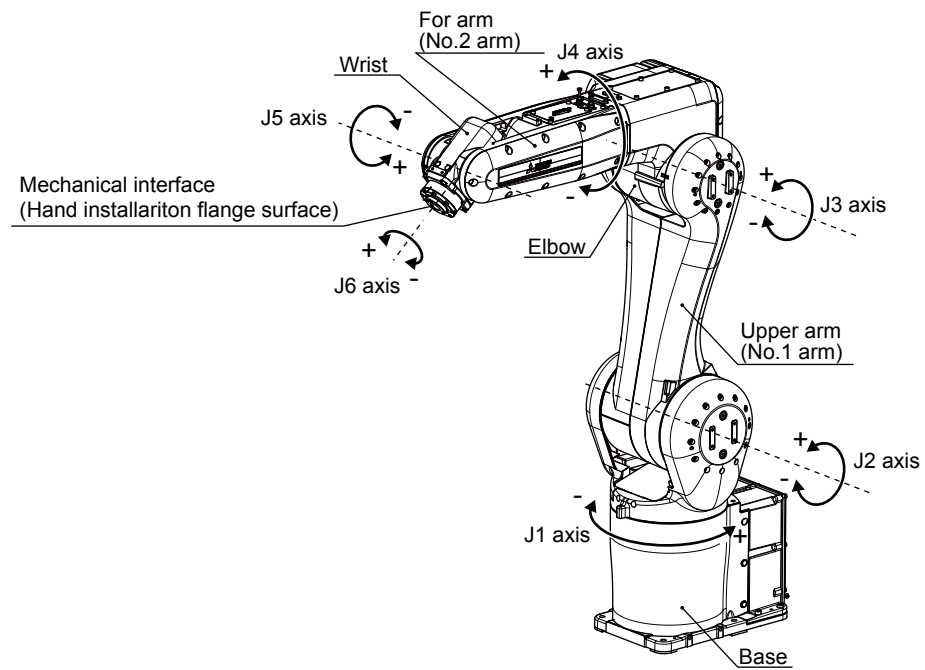
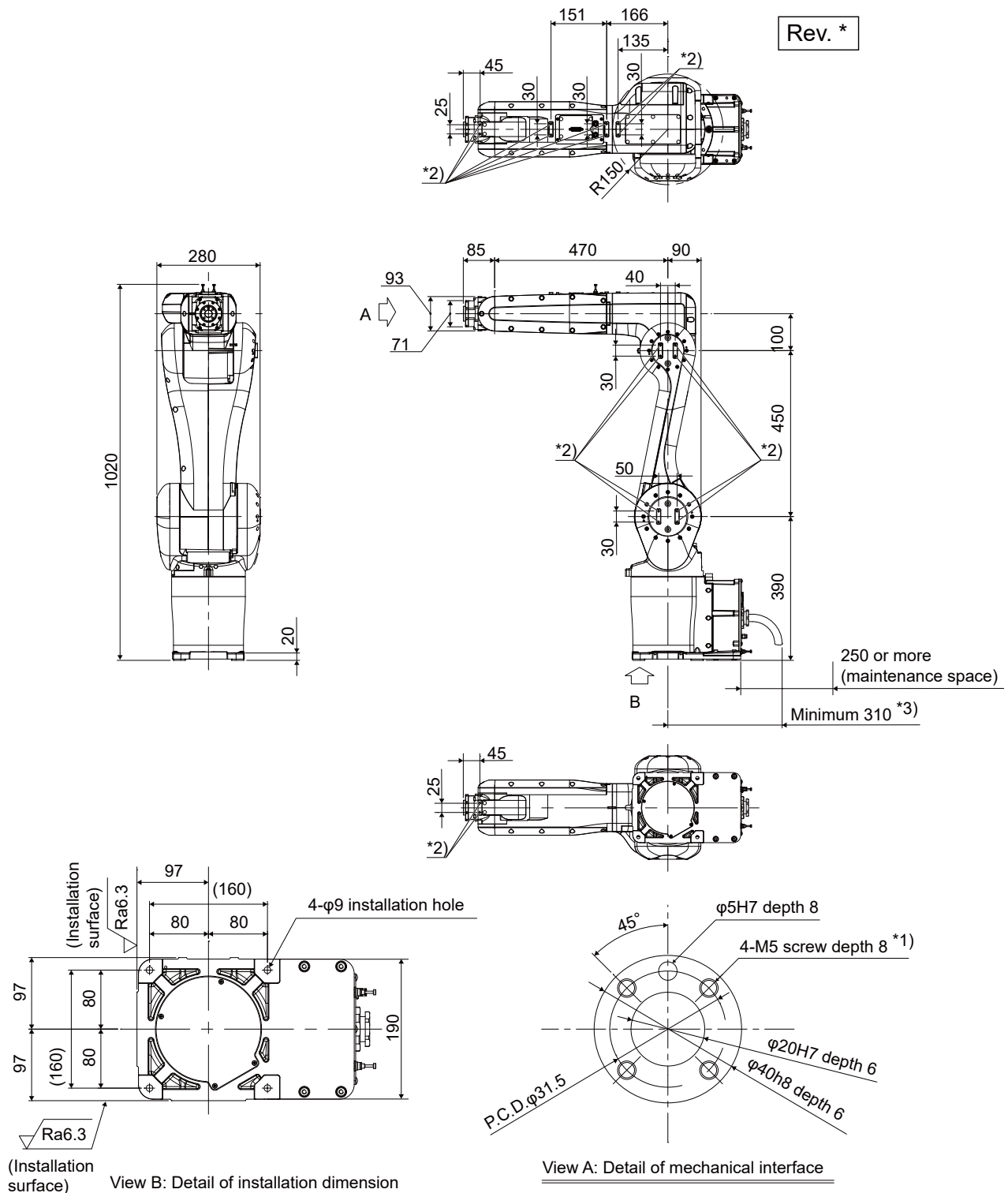


Fig.2-2: Names of each part of the robot

2.4 Outside dimension • Operating range diagram



*1) The depth in which the screw is tightened is 7.5 to 8mm.

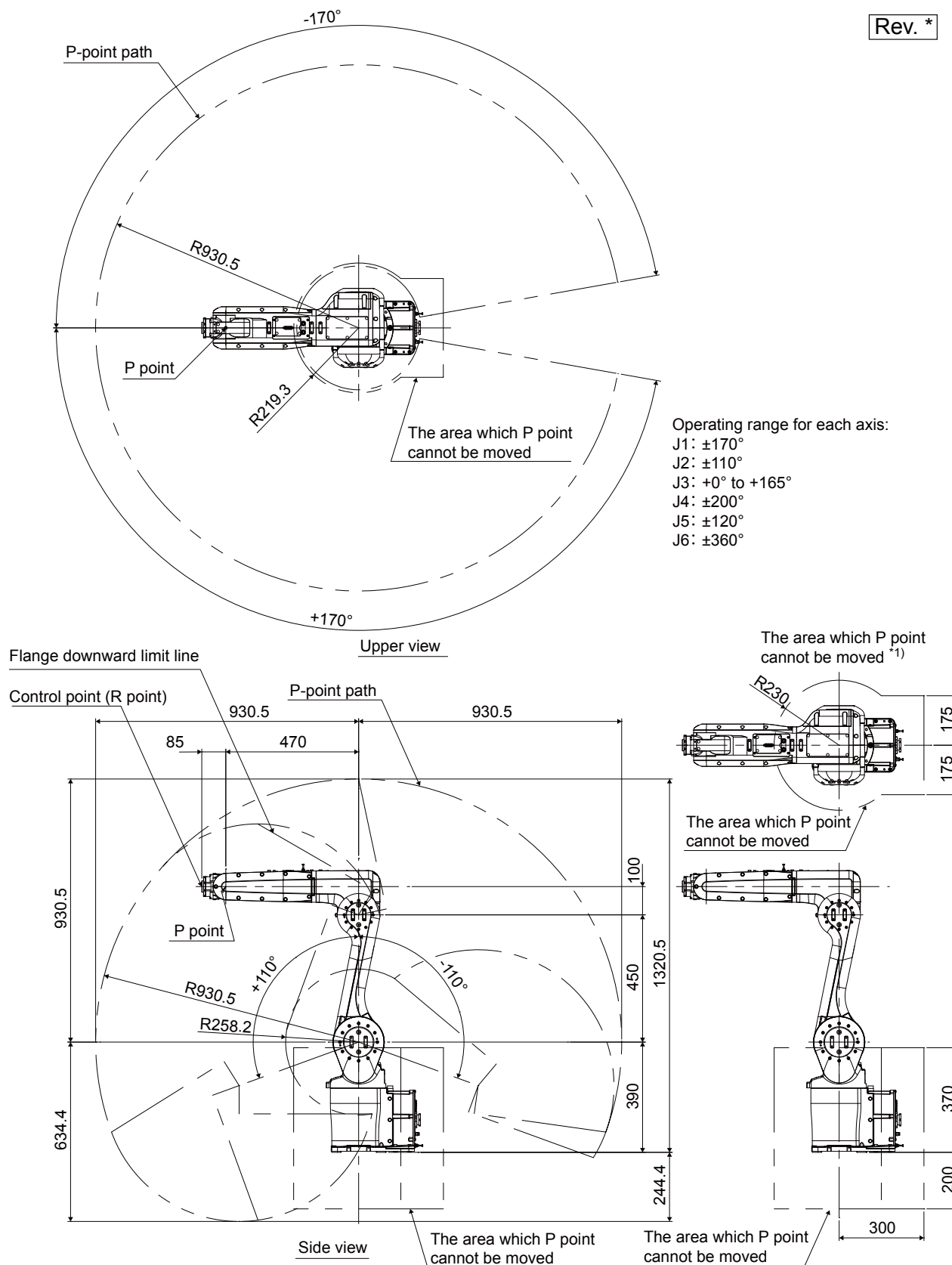
*2) Screw holes (M4, depth: 8) for securing the user wiring and piping.

*3) Dimensions including the minimum bending radius of the machine cable.

Fig.2-3: Outside dimensions

Note) Don't install the robot arm in the position where direct rays or the heat of lighting hits. The skin temperature of the robot arm may rise, and the error may occur.

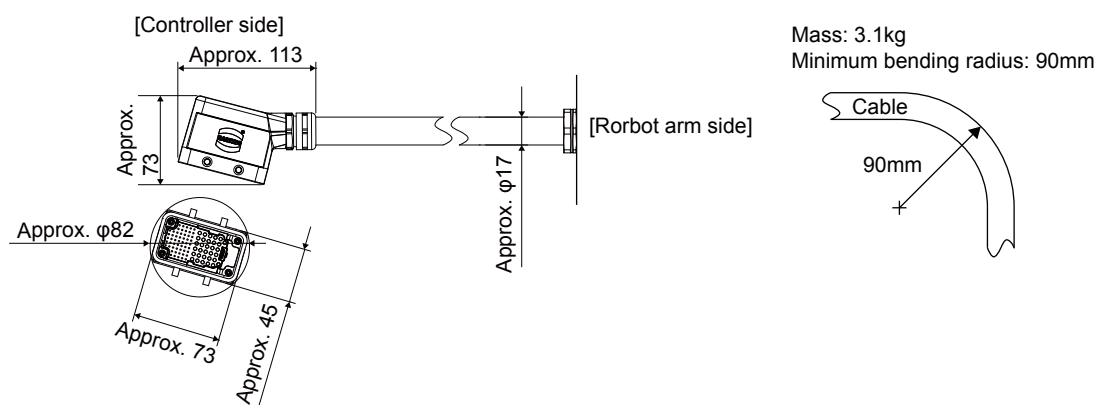
The following figure shows a robot at the position of:
 $J1=0^\circ$, $J2=0^\circ$, $J3=90^\circ$, $J4=0^\circ$, $J5=0^\circ$, and $J6=0^\circ$



*1) The area which P point cannot be moved: P point cannot move to this area. This limitation is valid at factory shipping, but it can be released by parameter MELTEXS.

Fig.2-4: Operating range diagram

2.4.1 Outside dimensions of machine cables



Note) When using machine cables (replaceable type), refer to [Page 25, "\(1\) Machine cable \(replaceable\): Fixed type"](#) for the cable diameter.

2.5 Tooling

2.5.1 Wiring and piping for hand

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

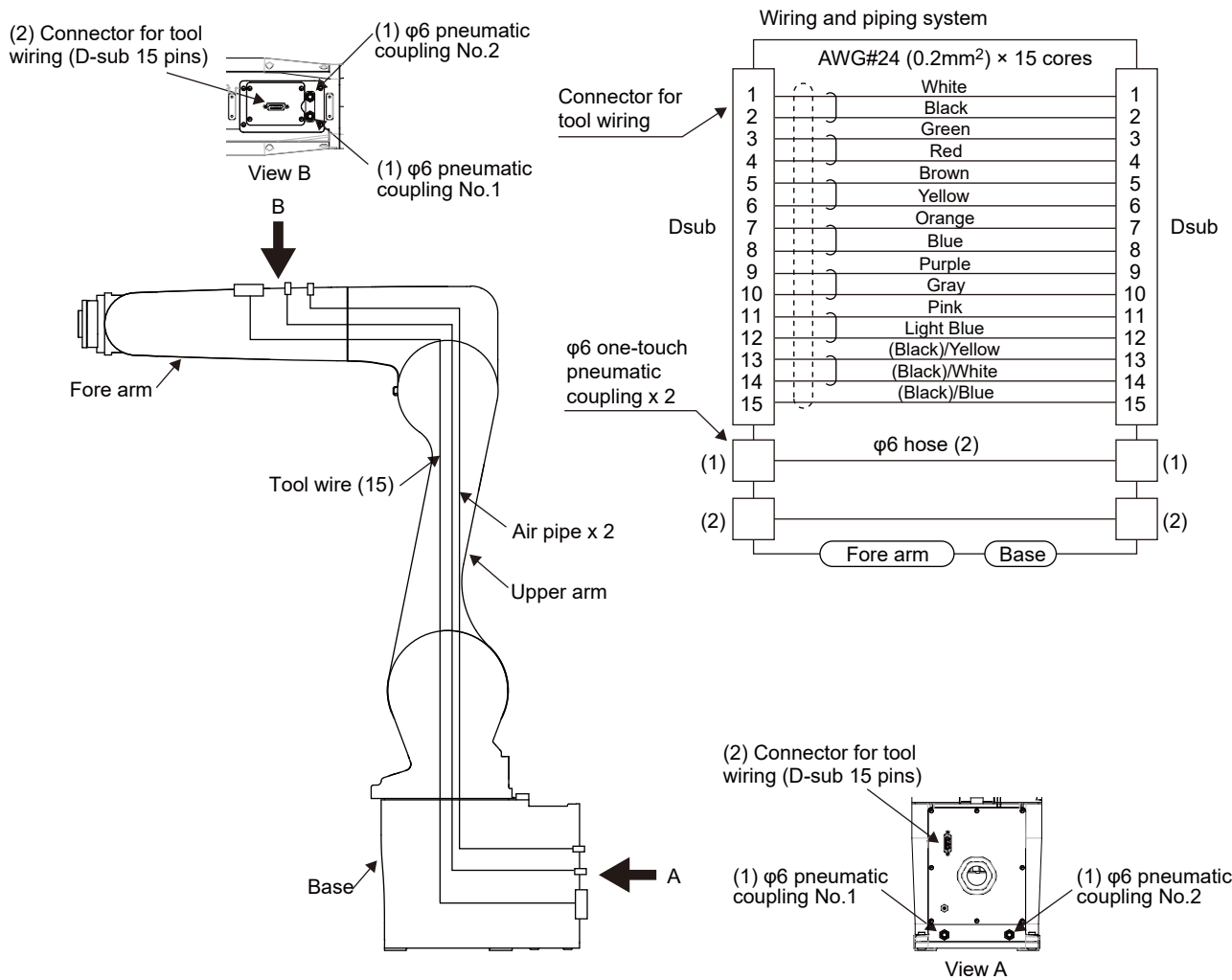


Fig.2-5: Wiring and piping for hand

Connector and pneumatic coupling

| No | Name | Qty. | Robot side (Robot arm side) | Counter side | Manufacturer | Remarks |
|-----|-----------|------|-----------------------------|--|--------------|------------------------------------|
| | | | Connectors, couplings | Connectors | | |
| (1) | Coupling | 4 | KQ2E06-00NJ | - | SMC | - |
| (2) | Connector | 2 | SDB-15PFFS-SL8001 | 15 pin D-sub connector (with hood) 17JE-23150-02(D8C)-CG (Jack screws: #4-40) | DDK | Enclosed No IP rating assigned. |

2.5.2 Internal wiring and piping

The robot has two $\phi 6$ air hoses between the pneumatic inlet on the base and the top part of the forearm.
The hose end section has four coupling bridges for a $\phi 6$ hose on both the base and forearm side.

2.5.3 Internal wiring for the hand cable

The cables for the hand run from the base to the top part of the forearm (AWG #24 (0.2 mm^2) x 15 cores).
The cable ends in connectors as a bridge of data.

Allowable current: 1A

Allowable voltage: 24V

2.5.4 Air supply circuit example for the hand

An example of pneumatic supply circuitry for the hand is shown below.

- 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. 2-6 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.

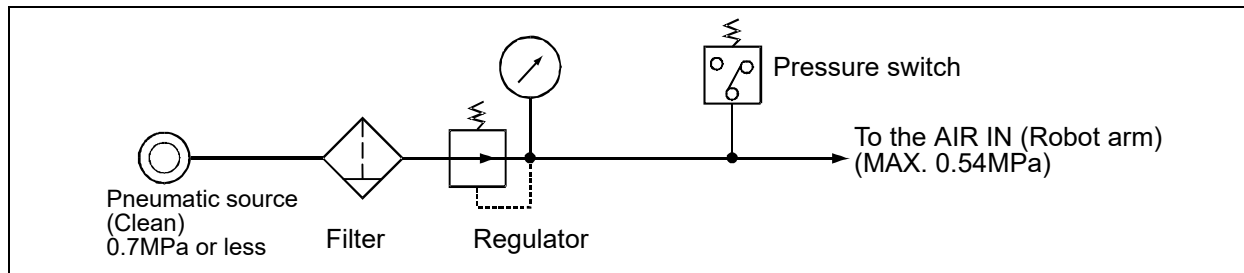


Fig.2-6: Air supply circuit example for the hand

2.5.5 About the Installation of Tooling 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 [Page 17](#), "2.4 Outside dimension • Operating range diagram".)

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 and set to parameter: HNDDAT. Moreover, Fix the parts, such as a solenoid valve, firmly to prevent the parts getting shaky during operation of a robot.
- Hand signals (900 to 907) are not available.

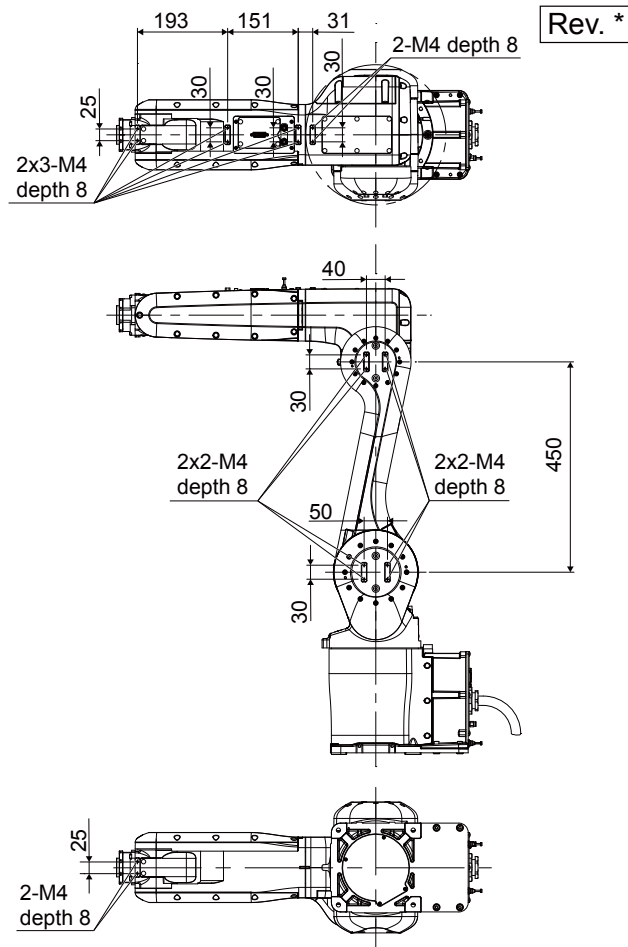


Fig.2-7: Location of screw holes for fixing wiring/piping

2.6 Options

■ What are options?

There are a variety of options for the robot designed to make the setting up process easier for customer needs.

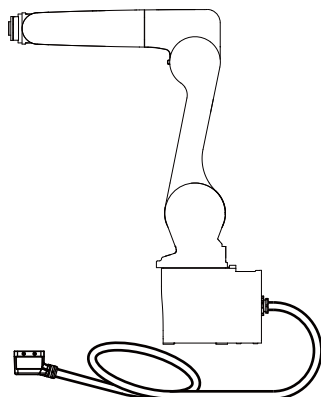
customer installation is required for the options.

(1) Machine cable (replaceable): Fixed type

■ Order type: • Fixed type 1F-□□UCBL-43

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

■ Outline



The fixed type machine cable can be used instead of the supplied one (5 m) to extend the distance between the controller and the robot.

■ Configuration

Table 2-5: Configuration equipment and types

| Part name | Type ^{Note1)} | Qty. | Mass (kg) ^{Note2)} | Remarks |
|--|------------------------|---------|--------------------------------------|----------------------|
| Fixed type machine cable (replaceable) | 1F-□□UCBL-43 | 1 cable | 5.4 (10m) 7.8 (15m) 10.1 (20m) | 10m, 15m or 20m each |
| Instruction Manual (cable replacement guide-lines) | BFP-A3691 | 1pc | - | - |

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

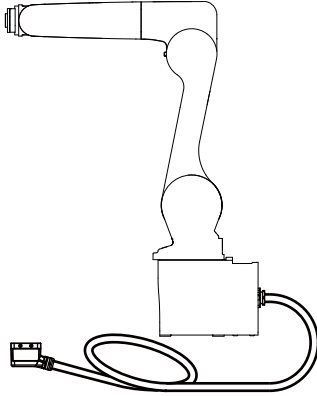
Note2) Mass indicates one set.

(2) Machine cable (replaceable): Flexed type

■Order type: ● Flexed type 1F-□□LUCBL-43

Note) The numbers in the boxes □□ refer the 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 (5m) with these cables.

■Configuration

Table 2-6: Configuration equipment and types

| Part name | Type ^{Note1)} | Qty. | Mass (kg) ^{Note2)} | Remarks |
|--|------------------------|---------|--|----------------------|
| Flexed type machine cable (replaceable) | 1F-□□LUCBL-43 | 1 cable | 11.1 (10m) 15.4 (15m) 19.8 (20m) | 10m, 15m or 20m each |
| Nylon clamp | NK-24N | 2 pcs. | - | - |
| Silicon rubber | - | 2 pcs. | - | - |
| Instruction Manual (cable replacement guide-lines) | BFP-A3691 | 1pc | - | - |

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

Note2) Mass indicates one set.

■Specifications

The specifications for the fixed type cables are the same as those for standard cables. Shows usage conditions for flexed type cables in [Table 2-7](#).

Table 2-7: Conditions for the flexed type cables

| Item | Specifications |
|-----------------------------------|--|
| Minimum flexed radius | 100mm or more |
| Cableveyor, etc., occupation rate | 50% or less |
| Maximum movement speed | 2,000mm/s or less |
| Guidance of life count | 7.5 million times (With silicone grease coating) |
| Environmental proof | IP54 |
| Cable configuration | φ8.9x3, φ6.5x6, φ6.2x4, φ6x2 |

[Caution] The guidance of life count may greatly differ according to the usage state items related to [Table 2-7](#) 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 flexible cable is shown in [Table 2-8](#). Refer to this table when selecting the cable.

Table 2-8: Cable configuration (Flexed type)

| Item | Motor signal cable | | Motor power cable | |
|--------------------|----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|
| | AWG #24 (0.2mm ²)-4P | AWG #28 (0.08mm ²)-4P | AWG #16 (1.25mm ²)-4C | AWG #18 (0.75mm ²)-3C |
| Finish dimensions | Approx. $\phi 6$ mm | Approx. $\phi 6.2$ mm | Approx. $\phi 8.9$ mm | Approx. $\phi 6.5$ mm |
| No. of cables used | 2 | 4 | 3 | 6 |
| No. in total | 6 | | 9 | |

■ Fixing the flexible cable

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

The connection method to a robot arm is the same as a standard machine cable. Please refer to the separate "Instruction Manual/ROBOT ARM SETUP & MAINTENANCE" and connect.

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

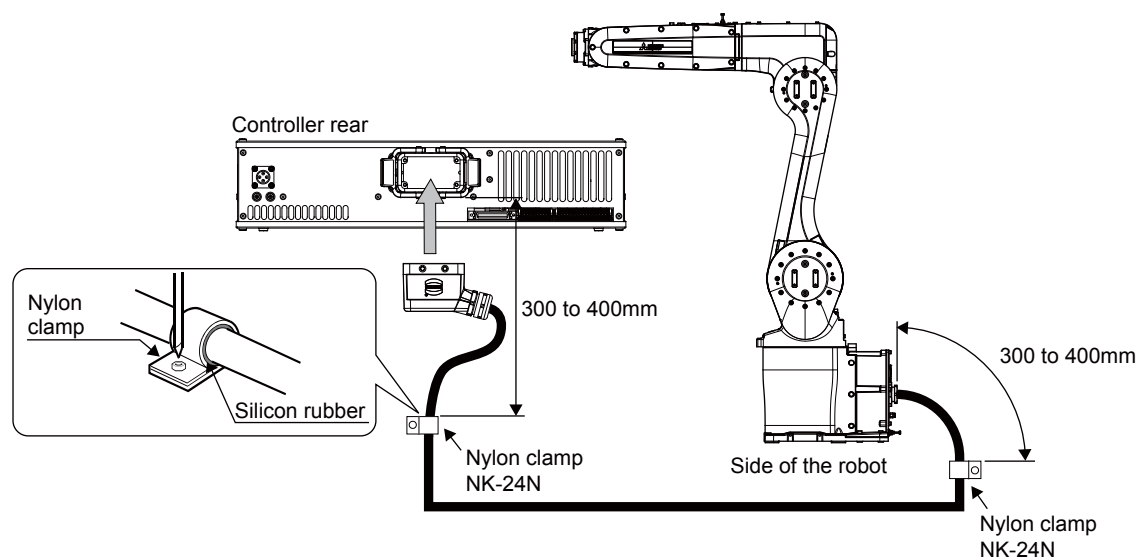


Fig.2-8: Fixing the flexible cable

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). 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.

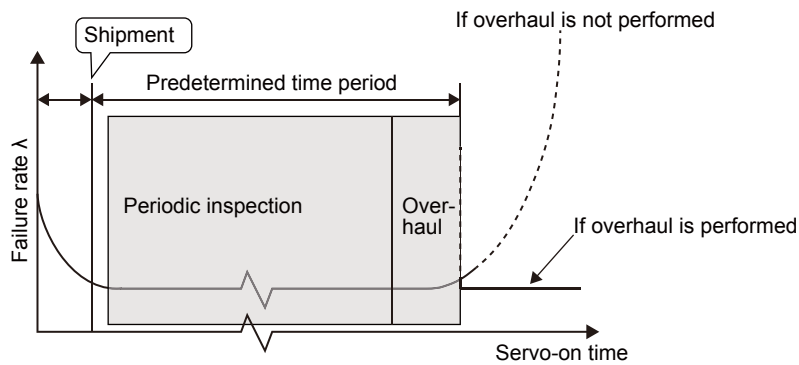


Fig.2-9: Periodic inspection/overhaul periods

2.8 Maintenance parts

A long-term use of industrial robots causes a malfunction due to wear or deterioration of their components, as well as general machines. To prevent such a malfunction and perform smooth operation of the robot for a long term, the regular maintenance, inspection, and replacement of consumable parts are required. Refer to "Maintenance and Inspection" in the separate manual "INSTRUCTION MANUAL/ROBOT ARM SETUP & MAINTENANCE" for details of the maintenance and inspection. The consumable parts used in the robot arm are shown in [Table 2-9](#). 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 2-9: Consumable part list

| No. | Part name | Type ^{Note1)} | Usage place | Qty. | Supplier |
|-----|-----------|------------------------|------------------------------|-----------|---------------------|
| 1 | Grease | - | Reduction gears of each axis | As needed | Mitsubishi Electric |

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

3 Controller

3.1 Standard specifications

3.1.1 Basic specifications

Table 3-1: Specifications of controller

| Item | | Unit | Specification | Remarks |
|--------------------------------------|--|---------|--|---|
| Type | | | CR800-CVD | Note1) |
| Number of control axis | | | Simultaneously 6 | Additional 8 axes available. |
| Memory capacity | Programmed positions | point | 39,000 | |
| | No. of steps | step | 78,000 | |
| | Number of program | | 512 | |
| Robot language | | | MELFA-BASIC V, VI | |
| Teaching method | | | Pose teaching method, MDI method ^{Note2)} | |
| External input and output | Input/output | point | 32/32 | 2D-TZ368 (sink type) is attached at the time of shipment. The 2D-TZ378 (source type) is installed from the factory in the S15 with special specifications. |
| | Dedicated input/output | | Assigned with general-purpose input/output | The signal number of "STOP" input signals is fixing. |
| | Emergency stop input ^{Note3)} | point | 1 (duplicated) | Note4) |
| | Emergency stop output | point | 1 (duplicated) | |
| | Mode selector switch input ^{Note5)} | point | 1 (duplicated) | |
| | Mode output | point | 1 (duplicated) | |
| | Robot error output | point | 1 (duplicated) | |
| | Additional axis synchronization output | point | 1 (duplicated) | |
| | Door switch input | point | 1 (duplicated) | |
| | Ecoder input | Channel | 2 | - |
| Interface | Additional axis, force sensor interface | Channel | 1 | SSCNET III/H (Connect with MR-J4-B series) |
| | Remote input/output | Channel | 1 | Compatible with Ver. 1.0/2.0 |
| | USB | port | 1 | Ver. 2.0 HighSpeed device functions only. USB mini-B |
| | Ethernet | port | 1 | For customer: 1000BASE-T/ 100BASE-TX/10BASE-T |
| | | | 1 | Dedicated T/B port: 100BASE-TX/ 10BASE-T |
| | Option slot | slot | 2 | For option interface 2D-TZ368 is installed to slot 1. The 2D-TZ378 is installed in the S15 with special specifications. ^{Note6)} |
| | SD memory card slot | slot | 1 | For extended memory |
| | RS-422 | port | 1 | Dedicated T/B port |
| Power source | Input voltage range | V | Single phase AC 200 to 230 | The rate of power-supply voltage fluctuation is within 10%. |
| | Power capacity | kVA | 2.0 | Does not include rush current. ^{Note7)} |
| | Power supply frequency | Hz | 50/60 | |
| Outline dimensions ^{Note8)} | | mm | 430(W) x 425(D) x 99.5(H) | Excluding protrusions |
| Mass | | kg | Approx. 12.5 | |
| Construction | | | Self-contained floor type, Opened type. Installation vertically or horizontally | IP20 ^{Note9)} |
| Ambient temperature | In use | °C | 0 to 40 | Without freeze |
| | At transport/storage | | -15 to +70 | |

| Item | | Unit | Specification | Remarks |
|---|----------------------|------|---------------|---|
| Ambient humidity | In use | %RH | 45 to 85 | Without dew drops |
| | At transport/storage | | 90 or less | |
| Overvoltage category ^{Note10)} | | | II or less | |
| Pollution level ^{Note11)} | | | 2 or less | |
| Altitude | | m | 1000 or less | |
| Grounding | | Ω | 100 or less | 100Ω or less (class D grounding) ^{Note12)} |
| Paint color | | | Dark gray | Equivalent to Munsell: 3.5PB3.2/0.8, PANTONE: 432C |

Note1) For details of the operation procedure, basic operations, and maintenance and inspection items of the controller, refer to the information on the CR800-D in the separate volume "Controller Setup, Basic Operation and Maintenance".

Note2) 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.

Note3) At factory settings, the STO function activated by an external emergency stop input meets the requirements of SIL 2, Category 3, and PL d. The STO function activated by an external emergency stop input meets the requirements of SIL 3, Category 4, and PL e when the parameter setting is changed by referring to [Page 115, "Appendix 3: Safety diagnosis function \(Test pulse diagnosis\)"](#).

Note4) For details on the functions using external input/output signals, always refer to [Page 114, "Appendix 2: Classification of functions using external input/output signals"](#).

Note5) Provide a mode selector switch to change the mode (MANUAL/AUTOMATIC) of the controller. Select the switch that meets the following specifications.

- The switch can be locked in each position of the selected mode.
- The selected switch position can be clearly distinguished from each other.
- Only one mode can be selected at a time.

(Recommended switch model: HA1K-2C2A-2 manufactured by IDEC. The key switch can be locked in each position by removing its key.)

The mode can be changed by other means than the selector switch.

For example, the user can use a mode change program. In the program, provide a means to lock the selected mode with a password.

Note6) Two connectors for 2D-TZ368/2D-TZ378 are attached (FCN-360 BKO-C11465H01).

Note7) The power capacity is the recommended value. 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. Use the short circuit breaker which operates by the current leakage under the commercial frequency domain (50-60Hz). If sensitive to the high frequency ingredient, it will become the cause in which below the maximum leak current value carries out the trip.

The following lists the current values of the representative models as a reference.

| Item | | Current [A] | Apparent power [kVA] | Voltage at measurement [V] |
|------------------------|-----------------|-------------|----------------------|----------------------------|
| At control power ON | | 0.42 | 0.09 | 219.3 |
| At servo ON | | 1.20 | 0.26 | 220.0 |
| In automatic operation | Effective value | 2.23 | 0.50 | 219.2 |
| | Peak | 9.19 | 2.26 | 220.0 |

Note8) Refer to [Page 35, "3.3.1 Outside dimensions"](#) for details.

Note9) This controller is standard specification. (Refer to [Page 32, "3.1.2 Protection specifications and operating supply"](#).)

Note10) This indicates the section of the power supply to which the equipment is assumed to be connected between the public electrical power distribution network and the machinery within premises.

Category II applies to equipment for which electrical power is supplied from fixed facilities. The surge voltage withstand level for up to the rated voltage of 300V is 2500V.

Note11) This index indicates the degree to which conductive material is generated in terms of the environment in which the equipment is used.

Pollution level 2 is when only non-conductive pollution occurs. A temporary conductivity caused by condensing must be expected occasionally.

Note12) The robot must be grounded by the customer.

3.1.2 Protection specifications and operating supply

(1) Protection specifications

A protection method complying with the IEC Standard IP20 (Opened type) is adopted for CR800 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 $12\text{ }_0^{+0.05}\text{mm}$ 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) Operating supply

The controller is supposed to be installed and used in the customer's system. Supply the primary power of the controller from the system. In addition, provide a safety device (ex. earth leakage breaker) that can shut off the power of the controller in the customer's system. When using an earth leakage breaker as a safety device, select a product with the highest sensitivity possible referring to the specifications in the table below.

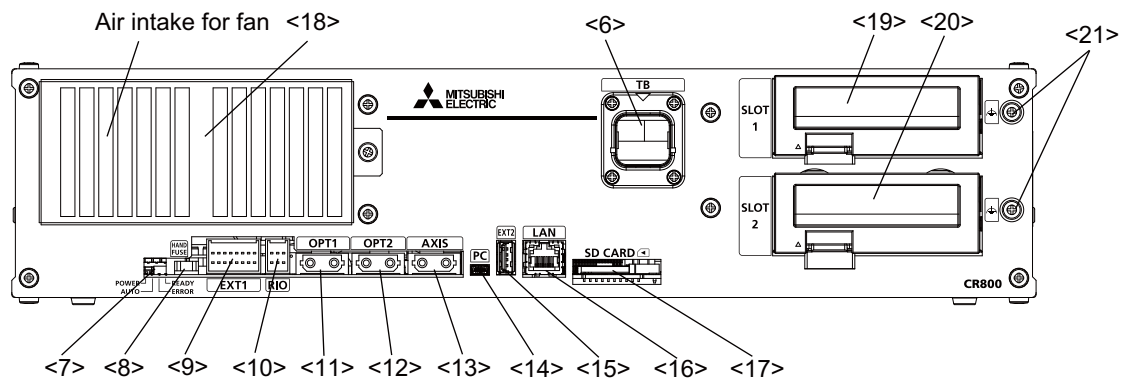
| Item | Unit | Specification |
|---------------------------|------|------------------------------------|
| Rated voltage | V | AC200 to 230 |
| Rated sensitivity current | mA | 30 or more, but as low as possible |
| Rated current | A | 10 or more, but as low as possible |

Refer to the section [Page 109, "6.2 Working environment"](#) for details on the working environment.

3.2 Names of each part

3.2.1 Controller

Controller front



Controller rear

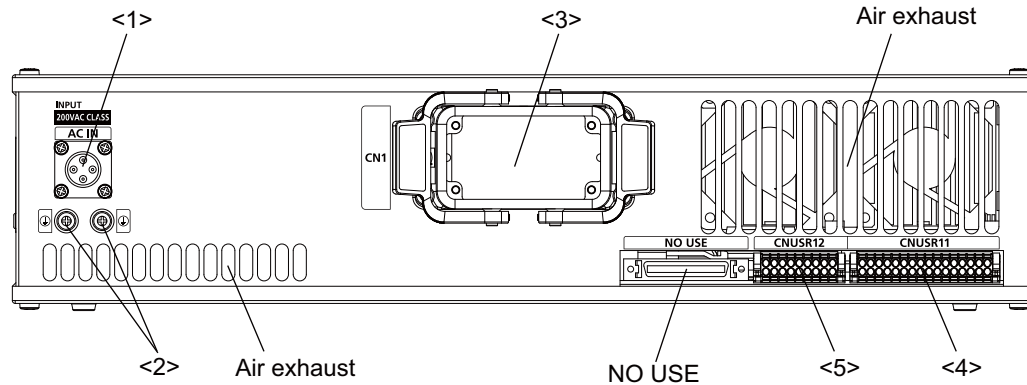
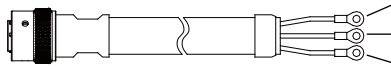


Fig.3-1: Names of controller parts

<1> ACIN connector.....Supplied ACIN cable connector (input voltage: AC200V).

| Number of phase | ACIN cable |
|-----------------|--|
| Single phase |  <p>Terminal: M5, cable length: 3m</p> |

<2> PE terminalTerminals for grounding (M4 screw x 2).

<3> CN1 cableMachine cable connector.

<4> <5> CNUSR connectorRobot I/O cable connectors.

<4>: CNUSR11, <5>: CNUSR12

<6> TB connector.....Dedicated connector for connecting T/B.

<7> LED Four LEDs indicating the controller status.

| LED | Details |
|-------|--|
| POWER | Indicates the control power status. On: Control power ON Off: Control power OFF |
| AUTO | Indicates the controller mode. On: AUTOMATIC mode Off: MANUAL mode |
| ERROR | Indicates the error status. On: Error occurred. Rapid flashing: High-level error occurred. Off: Normal operation |
| READY | Indicates the operation status. On: ON (ready) Slow flashing: During operation Rapid flashing: Operation suspended. |

<8> HAND FUSE Fuse for the hand.

<9> EXT1 Connector for releasing the brake in an emergency.
For details on the method of releasing the brake in an emergency, refer to the separate manual, "INSTRUCTION MANUAL/ROBOT ARM SETUP & MAINTENANCE".

<10> RIO Parallel I/O extension connector.

<11> OPT1 Unused.

<12> OPT2 Unused.

<13> AXIS Connector for additional axis connection.

<14> PC Connector for communication with a personal computer.

<15> EXT2 Connector for function extension.

<16> LAN Connector for Ethernet communication.

<17> SD CARD SD memory card slot.

<18> Filter cover Dustproof dust filter cover. An air filter is provided inside the filter cover.

<19> <20>Option slot..... Option card slots (must be covered when not used).
The 2D-TZ368 is attached to SLOT1 at factory shipment. The 2D-TZ378 (source type) is installed in the S15 with special specifications.
<19> SLOT1, <20> SLOT2

<21> FG terminal Option card cable terminals for grounding (M4 screw x 2).

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

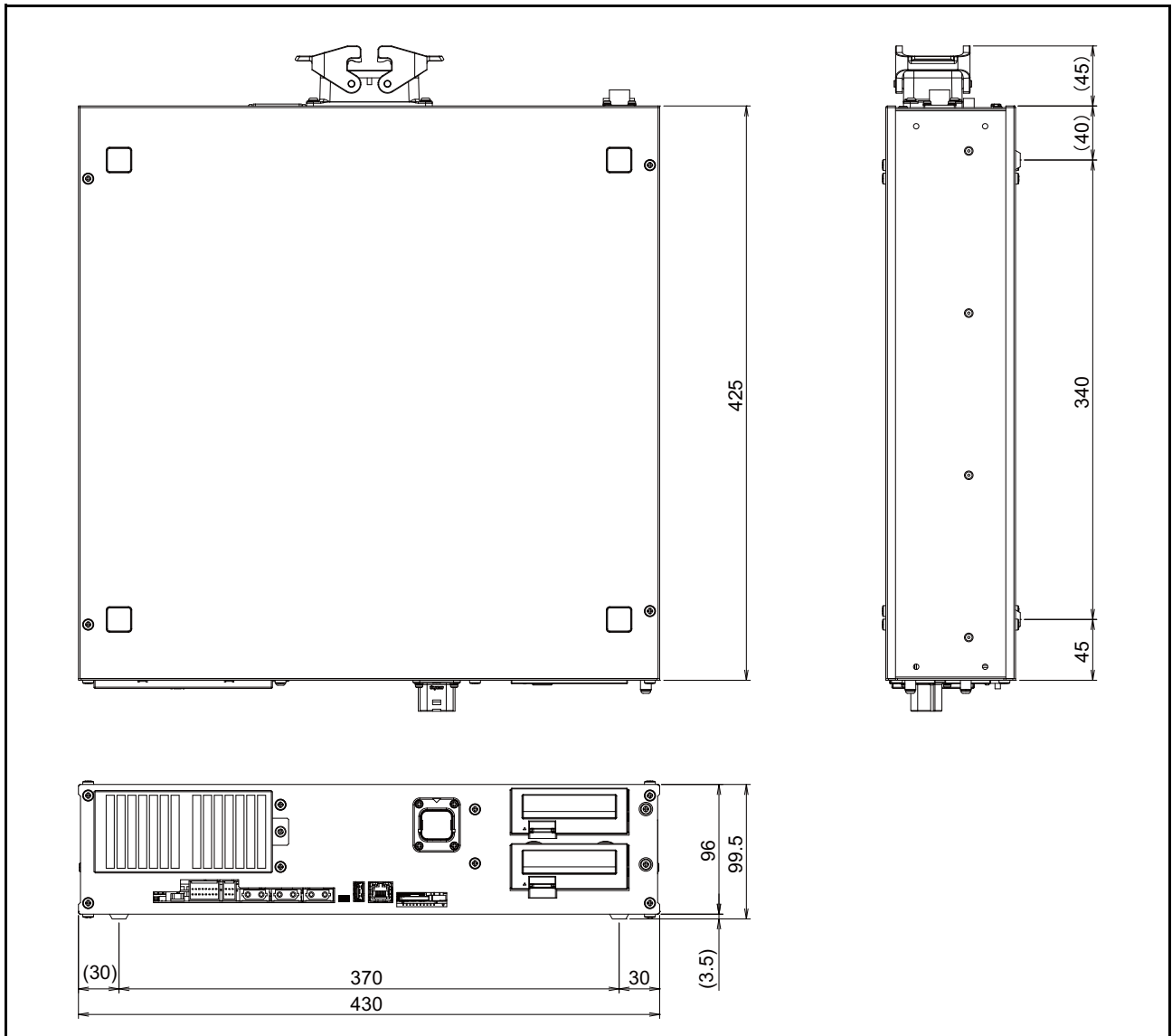


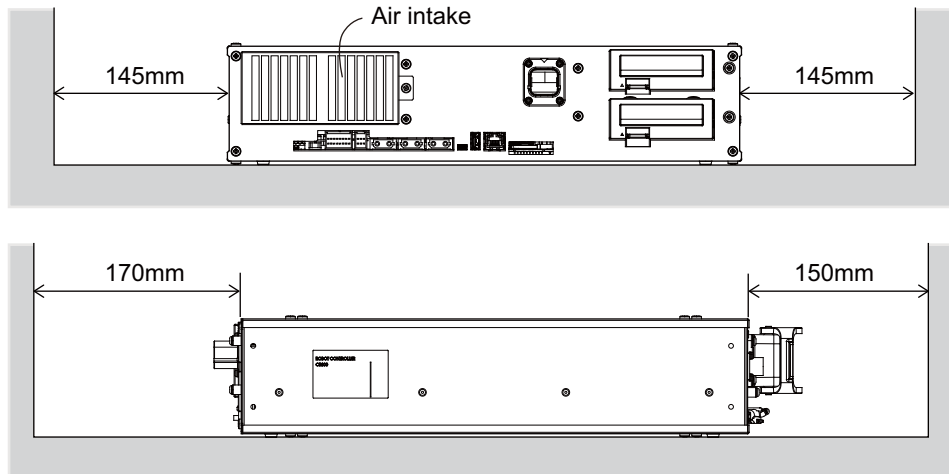
Fig.3-2: Outside dimensions of controller

3.3.2 Installation dimensions

The following figures show the dimensions required installing the controller.

For the placement of the controller on its side (the horizontal installation), two stacks is permitted.

Horizontal installation



Vertical installation

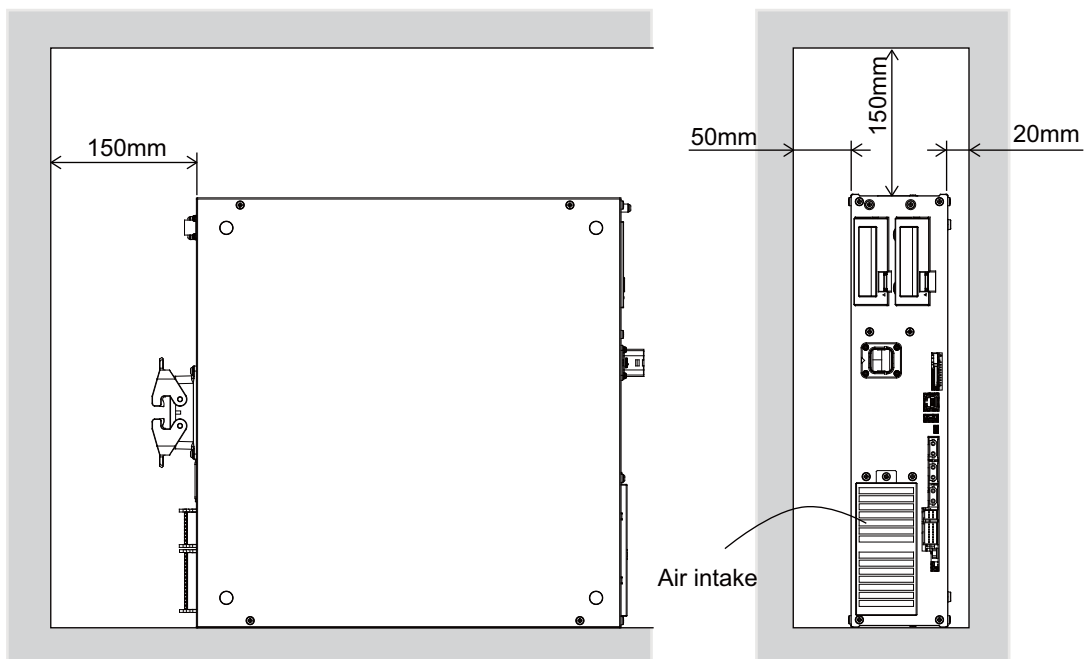


Fig.3-3: Installation dimensions

CAUTION When installing the controller vertically, ensure that the air intake is at the bottom as illustrated in [Fig. 3-3](#).

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 x 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.

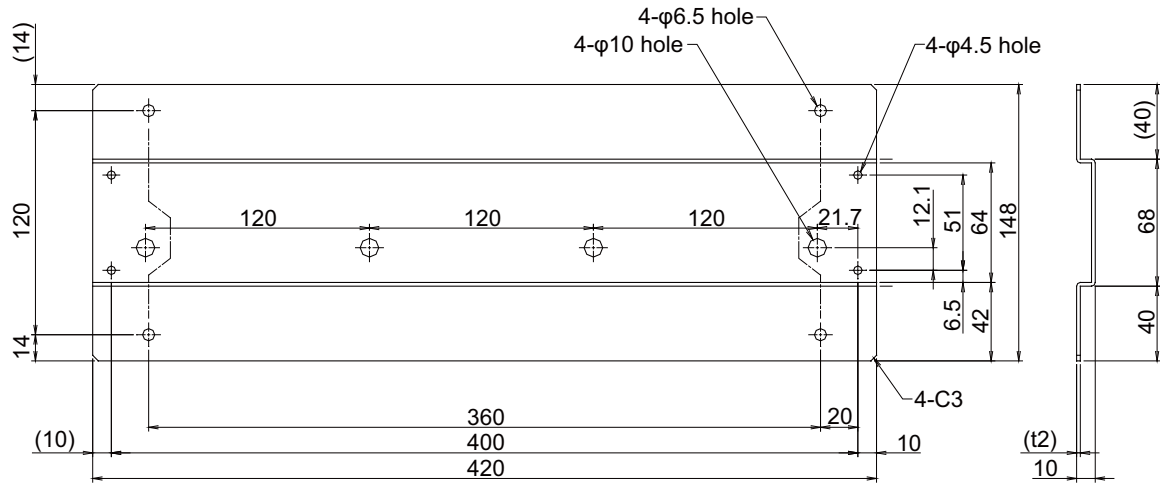


Fig.3-4: Reference figure of the fixing metal plate for vertical installation

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 42, "3.6 Emergency stop input and output etc."](#) and on [Page 104, "6.1.7 Examples of safety measures"](#).

<For Reference>

Linking our GOT2000 Series display equipment to the robot controller over the Ethernet permits you to control robot controller's input/output from a GOT (graphic operation terminal).

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 Note1) | | | Output | |
|----------------|--|--|-------|---|---|
| | Name | Function | Level | Name | Function |
| TEACHMD | None | | | Teaching mode output signal | Outputs that the teaching mode is entered. |
| ATTOPMD | None | | | Automatic mode output signal | Outputs that the automatic mode is entered. |
| ATEXTMD | None | | | Remote mode output signal | Outputs that the remote mode is entered. |
| RCREADY | None | | | Controller power ON complete signal | Outputs that external input signals can be received. |
| AUTOENA | Automatic operation enabled input signal | Allows automatic operation. | L | Automatic operation enabled output signal | Outputs the automatic operation enabled state. |
| START | Start input signal | Starts all slots. | E | Operating output signal | Outputs that the slot is operating. |
| STOP | Stop input signal | Stops all slots. The input signal No. is fixed to 0. Note) Use the emergency stop input for stop inputs related to safety. | L | Wait output signal | Outputs that the slot is temporarily stopped. |
| STOP2 | Stop input signal | The program during operation is stopped. Unlike the STOP parameter, change of the signal number is possible. Notes) Specification is the same as the STOP parameter. | L | Wait output signal | Outputs that the slot is temporarily stopped. 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 | Powers on the robot servos. 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. |

| Parameter name | Input Note1) | | | Output | |
|-------------------------------|--|---|-------|---|--|
| | Name | Function | Level | Name | Function |
| OUTRESET | General-purpose output signal reset | Resets the general-purpose output signal. | E | None | |
| EMGERR | None | | | Emergency stop output signal | Outputs that an emergency stop has occurred. |
| S1START : S32START | Start input | Starts each slot. | E | In operation output | Outputs the operating state for each slot. |
| S1STOP : S32STOP | Stop input | Stops each slot. | L | In wait output | Outputs that each slot is temporarily stopped. |
| PRGSEL | Program selection input signal | Designates the setting value for the program No. with numeric value input signals. | E | None | |
| OVRDSEL | Override selection input signal | Designates the setting value for the override with the numeric value input signals. | E | None | |
| IODATA Note2) | Numeric value input (start No., end No.) | Used to designate the program name, override value., mechanism value. | L | Numeric value output (start No., end No.) | Used to output the program name, override value., mechanism No. |
| PRGOUT | Program No. output request | Requests output of the program name. | E | Program No. output signal | Outputs that the program name is being output to the numeric value output signal. |
| LINEOUT | Line No. output request | Requests output of the line No. | E | Line No. output signal | Outputs that the line No. is being output to the numeric value output signal. |
| OVRDOUT | Override value output request | Requests the override output. | E | Override value output signal | Outputs that the override value is being output to the numeric value output signal. |
| ERROUT | Error No. output request | Requests the error No. output. | E | Error No. output signal | Outputs that the error No. is being output to the numeric value output signal. |
| JOGENA | Jog valid input signal | Validates jog operation with the external signals | E | Jog valid output signal | Outputs that the jog operation with external signals is valid. |
| JOGM | Jog mode input 2-bit | Designates the jog mode. | L | Jog mode output 2-bit | Outputs the current jog mode. |
| JOG+ | Jog feed + side for 8-axes | Requests the + side jog operation. | L | None | |
| JOG- | Jog feed - side for 8-axes | Requests the - side jog operation. | L | None | |
| 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. |

| Parameter name | Input Note1) | | | Output | |
|-----------------------------------|---|--|-------|---|---|
| | Name | Function | Level | Name | Function |
| 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. |
| USERAREA <small>Note3)</small> | None | | | User-designated area 32-points | Outputs that the robot is in the user-designated area. |

Note1) The level indicates the signal level.

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

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

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

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

3.6 Emergency stop input and output etc.

Do wiring of the external emergency stop, the special stop input, the door switch, and the mode selector switch 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 line, normal close |
| Input | Special stop input | Applies the stop. (Refer to Page 47, "3.6.2 Special stop input (SKIP)") |
| Input | Door switch | Servo-off. Dual line, normal close (Page 48, "3.6.3 Door switch function") |
| Input | Mode selector switch | Changes the mode (MANUAL/AUTOMATIC) of the controller. Dual line (Page 48, "3.6.4 Mode selector switch 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 T/B. |
| Output | Mode output | MANUAL mode: contactor is opening, AUTOMATIC mode: contactor is closing. |
| Output | Additional axis synchronization output | When an additional axis is used, the servo ON/OFF status of the additional axis can be synchronized with the robot arm. (Page 53, "3.8 Additional axis synchronization output") |

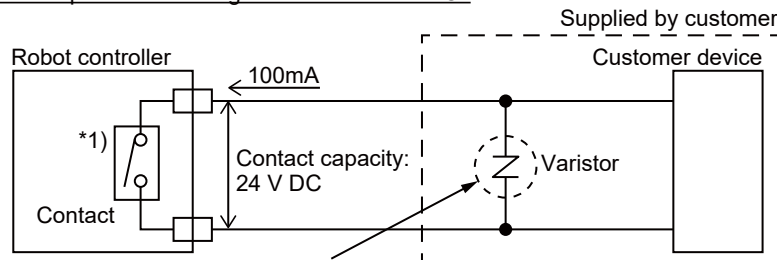
*At the time of the power supply OFF, the output point of contact is always open.

[Note] Wire for each input terminal as shown in [Fig. 3-8](#).

The contact capacity of each input/output terminal is DC24V/100mA. Do not connect the equipment except for this range. Noise or other effects that overload contact capacities will lead to failure. An example of noise prevention is shown in [Fig. 3-5](#).

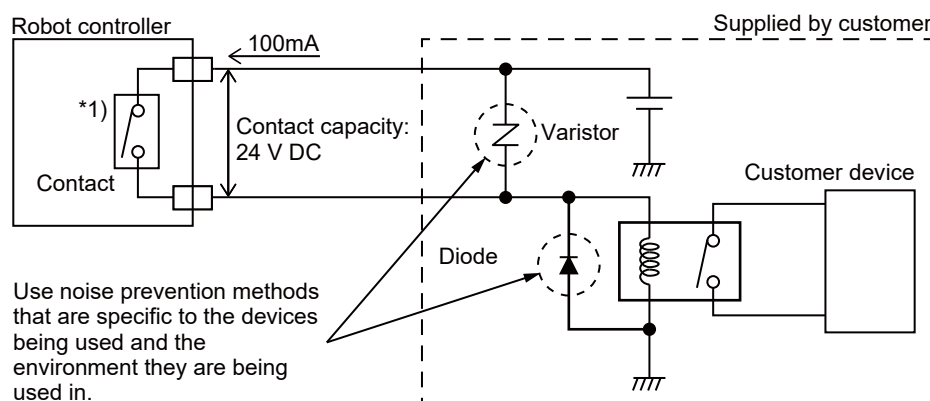
In the customer's system, do not ground the + side of 24V power supply prepared by customer for connect to the controller. (related with emergency stop and parallel input/output) If it connects with the controller under the condition that the + side is grounded, it will lead to failure of controller.

An example of connecting devices such as PLCs



Use noise prevention methods that are specific to the devices being used and the environment they are being used in.

An example of connecting devices such as relays



Use noise prevention methods that are specific to the devices being used and the environment they are being used in.

*1) The actual internal robot controller circuit differs from the internal robot controller circuit in the figure.

Recommended varistor

| Model | Manufacturer | Varistor voltage | Max. permissible circuit voltage |
|----------------|--------------|------------------|----------------------------------|
| ERZV10D390 | Panasonic | 39V | 31V |
| 72210S0250K101 | TDK | 39V | 31V |

Fig.3-5: Protection circuit example

[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. 3-8.

3.6.1 Connection of the external emergency stop and mode selector switch

The input terminals for the external emergency stop, door switch, and mode selector switch are arranged as shown in Fig. 3-8. Customers should be sure to prepare the external emergency stop, door switch, and mode selector switch, etc. and use the robot while these are connected. Connection procedures are shown below.

In addition, refer to Page 104, "6.1.7 Examples of safety measures" for the information on the emergency stop connection and cautions.

[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 mode selector switch.

2) Connect the contacts of each switch to the contacts as shown below:

a) External emergency stop switch

CNUSR11 connector "between 7 and 23" and "between 14 and 30".

b) Door switch

CNUSR11 connector "between 6 and 22" and "between 13 and 29".

c) Mode selector switch

CNUSR11 connector "between 5 and 21" and "between 12 and 28".

[Caution] Be sure to use a shield cable for the emergency stop wiring cable and dedicated stop input wiring cable. And when operating in an environment that is easily affected by noise, be sure to install the ferrite core (recommended model name: E04SR301334, manufacturer: Seiwa Electric Mfg. Co., Ltd.). Be sure to place the ferrite core in 300mm or less from the connecting terminal section.

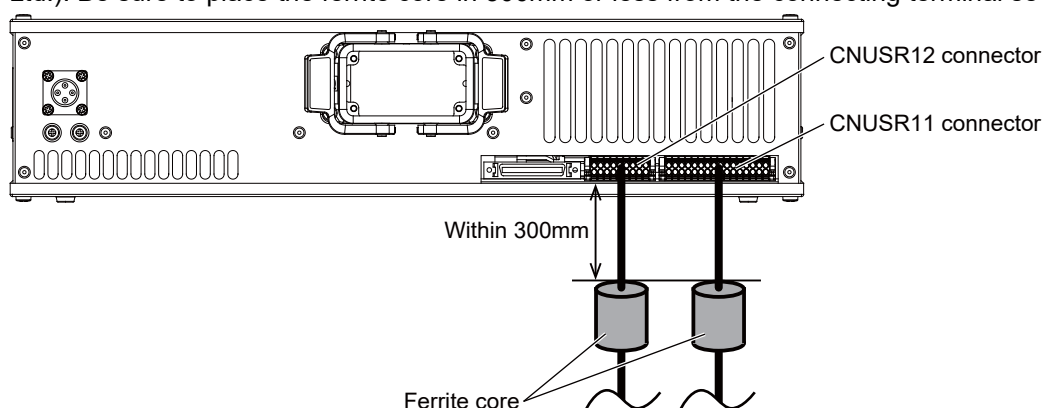


Fig.3-6: Installation position of ferrite cores

For information on the installation method, follow the instructions of the ferrite core being used.

⚠ 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 mode selector 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, additional axis synchronization 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).

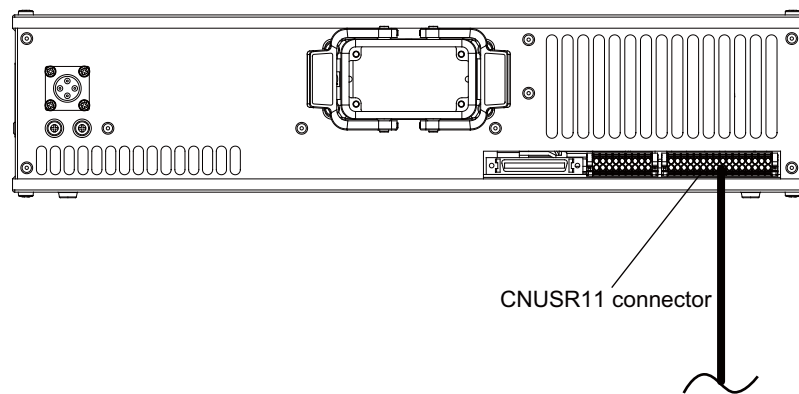


Fig.3-7: Emergency stop cable and mode selector switch connection

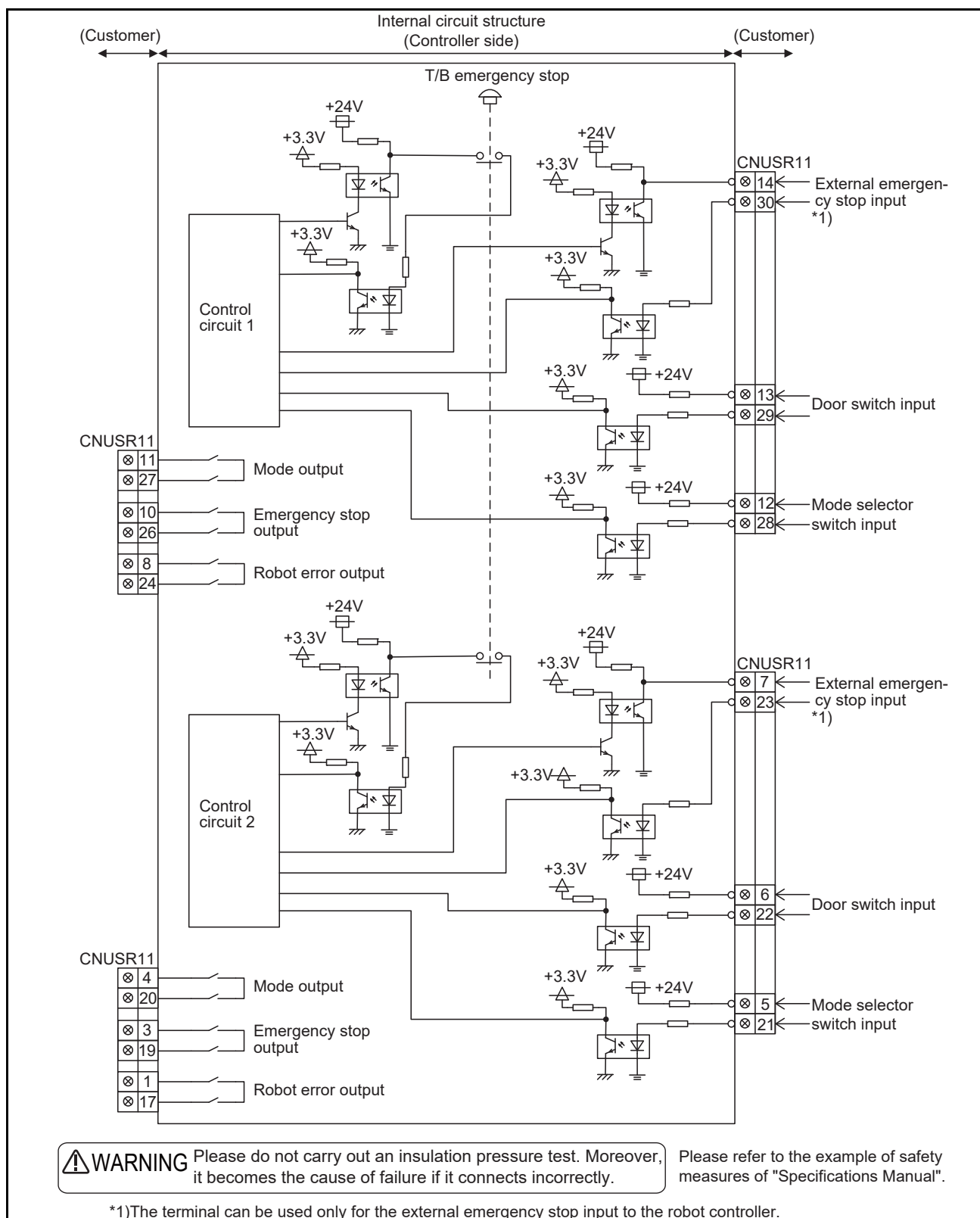


Fig.3-8: External emergency stop connection

CAUTION Place the emergency stop switch in an easily operable position, and be sure to wire it to the emergency stop correctly by referencing [Page 104, "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.

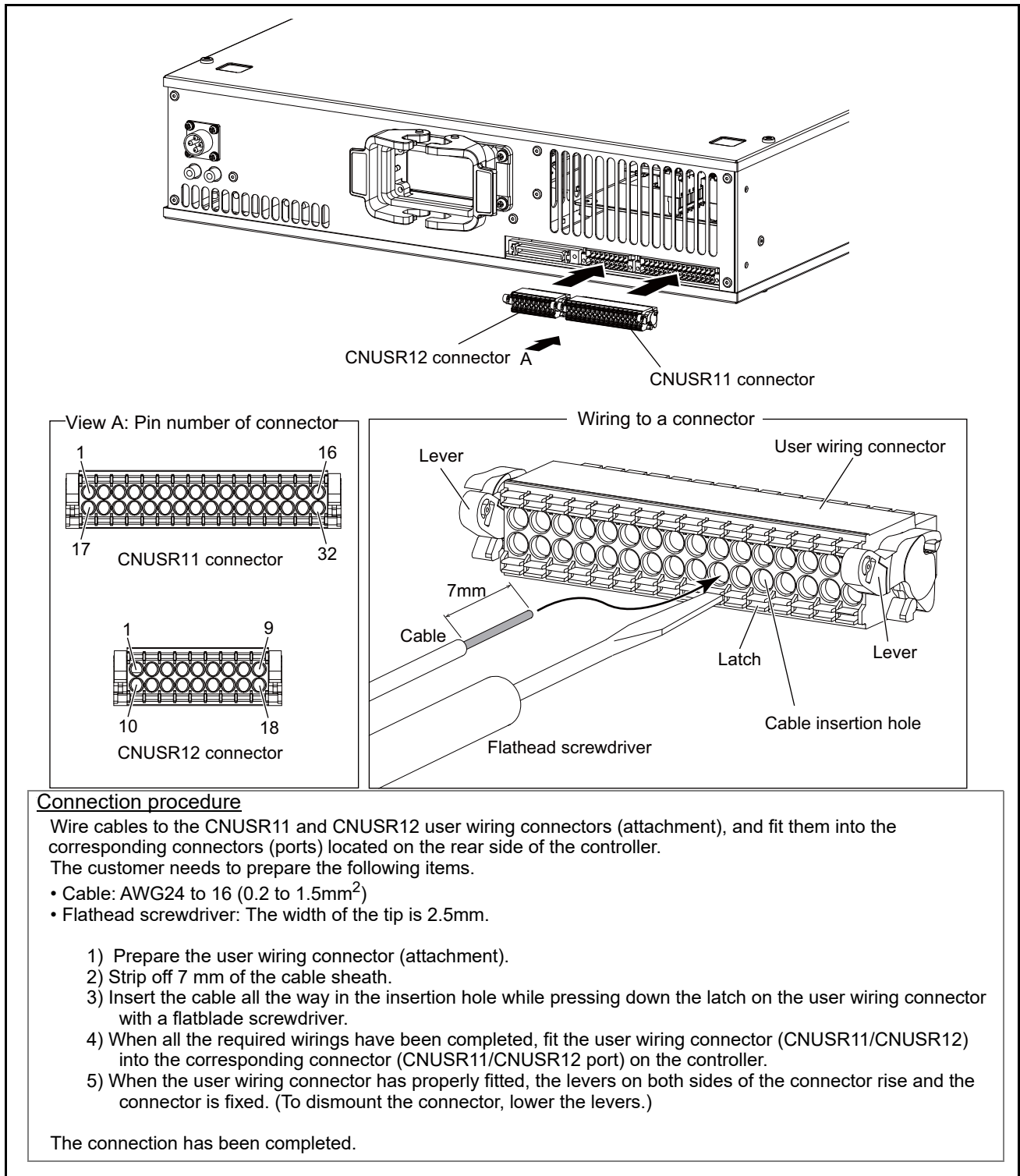


Fig.3-9: Wiring method to the user wiring connector

⚠ CAUTION

Fully check the number of the cable insertion hole (connector pin number) for incorrect connection. Incorrect wiring may damage the robot or cause a malfunction.

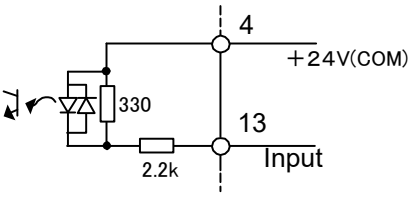
⚠ CAUTION

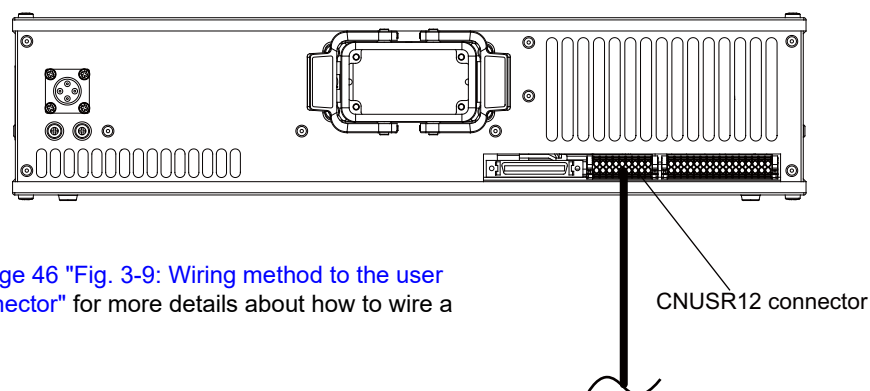
When wiring to the CNUSR11/CNUSR12 connector, pay attention to fraying wires of the core wires. The fraying wires can come into contact with the adjacent terminal, causing a short circuit.
Do not apply solder on core wires. Doing so may cause a contact failure.

3.6.2 Special stop input (SKIP)

The SKIP is the input signal to stop the robot. Please connect the pin 4, 13 of the CNUSR12 connector shown in [Fig. 3-10](#).

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 | | DC24V | |
| Rated input current | | Approx. 11mA | |
| Working voltage range | | DC 21.6 to 26.4V (Ripple rate within 5%) | |
| ON voltage/ON current | | DC 8V or more / 2mA or more | |
| OFF voltage/OFF current | | DC 4V or less / 1mA or less | |
| Input resistance | | Approx. 2.2kΩ | |
| Response time | OFF→ON | 1ms or less | |
| | ON→OFF | 1ms or less | |
| Common method | | 1 point per common | |
| External wire connection method | | Connector | |



* Refer to [Page 46 "Fig. 3-9: Wiring method to the user wiring connector"](#) for more details about how to wire a connector.

Note) 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.3-10: Connection of the special-stop-input

3.6.3 Door switch function

This function acquires the status of the switches attached on the door of the safety fence, and it turns OFF the servo to stop the robot when the door is opened.

Follow the wiring example shown in [Page 45 "Fig. 3-8: External emergency stop connection"](#) and [Page 104, "6.1.7 Examples of safety measures"](#). Details of this function according to the robot status are shown below (Fig. 3-11).

- *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, using a selector switch allows to turn the servo ON with the teaching pendant to operate the robot.

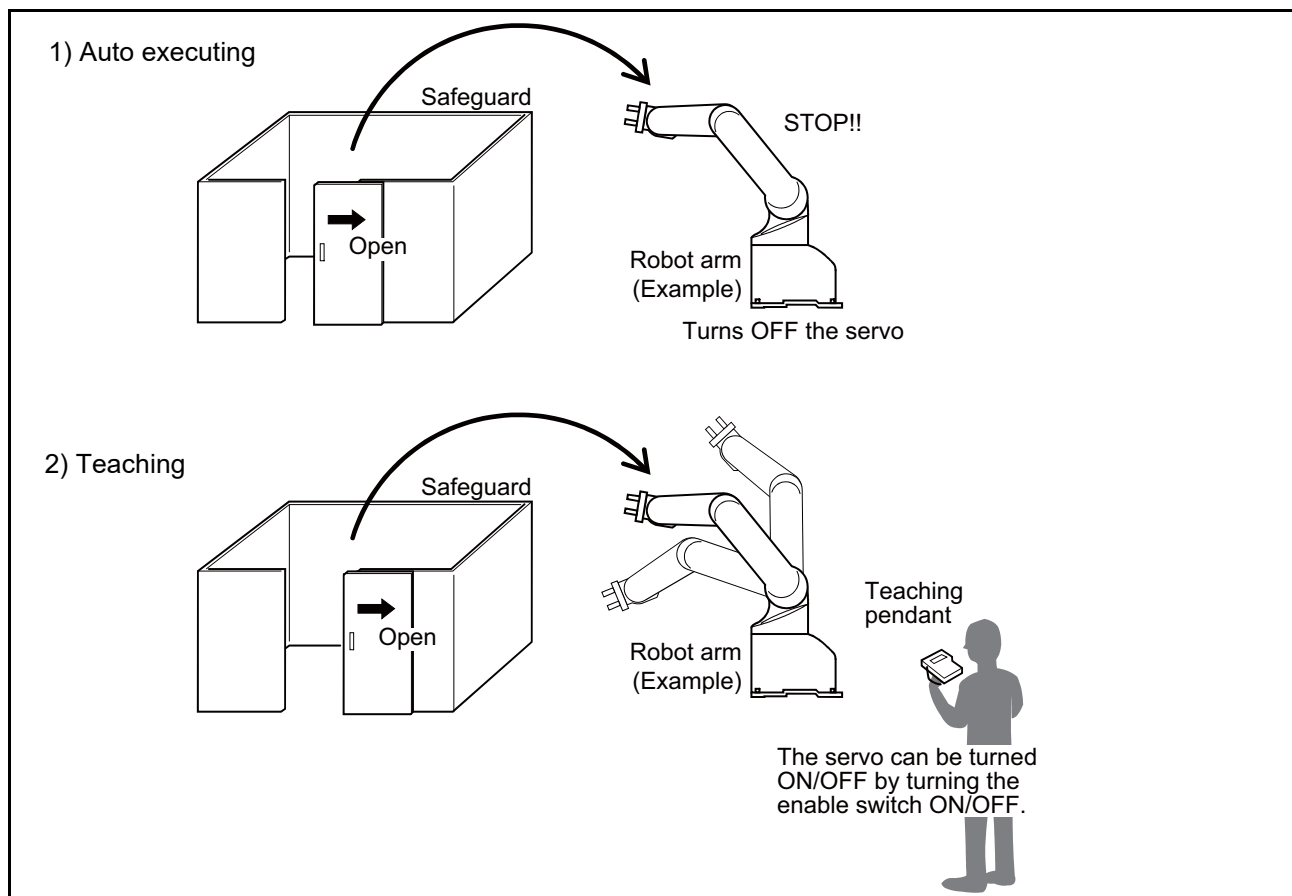


Fig.3-11: Door switch function

3.6.4 Mode selector switch function

The mode selector switch switches the mode of the controller between MANUAL mode and AUTOMATIC mode.

Table 3-5: States of input terminal

| Mode of controller | Input terminal |
|---------------------------------|----------------|
| MANUAL (Teaching) | Open |
| AUTOMATIC (Automatic operation) | Close |

(1) 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 3-6: Various operations and necessary switch settings

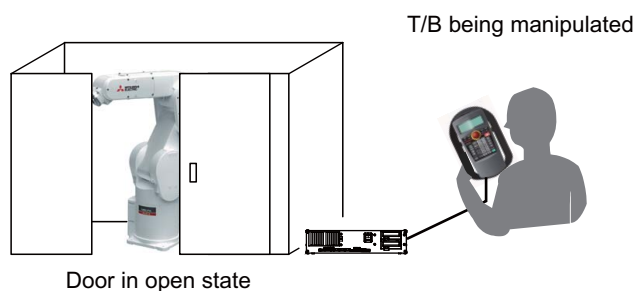
| No | Operation | Related switch settings ^{Note1)} | | | | Description |
|----|---------------------------------|---|-------------------|-------------------------------------|----------------------------|---|
| | | T/B enable/disable | T/B enable switch | Mode selector switch input terminal | Door switch input terminal | |
| 1 | Jog operation | Enable | ON | Open (MANUAL mode) | - | If the mode selector switch input is set to Open (MANUAL mode), the state of door switch input does not matter. |
| 2 | Brake release ^{Note2)} | Enable | ON | Open (MANUAL mode) | - | If the mode selector switch input is set to Open (MANUAL mode), the state of door switch input does not matter. |
| 3 | Automatic operation | Disable | - | Close (AUTOMATIC mode) | Close (Door Close) | Door switch input must always be in a state of Close (Door Close). |

Note1) "-" in the table indicates that the state of switch concerned does not matter.

Refer to the following for operation of each switch.

- T/B enable/disable: [Page 56, "\(1\) Teaching pendant \(T/B\)"](#)
- T/B enable switch: [Page 56, "\(1\) Teaching pendant \(T/B\)"](#)
- Mode selector switch input terminal: [Page 104, "6.1.7 Examples of safety measures"](#)
- Door switch input terminal: [Page 104, "6.1.7 Examples of safety measures"](#)

Note2) T/B is used for the brake release operation. Brake release can be effected only when the T/B enable switch is placed in intermediate position (lightly gripped position). At this point, the state of door switch input does not matter.



⚠ CAUTION

Upon the release of brake, the robot arm may fall under its own weight depending on the axis which has been released. To ensure safety, take appropriate measures such as supporting the axis to avoid the free fall.

Fig.3-12: Brake release operation

3.7 Additional Axis Function

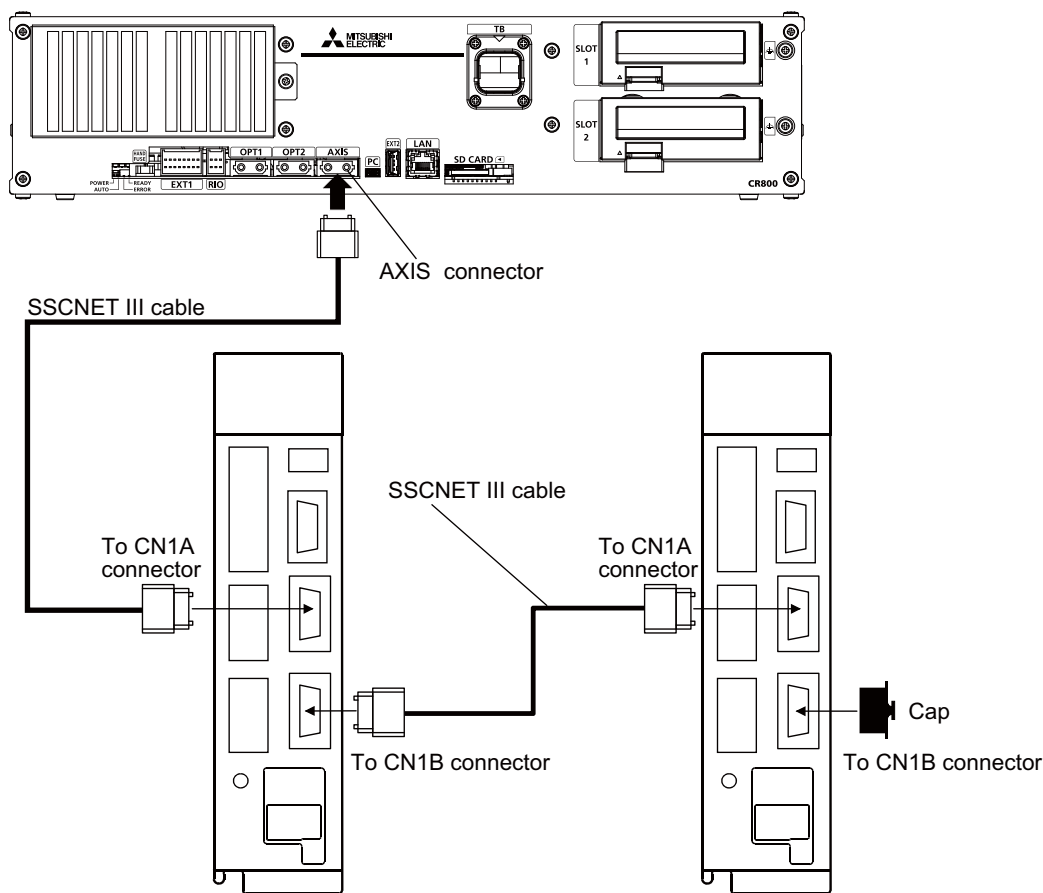
This controller is equipped with an additional axis interface for controlling an additional axis when a traveling axis or rotary table is added to the robot. A maximum of eight axes of servo motors can be controlled at the same time by connecting a general-purpose servo amplifier (MR-J4-B series) that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

3.7.1 Wiring of the Additional Axis Interface

Table 3-7 shows the connectors for additional axes inside the controller.
Fig. 3-13 shows a connection example (configuration example).

Table 3-7: Dedicated connectors inside the controller

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



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

Fig.3-13: Example of addition axis connection

(1) Example of the installation of the noise filter

■ EMC filter (recommended)

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

Table 3-8: Combination of a servo amplifier and filter (Soshin Electric)

| Servo amplifier | Recommended filter (Soshin Electric) | | | | Mass [kg] |
|---|--------------------------------------|-------------------|---------------------|----------------------|-----------|
| | Model | Rated current [A] | Rated voltage [VAC] | Leakage current [mA] | |
| MR-J4-10B(-RJ) to MR-J4-100B(-RJ) | HF3010A-UN ^{Note1)} | 10 | 250 | 5 | 3.5 |
| MR-J4-200B(-RJ) MR-J4-350B(-RJ) | HF3030A-UN ^{Note1)} | 30 | | | 5.5 |
| MR-J4-500B(-RJ) MR-J4-700B(-RJ) | HF3040A-UN ^{Note1)} | 40 | | 6.5 | 6 |
| MR-J4-11KB(-RJ) MR-J4-15KB(-RJ) MR-J4-22KB(-RJ) | HF3100A-UN ^{Note1)} | 100 | | | 12 |
| MR-J4-60B4(-RJ) MR-J4-100B4(-RJ) | TF3005C-TX | 5 | 500 | 5.5 | 6 |
| MR-J4-200B4(-RJ) MR-J4-700B4(-RJ) | TF3020C-TX | 20 | | | |
| MR-J4-11KB4(-RJ) | TF3030C-TX | 30 | | | 7.5 |
| MR-J4-15KB4(-RJ) | TF3040C-TX | 40 | | | 12.5 |
| MR-J4-22KB4(-RJ) | TF3060C-TX | 60 | | | |
| MR-J4-10B1(-RJ) to MR-J4-40B1(-RJ) | TF3010A-UN ^{Note1)} | 10 | 250 | 5 | 3.5 |

Note1) Following surge protector is separately required to use any of these EMC filters.

RSPD-250-U4 (Manufacture: OKAYA Electric Industries CO., Ltd.)

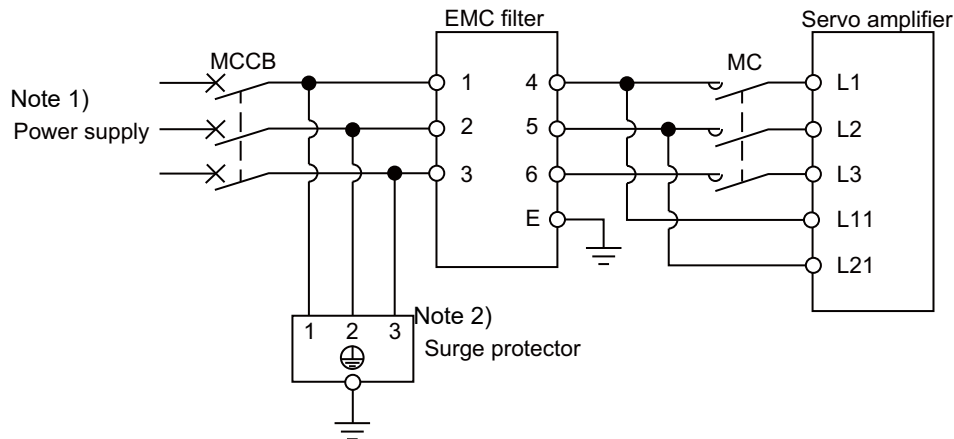
Table 3-9: Combination of a servo amplifier and filter (COSEL)

| Servo amplifier | Recommended filter (COSEL) | | | | Mass [kg] |
|---------------------------------------|---------------------------------|-------------------|---------------------|----------------------|-----------|
| | Model | Rated current [A] | Rated voltage [VAC] | Leakage current [mA] | |
| MR-J4-11KB(-RJ) to MR-J4-22KB(-RJ) | FTB-100-355-L ^{Note1)} | 100 | 500 | 40 | 5.3 |
| MR-J4-22KB4(-RJ) | FTB-80-355-L ^{Note1)} | 80 | 500 | 80 | 5.3 |

Note1) Following surge protector is separately required to use any of these EMC filters.

RSPD-500-U4 (Manufacture: OKAYA Electric Industries CO., Ltd.)

■Installing an EMC noise filter



Note 1) For 1-phase 200V to 230VAC 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.3-14: 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 0.5MHz to 5MHz band.

| Connection diagram | Outline drawing [Unit: mm] |
|--|---|
| <p>Use the line noise filters for wires of the main power supply ($L_1 \cdot L_2 \cdot L_3$) and of the motor power supply ($U \cdot V \cdot W$). Pass each of the 3-phase wires through the line noise filter an equal number of times in the same direction. For the main power supply, the effect of the filter rises as the number of passes increases, but generally four passes would be appropriate. For the motor power supply, passes must be four times or less. Do not pass the grounding (earth) wire through the filter, or the effect of the filter will drop. Wind the wires by passing through the filter to satisfy the required number of passes as shown in Example 1. If the wires are too thick to wind, use two or more filters to have the required number of passes as shown in Example 2. Place the line noise filters as close to the servo amplifier as possible for their best performance.</p> <p>Example 1</p> <p>(Number of turns: 4)</p> <p>Example 2</p> <p>Two filters are used (Total number of turns: 4)</p> | <p>FR-BSF01 (for wire size 3.5mm² (AWG12) or less))</p> <p>FR-BLF (for wire size 5.5mm² (AWG10) or more))</p> |

Fig.3-15: Example of noise filter installation

3.8 Additional axis synchronization output

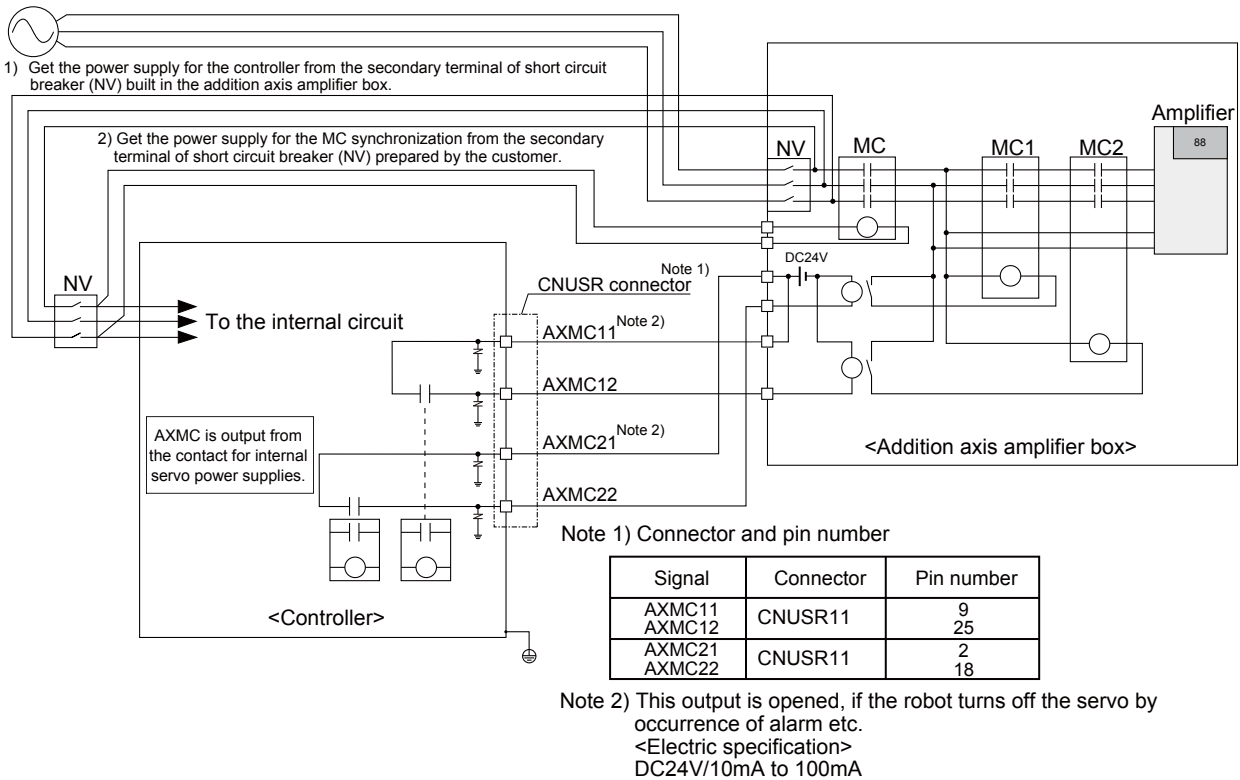
When an additional axis is used, the servo ON/OFF status of the additional axis can be synchronized with the servo ON/OFF status of the robot itself by using the output contact (AXMC) provided on the rear or inside of the controller and configuring a circuit so that the power to the servo amplifier for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

An example circuit is shown in Page 53, "(1) Example circuit". An image of how to connect the connector is shown in Page 54, "(2) Image of how to connect the controller connector".

When you are using an additional axis, please perform appropriate circuit connections by referring to these drawings. Refer to Page 50, "3.7 Additional Axis Function" and the separate "Additional axis interface Instruction Manual" for details on the additional axis function.

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

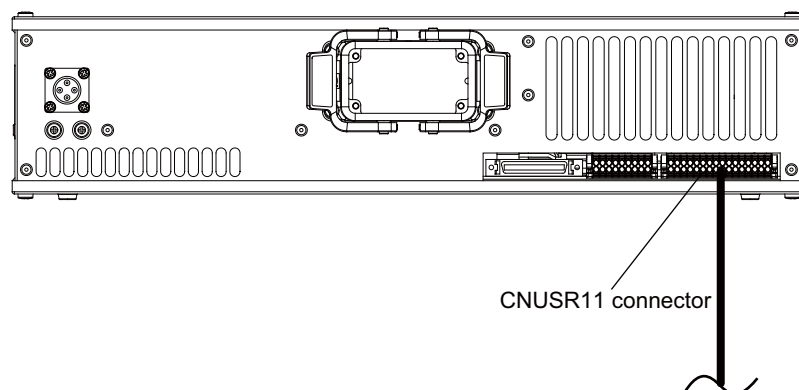
(1) Example circuit



[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.3-16: Example of circuit for additional axis synchronization output

(2) Image of how to connect the controller connector



* Refer to [Page 46 "Fig. 3-9: Wiring method to the user wiring connector"](#) for more details about how to wire a connector.

Fig.3-17: AXMC terminal connector

3.9 Options

- What are options?

There are a variety of options for the robot designed to make the setting up process easier for user needs.
User installation is required for the options.

(1) Teaching pendant (T/B)

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

■ Outline



This is used to create, edit and control the program, teach the operation position and for jog feed, etc. For safety proposes, a 3-position enable switch is mounted. *1)

For multiple robots, you can operate them with just one teaching pendant by repeating the removal of it from another robot and the connection of it to the target robot.

■ Configuration

Table 3-10: Configuration device

| Part name | Type | Qty. | Mass (kg) ^{Note1)} | Remarks |
|------------------|----------|----------------|-----------------------------|----------------------|
| Teaching pendant | R32TB | Either one pc. | 1.7 | Cable length is 7m. |
| | R32TB-15 | | 2.8 | Cable length is 15m. |

Note1) Mass indicates one set.

■ Specifications

Table 3-11: 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 (body only, excluding cables) | |
| Connection method | Connects with controller via 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).

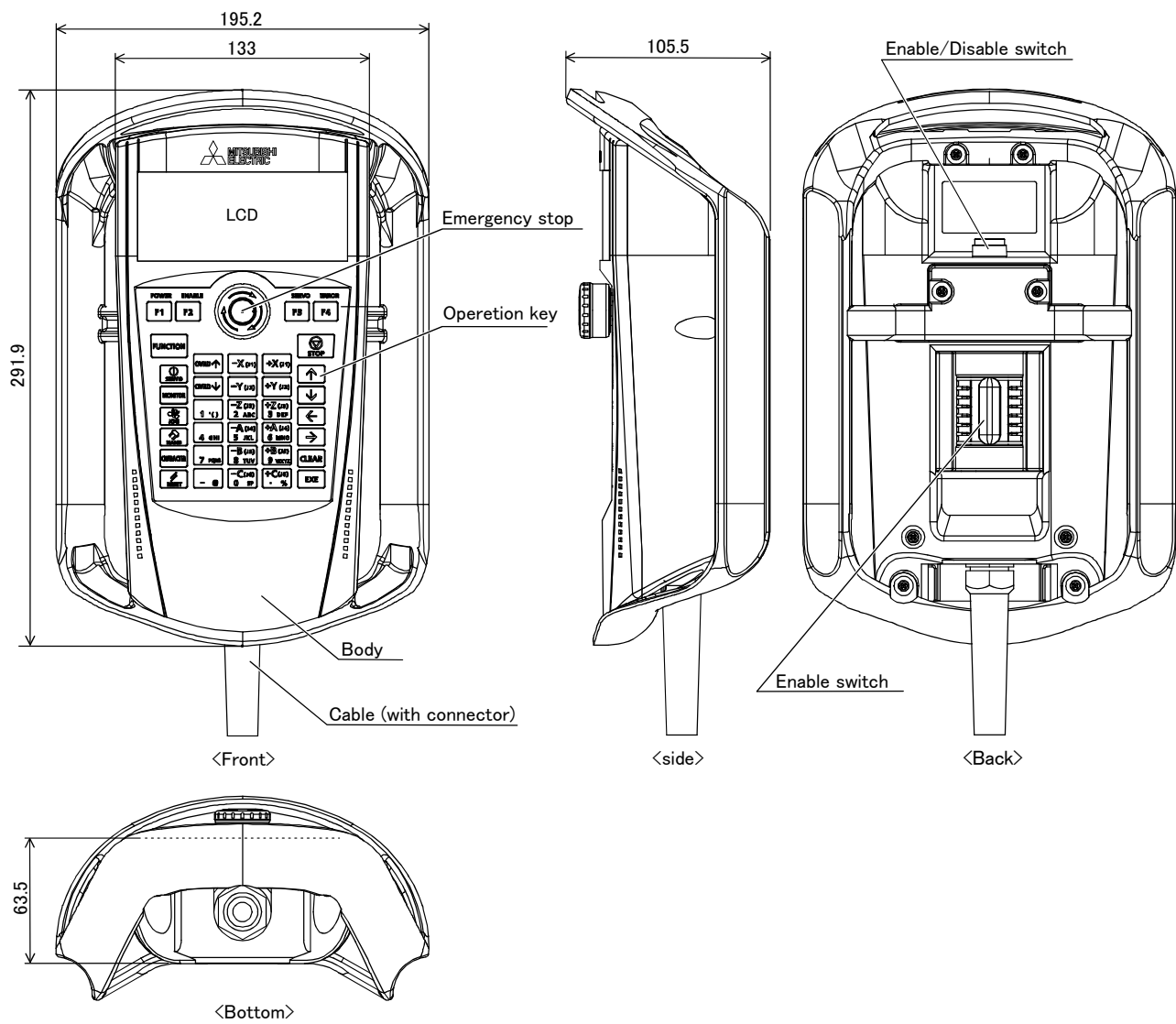


Fig.3-18: Outside dimensions of teaching pendant

■ Installation method

The teaching pendant is connected to the TB connector on the front of the controller.

■Key layout and main functions



Fig.3-19: Teaching pendant key layout and main functions

(2) High efficient teaching pendant (T/B)

- Order type: ● R56TB : Cable length 7m
 ● R56TB-15 : Cable length 15m

■ Outline



This is used to create, edit and control the program, to teach the operation position, or to perform jog feed, etc. This highly efficient teaching pendant has a touchscreen graphical user interface (GUI) which allows easy operation. In addition, the 3-position enable switch ^{*1)} is provided for the safety use.

For multiple robots, you can operate them with just one teaching pendant by repeating the removal of it from another robot and the connection of it to the target robot.

■ Configuration

Table 3-12: Configuration device

| Part name | Type | Qty. | Mass (kg) ^{Note1)} | Remarks |
|---------------------------------|----------|----------------|-----------------------------|----------------------|
| High efficient teaching pendant | R56TB | Either one pc. | 2.1 | Cable length is 7m. |
| | R56TB-15 | | 3.2 | Cable length is 15m. |

Note1) Mass indicates one set.

■ Specifications

Table 3-13: Specifications

| Items | Specifications | Remarks |
|--------------------|--|--------------------------------------|
| Outline dimensions | 252(W) x 240(H) x 114(D) (refer to outline drawing) | |
| Body color | Dark gray | |
| Mass | Approx. 1.25kg (body only, excluding cables) | |
| Connection method | Connects with controller via connector. | |
| Interface | RS-422, Ethernet (10BASE-T) | For connection with robot controller |
| | USB host | Note1) |
| Display | 6.5" TFT (640 x 480) color touchscreen, with backlight | |

Note1) The operation of the following USB memory sticks has been confirmed.

- a) Kingston Data Traveler Manufacture: Kingston, Type: USB 2.0 memory stick,
 Memory sizes: 128 MB - 1GB
 b) Transcend Jet Flash Manufacture: Transcend, Type: USB 2.0 memory stick,
 Memory sizes: 128 MB - 1GB

Notice) The operation of those other than the above is not guaranteed.

■ Installation method

The teaching pendant is connected to the TB connector on the front of the controller.

*1) <3-position enable switch>

In ISO/10218 (2006) 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".

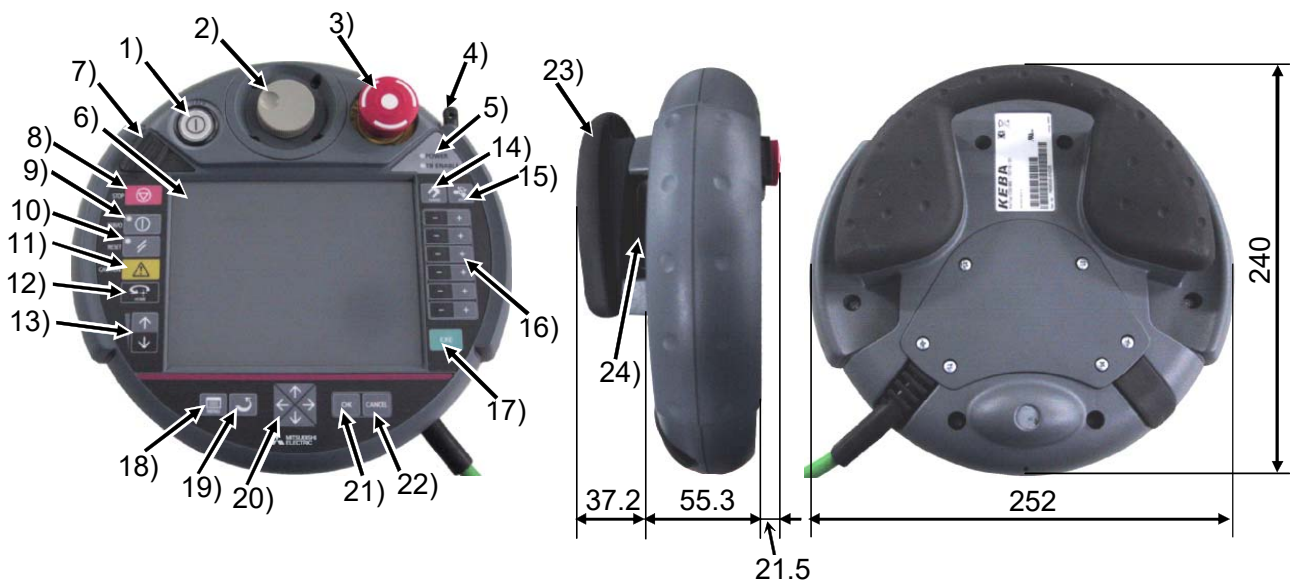
The 3-position enable switch has three statuses. The following modes are entered according to the switch state.

- 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).

■ Outside dimensions and main functions



- | | |
|---|---|
| 1) TEACH button..... | This changeover switch is used to enable or disable the T/B key operations. The lamp (white) lights up during enabling state. |
| 2) Wheel..... | Move the cursor to select the menu and so on. |
| 3) Emergency stop button | This stops the robot in an emergency state. The servo turns OFF. Turn to the right to cancel. |
| 4) Touch stylus (Integrated in housing) | The pen which operates the touch panel. |
| 5) Power supply LED, T/B enable LED | POWER LED lights up during supplying the power supply. TB ENABLE LED lights up during enabling state. |
| 6) Touch panel..... | Tap to operate with the stylus pen and the screen is displayed. |
| 7) USB connector..... | Plug-in the USB memory stick. |
| 8) STOP button | This stops the robot immediately. The servo does not turn OFF. |
| 9) SERVO button | This turns ON the servo power simultaneously with the enable switch. The LED (green) lights during servo ON. |
| 10) RESET button | This key resets an error state that has occurred. |
| 11) CAUTION button | If this button is pushed in jog operation, the limit switch can be canceled. Moreover, push this button, when releasing the brake. |
| 12) HOME button | Not use. |
| 13) OVRD button..... | This scrolls override up or down. |
| 14) HAND button..... | Display the screen of hand operation. |
| 15) JOG button..... | Display the screen of jog operation. |
| 16) +/- button..... | This button operates corresponding to the selected operation. |
| 17) EXE button..... | Move the robot, such as hand alignment. |
| 18) MENU button | Display the menu screen. |
| 19) RETURN button | Close each operation screen. |
| 20) Arrow button..... | Move the cursor |
| 21) OK button..... | Fix each screen operation. |
| 22) CANCEL button | Cancel each screen operation. |
| 23) Multi grip handle..... | Holds the T/B. |
| 24) Enable switch..... | If this switch is released or pressed with force while the T/B is enabled, the servo power supply turns OFF. To move the robot in jog operation or the like, press the switch lightly and hold it. The enable switch is mounted on each of the multi grip handle. |

Fig.3-20: Teaching pendant outside dimensions and main functions

(3) Function extension card

- Order type: ●2F-DQ510 MELFA Smart Plus card pack (A-type)
 ●2F-DQ520 MELFA Smart Plus card pack (AB-type)
 ●2F-DQ511 MELFA Smart Plus card (A-type)
 ●2F-DQ521 MELFA Smart Plus card (B-type)

■ Outline



This card is used to enable the MELFA Smart Plus option.
 Insert this card in the option slot on the front of the controller, and enable the MELFA Smart Plus software extension function.

■ Configuration

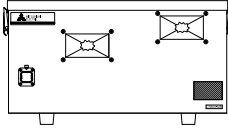
Table 3-14: Configuration device

| Part name | | Type | Qty. | Mass (Kg) | Remarks |
|----------------------------|---------|----------|------|-----------|--|
| MELFA Smart Plus card pack | A-type | 2F-DQ510 | 1 | 0.5 | Software version of controller: Ver. A5p or later |
| | AB-type | 2F-DQ520 | 1 | 0.5 | |
| MELFA Smart Plus card | A-type | 2F-DQ511 | 1 | 0.5 | |
| | B-type | 2F-DQ521 | 1 | 0.5 | |

(4) Controller protection box

■Order type: CR800-MB

■Outline



Storing the controller in this box protects the controller from dust and water. Use this option, when the controller is installed where environment is oil mist such as machine shop etc.

■Configuration

Table 3-15: Configuration equipment and types

| Part name | Type | Qty. | Mass (Kg) ^{Note1)} | Remarks |
|---|-----------|------|-----------------------------|---------|
| Controller protection box | CR800-MB | 1 | 21 | - |
| Label for serial number | - | 1 | | - |
| Transparent seal | - | 1 | | - |
| Cable tie | T50L | 4 | | - |
| Screw for fixing of the controller mounting plate | M4x8 | 4 | | - |
| Instruction Manual | BFP-A3501 | 1 | - | - |

Note1) Mass indicates one set.

■Specifications

Table 3-16: Specifications

| Item | Unit | Specifications | Remarks |
|-------------------|------|---------------------------------|--|
| Outside dimension | mm | 500(W)×725(D)×250(H) | Protrusions such as rubber legs are excluded. |
| Mass | kg | 21 | - |
| Construction | - | IP54 ^{Note1)} | Self-contained floor type |
| Grounding | - | 100 or less (class D grounding) | - |
| Paint color | - | Dark gray | Equivalent to Munsell: 3.5PB3.2/0.8, PANTONE: 432C |

Note1) In the environment where oil, such as machining oil, drops on the controller protection box, provide a shield plate to protect the controller protection box from the oil droplets.

(1) The robot must be grounded by the customer.

(2) The customer needs to prepare the power cable for protection box fan and the grounding cable.

(Power supply voltage for fan: 200 VAC, Screw size for power supply connection terminal block: M4)

■ Outside dimension

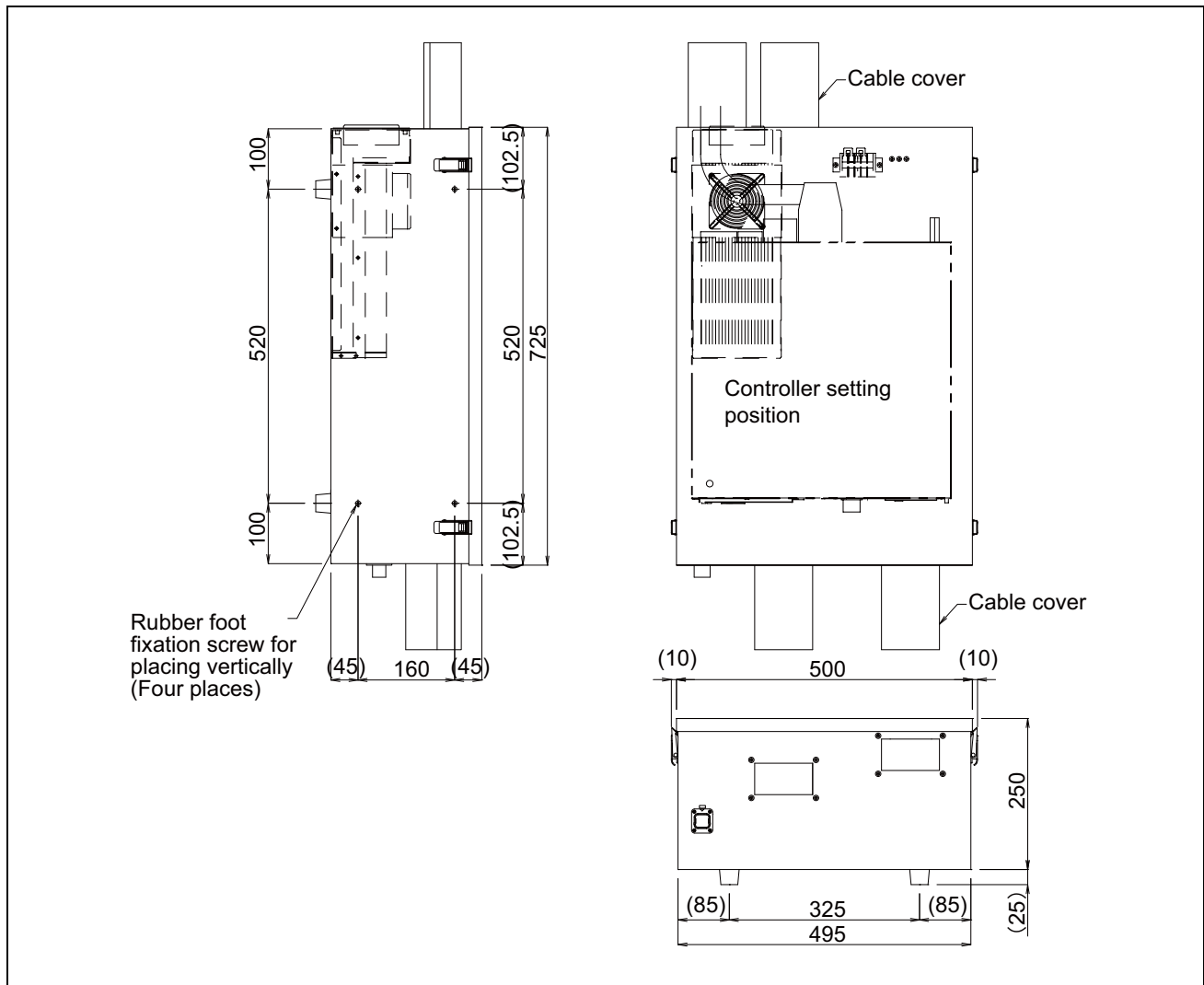


Fig.3-21: Outside dimension

■ Names of each part

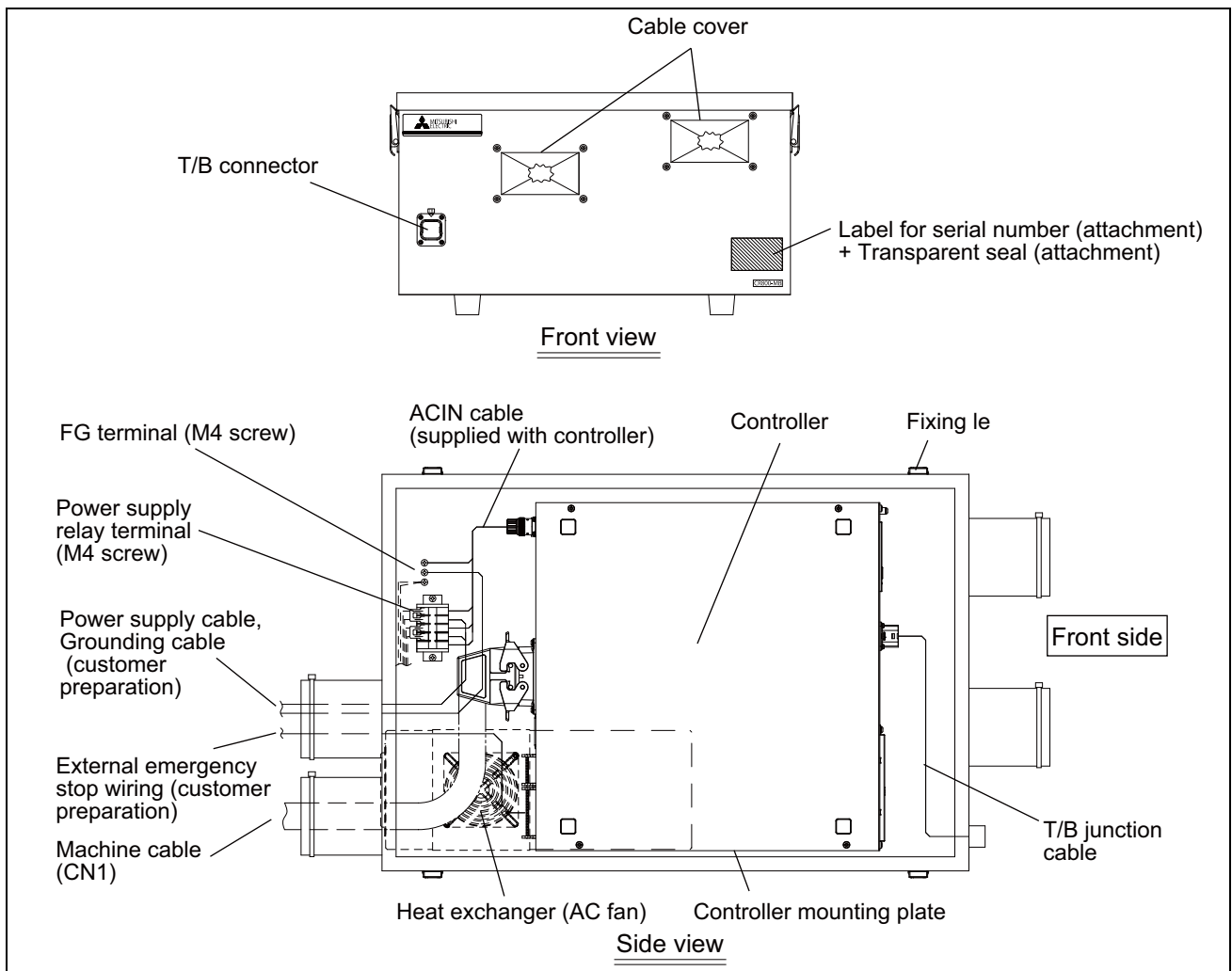


Fig.3-22: Names of each part

■ Wiring system diagram

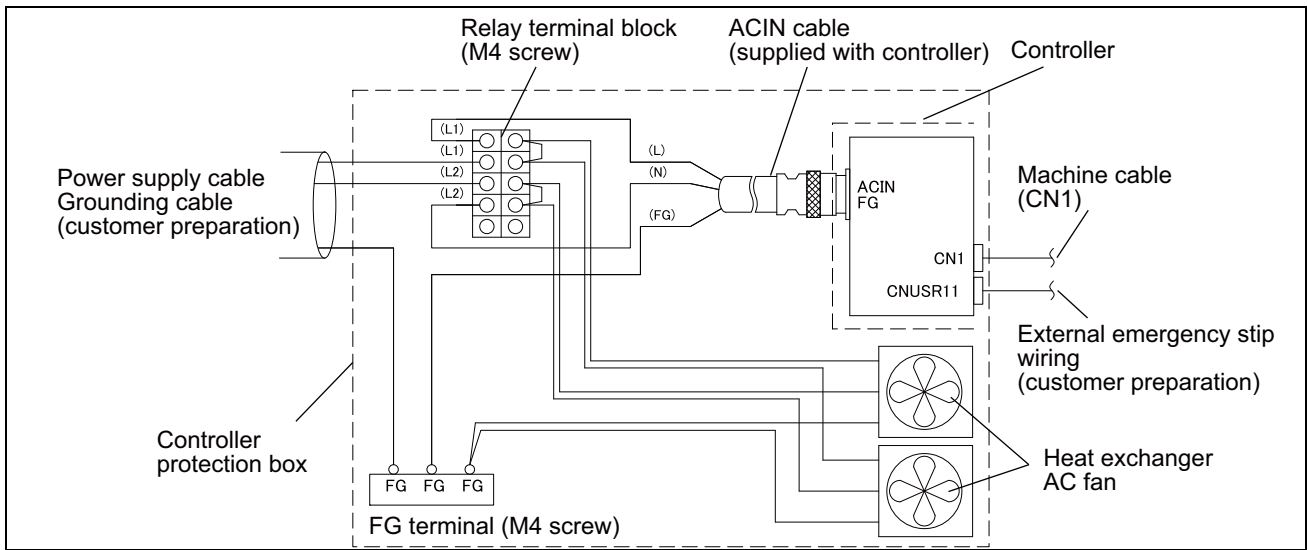


Fig.3-23: Wiring system diagram

[Note] The figure above is a diagrammatic illustration. The layout inside the controller protection box shown in the figure differs from the actual layout.

■ Installation dimensions

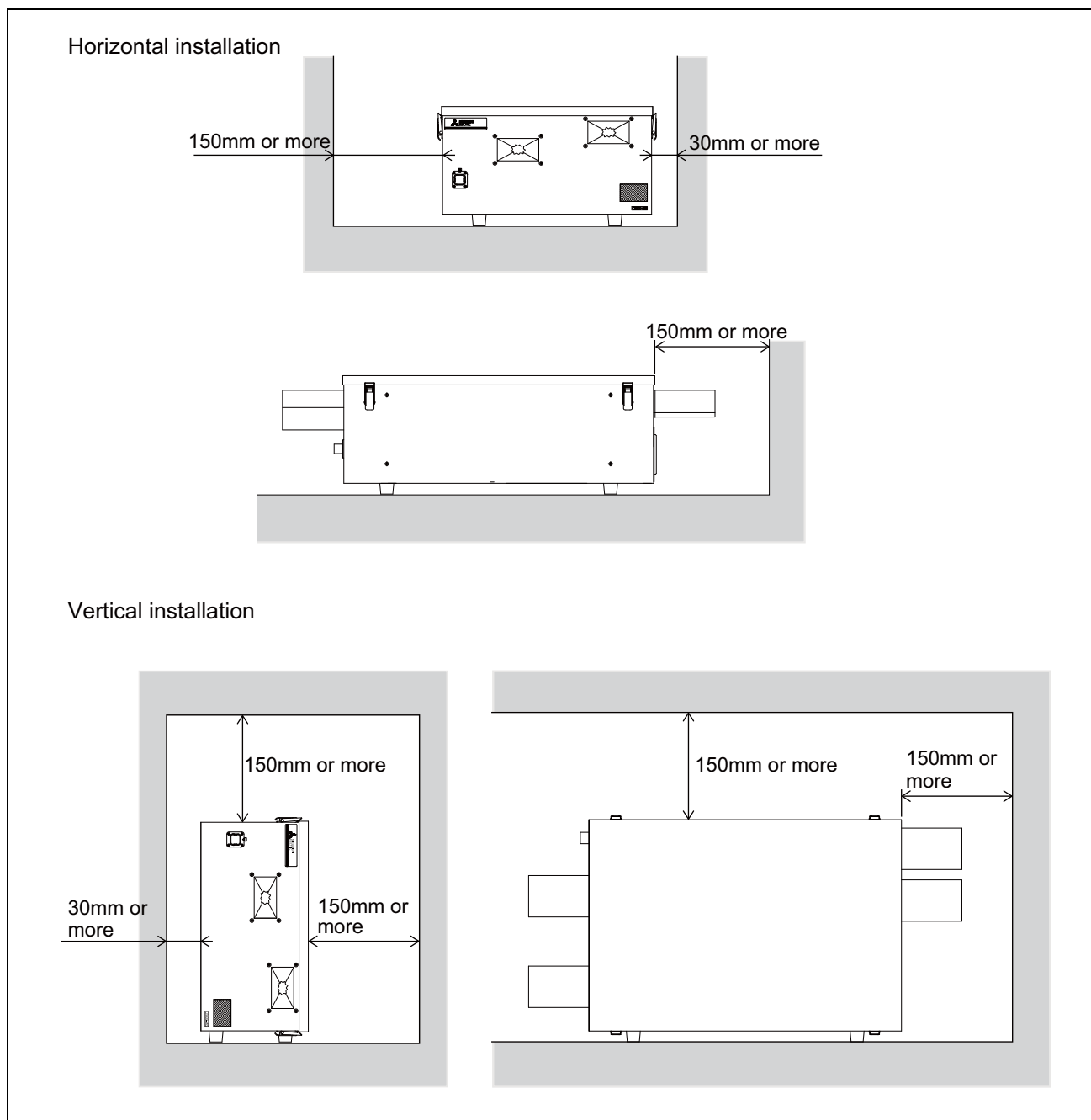


Fig.3-24: Installation dimensions

(5) MELSOFT RT ToolBox3/MELSOFT RT ToolBox3 mini/MELSOFT RT ToolBox3 Pro

- Order type:
- MELSOFT RT ToolBox3
*For windows DVD-ROM : 3F-14C-WINE
 - MELSOFT RT ToolBox3 mini
*For windows DVD-ROM : 3F-15C-WINE
 - MELSOFT RT ToolBox3 Pro
*For windows DVD-ROM : 3F-16D-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 (maintenance forecast).

■ Configuration

Table 3-17: Product configuration

| Part name | Type | Medium | Mass (kg) ^{Note1)} | Remarks |
|------------------|-------------|---------|-----------------------------|---------|
| RT ToolBox3 | 3F-14C-WINE | DVD-ROM | 0.2 | |
| RT ToolBox3 mini | 3F-15C-WINE | DVD-ROM | 0.2 | |
| RT ToolBox3 Pro | 3F-16D-WINE | DVD-ROM | 0.2 | |

Note1) 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 of MELSOFT RT ToolBox3, 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.

MELSOFT RT ToolBox3 Pro allows a simulation of robot operation on three-dimensional CAD software SolidWorks®.

(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.

Maintenance forecast is not supported with controller software versions A5n or earlier (shipped before April 2021). When updating the software version to a version that supports the maintenance forecast function, the maintenance forecast results will not be correct as the operation data for the period of time the robot was used with the unsupported software will not have been calculated.

(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 3-18: Functions

| Function | | Functional existence ^{Note1)} | | | Details |
|------------------------------------|---------------------|--|---|---|--|
| Compatible model | | ○ | ○ | ○ | Personal computer running Windows 7, Windows 8, Windows 8.1, or Windows 10. ^{Note2)} |
| Program editing functions | Editing functions | ○ | ○ | ○ | <ul style="list-style-type: none"> • MELFA BASIC V, VI language compatible • Multiple editing screen simultaneously display • Command input, comment writing • Position data editing • File operation (writing to controller, 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 |
| Simulation function on SolidWorks. | | ○ | × | × | <ul style="list-style-type: none"> • Off-line simulation of robot program operation using CG (computer graphics) • Tact time calculation • Complex motion path generation, etc. |

_____ MELSOFT RT ToolBox3 mini (3F-15C-WINE)

_____ MELSOFT RT ToolBox3 (3F-14C-WINE)

_____ MELSOFT RT ToolBox3 Pro (3F-16D-WINE)

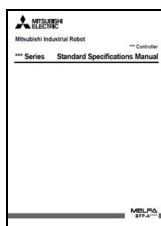
Note1) The functions included with the MELSOFT RT ToolBox3 ,MELSOFT RT ToolBox3 mini, and the MELSOFT RT ToolBox3 Pro are shown below. ○: Function provided ×: Function not provided

Note2) Recommend corresponding to CE Marking, an FCC standard, and a VCCI standard.

(6) Instruction Manual (bookbinding)

■Order type: • 5F-BR01-PE01: Instruction manuals of RV-8CRL

■Outline



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

■Configuration

Table 3-19: Product configuration

| Name | Type | Mass (Kg) ^{Note1)} | Specifications |
|---|--------------|-----------------------------|--|
| Instruction Manual | 5F-BR01-PE01 | 3.0 | The instructions manual set of RV-8CRL. |
| Safety Manual | BFP-A3541 | - | Items relating to safety in handling the robot |
| Standard Specifications | BFP-A3678 | - | Specification of the robot arm and controller |
| Robot Arm Setup & Maintenance | BFP-A3679 | - | Installation method of the robot arm, jog operation, and maintenance and inspection procedures |
| Controller Setup, Basic Operation and Maintenance | BFP-A3476 | - | Installation method of the controller, basic operation, and maintenance and inspection procedures |
| Detailed Explanation of Functions and Operations | BFP-A3478 | - | Functions of the controller and T/B, operation method, and explanation of MELFA-BASIC VI. |
| Troubleshooting | BFP-A3480 | - | Causes of errors occurred and their countermeasures |
| Additional axis function | BFP-A3504 | - | Function of the additional axis, operation method. |
| Tracking Function | BFP-A3520 | - | Function of the tracking, operation method. |
| GOT Direct Connection Extended Function | BFP-A3546 | - | Explains of data configuration of shared memory, monitoring, and operating procedures, between the GOT and controller. |
| Ethernet Function | BFP-A3379 | - | Ethernet communication method between personal computer and robot controller. |

Note1) Mass indicates one set.

(7) 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 3-20: Configuration device

| Part name | Type | Qty. | Mass (kg) ^{Note1)} | 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 | | | |

Note1) Mass indicates one set.

■Specifications

Table 3-21: Electrical specifications of input circuits

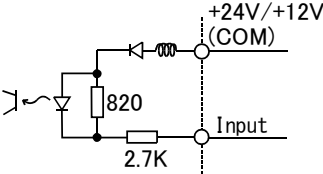
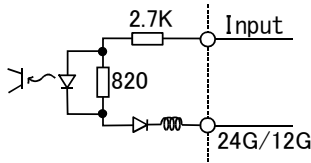
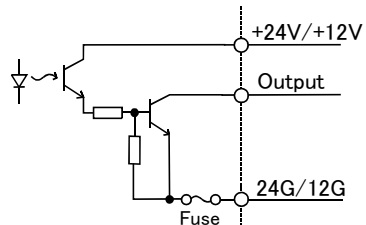
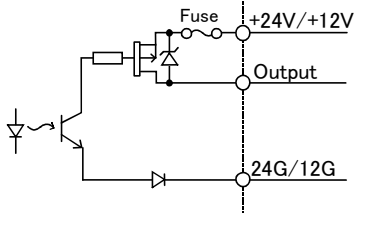
| Item | | Specification | Internal circuit |
|----------------------------------|--------|---|---|
| Type | | DC input | <div><Sink type></div>  <div><Source type></div>  |
| Number of input points | | 32 | |
| Insulation method | | Photo coupler insulation | |
| Rated input voltage | | DC12V DC24V | |
| Rated input current | | Approx. 3mA Approx.9mA | |
| Working voltage range | | DC10.2 to 26.4V (Ripple factor should be less than 5%) | |
| ON voltage/ON current | | DC8V or more/2mA or more | |
| OFF voltage/ OFF current | | DC4V or less/1mA or less | |
| Input resistance | | Approx. 2.7kΩ | |
| Response time | OFF-ON | 10ms or less(DC24V) | |
| | ON-OFF | 10ms or less(DC24V) | |
| Common method | | 32 points per common | |
| External cable connection method | | Connector | |

Table 3-22: 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 | | DC12V/DC24V | |
| Rated load voltage range | | DC10.2 to 30V (peak voltage DC30V) | |
| Max. load current | | 0.1A/point (100%) | |
| Leakage current at OFF | | Within 0.1mA | |
| Max. voltage drop at ON | | DC0.9V(TYP.) ^{Note1)} | |
| Response time | OFF-ON | 10ms or less (Resistance load) (hardware response time) | |
| | ON-OFF | 10ms or less (Resistance load) (hardware response time) | |
| Fuse rating | | Fuse 1.6A (one per common) Replacement possible (max. 3) | |
| Common method | | 16 points per common (common terminal: 2points) | |
| External wire connection method | | Connector | |
| External power supply | Voltage | DC12/24V(DC10.2 to 30V) | |
| | Current | 60mA (TYP.DC24V per common) (base drive current) | |

Note1) The maximum voltage drop value at signal ON.

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

*A voltage exceeding the rated voltage or incorrect wiring may damage the 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.

SLOT1: station number 0 (0 to 31)

SLOT2: 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.

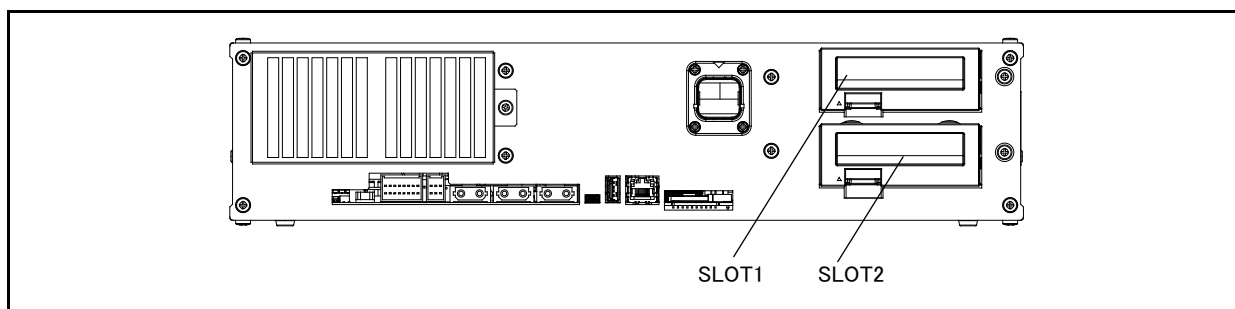


Fig.3-25: Parallel I/O interface installation position

■ Pin layout of connector

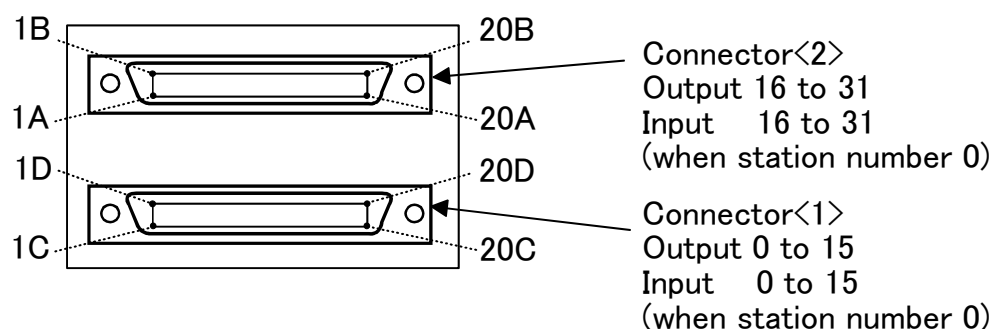


Fig.3-26: Pin layout of connector

■ 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 3-23: The slot number and the station number

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

The connector pin number of the parallel input-and-output interface installed in SLOT1 and signal number allocation are shown in [Table 3-24](#) and [Table 3-25](#). If it installs in other slots, please interpret and utilize.

Table 3-24: 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 COM: For pins 5C-20C ^{Note1)} Reserved Reserved | 1D | Orange/Black a | General-purpose output 15 | +24V/+12V(COM): For pins 5D-20D Reserved |
| 2C | Gray/Red a | | | 2D | Gray/Black a | | |
| 3C | White/Red a | | | 3D | White/Black a | | Reserved |
| 4C | Yellow/Red a | | | 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 ^{Note2)} | 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 ^{Note2)} | 16D | Orange/Black d | General-purpose output 4 | Operation rights output signal ^{Note2)} Error occurring output signal ^{Note2)} In servo ON output signal ^{Note2)} Operating output ^{Note2)} |
| 17C | Gray/Red d | General-purpose input 3 | Start input ^{Note2)} | 17D | Gray/Black d | General-purpose output 3 | |
| 18C | White/Red d | General-purpose input 2 | Error reset input signal ^{Note2)} | 18D | White/Black d | General-purpose output 2 | |
| 19C | Yellow/Red d | General-purpose input 1 | Servo OFF input signal ^{Note2)} | 19D | Yellow/Black d | General-purpose output 1 | |
| 20C | Pink/Red d | General-purpose input 0 | Stop input ^{Note3)} | 20D | Pink/Black d | General-purpose output 0 | |

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

Note2) The dedicated signal is assigned at shipping. It can change with the parameter.

Note3) The dedicated input signal (STOP) is assigned at shipping. The signal number is fixing.

Table 3-25: 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 COM: For pins 5A-20A ^{Note1)} Reserved Reserved | 1B | Orange/Black a | General-purpose output 31 | +24V/+12V(COM): For pins 5B-20B Reserved |
| 2A | Gray/Red a | | | 2B | Gray/Black a | | |
| 3A | White/Red a | | | 3B | White/Black a | | Reserved |
| 4A | Yellow/Red a | | | 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 | |

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

<Reference> The example of connection with our PLC

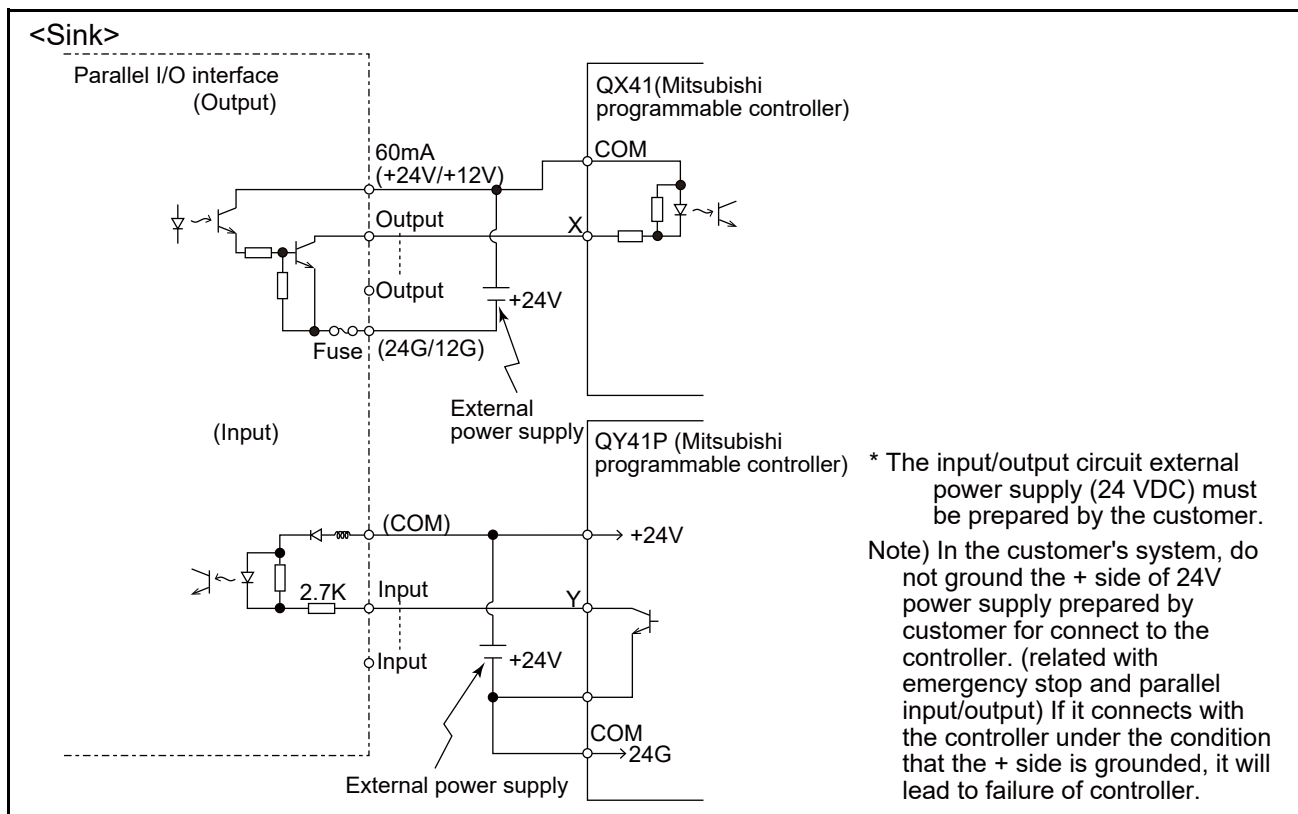


Fig.3-27: Connection with a Mitsubishi PLC (Example of sink type)

The following shows an example of a protective circuit.

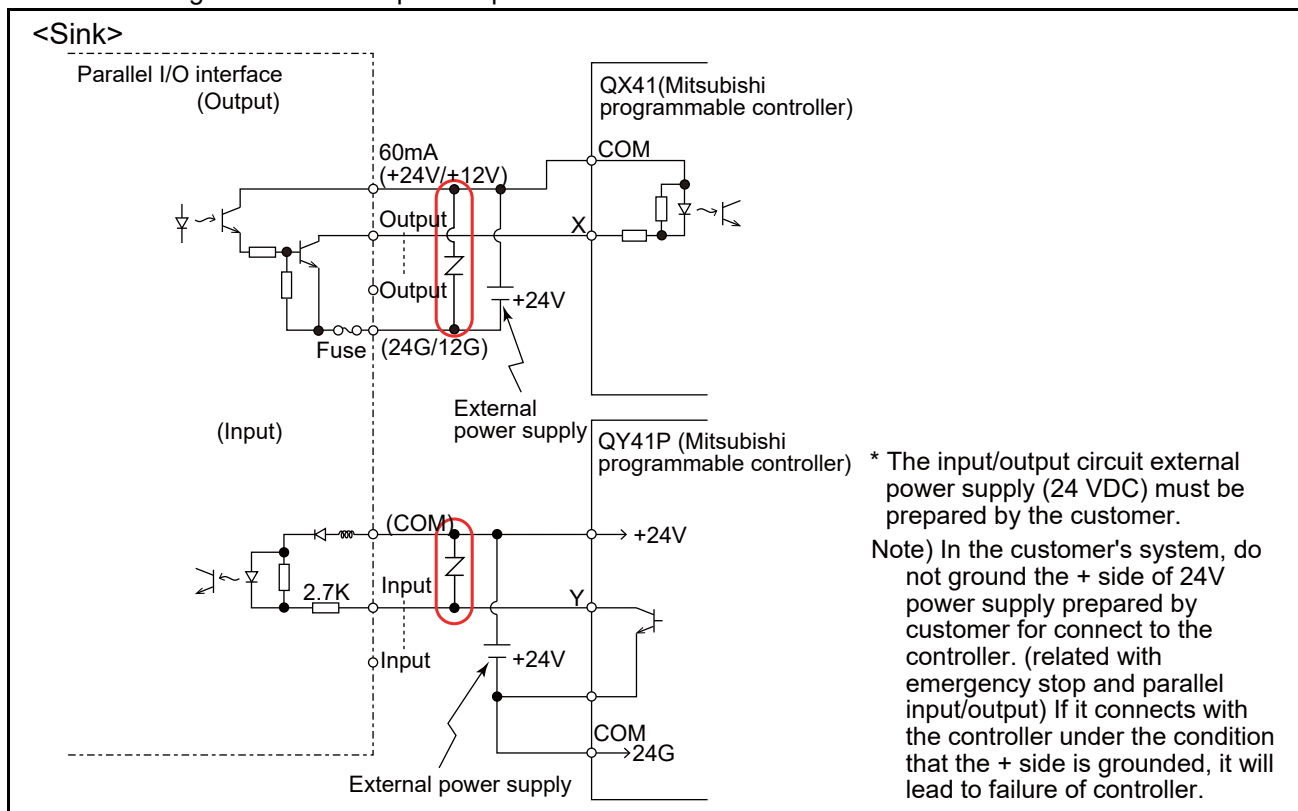


Fig.3-28: Connection with a Mitsubishi PLC (Example of sink type) for use of a protective circuit

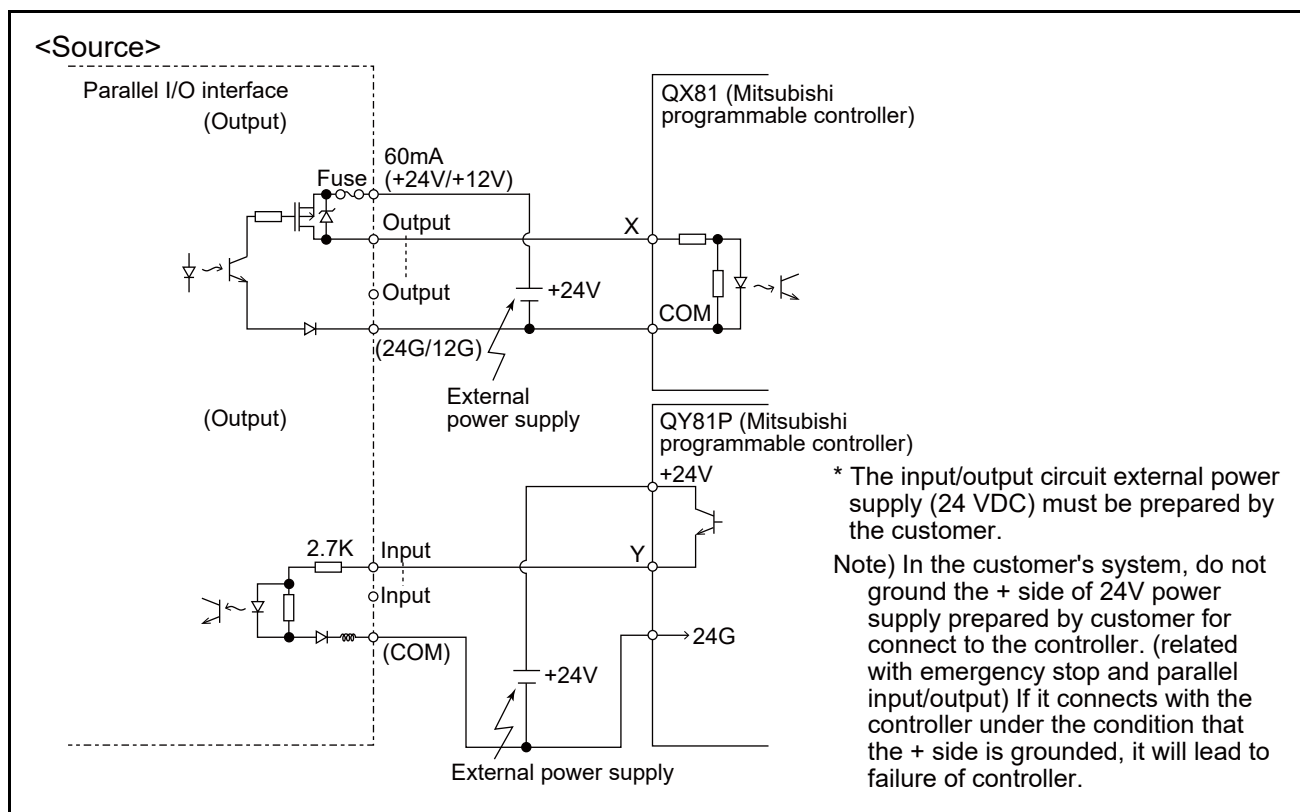


Fig.3-29: Connection with a Mitsubishi PLC (Example of source type)

The following shows an example of a protective circuit.

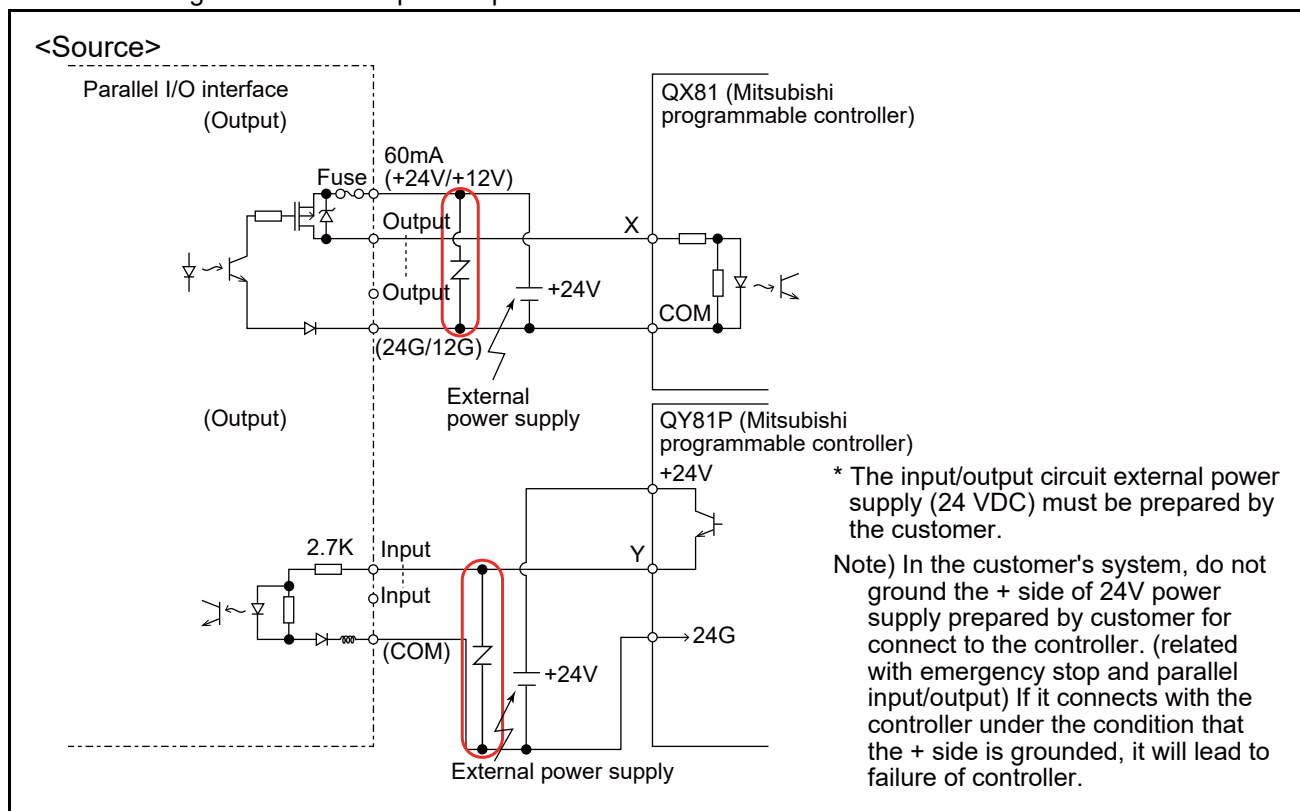


Fig.3-30: Connection with a Mitsubishi PLC (Example of source type) for use of a protective circuit

(8) External I/O cable

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

■Outline



This is the dedicated cable used to connect an external peripheral device to the connector on the parallel I/O interface. For parallel I/O unit is another option 2A-CBL□□.

One end matches the connector on the parallel input/output unit, and the other end is free. Connect the peripheral device's input/output signal using the free end. One cable correspond to the input 16 points and output 16 points.

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

■Configuration

Table 3-26: Configuration device

| Part name | Type | Qty. | Mass (kg) ^{Note1)} | Remarks |
|--------------------|----------|-------|-----------------------------|-----------|
| External I/O cable | 2D-CBL□□ | 1 pc. | 0.7(5m) 1.84(15m) | 5m or 15m |

Note1) Mass indicates one set.

■Specifications

Table 3-27: Specifications

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

■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 |
|---------|--------------|---------|--------------|---------|----------------|---------|----------------|
| 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 3-37: Connector pin numbers and cable colors" when making the connections.

(Eg.) Pin number: color indication

1 : Orange / Red / a

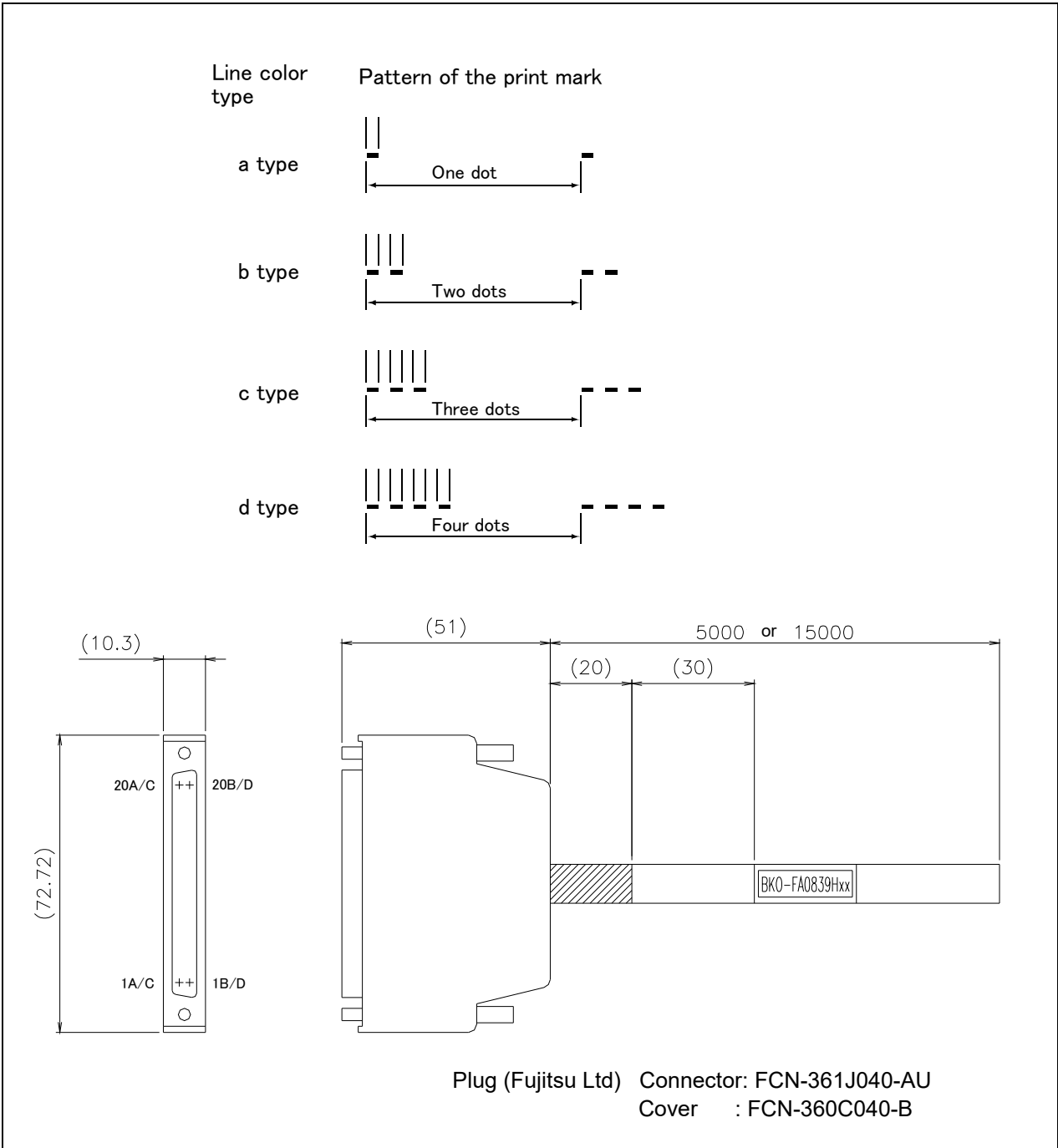
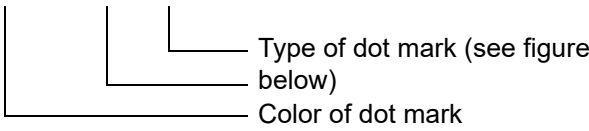


Fig.3-31: Connections and outside dimensions

(9) 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.

- 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-TZ368/2D-TZ378) 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 3-29: Configuration device

| Part name | Type | Qty. | Mass (kg) ^{Note1)} | 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 | | | |
| 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 | Each 1 set | - | Connector with pins. The cable must be prepared and wired by the customer. |
| Terminator | R-TM | 1 pc. | - | 100Ω (1/4W) |

Note1) Mass indicates one set.

■Specifications

- 1) Up to eight stations can be connected to this unit (one station occupies one unit).
The combined use with another optional parallel I/O interface (2D-TZ368/2D-TZ378) is possible, but the maximum number of stations is eight in total. In this case, set any of station numbers carefully so that they do not duplicate.
- 2) The power supply (24V) must be prepared by the customer and connected with the power connection cable (DCcable-2)
A separate 24V power supply is required for the input/output circuit wiring.

Table 3-30: Electrical specifications of input circuits

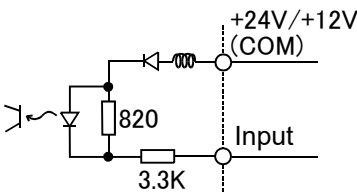
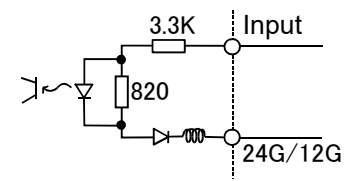
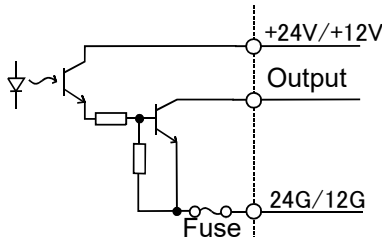
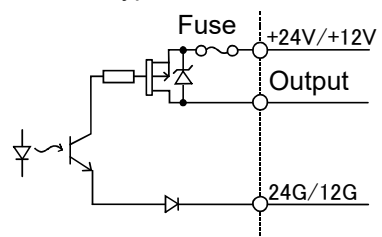
| Item | | Specification | Internal circuit |
|----------------------------------|--------|---|---|
| Type | | DC input | <div><Sink type></div>  <div><Source type></div>  |
| Number of input points | | 32 | |
| Insulation method | | Photo coupler insulation | |
| Rated input voltage | | 12VDC 24VDC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

Table 3-31: Electrical specifications for the output circuits

| Item | | Specification | Internal circuit |
|---------------------------------|---------|--|--|
| Type | | Transistor output | <div><Sink type></div>  <div><Source type></div>  |
| No. of output points | | 32 | |
| Insulation method | | Photo-coupler insulation | |
| Rated load voltage | | 12VDC/24VDC | |
| Rated load voltage range | | 10.2 to 30VDC (peak voltage 30VDC) | |
| Max. load current | | 0.1A/point (100%) | |
| Leakage current at OFF | | 0.1mA or less | |
| Max. voltage drop at ON | | 0.9VDC (TYP.) ^{Note1)} | |
| Response time | OFF-ON | 2ms or less (hardware response time) | |
| | ON-OFF | 2ms or less (Resistance load) (hardware response time) | |
| Fuse rating | | Fuse 3.2A (one per common) Replacement not possible | |
| Common method | | 8 points per common (common terminal: 4 points) | |
| External wire connection method | | Connector | |
| External power supply | Voltage | 12VDC/24VDC (10.2 to 30VDC) | |
| | Current | 60mA (TYP. 24VDC per common) (base drive current) | |

Note1) The maximum voltage drop value at signal ON.

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

*A voltage exceeding the rated voltage or incorrect wiring may damage the 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.

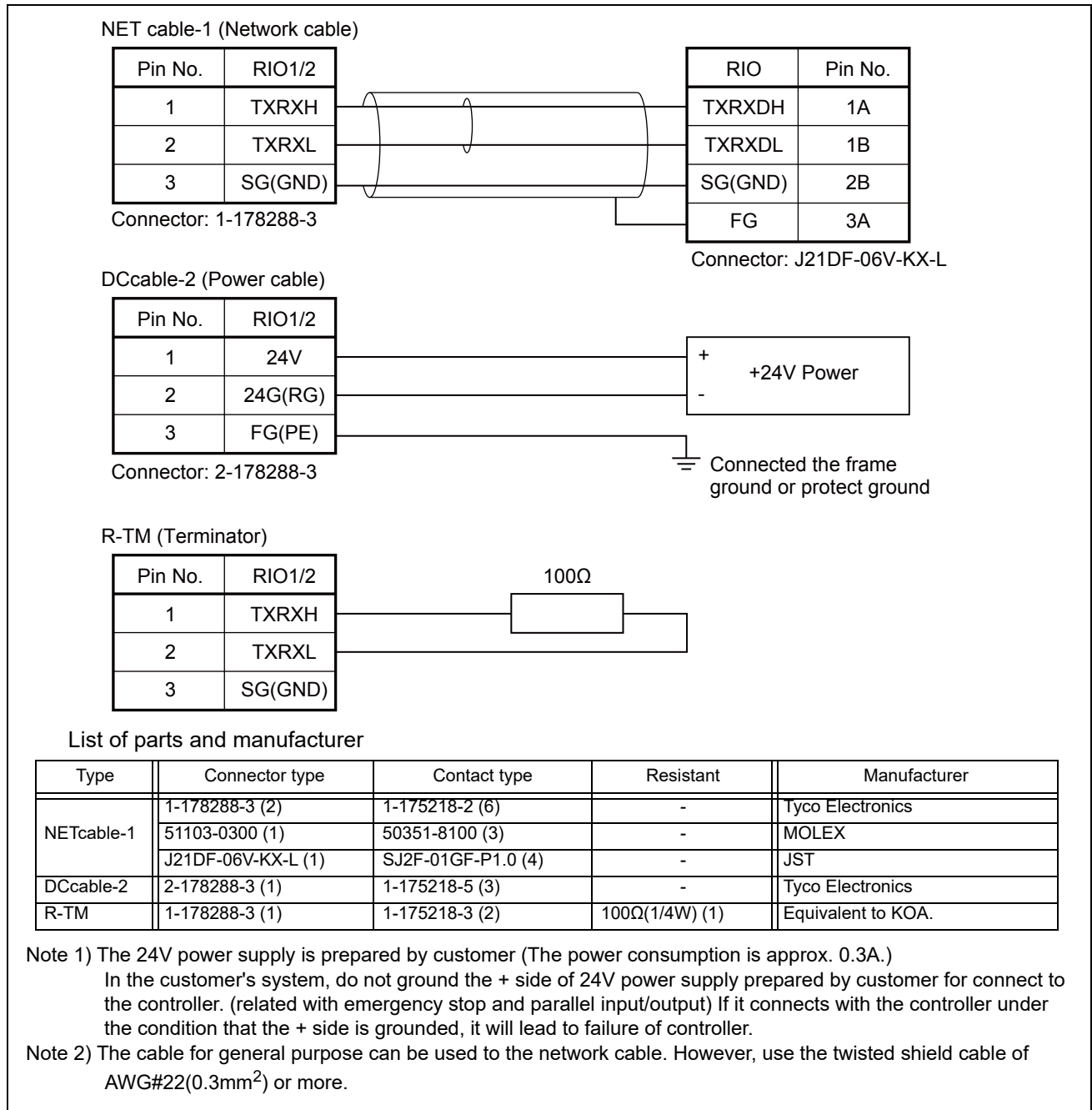


Fig.3-32: Specifications for the connection cable

■ 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 front of the controller.

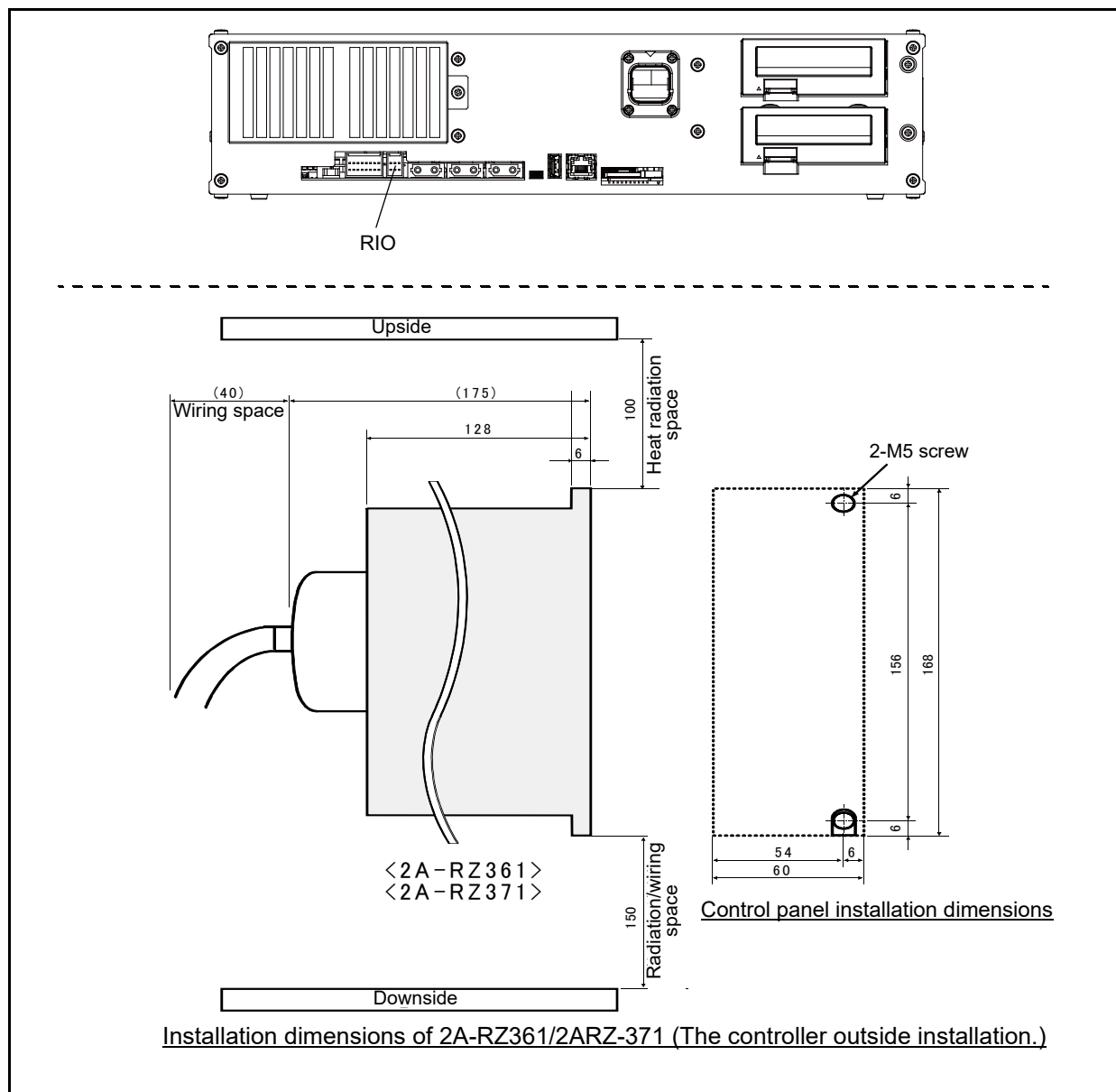


Fig.3-33: Installing the parallel I/O unit

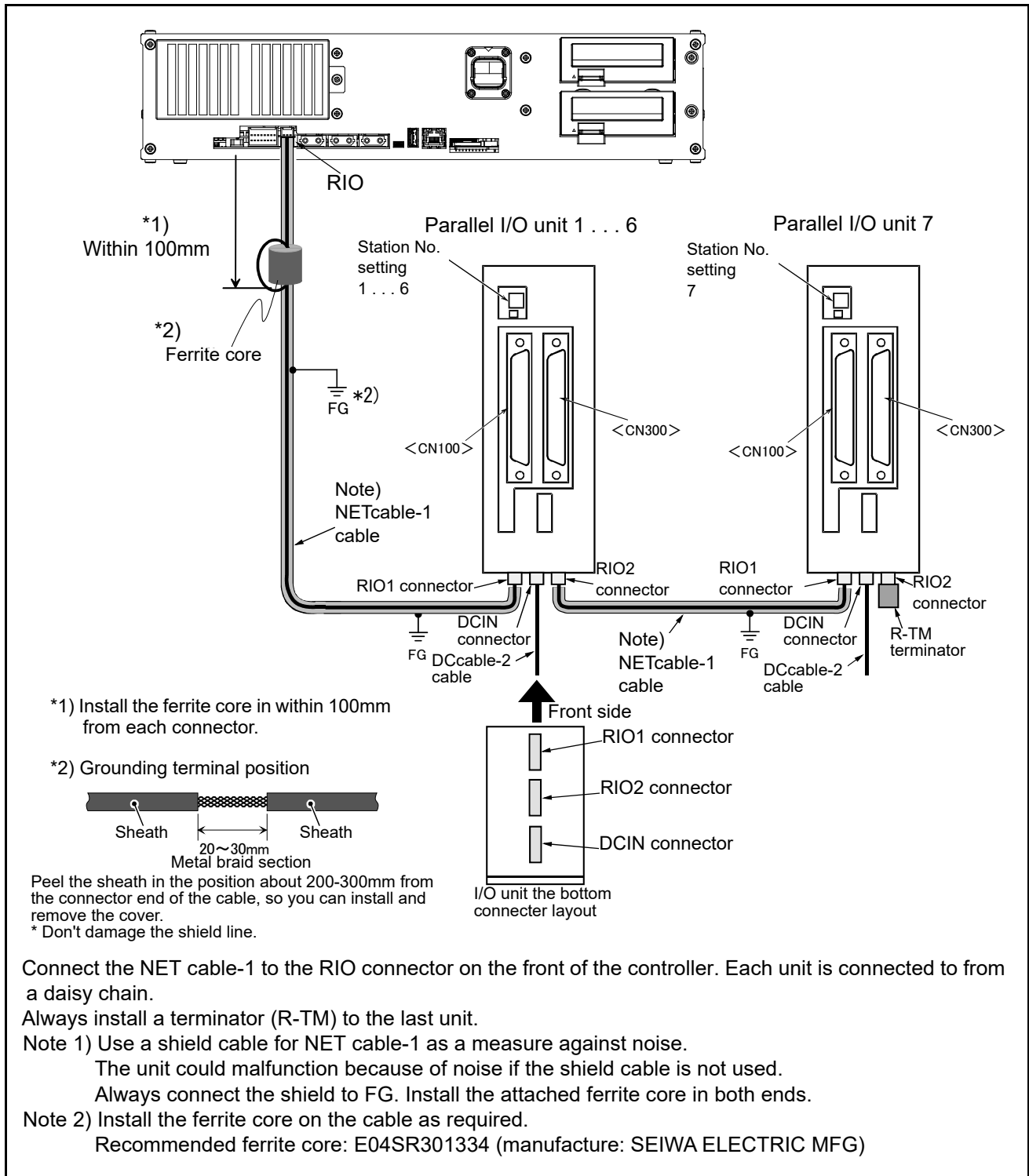


Fig.3-34: Connection method of expansion parallel I/O unit

■ Pin arrangement of the connector

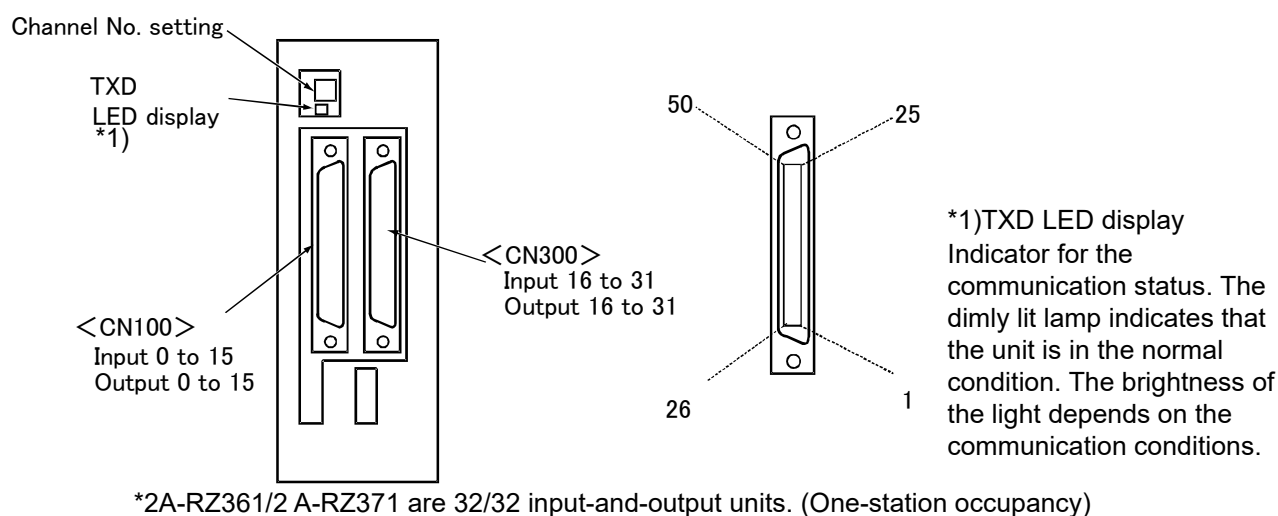


Fig.3-35: Pin arrangement of the parallel I/O unit

■ 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.

Although the combined use with the parallel I/O interface (2D-TZ368/2D-TZ378) of another option is also possible, please use the setup of the station number by the different number separately.

Table 3-32: 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 3-33](#) and [Table 3-34](#). If it is set as other station number, please interpret and utilize.

Table 3-33: CN100 connector signal assignment/external I/O cable 2A-CBL□□ wire color list (station number "0")

| 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 | | 0V:For pins 4-7, 10-13 | 27 | Gray/Blue A | | 0V:For pins 29-32, 35-38 |
| 3 | White/Red A | | 12V/24V:For pins 4-7 | 28 | White/Blue A | | 12V/24V:For pins 29-32 |
| 4 | Yellow/Red A | | Operating output ^{Note1)} | 29 | Yellow/Blue A | | |
| 5 | Pink/Red A | | In servo ON output signal ^{Note1)} | 30 | Pink/Blue A | | |
| 6 | Orange/Red B | General-purpose output 2 | Error occurring output signal ^{Note1)} | 31 | Orange/Blue B | General-purpose output 6 | |
| 7 | Gray/Red B | General-purpose output 3 | Operation rights output signal ^{Note1)} | 32 | Gray/Blue B | General-purpose output 7 | |
| 8 | White/Red B | General-purpose output 8 | 0V:For pins 4-7, 10-13 | 33 | White/Blue B | General-purpose output 12 | 0V:For pins 29-32, 35-38 |
| 9 | Yellow/Red B | | 12V/24V:For pins 10-13 | 34 | Yellow/Blue B | | 12V/24V:For pins 35-38 |
| 10 | Pink/Red B | | | 35 | Pink/Blue B | | |
| 11 | Orange/Red C | General-purpose output 9 | COM0:For pins 15-22 ^{Note2)} | 36 | Orange/Blue C | General-purpose output 13 | COM1:For pins 40-47 ^{Note2)} |
| 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 | | 40 | Pink/Blue C | General-purpose input 8 | |
| 16 | Orange/Red D | General-purpose input 1 | Servo OFF input signal ^{Note1)} | 41 | Orange/Blue D | General-purpose input 9 | |
| 17 | Gray/Red D | General-purpose input 2 | Error reset input signal ^{Note1)} | 42 | Gray/Blue D | General-purpose input 10 | |
| 18 | White/Red D | General-purpose input 3 | Start input ^{Note1)} | 43 | White/Blue D | General-purpose input 11 | |
| 19 | Yellow/Red D | General-purpose input 4 | Servo ON input signal ^{Note1)} | 44 | Yellow/Blue D | General-purpose input 12 | |
| 20 | Pink/Red D | General-purpose input 5 | Operation rights input signal ^{Note1)} | 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 | | |

Note1) The dedicated signal is assigned at shipping. It can change with the parameter.

Note2) Sink type:12V/24V(COM),Source type:0V(COM)

Note3) The dedicated input signal (STOP) is assigned at shipping. The signal number is fixing.

Table 3-34: CN300 connector signal assignment/external I/O cable 2A-CBL□□ wire color list (station number "0")

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

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

<Reference> The example of connection with our PLC

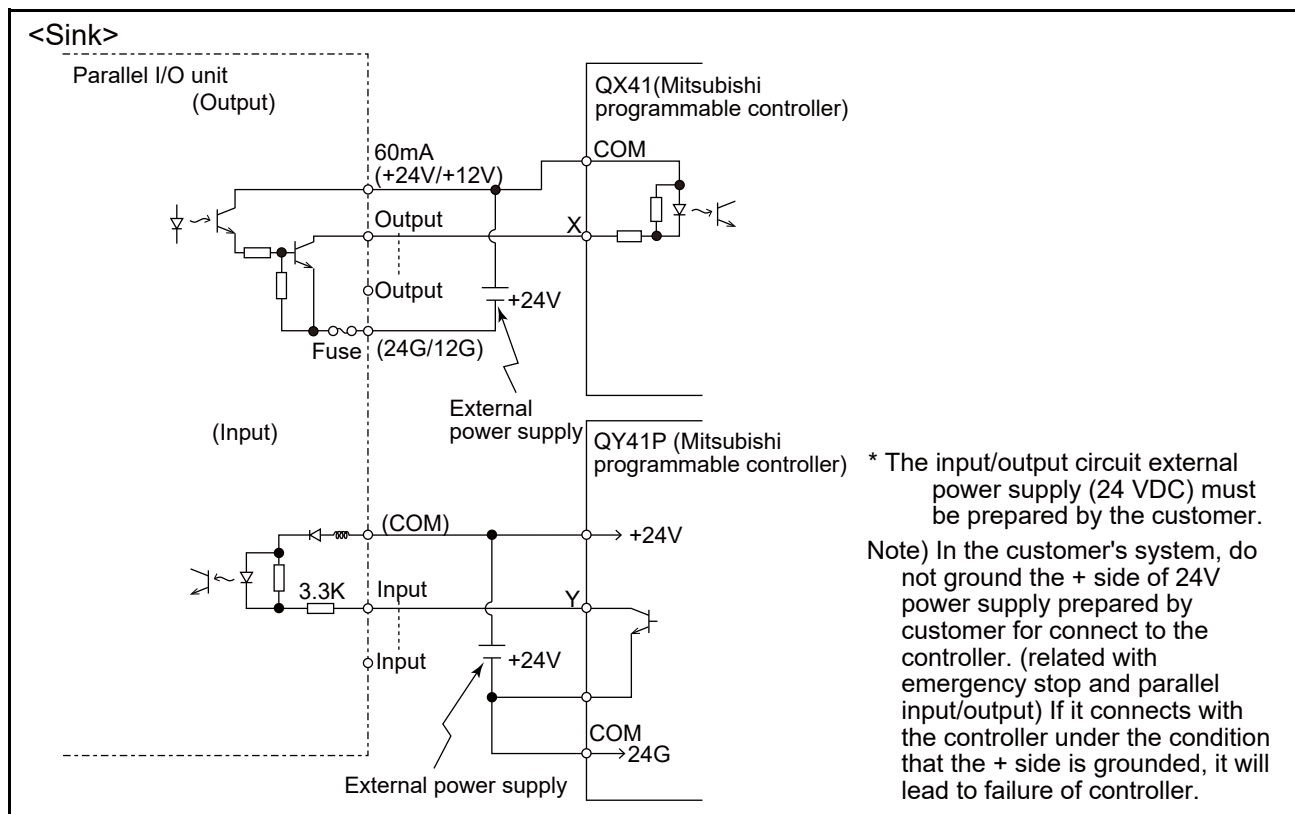


Fig.3-36: Connection with a Mitsubishi PLC (Example of sink type)

The following shows an example of a protective circuit.

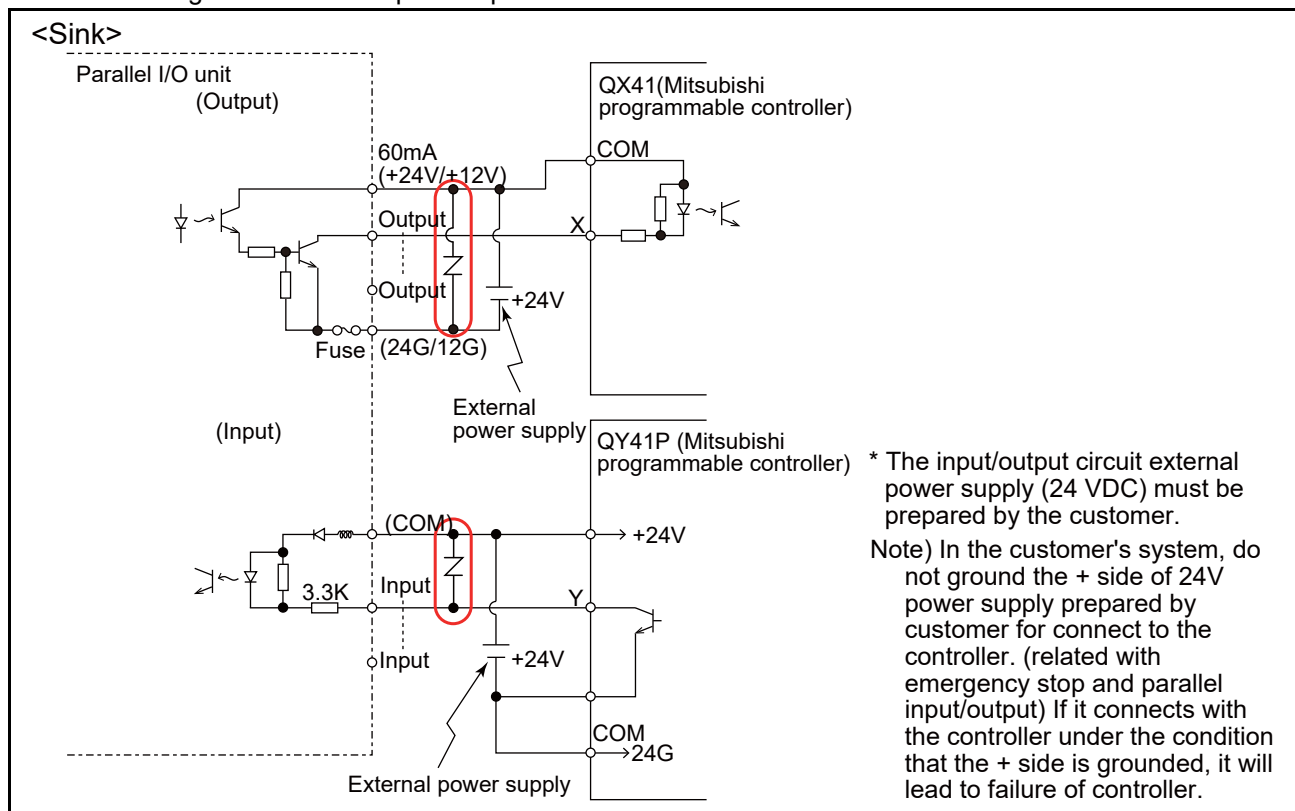


Fig.3-37: Connection with a Mitsubishi PLC (Example of sink type) for use of a protective circuit

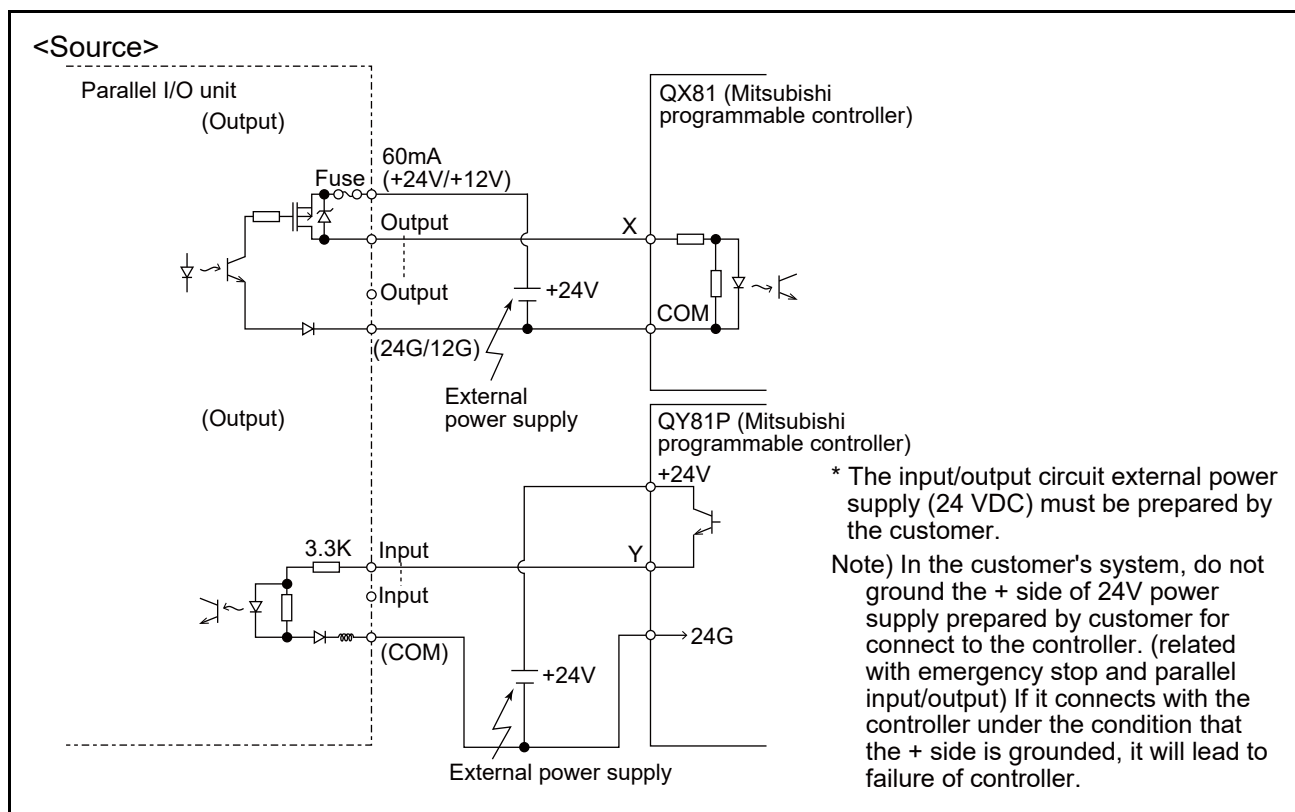


Fig.3-38: Connection with a Mitsubishi PLC (Example of source type)

The following shows an example of a protective circuit.

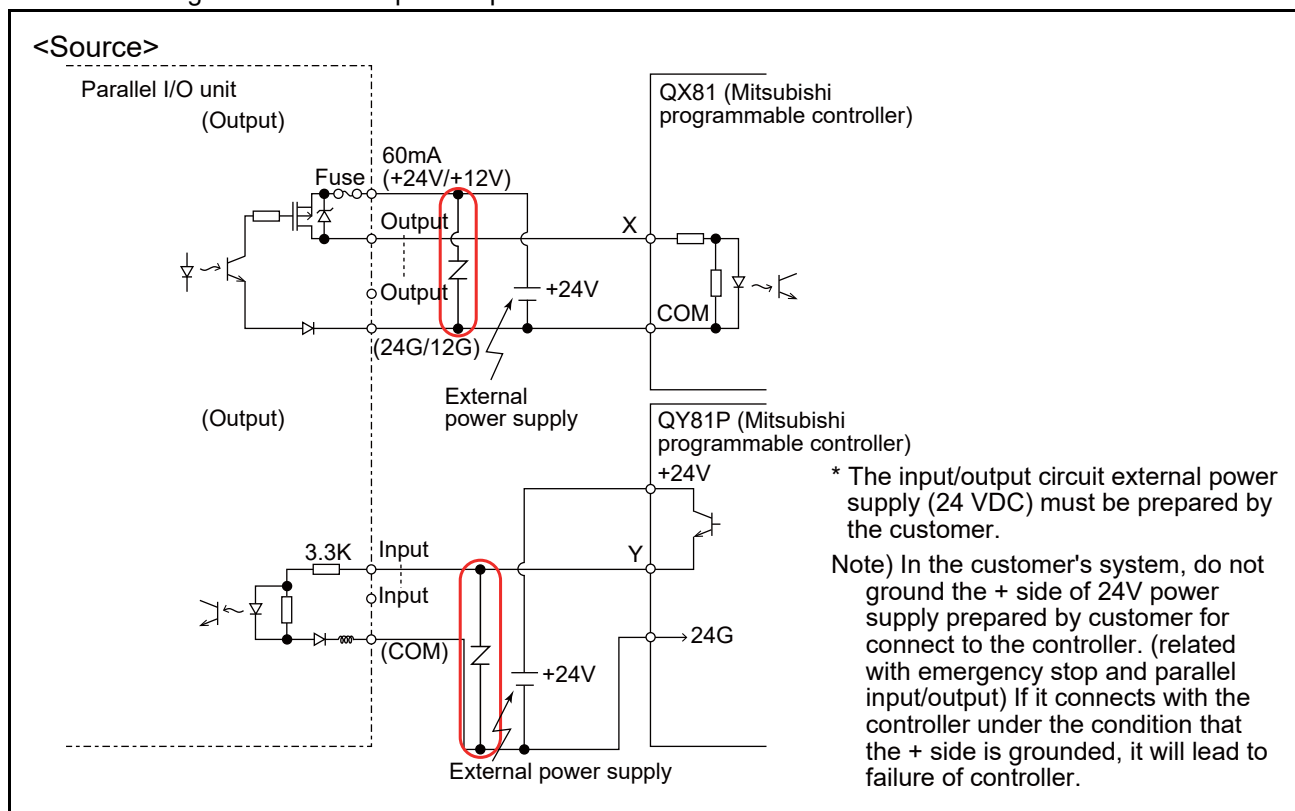


Fig.3-39: Connection with a Mitsubishi PLC (Example of source type) for use of a protective circuit

(10) External I/O cable

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

■Outline



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

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

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

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

■Configuration

Table 3-35: Configuration device

| Part name | Type | Qty. | Mass(kg) ^{Note1)} | Remarks |
|--------------------|----------|------|----------------------------|-----------|
| External I/O cable | 2A-CBL□□ | 1pc. | 0.7(5m) 1.84(15m) | 5m or 15m |

Note1) Mass indicates one set.

■Specifications

Table 3-36: Specifications

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

■Connector pin numbers and cable colors

Table 3-37: 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 3-37: Connector pin numbers and cable colors" when making the connections.

(Eg.) Pin number: color indication

1 : Orange / Red / A

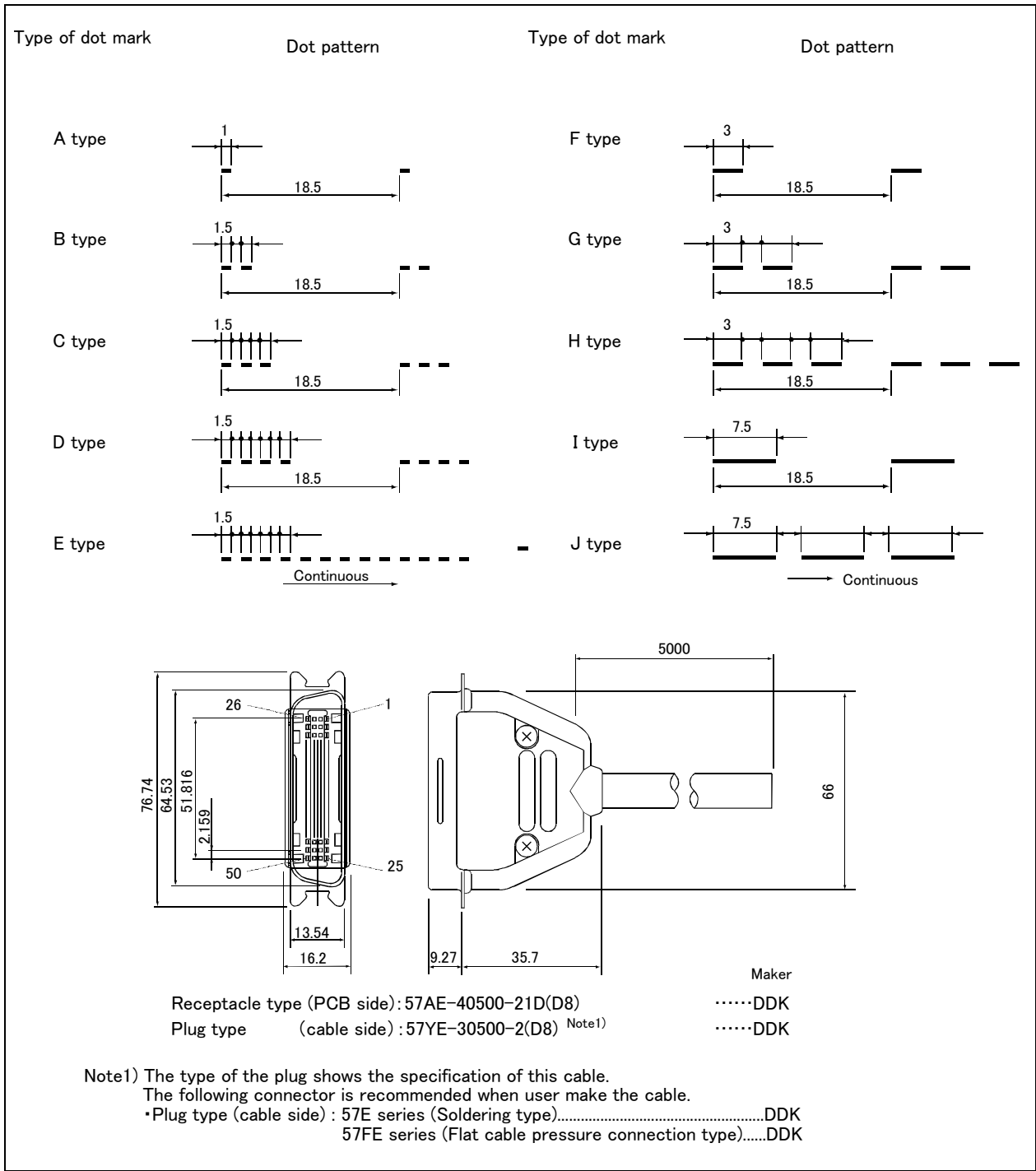
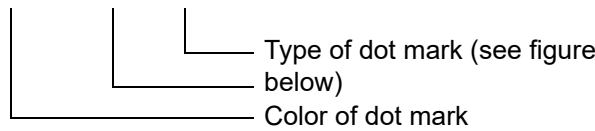


Fig.3-40: Connections and outside dimensions

(11) 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 3-38: Configuration device

| Part name | Type | Qty. | Mass(kg) ^{Note1)} | 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 | - | |

Note1) Mass indicates one set.

Table 3-39: Procured by the customer

| Part name | Type | Qty. | Remarks |
|---------------------|---|------|-----------------|
| Master station | FX3U-16CCL-M (FX series) | 1 | |
| | RJ61BT11 (R series) | | |
| | QJ61BT11 (Q series) | | |
| | QJ61BT11N (Q series) | | |
| | AJ61QBT11 (QnA series) | | |
| | A1SJ61QBT11 (QnAS series) | | |
| | AJ61BT11 (A series) | | |
| | A1SJ61BT11 (AnS series) | | |
| | A80BD-J61BT11 (personal computer board) | | |
| Communication cable | - | 1 | Dedicated cable |

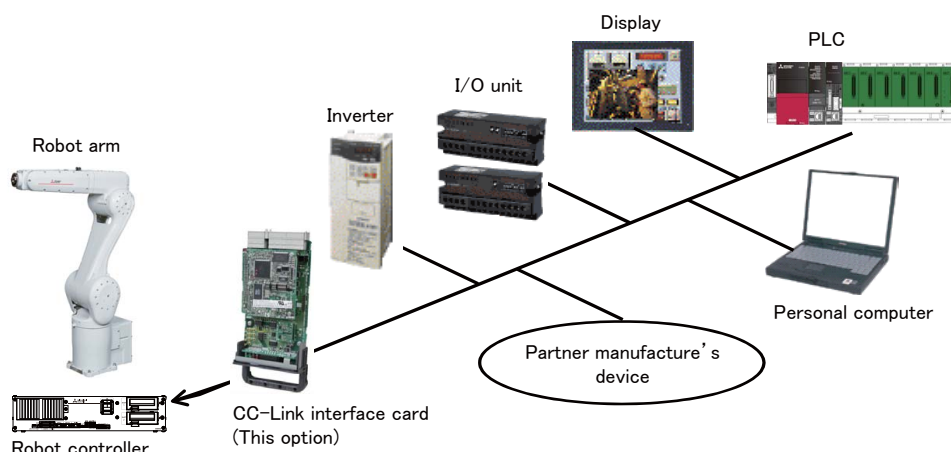


Fig.3-41: Example of CC-Link Product Configuration

■ Specifications

Table 3-40: Specifications

| Item | | | Specifications | | | | | Remarks |
|---|---------------------------------|--|--|--------------|--------------|--------------|--|--|
| Communication function | | | Bit data and word data can be transmitted. | | | | | Word data are used by the registers. |
| Station type | | | Intelligent device station ^{Note1)} | | | | | |
| Support station | | | Local station | | | | | No master station function |
| The version corresponding to CC-Link | | | Ver.2 | | | | | The extended cyclic setup is possible. |
| Mountable option slot | | | Slot 1, 2 | | | | | |
| 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 _r , RW _w) | Each 128 register | | | | | 16 bits/register |
| Extended cyclic setup | | - | 1 fold setup | 2 fold setup | 3 fold setup | 4 fold setup | | |
| Link point per set | When one station is occupied | Remote I/O (RX, RY). | 32 point | 32 point | 64 point | 128 point | | |
| | | Remote register (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." | | | | | |

Note1) 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, VI (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.
- A transmission speed can be selected from 10M, 5M, 2.5M, 625K and 156K bps according to the transmission distance.

(12) SD memory card

■Order type: 2F-2GBSD

■Outline



This card is used as an extended memory.

To save logging data, insert an SD card into the SD card slot on the front of the robot controller.

■Configuration

Table 3-41: Configuration device

| Part name | Type | Qty. | Remarks |
|----------------|----------|------|---------------------------|
| SD memory card | 2F-2GBSD | 1 | Memory card capacity: 2GB |

3.10 Maintenance parts

The consumable parts used in the controller are shown in [Table 3-42](#). 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 3-42: Controller consumable parts list

| No. | Name | Type ^{Note1)} | Qty. | Usage place | Supplier |
|-----|--------|------------------------|------|-------------------------|---------------------|
| 1 | Filter | BKOFA0773H42 | 1 | Inside the filter cover | Mitsubishi Electric |

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

4 Software

4.1 List of commands

The available new functions in MELFA-BASIC VI are given in [Table 4-1](#).

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

| Type | Class | Function | Input format (example) |
|--------------------------------|-------------------------|--|---|
| Structured programming | Function procedure | Defines the Function procedure. Function procedure summarizes a series of processing enclosed by the Function statement and the FEnd statement. | Function M Func(M1, M2) M3=M1+M2 Func=M3 Exit Function FEnd |
| | Library function | #Include statement | Reads the designated program. #Include "PRG1" |
| Position and operation control | Interpolation operation | Moves to the multiple designated positions with the designated interpolation operations and options. | Move L, P1, P2, P3, Spd=50 |
| | Joint interpolation | Moves to the designated position with joint interpolation. | Mov P1 |
| | Linear interpolation | Moves to the designated position with linear interpolation. | Mvs P1 |
| | Circular interpolation | Moves along a designated arc (start point→passing point→start point (end point)) with 3-dimensional circular interpolation (360 degrees). | Mvc P1,P2,P1 |
| | | Moves along a designated arc (start point→passing point→end point) with 3-dimensional circular interpolation. | Mvr P1,P2,P3 |
| | | Moves along the arc on the opposite side of a designated arc (start point→reference point→end point) with 3-dimensional circular interpolation. | Mvr2 P1,P9,P3 |
| | | Moves along a set arc (start point→end point) with 3-dimensional circular interpolation. | Mvr3 P1,P9,P3 |
| | Speed designation | Designates the speed for various interpolation operations with a percentage (0.1% unit). | Ovrd 100 |
| | | Designate the speed for joint interpolation operation with a percentage (0.1% unit). | JOvrd 100 |
| | | Designates the speed for linear and circular interpolation with a numerical value (mm/s unit). | Spd 123.5 |
| | | Designates the acceleration/deceleration time as a percentage in respect to the predetermined maximum acceleration/deceleration. (1% unit) | Accel 50,80 |
| | | Automatically adjusts the acceleration/deceleration according to the parameter setting value. | Oadl ON |
| | | 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. | Wthlf |
| | | 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 |
| | | 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 1.0,1.0,1.0,1.0,1.0,1.0,1.0,1.0,1.0 0 |

| Type | Class | Function | Input format (example) |
|--------------------------------|------------------------|--|--|
| Position and operation control | 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 |
| | Branching | Branches unconditionally to the designated place. | GoTo *LBL |
| | | Branches according to the designated conditions. | If M1=1 Then GoTo *L100 Else GoTo *L200 EndIf |
| | | 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. | FPm M10,P10 |
| | | Executes the subroutine corresponding to the designated expression value. | On M1 GoSub*La1,*La2,*La3 |
| | Interrupt | Defines the interrupt conditions and process. | Def Act 1, M1=1 GoTo *L123 |
| | | 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 *LABC |
| | | 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(20)=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,99 |
| | Input | Retrieves the general-purpose input signal. | M1=M_In (78) |
| | Output | Calls out the general-purpose output signal. | M_Out(23) =0 |
| Parallel execution | Mechanism designation | Acquires the mechanism with the designated mechanism No. | GetM 1 |
| | | Releases the mechanism with the designated mechanism No. | RelM 1 |
| | Selection | Selects the designated program for the designated slot. | XLoad 2,"P102" |
| | Start/stop | Carries out parallel execution of the designated program. | XRun 3,"100",0 |
| | | Stops parallel execution of the designated program. | XStp 3 |
| | | Returns the designated program's execution line to the head and enters the program selection enabled state. | XRst 3 |

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

4.2 List of parameters

Show the main parameter in the [Table 4-2](#).

Table 4-2: List of parameters

| Parameter | | Details |
|----------------------------------|--------------------------|---|
| Standard tool coordinates. | MEXTL | Set the default value for the tool data. Unit: mm or deg. |
| Standard base coordinates | MEXBS | Set the relation of the world coordinate system and robot coordinate system. Unit: mm or deg. |
| XYZ operation range | MEPAR | Designate the overrun limit value for the world coordinate system. |
| JOINT operation range | MEJAR | Set the overrun limit value for each joint axis. |
| Free plane limit | | This is the overrun limit set with the free plane. Create a plane with the three coordinates x1, y1, z1 to x3, y3, z3, and set the outer side of the plane as the outside operation range (error). The following three types of parameters are used. |
| | SFC1P : SFC8P | Eight types of free plane limits can be set in SFC1P to SFC8P. There are nine elements, set in the order of x1, y1, z1, x2, y2, z2, x3, y3, z3. |
| | SFC1ME : SFC8ME | Designate which mechanism to use eight types of set free plane limits. The mechanism No. to use is set with 1 to 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 turn the 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 | Sets the display language on the RT ToolBox3 (option). |

5 Instruction Manual

5.1 The details of each instruction manuals

The contents and purposes of the documents enclosed with this product are shown below.

Use these documents according to the application.

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

| Manual name | Description |
|--|---|
| Safety Manual | Explains the common precautions and safety measures to be taken for robot handling, system design and manufacture to ensure safety of the operators involved with the robot. |
| Standard Specifications | Explains the product's standard specifications, factory-set special specifications, option configuration and maintenance parts, etc. Precautions for safety and technology, when incorporating the robot, are also explained. |
| Robot Arm Setup & Maintenance | Explains the procedures required to operate the robot arm (unpacking, transportation, installation, confirmation of operation), and the maintenance and inspection procedures. |
| Controller setup, basic operation, and maintenance | Explains the procedures required to operate the controller (unpacking, transportation, installation, confirmation of operation), basic operation from creating the program to automatic operation, and the maintenance and inspection procedures. |
| Detailed explanations 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 | Explains the control function and specifications of conveyor tracking. |
| GOT Direct Connection Extended Function | Explains the detailed description of data configuration of shared memory, monitoring, and operating procedures about the GOT (standalone type robot). |
| Ethernet Function | Explains the measures to perform communication with personal computers on Ethernet with the TCP/IP protocol. |

6 Safety

6.1 Safety

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

6.1.1 Self-diagnosis stop functions

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

Table 6-1: Self-diagnosis stop functions

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

Table 6-2: List of stop functions

| Stop function | Teaching pendant | External input | Details |
|----------------|------------------|----------------|---|
| Emergency stop | ○ | ○ | The servo power is shut off and the mechanical brakes activate to stop the robot by stopping operation in an emergency. To recover, reset the alarm, and turn the servo ON with the servo ON command. |
| Stop | ○ | ○ | The robot immediately decelerates to stop by stopping operation as usual. 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 <small>Note1)</small> | Connector CNUSR11 | - | This servo power is shut off, and the robot stops immediately. | Externally installed emergency stop switch. Stopping at high-level error occurrence. |
| | Door switch input <small>Note1)</small> | | - | | The door switch of the safe protection fence. |
| | Stop | Parallel I/O unit or interface | STOP, STOP2 | 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 also shut off. |
| | Automatic operation enable | | AUTOENA | Disables automatic operation when inactive. | Door switch on safety protection fence. |
| Output | Emergency stop output | Connector CNUSR11 | - | 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, STOP2 | Outputs that the robot is temporarily stopped. | The temporary stop state is shown and alerted with the display lamps. |
| | In alarm | Connector CNUSR11 | ERRRESET | Outputs when an alarm occurs in the robot. | The alarm state is shown and alerted with the display lamps. |

Note1) The external emergency stop input and the door switch input have duplicate NC contacts for redundancy. Thus, if the emergency stop input circuit is opened when the robot is started up, the robot will not operate. Refer to [Page 104](#), "6.1.7 Examples of safety measures" for details. And, refer to [Page 49](#), "(1) Automatic Operation/Jog Operation/Brake Release and Necessary Switch Settings" for the function of the door switch input and the mode selector switch 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.

The safety measure examples are shown in Fig. 6-1 to Fig. 6-4. 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.

[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.

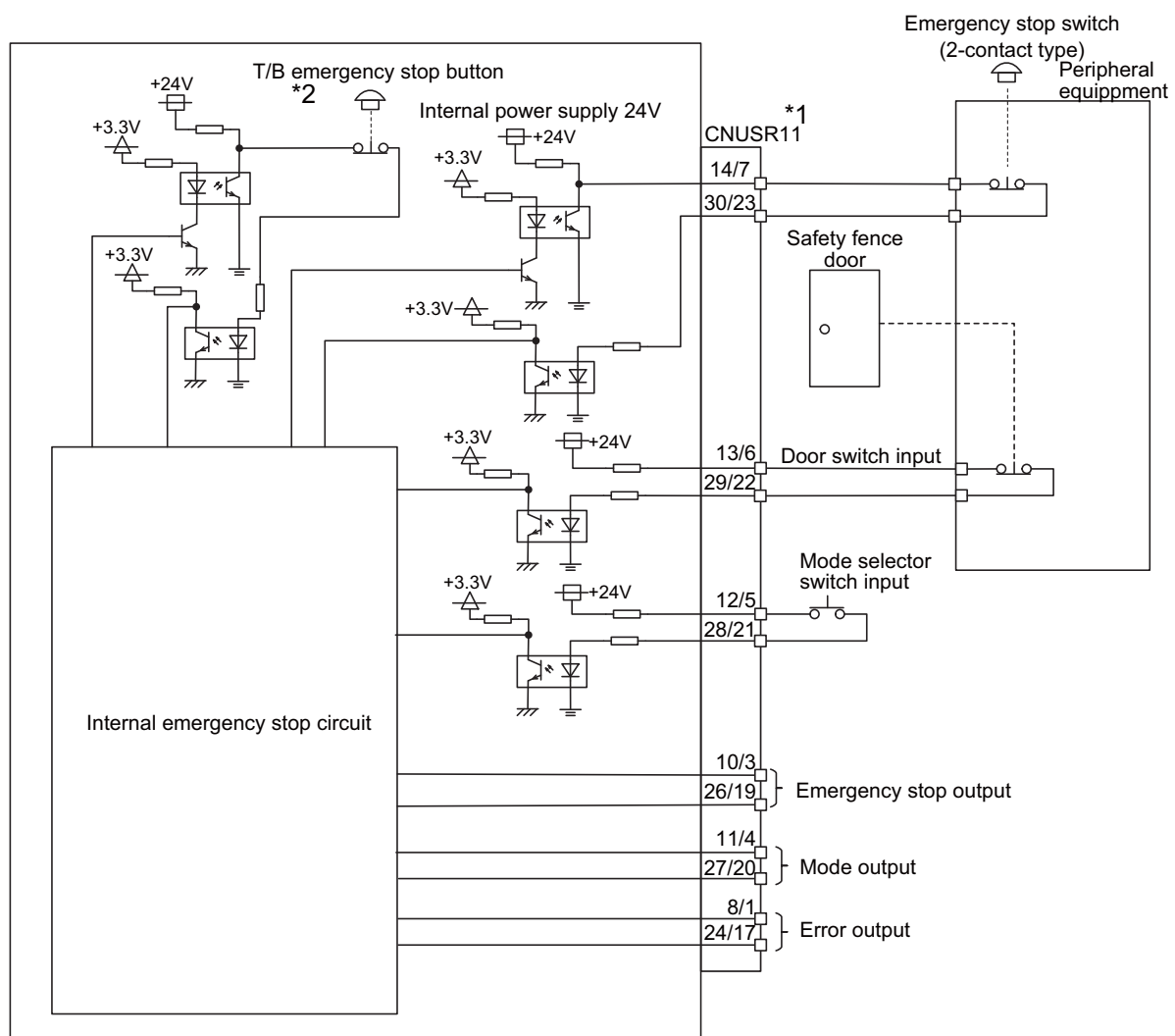
- Electric specification of the emergency-stop-related output terminal: 24V DC or less, related current 100mA or less.
- In the customer's system, do not ground the + side of 24V power supply prepared by customer for connect to the controller. (related with emergency stop and parallel input/output) If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

<Wiring example 1>: Connect the emergency stop switch of peripheral equipment to the controller.

The power supply for emergency stop input uses the power supply in the controller.

<Operation of the emergency stop>

If the emergency stop switch of peripheral equipment is pushed, the robot will also be in the emergency stop state.



*1) The CNUSR11 connector is a two-level terminal block, indicating that there are two circuits (channels). Two terminals (cable insertion holes) need to be used for one circuit.

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

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

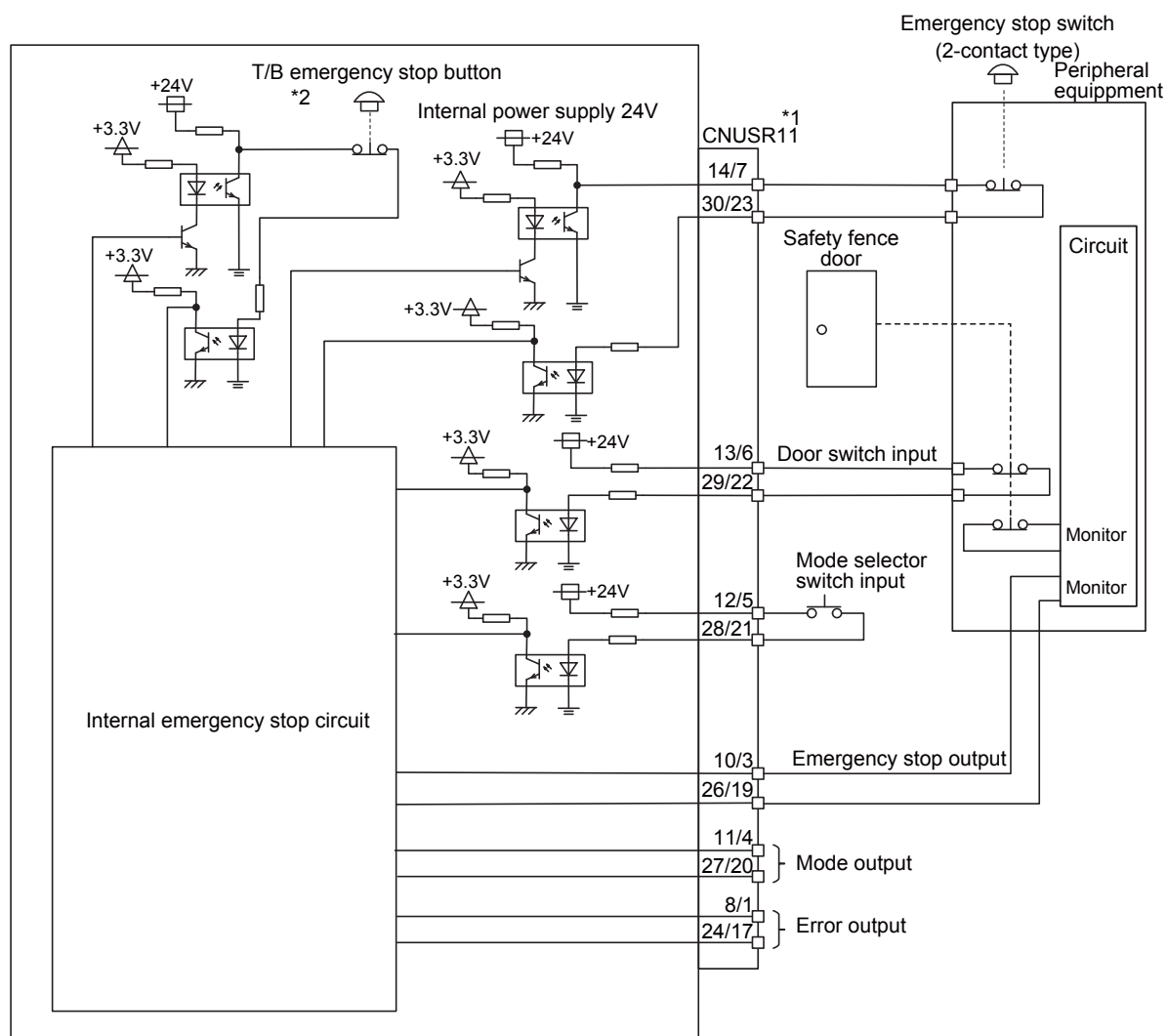
<Wiring example 2>: Connect the emergency stop switch, and door switch of peripheral equipment to the controller.

The power supply for emergency stop input uses the power supply in the controller. 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.

When the controller power is OFF, the peripheral devices are in the emergency stop state.



*1) The CNUSR11 connector is a two-level terminal block, indicating that there are two circuits (channels).

Two terminals (cable insertion holes) need to be used for one circuit.

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

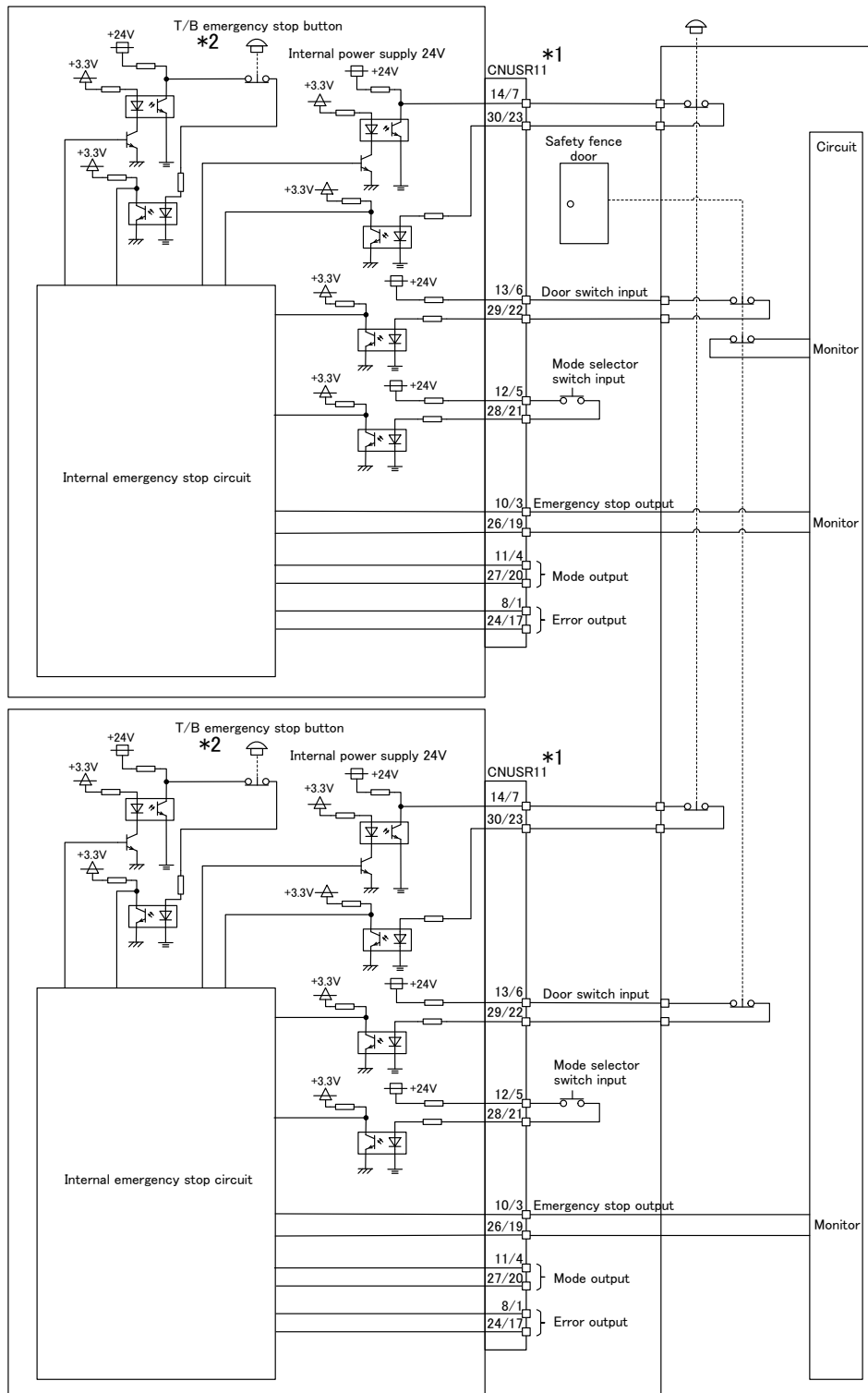
Fig.6-2: Example of safety measures (wiring example 2)

<Wiring example 3>: Connect the emergency stop switch of peripheral equipment, and the door switch to two controllers, and it interlocks. The power supply for emergency stop input uses the power supply in the controller. 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.

When the controller power is OFF, the peripheral devices are in the emergency stop state.



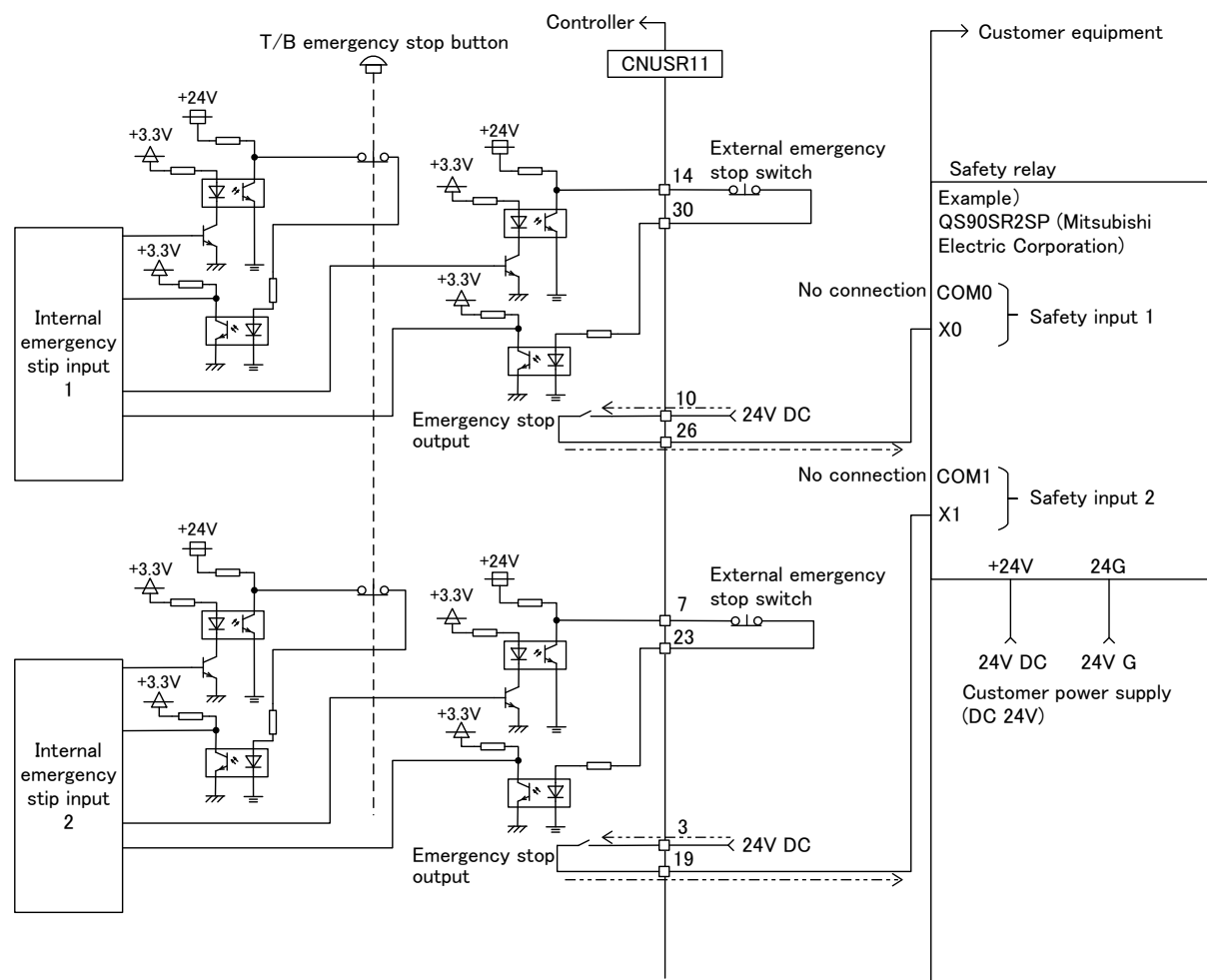
*1) The CNUSR11 connector is a two-level terminal block, indicating that there are two circuits (channels). Two terminals (cable insertion holes) need to be used for one circuit.

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

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

<Wiring example 4>: Connect the controller to the safety relay

Use the controller's emergency stop button to input safety relay.



[Caution]

- 1) Setup a safety relay on the user equipment, and when using to input the emergency stop button 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)).
- 2) When connecting emergency stop button 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 3 and 10 terminal of CNUSR11 connector to 24V.

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

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

[Caution] The emergency stop input (terminal block) on the user wiring in the controller can be used for safety measures as shown in 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 Related current of 24 VDC or higher for a no-voltage contact. ^{*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, if it is necessary, please fix a ferrite core (recommended model name: E04SR301334, manufacturer: Seiwa Electric Mfg. Co., Ltd.) to the shielded cable.
The size of the wire that fits to use is shown below.
CNUSR11 connector: AWG24 to 16 (0.2 to 1.25mm²)

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

CAUTION

Be sure to perform wiring correctly. If there are mistakes in the wiring, the robot may not stop when the emergency stop button 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 mode selector switch. If not duplicated, these functions may fail due to a broken relay used by customer, etc.

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

6.2 Working environment

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

(1) Power supply

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

CAUTION

Please use the controller with an input power supply voltage fluctuation rate of 10% or less. In the case of 200 VAC input, for example, if the controller is used with 180 VAC during the day and 220 VAC during the night, turn the servo off once and then on again.

If this is not performed, an excessive regeneration or overvoltage error may occur.

(2) Noise

- Where a surge voltage exceeding 2000V, 5kHz (equivalent to EN 61000-4-4) may be applied on the primary voltage. Locations where a strong electric field or magnetic field exists, such as near large inverters, high output frequency oscillator, large contactors and welding machines.

[Recommendation]

A noise-cut transformer; a noise filter; reinforcement of ground lines and electromagnetic shields; isolation by keeping away from noise sources; reduction of noise level of emission.

This product has undergone EMC testing for products intended for use in industrial environments (tested to standards EN 61000-6-2 and EN 61000-6-4). This product is not intended to be connected to residential, commercial, or light-industrial power supplies.

(3) Temperature and humidity

- Where the atmospheric temperature exceeds 40 degree , lower than 0 degree.
- Where the relative humidity exceeds 85% RH or below 45% RH, or condensation may occur.
- Where the robot will be subject to direct sunlight or near heat generating sources such as heaters.

(4) Vibration

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

(5) Installation environment

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

6.3 Precautions for handling

- (1) The robot has brakes. If the robot is moved with an excessive external force while the brake is applied, the robot accuracy may decrease, a backlash may occur, or the reduction gear may be damaged.
- (2) Avoid moving the robot arm by hand. When unavoidable, gradually move the arm. If moved suddenly, the accuracy may drop due to an excessive backlash, or the backed up data may be destroyed.
- (3) Note that depending on the posture, even when within the movement range, the wrist section could interfere with the base section. Take care to prevent interference during jog. ^{*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.

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

Please use the warm-up operation. (About the details of the warm-up operation, refer to "INSTRUCTION MANUAL/Detailed explanations of functions and operations".)

- (5) 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.
- (6) The items described in these specifications are conditions for carrying out the periodic maintenance and inspections described in the instruction manual.
- (7) When using the robot arm on a mobile axis or elevating table, the machine cables enclosed as standard configuration may break due to the fixed installation specifications. In this case, use a flexed type cable which is one of the optional replaceable machine cables.
- (8) If this robot interferes with the workpiece or peripheral devices during operation, the position may deviate, etc. Take care to prevent interference with the workpiece or peripheral devices during operation.
- (9) The hanging installation jig can be borrowed from the maker. Order to dealer when need.
- (10) Do not attach a tape or a label to the robot arm and the controller. If a tape or a label with strong adhesive power, such as a packaging tape, is attached to the coated surfaces of the robot arm and controller, the coated surface may be damaged when such tape or label is peeled off.
- (11) If the robot is operated with a heavy load and at a high speed, the surface of the robot arm gets very hot. It would not result in burns, however, it may cause secondary accidents if touched carelessly.
- (12) Do not shut down the input power supply to stop the robot. If the power supply is frequently shut down during a heavy load or high-speed operation, the speed reducer may be damaged, backlash may occur, and the program data may be destroyed.
- (13) If the robot collides with the mechanical stopper during automatic operation due to incorrect origin settings or other reasons, parts of the mechanical stopper or the reduction gear or other mechanical parts may need to be replaced. For parts replacement, contact Mitsubishi Electric or your local sales representative. If the robot is continued to be used with damaged mechanical parts or reduction gear, the degree of their damage may increase.
- (14) 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.
- (15) Do not conduct an insulated voltage test. If conducted by mistake, it may result in a breakdown.
- (16) 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 20mm or more.
- (17) The United Nations' Recommendations on the Transport of Dangerous Goods must be observed for transborder transportation of lithium batteries by air, sea, and land. The lithium batteries (ER6V) 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.
- (18) 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.
- (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

The EMC directive is coerced from January 1, 1996, and it is necessary to attach the CE mark which shows that the product is in conformity to directive.

Since the industrial robot is the component of the automation system, it considers that the EMC directive is not the target product of the direct. However, because it is one of the main components, introduces the method and components of the measures for conforming the automation system to the EMC directive.

And also we are carrying out the qualification test about the conformity of the EMC directive under the environment based on the contents of this document. However, the noise level is changed by the kind of equipment to be used, the layout, the construction of the controlling board, the course of wiring, etc. Therefore, please confirm by the customer eventually.

6.4.2 EMC directive

The Mitsubishi Electric industrial robot follows the European EMC directive. EMC can be broadly classified into two categories: EMI and EMS.

(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 |
|----------------|--|---|
| Emission (EMI) | Radiative noise disturbance | The electromagnetic noise etc. which are emitted to environs. |
| | 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 Example of EMC measures

Industrial robots are designed for use with other devices. We declare conformity with EMC Directive for our industrial robots by testing them in the following system architecture. However, it does not mean that every system meets the requirements of EMC standards.

Electromagnetic compatibility depends on the relationship between the industrial robot and devices in the system, wiring conditions, layout, or other factors. Therefore, check whether the entire machinery/system meets the requirements.

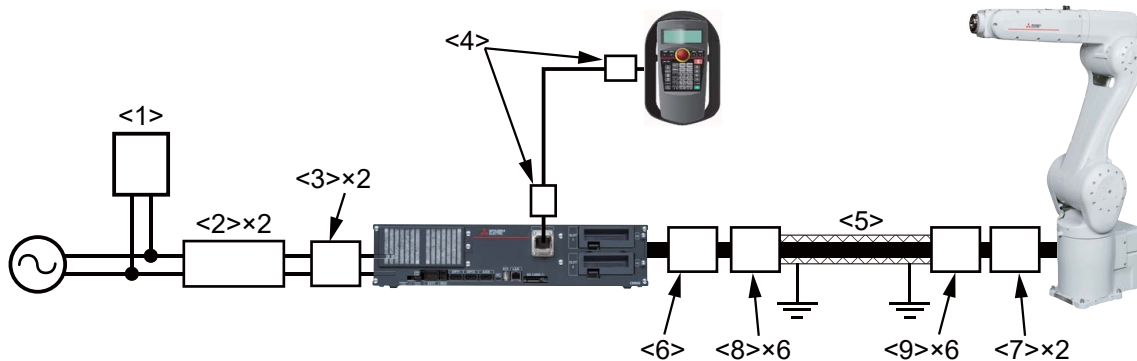


Fig.6-5: Example of EMC measures

- 1) Install ferrite cores <6> through <9> on the machine cable.
- 2) Attach the shield tube <5> to the machine cable and ground both ends of the tube.
- 3) Install the ferrite cores <4> on the cable of the teaching pendant.
- 4) Install the ferrite cores <3> on the power cable.
- 5) Attach the noise filters <2> and surge protector <1> to the power cable.

Table 6-4: Parts for EMC measures

| No. | Item | Model | Quantity | Manufacturer |
|-----|-----------------|--------------|----------|-------------------------------------|
| 1 | Surge protector | RSPD-250-Q4 | 1 | OKAYA ELECTRIC INDUSTRIES CO., LTD. |
| 2 | Noise filter | SUP-EL15-ER6 | 2 | OKAYA ELECTRIC INDUSTRIES CO., LTD. |
| 3 | Ferrite core | RFC-H13 | 2 | KITAGAWA INDUSTRIES CO.,LTD. |
| 4 | Ferrite core | E04SR301334 | 2 | SEIWA ELECTRIC MFG CO.Ltd |
| 5 | Shield tube | MTFX40 | 1 | Zippertubing (Japan), Ltd. |
| 6 | Ferrite core | RFC-20 | 1 | KITAGAWA INDUSTRIES CO.,LTD. |
| 7 | | | 2 | |
| 8 | Ferrite core | GTFC41-27-16 | 6 | KITAGAWA INDUSTRIES CO.,LTD. |
| 9 | | | 6 | |

6.4.5 Parts for EMC measures

For details on the parts for EMC measures described on [Page 112, "6.4.4 Example of EMC measures"](#), contact your nearest Mitsubishi branch or dealer.

7 Appendix

Appendix 1: Inertia calculation method

An allowable moment of inertia in the mechanical interface at the tip of the robot arm is determined. If a load exceeding the allowable moment of inertia is put, on the tip of the arm, vibration during operation and an overload alarm may occur. Therefore, consider the matching/appropriateness of the hand and load to be mounted on the tip of the arm for the robot specifications when you select a robot. The following describes the load inertia calculation method.

For the vertical multi-joint robot, consider the load moment and the load inertia on the wrist axes (J4 to J6 axes). To consider them, calculate the load moment and load inertia applied on each of J4 to J6 axes in consideration of the posture of the hand and workpiece. The following figures show the examples.

(1) Load moment calculation example (for J5 axis with flange facing downwards)

The items shown in the right picture are defined as follows.

Hand mass : W_1 (kg)

Center of gravity of the hand : L_1 (m)

Workpiece mass : W_2 (kg)

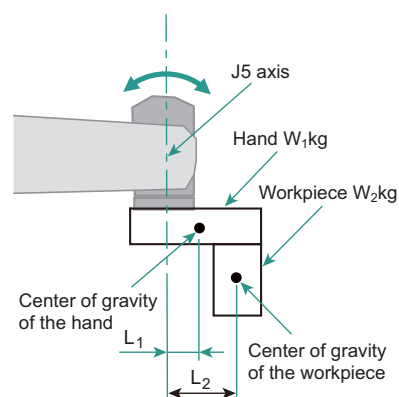
Center of gravity of the workpiece : L_2 (m)

The load moment applied to the J5 axis is calculated as follows.

Where g is gravitational acceleration (m/s^2).

$$\begin{aligned} \text{Load moment about the J5 axis : } M \text{ (Nm)} \\ = W_1 \times L_1 \times g + W_2 \times L_2 \times g \end{aligned}$$

Check that the value of M is equal to or less than the allowable load moment of the target model.



(2) Load inertia calculation example (for J6 axis)

The items shown in the right picture are defined as follows.

Hand mass : W_1 (kg)

Distance between the center of J6 axis and the center of gravity of the hand : L_1 (m)

Workpiece mass : W_2 (kg)

Center of gravity of the workpiece : L_2 (m)

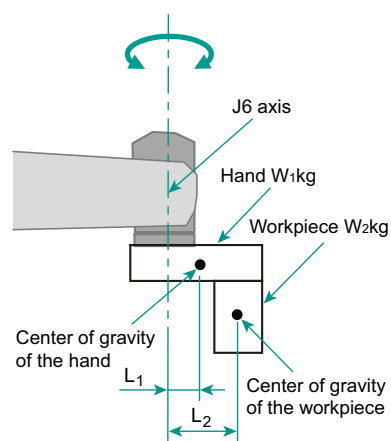
Assume that both hand and workpiece are rectangle. When their surface areas can be expressed as follows, respectively: $a_1 \times b_1$, and $a_2 \times b_2$ (where a = height, b = width), the load inertia about the J6 axis is calculated as follows.

$$\begin{aligned} \text{Load inertia about the J6 axis of the hand : } I_1 \text{ (kg}\cdot\text{m}^2\text{)} \\ = I_{z1} + W_1 \times L_1^2 = W_1 \times (a_1^2 + b_1^2)/12 + W_1 \times L_1^2 \end{aligned}$$

$$\begin{aligned} \text{Load inertia about the J6 axis of the workpiece : } I_2 \text{ (kg}\cdot\text{m}^2\text{)} \\ = I_{z2} + W_2 \times L_2^2 = W_2 \times (a_2^2 + b_2^2)/12 + W_2 \times L_2^2 \end{aligned}$$

$$\text{Total load inertia about the J6 axis of both hand and workpiece : } I \text{ (kg}\cdot\text{m}^2\text{)} = I_1 + I_2$$

Check that the value of I is equal to or less than the allowable load moment of the target model.



Note) When the robot changes its posture significantly in a direction other than the vertical downward direction, check the load moment inertia about the J4 axis as well.

Appendix 2: 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 | <p>Detects emergency stop inputs. The safety diagnosis function for the emergency stop input circuit makes the STO function meet the requirements of Category 4, PL e.</p> <p>At factory settings, the STO function meets the requirements of Category 3, PL d. To make the STO function meet the requirements of Category 4, PL e, change the parameter setting by referring to Page 115, "Appendix 3: Safety diagnosis function (Test pulse diagnosis)".</p> |
| | Mode selector switch input | Switches the controller mode between MANUAL and AUTOMATIC. |
| | Door switch input | Receives the status of the switch installed on the door of the safety fence to detect the opening of the door. |
| Non-safety signal | 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. |
| | Additional axis synchronization output | <p>Synchronizes the state of the additional axes (servo ON/OFF) with that of the robot arm.</p> <p>For details, refer to Page 53, "3.8 Additional axis synchronization output".</p> |

Appendix 3: Safety diagnosis function (Test pulse diagnosis)

This function enables diagnosis of external wiring by pulse signals output from the emergency stop ports (EXTEMG11, EXTEMG21). Changing parameter TPOEMG allows EXTEMG11 and EXTEMG21 to output off-pulses regularly. The width of output pulses is always approximately 20 ms. Checking regularly the test pulses inside the robot controller enables confirming the correct operation of the emergency stop lines.

When using this function, connect emergency stop switches by seeing [Fig. 7-2](#).

Make sure to prevent test pulses of this function from causing faulty operation of peripheral devices.

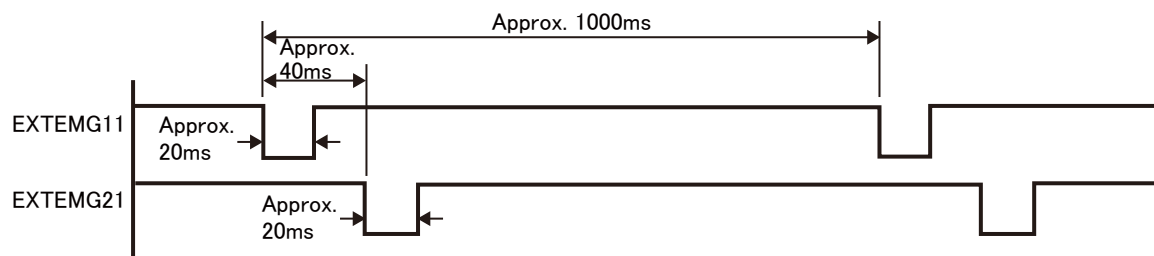


Fig.7-1: Test pulse diagnosis

Table 7-2: Parameter details

| Item | Description |
|-------------------------------|--|
| Parameter name | TPOEMG |
| Function | This enables configuring the pulse output function for outputting test pulse signals from emergency stop ports (EXTEMG11, EXTEMG21). |
| What parameter settings means | 0: Outputs no test pulses 1: Outputs test pulses |
| Default | 0 |

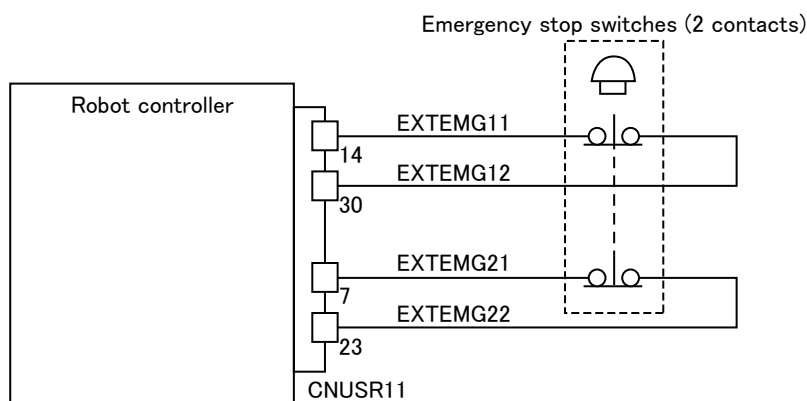


Fig.7-2: How to wire emergency stop lines

Appendix 4: Safety block diagram

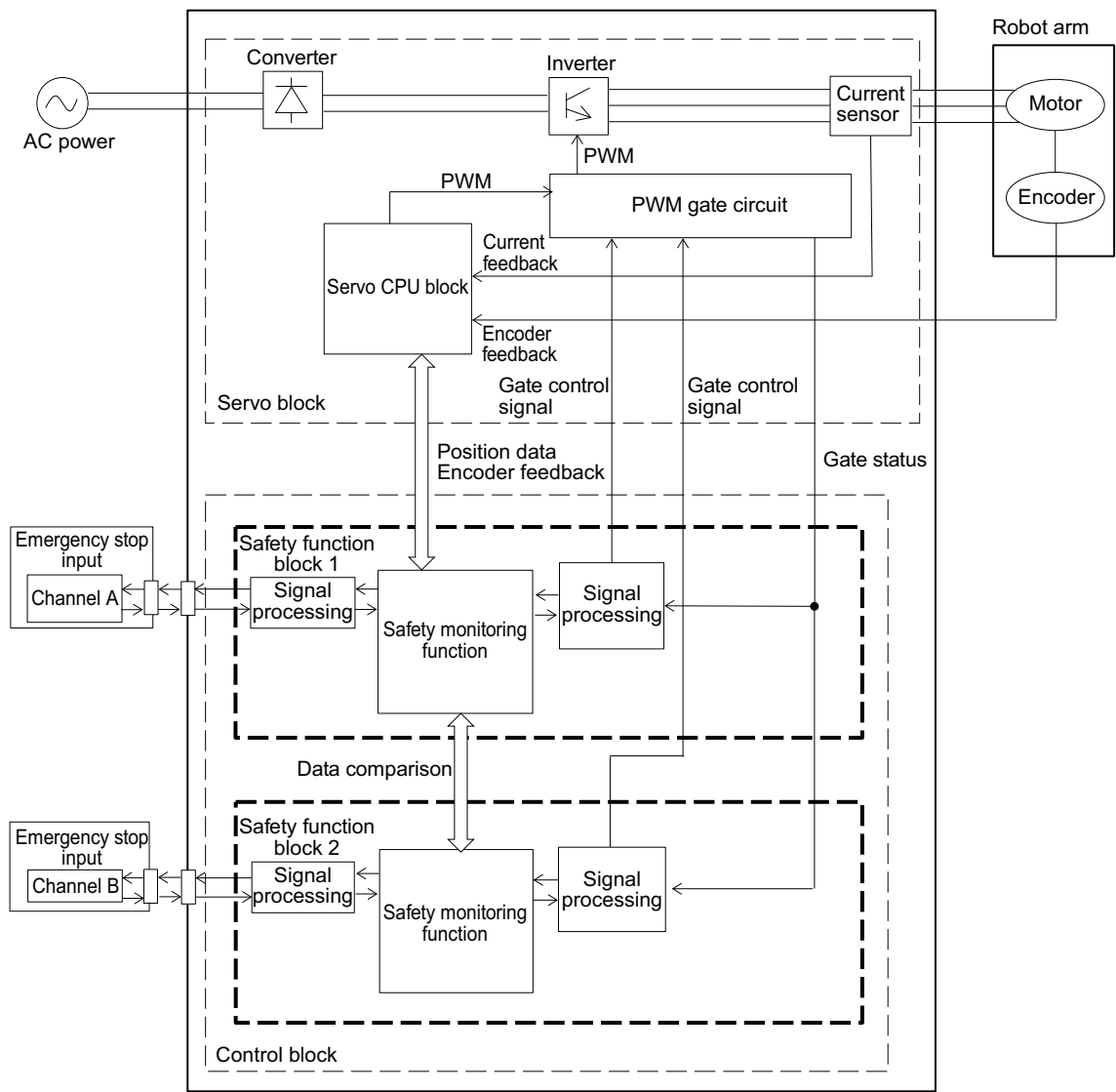


Fig.7-3: Safety block diagram

Appendix 5: Specifications discussion material

■ Customer information

| | | | |
|--------------|--|-----------|--|
| Company name | | Name | |
| Address | | Telephone | |

■ Purchased model

| Type ^{Note1)} | Controller |
|------------------------|------------|
| RV-8CRL-D | CR800-CVD |

Note1) Refer to the [Page 2, "1.2 Model type name of robot"](#) for the details of the robot arm type name.

■ Options (Installable after shipment)

| Item | | Type | Provision, and specifications when provided. |
|-----------------------|--|-----------------------------------|--|
| Robot arm | Machine cable (replacement) | 1F-□□UCBL-43 | Fixed type: <input type="checkbox"/> Not provide <input type="checkbox"/> 10m <input type="checkbox"/> 15m <input type="checkbox"/> 20m |
| | | 1F-□□LUCBL-43 | Flexed type: <input type="checkbox"/> Not provide <input type="checkbox"/> 10m <input type="checkbox"/> 15m <input type="checkbox"/> 20m |
| Control- ler | Simple teaching pendant | R32TB-□□ | <input type="checkbox"/> Not provided <input type="checkbox"/> 7m <input type="checkbox"/> 15m |
| | Highly efficient teaching pendant | R56TB-□□ | <input type="checkbox"/> Not provided <input type="checkbox"/> 7m <input type="checkbox"/> 15m |
| | Parallel I/O interface | 2D-TZ368/ 2D-TZ378 | <input type="checkbox"/> Not provided 2D-TZ368(Sink type)/ <input type="checkbox"/> -1pc. <input type="checkbox"/> -2pc. 2D-TZ378(Source type)/ <input type="checkbox"/> -1pc. <input type="checkbox"/> -2pc. |
| | External I/O cable (For parallel I/O interface) | 2D-CBL□□ (2D-TZ368/TZ378) | <input type="checkbox"/> Not provided <input type="checkbox"/> 5m-()pc. <input type="checkbox"/> 15m-()pc. |
| | Parallel I/O unit | 2A-RZ361/ 2A-RZ371 | <input type="checkbox"/> Not provided <input type="checkbox"/> 2A-RZ361(Sink type)/() unit <input type="checkbox"/> 2A-RZ371(Source type)/() unit |
| | External I/O cable (For Parallel I/O unit) | 2A-CBL□□ (2A-RZ361/RZ371) | <input type="checkbox"/> Not provided <input type="checkbox"/> 5m-()pc. <input type="checkbox"/> 15m-()pc. |
| | CC-Link interface | 2D-TZ576 | <input type="checkbox"/> Not provided <input type="checkbox"/> Provided |
| | EtherNet/IP interface | 2D-TZ535 | <input type="checkbox"/> Not provided <input type="checkbox"/> Provided |
| | PROFINET interface | 2D-TZ535-PN | <input type="checkbox"/> Not provided <input type="checkbox"/> Provided |
| | CC-Link IE Field interface | 2F-DQ535 | <input type="checkbox"/> Not provided <input type="checkbox"/> Provided |
| | EtherCAT interface | 2F-DQ535-EC | <input type="checkbox"/> Not provided <input type="checkbox"/> Provided |
| | Function extension card | 2F-DQ510 | MELFA Smart Plus card pack (A-type): <input type="checkbox"/> Not provided <input type="checkbox"/> Provided |
| | | 2F-DQ520 | MELFA Smart Plus card pack (AB-type): <input type="checkbox"/> Not provided <input type="checkbox"/> Provided |
| | | 2F-DQ511 | MELFA Smart Plus card (A-type): <input type="checkbox"/> Not provided <input type="checkbox"/> Provided |
| | | 2F-DQ521 | MELFA Smart Plus card (B-type): <input type="checkbox"/> Not provided <input type="checkbox"/> Provided |
| | SD memory card | 2F-2GBSD | <input type="checkbox"/> Not provided <input type="checkbox"/> Provided |
| | Safety option | 4F-SF002-01 | <input type="checkbox"/> Not provided <input type="checkbox"/> Provided |
| | Controller protection box | CR800-MB | <input type="checkbox"/> Not provided <input type="checkbox"/> Provided |
| | RT ToolBox3 | 3F-14C-WINE | <input type="checkbox"/> Not provided <input type="checkbox"/> Windows 7/8/8.1/10 English DVD-ROM |
| | RT ToolBox3 mini | 3F-15C-WINE | <input type="checkbox"/> Not provided <input type="checkbox"/> Windows 7/8/8.1/10 English DVD-ROM |
| | RT ToolBox3 Pro | 3F-16D-WINE | <input type="checkbox"/> Not provided <input type="checkbox"/> Windows 7/8/8.1/10 English DVD-ROM |
| | Instructions manual | 5F-BR01-PE01 | <input type="checkbox"/> Not provided <input type="checkbox"/> Provided () sets |
| Function extension | Force sensor set | 4F-FS002H-W200 | <input type="checkbox"/> Not provided <input type="checkbox"/> Provided |
| | | 4F-FS002H-W1000 ^{Note1)} | <input type="checkbox"/> Not provided <input type="checkbox"/> Provided |
| | MELFA-3D Vision 3.0 | 3F-53U-WINM | <input type="checkbox"/> Not provided <input type="checkbox"/> Provided |

Note1) Use the sensor attachment adapter "1F-FSFLGSET-01".

■ Maintenance parts (Consumable parts)

| | |
|-------------------|--|
| Maintenance parts | <input type="checkbox"/> Backup batteries ER6V () pcs. <input type="checkbox"/> Grease () cans |
|-------------------|--|

■ Robot selection check list

| | | | |
|--------------------------|---|------------|---|
| Work description | <input type="checkbox"/> Material handling <input type="checkbox"/> Assembly <input type="checkbox"/> Machining L/UL <input type="checkbox"/> Sealing <input type="checkbox"/> Testing and inspection <input type="checkbox"/> Other () | | |
| Workpiece mass ()g | Hand mass ()g | Atmosphere | <input type="checkbox"/> General environment <input type="checkbox"/> Oil mist: Confirm oil proof <input type="checkbox"/> request (Oil name:) ^{Note1)} / <input type="checkbox"/> not request <input type="checkbox"/> Other () |
| Remarks | | | |

Note1) Refer to [Page 14, "2.2.6 Protection specifications"](#) about oil resistance.

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