

# **FANUC Robot series**

## **R-30*i*A Mate CONTROLLER (Open Air)**

### **MAINTENANCE MANUAL**

MARMTOA3008081E REV. F

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**B-82965EN-1/06**

This manual can be used with controllers labeled R-30iA or R-J3iC. If you have a controller labeled R-J3iC, you should read R-30iA as R-J3iC throughout this manual.

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For customer assistance, including Technical Support, Service, Parts & Part Repair, and Marketing Requests, contact the Customer Resource Center, 24 hours a day, at 1-800-47-ROBOT (1-800-477-6268). International customers should call 011-1-248-377-7159.

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### **FANUC Robotics America Corporation Patent List**

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## Conventions

### **WARNING**

Information appearing under the "WARNING" caption concerns the protection of personnel. It is boxed and bolded to set it apart from the surrounding text.

### **CAUTION**

Information appearing under the "CAUTION" caption concerns the protection of equipment, software, and data. It is boxed and bolded to set it apart from the surrounding text.

**Note** Information appearing next to NOTE concerns related information or useful hints.



- **Original Instructions**

Before using the Robot, be sure to read the "FANUC Robot Safety Manual (B-80687EN)" and understand the content.

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Should you wish to export or re-export these products, please contact FANUC for advice.

The products in this manual are manufactured under strict quality control. However, when using any of the products in a facility in which a serious accident or loss is predicted due to a failure of the product, install a safety device.

In this manual we have tried as much as possible to describe all the various matters.

However, we cannot describe all the matters which must not be done, or which cannot be done, because there are so many possibilities.

Therefore, matters which are not especially described as possible in this manual should be regarded as "impossible".

# PREFACE

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This manual describes R-30iA Mate controller (Open Air) for the following robot models.

## Open air controller (Small size)

| Model                         | Abbreviation      |               |
|-------------------------------|-------------------|---------------|
| FANUC Robot LR Mate 200iC     | LR Mate 200iC     | LR Mate 200iC |
| FANUC Robot LR Mate 200iC/5C  | LR Mate 200iC/5C  |               |
| FANUC Robot LR Mate 200iC/5F  | LR Mate 200iC/5F  |               |
| FANUC Robot LR Mate 200iC/5H  | LR Mate 200iC/5H  |               |
| FANUC Robot LR Mate 200iC/5L  | LR Mate 200iC/5L  |               |
| FANUC Robot LR Mate 200iC/5LC | LR Mate 200iC/5LC |               |
| FANUC Robot M-1iA/0.5A        | M-1iA/0.5A        | M-1iA         |
| FANUC Robot M-1iA/0.5S        | M-1iA/0.5S        |               |

## Open air controller (Large size)

| Model                | Abbreviation |       |
|----------------------|--------------|-------|
| FANUC Robot M-3iA/6A | M-3iA/6A     | M-3iA |
| FANUC Robot M-3iA/6S | M-3iA/6S     |       |



# **SAFETY PRECAUTIONS**





# Safety

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FANUC Robotics is not and does not represent itself as an expert in safety systems, safety equipment, or the specific safety aspects of your company and/or its work force. It is the responsibility of the owner, employer, or user to take all necessary steps to guarantee the safety of all personnel in the workplace.

The appropriate level of safety for your application and installation can be best determined by safety system professionals. FANUC Robotics therefore, recommends that each customer consult with such professionals in order to provide a workplace that allows for the safe application, use, and operation of FANUC Robotics systems.

According to the industry standard ANSI/RIA R15-06, the owner or user is advised to consult the standards to ensure compliance with its requests for Robotics System design, usability, operation, maintenance, and service. Additionally, as the owner, employer, or user of a robotic system, it is your responsibility to arrange for the training of the operator of a robot system to recognize and respond to known hazards associated with your robotic system and to be aware of the recommended operating procedures for your particular application and robot installation.

Ensure that the robot being used is appropriate for the application. Robots used in classified (hazardous) locations must be certified for this use.

FANUC Robotics therefore, recommends that all personnel who intend to operate, program, repair, or otherwise use the robotics system be trained in an approved FANUC Robotics training course and become familiar with the proper operation of the system. Persons responsible for programming the system—including the design, implementation, and debugging of application programs—must be familiar with the recommended programming procedures for your application and robot installation.

The following guidelines are provided to emphasize the importance of safety in the workplace.

## **CONSIDERING SAFETY FOR YOUR ROBOT INSTALLATION**

Safety is essential whenever robots are used. Keep in mind the following factors with regard to safety:

- The safety of people and equipment
- Use of safety enhancing devices
- Techniques for safe teaching and manual operation of the robot(s)
- Techniques for safe automatic operation of the robot(s)
- Regular scheduled inspection of the robot and workcell
- Proper maintenance of the robot

### Keeping People and Equipment Safe

The safety of people is always of primary importance in any situation. However, equipment must be kept safe, too. When prioritizing how to apply safety to your robotic system, consider the following:

- People
- External devices
- Robot(s)
- Tooling
- Workpiece

### Using Safety Enhancing Devices

Always give appropriate attention to the work area that surrounds the robot. The safety of the work area can be enhanced by the installation of some or all of the following devices:

- Safety fences, barriers, or chains
- Light curtains
- Interlocks
- Pressure mats
- Floor markings
- Warning lights
- Mechanical stops
- EMERGENCY STOP buttons
- DEADMAN switches

### Setting Up a Safe Workcell

A safe workcell is essential to protect people and equipment. Observe the following guidelines to ensure that the workcell is set up safely. These suggestions are intended to supplement and not replace existing federal, state, and local laws, regulations, and guidelines that pertain to safety.

- Sponsor your personnel for training in approved FANUC Robotics training course(s) related to your application. Never permit untrained personnel to operate the robots.
- Install a lockout device that uses an access code to prevent unauthorized persons from operating the robot.
- Use anti-tie-down logic to prevent the operator from bypassing safety measures.
- Arrange the workcell so the operator faces the workcell and can see what is going on inside the cell.
- Clearly identify the work envelope of each robot in the system with floor markings, signs, and special barriers. The work envelope is the area defined by the maximum

motion range of the robot, including any tooling attached to the wrist flange that extend this range.

- Position all controllers outside the robot work envelope.
- Never rely on software or firmware based controllers as the primary safety element unless they comply with applicable current robot safety standards.
- Mount an adequate number of EMERGENCY STOP buttons or switches within easy reach of the operator and at critical points inside and around the outside of the workcell.
- Install flashing lights and/or audible warning devices that activate whenever the robot is operating, that is, whenever power is applied to the servo drive system. Audible warning devices shall exceed the ambient noise level at the end-use application.
- Wherever possible, install safety fences to protect against unauthorized entry by personnel into the work envelope.
- Install special guarding that prevents the operator from reaching into restricted areas of the work envelope.
- Use interlocks.
- Use presence or proximity sensing devices such as light curtains, mats, and capacitance and vision systems to enhance safety.
- Periodically check the safety joints or safety clutches that can be optionally installed between the robot wrist flange and tooling. If the tooling strikes an object, these devices dislodge, remove power from the system, and help to minimize damage to the tooling and robot.
- Make sure all external devices are properly filtered, grounded, shielded, and suppressed to prevent hazardous motion due to the effects of electro-magnetic interference (EMI), radio frequency interference (RFI), and electro-static discharge (ESD).
- Make provisions for power lockout/tagout at the controller.
- Eliminate *pinch points*. Pinch points are areas where personnel could get trapped between a moving robot and other equipment.
- Provide enough room inside the workcell to permit personnel to teach the robot and perform maintenance safely.
- Program the robot to load and unload material safely.
- If high voltage electrostatics are present, be sure to provide appropriate interlocks, warning, and beacons.
- If materials are being applied at dangerously high pressure, provide electrical interlocks for lockout of material flow and pressure.

## Staying Safe While Teaching or Manually Operating the Robot

Advise all personnel who must teach the robot or otherwise manually operate the robot to observe the following rules:

- Never wear watches, rings, neckties, scarves, or loose clothing that could get caught in moving machinery.

- Know whether or not you are using an intrinsically safe teach pendant if you are working in a hazardous environment.
- Before teaching, visually inspect the robot and work envelope to make sure that no potentially hazardous conditions exist. The work envelope is the area defined by the maximum motion range of the robot. These include tooling attached to the wrist flange that extends this range.
- The area near the robot must be clean and free of oil, water, or debris. Immediately report unsafe working conditions to the supervisor or safety department.
- FANUC Robotics recommends that no one enter the work envelope of a robot that is on, except for robot teaching operations. However, if you must enter the work envelope, be sure all safeguards are in place, check the teach pendant DEADMAN switch for proper operation, and place the robot in teach mode. Take the teach pendant with you, turn it on, and be prepared to release the DEADMAN switch. Only the person with the teach pendant should be in the work envelope.

### **WARNING**

**Never bypass, strap, or otherwise deactivate a safety device, such as a limit switch, for any operational convenience. Deactivating a safety device is known to have resulted in serious injury and death.**

- Know the path that can be used to escape from a moving robot; make sure the escape path is never blocked.
- Isolate the robot from all remote control signals that can cause motion while data is being taught.
- Test any program being run for the first time in the following manner:

### **WARNING**

**Stay outside the robot work envelope whenever a program is being run. Failure to do so can result in injury.**

- Using a low motion speed, single step the program for at least one full cycle.
- Using a low motion speed, test run the program continuously for at least one full cycle.
- Using the programmed speed, test run the program continuously for at least one full cycle.
- Make sure all personnel are outside the work envelope before running production.

## Staying Safe During Automatic Operation

Advise all personnel who operate the robot during production to observe the following rules:

- Make sure all safety provisions are present and active.
- Know the entire workcell area. The workcell includes the robot and its work envelope, plus the area occupied by all external devices and other equipment with which the robot interacts.
- Understand the complete task the robot is programmed to perform before initiating automatic operation.
- Make sure all personnel are outside the work envelope before operating the robot.
- Never enter or allow others to enter the work envelope during automatic operation of the robot.
- Know the location and status of all switches, sensors, and control signals that could cause the robot to move.
- Know where the EMERGENCY STOP buttons are located on both the robot control and external control devices. Be prepared to press these buttons in an emergency.
- Never assume that a program is complete if the robot is not moving. The robot could be waiting for an input signal that will permit it to continue its activity.
- If the robot is running in a pattern, do not assume it will continue to run in the same pattern.
- Never try to stop the robot, or break its motion, with your body. The only way to stop robot motion immediately is to press an EMERGENCY STOP button located on the controller panel, teach pendant, or emergency stop stations around the workcell.

## Staying Safe During Inspection

When inspecting the robot, be sure to

- Turn off power at the controller.
- Lock out and tag out the power source at the controller according to the policies of your plant.
- Turn off the compressed air source and relieve the air pressure.
- If robot motion is not needed for inspecting the electrical circuits, press the EMERGENCY STOP button on the operator panel.
- Never wear watches, rings, neckties, scarves, or loose clothing that could get caught in moving machinery.
- If power is needed to check the robot motion or electrical circuits, be prepared to press the EMERGENCY STOP button, in an emergency.
- Be aware that when you remove a servomotor or brake, the associated robot arm will fall if it is not supported or resting on a hard stop. Support the arm on a solid support before you release the brake.



## Staying Safe During Maintenance

When performing maintenance on your robot system, observe the following rules:

- Never enter the work envelope while the robot or a program is in operation.
- Before entering the work envelope, visually inspect the workcell to make sure no potentially hazardous conditions exist.
- Never wear watches, rings, neckties, scarves, or loose clothing that could get caught in moving machinery.
- Consider all or any overlapping work envelopes of adjoining robots when standing in a work envelope.
- Test the teach pendant for proper operation before entering the work envelope.
- If it is necessary for you to enter the robot work envelope while power is turned on, you must be sure that you are in control of the robot. Be sure to take the teach pendant with you, press the DEADMAN switch, and turn the teach pendant on. Be prepared to release the DEADMAN switch to turn off servo power to the robot immediately.
- Whenever possible, perform maintenance with the power turned off. Before you open the controller front panel or enter the work envelope, turn off and lock out the 3-phase power source at the controller.
- Be aware that when you remove a servomotor or brake, the associated robot arm will fall if it is not supported or resting on a hard stop. Support the arm on a solid support before you release the brake.

### WARNING

**Lethal voltage is present in the controller WHENEVER IT IS CONNECTED to a power source. Be extremely careful to avoid electrical shock. HIGH VOLTAGE IS PRESENT at the input side whenever the controller is connected to a power source. Turning the disconnect or circuit breaker to the OFF position removes power from the output side of the device only.**

- Release or block all stored energy. Before working on the pneumatic system, shut off the system air supply and purge the air lines.
- Isolate the robot from all remote control signals. If maintenance must be done when the power is on, make sure the person inside the work envelope has sole control of the robot. The teach pendant must be held by this person.
- Make sure personnel cannot get trapped between the moving robot and other equipment. Know the path that can be used to escape from a moving robot. Make sure the escape route is never blocked.
- Use blocks, mechanical stops, and pins to prevent hazardous movement by the robot. Make sure that such devices do not create pinch points that could trap personnel.

 **WARNING**

**Do not try to remove any mechanical component from the robot before thoroughly reading and understanding the procedures in the appropriate manual. Doing so can result in serious personal injury and component destruction.**

- Be aware that when you remove a servomotor or brake, the associated robot arm will fall if it is not supported or resting on a hard stop. Support the arm on a solid support before you release the brake.
- When replacing or installing components, make sure dirt and debris do not enter the system.
- Use only specified parts for replacement. To avoid fires and damage to parts in the controller, never use nonspecified fuses.
- Before restarting a robot, make sure no one is inside the work envelope; be sure that the robot and all external devices are operating normally.

## **KEEPING MACHINE TOOLS AND EXTERNAL DEVICES SAFE**

Certain programming and mechanical measures are useful in keeping the machine tools and other external devices safe. Some of these measures are outlined below. Make sure you know all associated measures for safe use of such devices.

### **Programming Safety Precautions**

Implement the following programming safety measures to prevent damage to machine tools and other external devices.

- Back-check limit switches in the workcell to make sure they do not fail.
- Implement “failure routines” in programs that will provide appropriate robot actions if an external device or another robot in the workcell fails.
- Use *handshaking* protocol to synchronize robot and external device operations.
- Program the robot to check the condition of all external devices during an operating cycle.

### **Mechanical Safety Precautions**

Implement the following mechanical safety measures to prevent damage to machine tools and other external devices.

- Make sure the workcell is clean and free of oil, water, and debris.
- Use software limits, limit switches, and mechanical hardstops to prevent undesired movement of the robot into the work area of machine tools and external devices.

## KEEPING THE ROBOT SAFE

Observe the following operating and programming guidelines to prevent damage to the robot.

### Operating Safety Precautions

The following measures are designed to prevent damage to the robot during operation.

- Use a low override speed to increase your control over the robot when jogging the robot.
- Visualize the movement the robot will make before you press the jog keys on the teach pendant.
- Make sure the work envelope is clean and free of oil, water, or debris.
- Use circuit breakers to guard against electrical overload.

### Programming Safety Precautions

The following safety measures are designed to prevent damage to the robot during programming:

- Establish *interference zones* to prevent collisions when two or more robots share a work area.
- Make sure that the program ends with the robot near or at the home position.
- Be aware of signals or other operations that could trigger operation of tooling resulting in personal injury or equipment damage.
- In dispensing applications, be aware of all safety guidelines with respect to the dispensing materials.

**NOTE:** Any deviation from the methods and safety practices described in this manual must conform to the approved standards of your company. If you have questions, see your supervisor.

## ADDITIONAL SAFETY CONSIDERATIONS FOR PAINT ROBOT INSTALLATIONS

Process technicians are sometimes required to enter the paint booth, for example, during daily or routine calibration or while teaching new paths to a robot. Maintenance personnel also must work inside the paint booth periodically.

Whenever personnel are working inside the paint booth, ventilation equipment must be used. Instruction on the proper use of ventilating equipment usually is provided by the paint shop supervisor.

Although paint booth hazards have been minimized, potential dangers still exist. Therefore, today's highly automated paint booth requires that process and maintenance personnel have full awareness of the system and its capabilities. They must understand the interaction that occurs between the vehicle moving along the conveyor and the robot(s), hood/deck and door opening devices, and high-voltage electrostatic tools.

**CAUTION**

**Ensure that all ground cables remain connected. Never operate the paint robot with ground provisions disconnected. Otherwise, you could injure personnel or damage equipment.**

Paint robots are operated in three modes:

- Teach or manual mode
- Automatic mode, including automatic and exercise operation
- Diagnostic mode

During both teach and automatic modes, the robots in the paint booth will follow a predetermined pattern of movements. In teach mode, the process technician teaches (programs) paint paths using the teach pendant.

In automatic mode, robot operation is initiated at the System Operator Console (SOC) or Manual Control Panel (MCP), if available, and can be monitored from outside the paint booth. All personnel must remain outside of the booth or in a designated safe area within the booth whenever automatic mode is initiated at the SOC or MCP.

In automatic mode, the robots will execute the path movements they were taught during teach mode, but generally at production speeds.

When process and maintenance personnel run diagnostic routines that require them to remain in the paint booth, they must stay in a designated safe area.

## Paint System Safety Features

Process technicians and maintenance personnel must become totally familiar with the equipment and its capabilities. To minimize the risk of injury when working near robots and related equipment, personnel must comply strictly with the procedures in the manuals.

This section provides information about the safety features that are included in the paint system and also explains the way the robot interacts with other equipment in the system.

The paint system includes the following safety features:

- Most paint booths have red warning beacons that illuminate when the robots are armed and ready to paint. Your booth might have other kinds of indicators. Learn what these are.

- Some paint booths have a blue beacon that, when illuminated, indicates that the electrostatic devices are enabled. Your booth might have other kinds of indicators. Learn what these are.
- EMERGENCY STOP buttons are located on the robot controller and teach pendant. Become familiar with the locations of all E–STOP buttons.
- An intrinsically safe teach pendant is used when teaching in hazardous paint atmospheres.
- A DEADMAN switch is located on each teach pendant. When this switch is held in, and the teach pendant is on, power is applied to the robot servo system. If the engaged DEADMAN switch is released or pressed harder during robot operation, power is removed from the servo system, all axis brakes are applied, and the robot comes to an EMERGENCY STOP. Safety interlocks within the system might also E–STOP other robots.



**An EMERGENCY STOP will occur if the DEADMAN switch is released on a bypassed robot.**

- Overtravel by robot axes is prevented by software limits. All of the major and minor axes are governed by software limits. Limit switches and hardstops also limit travel by the major axes.
- EMERGENCY STOP limit switches and photoelectric eyes might be part of your system. Limit switches, located on the entrance/exit doors of each booth, will EMERGENCY STOP all equipment in the booth if a door is opened while the system is operating in automatic or manual mode. For some systems, signals to these switches are inactive when the switch on the SOC is in teach mode.
- When present, photoelectric eyes are sometimes used to monitor unauthorized intrusion through the entrance/exit silhouette openings.
- System status is monitored by computer. Severe conditions result in automatic system shutdown.

### Staying Safe While Operating the Paint Robot

When you work in or near the paint booth, observe the following rules, in addition to all rules for safe operation that apply to all robot systems.



**Observe all safety rules and guidelines to avoid injury.**

 **WARNING**

**Never bypass, strap, or otherwise deactivate a safety device, such as a limit switch, for any operational convenience. Deactivating a safety device is known to have resulted in serious injury and death.**

 **WARNING**

**Enclosures shall not be opened unless the area is known to be nonhazardous or all power has been removed from devices within the enclosure. Power shall not be restored after the enclosure has been opened until all combustible dusts have been removed from the interior of the enclosure and the enclosure purged. Refer to the Purge chapter for the required purge time.**

- Know the work area of the entire paint station (workcell).
- Know the work envelope of the robot and hood/deck and door opening devices.
- Be aware of overlapping work envelopes of adjacent robots.
- Know where all red, mushroom-shaped EMERGENCY STOP buttons are located.
- Know the location and status of all switches, sensors, and/or control signals that might cause the robot, conveyor, and opening devices to move.
- Make sure that the work area near the robot is clean and free of water, oil, and debris. Report unsafe conditions to your supervisor.
- Become familiar with the complete task the robot will perform BEFORE starting automatic mode.
- Make sure all personnel are outside the paint booth before you turn on power to the robot servo system.
- Never enter the work envelope or paint booth before you turn off power to the robot servo system.
- Never enter the work envelope during automatic operation unless a safe area has been designated.
- Never wear watches, rings, neckties, scarves, or loose clothing that could get caught in moving machinery.
- Remove all metallic objects, such as rings, watches, and belts, before entering a booth when the electrostatic devices are enabled.
- Stay out of areas where you might get trapped between a moving robot, conveyor, or opening device and another object.
- Be aware of signals and/or operations that could result in the triggering of guns or bells.
- Be aware of all safety precautions when dispensing of paint is required.
- Follow the procedures described in this manual.

### Special Precautions for Combustible Dusts (Powder Paint)

When the robot is used in a location where combustible dusts are found, such as the application of powder paint, the following special precautions are required to insure that there are no combustible dusts inside the robot.

- Purge maintenance air should be maintained at all times, even when the robot power is off. This will insure that dust can not enter the robot.
- A purge cycle will not remove accumulated dusts. Therefore, if the robot is exposed to dust when maintenance air is not present, it will be necessary to remove the covers and clean out any accumulated dust. Do not energize the robot until you have performed the following steps.
  1. Before covers are removed, the exterior of the robot should be cleaned to remove accumulated dust.
  2. When cleaning and removing accumulated dust, either on the outside or inside of the robot, be sure to use methods appropriate for the type of dust that exists. Usually lint free rags dampened with water are acceptable. Do not use a vacuum cleaner to remove dust as it can generate static electricity and cause an explosion unless special precautions are taken.
  3. Thoroughly clean the interior of the robot with a lint free rag to remove any accumulated dust.
  4. When the dust has been removed, the covers must be replaced immediately.
  5. Immediately after the covers are replaced, run a complete purge cycle. The robot can now be energized.

### Staying Safe While Operating Paint Application Equipment

When you work with paint application equipment, observe the following rules, in addition to all rules for safe operation that apply to all robot systems.



#### **WARNING**

**When working with electrostatic paint equipment, follow all national and local codes as well as all safety guidelines within your organization. Also reference the following standards: NFPA 33 Standards for Spray Application Using Flammable or Combustible Materials, and NFPA 70 National Electrical Code.**

- **Grounding:** All electrically conductive objects in the spray area must be grounded. This includes the spray booth, robots, conveyors, workstations, part carriers, hooks, paint pressure pots, as well as solvent containers. Grounding is defined as the object or objects shall be electrically connected to ground with a resistance of not more than 1 megohms.
- **High Voltage:** High voltage should only be on during actual spray operations. Voltage should be off when the painting process is completed. Never leave high voltage on during a cap cleaning process.
- Avoid any accumulation of combustible vapors or coating matter.
- Follow all manufacturer recommended cleaning procedures.
- Make sure all interlocks are operational.

- No smoking.
- Post all warning signs regarding the electrostatic equipment and operation of electrostatic equipment according to NFPA 33 Standard for Spray Application Using Flammable or Combustible Material.
- Disable all air and paint pressure to bell.
- Verify that the lines are not under pressure.

## Staying Safe During Maintenance

When you perform maintenance on the painter system, observe the following rules, and all other maintenance safety rules that apply to all robot installations. Only qualified, trained service or maintenance personnel should perform repair work on a robot.

- Paint robots operate in a potentially explosive environment. Use caution when working with electric tools.
- When a maintenance technician is repairing or adjusting a robot, the work area is under the control of that technician. All personnel not participating in the maintenance must stay out of the area.
- For some maintenance procedures, station a second person at the control panel within reach of the EMERGENCY STOP button. This person must understand the robot and associated potential hazards.
- Be sure all covers and inspection plates are in good repair and in place.
- Always return the robot to the “home” position before you disarm it.
- Never use machine power to aid in removing any component from the robot.
- During robot operations, be aware of the robot’s movements. Excess vibration, unusual sounds, and so forth, can alert you to potential problems.
- Whenever possible, turn off the main electrical disconnect before you clean the robot.
- When using vinyl resin observe the following:
  - Wear eye protection and protective gloves during application and removal.
  - Adequate ventilation is required. Overexposure could cause drowsiness or skin and eye irritation.
  - If there is contact with the skin, wash with water.
  - Follow the Original Equipment Manufacturer’s Material Safety Data Sheets.
- When using paint remover observe the following:
  - Eye protection, protective rubber gloves, boots, and apron are required during booth cleaning.
  - Adequate ventilation is required. Overexposure could cause drowsiness.
  - If there is contact with the skin or eyes, rinse with water for at least 15 minutes. Then seek medical attention as soon as possible.
  - Follow the Original Equipment Manufacturer’s Material Safety Data Sheets.





# SAFETY PRECAUTIONS

For the safety of the operator and the system, follow all safety precautions when operating a robot and its peripheral devices installed in a work cell.

In addition, refer to the “FANUC Robot SAFETY HANDBOOK (B-80687EN)”.

## 1 WORKING PERSON

The personnel can be classified as follows.

Operator:

- Turns robot controller power ON/OFF
- Starts robot program from operator's panel

Programmer or teaching operator:

- Operates the robot
- Teaches robot inside the safety fence

Maintenance engineer:

- Operates the robot
- Teaches robot inside the safety fence
- Maintenance (adjustment, replacement)

- An operator cannot work inside the safety fence.
- A programmer, teaching operator, and maintenance engineer can work inside the safety fence. The working activities inside the safety fence include lifting, setting, teaching, adjusting, maintenance, etc..
- To work inside the fence, the person must be trained on proper robot operation.

During the operation, programming, and maintenance of your robotic system, the programmer, teaching operator, and maintenance engineer should take additional care of their safety by using the following safety precautions.

- Use adequate clothing or uniforms during system operation
- Wear safety shoes
- Use helmet

## 2 WORKING PERSON SAFETY

Working person safety is the primary safety consideration. Because it is very dangerous to enter the operating space of the robot during automatic operation, adequate safety precautions must be observed. The following lists the general safety precautions. Careful consideration must be made to ensure working person safety.

- (1) Have the robot system working persons attend the training courses held by FANUC.

FANUC provides various training courses. Contact our sales office for details.

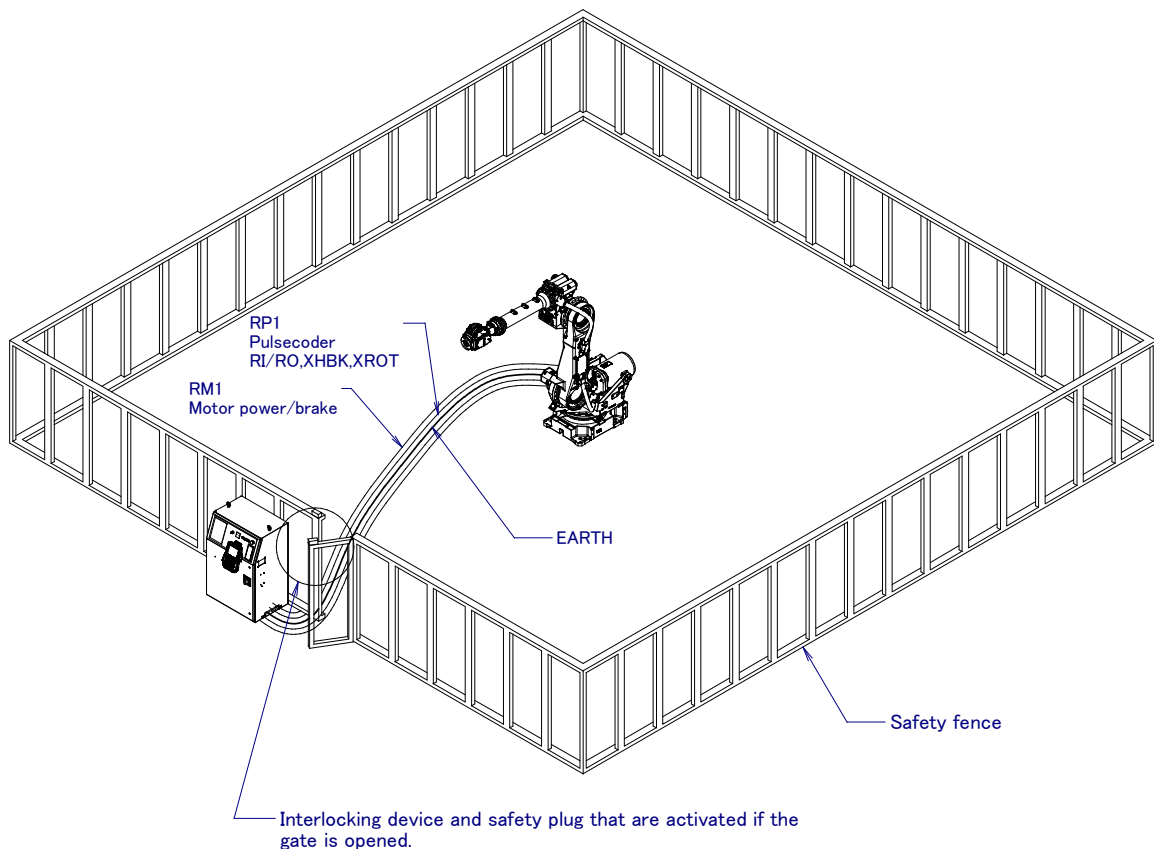
- (2) Even when the robot is stationary, it is possible that the robot is still in a ready to move state, and is waiting for a signal. In this state, the robot is regarded as still in motion. To ensure working person safety, provide the system with an alarm to indicate visually or aurally that the robot is in motion.
- (3) Install a safety fence with a gate so that no working person can enter the work area without passing through the gate. Install an interlocking device, a safety plug, and so forth in the safety gate so that the robot is stopped as the safety gate is opened.

The controller is designed to receive this interlocking signal of the door switch. When the gate is opened and this signal received, the controller stops the robot (Please refer to "STOP TYPE OF ROBOT" in SAFETY for detail of stop type). For connection, see Fig.2 (a) and Fig.2 (b).

- (4) Provide the peripheral devices with appropriate grounding (Class A, Class B, Class C, and Class D).
- (5) Try to install the peripheral devices outside the work area.
- (6) Draw an outline on the floor, clearly indicating the range of the robot motion, including the tools such as a hand.
- (7) Install a mat switch or photoelectric switch on the floor with an interlock to a visual or aural alarm that stops the robot when a working person enters the work area.
- (8) If necessary, install a safety lock so that no one except the working person in charge can turn on the power of the robot.

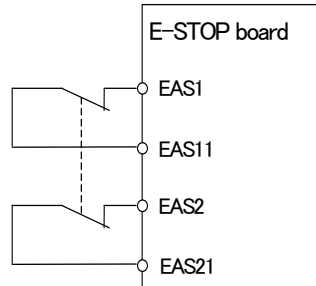
The circuit breaker installed in the controller is designed to disable anyone from turning it on when it is locked with a padlock.

- (9) When adjusting each peripheral device independently, be sure to turn off the power of the robot



**Fig.2 (a) Safety Fence and Safety gate**

CE/RIA controller



(Note)

Connect EAS1 and EAS11, EAS2 and EAS21 or FENCE1 and FENCE2.

Terminals EAS1,EA11,EAS2,EAS21 or FENCE1,FENCE2 are on the E-stop board or CRMA64 of connector panel.

STANDARD controller

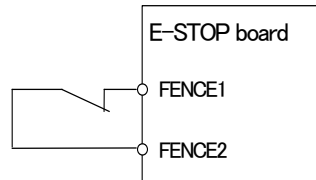


Fig.2 (b) Limit switch circuit diagram of the safety fence

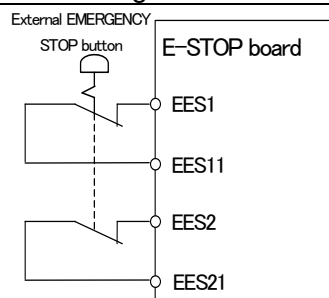
## 2.1 OPERATOR SAFETY

The operator is a person who operates the robot system. In this sense, a worker who operates the teach pendant is also an operator. However, this section does not apply to teach pendant operators.

- (1) If you do not have to operate the robot, turn off the power of the robot controller or press the EMERGENCY STOP button, and then proceed with necessary work.
- (2) Operate the robot system at a location outside of the safety fence
- (3) Install a safety fence with a safety gate to prevent any worker other than the operator from entering the work area unexpectedly and to prevent the worker from entering a dangerous area.
- (4) Install an EMERGENCY STOP button within the operator's reach.

The robot controller is designed to be connected to an external EMERGENCY STOP button. With this connection, the controller stops the robot operation (Please refer to "STOP TYPE OF ROBOT" in SAFETY for detail of stop type), when the external EMERGENCY STOP button is pressed. See the diagram below for connection.

CE/RIA controller



(Note)

Connect EES1 and EES11, EES2 and EES21 or EMGIN1 and EMGIN2.

EES1,EES11,EES2,EES21 or EMGIN1,EMGIN2 are on the E-stop board or CRMA64 of connector panel.

STANDARD controller

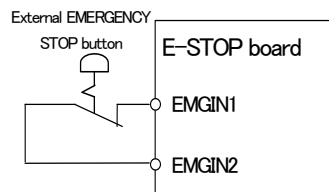


Fig.2.1 Connection Diagram for External Emergency Stop Button

## 2.2 SAFETY OF THE PROGRAMMER

While teaching the robot, the operator must enter the work area of the robot. The operator must ensure the safety of the teach pendant operator especially.

- (1) Unless it is specifically necessary to enter the robot work area, carry out all tasks outside the area.
- (2) Before teaching the robot, check that the robot and its peripheral devices are all in the normal operating condition.
- (3) If it is inevitable to enter the robot work area to teach the robot, check the locations, settings, and other conditions of the safety devices (such as the EMERGENCY STOP button, the DEADMAN switch on the teach pendant) before entering the area.
- (4) The programmer must be extremely careful not to let anyone else enter the robot work area.

### CE/RIA controller

The operator panel is provided with an emergency stop button and a key switch (mode switch) for selecting the automatic operation mode (AUTO) and the teach modes (T1 and T2). Before entering the inside of the safety fence for the purpose of teaching, set the switch to a teach mode, remove the key from the mode switch to prevent other people from changing the operation mode carelessly, then open the safety gate. If the safety gate is opened with the automatic operation mode set, the robot stops (Please refer to "STOP TYPE OF ROBOT" in SAFETY for detail of stop type). After the switch is set to a teach mode, the safety gate is disabled. The programmer should understand that the safety gate is disabled and is responsible for keeping other people from entering the inside of the safety fence.

### CE/RIA controller

The teach pendant is provided with a DEADMAN switch as well as an emergency stop button. These button and switch function as follows:

- (1) Emergency stop button: Causes an emergency stop (Please refer to "STOP TYPE OF ROBOT" in SAFETY for detail of stop type) when pressed.
- (2) DEADMAN switch: Functions differently depending on the mode switch setting status.
  - (a) Automatic operation mode: The DEADMAN switch is disabled.
  - (b) Teach mode: Servo power is turned off when the operator releases the DEADMAN switch. In case of dual-chain, Servo power is turned off when the operator presses the switch strongly, too.

### STANDARD controller

Before entering the inside of the safety fence for the purpose of teaching, set the enable/disable switch to a enable position. If the safety gate is opened with the disable position set, the robot stops (Please refer to "STOP TYPE OF ROBOT" in SAFETY for detail of stop type). After the switch is set to a enable, the safety gate is disabled. The programmer should understand that the safety gate is disabled and is responsible for keeping other people from entering the inside of the safety fence.

### STANDARD controller

The teach pendant is provided with a DEADMAN switch as well as an emergency stop button. These button and switch function as follows:

- (1) Emergency stop button: Causes an emergency stop (Please refer to "STOP TYPE OF ROBOT" in SAFETY for detail of stop type) when pressed.
- (2) DEADMAN switch: Functions differently depending on the enable/disable switch setting status.
  - (a) Disable: The DEADMAN switch is disabled.
  - (b) Enable: Servo power is turned off when the operator releases the DEADMAN switch.

The operator's intention of starting teaching is determined by the controller through the dual operation of setting the teach pendant enable/disable switch to the enable position and pressing the DEADMAN switch. The operator should make sure that the robot could operate in such conditions and be responsible in carrying out tasks safely.

The teach pendant, operator panel, and peripheral device interface send each robot start signal. However the validity of each signal changes as follows depending on the mode switch of the operator panel, the teach pendant enable/disable switch and the remote condition on the software.

**CE/RIA controller**

| Mode        | Teach pendant Enable/disable switch | Software remote condition | Teach pendant    | Operator panel   | Peripheral device |
|-------------|-------------------------------------|---------------------------|------------------|------------------|-------------------|
| AUTO mode   | On                                  | Local                     | Not allowed      | Not allowed      | Not allowed       |
|             |                                     | Remote                    | Not allowed      | Not allowed      | Not allowed       |
|             | Off                                 | Local                     | Not allowed      | Allowed to start | Not allowed       |
|             |                                     | Remote                    | Not allowed      | Not allowed      | Allowed to start  |
| T1, T2 mode | On                                  | Local                     | Allowed to start | Not allowed      | Not allowed       |
|             |                                     | Remote                    | Allowed to start | Not allowed      | Not allowed       |
|             | Off                                 | Local                     | Not allowed      | Not allowed      | Not allowed       |
|             |                                     | Remote                    | Not allowed      | Not allowed      | Not allowed       |

T1,T2 mode:DEADMAN switch is effective.

**STANDARD controller**

| Teach pendant enable/disable switch | Software remote condition | Teach pendant    | Peripheral device |
|-------------------------------------|---------------------------|------------------|-------------------|
| Enable                              | Ignored                   | Allowed to start | Not allowed       |
| Disable                             | Local                     | Not allowed      | Not allowed       |
|                                     | Remote                    | Not allowed      | Allowed to start  |

Enable:DEADMAN switch is effective.

- (5) (In case of CE/RIA controller) To start the system using the operator's panel, make certain that nobody is the robot work area and that there are no abnormal conditions in the robot work area.
- (6) When a program is completed, be sure to carry out a test run according to the procedure below.
  - (a) Run the program for at least one operation cycle in the single step mode at low speed.
  - (b) Run the program for at least one operation cycle in the continuous operation mode at low speed.
  - (c) Run the program for one operation cycle in the continuous operation mode at the intermediate speed and check that no abnormalities occur due to a delay in timing.
  - (d) Run the program for one operation cycle in the continuous operation mode at the normal operating speed and check that the system operates automatically without trouble.
  - (e) After checking the completeness of the program through the test run above, execute it in the automatic operation mode.
- (7) While operating the system in the automatic operation mode, the teach pendant operator should leave the robot work area.

## 2.3 SAFETY OF THE MAINTENANCE ENGINEER

For the safety of maintenance engineer personnel, pay utmost attention to the following.

- (1) During operation, never enter the robot work area.
- (2) Except when specifically necessary, turn off the power of the controller while carrying out maintenance. Lock the power switch, if necessary, so that no other person can turn it on.
- (3) If it becomes necessary to enter the robot operation range while the power is on, press the emergency stop button on the operator panel, or the teach pendant before entering the range. The maintenance personnel must indicate that maintenance work is in progress and be careful not to allow other people to operate the robot carelessly.
- (4) When disconnecting the pneumatic system, be sure to reduce the supply pressure.
- (5) Before the start of teaching, check that the robot and its peripheral devices are all in the normal operating condition.
- (6) Do not operate the robot in the automatic mode while anybody is in the robot work area.

- (7) When you maintain the robot alongside a wall or instrument, or when multiple workers are working nearby, make certain that their escape path is not obstructed.
- (8) When a tool is mounted on the robot, or when any moving device other than the robot is installed, such as belt conveyor, pay careful attention to its motion.
- (9) If necessary, have a worker who is familiar with the robot system stand beside the operator panel and observe the work being performed. If any danger arises, the worker should be ready to press the EMERGENCY STOP button at any time.
- (10) When replacing or reinstalling components, take care to prevent foreign matter from entering the system.
- (11) When handling each unit or printed circuit board in the controller during inspection, turn off the circuit breaker to protect against electric shock.  
If there are two cabinets, turn off the both circuit breaker.
- (12) When replacing parts, be sure to use those specified by FANUC.  
In particular, never use fuses or other parts of non-specified ratings. They may cause a fire or result in damage to the components in the controller.
- (13) When restarting the robot system after completing maintenance work, make sure in advance that there is no person in the work area and that the robot and the peripheral devices are not abnormal.

## **3 SAFETY OF THE TOOLS AND PERIPHERAL DEVICES**

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### **3.1 PRECAUTIONS IN PROGRAMMING**

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- (1) Use a limit switch or other sensor to detect a dangerous condition and, if necessary, design the program to stop the robot when the sensor signal is received.
- (2) Design the program to stop the robot when an abnormal condition occurs in any other robots or peripheral devices, even though the robot itself is normal.
- (3) For a system in which the robot and its peripheral devices are in synchronous motion, particular care must be taken in programming so that they do not interfere with each other.
- (4) Provide a suitable interface between the robot and its peripheral devices so that the robot can detect the states of all devices in the system and can be stopped according to the states.

### **3.2 PRECAUTIONS FOR MECHANISM**

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- (1) Keep the component cells of the robot system clean, and operate the robot in an environment free of grease, water, and dust.
- (2) Don't use unconfirmed liquid for cutting fluid and cleaning fluid.
- (3) Employ a limit switch or mechanical stopper to limit the robot motion so that the robot or cable does not strike against its peripheral devices or tools.
- (4) Observe the following precautions about the mechanical unit cables. When these attentions are not kept, unexpected troubles might occur.
  - Use mechanical unit cable that have required user interface.
  - Don't add user cable or hose to inside of mechanical unit.
  - Please do not obstruct the movement of the mechanical unit cable when cables are added to outside of mechanical unit.
  - In the case of the model that a cable is exposed, Please do not perform remodeling (Adding a protective cover and fix an outside cable more) obstructing the behavior of the outcrop of the cable.
  - Please do not interfere with the other parts of mechanical unit when install equipments in the robot.

- (5) The frequent power-off stop for the robot during operation causes the trouble of the robot. Please avoid the system construction that power-off stop would be operated routinely. (Refer to bad case example.) Please execute power-off stop after reducing the speed of the robot and stopping it by hold stop or cycle stop when it is not urgent. (Please refer to "STOP TYPE OF ROBOT" in SAFETY for detail of stop type.)  
(Bad case example)
- Whenever poor product is generated, a line stops by emergency stop.
  - When alteration was necessary, safety switch is operated by opening safety fence and power-off stop is executed for the robot during operation.
  - An operator pushes the emergency stop button frequently, and a line stops.
  - An area sensor or a mat switch connected to safety signal operate routinely and power-off stop is executed for the robot.
- (6) Robot stops urgently when collision detection alarm (SV050) etc. occurs. The frequent urgent stop by alarm causes the trouble of the robot, too. So remove the causes of the alarm.

## **4 SAFETY OF THE ROBOT MECHANISM**

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### **4.1 PRECAUTIONS IN OPERATION**

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- (1) When operating the robot in the jog mode, set it at an appropriate speed so that the operator can manage the robot in any eventuality.
- (2) Before pressing the jog key, be sure you know in advance what motion the robot will perform in the jog mode.

### **4.2 PRECAUTIONS IN PROGRAMMING**

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- (1) When the work areas of robots overlap, make certain that the motions of the robots do not interfere with each other.
- (2) Be sure to specify the predetermined work origin in a motion program for the robot and program the motion so that it starts from the origin and terminates at the origin.  
Make it possible for the operator to easily distinguish at a glance that the robot motion has terminated.

### **4.3 PRECAUTIONS FOR MECHANISMS**

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- (1) Keep the work areas of the robot clean, and operate the robot in an environment free of grease, water, and dust.

### **4.4 PROCEDURE TO MOVE ARM WITHOUT DRIVE POWER IN EMERGENCY OR ABNORMAL SITUATIONS**

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For emergency or abnormal situations (e.g. persons trapped in or by the robot), brake release unit can be used to move the robot axes without drive power.

Please refer to this manual and mechanical unit operator's manual for using method of brake release unit and method of supporting robot.



## 5 SAFETY OF THE END EFFECTOR

### 5.1 PRECAUTIONS IN PROGRAMMING

- (1) To control the pneumatic, hydraulic and electric actuators, carefully consider the necessary time delay after issuing each control command up to actual motion and ensure safe control.
- (2) Provide the end effector with a limit switch, and control the robot system by monitoring the state of the end effector.

## 6 STOP TYPE OF ROBOT

The following three robot stop types exist:

### Power-Off Stop (Category 0 following IEC 60204-1)

Servo power is turned off and the robot stops immediately. Servo power is turned off when the robot is moving, and the motion path of the deceleration is uncontrolled.

The following processing is performed at Power-Off stop.

- An alarm is generated and servo power is turned off.
- The robot operation is stopped immediately. Execution of the program is paused.

### Controlled stop (Category 1 following IEC 60204-1)

The robot is decelerated until it stops, and servo power is turned off.

The following processing is performed at Controlled stop.

- The alarm "SRVO-199 Controlled stop" occurs along with a decelerated stop. Execution of the program is paused.
- An alarm is generated and servo power is turned off.

### Hold (Category 2 following IEC 60204-1)

The robot is decelerated until it stops, and servo power remains on.

The following processing is performed at Hold.

- The robot operation is decelerated until it stops. Execution of the program is paused.



#### WARNING

The stopping distance and stopping time of Controlled stop are longer than the stopping distance and stopping time of Power-Off stop. A risk assessment for the whole robot system, which takes into consideration the increased stopping distance and stopping time, is necessary when Controlled stop is used.

When the E-Stop button is pressed or the FENCE is open, the stop type of robot is Power-Off stop or Controlled stop. The configuration of stop type for each situation is called *stop pattern*. The stop pattern is different according to the controller type or option configuration.

There are the following 3 Stop patterns.

| Stop pattern | Mode | E-Stop button | External E-Stop | FENCE open  | SVOFF input (*) |
|--------------|------|---------------|-----------------|-------------|-----------------|
| A            | AUTO | P-Stop        | P-Stop          | C-Stop      | C-Stop          |
|              | T1   | P-Stop        | P-Stop          | DEADMAN-sw. | C-Stop          |
|              | T2   | P-Stop        | P-Stop          | DEADMAN-sw. | C-Stop          |
| B            | AUTO | P-Stop        | P-Stop          | P-Stop      | P-Stop          |
|              | T1   | P-Stop        | P-Stop          | DEADMAN-sw. | P-Stop          |
|              | T2   | P-Stop        | P-Stop          | DEADMAN-sw. | P-Stop          |
| C            | AUTO | C-Stop        | C-Stop          | C-Stop      | C-Stop          |
|              | T1   | P-Stop        | P-Stop          | DEADMAN-sw. | C-Stop          |
|              | T2   | P-Stop        | P-Stop          | DEADMAN-sw. | C-Stop          |

P-Stop: Power-Off stop

C-Stop: Controlled stop

DEADMAN-sw.: Power-Off stop when the operator releases the DEADMAN switch or when the operator presses the switch strongly.

(\*) CE/RIA controller does not have SVOFF input.



#### WARNING

In this manual, the term "Emergency-stop" is used for the stop by above safety signals. Please refer to above table for actual stop type.

The following table indicates the Stop pattern according to the controller type or option configuration.

| Option                         | Standard controller | RIA controller | CE controller |
|--------------------------------|---------------------|----------------|---------------|
| Standard                       | A (*)               | A              | A             |
| Stop type set (Stop pattern C) | N/A                 | C              | C             |

(\*)The stop type of SVOFF input is Power-Off stop.

The stop pattern of the controller is displayed in "Stop pattern" line in software version screen. Please refer "Software version" in operator's manual of controller for the detail of software version screen.

#### Note

The RIA controller and the CE controller are certified to meet the North America and European safety standard. The standard controller (Shingle chain, Dual chain) does not have the certification. If the certification is required, use the RIA controller or the CE controller.

### "Stop type set (Stop pattern C)" option

"Stop type set (Stop pattern C)" is an optional function. When this option is loaded, the stop type of the following alarms becomes Controlled stop but only in AUTO mode. In T1 or T2 mode, the stop type is Power-Off stop which is the normal operation of the system.

| Alarm                                | Condition                                                       |
|--------------------------------------|-----------------------------------------------------------------|
| SRVO-001 Operator panel E-stop       | Operator panel E-stop is pressed.                               |
| SRVO-002 Teach pendant E-stop        | Teach pendant E-stop is pressed.                                |
| SRVO-218 Ext.E-stop/Servo Disconnect | External emergency stop input (EES1-EES11, EES2-EES21) is open. |
| SRVO-408 DCS SSO Ext Emergency Stop  | In DCS Safe I/O connect function, SSO[3] is OFF.                |
| SRVO-409 DCS SSO Servo Disconnect    | In DCS Safe I/O connect function, SSO[4] is OFF.                |

Controlled stop is different from Power-Off stop as follows:

- In Controlled stop, the robot is stopped on the program path. This function is effective for a system where the robot can interfere with other devices if it deviates from the program path.
- In Controlled stop, physical impact is less than Power-Off stop. This function is effective for systems where the physical impact to the mechanical unit or EOAT (End Of Arm Tool) should be minimized.
- The stopping distance and stopping time of Controlled stop is longer than the stopping distance and stopping time of Power-Off stop, depending on the robot model and axis. Please refer the operator's manual of a particular robot model for the data of stopping distance and stopping time.

This function is available only in CE or RIA type hardware.

When this option is loaded, this function can not be disabled.

The stop type of DCS Position and Speed Check functions is not affected by the loading of this option.

**⚠ WARNING**

The stopping distance and stopping time of Controlled stop are longer than the stopping distance and stopping time of Power-Off stop. A risk assessment for the whole robot system, which takes into consideration the increased stopping distance and stopping time, is necessary when this option is loaded.

## 7 WARNING LABEL

(1) Step-on prohibitive label



Fig.7 (a) Step-on Prohibitive Label

Description

Do not step on or climb the robot or controller as it may adversely affect the robot or controller and you may get hurt if you lose your footing.

(2) High-temperature warning label

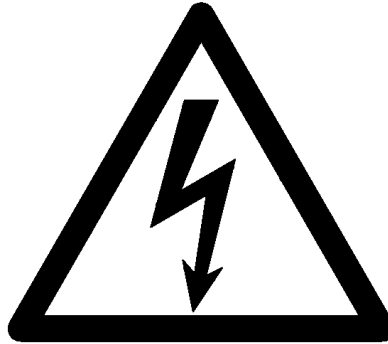


**Fig.7 (b) High-Temperature Warning Label**

**Description**

Be cautious about a section where this label is affixed, as the section generates heat. If you must touch such a section when it is hot, use a protective provision such as heat-resistant gloves.

(3) High-voltage warning label



**Fig.7 (c) High-Voltage Warning Label**

**Description**

A high voltage is applied to the places where this label is attached. Before starting maintenance, turn the power to the controller off, and turn the circuit breaker off to avoid electric shock hazards. Take additional precautions with the servo amplifier and other equipment, because high-voltage remains in these units for a certain amounts of time



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## **I. MAINTENANCE**



# 1 OVERVIEW

---

This manual describes the maintenance and connection of the R-30iA Mate controller (Open Air).

**Applicable controller:**

This manual is applied to both CE/RIA controller, and STANDARD controller.

CE/RIA controller uses dual check safety emergency stop circuit.

STANDARD controller uses single channel emergency stop circuit.

**Maintenance Part:**

Troubleshooting, and the setting, adjustment, and replacement of units

**Connection Part:**

Connection of the R-30iA Mate controller to the robot mechanical unit and peripheral devices, and installation of the controller

**Appendix**

Total connection diagram, and disassemble procedure, and brake release unit, and multi-arm.



**WARNING**

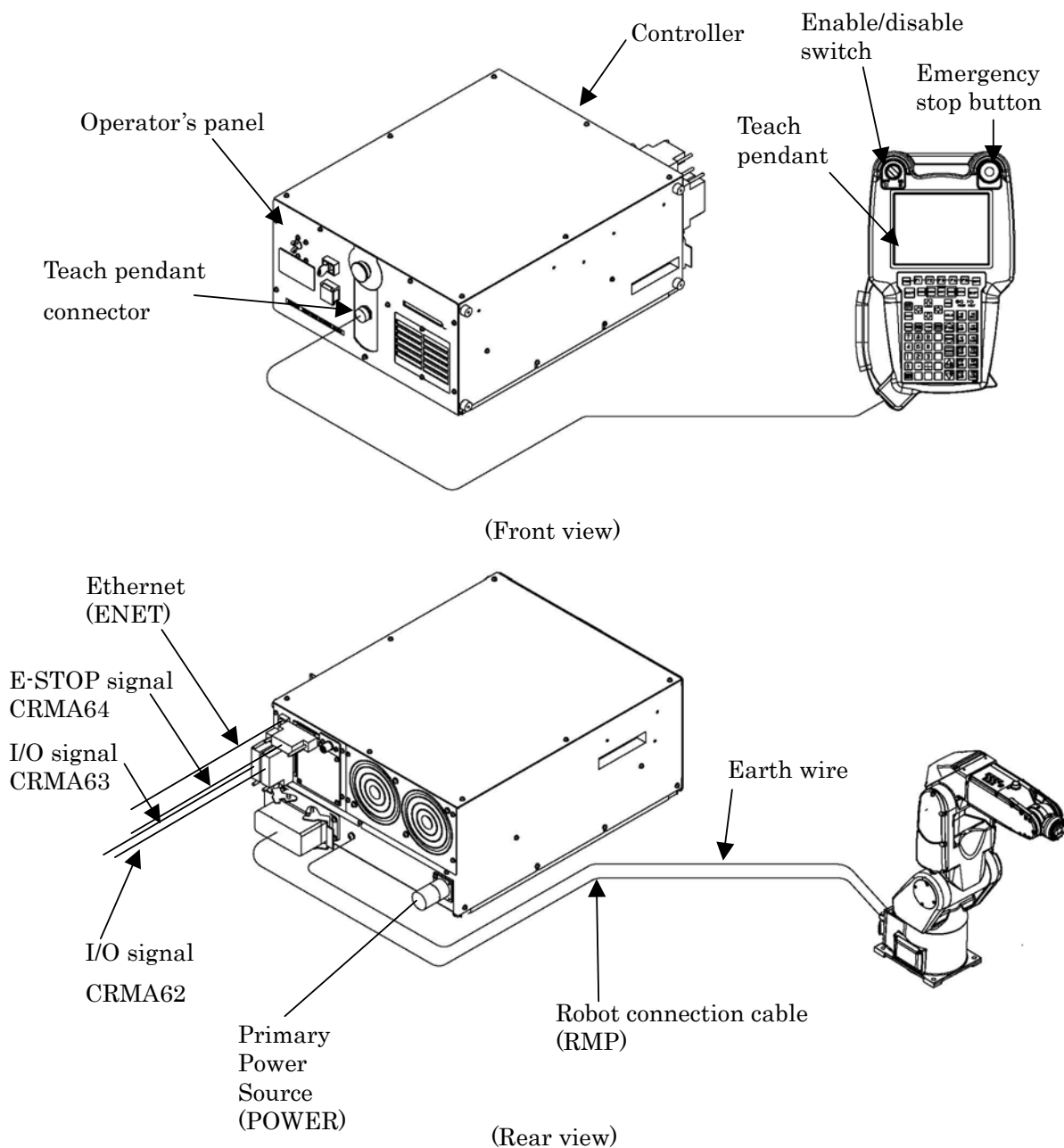
Before you enter the robot working area, be sure to turn off the power to the controller or press the EMERGENCY STOP button on the controller or teach pendant.

Otherwise, you could injure personnel or damage equipment.

# 2 CONFIGURATION

## 2.1 EXTERNAL VIEW OF THE CONTROLLER

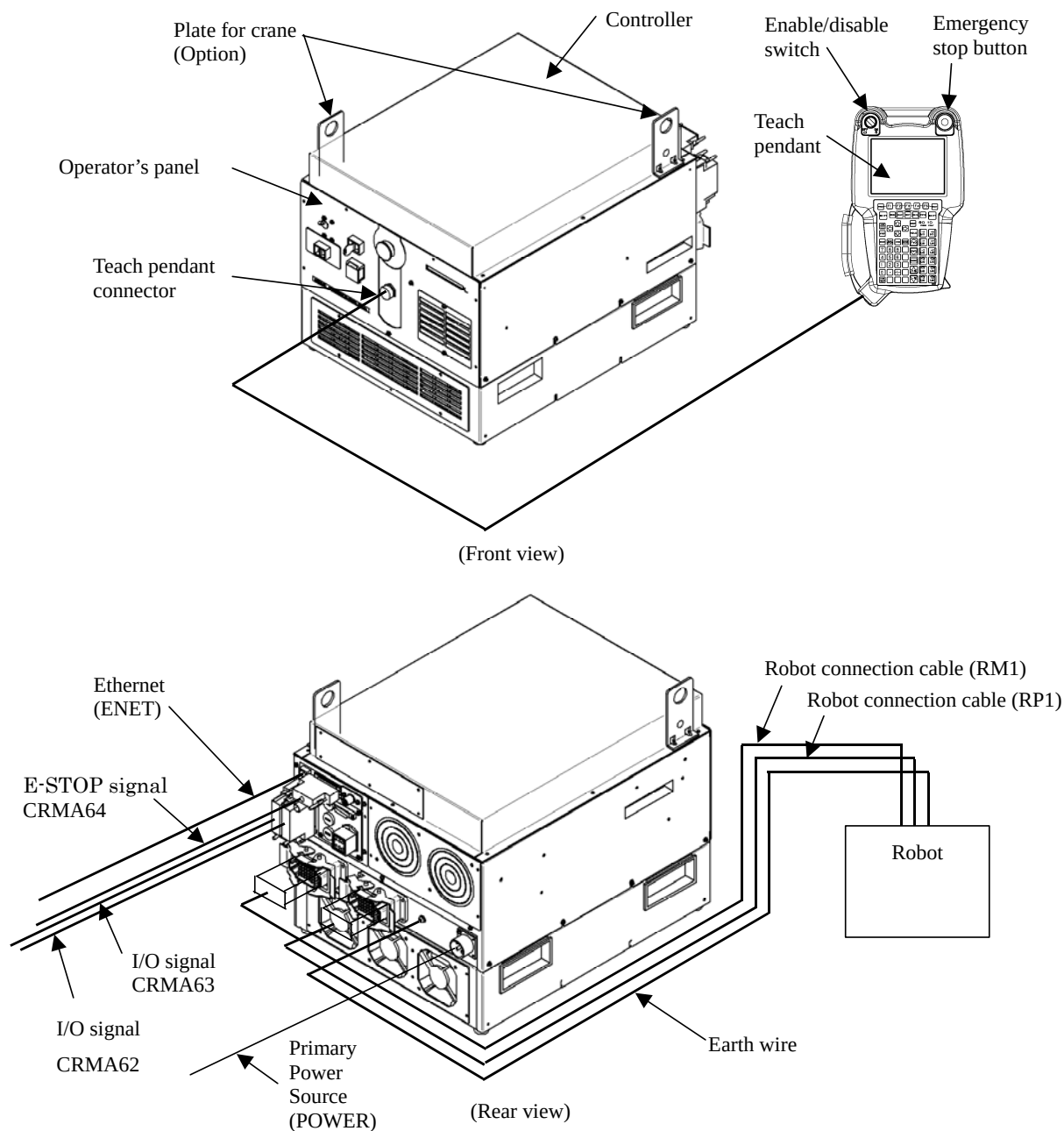
In case of Open Air controller (Small size)



### ⚠ WARNING

1. Do not touch radiation of heat fins of controller. Their hot surfaces may cause severe burns.
2. Do not insert fingers or foreign objects into controller. Doing so may cause electric shock or bodily injury.
3. Do not place anything on the controller.

## In case of Open Air controller (Large size)

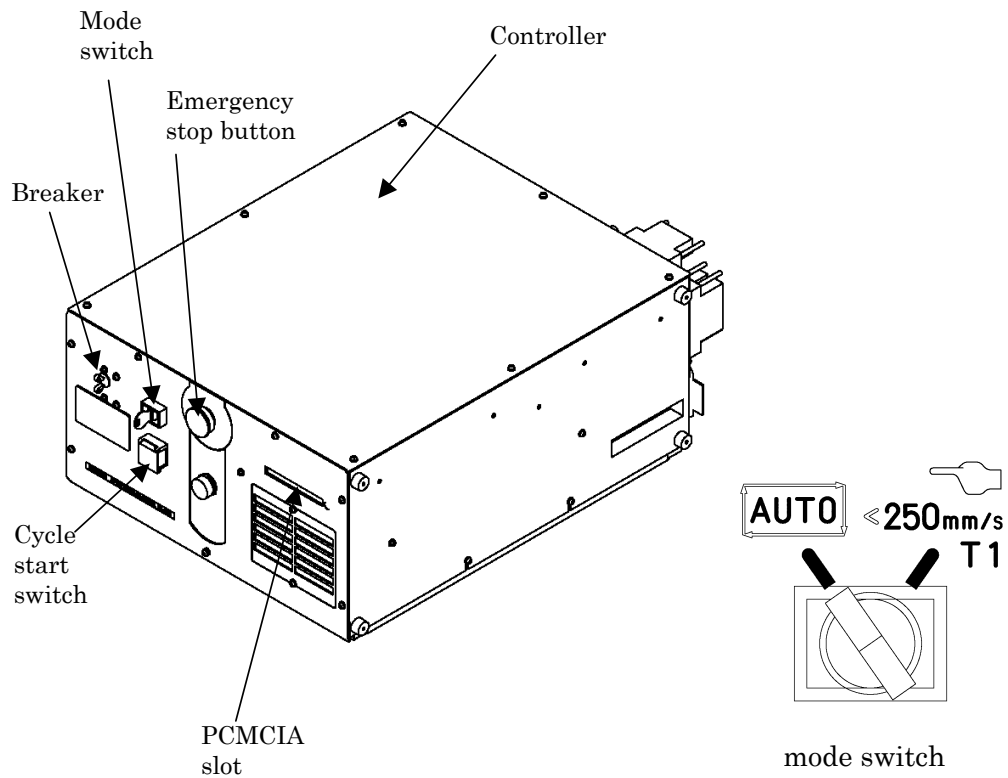


### WARNING

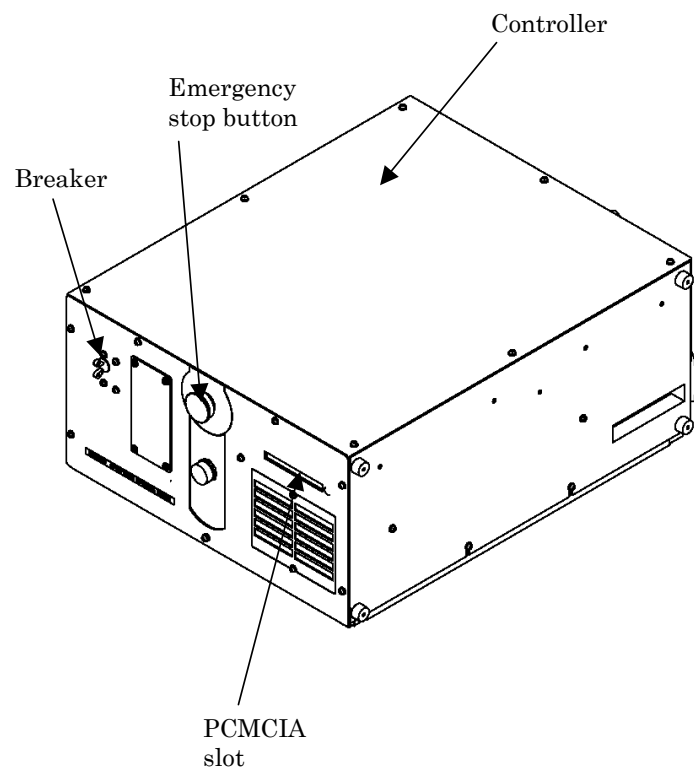
1. Do not insert fingers or foreign objects into controller. Doing so may cause electric shock or bodily injury.
2. Do not place anything on the controller.

## 2.2 OPERATOR'S PANEL

### In case of CE/RIA controller



### In case of STANDARD controller



## 2.3 COMPONENT FUNCTIONS

---

- **Main board**  
The main board contains a microprocessor, its peripheral circuits, memory, and operator's panel control circuit. The main CPU controls servo mechanism positioning.
- **E-stop board and MCC**  
This board controls the emergency stop system for both of the magnetic contactor and the precharge of the servo amplifier.
- **Power supply unit**  
The power supply unit converts the AC power to various levels of DC power.
- **Backplane printed circuit board**  
The various control printed circuit boards are mounted on the backplane printed circuit board.
- **Teach pendant**  
All operations including robot programming are performed with this unit. The controller status and data are indicated on the liquid-crystal display (LCD) on the pendant.
- **Servo amplifier**  
The servo amplifier controls servomotor, pulsecoder signal, brake control, overtravel and hand broken.
- **Operator's panel**  
Buttons and LEDs on the operator's panel are used to start the robot and to indicate the robot status. The controller has an interface to connect the memory card for data backup. It also controls the emergency stop control circuit.
- **Fan motor**  
These components cool the inside of the controller.
- **Circuit breaker**  
If the electric system in the controller malfunctions, or if abnormal input power causes high current in the system, the input power is connected to the circuit breaker to protect the equipment.
- **Regenerative resistor**  
To discharge the counter electromotive force from the servo motor, connect a regenerative resistor to the servo amplifier.

## 2.4 PREVENTIVE MAINTENANCE

---

Daily maintenance and periodic maintenance/inspection ensure reliable robot performance for extended periods of time.

- (1) **Daily maintenance**  
Before operating the system each day, clean each part of the system and check the system parts for any damage or cracks. Also, check the following:
  - (a) **Before operation**  
Check the cable connected to the teach pendant for excessive twisting. Check the controller and peripheral devices for abnormalities.
  - (b) **After operation**  
At the end of operation, return the robot to the specified position, and then turn off the controller. Clean each part, and check for any damage or cracks. If the ventilation port of the controller is dusty, clean it.
- (2) **Check after one month**  
Check that the fan is rotating normally. If the fan and filter have dirt and dust built up, clean the fan and filter according to step (3) described below for inspection to be performed every 6 months.
- (3) **Periodic inspection performed every 6 months.**  
Wipe off dirt and dust from the fan motor and filter.

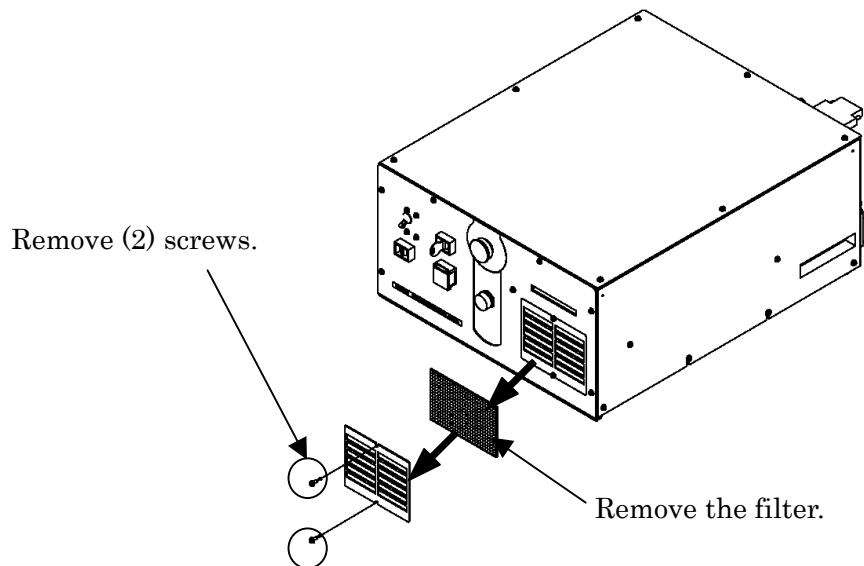


- (4) Battery daily check  
Replace the battery of the main board every 4 years. Please refer to the section 3.2.
- (5) Maintenance tools  
The following maintenance tools are recommended:
  - (a) Measuring instruments  
AC/DC voltmeter (A digital voltmeter is sometimes required.)  
Oscilloscope with a frequency range of 5 MHz or higher, two channels
  - (b) Tools  
Phillips screwdrivers : Large, medium, and small  
Standard screwdrivers : Large, medium, and small  
Nut driver set (Metric) : Large, medium, and small  
Pliers  
Needle-nose pliers  
Diagonal cutting pliers

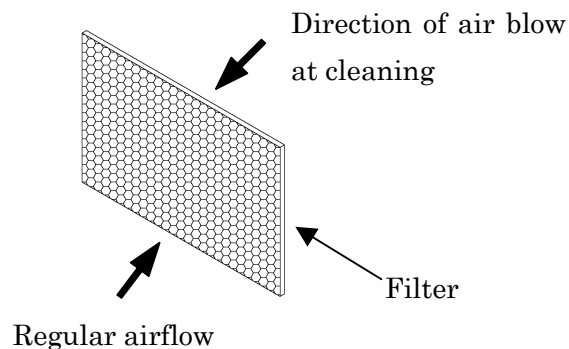
# 3 REPLACING PROCEDURE

## 3.1 CLEANING THE FILTER

- Remove (2) screws.
- Remove the plate and filter.



- Blow compressed air to the filter in the direction opposite to the regular airflow.



- If the filter is excessively dirty, wash it with water or warm water (40°C or lower). A neutral detergent is most effective.

**CAUTION**

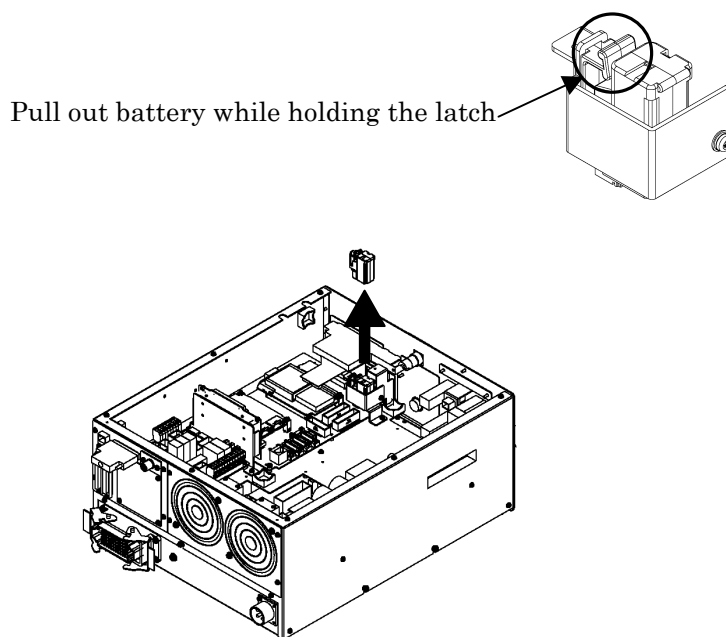
Use dehumidified, oil-free, pure compressed air for cleaning.

**CAUTION**

Dry the washed filter completely before replacing it. If the filter is still dirty after air blowing or washing, replace it with new one.

## 3.2 REPLACING THE BATTERY

- Use a specified lithium battery (specification : A05B-2550-K030) include lithium dry cell.
- Turn the controller on for about 30 seconds.
- Turn the controller off.
- Pull out the battery.  
(Hold the latch of the battery, and pull out the battery from the plate.)
- Install a new battery. (Insert the battery until the latch snaps into the plate.)  
Check that the battery is latched securely.

**WARNING**

Using other than the specified battery may result in the battery explosion. Replace the battery only with the specified battery (A05B-2550-K030).

**CAUTION**

Install a new battery within 30 minutes after turning the controller off. To prevent possible data loss, it is recommended that the robot data such as programs and system variables be backed up before battery replacement.

**NOTE**

Dispose of the replaced battery as an industrial waste, according to the laws and other rules in the country where the controller is installed and those established by the municipality and other organizations that have jurisdiction over the area where the controller is installed.

### 3.3 REPLACING THE FUSES

- The following fuses are in the main board.  
 FUSE1 : Fuse for protecting the +24V output : A60L-0001-0290#LM50C  
 FUSE3 : Fuse for protecting the +24V output for peripheral equipment interfaces : A60L-0001-0290#LM10C  
 Spare-fuse-kit specification : A05B-2550-K001
- The following fuses are in the servo amplifier.  
 FS1 : For generation of the power to the amplifier control circuit : A60L-0001-0290#LM32C  
 FS2 : For protection of the 24V output to the end effector, ROT, and HBK  
 For protection of the 24V output to the mechanical unit fan motor (Option)  
 (In case of M-3iA)  
 : A60L-0001-0290#LM32C  
 FS3 : For protection of the 24V output to the regenerative resistor and the additional axis amplifier : A60L-0001-0290#LM50C  
 Spare-fuse-kit specification : A05B-2550-K001
- The following fuses are in the E-STOP board.

#### In case of CE/RIA controller

FUSE1 : For protecting +24V to the E-STOP circuit : A60L-0001-0046#1.0  
 FUSE2 : For protecting +24V to the teach pendant : A60L-0001-0046#1.0  
 FUSE3 : For protecting +24V to the power supply unit : A60L-0001-0046#2.0  
 FU1,FU2 : For protection of the fan motor input : A60L-0001-0175#0.5A  
 Spare-fuse-kit specification : A05B-2550-K002

#### In case of STANDARD controller

FUSE1 : For protecting +24V to the teach pendant : A60L-0001-0046#1.0  
 FUSE2 : For protecting +24V to the E-STOP circuit : A60L-0001-0046#2.0  
 FU1,FU2 : For protection of the fan motor input : A60L-0001-0175#0.5A  
 Spare-fuse-kit specification : A05B-2550-K002

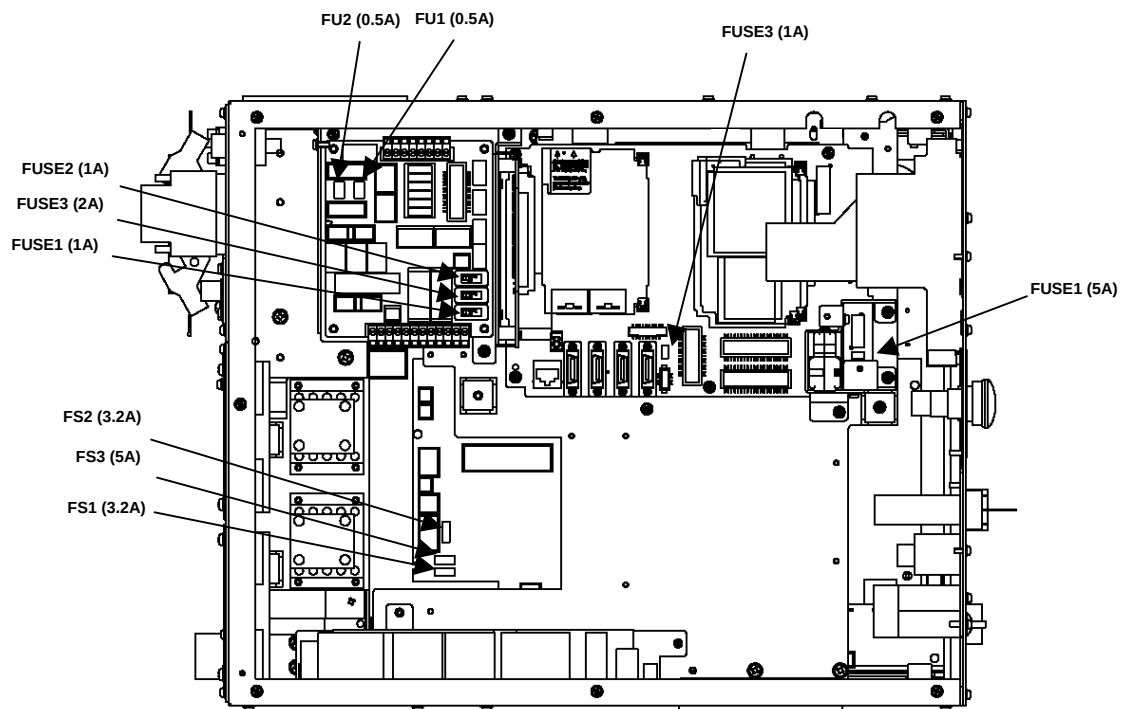


Fig.3.3 (a) Replacing the fuses (CE/RIA controller)

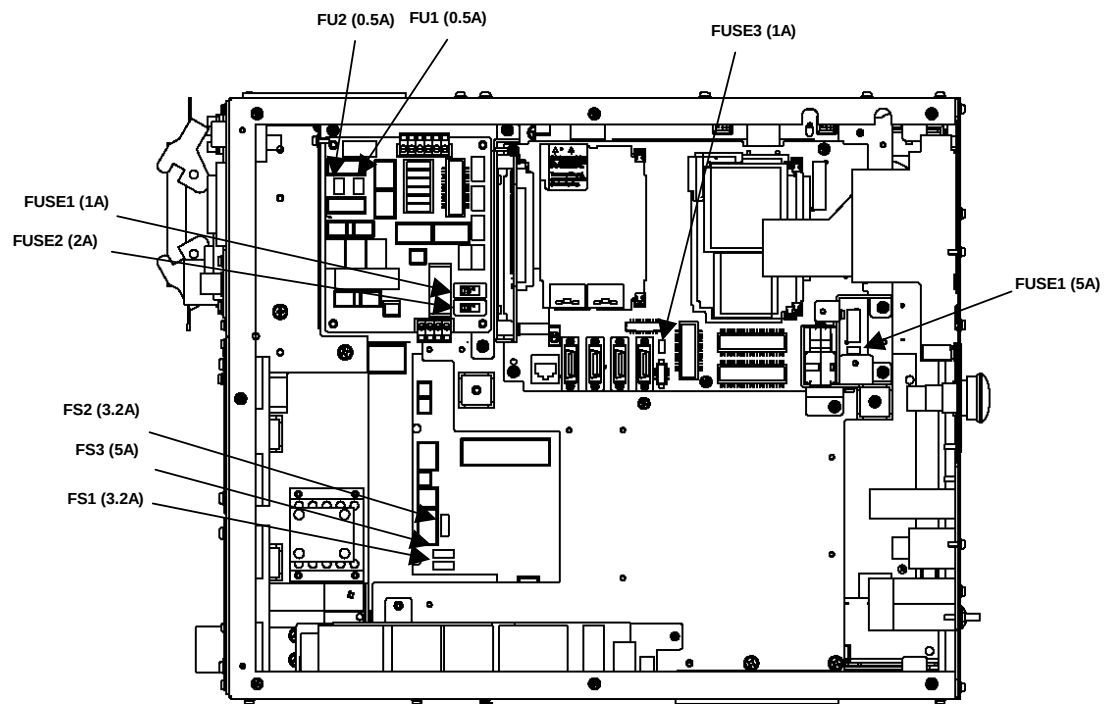
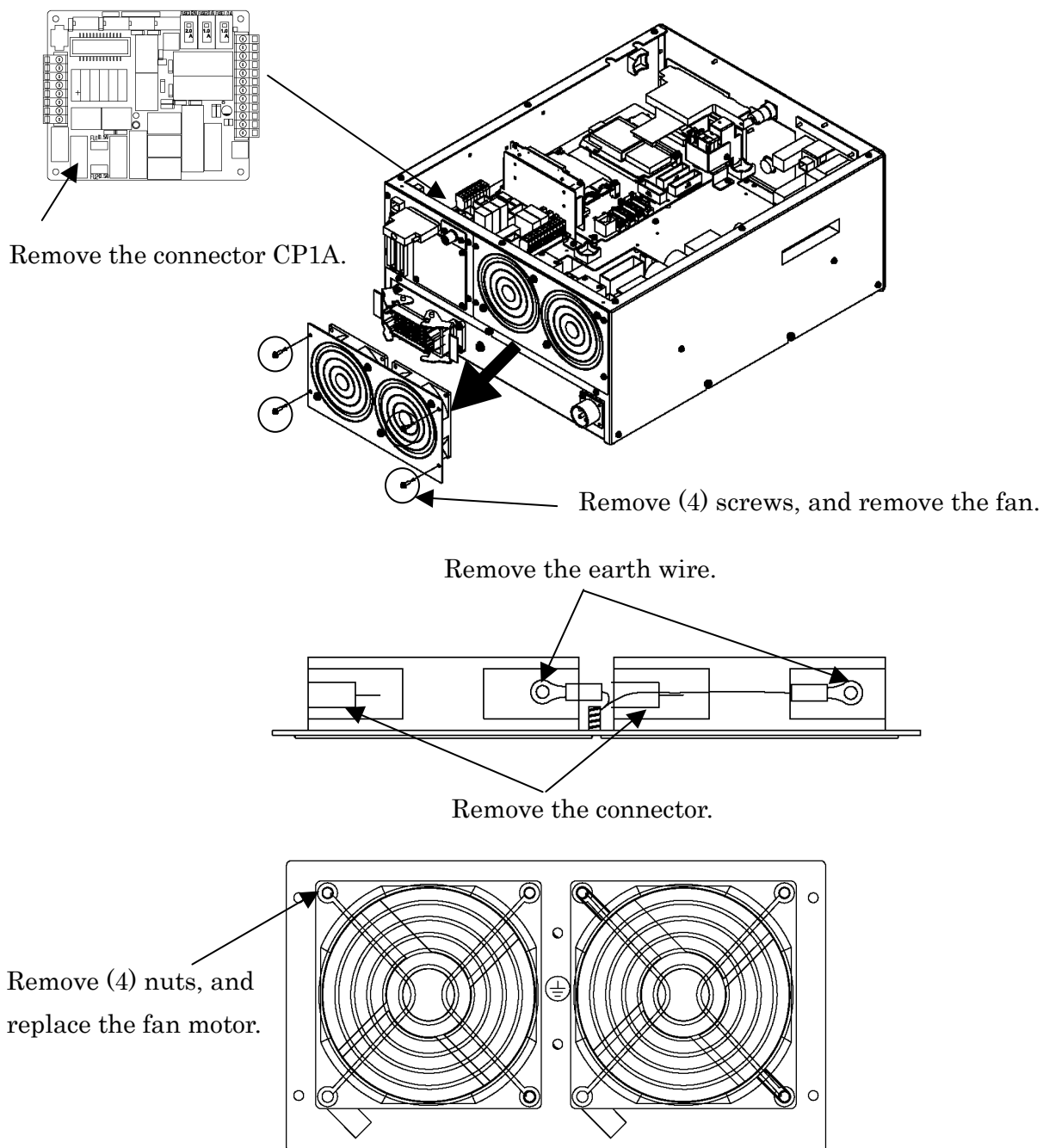


Fig.3.3 (b) Replacing the fuses (STANDARD controller)

## 3.4 REPLACING THE FAN MOTOR

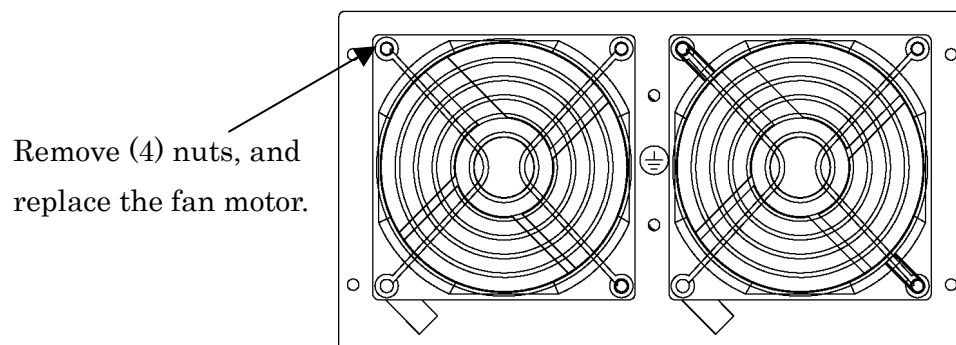
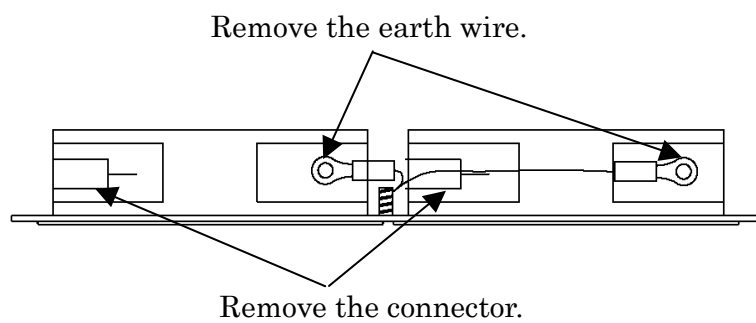
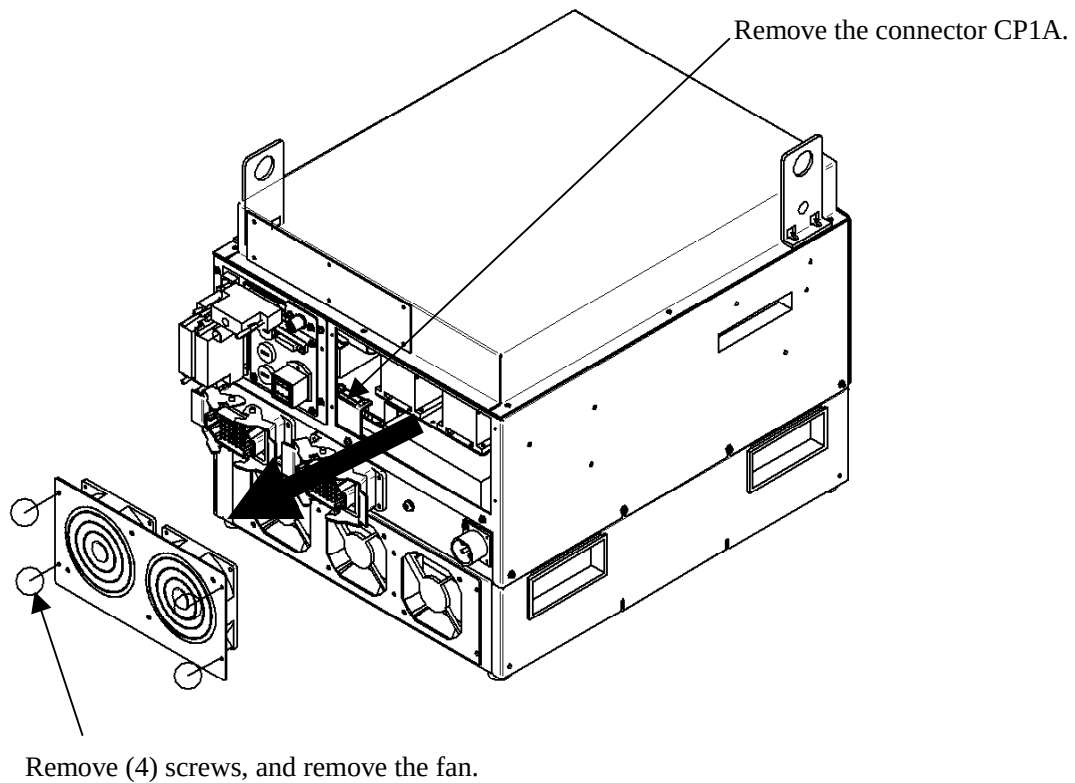
### In case of Open Air controller (Small size)

- Remove the connector CP1A on the E-STOP board.
- Remove (4) screws, and remove the fan.
- Remove the connector and earth wire from the fan motor.
- Remove (4) nuts, and replace the fan motor.



**In case of Open Air controller (Large size)**

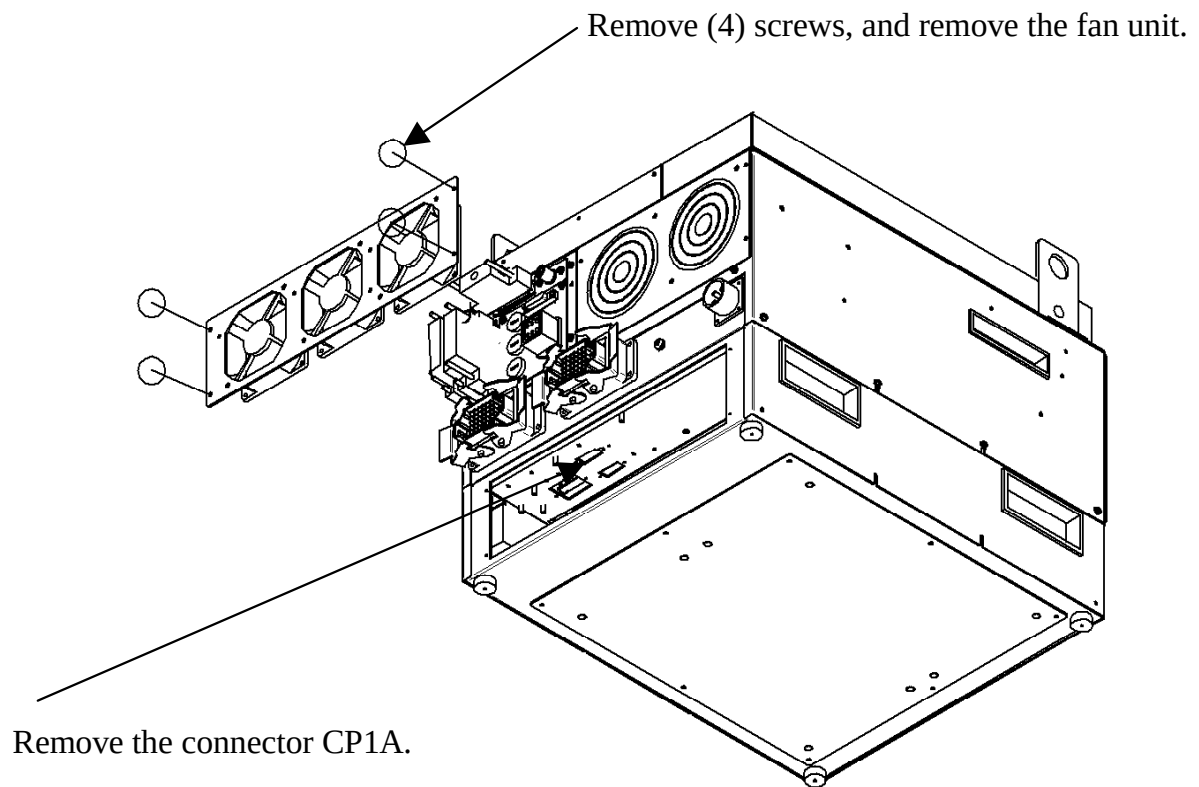
- Remove (4) screws, and remove the fan.
- Remove the connector CP1A.
- Remove the connector and earth wire from the fan motor.
- Remove (4) nuts, and replace the fan motor.



## 3.5 FAN UNIT FOR REGENERATIVE RESISTER

### In case of Open Air controller (Large size)

- Remove (4) screws, and remove the fan unit.
- Remove the connector CP1A.
- Replace the fan unit.





# 4 TROUBLESHOOTING

---

This chapter describes the checking method and corrective action for each error code indicated if a hardware alarm occurs. Refer to the operator's manual to release program alarms.

## 4.1 POWER CANNOT BE TURNED ON

---

Check that the circuit breaker is on and has not tripped. Turn on the circuit breaker.

### 4.1.1 When the Teach Pendant Cannot Be Powered On

---

Parts to cause this trouble;

- Teach pendant
- Teach pendant cable
- E-stop board
- Fuse (FUSE2) on the E-stop board

### 4.1.2 When the Teach Pendant Does Not Change from the Initial Screen

---

Parts to cause this trouble;

- Backplane board
- Main board
- Fuse(FUSE1) on the Main board
- Option board
- E-stop board
- Controller internal cables

## 4.2 ALARM OCCURRENCE SCREEN

---

The alarm occurrence screen displays only the alarm conditions that are currently active. If an alarm reset signal is input to reset the alarm conditions, the alarm occurrence screen displays the message "PAUSE or more serious alarm has not occurred."

The alarm occurrence screen displays only the alarm conditions (if any) that occur after the most recently entered alarm reset signal. To erase all alarm displays from the alarm occurrence screen. Press the CLEAR key (+ shift) on the alarm history screen.

The alarm occurrence screen is intended to display PAUSE or more serious alarms. It will not display WARN, NONE, or a reset. It is possible to disable PAUSE and some of more serious alarms from being displayed by setting the \$ER\_NOHIS system variable appropriately.

If two or more alarms have occurred, the display begins with the most recent alarm.

Up to 100 lines can be displayed.

If an alarm has a cause code, it is displayed below the line indicating the alarm.

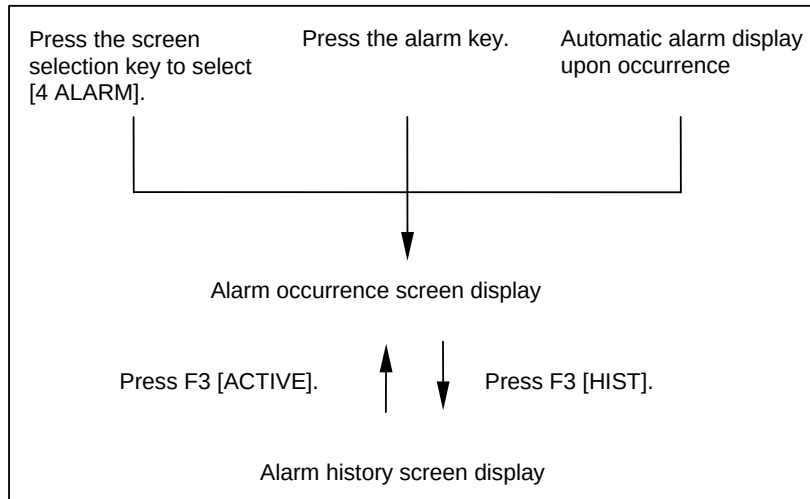
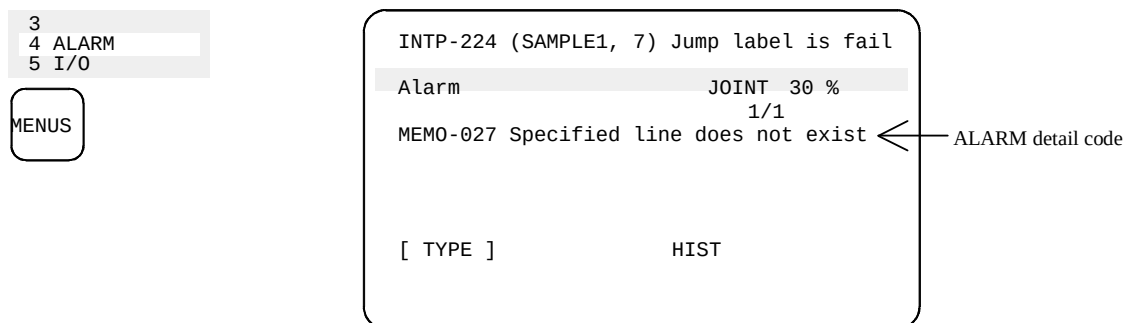


Fig.4.2 Alarm occurrence screen and alarm history screen display procedure

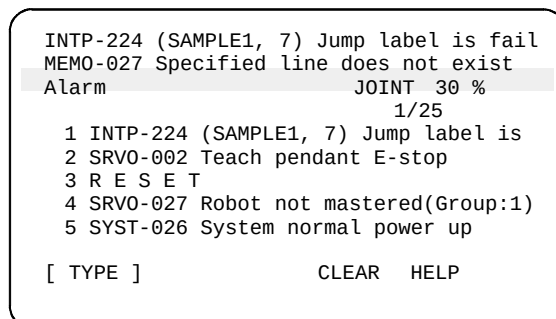
## Displaying the alarm history/alarm detail information

### Step

- (1) Press the MENUS key to display the screen menu.
- (2) Select [ALARM]. You will see a screen similar to the following.  
If an alarm has occurred, however, the alarm screen appears automatically.



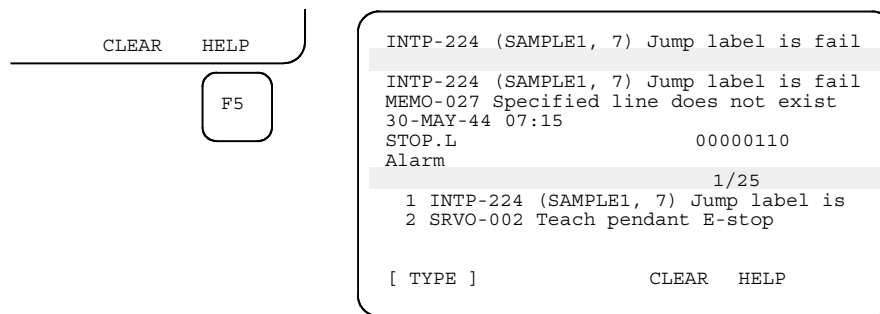
- (3) To display the alarm history screen, press F3, [HIST].  
Press F3 [ACTIVE] again, the alarm screen appears.



### NOTE

The latest alarm is assigned number 1. To view messages that are currently not on the screen, press the F5, HELP, then press the right arrow key.

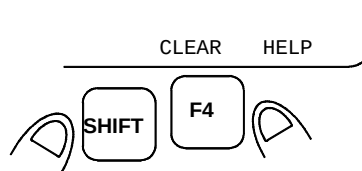
- (4) To display the alarm detail screen, press F5, [HELP].



- (5) To return to the alarm history screen, press the PREV key.



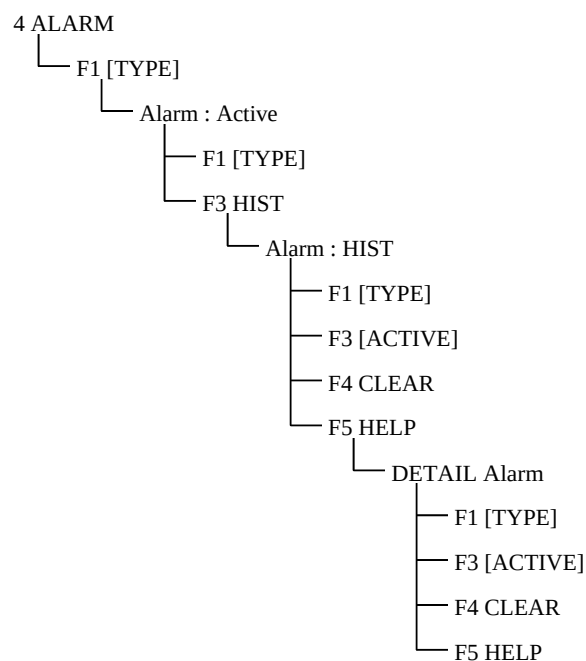
- (6) To delete all the alarm histories, press and hold down the SHIFT key, then press F4, [CLEAR].



#### NOTE

When system variable \$ER\_NOHIS = 1, NONE alarms or WARN alarms are not recorded. When \$ER\_NOHIS=2, resets are not recorded in the alarm history. When \$ER\_NOHIS=3, resets, WARN alarms, and NONE alarms are not recorded.

The following map indicates teach pendant operations used to check an alarm.



## 4.3 SAFETY SIGNALS

The safety signal screen indicates the state of signals related to safety.

To be specific, the screen indicates whether each safety signal is currently on. On this screen, it is impossible to change the state of any safety signal.

| Safety signal          | Description                                                                                                                                                                                                                                                                                                                                               |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Controller E-stop      | This item indicates the state of the emergency stop button on the controller. If the emergency stop button is pressed, the state is indicated as "TRUE".                                                                                                                                                                                                  |
| Teach pendant E-stop   | This item indicates the state of the emergency stop button on the teach pendant. If the emergency stop button is pressed, the state is indicated as "TRUE".                                                                                                                                                                                               |
| External E-stop        | This item indicates the state of the external E-stop signal. If the E-STOP signal is asserted, the state is indicated as "TRUE".                                                                                                                                                                                                                          |
| Fence open             | This item indicates the state of the safety fence. If the safety fence is open, the state is indicated as "TRUE".                                                                                                                                                                                                                                         |
| DEADMAN switch         | This item indicates whether the DEADMAN switch on the teach pendant is grasped. If the teach pendant is operable, and the DEADMAN switch is grasped correctly, the state is indicated as "TRUE". If the DEADMAN switch is released or is grasped tightly when the teach pendant is operable, an alarm occurs, causing the servo power to be switched off. |
| Teach pendant operable | This item indicates whether the teach pendant is operable. If the teach pendant is operable, the state is indicated as "TRUE".                                                                                                                                                                                                                            |
| Hand broken            | This item indicates the state of the hand safety joint. If the hand interferes with a workpiece or anything like this, and the safety joint is opened, the state is indicated as "TRUE". In this case, an alarm occurs, causing the servo power to be switched off.                                                                                       |
| Robot overtravel       | This item indicates whether the current position of the robot is out of the operation range. If any robot articulation goes out of the operation range beyond the overtravel switch, the state is indicated as "TRUE". In this case, an alarm occurs, causing the servo power to be switched off.                                                         |
| Abnormal air pressure  | This item indicates the state of the air pressure. The abnormal air pressure signal is connected to the air pressure sensor. If the air pressure is not higher than the specified value, the state is indicated as "TRUE".                                                                                                                                |

### Step

- (1) Press the MENUS key to display the screen menu.
- (2) Select STATUS on the next page.
- (3) Press F1, [TYPE] to display the screen switching menu.
- (4) Select Safety Signal. You will see a screen similar to the following.

|                  |        |           |
|------------------|--------|-----------|
| SYSTEM Safety    |        | JOINT 30% |
| SIGNAL NAME      | STATUS | 1/11      |
| 1 SOP E-Stop:    | FALSE  |           |
| 2 TP E-stop:     | FALSE  |           |
| 3 Ext E-Stop:    | FALSE  |           |
| 4 Fence Open:    | FALSE  |           |
| 5 TP Deadman:    | TRUE   |           |
| 6 TP Enable:     | TRUE   |           |
| 7 Hand Broken:   | FALSE  |           |
| 8 Over Travel:   | FALSE  |           |
| 9 Low Air Alarm: |        | FALSE     |

## 4.4 MASTERING

Mastering is needed if:

- (1) The SRVO-062 BZAL or SRVO-038 pulse mismatch alarm occurs, or
- (2) The pulsecoder is replaced.

Item (1) requires quick mastering, while item (2) requires zero-degree or fixture position mastering. (Zero-degree position mastering is just for quick-fix purposes. After zero-degree position mastering is used, fixture position mastering should be performed later.)

The mastering procedure is described below. For the procedure of mastering other than fixture position mastering, refer to the operator's manual of the mechanical unit.

### Condition

System variable \$MASTER\_ENB must be set to 1 or 2.

| SYSTEM Variables | JOINT 10% |
|------------------|-----------|
| 57 \$MASTER_ENB  | 1         |

### Step

- (1) Press <MENUS>.
- (2) Select SYSTEM.
- (3) Press F1, TYPE.
- (4) Select Master/Cal you will see a screen similar to the following.

```

9
0 -- NEXT --

```

MENUS

```

5 POSITION
6 SYSTEM
7

```

```

Master
TYPE

```

F1

| SYSTEM Master/Cal         | JOINT 30% |
|---------------------------|-----------|
| 1 FIXTURE POSITION MASTER |           |
| 2 ZERO POSITION MASTER    |           |
| 3 QUICK MASTER            |           |
| 4 SINGLE AXIS MASTER      |           |
| 5 SET QUICK MASTER REF    |           |
| 6 CALIBRATE               |           |

- 1 FIXTURE POSITION MASTER
- 2 ZERO POSITION MASTER
- 3 QUICK MASTER
- 4 SINGLE AXIS MASTER
- 5 SET QUICK MASTER REF
- 6 CALIBRATE

Press 'ENTER' or number key to select.

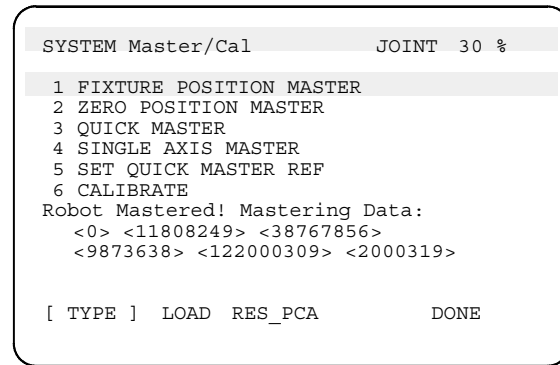
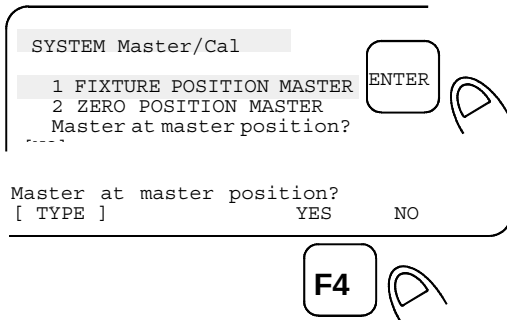
[TYPE]    LOAD RES\_PCA    DONE

- (5) Move the robot by jog feed to the mastering position. Release the brake on the manual brake control screen if necessary.

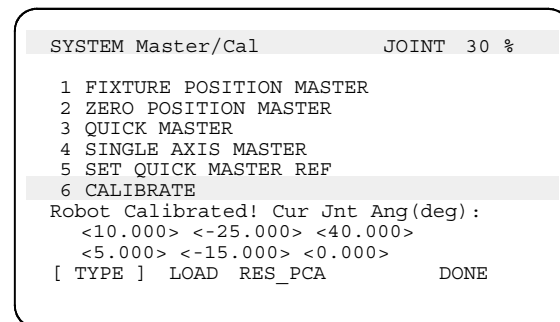
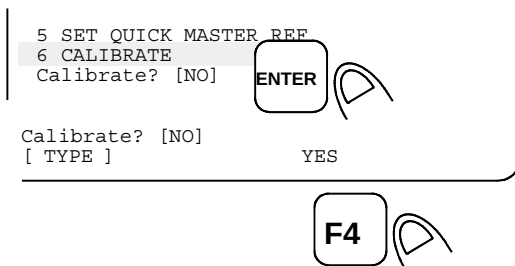
### NOTE

Mastering can not be performed until axis is rotated enough to establish a pulse.

- (6) Select "1 FIXTURE POSITION MASTER" and press the F4 key (yes). Mastering data is set.



- (7) Select "6 CALIBRATE" and press the F4 key (yes). Calibration is performed. Alternatively, to perform positioning, turn the power off, then turn it on again. Calibration is performed whenever the power is turned on.



- (8) Press F5 "DONE", after mastering.



## 4.5 TROUBLESHOOTING USING THE ERROR CODE

---

(1) SRVO-001 Operator panel E-stop

(Explanation) The emergency stop button on the controller is pressed.

(Action) Release the emergency stop button pressed on the controller.

Parts to cause this alarm;

- Emergency stop button
- E-stop board
- Main board
- Controller internal cables

(2) SRVO-002 Teach pendant E-stop

(Explanation) The emergency stop button on the teach pendant was pressed.

(Action) Release the emergency stop button on the teach pendant.

Parts to cause this alarm;

- Teach pendant

(3) SRVO-003 DEADMAN switch released

**In case of CE/RIA controller**

(Explanation) The teach pendant is enabled, but the DEADMAN switch is not pressed. Alternatively, the DEADMAN switch is pressed strongly.

(Action 1) Check the intermediate position of the DEADMAN switch on the teach pendant.

(Action 2) Check that the mode switch on the controller and the enable switch on the teach pendant are at the correct positions.

Parts to cause this alarm;

- Teach pendant
- Mode switch
- E-stop board
- Main board
- Controller internal cables

**In case of STANDARD controller**

(Explanation) The teach pendant is enabled, but the DEADMAN switch is not pressed. Alternatively, the DEADMAN switch is pressed strongly.

(Action 1) Check the intermediate position of the DEADMAN switch on the teach pendant.

(Action 2) Check that the enable switch on the teach pendant are at the correct positions.

Parts to cause this alarm;

- Teach pendant
- E-stop board
- Main board
- Controller internal cables

(4) SRVO-004 Fence open

**In case of CE/RIA controller**

(Explanation) In the automatic operation mode, the safety fence contact connected to EAS1-EAS11 or EAS2-EAS21 of CRMA64 or TBOP7 is open.

(Action 1) When a safety fence is connected, close the safety fence.

- (Action 2) Check the cables and switches connected between EAS1 and EAS11 and between EAS2 and EAS21 of CRMA64 or TBOP7.
- (Action 3) If the safety fence signal is not used, make a connection between EAS1 and EAS11 and between EAS2 and EAS21 of CRMA64 or TBOP7.

Parts to cause this alarm;

- Mode switch
- E-stop board
- Main board
- Controller internal cables



### **WARNING**

In a system using the safety fence signal, it is very dangerous to disable the signal when a connection is made between EAS1 and EAS11 and between EAS2 and EAS21 of CRMA64 or TBOP7. Never make such an attempt. If a temporary connection is needed for operation, another safety measures must be taken.

#### **In case of STANDARD controller**

(Explanation) In the automatic operation mode, the safety fence signal contacts connected to the panel board are open. Between EAS1 and EAS11 of the TBOP9 terminal block

- (Action 1) When a safety fence is connected, close the safety fence.
- (Action 2) Check the cables and switches connected between terminals on the E-stop board (between EAS1 and EAS11 of TBOP9).
- (Action 3) If the safety fence signal is not used, connect EAS1 and EAS11 of TBOP9 on the E-stop board with a jumper.

Parts to cause this alarm;

- E-stop board
- Main board
- Controller internal cables



### **WARNING**

In a system using the safety fence signal, it is very dangerous to disable the signal when a connection is made between EAS1 and EAS11 of the TBOP9. Never make such an attempt. If a temporary connection is needed for operation, another safety measures must be taken.

#### **(5) SRVO-005 Robot overtravel**

(Explanation) The robot has moved beyond a hardware limit switch on the axes.

- (Action 1) Select [System OT release] on the overtravel release screen to release each robot axis from the overtravel state.
- (Action 2) Hold down the shift key, and press the alarm release button to reset the alarm condition.
- (Action 3) Still hold down the shift key, and jog to bring all axes into the movable range.



Parts to cause this alarm;

- Limit switch
- FS2 fuse on the servo amplifier (If SRVO-214 alarm occurred)
- Servo amplifier
- Robot connection cable
- Controller internal cables
- Robot internal cables
- End effector connector
- Jumper connection on the mechanical unit (If in use)

**NOTE**

It is factory-placed in the overtravel state for packing purposes.  
If the Overtravel signal is not in use, it may have been disabled by jumper connection on the mechanical unit.

(6) SRVO-006 Hand broken

(Explanation) The safety joint (if in use) might have been broken. Alternatively, the HBK signal on the robot connection cable might be a ground fault or a cable disconnection.

(Action) Hold down the shift key, and press the alarm release button to reset the alarm condition. Still hold down the shift key, and jog the tool to the work area.

Parts to cause this alarm;

- Servo amplifier
- Robot connection cable
- Safety joint, Safety joint cable
- Controller internal cables
- Robot internal cables

**NOTE**

If the Hand broken signal is not in use, it can be disabled by software setting.  
Refer to Subsection 2.5.3 How to Disable/Enable HBK in Part III,  
"CONNECTIONS" of "Maintenance Manual" to disable the Hand broken signal.

(7) SRVO-009 Pneumatic pressure abnormal

(Explanation) An abnormal air pressure was detected. The input signal is located on the end effector of the robot. Refer to the manual of your robot.

(Action) If an abnormal air pressure is detected, check the cause.

Parts to cause this alarm;

- Servo amplifier
- Controller internal cables
- Robot internal cables
- End effector connector
- Robot connection cable

**NOTE**

Pneumatic pressure alarm input is on the end effector. Please refer to the manual of your robot.

## (8) SRVO-014 Fan motor abnormal

(Explanation) In normal condition, controller does not generate this alarm.

Parts to cause this alarm;

- Main board
- Jumper connector on main board

## (9) SRVO-015 SYSTEM OVER HEAT (Group : i Axis : j)

(Explanation) The temperature in the controller exceeds the specified value.

(Action) If the ambient temperature is higher than specified, cool down the ambient temperature.

Parts to cause this alarm;

- Fan motor
- Main board
- E-stop board
- Controller internal cables
- Fuse FU1, FU2 on E-stop board

## (10) SRVO-018 Brake abnormal

(Explanation) An excessive brake current is detected.

Parts to cause this alarm;

- Servo amplifier
- Robot connection cable
- Controller internal cables
- Motor brakes
- Internal cable of mechanical unit

## (11) SRVO-021 SRDY off (Group : i Axis : j)

(Explanation) The HRDY is on and the SRDY is off, although there is no other cause of an alarm. (HRDY is a signal with which the host detects the servo system whether to turn on or off the servo amplifier magnetic contactor. SRDY is a signal with which the servo system informs the host whether the magnetic contactor is turned on.)

If the servo amplifier magnetic contactor cannot be turned on when directed so, it is most likely that a servo amplifier alarm has occurred. If a servo amplifier alarm has been detected, the host will not generate this alarm (SRDY off). Therefore, this alarm indicates that the magnetic contactor cannot be turned on for an unknown reason.

(Action) There is a possibility that an instant disconnection of power source causes this alarm. Check whether an instant disconnection occurred.

Parts to cause this alarm;

- E-stop board
- Servo amplifier
- Controller internal cables

## (12) SRVO-022 SRDY on (Group : i Axis : j)

(Explanation) When the HRDY is about to go on, the SRDY is already on. (HRDY is a signal with which the host directs the servo system whether to turn on or off the servo amplifier magnetic contactor. SRDY is a signal with which the servo system informs the host whether the magnetic contactor is turned on.)

Parts to cause this alarm;

- Servo amplifier

## (13) SRVO-023 Stop error excess (Group : i Axis : j)

(Explanation) When the servo is at stop, the position error is abnormally large. Check whether the brake is released through the clack sound of the brake or vibration.

In case that the brake is not released.

Parts to cause this alarm;

- Servo amplifier
- Servo motor
- Robot connection cable
- Controller internal cables
- Robot internal cables

In case that the brake is released.

(Action 1) Check whether the obstacle disturbs the robot motion.

(Action 2) Check to see if the load is greater than the rating. If greater, reduce it to within the rating. (If the load is too great, the torque required for acceleration / deceleration becomes higher than the capacity of the motor. As a result, the motor becomes unable to follow the command, and an alarm is generated.)

(Action 3) Check the input voltage to the controller is within the rated voltage and no phase is lack.

Parts to cause this alarm;

- Servo amplifier
- Servo motor
- Robot connection cable
- Controller internal cables
- Robot internal cables

**NOTE**

Incorrect setting of the brake number causes this alarm.

## (14) SRVO-024 Move error excess (Group : i Axis : j)

(Explanation) When the robot is running, its position error is greater than a specified value (\$PARAM \_ GROUP. \$MOVER \_ OFFST). It is likely that the robot cannot follow the speed specified by program.

(Action) Take the same actions as SRVO-023.

## (15) SRVO-027 Robot not mastered (Group : i)

(Explanation) An attempt was made to calibrate the robot, but the necessary adjustment had not been completed.

(Action) Check whether the mastering is valid. If the mastering is invalid, master the robot.

**WARNING**

If the position data is incorrect, the robot moves abnormally, set the position data correctly. Otherwise, you could injure personnel or damage equipment.

- (16) SRVO-030 Brake on hold (Group:i)  
 (Explanation) If the temporary halt alarm function is enabled (\$SCR.\$BRKHOLD ENB=1), SRVO-030 occurred when a temporary halt occurs. When this function is not used, disable the setting.  
 (Action) Disable [Servo-off in temporary halt] on the general item setting screen [6 General Setting Items].
- (17) SRVO-033 Robot not calibrated (Group : i)  
 (Explanation) An attempt was made to set up a reference point for quick mastering, but the robot had not been calibrated.  
 (Action) Calibrate the robot. Set up a quick mastering reference point using [Positioning] on the positioning menu.
- (18) SRVO-034 Ref pos not set (Group : i)  
 (Explanation) An attempt was made to perform quick mastering, but the reference point had not been set up.  
 (Action) Set up a quick mastering reference point on the positioning menu.
- (19) SRVO-036Inpos time over (Group : i Axis : j)  
 (Explanation) The robot did not get to the effective area (\$PARAM \_ GROUP.\$ STOPTOL) even after the position check monitoring time (\$PARAM \_ GROUP. \$INPOS \_ TIME) went on.  
 (Action) Take the same actions as for SRVO-023 (large position error at a stop).
- (20) SRVO-038 Pulse mismatch (Group : i Axis : j)  
 (Explanation) The pulse count obtained when power is turned off does not match the pulse count obtained when power is applied. This alarm is asserted after exchange the pulsecoder or battery for back up of the pulsecoder data or loading back up data to the Main Board. Check the alarm history.  
 (Action 1) If the brake number is set to the non-brake motors, this alarm may occur. Check the software setting of the brake number.  
 (Action 2) In case the robot has been moved by using the brake release unit while the power is off or when restoring the back-up data to the main board, this alarm may occur. Remaster the robot.

Parts to cause this alarm;

- Pulsecoder
- Motor brake

- (21) SRVO-042 MCAL alarm (Group : i Axis : j)

(Explanation) This alarm means that the contacts of the magnetic contactor have stuck to each other.  
 The alarm occurs if the magnetic contactor turns out to be already on when an attempt is made to turn it on. The alarm state is detected between the time contact sticking occurs and the time an attempt is made to turn on the magnetic contactor.

Parts to cause this alarm;

- E-stop board
- Servo amplifier
- Magnetic contactor
- Controller internal cables

## (22) SRVO-043 DCAL alarm (Group : i Axis : j)

(Explanation) The regenerative discharge energy was too high to be dissipated as heat. (To run the robot, the servo amplifier supplies energy to the robot. When going down the vertical axis, the robot operates from the potential energy. If a reduction in the potential energy is higher than the energy needed for acceleration, the servo amplifier receives energy from the motor. A similar phenomenon occurs even when no gravity is applied, for example, at deceleration on a horizontal axis. The energy that the servo amplifier receives from the motor is called the regenerative energy. The servo amplifier dissipates this energy as heat. If the regenerative energy is higher than the energy dissipated as heat, the difference is stored in the servo amplifier, causing an alarm.)

(Action 1) This alarm may occur if the axis is subjected to frequent acceleration/deceleration or if the axis is vertical and generates a large amount of regenerative energy. If this alarm has occurred, relax the service conditions.

(Action 2) Clean up the fan motor and the filter if they are dirty.

Parts to cause this alarm;

- FS3 fuse on the servo amplifier
- Fan motor of controller
- E-stop unit
- Regenerative resistor
- Servo amplifier

## (23) SRVO-044 HVAL alarm (Group : i Axis : j)

(Explanation) The DC voltage (DC link voltage) of the main circuit power supply is abnormally high.

(Action 1) Check the three-phase input voltage. If the three-phase input voltage is higher than 230 VAC, high acceleration/deceleration is caused in this alarm.

(Action 2) Check that the load weight is within the rating. If it is higher than the rating, reduce it to within the rating. (If the machine load is higher than the rating, the accumulation of regenerative energy might result in the HVAL alarm even when the three-phase input voltage is within the rating.)

Parts to cause this alarm;

- Regenerative resistor
- Servo amplifier

## (24) SRVO-045 HCAL alarm (Group : i Axis : j)

(Explanation) Abnormally high current flowed in the main circuit of the servo amplifier.

Parts to cause this alarm;

- Servo amplifier
- Robot connection cable
- Servo motor
- Controller internal cables
- Robot internal cables

## (25) SRVO-046 OVC alarm (Group : i Axis : j)

(Explanation) This alarm is generated to prevent the motor from thermal damage that might occur when the root mean square current calculated within the servo system is out of the allowable range.

- (Action 1) Check the operating condition for the robot and relax the service condition if possible.  
If the load or operating condition has exceeded the rating, reduce the load or relax the operating condition to meet the rating.
- (Action 2) Check whether the voltage input to the controller is within the rated voltage.
- (Action 3) Check whether there is a factor that has increased the mechanical load on the corresponding axis.

Parts to cause this alarm;

- Servo amplifier
- Servo motor
- E-stop board
- Robot connection cable
- Controller internal cables
- Robot internal cables

## Reference

Relationships among the OVC, OHAL, and HC alarms

### - Overview

This section points out the differences among the OVC, OHAL, and HC alarms and describes the purpose of each alarm.

### - Alarm detection section

| Abbreviation | Designation        | Detection section                                                                                                               |
|--------------|--------------------|---------------------------------------------------------------------------------------------------------------------------------|
| OVC          | Overcurrent alarm  | Servo software                                                                                                                  |
| OHAL         | Overheat alarm     | Thermal relay in the motor<br>Thermal relay in the servo amplifier<br>Thermal relay in the separate regenerative discharge unit |
| HC           | High current alarm | Servo amplifier                                                                                                                 |

### - Purpose of each alarm

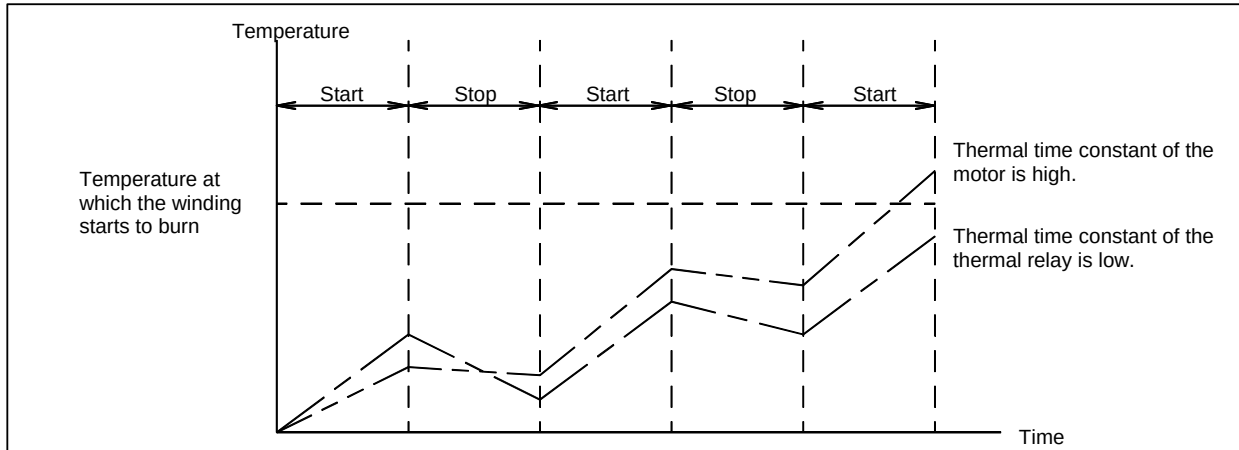
#### 1) HC alarm (high current alarm)

If high current flow in a power transistor momentarily due to abnormality or noise in the control circuit, the power transistor and rectifier diodes might be damaged, or the magnet of the motor might be degaussed. The HC alarm is intended to prevent such failures.

#### 2) OVC and OHAL alarms (overcurrent and overload alarms)

The OVC and OHAL alarms are intended to prevent overheat that may lead to the burnout of the motor winding, the breakdown of the servo amplifier transistor, and the separate regenerative resistor.

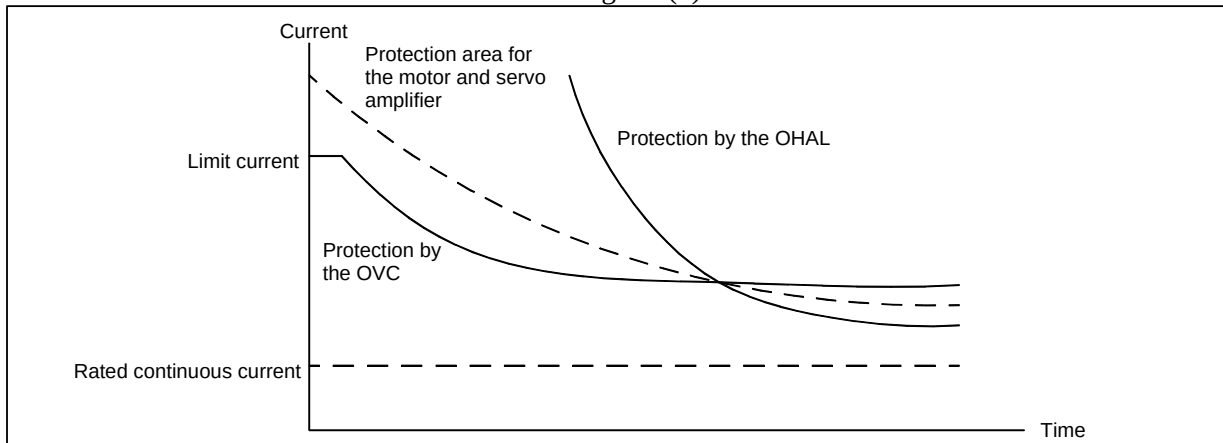
The OHAL alarm occurs when each built-in thermal relay detects a temperature higher than the rated value. However, this method is not necessarily perfect to prevent these failures. For example, if the motor frequently repeats to start and stop, the thermal time constant of the motor, which has a large mass, becomes higher than the time constant of the thermal relay, because these two components are different in material, structure, and dimension. Therefore, if the motor continues to start and stop within a short time as shown in Fig. 4.5 (a), the temperature rise in the motor is steeper than that in the thermal relay, thus causing the motor to burn before the thermal relay detects an abnormally high temperature.



**Fig.4.5 (a) Relationship between the temperatures of the motor and thermal relay on start/stop cycles**

To prevent the above defects, software is used to monitor the current in the motor constantly in order to estimate the temperature of the motor. The OVC alarm is generated based on this estimated temperature. This method estimates the motor temperature with substantial accuracy, so it can prevent the failures described above.

To sum up, a double protection method is used; the OVC alarm is used for protection from a short-time overcurrent, and the OHAL alarm is used for protection from long-term overload. The relationship between the OVC and OHAL alarms is shown in Fig.4.5 (b).



**Fig.4.5 (b) Relationship between the OVC and OHAL alarms**

#### NOTE

The relationship shown in Fig.4.5 (b) is taken into consideration for the OVC alarm. The motor might not be hot even if the OVC alarm has occurred. In this case, do not change the parameters to loosen protection.

#### (26) SRVO-047 LVAL alarm (Group : i Axis : j)

(Explanation) The control power supply voltage (+5 V, etc.) supplied from the power supply circuit in the servo amplifier is abnormally low.

Parts to cause this alarm;

- Servo amplifier
- Power supply unit

#### (27) SRVO-050 CLALM alarm (Group : i Axis : j)

(Explanation) The disturbance torque estimated by the servo software is abnormally high.  
(A collision has been detected.)

- (Action 1) Check whether the robot has collided and also check whether there is a factor that has increased the mechanical load on the corresponding axis.
- (Action 2) Check whether the load settings are valid.
- (Action 3) If the load weight exceeds the rated range, decrease it to within the limit.
- (Action 4) Check whether the voltage input to the controller is within the rated voltage.

Parts to cause this alarm;

- Servo amplifier
- Servo motor
- E-stop board
- Robot connection cable
- Controller internal cables
- Robot internal cables

- (28) SRVO-051 CUER alarm (Group : i Axis : j)  
(Explanation) The offset of the current feedback value is abnormally high.

Parts to cause this alarm;

- Servo amplifier

- (29) SRVO-055 FSSB com error 1 (Group : i Axis : j)  
(Explanation) A communication error has occurred between the main board and servo amplifier.

Parts to cause this alarm;

- Optical cable between the main board and servo amplifier
- Axis control card on the main board
- Servo amplifier

- (30) SRVO-056 FSSB com error 2 (Group : i Axis : j)  
(Explanation) A communication error has occurred between the main board and servo amplifier.

Parts to cause this alarm;

- Optical cable between the main board and servo amplifier
- Axis control card on the main board
- Servo amplifier

- (31) SRVO-057 FSSB disconnect (Group : i Axis : j)  
(Explanation) Communication was interrupted between the main board and servo amplifier.

Parts to cause this alarm;

- Servo amplifier
- Optical cable between the axis control card and servo amplifier
- Axis control card on the main board
- Main board
- Robot connection cable
- Controller internal cables
- Robot internal cables

- (32) SRVO-058 FSSB init error (Group : i Axis : j)  
(Explanation) Communication was interrupted between the main board and servo amplifier.



Parts to cause this alarm;

- Servo amplifier
- Robot connection cable
- Controller internal cables
- Robot internal cables
- Optical cable between the axis control board and servo amplifier
- Servo card on the main board
- Main board

(33) SRVO-059 Servo amp init error

(Explanation) Servo amplifier initialization is failed.

Parts to cause this alarm;

- Servo amplifier

(34) SRVO-062 BZAL alarm (Group : i Axis : j)

(Explanation) This alarm occurs if battery for pulsecoder absolute-position backup is empty.

Parts to cause this alarm;

- Battery in the battery box of the robot base
- Pulsecoder
- Robot internal cable



**CAUTION**

After correcting the cause of this alarm, set the system variable (\$MCR.\$SPC\_RESET) to TRUE then turn on the power again. Mastering is needed.

(35) SRVO-064 PHAL alarm (Group : i Axis : j)

(Explanation) This alarm occurs if the phase of the pulses generated in the pulsecoder is abnormal.

Parts to cause this alarm;

- Pulsecoder

**NOTE**

This alarm might accompany the DTERR, CRCERR, or STBERR alarm. In this case, however, there is no actual condition for this alarm.

(36) SRVO-065 BLAL alarm (Group : i Axis : j)

(Explanation) The battery voltage for the pulsecoder is lower than the rating.

(Action) Replace the battery.

If this alarm occurs, turn on the power and replace the battery as soon as possible. A delay in battery replacement may result in the BZAL alarm being detected. In this case, the position data will be lost. Once the position data is lost, mastering will become necessary.

(37) SRVO-067 OHAL2 alarm (Group : i Axis : j)

(Explanation) The temperature inside the pulsecoder or motor is abnormally high, and the built-in thermostat has operated.

(Action) Check the robot operating conditions. If a condition such as the duty cycle and load weight has exceeded the rating, relax the robot load condition to meet the allowable range.

Parts to cause this alarm;

- Servo motor

(When power is supplied to the motor after it has become sufficiently cool, if the alarm still occurs.)

(38) SRVO-068 DTERR alarm (Group : i Axis : j)

(Explanation) The serial pulsecoder does not return serial data in response to a request signal.

(Action 1) Make sure that the RMP connector of servo amplifier (motor side) is connected tightly.

(Action 2) Check that the shielding of the robot connection cable is grounded securely in the cabinet.

Parts to cause this alarm;

- Servo amplifier
- Robot connection cable
- Controller internal cables
- Robot internal cables

(39) SRVO-069 CRCERR alarm (Group : i Axis : j)

(Explanation) The serial data has disturbed during communication.

-See actions on SRVO-068

(40) SRVO-070 STBERR alarm (Group : i Axis : j)

(Explanation) The start and stop bits of the serial data are abnormal.

-See actions on SRVO-068

(41) SRVO-071 SPHAL alarm (Group : i Axis : j)

(Explanation) The feedback speed is abnormally high.

(Action) Action as same as the SRVO-068.

**NOTE**

If this alarm occurs together with the PHAL alarm (SRVO-064), this alarm does not correspond to the major cause of the failure.

(42) SRVO-072 PMAL alarm (Group : i Axis : j)

(Explanation) It is likely that the pulsecoder is abnormal.

Parts to cause this alarm;

- Pulsecoder

(43) SRVO-073 CMAL alarm (Group : i Axis : j)

(Explanation) It is likely that the pulsecoder is abnormal or the pulsecoder has malfunctioned due to noise.

(Action 1) Check whether the connection of the controller earth is good. Check the earth cable connection between controller and robot. Check whether the shielding of the robot connection cables are connected securely to the grounding plate.

(Action 2) Reinforce the earth of the motor flange.(In case of Auxiliary axis)

Parts to cause this alarm;

- Pulsecoder

(44) SRVO-074 LDAL alarm (Group : i Axis : j)

(Explanation) The LED in the pulsecoder is broken.

Parts to cause this alarm;

- Pulsecoder

(45) SRVO-075 Pulse not established (Group : i Axis : j)

(Explanation) The absolute position of the pulsecoder cannot be established.

(Action) Reset the alarm, and jog the axis on which the alarm has occurred until the same alarm will not occur again.

(46) SRVO-076 Tip Stick Detection (Group : i Axis : j)

(Explanation) An excessive disturbance was assumed in servo software at the start of operation. (An abnormal load was detected. The cause may be welding.)

(Action 1) Check whether the robot has collided. Or check whether the machinery load of the corresponding axis is increased.

(Action 2) Check whether the load settings are valid.

(Action 3) Check whether the brake of the corresponding axis is released.

(Action 4) Check whether the load weight is within the rated range. If the weight exceeds the upper limit, decrease it to the limit.

(Action 5) Check whether the voltage input to the controller is within the rated voltage.

Parts to cause this alarm;

- Servo amplifier
- Servo motor
- E-stop board
- Robot connection cable
- Controller internal cables
- Robot internal cables

(47) SRVO-081 EROFL alarm (Track enc : i)

(Explanation) The pulse counter for line tracking has overflowed.

(Action) Check whether the condition of the line tracking exceeds the limitation.

Parts to cause this alarm;

- Line tracking interface board
- Pulsecoder

(48) SRVO-082 DAL alarm (Track enc : i)

(Explanation) The line tracking pulsecoder has not been connected.

(Action) Check whether the shielding of the connection cable is connected securely to the grounding plate.

Parts to cause this alarm;

- Line tracking interface board
- Line tracking cable
- Pulsecoder

(49) SRVO-084 BZAL alarm (Track enc : i)

(Explanation) This alarm occurs if the backup battery for the absolute position of the pulsecoder has not been connected. See the description about the BZAL alarm (SRVO-062).

(50) SRVO-087 BLAL alarm (Track enc : i)

(Explanation) This alarm occurs if the voltage of the backup battery for the absolute position of the pulsecoder is low. See the description about the BLAL alarm (SRVO-065).

## (51) SRVO-089 OHAL2 alarm (Track enc : i)

(Explanation) The motor has overheated. When power is supplied to the pulsecoder after it has become sufficiently cool, if the alarm still occurs. See the description about the OHAL2 alarm (SRVO-067).

## (52) SRVO-090 DTERR alarm (Track enc : i)

(Explanation) Communication between the pulsecoder and line tracking interface board is abnormal.

See the SRVO-068 DTERR alarm.

(Action) Check whether the shielding of the connection cable is connected securely to the grounding plate.

Parts to cause this alarm;

- Line tracking interface board
- Line tracking cable
- Pulsecoder

## (53) SRVO-091 CRCERR alarm (Track enc : i)

(Explanation) Communication between the pulsecoder and line tracking interface board is abnormal.

(Action) Action as same as the SRVO-090.

## (54) SRVO-092 STBERR alarm (Track enc : i)

(Explanation) Communication between the pulsecoder and line tracking interface board is abnormal.

(Action) Action as same as the SRVO-090.

## (55) SRVO-093 SPHAL alarm (Track enc : i)

(Explanation) This alarm occurs if the current position data from the pulsecoder is higher than the previous position data.

(Action) Action as same as the SRVO-090.

## (56) SRVO-094 PMAL alarm (Track enc : i)

(Explanation) It is likely that the pulsecoder is abnormal. See the description about the PMAL alarm (SRVO-072)

## (57) SRVO-095 CMAL alarm (Track enc : i)

(Explanation) It is likely that the pulsecoder is abnormal or the pulsecoder has malfunctioned due to noise. See the description about the CMAL alarm (SRVO-073).

(Action) Verify that the pulsecoder cable is grounded.

Parts to cause this alarm;

- Pulsecoder

## (58) SRVO-096 LDAL alarm (Track enc : i)

(Explanation) The LED in the pulsecoder is broken. See the description about the LDAL alarm (SRVO-074).

## (59) SRVO-097 Pulse not established (enc : i)

(Explanation) The absolute position of the pulsecoder cannot be established. See the description about (SRVO-075). Pulse not established.

(Action) Reset the alarm, and jog the axis on which the alarm has occurred until the same alarm does not occur again. (Jog one motor revolution)

## (60) SRVO-105 Door open or E-stop

Parts to cause this alarm;

- E-stop board
- Servo amplifier

## (61) SRVO-136 DCLVAL alarm (Group : i Axis : j)

(Explanation) The servo the DC current of amplifier (DC link voltage) of the main power supply is abnormally low.

-This alarm occurred during robot operation.

(Action 1) Check the input voltage to the controller is within the rated voltage and no phase is lack.

(Action 2) It is possible that an instant disconnection of power source causes this alarm. Check whether an instant disconnection occurred.

(Action 3) Modify the program in order that robot and the auxiliary axis do not accelerate simultaneously in the system with the auxiliary axis.

Parts to cause this alarm;

- E-stop board
- Servo amplifier.

-If this alarm occurred before the magnetic contactor is turned on:

(Action) Check the input voltage to the controller is within the rated voltage and no phase is lack.

Parts to cause this alarm;

- Controller internal cables
- E-stop board
- Servo amplifier

## (62) SRVO-156 IPMAL alarm (Group : i Axis : j)

(Explanation) Abnormally high current flowed through the main circuit of the servo amplifier.

(Action) Turn off the power, and disconnect the power cable from the servo amplifier indicated by the alarm message. (And disconnect the brake cable (CRR88 on the servo amplifier) to avoid the axis falling unexpectedly.) Turn on the power.

Parts to cause this alarm;

- Servo amplifier
- Robot connection cable
- Controller internal cables
- Robot internal cables

## (63) SRVO-157 CHGAL alarm (Group : i Axis : j)

(Explanation) The capacitor for the condenser voltage of the servo amplifier was not charged within the specified time when the servo power is on.

Parts to cause this alarm;

- E-stop board
- Servo amplifier
- Auxiliary amplifier for system of the auxiliary axis

(64) SRVO-169 Ext.E-stop/SVOFF/ServoDisconnect (**In case of STANDARD controller**)

(Explanation) An external E-stop contact (EES, EGS) connected to the terminal block on the E-stop board is open.

- Between EES1 and EES11 of the TBOP9 terminal block, or between EGS1 and EGS11 of the TBOP9 terminal block
- (Action) If an external E-stop switch is connected, release the switch.

Parts to cause this alarm;

- E-stop board
- External emergency stop button
- Cable connected to EES1–EES11 and EGS1–EGS11 on the TBOP9 terminal block
- Teach pendant
- Teach pendant cable
- Main board
- Controller internal cables



### **WARNING**

In a system using the external E-stop signal, it is very dangerous to disable the signal when a connection is made between EES1 and EES11 of TBOP9, or made between EGS1 and EGS11 of the TBOP9. Never make such an attempt. If a temporary connection is needed for operation, separate safety measures must be taken.

#### (65) SRVO-201 Panel E-stop or SVEMG abnormal

- (Explanation) The emergency stop button on the controller was pressed, but the E-STOP line was not disconnected.

Parts to cause this alarm;

- E-stop board
- Servo amplifier
- Main board

#### (66) SRVO-202 TP E-stop or SVEMG abnormal

- (Explanation) The emergency stop button on the Teach pendant was pressed, but the E-STOP line was not disconnected.

Parts to cause this alarm;

- Teach pendant
- Teach pendant cable
- Emergency stop button on controller
- E-stop board
- Controller internal cables

### **NOTE**

This alarm might occur if the emergency stop button is pressed slowly.

#### (67) SRVO-204 External (SVEMG abnormal) E-stop

##### **In case of CE/RIA controller**

- (Explanation) The emergency stop line was not disconnected when the switch connected to the external emergency stop contacts on CRMA64 or TBOP7 was pressed.  
Terminal connection: Between EES1 and EES11 and between EES2 and EES21 on CRMA64 or TBOP7.

- (Action) Check the switches and cables connected between terminals on CRMA64 or TBOP7 (between EES1 and EES11 and between EES2 and EES21 on CRMA64 or TBOP7).

Parts to cause this alarm;

- E-stop board
- Servo amplifier
- Controller internal cables
- Switch connected to EES1 – EES11 and EES2 – EES21 on CRMA64 or TBOP7
- Cable connected to EES1 – EES11 and EES2 – EES21 on CRMA64 or TBOP7

**In case of STANDARD controller**

(Explanation) An external E-stop switch connected to the E-stop board was pressed, but the E-STOP line was not disconnected.

Terminal connection: Between EES1 and EES11, or EGS1 and EGS11 of the TBOP9 terminal block

(Action 1) Check the switches and cables connected between terminals on the E-stop board (between EES1 and EES11, and EGS1 and EGS11 of TBOP9).

Parts to cause this alarm;

- E-stop board
- Servo amplifier
- Controller internal cables
- Switch connected to EES1–EES11 and EGS1–EGS11 on the TBOP9 terminal block
- Cable connected to EES1–EES11 and EGS1–EGS11 on the TBOP9 terminal block

(68) SRVO-205 Fence open (SVEMG abnormal)

**In case of CE/RIA controller**

(Explanation) The emergency stop line was not disconnected when the switch connected to the safety fence contacts on CRMA64 or TBOP7 was pressed.

Terminal connection: Between EAS1 and EAS11 and between EAS2 and EAS21 on CRMA64 or TBOP7.

(Action) Check the switches and cables connected between terminals on CRMA64 or TBOP7 (between EAS1 and EAS11 and between EAS2 and EAS21 on CRMA64 or TBOP7)

Parts to cause this alarm;

- E-stop board
- Servo amplifier
- Controller internal cables
- Switch connected to EAS1 – EAS11 and EAS2 – EAS21 on CRMA64 or TBOP7
- Cable connected to EAS1 – EAS11 and EAS2 – EAS21 on CRMA64 or TBOP7

**In case of STANDARD controller**

(Explanation) The E-stop line was not disconnected when a switch connected to a safety fence contact on the E-stop board was pressed.

Terminal connection: Between EAS1 and EAS11 of the TBOP9 terminal block

(Action 1) Check the switches and cables connected between terminals on the E-stop board (between EAS1 and EAS11 of TBOP9).

Parts to cause this alarm;

- E-stop board
- Servo amplifier
- Controller internal cables
- Switch connected to EAS1– EAS11 on the TBOP9 terminal block
- Cable connected to EAS1– EAS11 on the TBOP9 terminal block

## (69) SRVO-206 DEADMAN switch (SVEMG abnormal)

(Explanation) When the teach pendant was enabled, the DEADMAN switch was released or pressed strongly, but the E-stop line was not disconnected.

Parts to cause this alarm;

- E-stop board
- Servo amplifier
- Teach pendant
- Teach pendant cable
- Controller internal cables

## (70) SRVO-214 Fuse blown (Servo amplifier)

(Explanation) A fuse in the servo amplifier has blown.

(Action) A fuse is blown, eliminate the cause, then replace the fuse.

Parts to cause this alarm;

In case that FS2 is blown

- Robot connection cable, Robot internal cables, End effector connector
- Optional FAN in the mechanical unit (M-3iA)

In case that FS3 is blown

- Regenerative resister, Auxiliary amplifier

## (71) SRVO-216 OVC (total) (Robot : i)

(Explanation) The current (total current for six axes) flowing through the motor is too large.

(Action 1) Slow the motion of the robot where possible. Check the robot operation conditions. If the robot is used with a condition exceeding the duty or load weight robot rating, reduce the load condition value to the specification range.

(Action 2) Check the input voltage to the controller is within the rated voltage and no phase is lack.

Parts to cause this alarm;

- Servo amplifier

(72) SRVO-218 Ext.E-stop/ServoDisconnect (**In case of CE/RIA controller**)

(Explanation) The switch connected across EES1 – EES11 and EES2 – EES21 on CRMA64 or TBOP7 was pressed.

(Action) When the external emergency stop button is connected, release the button.

Parts to cause this alarm;

- E-stop board
- External emergency stop button
- Cable connected to EES1 – EES11 and EES2 – EES21 on CRMA64 or TBOP7
- Controller internal cables
- Teach pendant
- Teach pendant cable



## (73) SRVO-220 SDI fuse blown

(Explanation) A fuse (FUSE3) on the main board has blown.

(Action 1) Check whether the fuse (FUSE3) on the main board has blown. If the fuse has blown, 24SDI may be short-circuited to 0V. Take Action 2.

(Action 2) Remove the cause of the 24SDI ground-fault, then check that FUSE3 does not blow. Disconnect the following, then turn on the power.

**In case of controller with connector panel**

- CRMA62 (on the connector panel)
- CRMA63 (on the connector panel)

**In case of controller without connector panel**

- CRMA15 (on the main board)
- CRMA16 (on the main board)

If FUSE3 does not blow in this state, 24SDI and 0V may be short-circuited at any of the above locations. Determine the faulty location, then take appropriate action.

Parts to cause this alarm;

- Main board
- Controller internal cables
- E-stop board
- Servo amplifier

## (74) SRVO-221 Lack of DSP (Group : i Axis : j)

(Explanation) A controlled axis card corresponding to the set number of axes is not mounted.

(Action) Check whether the set number of axes is valid. If the number is invalid, set the correct number.

Parts to cause this alarm;

- Axis control card on main board

## (75) SRVO-223 DSP dry run(a b)

(Explanation) Servo system initialization was stopped because of a hardware failure or improper software setting. The controller has been started in the DSP dry run mode.

(Action 1) When the value is 1, 5, or 6: An incorrect setting is made. Check whether the dry run mode is set and also check whether the setting of the hard start axis is correct.

(Action 2) When the value is 8 or 10: Take action for an FSSB initialization error that has occurred at the same time.

Parts to cause this alarm;

- Axis control card on main board
- Optical cable between the axis control card and servo amplifier
- Servo amplifier

- (76) SRVO-230 Chain 1 abnormal a,b  
 SRVO-231 Chain 2 abnormal a,b

(Explanation) A mismatch occurred between duplicate safety signals.

SRVO-230 occurred if such a mismatch that a contact connected on the chain 1 side (between EES1 and EES11, between EAS1 and EAS11, between SD4 and SD41, and so forth) is closed, and a contact on the chain 2 side (between EES2 and EES21, between EAS2 and EAS21, between SD5 and SD51, and so forth) is open occurs. SRVO-231 is issued if such a mismatch that a contact on the chain 1 side is open, and a contact on the chain 2 side is closed occurs.

If a chain error is detected, correct the cause of the alarm then reset the alarm according to the method described later.

- (Action) Check the alarms issued at the same time in order to identify with which signal the mismatch occurred.  
 SRVO-266 through SRVO-275 and SRVO-370 through SRVO-385 are issued at the same time. Take the action(s) described for each item.

### **WARNING**

If this alarm occurred, do not reset the chain error alarm until the failure is identified and repaired. If robot use is continued with one of the duplicate circuits being faulty, safety may not be guaranteed when the other circuit fails.

### **CAUTION**

- 1 The state of this alarm is preserved by software. After correcting the cause of the alarm, reset the chain error alarm according to the chain error reset procedure described later.
- 2 Until a chain error is reset, no ordinary reset operation must be performed. If an ordinary reset operation is performed before chain error resetting, the message "SRVO-237 Chain error cannot be reset" is displayed on the teach pendant.

## Alarm history display method

1. Press the screen selection key on the teach pendant.
2. Select [4 ALARM] on the teach pendant.
3. Press F3 [HIST] on the teach pendant.

## Chain error reset procedure

### **CAUTION**

Do not perform this operation until the cause of the alarm is corrected.

#### <Method 1>

1. Press the emergency stop button.
2. Press the screen selection key on the teach pendant.
3. Select [0 NEXT PAGE] on the teach pendant.
4. Press [6 SYSTEM] on the teach pendant.
5. Press [7 SYSTEM SETTING] on the teach pendant.
6. Find "28" Chain Error Reset Execution.
7. Press F3 on the teach pendant to reset "Chain Error".

#### <Method 2>

1. Press the screen selection key on the teach pendant.
2. Select [4 ALARM] on the teach pendant.

3. Press F4 [CHAIN RESET] on the teach pendant.

(77) SRVO-233 TP disabled in T1, T2/Door open (**In case of CE/RIA controller**)

(Explanation) Teach pendant is disabled when the mode switch is T1 or T2.

(Action) Enable the teach pendant in teaching operation. In other case the mode switch should be AUTO mode.

Parts to cause this alarm;

- Teach pendant
- Teach pendant cable
- Controller internal cables
- Mode switch
- E-stop board
- Servo amplifier

(78) SRVO-235 Short term Chain abnormal

(Explanation) Short term single chain failure condition is detected.

- Cause of this alarm is ;
  - Half release of DEADMAN switch
  - Half operation of E-stop switch.

(Action) Cause the same error to occur again, then perform resetting.

Parts to cause this alarm;

- E-stop board
- Servo amplifier

(79) SRVO-251 DB relay abnormal

(Explanation) An abnormality was detected in the internal relay (DB relay) of the servo amplifier.

Parts to cause this alarm;

- Servo amplifier

(80) SRVO-252 Current detect abnl

(Explanation) An abnormality was detected in the current detection circuit inside the servo amplifier.

Parts to cause this alarm;

- Servo amplifier

(81) SRVO-253 Amp internal over heat

(Explanation) An overheat was detected inside the servo amplifier.

Parts to cause this alarm;

- Servo amplifier

(82) SRVO-266 EAS1 status abnormal

SRVO-267 EAS2 status abnormal

(Explanation) A chain alarm was detected with the EAS (FENCE) signal.

(Action 1) Check whether the circuitry connected to the dual input signal (EAS) is faulty.

(Action 2) Check whether the timing of the dual input signal (EAS) satisfies the timing specification

(See Section 1.2 of Part III CONNECTIONS).

Parts to cause this alarm;

- E-stop board
- Main board

**WARNING**

If this alarm occurred, do not reset the chain error alarm until the failure is identified and repaired. If robot use is continued with one of the duplicate circuits being faulty, safety may not be guaranteed when the other circuit fails.

**NOTE**

For the procedure of recovery from this alarm, see the descriptions of SRVO-230 and SRVO-231.

(83) SRVO-270 EXEMG1 status abnormal

SRVO-271 EXEMG2 status abnormal

(Explanation) A chain alarm was detected with the EES (EXEMG) signal.

(Action 1) Check whether the circuitry connected to the dual input signal (EES) is faulty.

(Action 2) Check whether the timing of the dual input signal (EES) satisfies the timing specification

(See Section 1.2 of Part III CONNECTIONS).

Parts to cause this alarm;

- Teach pendant
- Teach pendant cable
- Controller internal cables
- E-stop board
- Main board

**WARNING**

If this alarm occurred, do not reset the chain error alarm until the failure is identified and repaired. If robot use is continued with one of the duplicate circuits being faulty, safety may not be guaranteed when the other circuit fails.

**NOTE**

For the procedure of recovery from this alarm, see the descriptions of SRVO-230 and SRVO-231.

(84) SRVO-277 Panel E-stop(SVEMG abnormal)

(Explanation) The emergency stop line was not disconnected although the emergency stop button on the controller was pressed.

Parts to cause this alarm;

- E-stop board
- Servo amplifier
- Main board

(85) SRVO-278 TP E-stop(SVEMG abnormal)

(Explanation) The emergency stop line was not disconnected although the emergency stop button on the teach pendant was pressed.

Parts to cause this alarm;

- Teach pendant
- Teach pendant cable
- Controller internal cables
- E-stop board
- Servo amplifier

**NOTE**

This alarm may be issued if the emergency stop button is pressed very slowly.

(86) SRVO-291 IPM over heat (G:i A:j)

(Explanation) IPM on the servo amplifier is overheated.

(Action 1) Check whether the fan for cabinet ventilation is stopped and also check whether the vent hole is clogged. If necessary, clean or replace them.

(Action 2) If SRVO-291 is issued when the robot operating condition is severe, check the robot operating condition then relax the condition when possible.

Parts to cause this alarm;

- Servo amplifier
- Fan motor of controller

(87) SRVO-300 Hand broken/HBK disabled

SRVO-302 Set Hand broken to ENABLE

(Explanation) Although HBK was disabled, the HBK signal was input.

(Action 1) Press RESET on the teach pendant to release the alarm.

(Action 2) Check whether the hand broken signal is connected to the robot. When the hand broken signal circuit is connected, enable hand broken.  
(See Subsection 2.5.3 in Part III, "CONNECTIONS".)

(88) SRVO-335 DCS OFFCHK alarm a,b

(Explanation) A failure was detected in the safety signal input circuit.

Parts to cause this alarm;

- E-stop board
- Main board

(89) SRVO-348 DCS MCC OFF alarm a,b

(Explanation) A command was issued to turn off the magnetic contactor, but the magnetic contactor was not turned off.

Parts to cause this alarm;

- E-stop board
- Main board

(90) SRVO-349 DCS MCC ON alarm a,b

(Explanation) A command was issued to turn on the magnetic contactor, but the magnetic contactor was not turned on.

Parts to cause this alarm;

- E-stop board
- Servo amplifier
- Main board

(91) SRVO-370 SVON1 status abnormal a,b

SRVO-371 SVON2 status abnormal a,b

(Explanation) A chain alarm was detected with the main board internal signal (SVON).

Parts to cause this alarm;

- Main board

 **WARNING**

If this alarm occurred, do not reset the chain error alarm until the failure is identified and repaired. If robot use is continued with one of the duplicate circuits being faulty, safety may not be guaranteed when the other circuit fails.

**NOTE**

For the procedure of recovery from this alarm, see the descriptions of SRVO-230 and SRVO-231.

(92) SRVO-372 OPEMG1 status abnormal a,b

SRVO-373 OPEMG2 status abnormal a,b

(Explanation) A chain alarm was detected with the E-stop switch on the controller.

Parts to cause this alarm;

- Controller internal cables
- E-stop board
- Emergency stop button on the controller
- Main board

 **WARNING**

If this alarm occurred, do not reset the chain error alarm until the failure is identified and repaired. If robot use is continued with one of the duplicate circuits being faulty, safety may not be guaranteed when the other circuit fails.

**NOTE**

For the procedure of recovery from this alarm, see the descriptions of SRVO-230 and SRVO-231.

(93) SRVO-374 MODE11 status abnormal a,b

SRVO-375 MODE12 status abnormal a,b

SRVO-376 MODE21 status abnormal a,b

SRVO-377 MODE22 status abnormal a,b

(Explanation) A chain alarm was detected with the mode switch signal.

Parts to cause this alarm;

- Mode switch
- E-stop board
- Controller internal cables
- Main board

**WARNING**

If this alarm occurred, do not reset the chain error alarm until the failure is identified and repaired. If robot use is continued with one of the duplicate circuits being faulty, safety may not be guaranteed when the other circuit fails.

**NOTE**

For the procedure of recovery from this alarm, see the descriptions of SRVO-230 and SRVO-231.

## 4.6 FUSE-BASED TROUBLESHOOTING

(1) Fuses on the main board

FUSE1: For protecting the +24V output

FUSE3: For protecting the +24V output of the peripheral device interface

FUSE1

(Symptom observed when fuse has blown)

The teach pendant becomes inoperative, and all LEDs on the main board go off.

Parts to cause this fuse blows;

- Backplane board
- Main board

FUSE3

(Symptom observed when fuse has blown)

An alarm (SRVO-220) is displayed on the teach pendant.

(2) Fuses on the servo amplifier

FS1: For generation of the power to the amplifier control circuit

FS2: For protection of the 24V output to the end effector, ROT, and HBK

For protection of the 24V output to the mechanical unit fan motor (Option)(In case of M-3iA)

FS3: For protection of the 24V output to the regenerative resistor and the additional axis amplifier

FS1

(Symptom observed when fuse has blown)

The FSSB disconnection or initialization alarm is displayed on the teach pendant.

FS2

(Symptom observed when fuse has blown)

The Fuse Blown (Amp) alarm (SRVO-214), Hand broken (SRVO-006), and ROBOT OVER TRAVEL (SRVO-005) are displayed on the teach pendant.

FS3

(Symptom observed when fuse has blown)

The Fuse Blown (Amp) alarm (SRVO-214) and DCAL (SRVO-043) are displayed on the teach pendant.

(3) Fuses on the E-stop board

**In case of CE/RIA controller**

FUSE1: For protecting +24EXT for the E-stop circuit

FUSE2: For protecting +24V for the teach pendant

FUSE3: For protecting +24V

FU1 and FU2: For protecting input for the fan

**FUSE1**

(Symptom observed when fuse has blown)

Alarm(SRVO-218) is displayed on the teach pendant

**FUSE2**

(Symptom observed when fuse has blown)

The display on the teach pendant disappears.

Parts to cause this fuse blows;

- Teach pendant cable
- Teach pendant
- E-stop board

**FUSE3**

(Symptom observed when fuse has blown)

An alarm relating to an input signal that causes an E-stop occurred.

**FU1,FU2**

(Symptom observed when fuse has blown)

The fan stops.

Parts to cause this fuse blows;

- Fan cable
- Fan unit
- E-stop board

**In case of STANDARD controller**

FUSE1: For protecting +24V for the teach pendant

FUSE2: For protecting +24V for the E-stop circuit

FU1 and FU2: For protecting input for the fan

**FUSE1**

(Symptom observed when fuse has blown)

The display on the teach pendant disappears.

Parts to cause this fuse blows;

- Teach pendant cable
- Teach pendant
- E-stop board

**FUSE2**

(Symptom observed when fuse has blown)

An alarm relating to an input signal that causes an E-stop occurred.

**FU1,FU2**

(Symptom observed when fuse has blown)

The fan stops.

Parts to cause this fuse blows;

- Fan cable
- Fan unit
- E-stop board



## 4.7 POSITION DEVIATION FOUND IN RETURN TO THE REFERENCE POSITION (POSITIONING)

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(Check 1) On the status screen, check the position deviation in the stopped state. To display the position deviation, press the screen selection key, and select STATUS from the menu. Press F1, [TYPE], select AXIS from the menu, then press the F4, PULSE.

(Corrective action)

Correct the parameters related to return to the reference position (positioning).

(Check 2) Check whether the motor axis can be positioned normally.

(Corrective action)

If the motor axis can be positioned normally, check the mechanical unit.

(Check 3) Check the mechanical unit for backlash.

(Corrective action)

Replace a faulty key of motor shaft or other faulty parts.

(Check 4) If checks 1 to 3 show normal results

(Corrective action)

Replace the pulsecoder.

Parts to cause this alarm;

- Main board

If the main board or FROM/SRAM module is replaced, the contents of memory (parameters, specified data, etc.) will be lost. Before you replace the unit, therefore, make a backup copy of the data.

## 4.8 MANUAL OPERATION IMPOSSIBLE

---

The following explains checking and corrective action required if the robot cannot be operated manually after the controller is turned on:

(1) Check and corrective action to be made if manual operation is impossible

(Check 1) Check whether the teach pendant is enabled.

(Corrective action)

Turn on the teach pendant "enable".

(Check 2) Check whether the teach pendant is handled correctly.

(Corrective action)

To move an axis by manual operation, press the axis selection key and shift key at the same time.

Set the override for manual feed to a position other than the FINE and VFINE positions.

(Check 3) Check whether the ENBL signal of the peripheral device control interface is on.

(Corrective action)

Place the peripheral device control interface in the ENBL status.

(Check 4) Check whether the HOLD signal of the peripheral device control interface (hold status).

(Check whether the hold lamp on the teach pendant is on.)

(Corrective action)

Turn off the HOLD signal of the peripheral device control interface.

- (Check 5) Check whether the previous manual operation has been completed.  
(Corrective action)  
If the robot cannot be placed in the effective area because of the offset of the speed command voltage preventing the previous operation from being completed, check the position deviation on the status screen, and change the setting.
- (Check 6) Check whether the controller is in the alarm status.  
(Corrective action)  
Release the alarm.
- (2) Check and corrective action to be taken if the program cannot be executed
- (Check 1) Check whether the ENBL signal for the peripheral-device control interface is on.  
(Corrective action)  
Put the peripheral-device control interface in the ENBL state.
- (Check 2) Check whether the HOLD signal for the peripheral-device control interface is on. Also check whether the HOLD lamp on the teach pendant is on.  
(Corrective action)  
If the HOLD signal of the peripheral device control interface is on, turn it off.
- (Check 3) Check whether the previous manual operation has been completed.  
(Corrective action)  
If the robot cannot be placed in the effective area because of the offset of the speed command voltage, which prevents the previous operation from being completed, check the position deviation on the status screen, then change the setting.
- (Check 4) Check whether the controller is in the alarm status.  
(Corrective action)  
Release the alarm.



## **II. CONNECTIONS**



# 1 ELECTRICAL CONNECTIONS

## 1.1 ELECTRICAL CONNECTION OF CONNECTOR PANEL (In case of controller with connector panel)

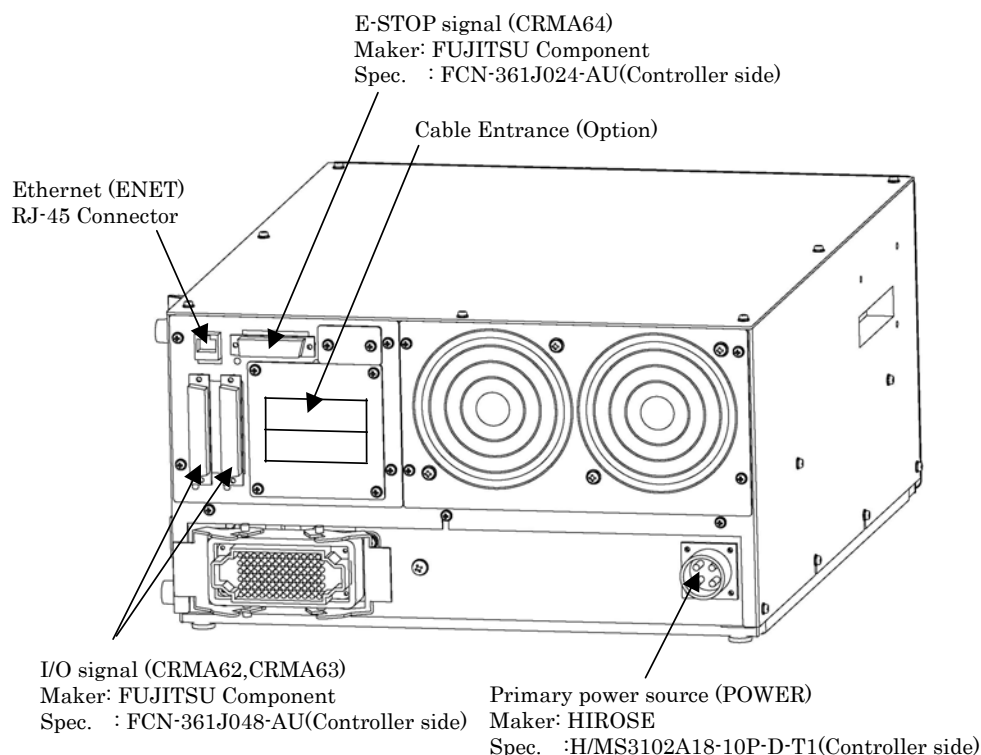


Fig.1.1 Connector panel

### Connector table

| CRMA62 |        |         | CRMA63 |         |         | CRMA64 |       |        | POWER                            |    |   |    |
|--------|--------|---------|--------|---------|---------|--------|-------|--------|----------------------------------|----|---|----|
|        | B      | A       |        | B       | A       |        | B     | A      | Open air controller (Small size) |    |   |    |
| 1      | DO101  | DI101   | 1      | DO109   | XHOLD   | 1      | EES1  | ESPB1  | D                                | PE | A | L  |
| 2      | DO102  | DI102   | 2      | DO110   | RESET   | 2      | EES11 | ESPB11 | C                                |    | B | N  |
| 3      | DO103  | DI103   | 3      | DO111   | START   | 3      | EES2  | ESPB2  | Open air controller (Large size) |    |   |    |
| 4      | DO104  | DI104   | 4      | DO112   | ENBL    | 4      | EES21 | ESPB21 | D                                | PE | A | L1 |
| 5      | DO105  | DI105   | 5      | DO113   | PNS1    | 5      | EAS1  | ESPB3  | C                                | L3 | B | L2 |
| 6      | DO106  | DI106   | 6      | DO114   | PNS2    | 6      | EAS11 | ESPB31 |                                  |    |   |    |
| 7      | DO107  | DI107   | 7      | DO115   | PNS3    | 7      | EAS2  | ESPB4  |                                  |    |   |    |
| 8      | DO108  | DI108   | 8      | DO116   | PNS4    | 8      | EAS21 | ESPB41 |                                  |    |   |    |
| 9      |        | SDICOM1 | 9      | DO117   | SDICOM3 | 9      |       | EXT24V |                                  |    |   |    |
| 10     |        | DI109   | 10     | DO118   |         | 10     |       | INT24V |                                  |    |   |    |
| 11     |        | DI110   | 11     | DO119   |         | 11     |       | INT0V  |                                  |    |   |    |
| 12     |        | DI111   | 12     | DO120   |         | 12     |       | EXT0V  |                                  |    |   |    |
| 13     |        | DI112   | 13     | CMDENBL |         |        |       |        |                                  |    |   |    |
| 14     |        | DI113   | 14     | FAULT   |         |        |       |        |                                  |    |   |    |
| 15     |        | DI114   | 15     | BATALM  |         |        |       |        |                                  |    |   |    |
| 16     |        | DI115   | 16     | BUSY    |         |        |       |        |                                  |    |   |    |
| 17     | DOSRC1 | DI116   | 17     | DOSRC2  |         |        |       |        |                                  |    |   |    |
| 18     | DOSRC1 | DI117   | 18     | DOSRC2  |         |        |       |        |                                  |    |   |    |
| 19     | 0V     | DI118   | 19     | 0V      |         |        |       |        |                                  |    |   |    |
| 20     | 0V     | DI119   | 20     | 0V      |         |        |       |        |                                  |    |   |    |
| 21     | 24F    | DI120   | 21     | 24F     |         |        |       |        |                                  |    |   |    |
| 22     | 24F    | SDICOM2 | 22     | 24F     |         |        |       |        |                                  |    |   |    |
| 23     | 24F    | 0V      | 23     | 24F     | 0V      |        |       |        |                                  |    |   |    |
| 24     | FG     | 0V      | 24     | FG      | 0V      |        |       |        |                                  |    |   |    |

(View from connection side of controller connector)

## 1.2 CONNECTING THE EXTERNAL EMERGENCY STOP

After connecting the safety signals like external emergency stop signal and/or safety fence signal, verify that,

- All safety signals stop the robot as intended.
- There is no mistake in connection of safety signals.

Generally, dual circuit (DCS or dual chain) is required in emergency stop circuit because it is safe even when a single failure of a component occurs.

In case that the single chain emergency stop circuit is used due to user's reasons, take additional safety measures to ensure that safety signal circuits like external emergency stop circuit and/or safety fence circuit work as intended without failure. (Example: Applying verification procedure at the starting of the daily operation.) This should be done on user's responsibility.

### 1.2.1 Connecting the External Emergency Stop (In case of CE/RIA controller)

#### External emergency stop output (CE/RIA controller)

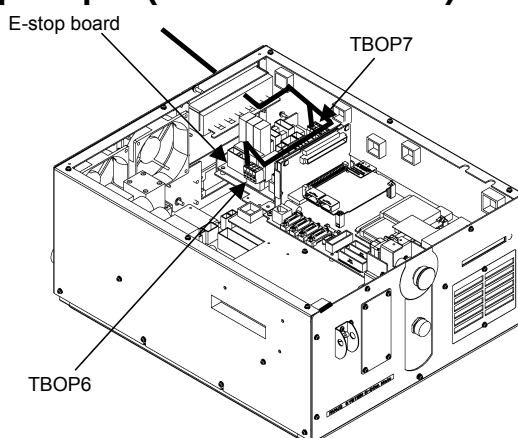


Fig.1.2.1 (a) Connection of the external emergency stop (In case of the controller without connector panel)

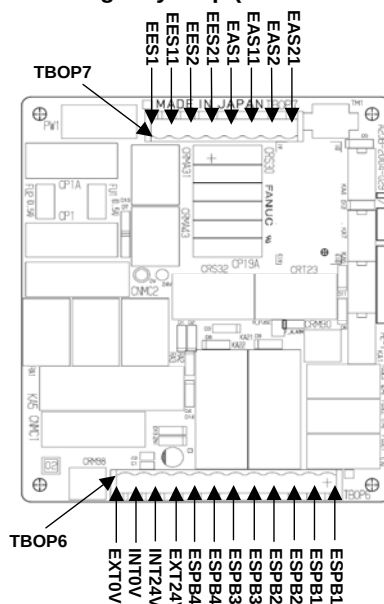
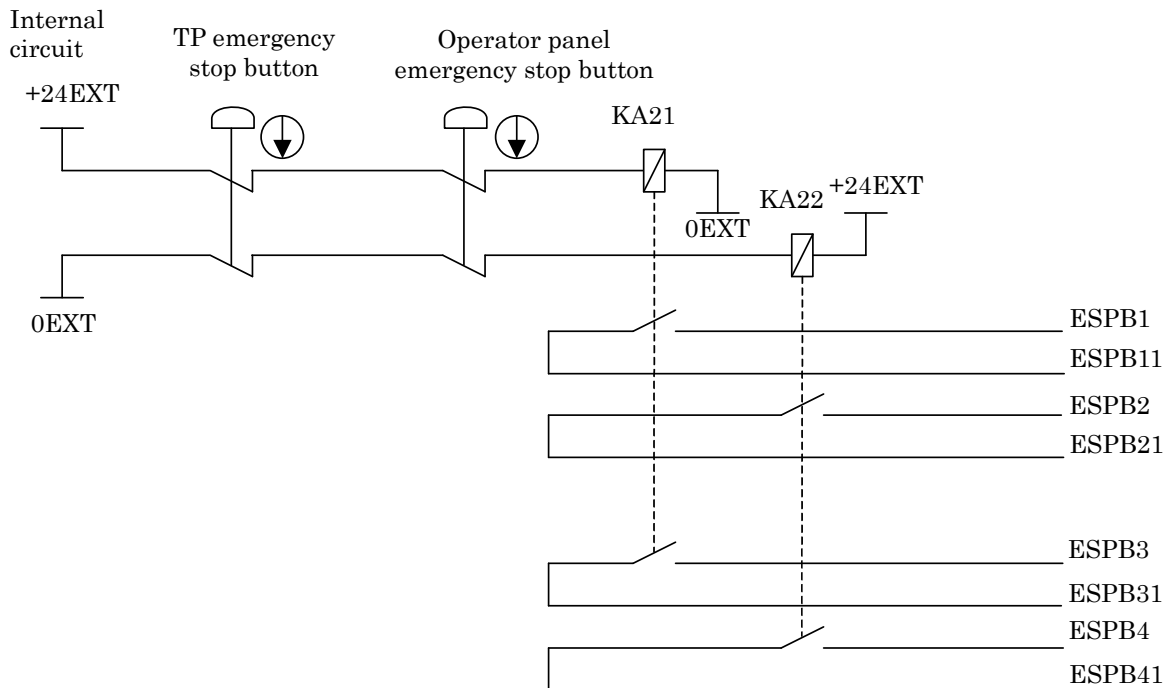
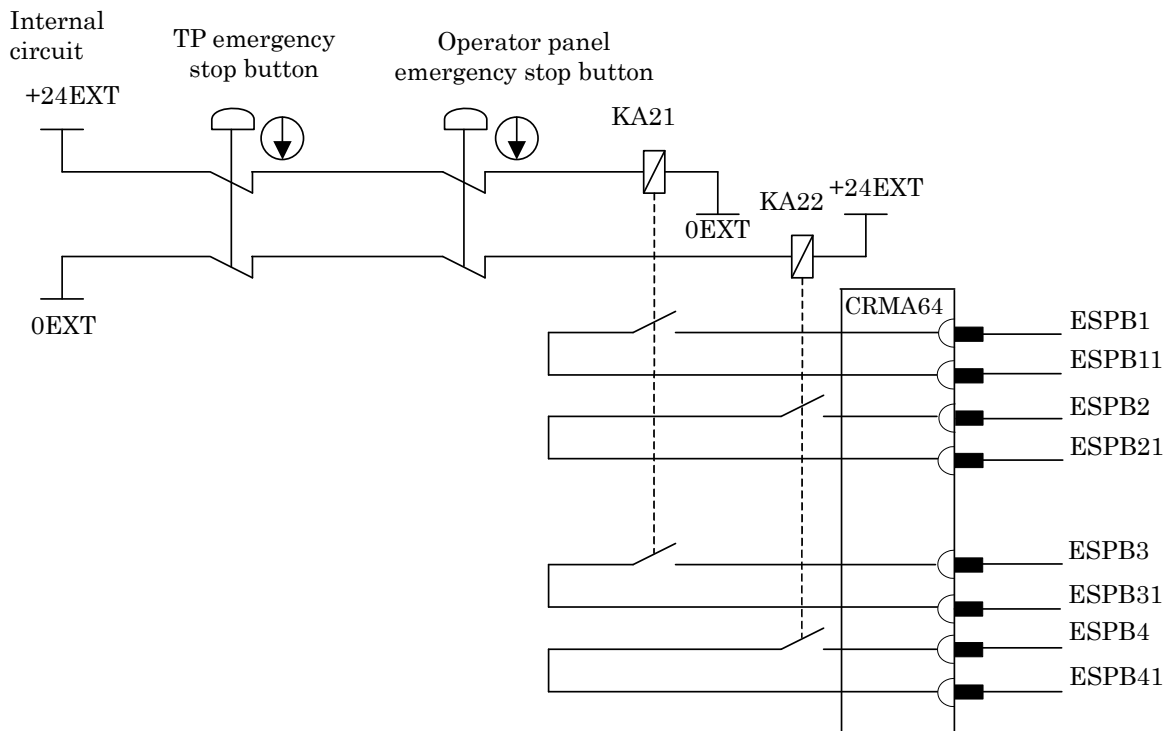


Fig.1.2.1 (b) E-stop board

**In case of the controller without connector panel****In case of the controller with connector panel****⚠ WARNING**

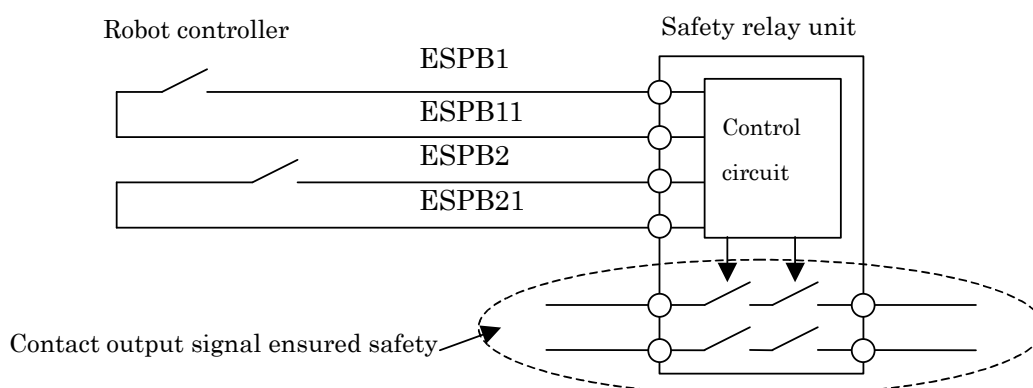
In case of using the contact of the emergency stop output signal, be sure to pair ESPB1 with ESPB2, and ESPB3 with ESPB4.

Robot controller does not detect the breakdown of the contact of the emergency stop output signal. Take countermeasures such as inspecting the duplicated contacts, or using a safety relay circuit that can detect the breakdown.

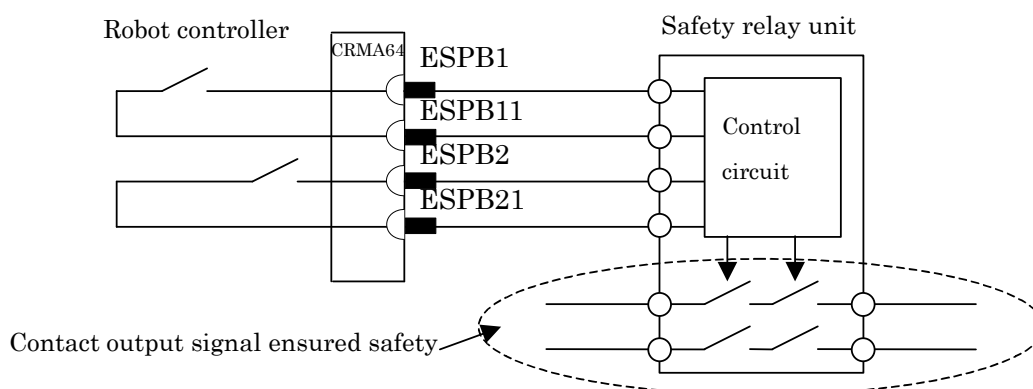


**In case of the controller without connector panel**

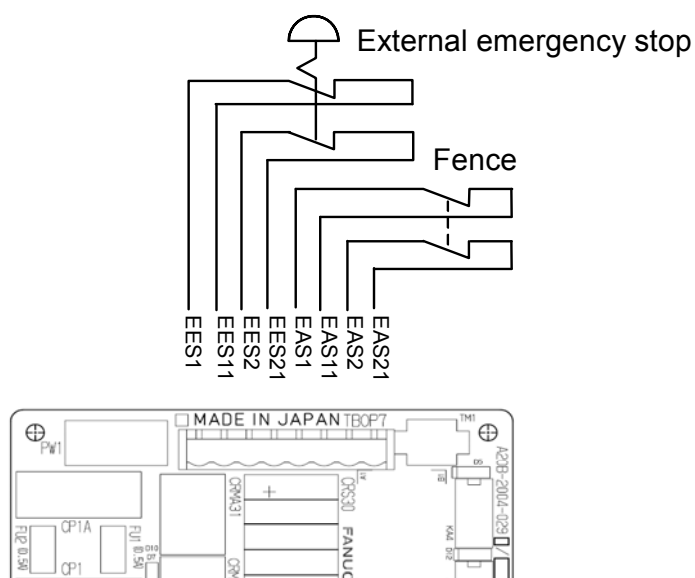
Example of the connection with the safety relay unit

**In case of the controller with connector panel**

Example of the connection with the safety relay unit

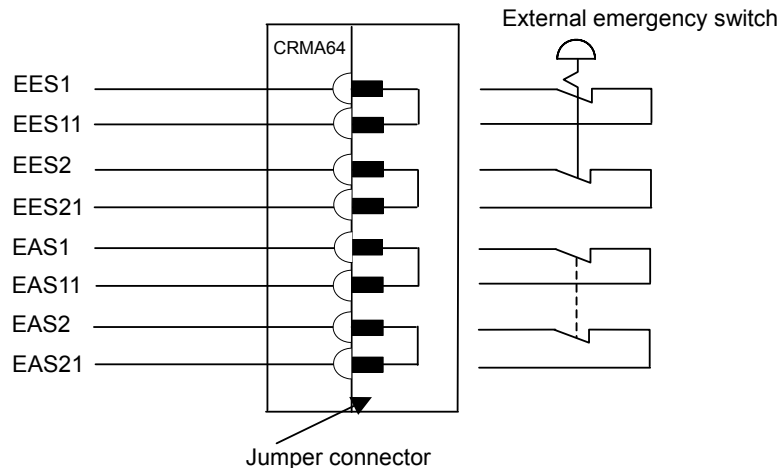
**External emergency stop input (CE/RIA controller)**

In case of the controller without connector panel



**In case of the controller with connector panel**

These terminals are factory-jumpered. When using external emergency stop inputs, remove the Jumper connector.



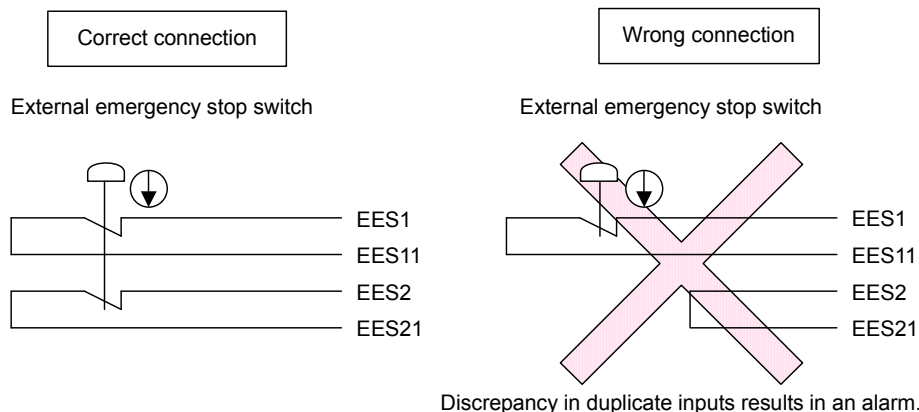
| Signal                                                               | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Current, voltage                                                         | Min. load                      |
|----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|--------------------------------|
| ESPB1———ESPB11<br>ESPB2———ESPB21<br>ESPB3———ESPB31<br>ESPB4———ESPB41 | The contact is open when one of the TP emergency stop button or the Operator panel emergency stop button is pressed. The contact is also open while the controller is powered off regardless of status of emergency stop buttons. By connecting external power supply to the emergency stop circuit, the contact works even while the robot controller is powered off. (See “External power connection” of this section) The contact is closed during normal operation. | Rated contact:<br>250 VAC, 5A resistor load<br>300 VDC, 5A resistor load | (Reference value)<br>DC5V 10mA |

| Signal                                           | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Current, voltage                          |
|--------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
| EES1    ]<br>EES11   ]<br>EES2    ]<br>EES21   ] | Connect the contacts of the external emergency stop switch to these terminals. When a contact is open, the servo power supply is turned off, and the robot is immediately placed in the emergency stop state. When using the contacts of a relay or contactor instead of the switch, connect a spark killer to the coil of the relay or contactor, to suppress noise. When these terminals are not used, jumper them.                                                                                                                                                        | Open and close of<br>24VDC 0.1A<br>(Note) |
| EAS1    ]<br>EAS11   ]<br>EAS2    ]<br>EAS21   ] | These signals are used to stop the robot safely when the safety fence gate is opened during operation in the AUTO mode. When a contact is open, the robot decelerates then stops, and the servo power supply is turned off. In the T1 or T2 mode and the DEADMAN switch is held correct position, the robot can be operated even when the safety fence gate is open. When using the contacts of a relay or contactor instead of the switch, connect a spark killer to the coil of the relay or contactor, to suppress noise. When these terminals are not used, jumper them. | Open and close of<br>24VDC 0.1A<br>(Note) |

**NOTE**

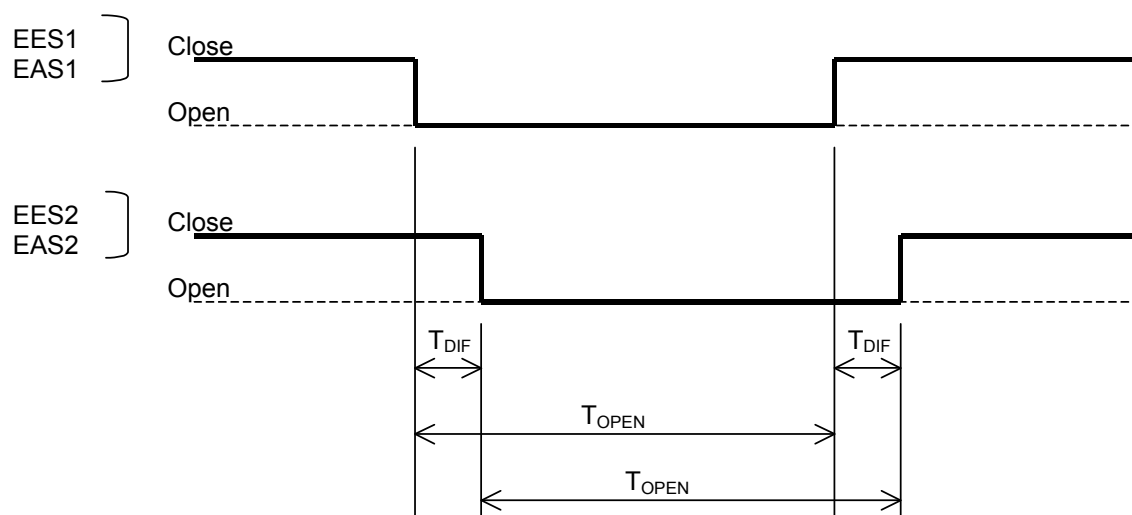
Use a contact which minimum load is 5 mA or less.

Examples of connection of duplicate safety signals



### Input timing of duplicate safety signals (CE/RIA controller)

Duplicate inputs are used for signals such as the external emergency stop signal, safety fence signal, and servo off signal so that a response is made even when a single failure occurs. The statuses of these duplicate input signals must always be changed at the same timing according to the timing specifications provided in this section. The robot controller always checks that the statuses of the duplicate inputs are the same, and if the controller finds a discrepancy, it issues an alarm. If the timing specifications are not satisfied, an alarm may be issued because of a signal discrepancy.



$$T_{DIF} \text{ (input time difference)} < 200\text{msec}$$

$$T_{OPEN} \text{ (input hold period)} > 2\text{sec}$$

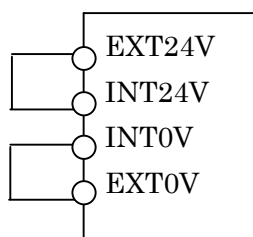
## External power connection (CE/RIA controller)

The relays for emergency stop input and output can be separated from controller's power. Please connect external +24V instead of internal +24V, if emergency stop output must not be effected controller's power.

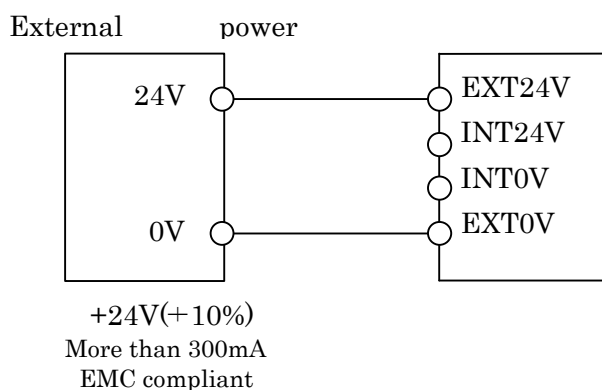
### In case of the controller without connector panel

Example of the connection

In case of using the external power source



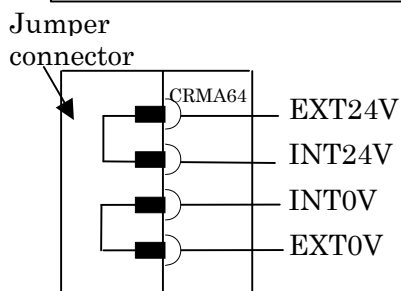
In case of using the external power source



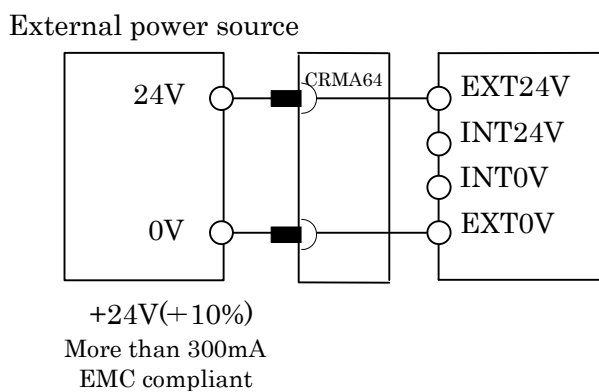
### In case of the controller with connector panel

Example of the connection

In case of using the external power source



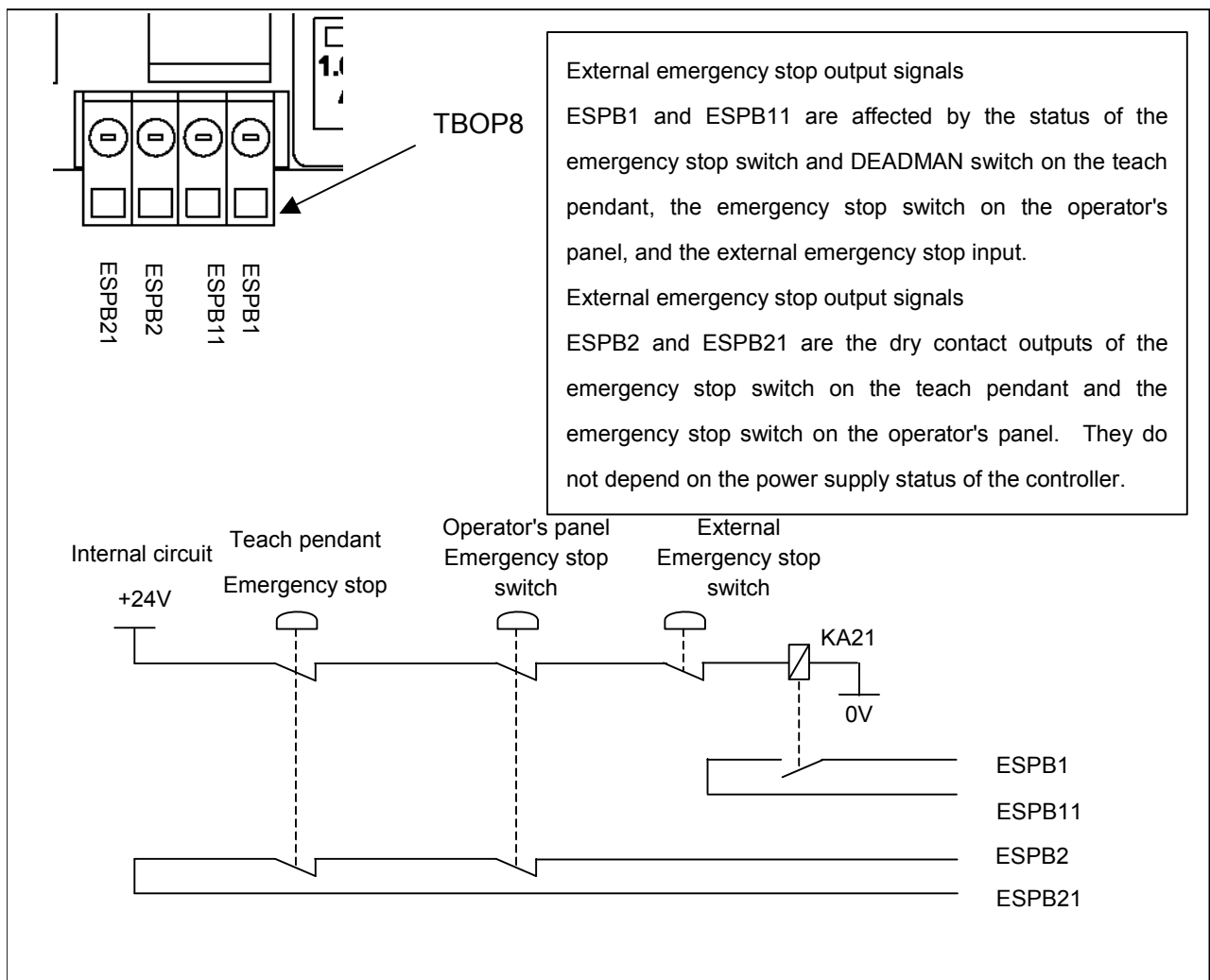
In case of using the external powersource





For the circuit, see Appendix A, "TOTAL CONNECTION DIAGRAM".  
The SVOFF input signal does not affect EMGOUT.

| Signal          | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Load rating                | Min. load                      |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|--------------------------------|
| ESPB1<br>ESPB11 | Automatic operation mode: The contact is open when one of the TP emergency stop button or the Operator panel emergency stop button is pressed or the External emergency stop input.<br>T1,T2 Mode: The contact is open when one of the TP emergency stop button or the Operator panel emergency stop button is pressed, the External emergency stop input or DEADMAN switch is released.<br>The contact is also open while the controller is powered off regardless of status of emergency stop buttons. The contact is closed during normal operation. | Rated contact<br>30 VDC 1A | (Reference value)<br>5 VDC 1mA |
| ESPB2<br>ESPB21 | The contact is open if the emergency stop button on the teach pendant or the operator's panel is pressed or the External emergency stop input.<br>The contact is closed during normal operation.<br>* The contact status does not depend on the power status of the control unit.                                                                                                                                                                                                                                                                       | Rated contact<br>30 VDC 1A | (Reference value)<br>5 VDC 1mA |

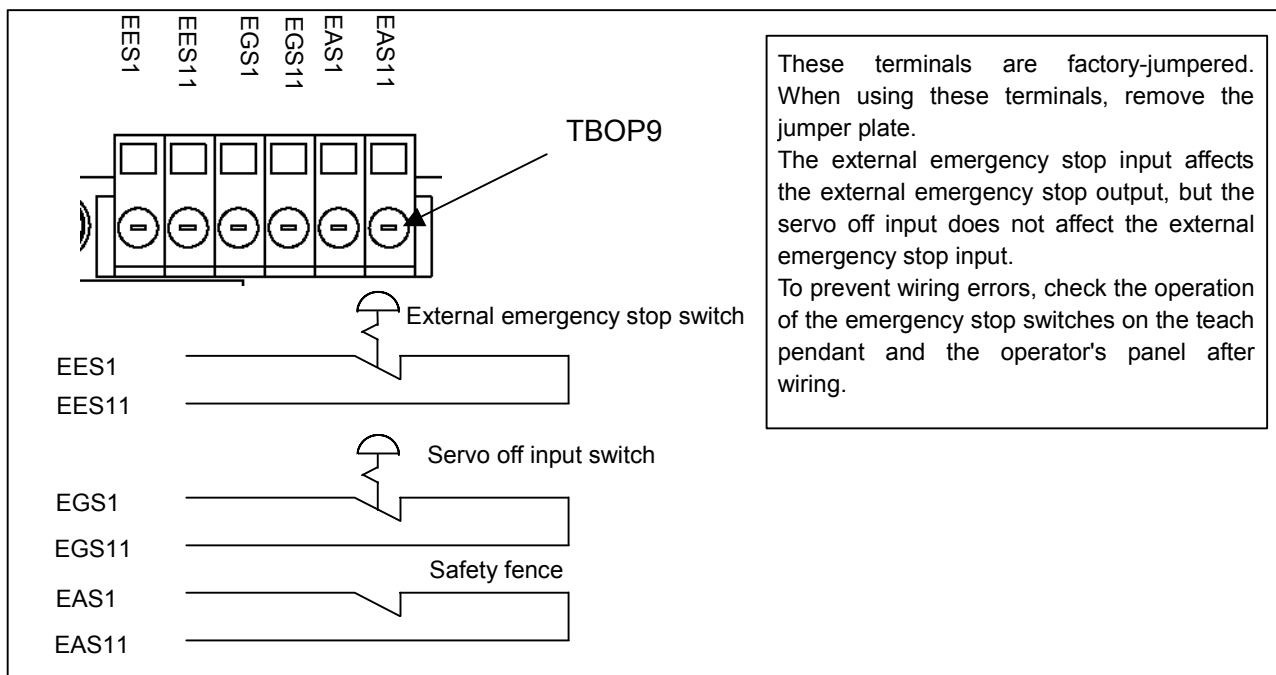


## External emergency stop input signals (STANDARD controller)

| Signal        | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Current, voltage                        |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
| EES1<br>EES11 | <p>Connect the contacts of the external emergency stop switch to these terminals.</p> <p>When a contact is open, the servo power supply is turned off, and the robot is immediately placed in the emergency stop state.</p> <p>When using the contacts of a relay or contactor instead of the switch, connect a spark killer to the coil of the relay or contactor, to suppress noise.</p> <p>When these terminals are not used, jumper them.</p>                                                                                                                                                  | Open and close of 24 VDC 0.1 A (Note 1) |
| EAS1<br>EAS11 | <p>If the Automatic operation mode is selected, these signals are used to stop the robot safely when the safety fence is opened. When the contacts are opened, the robot stops immediately.</p> <p>In the Teach mode and the DEADMAN switch is held correct position, the robot can be operated even when the safety fence gate is open.</p> <p>If the contacts of a relay or contactor are used in place of the switch contacts, attach a spark killer to the relay or contactor coil so that noise can be reduced.</p> <p>When these signals are not used, attach a jumper to the terminals.</p> | Open and close of 24 VDC 0.1 A (Note 1) |
| EGS1<br>EGS11 | <p>Connect the servo off switch contacts to these terminals.</p> <p>When a contact is open, the servo power supply is turned off, and the robot is immediately placed in the stop state.</p> <p>When using the contacts of a relay or contactor instead of the switch, connect a spark killer to the coil of the relay or contactor, to suppress noise.</p> <p>When these terminals are not used, jumper them.</p>                                                                                                                                                                                 | Open and close of 24 VDC 0.1 A (Note 1) |

### NOTE

The contacts connected to the terminals mentioned above must be those rated to a minimum load of 5 mA or less.



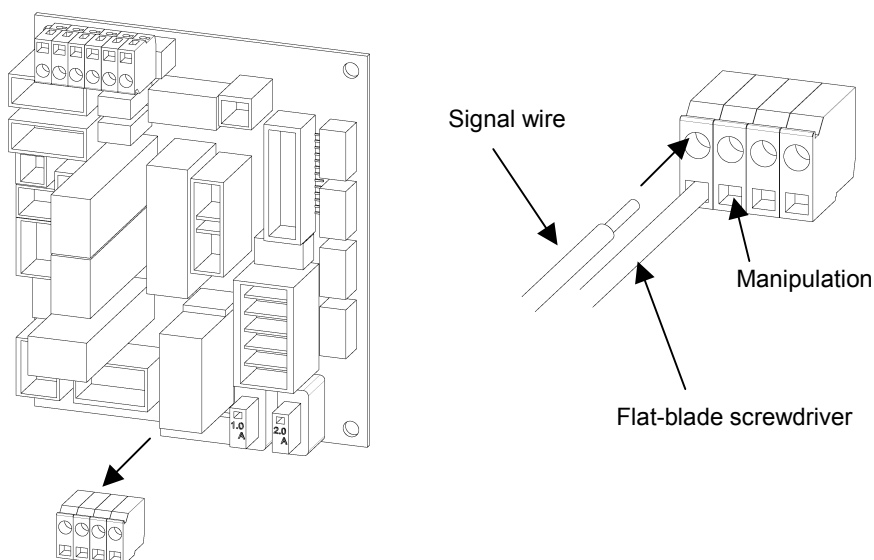
## 1.3 CONNECTING EXTERNAL ON/OFF AND EXTERNAL EMERGENCY STOP SIGNAL INPUT/OUTPUT WIRES

|                                | FANUC's specification | Manufacturer's specification (WAGO) | Remark                                                                          |
|--------------------------------|-----------------------|-------------------------------------|---------------------------------------------------------------------------------|
| 12-pole terminal block (TBOP6) | A63L-0001-0783#312    | 231-312/026-000                     | External emergency stop                                                         |
| 8-pole terminal block (TBOP7)  | A63L-0001-0783#308    | 231-308/026-000                     | External emergency stop                                                         |
| 4-pole terminal block (TBOP8)  | A63L-0001-0783#304    | 231-304/026-000                     | External emergency stop                                                         |
| 6-pole terminal block (TBOP9)  | A63L-0001-0783#306    | 231-306/026-000                     | External emergency stop                                                         |
| Jumper pin                     | A63L-0001-0783#902    | 231-902                             |                                                                                 |
| Operation lever                | A63L-0001-0783#131-M  | 231-131                             | 2 pieces of 231-131 and operation manual are included in FANUC's specification. |

1. Detach the plug connector block from the panel board.
2. Insert the tip of a flat-blade screwdriver into the manipulation slot and push down its handle.
3. Insert the end of the signal wire into the wire slot.
4. Pull out the screwdriver.
5. Attach the plug connector block to the panel board.

Do not insert a wire into a wire slot of the plug connector or pull out a wire with the plug connector block mounted on the E-stop board. Otherwise, the E-stop board may be damaged.

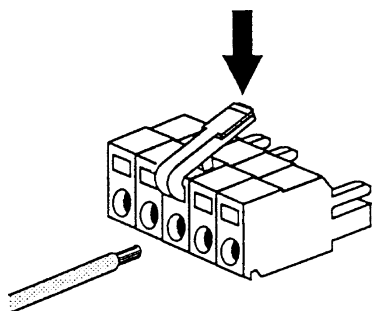
FANUC recommends the lever (A05B-2400-K030) for connecting the signal wire to the plug connector block instead of Flat-blade screwdriver.



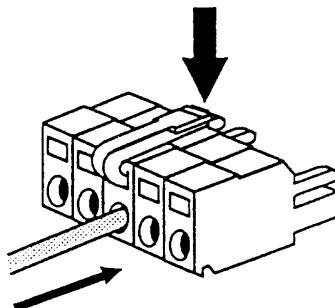


**Wiring**

(1) Pull down the lever.

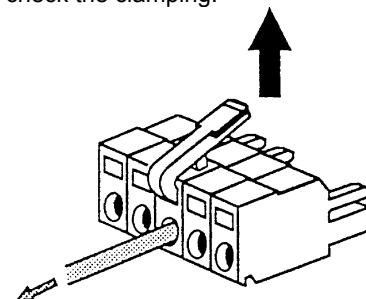


(2) Push in the conductor while holding the lever.



(3) Set the lever free.

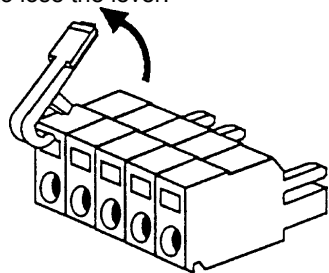
\* And pull the conductor softly to check the clamping.



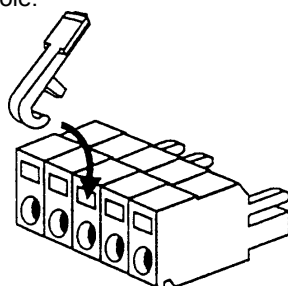
\* Don't pull strongly.

**Replace the lever**

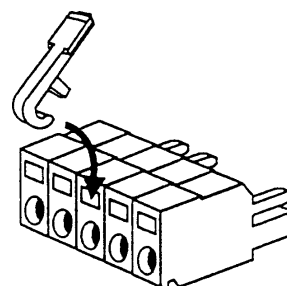
(1) Pull off the lever. Be careful not to lose the lever.



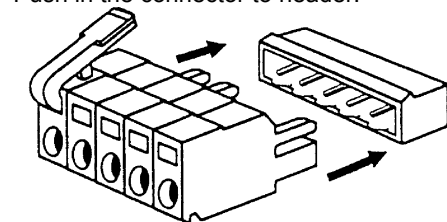
(2) Hook the lever to the rectangle hole.



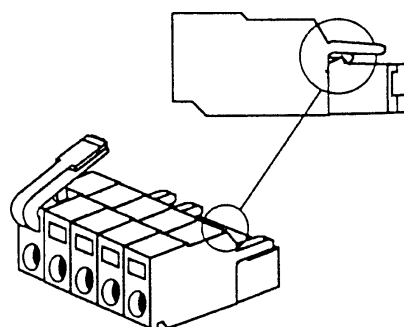
(3) Push down the lever until click in.

**Fit to header**

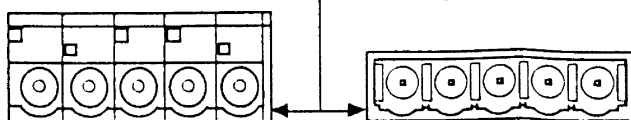
(1) Push in the connector to header.



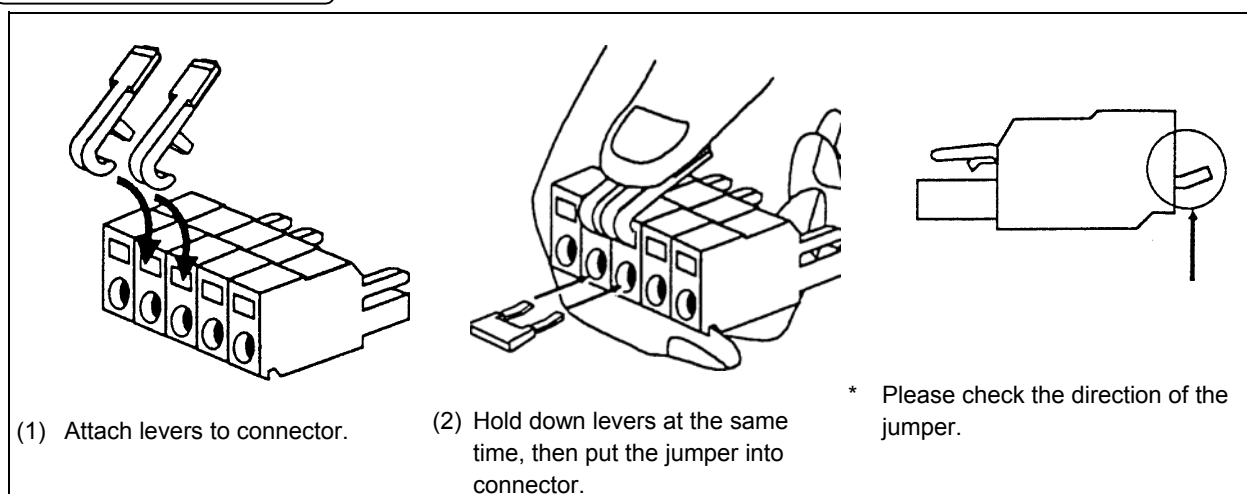
(2) Please check if the latch is hooked to header.



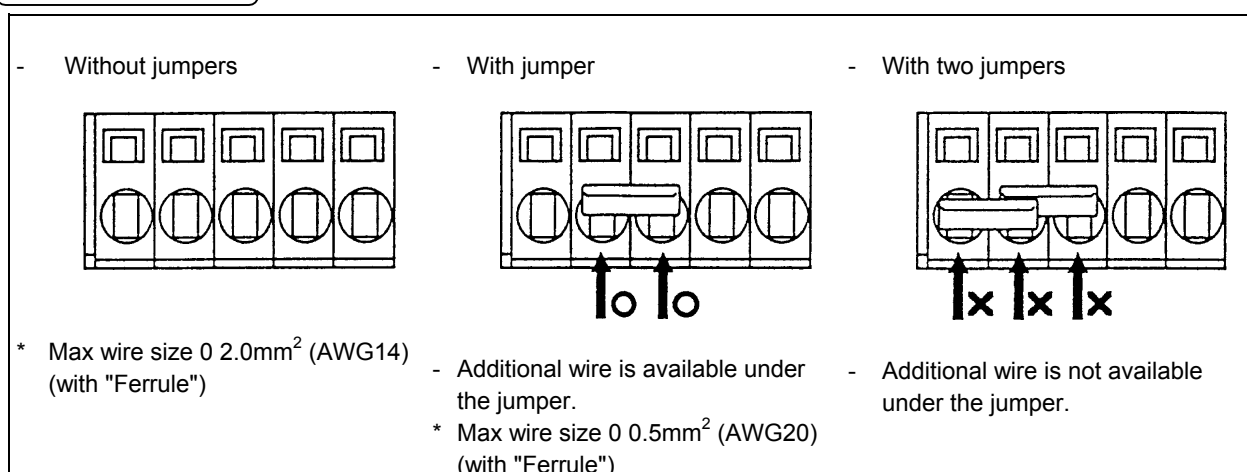
\* Be careful to fit the shape of each other.



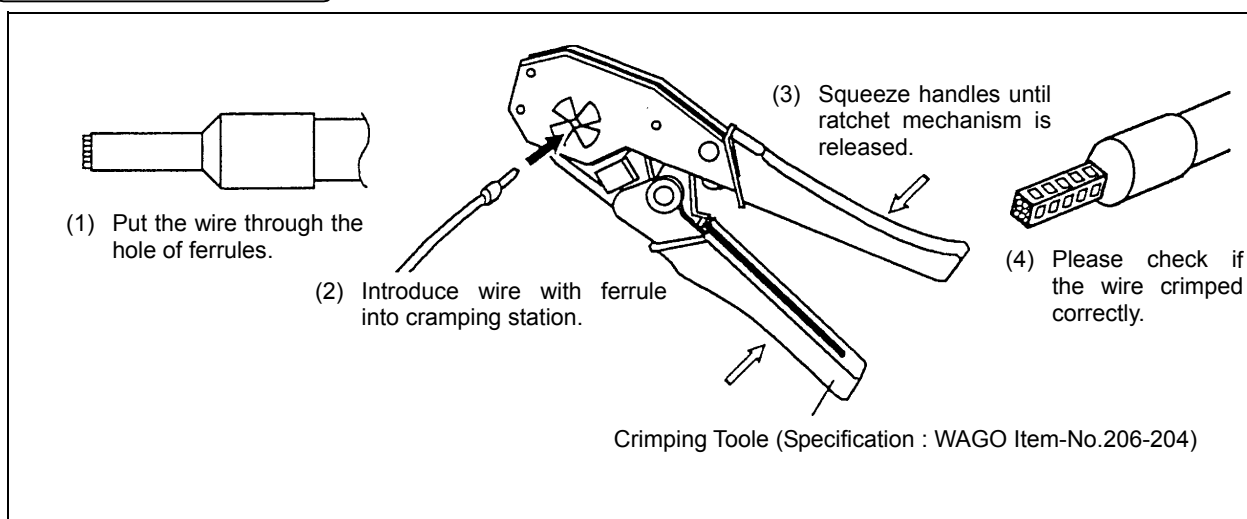
### Installation of "Jumper"



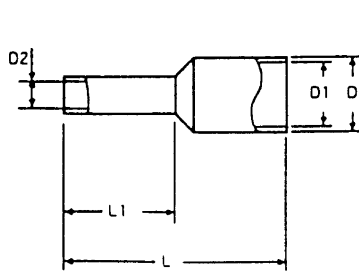
### Availability of



### Installation of "Ferrules"



## Specifications of Ferrules



| WAGO Item-No. | Wire for mm <sup>2</sup> (AWG) | Color        | Stripped Length (m) | L    | L1  | D (m) | D1  | D2  | Pack.-unit pcs |
|---------------|--------------------------------|--------------|---------------------|------|-----|-------|-----|-----|----------------|
| 216-301       | 0.25                           | light yellow | 9.5                 | 12.5 | 8.0 | 2.5   | 2.0 | 0.8 | 100            |
| 216-302       | 0.34                           | light green  | 9.5                 | 12.5 | 8.0 | 2.5   | 2.0 | 0.8 | 100            |
| 216-201       | 0.5                            | white        | 9.5                 | 14.0 | 8.0 | 3.1   | 2.6 | 1.0 | 100            |
| 216-202       | 0.75                           | gray         | 10.0                | 14.0 | 8.0 | 3.3   | 2.8 | 1.2 | 100            |
| 216-203       | 1.0                            | red          | 10.0                | 14.0 | 8.0 | 3.5   | 3.0 | 1.4 | 100            |
| 216-204       | 1.5                            | black        | 10.0                | 14.0 | 8.0 | 4.0   | 3.5 | 1.7 | 100            |
| 216-205       | 2.0                            | black        | 10.0                | 14.0 | 8.0 | 4.2   | 3.7 | 2.0 | 100            |

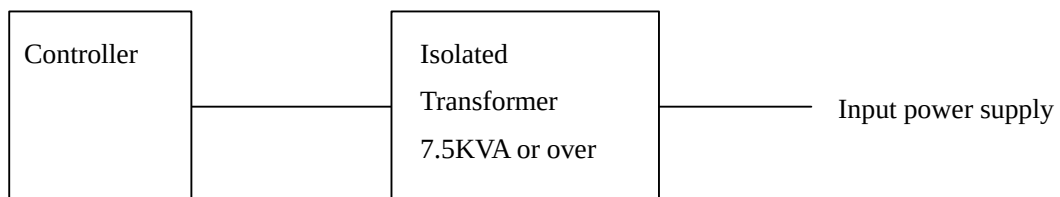
**CAUTION**

Please make sure to use WAGO 206-204 to crimp the ferrules.

## 1.4 CONNECTING THE INPUT POWER SUPPLY

### 1.4.1 In Case of the Isolated Transformer Required (CE Controller)

In case of Open air controller (large size/CE controller), an isolated transformer should be required. (Refer to installation condition)

**NOTE**

Example of isolated transformer (In case of M-3iA)

Manufacture: Rist Transformatorenbau GmbH

Specification: 12kVA-400V200V-3UI210/73LK

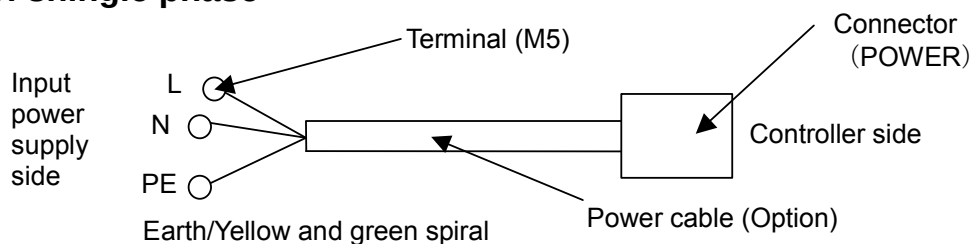
Capacity: 12kVA

Output: AC200V

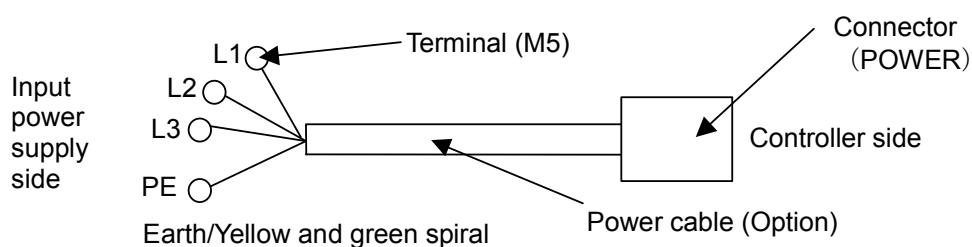
### 1.4.2 Power Cable (Option)

- Terminals are attached to the power cable.

#### In case of shingle phase



## In case of three phase



## 1.5 PERIPHERAL DEVICE CONNECTION

### 1.5.1 DI/DO Connection

(In case of controller with connector panel)

#### DI/DO connection

SDICOM1~3 signal are common selection signal for SDI.

When +24F common is used, connect to 0V.

When 0V common is used, connect to +24F.

SDICOM1 → Selects a common for DI101~DI108.

SDICOM2 → Selects a common for DI109~DI120.

SDICOM3 → Selects a common for XHOLD、RESET、START、ENBL、PNS1~PNS4.

#### NOTE

1 The peripheral device connection cables are made by customer ,connector for These cables are optional.

2 The DOSRC1 and DOSRC2 pins of the CRMA62 and CRMA63 are pins for supplying power to drivers. (None of these pins can be left open.)

### DI/DO SIGNALS

There are 28 data inputs (DI) and 24 data outputs (DO) on controller main board.

Table 1.5.1 DI/DO signals (Controller with connector panel)

| Connector number | Signal name | Description              | Remarks        |
|------------------|-------------|--------------------------|----------------|
| (DI signals)     |             |                          |                |
| CRMA62-A1        | DI101       | Peripheral device status | General signal |
| CRMA62-A2        | DI102       |                          |                |
| CRMA62-A3        | DI103       |                          |                |
| CRMA62-A4        | DI104       |                          |                |
| CRMA62-A5        | DI105       |                          |                |
| CRMA62-A6        | DI106       |                          |                |
| CRMA62-A7        | DI107       |                          |                |
| CRMA62-A8        | DI108       |                          |                |
| CRMA62-A10       | DI109       |                          |                |
| CRMA62-A11       | DI110       |                          |                |

| Connector number | Signal name | Description              | Remarks        |
|------------------|-------------|--------------------------|----------------|
| (DI signals)     |             |                          |                |
| CRMA62-A12       | DI111       | Peripheral device status | General signal |
| CRMA62-A13       | DI112       |                          |                |
| CRMA62-A14       | DI113       |                          |                |
| CRMA62-A15       | DI114       |                          |                |
| CRMA62-A16       | DI115       |                          |                |
| CRMA62-A17       | DI116       |                          |                |
| CRMA62-A18       | DI117       |                          |                |
| CRMA62-A19       | DI118       |                          |                |
| CRMA62-A20       | DI119       |                          |                |
| CRMA62-A21       | DI120       |                          |                |
| CRMA63-A1        | XHOLD       | Temporary stop           |                |
| CRMA63-A2        | FAULT RESET | External reset           |                |
| CRMA63-A3        | START       | Start                    |                |
| CRMA63-A4        | ENBL        | Operation enabled        |                |
| CRMA63-A5        | PNS1        | Robot service request    |                |
| CRMA63-A6        | PNS2        |                          |                |
| CRMA63-A7        | PNS3        |                          |                |
| CRMA63-A8        | PNS4        |                          |                |

| Connector number | Signal name | Description                      | Remarks        |
|------------------|-------------|----------------------------------|----------------|
| (DO signals)     |             |                                  |                |
| CRMA62-B1        | DO101       | Peripheral device control signal | General signal |
| CRMA62-B2        | DO102       |                                  |                |
| CRMA62-B3        | DO103       |                                  |                |
| CRMA62-B4        | DO104       |                                  |                |
| CRMA62-B5        | DO105       |                                  |                |
| CRMA62-B6        | DO106       |                                  |                |
| CRMA62-B7        | DO107       |                                  |                |
| CRMA62-B8        | DO108       |                                  |                |
| CRMA63-B1        | DO109       |                                  |                |
| CRMA63-B2        | DO110       |                                  |                |
| CRMA63-B3        | DO111       |                                  |                |
| CRMA63-B4        | DO112       |                                  |                |
| CRMA63-B5        | DO113       |                                  |                |
| CRMA63-B6        | DO114       |                                  |                |
| CRMA63-B7        | DO115       |                                  |                |
| CRMA63-B8        | DO116       |                                  |                |
| CRMA63-B9        | DO117       |                                  |                |
| CRMA63-B10       | DO118       |                                  |                |
| CRMA63-B11       | DO119       |                                  |                |
| CRMA63-B12       | DO120       |                                  |                |
| CRMA63-B13       | CMDENBL     | During automatic operation       |                |
| CRMA63-B14       | FAULT       | Alarm                            |                |
| CRMA63-B15       | BATALM      | Battery voltage drop             |                |
| CRMA63-B16       | BUSY        | During operation                 |                |

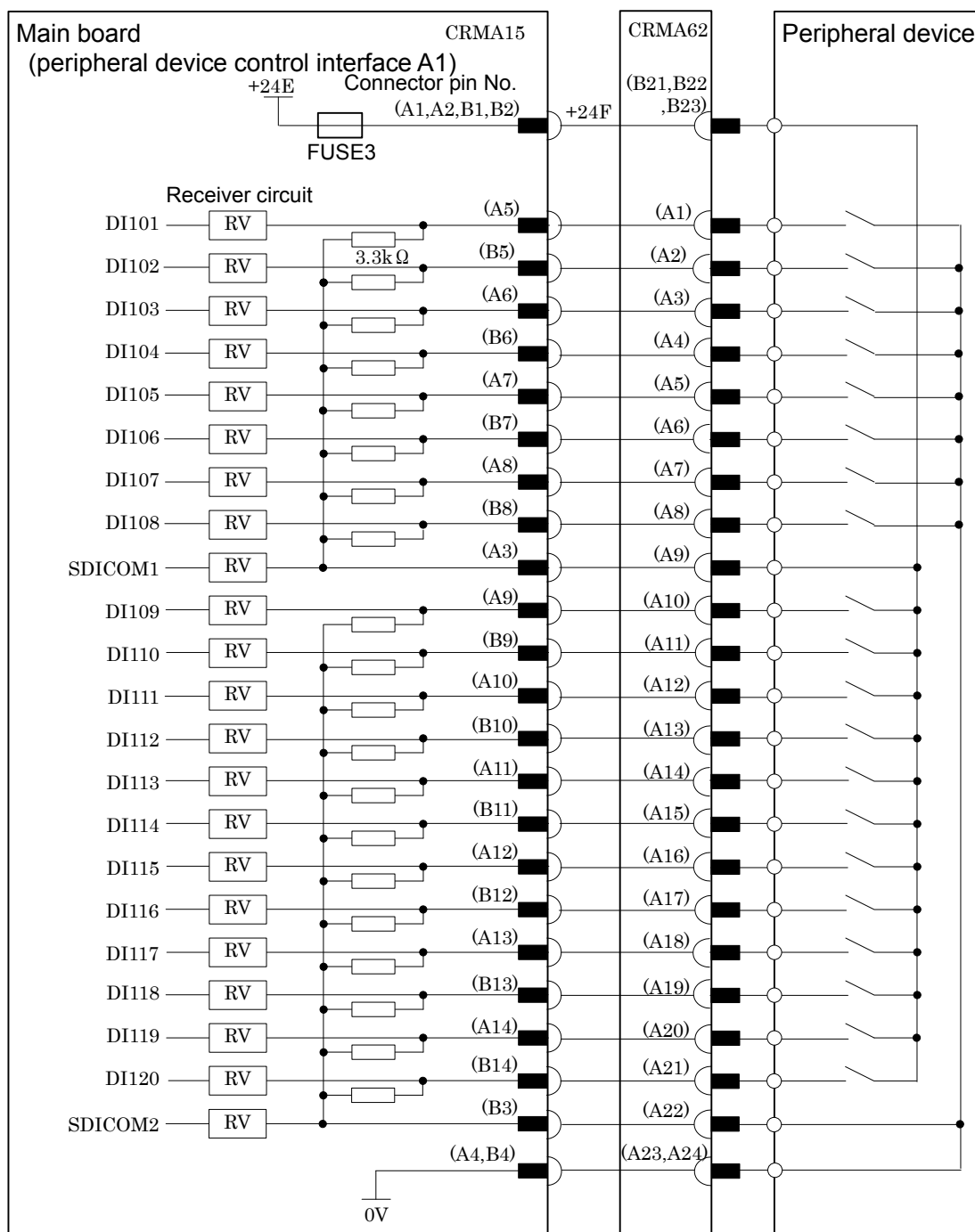


Fig.1.5.1 (a) DI/DO connection (1) (Controller with connector panel)

**NOTE**

DI signal's common can be changed by SDICOM connection.  
 This diagram shows (2) case of common connection. DI 101~DI108 show that common voltage of input devices is 0V. DI 109~DI120 show that common voltage of input devices is +24V.

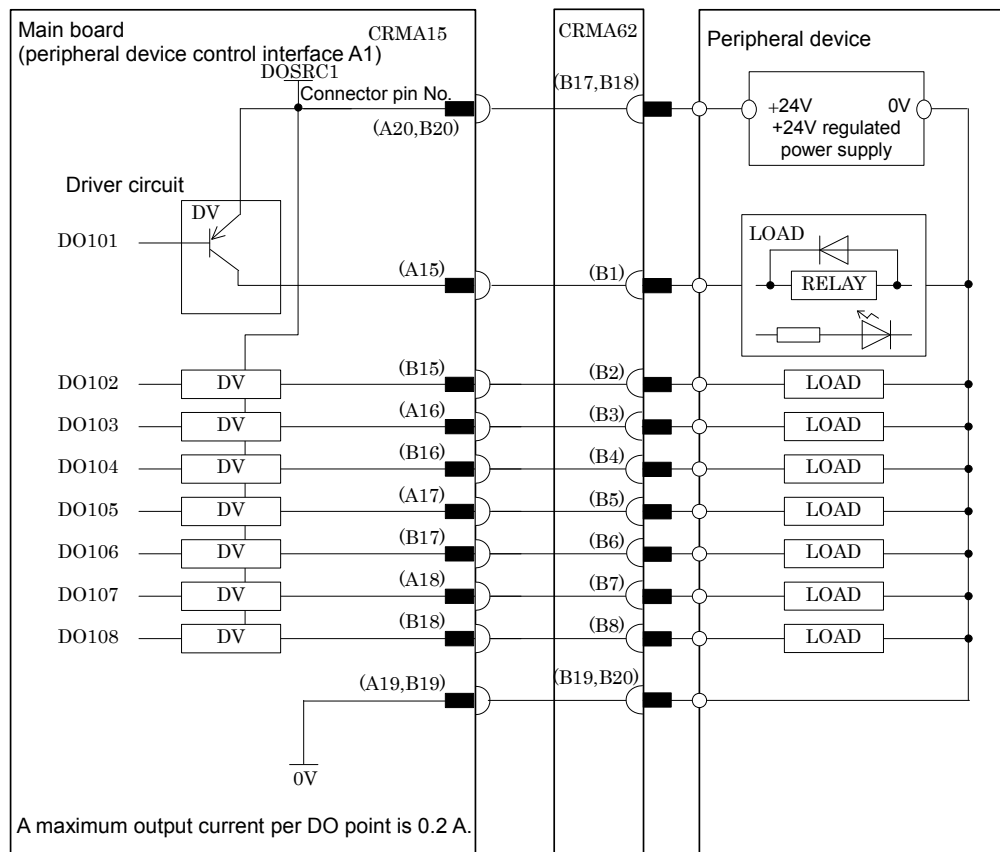


Fig.1.5.1 (b) DI/DO connection (2) (Controller with connector panel)

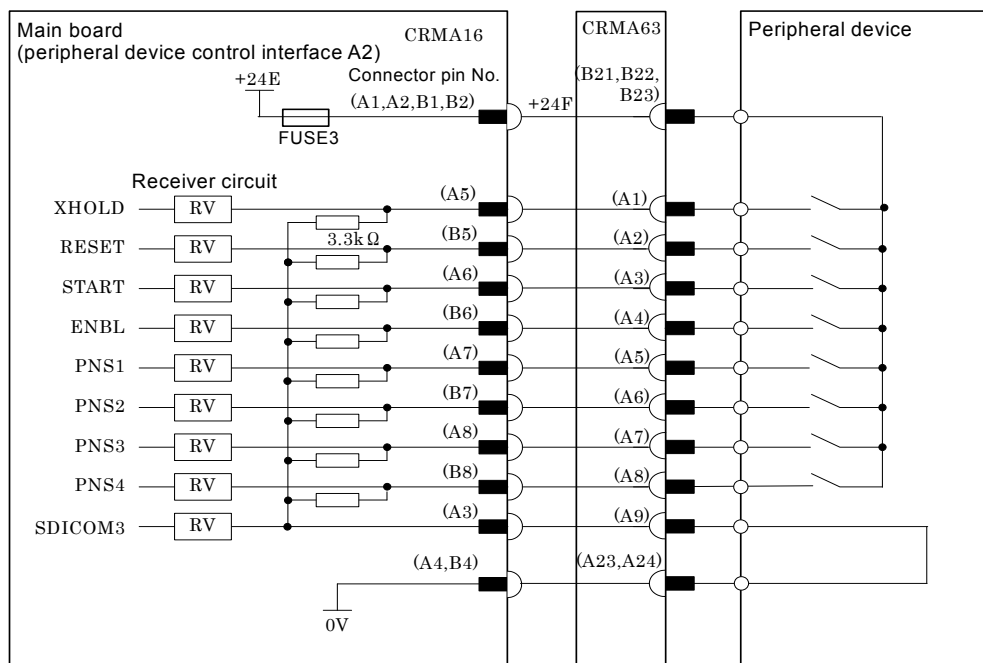


Fig.1.5.1 (c) DI/DO connection (3) (Controller with connector panel)

**NOTE**

In this diagram, common voltage of input devices is +24V.

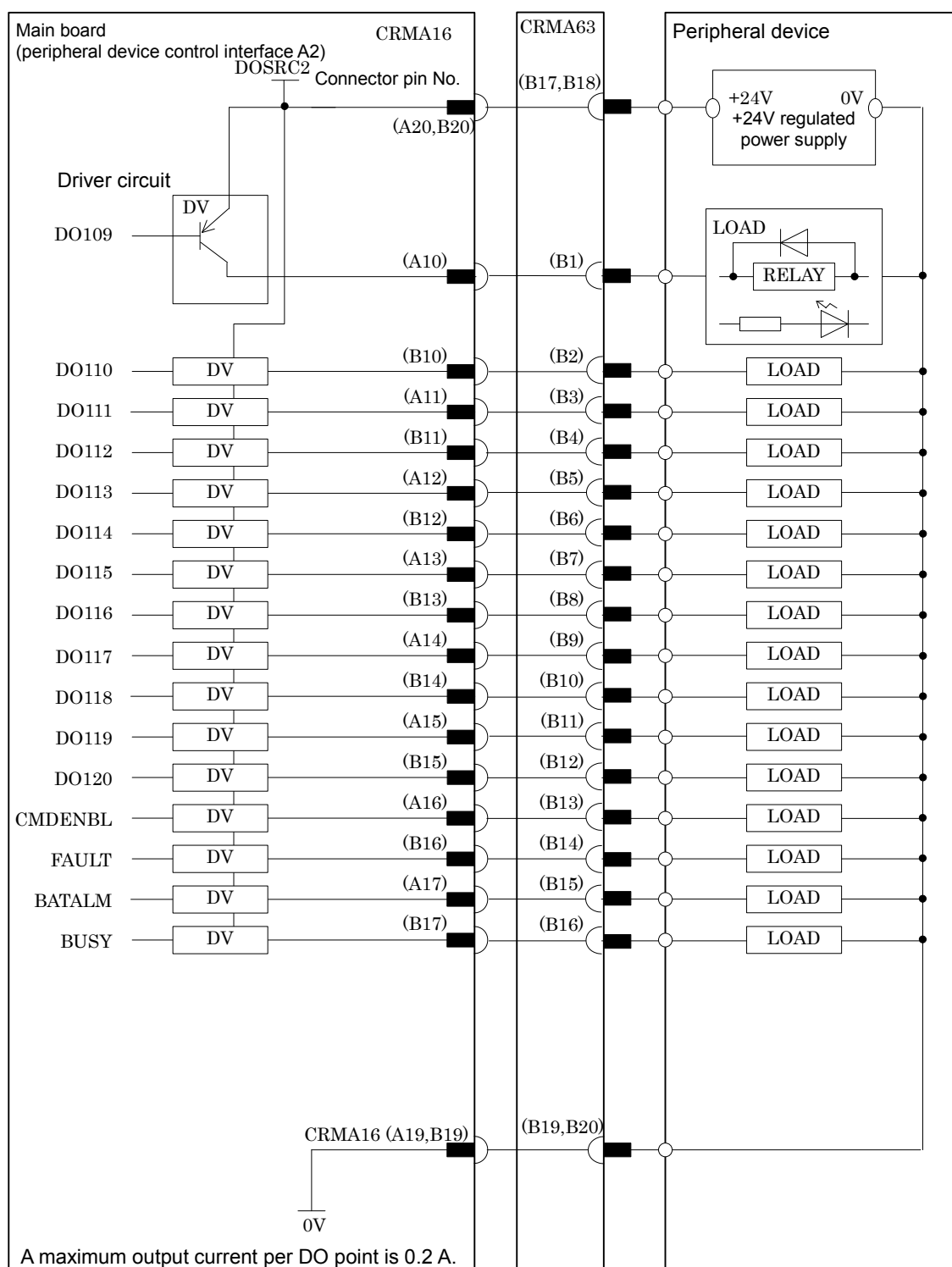


Fig.1.5.1 (d) DI/DO connection (4) (Controller with connector panel)



## 1.5.2 DI/DO CONNECTION

### (In case of controller without connector panel)

#### DI/DO connection

SDICOM1~3 signal are common selection signal for SDI.

When +24F common is used, connect to 0V.

When 0V common is used, connect to +24F.

SDICOM1 → Selects a common for DI101~DI108.

SDICOM2 → Selects a common for DI109~DI120.

SDICOM3 → Selects a common for XHOLD、RESET、START、ENBL、PNS1~PNS4.

#### NOTE

Table 1.□.□ The peripheral device connection cables are made by customer ,connector for These cables are optional.

2 The DOSRC1 and DOSRC2 pins of the CRMA15 and CRMA16 are pins for supplying power to drivers. (None of these pins can be left open.)

#### DI/DO SIGNALS

There are 28 data inputs (DI) and 24 data outputs (DO) on main board.

Table 1.5.2 DI/DO signals (Controller without connector panel)

| Connector number | Signal name | Description              | Remarks        |
|------------------|-------------|--------------------------|----------------|
| (DI signals)     |             |                          |                |
| CRMA15-A5        | DI101       | Peripheral device status | General signal |
| CRMA15-B5        | DI102       |                          |                |
| CRMA15-A6        | DI103       |                          |                |
| CRMA15-B6        | DI104       |                          |                |
| CRMA15-A7        | DI105       |                          |                |
| CRMA15-B7        | DI106       |                          |                |
| CRMA15-A8        | DI107       |                          |                |
| CRMA15-B8        | DI108       |                          |                |
| CRMA15-A9        | DI109       |                          |                |
| CRMA15-B9        | DI110       |                          |                |
| CRMA15-A10       | DI111       |                          |                |
| CRMA15-B10       | DI112       |                          |                |
| CRMA15-A11       | DI113       |                          |                |
| CRMA15-B11       | DI114       |                          |                |
| CRMA15-A12       | DI115       |                          |                |
| CRMA15-B12       | DI116       |                          |                |
| CRMA15-A13       | DI117       |                          |                |
| CRMA15-B13       | DI118       |                          |                |
| CRMA15-A14       | DI119       |                          |                |
| CRMA15-B14       | DI120       |                          |                |
| CRMA16-A5        | XHOLD       | Temporary stop           |                |
| CRMA16-B5        | FAULT RESET | External reset           |                |
| CRMA16-A6        | START       | Start                    |                |
| CRMA16-B6        | ENBL        | Operation enabled        |                |
| CRMA16-A7        | PNS1        | Robot service request    |                |
| CRMA16-B7        | PNS2        |                          |                |
| CRMA16-A8        | PNS3        |                          |                |
| CRMA16-B8        | PNS4        |                          |                |

| Connector number | Signal name | Description                      | Remarks        |
|------------------|-------------|----------------------------------|----------------|
| (DO signals)     |             |                                  |                |
| CRMA15-A15       | DO101       | Peripheral device control signal | General signal |
| CRMA15-B15       | DO102       |                                  |                |
| CRMA15-A16       | DO103       |                                  |                |
| CRMA15-B16       | DO104       |                                  |                |
| CRMA15-A17       | DO105       |                                  |                |
| CRMA15-B17       | DO106       |                                  |                |
| CRMA15-A18       | DO107       |                                  |                |
| CRMA15-B18       | DO108       |                                  |                |
| CRMA16-A10       | DO109       |                                  |                |
| CRMA16-B10       | DO110       |                                  |                |
| CRMA16-A11       | DO111       |                                  |                |
| CRMA16-B11       | DO112       |                                  |                |
| CRMA16-A12       | DO113       |                                  |                |
| CRMA16-B12       | DO114       |                                  |                |
| CRMA16-A13       | DO115       |                                  |                |
| CRMA16-B13       | DO116       |                                  |                |
| CRMA16-A14       | DO117       |                                  |                |
| CRMA16-B14       | DO118       |                                  |                |
| CRMA16-A15       | DO119       |                                  |                |
| CRMA16-B15       | DO120       |                                  |                |
| CRMA16-A16       | CMDENBL     | During automatic operation       |                |
| CRMA16-B16       | FAULT       | Alarm                            |                |
| CRMA16-A17       | BATALM      | Battery voltage drop             |                |
| CRMA16-B17       | BUSY        | During operation                 |                |

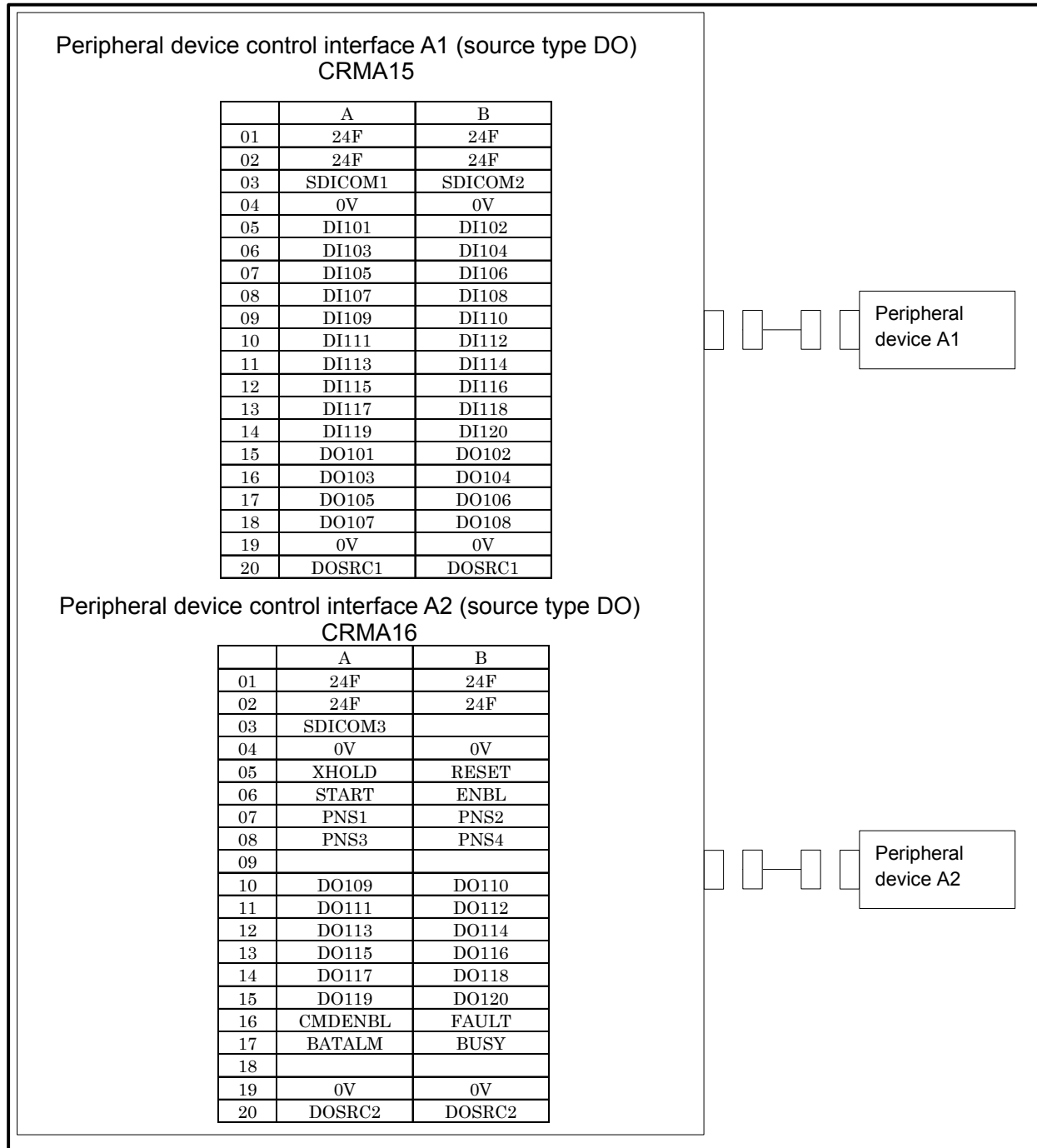


Fig.1.5.2 (a) DI/DO connection (1) (Controller without connector panel)

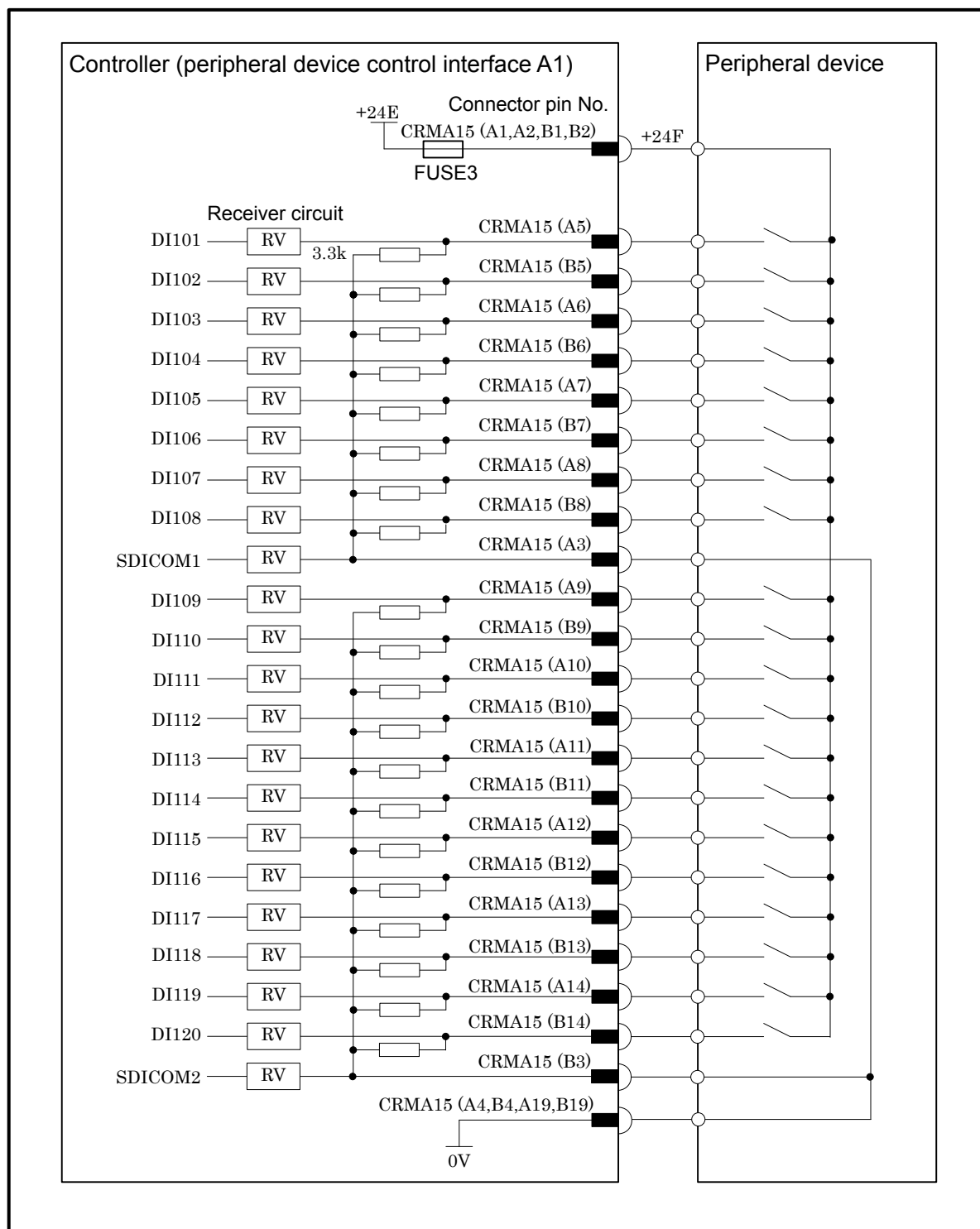


Fig.1.5.2 (b) DI/DO connection (2) (Controller without connector panel)

**NOTE**

In this diagram, common voltage of input devices is +24V.

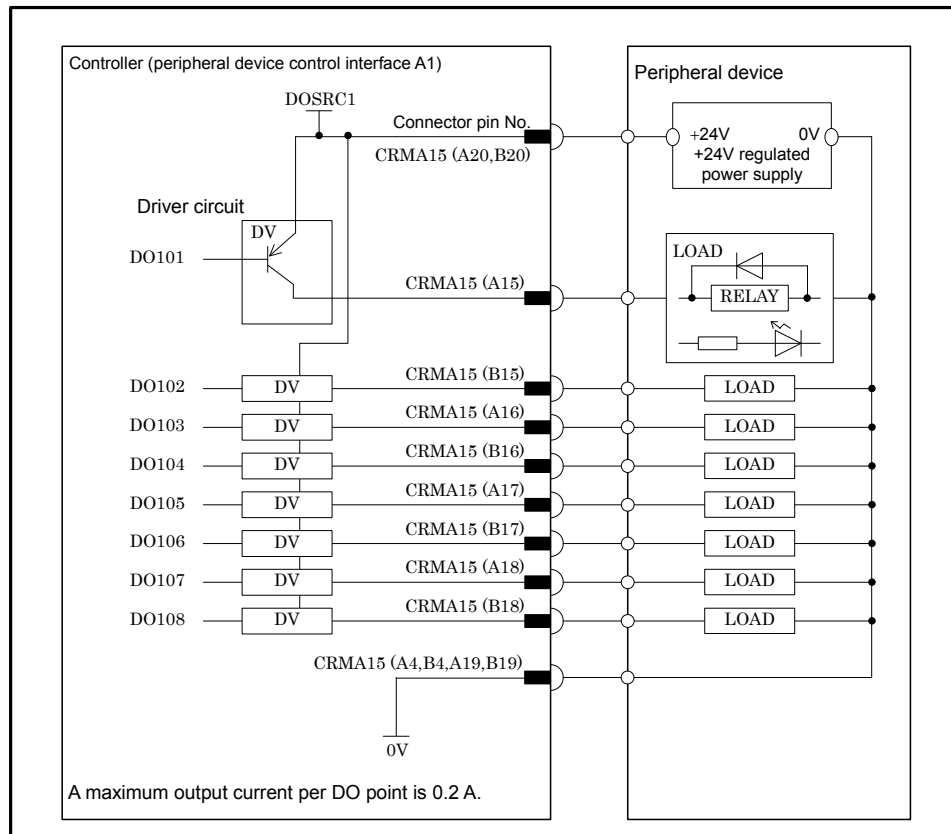


Fig.1.5.2 (c) DI/DO connection (3) (Controller without connector panel)

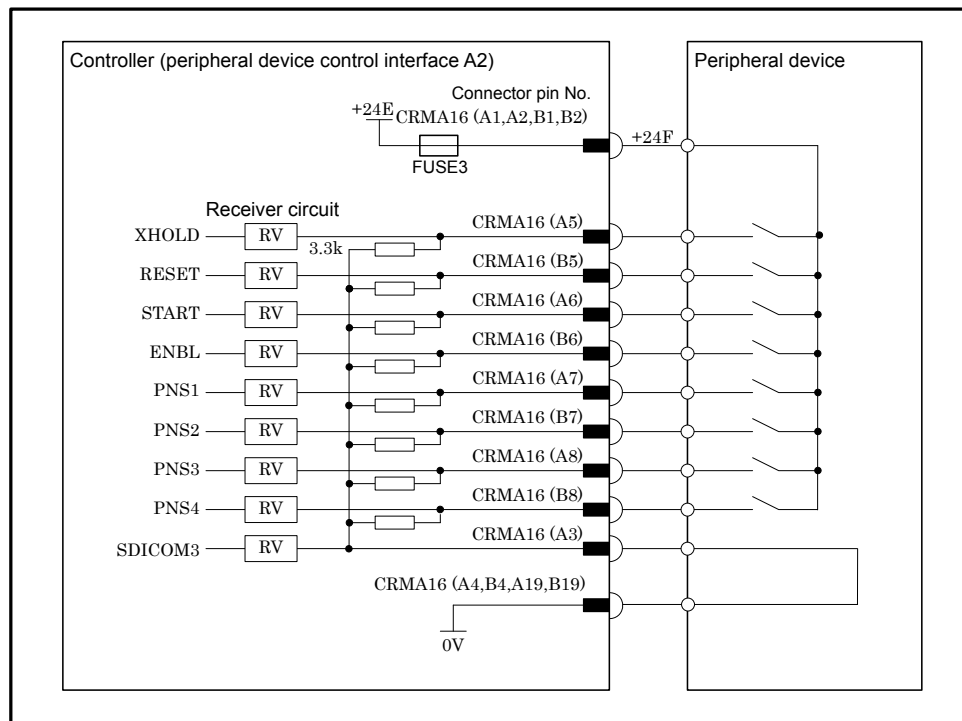


Fig.1.5.2 (d) DI/DO connection (4) (Controller without connector panel)

**NOTE**

In this diagram, common voltage of input devices is +24V.

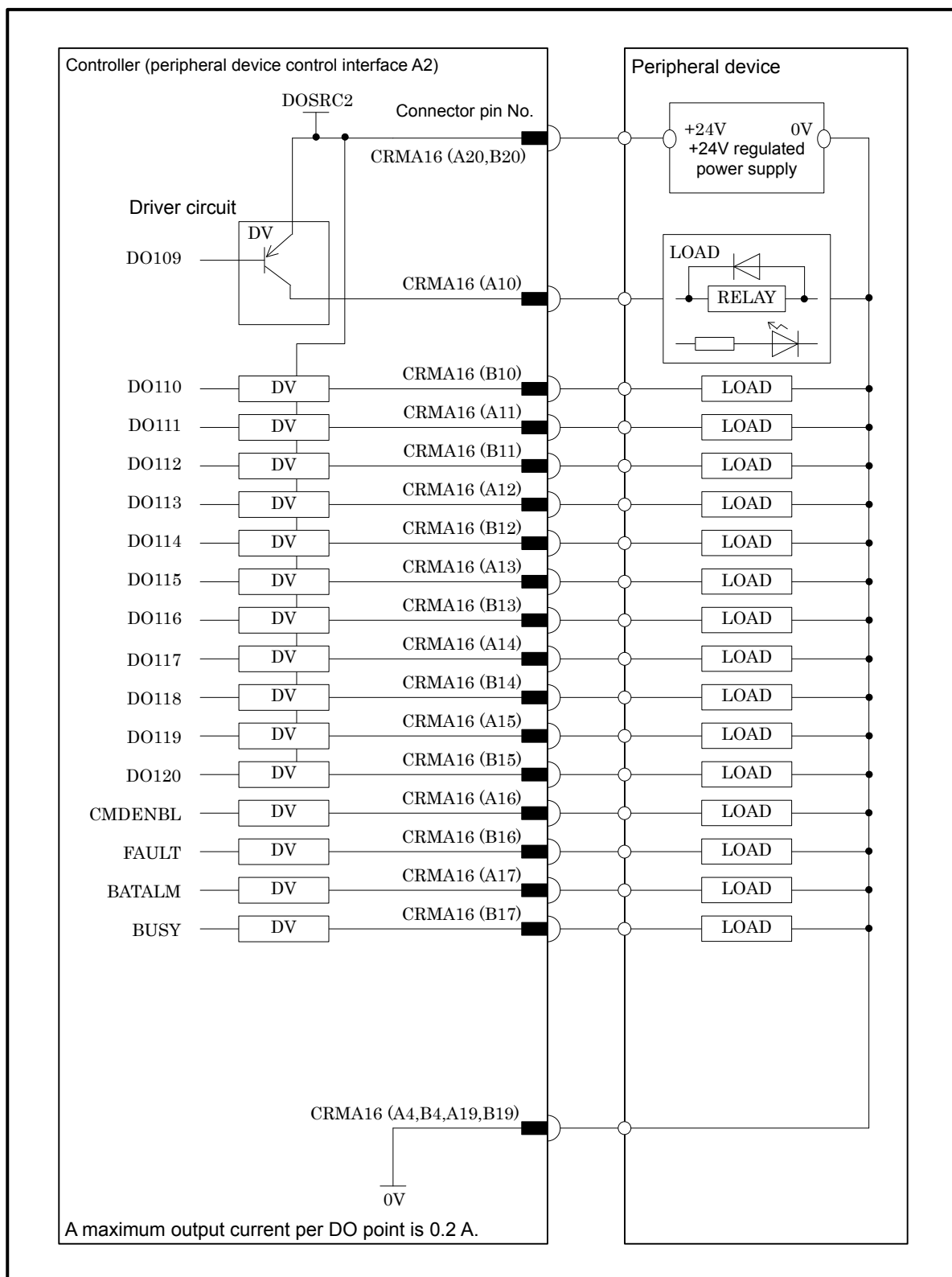


Fig.1.5.2 (e) DI/DO connection (5) (Controller without connector panel)

The following shows the connector interface of the optional peripheral device cables on the peripheral device side.

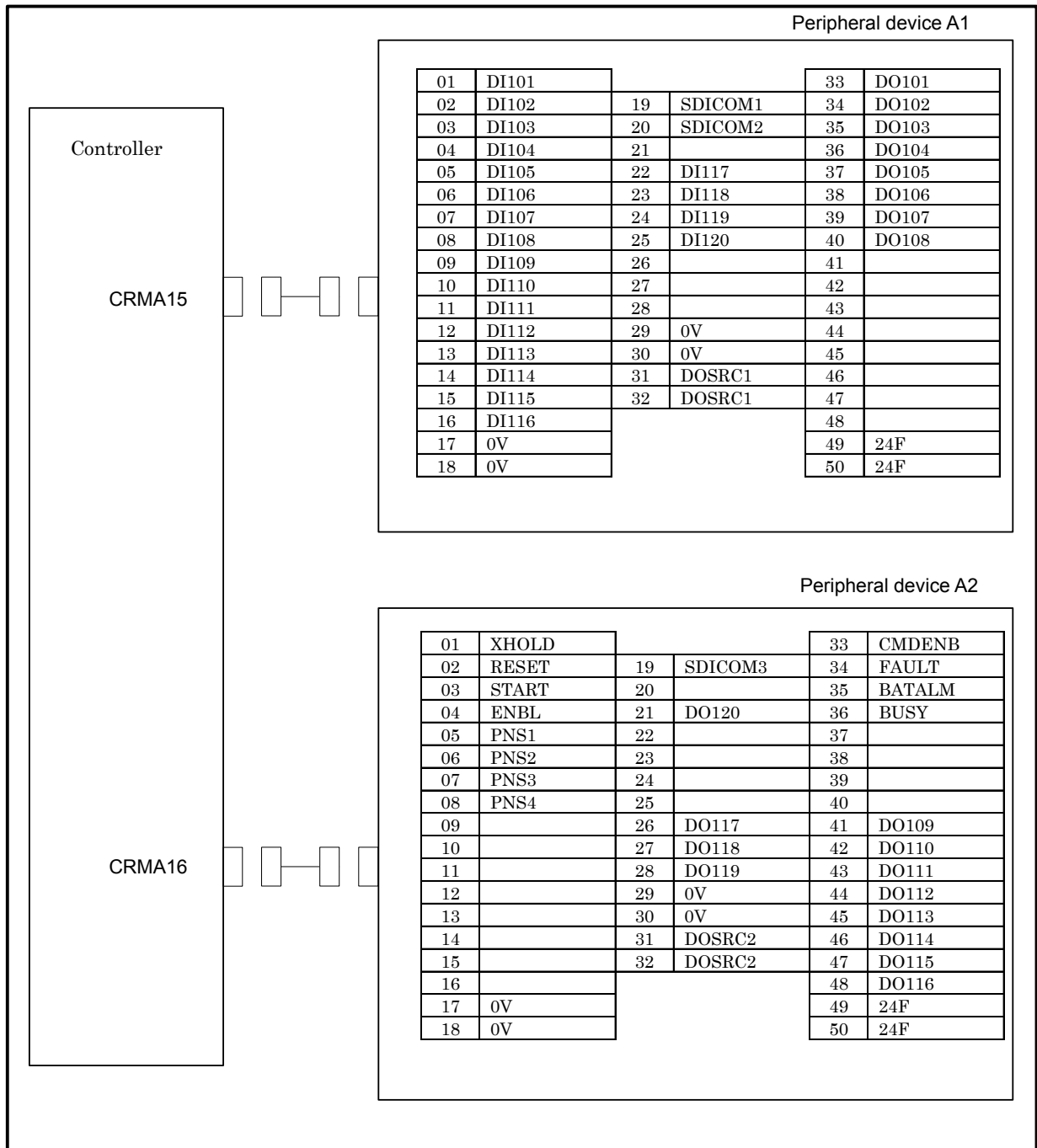


Fig.1.5.2 (f) DI/DO connection (6) (Controller without connector panel)

# 1.6 INTERFACE FOR END EFFECTOR

## Connection-Between the Mechanical Unit and End Effector

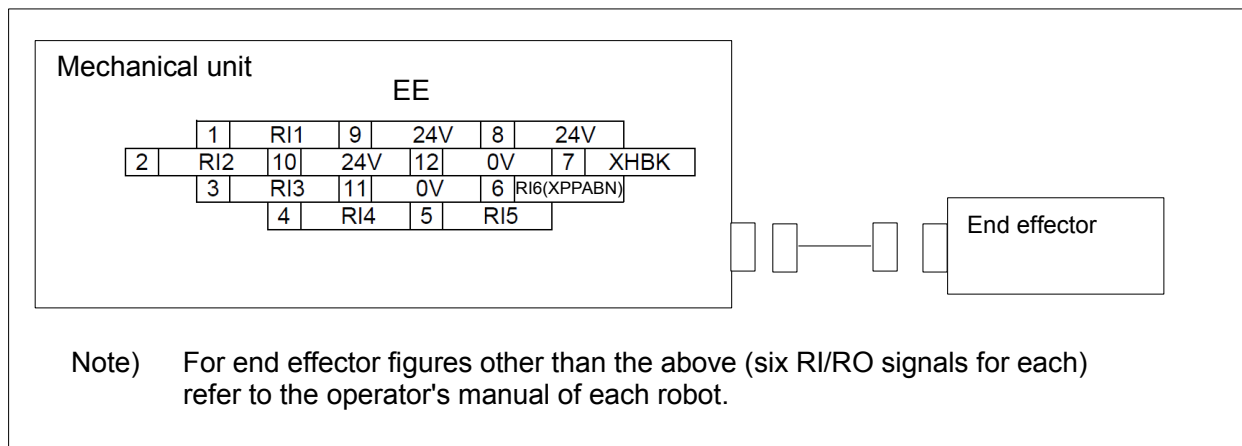
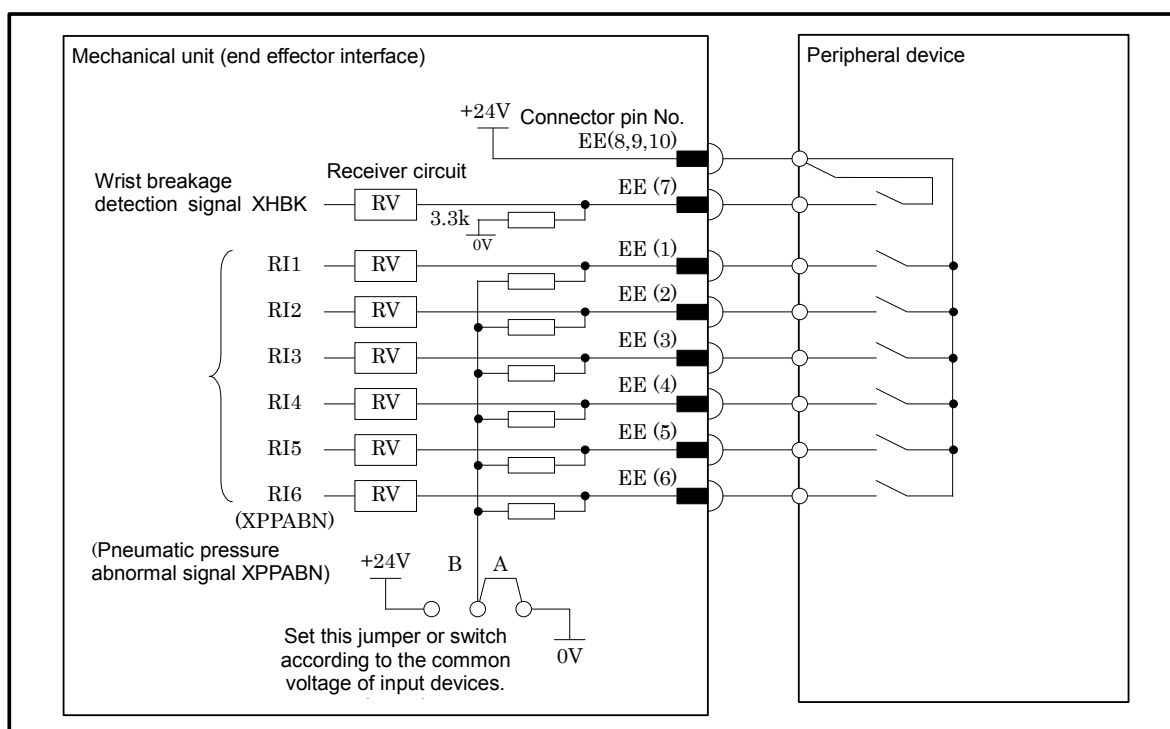


Fig.1.6 (a) End effector interface

### NOTE

RO1 to RO6 are used as the on/off signals of the solenoid valve option.  
The RI and XHBK signals can be used for the end effector.  
For RO, refer to the operator's manual of the mechanical unit.





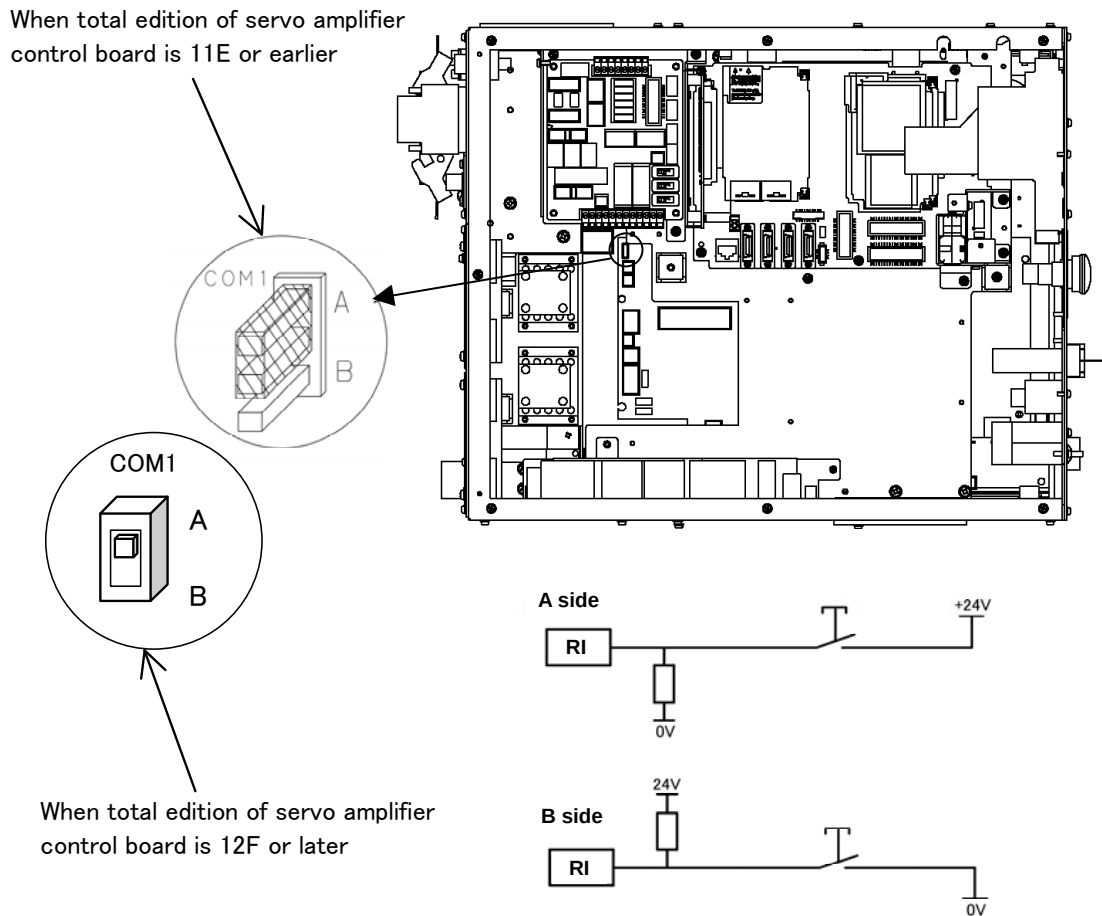


Fig.1.6 (b) Circuit based on jumper pin location or setting of switch

**NOTE**

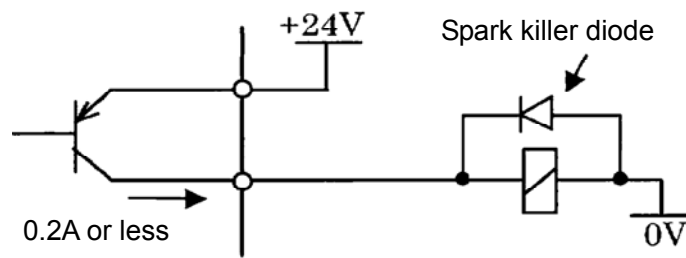
- 1 In this diagram, common voltage of input devices is +24V.
- 2 The common-level change-over setting pin or switch (COM1) is in the servo amplifier. (except XHBK)

## 1.7 DIGITAL I/O SIGNAL SPECIFICATIONS

This section describes the specifications of the digital I/O signals interfaced with the peripheral device, end effector, and arc welder.

### Peripheral device interface

- (1) Output signals in peripheral device interface (Source type DO)
  - (a) Example of connection



(b) Electrical specifications

Maximum load current when driver is on: 200 mA (including momentary level)

Saturation voltage when driver is on: 1.0 V max.

Dielectric strength: 24 V  $\pm$ 20% (including momentary level)

Leakage current when driver is off: 100  $\mu$ A

(c) The external power supply to output signals must satisfy the following:

Power supply voltage: +24 V  $\pm$ 10%

Power supply current:

For each printed circuit-board of this type

(Total sum of maximum load currents including momentary levels + 100 mA or more)

Power-on timing:

At the same time when the controller is turned on or earlier

Power-off timing:

At the same time when the controller is turned off or later

(d) Spark killer diode

Rated peak reverse voltage : 100 V or more

Rated effective forward current : 1 A or more

(e) Driver for output signals

In the driver device, the current of each output signal is monitored, and when an overcurrent is detected, the relevant output is turned off. After an output has been turned off by an overcurrent, the overcurrent state is released because the output is off, so the output on state is restored. Therefore, in the ground fault or overcurrent state, the output is turned on and off repeatedly. Such a condition is found also when a load with a high surge current is connected. The driver device also includes an overheat detection circuit, which turns off all outputs of the device when the internal temperature of the device has increased as a result of a continued overcurrent state due to a ground fault of an output and so on. The outputs are held off, but their normal states can be restored by turning the power to the controller on and off after the internal temperature of the device has lowered.

(f) Note on use

When adding a relay, solenoid, or the like directly to the circuit, connect a diode for counter electromotive voltage protection in parallel to the load.

(g) Applicable signals

**In case of controller with connector panel**

Output signals of CRMA62, CRMA63

CMDENBL, FAULT, BATALM, BUSY,

DO101 to DO120

**In case of controller without connector panel**

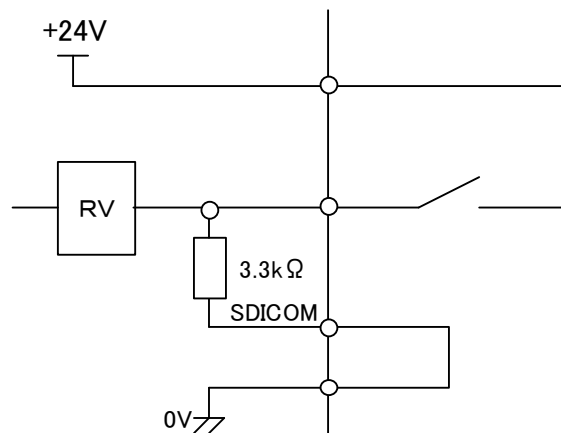
Output signals of main board CRMA15, CRMA16

CMDENBL, FAULT, BATALM, BUSY,

DO101 to DO120

(2) Input signals in peripheral device interface A

(a) Example of connection

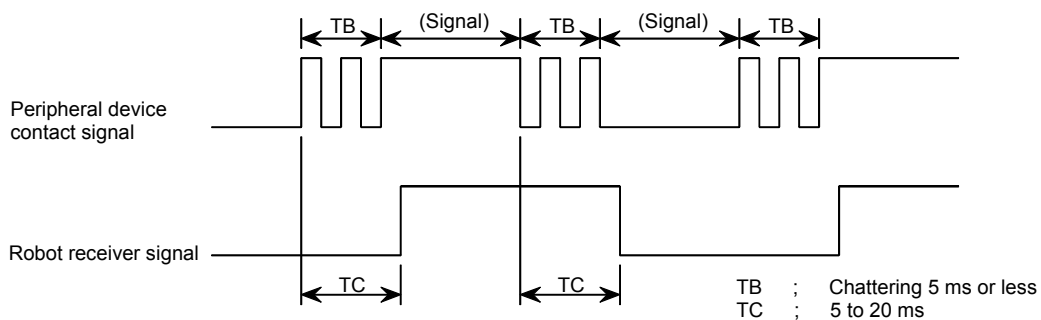


## (b) Electrical specifications of the receiver

|                               |                              |
|-------------------------------|------------------------------|
| Type                          | : Grounded voltage receiver  |
| Rated input voltage           | : Contact close +20V to +28V |
|                               | : Contact open 0V to +4V     |
| Maximum applied input voltage | : +28VDC                     |
| Input impedance               | : 3.3kΩ (approx.)            |
| Response time                 | : 5ms to 20ms                |

## (c) specifications of the peripheral device contact

|                           |                                                 |
|---------------------------|-------------------------------------------------|
| Rated contact capacity    | : DC24V, 0.1A                                   |
|                           | (Use a contact which minimum load is 5mA less.) |
| Input signal width        | : 200ms or more (on/off)                        |
| Chattering time           | : 5ms or less                                   |
| Closed circuit resistance | : 100Ω or less                                  |
| Opened circuit resistance | : 100kΩ or more                                 |



## (d) Note on use

Apply the +24 V power at the robot to the receiver.

However, the above signal specifications must be satisfied at the robot receiver.

## (e) Applicable signals

**In case of controller with connector panel**

Input signals of CRMA62, CRMA63 and CRMA64  
XHOLD, RESET, START, PNS1 to PNS4, ENBL  
DI101 to DI120

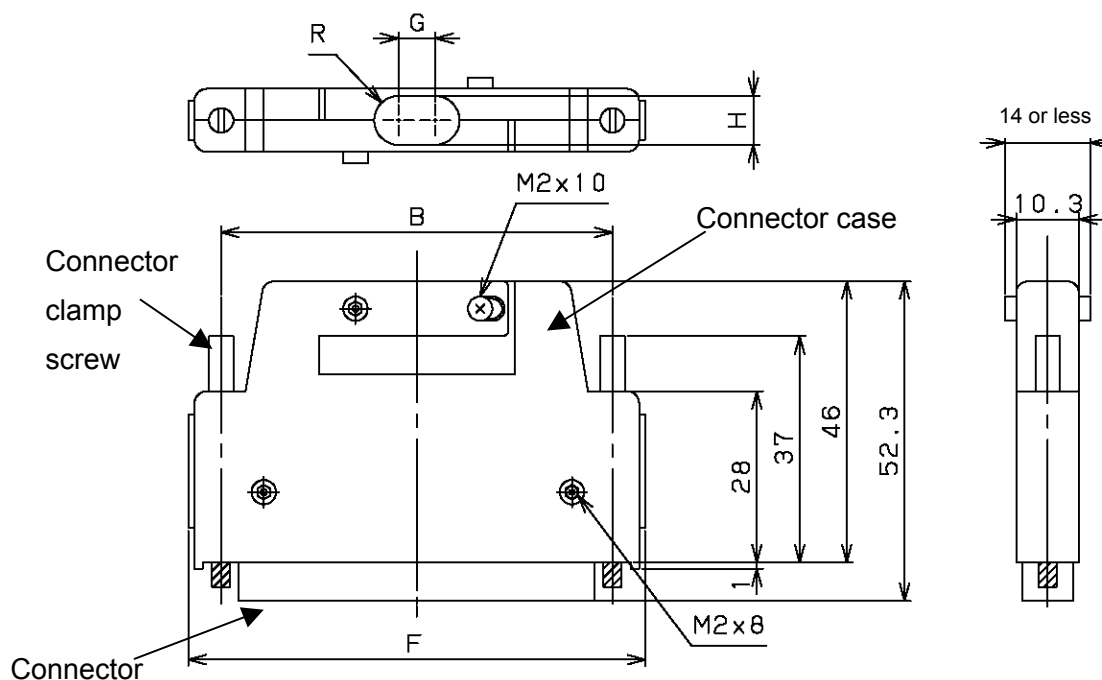
**In case of controller without connector panel**

Input signals of main board CRMA15 and CRMA16  
XHOLD, RESET, START, PNS1 to PNS4, ENBL,  
DI101 to DI120

## End effector control interface

- (1) Input signal in peripheral device interface  
The input signals are the same as those of other DIs.
- (a) Applicable signals  
R11 to RI5, RI6 (XPPABN), XHBK

## 1.8 I/O SIGNAL CONNECTOR(In case of controller with connector panel)



| Connector specifications        | Applicable interface | Dimensions |       |      |     |     | Remark                            |
|---------------------------------|----------------------|------------|-------|------|-----|-----|-----------------------------------|
|                                 |                      | B          | F     | G    | H   | R   |                                   |
| FCN-361P048-AU<br>FCN-360C048-A | CRMA62               | 74.14      | 82.88 | 10.0 | 8.0 | 4.0 | FUJITSU COMPONENT LIMITED,48 pins |
| FCN-361P048-AU<br>FCN-360C048-A | CRMA63               |            |       |      |     |     | FUJITSU COMPONENT LIMITED,48 pins |
| FCN-361P024-AU<br>FCN-360C024-A | CRMA64               | 43.66      | 52.40 | -    | 8.0 | 4.0 | FUJITSU COMPONENT LIMITED,24 pins |

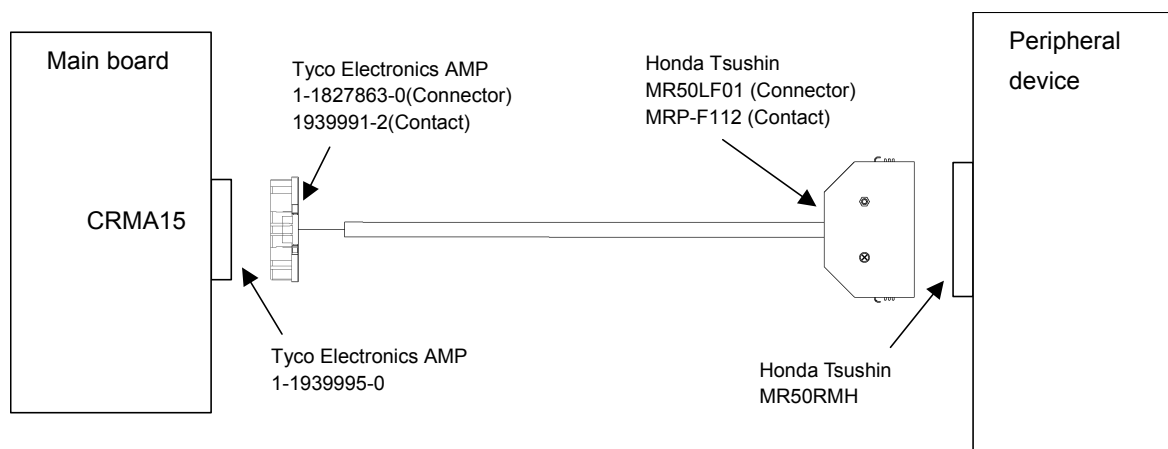
• Applicable wire size : AWG23 or less (  $\phi$  0.60 or less)

## 1.9 SPECIFICATIONS OF THE CABLES USED FOR PERIPHERAL DEVICES (In case of controller without connector panel)

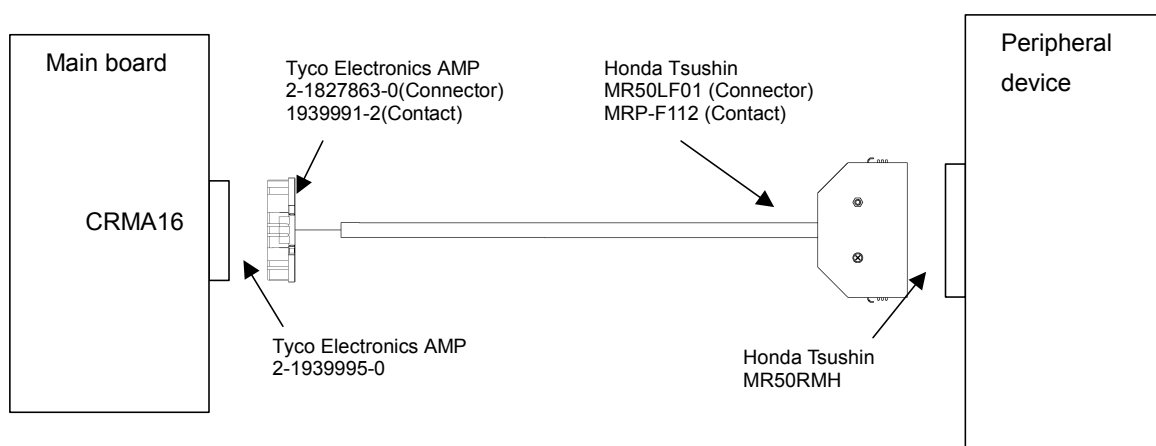
If the customer manufactures cables, make sure they conform to the FANUC standard cables described in this section.

(See the description in "Peripheral Device Interface" in this manual for the specifications of the FANUC standard cables.)

### 1.9.1 Peripheral Device Interface A1 Cable (CRMA15: Tyco Electronics AMP, 40 pins)



### 1.9.2 Peripheral Device Interface A2 Cable (CRMA16: Tyco Electronics AMP, 40 pins)



### 1.9.3 Peripheral Device Connection Cable (Controller without connector panel)

Fig.1.9.3 shows the connection of the peripheral device cable in the cabinet.

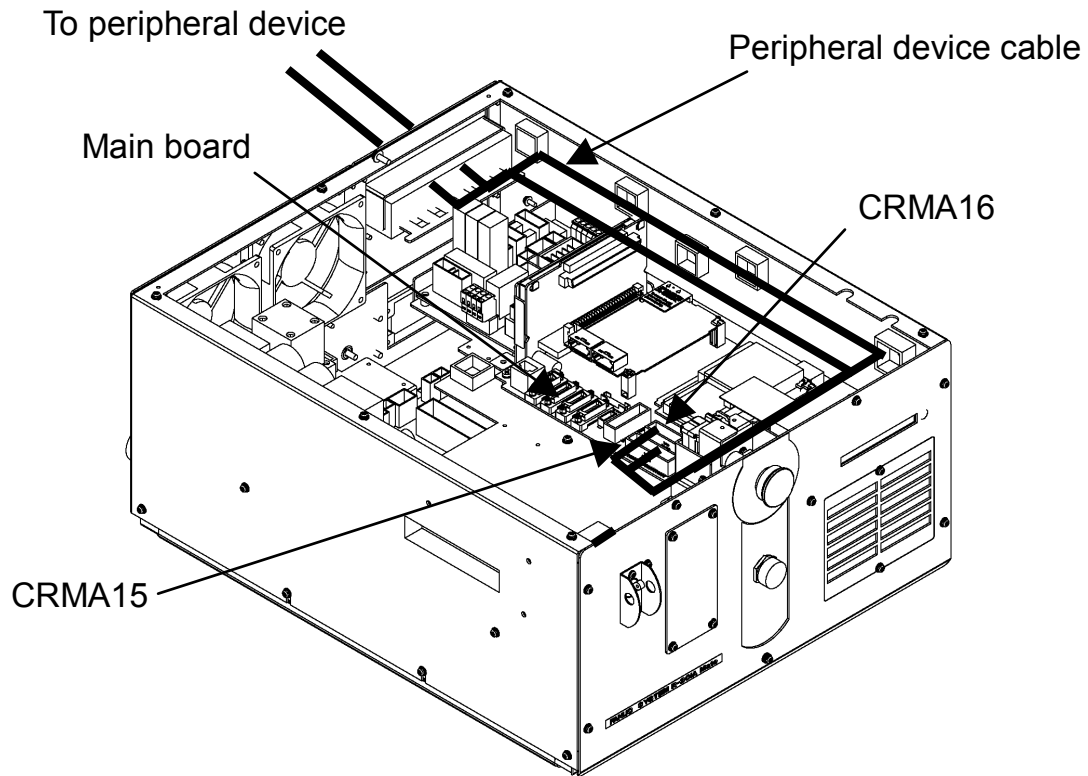
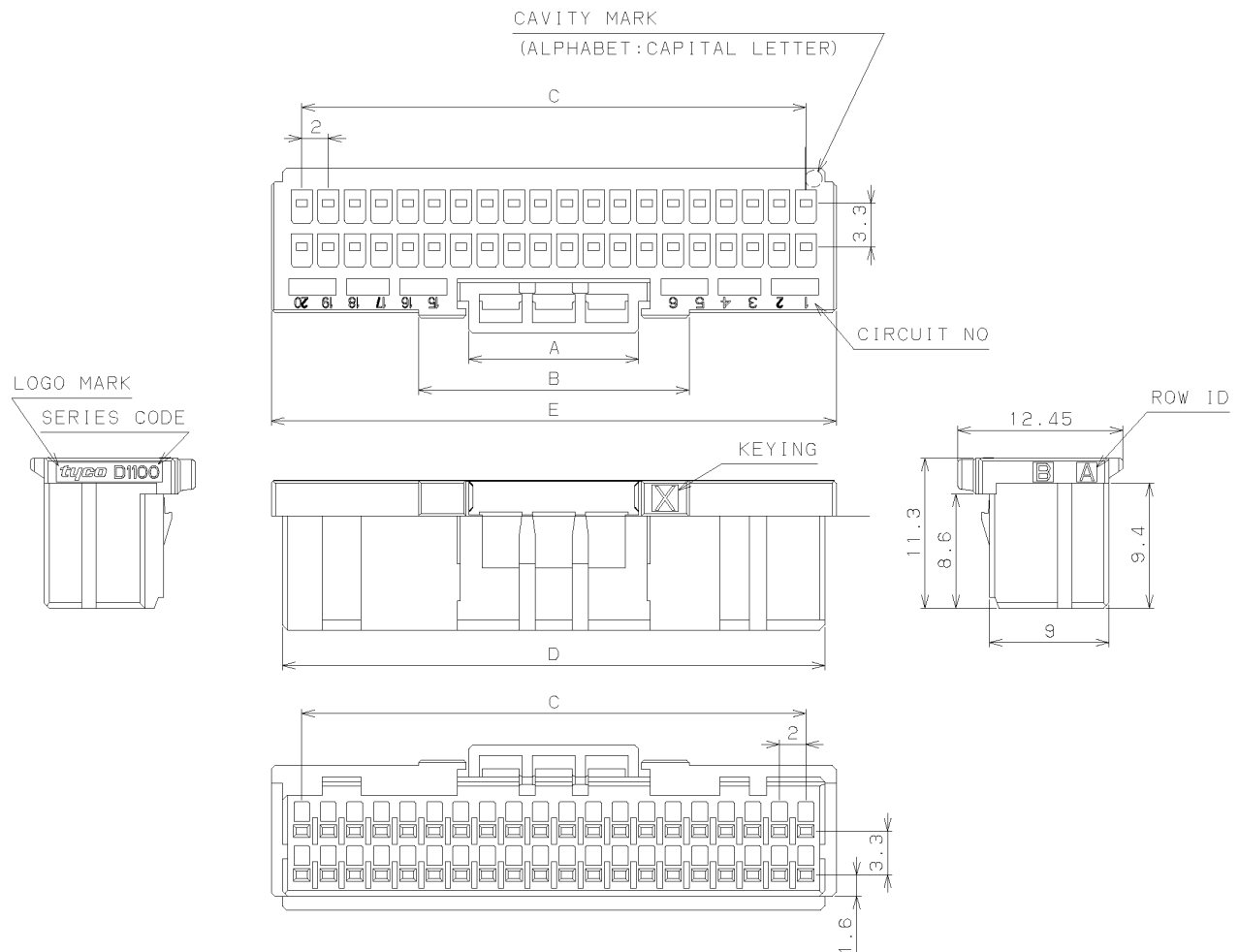


Fig.1.9.3 Peripheral Device Cable Connection (Controller without connector panel )

## 1.9.4 Peripheral Device Cable Connector (Controller without connector panel)

(1) Fig.1.9.4 (a), (b) shows the connector for peripheral device cables.



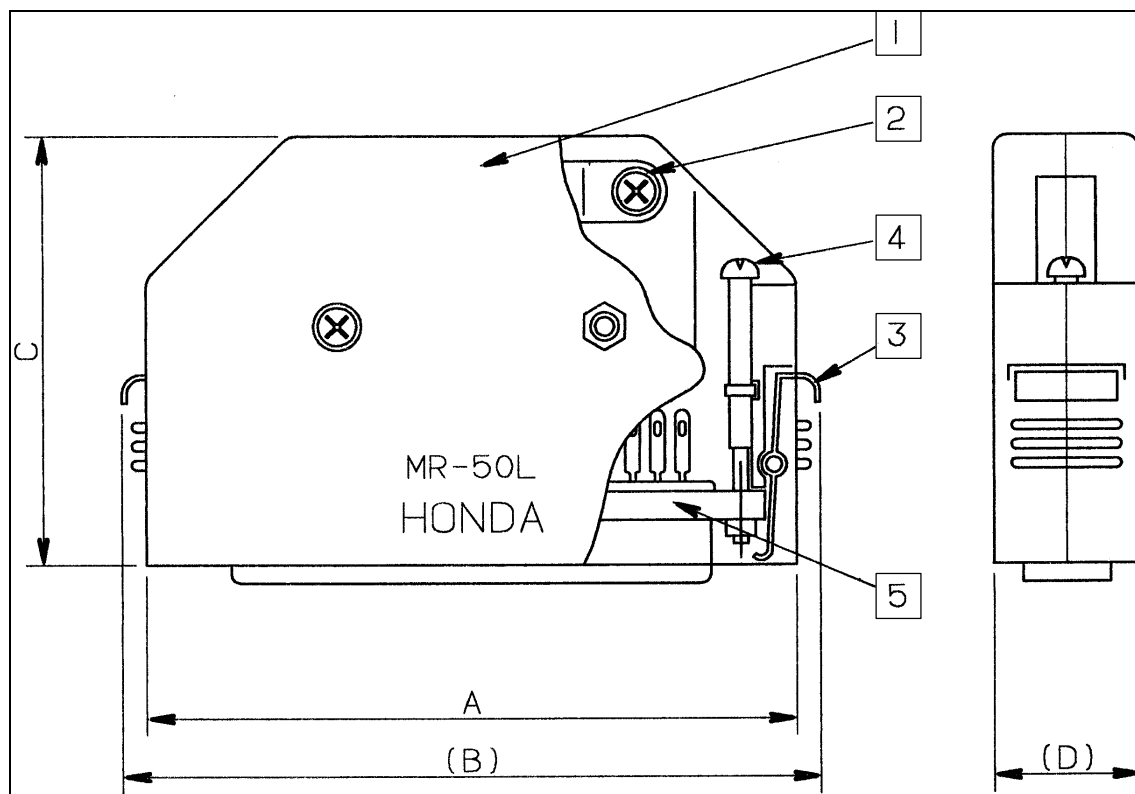
| Connector specifications | Applicable interface | Dimensions |      |      |      |      | Remark                                           |
|--------------------------|----------------------|------------|------|------|------|------|--------------------------------------------------|
|                          |                      | A          | B    | C    | D    | E    |                                                  |
| 1-1827863-0 (Housing)    | CRMA15               | 12.8       | 20.4 | 38.0 | 40.9 | 42.6 | Tyco Electronics AMP D-1000 series 40pin (X-key) |
| 2-1827863-0 (Housing)    | CRMA16               |            |      |      |      |      | Tyco Electronics AMP D-1000 series 40pin (Y-key) |
| 1939991-2 (Contact)      | CRMA15               |            |      |      |      |      | Tyco Electronics AMP D-1000 series               |
|                          | CRMA16               |            |      |      |      |      |                                                  |

Fig.1.9.4 (a) Peripheral device cable connector (Tyco Electronics AMP) (Controller without connector panel)

### ▪ Maintenance Tools

Crimping Tool (1762846-1): A05B-2550-K060

Extraction Tool (1891526-1): A05B-2550-K061



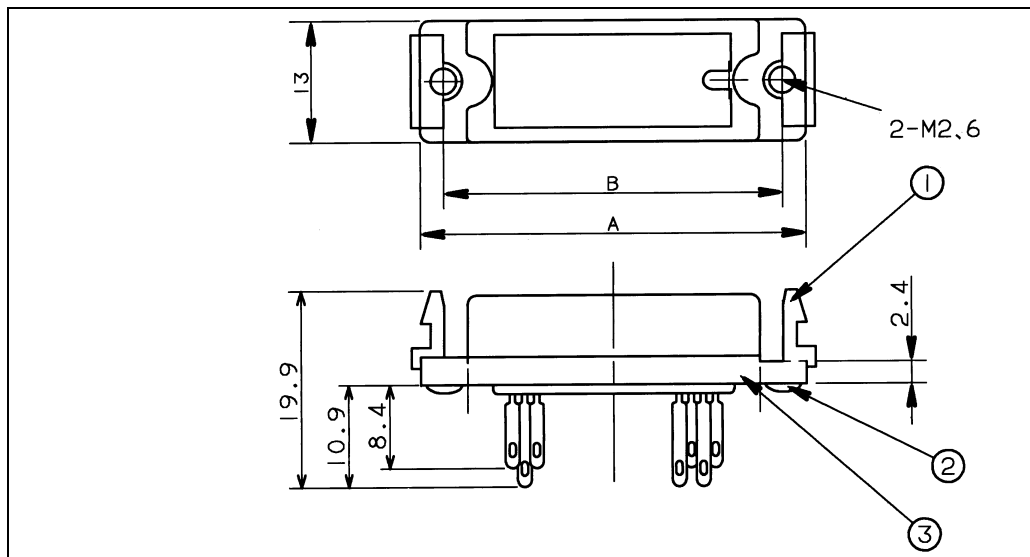
| Connector specifications | Applicable interface | Dimensions |      |      |     | Remark                               |
|--------------------------|----------------------|------------|------|------|-----|--------------------------------------|
|                          |                      | A          | (B)  | C    | (D) |                                      |
| MR50LF<br>(Connector)    | CRMA15<br>CRMA16     | 67.9       | 73.5 | 44.8 | 18  | Honda Tsushin Kogyo, 50 pins, female |
| MRP-F112<br>(Contact)    | CRMA15<br>CRMA16     |            |      |      |     | Honda Tsushin Kogyo                  |

| Symbol | Name                                                                 |
|--------|----------------------------------------------------------------------|
| 1      | Connector cover                                                      |
| 2      | Cable clamp screw                                                    |
| 3      | Connector clamp spring                                               |
| 4      | Connector clamp screw                                                |
| 5      | Connector 50 pins (female) MR50LF<br>Connector 50 pins (male) MR50LM |

Fig.1.9.4 (b) Peripheral device cable connector (Honda Tsushin Kogyo) (Controller without connector panel)



## (2) Peripheral device connector



| Connector specifications | Applicable interface | Dimensions |      | Remark                       |
|--------------------------|----------------------|------------|------|------------------------------|
|                          |                      | A          | B    |                              |
| MR50RM                   | (CRMA15)<br>(CRMA16) | 61.4       | 56.4 | Honda Tsushin Kogyo, 50 pins |

| Symbol | Name                  |
|--------|-----------------------|
| 1      | Connector clamp screw |
| 2      | Screw M2.6 8          |
| 3      | Connector (MR50RM)    |

Fig.1.9.4 (c) Peripheral device connector (Honda Tsushin Kogyo) (Controller without connector panel)

## 1.9.5 Recommended Cables (Controller without connector panel)

## (1) Peripheral device connection cable

Connect a peripheral device using a completely shielded, heavily protected cable conforming to the specifications in Table 1.9.5 (a).

Allow an extra 50 cm for routing the cable in the controller.

The maximum cable length is 30 m.

Table 1.9.5 (a) Recommended Cable (for Peripheral Device Connection)

| Number of wires | Wire specifications<br>(FANUC specifications) | Conductor     |               | Sheath thickness (mm) | Effective outside diameter (mm) | Electrical characteristics  |                       |
|-----------------|-----------------------------------------------|---------------|---------------|-----------------------|---------------------------------|-----------------------------|-----------------------|
|                 |                                               | Diameter (mm) | Configuration |                       |                                 | Conductor resistance (Ω/km) | Allowable current (A) |
| 50              | A66L-0001-0042                                | φ1.05         | 7/0.18 AWG24  | 1.5                   | φ12.5                           | 106                         | 1.6A                  |

## (2) End effector connection cable

Connect an end effector using a heavily protected cable with a movable wire conforming to the specifications in Table 1.9.5 (b).

The cable length is determined so that the cable will not interfere with the end effector and the wrist can move through its full stroke.

Table 1.9.5 (b) Recommended Cable (for End Effector Connection)

| Number of wires | Wire specifications<br>(FANUC specifications) | Conductor     |                  | Sheath thickness (mm) | Effective outside diameter (mm) | Electrical characteristics                  |                       |
|-----------------|-----------------------------------------------|---------------|------------------|-----------------------|---------------------------------|---------------------------------------------|-----------------------|
|                 |                                               | Diameter (mm) | Configuration    |                       |                                 | Conductor resistance ( $\Omega/\text{km}$ ) | Allowable current (A) |
| 6               | A66L-0001-0143                                | $\phi$ 1.1    | 40/0.08<br>AWG24 | 1.0                   | $\phi$ 5.3                      | 91                                          | 3.7                   |
| 20              | A66L-0001-0144                                | $\phi$ 1.1    | 40/0.08<br>AWG24 | 1.0                   | $\phi$ 8.6                      | 91                                          | 2.3                   |
| 24              | A66L-0001-0459                                | $\phi$ 0.58   | 40/0.08<br>AWG24 | 1.0                   | $\phi$ 8.3                      | 93                                          | 2.3                   |

## 1.9.6 Ethernet Interface

This section describes information relating to the physical Ethernet connection.



### CAUTION

- 1 Before connecting or disconnecting the cable to or from the FAST Ethernet/FAST Data Server, make sure that the power to the CNC is turned off.
- 2 Please inquire of each manufacturer about the construction of network or the condition of using the equipment except the FAST Ethernet/FAST Data Server (hub, transceiver, cable etc.). When configuring your network, you must take other sources of electrical noise into consideration to prevent your network from being influenced by electrical noise. Make sure that network wiring is sufficiently separated from power lines and other sources of electrical noise such as motors, and ground each of the devices as necessary. In addition, high and insufficient ground impedance may cause interference during communications. After installing the machine, conduct a communications test before you actually start operating the machine.

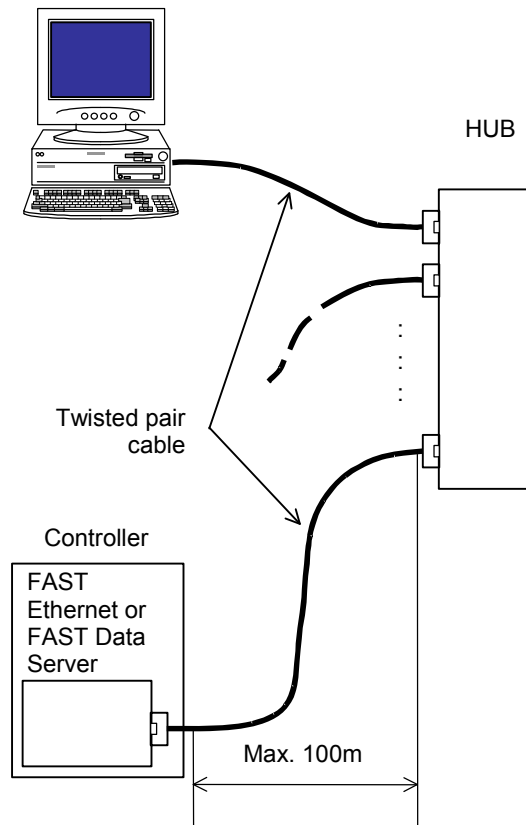
We cannot ensure operation that is influenced by network trouble caused by a device other than the FAST Ethernet or FAST Data Server.

## Connection to Ethernet

The FAST Ethernet or FAST Data Server is provided with a 100BASE-TX interface.

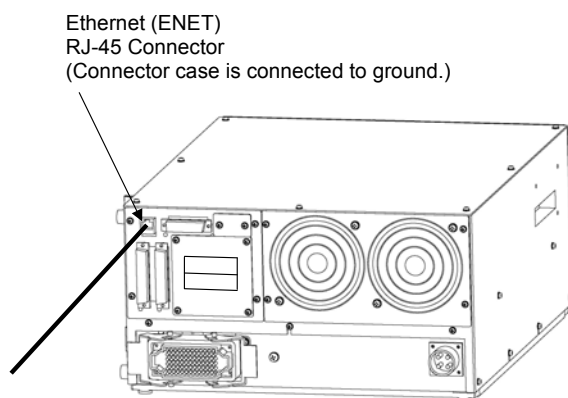
Prepare a hub for connecting the FAST Ethernet board to the Ethernet trunk. The following shows an example of a general connection.

Some devices (hub, transceiver, etc.) that are needed for building a network do not come in a dust-proof construction. Using such devices in an atmosphere where they are subjected to dust or oil mist will interfere with communications or damage the FAST Ethernet or FAST Data Server. Be sure to install such devices in a dust-proof cabinet.

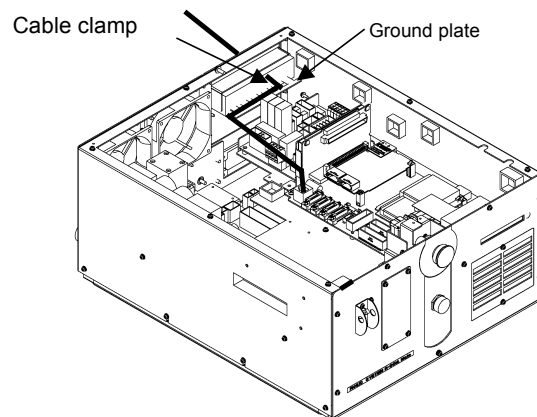


### Leading out the Ethernet Cable

For this type of control unit, the cable is drawn out only from the front of the control unit. See the outline drawing of each type of board for the location of the connector.



In case of controller with  
connector panel



In case of controller without  
connector panel

The Ethernet cable must be fastened by a cable clamp to prevent tension being applied to the modular connector (RJ-45) that connects the cable to the control unit even if the Ethernet cable is pulled directly.

## 100BASE-TX Connector (CD38R) Pin Assignments

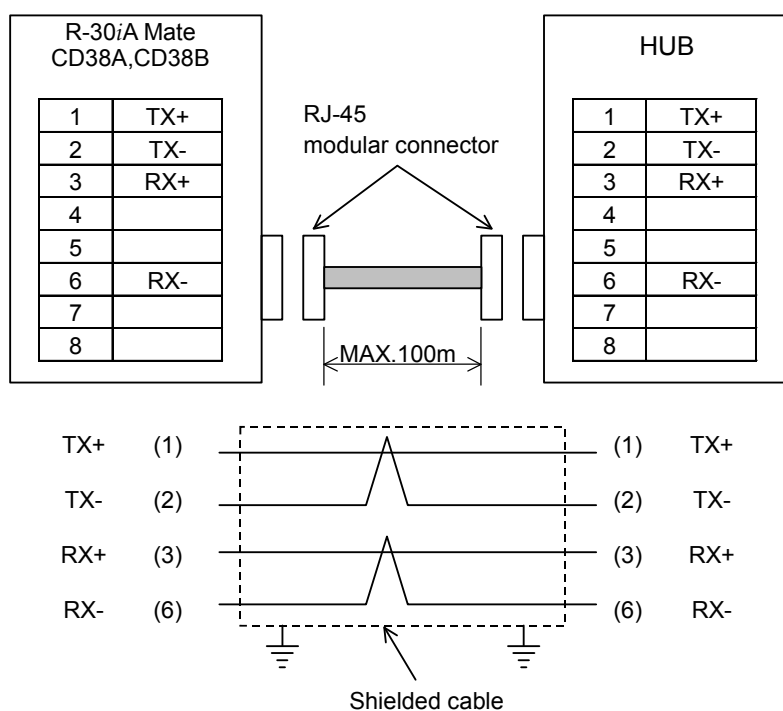
Table 4.8.2.3 CD38R

| Pin No. | Signal name | Description |
|---------|-------------|-------------|
| 1       | TX+         | Send +      |
| 2       | TX-         | Send -      |
| 3       | RX+         | Receive +   |
| 4       |             | Not used    |
| 5       |             | Not used    |
| 6       | RX-         | Receive -   |
| 7       |             | Not used    |
| 8       |             | Not used    |

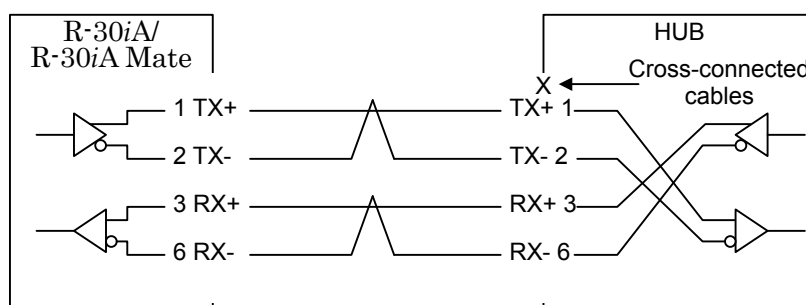
## Twisted-pair Cable Specification

### Cable Connection

The cable used for connection between the 100BASE-TX interface, CD38, of the controller and the hub is connected as follows:



- Keep the total cable length within 100 m.  
Do not extend the cable more than is necessary.
- The figure above shows the cable connection when cables are crossed in the hub.  
"X" is usually indicated at the port of the hub to signify that cables are crossed in the hub.



## Cable Materials



### CAUTION

Unshielded cable (UTP cable) is commercially available as 100BASE-TX twisted-pair cable: You should, however, use shielded Category 5 twisted-pair cable (STP cable) to improve the resistance to electrical noise in an FA environment.

Table 4.8.2.4 (a) Recommended Cables

| Manufacturer                | Specification | Remarks                |
|-----------------------------|---------------|------------------------|
| FURUKAWA ELECTRIC CO., LTD. | DTS5087C-4P   | Twisted-pair cable     |
| NISSEI ELECTRIC CO., LTD.   | F-4PFWMF      | Single-conductor cable |

Table 4.8.2.4 (b) Inquiries

| Manufacturer                                      | Contact address                                                                                                                                                                       |
|---------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| FURUKAWA ELECTRIC CO., LTD.<br>Sales Headquarters | 2-6-1 Marunouchi, Chiyoda-ku. Tokyo<br>100-8322<br>TEL: 03-3286-3126 FAX: 03-3286-3979                                                                                                |
| Remarks                                           |                                                                                                                                                                                       |
| NISSEI ELECTRIC CO., LTD.<br>Machida Branch       | 3F MU Bldg., 1-9-1 Minami-narise,<br>Machida City, Tokyo 194-0045<br>TEL: 0427-29-2531 FAX: 0427-29-3375                                                                              |
| Overseas Sales Office                             | IWATANI International Corporation Tokyo Head Office<br>21-8 Nishi-shinbashi 3-chome, Minato-ku, TOKYO, 105-8458, JAPAN<br>TEL: 03-5405-5810 FAX: 03-5405-5666 Telex: 2524256 IWATYO J |
| Remarks                                           | A finished cable with connectors at both ends can be offered.                                                                                                                         |

### NOTE

The recommended cables cannot be connected to moving parts.

Table 4.8.2.4 (c) Recommended cable (for movable parts)

| Manufacturer                         | Specification           | Remarks            |
|--------------------------------------|-------------------------|--------------------|
| Oki Electric Cable Co., Ltd.         | AWG26 4P TPMC-C5-F (SB) | Dedicated to FANUC |
| Shinko Electric Industrial Co., Ltd. | FNC-118                 |                    |

### Specification

- Electric characteristics:  
Conforms to EIA/TIA 568A Category 3 and Category 5.  
From the viewpoint of attenuation performance, ensure that the length to the hub is 50 m or less.
- Structure:  
Group shielded (braided shield). A drain wire is available.  
The conductor is an AWG26 annealed copper twisted wire, with a sheath thickness of 0.8 mm and an outer diameter of 6.7 mm  $\pm$  0.3 mm.
- Fire retardancy  
UL1581 VW-1
- Oil resistance  
Conforms to the FANUC internal standards (equivalent to the conventional oil-resistant electric cables).
- Flexing resistance:  
1,000,000 times or more with a bending radius of 50 mm (U-shaped flex test)
- UL style No.  
AWM 20276 (80°C/30V/VW-1)

**NOTE**

Be sure to use the connector TM21CP-88P (03) manufactured by HIROSE ELECTRIC CO., LTD. for this cable.

Table 4.8.2.4 (d) Inquiries

| Manufacturer                         | Contact address                      |
|--------------------------------------|--------------------------------------|
| Oki Electric Cable Co., Ltd.         | Nagano Sales Office TEL:0266-27-1597 |
| Remarks                              |                                      |
| Shinko Electric Industrial Co., Ltd. | Tokyo Sales Office TEL:03-3492-0073  |
| Remarks                              |                                      |

## Cable assembly

Oki Electric Cable Co., Ltd. can also supply the cable assembly mentioned above.

Contact Oki Electric directly to determine the specifications (length, factory test, packing, and so forth) for purchase.

**Connector Specification**

Use an 8-pin modular connector (RJ-45) with the twisted-pair cable for the Ethernet connection. The following connectors or equivalents must be used.

| For general use    | Specification | Manufacturer               | Remarks                |
|--------------------|---------------|----------------------------|------------------------|
| Solid wire         | 5-569530-3    | Tyco Electronics AMP K.K.. |                        |
| Solid wire         | MS8-RSZT-EMC  | SK KOHKI CO., LTD.         | Special tools required |
| Twisted-pair cable | 5-569552-3    | Tyco Electronics AMP K.K.. |                        |
| Twisted-pair cable | TM11AP-88P    | HIROSE ELECTRIC CO., LTD.  | Special tools required |

| For movable parts                            | Specification   | Manufacturer              | Remarks |
|----------------------------------------------|-----------------|---------------------------|---------|
| For cable AWG26 4P TPMC-C5-F (SB) or FNC-118 | TM21CP-88P (03) | HIROSE ELECTRIC CO., LTD. | Note    |

**NOTE**

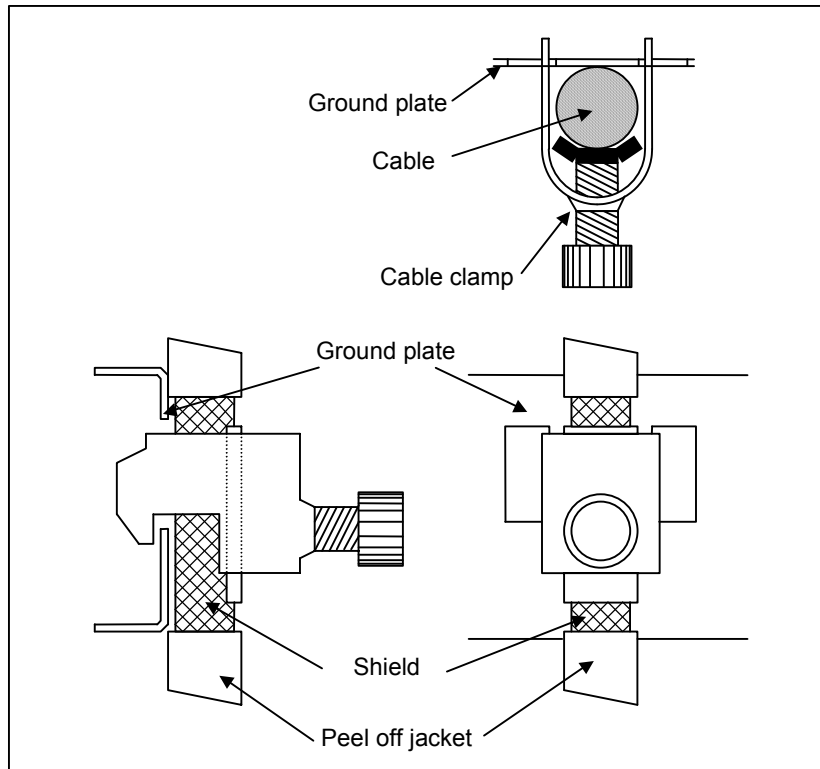
Information about TM21CP-88P (03):  
 Connector (standard product of the manufacturer)  
 Drawing number: A63L-0001-0823#P  
 Manufacturer: HIROSE ELECTRIC CO., LTD.  
 Manufacturer type number: TM21CP-88P (03)  
 Conforms to EIA/TIA 568A Category 3 and Category 5.  
 For assembly with a cable, contact HIROSE ELECTRIC CO., LTD. directly.  
 (From HIROSE ELECTRIC CO., LTD., "TM21CP-88P (03) Connection Procedure Manual (Technical Specification No. ATAD-E2367)" is available as a technical document.)

**Electrical Noise Countermeasures****Clamping and Shielding Cables**

Clamp an Ethernet twisted pair cable according to the method described below, as with cables that need to be shielded. Clamping cables provides support and shielding and is extremely important to the safe operation of the system. Never overlook cable clamping.

Peel off part of the jacket as shown in the figure to expose the outer coating of the shield, and press this outer coating against the ground plate with the clamp fixture.

The machine manufacturer must prepare the ground plate and install it as follows:

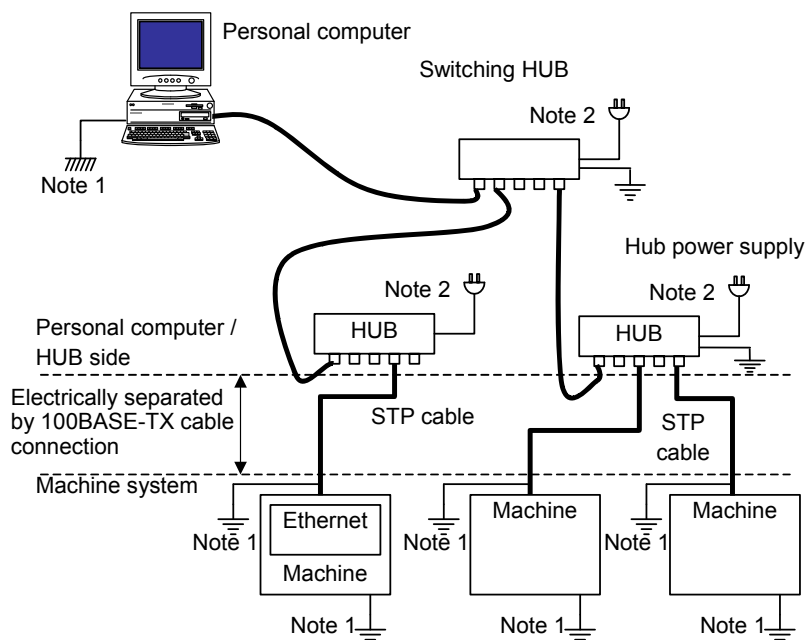
**NOTE**

To ensure the safe operation of the system, clamp and shield the cables.

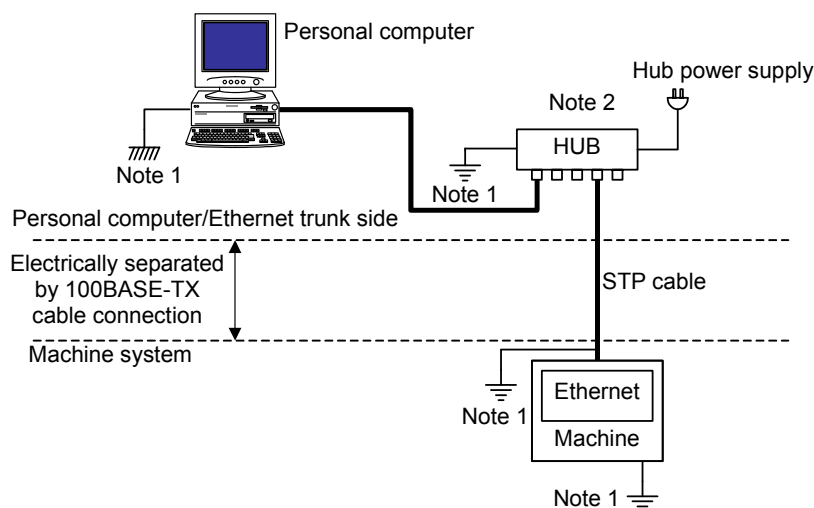
Connect the Ethernet board and hub with a twisted-pair cable. Shield the cable with clamp fixtures.

## Grounding the Network

Even if the grounding condition on the machine side is satisfied, the communication line can pick up noise from the machine, depending on the machine installation condition and environment, thus resulting in a communication error. To protect against such noise, the machine should be separated and insulated from the Ethernet trunk cable and personal computer. Examples of connection are given below.



**Large-Scale Network**

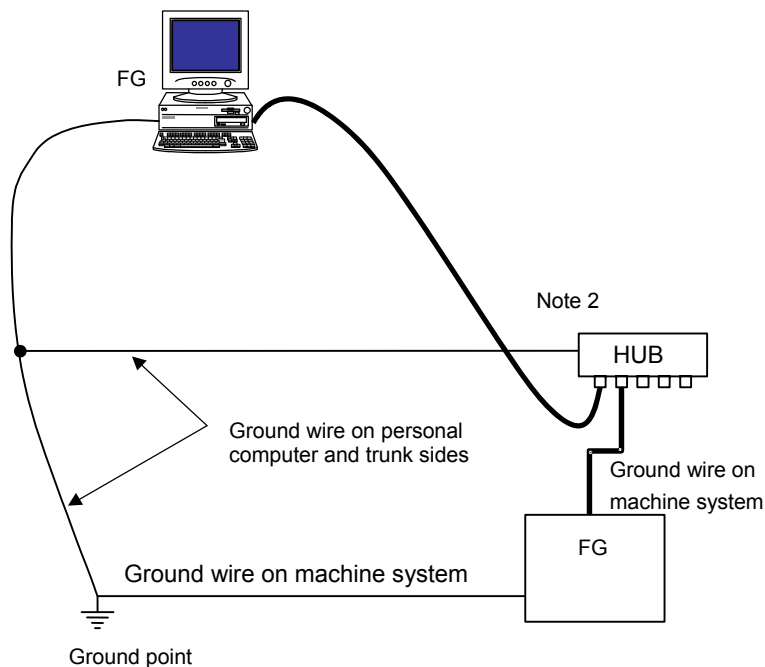


**Small-Scale Network**



**NOTE**

- 1 The ground between PC/HUB side and machine system side must be separated. If it is impossible to separate the ground because there is only one grounding point, connect the ground cable for each system to the grounding point independently. (See figure below.)  
The resistance for grounding must be less than 100-ohm (Class D). The thickness of the ground cable is the same as the thickness of AC power cable or more. At least thickness of  $5.5\text{mm}^2$  is necessary.
- 2 Note that the number of allowable hub-to-hub connections depends on the type of hub.
- 3 There is possibility that noise makes the obstacle of communication even if the ground is separated using the 100BASE-TX. In the case of using the FAST Ethernet/FAST Data Server under the worst environment, please separate between the PC/Trunk line side and machine system side completely using the 100BASE-FX (Optical fiber media).

**Wiring on a single ground point**

## Check Items at Installation

The following table lists check items at installation.

| Check item       | Description                                                                                                                                            | Check |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Ethernet cable   |                                                                                                                                                        |       |
| Type             | Use cables which satisfies all the following conditions:                                                                                               |       |
|                  | 1) With shielding                                                                                                                                      |       |
|                  | 2) Twisted-pair cable                                                                                                                                  |       |
|                  | 3) Category 5                                                                                                                                          |       |
| Length           | The cable length shall be within 100 m (50 m for a movable cable recommended by FANUC).                                                                |       |
| Connection       | For a twisted-pair cable, the following pins shall be paired:                                                                                          |       |
|                  | 1) Pin No. 1 (TX+) – pin No. 2 (TX-)<br>2) Pin No. 3 (RX+) – pin No. 6 (RX-)                                                                           |       |
| Separation       | The Ethernet cables shall be bound separately from the following cables or covered with an electromagnetic shield:                                     |       |
|                  | 1) Group A: AC power lines, power lines for motors, and others                                                                                         |       |
|                  | 2) Group B: Current DC (24 VDC) and others                                                                                                             |       |
| Shielding        | For a shielded cable, the part of which outer coating is peeled off and exposed shall be fixed to the ground plate with a clamp fixture.               |       |
| Clamping         | The ground plate shall be located as nearest to the CNC as possible (to make the cable between the ground plate and CNC hard to be affected by noise). |       |
| Connectors       | Any cable connector shall not be pulled (to prevent poor contact of the connector).                                                                    |       |
| Wiring           | No cable shall be laid under a heavy object.                                                                                                           |       |
| Bending radius   | The bending radius shall be at least four times as long as the diameter of the cable.                                                                  |       |
| For movable part | For a movable part, a cable for a movable part shall be used.                                                                                          |       |
| HUB              |                                                                                                                                                        |       |
| Use conditions   | The "cautions on use" of the hub shall be observed (A terminating resistor shall be mounted properly if required).                                     |       |
| Grounding        | The hub shall be grounded.                                                                                                                             |       |
| Cabinet          | The hub shall be installed in an enclosed cabinet.                                                                                                     |       |
| Vibration        | The hub shall be installed so that it is not affected by vibration.                                                                                    |       |
| Bending radius   | The bending radius shall be at least four times as long as the diameter of the cable.                                                                  |       |

# 2 INSTALLATION

## 2.1 INSTALLATION OF ROBOT CONTROLLER

### In case of Open Air controller (Small size)

Robot controller can be installed Horizontal or vertical.

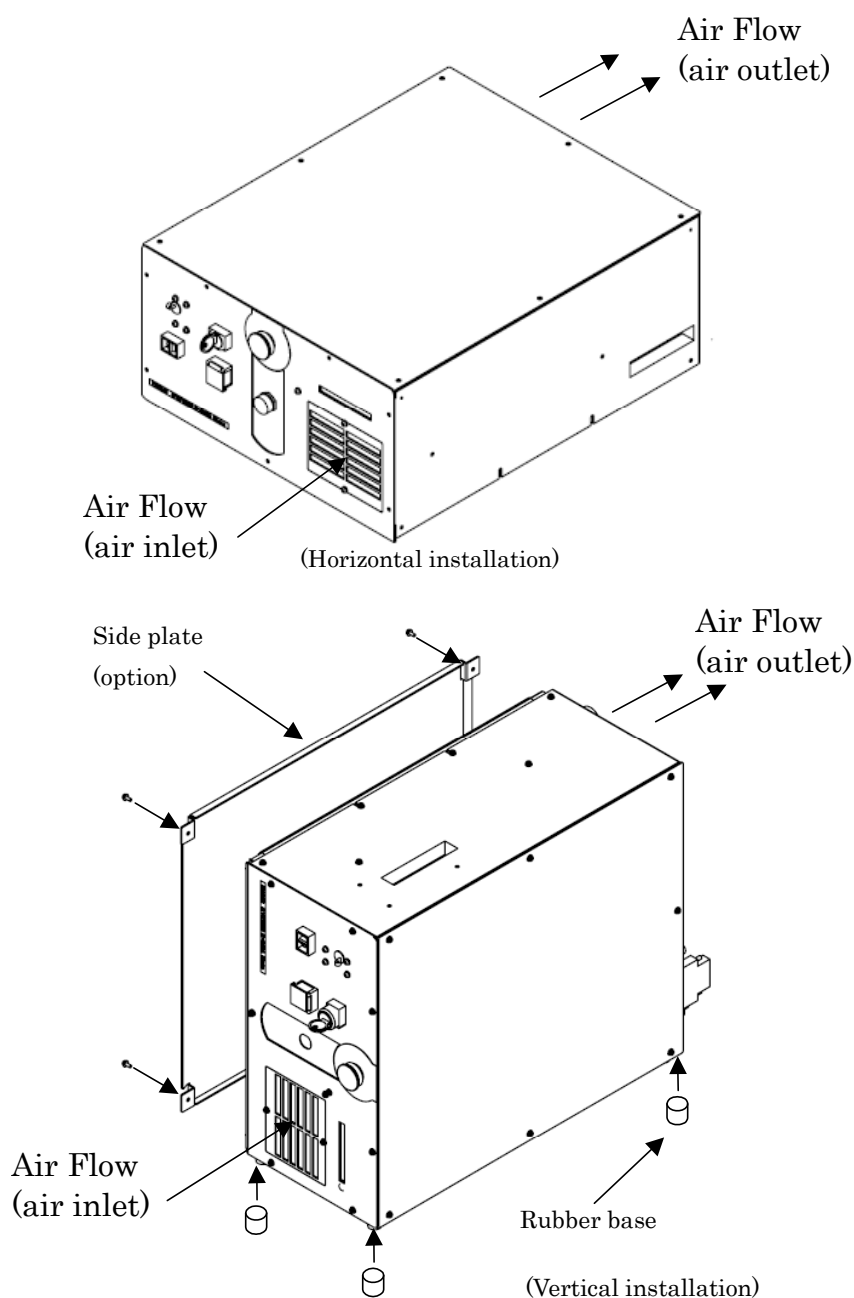
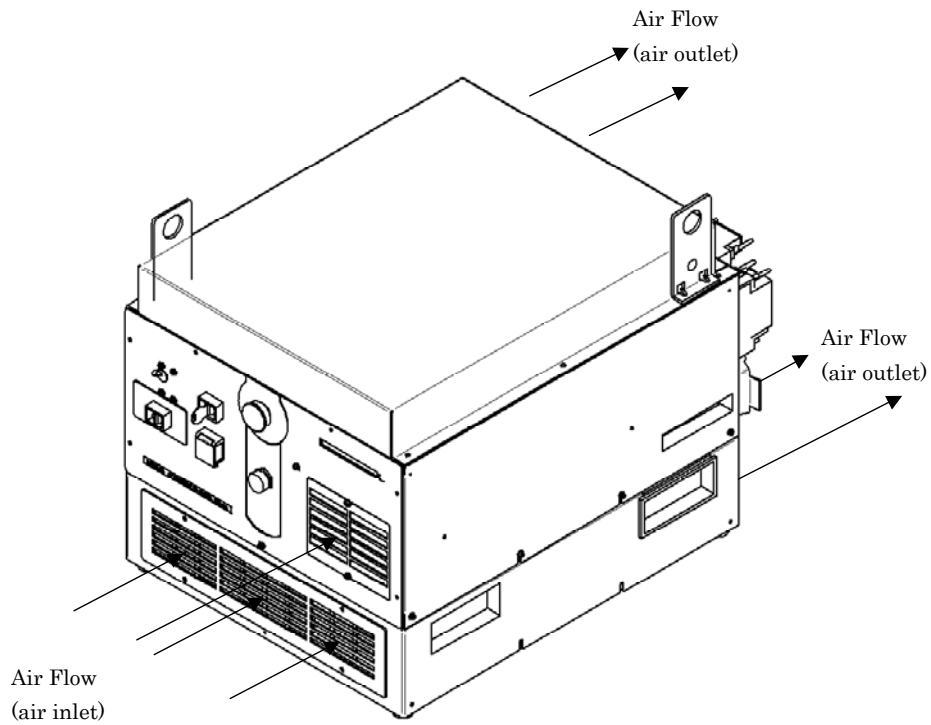


Fig.2.1 (a) Installation of robot controller



### CAUTION

Do not place anything within 150 mm from the air inlet and outlet of the robot controller.

**In case of Open Air controller (Large size)****Fig.2.1 (b) Installation of robot controller****CAUTION**

Do not place anything within 150 mm from the air inlet and outlet of the robot controller.

## 2.2 CONTROLLER DIMENSION

In case of Open Air controller (Small size)

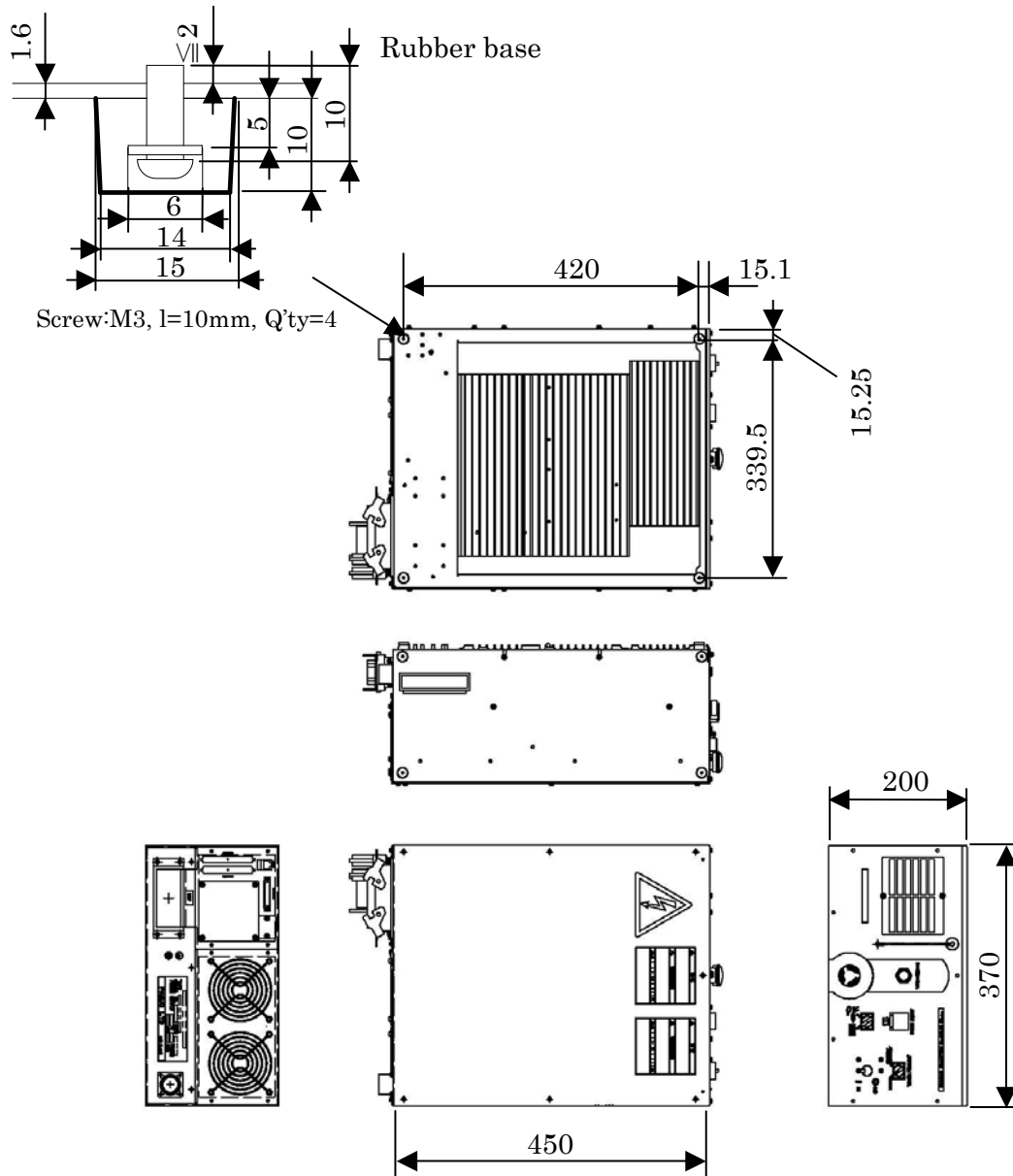


Fig.2.2 (a) External dimension



### WARNING

This controller is not designed to be dust-proof, splash-proof, or explosion-proof.

### In case of Open Air controller (Large size)

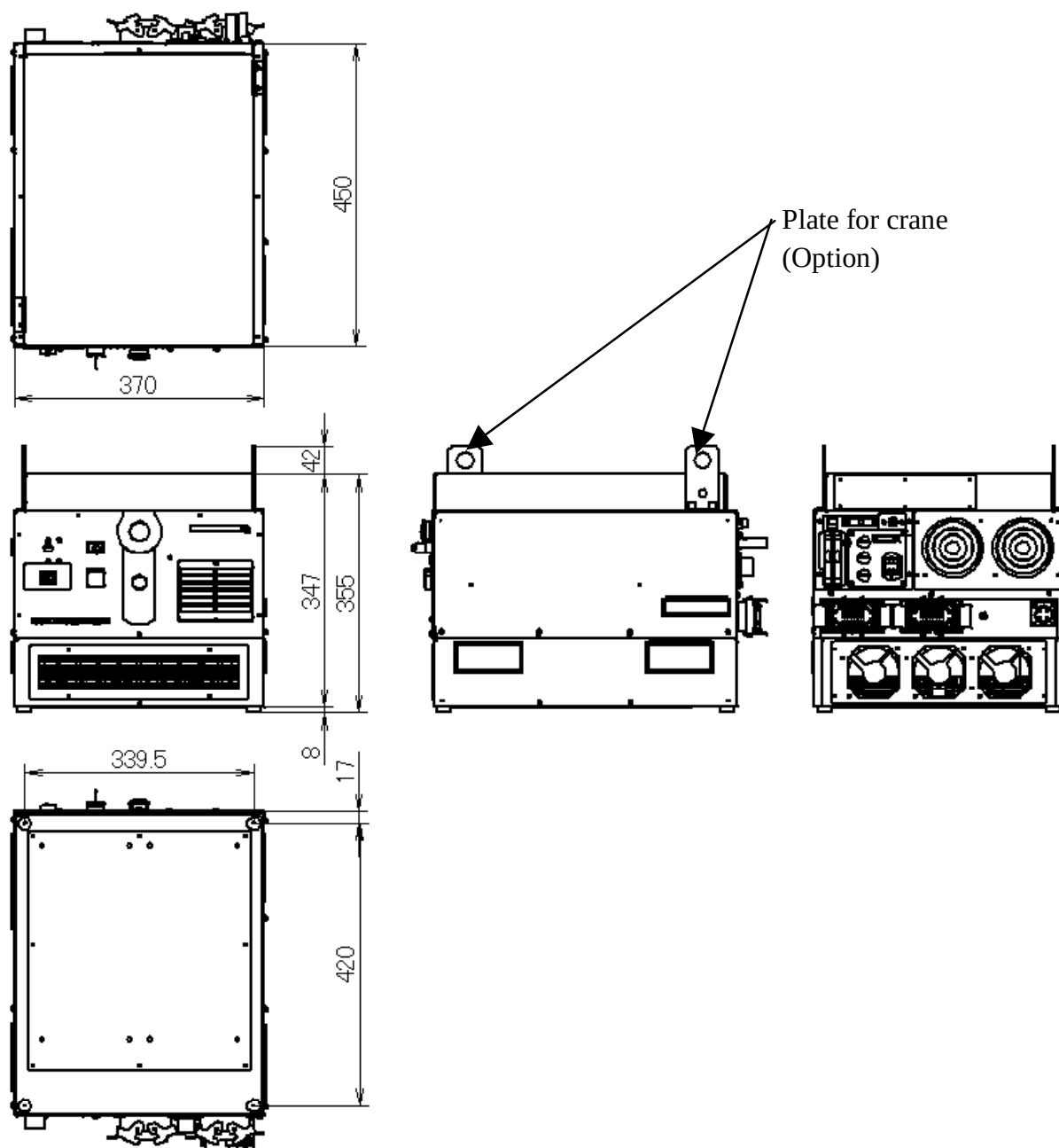


Fig.2.2 (b) External dimension



#### WARNING

This controller is not designed to be dust-proof, splash-proof, or explosion-proof.

## 2.3 INSTALLATION CONDITION

| Item                              | Model                  | Specification/condition                                                                                                                                                         |
|-----------------------------------|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Rated Voltage                     | LR Mate 200iC<br>M-1iA | 200-230VAC +10% -15%<br>50/60Hz $\pm$ 1Hz Single phase                                                                                                                          |
|                                   | M-3iA                  | 200-230VAC +10% -15%<br>50/60Hz $\pm$ 1Hz 3 phase (CAUTION 5)                                                                                                                   |
| Tolerant fluctuation              | All models             | Tolerant voltage fluctuation: +10% -15%<br>Tolerant frequency fluctuation: $\pm$ 1Hz                                                                                            |
| Input power source capacity       | M-1iA                  | 1.0KVA                                                                                                                                                                          |
|                                   | LR Mate 200iC          | 1.2KVA                                                                                                                                                                          |
|                                   | M-3iA                  | 12KVA                                                                                                                                                                           |
| Average power consumption         | M-1iA                  | 0.2KW                                                                                                                                                                           |
|                                   | LR Mate 200iC          | 0.5KW                                                                                                                                                                           |
|                                   | M-3iA                  | 2.5KW                                                                                                                                                                           |
| Permissible ambient temperature   | All models             | Operating 0°C to 40°C<br>Storage, Transport -20°C to 60°C<br>Temperature change 0.3°C/minute or less                                                                            |
| Permissible ambient humidity      | All models             | Normal : 75% RH or less,<br>no condensation<br>Short period(less than 1 month) : 95% RH or less,<br>no condensation                                                             |
| Surrounding gas                   | All models             | Refer to the caution on this page.                                                                                                                                              |
| Installation Category             | All models             | Installation category (Over voltage category) II,<br>Pollution degree 2,<br>IEC60664-1 (JIS C 0664)                                                                             |
| Vibration                         | All models             | 0.5G or less.<br>When using the robot in a location subject to serious vibration, consult with your FANUC sales representative.                                                 |
| Altitude                          | All models             | Operating : Up to 1,000m<br>Non-operating : Up to 12,000m                                                                                                                       |
| Ionized and non-ionized radiation | All models             | A shielding provision is necessary if the machine is installed in an environment in which it is exposed to radiation (microwave, ultraviolet rays, laser beams, and/or X-rays). |
| Mass of controller                | LR Mate 200iC<br>M-1iA | Approx. 20kg                                                                                                                                                                    |
|                                   | M-3iA                  | Approx. 35kg                                                                                                                                                                    |

### WARNING

Do not connect or disconnect connectors to/from the controller while the power switch is on. Doing so may cause electric shock or controller failure.

### CAUTION

1. This controller is open air type, it should be installed in the environment of "Pollution degree 2" regulated in IEC 60664-1(JIS C 0664) "Pollution degree 2" means cleanly environment like an office.
2. The robot controller connectors are of a screw-lock type and so on. Lock the connectors securely. If even one of the connectors is not locked, weak contact may result thereby causing an error.
3. Be sure to turn the robot controller OFF before connecting/disconnecting the power connector or motor connector. Otherwise, the internal circuits of the robot controller may be damaged.

**⚠ CAUTION****In case of CE controller**

4. Open air controller (small size) is a class A (EN55022) product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.
5. In case of Open air controller (large size), set up isolated transformer between input power and controller.

**NOTE**

The power rating indicated above is sufficient as the continuous rating. However, when the robot is rapidly accelerating, the instantaneous requirement may increase to several times the continuous rating.

If the acceleration/deceleration override (ACC) greater than 100% is set in the robot program, the extreme current may flow to the robot controller instantaneously and the input voltage of robot controller will drop.

In this case, if the supply voltage is decreased 10% or more per rated voltage, Power supply alarm, Move error excess alarm, DCLV alarm of servo amplifier may occur.

**In case that an earth leakage breaker in the power panel tripped**

A noise filter is installed in the open air controller (large size). The noise filter is designed to connect to star connection / neutral grounding power system (TN-power system, NOTE.1). In case that the controller is connected to delta connection / single-phase grounding power system (TT-power system NOTE.1), there is a possibility that small leakage current flows via noise filter.

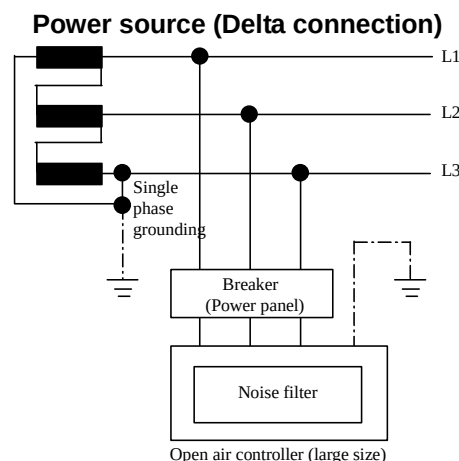
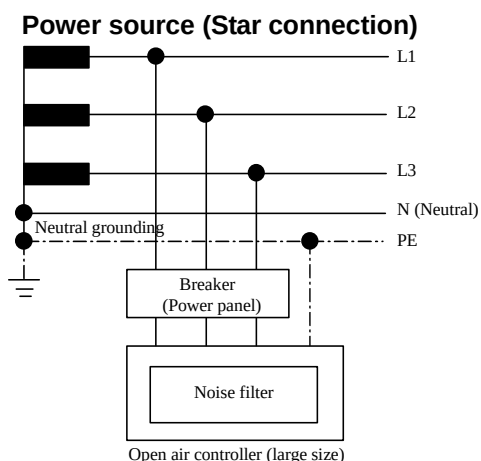
Therefore, if leakage breaker (Rated leakage current: less than 30mA) is installed in a power panel of the building and many controllers are connected to one leakage breaker, the leakage breaker may trip by amount of the leakage current.

In this case, following countermeasures will be effective.

- (1) Use leakage breaker that has large rated leakage current. Or reduce the number of controllers that is connected to one leakage breaker.
- (2) Install isolated transformer between input power and controller.
- (3) In case of large size open air controller, it is possible to reduce the leakage current by turning off a switch at the noise filter. (NOTE.2)

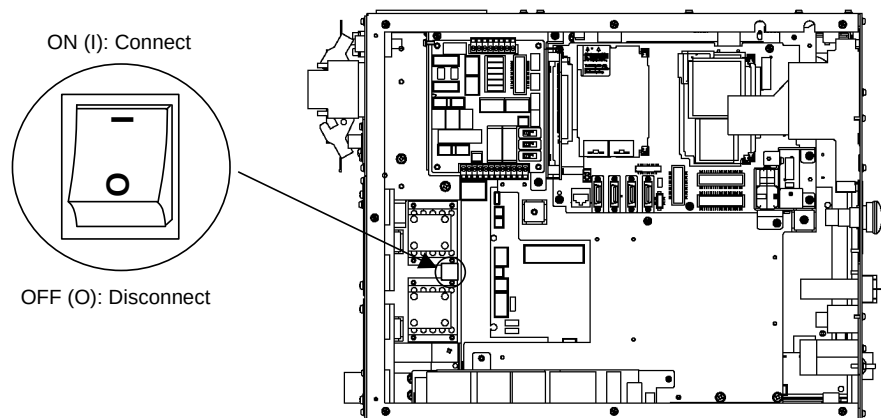
If the controller used in region where CE mark is required, this switch should be ON because European power system is star connection / neutral grounding.

NOTE.1) The TN-power system and TT-power system are based on the AC power distribution system standard IEC60364.





NOTE.2) Open air controller (large size) has a noise filter with switch that connect/disconnect the internal capacitor to the ground. In case that the controller connected to delta connection / single-phase grounding power system (TT-power system), it is possible to reduce the leakage current to less than 10mA by turning off (O-side) the switch at the noise filter.



## 2.4 CHECKS AT INSTALLATION

Check the robot according to the following procedure at installation.

| No. | Description                                                                   |
|-----|-------------------------------------------------------------------------------|
| 1   | Visually check the outside of the controller.                                 |
| 2   | Connect controller and mechanical unit cables.                                |
| 3   | The breaker off and connect the input power cable.                            |
| 4   | Check the input power voltage.                                                |
| 5   | Press the EMERGENCY STOP button on the controller and turn on the controller. |
| 6   | Check the interface signals between controller and robot mechanical unit.     |
| 7   | Check the parameters. If necessary, set them.                                 |
| 8   | Release the EMERGENCY STOP button on the controller.                          |
| 9   | Check the movement along each axis in manual jog mode.                        |
| 10  | Check the end effector interface signals.                                     |
| 11  | Check the DI/DO signals.                                                      |

## 2.5 RESETTING THE ALARMS AT INSTALLATION

An overtravel and some alarms occur when the robot is operated for the first time after it is installed, the mechanical and controller are wired. This section describes how to reset the alarms.

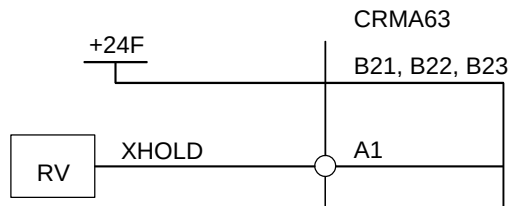
Remove the red plate fastening the swiveling axis beforehand.

The J2 and J3 axes are pressed against the hard stops at shipment. Therefore, an overtravel alarm occurs when the power is turned on after installation.

The robot is also in an alarm state if the peripheral device control interface is not connected.

### 2.5.1 Peripheral Device Interface Connection

Connect as following if signals XHOLD and ENBL are not used.



## 2.5.2 Resetting Overtravel

- 1) Select [OT release] on the overtravel release screen to release each robot axis from the overtravel state.
- 2) Hold down the shift key, and press the alarm release button to reset the alarm state.
- 3) Still hold down the shift key, and jog to bring all axes into the movable range.

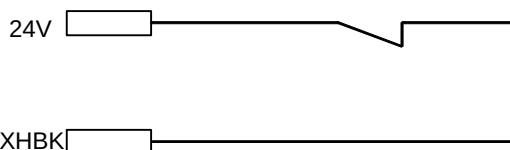
## 2.5.3 How to Disable/Enable HBK

- 1) Press [MENUS] on the teach pendant.
- 2) Select [NEXT].
- 3) Select [SYSTEM].
- 4) Press "F1" (TYPE) on the teach pendant.
- 5) Select "Config" to disable/enable HBK.

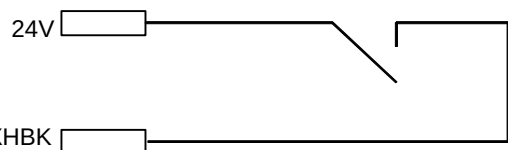
| Status | Hand Broken enable/disable setting | HBK (*1) | HBK detection | Robot operation | Message                 |
|--------|------------------------------------|----------|---------------|-----------------|-------------------------|
| 1      | Enable                             | CLOSE    | Yes           | Possible        | None                    |
| 2      | Enable                             | OPEN     | Yes           | Impossible      | SRVO-006                |
| 3      | Disable                            | CLOSE    | Yes (NOTE2)   | Possible        | None                    |
| 4      | Disable                            | OPEN     | No            | Possible        | At cold start, SRVO-300 |

### NOTE

- 1 Robot end effector connector  
CLOSE



- OPEN



- 2 The moment the HBK circuit is closed, HBK detection becomes enabled. When the HBK circuit is opened again, alarm "SRVO-300" or "SRVO-302" occurs, causing the robot to stop.
- 3 If the power is turned off and on again under the condition stated in NOTE2, status 4 is entered, so the alarm condition is removed.

## 2.5.4 How to Disable/Enable Pneumatic Pressure Alarm (PPABN)

- 1) Press [MENUS] on the teach pendant.
- 2) Select [NEXT].
- 3) Select [SYSTEM].
- 4) Press "F1" (TYPE) on the teach pendant.
- 5) Select "Config" to disable/enable PPABN.



# APPENDIX



# **A**

## **TOTAL CONNECTION DIAGRAM**

---

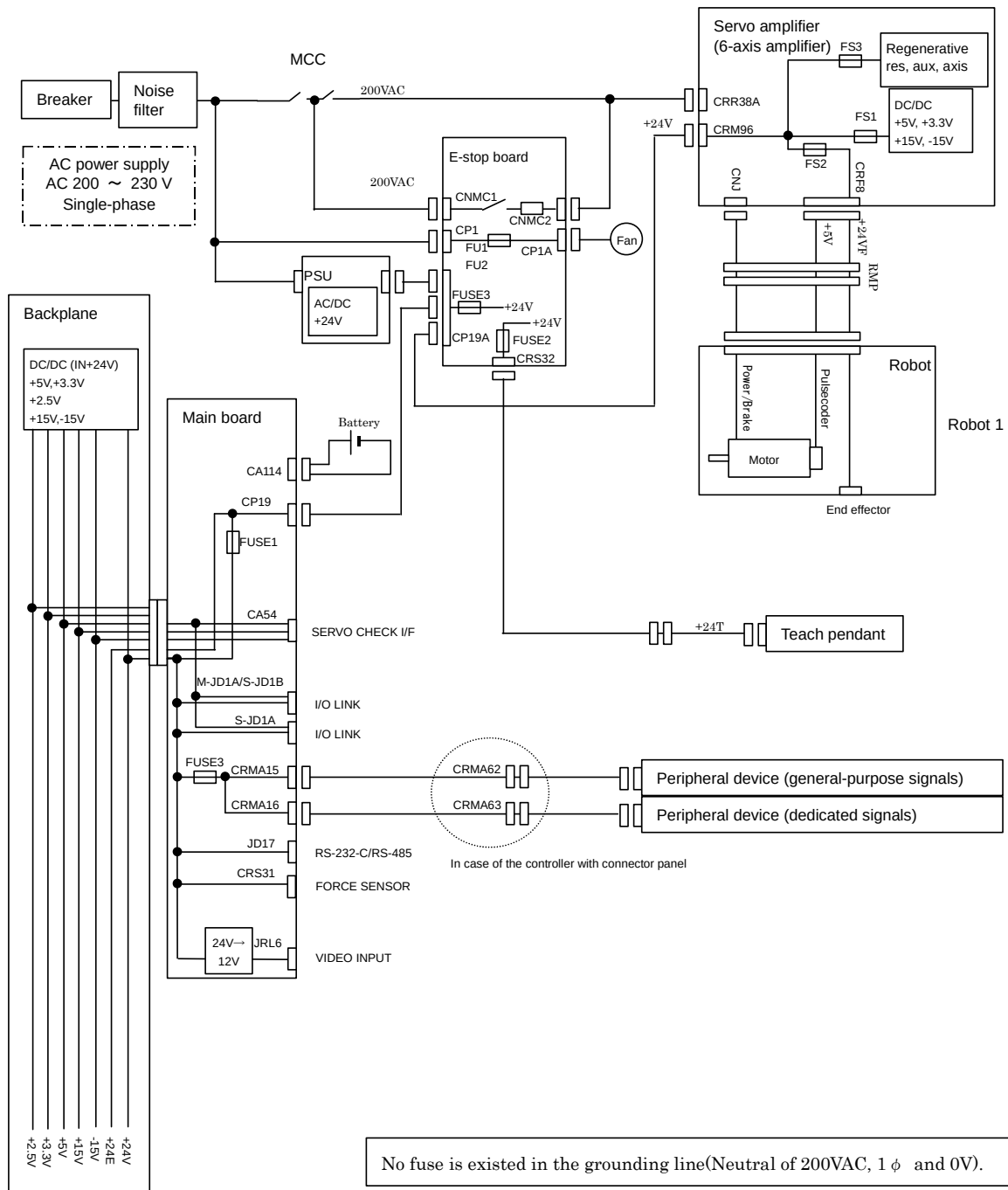
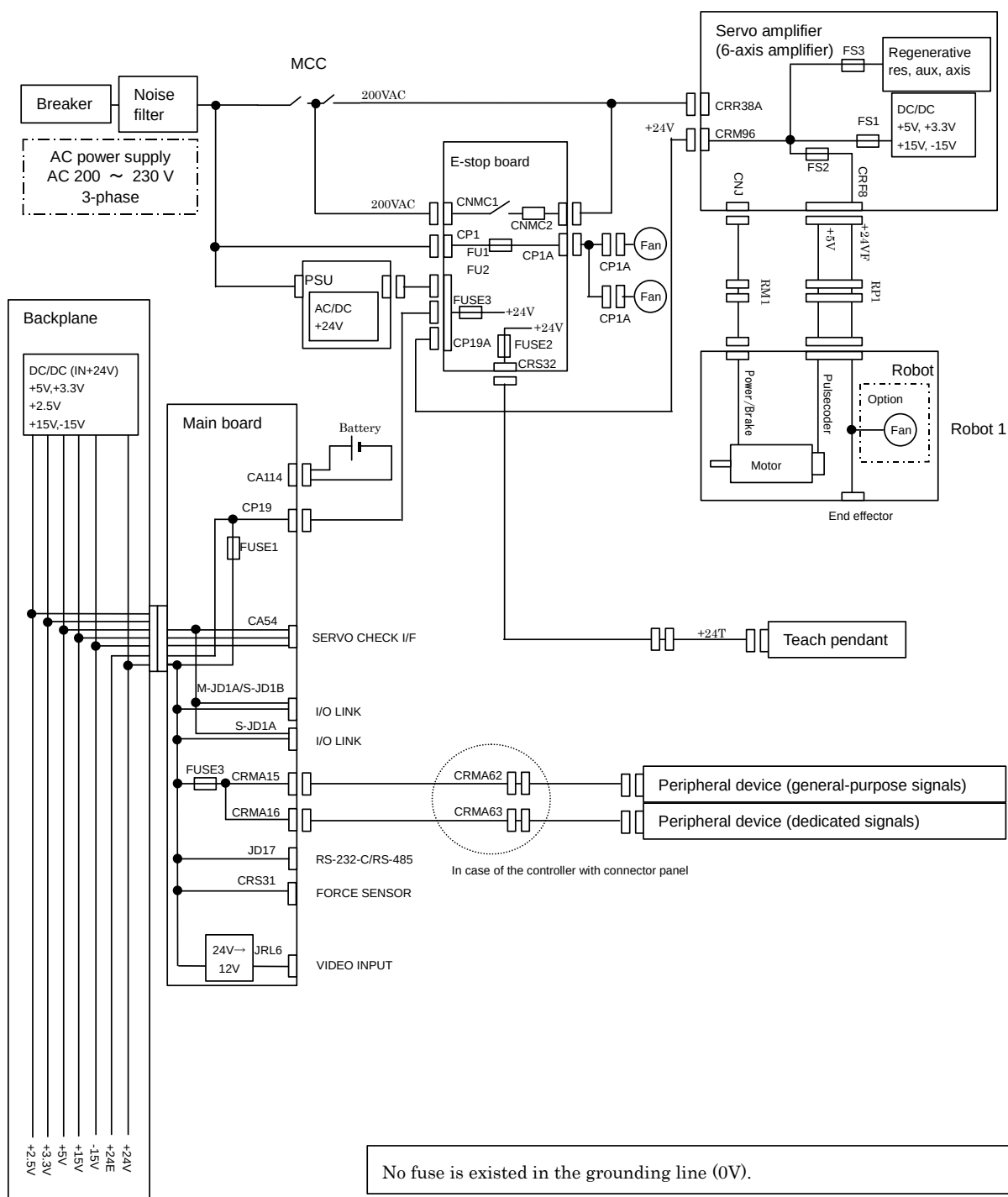


Fig.A (a-1) Block diagram of the power supply (CE/RIA / Open air controller (Small size))



**Fig.A (a-2) Block diagram of the power supply (CE/RIA / Open air controller (Large size))**



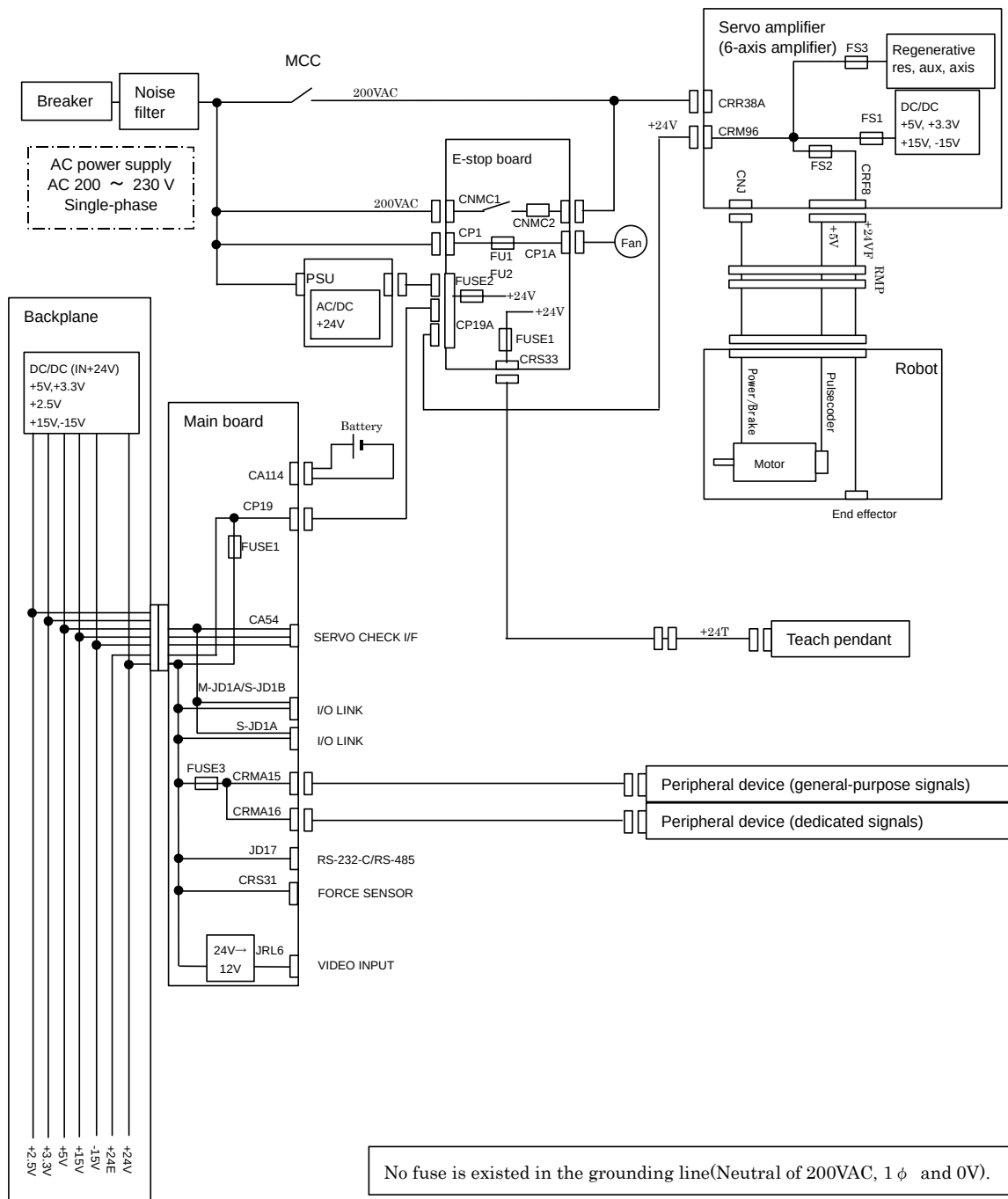


Fig.A (b-1) Block diagram of the power supply (STANDARD / Open air controller (Small size))

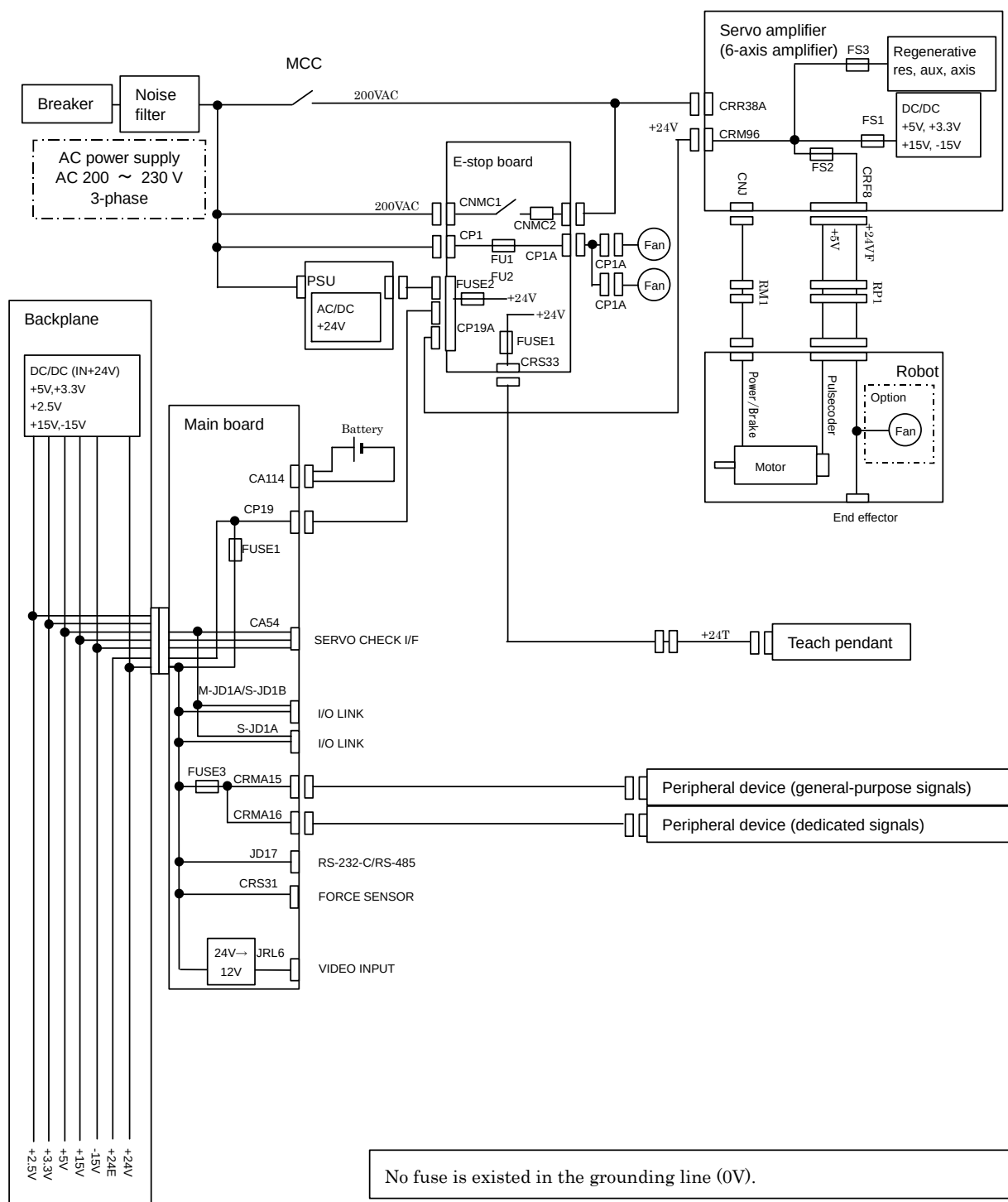


Fig.A (b-2) Block diagram of the power supply (STANDARD / Open air controller (Large size))

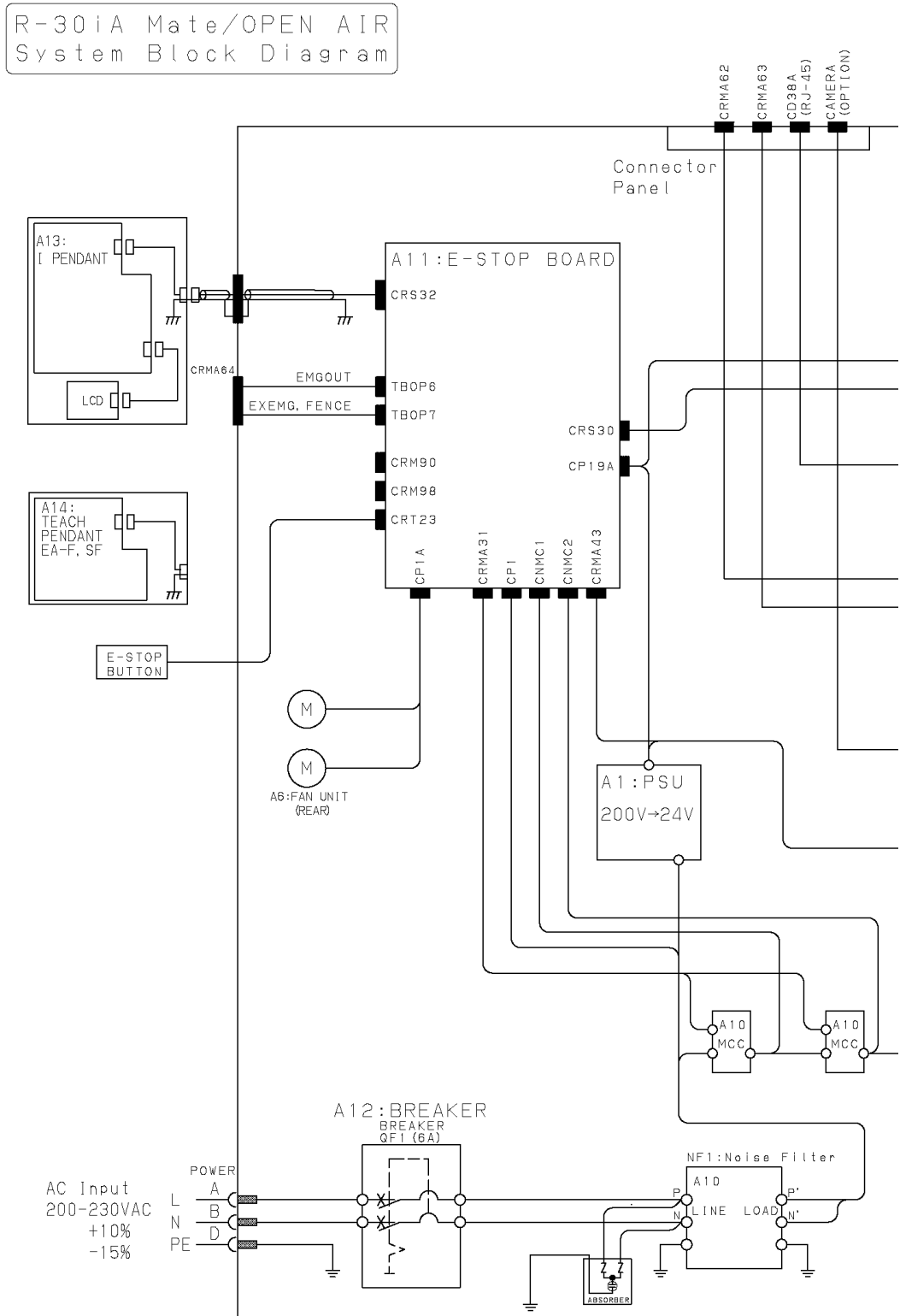
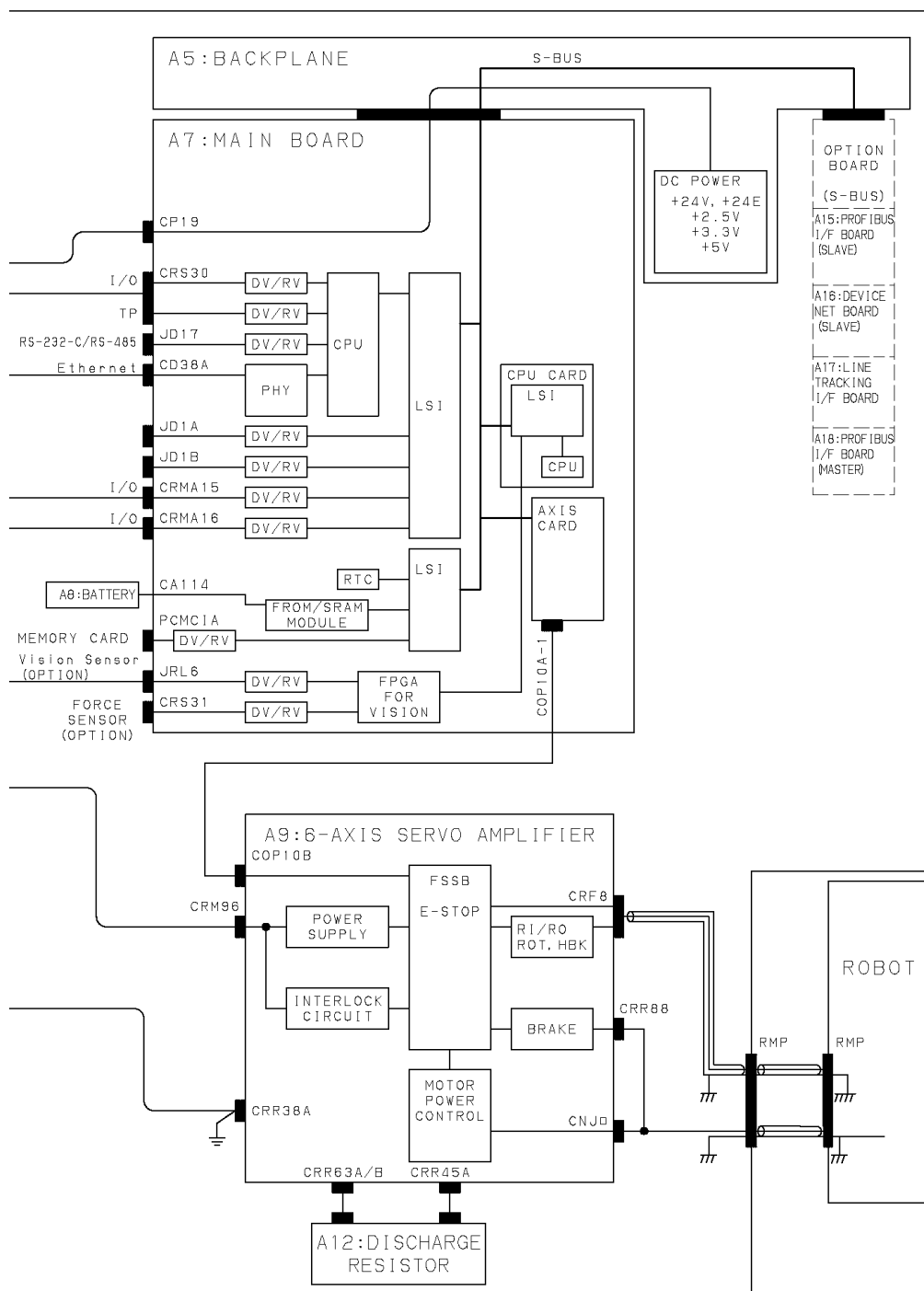


Fig.A (c-1) System block diagram (CE/RIA / Open air controller (Small size))



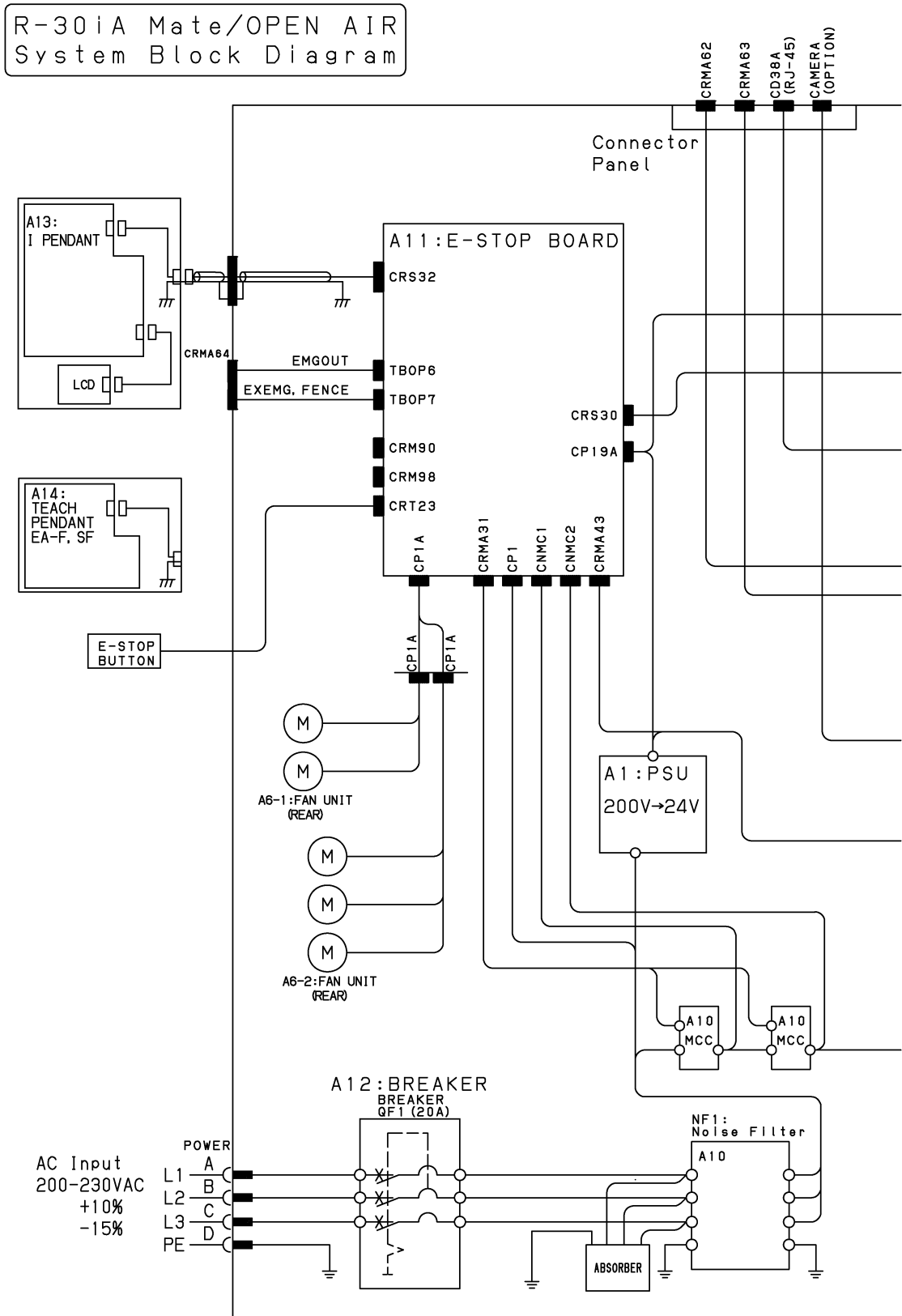
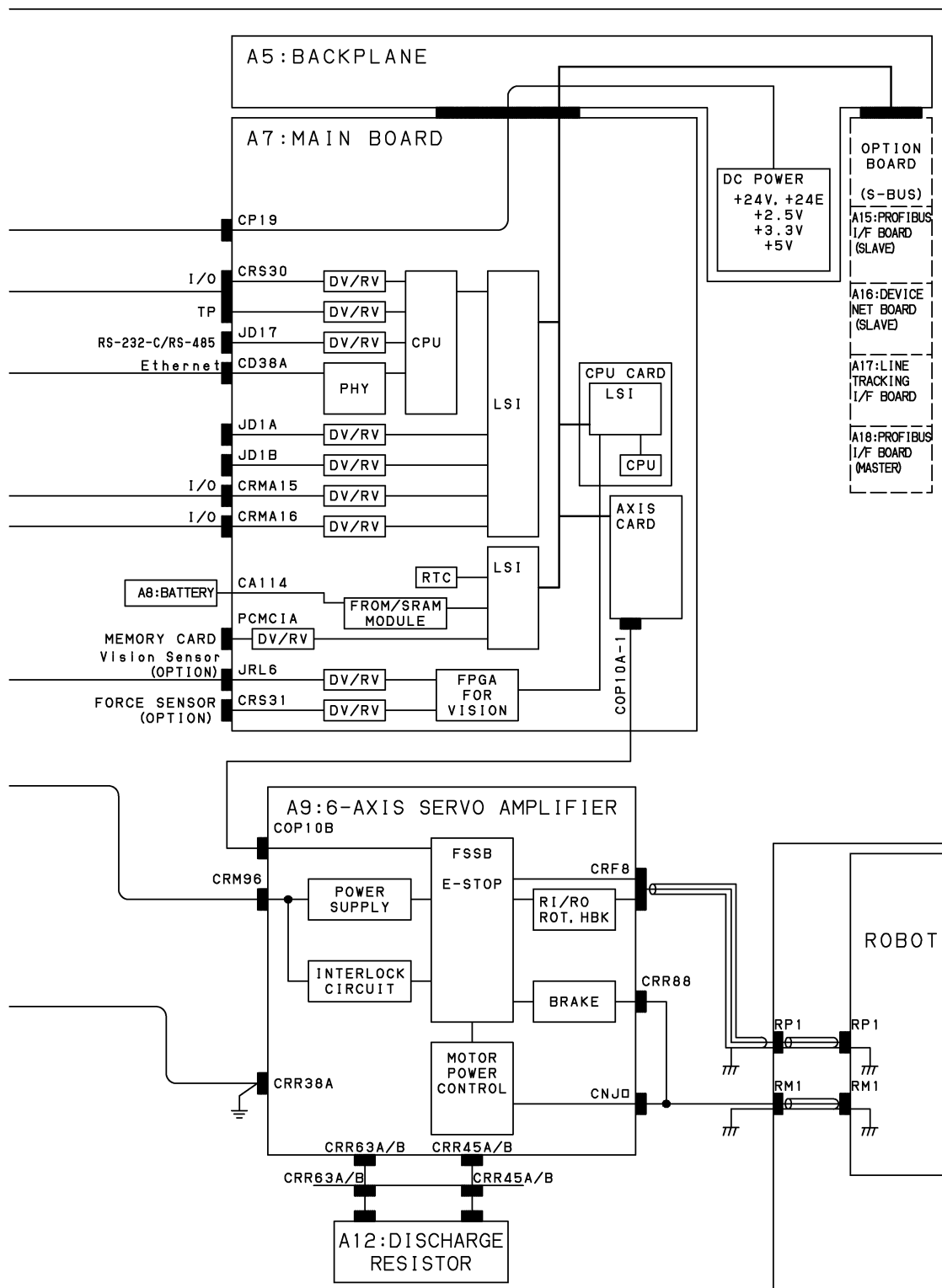


Fig.A (c-2) System block diagram (CE/RIA / Open air controller (Large size))



R-301A Mate/OPEN AIR  
System Block Diagram

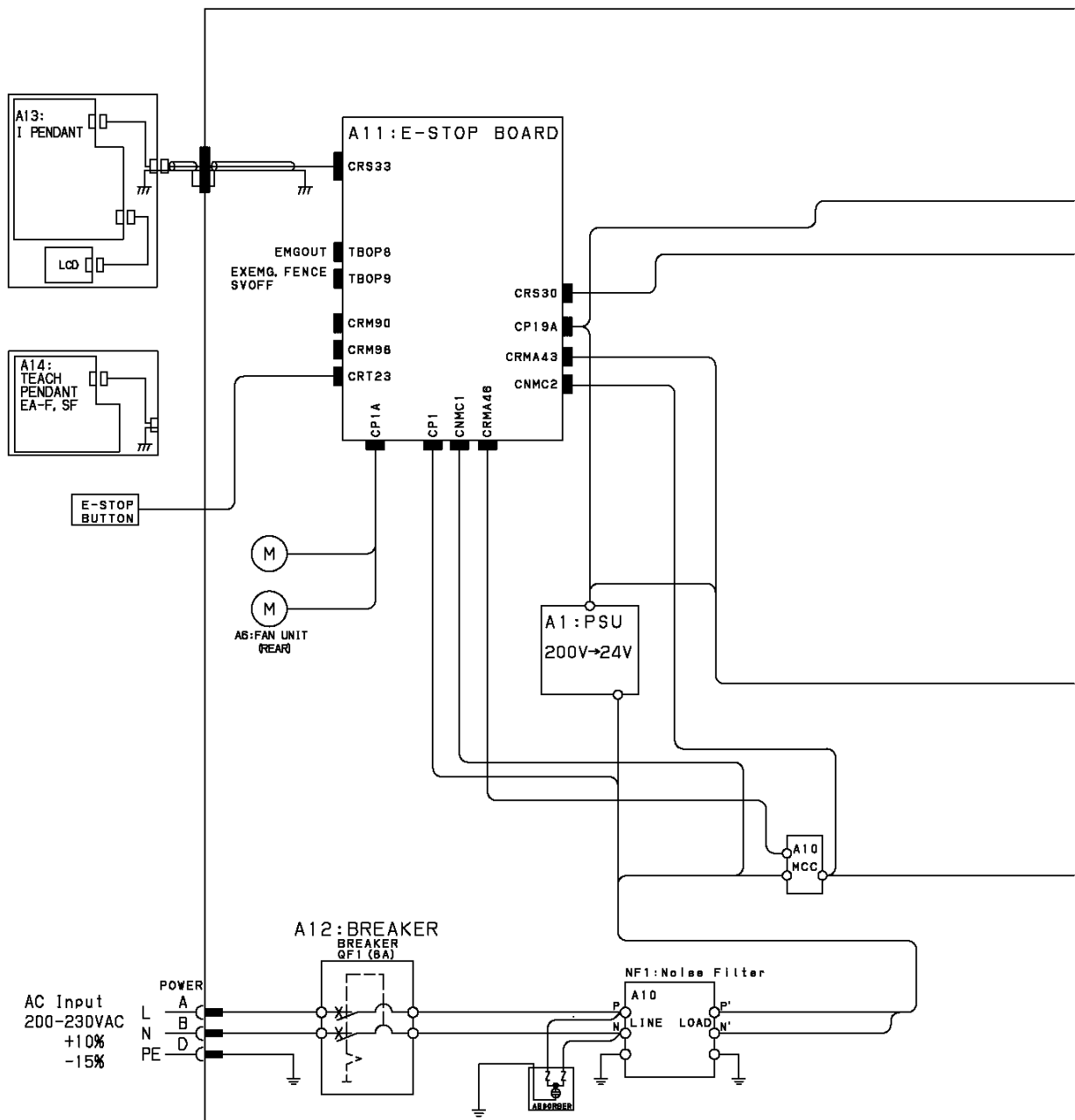
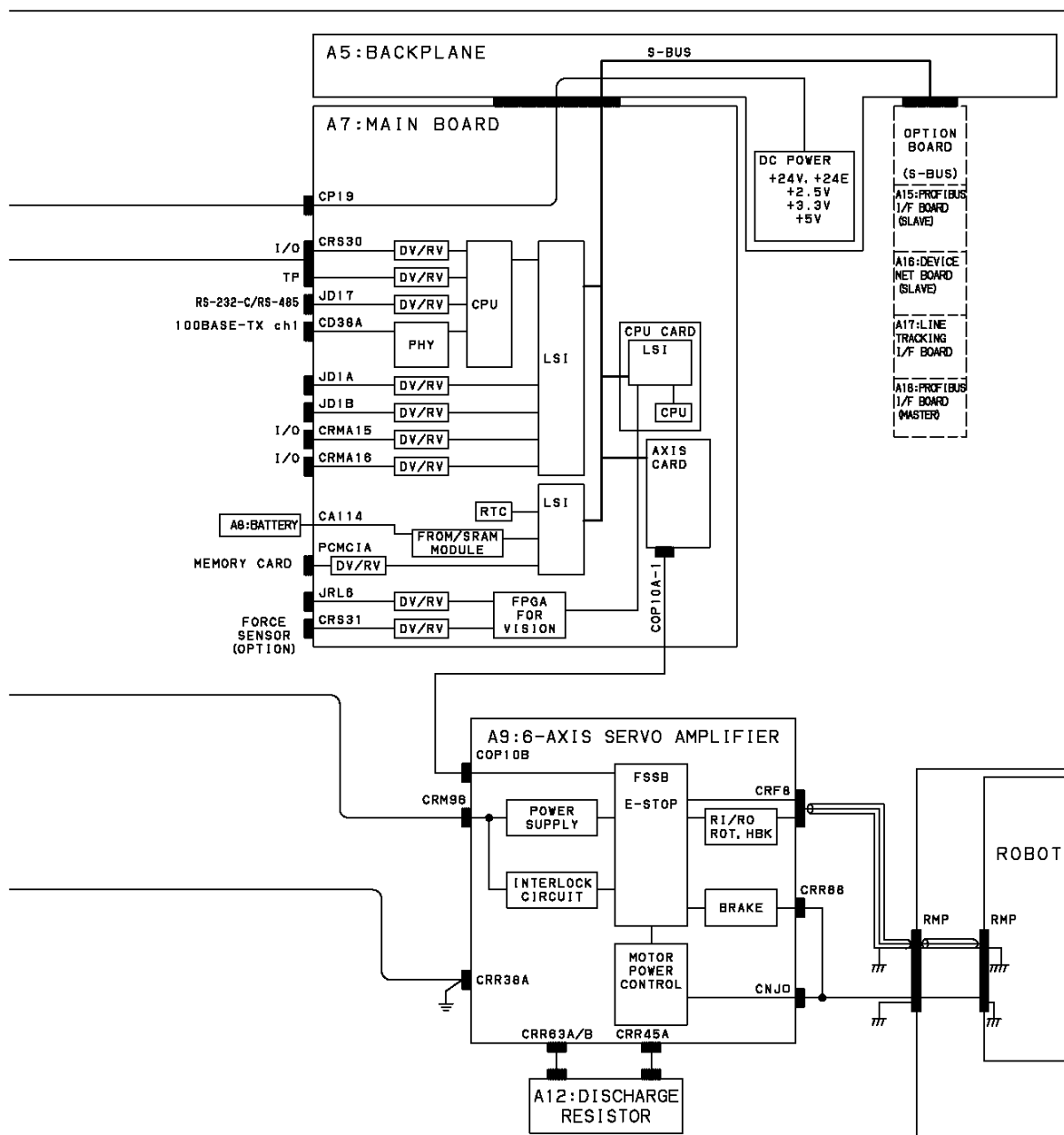


Fig.A (d-1) System block diagram (STANDARD / Open air controller (Small size))





R-30iA Mate/OPEN AIR  
System Block Diagram

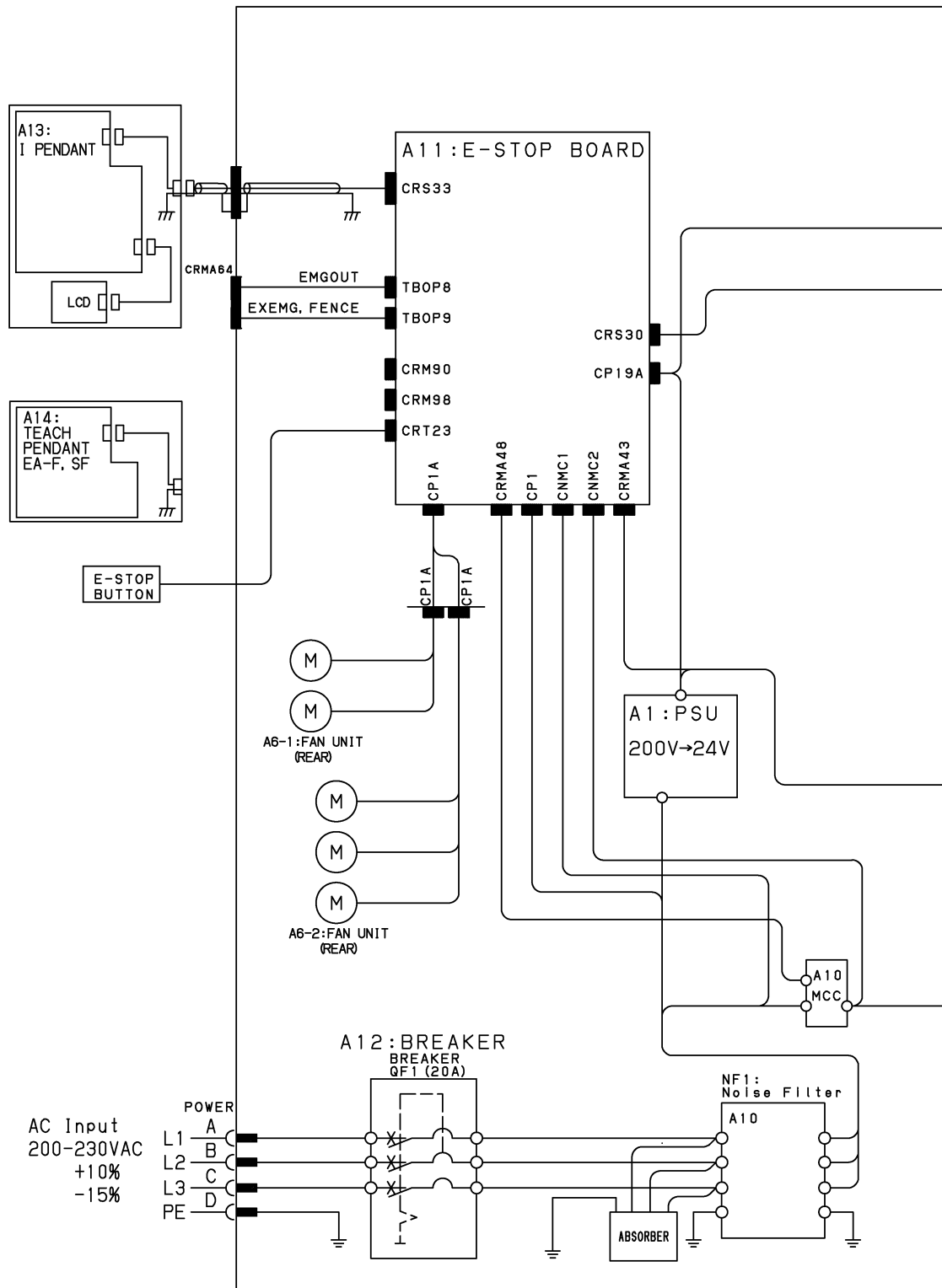
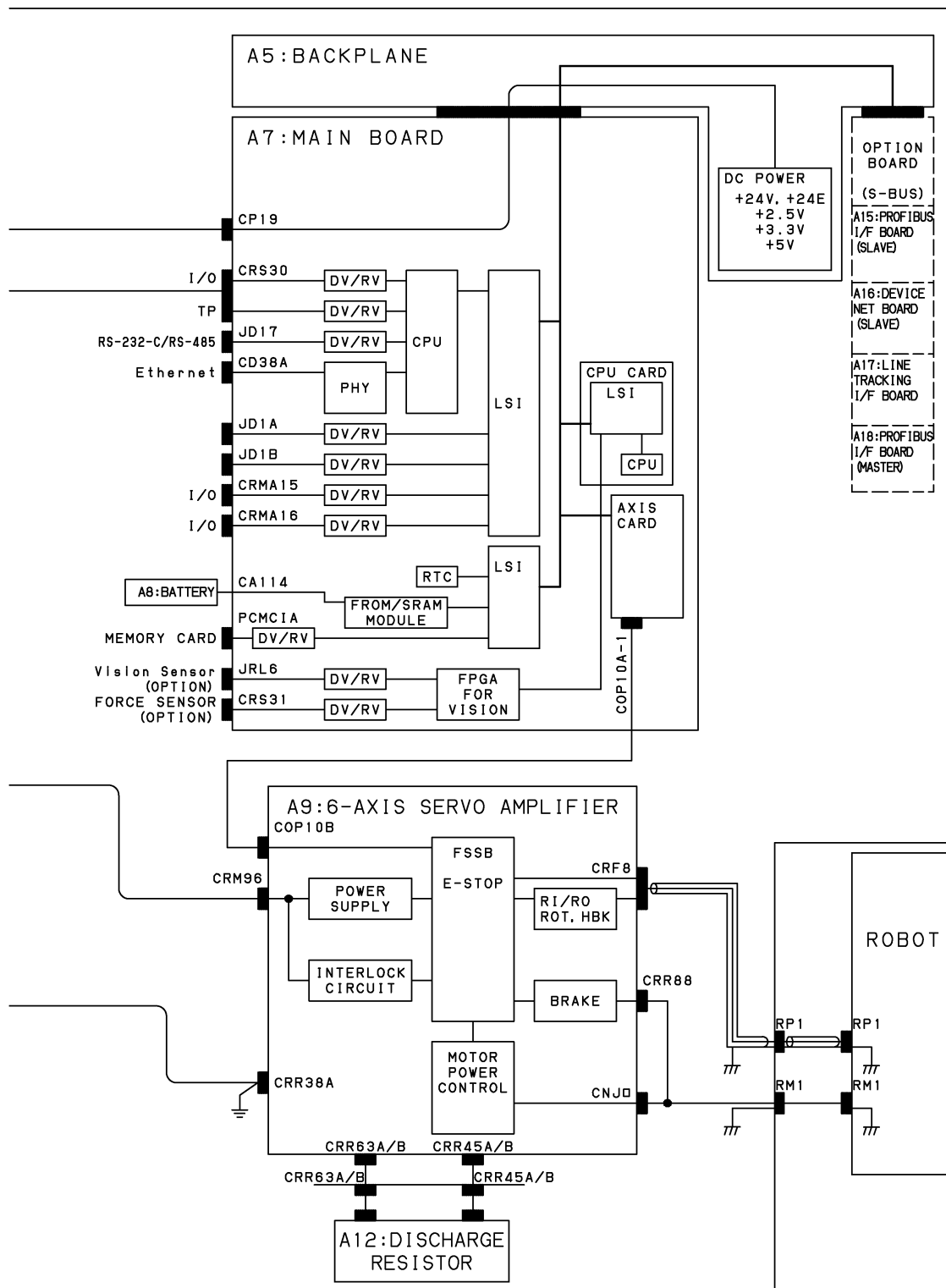


Fig.A (d-2) System block diagram (STANDARD / Open air controller (Large size))



# E-STOP CIRCUIT <R-30iA Mate/OPEN AIR> Dual check safety

D1:Simple D1

P1:Photo coupler D1

Not showing the diodes to protect from reverse electric power.

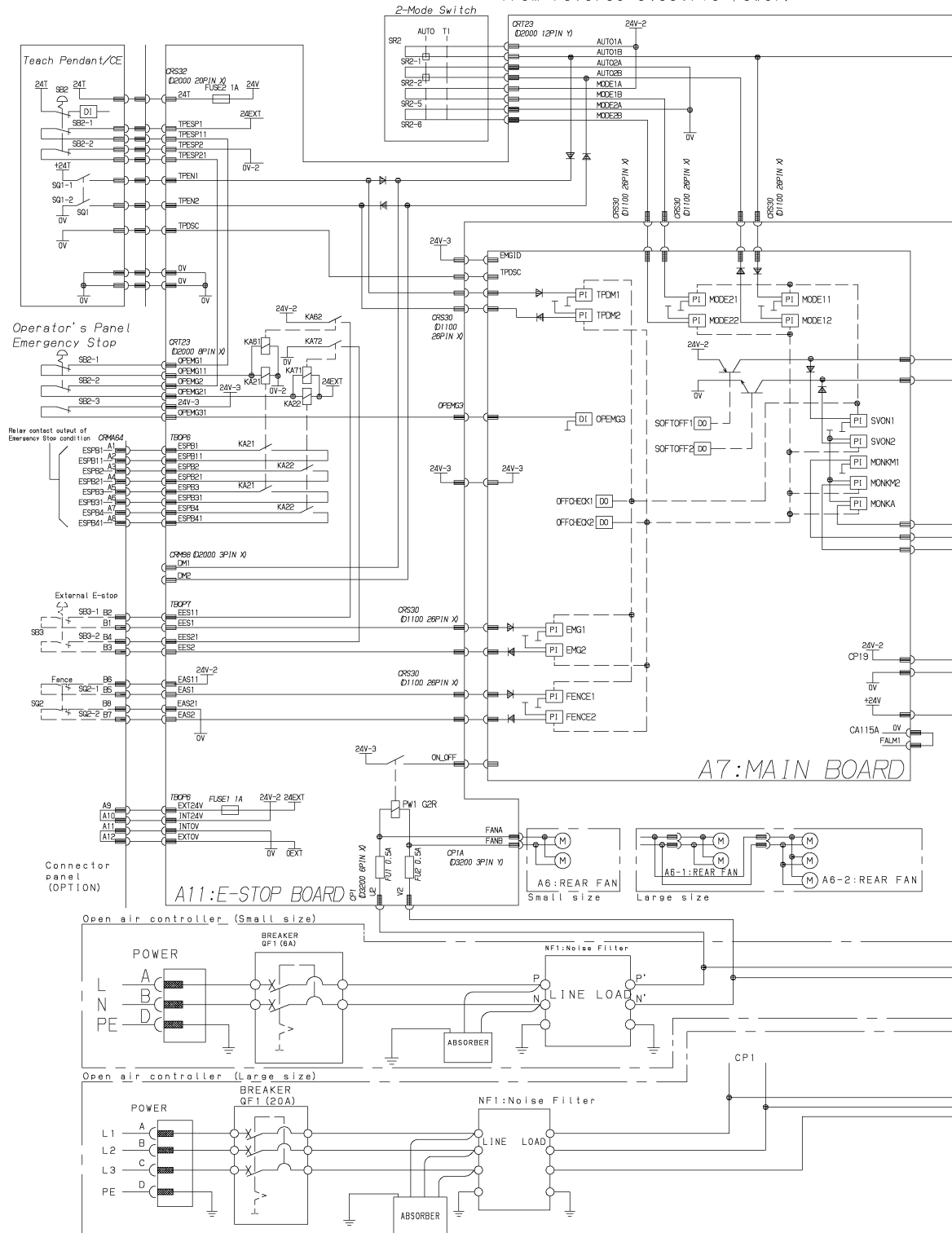
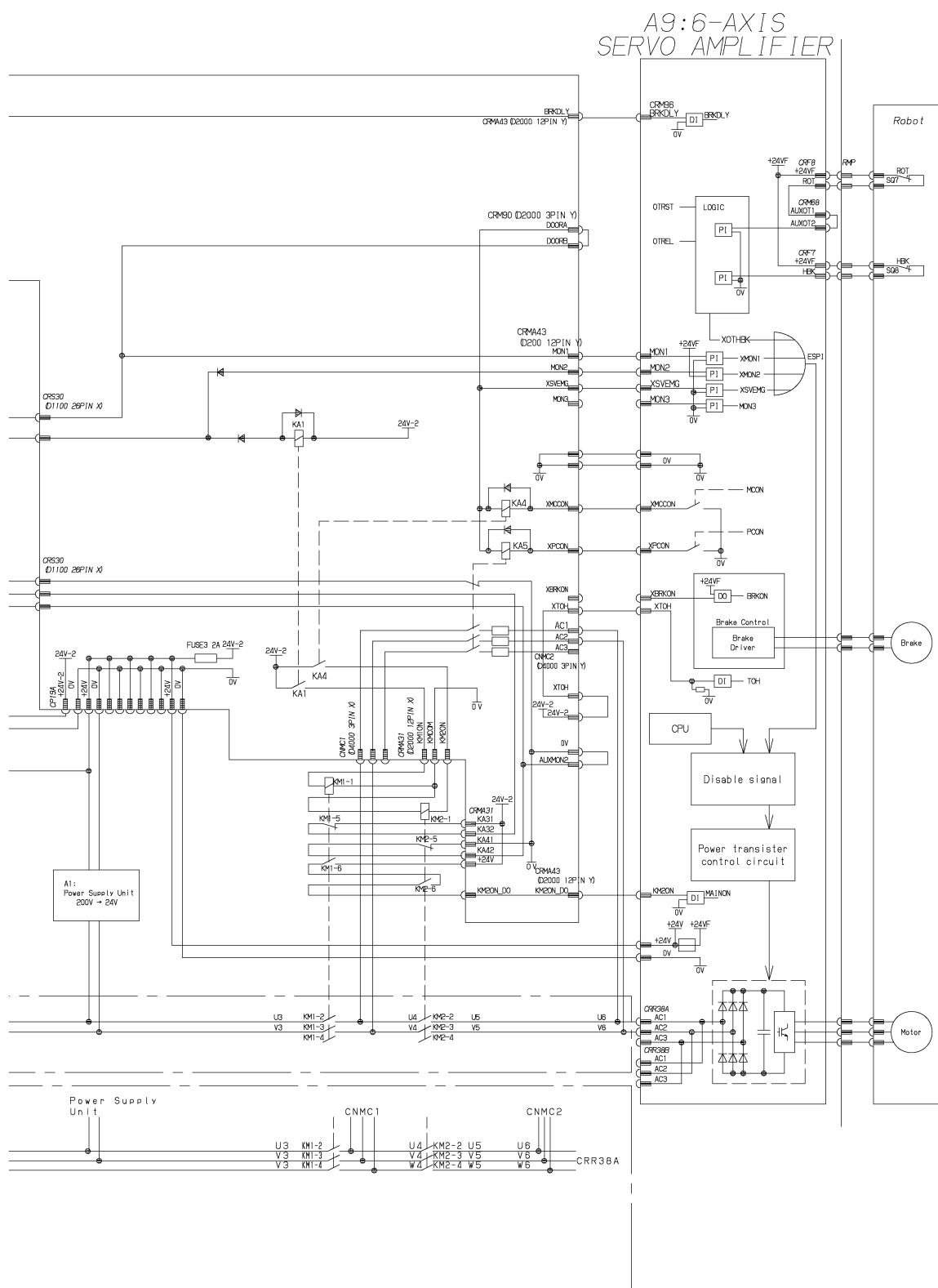


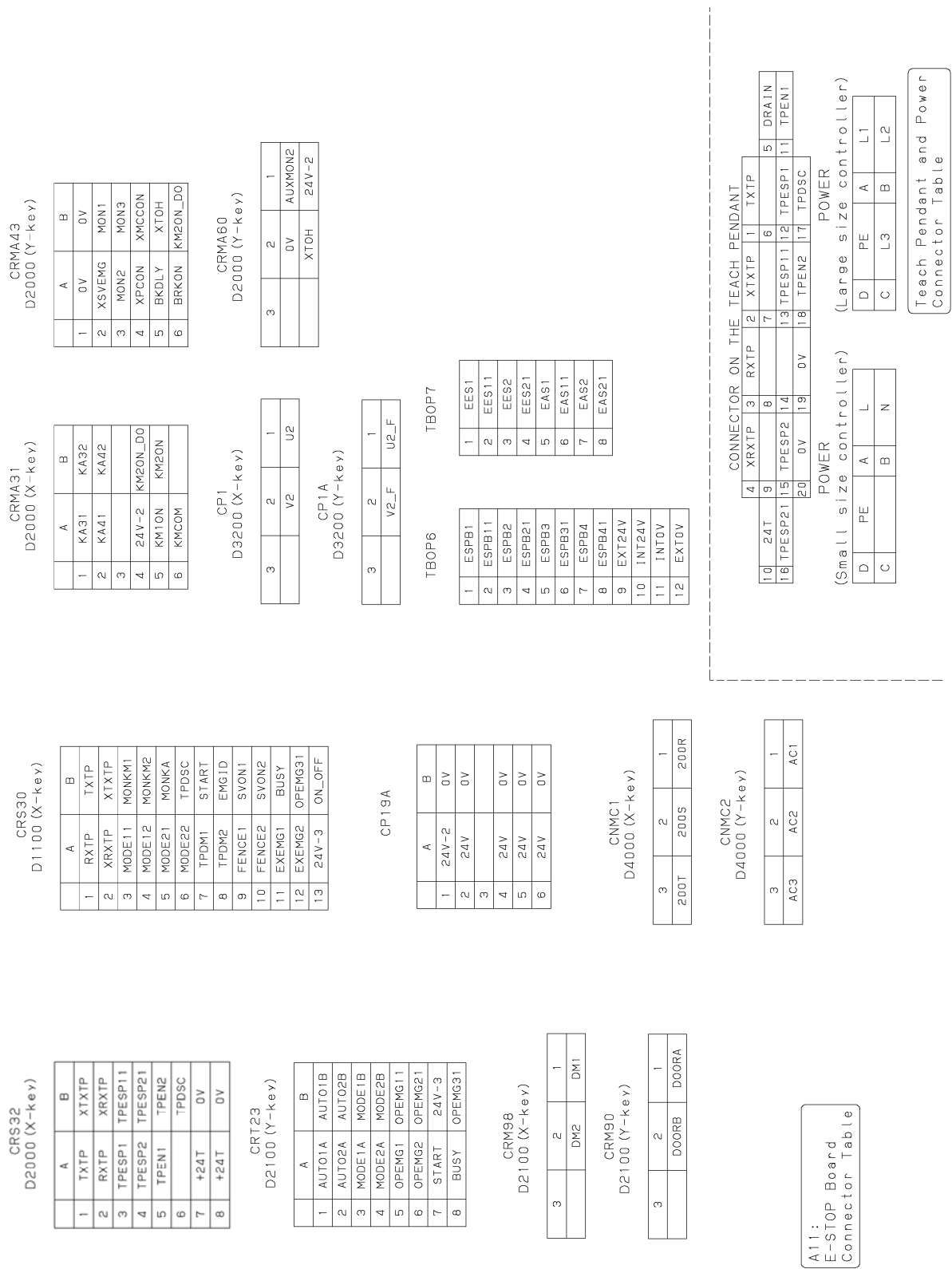
Fig.A (e) E-stop circuit diagram (CE/RIA controller)

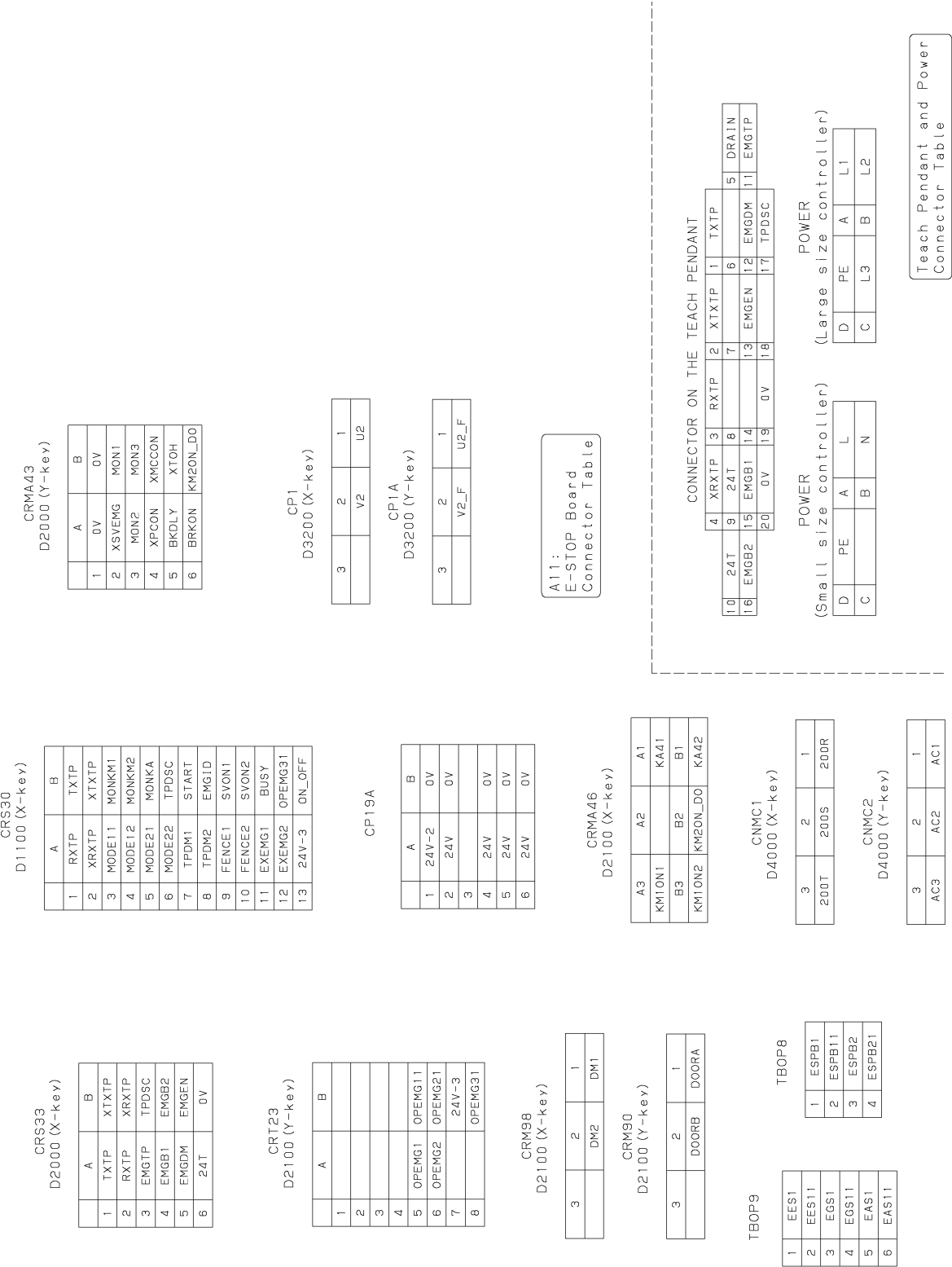


DI:Simple DI  
PI:Photo coupler DI  
Not showing the diodes to protect  
from reverse electric power.











|                                                             |          |                                                                 |       |                         |         |                 |         |
|-------------------------------------------------------------|----------|-----------------------------------------------------------------|-------|-------------------------|---------|-----------------|---------|
| M-JD1A/S-JD1B<br>I/O Link (1 CH)<br>(Main Board I/O Device) |          | CRS30<br>TP Signal/E-stop Signal<br>(Main Board - E-stop Board) |       | JRL6<br>Video Interface |         | CRMA15<br>DI/DO |         |
| 1                                                           | SLINA    | 11                                                              | 0V    | 1                       | XVD     | 11              | A       |
| 2                                                           | XSLINA   | 12                                                              | 0V    | 2                       | 0V      | 12              | 24F     |
| 3                                                           | SLOUTA   | 13                                                              | 0V    | 3                       | XHD     | 13              | 24F     |
| 4                                                           | XSLOUTA  | 14                                                              | 0V    | 4                       | 0V      | 14              | SDICOM1 |
| 5                                                           | SLC1IN   | 15                                                              | 0V    | 5                       | XTRIG   | 15              | SDICOM2 |
| 6                                                           | XSLC1IN  | 16                                                              | 0V    | 6                       | 0V      | 16              | 0V      |
| 7                                                           | SLC1OUT  | 17                                                              |       | 7                       | VIDEOIN | 17              | D1101   |
| 8                                                           | XSLC1OUT | 18                                                              | 5V    | 8                       | 0V      | 18              | D1102   |
| 9                                                           | 5V       | 19                                                              | 24V-3 | 9                       |         | 19              | D1103   |
| 10                                                          | 24V-3    | 20                                                              | 5V    | 10                      | 0V      | 20              | D1104   |

|                                                      |          |               |       |                       |       |                 |         |
|------------------------------------------------------|----------|---------------|-------|-----------------------|-------|-----------------|---------|
| S-JD1A<br>I/O Link (2 CH)<br>(Main Board I/O Device) |          | CP19<br>DC24V |       | CRS31<br>Force Sensor |       | CRMA16<br>DI/DO |         |
| 1                                                    | SLINB    | 11            | 0V    | 3                     | 24V-2 | 2               | A       |
| 2                                                    | XSLINB   | 12            | 0V    | 4                     | IN0V  | 1               | 24F     |
| 3                                                    | SLOUTB   | 13            | 0V    |                       |       |                 | 24F     |
| 4                                                    | XSLOUTB  | 14            | 0V    |                       |       |                 | SDICOM3 |
| 5                                                    | SLC2IN   | 15            | 0V    |                       |       |                 | 0V      |
| 6                                                    | XSLC2IN  | 16            | 0V    |                       |       |                 | DI121   |
| 7                                                    | SLC2OUT  | 17            |       |                       |       |                 | DI123   |
| 8                                                    | XSLC2OUT | 18            | 5V    |                       |       |                 | DI124   |
| 9                                                    | 5V       | 19            | 24V-3 |                       |       |                 | DI126   |
| 10                                                   | 24V-3    | 20            | 5V    |                       |       |                 | DI127   |

|                                                           |        |                                                        |        |                   |     |
|-----------------------------------------------------------|--------|--------------------------------------------------------|--------|-------------------|-----|
| JD17<br>RS-232-C & RS-485<br>(Main Board - Serial Device) |        | CD38A<br>Ethernet 100Base-TX<br>(Main Board - Network) |        | A3:<br>MAIN BOARD |     |
| 1                                                         | RD     | 11                                                     | SD     | 1                 | TX+ |
| 2                                                         | SG     | 12                                                     | SG     | 2                 | TX- |
| 3                                                         | DR     | 13                                                     | ER     | 3                 | RX+ |
| 4                                                         | SG     | 14                                                     | SG     | 4                 |     |
| 5                                                         | CS     | 15                                                     | RS     | 5                 |     |
| 6                                                         | SG     | 16                                                     | SG     | 6                 | RX- |
| 7                                                         | RX485D | 17                                                     | TX485D | 7                 |     |
| 8                                                         | XR485D | 18                                                     | TX485D | 8                 |     |
| 9                                                         |        | 19                                                     | +24V   |                   |     |
| 10                                                        | +24V   | 20                                                     |        |                   |     |

|                    |  |                  |       |
|--------------------|--|------------------|-------|
| CA115A<br>INVERTER |  | CA114<br>BATTERY |       |
| 1                  |  | 7                | 24V-3 |
| 2                  |  | 8                | 0V    |
| 3                  |  | 9                | FALM1 |
| 4                  |  | 10               |       |
| 5                  |  | 11               |       |
| 6                  |  | 12               |       |

|   |    |     |
|---|----|-----|
| 3 | 2  | 1   |
|   | 0V | BAT |

Fig.A (i) Main board connector table

|                        |    |       |    |       |
|------------------------|----|-------|----|-------|
| CRR45A/B<br>D4200 (XX) | A1 | DCRA1 | B1 | DCRB1 |
|                        | A2 | DCRA2 | B2 | DCRB2 |

|                       |        |  |
|-----------------------|--------|--|
| CRR63A/B<br>D3100 (X) |        |  |
| 1                     | DCTHB1 |  |
| 2                     | DCTHB2 |  |
| 3                     |        |  |

|    |        |       |    |
|----|--------|-------|----|
| 1  | A      | B     | C  |
| 1  | XPRQJ1 | PRQJ1 | 5V |
| 2  | XPRQJ2 | PRQJ2 | 5V |
| 3  | XPRQJ3 | PRQJ3 | 5V |
| 4  | XPRQJ4 | PRQJ4 | 5V |
| 5  | XPRQJ5 | PRQJ5 | 5V |
| 6  | XPRQJ6 | PRQJ6 | 5V |
| 7  | S+     | S-    | 0V |
| 8  | R11    | R12   | 0V |
| 9  | R13    | R14   | 0V |
| 10 | R15    | R16   | 0V |
| 11 | R17    | R18   | 0V |
| 12 | R19    | R01   | 0V |
| 13 | R02    | R03   |    |
| 14 | R04    | R05   |    |
| 15 | R06    | R07   |    |
| 16 | R08    | XHBK  |    |
| 17 | 24VF   | XR0T  |    |
| 18 | 24VFIN | 0V    |    |

|                   |      |      |
|-------------------|------|------|
| CNGA<br>D5200 (Y) |      |      |
| 1                 | 2    | 3    |
| J1G1              | J2G1 | J3G1 |

|                    |      |      |
|--------------------|------|------|
| CNJ1A<br>D5200 (X) |      |      |
| 1                  | 2    | 3    |
| J1U1               | J1V1 | J1W1 |

|                   |      |      |
|-------------------|------|------|
| CNGC<br>D4200 (Y) |      |      |
| 1                 | 2    | 3    |
| J4G1              | J5G1 | J6G1 |

|                    |      |      |
|--------------------|------|------|
| CNJ3A<br>D5200 (X) |      |      |
| 1                  | 2    | 3    |
| J3U1               | J3V1 | J3W1 |

|                   |      |      |
|-------------------|------|------|
| CNGC<br>D4200 (Y) |      |      |
| 1                 | 2    | 3    |
| J4G1              | J5G1 | J6G1 |

|                   |      |      |
|-------------------|------|------|
| CNJ4<br>D4200 (X) |      |      |
| 1                 | 2    | 3    |
| J4U1              | J4V1 | J4W1 |

|                   |      |      |
|-------------------|------|------|
| CNGA<br>D5200 (Y) |      |      |
| 1                 | 2    | 3    |
| J1G1              | J2G1 | J3G1 |

|                   |      |      |
|-------------------|------|------|
| CNJ5<br>D4200 (X) |      |      |
| 1                 | 2    | 3    |
| J5U1              | J5V1 | J5W1 |

|                   |      |      |
|-------------------|------|------|
| CNJ6<br>D4200 (X) |      |      |
| 1                 | 2    | 3    |
| J6U1              | J6V1 | J6W1 |

Discharge Resistor  
Interface  
Connector Table  
(Open air controller  
(Large size))

CRF8  
D-2600

COP10B

|   |       |
|---|-------|
| 1 | FSSB1 |
| 2 | FSSB2 |

COP10A

|   |       |
|---|-------|
| 1 | FSSB1 |
| 2 | FSSB2 |

CRM96

D2100D (X)

|    |        |    |        |
|----|--------|----|--------|
| A1 | 24V    | B1 | 24V    |
| A2 | 0V     | B2 | 0V     |
| A3 | XSVEMG | B3 | MON1   |
| A4 | MON2   | B4 | MON3   |
| A5 | XPCHON | B5 | XMCCON |
| A6 |        | B6 | XTON   |
| A7 | BRKDLY | B7 | KM2ON  |
| A8 | XBRKON | B8 | XOTHBK |

CRM97

D2100D (Y)

|    |          |    |          |
|----|----------|----|----------|
| A1 | XBRKRLS2 | B1 | 24VF     |
| A2 | XBRKRLS3 | B2 | 0V       |
| A3 | XBRKRLS4 | B3 | XFUSEALM |
| A4 | GUNCHG   | B4 | XSVEMG   |
| A5 | KM3ON    | B5 | OTHBK    |
| A6 |          | B6 |          |

CRR68

D4200 (X)

|   |     |
|---|-----|
| 1 | DCP |
| 2 | DCP |
| 3 | DCN |
| 4 | DCN |

CRS23

D2100 (Y)

|    |     |
|----|-----|
| A1 | S2+ |
| A2 | S2- |
| A3 | 0V  |

CXS2A

D2100D (X)

|    |       |    |      |
|----|-------|----|------|
| A1 | 24VS  | B1 | 24VS |
| A2 | 0V    | B2 | 0V   |
| A3 |       | B3 |      |
| A4 | XESF2 | B4 |      |

CRM68

D2100 (X)

|    |        |
|----|--------|
| A1 | AUXOT1 |
| A2 | AUXOT2 |
| A3 |        |

CRR88

D3200M (YY)

|    |             |    |     |
|----|-------------|----|-----|
| A1 | BK (J1, J2) | B1 | BKC |
| A2 | BK (J3)     | B2 | BKC |
| A3 | BK (J456)   | B3 | BKC |

CRR38A

D5200 (X)

|   |     |
|---|-----|
| 1 | PE  |
| 2 | AC1 |
| 3 | AC2 |
| 4 | AC3 |

CRR65A/CRR65B

D3200M (XX)

|    |         |    |         |
|----|---------|----|---------|
| A1 | BK (J7) | B1 | BK (J8) |
| A2 |         | B2 |         |
| A3 | BKC     | B3 | BKC     |

CRR45B

D4200 (X)

|   |       |
|---|-------|
| 1 | DCRB1 |
| 2 | DCRB2 |

CRR63B

D2100 (X)

|   |         |
|---|---------|
| 1 | DCTHB1  |
| 2 | DCTHB2  |
| 3 | DCEXSTB |

CRR63A

D2100 (X)

|   |        |
|---|--------|
| 1 | DCTHA1 |
| 2 | DCTHA2 |

Discharge Resistor  
Interface  
Connector Table  
(Open air controller  
(Large size))

A9:  
6-Axis Servo Amplifier  
Connector Table

**Fig.A (j) Servo amplifier connector table**

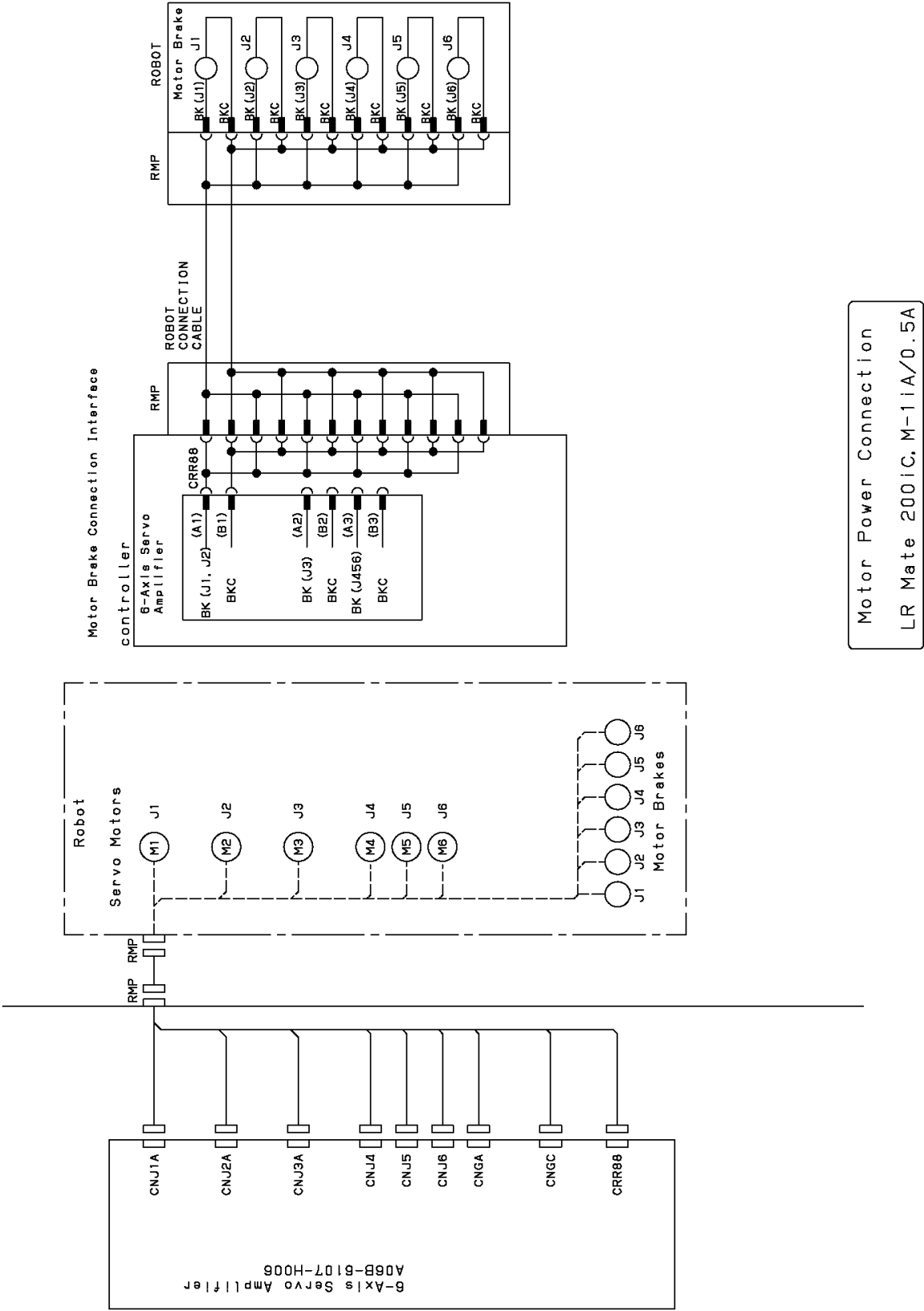


Fig.A (k) Motor power connection (LR Mate 200iC(6-Axis),M-1iA/0.5A)

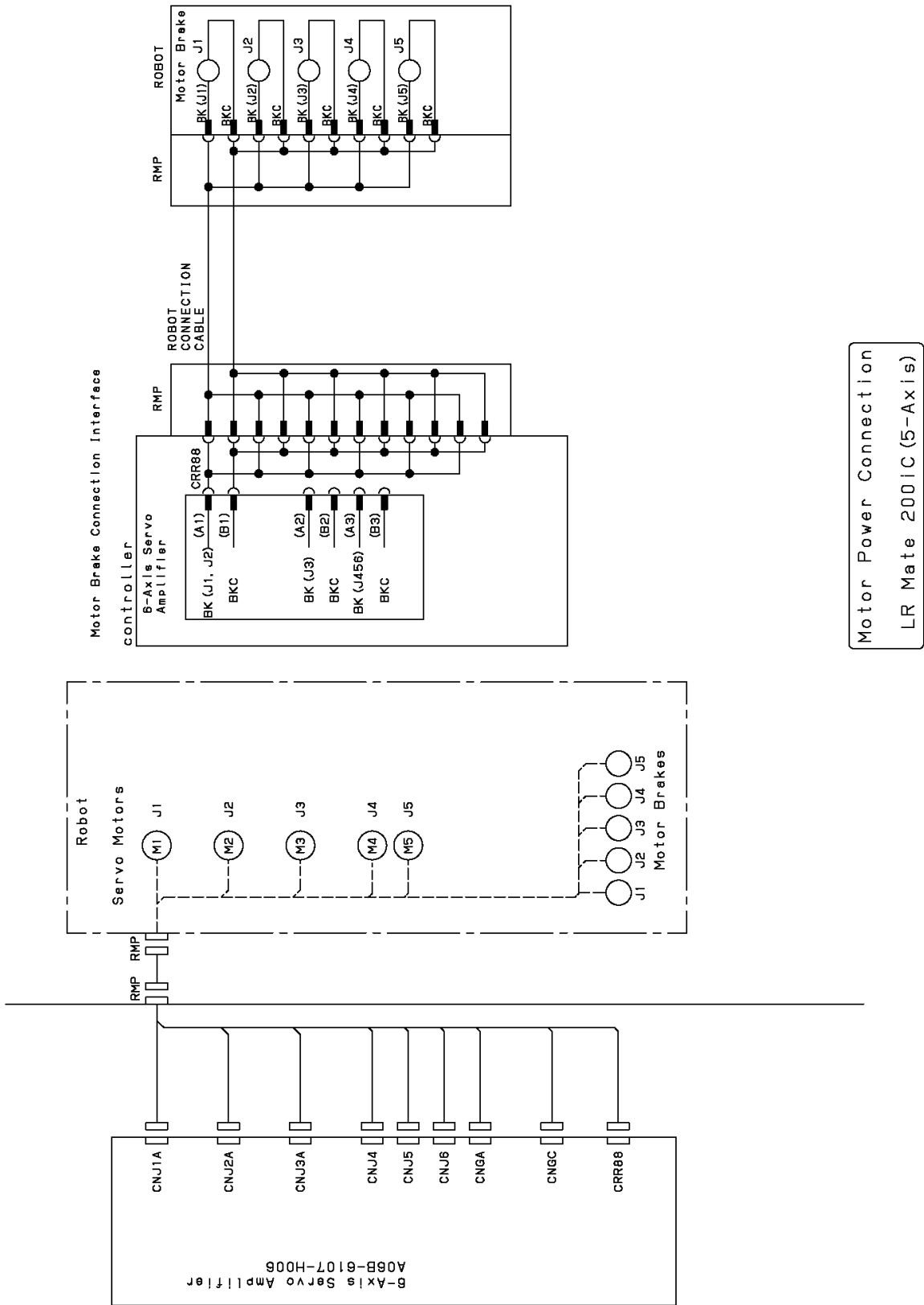


Fig.A (I) Motor power connection (LR Mate 200iC(5-Axis))

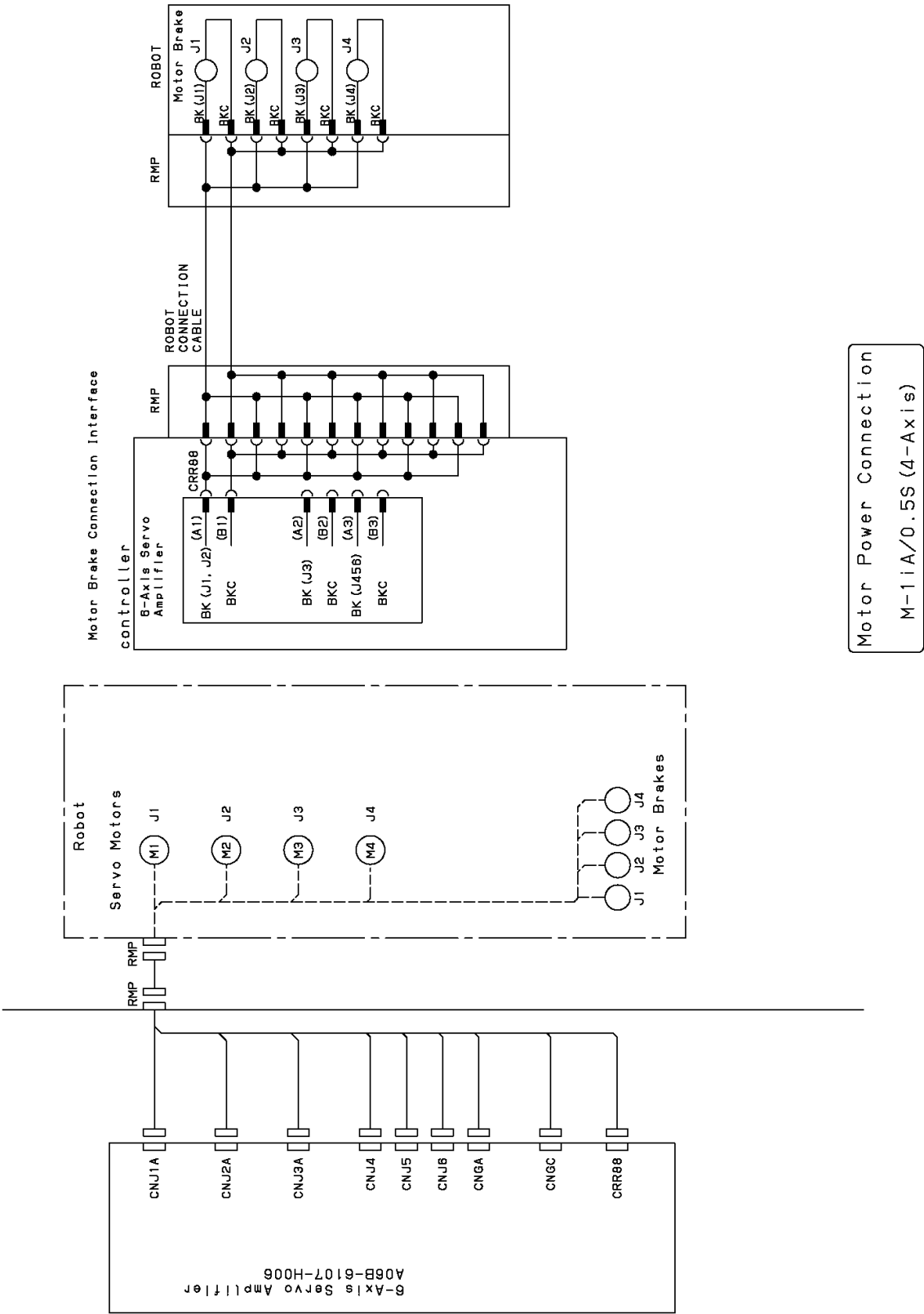
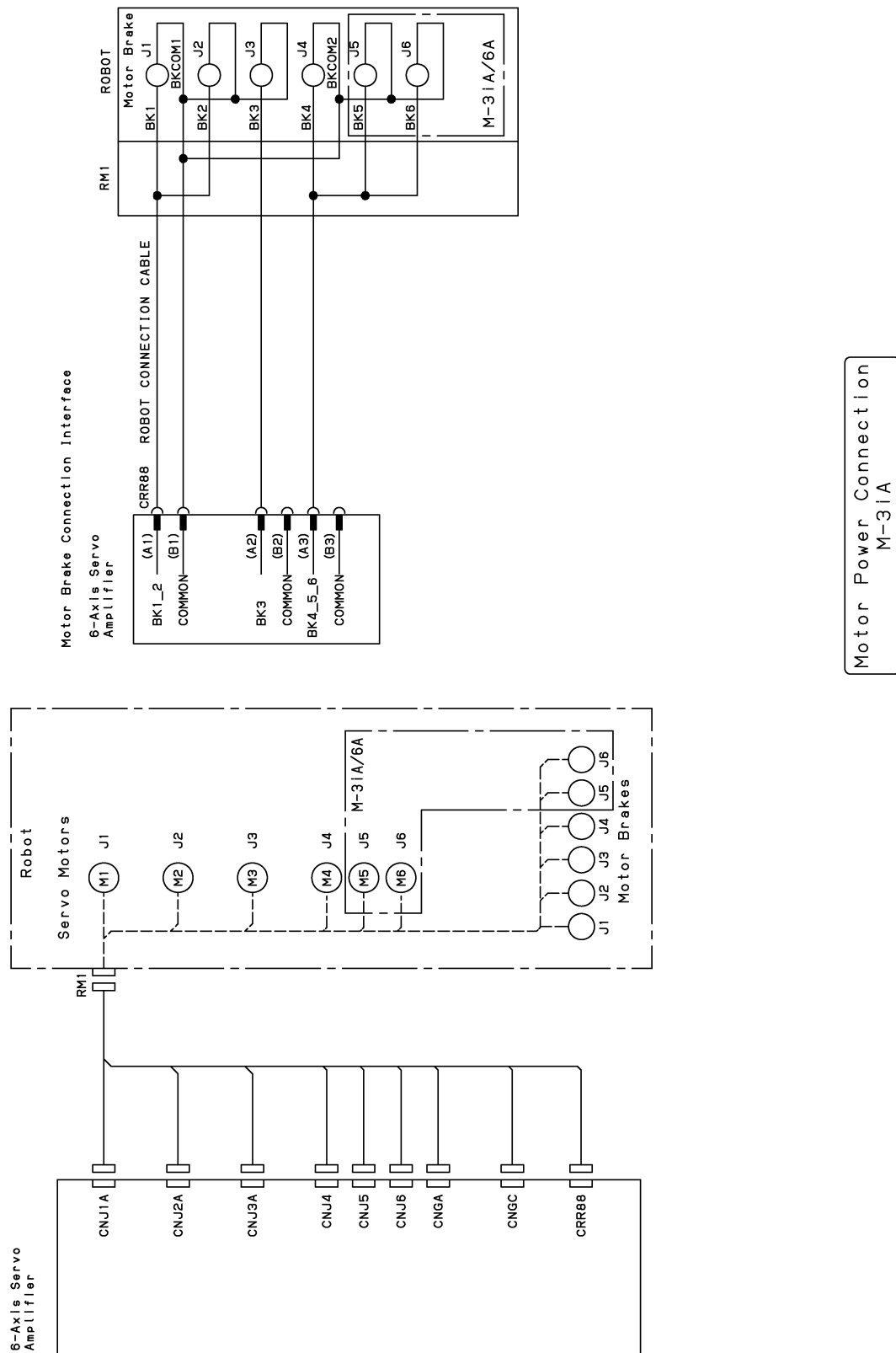


Fig.A (m-1) Motor power connection (M-1iA/0.5S(4-Axis))



**Fig.A (m-2) Motor power connection (M-3iA)**

1

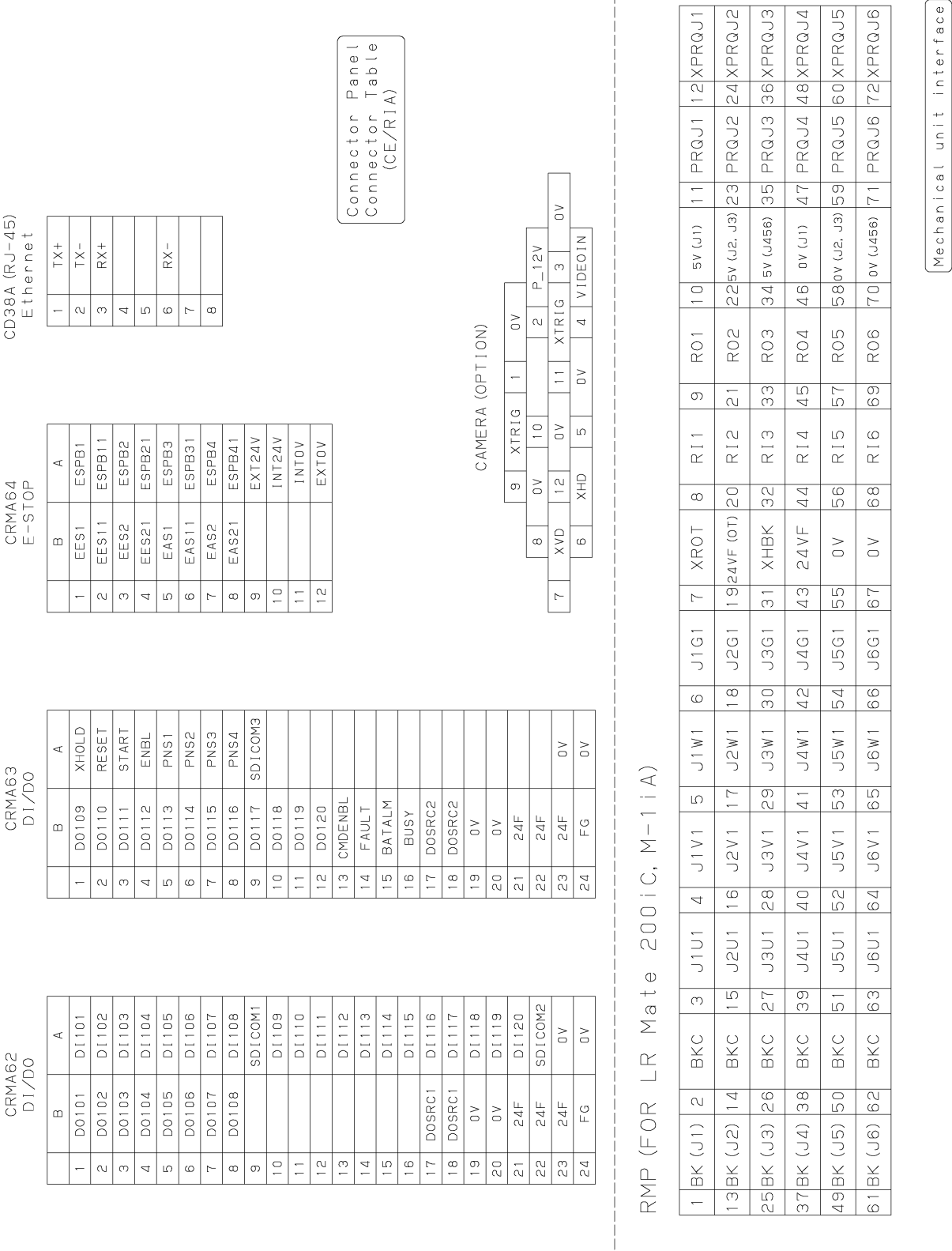
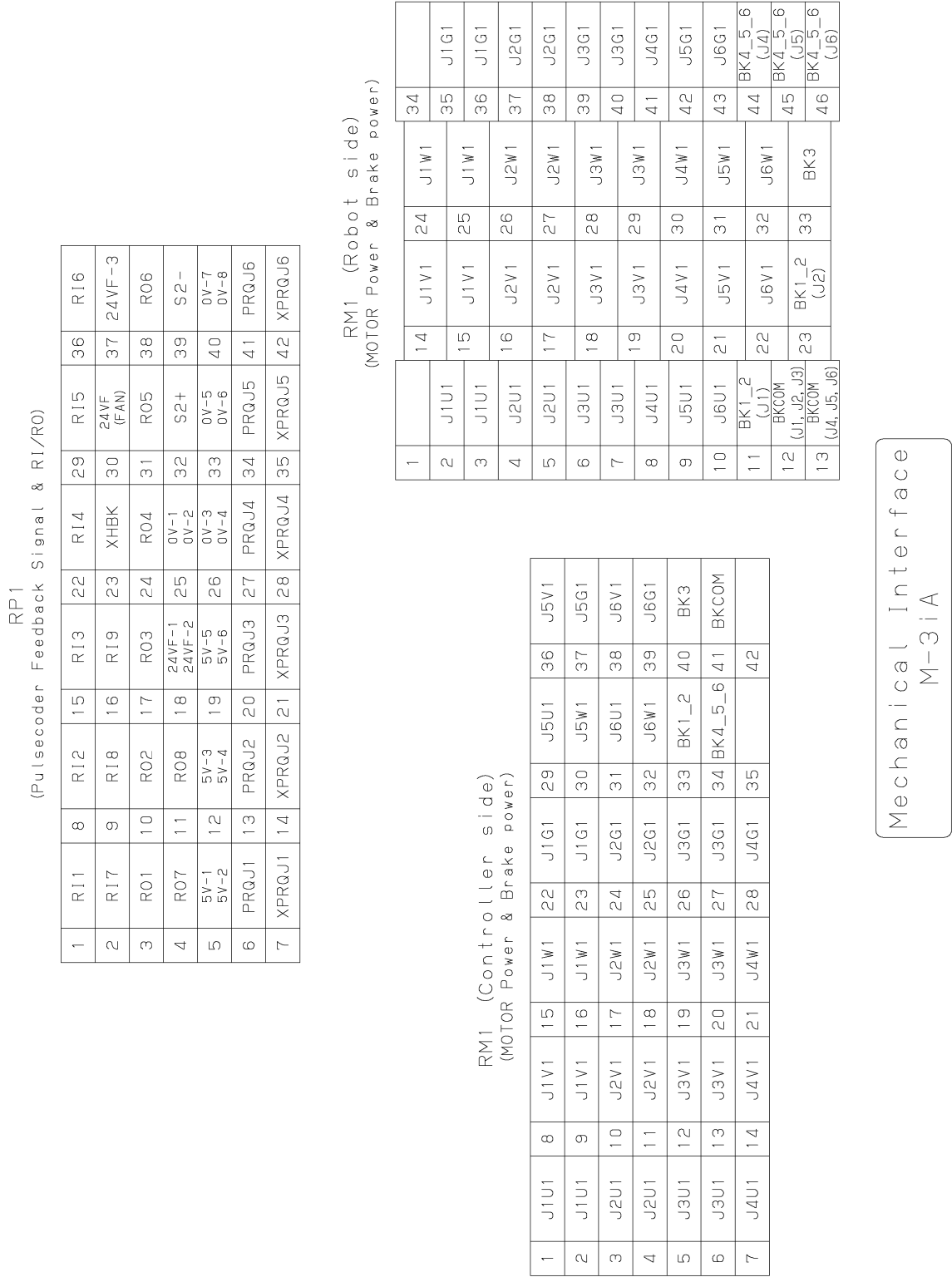


Fig.A (n-1) Mechanical unit interface, Connector panel connector table





# B DISASSEMBLE PROCEDURE

## B.1 DISASSEMBLE PROCEDURE



### WARNING

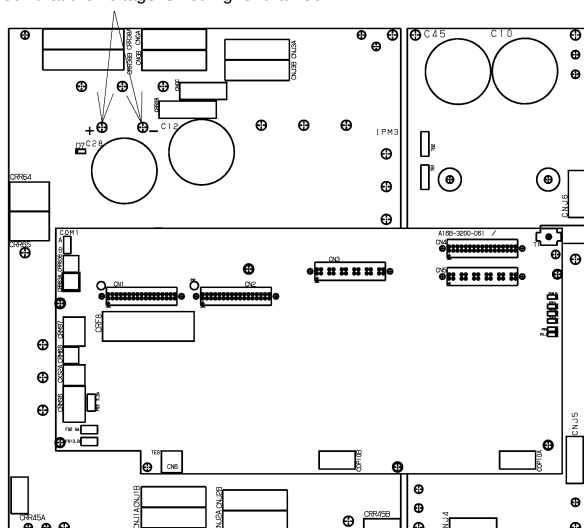
Before opening the controller cover and accessing the inside of the controller for maintenance, be sure to turn off the power switch, disconnect the power cable, and wait 1 minute or more. This is for protecting you from electric shock.



### WARNING

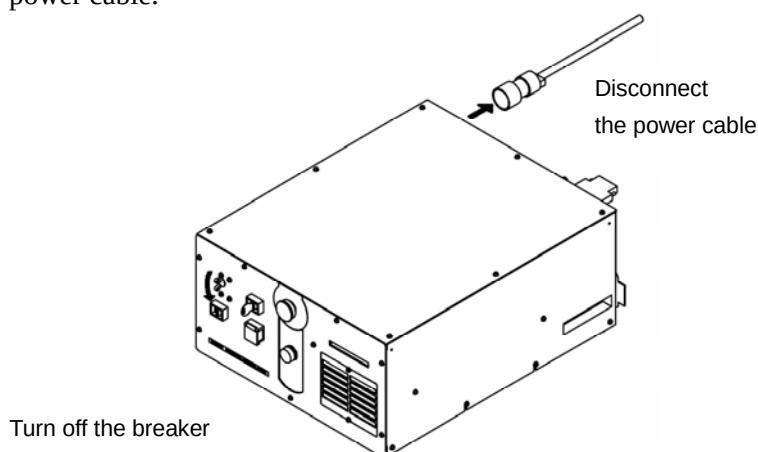
Before touching the servo amplifier, for example, for maintenance purposes, check the voltage at the screw above the LED "D7" with a DC voltage tester to see if the remaining voltage is not higher than 50V.

Check that the voltage is not higher than 50V.



### B.1.1 Turn off the Breaker and Disconnect the Power Cable.

- Turn off the breaker.
- Disconnect the power cable.

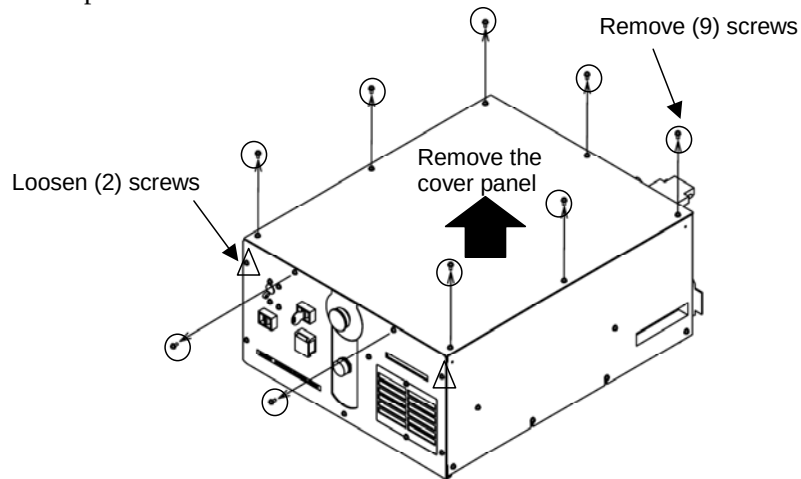


**WARNING**

Disconnect the plug connected to the power supply before disconnecting power cable of controller.

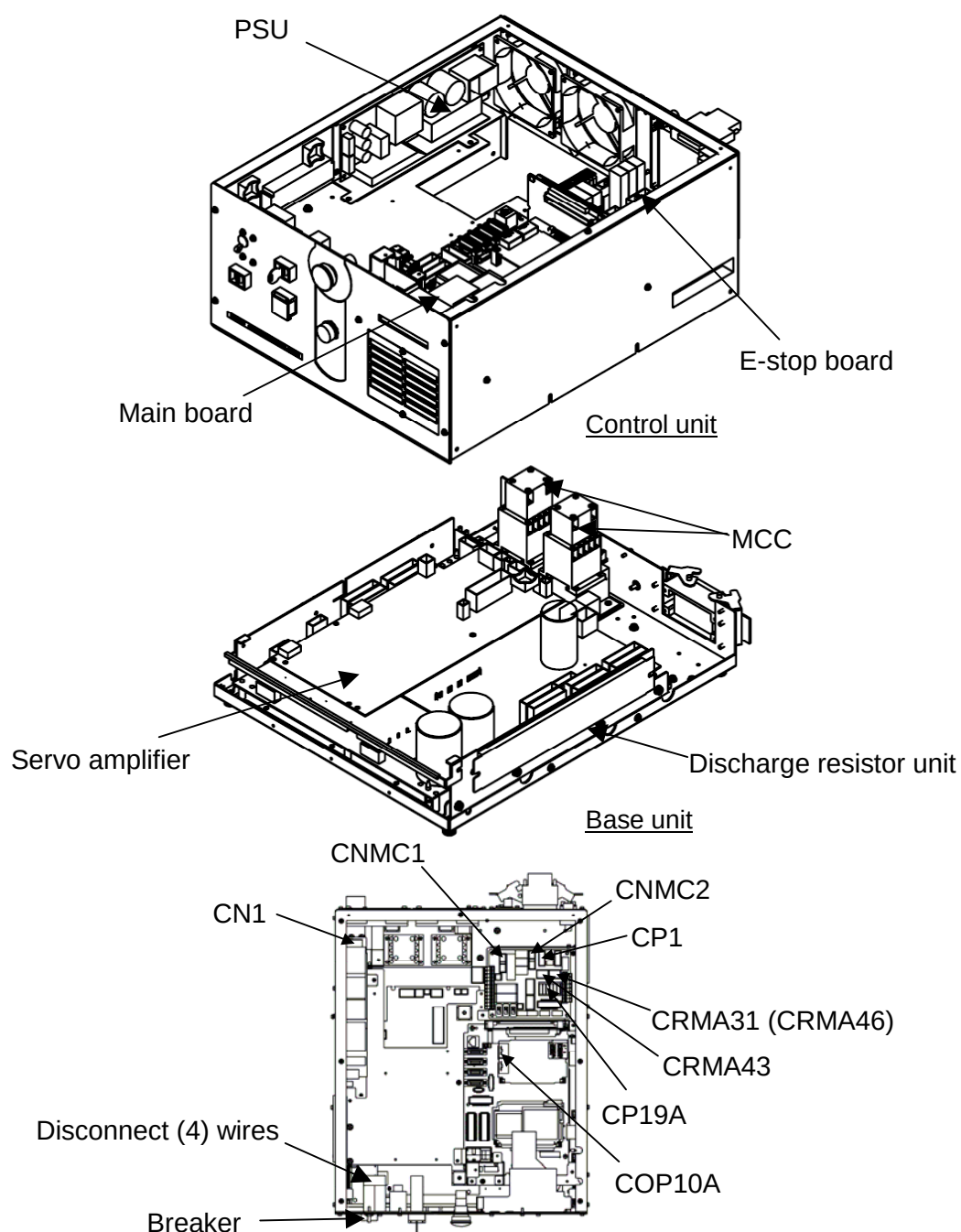
## B.1.2 Remove the Cover Panel.

- Remove (9) screws.
- Loosen (2) screws.
- Remove the cover panel.



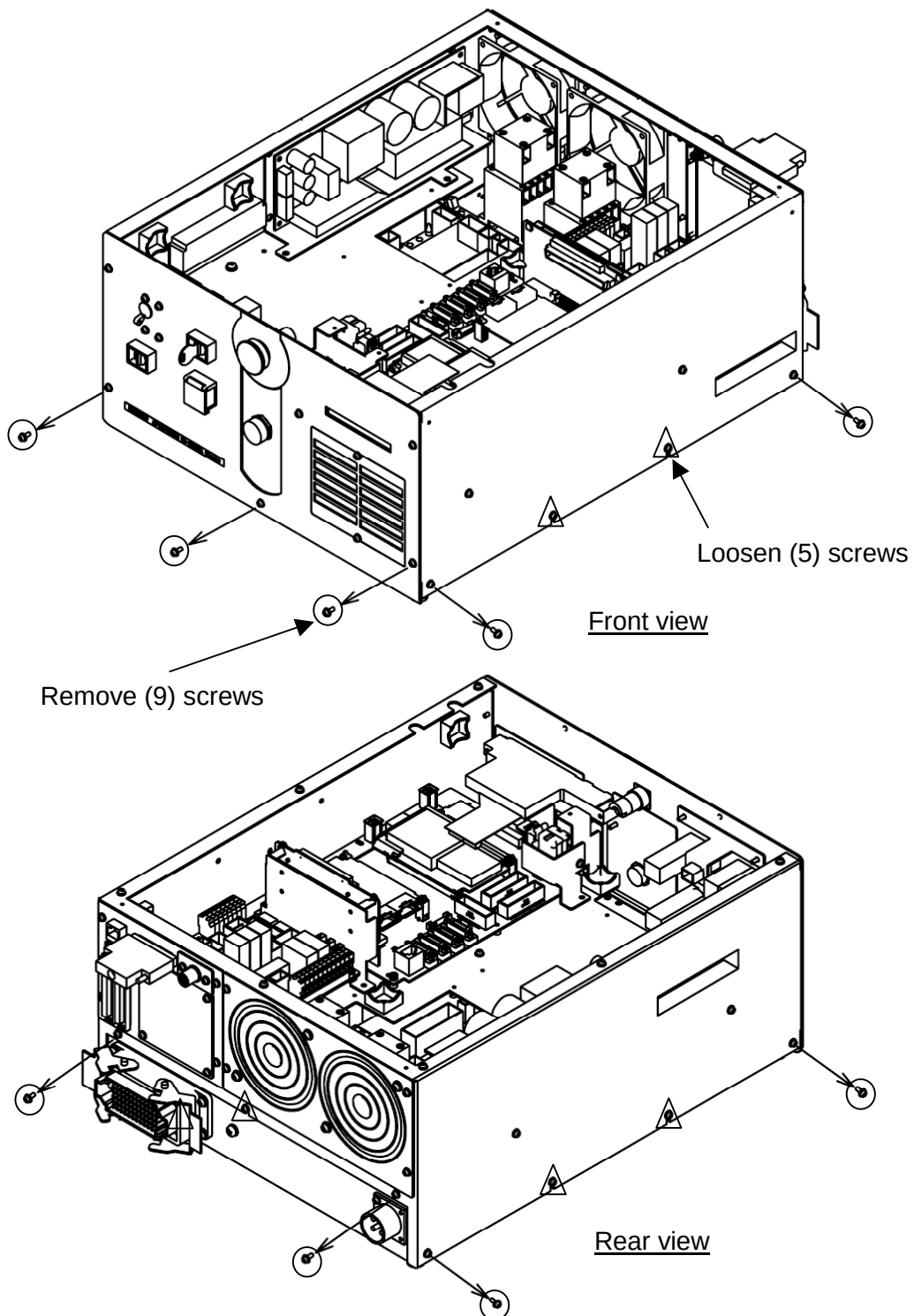
### B.1.3 Remove the Control Unit from the Base Unit

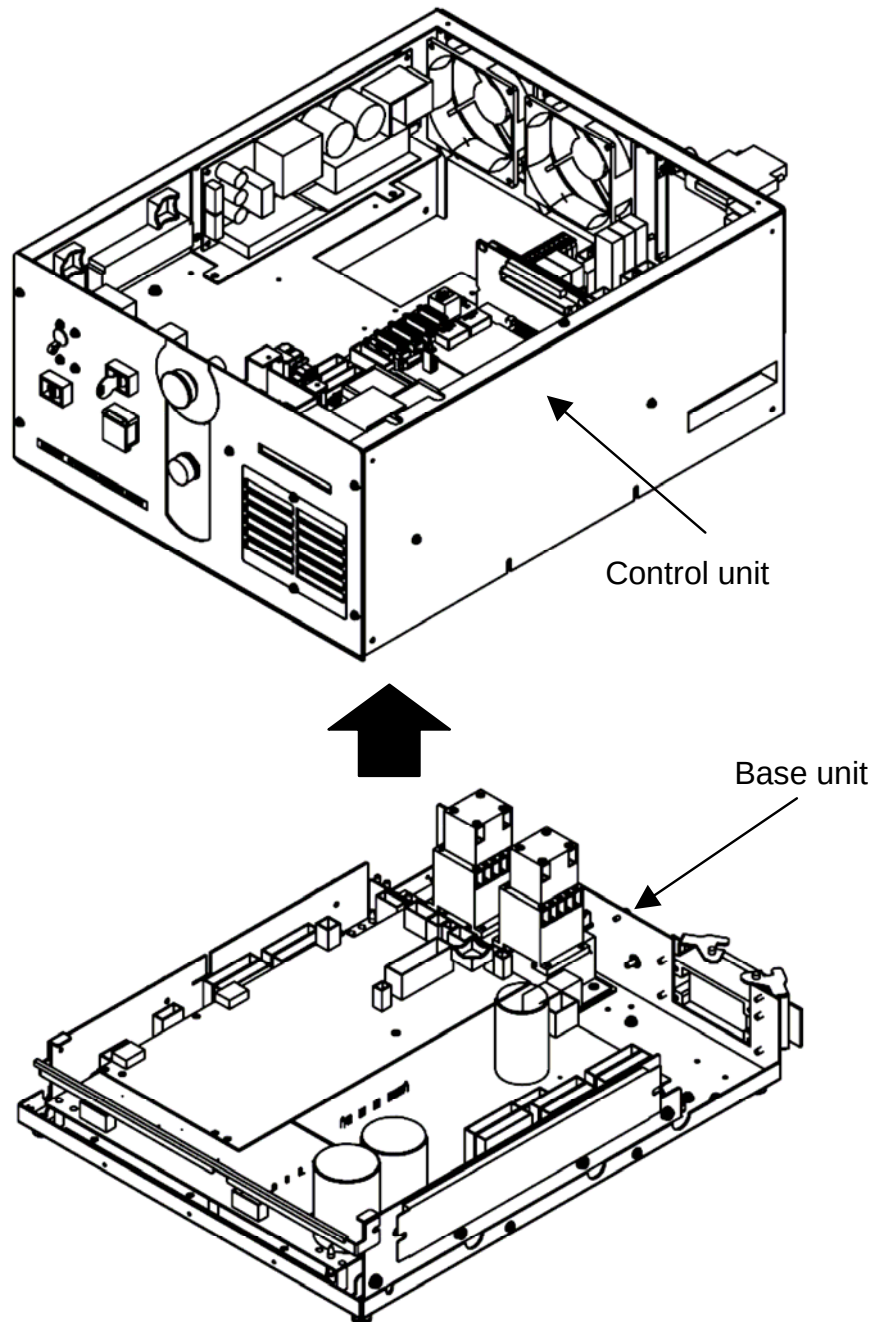
- Control unit includes Main board, E-stop board, PSU and so on.
- Base unit includes servo amplifier, MCCs, discharge resistor and so on.
- Disconnect (8) cables that have yellow nylon band.
- Disconnect (4) wires from the breaker.



Disconnect cables connected Control unit and Base unit.

- Remove (9) screws.
- Loosen (5) screws.

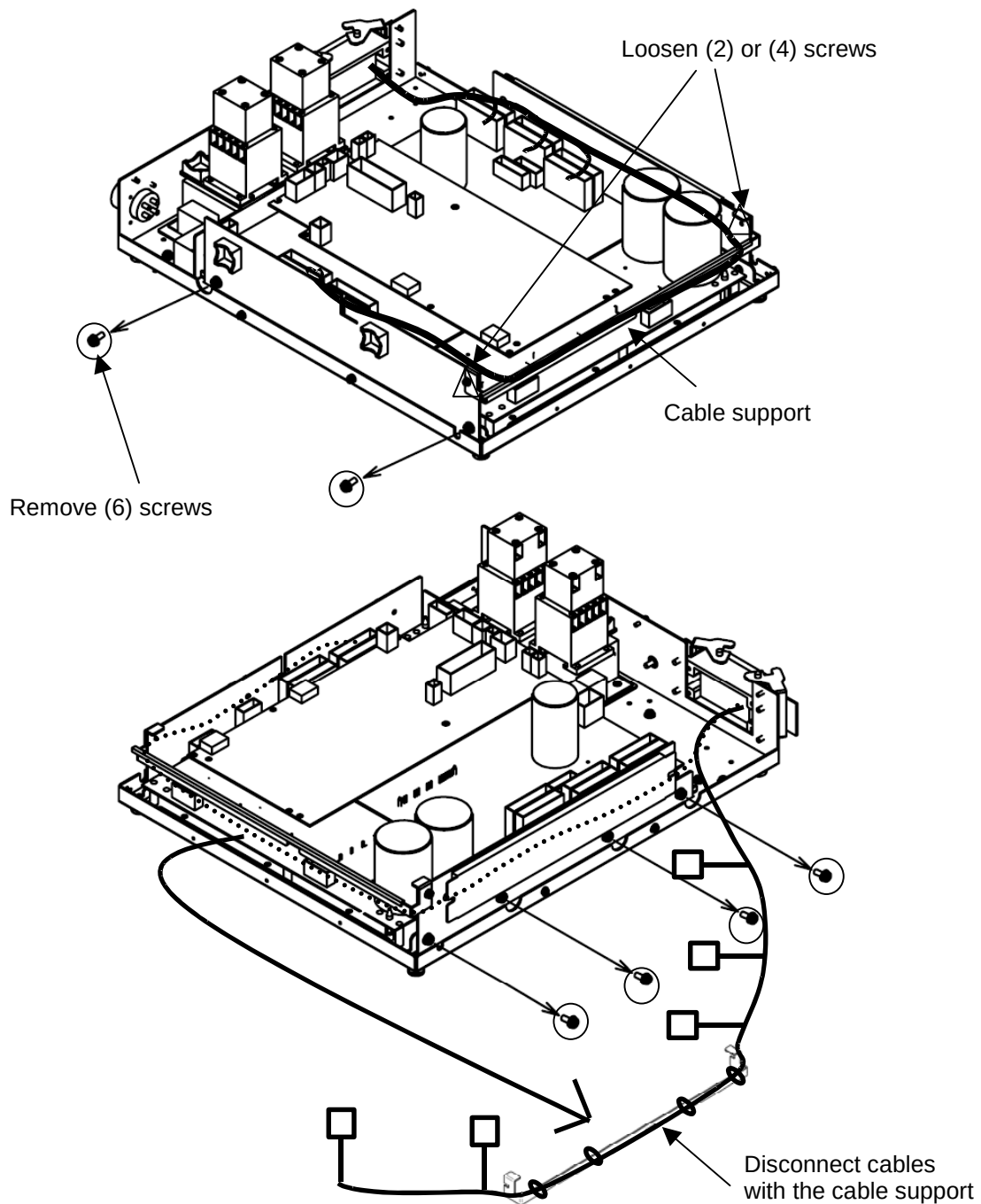


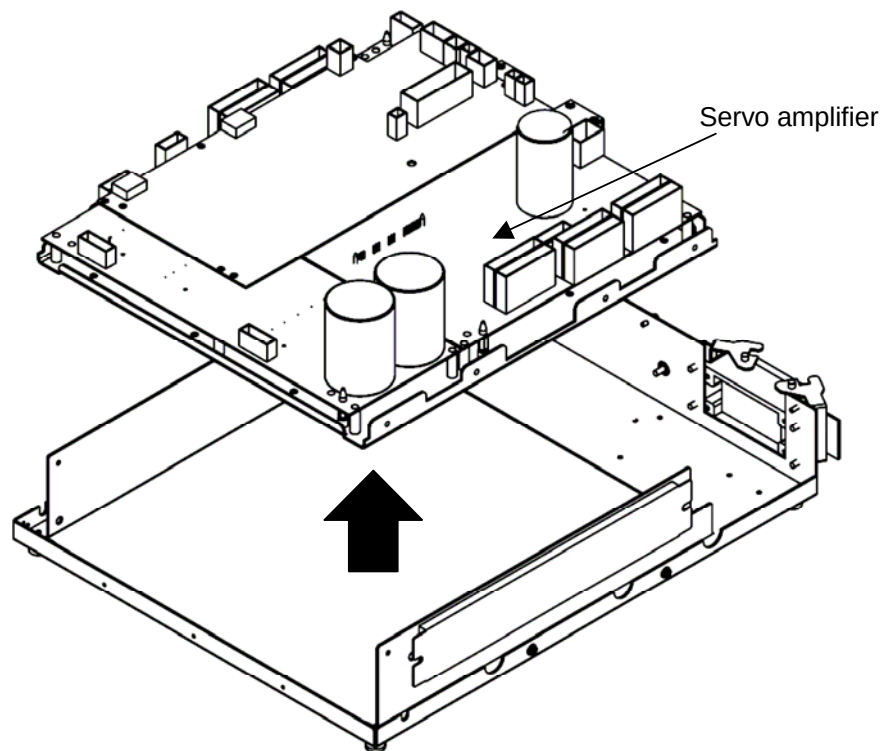


## B.2 REMOVING THE UNIT

### B.2.1 Remove the Servo Amplifier

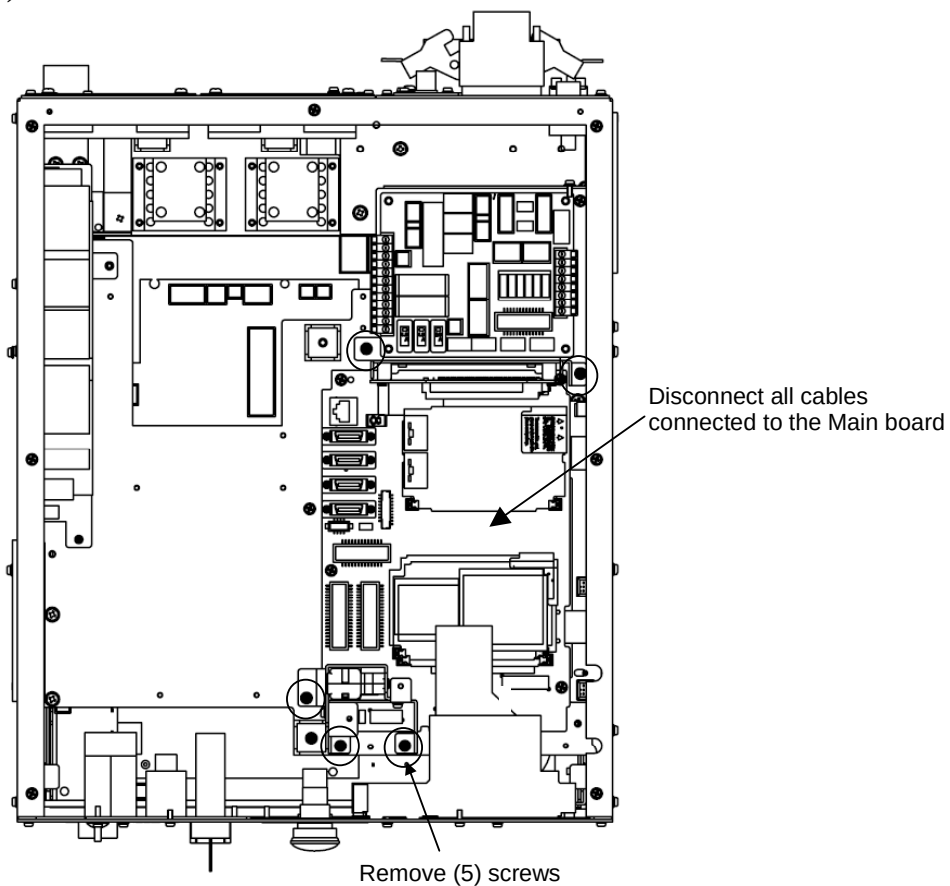
- Loosen (2) or (4) screws to disconnect cable support.
- Disconnect all cables connected to the servo amplifier.
- Disconnect cables with the cable support.
- Remove (6) screws.



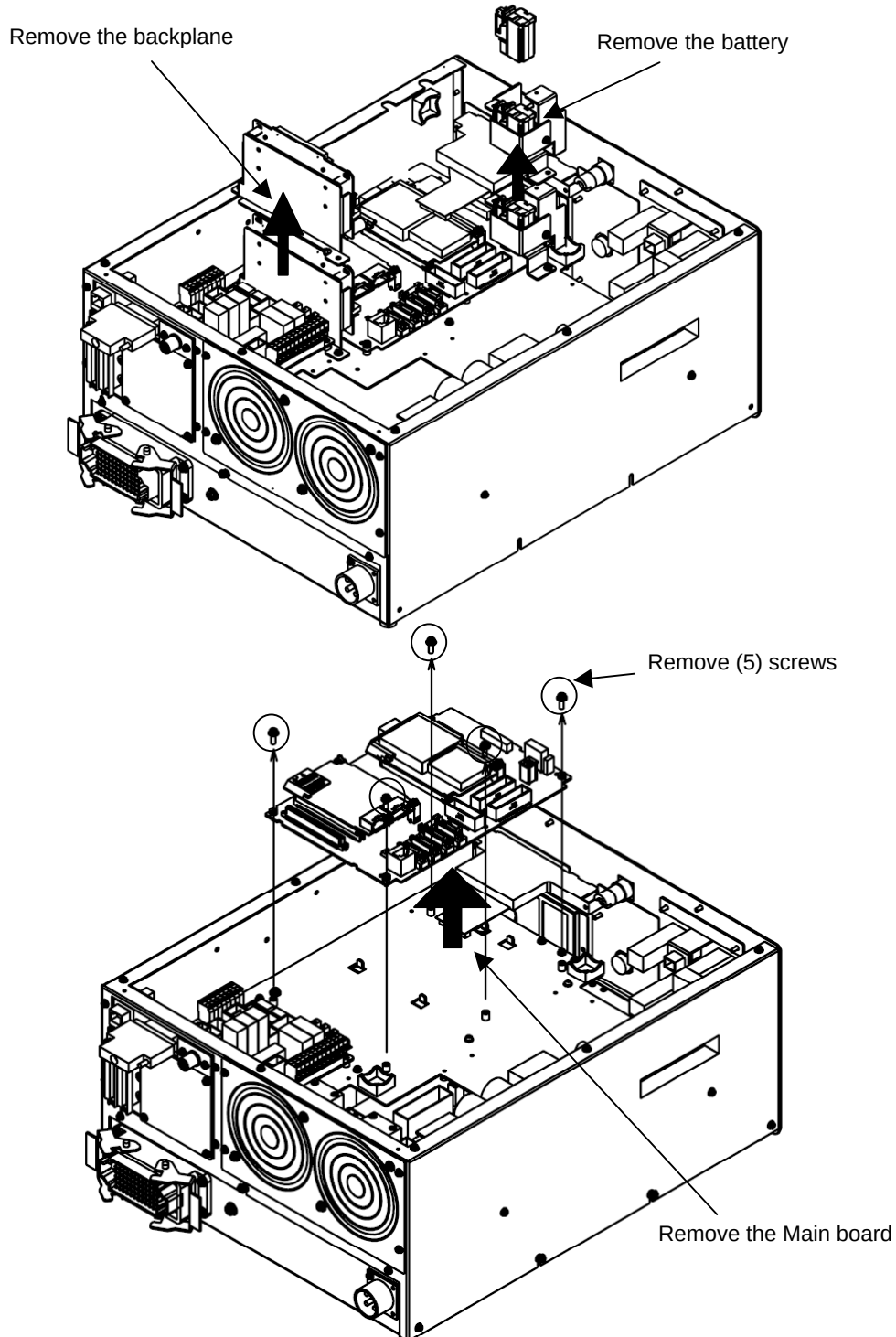


## B.2.2 Remove the Main Board

- Disconnect all cables connected to the Main board.
- Remove (5) screws.



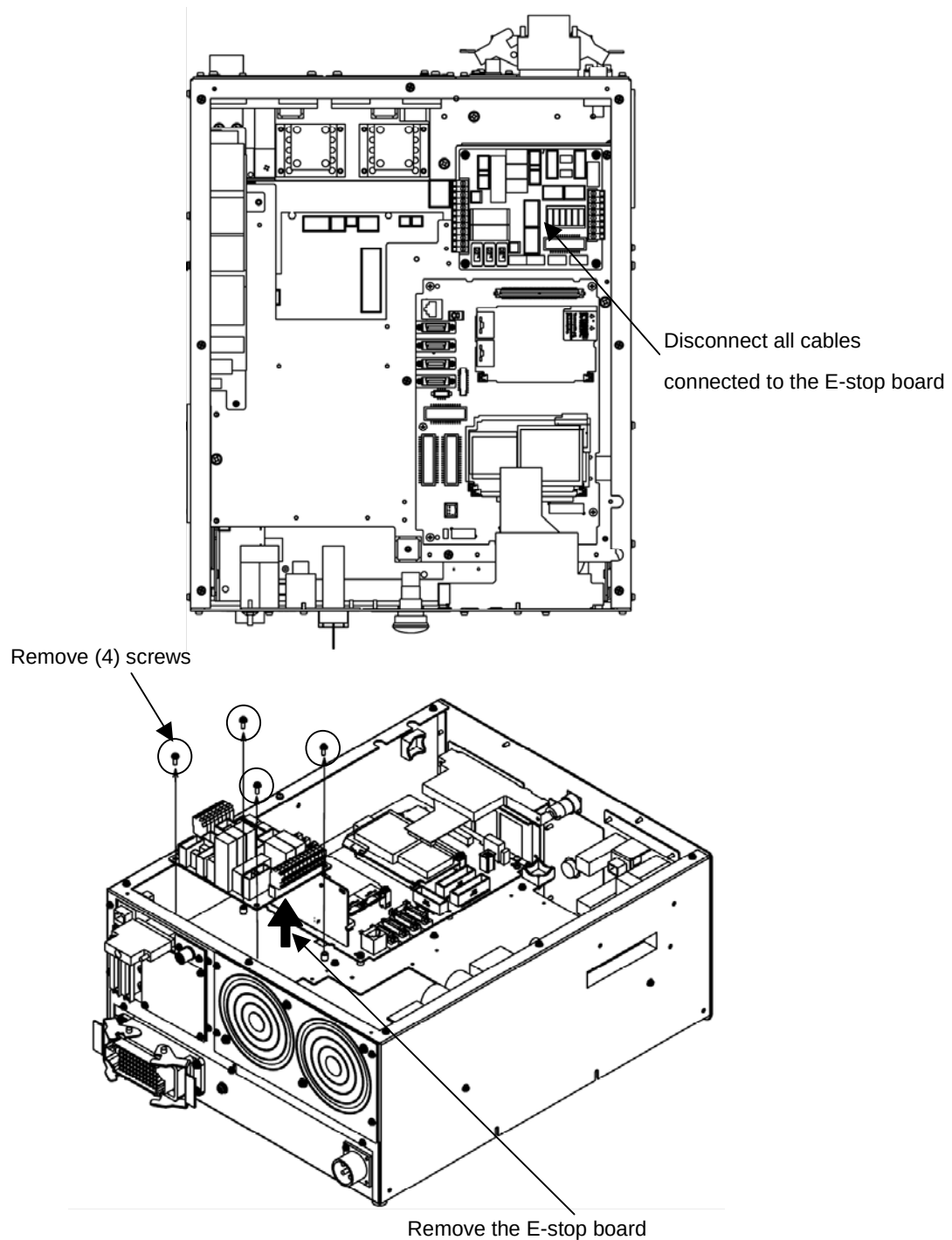
- Remove the Backplane and the battery.  
(Refer to II .MAINTENANCE 3.2 before removing the battery.)
- Remove (5) screws.
- Remove the Main board.





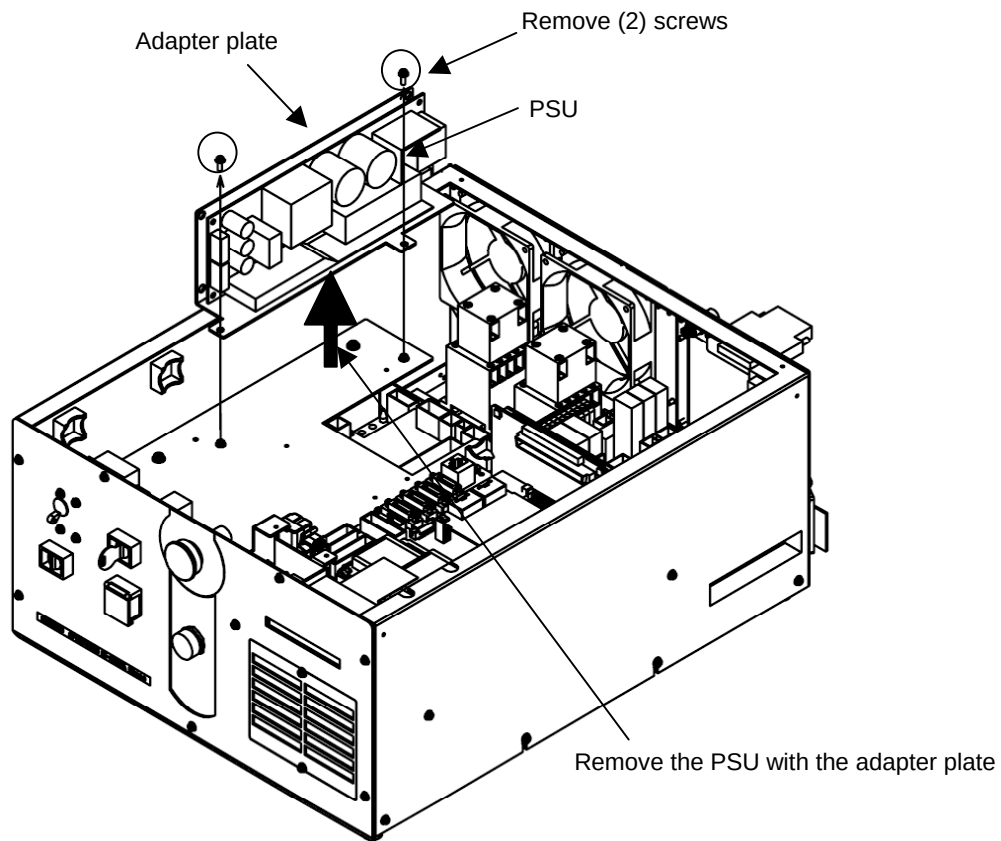
## B.2.3 Remove the E-stop Board

- Disconnect all cables connected to the E-stop board.
- Remove (4) screws.
- Remove the E-stop board.



## B.2.4 Remove the PSU

- Disconnect all cables connected to the PSU.
- Remove (2) screws.
- Remove the PSU with the adapter plate.



# C BRACKE RELEASE UNIT

## C.1 SAFETY PRECAUTIONS

### ⚠ WARNING

Support the robot arm by mechanical means to prevent it from falling down or rising up when brake is released. Before using the brake release unit, read the Operator's manual of the robot that tries to release the brake. Confirm that the robot is fixed tightly to the floor to prevent the falling down and unexpected movement of robot. Confirm that the outlet with earth is used for the power supply of brake release unit and earth of brake release unit is surely connected to earth of power supply. There is danger of getting an electric shock if earth is not connected.

## C.2 CONFIRMATIONS BEFORE OPERATION

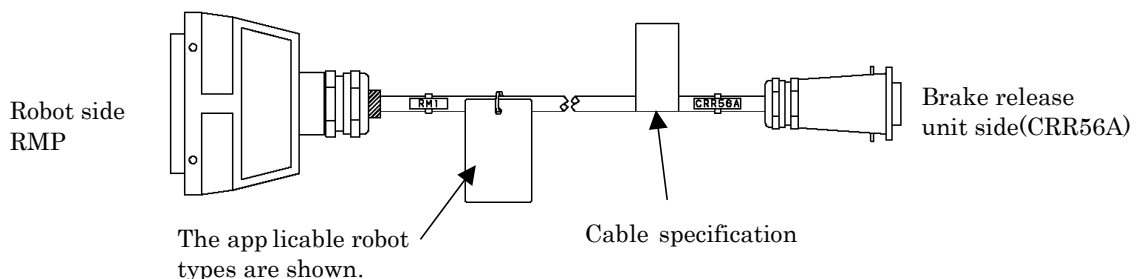
Confirm the followings before operation.

- (1) Confirm the exterior of the brake release unit and the power cable. Do not use it when there are damages in the unit and the cable.
- (2) Confirm that the power supply of the robot controller is disconnected.
- (3) There are Two types of brake release units according to the input voltage as shown in Table C.2(a). Confirm the input voltage of the unit to refer to the input voltage label put to the unit (Fig.C.5(a)).
- (4) Confirm that the voltage of power supply before connecting the power supply to the brake release unit. There is possibility to give the damaging to the brake or the brake release unit when the incorrect power supply is connected to the unit.

**Table C.2 (a) Specification of Brake release unit**

| Brake release unit           | Remarks                                |
|------------------------------|----------------------------------------|
| Brake release unit (AC 100V) | Input voltage AC100-115V, single phase |
| Brake release unit (AC 200V) | Input voltage AC200-240V, single phase |

- (5) The brake release unit connection cable is different in each robot. Confirm the cable specification corresponding to the robot referring to Table C.2 (b).



**Fig.C.2 Brake release unit connection cable**

**Table C.2 (b) Specification of brake release unit connection cable**

| Applicable robot types | Specification of cable |
|------------------------|------------------------|
| LR Mate 200iC, M-1iA   | A660-2006-T474         |
| M-3iA                  | A660-2006-T559         |

## C.3 OPERATION

Operate the brake release unit according to the following procedures.

- (1) Support the robot arm by mechanical means to prevent it from falling down or rising up when brake is released. Refer to the Operator's manual for each robot.
- (2) Connect the Brake Release Unit connection cable to Brake Release Unit.
- (3) Disconnect the RMP connector from Robot, and connect the Brake Release Unit connection cable to the Robot. Keep the connection of Robot connection cable except RMP cable.
- (4) Connect the power cable of Brake release unit to power supply.
- (5) Press and hold the deadman switch in the middle position.
- (6) Press the brake switch '1'..'6' according to the axis that tries to release the brake, then brake will be released. (Refer to Table C.3) Two axes or more cannot be operated at the same time.

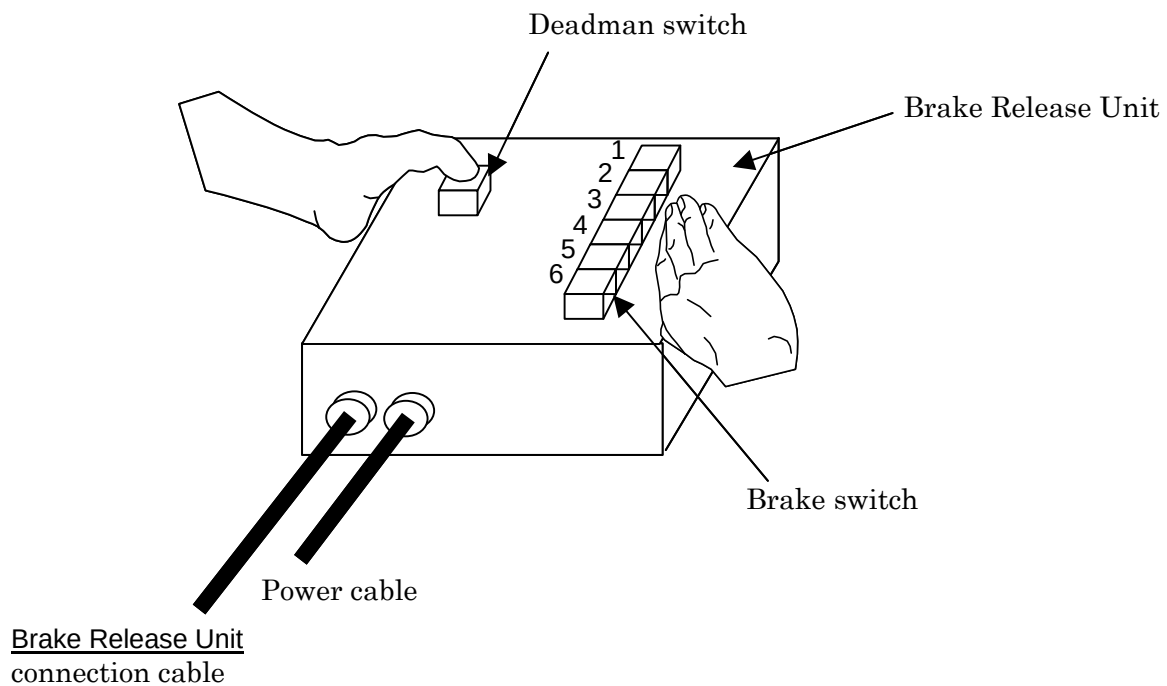


Fig.C.3 (a) Brake Release Unit

Table C.3 The relation between brake switch and robot axis

|                                                               | Brake switch |    |    |    |    |    |
|---------------------------------------------------------------|--------------|----|----|----|----|----|
|                                                               | 1            | 2  | 3  | 4  | 5  | 6  |
| LR Mate 200iC(6 axes), M-1iA/0.5A(6 axes)<br>M-3iA/6A(6 axes) | J1           | J2 | J3 | J4 | J5 | J6 |
| LR Mate 200iC(5 axes)                                         | J1           | J2 | J3 | -  | J4 | J5 |
| M-1iA/0.5S(4 axes), M-3iA/6S(4 axes)                          | J1           | J2 | J3 | J4 | -  | -  |

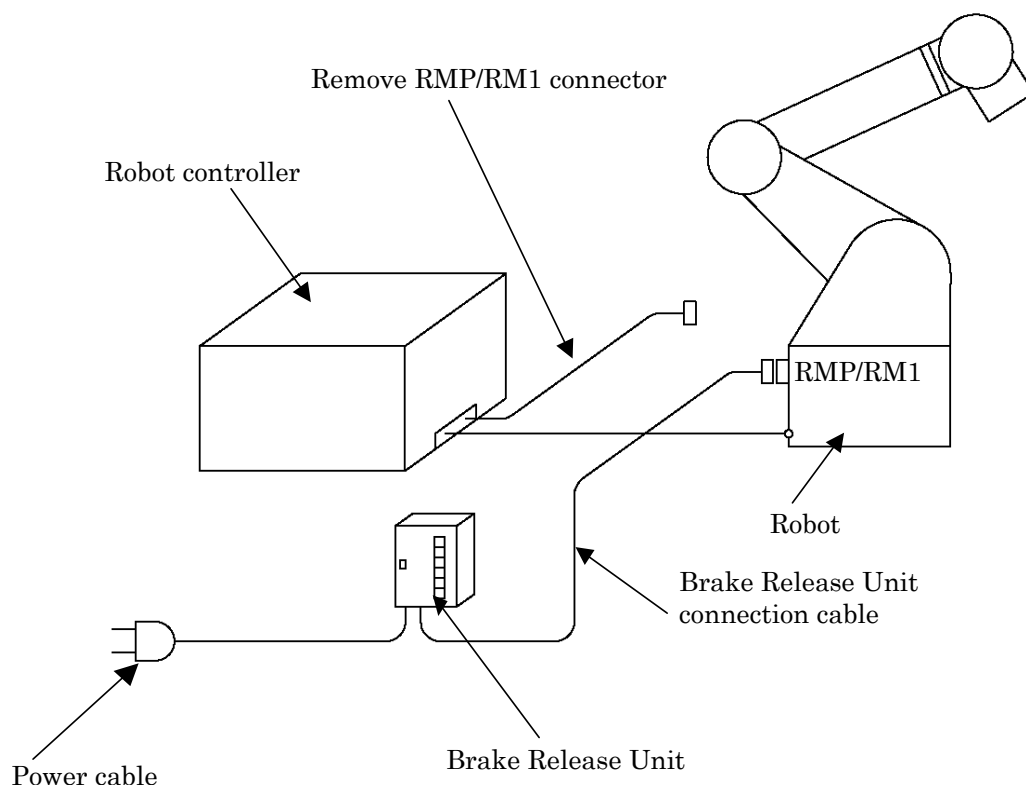


Fig.C.3 (b) How to connect Brake Release Unit

## C.4 HOW TO CONNECT THE PLUG TO THE POWER CABLE (IN CASE OF NO POWER PLUG)

Connect the plug to the power cable as follows. This plug is provided by customer.

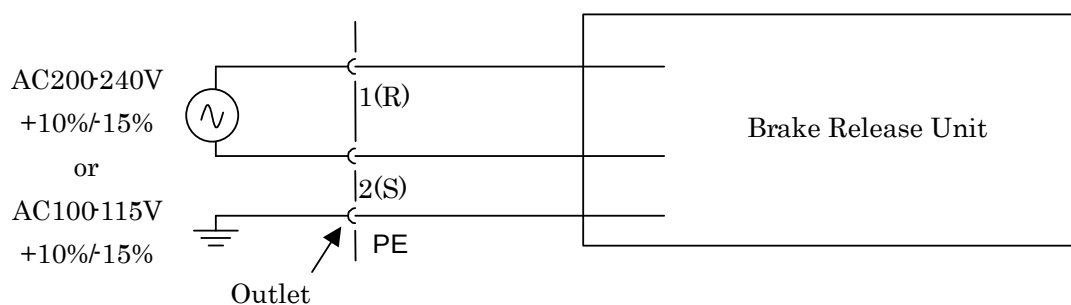
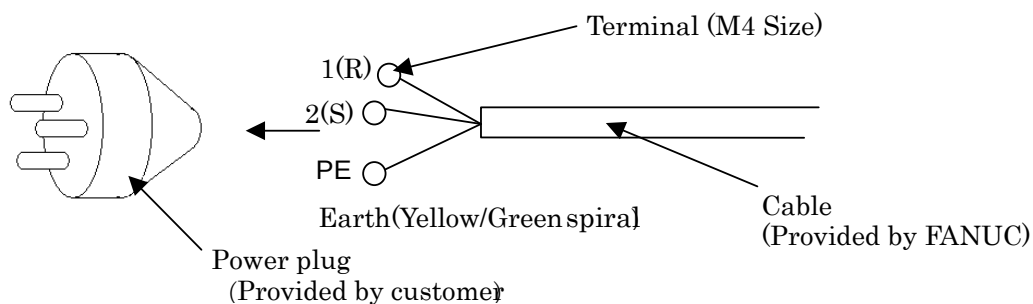


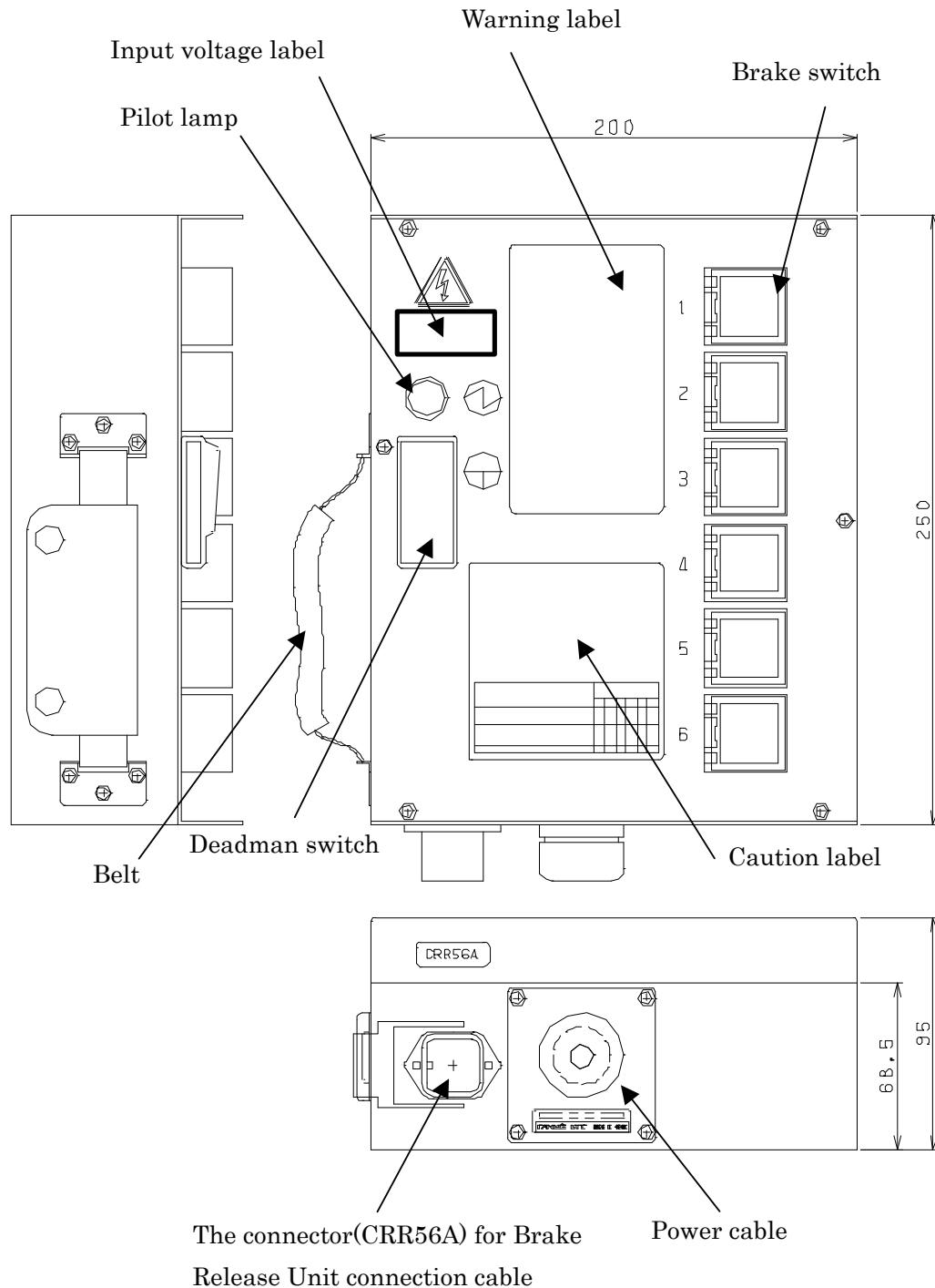
Fig.C.4 How to connect the plug to the power cable

**⚠ WARNING**

Only a specialist having the relevant expertise knowledge is permitted to connect the plug to the power cable.

In the EU area, only plug complying with the relevant European product standard can be used.

Do not install the plugs without protective earth pin.

**C.5 DIMENSION**

**Fig.C.5 (a) Dimension of Brake Release Unit (Front view)**

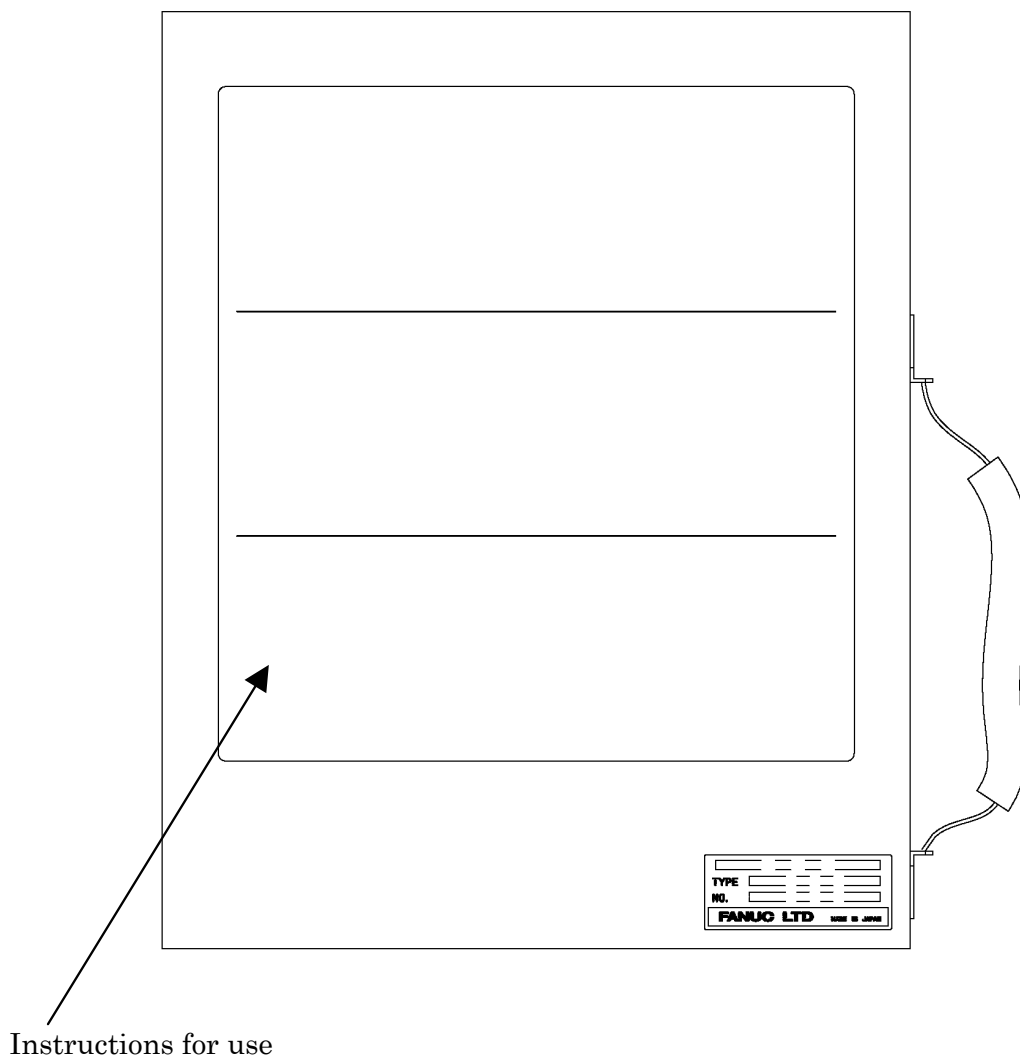


Fig.C.5 (b) Dimension of Brake Release Unit(Rear view)

## C.6 FUSE

The fuses are mounted inside this unit. Please check the fuse when the pilot lamp doesn't light even if deadman switch is pressed. When the fuse is blown, exchange the fuse after finding the root cause of failure, and taking the appropriate countermeasures.

Manufacturer : Daito Communication Co.  
Specification : P420H (FANUC Spec. : A60L-0001-0101#P420H)  
Rating : 2A

**⚠ WARNING**

When the fuse is replaced, the power cable of brake release unit must be disconnected.

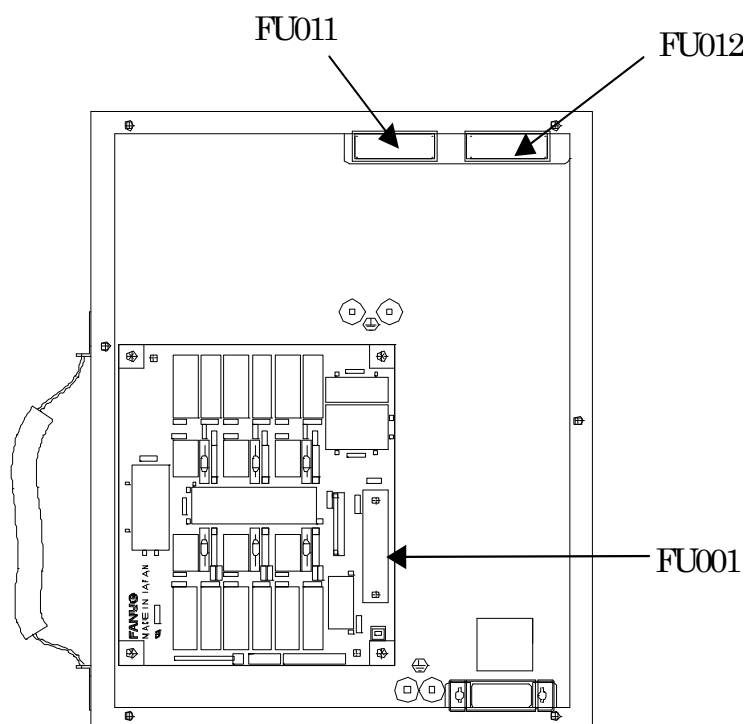


Fig.C.6 The location of fuses

## C.7 SPECIFICATIONS

### Input power supply

AC100-115V, 50/60Hz $\pm$ 1Hz, single phase, +10%/-15%, 1A

AC200-240V, 50/60Hz $\pm$ 1Hz, single phase, +10%/-15%, 1A

### Weight

Brake Release Unit (AC 100V) ; 2.3 kg

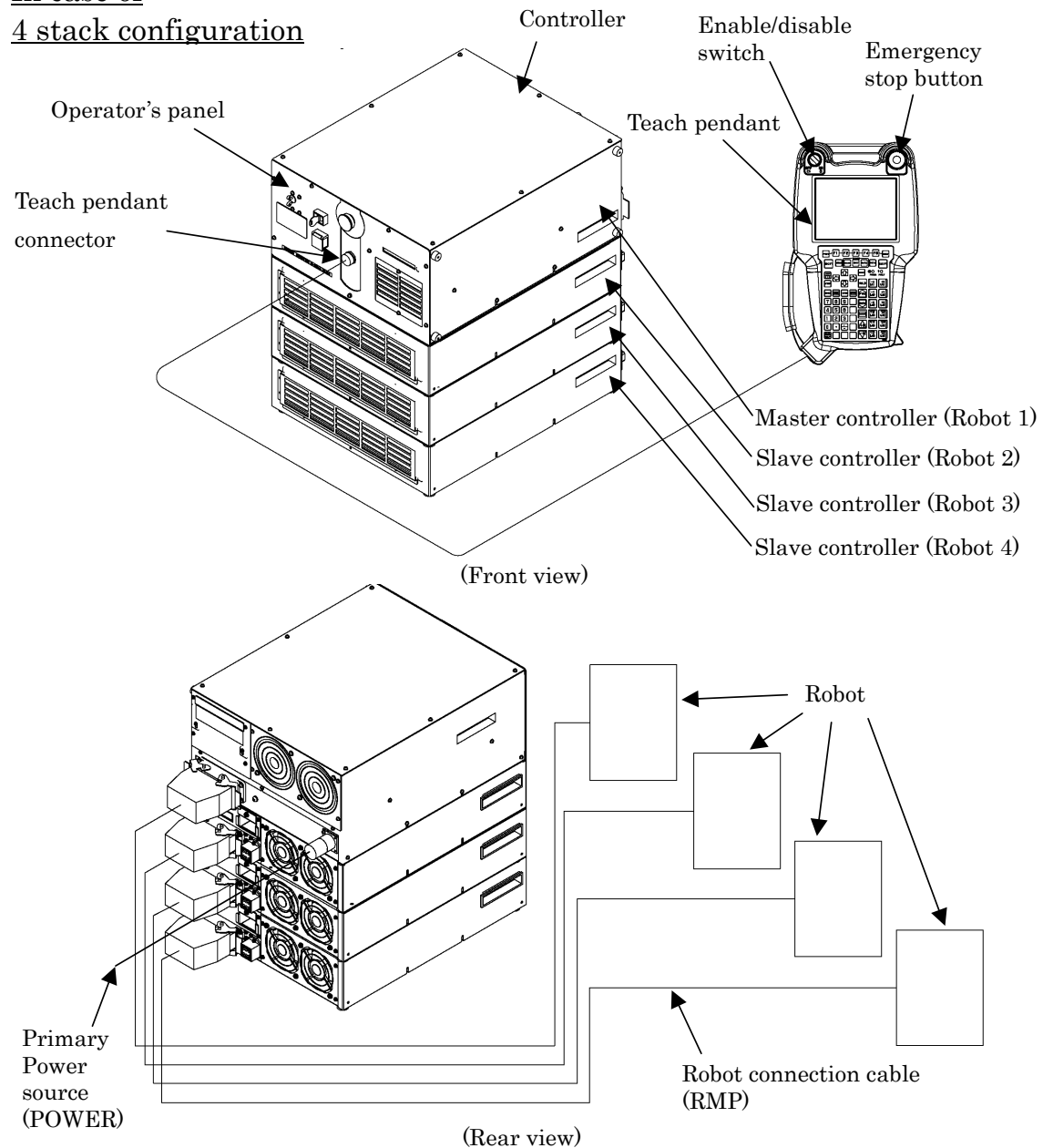
Brake Release Unit (AC 200V) ; 3.5 kg



# D MULTI-ARM

## D.1 CONFIGURATION

In case of  
4 stack configuration



### ⚠ WARNING

1. Do not touch radiation of heat fins of controller. Their hot surfaces may cause severe burns.
2. Do not insert fingers or foreign objects into controller. Doing so may cause electric shock or bodily injury.
3. Do not place anything on the controller.

## D.2 REPLACING PROCEDURE

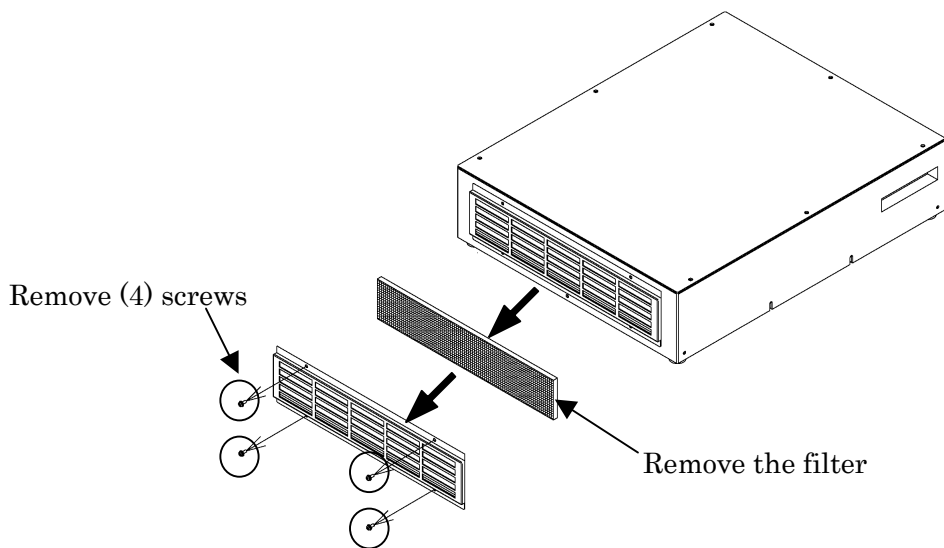


### WARNING

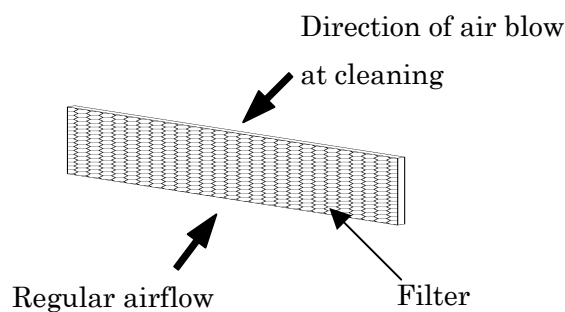
Before opening the controller cover and accessing the inside of the controller for maintenance, be sure to turn off the power switch, disconnect the power cable, and wait 1 minute or more. This is for protecting you from electric shock.

### D.2.1 Cleaning the Filter

- Remove (4) screws.
- Remove the plate and filter.



- Blow compressed air to the filter in the direction opposite to the regular airflow.



- If the filter is excessively dirty, wash it with water or warm water (40°C or lower). A neutral detergent is most effective.



### CAUTION

Use dehumidified, oil-free, pure compressed air for cleaning.

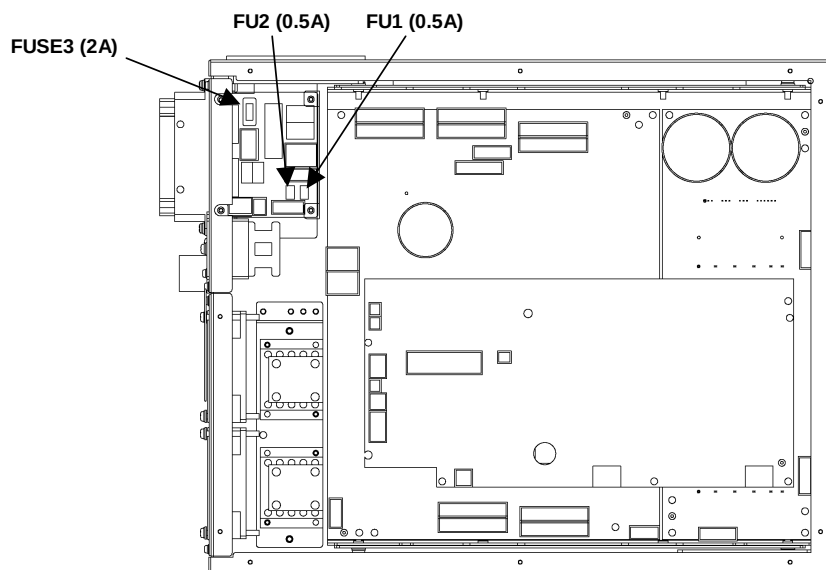


### CAUTION

Dry the washed filter completely before replacing it. If the filter is still dirty after air blowing or washing, replace it with new one.

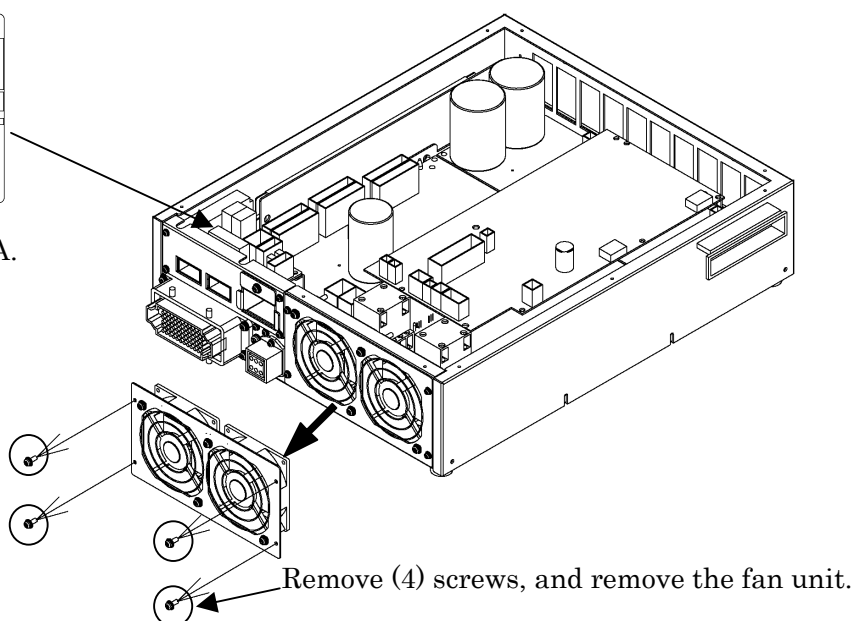
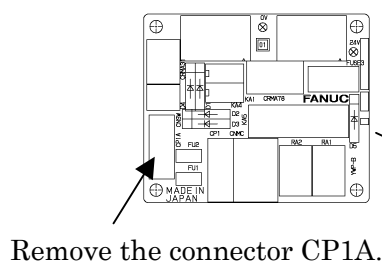
## D.2.2 Replacing the Fuses

- The fuses in the servo amplifier  
Refer to Section 3.3 in part II “MAINTENANCE”.
- The following fuses are in the E-STOP board.  
FUSE3 : For protecting +24V to the power supply unit : A60L-0001-0075#5.0  
FU1,FU2 : For protection of the fan motor input : A60L-0001-0175#0.5A  
Spare-fuse-kit specification : A05B-2557-K001



## D.2.3 Replacing The Fan Unit

- Remove the connector CP1A on the E-STOP board.
- Remove (4) screws, and remove the fan unit.



## D.3 INSTALLATION

### D.3.1 Slave Controller Dimension

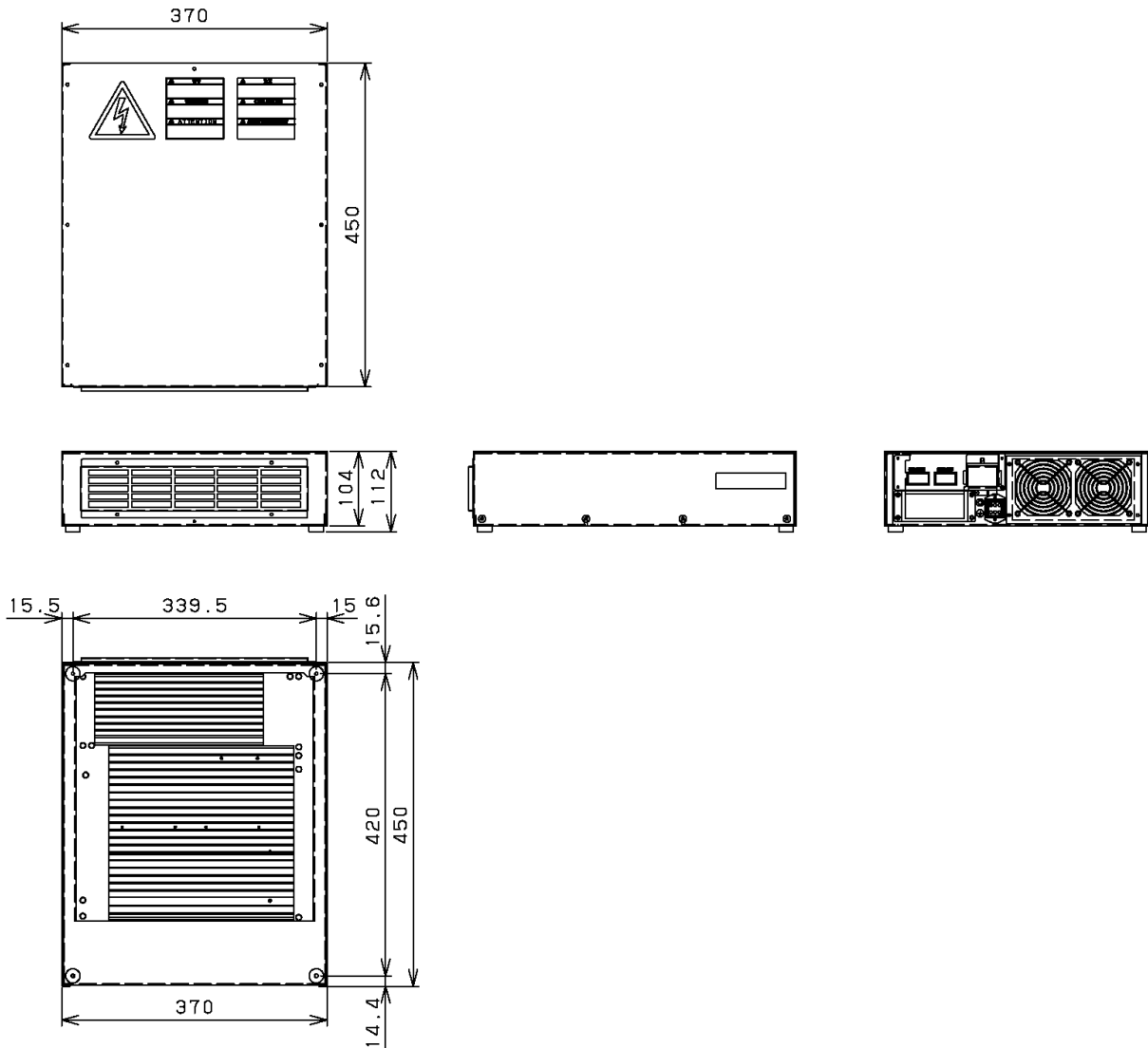


Fig.D.3.1 External dimension

Mass of controller      Approx. 13kg



#### WARNING

This controller is not designed to be dust-proof, splash-proof, or explosion-proof.

### D.3.2 Stack Controller Dimension

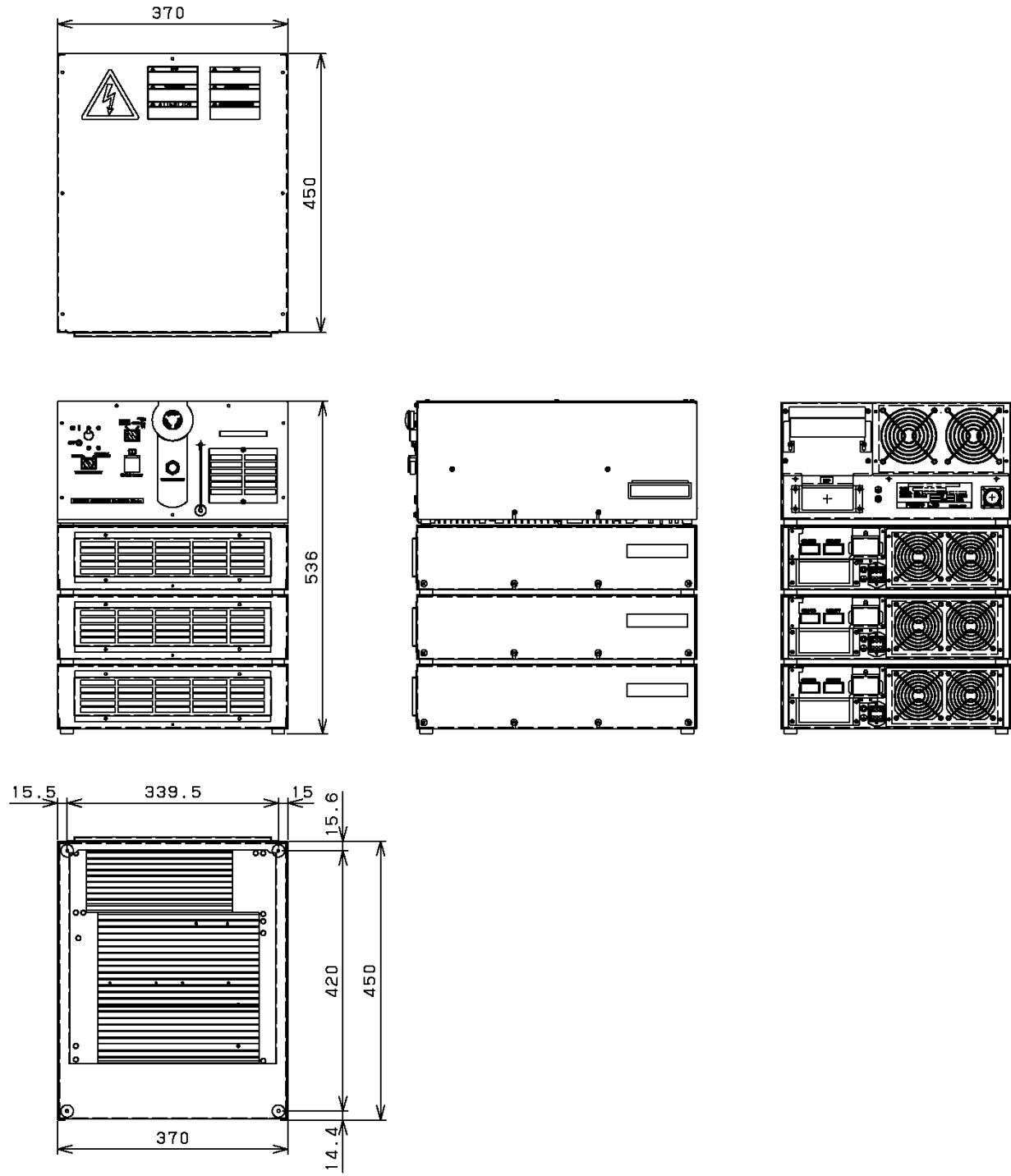


Fig.D.3.2 Stack controller dimension

### D.3.3 Installation of Cabinet Connection Cable

Master-Slave connection cables are removed from the slave controller when controller is shipped from factory. Slave-Slave connection cables and terminators are annex to the master controller. Fig. D.3.3 (a), (b) show the connection at customer site.

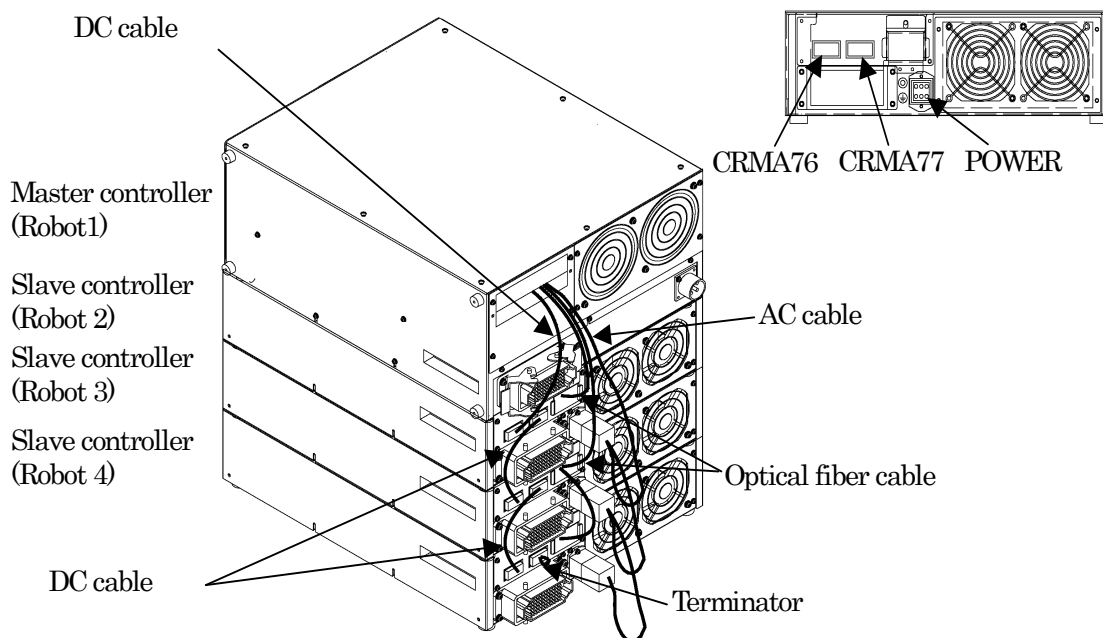


Fig.D.3.3 (a) Installation of the cabinet connection cables

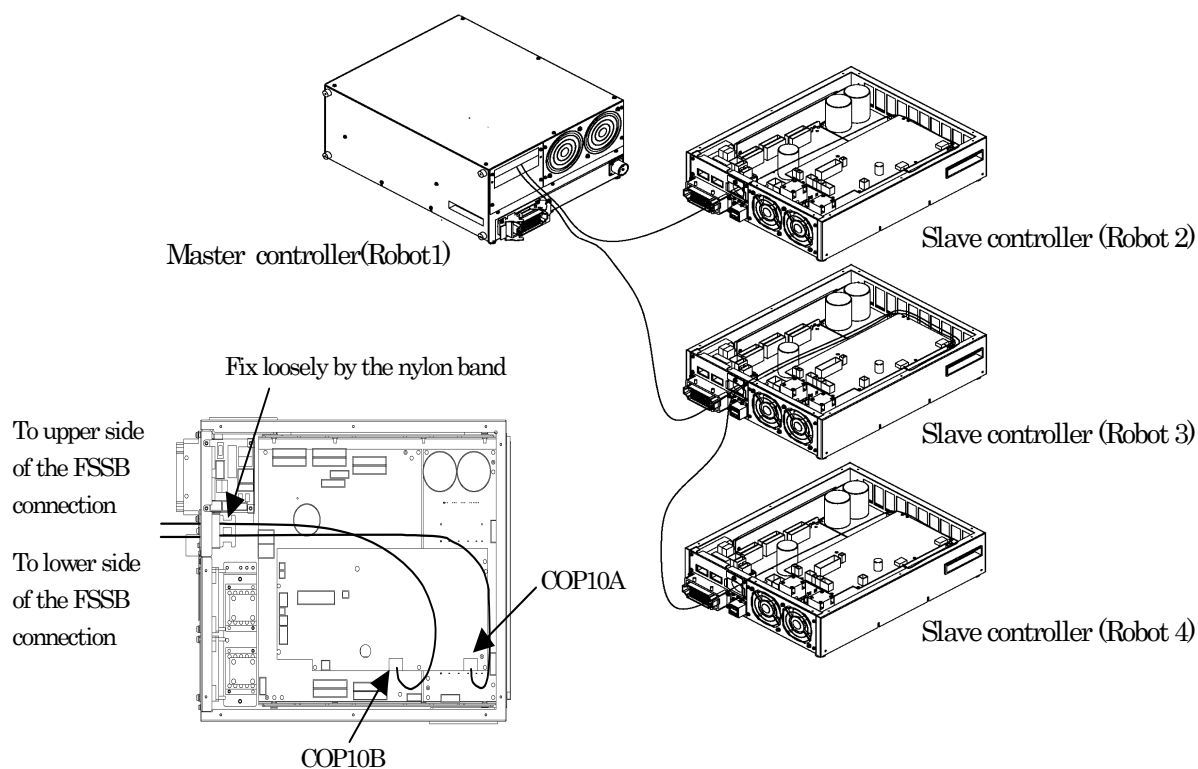
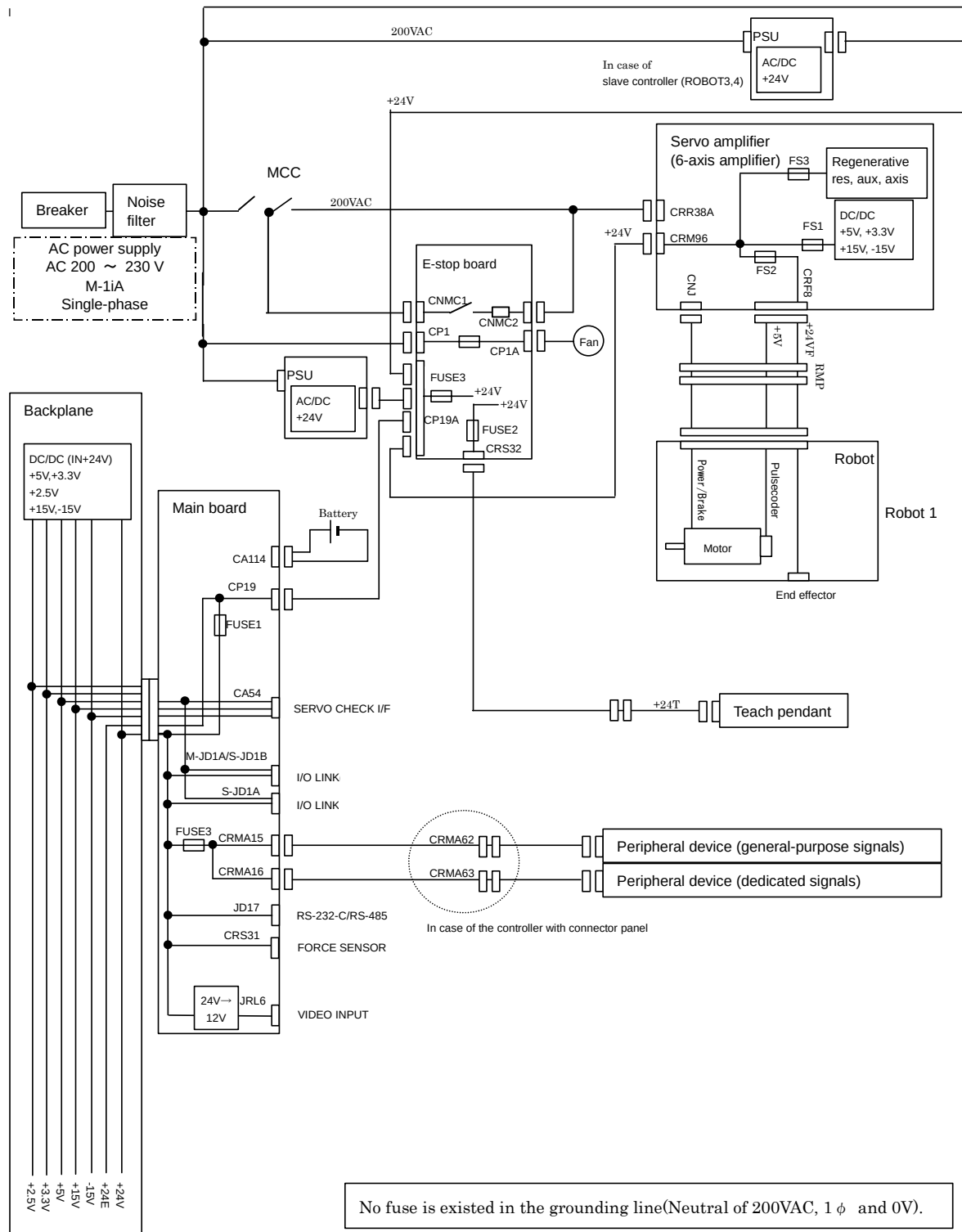


Fig.D.3.3 (b) Installation of the optical fiber cable

## D.4 TOTAL CONNECTION DIAGRAM



**Fig.D.4 (a) Block diagram of the power supply (CE/RIA master controller)**

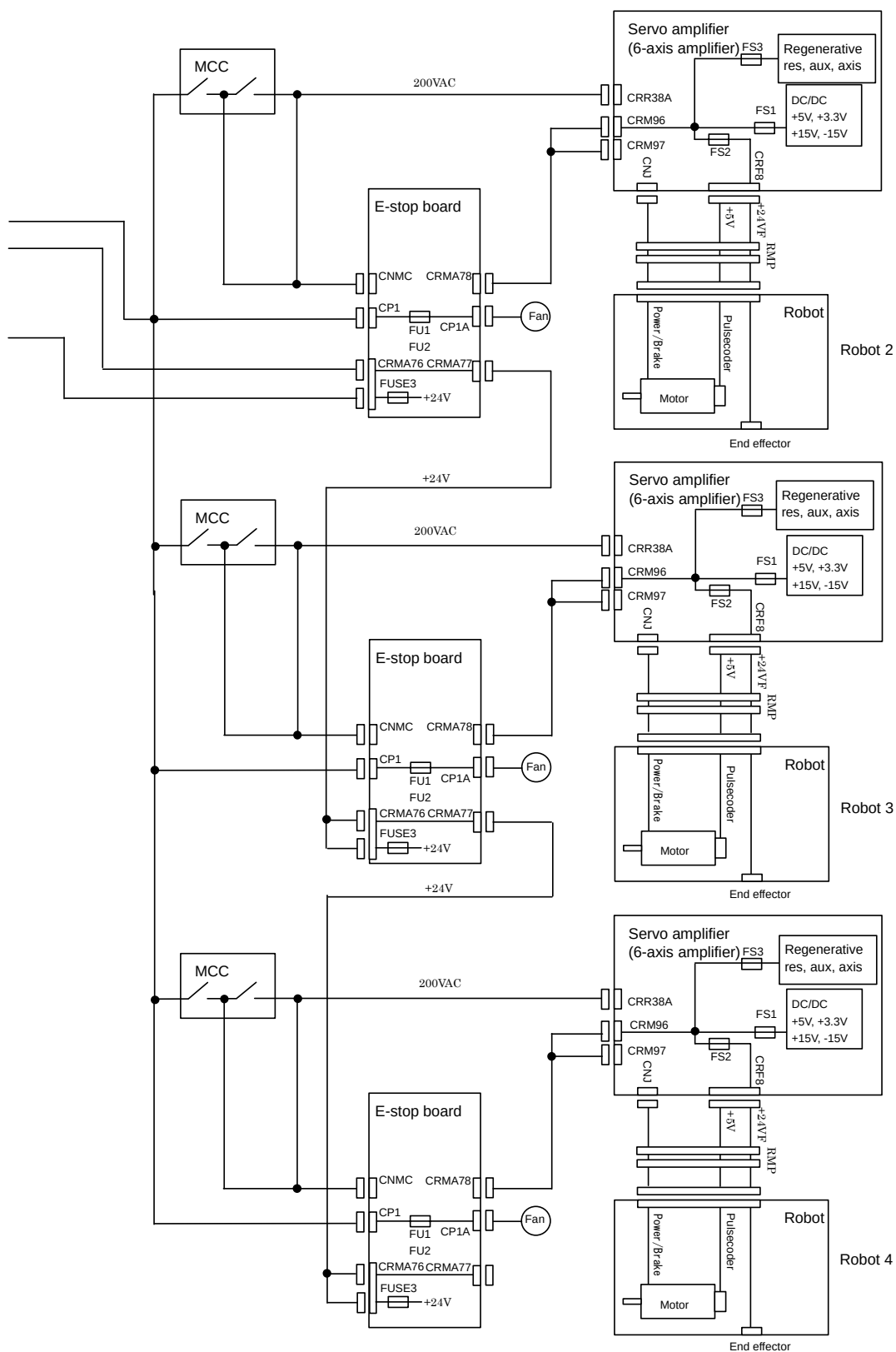
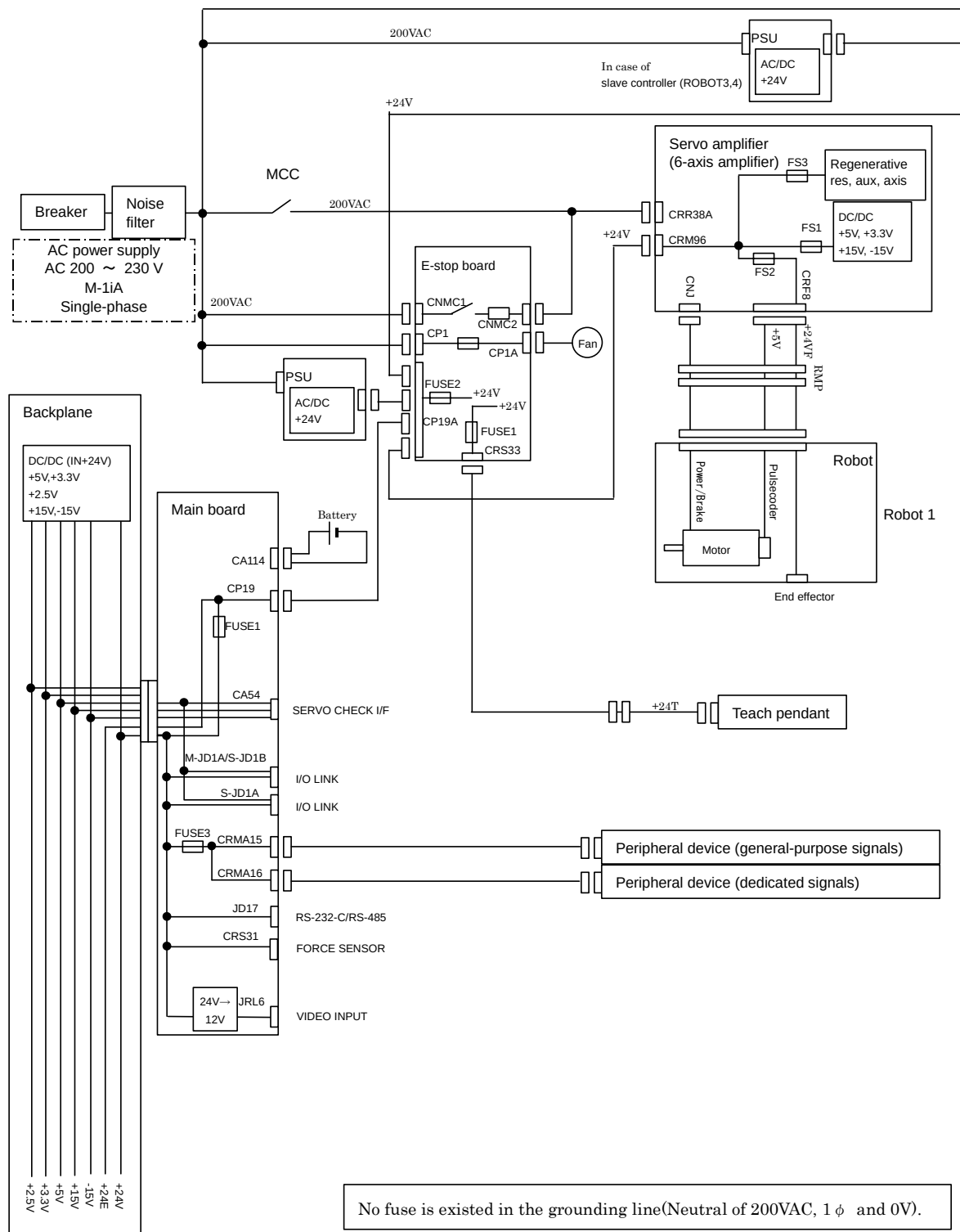
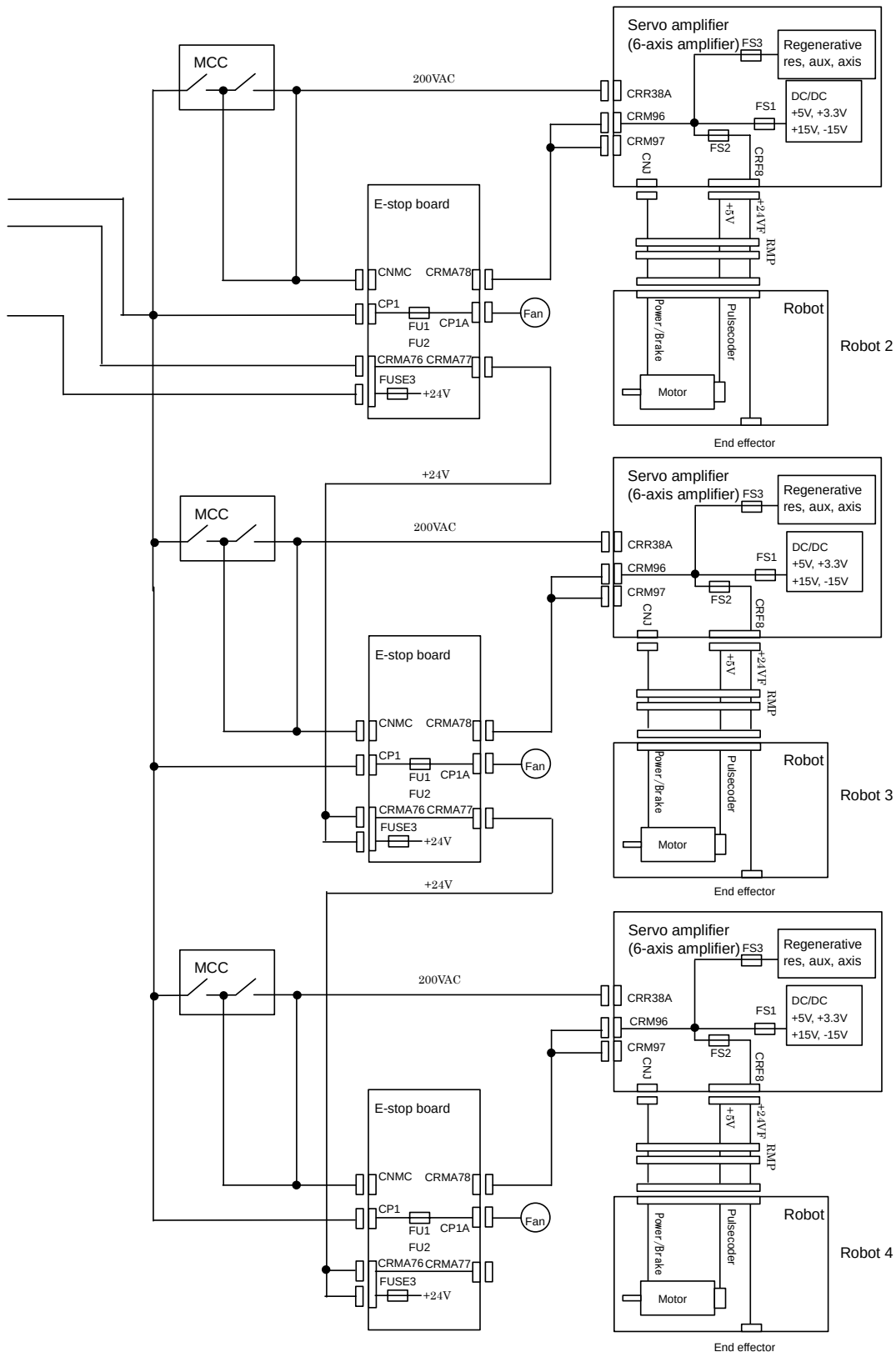


Fig.D.4 (b) Block diagram of the power supply (CE/RIA slave controller)

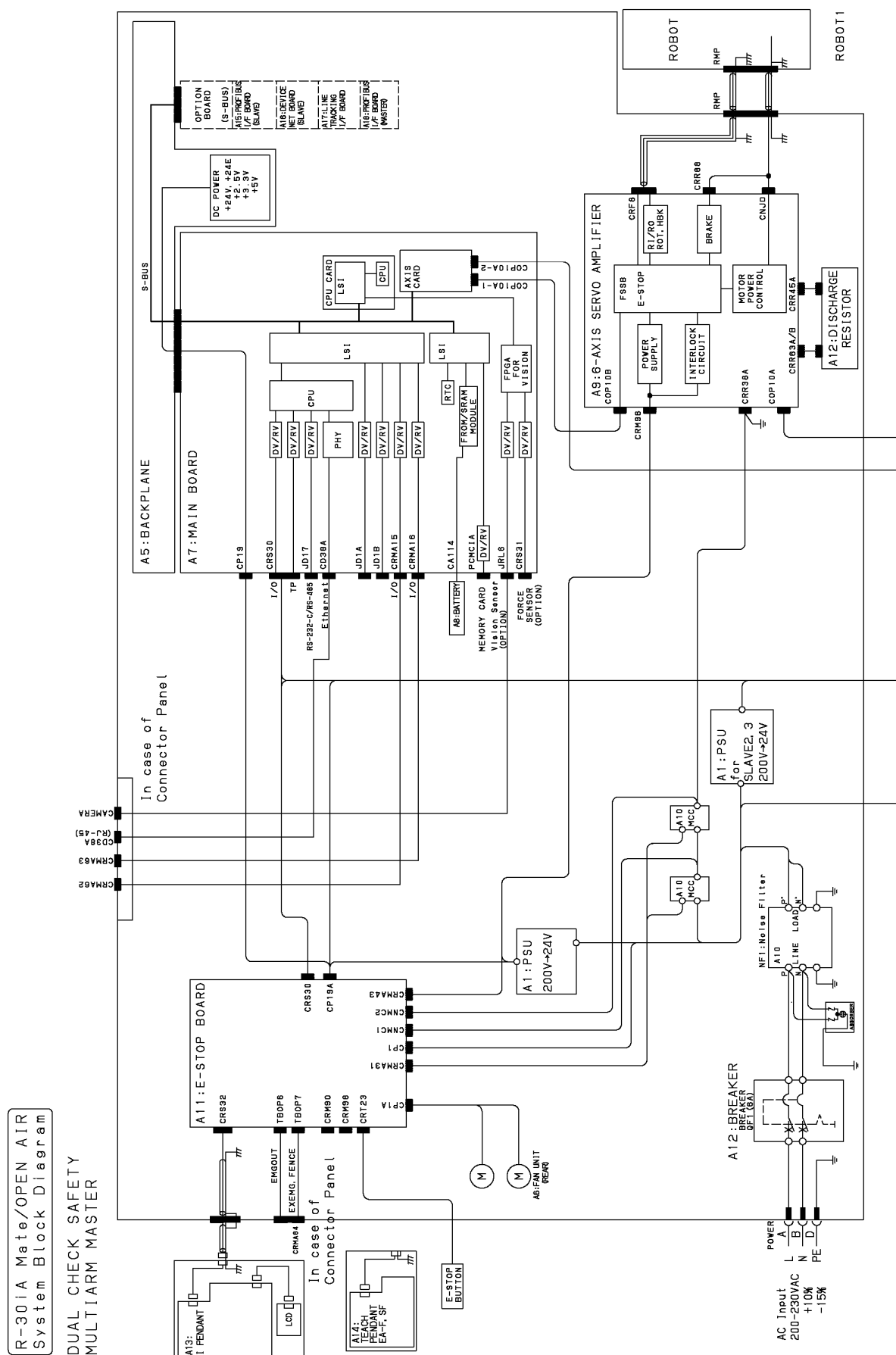




**Fig.D.4 (c) Block diagram of the power supply (STANDARD master controller)**



**Fig.D.4 (d) Block diagram of the power supply (STANDARD slave controller)**



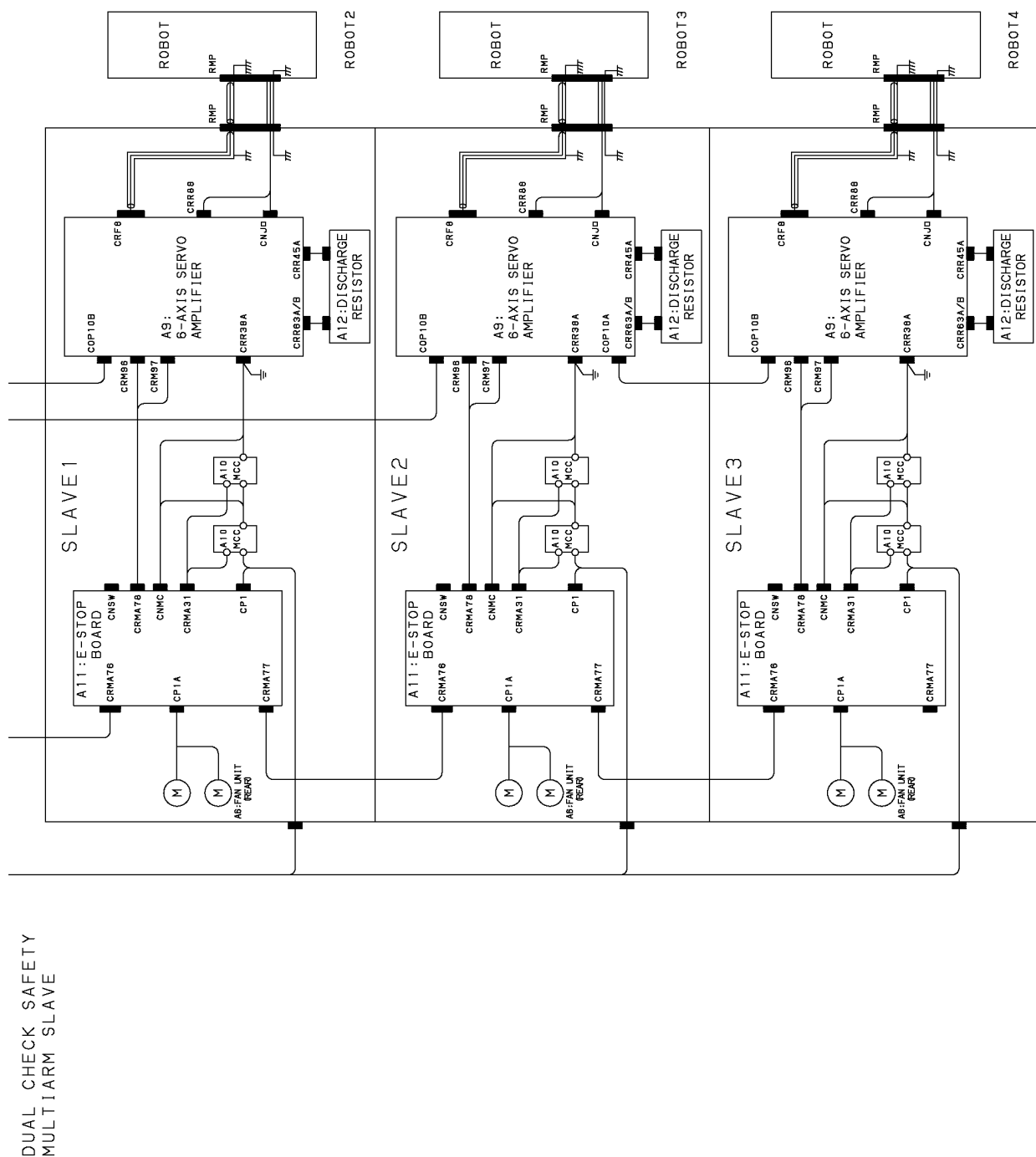


Fig.D.4 (f) System block diagram (CE/RIA slave controller)

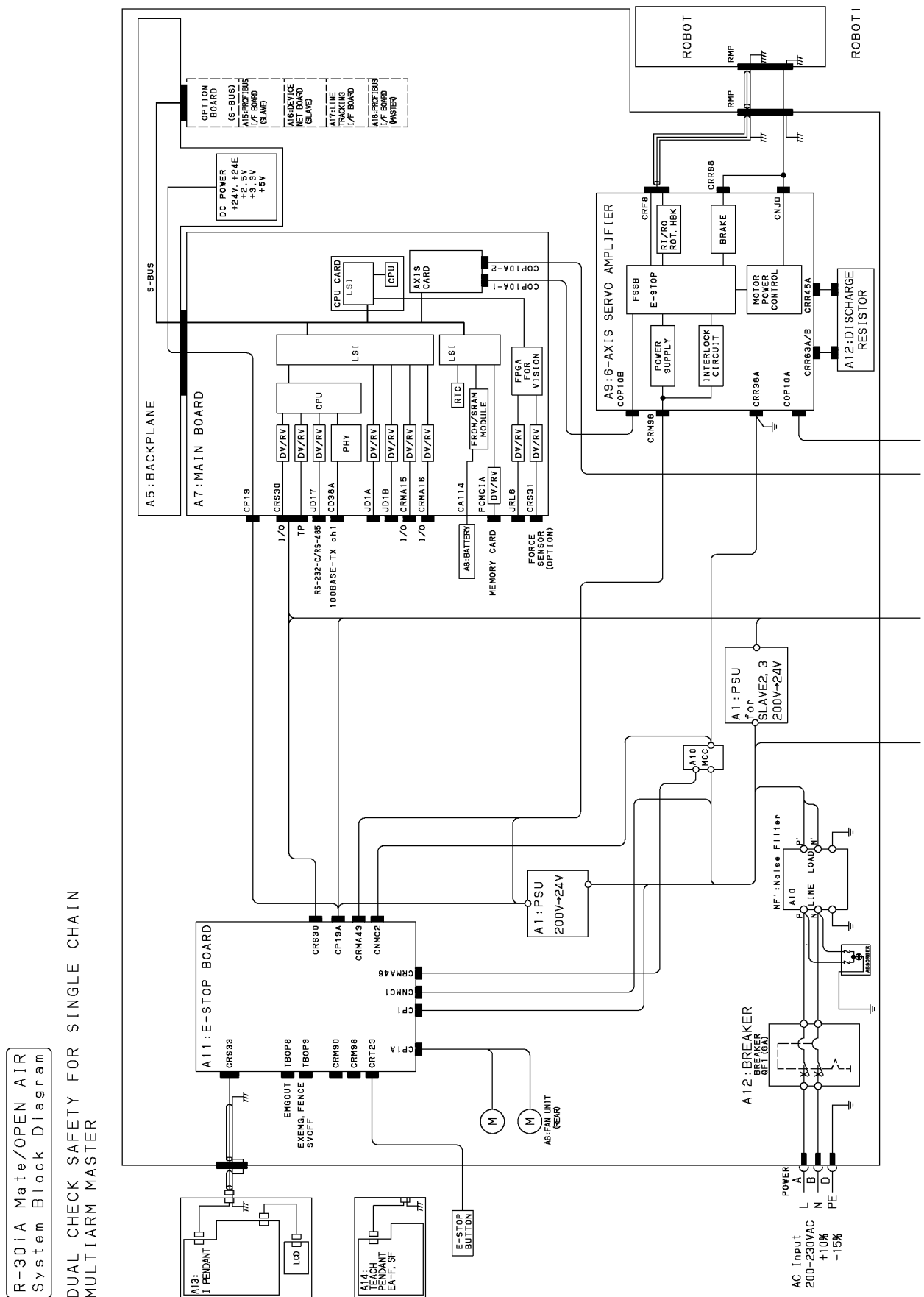
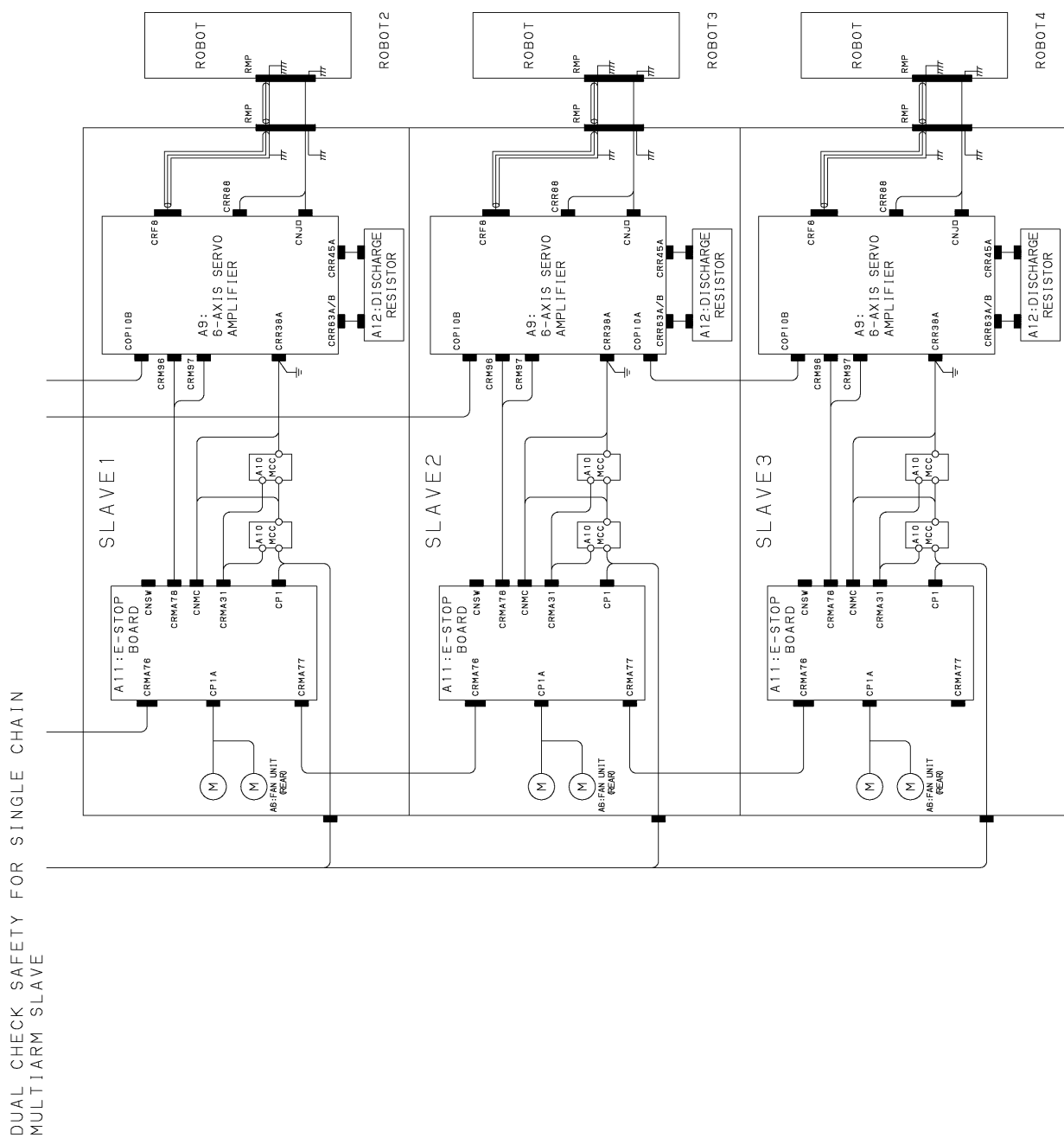


Fig.D.4 (g) System block diagram (STANDARD master controller)



**Fig.D.4 (h) System block diagram (STANDARD slave controller)**

E-STOP CIRCUIT <R-30iA Mate/OPEN AIR>  
Dual check safety  
MULTI ARM MASTER

DI: Simple DI  
PI: Photo coupler DI  
Not showing the diodes to protect  
from reverse electric power.

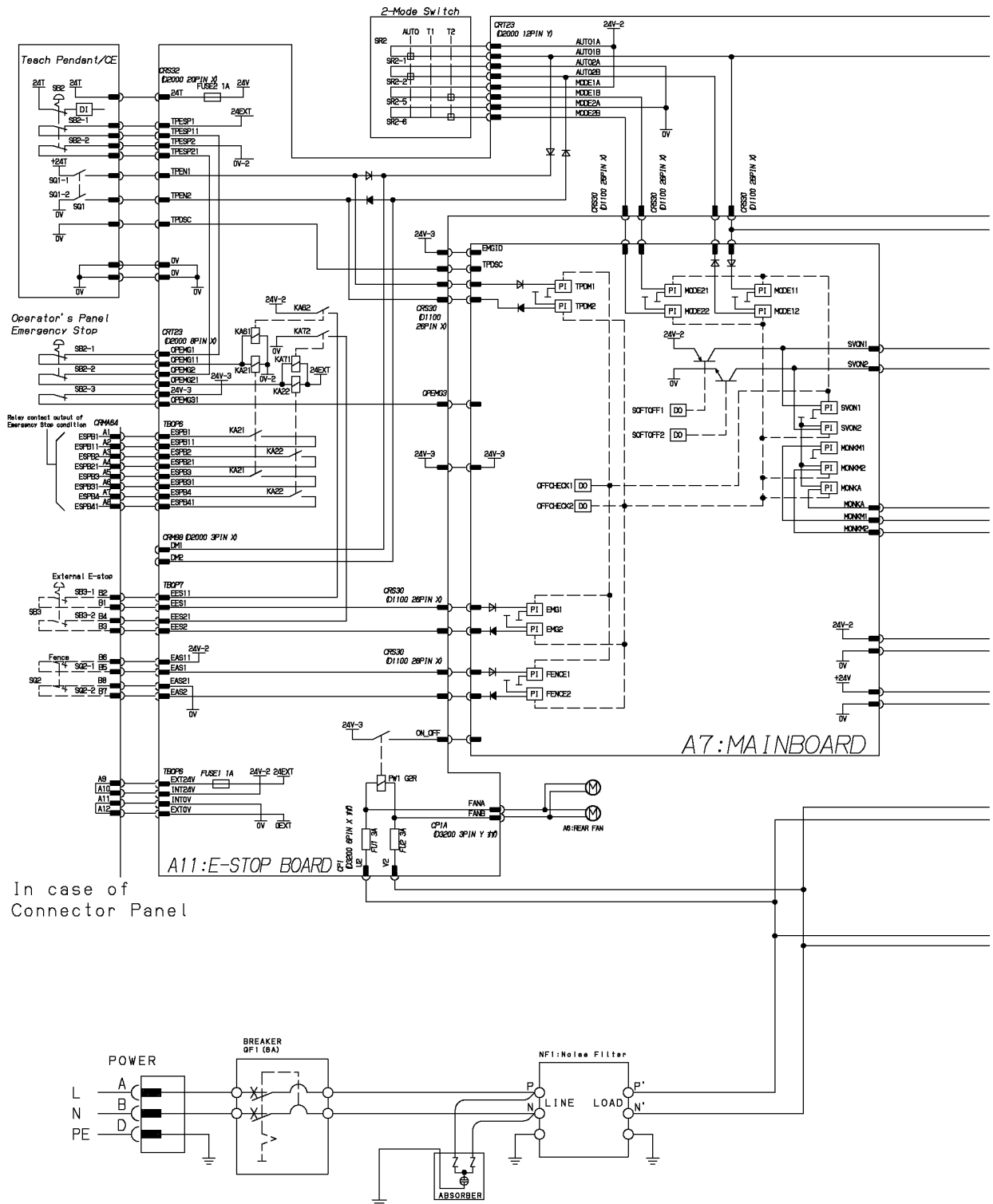


Fig.D.4 (i) E-stop circuit diagram (CE/RIA master controller)





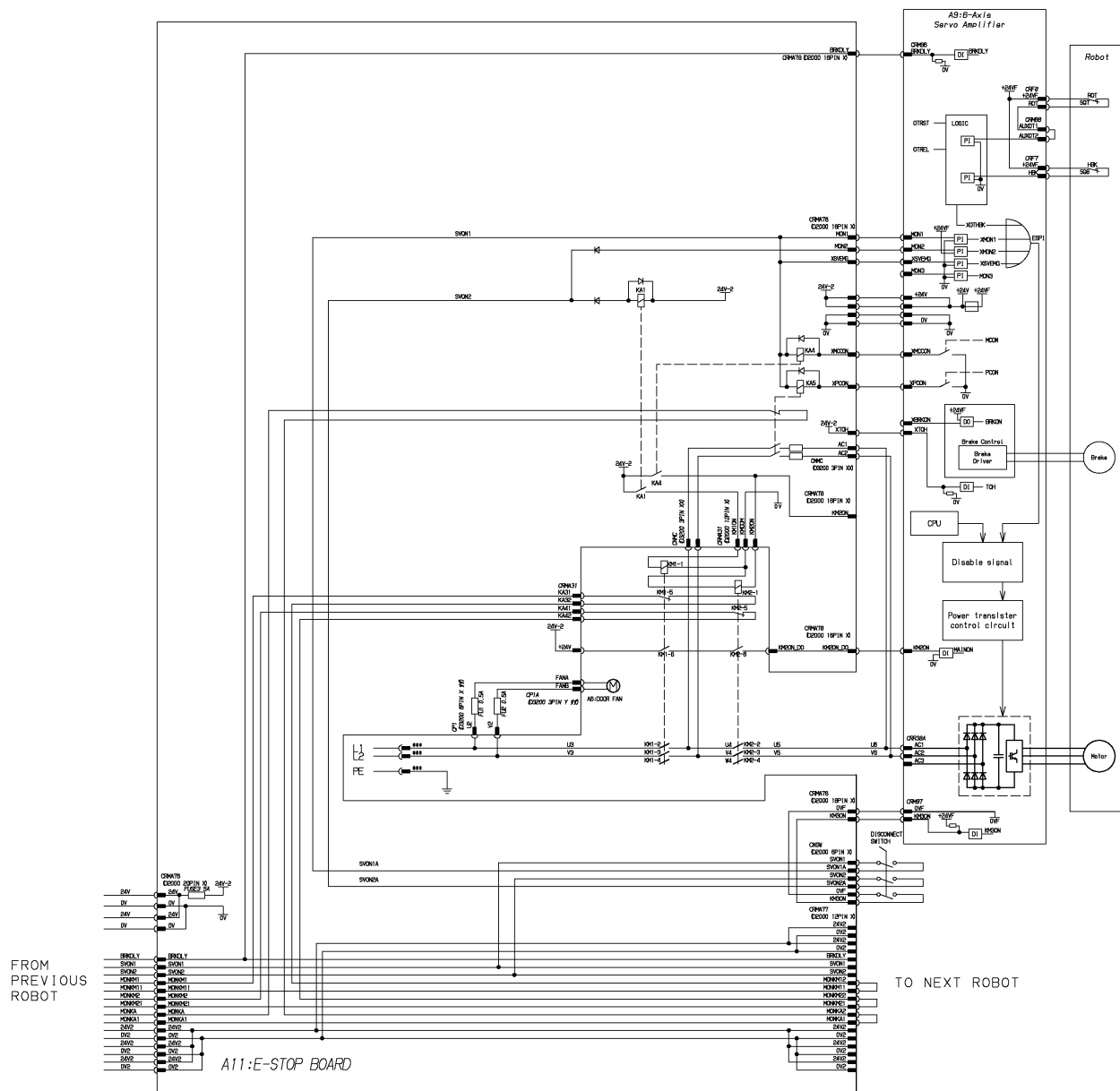


Fig.D.4 (j) E-stop circuit diagram (CE/RIA slave controller)

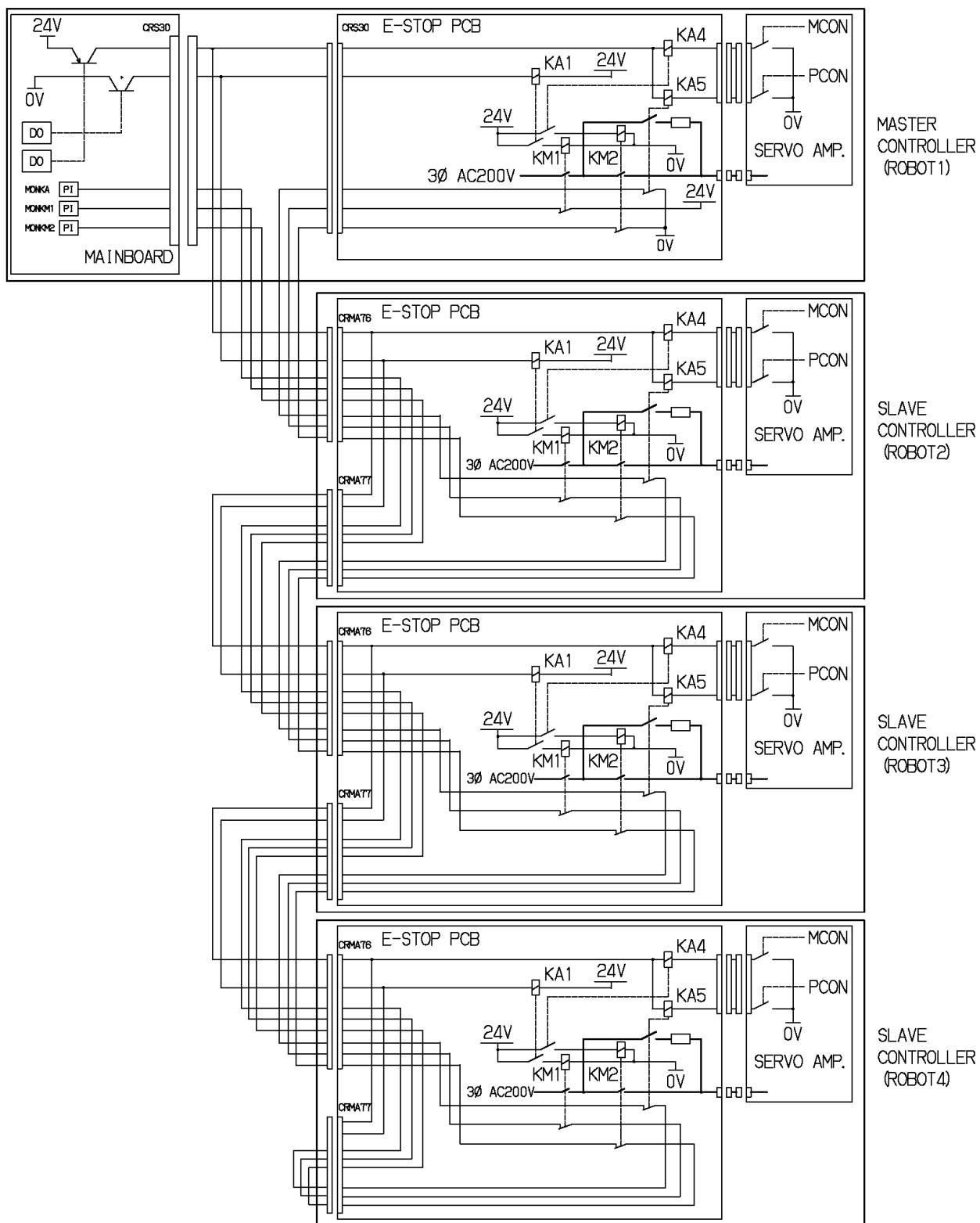
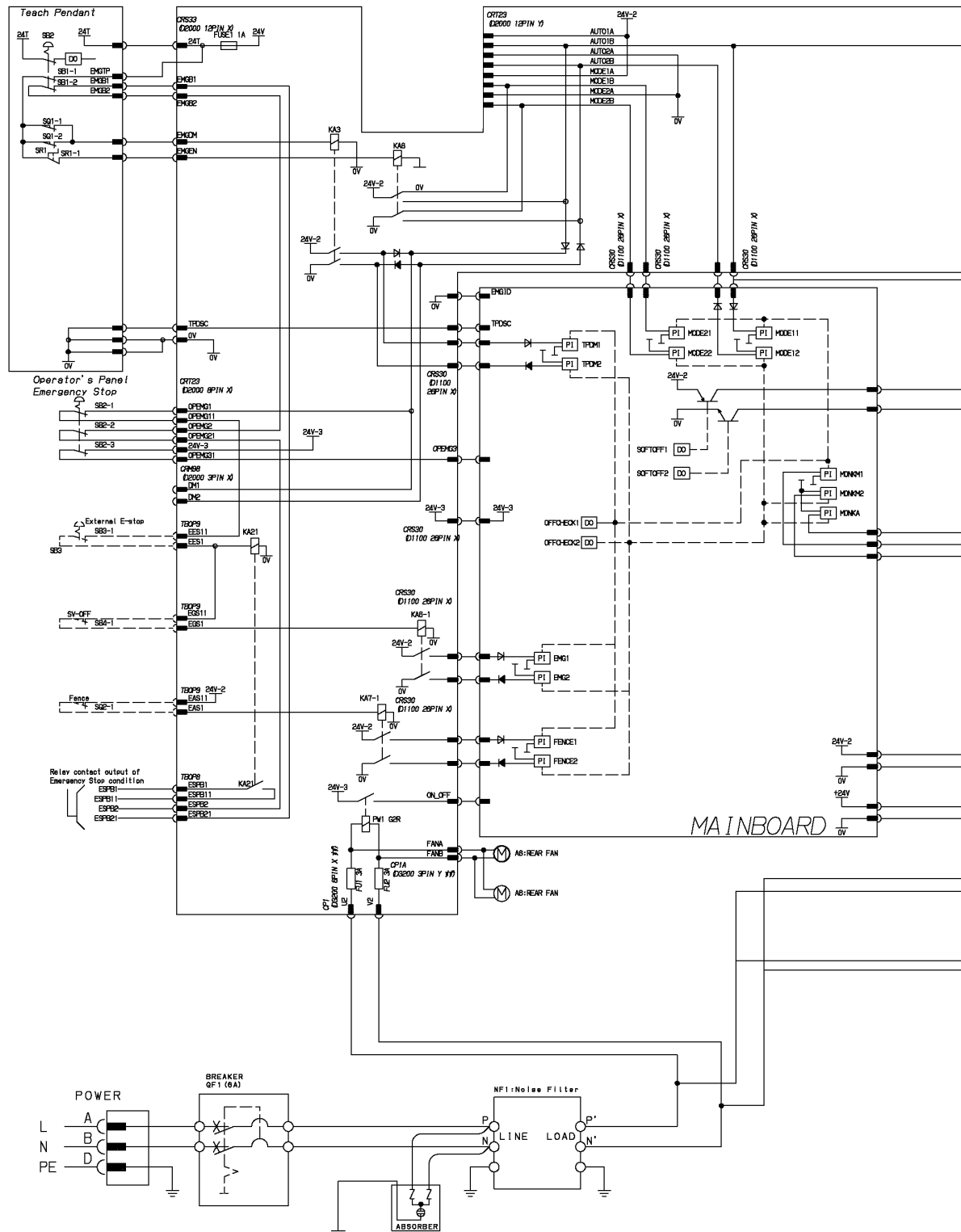


Fig.D.4 (k) E-stop signal diagram (CE/RIA 4 stack configuration)

```
DI:Simple DI
PI:Photo coupler DI
Not showing the diodes to protect
from reverse electric power.
```



**Fig.D.4 (I) E-stop circuit diagram (STANDARD master controller)**





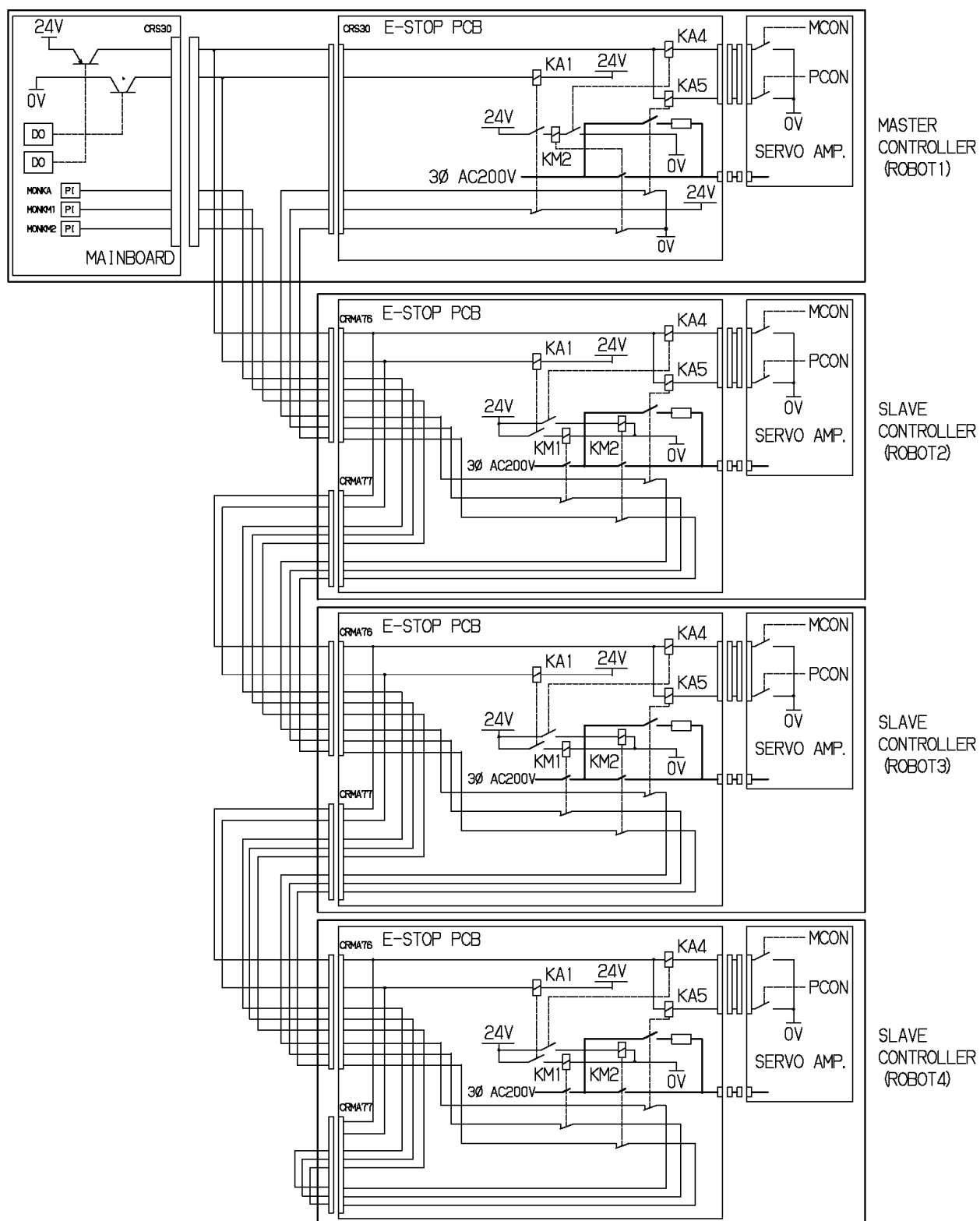


Fig.D.4 (n) E-stop signal diagram (STANDARD 4 stack configuration)

CRMA76

|    | A      | B       |
|----|--------|---------|
| 1  | 24V    | 0V      |
| 2  | 24V    | 0V      |
| 3  | SVON1  | SVON2   |
| 4  | MONKM1 | MONKM11 |
| 5  | MONKM2 | MONKM21 |
| 6  | MONKA  | MONKA1  |
| 7  | FG     | BKDLY   |
| 8  | 24V2   | 0V2     |
| 9  | 24V2   | 0V2     |
| 10 | 24V2   | 0V2     |

CRMA77

|    | A       | B       |
|----|---------|---------|
| 1  | 24V2    | 0V2     |
| 2  | 24V2    | 0V2     |
| 3  | SVON1   | SVON2   |
| 4  | MONKM12 | MONKM11 |
| 5  | MONKM22 | MONKM21 |
| 6  | MONKA2  | MONKA1  |
| 7  |         | BKDLY   |
| 8  | 24V2    | 0V2     |
| 9  | 24V2    | 0V2     |
| 10 |         |         |

CRMA78

|   | A      | B        |
|---|--------|----------|
| 1 | 24V    | 24V      |
| 2 | 0V     | 0V       |
| 3 | XSVEMG | MON1     |
| 4 | MON2   | KM20N    |
| 5 | XPCON  | XMCCON   |
| 6 | KM30N  | XTOH     |
| 7 | BKDLY  | KM20N_DO |
| 8 | BRKON  | 0VF      |

CNSW

|   | A      | B      |
|---|--------|--------|
| 1 | SVON1  | SVON2  |
| 2 | SVON1A | SVON2A |
| 3 | 0VF    | KM30N  |

CRMA31

|   | A     | B        |
|---|-------|----------|
| 1 | KA31  | KA32     |
| 2 | KA41  | KA42     |
| 3 |       |          |
| 4 | 24V-2 | KM20N-DO |
| 5 | KM10N | KM20N    |
| 6 | KMCOM |          |

CP1

|   |    |
|---|----|
| 1 | U2 |
| 2 | V2 |
| 3 | PE |

CP1A

|   |      |
|---|------|
| 1 | U2_F |
| 2 | V2_F |
| 3 | PE   |

POWER

|   |    |    |    |   |    |
|---|----|----|----|---|----|
| 1 | U3 | PE | PE | 2 | U3 |
| 3 | V3 | 4  |    | 5 | V3 |

CNMC

|   | A    | B   |
|---|------|-----|
| 1 | 200R | AC1 |
| 2 | 200S | AC2 |
| 3 |      |     |

Multiarm E-stop board  
Connector Table

Fig.D.4 (o) E-stop board connector table

## D.5 DISASSEMBLE PROCEDURE



### WARNING

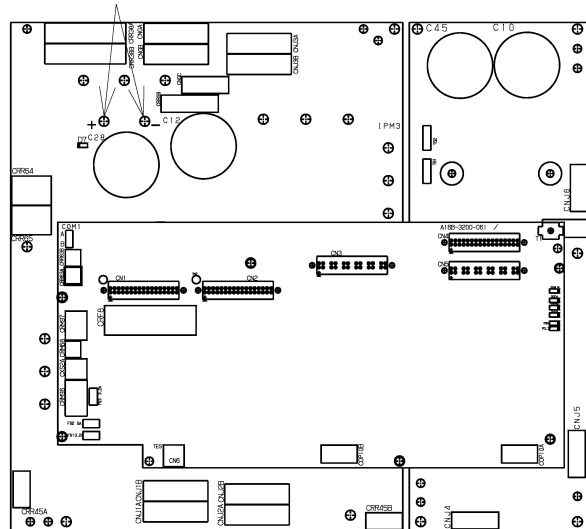
Before opening the controller cover and accessing the inside of the controller for maintenance, be sure to turn off the power switch, disconnect the power cable, and wait 1 minute or more. This is for protecting you from electric shock.



### WARNING

Before touching the servo amplifier, for example, for maintenance purposes, check the voltage at the screw above the LED "D7" with a DC voltage tester to see if the remaining voltage is not higher than 50V.

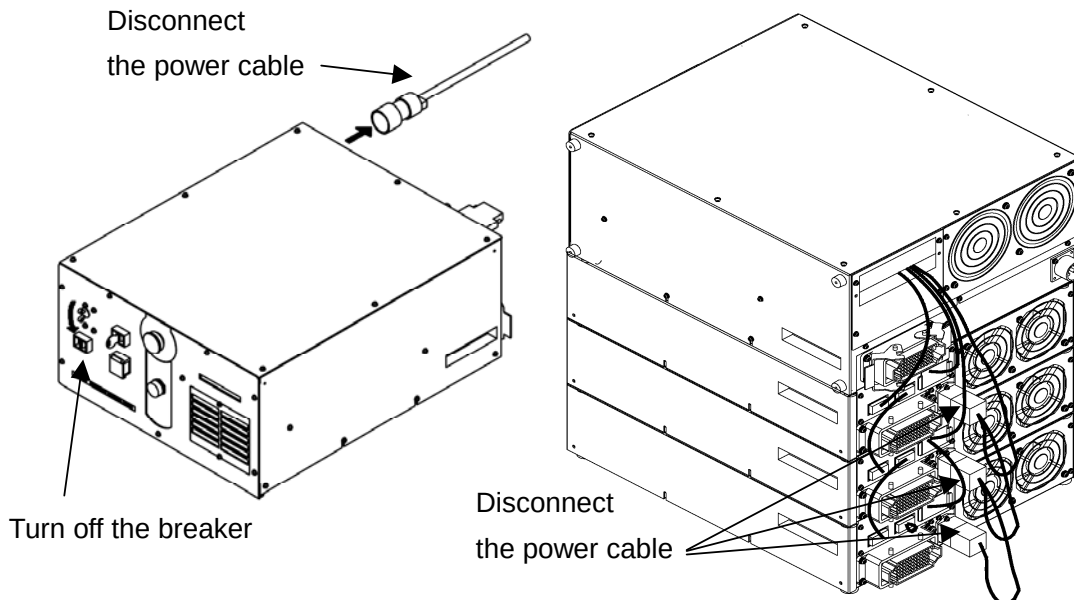
Check that the voltage is not higher than 50V.





## D.5.1 Turn off the Breaker of Master Controller and Disconnect the Power Cable.

- Turn off the breaker of master controller.
- Disconnect the power cable of master and slave controller.



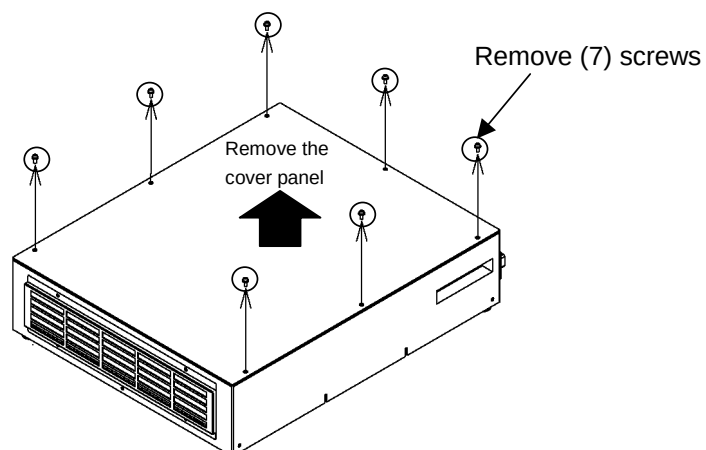
### WARNING

Disconnect the plug connected to the power supply before disconnecting power cable of master controller.

Disconnect the plug connected to master controller before disconnecting power cable of slave controller.

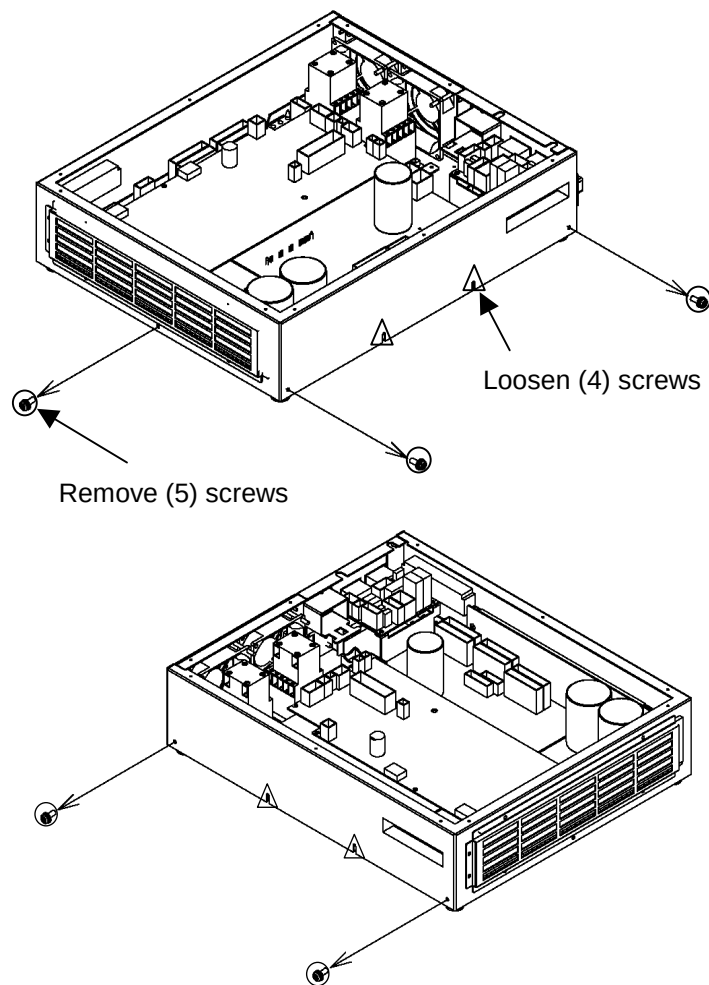
## D.5.2 Remove the Cover Panel.

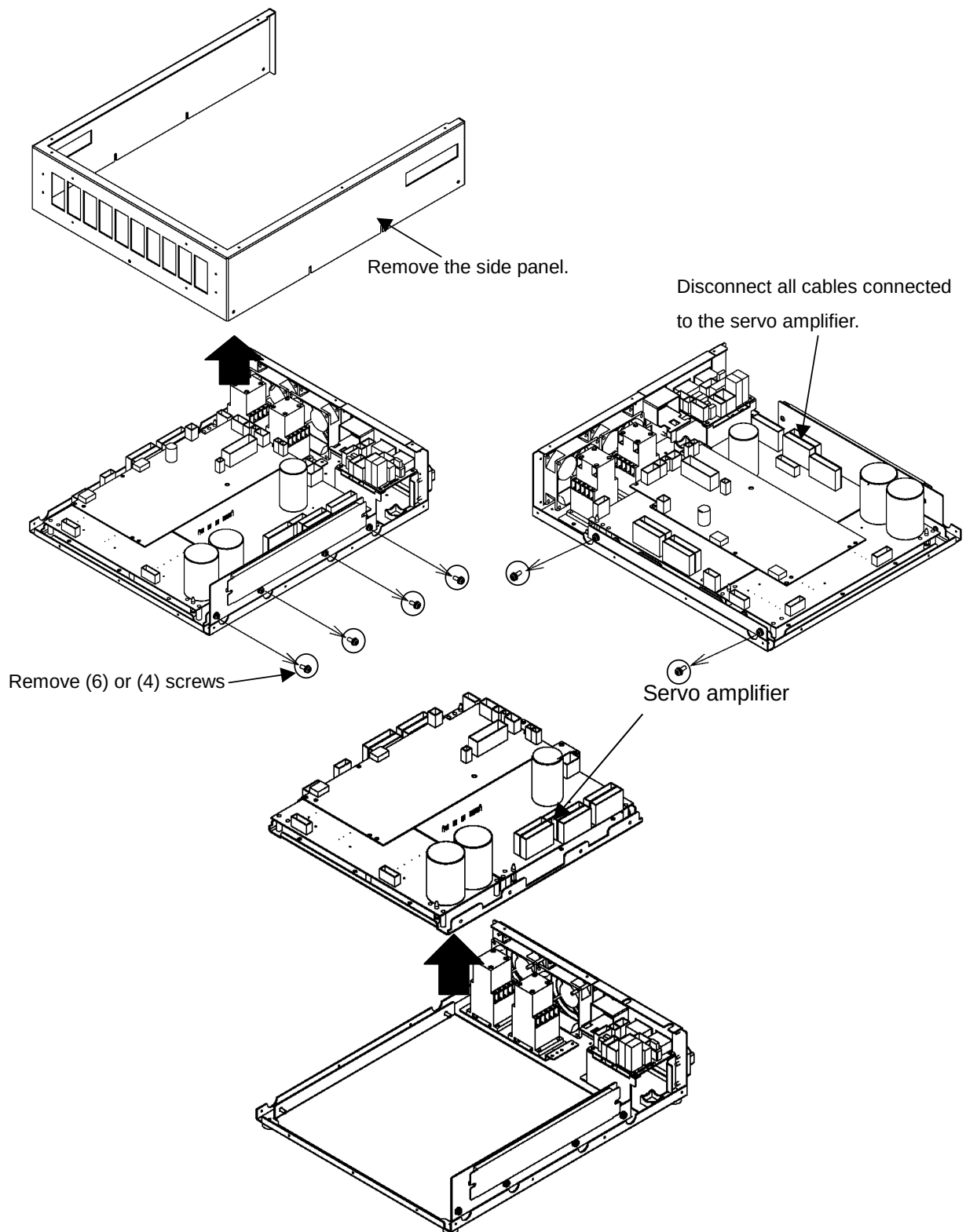
- Remove (7) screws.
- Remove the cover panel.



### D.5.3 Remove the Servo Amplifier

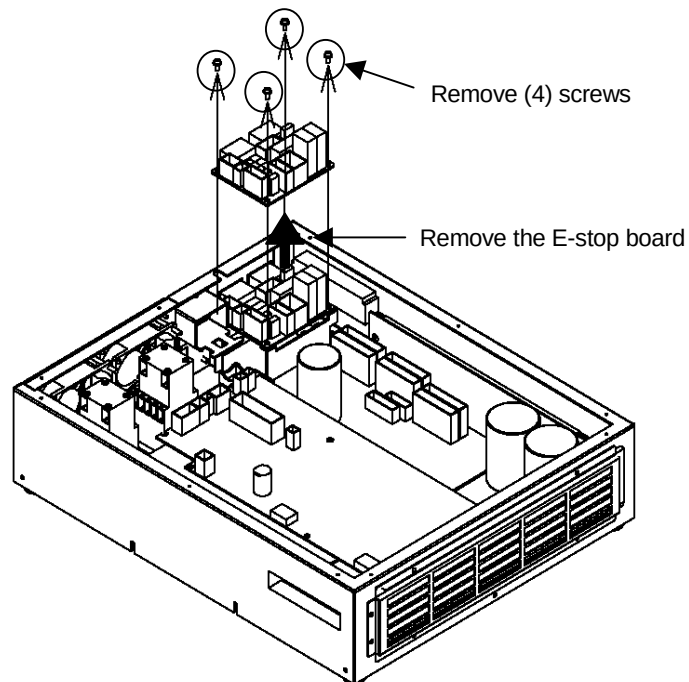
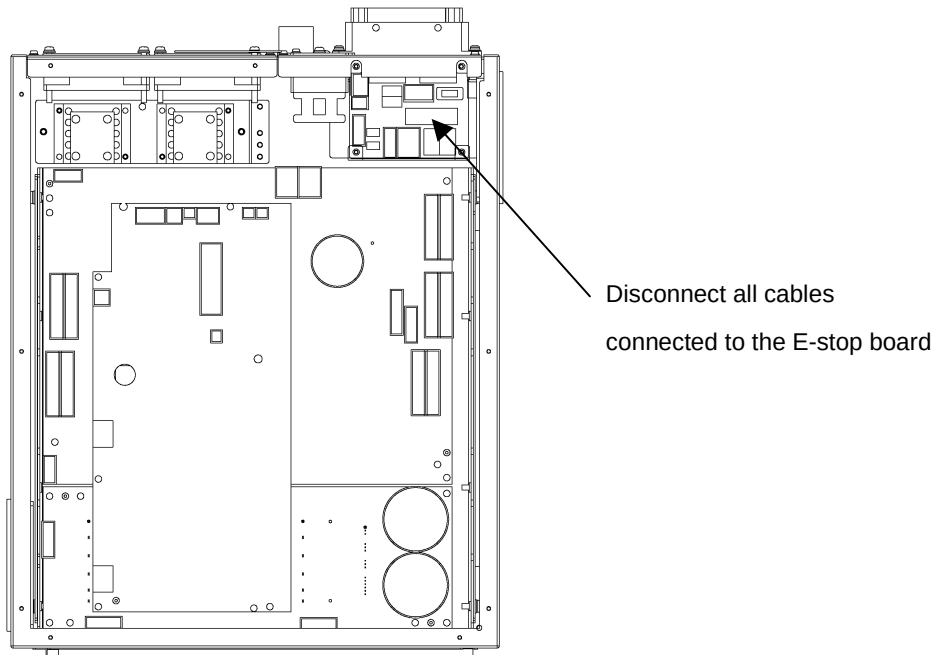
- Remove (5) screws.
- Loosen (4) screws.
- Remove the side plate.
- Disconnect all cables connected to the servo amplifier.
- Remove (6) or (4) screws.
- Remove the servo amplifier.





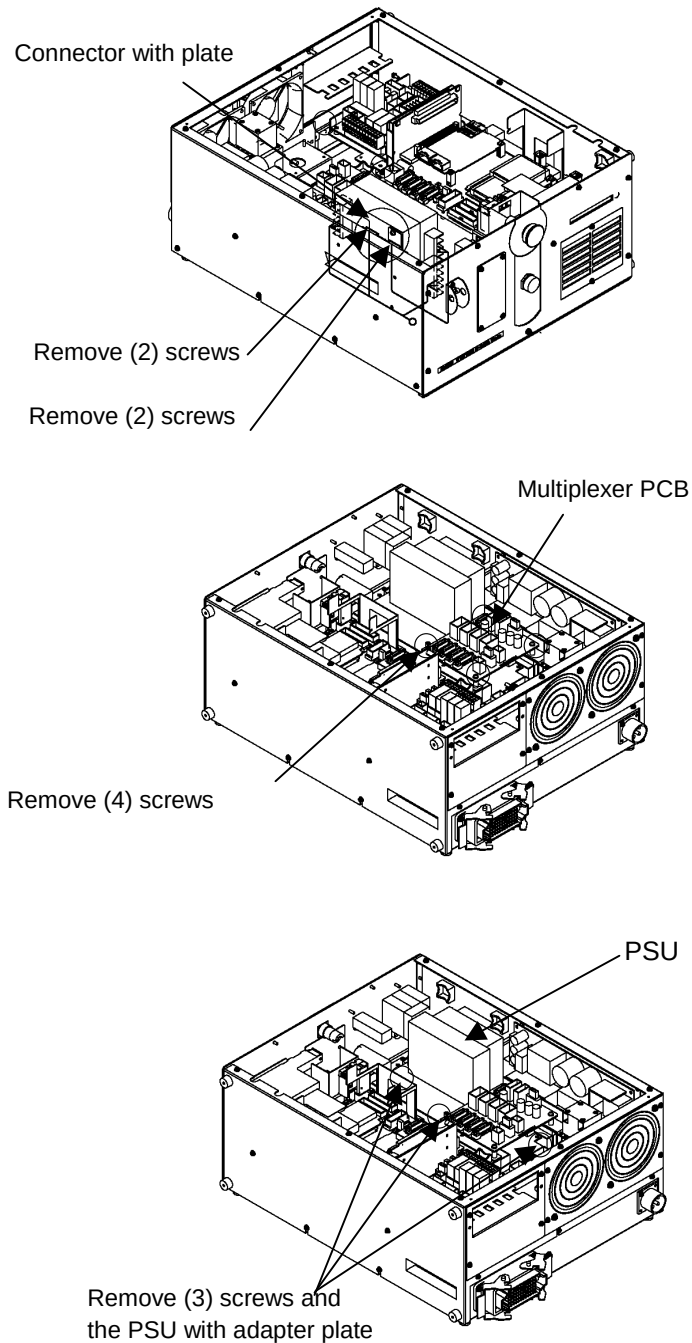
## D.5.4 Remove the E-stop Board

- Disconnect all cables connected to the E-stop board.
- Remove (4) screws.
- Remove the E-stop board.



## D.5.5 Remove the PSU for Robot3, Robot4 (Master controller)

- Disconnect all cables connected to the connector.
- Remove (2) screws and the connector with plate.
- Remove (4) screws and Multiplexer PCB.
- Remove (3) screws and the PSU with adapter plate.
- Remove (2) screws and the PSU from adapter plate.



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| TROUBLESHOOTING USING THE ERROR CODE<br>.....                                     | 22      |
| Turn off the Breaker and Disconnect the Power Cable<br>.....                      | 136     |
| Turn off the Breaker of Master Controller and<br>Disconnect the Power Cable ..... | 176     |

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|                                                                         |    |
|-------------------------------------------------------------------------|----|
| When the Teach Pendant Cannot Be Powered On .....                       | 16 |
| When the Teach Pendant Does Not Change from the<br>Initial Screen ..... | 16 |

# REVISION RECORD

| Edition | Date       | Contents                                                                                                      |
|---------|------------|---------------------------------------------------------------------------------------------------------------|
| 06      | May.2011   | <ul style="list-style-type: none"><li>• Addition of Ethernet interface</li><li>• Error correction</li></ul>   |
| 05      | May.2010   | <ul style="list-style-type: none"><li>• Addition of M-3iA</li><li>• Error correction</li></ul>                |
| 04      | Nov.,2009  | <ul style="list-style-type: none"><li>• Addition of MULTI-ARM control</li></ul>                               |
| 03      | Jun.,2009  | <ul style="list-style-type: none"><li>• Addition of standard controller</li><li>• Addition of M-1iA</li></ul> |
| 02      | Nov., 2008 | <ul style="list-style-type: none"><li>• Addition of brake release unit</li></ul>                              |
| 01      | Jun., 2008 |                                                                                                               |



**B-82965EN-1/06**



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