FANUC Robot series

R-30*i*B Mate/R-30*i*B Mate Plus CONTROLLER

MAINTENANCE MANUAL

MARETIBCN01121E REV. G

FANUC America Corporation
3900 W. Hamlin Road
Rochester Hills, Michigan 48309–3253

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FANUC manuals present descriptions, specifications, drawings, schematics, bills of material, parts, connections and/or procedures for installing, disassembling, connecting, operating and programming FANUC products and/or systems. Such systems consist of robots, extended axes, robot controllers, application software, the KAREL® programming language, INSIGHT® vision equipment, and special tools.

FANUC recommends that only persons who have been trained in one or more approved FANUC Training Course(s) be permitted to install, operate, use, perform procedures on, repair, and/or maintain FANUC products and/or systems and their respective components. Approved training necessitates that the courses selected be relevant to the type of system installed and application performed at the customer site.

WARNING

This equipment generates, uses, and can radiate radiofrequency energy and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. As temporarily permitted by regulation, it has not been tested for compliance with the limits for Class A computing devices pursuant to Subpart J and Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference. Operation of the equipment in a residential area is likely to cause interference, in which case the user, at his own expense, will be required to take whatever measure may be required to correct the interference.

FANUC conducts courses on its systems and products on a regularly scheduled basis at the company's world headquarters in Rochester Hills, Michigan. For additional information contact

FANUC America Corporation
Training Department
3900 W. Hamlin Road
Rochester Hills, Michigan 48309-3253
www.fanucamerica.com

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.

Send your comments and suggestions about this manual to:
product.documentation@fanucamerica.com

Patents

One or more of the following U.S. patents might be related to the FANUC products described in this manual.

FANUC 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

Thank you very much for purchasing FANUC Robot.
Before using the Robot, be sure to read the "FANUC Robot SAFETY HANDBOOK (B-80687EN)" and understand the content.

The products in this manual are controlled based on Japan's "Foreign Exchange and Foreign Trade Law". The export from Japan may be subject to an export license by the government of Japan. Further, re-export to another country may be subject to the license of the government of the country from where the product is re-exported. Furthermore, the product may also be controlled by re-export regulations of the United States government. 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 endeavor to include all pertinent matters. There are, however, a very large number of operations that must not or cannot be performed, and if the manual contained them all, it would be enormous in volume. It is, therefore, requested to assume that any operations that are not explicitly described as being possible are "not possible".

Safety

FANUC America Corporation 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 America Corporation 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 America Corporation 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 America Corporation therefore, recommends that all personnel who intend to operate, program, repair, or otherwise use the robotics system be trained in an approved FANUC America Corporation 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 Safe

The safety of people is always of primary importance in any situation. When applying safety measures to your robotic system, consider the following:

- 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 America Corporation 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 America Corporation 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 DCS (Dual Check Safety), 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.

WARNING

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. DCS (Dual Check Safety), 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.

WARNING

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

This chapter describes the precautions which must be followed to ensure the safe use of the robot.
Before using the robot, be sure to read this chapter thoroughly.

For detailed functions of the robot operation, read the relevant operator's manual to understand fully its specification.
For the safety of the operator and the system, follow all safety precautions when operating a robot and its peripheral equipment installed in a work cell.
In addition, refer to the “FANUC Robot SAFETY HANDBOOK (**B-80687EN)**”.

1 DEFINITON OF USER

The personnel can be classified as follows.

Operator:
- Turns the robot controller power on/off
- Starts the robot program from operator panel

Programmer:
- Operates the robot
- Teaches the robot inside the safety fence

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

- Operator is not allowed to work in the safety fence.
- Programmer and maintenance engineer is allowed to work in the safety fence. Works carried out in the safety fence include transportation, installation, teaching, adjustment, and maintenance.
- To work inside the safety fence, the person must be trained on proper robot operation.

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

- Adequate clothes for the operation
- Safety shoes
- A helmet

2 DEFINITION OF SAFETY NOTATIONS

To ensure the safety of users and prevent damage to the machine, this manual indicates each precaution on safety with "**WARNING**" or "**CAUTION**" according to its severity. Supplementary information is indicated by "**NOTE**". Read the contents of each "**WARNING**", "**CAUTION**" and "**NOTE**" before using the robot.

Symbol	Definitions
⚠WARNING	Used if hazard resulting in the death or serious injury of the user will be expected to occur if he or she fails to follow the approved procedure.
⚠CAUTION	Used if a hazard resulting in the minor or moderate injury of the user, or equipment damage may be expected to occur if he or she fails to follow the approved procedure.
NOTE	Used if a supplementary explanation not related to any of WARNING and CAUTION is to be indicated.

- Check this manual thoroughly, and keep it handy for the future reference.

3 USER SAFETY

User 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 user safety.

(1) Have the robot system users 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 user 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 user 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 PRECAUTIONS" for detail of stop type). For connection, see Fig. 3 (b).

(4) Provide the peripheral equipment with appropriate earth (Class A, Class B, Class C, and Class D).
(5) Try to install the peripheral equipment outside the robot operating space.
(6) Draw an outline on the floor, clearly indicating the range of the robot operating space, 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 user enters the work area.
(8) If necessary, install a safety lock so that no one except the user 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 equipment independently, be sure to turn off the power of the robot.
(10) Operators should be ungloved while manipulating the operator panel or teach pendant. Operation with gloved fingers could cause an operation error.

(11) Programs, system variables, and other information can be saved on memory card or USB memories. Be sure to save the data periodically in case the data is lost in an accident. (refer to Controller OPERATOR'S MANUAL.)
(12) The robot should be transported and installed by accurately following the procedures recommended by FANUC. Wrong transportation or installation may cause the robot to fall, resulting in severe injury to workers.
(13) In the first operation of the robot after installation, the operation should be restricted to low speeds. Then, the speed should be gradually increased to check the operation of the robot.
(14) Before the robot is started, it should be checked that no one is inside the safety fence. At the same time, a check must be made to ensure that there is no risk of hazardous situations. If detected, such a situation should be eliminated before the operation.
(15) When the robot is used, the following precautions should be taken. Otherwise, the robot and peripheral equipment can be adversely affected, or workers can be severely injured.
- Avoid using the robot in a flammable environment.
- Avoid using the robot in an explosive environment.
- Avoid using the robot in an environment full of radiation.
- Avoid using the robot under water or at high humidity.
- Avoid using the robot to carry a person or animal.
- Avoid using the robot as a stepladder. (Never climb up on or hang from the robot.)
- Outdoor
(16) When connecting the peripheral equipment related to stop (safety fence etc.) and each signal (external emergency, fence etc.) of robot, be sure to confirm the stop movement and do not take the wrong connection.
(17) When preparing footstep, please consider security for installation and maintenance work in high place according to Fig. 3 (c). Please consider footstep and safety belt mounting position.

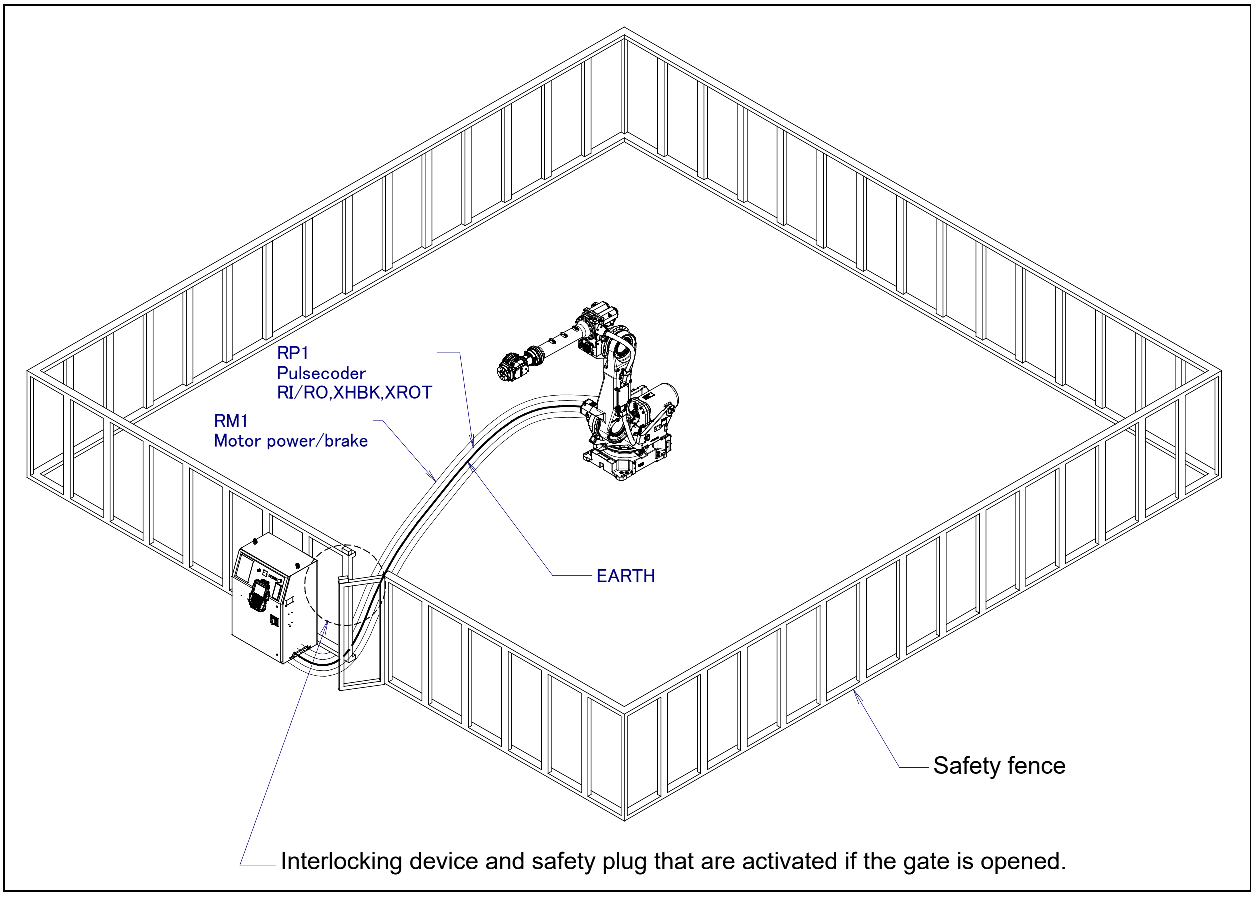


Fig. 3 (a) Safety fence and safety gate

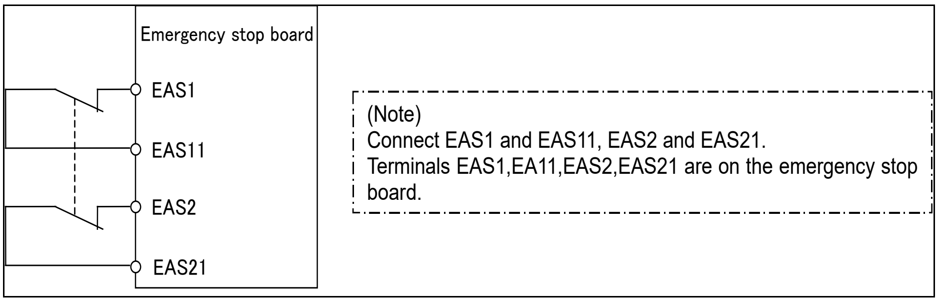


Fig.3 (b) Limit switch circuit diagram of the safety fence

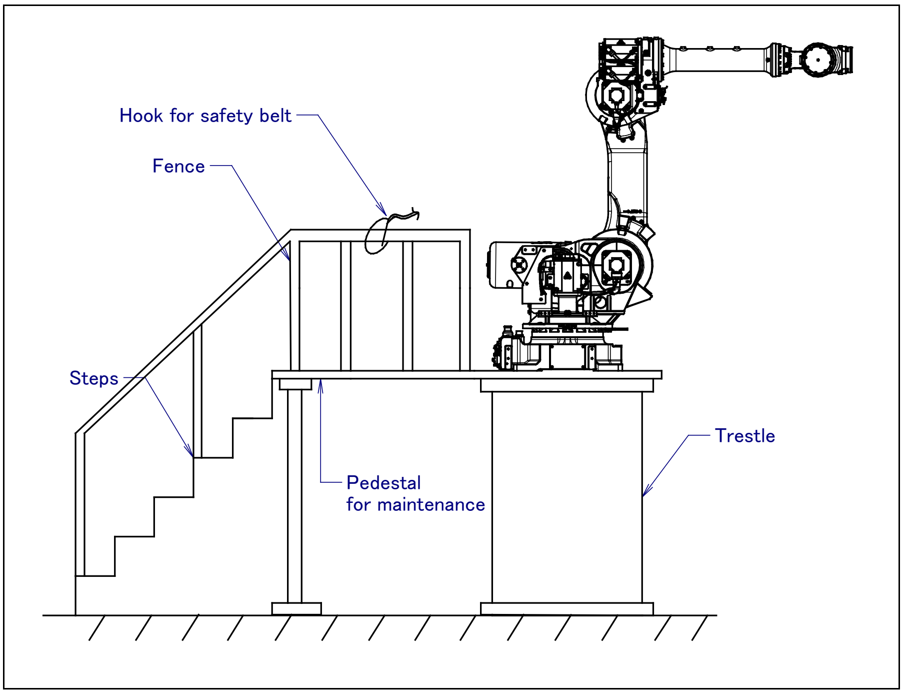


Fig. 3 (c) Pedestal for maintenance

3.1 SAFETY OF THE OPERATOR

An operator refers to a person who turns on and off the robot system and starts a robot program from, for example, the operator panel during daily operation.
Operators cannot work inside of the safety fence.

(1) If the robot does not need to be operated, turn off the robot controller power or press the EMERGENCY STOP button during working.
(2) Operate the robot system outside the operating space of the robot.
(3) Install a safety fence or safety door to avoid the accidental entry of a person other than an operator in charge or keep operator out from the hazardous place.
(4) Install one or more necessary quantity of EMERGENCY STOP button(s) within the operator's reach in appropriate location(s) based on the system layout.

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 PRECAUTIONS" for detail of stop type) when the external EMERGENCY STOP button is pressed. See the diagram below for connection.

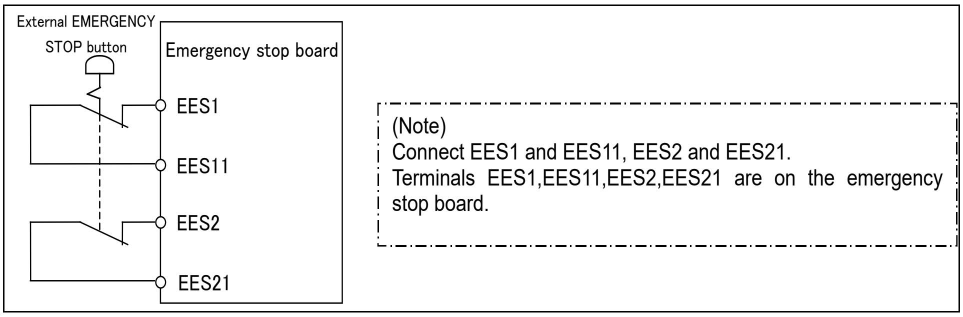


Fig. 3.1 Connection diagram for external emergency stop button

3.2 SAFETY OF THE PROGRAMMER

While teaching the robot, the operator must enter the robot operation area. The programmer must ensure the safety especially.

(1) Unless it is specifically necessary to enter the robot operating space, carry out all tasks outside the operating space.
(2) Before teaching the robot, check that the robot and its peripheral equipment are all in the normal operating condition.
(3) If it is inevitable to enter the robot operating space 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 operating space.
(5) Programming should be done outside the area of the safety fence as far as possible. If programming needs to be done inside the safety fence, the programmer should take the following precautions:
- Before entering the area of the safety fence, ensure that there is no risk of dangerous situations in the area.
- Be prepared to press the emergency stop button whenever necessary.
- Robot motions should be made at low speeds.
- Before starting programming, check the whole robot system status to ensure that no remote instruction to the peripheral equipment or motion would be dangerous to the user.

Our operator panel is provided with an emergency stop button and a key switch (mode switch) for selecting the automatic operation (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 set, the robot stops (Please refer to "STOP TYPE OF ROBOT" in "SAFETY PRECAUTIONS" 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.

Our 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 the stop of the robot (Please refer to "STOP TYPE OF ROBOT" in "SAFETY PRECAUTIONS" for detail of stop type) when pressed.
(2) DEADMAN switch: Functions differently depending on the teach pendant enable/disable switch setting status.
   (a) Enable: Servo power is turned off when the operator releases the DEADMAN switch or when the operator presses the switch strongly.
   (b) Disable: The DEADMAN switch is disabled.
   (Note) The DEADMAN switch is provided to stop the robot when the operator releases the teach pendant or presses the pendant strongly in case of emergency. The R-30*i*B/R-30*i*B Plus/R-30*i*B Mate/R-30*i*B Mate Plus employs a 3-position DEADMAN switch, which allows the robot to operate when the 3-position DEADMAN switch is pressed to its intermediate point. When the operator releases the DEADMAN switch or presses the switch strongly, the robot stops immediately.

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.

Based on the risk assessment by FANUC, number of operation of DEADMAN SW should not exceed about 10000 times per year.

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

Mode	Teach pendant enable switch	Software remote condition	Teach pendant	Operator panel	Peripheral equipment
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.

(6) To start the system using the operator box or operator panel, make certain that nobody is the robot operating space area and that there are no abnormalities in the robot operating space.
(7) When a program is completed, be sure to carry out a test operation according to the following procedure.
  (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 continuous operation at low speed.
  (c) Run the program for one operation cycle in continuous operation 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 continuous operation 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 operation above, execute it in the automatic operation.
(8) While operating the system in the automatic operation, the programmer should leave the safety fence.

3.3 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 operating space.
(2) A hazardous situation may arise when the robot or the system, are kept with their power-on during maintenance operations. Therefore, for any maintenance operation, the robot and the system should be put into the power-off state. If necessary, a lock should be in place in order to prevent any other person from turning on the robot and/or the system. In case maintenance needs to be executed in the power-on state, the emergency stop button must be pressed.
(3) If it becomes necessary to enter the robot operating space while the power is on, press the emergency stop button on the operator box or operator panel, or the teach pendant before entering the range. The maintenance worker must indicate that maintenance work is in progress and be careful not to allow other people to operate the robot carelessly.

(4) When entering the area enclosed by the safety fence, the worker must check the whole robot system in order to make sure no dangerous situations exist. In case the worker needs to enter the safety area whilst a dangerous situation exists, extreme care must be taken, and whole robot system status must be carefully monitored.
(5) Before the maintenance of the pneumatic system is started, the supply pressure should be shut off and the pressure in the piping should be reduced to zero.
(6) Before the start of maintenance work, check that the robot and its peripheral equipment are all in the normal operating condition.
(7) Do not operate the robot in the automatic operation while anybody is in the robot operating space.
(8) When you maintain the robot alongside a wall or instrument, or when multiple users are working nearby, make certain that their escape path is not obstructed.
(9) When a tool is mounted on the robot, or when any movable device other than the robot is installed, such as belt conveyor, pay careful attention to its motion.
(10) If necessary, have a user who is familiar with the robot system stand beside the operator panel and observe the work being performed. If any danger arises, the user should be ready to press the EMERGENCY STOP button at any time.
(11) When replacing a part, please contact your local FANUC representative. If a wrong procedure is followed, an accident may occur, causing damage to the robot and injury to the user.
(12) When replacing or reinstalling components, take care to prevent foreign material from entering the system.
(13) 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.
(14) A part should be replaced with a part recommended by FANUC. If other parts are used, malfunction or damage would occur. Especially, a fuse that is not recommended by FANUC should not be used. Such a fuse may cause a fire.
(15) When restarting the robot system after completing maintenance work, make sure in advance that there is no person in the operating space and that the robot and the peripheral equipment are not abnormal.
(16) When a motor or brake is removed, the robot arm should be supported with a crane or other equipment beforehand so that the arm would not fall during the removal.
(17) Whenever grease is spilled on the floor, it should be removed as quickly as possible to prevent dangerous falls.
(18) The following parts are heated. If a maintenance user needs to touch such a part in the heated state, the user should wear heat-resistant gloves or use other protective tools.
- Servo motor
- Inside the controller
- Reducer
- Gearbox
- Wrist unit

(19) Maintenance should be done under suitable light. Care must be taken that the light would not cause any danger.
(20) When a motor, reducer, or other heavy load is handled, a crane or other equipment should be used to protect maintenance workers from excessive load. Otherwise, the maintenance workers would be severely injured.
(21) The robot should not be stepped on or climbed up during maintenance. If it is attempted, the robot would be adversely affected. In addition, a misstep can cause injury to the worker.
(22) When performing maintenance work in high place, secure a footstep and wear safety belt.
(23) After the maintenance is completed, spilled oil or water and metal chips should be removed from the floor around the robot and within the safety fence.
(24) When a part is replaced, all bolts and other related components should put back into their original places. A careful check must be given to ensure that no components are missing or left not mounted.
(25) In case robot motion is required during maintenance, the following precautions should be taken :

- Foresee an escape route. And during the maintenance motion itself, monitor continuously the whole robot system so that your escape route will not become blocked by the robot, or by peripheral equipment.
- Always pay attention to potentially dangerous situations, and be prepared to press the emergency stop button whenever necessary.

(26) The robot should be periodically inspected. (Refer to the robot mechanical manual and controller maintenance manual.) A failure to do the periodical inspection can adversely affect the performance or service life of the robot and may cause an accident

(27) After a part is replaced, a test execution should be given for the robot according to a predetermined method. (See TESTING section of “Controller operator’s manual”.) During the test execution, the maintenance worker should work outside the safety fence.

4 SAFETY OF THE TOOLS AND PERIPHERAL DEVICES

4.1 PRECAUTIONS IN PROGRAMMING

(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 abnormality occurs in any other robots or peripheral equipment, even though the robot itself is normal.

(3) For a system in which the robot and its peripheral equipment 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 equipment so that the robot can detect the states of all devices in the system and can be stopped according to the states.

4.2 PRECAUTIONS FOR MECHANISM

(1) Keep the component cells of the robot system clean, operate the robot where insulated from the influence of oil, water, and dust.

(2) Don’t use unconfirmed liquid for cutting fluid and cleaning fluid.

(3) Adopt limit switches or mechanical stoppers to limit the robot motion, and avoid the robot from collisions against peripheral equipment or tools.

(4) Observe the following precautions about the mechanical unit cables. Failure to follow precautions may cause problems.

- Use mechanical unit cable that have required user interface.
- Do not add user cable or hose to inside of the mechanical unit.
- Please do not obstruct the movement of the mechanical unit 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.
- When installing user peripheral equipment on the robot mechanical unit, please pay attention that the device does not interfere with the robot itself.

(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 perform 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 PRECAUTIONS" for detail of stop type.)

(Bad case example)

- Whenever poor product is generated, a line stops by emergency stop and power-off of the robot is incurred.
- When alteration is necessary, safety switch is operated by opening safety fence and power-off stop is incurred 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 operates routinely and power-off stop is incurred for the robot.
- Power-off stop is regularly incurred due to an inappropriate setting for Dual Check Safety (DCS).

(6) Power-off stop of Robot is executed when collision detection alarm (SRVO-050) etc. occurs. Please try to avoid unnecessary power-off stops. It may cause the trouble of the robot, too. So remove the causes of the alarm.

5 SAFETY OF THE ROBOT MECHANISM

5.1 PRECAUTIONS IN OPERATION

(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.

5.2 PRECAUTIONS IN PROGRAMMING

(1) When the operating spaces 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.

5.3 PRECAUTIONS FOR MECHANISMS

Keep the robot operation area clean, and operate the robot in an environment free of grease, water, and dust.

5.4 PROCEDURE TO MOVE ARM WITHOUT DRIVE POWER IN EMERGENCY OR ABNORMAL SITUATIONS

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

Please refer to controller maintenance manual and mechanical unit operator’s manual for using method of brake release unit and method of supporting robot.

6 SAFETY OF THE END EFFECTOR

6.1 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.

7 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 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.

Frequent Power-Off stop of the robot during operation can cause failures of the robot.
Avoid system designs that require routine or frequent Power-Off stop conditions.

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 emergency 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	Emergency stop button	External Emergency stop	FENCE open	SVOFF input	Servo disconnect
A	AUTO	P-Stop	P-Stop	C-Stop	C-Stop	P-Stop
	T1	P-Stop	P-Stop	-	C-Stop	P-Stop
	T2	P-Stop	P-Stop	-	C-Stop	P-Stop
B	AUTO	P-Stop	P-Stop	P-Stop	P-Stop	P-Stop
	T1	P-Stop	P-Stop	-	P-Stop	P-Stop
	T2	P-Stop	P-Stop	-	P-Stop	P-Stop
C	AUTO	C-Stop	C-Stop	C-Stop	C-Stop	C-Stop
	T1	P-Stop	P-Stop	-	C-Stop	P-Stop
	T2	P-Stop	P-Stop	-	C-Stop	P-Stop

P-Stop: Power-Off stop
C-Stop: Controlled stop
-: Disable

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

Option	R-30*i*B/ R-30*i*B Mate
Standard	A (*)
Controlled stop by E-Stop (A05B-2600-J570)	C (*)

(*) R-30*i*B / R-30*i*B Mate does not have servo disconnect. / R-30*i*B Mate does not have SVOFF input.

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

"Controlled stop by E-Stop" option

When "Controlled stop by E-Stop" (A05B-2600-J570) option is specified, 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 emergency stop is pressed.
SRVO-002 Teach pendant E-stop	Teach pendant emergency stop is pressed.
SRVO-007 External emergency stops	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 to the operator's manual of a particular robot model for the data of stopping distance and stopping time.

When this option is loaded, this function cannot 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.

8 WARNING & CAUTION LABEL

(1) Step-on prohibitive label

Fig.8 (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.8 (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

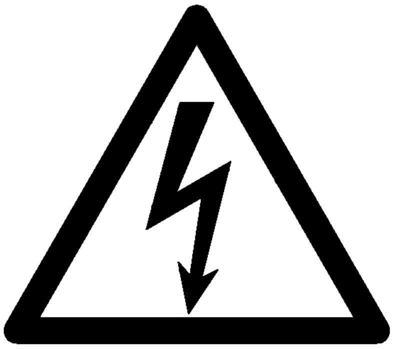


Fig.8 (c) High-voltage warning label

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

PREFACE

This manual describes the following models (R-30*i*B Mate/ R-30*i*B Mate Plus controller).

Model	Abbreviation		Controller Size
FANUC Robot LR Mate 200*i*C	LR Mate 200*i*C/5WP	LR Mate 200*i*C	Small
FANUC Robot LR Mate 200*i*D	LR Mate 200*i*D	LR Mate 200*i*D	Small
FANUC Robot LR Mate 200*i*D/4S	LR Mate 200*i*D/4S		
FANUC Robot LR Mate 200*i*D/7L	LR Mate 200*i*D/7L		
FANUC Robot LR Mate 200*i*D/7C	LR Mate 200*i*D/7C		
FANUC Robot LR Mate 200*i*D/4SC	LR Mate 200*i*D/4SC		
FANUC Robot LR Mate 200*i*D/7LC	LR Mate 200*i*D/7LC		
FANUC Robot LR Mate 200*i*D/7H	LR Mate 200*i*D/7H		
FANUC Robot LR Mate 200*i*D/4SH	LR Mate 200*i*D/4SH		
FANUC Robot LR Mate 200*i*D/7WP	LR Mate 200*i*D/7WP		
FANUC Robot M-1*i*A/0.5A	M-1*i*A/0.5A	M-1*i*A	Small
FANUC Robot M-1*i*A/0.5S	M-1*i*A/0.5S		
FANUC Robot M-1*i*A/1H	M-1*i*A/1H		
FANUC Robot M-1*i*A/0.5AL	M-1*i*A/0.5AL		
FANUC Robot M-1*i*A/0.5SL	M-1*i*A/0.5SL		
FANUC Robot M-1*i*A/1HL	M-1*i*A/1HL		
FANUC Robot M-2*i*A/3S	M-2*i*A/3S	M-2*i*A	Large
FANUC Robot M-2*i*A/3SL	M-2*i*A/3SL		
FANUC Robot M-2*i*A/6H	M-2*i*A/6H		
FANUC Robot M-2*i*A/6HL	M-2*i*A/6HL		
FANUC Robot M-2*i*A/3A	M-2*i*A/3A		
FANUC Robot M-2*i*A/3AL	M-2*i*A/3AL		
FANUC Robot M-3*i*A/6A	M-3*i*A/6A	M-3*i*A	Large
FANUC Robot M-3*i*A/6S	M-3*i*A/6S		
FANUC Robot M-3*i*A/12H	M-3*i*A/12H		
FANUC Robot M-10*i*A	M-10*i*A	M-10*i*A	Medium
FANUC Robot M-10*i*A/6L	M-10*i*A/6L		
FANUC Robot M-10*i*A/7L	M-10*i*A/7L		
FANUC Robot M-10*i*A/8L	M-10*i*A/8L		
FANUC Robot M-10*i*A/10S	M-10*i*A/10S		
FANUC Robot M-10*i*A/10M	M-10*i*A/10M		
FANUC Robot M-10*i*A/10MS	M-10*i*A/10MS		
FANUC Robot M-10*i*A/12	M-10*i*A/12		
FANUC Robot M-10*i*A/12S	M-10*i*A/12S		
FANUC Robot M-10*i*D/12	M-10*i*D/12	M-10*i*D	Medium
FANUC Robot M-20*i*A	M-20*i*A	M-20*i*A	Medium
FANUC Robot M-20*i*A/10L	M-20*i*A/10L		
FANUC Robot M-20*i*A/12L	M-20*i*A/12L		
FANUC Robot M-20*i*A/20M	M-20*i*A/20M		
FANUC Robot M-20*i*A/35M	M-20*i*A/35M		
FANUC Robot M-20*i*B/25	M-20*i*B/25	M-20*i*B	Medium
FANUC Robot ARC Mate 50*i*D	ARC Mate 50*i*D	ARC Mate 50*i*D	Medium or Small
FANUC Robot ARC Mate 50*i*D/7L	ARC Mate 50*i*D/7L		

Model	Abbreviation		Controller Size
FANUC Robot ARC Mate 100*i*C FANUC ROBOWELD 100*i*C	ARC Mate 100*i*C	ARC Mate 100*i*C	Medium
FANUC Robot ARC Mate 100*i*C/6L FANUC ROBOWELD 100*i*C/6L	ARC Mate 100*i*C/6L		
FANUC Robot ARC Mate 100*i*C/7L	ARC Mate 100*i*C/7L		
FANUC Robot ARC Mate 100*i*C/8L	ARC Mate 100*i*C/8L		
FANUC Robot ARC Mate 100*i*C/10S	ARC Mate 100*i*C/10S		
FANUC Robot ARC Mate 100*i*C/12	ARC Mate 100*i*C/12		
FANUC Robot ARC Mate 100*i*C/12S	ARC Mate 100*i*C/12S		
FANUC Robot ARC Mate 100*i*D	ARC Mate 100*i*D	ARC Mate 100*i*D	Medium
FANUC Robot ARC Mate 120*i*C FANUC ROBOWELD 120*i*C	ARC Mate 120*i*C	ARC Mate 120*i*C	Medium
FANUC Robot ARC Mate 120*i*C/10L FANUC ROBOWELD 120*i*C/10L	ARC Mate 120*i*C/10L		
FANUC Robot ARC Mate 120*i*C/12L	ARC Mate 120*i*C/12L		
FANUC Robot ARC Mate 0*i*B	ARC Mate 0*i*B	ARC Mate 0*i*B	Medium
FANUC Robot R-0*i*B	R-0*i*B	R-0*i*B	Medium
FANUC Robot R-2000*i*C/125L	R-2000*i*C/125L	R-2000*i*C	Large
FANUC Robot R-2000*i*C/165F	R-2000*i*C/165F		
FANUC Robot R-2000*i*C/165R	R-2000*i*C/165R		
FANUC Robot R-2000*i*C/210F	R-2000*i*C/210F		
FANUC Robot R-2000*i*C/210R	R-2000*i*C/210R		
FANUC Robot R-1000*i*A/80F	R-1000*i*A/80F	R-1000*i*A	Large
FANUC Robot R-1000*i*A/100F	R-1000*i*A/100F		
FANUC Robot M-710*i*C/70	M-710*i*C/70	M-710*i*C	Large
FANUC Robot M-710*i*C/70T	M-710*i*C/70T		
FANUC Robot M-710*i*C/50	M-710*i*C/50		
FANUC Robot M-710*i*C/50S	M-710*i*C/50S		
FANUC Robot M-710*i*C/50T	M-710*i*C/50T		
FANUC Robot M-710*i*C/50E	M-710*i*C/50E		
FANUC Robot M-710*i*C/45M	M-710*i*C/45M		
FANUC Robot M-710*i*C/20L	M-710*i*C/20L		
FANUC Robot M-710*i*C/20M	M-710*i*C/20M		
FANUC Robot M-710*i*C/12L	M-710*i*C/12L		
FANUC Robot CR-4*i*A	CR-4*i*A	CR-4*i*A	Small
FANUC Robot CR-7*i*A	CR-7*i*A	CR-7*i*A	Small
FANUC Robot CR-7*i*A/L	CR-7*i*A/L		

Explanation of Controller size

Controller size	Dimension (Height X Width X Depth)	Discharge resistor	Breaker capacity	Single phase/Three phase
Small	400X470X322	Small	10A	Single phase/Three phase
Medium	400X470X402	Large	20A	Three phase
Large	400X470X402	Large	30A	Three phase

TABLE OF CONTENTS

II. CONNECTIONS

APPENDIX

I. MAINTENANCE

1 OVERVIEW

This manual is applied to R-30*i*B Mate/ R-30*i*B Mate Plus controller (called R-30*i*B Mate/ R-30*i*B Mate Plus).

R-30*i*B Mate/ R-30*i*B Mate Plus has different controller depending on the required standards.

NRTL controller: To meet UL/CSA standard
CE controller : To meet Machinery Directive, Low voltage Directive, EMC Directive to cover the requirement of CE mark

This manual covers these controllers of the R-30*i*B Mate/ R-30*i*B Mate Plus.
The difference of NRTL and CE controller from the Basic controller is small as shown in Table 1 (ex. EMC parts, Breakers).
And the specific descriptions of CE and NRTL controller have notifications in this manual.

Table 1. Applied standards

	Functional Safety	EMC Standard	Robot Standard Electrical Standard	Requirement	Difference
Basic controller	ISO 13849-1 IEC 61508	-	-	-	-
NRTL controller		-	UL1740 CAN/CSA Z434 NFPA79	UL standard CSA standard •USA and Canada	•UL listed main breaker
CE controller		EN 55011 EN 61000-6-2 EN 61000-6-4	EN/ISO 10218-1 EN 60204-1	CE Marking •Europe	•Noise filter •EMC Cabinet •Shielded cable

This manual describes the maintenance and connection of R-30*i*B Mate/ R-30*i*B Mate Plus.

- Maintenance Part: Troubleshooting, and the setting, adjustment, and replacement of units
- Connection Part: Connection of R-30*i*B Mate/ R-30*i*B Mate Plus to the robot mechanical unit and peripheral devices, and installation of the controller

⚠ **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 operator's panel or teach pendant.
Otherwise, you could injure personnel or damage equipment.

2 CONFIGURATION

2.1 EXTERNAL VIEW OF THE CONTROLLER

The appearance and components might slightly differ depending on the controlled robot, application, and options used.
Fig.2.1 (a) to (b) show the view of R-30*i*B Mate/ R-30*i*B Mate Plus.
Fig.2.1 (c) to (g) show the construction of the R-30*i*B Mate/ R-30*i*B Mate Plus controller.
Fig.2.1 (h) to (j) show the external view of the operator's panel and teach pendant.

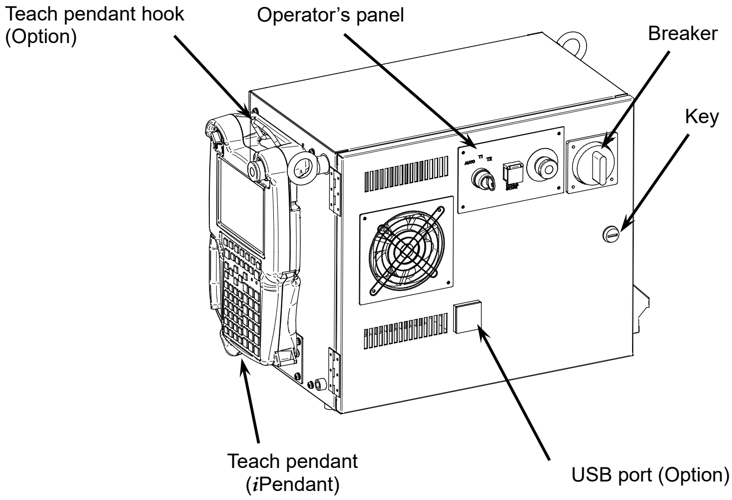


Fig.2.1 (a) External view of the R-30*i*B Mate/ R-30*i*B Mate Plus controller

> **NOTE**
> Be sure to lock the key.

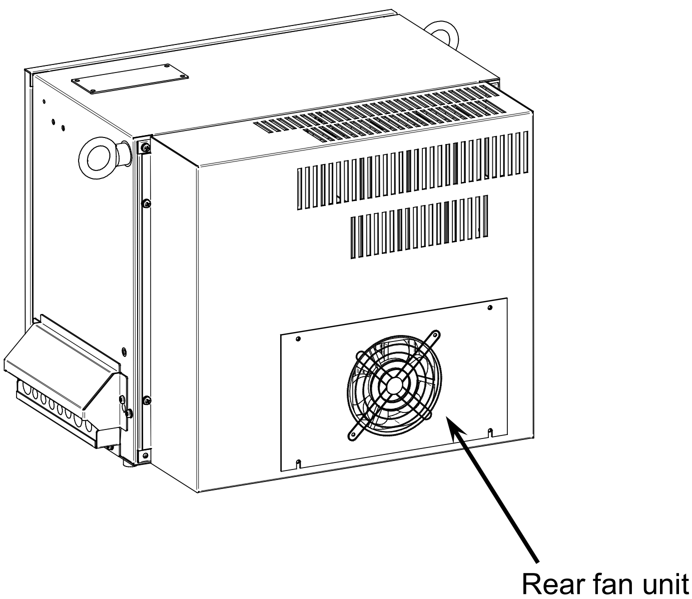


Fig.2.1 (b) External view of the R-30*i*B Mate/ R-30*i*B Mate Plus controller (Middle/Large size) (Rear)

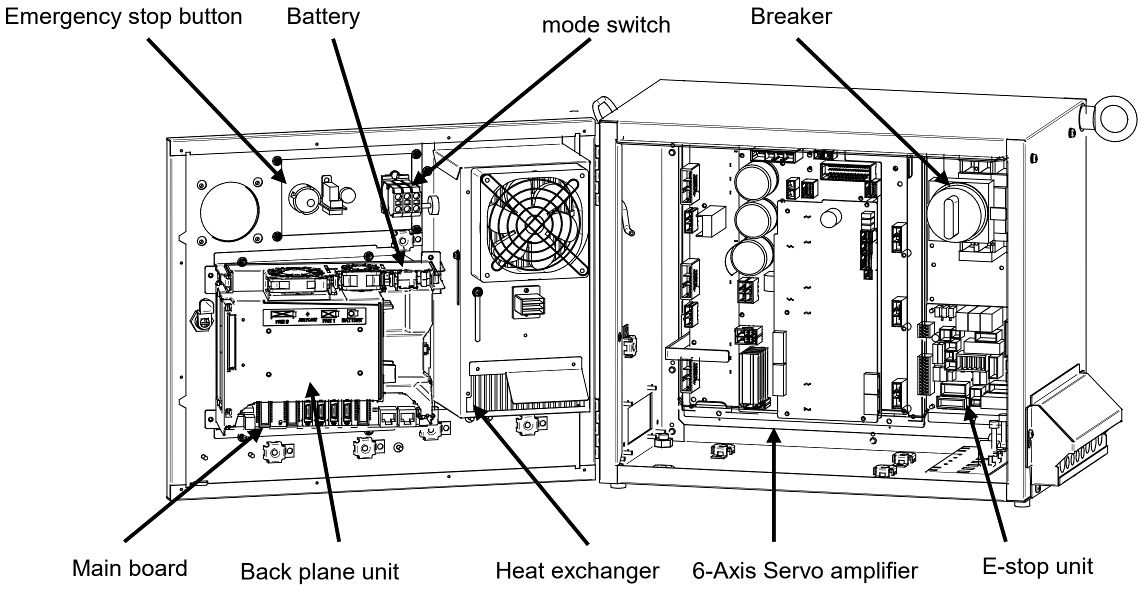


Fig.2.1 (c) R-30*i*B Mate/ R-30*i*B Mate Plus cabinet interior (Front-1)

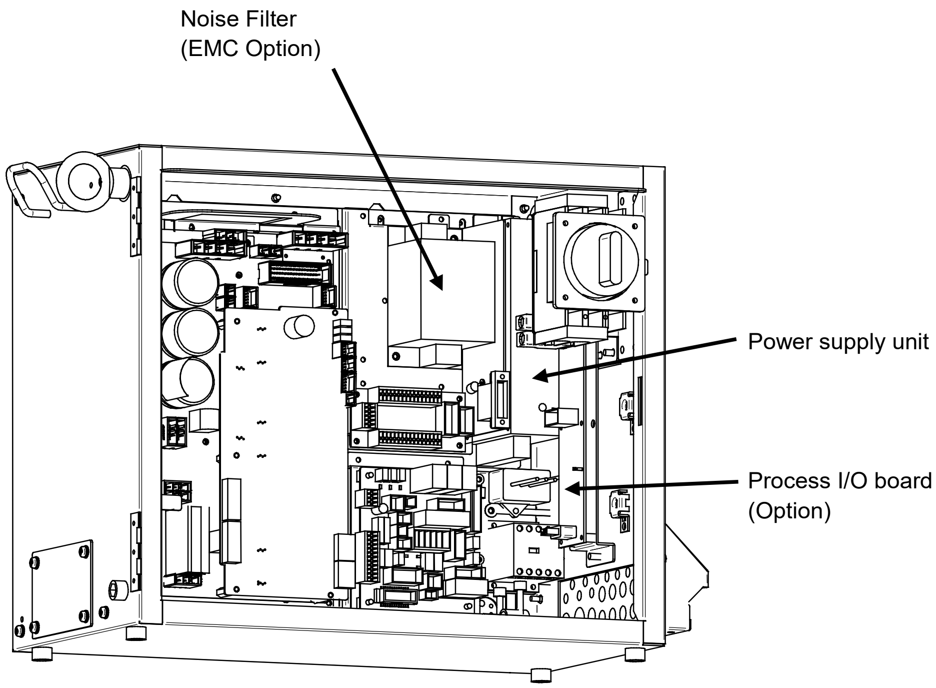


Fig.2.1 (d) R-30*i*B Mate/ R-30*i*B Mate Plus cabinet interior (Front-2)

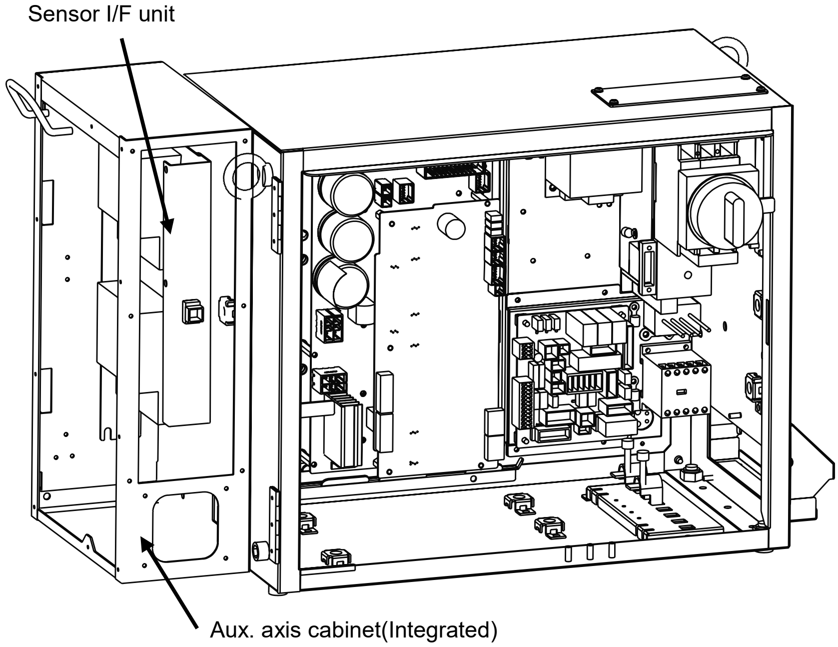
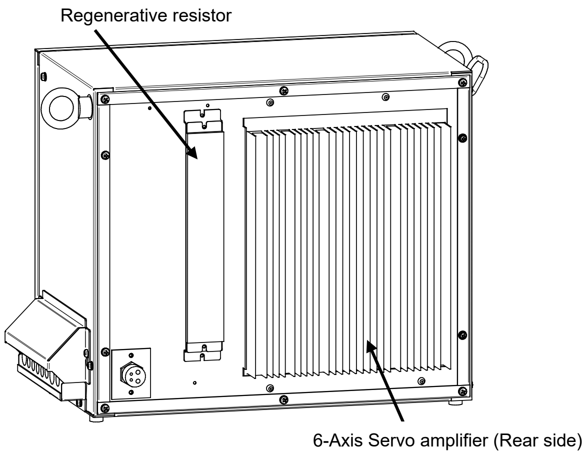
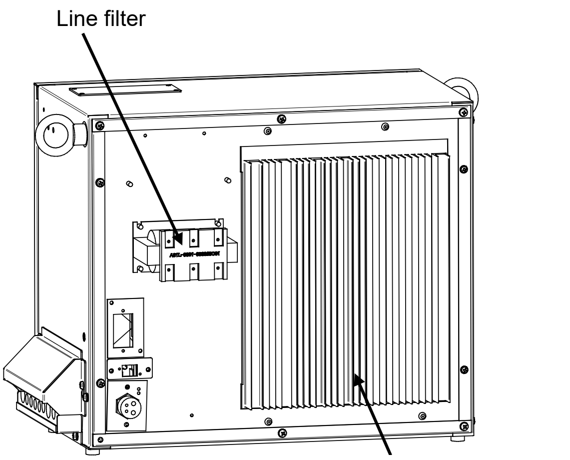
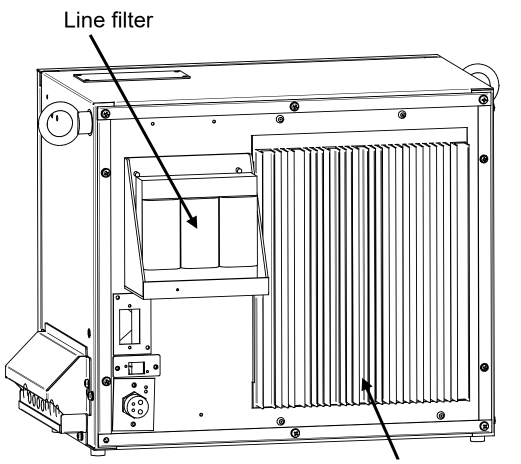


Fig.2.1 (e) R-30*i*B Mate/ R-30*i*B Mate Plus cabinet interior (Front-3) (CR-4*i*A, CR-7*i*A)



(Small size)





(Middle size) **(Large size)**

Fig.2.1 (f) R-30*i*B Mate/ R-30*i*B Mate Plus cabinet interior (Rear)

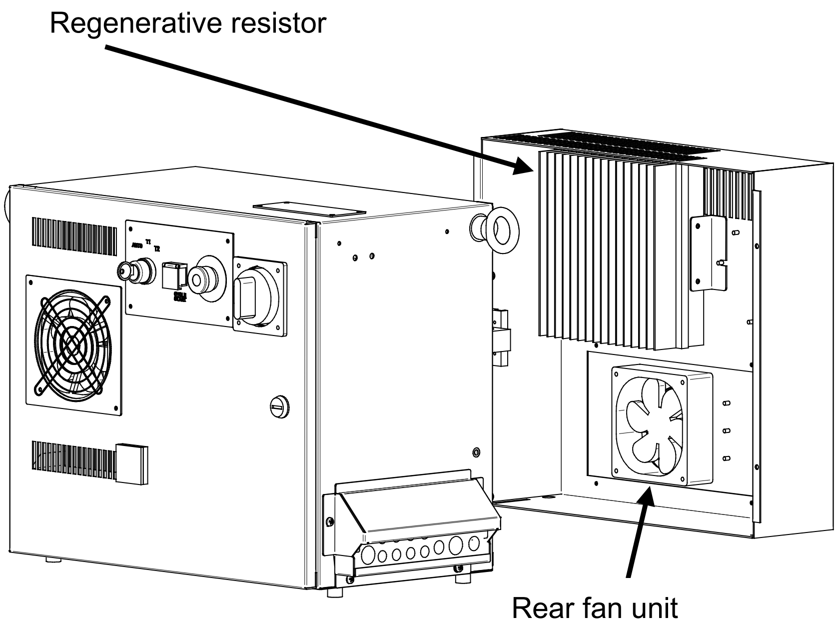


Fig.2.1 (g) R-30*i*B Mate/ R-30*i*B Mate Plus cabinet interior (Middle/Large size) (Rear)

> **NOTE**
> The number of fans on the fan unit (0,1,2) will vary depending on the robot type.

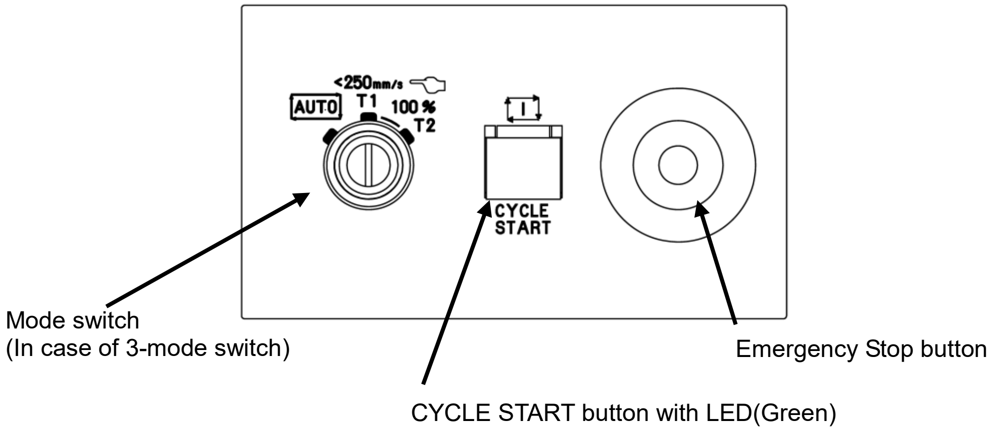


Fig.2.1 (h) R-30*i*B Mate/ R-30*i*B Mate Plus operator's panel

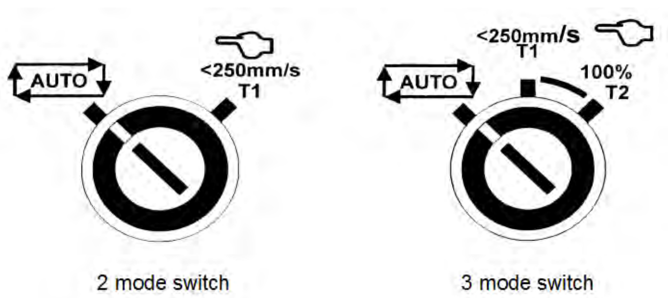


Fig.2.1 (i) Mode switch

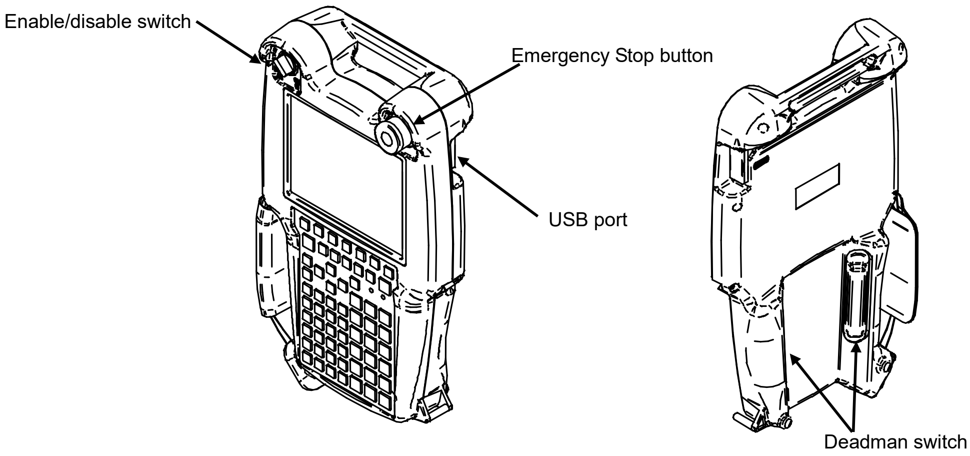


Fig.2.1 (j) Teach pendant (*i*Pendant)

2.2 COMPONENT FUNCTIONS

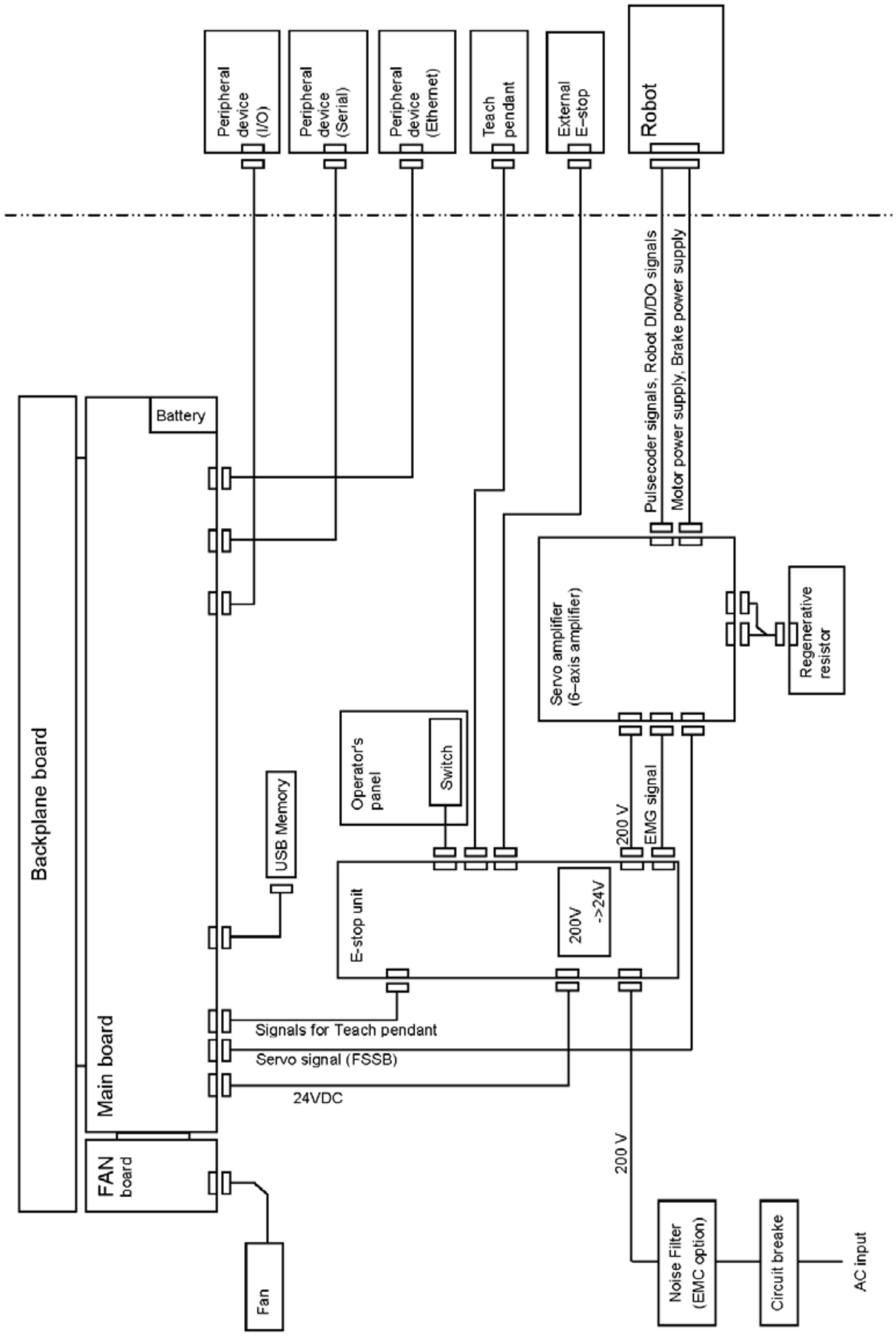


Fig.2.2 Block diagram of the R-30*i*B Mate/ R-30*i*B Mate Plus

- 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.
- I/O printed circuit board
  Various types of printed circuit boards are provided for applications including process I/O board. These are connected with FANUC I/O Link.
- E-stop unit
  This unit controls the emergency stop system of the robot controller. It also has user interface terminals of safety relevant signals, external on/off signals etc.
- 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.
- 6-Axis 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.
- Fan unit, heat exchanger
  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 servomotor, connect a regenerative resistor to the servo amplifier.

2.3 CHECKS AND MAINTENANCE

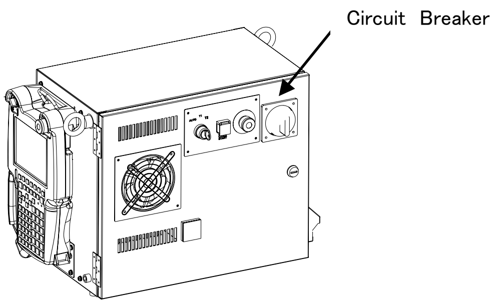
Daily maintenance and periodic maintenance/inspection ensure reliable robot performance for extended periods of time.

(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 has dirt and dust built up, clean the fan according to step (3) described below for inspection to be performed every 6 months.
(3) Periodic inspection performed every six months
Remove any dirt and dust from the inside of the cabinet. Wipe off dirt and dust from the fan.
(4) Battery daily check
Replace the battery on the front panel of the main board every 4 years. Please refer to the Section 7.11.
(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
Cross-head screwdrivers: Large, medium, and small
Straight-head screwdrivers: Large, medium, and small
Nut driver set (Metric)
Pliers
Cutting pliers
Diagonal cutting pliers
(6) Automatic backup
When the automatic backup area (FRA:) of F-ROM in the controller is specified as a backup copy destination and automatic backup is performed frequently, F-ROM may be damaged. If the automatic backup is performed frequently, use the external storage device.

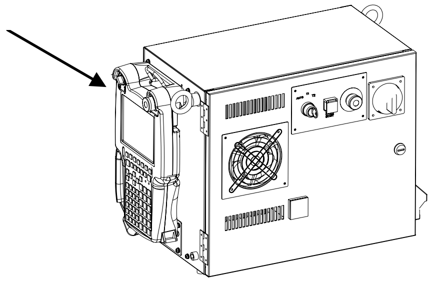
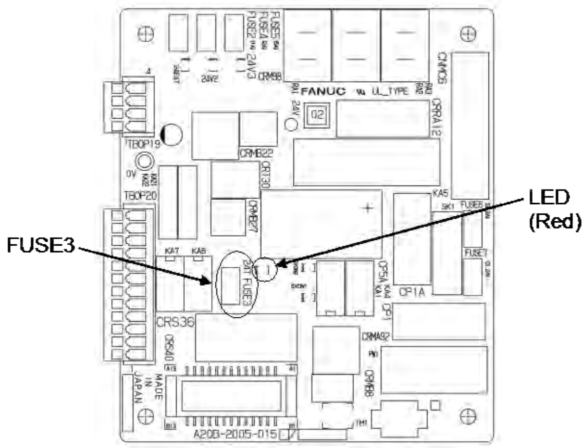
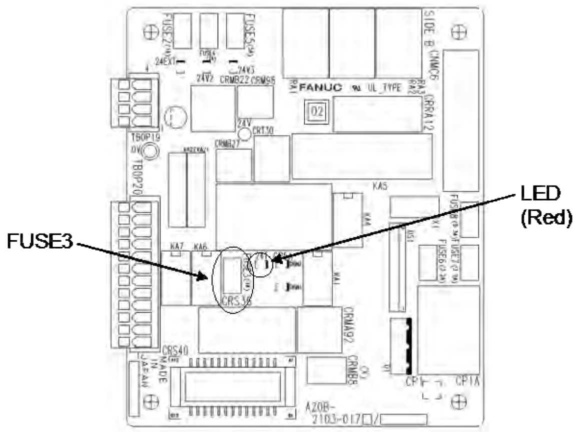
3 TROUBLESHOOTING

This chapter describes the checking method and corrective action for each alarm code indicated if a hardware alarm occurs. Refer to the OPERATOR'S MANUAL (ALARM CODE LIST) (B-83284EN-1) to release program alarms.

3.1 POWER CANNOT BE TURNED ON

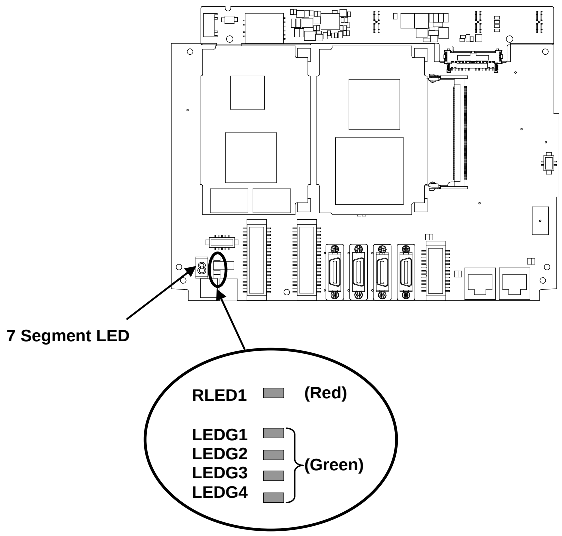
Inspection and action	Figure
(Inspection 1) Check that the circuit breaker is on and has not tripped. (Action) a) If circuit breaker is OFF. Turn on the circuit breaker. b) If the circuit breaker has tripped, find the cause by referencing the total connection diagram presented in the appendix.	

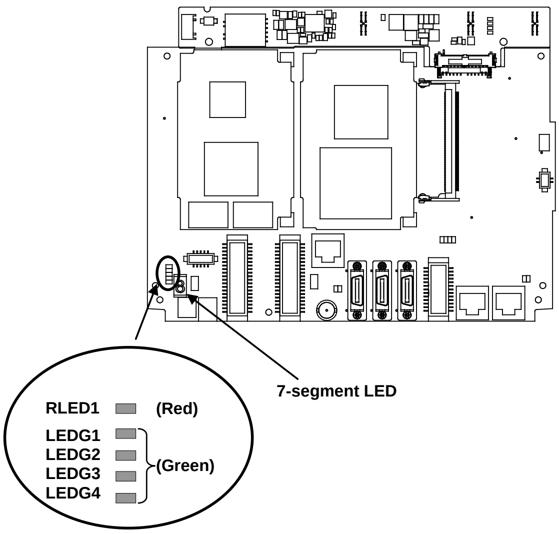
3.1.1 When the Teach Pendant Cannot be Powered on

Inspection and action	Illustration
(Inspection 1) Confirm that fuse (FUSE3) on the emergency stop board is not blown. When it is blown, the LED on the emergency stop board lights in red. When fuse (FUSE3) is blown, carry out action 1 and replace the fuse. (Inspection 2) When fuse (FUSE3) is not blown, carry out action 2. (Action 1) (a) Check the cable of the teach pendant for failure and replace it as necessary. (b) Check the teach pendant for failure and replace it as necessary. (c) Replace the emergency stop board. (Action 2) When the LED on the main board does not light, replace the emergency stop unit. When the LED on the main board lights, carry out action 1.	Teach pendant   **(R-30*i*B Mate)**  **(R-30*i*B Mate Plus)**

3.1.2 When the Teach Pendant does not Change from the Initial Screen

<table>
<tr><th>Inspection and action</th><th>Illustration</th></tr>
<tr><td>(Inspection 1)
Check that the status display LED and 7-segment LED on the main board operate normally.

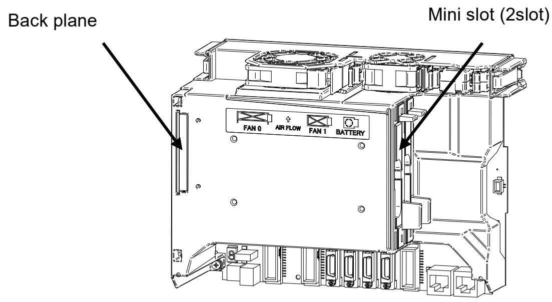
(Action) Carry out an action according to the LED status. For details, see "TROUBLESHOOTING USING THE LEDS ON THE MAIN BOARD".</td><td>

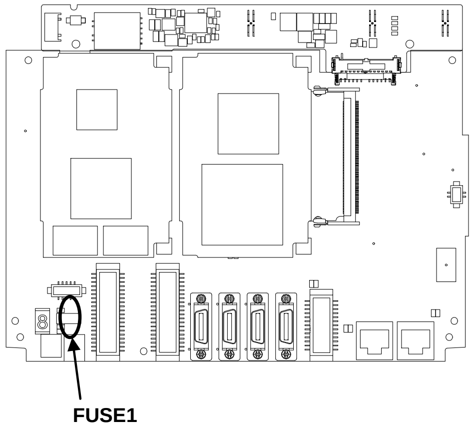
(R-30iB Mate)


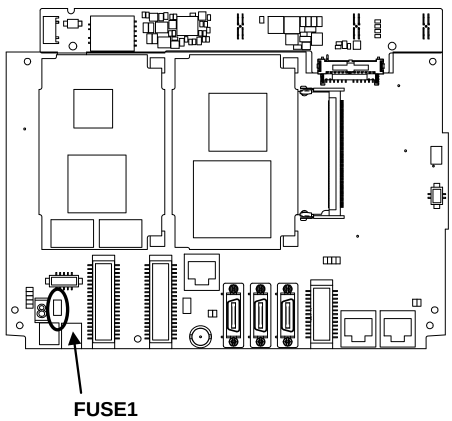
(R-30iB Mate Plus)</td></tr>
</table>

<table>
<tr><th>Inspection and action</th><th>Illustration</th></tr>
<tr><td>
(Inspection 2)
When the LED on the main board does not light in inspection 1, check if fuse (FUSE1) on the main board is blown.
(a) When fuse (FUSE1) is blown
See action 1.
(b) When fuse (FUSE1) is not blown
See action 2.

(Action 1) (a) Replace the backplane board.
(b) Replace the main board.
(c) When an option board is installed in the mini slot, replace the option board.

(Action 2) (a) Replace the emergency stop unit.
(b) Replace the cable between the main board and the emergency stop unit.
(c) Replace the boards indicated in action 1.
</td><td>




(R-30iB Mate)


(R-30iB Mate Plus)
</td></tr>
</table>

3.2 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 alarms that are more serious. 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.

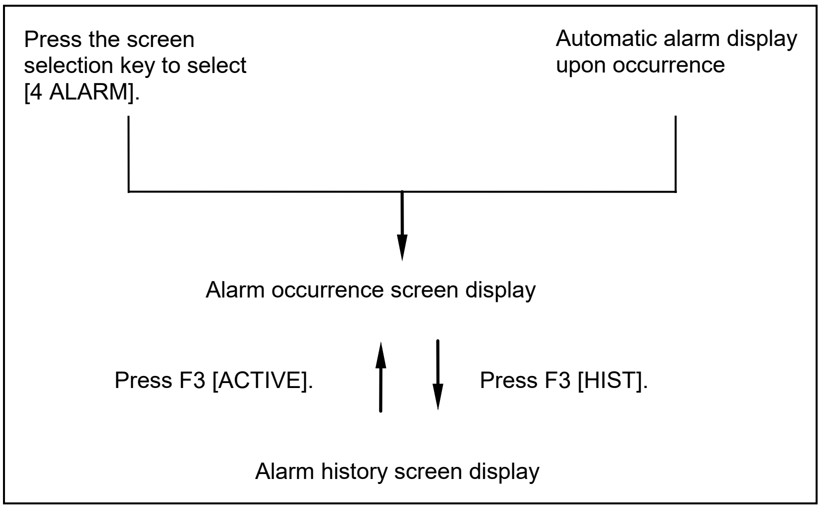
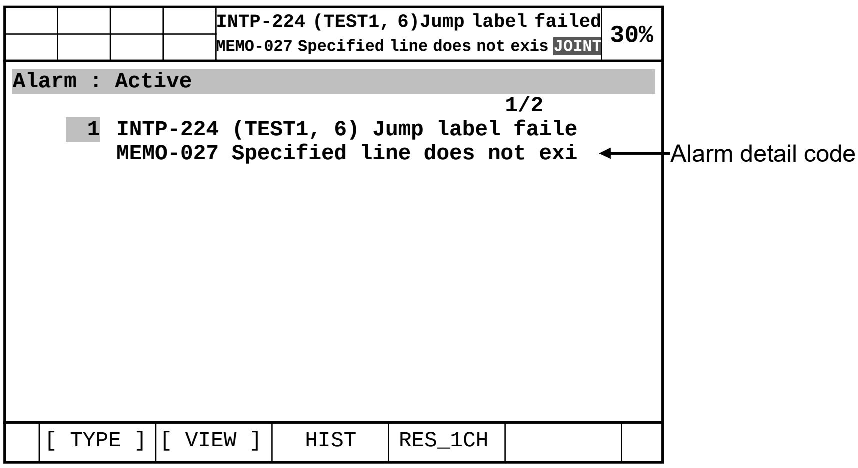


Fig.3.2 Alarm occurrence screen and alarm history screen display procedure

Displaying the alarm active/ alarm history/alarm detail information

Step

(1) Press the [MENU] 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.

```
Alarm : Hist
                                            1/25
     1 INTP-224 (TEST1, 6) Jump label faile
     2 R E S E T
     3 SRVO-007 External emergency stop
     4 SRVO-001 Operator panel E-stop
     5 R E S E T
     6 SRVO-001 Operator panel E-stop
     7 SRVO-012 Power failure recovery
     8 INTP-127 Power fail detected
     9 SRVO-047 LVAL alarm (Group:1 Axis:5)
    10 SRVO-047 LVAL alarm (Group:1 Axis:4)
    11 SRVO-002 Teach pendant E-stop

   [ TYPE ] [ VIEW ]  ACTIVE  CLEAR  DETAIL
```

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

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

```
Alarm : Hist
    DETAIL Alarm
    INTP-224 (TEST1, 6) Jump label failed
    MEMO-027 Specified line does not exist
    STOP.L    21-NOV-11 12:16
    Alarm : Hist
      1 INTP-224 (TEST1, 6) Jump label faile
      2 R E S E T
      3 SRVO-007 External emergency stop
      4 SRVO-001 Operator panel E-stop
      5 R E S E T
      6 SRVO-001 Operator panel E-stop
      7 SRVO-012 Power failure recovery

   [ TYPE ][ VIEW ]  ACTIVE  CLEAR  DETAIL
```

(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 ALARM
  - F1 [TYPE]
    - Alarm : Active
      - F1 [TYPE]
      - F3 HIST
        - Alarm : HIST
          - F1 [TYPE]
          - F3 [ACTIVE]
          - F4 CLEAR
          - F5 HELP
            - DETAIL Alarm
              - F1 [TYPE]
              - F3 [ACTIVE]
              - F4 CLEAR
              - F5 HELP

3.3 STOP SIGNALS

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

Table 3.3 Stop signals

Stop signal	Description
Operator's panel emergency stop	This item indicates the state of the emergency stop button on the operator's panel. If the EMERGENCY STOP button is pressed, the state is indicated as "TRUE".
Teach pendant emergency 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 emergency stop	This item indicates the state of the external emergency stop signal. If the EMERGENCY 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.

Stop signal	Description
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 [MENU] 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 Stop Signal. You will see a screen similar to the following.

```
STATUS Stop Signal
         SIGNAL NAME          STATUS   1/12

      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 Overtravel:             FALSE
      9 Low Air Alarm:          FALSE
     10 Belt Broken:            FALSE
     11 SVOFF Input:            FALSE
     12 Non Teacher Enb. Dev.: FALSE

 [ TYPE ]
```

3.4 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 single axis or fixture position mastering.
The mastering procedure is described below. For details, refer to an applicable maintenance manual of mechanical unit or Mastering chapter of the Appendix B of the OPERATOR’S MANUAL (BASIC OPERATION) (B-83284EN) .

Condition

System variable $MASTER_ENB must be set to 1 or 2.

```
SYSTEM Variables

     272 $MASTER_ENB       1
```

Step

(1) Press the [MENU] key to display the screen menu.
(2) Select SYSTEM on the next page.
(3) Press F1, [TYPE] to display the screen switching menu.
(4) Select Master/Cal you will see a screen similar to the following.

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

```
SYSTEM Master/Cal
                              TORQUE = [ON ]
      1 FIXTURE POSITION MASTER
      2 ZERO POSITION MASTER
      3 QUICK MASTER
      4 QUICK MASTER FOR SINGLE AXIS
      5 SINGLE AXIS MASTER
      6 SET QUICK MASTER REF
      7 CALIBRATE

       Press 'ENTER' or number key to select.

   [ TYPE ]  LOAD   RES_PCA          DONE
```

> **NOTE**
> Mastering cannot 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.

```
SYSTEM Master/Cal
                              TORQUE = [ON ]
      1 FIXTURE POSITION MASTER
      2 ZERO POSITION MASTER
      3 QUICK MASTER
      4 QUICK MASTER FOR SINGLE AXIS
      5 SINGLE AXIS MASTER
      6 SET QUICK MASTER REF
      7 CALIBRATE
      Robot Mastered! Mastering Data:
        <-3105333> <-13216881> <22995280>
        <-1354153> <0> <0>

   [ TYPE ]  LOAD   RES_PCA          DONE
```

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

```
SYSTEM Master/Cal
                              TORQUE = [ON ]
      1 FIXTURE POSITION MASTER
      2 ZERO POSITION MASTER
      3 QUICK MASTER
      4 QUICK MASTER FOR SINGLE AXIS
      5 SINGLE AXIS MASTER
      6 SET QUICK MASTER REF
      7 CALIBRATE
      Robot Calibrated! Cur Jnt Ang(deg):
         <   0.0000> <  24.6528> < -94.2241>
         <   0.0000> < -85.7759> <   0.0000>

   [ TYPE ]  LOAD   RES_PCA          DONE
```

(8) Press F5 "DONE", after mastering.
(9) Restore the brake condition to its original condition.

3.5 TROUBLESHOOTING USING THE ALARM CODE

SRVO-001 Operator panel E-stop

(Explanation) The emergency stop button on the operator's panel is pressed.

(Action 1) Release the emergency stop button pressed on the operator's panel.

(Action 2) Check the wires connecting between the emergency stop button and the emergency stop board (CRT30) for continuity. If an open wire is found, replace the entire harness.

(Action 3) Check the wires connecting between the teach pendant and the emergency stop board (CRS36) for continuity. If an open wire is found, replace the entire harness.

(Action 4) With the emergency stop in the released position, check for continuity across the terminals of the switch. If continuity is not found, the emergency stop button is broken. Replace the emergency stop button or the operator's panel.

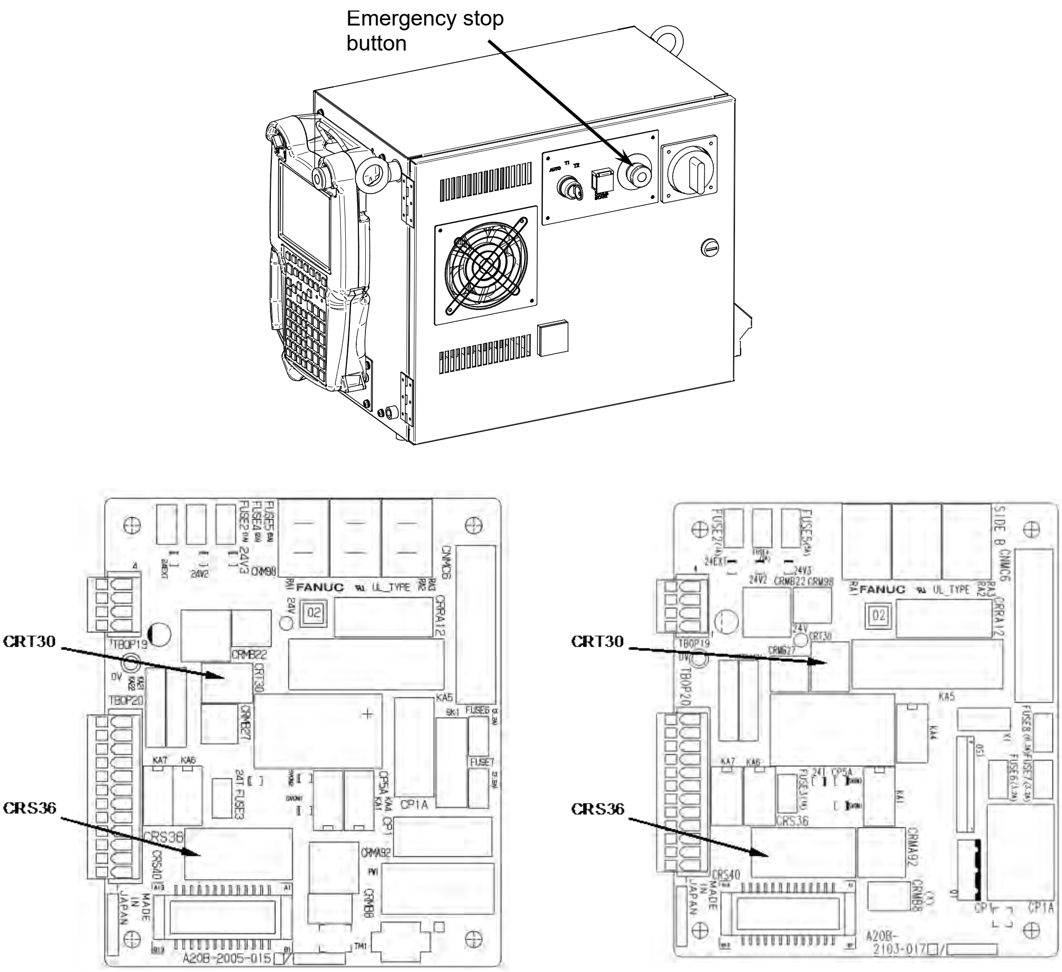
(Action 5) Replace the teach pendant.

(Action 6) Replace the emergency stop board.

Before executing the (Action 7), perform a complete controller back-up to save all your programs and settings.

(Action 7) Replace the main board.

> **NOTE**
> If SRVO-001 is issued together with SRVO-213, a fuse may have blown. Take the same actions as for SRVO-213.



(R-30*i*B Mate) (R-30*i*B Mate Plus)

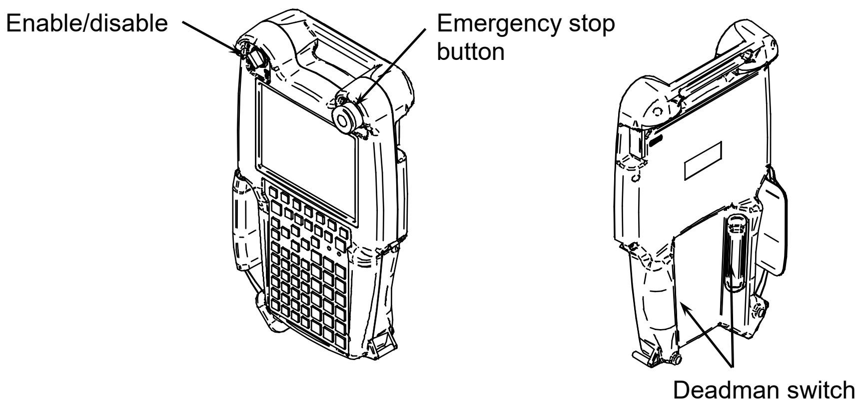
Fig.3.5 (a) SRVO-001 Operator panel E-stop

SRVO-002 Teach pendant E-stop

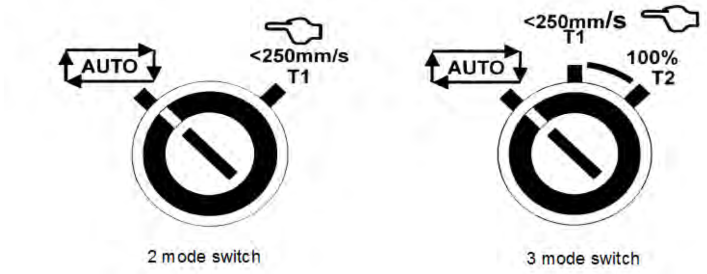
(Explanation) The emergency stop button on the teach pendant was pressed.
(Action 1) Release the emergency stop button on the teach pendant.
(Action 2) Replace the teach pendant.

SRVO-003 Deadman switch released

(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 operator's panel and the enable/disable switch on the teach pendant are at the correct positions.
(Action 3) Replace the teach pendant.
(Action 4) Check the mode switch connection and operation. If trouble is found, replace the mode switch.
(Action 5) Replace the emergency stop board.



(Teach pendant)



(Mode switch)

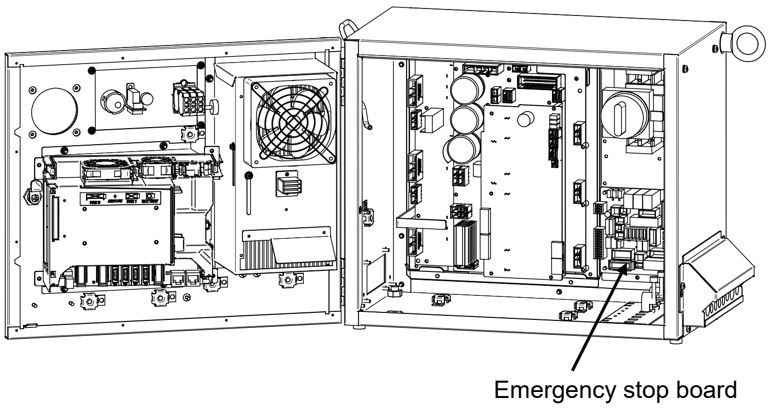


Fig.3.5 (b) SRVO-002 Teach pendant E-stop
SRVO-003 Deadman switch released

SRVO-004 Fence open

(Explanation) In the automatic operation mode, the safety fence contact connected to EAS1-EAS11 or EAS2-EAS21 of TBOP20 is open.

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

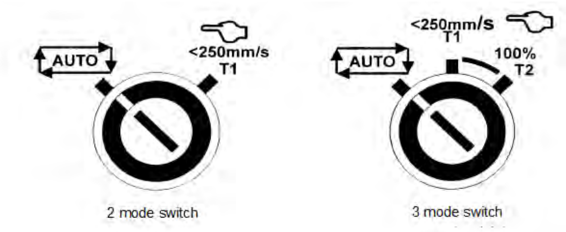
(Action 2) Check the cables and switches connected between EAS1 and EAS11 and between EAS2 and EAS21 of the terminal block TBOP20 on the emergency stop board.

(Action 3) If the safety fence signal is not used, make a connection between EAS1 and EAS11 and between EAS2 and EAS21 of the terminal block TBOP20 on the emergency stop board.

(Action 4) Check the mode switch. If trouble is found, replace the mode switch.

(Action 5) Replace the emergency stop board.

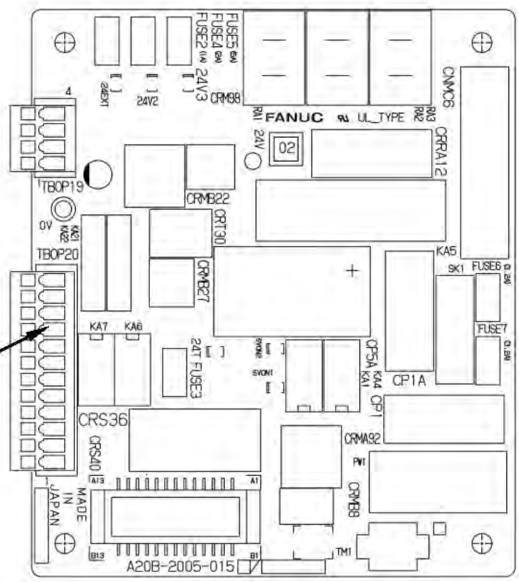
> **NOTE**
> If SRVO-004 is issued together with SRVO-213, a fuse may have blown. Take the same actions as for SRVO-213.



(Mode switch)

TBOP20

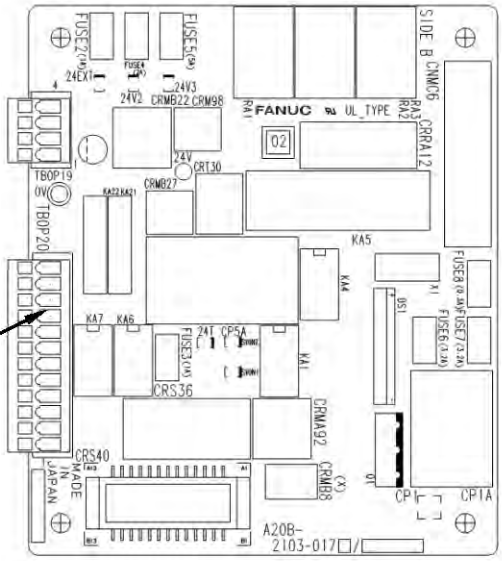
No.	Name	
12	E-STOP (ESPB)	21
11		2
10		11
9		1
8	FENCE (EAS)	21
7		2
6		11
5		1
4	EMGIN (EES)	21
3		2
2		11
1		1



(R-30*i*B Mate)

TBOP20

No.	Name	
12	E-STOP (ESPB)	21
11		2
10		11
9		1
8	FENCE (EAS)	21
7		2
6		11
5		1
4	EMGIN (EES)	21
3		2
2		11
1		1



(R-30*i*B Mate Plus)

Fig.3.5 (c) SRVO-004 Fence open

> ⚠ **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. Never make such an attempt. If a temporary connection is needed for operation, separate safety measures must be taken.

SRVO-005 Robot overtravel

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

(Action 1)
1) Select [System 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 key to reset the alarm condition.
3) Still hold down the shift key, and jog to bring all axes into the movable range.

(Action 2) Replace the limit switch.

(Action 3) Check the FS2 fuse on the servo amplifier. If the SRVO-214 6ch amplifier fuse blown alarm is also generated, the FS2 fuse has blown.

(Action 4) Check the EE connector.

(Action 5) Replace the 6-Axis servo amplifier.

(Action 6) Verify the following for connector RMP1, RP1 at the base of the robot:
1) There are no bent or dislocated pins in the male or female connectors.
2) The connector is securely connected.

Then verify that connectors CRF8 and CRM68 on the servo amplifier are securely connected. Also, verify that the robot connection cable (RMP1, RP1) is in good condition, and there are no cuts or kinks visible. Check the internal cable of the robot for a short circuit or connection to ground.

> **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 short-circuiting in the mechanical unit.

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

1) Replace the safety joint.
2) Check the safety joint cable.

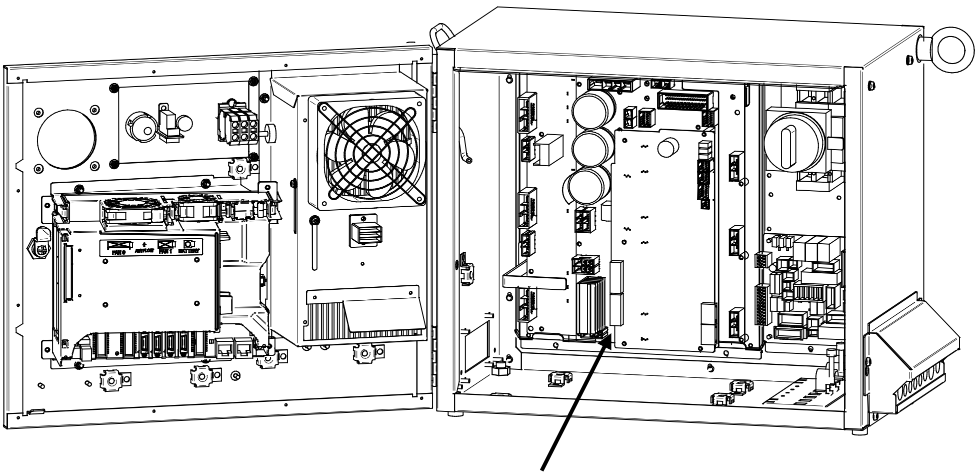
(Action 2) Replace the 6-Axis servo amplifier.

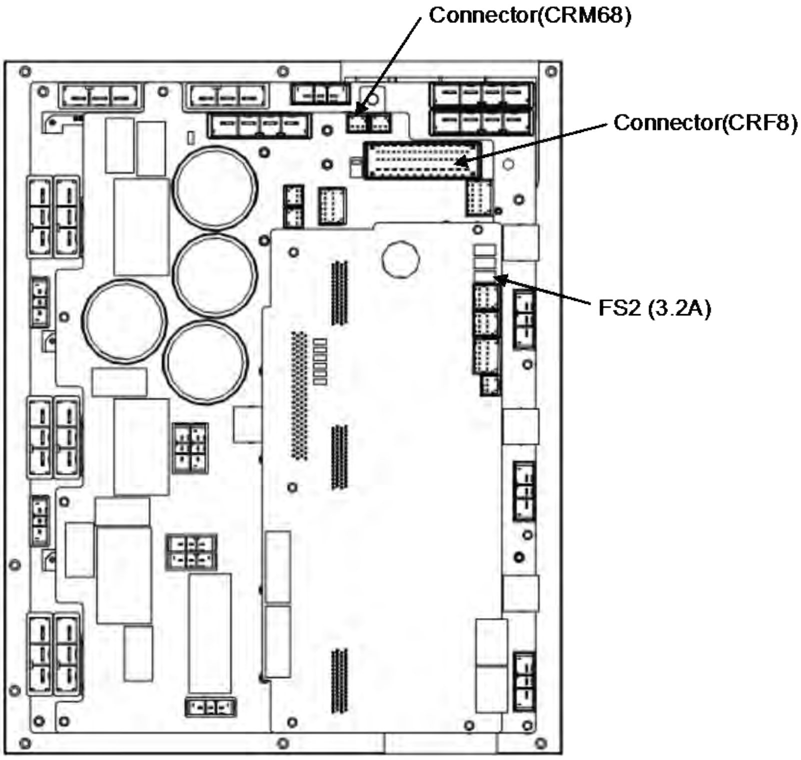
(Action 3) Verify the following for connector RMP1, RP1 at the base of the robot:

1) There are no bent or dislocated pins in the male or female connectors.
2) The connector is securely connected.

Then verify that connectors CRF8 and CRM68 on the servo amplifier are securely connected. Also, verify that the robot connection cable (RMP1, RP1) is in good condition, and there are no cuts or kinks visible. Check the internal cable of the robot for a short circuit or connection to ground.

NOTE
If the Hand broken signal is not in use, it can be disabled by software setting. Refer to Subsection 5.6.3 in CONNECTIONS to disable the Hand broken signal.





(6-Axis servo amplifier)

Fig.3.5 (d) **SRVO-005 Robot overtravel**
SRVO-006 Hand broken

SRVO-007 External emergency stops

(Explanation) On the terminal block TBOP20 of the emergency stop board, no connection of external emergency stop is made between EES1 and EES11, EES2 and EES21.

(Action 1) If an external emergency stop switch is connected, release the switch.

(Action 2) Check the switch and cable connected to EES1-EES11 and EES2-EES21 on TBOP20 of the emergency stop board.

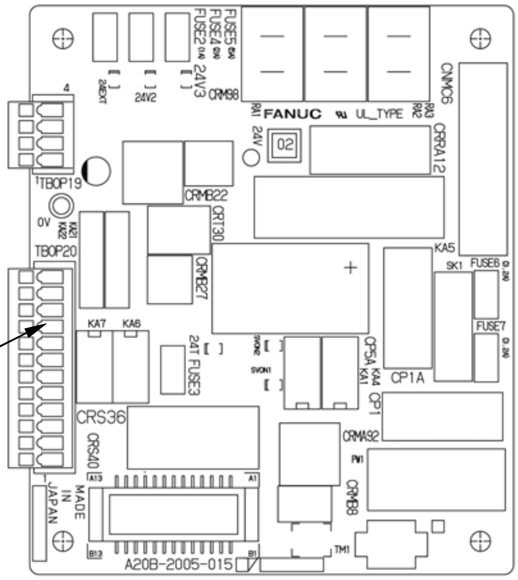
(Action 3) When this signal is not used, make a connection between EES1 and EES11, EES2 and EES21.

(Action 4) Replace the emergency stop board.

> **NOTE**
> If SRVO-007 is issued together with SRVO-213, a fuse may have blown. Take the same actions as for SRVO-213.

TBOP20

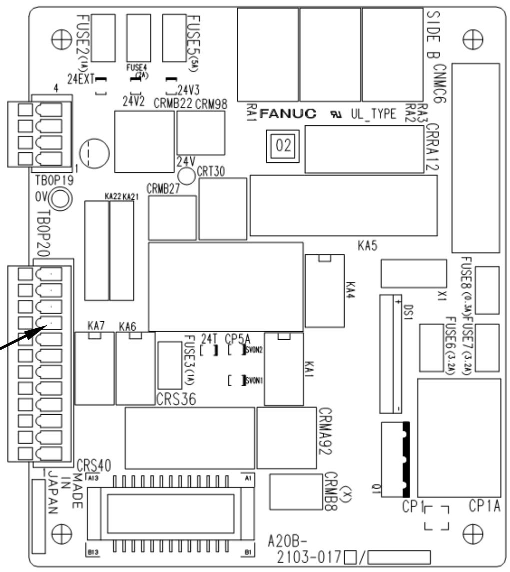
No.	Name	
12	E-STOP (ESPB)	21
11		2
10		11
9		1
8	FENCE (EAS)	21
7		2
6		11
5		1
4	EMGIN (EES)	21
3		2
2		11
1		1



(R-30*i*B Mate)

TBOP20

No.	Name	
12	E-STOP (ESPB)	21
11		2
10		11
9		1
8	FENCE (EAS)	21
7		2
6		11
5		1
4	EMGIN (EES)	21
3		2
2		11
1		1



(R-30*i*B Mate Plus)

(Emergency stop board)

Fig.3.5 (e) SRVO-007 External emergency stops

> ⚠ **WARNING**
> In a system using the external emergency stop signal, it is very dangerous to disable the signal when a connection is made between EES1 and EES11 and between EES2 and EES21. Never make such an attempt. If a temporary connection is needed for operation, separate safety measures must be taken.

SRVO-009 Pneumatic pressure alarm

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

(Action 1) If an abnormal air pressure is detected, check the cause.

(Action 2) Check the EE connector.

(Action 3) Check the robot connection cable (RMP1, RP1) and the internal cable of the robot for a ground fault or a cable disconnection. If a fault or a disconnection is detected, replace the cable.

(Action 4) Replace the 6-Axis servo amplifier.

(Action 5) Replace the internal cables of the robot.

> **NOTE**
> Pneumatic pressure alarm input is on the EE interface. Please refer to the manual of your robot.

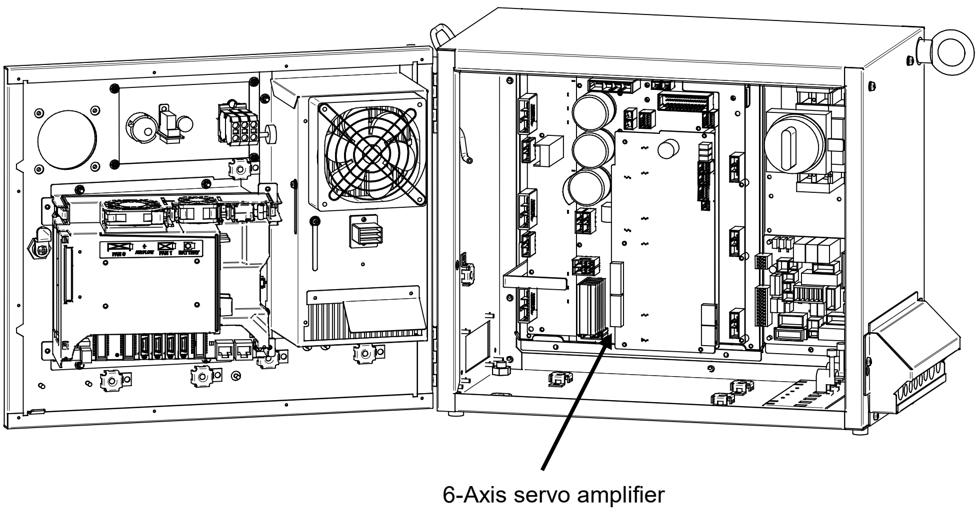


Fig.3.5 (f) SRVO-009 Pneumatic pressure alarm

SRVO-014 Fan motor abnormal (n), CPU STOP

(Explanation) When a fan motor stops on backplane unit, Teach pendant shows the following message. In one minutes from occurring of alarm, robot stops and cannot be operated from TP. The robot can be recovered by replacing a fan motor. Number in the bracket indicates which fan is abnormal.

(1): FAN0
(2): FAN1
(3): both fans

(Action 1) Check the fan motor and its cables. Replace them if necessary.

(Action 2) Replace the fan board.

Before executing the (Action 3), perform a complete controller back up to save all your programs and settings.

(Action 3) Replace the main board.

> **NOTE**
> The controller will stop operation after 1 minutes of this alarm.

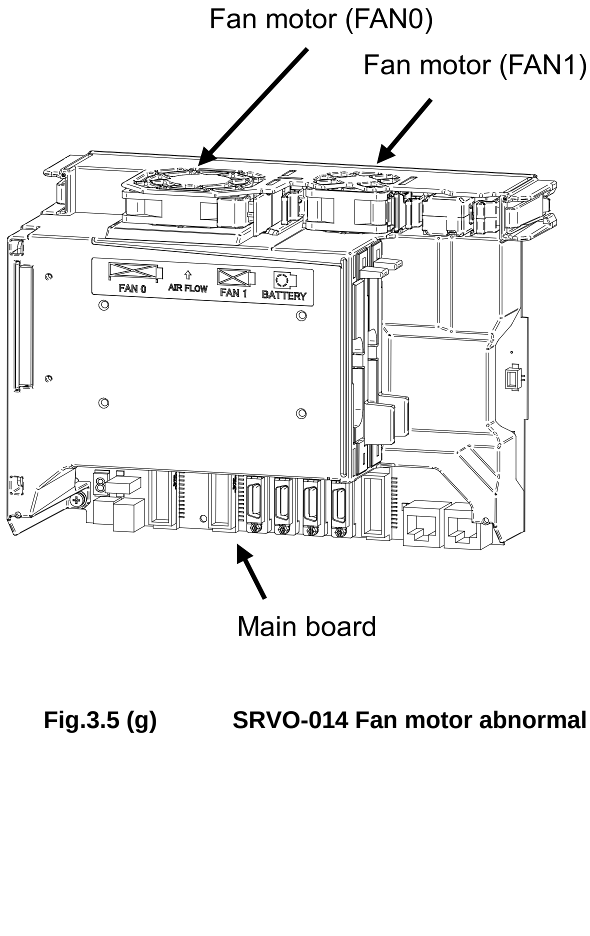


Fig.3.5 (g) SRVO-014 Fan motor abnormal

SRVO-015 System over heat

(Explanation) The temperature in the controller exceeds the specified value. In one minutes from occurring of alarm, robot stops and cannot be operated from TP.

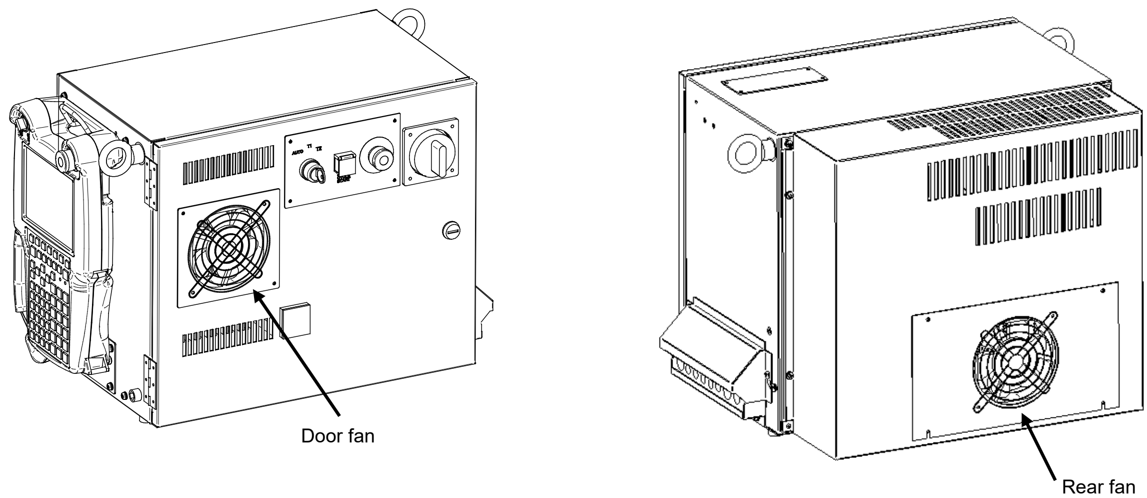
(Action 1) If the ambient temperature is higher than specified (45°C), cool down the ambient temperature.

(Action 2) If the fan motor is not running, check it, its cables and related fuses. Replace them if necessary.

Before executing the (Action 3), perform a complete controller backup to save all your programs and settings.

(Action 3) Replace the main board. (The thermostat on the main board may be faulty.)

> **NOTE**
> The controller will stop operation after 1 minutes of this alarm.



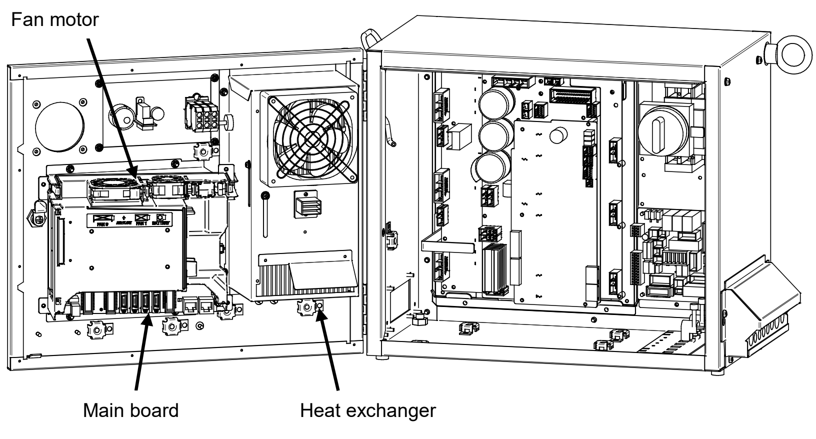


Fig.3.5 (h) SRVO-015 System over heat

SRVO-018 Brake abnormal (G:i A:j)

(Explanation) An excessive brake current is detected. The ALM LED (SVALM) on the 6-Axis servo amplifier is lit.

(Action 1) Check the robot connection cable (RMP1, RP1) and the internal cable of the robot and motor brakes connected to CRR88 connector on the 6-Axis servo amplifier.
If a short-circuit or grounding fault is found, replace the failed part.

(Action 2) Check the cables and motor brakes connected to CRR65A, CRR65B connector on the 6-Axis servo amplifier. If a short-circuit or grounding fault is found, replace the failed part.

(Action 3) Replace the 6-Axis servo amplifier.

> ⚠ **CAUTION**
> This error can be caused by the optional brake release unit if the on/off switch is left in on position while the operator attempts to jog the robot. To recover, turn the brake release unit off and cycle the controller power.

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 issue this alarm (SRDY off). Therefore, this alarm indicates that the magnetic contactor cannot be turned on for an unknown reason.

(Action 1) Make sure that the emergency stop board connectors CP5A, CRMA92, CRMB22, and 6-Axis servo amplifier CRMA91 are securely attached to the servo amplifier.
In case of using aux. axis amplifier, make sure that the connectors CXA2A (6-axis amplifier) or CXA2B (aux. axis amplifier) are securely attached to the servo amplifier.

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

(Action 3) Replace the E-stop unit.

(Action 4) Replace the servo amplifier.

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.)

(Action 1) Replace the servo amplifier as the alarm message.

SRVO-023 Stop error excess (G:i A: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.

(Action 1) If the brake is not released, check the continuity of the brake line in the robot connection cable and the mechanical unit cable.

(Action 2) If the disconnection is not found, replace the 6-Axis servo amplifier or the servo motor.

In case that the brake is released.

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

(Action 2) Make sure that connectors CNJ1A-CNJ6 are securely attached to the 6-Axis servo amplifier.

(Action 3) Check the continuity of the robot connection cable and the internal robot power cable.

(Action 4) 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 issued.)

(Action 5) Check the input voltage to the controller is within the rated voltage and no phase is lack.
Check each phase voltage of the CRR38A or CRR38B connector of the three-phase power (200 VAC) input to the 6-Axis servo amplifier. If it is 210 VAC or lower, check the line voltage. (If the voltage input to the 6-Axis servo amplifier becomes low, the torque output also becomes low. As a result, the motor may become unable to follow the command, hence possibly causing an alarm.).

(Action 6) Replace the servo amplifier.

(Action 7) Replace the motor of the alarm axis.

> **NOTE**
> Incorrect setting of the brake number causes this alarm.

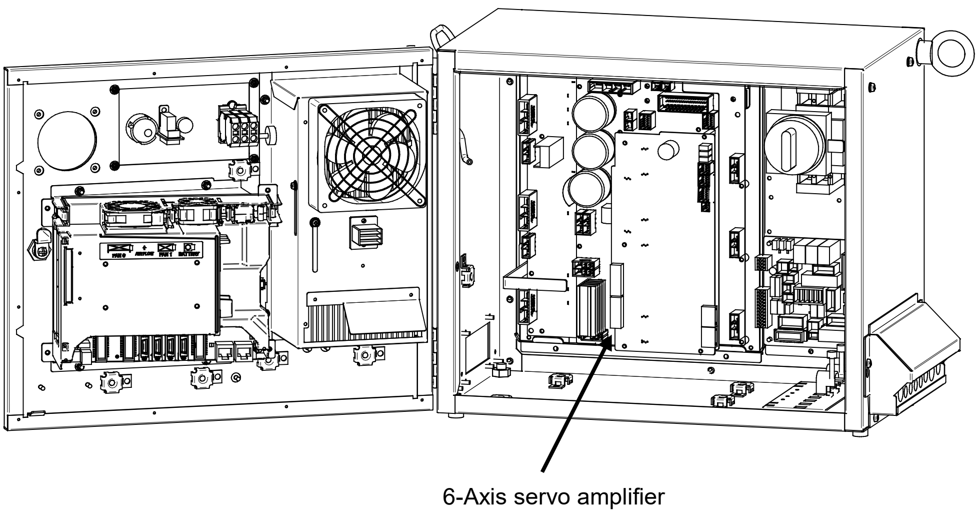


Fig.3.5 (i) SRVO-018 Brake abnormal
SRVO-021 SRDY off
SRVO-022 SRDY on
SRVO-023 Stop error excess

SRVO-024 Move error excess (G:i A: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 1) Take the same actions as SRVO-023.

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 or additional axis can operate abnormally, set the position data correctly. Otherwise, you could injure personnel or damage equipment.

SRVO-030 Brake on hold (Group:i)

(Explanation) If the temporary halt alarm function is enabled ($SCR.$BRKHOLD ENB=1), SRVO-030 is issued 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].

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.

1. Supply power.
2. Set up a quick mastering reference point using [Positioning] on the positioning menu.

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.

SRVO-036 Inpos time over (G:i A: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) elapsed.

(Action) Take the same actions as for SRVO-023 (large position error at a stop).

SRVO-037 IMSTP input (Group:i)

(Explanation) The *IMSTP signal for a peripheral device interface was input.

(Action) Turn on the *IMSTP signal.

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.

(Action 3) If the robot has been moved because the brake failed, this alarm may occur. Check the cause of the brake trouble. Then remaster the robot.

(Action 4) Replace the Pulsecoder and master the robot.

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.

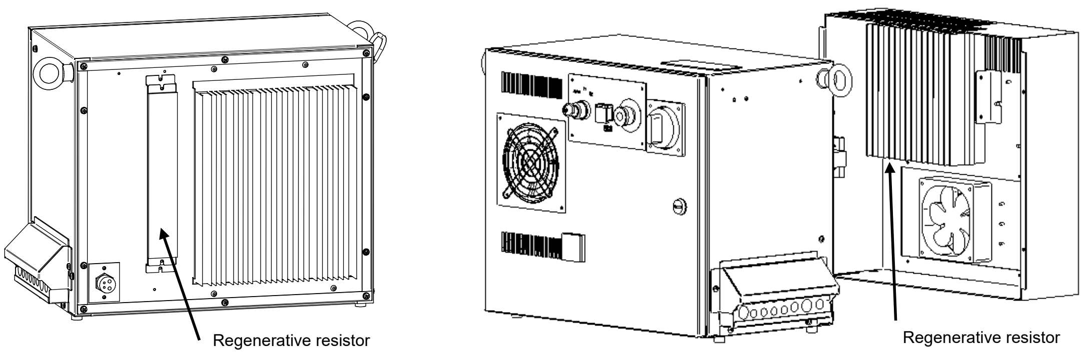
(Action 2) Check fuse (FS3) in the 6-Axis servo amplifier. If it has blown, remove the cause, and replace the fuse.

(Action 3) The ambient temperature is excessively high. Or the regenerative resistor can't be cooled effectively. Check the external fan unit and related fuses. Clean up the fun unit, the regenerative resistor and the louver if they are dirty.

(Action 4) Make sure that the 6-Axis servo amplifier CRR63A and CRR63B connectors are connected tightly. Then detach the cable from CRR63A and CRR63B connectors on the 6-Axis servo amplifier, and check for continuity between pins 1 and 2 of the cable-end connector. If there is no continuity between the pins, replace the regenerative resistor.

(Action 5) Make sure that the 6-Axis servo amplifier CRRA11A and CRRA11B are connected tightly, then detach the cables from CRRA11A and CRRA11B on the 6-Axis servo amplifier and check the resistance between pins 1 and 3 of each cable end connector. If the resistance is not 6.5Ω, replace the regenerative resistor. CRRA11B may not be used depending on the robot model.

(Action 6) Replace the 6-Axis servo amplifier.



(Small size) **(Middle/Large size)**

Fig.3.5 (ja) SRVO-043 DCAL alarm

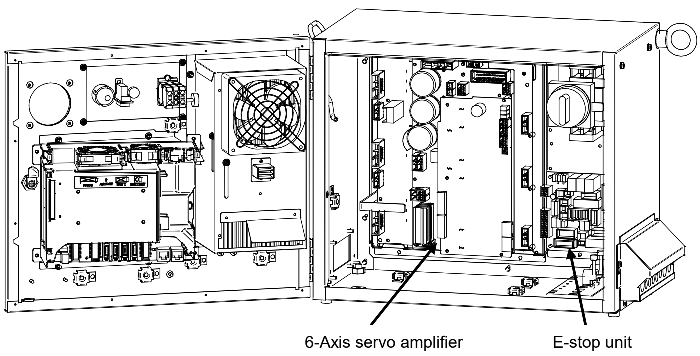


Fig.3.5 (jb) SRVO-043 DCAL alarm

SRVO-044 DCHVAL%s alarm (G:i A:j)

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

(Action 1) Check the input voltage to the controller is within the rated voltage. And check the setting of the transformer is correct.

(Action 2) Check the three-phase input voltage at the 6-Axis servo amplifier. If it is 240 VAC or higher, check the line voltage. (If the three-phase input voltage is higher than 240 VAC, high acceleration/deceleration can cause in this alarm.)

(Action 3) 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.)

(Action 4) Check that the CRRA11A and CRRA11B connectors of the 6-Axis servo amplifier are attached firmly. Next, detach the cables then check the continuity between pins. If the resistance is not 6.5Ω, replace the regenerative resistor. CRRA11B may not be used depending on the robot model.

(Action 5) Replace the 6-Axis servo amplifier.

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

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

(Action 1) 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 6-Axis servo amplifier) to avoid the axis falling unexpectedly.) Supply power and see if the alarm occurs again. If the alarm occurs again, replace the servo amplifier.

(Action 2) Turn off the power and disconnect the power cable from the servo amplifier indicated by the alarm message, and check the insulation of their U, V, W and the GND lines each other. If there is a short-circuit, replace the power cable.

(Action 3) Turn off the power and disconnect the power cable from the servo amplifier by the alarm message, and measure the resistance between their U and V, V and W and W and U with an ohmmeter that has a very low resistance range. If the resistances at the three places are different from each other, the motor, the power cable is defective. Check each item in detail and replace it if necessary.

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

(Explanation) This alarm is issued to prevent the motor from thermal damage that might occur when the root meant 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 the brake of the corresponding axis is released.

(Action 4) Check whether there is a factor that has increased the mechanical load on the corresponding axis.

(Action 5) Replace the servo amplifier.

(Action 6) Replace the motor of the corresponding axis.

(Action 7) Replace the E-stop unit

(Action 8) Replace the motor power line (robot connection cable) of the corresponding axis.

(Action 9) Replace the motor power line and brake line (internal cable of the robot) of the corresponding axis.

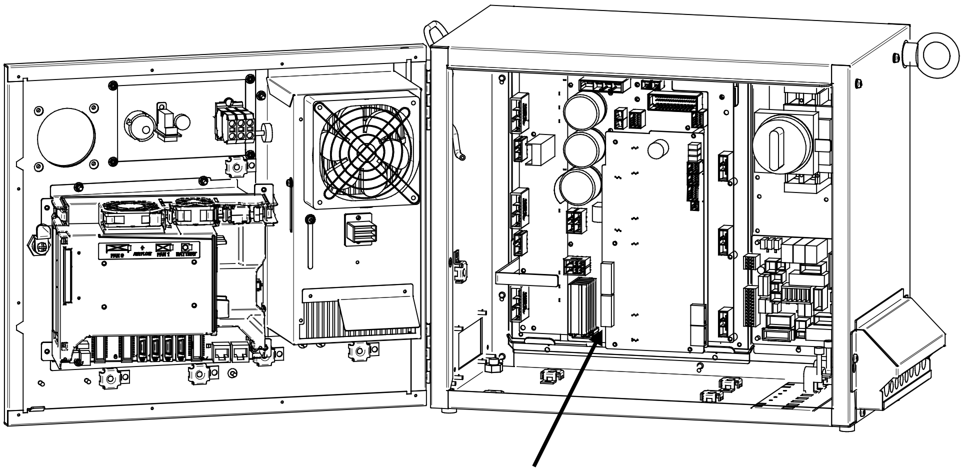


Fig.3.5(k) SRVO-044 HVAL alarm
SRVO-045 HCAL alarm
SRVO-046 OVC alarm

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 Thermal relay in the servo amplifier Thermal relay in the separate regenerative resister
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. 3.5 (l), 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.

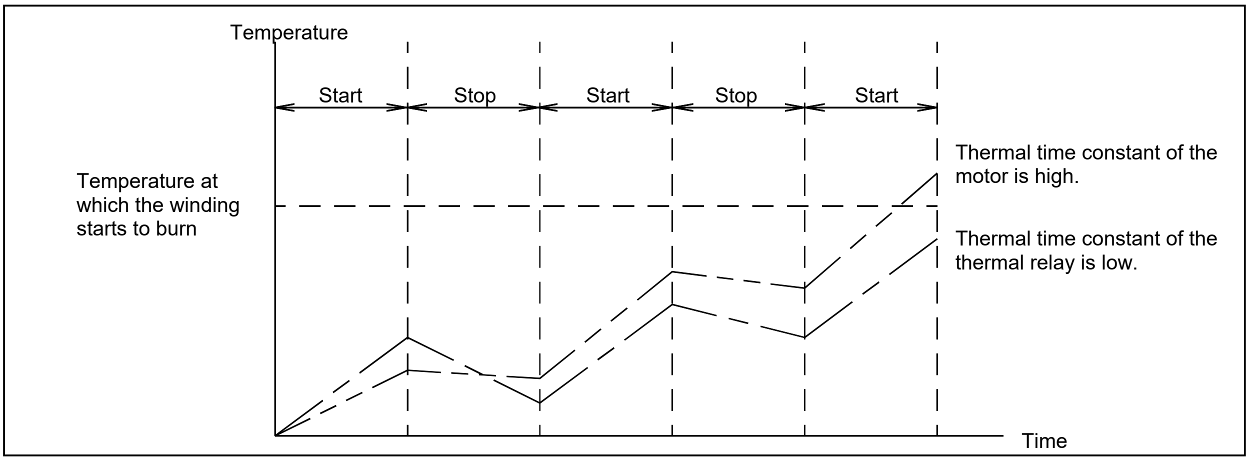


Fig.3.5 (l) Relationship between the temperatures of the motor and thermal relay on start/stop cycles

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 issued 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.3.5 (m).

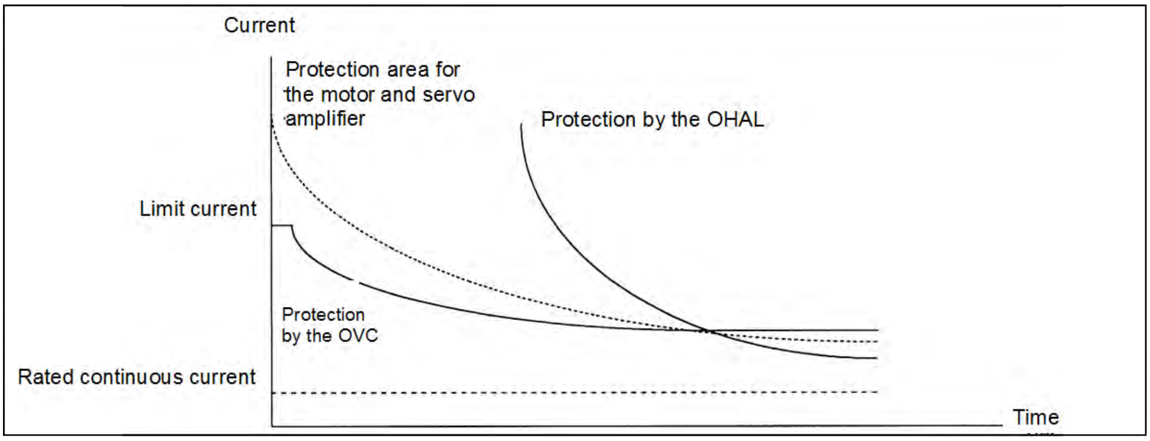


Fig.3.5 (m) Relationship between the OVC and OHAL alarms

> **NOTE**
> The relationship shown in Fig.3.5 (m) 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 relax protection.

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.
(Action 1) Replace the servo amplifier.
(Action 2) Replace the power supply unit.

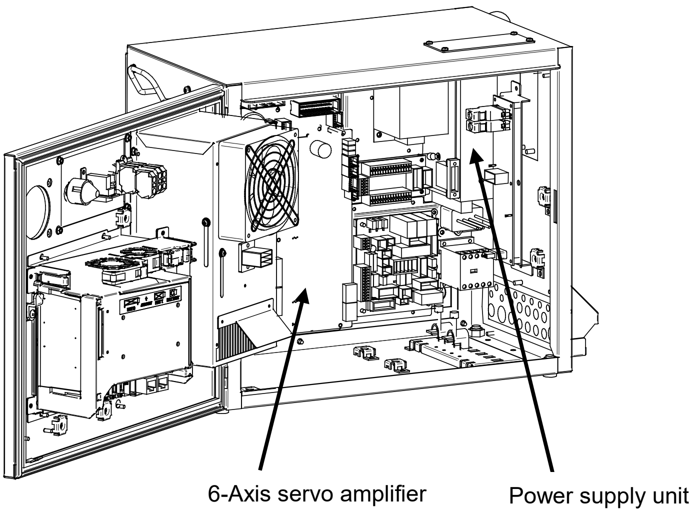


Fig.3.5 (n) SRVO-047 LVAL alarm

SRVO-049 OHAL1 alarm (Grp:i Ax:j)

(Explanation) The 6-Axis servo amplifier detects transformer overheat signal.
(Action 1) Check that a connection is made between the 6-Axis servo amplifier CRMA91.
(Action 2) Check whether no phase occurs.
(Action 3) Replace the E-stop unit.
(Action 4) Replace the 6-Axis servo amplifier.

SRVO-050 Collision Detect alarm (G:i A: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) Check whether the brake of the corresponding axis is released.
(Action 4) If the load weight exceeds the rated range, decrease it to within the limit.
(Action 5) Check whether the voltage input to the controller is within the rated voltage.
(Action 6) Replace the servo amplifier.
(Action 7) Replace the motor of the corresponding axis.
(Action 8) Replace the E-stop unit.
(Action 9) Replace the motor power line (robot connection cable) of the corresponding axis.
(Action 10) Replace the motor power line and brake line (internal cable of the robot) of the corresponding axis.

SRVO-051 CUER alarm (Group:i Axis:j)

(Explanation) The offset of the current feedback value is abnormally high.
(Action) Replace the servo amplifier.

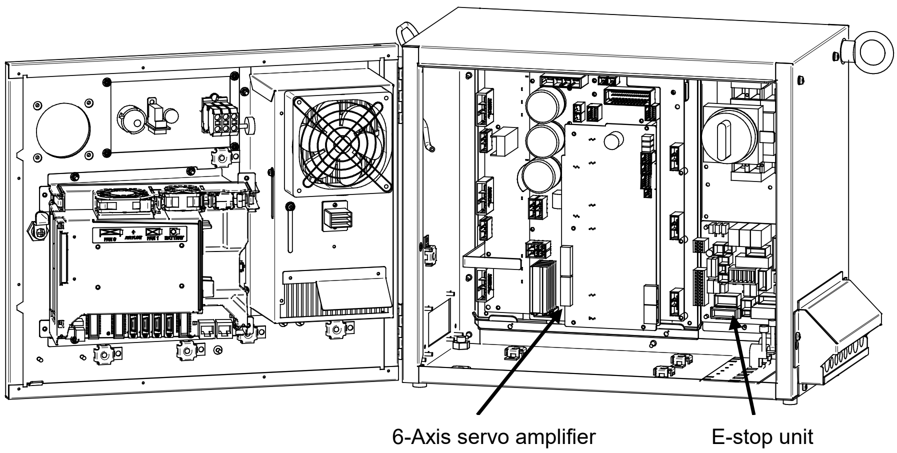


Fig.3.5 (o) SRVO-049 OHAL1 alarm
SRVO-050 CLALM alarm
SRVO-051 CUER alarm

SRVO-055 FSSB com error 1 (G:i A:j)

(Explanation) A communication error has occurred between the main board and servo amplifier.
(Action 1) Check the optical fiber cable between the axis control card and servo amplifier. Replace it if it is faulty.
(Action 2) Replace the axis control card on the main board.
(Action 3) Replace the servo amplifier.

SRVO-056 FSSB com error 2 (G:i A:j)

(Explanation) A communication error has occurred between the main board and servo amplifier.
(Action 1) Check the optical fiber cable between the axis control card and servo amplifier. Replace it if it is faulty.
(Action 2) Replace the axis control card on the main board.
(Action 3) Replace the servo amplifier.

SRVO-057 FSSB disconnect (G:i A:j)

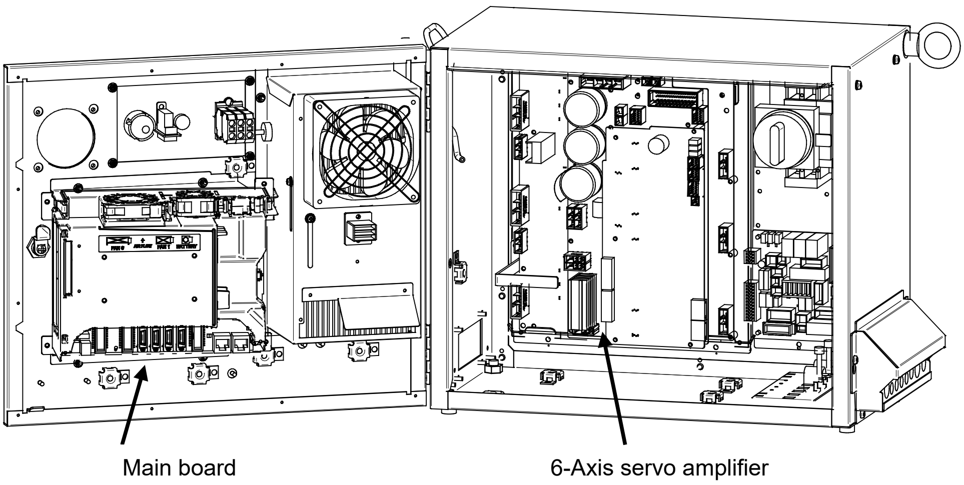
(Explanation) Communication was interrupted between the main board and servo amplifier.
(Action 1) Check whether fuse (FS1) on the 6-Axis servo amplifier has blown. If the fuse has blown, replace the 6-Axis servo amplifier including the fuse.
(Action 2) Check the optical fiber cable between the axis control card and servo amplifier. Replace it if it is faulty.
(Action 3) Replace the axis control card on the main board.
(Action 4) Replace the servo amplifier.
(Action 5) Check for a point where the robot connection cable (RMP1, RP1) or an internal cable running to each Pulsecoder through the robot mechanical section is grounded.

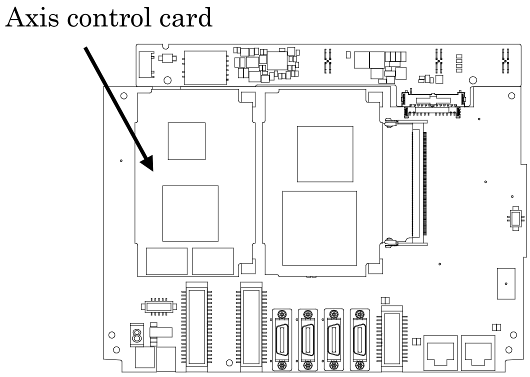
Before continuing to the next step, perform a complete controller back up to save all your programs and settings.
(Action 6) Replace the main board.

SRVO-058 FSSB xx init error (yy)

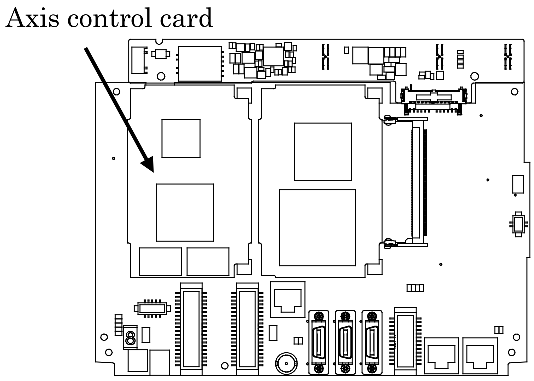
(Explanation) Communication was interrupted between the main board and servo amplifier.
(Action 1) Check whether fuse (FS1) on the 6-Axis servo amplifier has blown. If the fuse has blown, replace the 6-Axis servo amplifier including the fuse.
(Action 2) Turn off the power and disconnect the CRF8 connector on the 6-Axis servo amplifier. Then check whether this alarm occurs again. (Ignore the alarm SRVO-068 because of disconnecting the CRF8 connector.)
If this alarm does not occur, the robot connection cable (RMP1, RP1) or the internal cable of the robot may be short-circuited to the ground. Check the cables and replace it if necessary.
(Action 3) Check whether the LED (P5V and P3.3V) on the 6-Axis servo amplifier is lit. If they are not lit, the DC power is not supplied to the 6-Axis servo amplifier.
Make sure the connector CP5 on the power supply unit and the connector CXA2B on the 6-Axis servo amplifier are connected tightly. If they are connected tightly, replace the 6-Axis servo amplifier.
(Action 4) Check the optical fiber cable between the axis control card and servo amplifier. Replace it if it is faulty.
(Action 5) Replace the axis control card on the main board.
(Action 6) Replace the 6-Axis servo amplifier.
(Action 7) If the other units (the servo amplifier for the auxiliary axis and the line tracking interface) are connected in the FSSB optical communication, disconnect these units and connect only 6-Axis servo amplifier for the robot. Then turn on the power. If this alarm does not occur, search the failed unit and replace it.

Before executing the (Action 8), perform a complete controller back up to save all your programs and settings.
(Action 8) Replace the main board.





(R-30*i*B Mate)



(R-30*i*B Mate Plus)

(Main board)

Fig.3.5 (p) SRVO-055 FSSB com error 1
SRVO-056 FSSB com error 2
SRVO-057 FSSB disconnect
SRVO-058 FSSB init error

SRVO-059 Servo amp init error (G:i A:j)

(Explanation) Servo amplifier initialization is failed.
(Action 1) Check the optical fiber cable between the axis control card on the main board servo amplifier. Replace it if it is faulty.
(Action 2) Turn off the power and disconnect the CRF8 connector on the 6-Axis servo amplifier. Then check whether this alarm occurs again. (Ignore the alarm SRVO-068 because of disconnecting the CRF8 connector.)
If this alarm does not occur, the robot connection cable (RMP1, RP1) or the internal cable of the robot (Pulsecoder cable) may be short-circuited to the ground. Check the cables and replace it if necessary.
(Action 3) Check whether the LED (P5V and P3.3V) on the 6-Axis servo amplifier is lit. If they are not lit, the DC power is not supplied to the servo amplifier.
Make sure the connector CP5 on the power supply unit and the connector CXA2B on the 6-Axis servo amplifier are connected tightly. If they are connected tightly, replace the 6-Axis servo amplifier.
(Action 4) Replace the servo amplifier.
(Action 5) Replace the line tracking board (If installed).
(Action 6) Replace the Pulsecoder

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

(Explanation) This alarm occurs if battery for Pulsecoder absolute-position backup is empty.
A probable cause is a broken battery cable or no batteries in the robot.
(Action 1) Replace the battery in the battery box of the robot base.
(Action 2) Replace the Pulsecoder with which an alarm has been issued.
(Action 3) Check whether the mechanical unit cable for feeding power from the battery to the Pulsecoder is not disconnected and grounded. If an abnormality is found, replace the 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.

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

(Explanation) This alarm occurs if the phase of the pulses generated in the Pulsecoder is abnormal.
(Action) Replace the Pulsecoder with which an alarm has been issued.

> **NOTE**
> This alarm might accompany the DTERR, CRCERR, or STBERR alarm. In this case, however, there may be no actual condition for this alarm.

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.

SRVO-067 OHAL2 alarm (Grp:i Ax:j)

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

(Action 1) 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.

(Action 2) When power is supplied to the motor after it has become sufficiently cool, if the alarm still occurs, replace the motor.

SRVO-068 DTERR alarm (Grp:i Ax:j)

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

(Action 1) Make sure that the robot connection cable (RMP1, RP1) connector (CRF8) of 6-Axis servo amplifier and the connector (motor side) are connected tightly.

(Action 2) Check that the shielding of the robot connection cable (RMP1, RP1) is grounded securely in the cabinet.

(Action 3) Replace the Pulsecoder.

(Action 4) Replace the servo amplifier.

(Action 5) Replace the robot connection cable (RMP1, RP1, RM1).

(Action 6) Replace the internal cable of the robot (for the Pulsecoder, For the Motor).

SRVO-069 CRCERR alarm (Grp:i Ax:j)

(Explanation) The serial data has disturbed during communication.

(Action) See actions on SRVO-068

SRVO-070 STBERR alarm (Grp:i Ax:j)

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

(Action) See actions on SRVO-068

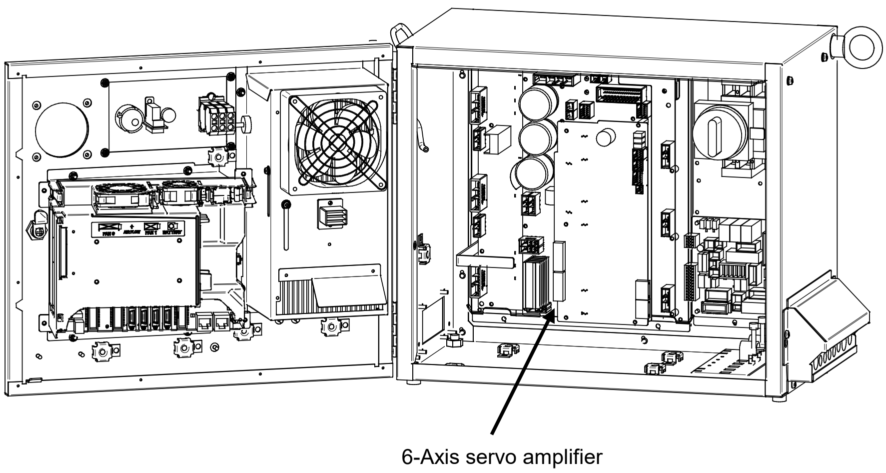


Fig.3.5 (q) SRVO-059 Servo amp init error
SRVO-070 STBERR alarm

SRVO-071 SPHAL alarm (Grp:i Ax: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.

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

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

(Action) Replace the Pulsecoder and remaster the robot.

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 connection cables are connected securely to the grounding plate.
(Action 2) Reinforce the earth of the motor flange. (In case of Auxiliary axis)
(Action 3) Reset the Pulse count.
(Action 4) Replace the Pulsecoder.
(Action 5) Replace the robot connection cable (RMP1, RM1, RP1).
(Action 6) Replace the internal cable of the robot (for the Pulsecoder, For the Motor).

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

(Explanation) The LED in the Pulsecoder is broken.
(Action) Replace the Pulsecoder, and remaster the robot.

SRVO-075 Pulse not established (G:i A: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.

SRVO-076 Tip Stick Detection (G:i A: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.
(Action 6) Replace the servo amplifier.
(Action 7) Replace the corresponding servo motor.
(Action 8) Replace the E-stop unit.
(Action 9) Replace the power cable of the robot connection cable in which the corresponding axis is connected.
(Action 10) Replace the internal cable of the robot (power/brake) in which the corresponding axis is connected.

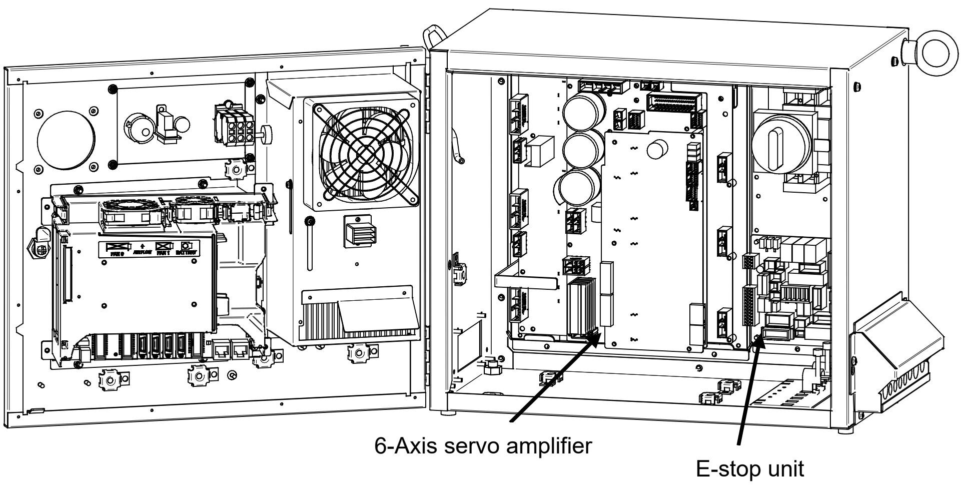


Fig.3.5 (r) SRVO-076 Tip stick detection

SRVO-081 EROFL alarm (Track enc:i)

(Explanation) The pulse counter for line tracking has overflowed.
(Action 1) Check whether the condition of the line tracking exceeds the limitation.
(Action 2) Replace the Pulsecoder.
(Action 3) Replace the line tracking board.

SRVO-082 DAL alarm (Track encoder:i)

(Explanation) The line tracking Pulsecoder has not been connected.
(Action 1) Check the connection cable at each end (the line tracking board and the motor side)
(Action 2) Check whether the shielding of the connection cable is connected securely to the grounding plate.
(Action 3) Replace the line tracking cable.
(Action 4) Replace the Pulsecoder.
(Action 5) Replace the line tracking board.

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).

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).

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).

SRVO-090 DTERR alarm (Track enc:i)

(Explanation) Communication between the Pulsecoder and line tracking board is abnormal. See the SRVO-068 DTERR alarm.
(Action 1) Check the connection cable at each end (the line tracking board and the Pulsecoder)
(Action 2) Check whether the shielding of the connection cable is connected securely to the grounding plate.
(Action 3) Replace the Pulsecoder.
(Action 4) Replace the line tracking cable.
(Action 5) Replace the line tracking board.

SRVO-091 CRCERR alarm (Track enc:i)

(Explanation) Communication between the Pulsecoder and line tracking board is abnormal.
(Action) Action as same as the SRVO-090.

SRVO-092 STBERR alarm (Track enc:i)

(Explanation) Communication between the Pulsecoder and line tracking board is abnormal.
(Action) Action as same as the SRVO-090.

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.

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).
(Action) Replace the Pulsecoder.

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 1) Reinforce the earth of the flange of the Pulsecoder.
(Action 2) Reset the Pulse count.
(Action 3) Replace the Pulsecoder.

SRVO-096 LDAL alarm (Track enc:i)

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

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 1) 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)

SRVO-105 Door open or E.Stop

(Explanation) The cabinet door is open.

- When the door switch is not mounted skip Action 1 and 2 and start from Action 3

(Action 1) If the auxiliary cabinet (option) is installed, check whether the door of the auxiliary cabinet is open. When the door is open, close it
(Action 2) If the auxiliary cabinet (option) is installed, check the door switch and its wiring. If the switch or wiring is faulty, replace it.
(Action 3) Check that the CRMA92, CRMB8 connectors on the E-STOP unit and CRMA91 on the 6-Axis servo amplifier are connected securely.
(Action 4) Replace the emergency stop board.
(Action 5) Replace the 6- Axis servo amplifier.

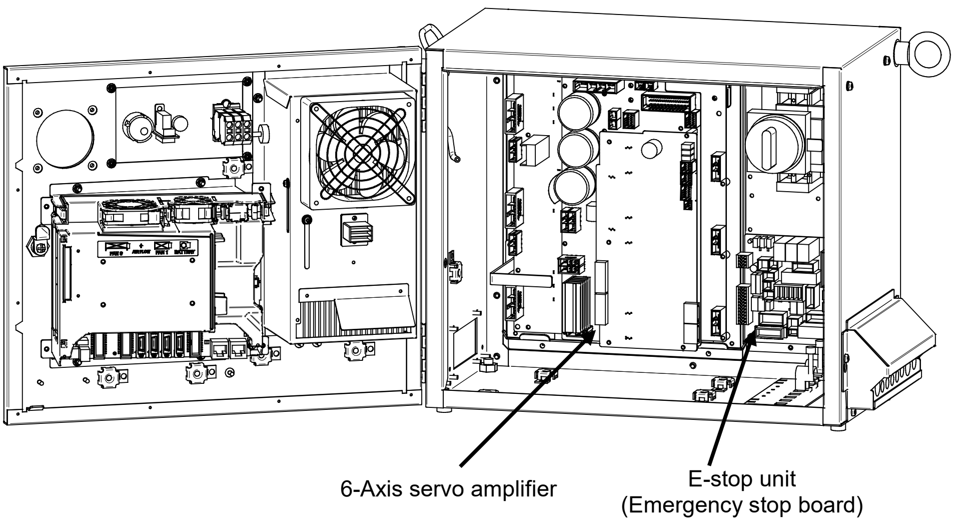


Fig.3.5 (s) SRVO-105 Door open or E-stop

SRVO-123 Fan motor rev slow down(i)

(Explanation) The rotation speed of fan motor is slow down.

(Action 1) Check the fan motor and its cables. Replace them if necessary.
(Action 2) Replace the backplane unit.
Before executing the (Action 3), perform a complete controller back up to save all your programs and settings.
(Action 3) Replace the main board.

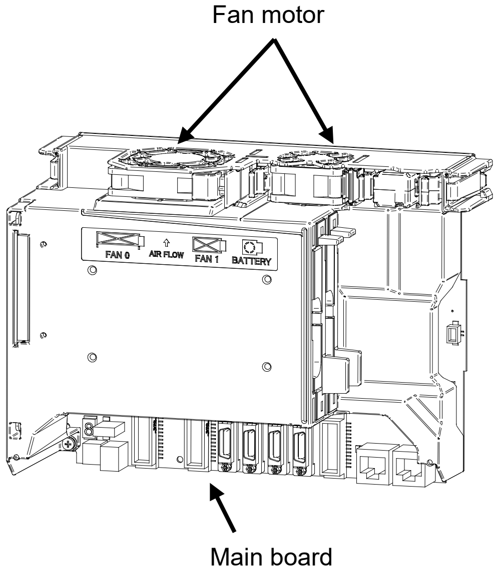


Fig.3.5 (t) SRVO-123 Fan motor rev slow down(i)

SRVO-134 DCLVAL alarm (G:i A:j)

(Explanation) The DC voltage (DC link voltage) of the main circuit power supply for the servo amplifier is abnormally low.
(Action 1) It is possible that an instant disconnection of power source causes this alarm. Check whether an instant disconnection occurred.
(Action 2) Check the input voltage to the controller is within the rated voltage.
(Action 3) Modify the program in order that robot and the auxiliary axis do not accelerate simultaneously in the system with the auxiliary axis.
(Action 4) Replace the E-stop unit.
(Action 5) Replace the servo amplifier.

SRVO-156 IPMAL alarm (G:i A:j)

(Explanation) Abnormally high current flowed through the main circuit of the servo amplifier.
(Action 1) 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, and if the alarm occurs again, replace the servo amplifier.
(Action 2) Turn off the power and disconnect the power cable from the servo amplifier indicated by the alarm message, and check the insulation of their U, V, W and the GND lines each other. If there is a short-circuit, replace the power cable.
(Action 3) Turn off the power and disconnect the power cable from the servo amplifier by the alarm message, and measure the resistance between their U and V, V and W and W and U with an ohmmeter that has a very low resistance range. If the resistances at the three places are different from each other, the motor, the power cable is defective. Check each item in detail and replace it if necessary.

SRVO-157 CHGAL alarm (G:i A:j)

(Explanation) The capacitor on the servo amplifier was not charged properly within the specified time when the servo power is on.

(Action 1) Check the input voltage to the controller is within the rated voltage.

(Action 2) Make sure that the 6-axis servo amplifier CRRA12 and emergency stop board CRRA12 connector are connected tightly.
In case of single phase, make sure that the connectors CRRB14 is securely attached to the servo amplifier.

(Action 3) Replace the E-stop unit.

(Action 4) Replace the 6 axis servo amplifier.

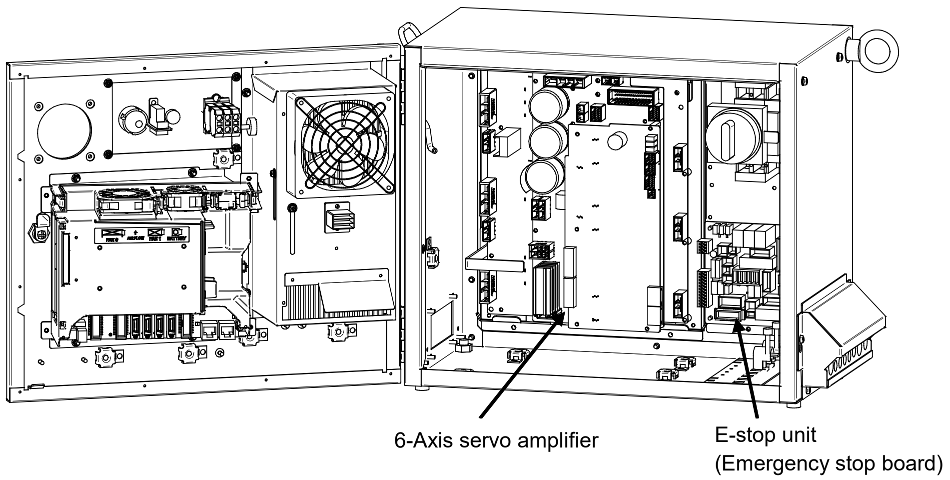


Fig.3.5 (u) SRVO-156 IPMAL alarm
SRVO-157 CHGAL alarm

SRVO-204 External (SVEMG abnormal) E-stop

(Explanation) The switch connected across EES1 – EES11 and EES2 – EES21 on the TBOP20 on the emergency stop board was pressed, but the EMERGENCY STOP line was not disconnected.

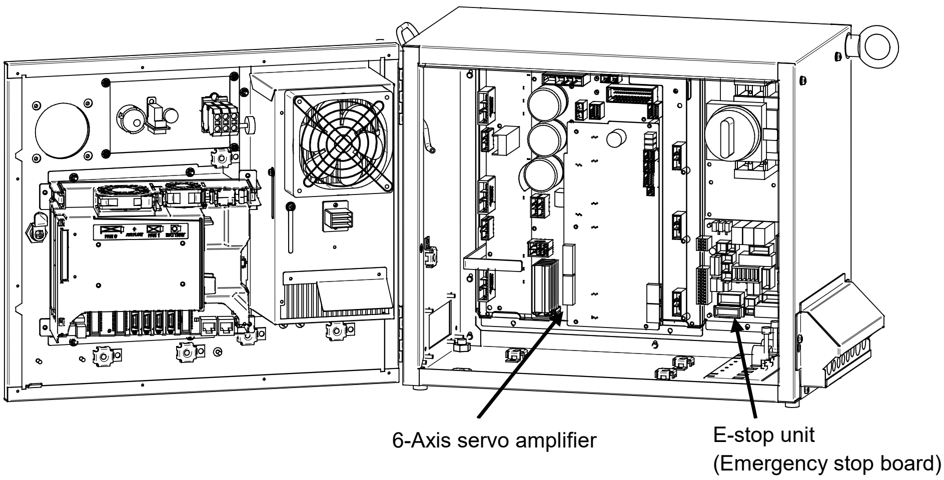
(Action 1) Check the switch and cable connected to EES1 – EES11 and EES2 – EES21 on the TBOP20. If the cable is abnormal, replace it.

Before executing the (Action 2), perform a complete controller back up to save all your programs and settings.

(Action 2) Replace the main board.

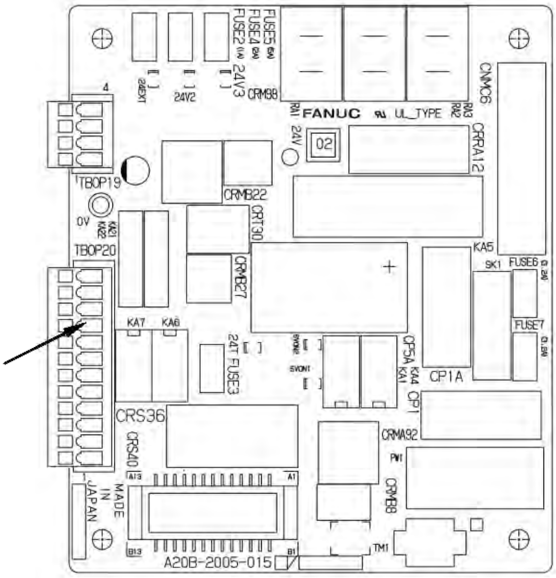
(Action 3) Replace the emergency stop board.

(Action 4) Replace the 6-Axis servo amplifier.



TBOP20

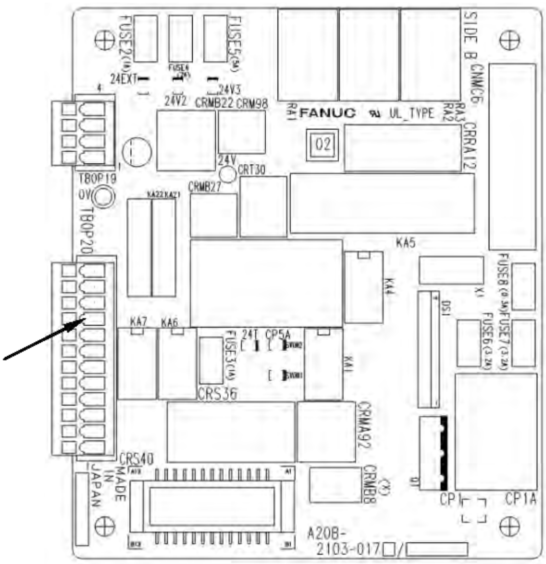
No.	Name	
12	E-STOP	21
11	(ESPB)	2
10		11
9		1
8	FENCE	21
7	(EAS)	2
6		11
5		1
4	EMGIN	21
3	(EES)	2
2		11
1		1



(R-30*i*B Mate)

TBOP20

No.	Name	
12	E-STOP	21
11	(ESPB)	2
10		11
9		1
8	FENCE	21
7	(EAS)	2
6		11
5		1
4	EMGIN	21
3	(EES)	2
2		11
1		1



(R-30*i*B Mate Plus)

(Emergency stop board)

Fig.3.5 (v) SRVO-204 External (SVEMG abnormal) E-stop

SRVO-205 Fence open (SVEMG abnormal)

(Explanation) The switch connected across EAS1 – EAS11 and EAS2 – EAS21 on the TBOP20 on the emergency stop board was opened, but the EMERGENCY STOP line was not disconnected.

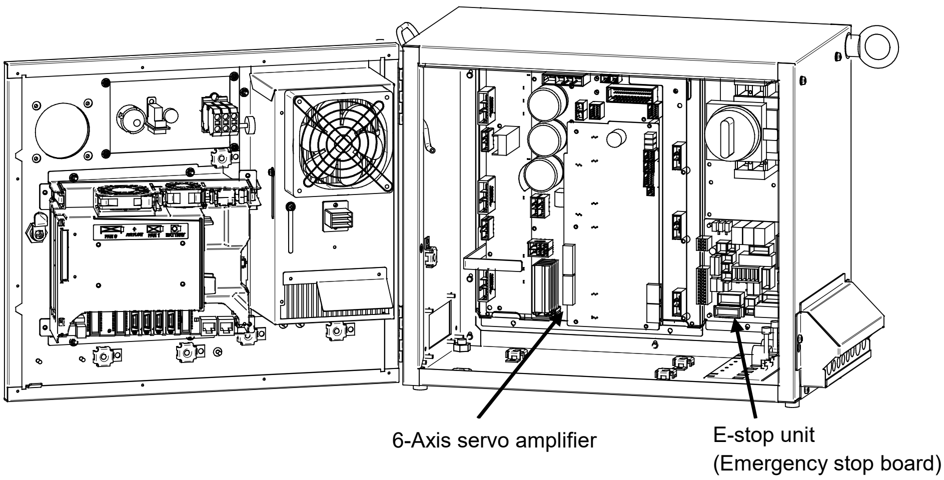
(Action 1) Check the switch and cable connected to EAS1 – EAS11 and EAS2 – EAS21 on the TBOP20. If the cable is abnormal, replace it.

Before executing the (Action 2), perform a complete controller back up to save all your programs and settings.

(Action 2) Replace the main board.

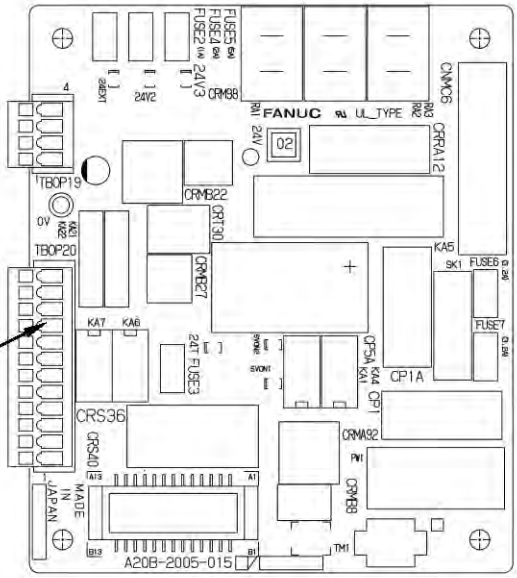
(Action 3) Replace the emergency stop board.

(Action 4) Replace the 6-Axis servo amplifier.



TBOP20

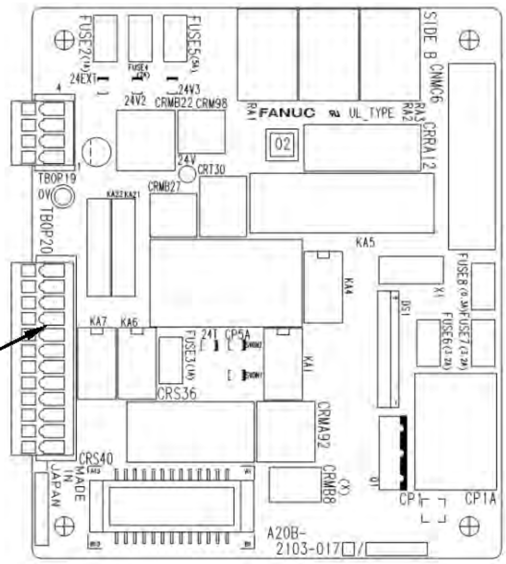
No.	Name	
12	E-STOP	21
11	(ESPB)	2
10		11
9		1
8	FENCE	21
7	(EAS)	2
6		11
5		1
4	EMGIN	21
3	(EES)	2
2		11
1		1



(R-30*i*B Mate)

TBOP20

No.	Name	
12	E-STOP	21
11	(ESPB)	2
10		11
9		1
8	FENCE	21
7	(EAS)	2
6		11
5		1
4	EMGIN	21
3	(EES)	2
2		11
1		1



(R-30*i*B Mate Plus)

(Emergency stop board)

Fig.3.5 (w) SRVO-205 Fence open (SVEMG abnormal)

SRVO-206 Deadman switch (SVEMG abnormal)

(Explanation) When the teach pendant was enabled, the DEADMAN switch was released or pressed strongly, but the emergency stop line was not disconnected.
(Action 1) Replace the teach pendant.
(Action 2) Check the teach pendant cable. If it is inferior, replace the cable.

Before executing the (Action 3), perform a complete controller back up to save all your programs and settings.
(Action 3) Replace the main board.
(Action 4) Replace the emergency stop board.
(Action 5) Replace the 6-Axis servo amplifier.

SRVO-213 E-STOP Board FUSE2 blown

(Explanation) A fuse (FUSE2) on the emergency stop board has blown, or no voltage is supplied to EXT24V.
(Action 1) Check whether the fuse (FUSE2) on the emergency stop board has blown. If the fuse has blown, 24EXT may be short-circuited to 0EXT. Take Action 2. If FUSE2 has not blown, take Action 3 and up.
(Action 2) Disconnect the connection destinations of 24EXT that can cause grounding then check that the fuse (FUSE2) does not blow. Disconnect the following on the emergency stop board then turn on the power:
- CRS36
- CRT30
- TBOP20: EES1, EES11, EAS1, EAS11

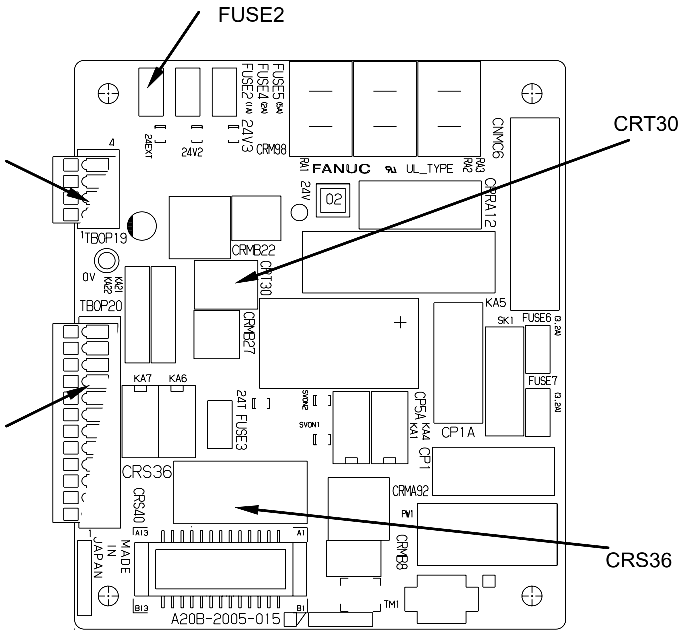
If the fuse (FUSE2) does not blow in this state, 24EXT and 0EXT may be short-circuited at any of the connection destinations above. Isolate the faulty location then take action.
If the fuse (FUSE2) blows even when the connection destinations above are detached, replace the emergency stop board.
(Action 3) Check whether 24 V is applied to between EXT24V and EXT0V of TBOP19. If not, check the external power supply circuit.
If no external power supply is used, check whether the terminals above are connected to the INT24V and INT0V terminals, respectively.
(Action 4) Replace the emergency stop board.
(Action 5) Replace the teach pendant cable.
(Action 6) Replace the teach pendant.
(Action 7) Replace the operator’s panel cable (CRT30).

TBOP19

No.	Name
4	EXT0V
3	INT0V
2	INT24V
1	EXT24V

TBOP20

No.	Name	
12	E-STOP (ESPB)	21
11		2
10		11
9		1
8	FENCE (EAS)	21
7		2
6		11
5		1
4	EMGIN (EES)	21
3		2
2		11
1		1



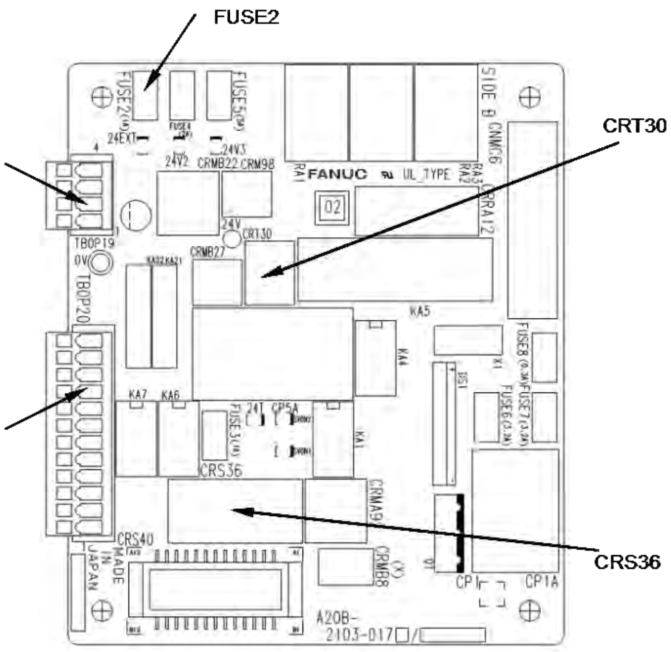
(R-30*i*B Mate)

TBOP19

No.	Name
4	EXT0V
3	INT0V
2	INT24V
1	EXT24V

TBOP20

No.	Name	
12	E-STOP (ESPB)	21
11		2
10		11
9		1
8	FENCE (EAS)	21
7		2
6		11
5		1
4	EMGIN (EES)	21
3		2
2		11
1		1



(R-30*i*B Mate Plus)

(Emergency stop board)

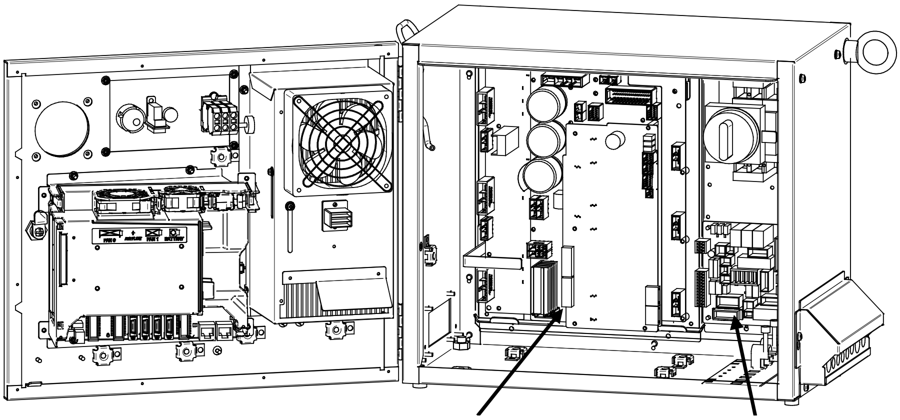


Fig.3.5 (x) SRVO-206 DEADMAN switch (SVEMG abnormal)
SRVO-213 E-STOP Board FUSE2 blown

SRVO-214 6ch amplifier fuse blown (Robot:i)

(Explanation) A fuse (FS2 or FS3) in the 6-Axis servo amplifier has blown.

(Action 1) A fuse (FS2 or FS3) is blown, eliminate the cause, and then replace the fuse. (See Section 3.6)

(Action 2) Replace the 6-Axis servo amplifier.

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.

(Action 3) Replace the 6-Axis servo amplifier.

SRVO-221 Lack of DSP (G:i A:j)

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

(Action 1) Check whether the set number of axes is valid. If the number is invalid, set the correct number.

(Action 2) Replace the axis control card with a card corresponding to the set number of axes.

SRVO-223 DSP dry run (a,b)

(Explanation) A servo DSP initialization failure occurred due to hardware failure or wrong software setting. Then, the software entered DSP dry run mode. The first number indicates the cause of the failure. The second number is extra information.

(Action) Perform an action according to the first number that is displayed in the alarm message.

1: This is a warning due to $scr.$startup_cnd=12.

2,3,4,7: Replace a servo card.

5: Invalid ATR setting. Software axis config (FSSB line number, hardware start axis number, amplifier number, and amplifier type) might be wrong.

6: SRVO-180 occurs simultaneously. Controllable axis does not exist on any group. Execute aux axis setting to add axis at controlled start.

8,10: SRVO-058 (FSSB init error) occurs simultaneously. Follow the remedy of SRVO-058.

9: There is no amplifier that is connected to the servo card.

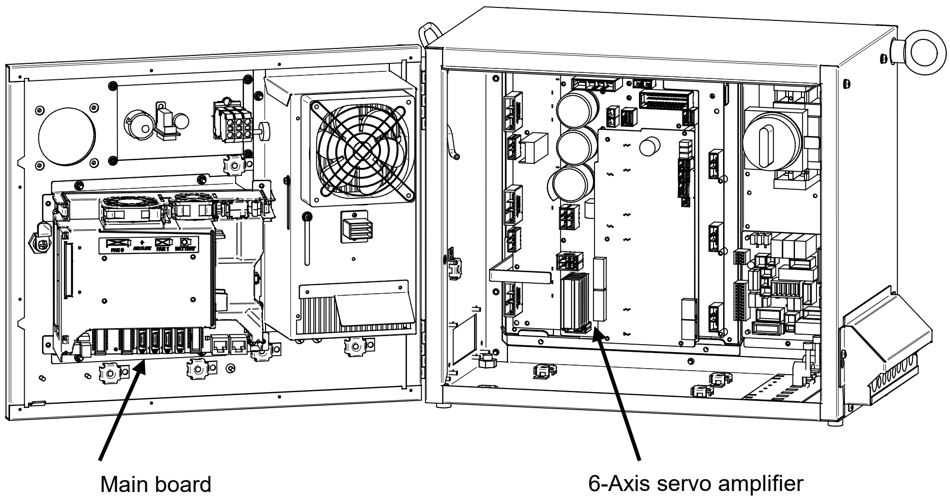
- Check the hardware connection.

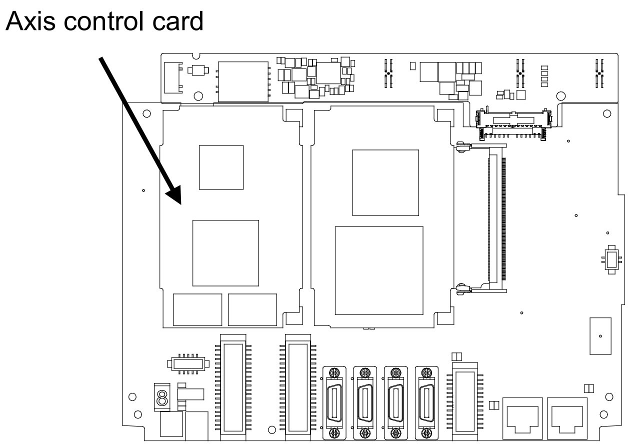
•Check the optical fiber cable.
•In case of using aux. axis amplifier, make sure that the connectors CXA2A (6-axis amplifier) or CXA2B (aux. axis amplifier) are securely attached to the servo amplifier.
•Check whether the servo amplifier power is supplied.
•Check whether the fuse on the servo amplifier has blown.
•Replace the optical fiber cable.
•Replace the servo amplifier

11: Invalid axisorder setting. Non-existing axis number is specified. Software axis config (FSSB line number) might be wrong or auxiliary axis board is necessary.

12: SRVO-059 (Servo amp init error) occurs simultaneously. Follow the remedy of SRVO-059.

13,14,15: Document the events that led to the error, and contact your FANUC technical representative.





(Main board)

Fig.3.5 (y) SRVO-214 6ch amplifier fuse blown (Panel PCB)
SRVO-216 OVC (total)
SRVO-221 Lack of DSP
SRVO-223 DSP dry run (a,b)

SRVO-230 Chain 1 abnormal a, b
SRVO-231 Chain 2 abnormal a, b

(Explanation) A mismatch occurred between duplicate safety signals.
SRVO-230 is issued if such a mismatch that a contact connected on the chain 1 side (between EES1 and EES11, between EAS1 and EAS11, and so forth) is closed, and a contact on the chain 2 side (between EES2 and EES21, between EAS2 and EAS21, 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 is issued, 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.

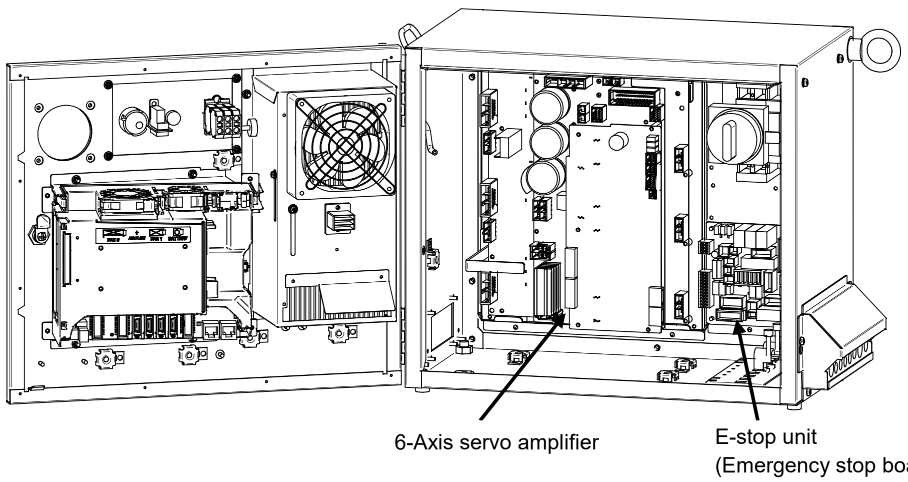


Fig.3.5 (z) SRVO-230 Chain 1 (+24V) abnormal a, b
SRVO-231 Chain 2 (0V) abnormal a, b

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.

SRVO-233 TP OFF in T1/ T2

(Explanation) Teach pendant is disabled when the mode switch is T1 or T2. Or controller door is opened.
(Action 1) Enable the teach pendant in teaching operation. In other case the mode switch should be AUTO mode.
(Action 2) Close the controller door, if open.
(Action 3) Replace the teach pendant.
(Action 4) Replace the teach pendant cable.
(Action 5) Replace the mode switch.
(Action 6) Replace the emergency stop board.
(Action 7) Replace the 6-Axis servo amplifier.

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 emergency stop switch.

(Action 1) Cause the same error to occur again, and then perform resetting.
(Action 2) Replace the emergency stop board.
(Action 3) Replace the 6-Axis servo amplifier.

SRVO-251 DB relay abnormal (G:i A:j)

(Explanation) An abnormality was detected in the internal relay (DB relay) of the servo amplifier.
(Action 1) Replace the servo amplifier.
(Action 2) Replace the E-stop unit.

SRVO-252 Current detect abnl (G:i A:j)

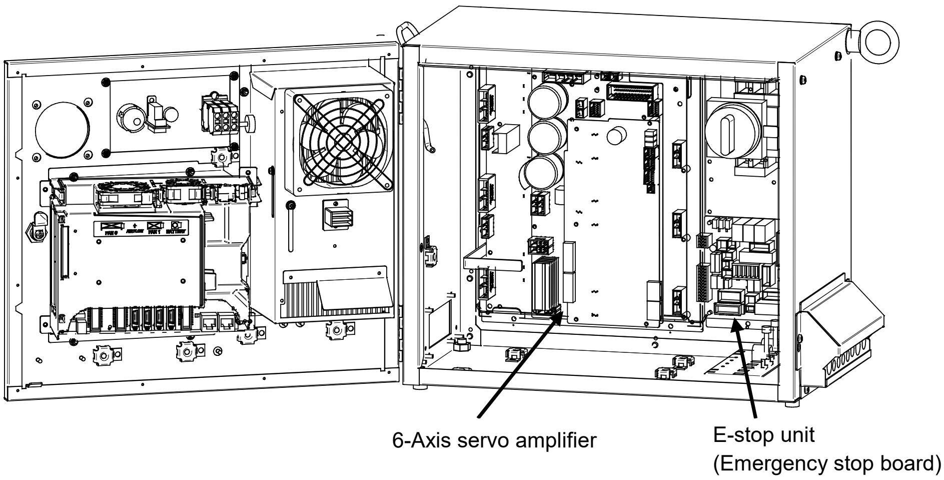
(Explanation) An abnormality was detected in the current detection circuit inside the servo amplifier.

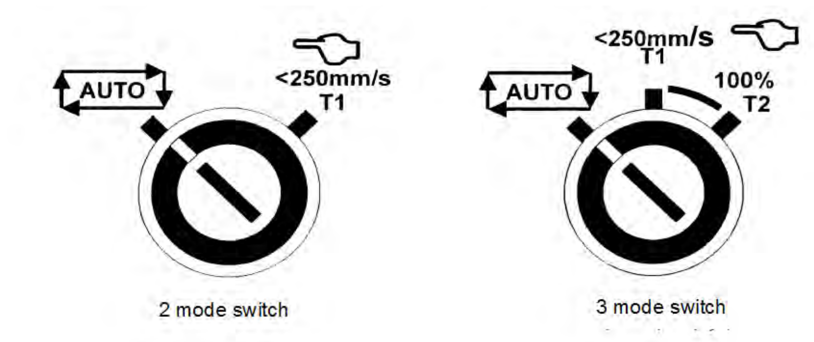
(Action) Replace the servo amplifier.

SRVO-253 Amp internal over heat (G:i A:j)

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

(Action) Replace the servo amplifier.





(Mode switch)

Fig.3.5 (aa) **SRVO-233 TP OFF in T1, T2**
SRVO-235 Short term Chain abnormal
SRVO-251 DB relay abnormal
SRVO-252 Current detect abnl
SRVO-253 Amp internal over heat

SRVO-266 FENCE1 status abnormal
SRVO-267 FENCE2 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 Subsection 3.2.5, Table 3.2.5 in CONNECTIONS).

Before executing the (Action 3), perform a complete controller back up to save all your programs and settings.

(Action 3) Replace the main board.

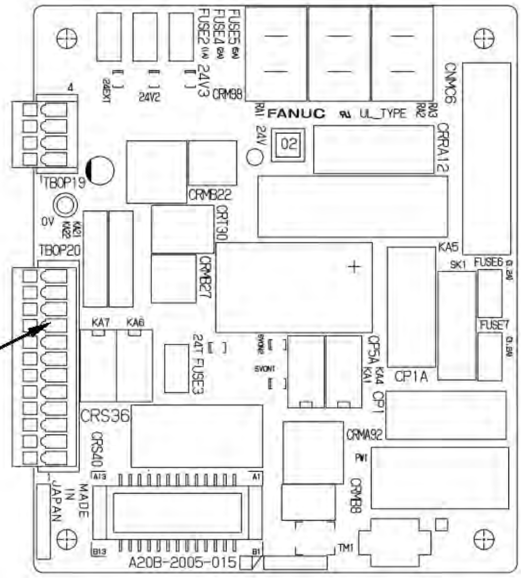
(Action 4) Replace the emergency stop board.

> ⚠ **WARNING**
> If this alarm is issued, 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.

TBOP20

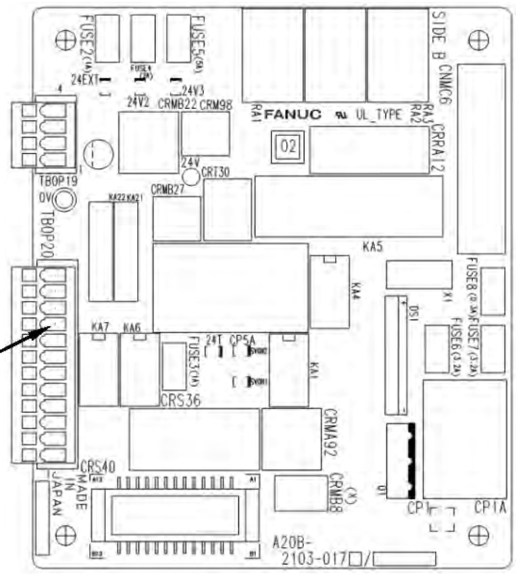
No.	Name	
12	E-STOP (ESPB)	21
11		2
10		11
9		1
8	FENCE (EAS)	21
7		2
6		11
5		1
4	EMGIN (EES)	21
3		2
2		11
1		1



(R-30*i*B Mate)

TBOP20

No.	Name	
12	E-STOP (ESPB)	21
11		2
10		11
9		1
8	FENCE (EAS)	21
7		2
6		11
5		1
4	EMGIN (EES)	21
3		2
2		11
1		1



(R-30*i*B Mate Plus)

(Emergency stop board)

Fig.3.5 (ab) SRVO-266 FENCE1 status abnormal
SRVO-267 FENCE2 status abnormal

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 Subsection 3.2.5, Fig 3.2.5(c) in CONNECTIONS).
(Action 3) Replace the teach pendant cable.
(Action 4) Replace the teach pendant.
(Action 5) Replace the emergency stop board.
(Action 6) Replace the emergency stop switch on the operator's panel (or replace entire operator’s panel).

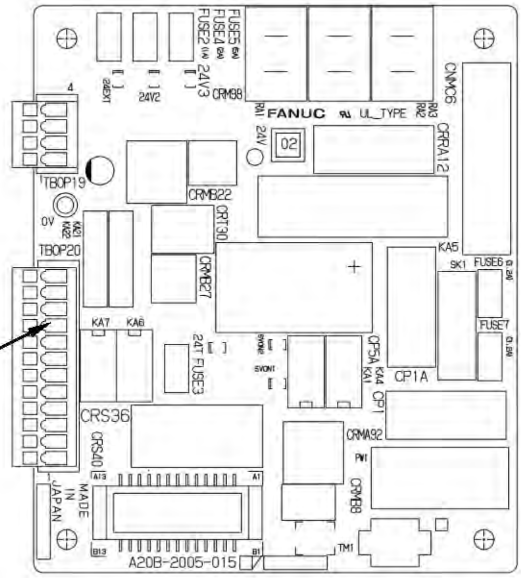
Before executing the (Action 7), perform a complete controller back up to save all your programs and settings.
(Action 7) Replace the main board.

> ⚠ **WARNING**
> If this alarm is issued, 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.

TBOP20

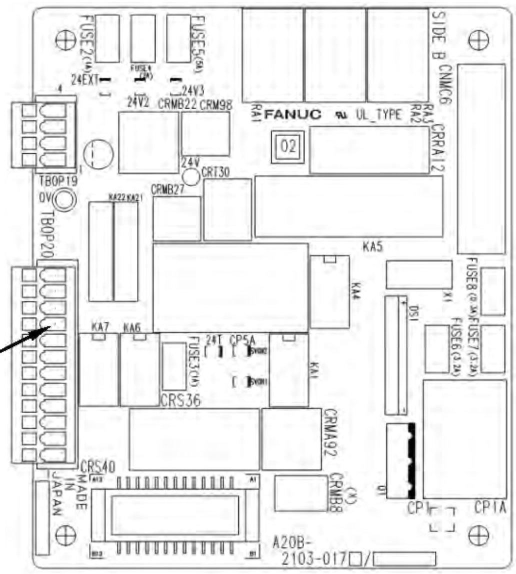
No.	Name	
12	E-STOP	21
11	(ESPB)	2
10		11
9		1
8	FENCE	21
7	(EAS)	2
6		11
5		1
4	EMGIN	21
3	(EES)	2
2		11
1		1



(R-30*i*B Mate)

TBOP20

No.	Name	
12	E-STOP	21
11	(ESPB)	2
10		11
9		1
8	FENCE	21
7	(EAS)	2
6		11
5		1
4	EMGIN	21
3	(EES)	2
2		11
1		1



(R-30*i*B Mate Plus)

(Emergency stop board)

Fig.3.5 (ac) SRVO-270 EXEMG1 status abnormal
SRVO-271 EXEMG2 status abnormal

SRVO-274 NTED1 status abnormal
SRVO-275 NTED2 status abnormal

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

(Action 1) This alarm may be issued when the DEADMAN switch is pressed to a proper position or is operated very slowly. In such a case, release the DEADMAN switch once completely then press the DEADMAN switch again.

(Action 2) Check whether the circuitry connected to the dual input signal (NTED) is faulty.

(Action 3) Check whether the timing of the dual input signal (NTED) satisfies the timing specification
(See Subsection 3.2.5, Fig 3.2.5(c) in CONNECTIONS).

(Action 4) Replace the teach pendant cable.

(Action 5) Replace the teach pendant.

(Action 6) Replace the emergency stop board.

(Action 7) Replace the mode switch on the operator's panel.

Before executing the (Action 8), perform a complete controller back up to save all your programs and settings.

(Action 8) Replace the main board.

> ⚠ **WARNING**
> If this alarm is issued, 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.

SRVO-277 Panel E-stop (SVEMG abnormal)

(Explanation) The emergency stop line was not disconnected although the emergency stop button on the operator's panel was pressed.

Before executing the (Action 1), perform a complete controller back up to save all your programs and settings.

(Action 1) Replace the main board.

(Action 2) Replace the emergency stop board.

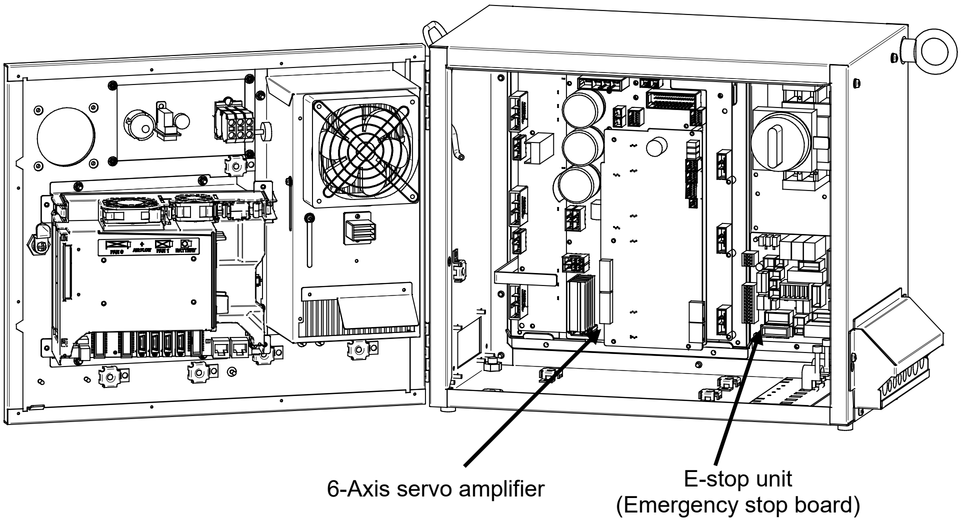
(Action 3) Replace the 6-Axis servo amplifier.

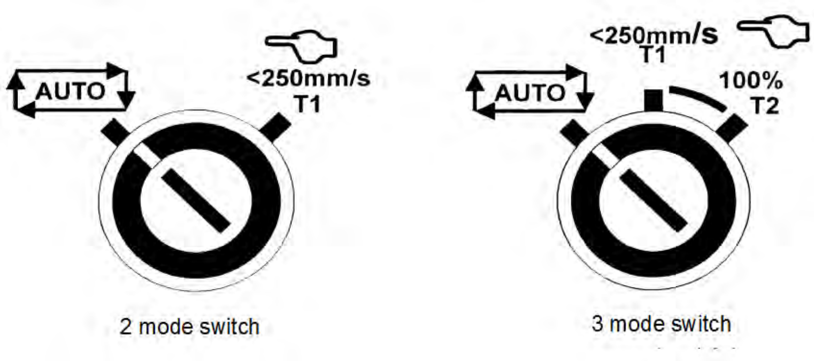
SRVO-278 TP E-stop (SVEMG abnormal)

(Explanation) The emergency stop line was not disconnected although the emergency stop button on the teach pendant was pressed.
(Action 1) Replace the teach pendant.
(Action 2) Replace the teach pendant cable.

Before executing the (Action 3), perform a complete controller back up to save all your programs and settings.
(Action 3) Replace the main board.
(Action 4) Replace the emergency stop board.
(Action 5) Replace the 6-Axis servo amplifier.

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





(Mode switch)

Fig.3.5 (ad) SRVO-274 NTED1 status abnormal
SRVO-275 NTED2 status abnormal
SRVO-277 Panel E-stop (SVEMG abnormal)
SRVO-278 TP E-stop (SVEMG abnormal)

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

(Explanation) IPM on the servo amplifier is overheated.
(Action 1) Check whether the vent hole is clogged. If necessary, clean 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.
(Action 3) If SRVO-291 is issued frequently, replace the servo amplifier.

SRVO- 295 Amp com error(G:i A:j)

(Explanation) A communication error occurred in the 6-axis servo amplifier.
(Action 1) Replace the 6-axis servo amplifier.

SRVO- 297 Improper input power (G:i A:j)

(Explanation) The 6-axis servo amplifier has detected the input voltage phase lack.
(Action 1) Check the input voltage of the controller whether phase is not lack.
(Action 2) Measure the secondary voltage between each phase at the main breaker, if phase lack is detected, replace the main breaker.
(Action 3) Replace the E-stop unit.
(Action 4) Replace the 6-axis servo amplifier.

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 5.6.3 in CONNECTIONS)

SRVO-335 DCS OFFCHK alarm a, b

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

Before executing the (Action 1), perform a complete controller back up to save all your programs and settings.
(Action 1) Replace the main board.

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.
(Action 1) If a signal is connected to the E-stop unit CRMB8, check whether there is a problem in the connection destination. Make sure that the connector CRMB16 (6-axis amplifier) is securely attached to the servo amplifier.
(Action 2) Replace the E-stop unit (included the magnetic contactor).

Before executing the (Action 3), perform a complete controller back up to save all your programs and settings.
(Action 3) Replace the main board.
(Action 4) Replace the 6-Axis servo amplifier.

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.

(Action 1) Replace the E-stop unit (included the magnetic contactor).

Before executing the (Action 2), perform a complete controller back up to save all your programs and settings.

(Action 2) Replace the main board.

(Action 3) Replace the 6-Axis servo amplifier.

SRVO-370 SVON1 status abnormal
SRVO-371 SVON2 status abnormal

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

Before executing the (Action 1), perform a complete controller back up to save all your programs and settings.

(Action 1) Replace the main board.

(Action 2) Replace the 6-Axis servo amplifier.

(Action 3) Replace the emergency stop board.

> ⚠ **WARNING**
> If this alarm is issued, 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.

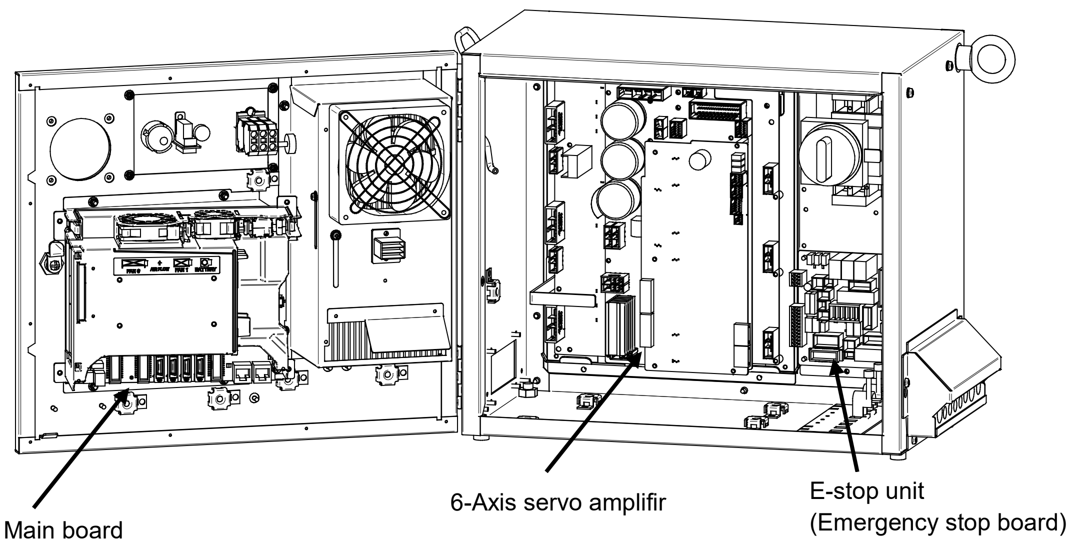


Fig.3.5 (ae) SRVO-291 IPM over heat
SRVO-295 Amp com error
SRVO-297 Improper input power
SRVO-335 DCS OFFCHK alarm a, b
SRVO-348 DCS MCC OFF alarm a, b
SRVO-349 DCS MCC ON alarm a, b
SRVO-370 SVON1 status abnormal
SRVO-371 SVON2 status abnormal

SRVO-372 OPEMG1 status abnormal
SRVO-373 OPEMG2 status abnormal

(Explanation) A chain alarm was detected with the emergency stop button on the operator's panel.
(Action 1) Replace the emergency stop board.
(Action 2) Replace the teach pendant cable.
(Action 3) Replace the teach pendant.
(Action 4) Replace the emergency stop button on the operator's panel.

Before executing the (Action 5), perform a complete controller back up to save all your programs and settings.
(Action 5) Replace the main board.

> ⚠ **WARNING**
> If this alarm is issued, 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.

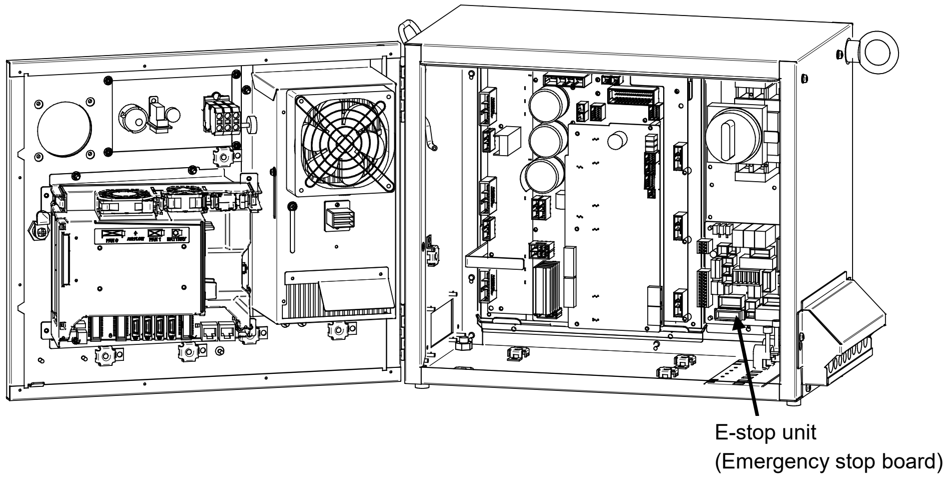
> **NOTE**
> For the procedure of recovery from this alarm, see the descriptions of SRVO-230 and SRVO-231.

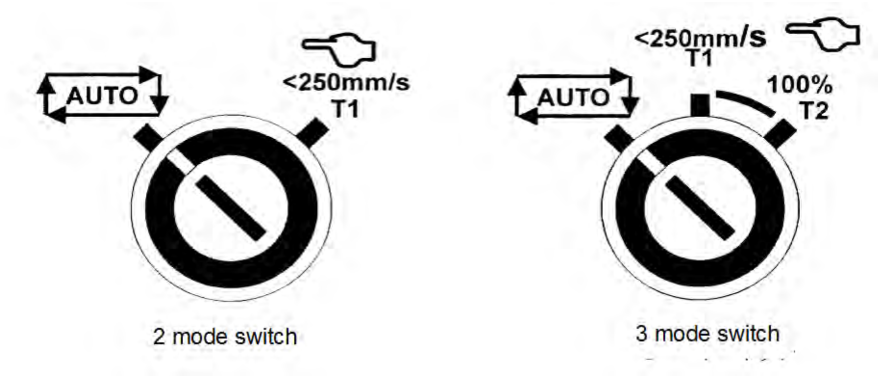
SRVO-374 MODE11 status abnormal
SRVO-375 MODE12 status abnormal
SRVO-376 MODE21 status abnormal
SRVO-377 MODE22 status abnormal

(Explanation) A chain alarm was detected with the mode switch signal.
(Action 1) Check the mode switch and its cable. Replace them if a defect is found.
(Action 2) Replace the emergency stop board.
Before executing the (Action 3), perform a complete controller back up to save all your programs and settings.
(Action 3) Replace the main board.

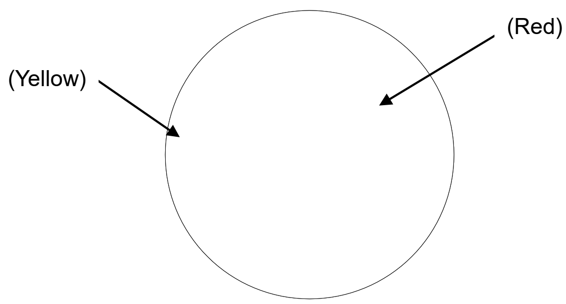
> ⚠ **WARNING**
> If this alarm is issued, do not reset the chain error alarm until the failure is identified and repaired. If robot use is continued with one of the duplicate circuits being faulty, safety may not be guaranteed when the other circuit fails.

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





(Mode switch)



(Emergency stop button)

Fig.3.5 (af) SRVO-372 OPEMG1 status abnormal
SRVO-373 OPEMG2 status abnormal
SRVO-374 MODE11 status abnormal
SRVO-375 MODE12 status abnormal
SRVO-376 MODE21 status abnormal
SRVO-377 MODE22 status abnormal

SRVO-378 SFDIxx status abnormal

(Explanation) A chain alarm was detected with the SFDI signal. xx shows signal name.
(Action 1) Check whether the circuitry connected to the dual input signal (SFDI) is faulty.
(Action 2) Check whether the timing of the dual input signal (SFDI) satisfies the timing specification. (See Subsection 3.3.4, Fig 3.3.4(c) in CONNECTIONS).

> ⚠ **WARNING**
> If this alarm is issued, 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.

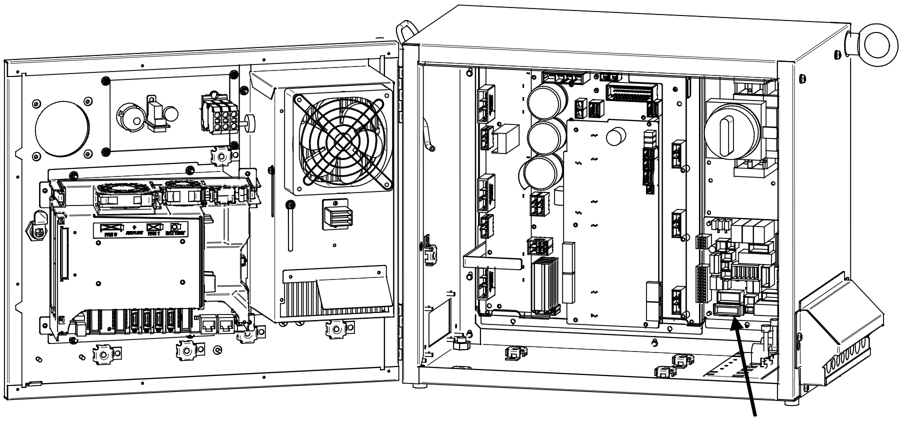


Fig.3.5 (ag) SRVO-378 SFDIxx status abnormal

SRVO-450 Drvoff circuit fail(G:i A:j)

(Explanation) The two drive off inputs are not in the same status.

(Action 1) Check the line of the two drive off inputs.
(Action 2) Make sure that the connector CRMB16 (6-axis amplifier) is securely attached to the servo amplifier.
(Action 3) Replace the servo amplifier.

SRVO-451 Internal S-BUS fail(G:i A:j)

(Explanation) An error is found in the serial bus communication in the servo amplifier.

(Action 1) Replace the servo amplifier.

SRVO-452 ROM data failure (G:i A:j)

(Explanation) An error is found in the ROM data in the servo amplifier.
(Action 1) Replace the servo amplifier.

SRVO-453 Low volt driver (G:i A:j)

(Explanation) Driver supply voltage in the servo amplifier is low.
(Action 1) Replace the servo amplifier.

SRVO-454 CPU BUS failure (G:i A:j)

(Explanation) An error was found in CPU bus data in the amplifier.
(Action 1) Replace the servo amplifier.

SRVO-455 CPU watch dog (G:i A:j)

(Explanation) An error occurred in CPU operation in the amplifier.
(Action 1) Replace the servo amplifier.

SRVO-456 Ground fault (G:i A:j)

(Explanation) An error is found in the motor current detection data in the servo amplifier.
(Action 1) Replace the servo amplifier.

SRVO-459 Excess regeneration2%s (G:i A:j)

(Explanation) An error is found in the discharge circuit in the servo amplifier.
(Action 1) Replace the servo amplifier.

SRVO-460 Illegal parameter%s (G:i A:j)

(Explanation) An error is found in the setting of the parameters in the servo amplifier.
(Action 1) Replace the servo amplifier.

SRVO-461 Hardware error%s (G:i A:j)

(Explanation) An error is found in the circuit in the servo amplifier.
(Action 1) Replace the servo amplifier.

SRVO-473 DCS CLLB CC_EXTF alarm

(Explanation) The result is different in 2 CPU for Collaborative Robot.
(Action) Check the other alarms for more information.
Note: You need to cycle power to release this alarm.

SRVO-476 CLLB alarm %x,%x

(Explanation) Internal error of the collaborative robot function.
(Action) Restart the controller. If the error is not cleared, document the events that led to the error and contact your localFANUC representative.

SRVO-477 Calibration data error

(Explanation) The force sensor calibration data are wrong.
(Action) Please load correct force sensor calibration data and apply them again.

SRVO-478 Temperature difference too large

(Explanation) The force sensor temperature difference is too large.
(Action) Please make sure that the environment temperature does not change greatly, and then restart the controller.
If the error is not cleared, document the events that led to the error and contact your FANUC technical representative.

SRVO-479 Temperature changes too fast

(Explanation) The force sensor temperature changes too fast.
(Action) Please make sure that the environment temperature does not change greatly, and then restart the controller.
If the error is not cleared, document the events that led to the error and contact your FANUC technical representative.

SRVO-480 FORCE alarm %x,%x

(Explanation) Force sensor error.
(Action1) Restart the controller.
(Action2) Replace the sensor cable.
If the error is not cleared, document the events that led to the error and contact your FANUC technical representative.

SRVO-486 Hand Guidance E-stop

(Explanation) The EMERGENCY STOP button on the Hand Guidance device was pressed.
(Action1) Release EMERGENCY STOP on the Hand Guidance device, then press the [RESET] key.
(Action2) Check setting and connection to Safety I/O board.

SRVO-487 Hand Guidance Deadman switch

(Explanation) The deadman switch on the Hand Guidance device was released.
(Action1) Grip the deadman switch, then press the [RESET] key.
(Action2) Enable Contact stop, when Collaborative robot is used.
(Action3) Set Hand Guidance disable I/O to ON if you do not use Hand Guidance function.

SRVO-489 Force sensor type error %x, %x

(Explanation) Force sensor type error.
(Action1) Restart the controller.
If the error is not cleared, document the events that led to the error and contact your local FANUC representative.

SRVO-490 FORCE alarm 2 %x, %x

(Explanation) Force sensor error.
(Action1) Restart the controller.
(Action2) Replace the force sensor cable.
If the error is not cleared, document the events that led to the error and contact your local FANUC representative.

PRIO-095 Overload <Connector>

(Explanation) The DO of the specified connector might be grounded.
(Action 1) Check the connection of the DO of the specified connector.

Before executing the (Action 2), perform a complete controller back-up to save all your programs and settings.
(Action 2) Replace the main board.

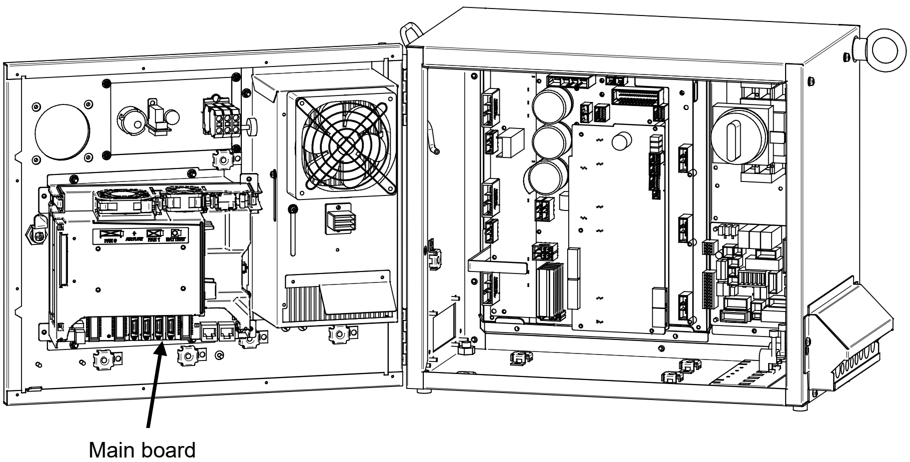


Fig.3.5 (ah) PRIO-095 Overload

3.6 FUSE-BASED TROUBLESHOOTING

This section describes the alarms and symptoms generated and actions required when the fuses installed on the printed circuit boards and units have blown.

(1) Fuses on the main board

FUSE1: For protecting the +24 V output of the peripheral device interface

(A60L-0001-0290#LM10)

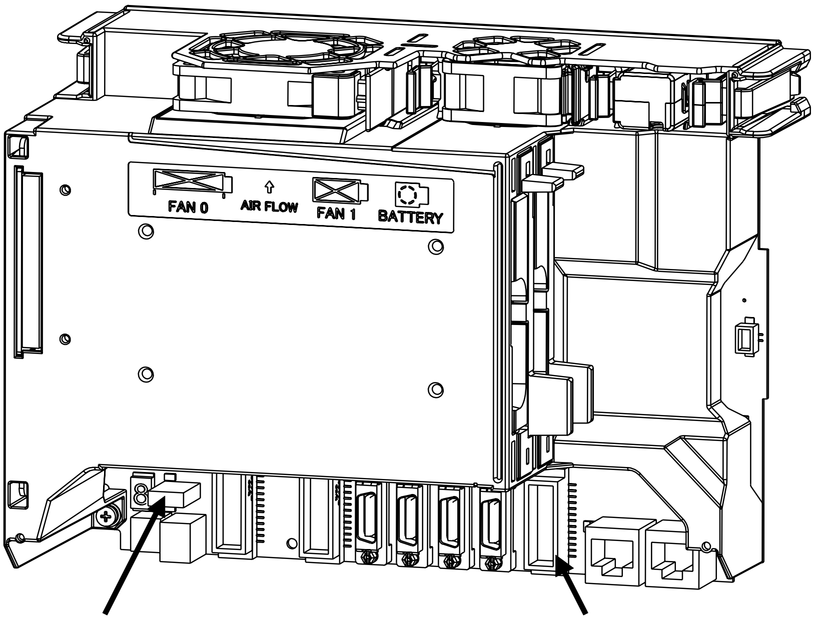
(R-30*i*B Mate Plus)

FUSE9:For protecting the +24E output for vision

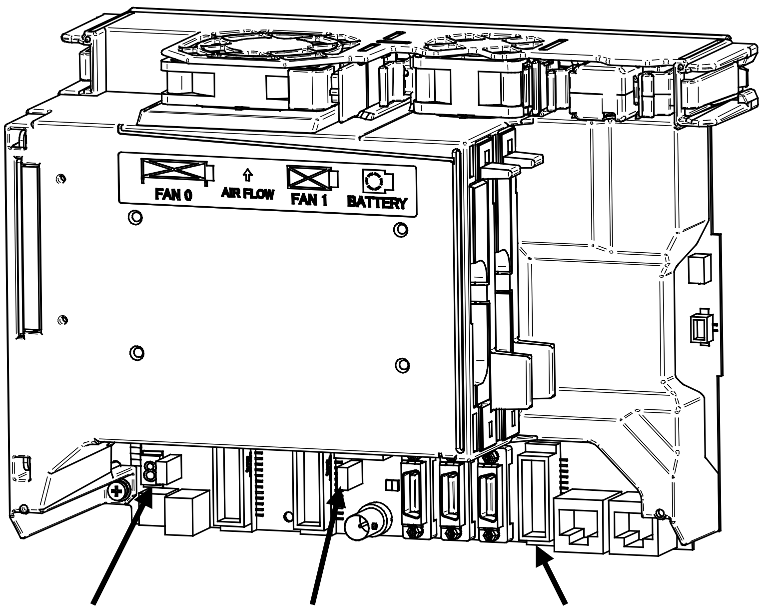
(This fuse is installed on the R-30*i*B Mate Plus main board.)

(A60L-0001-0290#LM05C)

Name	Symptom observed when fuse has blown	Action
FUSE1	An alarm (SRVO-220) is displayed on the teach pendant.	1. 24SDI and 0 V may be short-circuited. Check the peripheral device cable for any abnormality, and replace it if necessary. 2. Disconnect CRS40. If fuse (FUSE3) still blows, replace the main board. 3. Replace the cable between the emergency stop unit and the servo amplifier. 4. Replace the cable between the main board and the emergency stop unit. 5. Replace the emergency stop unit. 6. Replace the servo amplifier.
FUSE9 (R-30*i*B Mate Plus)	+24E used for vision is not output.	1. Check +24E used by the vision for a ground fault. 2. Check the cables connecting to the vision camera and the related parts for an abnormally. 3. Replace the main board.



(R-30*i*B Mate)



(R-30*i*B Mate Plus)

Fig.3.6(a) Fuse on the main board

(2) Servo amplifier fuse

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, XROT, XHBK, and the fan motor inside the robot (M-3*i*A, option). (A60L-0001-0290#LM32C)

FS3: For protection of the 24V output to the regenerative resister (A60L-0001-0290#LM32C)

Name	Symptom observed when fuse has blown	Action
FS1	All LEDs on the servo amplifier go out. The FSSB disconnection alarm (SRVO-057) or FSSB initialization alarm (SRVO-058) is displayed on the teach pendant.	Replace the 6-Axis servo amplifier.
FS2	The 6-Axis servo amplifier fuse blown (SRVO-214), Hand broken (SRVO-006), and Robot overtravel (SRVO-005) are displayed on the teach pendant.	1 Check +24VF used by the end effector for a ground fault. 2 Check the robot connection cable and the robot's internal cable. 3 Replace the 6-Axis servo amplifier. 4 In case of M-3*i*A, check the fan motor inside the robot (option).
FS3	The 6-Axis servo amplifier fuse blown (SRVO-214), DCAL alarm (SRVO-043) are displayed on the teach pendant.	1 Check the regenerative resister, and replace it if required. 2 Replace the 6-Axis servo amplifier.

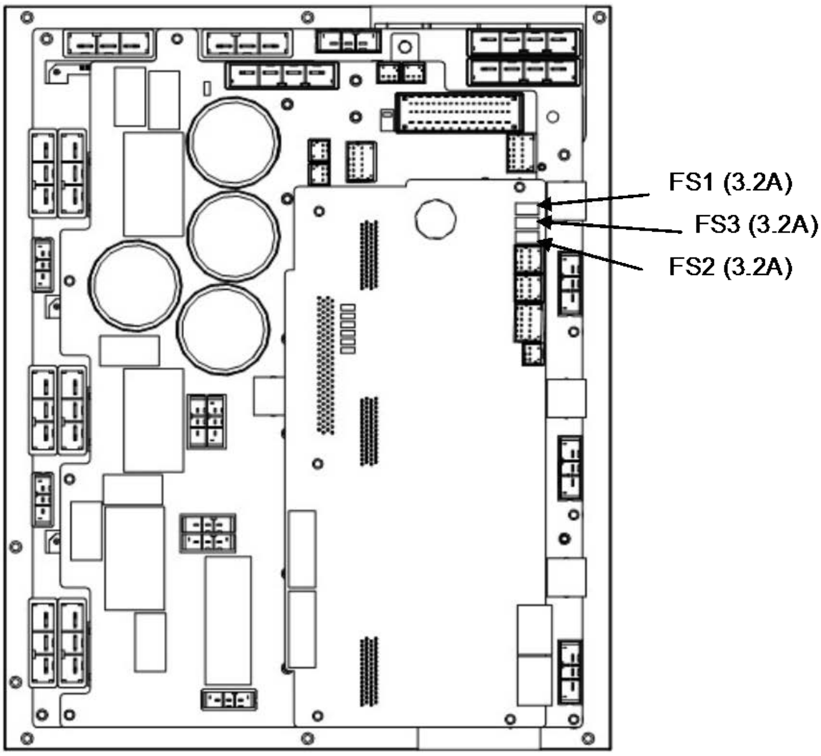


Fig.3.6(b) Fuse on the servo amplifier

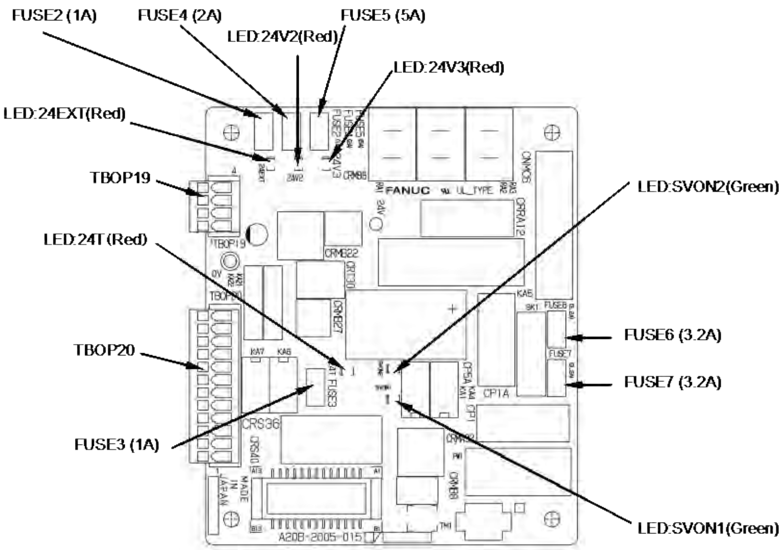
(3) Emergency stop board fuses

FUSE2:	For emergency stop circuit	(A60L-0001-0290#LM10C)
FUSE3:	For teach pendant power supply circuit	(A60L-0001-0290#LM10C)
FUSE4:	For +24V protection	(A60L-0001-0290#LM20C)
FUSE5:	For +24V of mainboard protection	(A60L-0001-0290#LM50C)
FUSE6,FUSE7: (R-30*i*B Mate Plus)	For AC200V of fans protection (door/rear)	(A60L-0001-0175#3.2A)
FUSE8:	For 200V power monitor circuit	(A60L-0001-0175#0.3A)

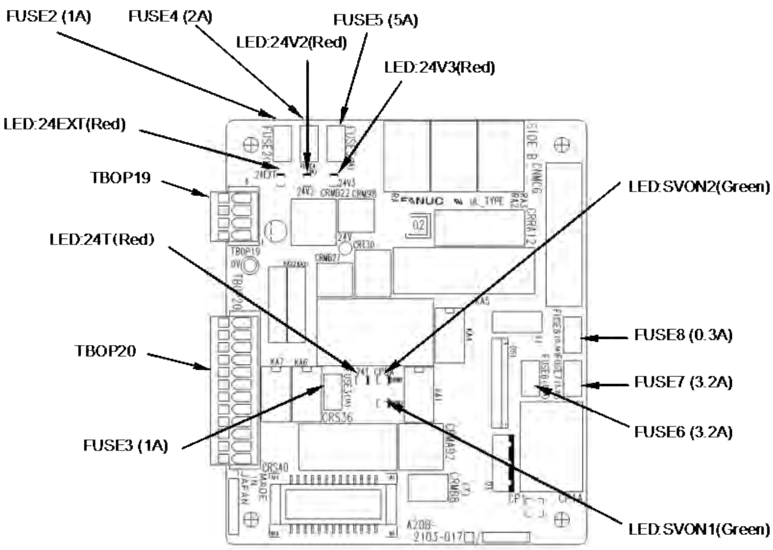
Name	Symptom observed when fuse has blown	Action
FUSE2	Alarm (SRVO-007) is displayed on the teach pendant, and the red LED (24EXT) on the emergency stop board lights.	1. Check the voltage between EXT24V and EXT0V (TBOP19). If no external power supply is used, check the jumper pin between EXT24V and INT24V or between EXT0V and INT0V. 2. Check the 24EXT (emergency stop line) for a short circuit or connection to ground. 3. Replace the emergency stop board. 4. Check the teach pendant and replace it if necessary.
FUSE3	The display on the teach pendant disappears, and the red LED (24T) on the emergency stop board lights.	1. Check the teach pendant cable and replace it if necessary. 2. Check the cable between the emergency stop board (CRS40) and the main board (CRS40) , and replace it if necessary. 3. Check the teach pendant and replace it if necessary. 4. Replace the emergency stop board. 5. Replace the main board. (*)
FUSE4	An alarm relating to an input signal that causes an emergency stop is issued, and the red LED (24V2) on the emergency stop board lights.	1. Check the connection on TROP20. 2. Check the cable between the emergency stop board (CRS40) and the main board (CRS40), and replace it if necessary. 3. Check the cable between the emergency stop board (CRMA92) and the 6-Axis servo amplifier (CRMA91), and replace it if necessary. 4. If the cable between the emergency stop board (CRMB22) and the 6-Axis servo amplifier (CRMB16) exist. Check this cable and replace it if necessary. 5. Replace the emergency stop board. 6. Replace the E-stop unit. 7. Replace the main board. (*) 8. Replace the 6-Axis servo amplifier.
FUSE5	The teach pendant can not be operated and the red LED (24V3) on the emergency stop board lights.	1. Check the cable between the emergency stop board (CRS40) and the main board (CRS40), and replace it if necessary. 2. Check the cable between the emergency stop board (CRMA92) and the 6-Axis servo amplifier (CRMA91), and replace it if necessary. 3. Replace the back plane board. 4. Replace the main board. (*) 5. Replace the emergency stop board. 6. Replace the 6-Axis servo amplifier.
FUSE6 FUSE7	The fan stops.	1. Check the fan cable and replace it if necessary. 2. Replace the fan unit. 3. Replace the emergency stop board.

Name	Symptom observed when fuse has blown	Action
FUSE8 (R-30*i*B Mate Plus)	The teach pendant can not be operated and the seven segment LED located on the main board displays “7”. If this fuse blows when power-on, the green LEDs “LEDG2” and “LEDG4” of the status LEDs on the main board light. The system does not work correctly.	1. Replace the emergency stop 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.
If an alarm is issued, data backup may be disabled. So, back up the contents of memory routinely.



(R-30*i*B Mate)



(R-30*i*B Mate Plus)

Fig.3.6 (c) Fuse on the emergency stop board

(4) Fuse on the process I/O MA,MB

FUSE1: Fuse for +24E (A60L-0001-0046#1.0)

Name	Symptom observed when fuse has blown	Action
FUSE1	The LED (ALM1 or FALM) the process I/O board lights.	1. Check if the cables and peripheral devices connected to the process I/O board are normal. 2. Replace the process I/O board.

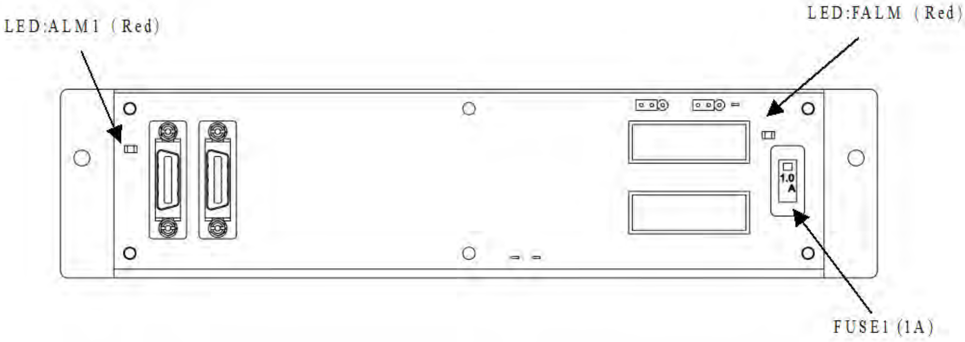


Fig.3.6 (d) Fuse on the process I/O board MA

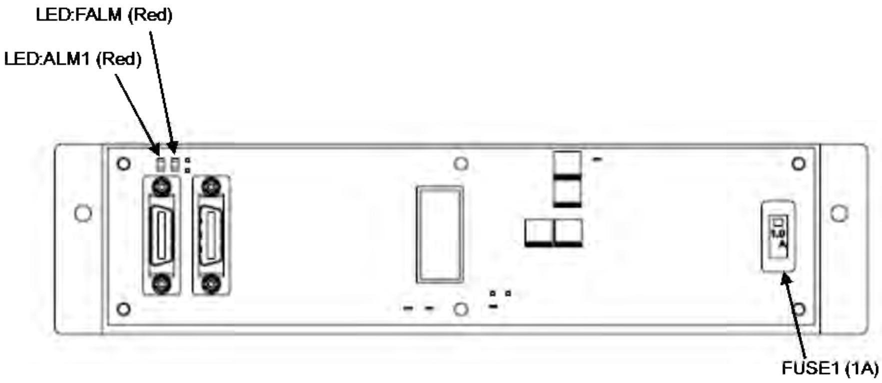


Fig.3.6 (e) Fuse on the process I/O board MB

(5) Fuse on the sensor I/F unit for CR-4*i*A, CR-7*i*A

FUSE: For internal power supply circuit (A60L-0001-0290#LM20)

Name	Symptom observed when fuse has blown	Action
FUSE	The LED of the sensor I/F unit lights.	1. Check if the cables and peripheral devices connected to the sensor I/F unit are normal. 2. Replace the sensor I/F unit.

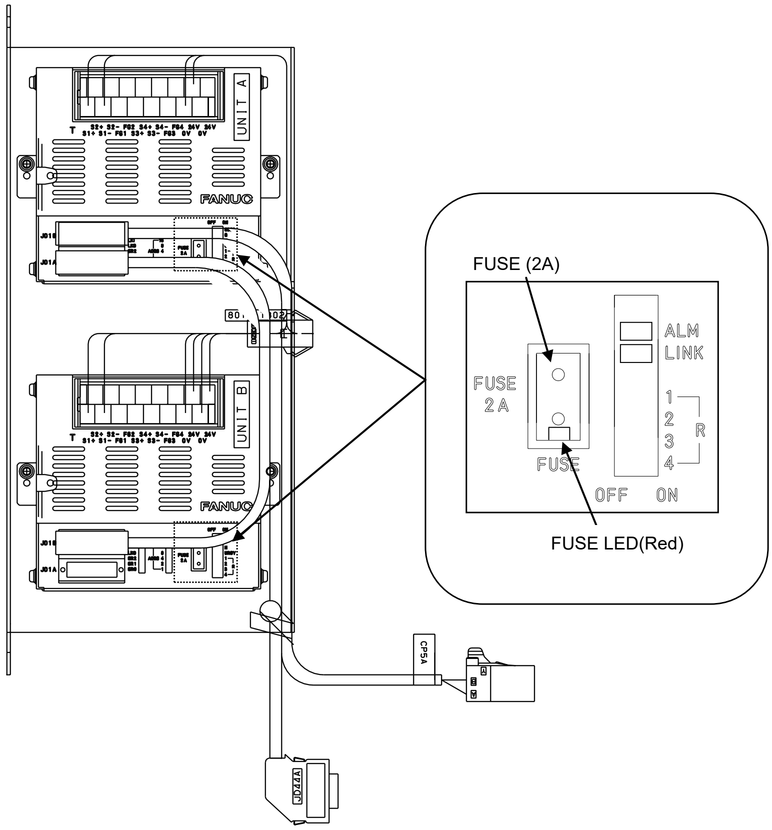


Fig.3.6 (f) Fuse on sensor I/F unit for CR-4*i*A, CR-7*i*A

3.7 TROUBLESHOOTING BASED ON LED INDICATIONS

The printed circuit boards and servo amplifier are provided with alarm LEDs and status LEDs. The LED status and corresponding troubleshooting procedures are described below.

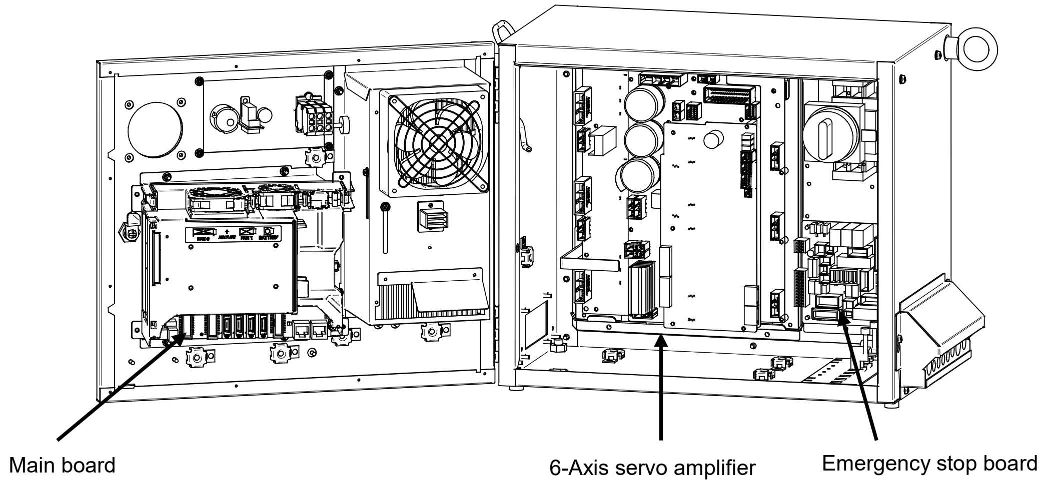
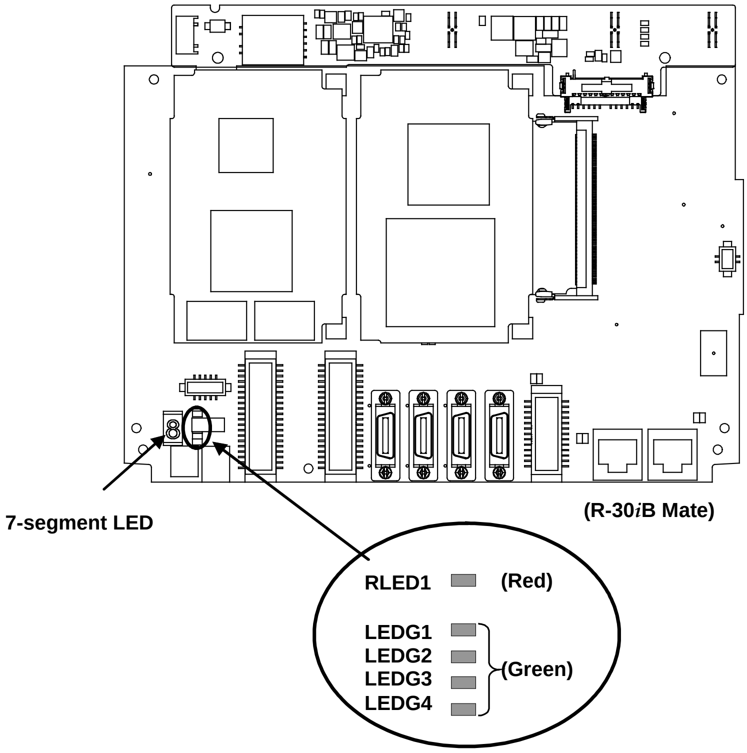


Fig.3.7 Troubleshooting based on LED indication

3.7.1 Troubleshooting Using the LEDS on the Main Board

(1) Troubleshooting using the status display LED
To troubleshoot an alarm that arises before the teach pendant is ready to display, check the status LEDs (green) on the main board at power-on. After power-on, the LEDs light as described in steps 1 to end, in the order described. If an alarm is detected, the step in which the alarm occurred can be determined from which LEDs are lit.



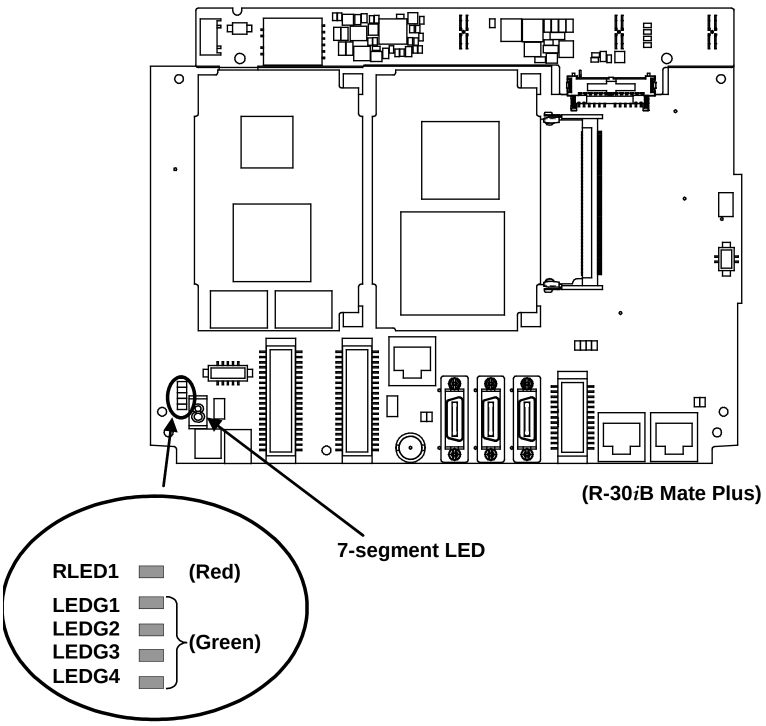
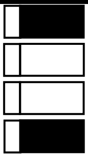
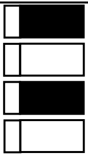
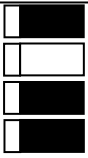
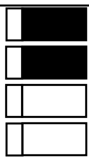
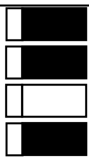
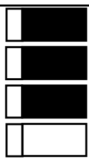
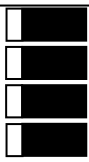
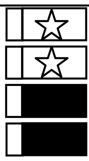


Fig. 3.7.1 Troubleshooting Using the LEDS On the Main Board

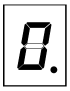
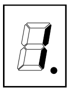
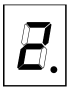
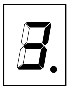
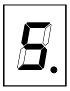
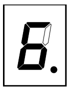
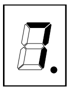
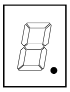
Step	LED	Action to be taken
1: After power-on, all LEDs are lit.	■ LEDG1 ■ LEDG2 ■ LEDG3 ■ LEDG4	[Action 1] Replace the CPU card. * [Action 2] Replace the main board.
2: Software operation start-up.	□ LEDG1 □ LEDG2 □ LEDG3 □ LEDG4	[Action 1] Replace the CPU card. * [Action 2] Replace the main board.
3: The initialization of dram on the CPU card is completed.	□ LEDG1 □ LEDG2 □ LEDG3 ■ LEDG4	[Action 1] Replace the CPU card. * [Action 2] Replace the main board.
4: The initialization of DPRAM on the communication IC is completed.	□ LEDG1 □ LEDG2 ■ LEDG3 □ LEDG4	[Action 1] Replace the CPU card. * [Action 2] Replace the main board. * [Action 3] Replace the FROM/SRAM module.
5: The initialization of the communication IC is completed.	□ LEDG1 □ LEDG2 ■ LEDG3 ■ LEDG4	[Action 1] Replace the CPU card. * [Action 2] Replace the main board. * [Action 3] Replace the FROM/SRAM module.
6: The loading of the basic software is completed.	□ LEDG1 ■ LEDG2 □ LEDG3 □ LEDG4	* [Action 1] Replace the main board. * [Action 2] Replace the FROM/SRAM module.
7: Basic software start-up.	□ LEDG1 ■ LEDG2 □ LEDG3 ■ LEDG4	* [Action 1] Replace the main board. * [Action 2] Replace the FROM/SRAM module. * [Action3] Replace the power supply unit.
8: Start-up of communication with the teach pendant.	□ LEDG1 ■ LEDG2 ■ LEDG3 □ LEDG4	* [Action 1] Replace the main board. [Action 2] Replace the FROM/SRAM module.
9: The loading of optional software is completed.	□ LEDG1 ■ LEDG2 ■ LEDG3 ■ LEDG4	* [Action 1] Replace the main board. [Action 2] Replace the process I/O board.
10: DI/DO initialization	■ LEDG1 □ LEDG2 □ LEDG3 □ LEDG4	[Action 1] Replace the FROM/SRAM module. [Action 2] Replace the main board.

Step	LED	Action to be taken
11: The preparation of the SRAM module is completed.	 LEDG1 LEDG2 LEDG3 LEDG4	[Action 1] Replace the axis control card. * [Action 2] Replace the main board. [Action 3] Replace the servo amplifier.
12: Axis control card initialization	 LEDG1 LEDG2 LEDG3 LEDG4	[Action 1] Replace the axis control card. * [Action 2] Replace the main board. [Action 3] Replace the servo amplifier.
13: Calibration is completed.	 LEDG1 LEDG2 LEDG3 LEDG4	[Action 1] Replace the axis control card. * [Action 2] Replace the main board. [Action 3] Replace the servo amplifier.
14: Start-up of power application for the servo system	 LEDG1 LEDG2 LEDG3 LEDG4	* [Action 1] Replace the main board.
15: Program execution	 LEDG1 LEDG2 LEDG3 LEDG4	* [Action 1] Replace the main board. [Action 2] Replace the process I/O board.
16: DI/DO output start-up.	 LEDG1 LEDG2 LEDG3 LEDG4	* [Action 1] Replace the main board.
17: Initialization is terminated.	 LEDG1 LEDG2 LEDG3 LEDG4	Initialization has ended normally.
18: Normal status	 LEDG1 LEDG2 LEDG3 LEDG4	Status LEDs 1 and 2 blink when the system is operating normally.

* 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.
If an alarm is issued, data backup may be disabled. So, back up the contents of memory routinely.

LED indication	Description
RLED1 (Red)	[Description] CPU card is not working. [Action 1] Replace the CPU card.

(2) TROUBLESHOOTING BY 7-SEGMENT LED INDICATOR

7-segment LED indicator	Description
	[Description] A parity alarm condition has occurred in DRAM on the CPU card installed on the main board. [Action1] Replace the CPU card.3.7 * [Action2] Replace the main board.
	[Description] A parity alarm condition has occurred in SRAM on the FROM/SRAM module installed on the main board. [Action1] Replace the FROM/SRAM module. * [Action2] Replace the main board.
	[Description] A bus error has occurred in the communication controller. * [Action] Replace the main board.
	[Description] A parity alarm condition has occurred in DRAM controlled by the communication controller. * [Action] Replace the main board.
	[Description] A servo alarm condition has occurred on the main board. [Action1] Replace the axis control card. * [Action2] Replace the main board. [Action3] If an option board is installed, replace the option board.
	[Description] The SYSEMG alarm has occurred. [Action1] Replace the axis control card. [Action2] Replace the CPU card. * [Action3] Replace the main board.
	[Description] The SYSFAIL alarm has occurred. [Action1] Replace the axis control card. [Action2] Replace the CPU card. * [Action3] Replace the main board. [Action4] If an option board is installed, replace the option board.
	[Description] 5V is supplied to Main board. Above alarms do not occur.

* 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.
If an alarm is issued, data backup may be disabled. So, back up the contents of memory routinely.

3.7.2 Troubleshooting by LEDs on the 6-Axis Servo Amplifier

The 6-Axis servo amplifier has alarm LEDs. Troubleshoot the alarm indicated by the LEDs, referring also to the alarm indication on the teach pendant.

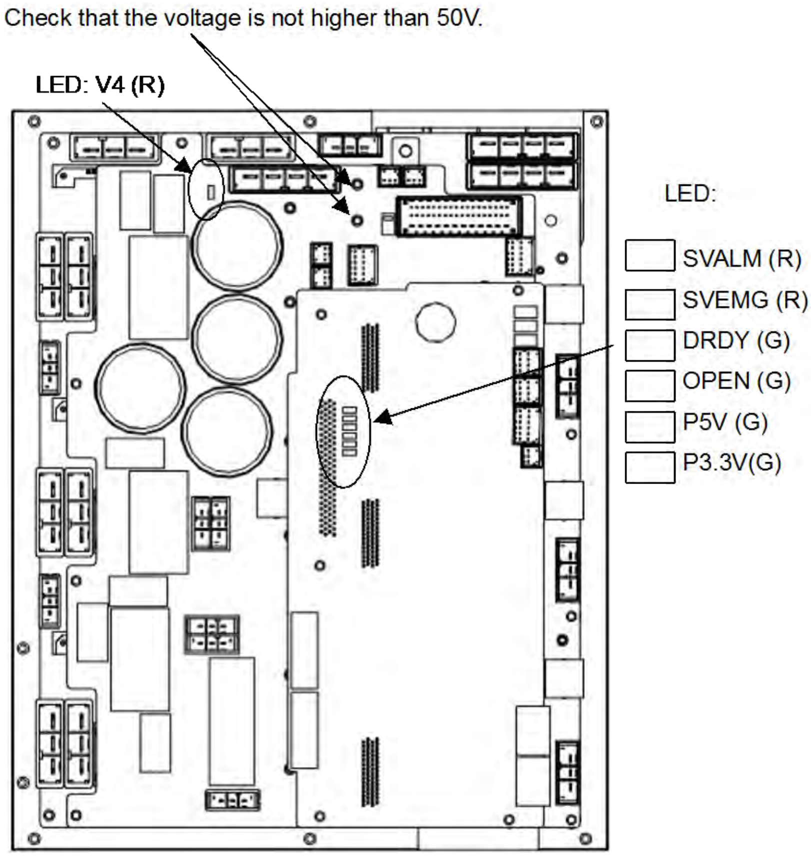


Fig.3.7.2 LEDs on the 6-Axis servo amplifier

> ⚠ **WARNING**
> Before touching the 6-Axis servo amplifier, check the DC link voltage with the screws located above the LED "V4". By using a DC voltage tester, check that the voltage is 50 V or less.

LED	Color	Description
V4	Red	Lights when the DCLINK circuit inside the servo amplifier is charged to reach the specified voltage. If the LED does not light after pre-charge is finished: [Action 1] The DC Link may be short-circuited. Check for connection. [Action 2] The charge current control resistor may be defective. Replace the emergency stop unit. [Action 3] Replace the servo amplifier.
SVALM	Red	Lights when the servo amplifier detects an alarm. If the LED lights when there is no alarm condition in the machine: [Action] Replace the servo amplifier. If the LED does not light when there is an alarm condition in the machine: [Action] Replace the servo amplifier.

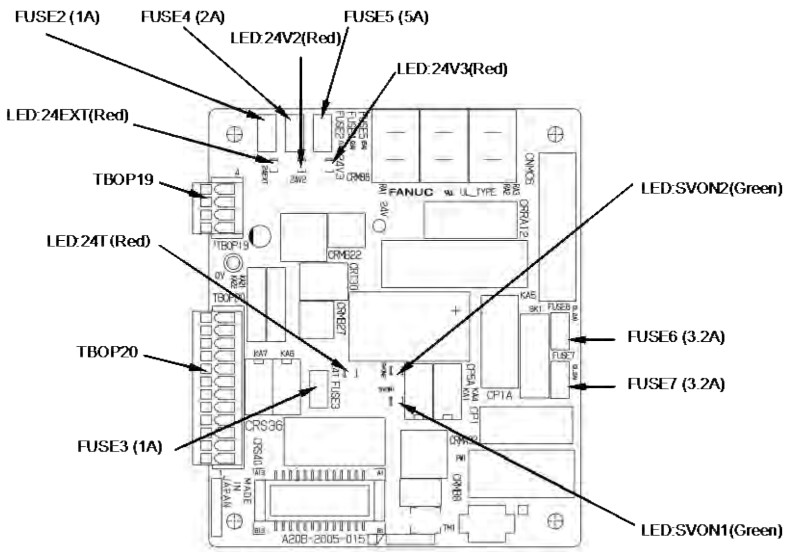
LED	Color	Description
SVEMG	Red	Lights when an emergency stop signal is input to the servo amplifier. If the LED lights when the machine is not at an emergency stop: [Action] Replace the servo amplifier. If the LED does light when the machine is at an emergency stop: [Action] Replace the servo amplifier.
DRDY	Green	Lights when the servo amplifier is ready to drive the servo motor. If the LED does not light when the motor is activated: [Action] Replace the servo amplifier.
OPEN	Green	Lights when the communication between the servo amplifier and the main board is normal. If the LED does not light: [Action 1] Check for the connection of the FSSB optical cable. [Action 2] Replace the servo card. [Action 3] Replace the servo amplifier.
P5V	Green	Lights when the power supply circuit inside the servo amplifier outputs a voltage of +5 V normally. If the LED does not light: [Action 1] Check the robot connection cable (RP1/RMP1) to see if there is a ground fault in the +5V wire. [Action 2] Replace the servo amplifier.
P3.3V	Green	Lights when the power supply circuit inside the servo amplifier outputs a voltage of +3.3 V normally. If the LED does not light: [Action] Replace the servo amplifier.

3.7.3 Troubleshooting by LED on the Emergency Stop Board

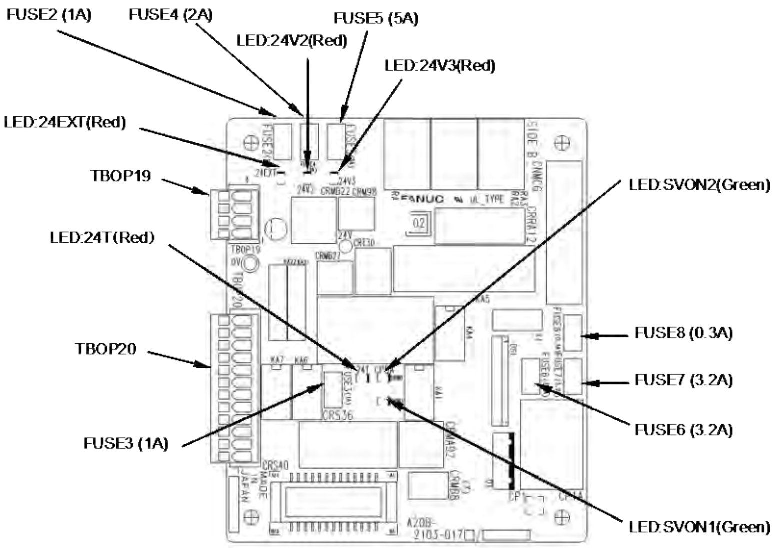
LED indication	Failure description and required measure
24EXT (Red)	[Description] When the LED (red) turned on, the fuse (FUSE2) is brown. 24EXT for the emergency stop circuit is not supplied. [Action 1] If the fuse (FUSE2) has not brown in this state, check the voltage between EXT24V and EXT0V (TBOP19). If no external power supply is used, check the jumper pin between EXT24V and INT24V or between EXT0V and INT0V. [Action 2] Check the 24EXT (emergency stop line) for a short circuit or connection to ground. [Action 3] Replace the emergency stop board. [Action 4] Check the teach pendant, and replace it if required.
24T (Red)	[Description] When the LED (red) turned on, the fuse (FUSE3) is brown. 24T for the teach pendant is not supplied. [Action 1] Check the teach pendant cable (CRS36), and replace it if required. [Action 2] Check the cable between the emergency stop board (CRS40) and the main board (CRS40), and replace it if necessary. [Action 3] Check the teach pendant, and replace it if required. [Action 4] Replace the emergency stop board. *[Action 5] Replace the main board.

LED indication	Failure description and required measure
24V2 (Red)	[Description] When the LED (red) turned on, the fuse (FUSE4) is brown. 24V-2 for the emergency stop input signal is not supplied. [Action 1] Check the connection of TBOP20. [Action 2] Check the cable between the emergency stop board (CRS40) and the main board (CRS40), and replace it if necessary. [Action 3] Check the cable between the emergency stop board (CRMA92) and the 6-Axis servo amplifier (CRMA91), and replace it if necessary. [Action 4] If the cable between the emergency stop board (CRMB22) and the 6-Axis servo amplifier (CRMB16) exist. Check this cable and replace it if necessary. [Action 5] Replace the emergency stop board. [Action 6] Replace the E-stop unit. *[Action 7] Replace the main board. [Action 8] Replace the 6-Axis servo amplifier.
24V3 (Red)	[Description] When the LED (red) turned on, the fuse (FUSE5) is brown. 24V-3 for the main board is not supplied. [Action 1] Check the cable between the emergency stop board (CRS40) and the main board (CRS40), and replace it if necessary. [Action 2] Check the cable between the emergency stop board (CRMA92) and the 6-Axis servo amplifier (CRMA91), and replace it if necessary. [Action 3] Replace the backplane board. *[Action 4] Replace the main board. [Action 5] Replace the emergency stop board. [Action 6] Replace the 6-Axis servo amplifier.
SVON1/SVON2 (Green)	[Description] These LEDs (green) indicate the status of SVON1/SVON2 signals from the emergency stop board to the servo amplifier. When the SVON1 and SVON2 (green) turned on, the servo amplifier is ready to energize.

* 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.
If an alarm is issued, data backup may be disabled. So, back up the contents of memory routinely.



(R-30*i*B Mate)



(R-30*i*B Mate Plus)

Fig.3.7.3 LEDs on the emergency stop board

3.7.4 Troubleshooting by Alarm LEDs on the Process I/O Board

Process I/O MA,MB

LED	Color	Description
ALM1	Red	[Description] An alarm was issued during communication between the main board and the process I/O board. [Action 1] Replace the process I/O board. [Action 2] Replace the I/O link connection cable. [Action 3] Replace the main board.
FALM	Red	[Description] The fuse on the process I/O board was blown. [Action1] Replace the fuse on the process I/O board. [Action2] Check the cables and peripheral units connected to the process I/O board and replace the defective units. [Action3] Replace the process I/O board.

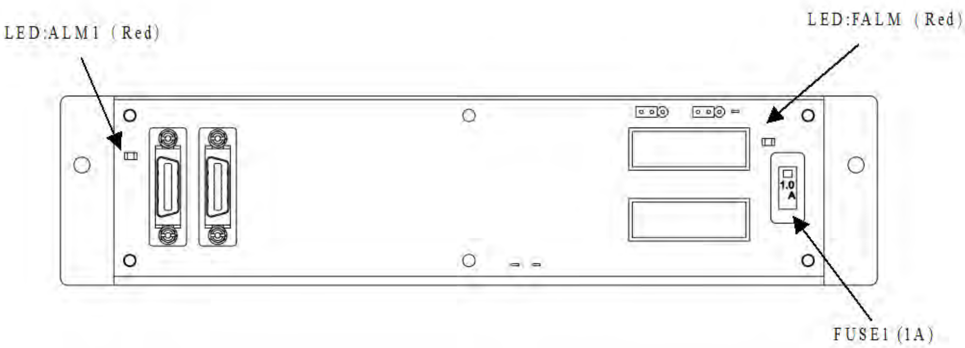


Fig.3.7.4 (a) LEDs on the process I/O board MA

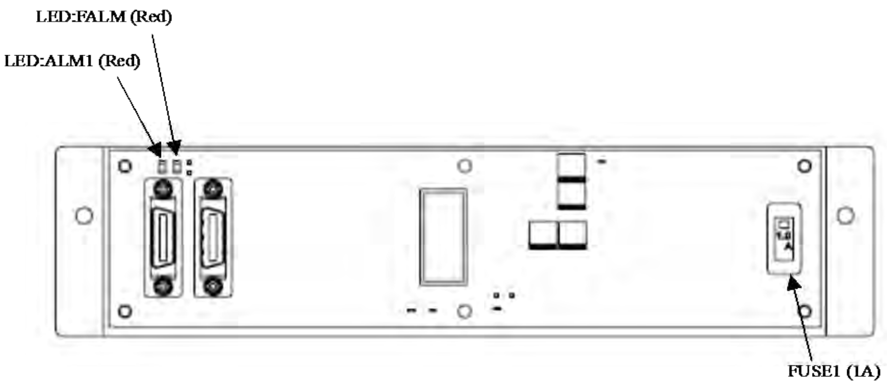


Fig.3.7.4 (b) LEDs on the process I/O board MB

3.7.5 Troubleshooting by LEDs on the Sensor I/F Unit for CR-4*i*A, CR-7*i*A

The sensor I/F unit for the I/O Link *i* only has the following LEDs to indicate the communication status of the I/O Link *i* and sensor.

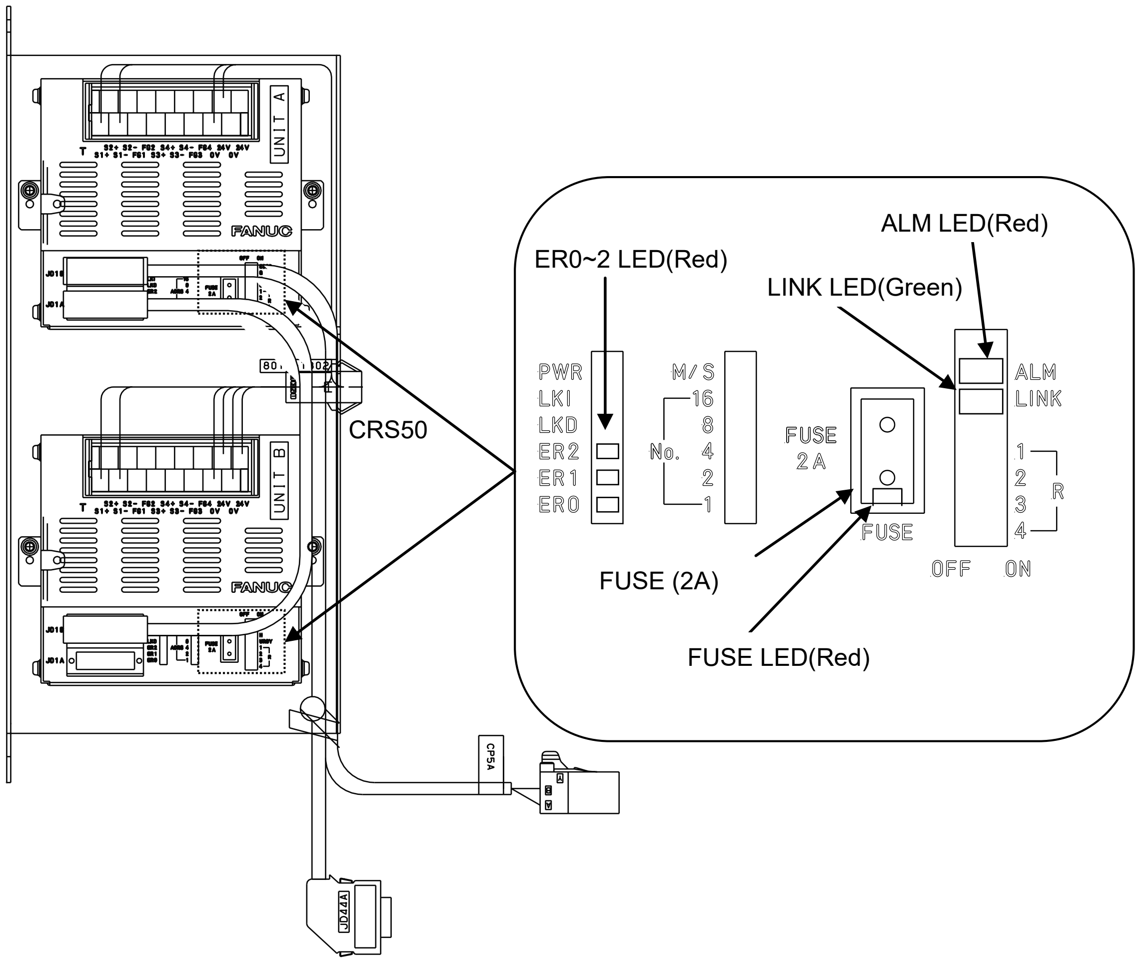


Fig.3.7.5 LEDs on the sensor I/F unit for CR-4*i*A, CR-7*i*A

- ER0~2 LED
  Lights when an error occurs in communication with the force sensor.
  For confirmation, remove the cable connected to the CRS50 connector, turn on the power, and check whether the ER 0 ~ 2 LEDs change.
  When one of the ER 0 to 2 LEDs lights up: Replace the sensor I/F unit.
  When all of the ER 0 to 2 LEDs are turned off: Check whether there is any abnormality in the sensor connection cable connected to CRS50.
- FUSE LED
  Lights when the fuse blows.
  Remove the cause of the blown fuse, and the replace the fuse.
- LINK LED
  The LINK LED indicates the group communication status as described below.

Operation mode	LED Indications	Meaning	Remarks
I/O Link *i*	OFF	Power OFF	
	ON	Power ON	
	Blink (1:1)	Communication in progress Standard	ON = approx. 0.5 sec OFF = approx. 0.5 sec
	Blink (3:1)	Communication in progress (Dual check safety in use)	ON = approx. 1.5 sec OFF = approx. 0.5 sec
	Blink (1:1 at high speed)	Communication not in progress Watch-dog alarm occurrence	ON = approx. 0.25 sec OFF = approx. 0.25 sec

- ALM LED
  The ALM LED indicates the types of I/O Link *i* alarms as described below.

Operation mode	LED Indications	Meaning	Remarks
I/O Link *i*	OFF	Normal state or power OFF	
	ON	Occurrence of any of a parity alarm, external input alarm, and dual check safety alarm	
	Blink (1:1)	Broken wire between the group of interest and a group subsequent to it	ON = approx. 0.5 sec OFF = approx. 0.5 sec
	Blink (3:1)	Power failure (including instantaneous power failure) in a group subsequent to the group of interest	ON = approx. 1.5 sec OFF = approx. 0.5 sec
	Blink (1:3)	Status alarm	ON = approx. 0.5 sec OFF = approx. 1.5 sec
	Blink (1:1 at high speed)	Alarm occurred due to a command from the master	ON = approx. 0.25 sec OFF = approx. 0.25 sec

3.8 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 set to 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.

3.9 LEDS ON UNITS SUPPORTING I/O LINK *i*

3.9.1 Meanings of LEDs on Units Supporting I/O Link *i*

The standard I/O Link *i* incorporates three LEDs, “LINK” (green), “ALM” (red), and “FUSE” (red) for each unit separately. These LEDs indicate the states of the units.
The following table lists the ON/OFF states of the LEDs and their meanings.

LED ON/OFF state	ON and OFF duration
Steadily OFF	
Steadily ON	
Blink (1:1)	ON = approx. 0.5 sec, OFF = approx. 0.5 sec
Blink (3:1)	ON = approx. 1.5 sec, OFF = approx. 0.5 sec
Blink (1:3)	ON = approx. 0.5 sec, OFF = approx. 1.5 sec
Blink (1:1 at high speed)	ON = approx. 0.25 sec, OFF = approx. 0.25 sec

LED「LINK」(green)

The “LINK” (green) LED indicates the state of communication. The following table lists the meanings of LED states.

Operation mode	LED state	Meaning	Fault location and action
Common	OFF	Power OFF	
	ON	Power ON (before communication start)	
	Blink (1:1 at high speed)	Communication at halt	Communication is at halt because of an alarm. Identify the cause according to the states of the red LED stated below or information displayed on the CNC screen.
I/O Link	Blink (1:3)	Communication in progress	
I/O Link *i*	Blink (1:1)	Communication in progress	
	Blink (3:1)	Communication in progress (Dual check safety in use)	

LED「ALM」(red)

The "ALM" (red) LED indicates an alarm in the unit of interest or a unit subsequent to it. The following table lists the meanings of LED states.

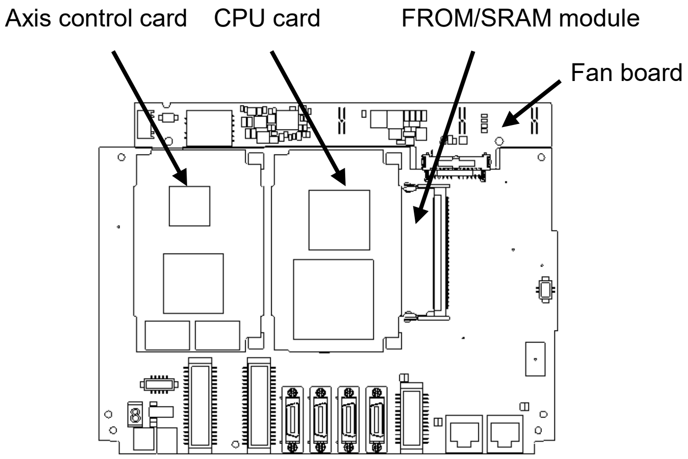
Operation mode	LED state	Meaning	Fault location and action
Common	OFF	Normal state or power OFF	
I/O Link	ON	Alarm	It is likely that the hardware may be defective. Replace the unit.
I/O Link i	ON	Alarm	It is likely that the hardware may be defective. Replace the unit.
	Blink (1:1)	Broken wire between the unit of interest and a unit subsequent to it	Check for a defective cable or a poor cable connection between JD1A on the unit of interest and JD1B on a unit subsequent to that unit. Alternatively, it is likely that there may be noise. Check to see if there is noise around the cable.
	Blink (3:1)	Power failure (including instantaneous power failure) in a unit subsequent to the unit of interest	Identify and remove the cause of a power failure in a unit subsequent to the unit of interest.
	Blink (1:3)	Status alarm	A status alarm, such as a DO ground fault, has occurred. Identify and remove the cause of the alarm.

4 PRINTED CIRCUIT BOARDS

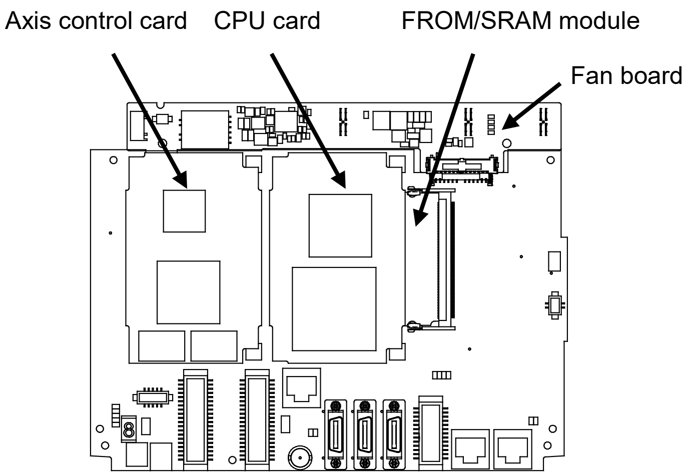
The printed circuit boards are factory-set for operation. Usually, you do not need to set or adjust them. This chapter describes the standard settings and adjustment required if a defective printed circuit board is replaced. It also describes the test pins and the LED indications.
The controller printed circuit board includes the main unit printed circuit board and one or more cards or modules installed horizontally to the main-unit printed-circuit board.
These PC boards have interface connectors, LED indicators, and a plastic panel at the front. At the rear, there is a backplane connector.

4.1 MAIN BOARD

Card and Modules



(R-30*i*B Mate)



(R-30*i*B Mate Plus)

Fig.4.1 Main board

Name	Ordering Specification	Board Specification	Note
Main board	A05B-2650-H001	A20B-8200-0790	Standard, Ethernet:1ch
	A05B-2650-H002	A20B-8200-0791	Ethernet:2ch, Vision I/F, Force sensor I/F
	A05B-2650-H003	A20B-8200-0792	Ethernet:2ch, Vision I/F, Force sensor I/F, PMC, HDI
	A05B-2650-H004	A20B-8201-0420	Standard, Ethernet:1ch For I/O Link *i* slave
	A05B-2650-H005	A20B-8201-0421	Ethernet:2ch, Vision I/F, Force sensor I/F For I/O Link *i* slave
	A05B-2650-H006	A20B-8201-0422	Ethernet:2ch, Vision I/F, Force sensor I/F, PMC, HDI For I/O Link *i* slave
	A05B-2680-H001 (R-30*i*B Mate Plus)	A20B-8201-0750	Standard, Ethernet:2ch For I/O Link *i* slave
	A05B-2680-H002 (R-30*i*B Mate Plus)	A20B-8201-0751	Ethernet:3ch, Vision I/F, Force sensor I/F For I/O Link *i* slave
	A05B-2680-H003 (R-30*i*B Mate Plus)	A20B-8201-0752	Ethernet:3ch, Vision I/F, Force sensor I/F, PMC, HDI For I/O Link *i* slave
CPU card	A05B-2600-H020	A20B-3300-0686 A17B-3301-0106	Standard / SDRAM 32Mbyte
	A05B-2600-H021	A20B-3300-0687 A17B-3301-0107	Standard / SDRAM 64Mbyte
	A05B-2600-H022	A20B-3300-0688 A17B-3301-0108	Standard / SDRAM 128Mbyte
	A05B-2600-H023	A20B-3300-0683 A17B-3301-0103	High speed / SDRAM 32Mbyte
	A05B-2600-H024	A20B-3300-0684 A17B-3301-0104	High speed / SDRAM 64Mbyte
	A05B-2600-H025	A20B-3300-0685 A17B-3301-0105	High speed / SDRAM 128Mbyte
	A05B-2600-H026	A17B-3301-0109	Standard / SDRAM 32Mbyte For I/O Link *i* slave
	A05B-2600-H027	A17B-3301-0110	Standard / SDRAM 64Mbyte For I/O Link *i* slave
	A05B-2600-H028	A17B-3301-0111	Standard / SDRAM 128Mbyte For I/O Link *i* slave
	A05B-2600-H029	A17B-3301-0112	High speed / SDRAM 32Mbyte For I/O Link *i* slave
	A05B-2600-H030	A17B-3301-0113	High speed / SDRAM 64Mbyte For I/O Link *i* slave
	A05B-2600-H031	A17B-3301-0114	High speed / SDRAM 128Mbyte For I/O Link *i* slave
	A05B-2670-H020 (R-30*i*B Mate Plus)	A17B-3301-0250	Standard / DRAM 1GB For I/O Link I slave

Name	Ordering Specification	Board Specification	Note
Axis control card	A05B-2600-H040	A20B-3300-0664	6-axis
		A20B-3300-0774	
	A05B-2600-H041	A20B-3300-0663	12-axis
		A20B-3300-0773	
	A05B-2600-H042	A20B-3300-0662	18-axis
		A20B-3300-0772	
	A05B-2600-H043	A20B-3300-0661	24-axis
		A20B-3300-0771	
	A05B-2600-H044	A20B-3300-0660	36-axis
		A20B-3300-0770	
	A05B-2670-H040 (R-30*i*B Mate Plus)	A20B-3300-0819	6-axis
	A05B-2670-H041 (R-30*i*B Mate Plus)	A20B-3300-0818	12-axis
	A05B-2670-H042 (R-30*i*B Mate Plus)	A20B-3300-0817	18-axis
	A05B-2670-H043 (R-30*i*B Mate Plus)	A20B-3300-0816	24-axis
	A05B-2670-H044 (R-30*i*B Mate Plus)	A20B-3300-0815	36-axis
FROM/SRAM module	A05B-2600-H060	A20B-3900-0283	FROM 32M/ SRAM 1M
		A20B-3900-0297	
	A05B-2600-H061	A20B-3900-0284	FROM 32M/ SRAM 2M
		A20B-3900-0298	
	A05B-2600-H062	A20B-3900-0285	FROM 32M/ SRAM 3M
		A20B-3900-0299	
	A05B-2600-H063	A20B-3900-0286	FROM 64M/ SRAM 1M
	A05B-2600-H064	A20B-3900-0287	FROM 64M/ SRAM 2M
	A05B-2600-H065	A20B-3900-0288	FROM 64M/ SRAM 3M
	A05B-2600-H066	A20B-3900-0280	FROM 128M/ SRAM 1M
	A05B-2600-H067	A20B-3900-0281	FROM 128M/ SRAM 2M
	A05B-2600-H068	A20B-3900-0282	FROM 128M/ SRAM 3M
	A05B-2600-H069 (R-30*i*B Mate Plus)	A20B-3900-0293	FROM 256M/ SRAM 1M
	A05B-2600-H070 (R-30*i*B Mate Plus)	A20B-3900-0295	FROM 256M/ SRAM 2M
	A05B-2600-H071 (R-30*i*B Mate Plus)	A20B-3900-0296	FROM 256M/ SRAM 3M
Fan board	A05B-2650-H001	A20B-8200-0669	
	A05B-2650-H002		
	A05B-2650-H003		

NOTE

In case of using the function of I/O Link *i* slave, the combination of the specification of mainboard, CPU card and software is limited as below.

[Main board (For I/O Link *i* slave)] + [CPU card (For I/O Link *i* slave)]
+ [Software (V8.30P14 or later)]

Except for the above condition, the system does not work correctly as followings.

a) [Main board] + [CPU card (For I/O Link *i* slave)]
Neither the function of I/O Link slave nor I/O Link *i* slave work correctly. And the alarm regarding I/O Link or I/O Link *i* occur on the master side.
And in case the software version is not correct, system does not work correctly.

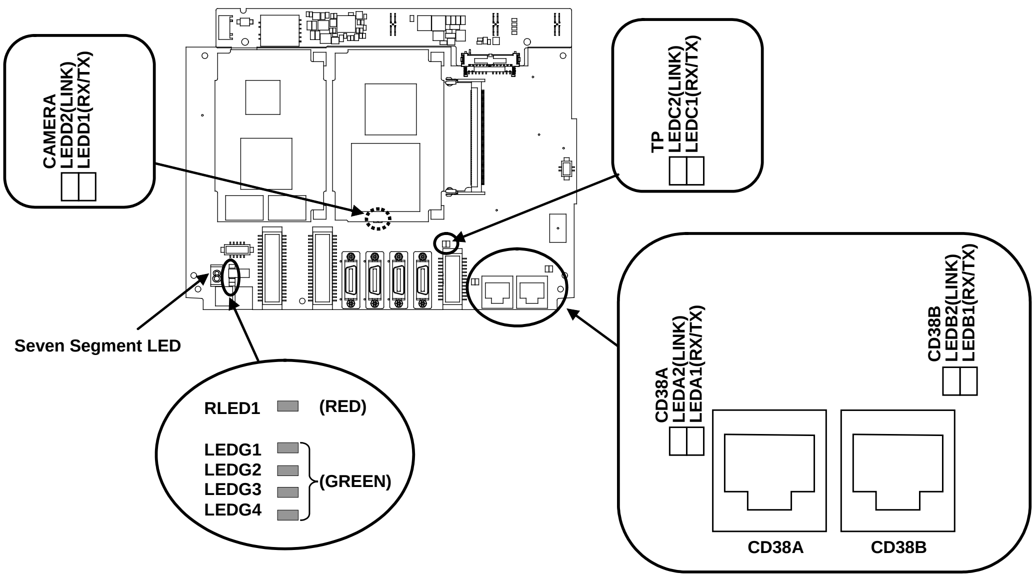
b) [Main board (For I/O Link *i* slave)] + [CPU card]
The system does not work correctly.

In case of using the R-30*i*B Mate Plus, the combination of the specification of mainboard, CPU card and software is limited as below.

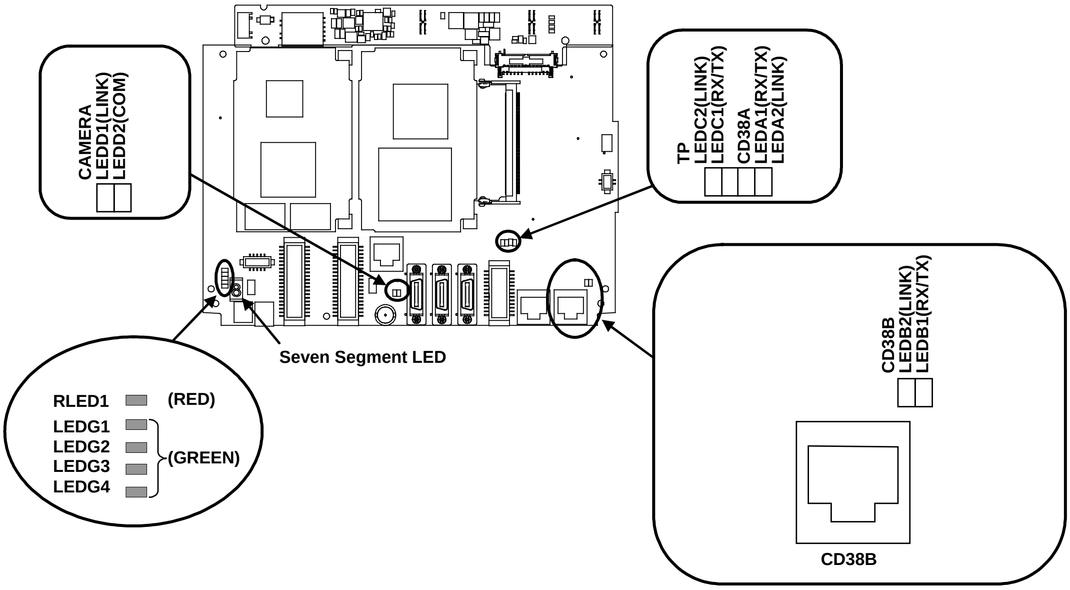
[Main board (R-30*i*B Mate Plus)] + [CPU card (R-30*i*B Mate Plus)]
+ [Software (V9.00P03 or later)]

Except for the above condition, the system does not work correctly. And CPU card (R-30*i*B Mate Plus) may be broken.

LEDs



(R-30*i*B Mate)



(R-30*i*B Mate Plus)

Seven segment LED	Description
	When the alarm condition has occurred in the main board, this LED is turned on. Please see the Section 3.7.TROUBLESHOOTING BASED ON LED INDICATIONS.

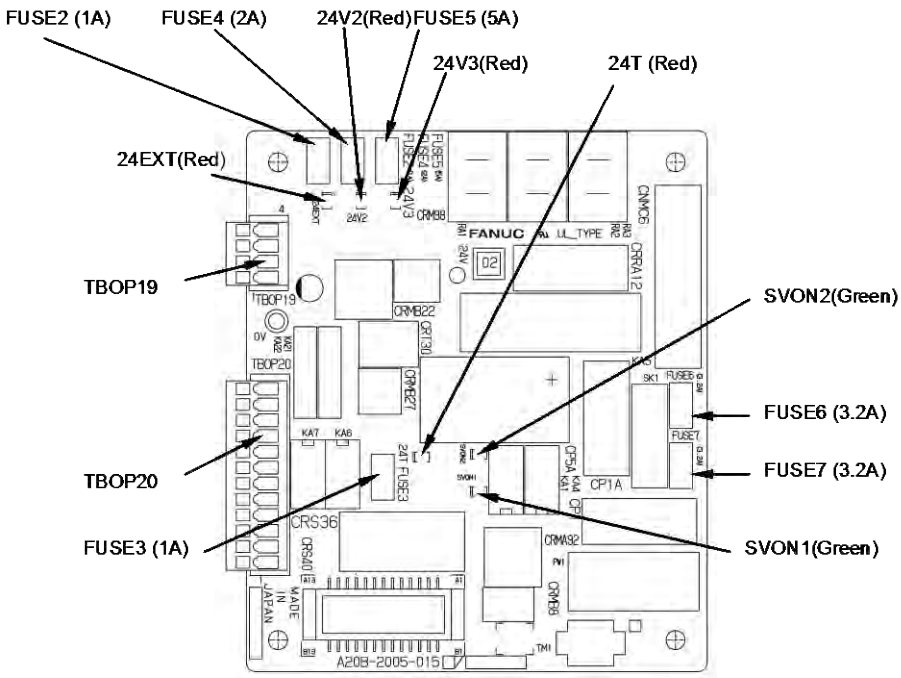
ALARM LED	Color	Description
RLED1	Red	When the alarm condition has occurred in the CPU card, this LED is turned on. Please see the Section 3.7.TROUBLESHOOTING BASED ON LED INDICATIONS.

STATUS LED	Color	Description
LEDG1	Green	These LEDs show the operating status of the system. Please see the Section 3.7.TROUBLESHOOTING BASED ON LED INDICATIONS.
LEDG2	Green	
LEDG3	Green	
LEDG4	Green	

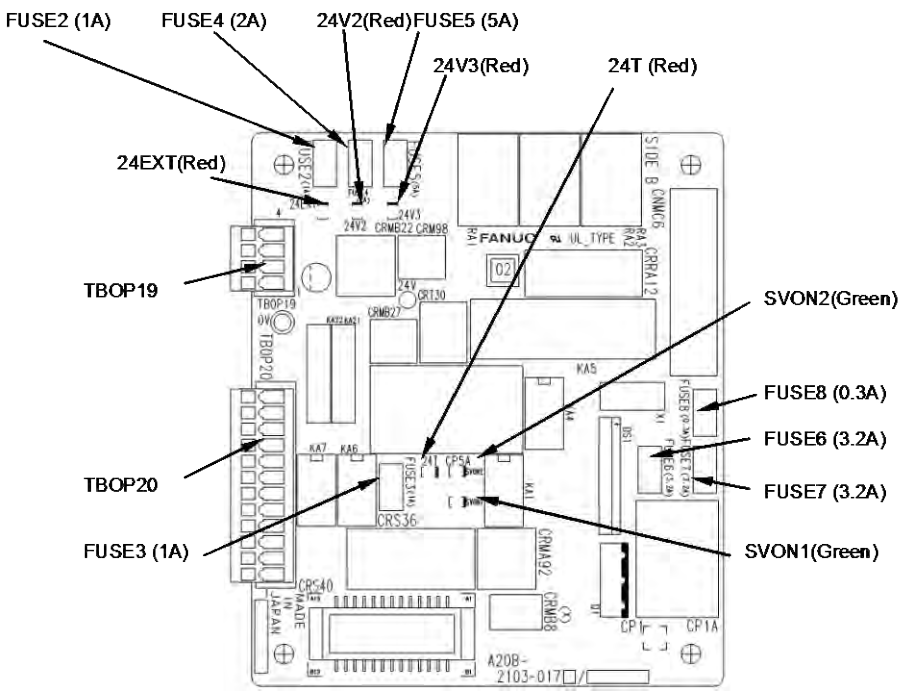
ETHERNET LED	Color	Description
RX/TX	Green	Blink during data transmission of Ethernet TP
LINK	Green	Light when a link of Ethernet is established

Note. TP:For Ethernet TP, CAMERA: For camera

4.2 EMERGENCY STOP BOARD (A20B-2005-0150, A20B-2103-0170)



(R-30*i*B Mate A20B-2005-0150)



(R-30*i*B Mate Plus A20B-2103-0170)

Fig.4.2 Emergency stop board

4.3 BACKPLANE

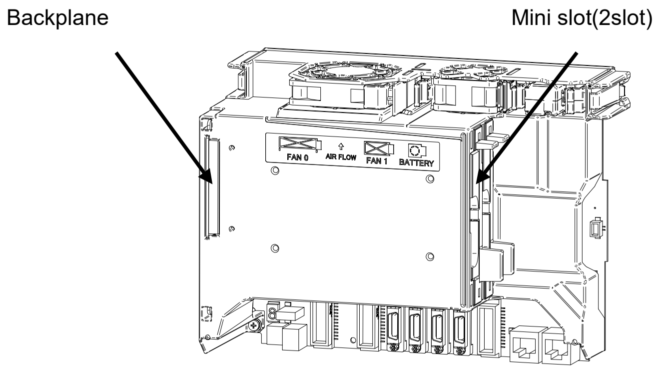


Fig.4.3 Backplane

Name	Ordering Specification	Parts number	Board specification
2 slot backplane	A05B-2650-H080	A05B-2650-C040	A20B-8200-0680

4.4 PROCESS I/O BOARD MA (A20B-2004-0381)

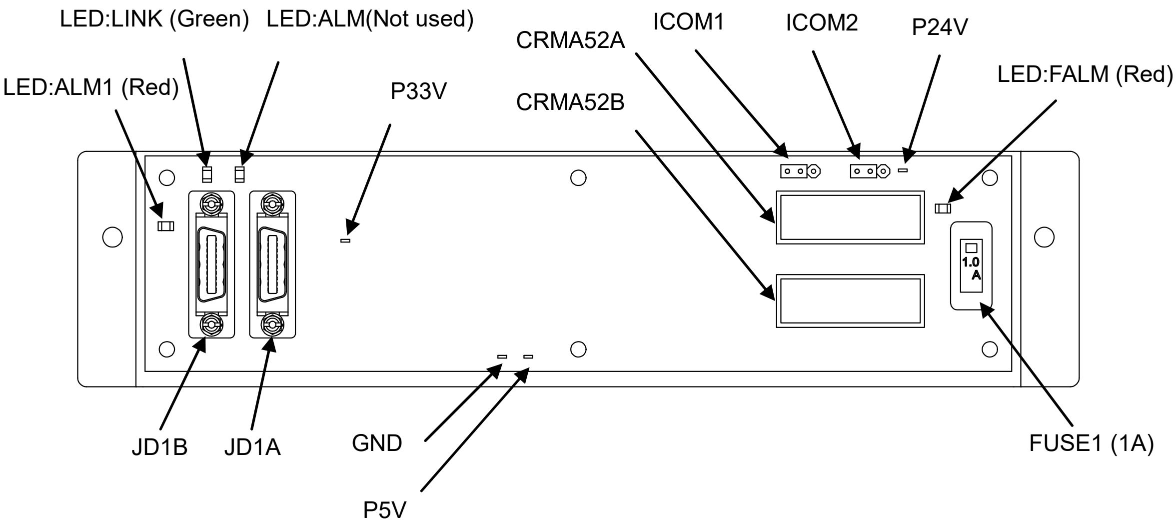


Fig.4.4 Process I/O Board MA

(1) Test pins

Name		Use
P24V P5V GND P33V	+24V +5V GND +3.3V	For measuring the DC supply voltage

(2) Settings

Name		Standard setting	Description
ICOM1	UDI1- 10 (Connector CRMA52A)	Side A	For common voltage setting Side A: +24V common Side B: 0V common
ICOM2	UDI11- 20 (Connector CRMA52B)		

(3) LEDs

Name	Color	Description
ALM1	Red	A communication alarm occurred between the main board and process I/O board.
FALM	Red	The fuse (FUSE1) on the process I/O board has blown.
LINK	Green	Blink (1:3) Communication in progress ON = approx. 0.5 sec, OFF = approx. 1.5 sec
		Blink (1:1) Communication not in progress ON = approx. 0.25 sec, OFF = approx. 0.25 sec
ALM	Red	Not used

4.5 PROCESS I/O BOARD MB (A20B-2101-0731)

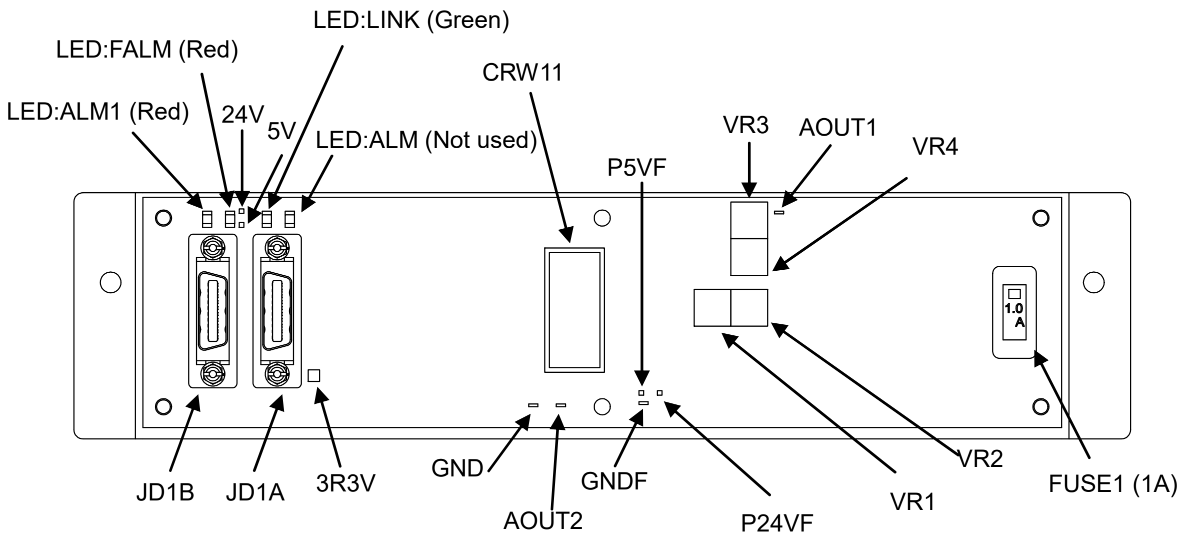


Fig.4.5 Process I/O Board MB

(1) Test pins and pads

Name		Use
24V 5V GND 3R3V	+24V +5V GND +3.3V	For measuring the DC supply voltage
P24VF P5VF GNDF	+24V +5V GND	D/A converter power supply
AOUT1 AOUT2	Channel 1 Channel 2	For analog output signal (D/A) voltage measurement

(2) Adjustment

VR1/VR2 Channel 1 gain and offset adjustment

Connect the "+" and "-" terminals of a digital voltmeter, respectively, to the AOUT1 check pin and the GNDF check pin (not a general ground point). From the teach pendant, execute AOUT[1]=3413, using a robot program. While observing the voltage at the AOUT1 check pin with the digital voltmeter, adjust potentiometers VR1 and VR2 for 15.0V.

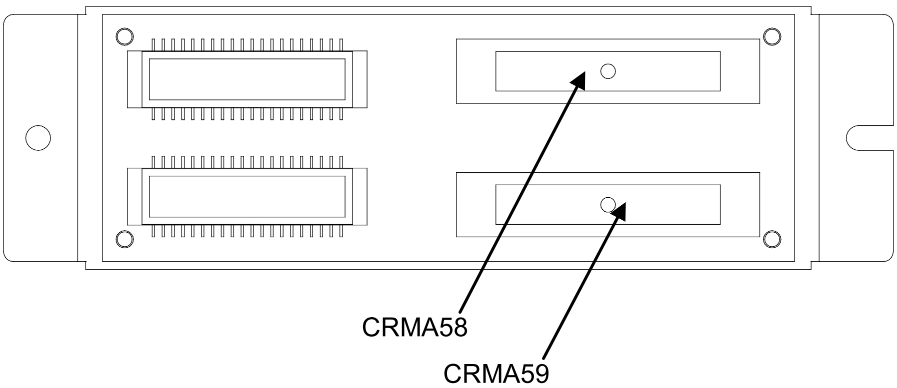
VR3/VR4 Channel 2 gain and offset adjustment

Connect the "+" and "-" terminals of a digital voltmeter, respectively, to the AOUT2 check pin and the GNDF check pin (not a general ground point). From the teach pendant, execute AOUT[2]=3413, using a robot program. While observing the voltage at the AOUT2 check pin with the digital voltmeter, adjust potentiometers VR3 and VR4 for 15.0V.

(3) LEDs

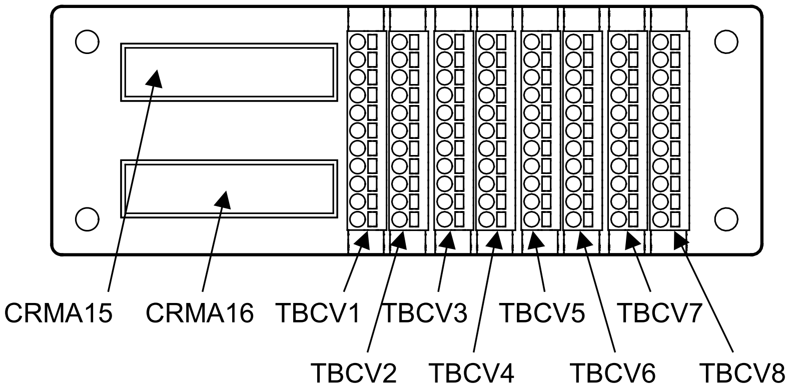
Name	Color	Description
ALM1	Red	A communication alarm occurred between the main CPU and process I/O board.
FALM	Red	The fuse (FUSE1) on the process I/O board has blown.
LINK	Green	Blink (1:3) Communication in progress ON = approx. 0.5 sec, OFF = approx. 1.5 sec
		Blink (1:1) Communication not in progress ON = approx. 0.25 sec, OFF = approx. 0.25 sec
ALM	Red	Not used

4.6 CONNECTOR CONVERTER BOARD (A20B-2004-0411)



(Connector converter board)

4.7 TERMINAL CONVERTER BOARD (A20B-1009-0690)



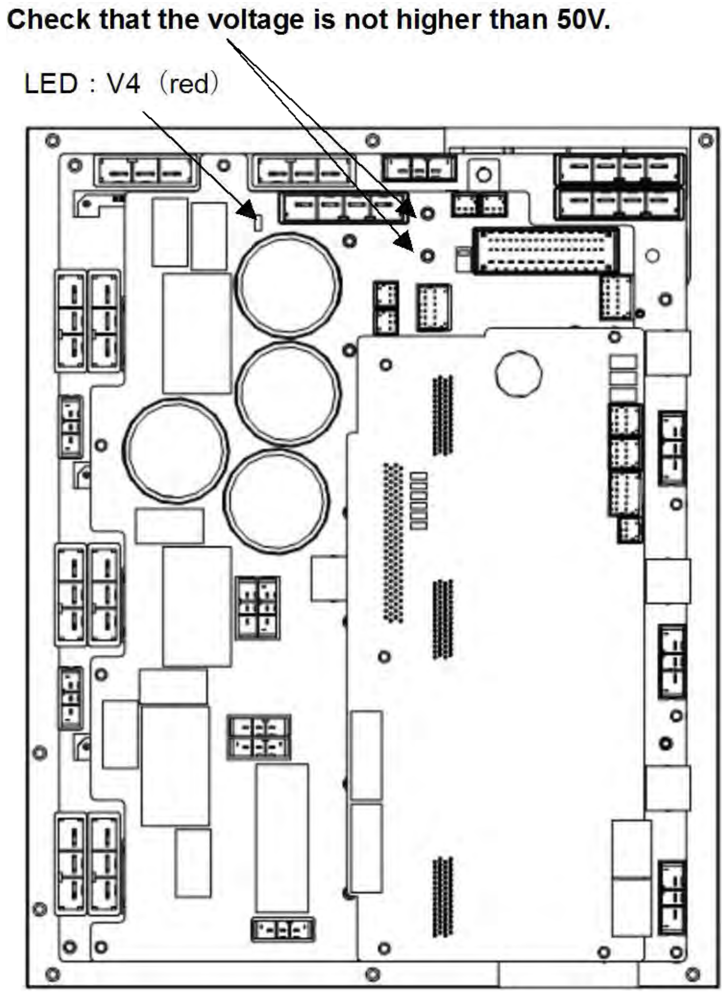
(Terminal converter board)

5 6-AXIS SERVO AMPLIFIERS

The 6-axis servo amplifiers are factory-set for operation. Usually, you do not need to set or adjust them. This chapter describes the standard settings and adjustment required if a defective 6-axis servo amplifier is replaced. It also describes the use of test pins and meanings of the LED indications.

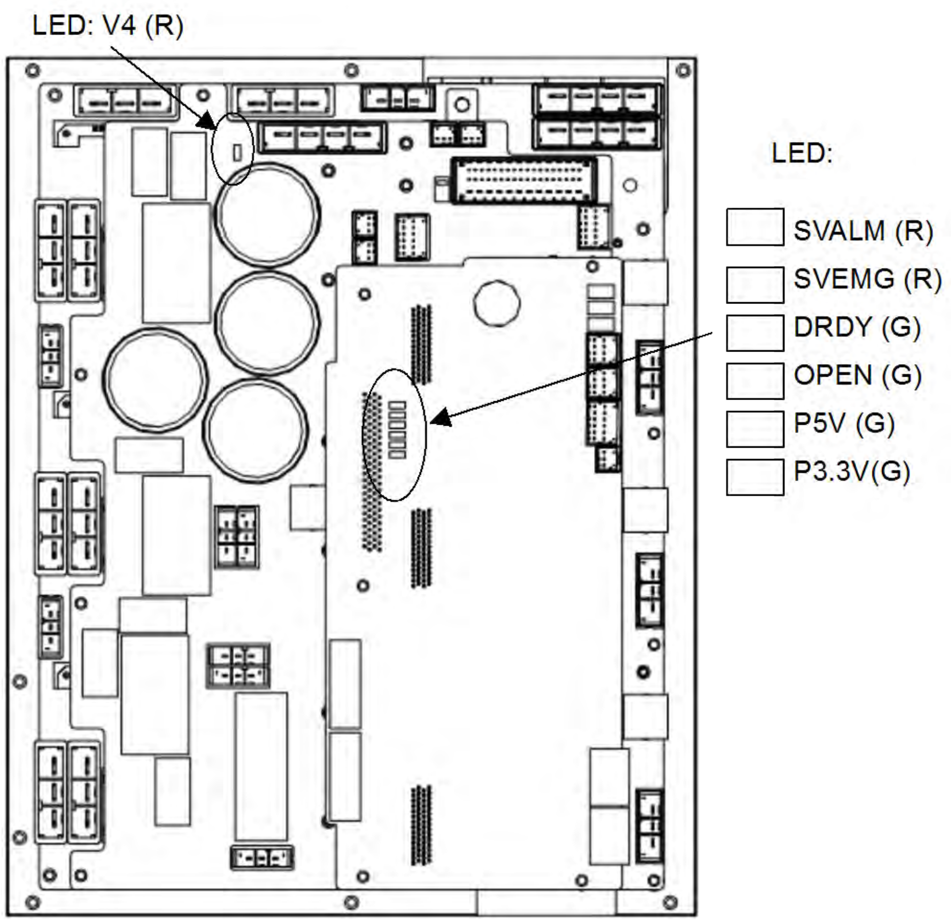
Table 5 6-axis servo amplifier specification (Power supply regeneration)

ROBOT	6-AXIS SERVO AMPLIFIER	REGENERATIVE RESISTOR
ARC Mate 120*i*C, M-20*i*A, M-20*i*B M-710*i*C, R-1000*i*A	A06B-6400-H102	A05B-2650-C101
R-2000*i*C, M-2*i*A, M-3*i*A	A06B-6400-H002	A05B-2650-C101
ARC Mate 100*i*C M-10*i*A	A06B-6400-H003	A05B-2650-C101
ARC Mate 50*i*D	A06B-6400-H005	A05B-2650-C101
LR Mate 200*i*D, M-1*i*A ARC Mate 50*i*D (Limited type) CR-4*i*A, CR-7*i*A	A06B-6400-H005	A05B-2650-C100



> ⚠ **WARNING**
> Before touching the servo amplifier, for example, for maintenance purposes, check the voltage at the screw above the LED "V4" with a DC voltage tester to see if the remaining voltage is not higher than 50V.

5.1 LEDS OF 6-AXIS SERVO AMPLIFIER

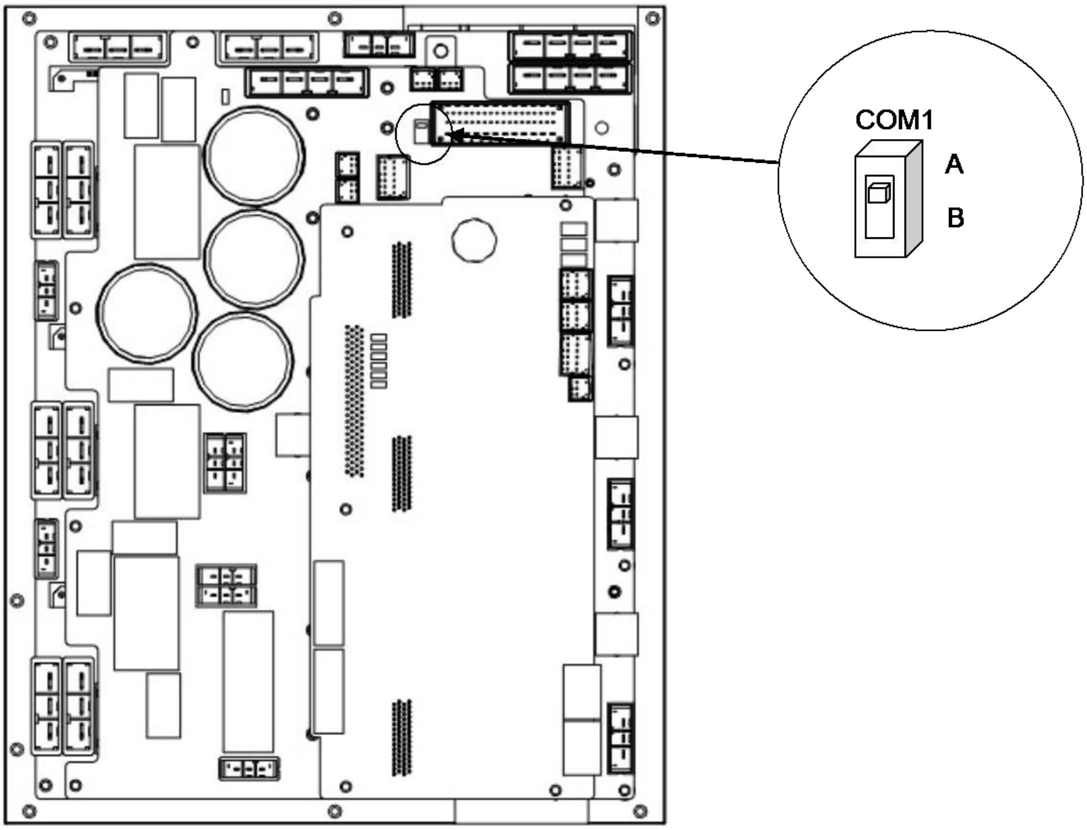


LED	Color	Description
V4	Red	Lights when the DCLINK circuit inside the servo amplifier is charged to reach a specific voltage.
SVALM	Red	Lights when the servo amplifier detects an alarm.
SVEMG	Red	Lights when an emergency stop signal is input to the servo amplifier.
DRDY	Green	Lights when the servo amplifier is ready to drive the servo motor.
OPEN	Green	Lights when the communication between the servo amplifier and the main board is normal.
P5V	Green	Lights when the power supply circuit inside the servo amplifier outputs a voltage of +5 V normally.
P3.3V	Green	Lights when the power supply circuit inside the servo amplifier outputs a voltage of +3.3 V normally.

5.2 SETTING OF 6-AXIS SERVO AMPLIFIER

Table 5.2 6-axis servo settings

Name	Standard setting	Description
COM1	Side A	Robot Digital Input (RI) device common voltage. Side A: +24V common Side B: 0V common



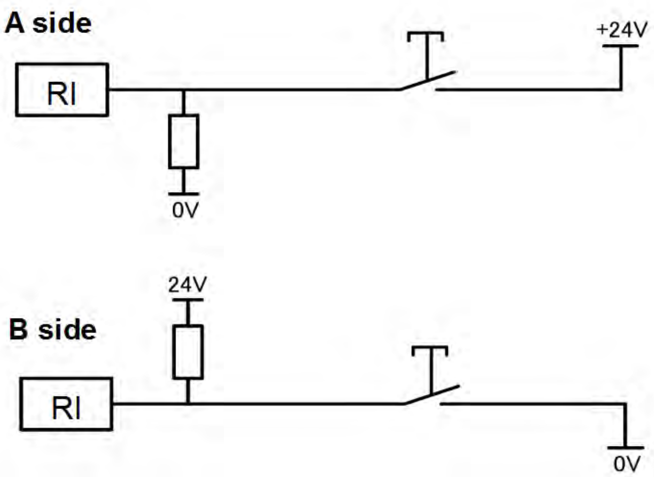


Fig.5.2 Circuit based on jumper pin location or setting of switch

5.3 6-AXIS SERVO AMPLIFIER SPECIFICATIONS

SPECIFICATIONS TABLE：（A06B-6400-H*）**

UNIT		A06B-6400-H102	A06B-6400-H002	A06B-6400-H003
INPUT RATINGS	VOLTAGE	AC200~AC240V (+10% / -15%), 50/60Hz, 3phase		
	POWER CAPACITY	5.1KVA	5.1KVA	2.7KVA
OUTPUT RATINGS	MAXIMUM OUTPUT	240V ~		
	CURRENT：J1	80Ap / 23.0Arms	80Ap / 23.0Arms	40Ap / 13.4Arms
	CURRENT：J2	80Ap / 23.0Arms	80Ap / 23.0Arms	40Ap / 13.4Arms
	CURRENT：J3	80Ap / 23.0Arms	80Ap / 23.0Arms	20Ap / 6.5Arms
	CURRENT：J4	40Ap / 13.4Arms	40Ap / 13.4Arms	20Ap / 6.5Arms
	CURRENT：J5	40Ap / 13.4Arms	40Ap / 13.4Arms	20Ap / 6.5Arms
	CURRENT：J6	40Ap / 13.4Arms	40Ap / 13.4Arms	20Ap / 6.5Arms
	TOTAL CURRENT	70Arms	70Arms	30Arms

UNIT		A06B-6400-H005
INPUT RATINGS	VOLTAGE	AC200~AC240V (+10% / -15%), 50/60Hz, 3/1phase
	POWER CAPACITY	1.3/1.4 (3/1phase)
OUTPUT RATINGS	MAXIMUM OUTPUT	240V ~
	CURRENT：J1	20Ap / 3.6Arms
	CURRENT：J2	20Ap / 3.6Arms
	CURRENT：J3	20Ap / 3.6Arms
	CURRENT：J4	20Ap / 3.6Arms
	CURRENT：J5	10Ap / 2.0Arms
	CURRENT：J6	10Ap / 2.0Arms
	TOTAL CURRENT	18.4Arms

6 SENSOR I/F UNIT FOR CR-4*i*A, CR-7*i*A

Specification of sensor I/F unit: A05B-2650-C200

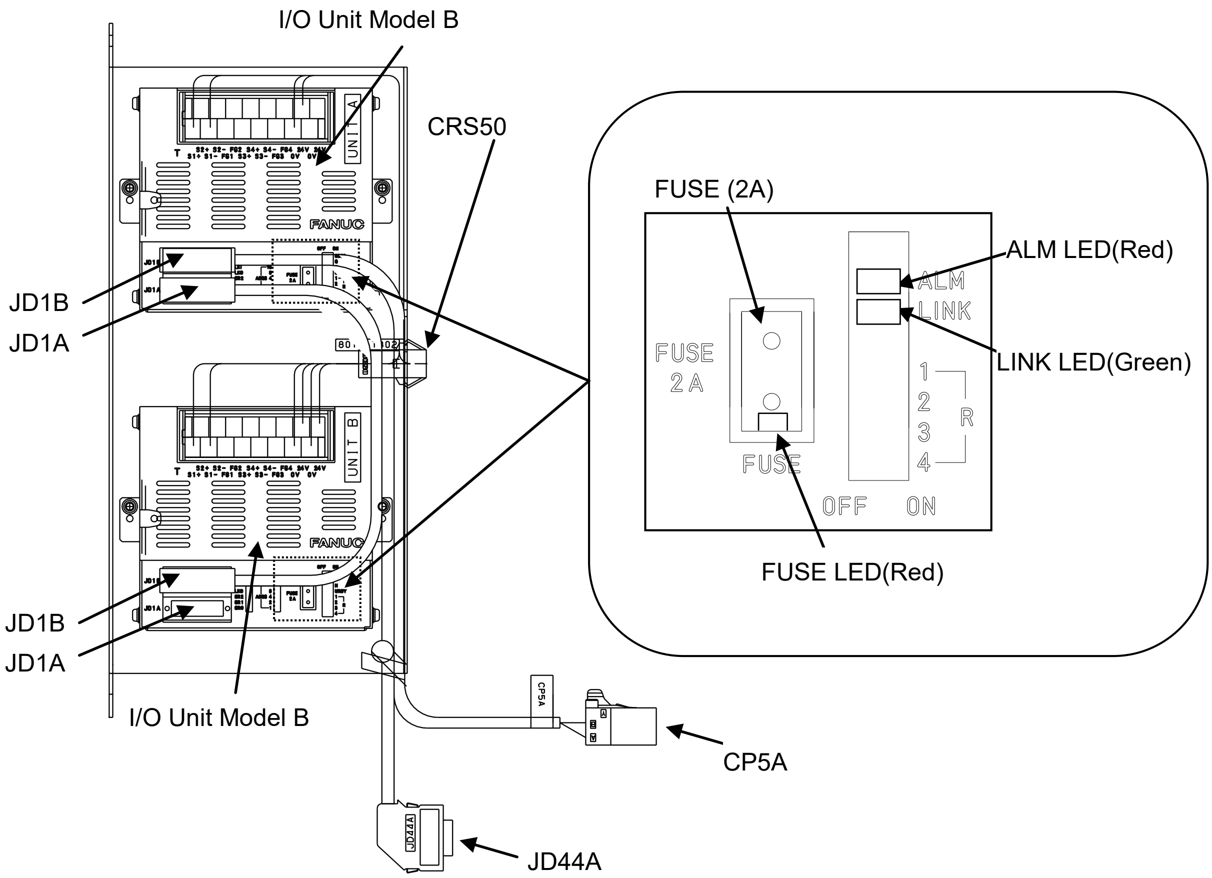
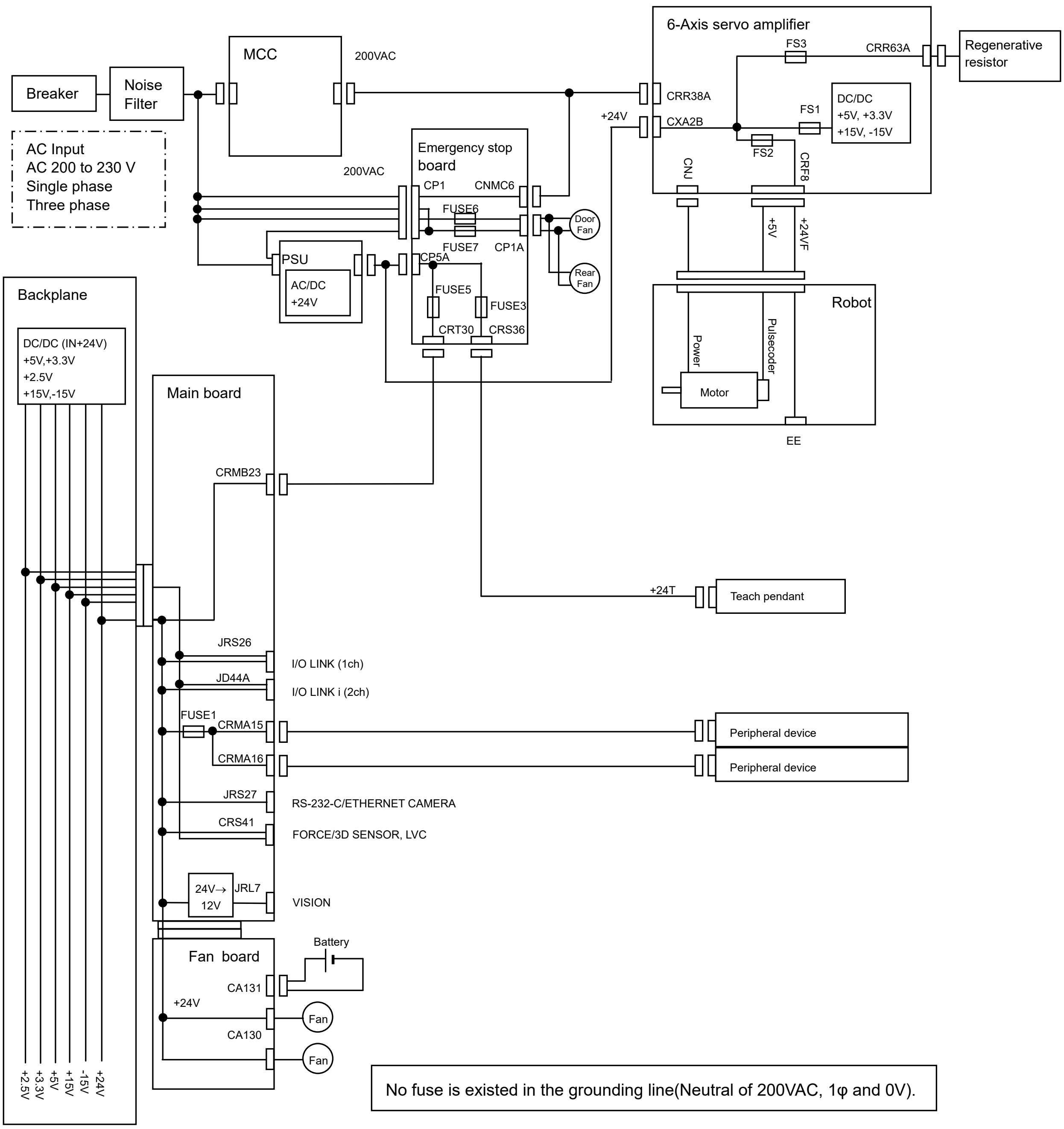


Fig.6 Sensor I/F unit for CR-4*i*A, CR-7*i*A

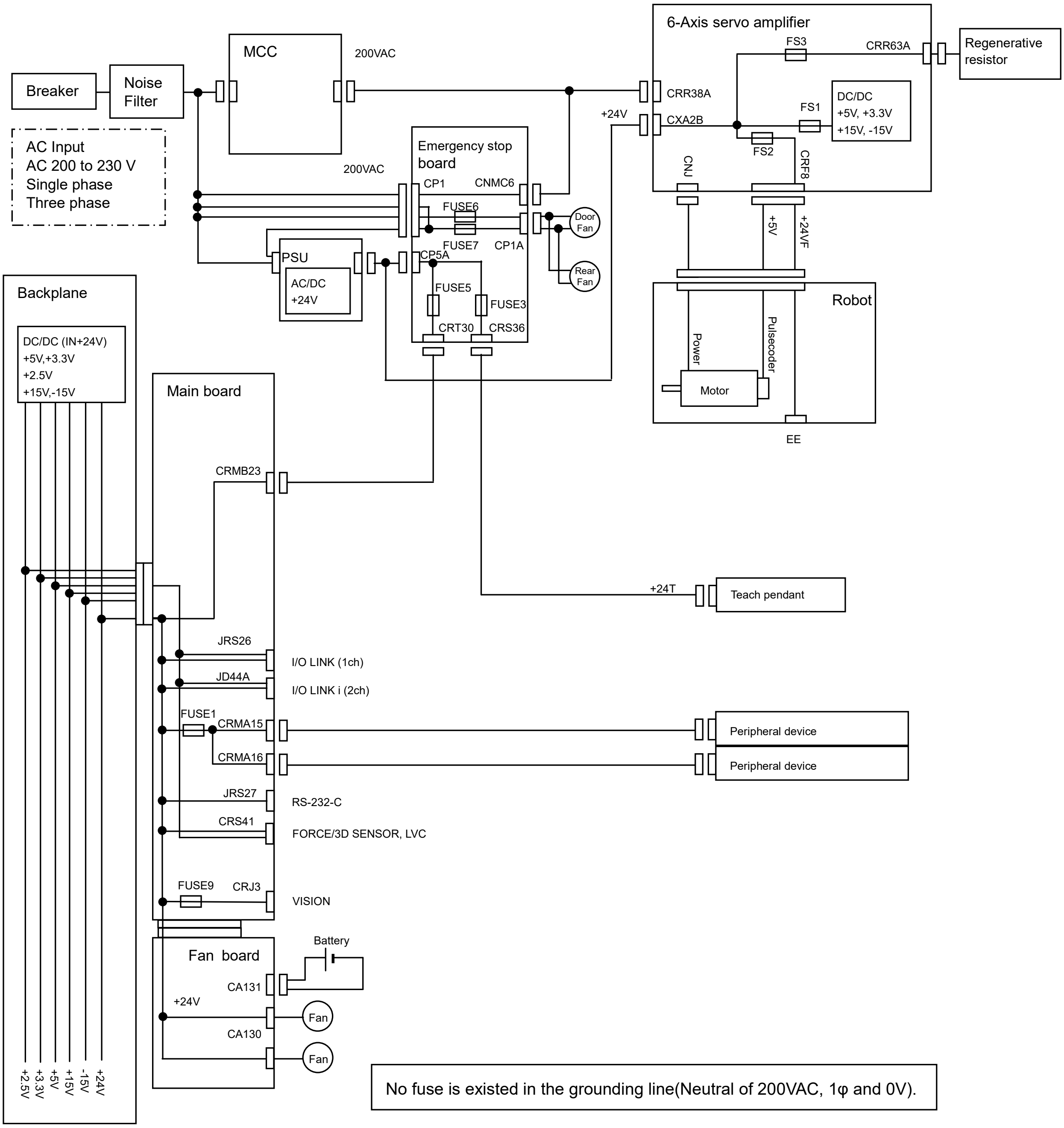
7 POWER SUPPLY

Setting and adjustment of the power supply is factory-set for operation. Usually, you do not need to set or adjust it.

7.1 BLOCK DIAGRAM OF THE POWER SUPPLY



(R-30*i*B Mate)



(R-30*i*B Mate Plus)

Fig.7.1 Block diagram of the power supply

8 REPLACING UNITS

This section explains how to replace each unit in the control section.

> ⚠ **WARNING**
> Before you start to replace a unit, turn off the controller main power. Also keep all machines in the area of the controller switched. Otherwise, you could injure personnel or damage equipment.

> ⚠ **WARNING**
> Before replacing components, read the maintenance manual to understand the replacement procedure. Performing an incorrect replacement procedure can lead to an unpredictable accident, resulting in breakage in the robot or personal injury.

> ⚠ **WARNING**
> When a heavy component or unit is to be handled, support the workers with a crane or the like not to apply excessive loads to the workers. Note that incorrect handling can cause serious injury to the workers.

> ⚠ **CAUTION**
> Components in the controller heat up, so care should be taken. When you have to touch a heated component, prepare a protector such as heat-resistant gloves.

Before attempting to replace units, be sure to read the chapter of "SAFETY PRECAUTIONS" in this manual thoroughly.

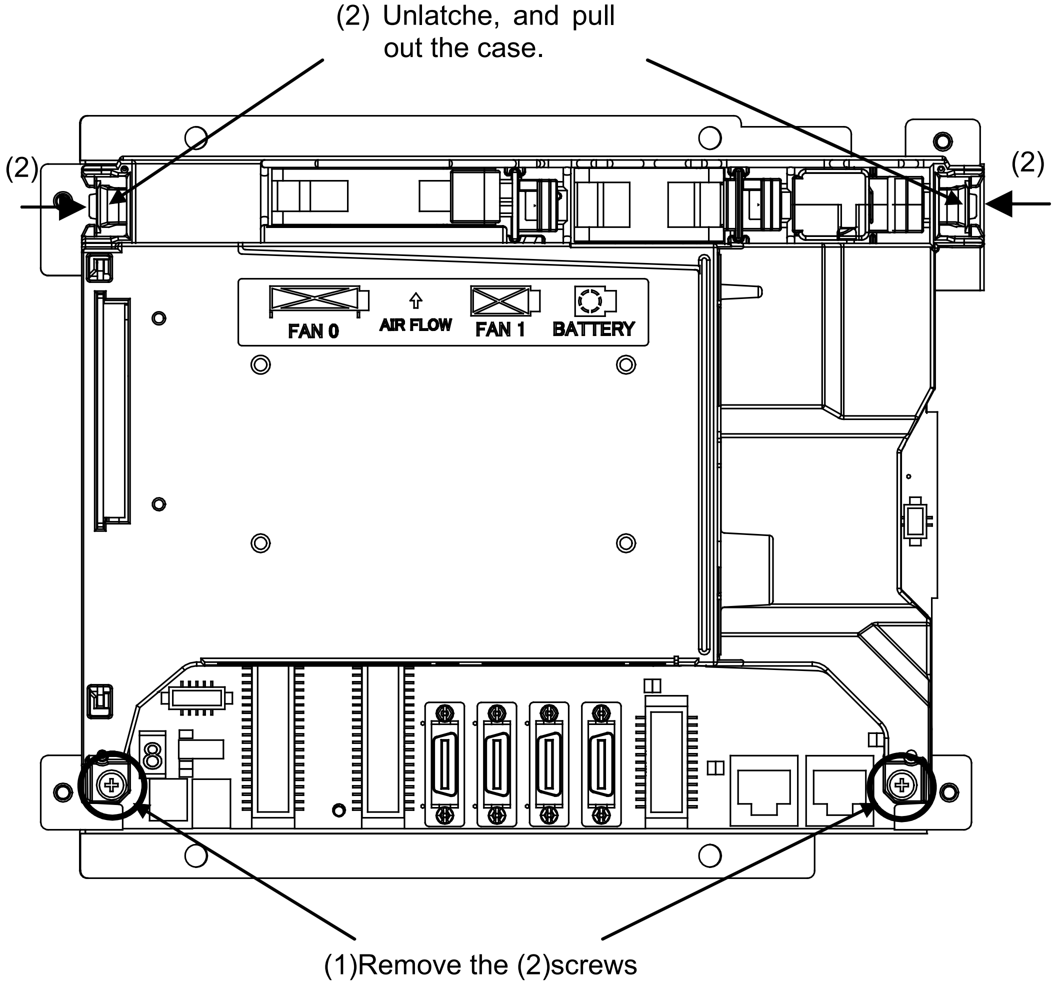
8.1 REPLACING THE PRINTED-CIRCUIT BOARDS

> ⚠ **CAUTION**
> When you replace printed-circuit boards, observe the following cautions:
> 1 Keep the controller power switched off.
> 2 When you remove a printed-circuit board, do not touch the semiconductor devices on the board with your hand or make them touch other components.
> 3 Make sure that the replacement printed-circuit board has been set up appropriately. (Setting plug etc.)
> 4 After replacing a printed-circuit board, make adjustments correctly if the board needs to be adjusted.
> 5 If the backplane board, power supply unit, or main board (including cards and modules) is replaced, it is likely that robot parameters and taught data are lost. Before you start to replace these components, save a backup copy of the robot parameters and taught data to an external memory device.
> 6 Before you disconnect a cable, note its location. If a cable is detached for replacement, reconnect it exactly as before.

8.1.1 Replacing the Backplane Board (Unit)

Replace the backplane board together with the plastic case.

(1) Remove the (2) screws fastening the case. (When cables are connected to option boards, detach the cables.)
(2) Release the latches in the upper part on each side of the case from the base metal plate, and pull out the case. The case can be pulled out with the backplane board, fan, and battery installed in the case.



(3) Replace the backplane unit with a new one.
(4) Confirm that the screw and latch positions of the case are in place, and slowly set the case. When the case is attached, the backplane board installed in the case is connected to the main board with the connectors. When setting the case, check that the connectors are connected properly, and be careful not to apply excessive force.
(5) After confirming that the case is surely latched, tighten the (2) screws of the case. Lightly press the fan and battery, and make sure that the connectors are connected securely. (If the cables of option boards have been detached, connect the cables again.)

⚠ CAUTION

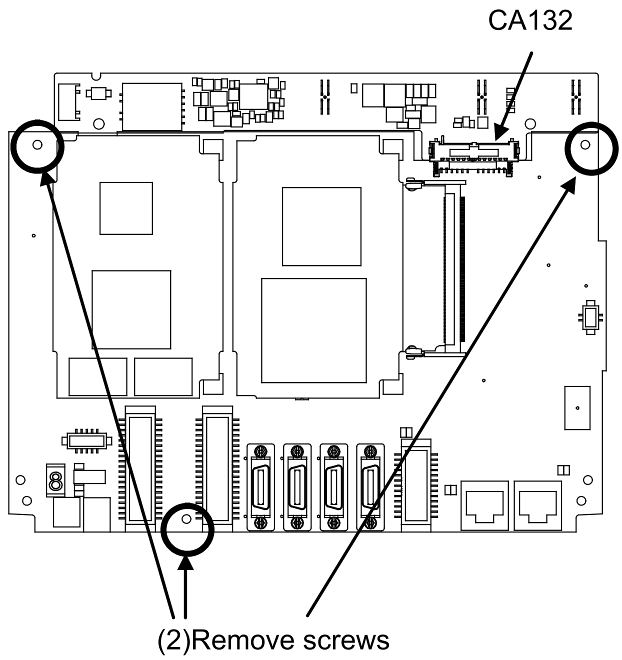
When you remove the backplane unit, be sure that the battery is good (3.1-3.3VDC) and it is installed correctly. USE STATIC PROTECTION.

8.1.2 Replacing the Main Board

The backplane unit incorporates the backplane board, main board, and option boards.

> ⚠ **CAUTION**
> Before starting replacement, turn off the main power of the controller. The main board is equipped with battery-backed memory devices for holding robot parameters and taught data. When the main board is replaced, the memory contents are lost.

(1) Remove the case. (See Subsection 8.1.1.)
(2) Detach cables from the connectors on the main board, and remove the (3) screws fastening the main board. The main board and fan board are connected directly with connector CA132. Detach the main board by sliding the main board downward.



(3) Replace the main board with a new one.
(4) Install the case. (See Subsection 8.1.1.)

8.2 REPLACING CARDS AND MODULES ON THE MAIN BOARD

> ⚠ **CAUTION**
> Before you start to replace a card or module, make a backup copy of robot parameters and programs. If the FROM/SRAM module is replaced, SRAM memory contents are lost.

Demounting a Card

1. Pull up the spacer metal fitting. (Fig. 8.2 (a))
2. Insert a finger into the rear of the card and pull up the card slowly in the arrow direction. (Fig. 8.2 (b)) (Note: At this time, hold the neighborhood of the main board on the opposite side with the other hand whenever possible. A force of 7 to 8 kgf is required for extraction.)

3. When one side of the card board is raised slightly by pulling up, do not fully extract the card board, but push back the card softly.
4. When the card board is pushed back to be parallel with the main board, pinch two sides of the card board and pull up the card board. This completes the extraction of the card board.

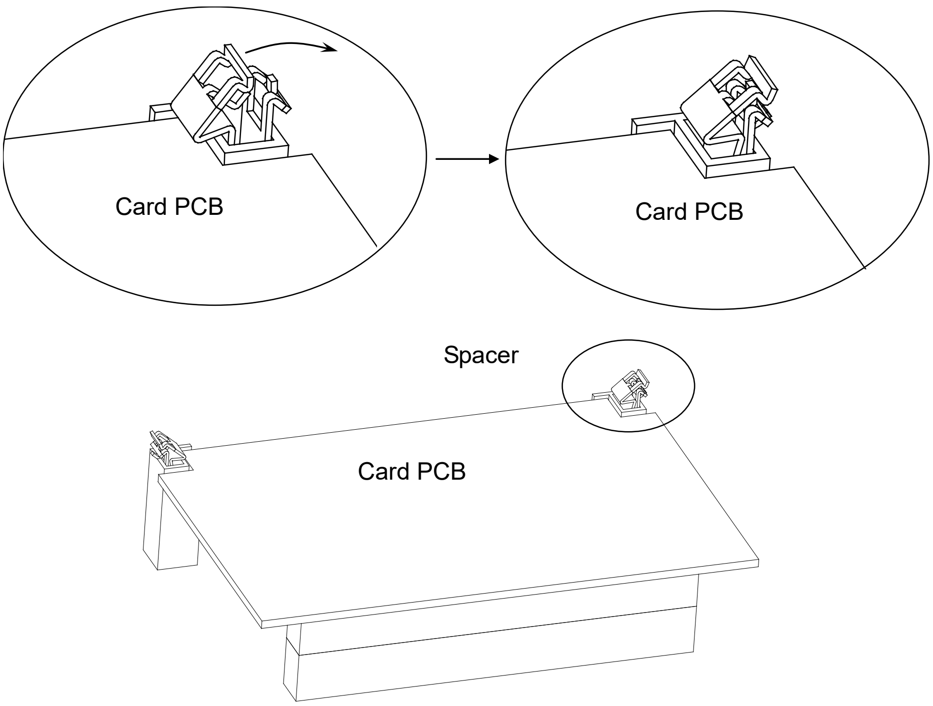


Fig.8.2 (a) Demounting a card

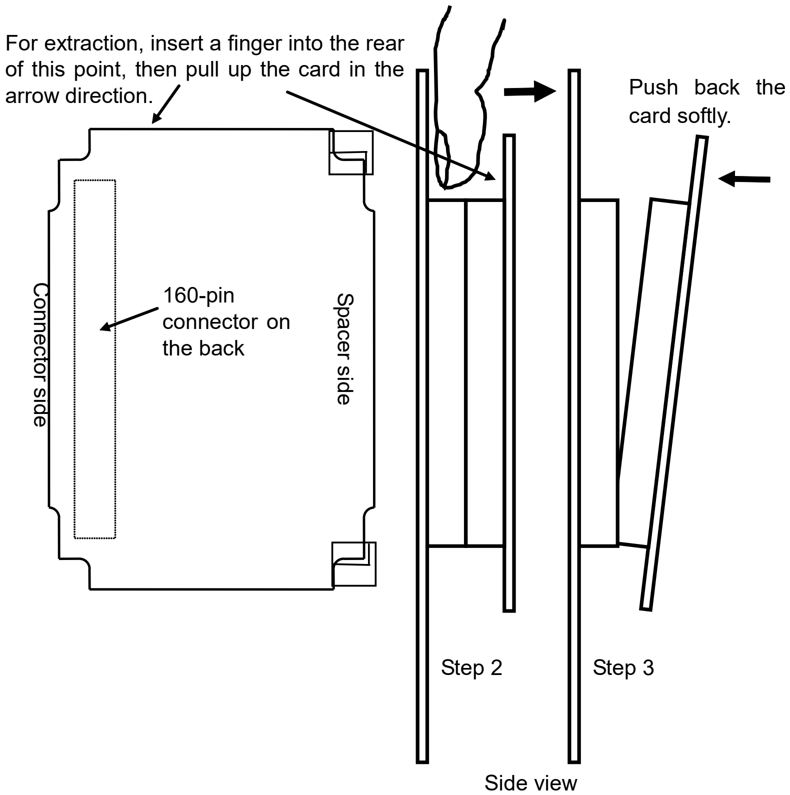


Fig.8.2 (b) Demounting a card

Mounting a Card

1. Check that the metal fittings of the spacers are raised. (Fig.8.2 (c))
2. To align the board insertion position, touch the spacer end faces of the board with the spacer. (Fig. 8.2 (d)) (At this time, the board is touching the spacers only.)
3. While aligning the board with the spacers, lower the connector side slowly until the connectors touch each other. (Fig.8.2 (d)) (do not press until aligned.)
4. The mating position can be determined more easily by moving the card back and forth until the alignment “nubs” and “holes” are aligned on the connectors. The board must be turned to view the board connectors on the side. (Fig.8.2 (d))
5. At this time, push on the back of the board over the connector. The force required for connector insertion is about 10 kgf. If the connector will not insert easily, re-check the alignment of the connector to prevent damaging the connector(s). If installing a standard CPU CARD, do not press on the heat sink installed on the CPU and LSI chip. Otherwise, the CPU or LSI chip can be damaged. (Fig.8.2 (e))
6. Push in the spacer metal fitting to lock the board in place. (Fig.8.2 (f))

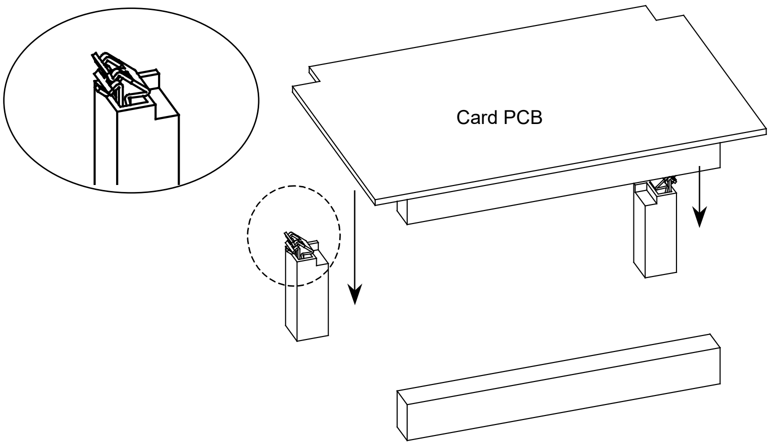


Fig.8.2 (c) Mounting a card

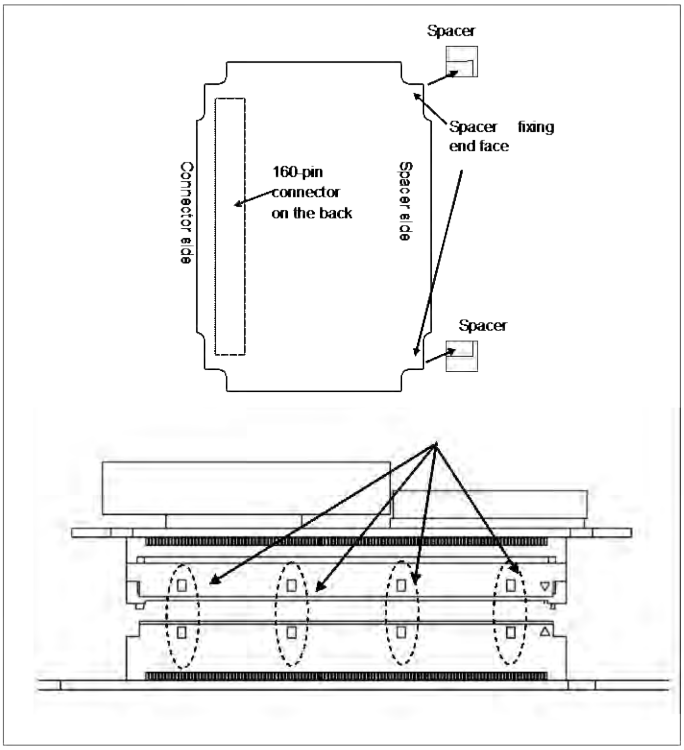


Fig.8.2 (d) Mounting a card

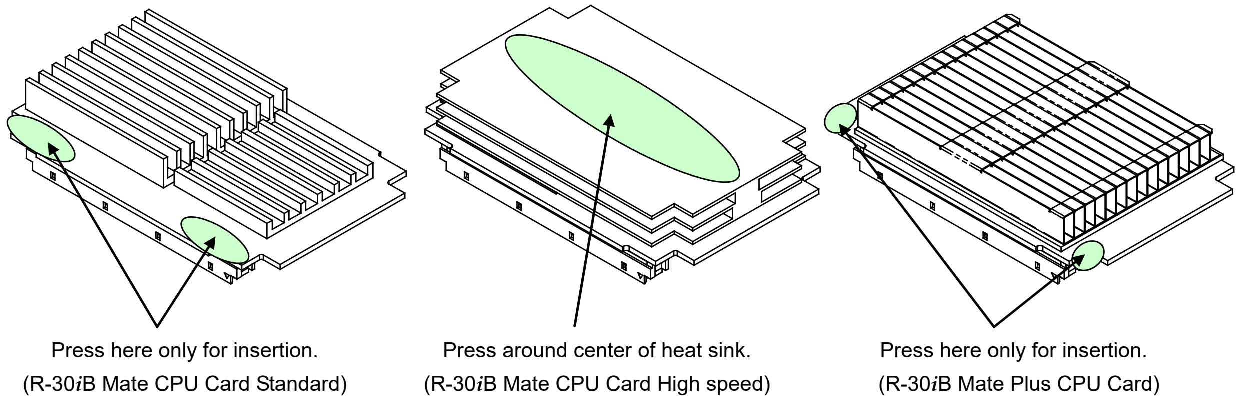


Fig.8.2 (e) Mounting a card

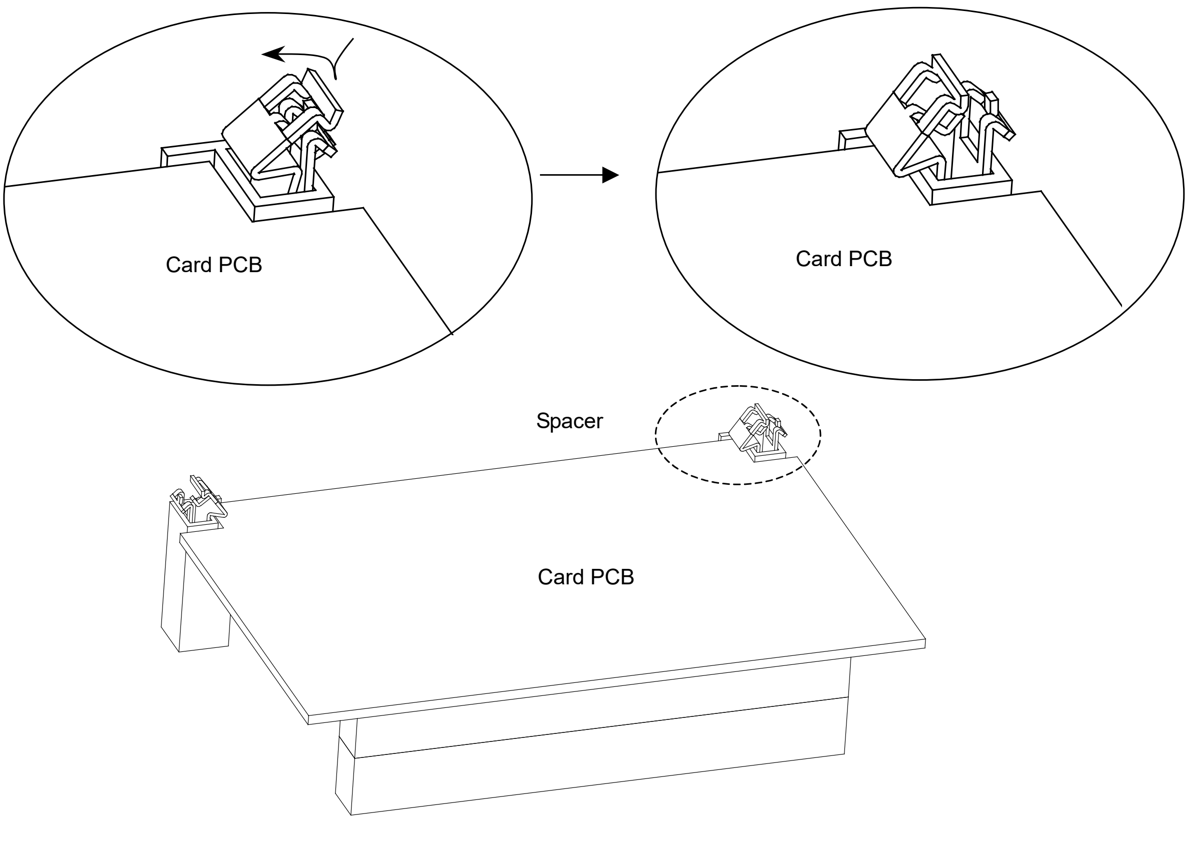


Fig.8.2 (f) Mounting a card

Demounting a module

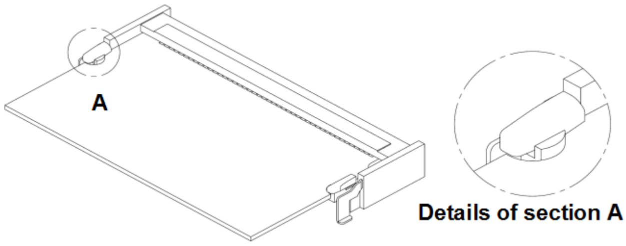
> ⚠ **CAUTION**
> When replacing the module, be careful not to touch the module edge connector. If you touch the edge connector inadvertently, wipe any dirt off of the contact with a clean cloth.

(1) Move the clip of the socket outward. (a)
(2) Extract the module by raising it at a 30 degree slant and pulling outward.

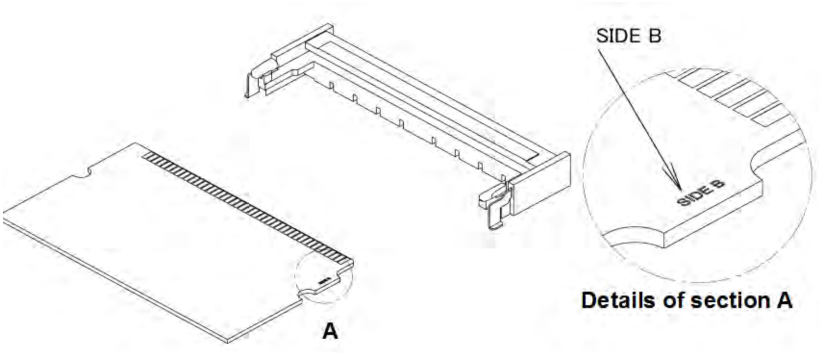
Mounting a module

(1) Insert the module at a 30 degree slant into the module socket, with side B facing upward. (b)
(2) Push the module inward and downward until it is locked. (c)

(a)



(b)



(c)

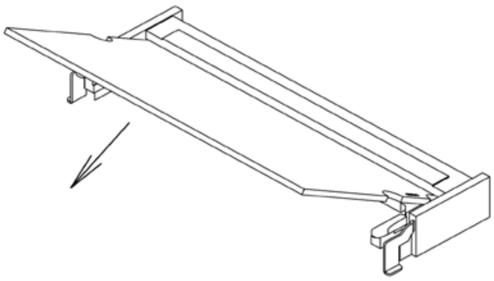


Fig.8.2 (g) Demounting/mounting a module

Figure 8.2 (h) shows the locations of the cards and modules.

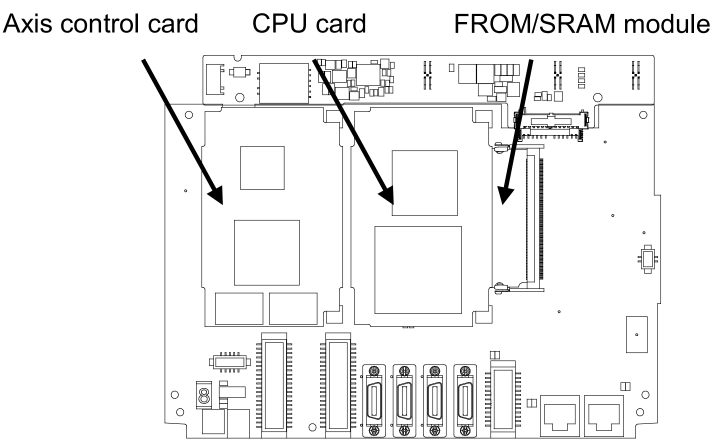
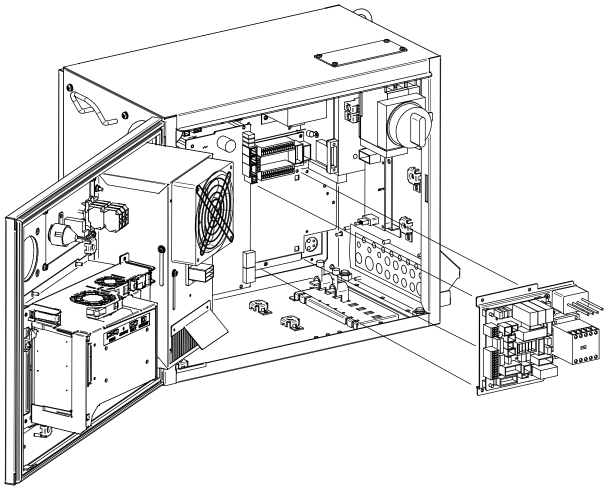


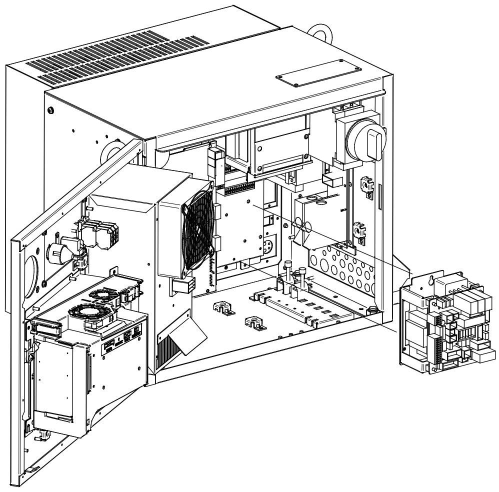
Fig.8.2 (h) Locations of cards and modules

8.3 REPLACING THE EMERGENCY STOP UNIT

(1) Detach the cables from the emergency stop unit.
(2) Remove (4(small size), 2(middle/large size)) screws, and replace the emergency stop unit.
(3) Reconnect the cables.



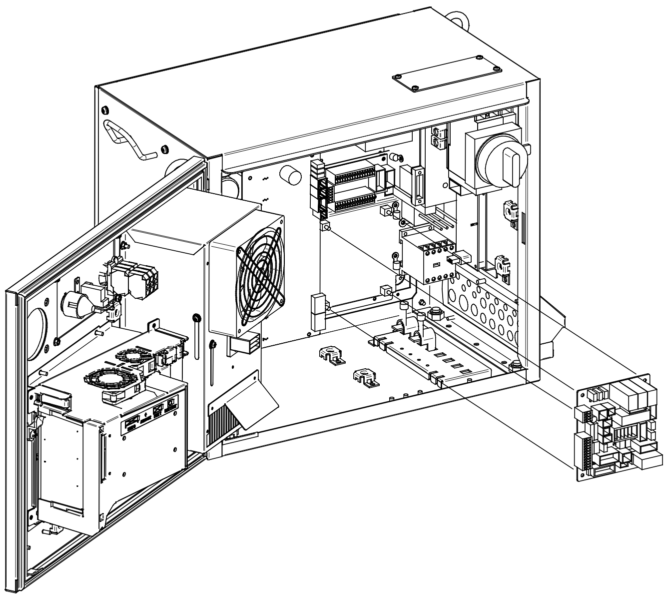
(Small size)



(Middle/Large size)

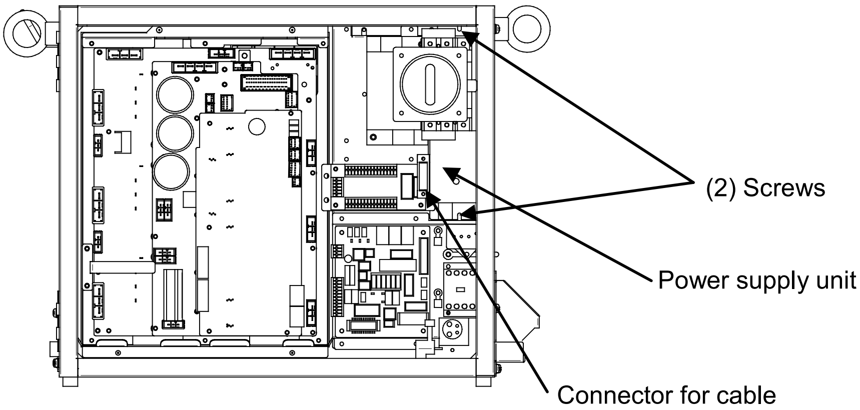
8.4 REPLACING THE EMERGENCY STOP BOARD

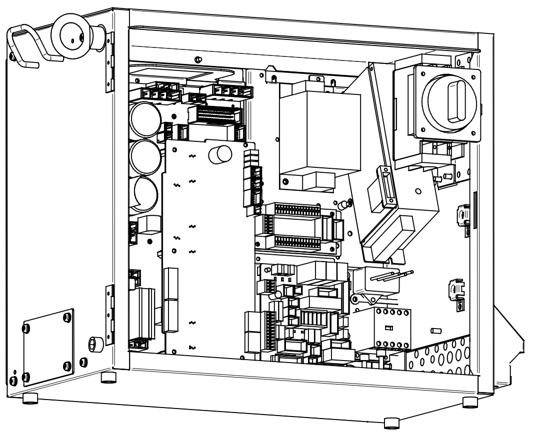
(1) Detach the cables from the emergency stop board unit.
(2) Unlock the nylon latches (4 places) holding the board, and replace the board.
(3) Reconnect the cables.

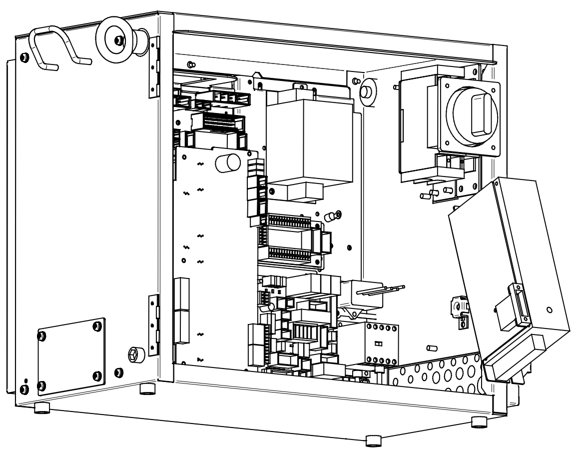


8.5 REPLACING THE POWER SUPPLY UNIT

(1) Detach the cable from the power supply unit.
(2) Remove the (2) screws, and remove the power supply unit.
(3) Install a replacement power supply unit by reversing above steps.



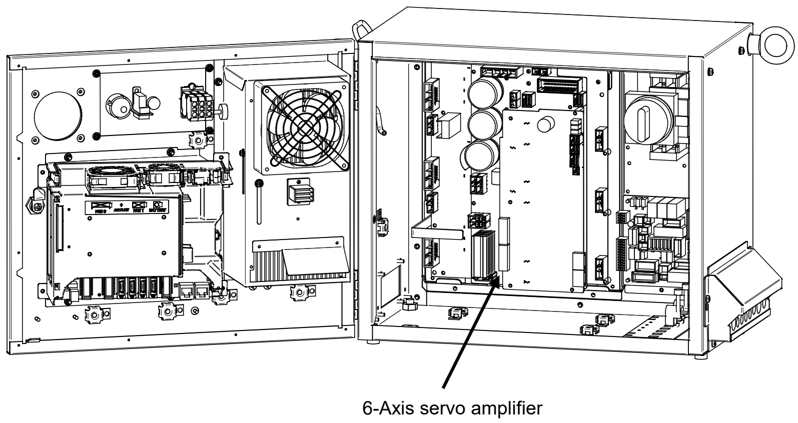


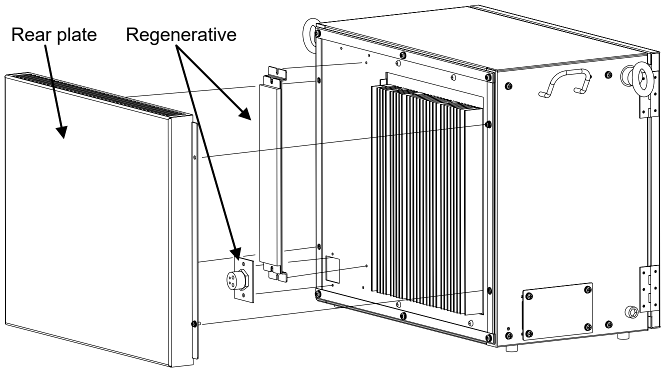


8.6 REPLACING THE REGENERATIVE RESISTOR UNIT

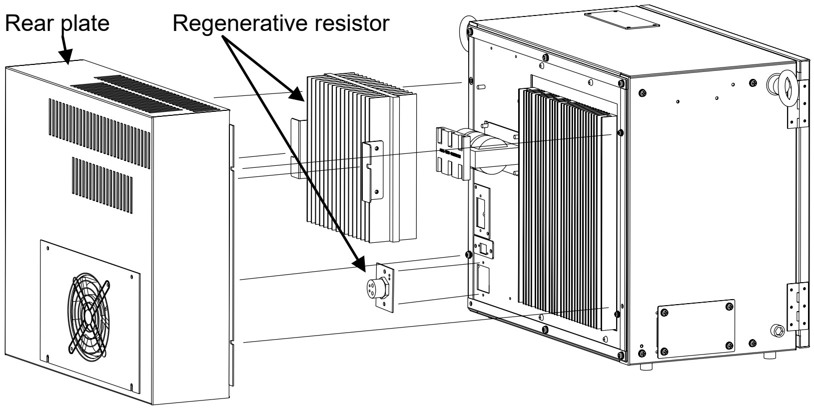
> ⚠ **CAUTION**
> Before you start, turn off the controller main power. Be careful not to get burned, because the regenerative resistor unit is very hot immediately after operation.

(1) Remove the (4) screws fastening the rear plate of the cabinet, and remove the rear plate.
(2) Unplug connector CRR63 and CRR11 at the 6-Axis servo amplifier.
(3) Remove the (4) screws on the regenerative resistor unit and remove it.
(4) Install the replacement unit by reversing above steps.





(Small size)



(Middle/Large size)

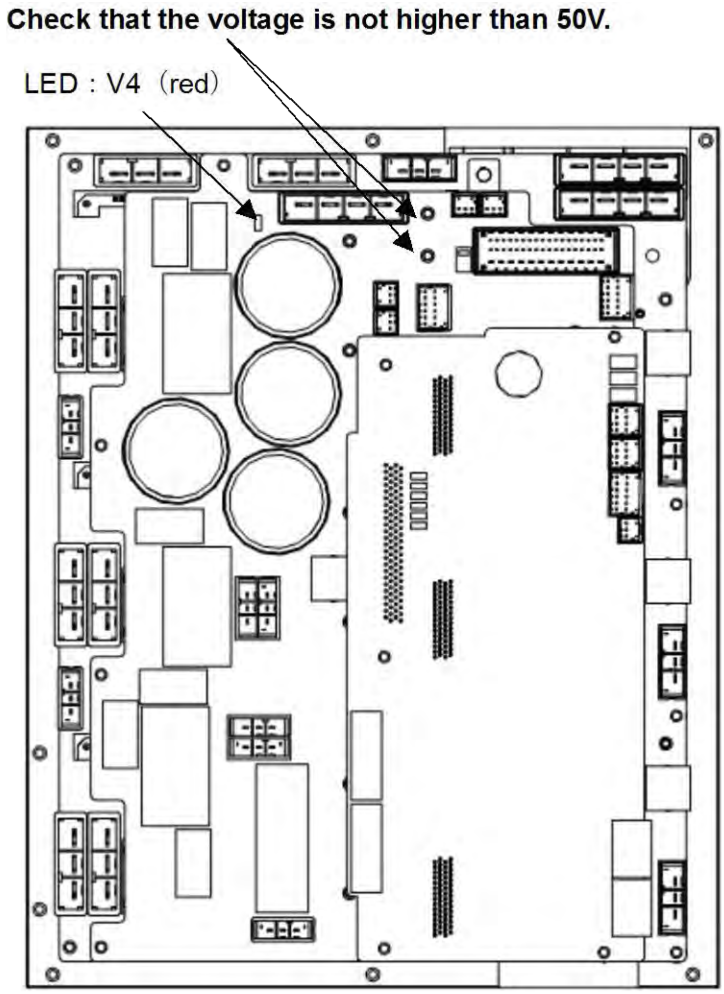
Fig. 8.6 Regenerative resister

8.7 REPLACING THE 6-AXIS SERVO AMPLIFIER

> ⚠ **WARNING**
> Before touching the 6-Axis servo amplifier, for example, for maintenance purposes, check the voltage at the screw above the LED “V4” with a DC voltage tester to see if the remaining voltage is not higher than 50V.

> ⚠ **CAUTION**
> Because the 6-Axis servo amplifier is heated immediately after operation, leave the 6-Axis servo amplifier until it cools down thoroughly, before replacing it.

(1) Check the voltage at the screw above the LED "V4" with a DC voltage tester to see if the remaining voltage is not higher than 50V.



(2) Detach the cables from the 6-Axis servo amplifier.
(3) Remove (2) screws fastening the 6-Axis servo amplifier.

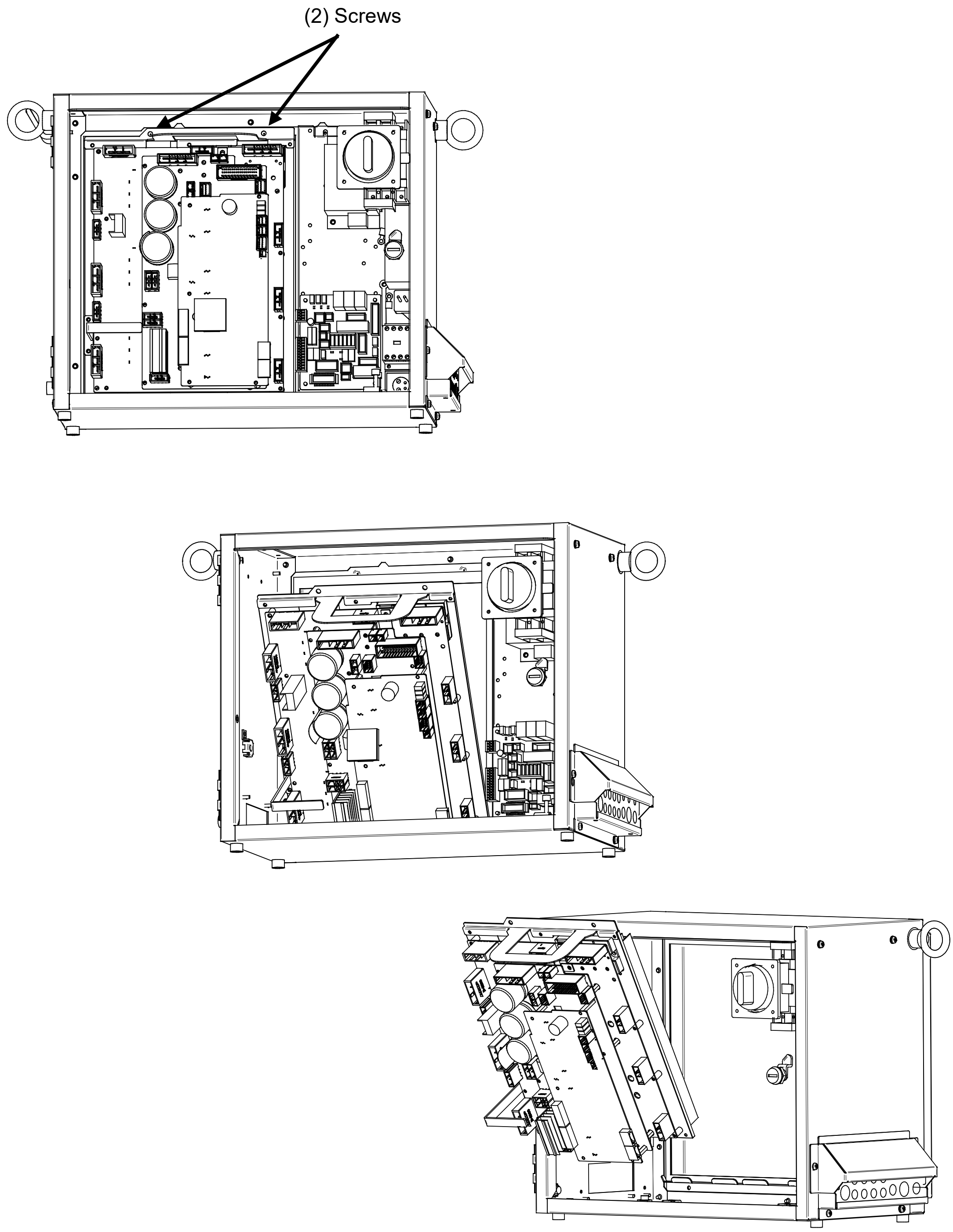


Fig.8.7 Replacing the servo amplifier

(4) Hold the handle at the upper side of the amplifier and remove 6-Axis servo amplifier.
(5) Install a replacement amplifier by reversing above procedure.

> ⚠ **CAUTION**
> If the controller is not fixed on the floor, the controller falls down when the 6-Axis servo amplifier is removed.

8.8 REPLACING THE TEACH PENDANT

The specifications of the teach pendant vary with its use. When you replace the teach pendant, check its specifications carefully.

(1) Be sure that the power of a robot controller is off.
(2) Detach the cable from the teach pendant.
(3) Replace the teach pendant.

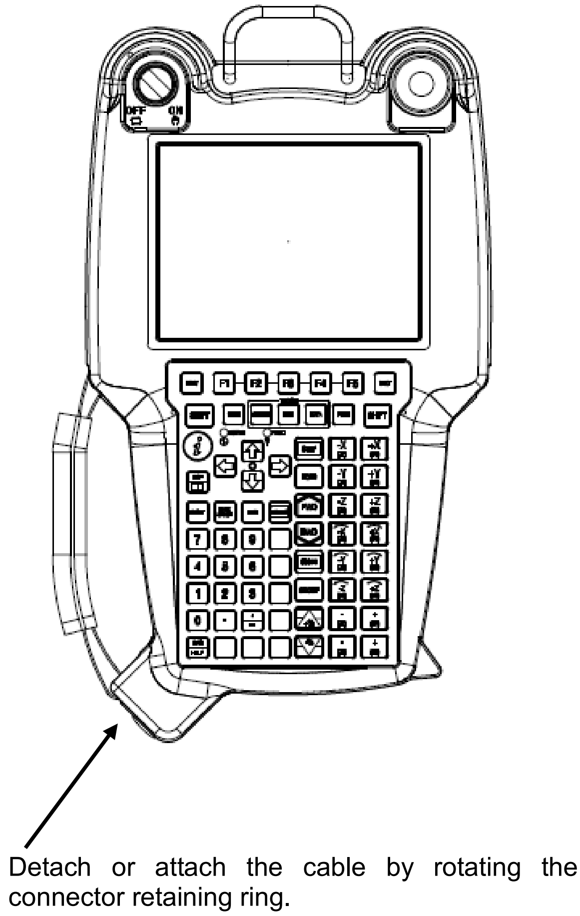
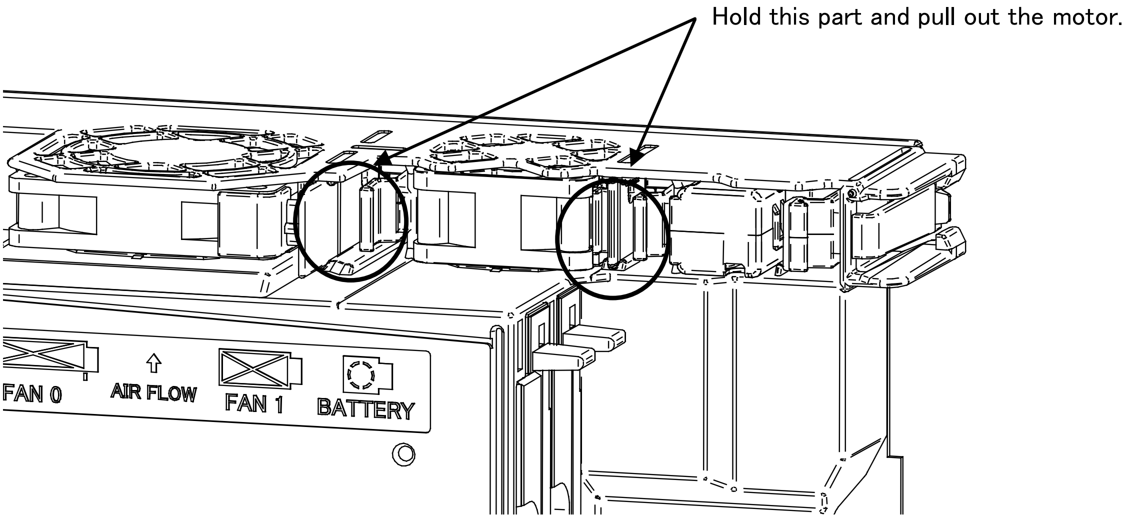


Fig.8.8 Replacing the teach pendant

8.9 REPLACING THE CONTROL SECTION FAN MOTOR

The control section fan motor can be replaced without using a tool. The fan motor is mounted on the backplane unit.

(1) Be sure that the power to the robot controller is turned off.
(2) Pull out the fan motor to be replaced. (When pulling out the fan motor, hold the latch of the fan unit, and unlatch the unit from the case.)



(3) Install a new fan unit. (Insert the unit until the latch of the unit snaps into the case.)

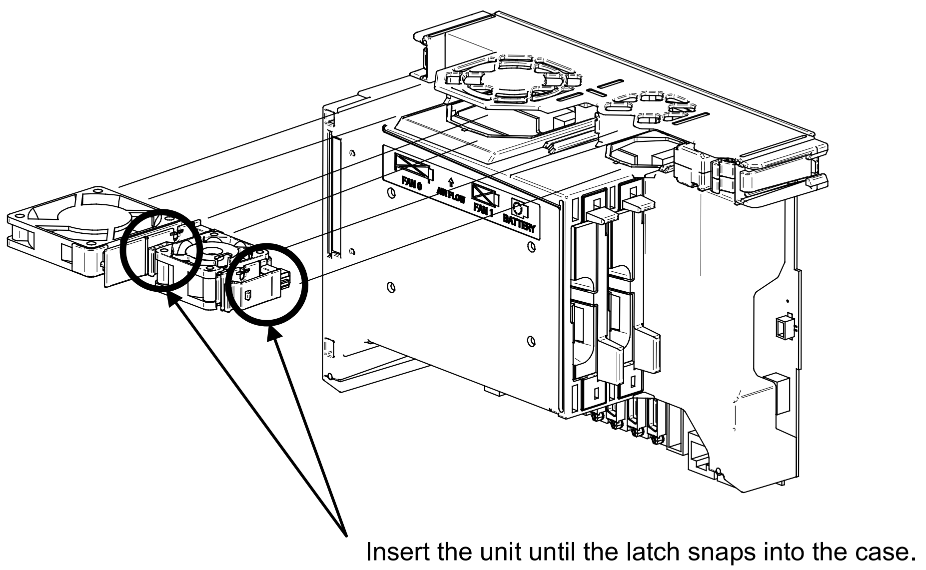


Fig.8.9 Replacing the control section fan motor

8.10 REPLACING THE AC FAN MOTOR

> ⚠ **CAUTION**
> Do not touch the fan motor when it is rotating, or you could be injured.

8.10.1 Replacing the Heat Exchanger and Door Fan Unit

The heat exchanger is inside its door. To replace the heat exchanger, it is necessary to remove the door fan unit in advance.

Door fan unit

(1) Remove (4) M4 screws.
(2) Disconnect the connector at the FAN.
(3) Mount the replacement fan unit by reversing above procedure. Be careful not to let the cable get caught in the fan.

Heat exchanger

(1) Dismount the door fan unit. (See the above procedure.)
(2) Open the cabinet door, and detach cables.
(3) Remove retaining (4) M5 nuts, and dismount the unit.
(4) Mount the replacement unit by reversing above procedure.

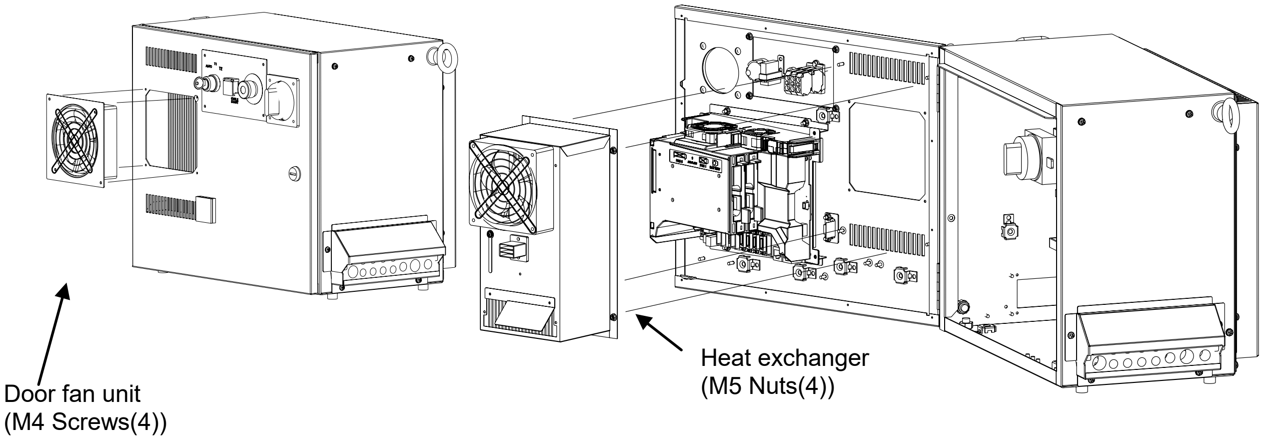


Fig.8.10.1(a) Replacing the heat exchanger and door fan unit

Rear fan unit

(1) Remove (4) M4 screws.
(2) Dismount the rear fan unit and disconnect the connector.
(3) Mount the replacement fan unit by reversing above procedure. Be careful not to let the cable get caught in the fan.

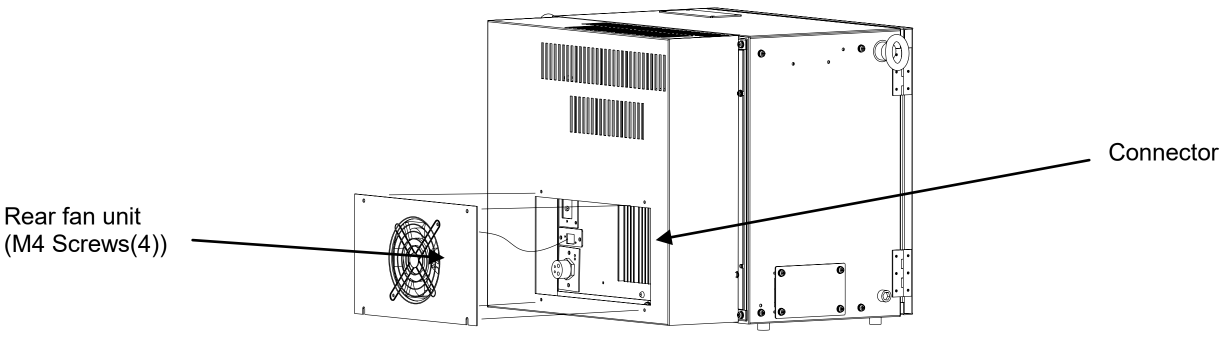


Fig.8.10.1(b) Replacing the rear fan unit

8.11 REPLACING THE BATTERY

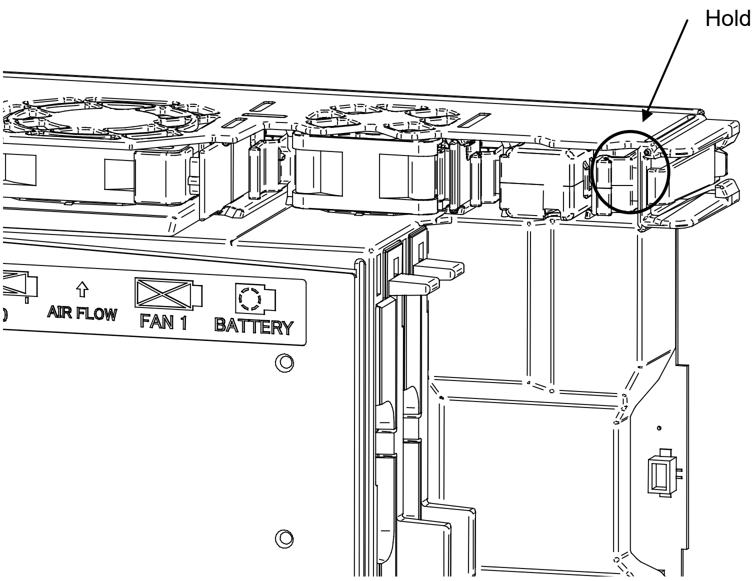
8.11.1 Battery for Memory Backup (3 VDC)

The programs and system variables are stored in the SRAM in the main board. The power to the SRAM memory is backed up by a lithium battery mounted on the front panel of the main board. The above data is not lost even when the main power of controller is turned off. A new battery can maintain the contents of memory for about 4 years (Note).
When the voltage of the battery becomes low, the low-voltage battery alarm (system-035) is displayed on the teach pendant. When this alarm is displayed, replace the battery as soon as possible. In general, the battery can be replaced within one or two weeks, however, this depends on the system configuration.
If the battery voltage gets lower, it becomes impossible to back up the content of the SRAM. Cycling power to the controller in this state causes the system not to start, and the seven segment LED located on the main board displays “1” because the contents of memory have been lost. Clear the entire SRAM memory and reenter data after replacing the battery. Important data should be saved to the memory card or other external device beforehand in case of emergency.

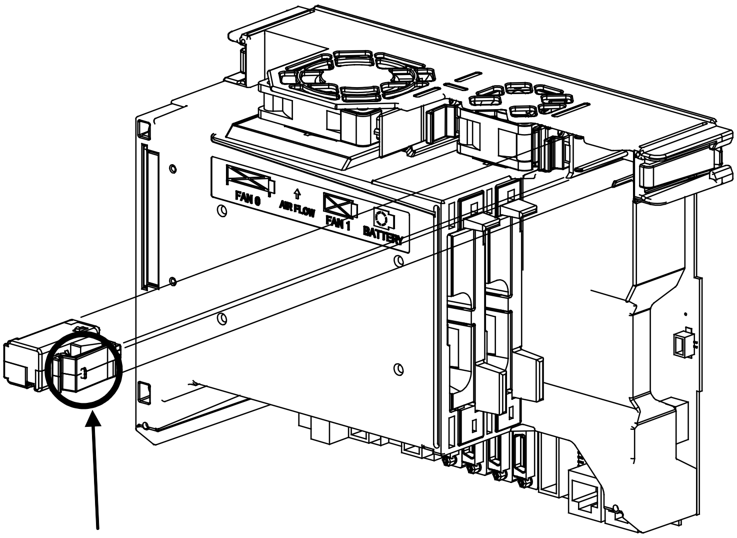
> ⚠**CAUTION**
> In a newly introduced robot, the battery is factory-installed. Battery replacement may, therefore, be needed within 4 years after the introduction of the robot.

Replacing the lithium battery

(1) Prepare a new lithium battery (ordering drawing number: A05B-2650-K030, A98L-0031-0028).
(2) Turn the robot controller on for about 30 seconds.
(3) Turn the robot controller off.
(4) Pull out the battery unit located in the lower right part of the backplane unit. (Hold the latch of the battery unit, unlatch the battery unit from the case, and pull out the unit.).



(5) Install a new battery unit. (Insert the battery unit until the latch of the unit snaps into the case.) Check that the battery unit is latched securely.



Insert the unit until the latch snaps into the case

> ⚠ **CAUTION**
> Execute steps (3) to (5) within 30 minutes.
> Note that keeping the control unit unconnected to a battery for a long period of time may result in the memory contents being lost.
> For a rainy day, you should make a backup copy of the robot programs and system variables before replacing the battery.

> ⚠ **WARNING**
> Using other than the recommended battery may result in the battery explosion.
> Replace the battery only with the specified battery (A05B-2650-K030, A98L-0031-0028).

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.

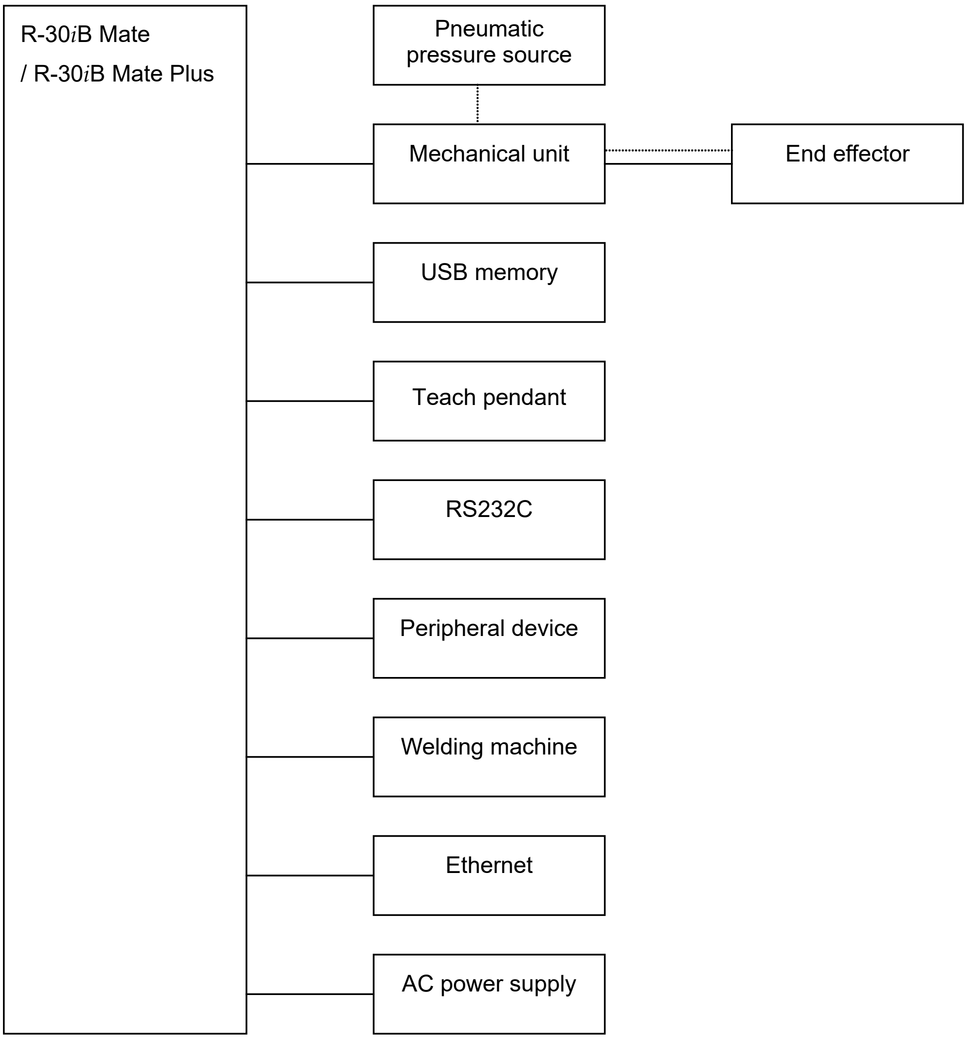
II. CONNECTIONS

1 OVERVIEW

This section describes the electrical interface connections in the R-30*i*B Mate/ R-30*i*B Mate Plus. It also includes information about installation of the R-30*i*B Mate/ R-30*i*B Mate Plus.

2 BLOCK DIAGRAM

Fig.2 is a block diagram of electrical interface connections with the R-30*i*B Mate/ R-30*i*B Mate Plus.



NOTE

——— : Indicates electrical connection.
-------- : Indicates mechanical connection.

Fig.2 Block diagram of electrical interface connection

3 ELECTRICAL CONNECTIONS

3.1 CONNECTION DIAGRAM BETWEEN MECHANICAL UNITS

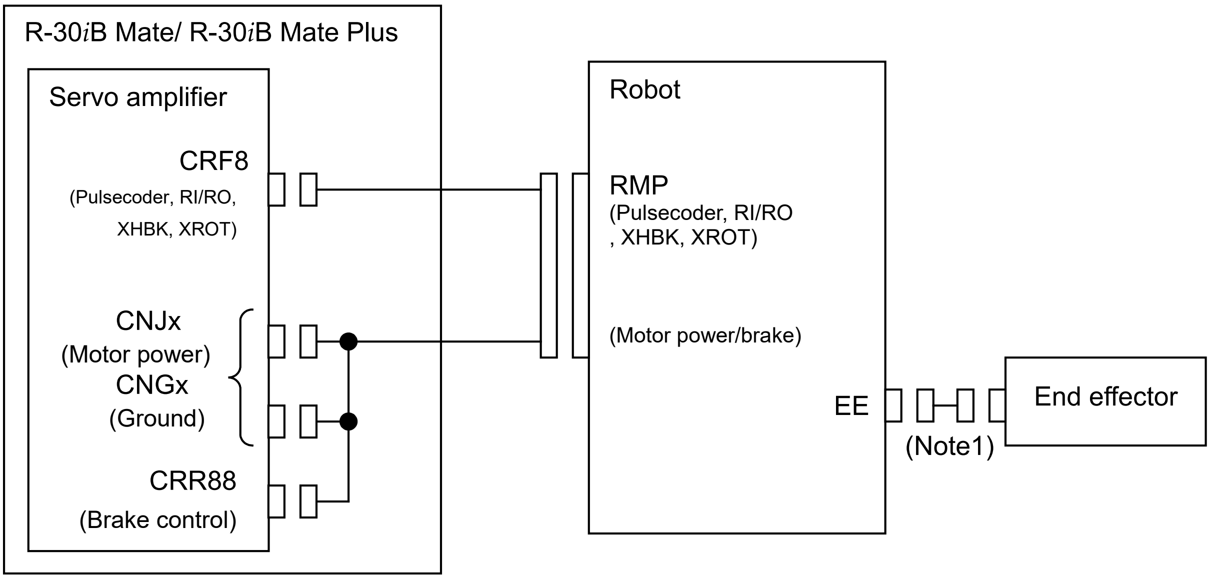
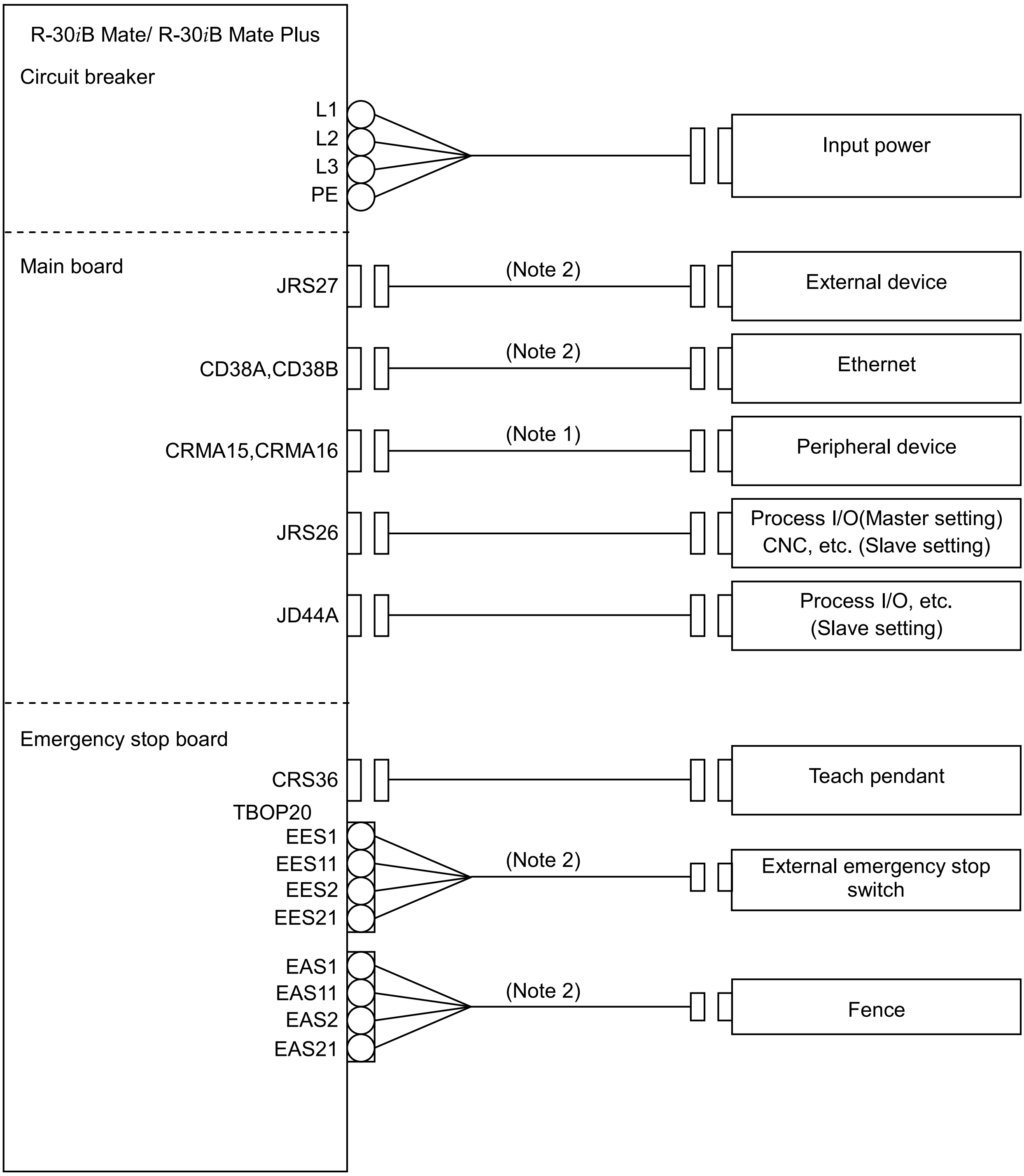


Fig.3.1 (a) Mechanical connection diagram

NOTE
1 This cable is not included. It must be supplied by the customer.



NOTE

1. For detail of the peripheral device connection, see the section 4.3 of Peripheral device interface.
2. This cable is not included. It must be supplied by the customer.

Fig.3.1 (b) Unit-to-unit connection diagram

3.2 CONNECTION TO FANUC I/O Link and FANUC I/O Link *i*

3.2.1 Connection of I/O Link and I/O Link *i* by Using JRS26 Connector

The connection of I/O link and I/O Link ***i*** by using JRS26 connector is shown below.

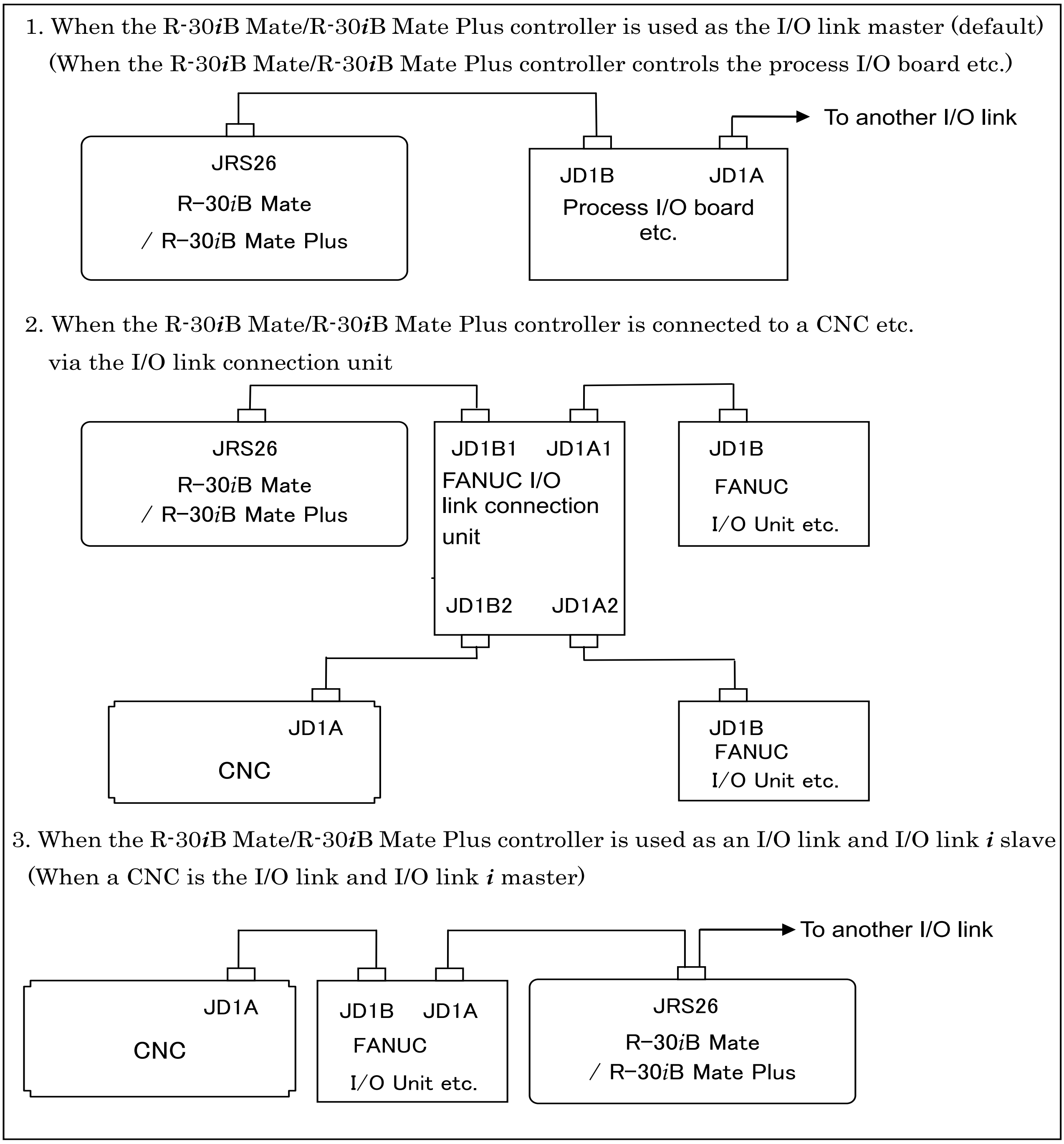


Fig.3.2.1 Connection of I/O link and I/O Link *i* by using JRS26 connector

3.2.1.1 Connection of the I/O Link cable by using JRS26 connector

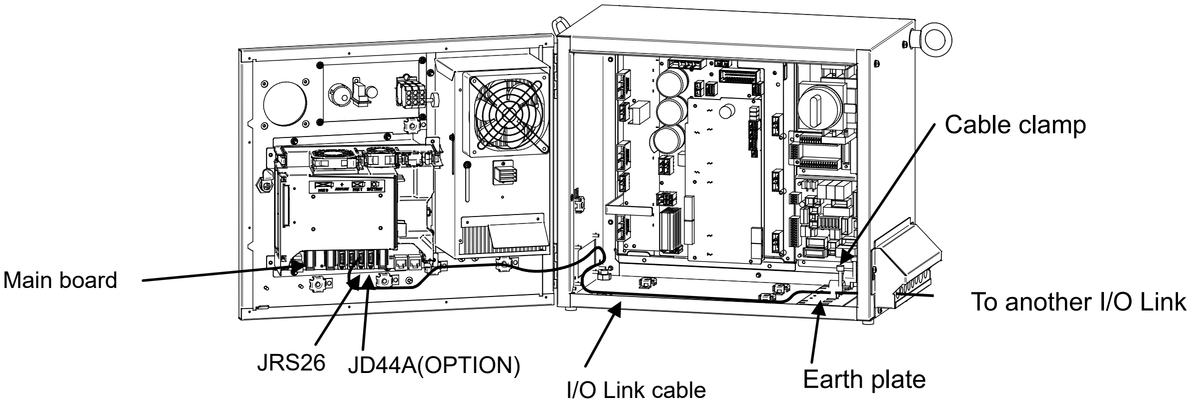


Fig.3.2.1.1 Path of the I/O link cable by using JRS26 connector

1. Connect the cable according to the system. Be sure to perform shielding.
   Shield the cable collectively and ground the shield on the CNC side.

2. Before connection turn off the power.

> **NOTE**
> For connection with the CNC with I/O Link and I/O Link *i*, turn on or off the power of the CNC and the robot controller at the following timing.
> a) Slave units and the master must be powered on or off at the same time.
> b) If the CNC or robot controller is powered off after startup of the system, I/O Link and I/O Link *i* error occur. To successfully make connection with I/O Link and I/O Link *i* again, power off all of the units and then power them on at the timing indicated in a).

When used as master interface
JRS26
interface

11	0V	01	RXSLC1
12	0V	02	XRXSLC1
13	0V	03	TXSLC1
14	0V	04	XTXSLC1
15	0V	05	RXSLC2
16	0V	06	XRXSLC2
17		07	TXSLC2
18	(+5V)	08	XTXSLC2
19	(24V)	09	(+5V)
20	(+5V)	10	(24V)

Master interface (pins 01–04)

Note: +5V is connected when the optical I/O link adapter is used.

When used as slave interface
JRS26
Interface
Refer to item 3 of Fig. 3.2.1

11	0V	01	RXSLC1
12	0V	02	XRXSLC1
13	0V	03	TXSLC1
14	0V	04	XTXSLC1
15	0V	05	RXSLC2
16	0V	06	XRXSLC2
17		07	TXSLC2
18	(+5V)	08	XTXSLC2
19	(24V)	09	(+5V)
20	(+5V)	10	(24V)

From Master controller (pins 01–04)
To the next I/O link device (pins 05–08)

Note: +5V is connected when the optical I/O link adapter is used.

3. When the R-30*i*B Mate/ R-30*i*B Mate Plus controller is connected to CNC or preceding I/O link *i* slave unit, use a twisted-pair cable in which wires RXSLC1 (Pin No.1 of JRS26) and XRXSLC1 (Pin No.2 of JRS26) are paired and wires TXSLC1 (Pin No.3 of JRS26) and XTXSLC1 (Pin No.4 of JRS26) are paired.

4. When the R-30*i*B Mate/ R-30*i*B Mate Plus controller is connected to next I/O link ***i*** slave unit, use a twisted-pair cable in which wires RXSLC2 (Pin No.5 of JRS26) and XRXSLC2 (Pin No.6 of JRS26) are paired and wires TXSLC2 (Pin No.7 of JRS26) and XTXSLC2 (Pin No.8 of JRS26) are paired.

3.2.1.2 Cable connection diagram of the I/O Link cable by using JRS26 connector

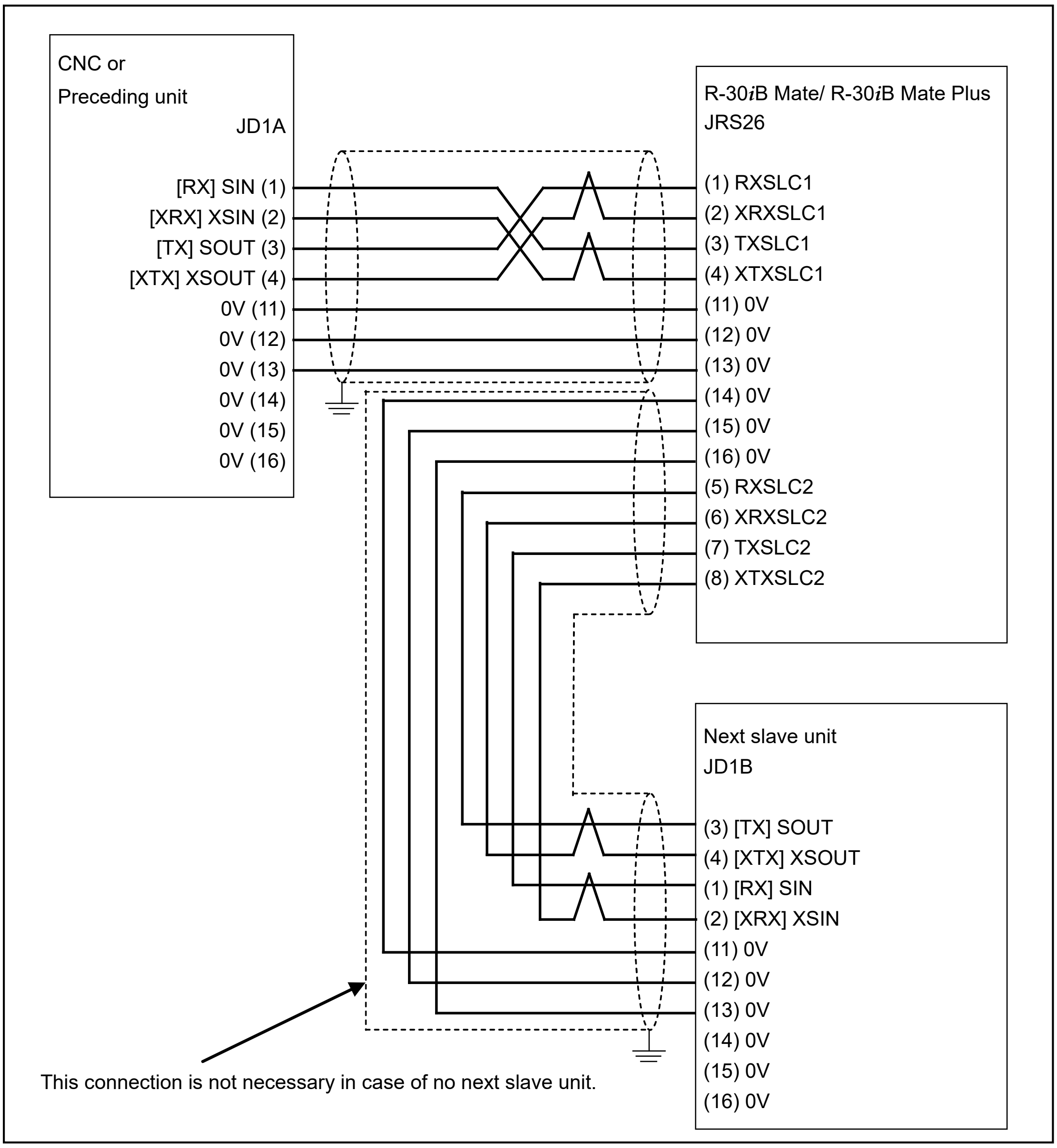


Fig.3.2.1.2 Cable connection diagram of the I/O Link cable by using JRS26 connector

3.2.2 Connection of JD44A Connector(Option)

JD44A is used to connect the Additional safety I/O board (Mini slot)
The connection of JD44A connector is shown below.

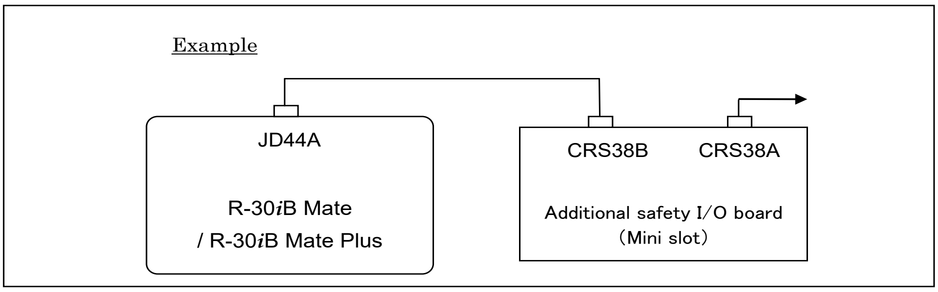


Fig.3.2.2 Connection of JD44A connector

3.2.2.1 Connection of the I/O Link cable by using JD44A connector

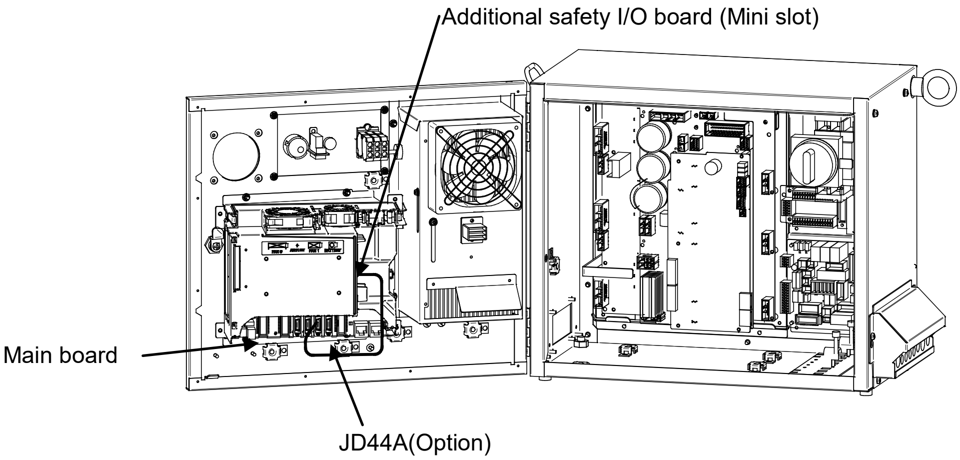


Fig.3.2.2.1 Path of the I/O link cable by using JD44A connector

JD44A
Interface

11	0V	01	(Reserve)
12	0V	02	(Reserve)
13	0V	03	(Reserve)
14	0V	04	(Reserve)
15	0V	05	RXSLCS
16	0V	06	XRXSLCS
17		07	TXSLCS
18	(+5V)	08	XTXSLCS
19	(24V)	09	(+5V)
20	(+5V)	10	(24V)

Note: +5V is connected when the optical I/O link adapter is used.

When the R-30*i*B Mate/ R-30*i*B Mate Plus controller is connected to Additional I/O board, use a twisted-pair cable in which wires RXSLCS (Pin No.5 of JD44A) and XRXSLCS (Pin No.6 of JD44A) are paired and wires TXSLCS (Pin No.7 of JD44A) and XTXSLCS (Pin No.8 of JD44A) are paired.

3.2.2.2 Cable connection diagram of the I/O Link cable by using JD44A connector

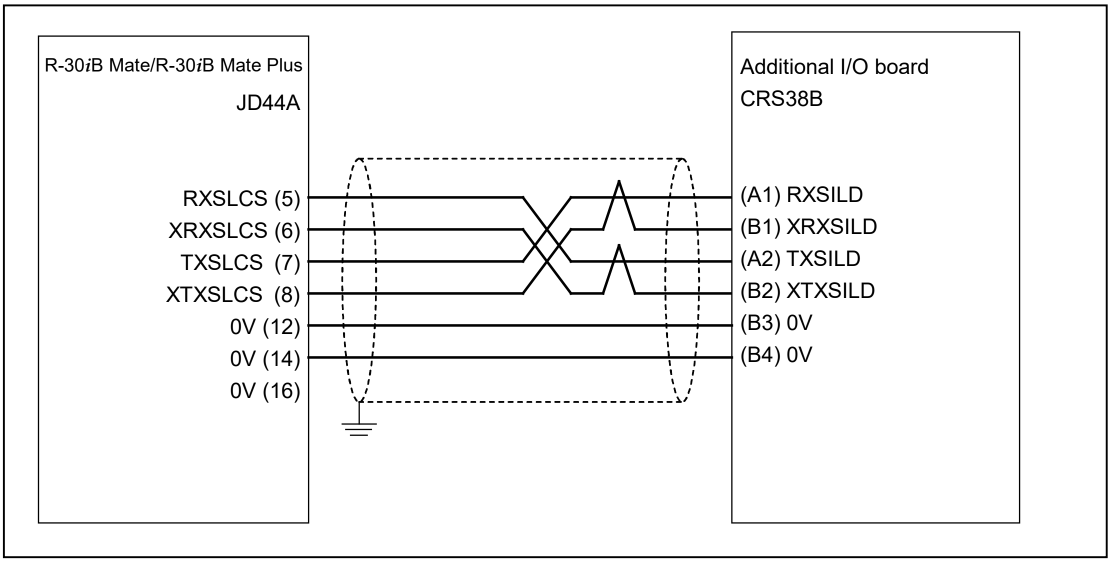


Fig.3.2.2.2 Cable connection diagram of the I/O Link cable by using JD44A connector

3.3 EXTERNAL CABLE WIRING DIAGRAM

3.3.1 Robot Connection Cables

⚠ **WARNING**
Before operating the robot, uncoil the interconnection cables from their shipping position to prevent excessive heat, which may damage the cables.
(Coiled part should be shorter than 10 meter.)

There are two types of the robot connection cable;
Non-flex type: usage is restricted to fixed laying
Flex type: possible to use in the cable track

Specification of cable

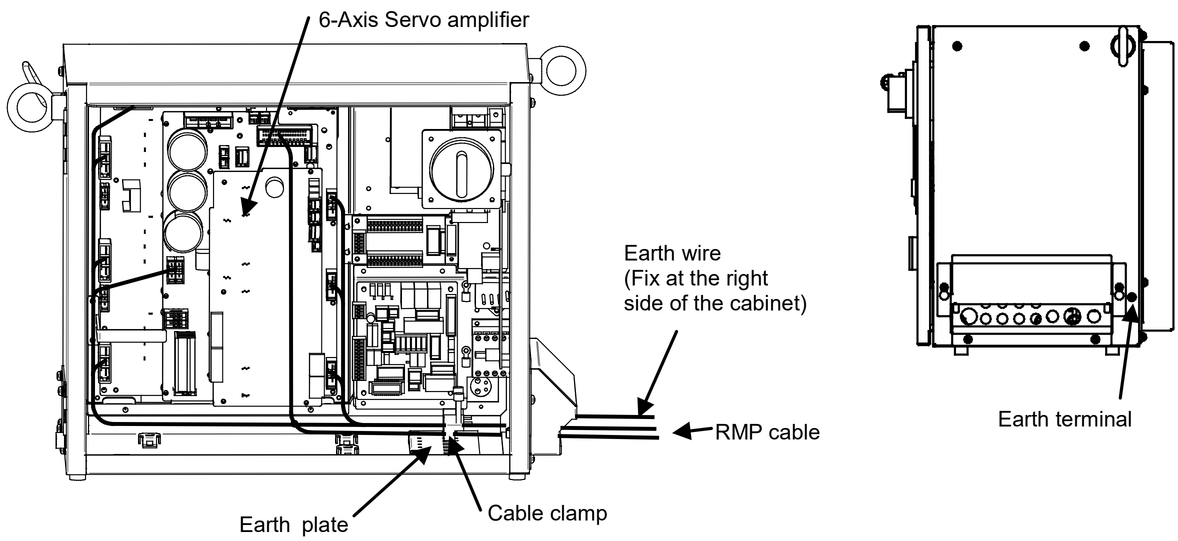
		Robot	Non-flex type			Flex type		
			Diameter (mm)	Weight (kg/m)	Minimum bending radius (mm)	Diameter (mm)	Weight (kg/m)	Minimum bending radius (mm)
RP1		**Group 1 Group 11**	16.0	0.45	200	20.5	0.71	200
RM1		**Group 1 Group 11**	26.1	1.22	200	25.4	1.2	200
RMP	**RP**	**Group 8**	16.0	0.45	200	20.5	0.71	200
	RM		20.0	0.7	200	18.4	0.7	200
RMP	**RP**	**Group 12**	14.2	0.31	200	20.5	0.71	200
	RM		15.5	0.3	200	15.5	0.49	200
EARTH		**All models**	4.7	0.065	200	4.7	0.065	200

Group 1	M-710*i*C, R-1000*i*A, R-2000*i*C
Group 8	ARC Mate 100*i*C, ARC Mate 100iD, ARC Mate 120*i*C, M-10*i*A, M-10iD, M-20*i*A, M-20*i*B, ARC Mate 0*i*B, R-0*i*B
Group 11	M-2*i*A, M-3*i*A
Group 12	LR Mate 200 *i*C, LR Mate 200*i*D, M-1*i*A, ARC Mate 50*i*D, CR-4*i*A, CR-7*i*A

Using condition of flex type cable

(1) When routing cables in movable places, use a cable bearer.
(2) The bending radius (R) of the cable track is more than 200mm.
(3) The cable should be fixed to the cable track by using the clamp. (e.g. foam rubber)
(4) The size of the hole to support a cable in the cable track should be more than 110% of the cable size and should have the gap more than 3mm.
(5) When cables are laid in the cable track, pay attention for the cable not to be twisted.

Cable Route



⚠ **CAUTION**
Signal cable should be clamped to Earth plate by cable clamp.
In case of CE controller, Power/Brake cable should be clamped to Earth plate by cable clamp.

Robot Model: LR Mate 200*i*C, LR Mate 200*i*D, M-1*i*A, ARC Mate 50*i*D, ARC Mate 100*i*C, ARC Mate 100D, ARC Mate 120*i*C, M-10*i*A, M-10*i*D, M-20*i*A, M-20*i*B, ARC Mate 0*i*B, R-0*i*B, CR-4*i*A, CR-7*i*A

Detail of cable connection to servo amplifier

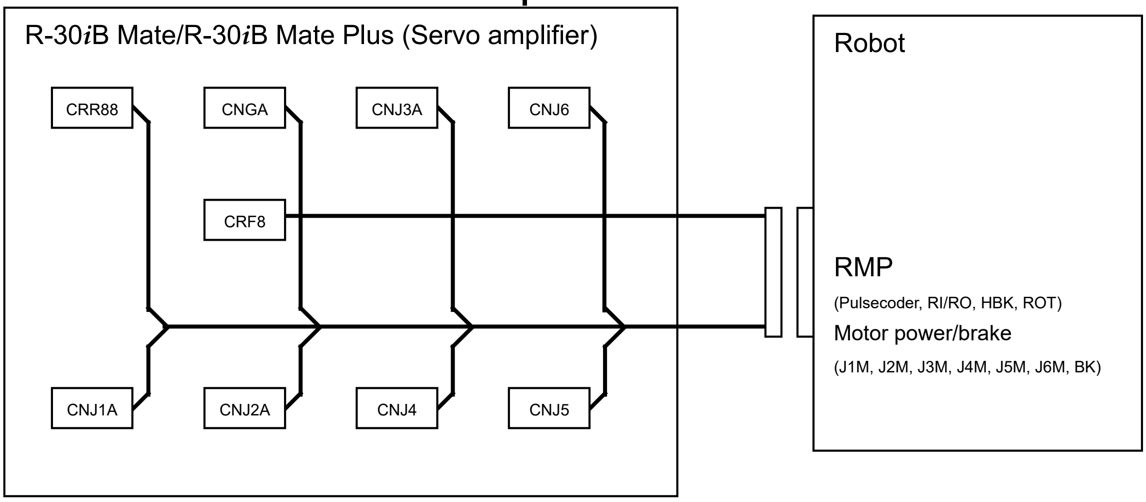


Fig.3.3.1 (a) Robot connection cable

Robot Model: M-2*i*A, M-3*i*A, R-1000*i*A, M-710*i*C, R-2000*i*C

Detail of cable connection to servo amplifier

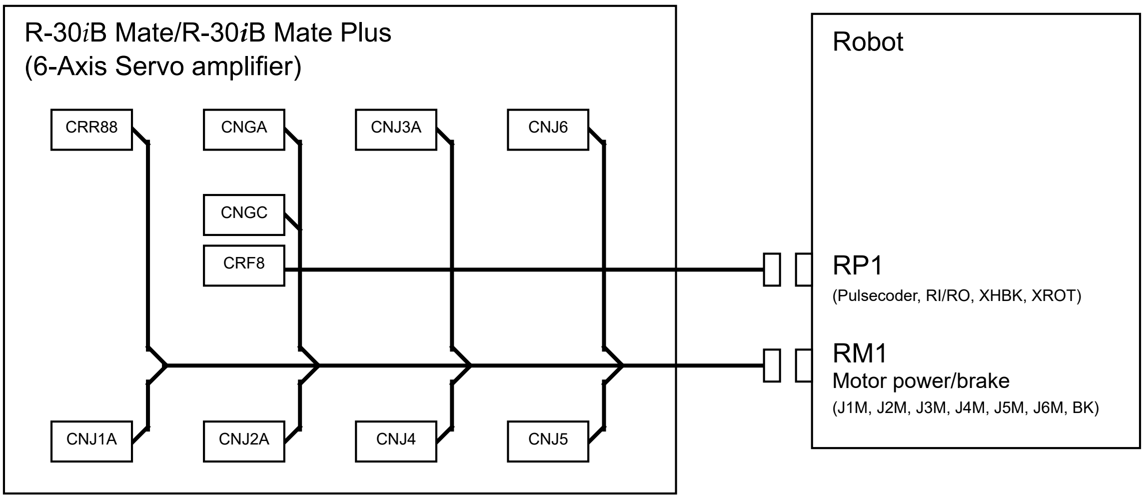


Fig.3.3.1 (b) Robot connection cable

3.3.2 Teach Pendant Cable

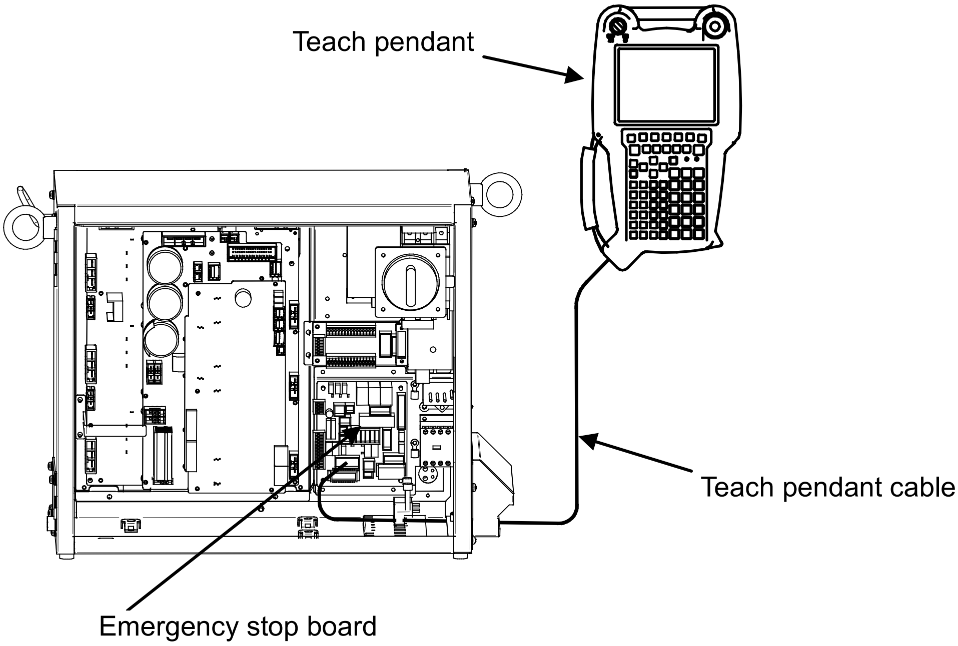


Fig.3.3.2 Teach pendant cable

3.3.3 Connecting the Input Power

3.3.3.1 Connecting the input power cable

(1) Fig.3.2.3.1 shows the method of connecting the input power supply cable.
(2) Use the input power cable according to the following Table 3.2.3.1. However, the input power cable according to the breaker or the fuse of the input power supply (power distribution panel) connected to the robot controller must be used.
(3) Provide a class-D or better ground.
There shall be no switches or disconnects in the grounding conductor.
The resistance to the ground must not exceed 100Ω.
Use a thick wire to withstand the maximum current used.

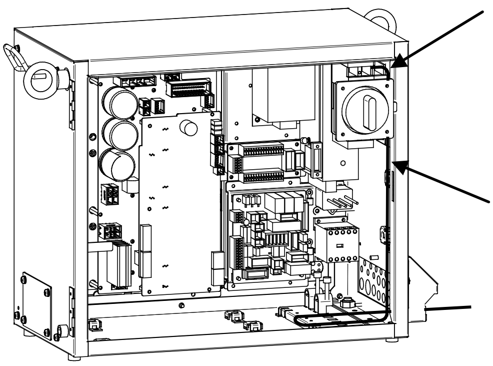
In case of NRTL controller
Provide a grounding conductor of equivalent gauge as the supply conductors.
Grounding/Bonding to comply with NEC Article 250 or CEC Section 10 as appropriate.

Table 3.3.3.1 Conductor size and terminal size of AC power supply

Input Voltage	Input power source capacity (Refer to CONNECTIONS 5.3)	Conductor size of AC Power supply cable	Terminal size of AC power supply cable	Conductor size of earth cable	Terminal size of earth cable
200V	<12kVA	AWG14 to AWG10 (Note 1)	M5	WARNING 2	M5
200V	12kVA≦	AWG10≦ (Note 1)	M5	WARNING 2	M5

⚠ **WARNING**

1. The input power cable according to the breaker or the fuse of the input power supply (power distribution panel) connected to the robot controller must be used.
2. Use conductor of earth cable size is as well as the AC power supply cable size.
3. Disconnection of protective earth ground may impair the protection provided by the system.



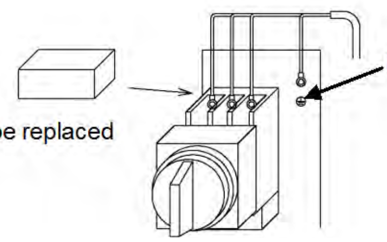


Fig.3.3.3.1 Connecting the input power cable

⚠ **WARNING**

The cover for primly terminal of main breaker should be replaced after completing.

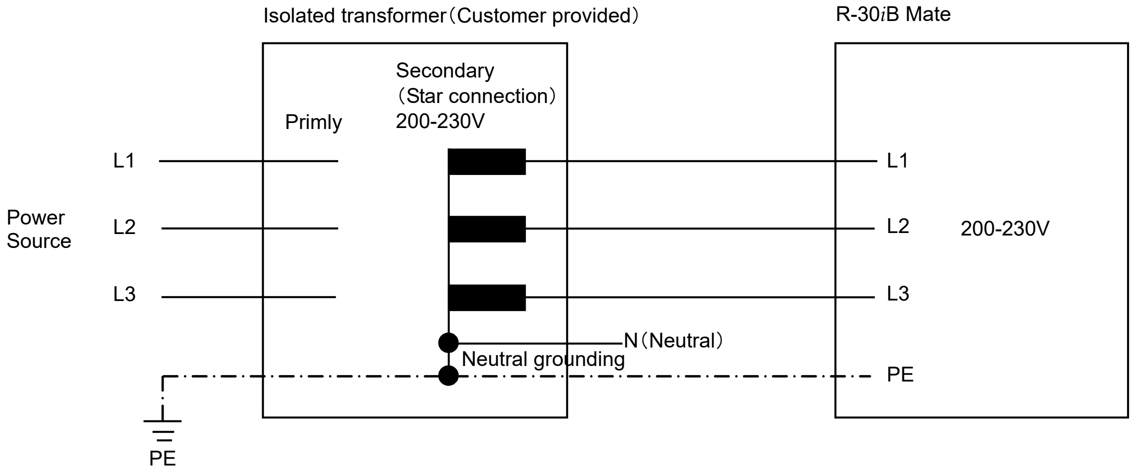
3.3.3.2 Isolated transformer

(1) According to the voltage of the input power source, an isolated transformer should be required. Refer to table 3.3.3.2. If required, set up isolated transformer between input power source and controller.

(2) In case of CE controller, the output of transformer should be the star connection with neutral grounding.

Table 3.3.3.2 Isolated transformer

Input power source	BASIC	NRTL	CE
200-230VAC single phase	No	No	No
200-230VAC three phase	No	No	Yes
others	Yes	Yes	Yes



> ⚠ **WARNING**
> In case of CE controller, the output of transformer should be the star connection with neutral grounding.

> **NOTE**
> Isolated transformer is provided by customer.
> Choose the appropriate transformer according the required power source capacity of the robot.
> Example of Isolated transformer
>
> | | |
> |---|---|
> | Manufacture | RIST Transformatorenbau GmbH |
> | Specification | 25065LK |
> | Capacity | 3kVA |
> | Output | AC200V |

3.3.3.3 Leakage breaker

(1) The motor is driven by the PWM inverter system using a power transistor bridge. A high-frequency leakage current flows through the stray capacitance between the ground and the motor coils, power cable, and amplifier. This might cause the leakage-current circuit breaker or leakage-protection relay installed in the path of the power supply to cut out.
Use the following leakage current circuit breaker for inverters to prevent incorrect operation.
(2) Leakage breaker using robot controller has sensitive electric current of 30mA.

Table 3.3.3.3 Example of leakage current circuit breaker for inverters

Manufacture	Type
Fuji Electric Co., Ltd.	EG A series or later SG A series or later
Hitachi, Ltd.	ES100C type or later ES225C type or later
Matsushita Electric Works, Ltd.	Leakage current circuit breaker, C type or later Leakage current circuit breaker, KC type or later

3.3.4 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.

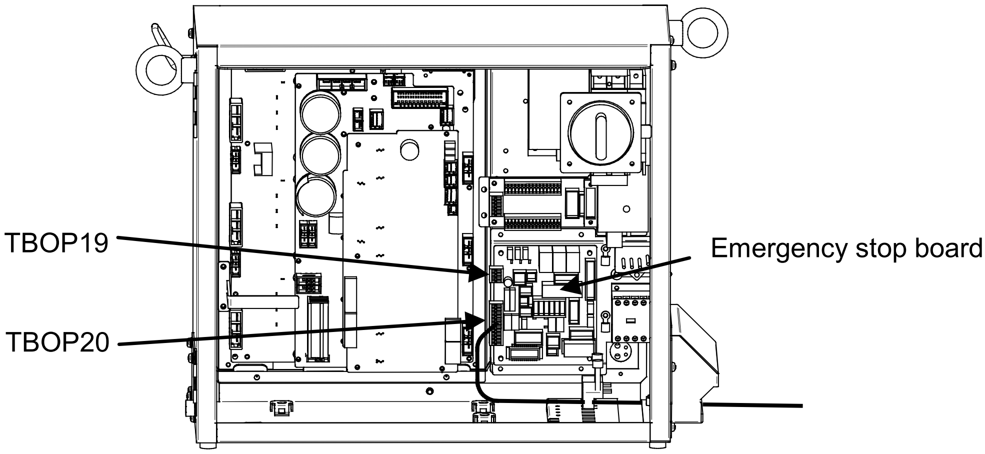


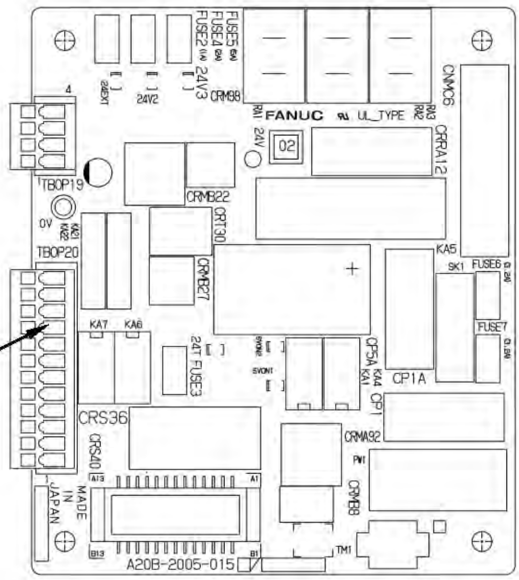
Fig.3.3.4 (a) Connecting the external emergency stop

> **NOTE**
> For protection against the noise, the shielded cable is recommended for the connection cable.
> Cut part of the jacket of the cable to expose the shield , and fasten this part to the earth plate with the cable clamp.

External emergency stop output

TBOP20

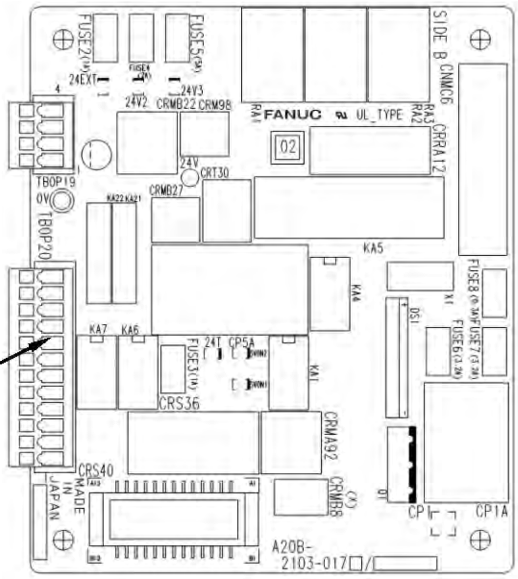
No.	Name	
12	E-STOP (ESPB)	21
11		2
10		11
9		1
8	FENCE (EAS)	21
7		2
6		11
5		1
4	EMGIN (EES)	21
3		2
2		11
1		1



(R-30*i*B Mate)

TBOP20

No.	Name	
12	E-STOP (ESPB)	21
11		2
10		11
9		1
8	FENCE (EAS)	21
7		2
6		11
5		1
4	EMGIN (EES)	21
3		2
2		11
1		1



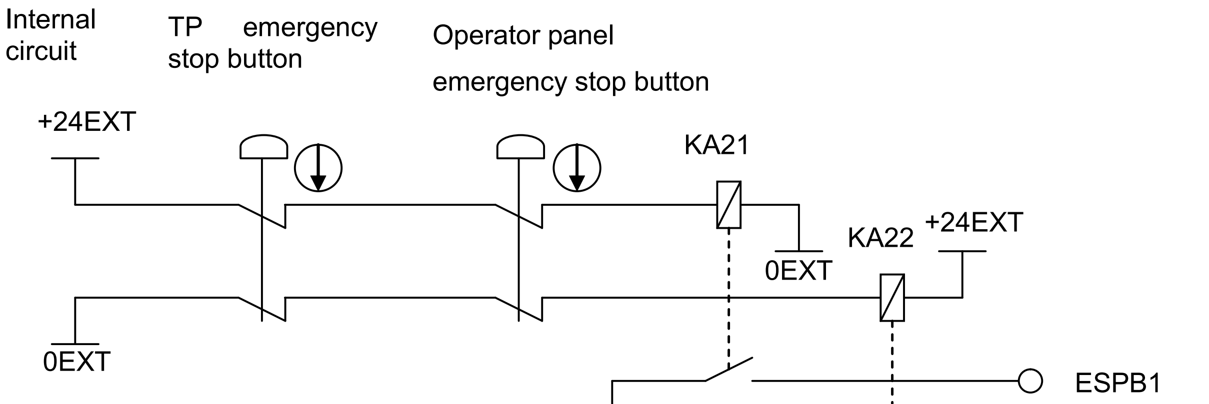
(R-30*i*B Mate Plus)

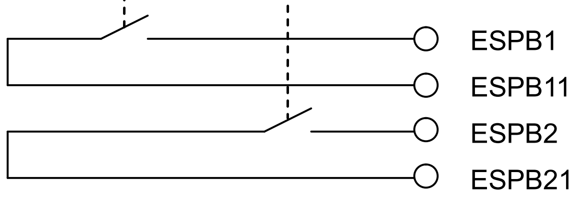
Fig.3.3.4 (b) Emergency stop board

For the circuit, see Fig. B (e) in Appendix B, "TOTAL CONNECTION DIAGRAM".

Signal	Description	Current, voltage	Min. load
ESPB1 —— ESPB11 ESPB2 —— ESPB21	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: 30 VDC, 5 A resistor load	(Reference value) DC5V 10mA

> **NOTE**
> For protection against the noise, the shielded cable is recommended for the connection cable.
> Cut part of the jacket of the cable to expose the shield, and fasten this part to the earth plate with the cable clamp.

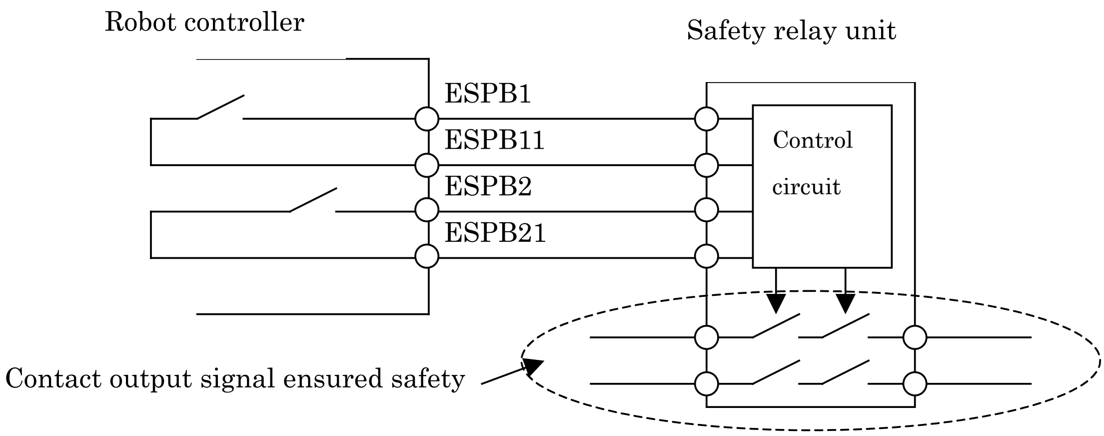




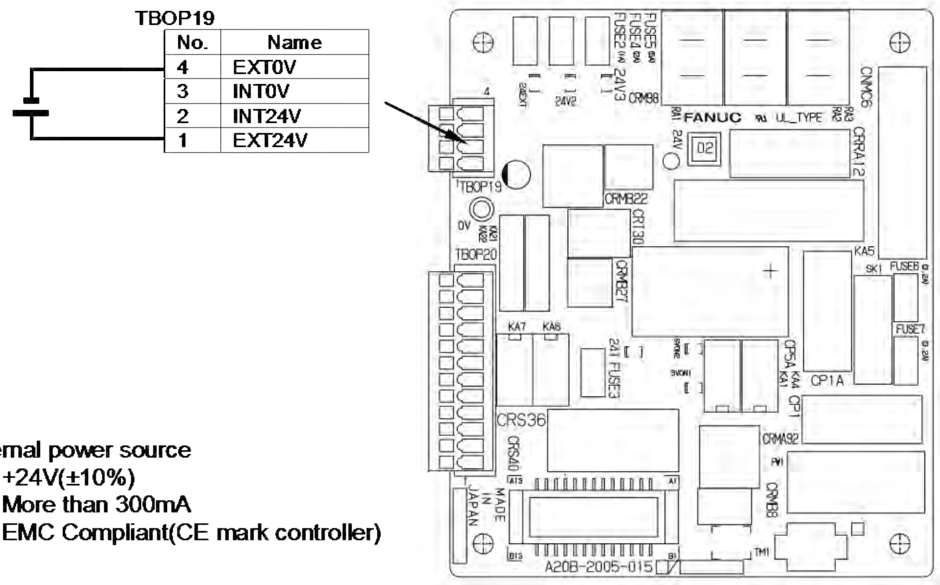
⚠WARNING

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.

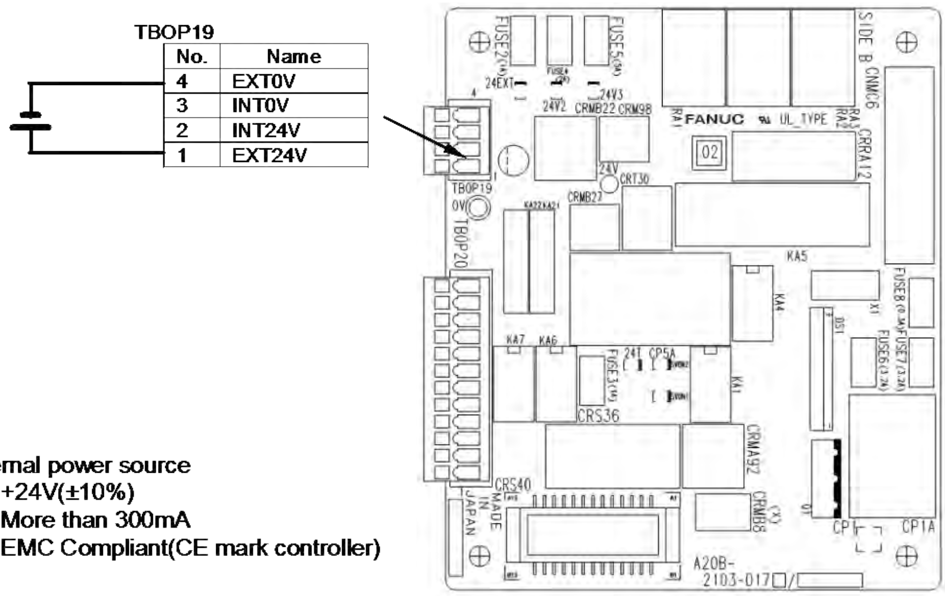
Example of the connection with the safety relay unit



External power connection



(R-30*i*B Mate)

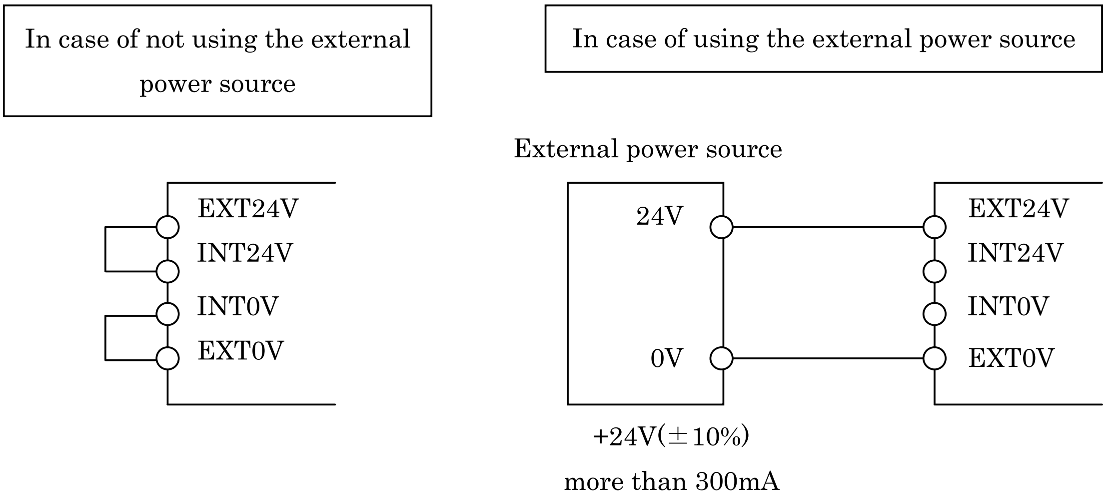


(R-30*i*B Mate Plus)

Emergency stop board

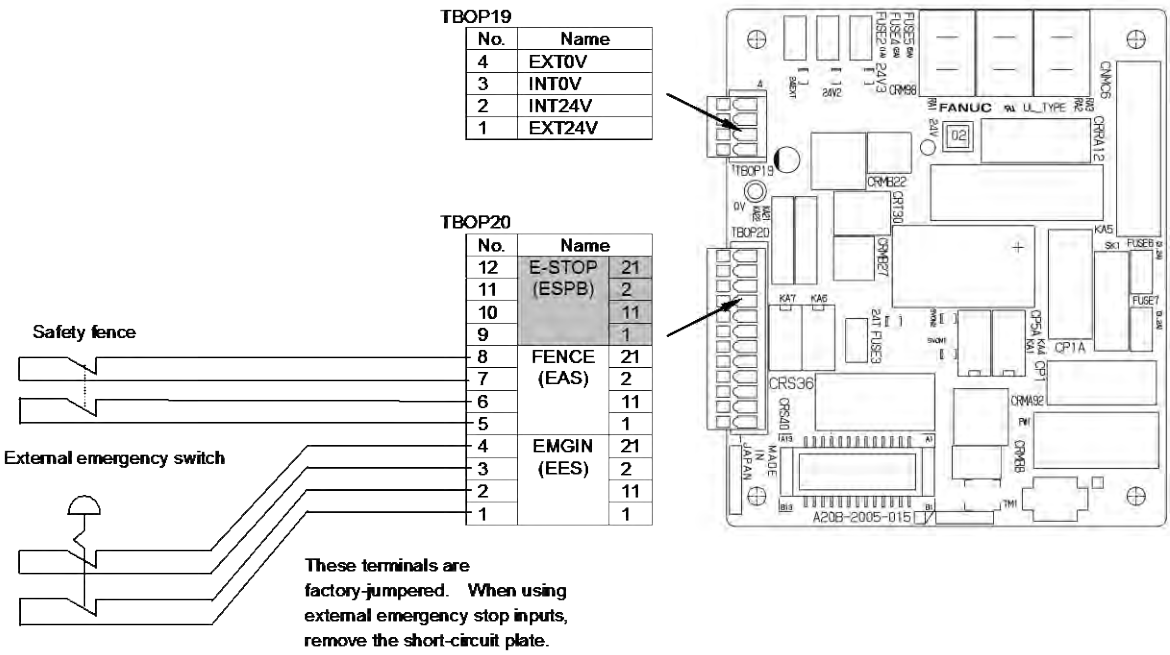
The relays for emergency stop input and output can be separated from controller’s power. Please connect external +24V instead of internal +24V, if emergency stop output must not be effected controller’s power.

Example of the connection

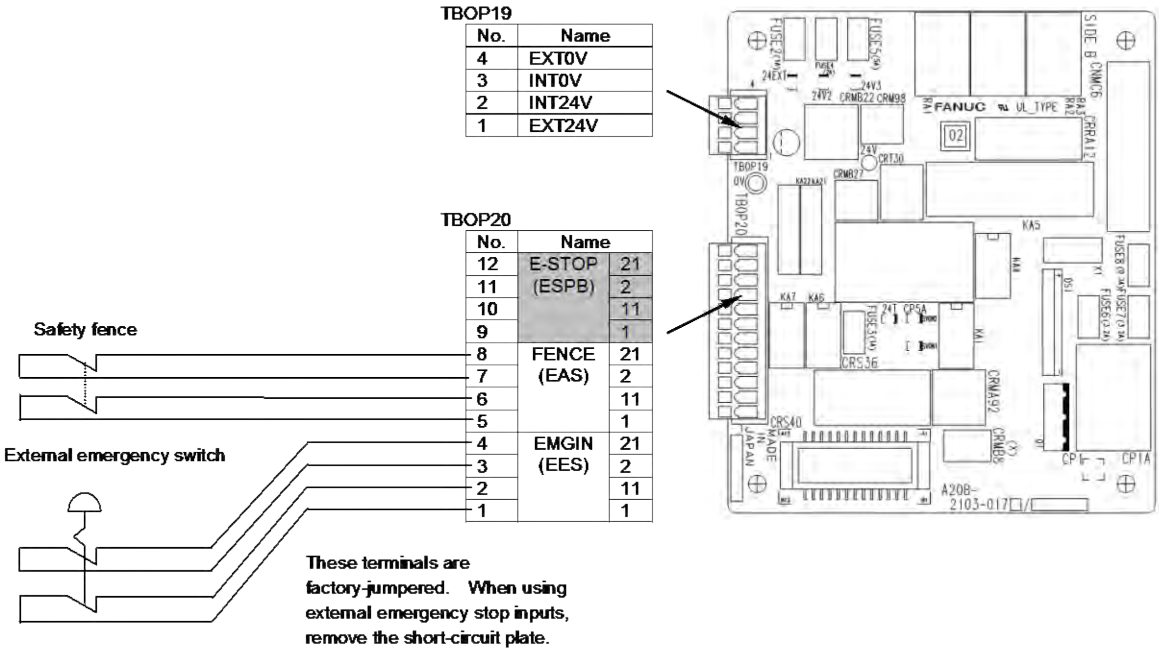


> **NOTE**
> For protection against the noise, the shielded cable is recommended for the connection cable.
> Cut part of the jacket of the cable to expose the shield, and fasten this part to the earth plate with the cable clamp.

External emergency stop input



(R-30*i*B Mate)



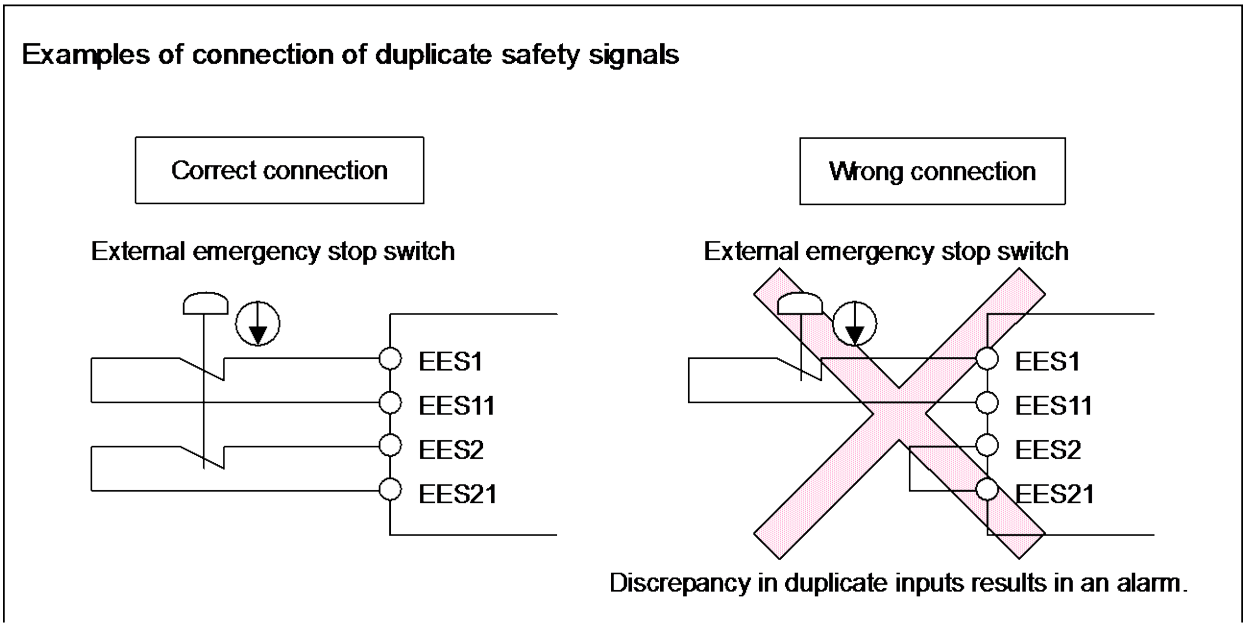
(R-30*i*B Mate Plus)

Emergency stop board

Signal	Description	Current, voltage
EES1 EES11 EES2 EES21	Connect the contacts of the external emergency stop switch to these terminals. When the contacts are open, the robot stops according to predetermined stop pattern. (Note 2) 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 24VDC 0.1A (Note 1)
EAS1 EAS11 EAS2 EAS21	These signals are used to stop the robot safely when the safety fence gate is opened during operation in the AUTO mode. When the contacts are open in the AUTO mode, the robot stops according to predetermined stop pattern. (Note 2) 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 24VDC 0.1A (Note 1)

NOTE
1. Use a contact which minimum load is 5 mA less.
2. See Chapter 7 in SAFETY PRECAUTIONS.

NOTE
For protection against the noise, the shielded cable is recommended for the connection cable.
Cut part of the jacket of the cable to expose the shield, and fasten this part to the earth plate with the cable clamp.



Input timing of duplicate safety signals

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.

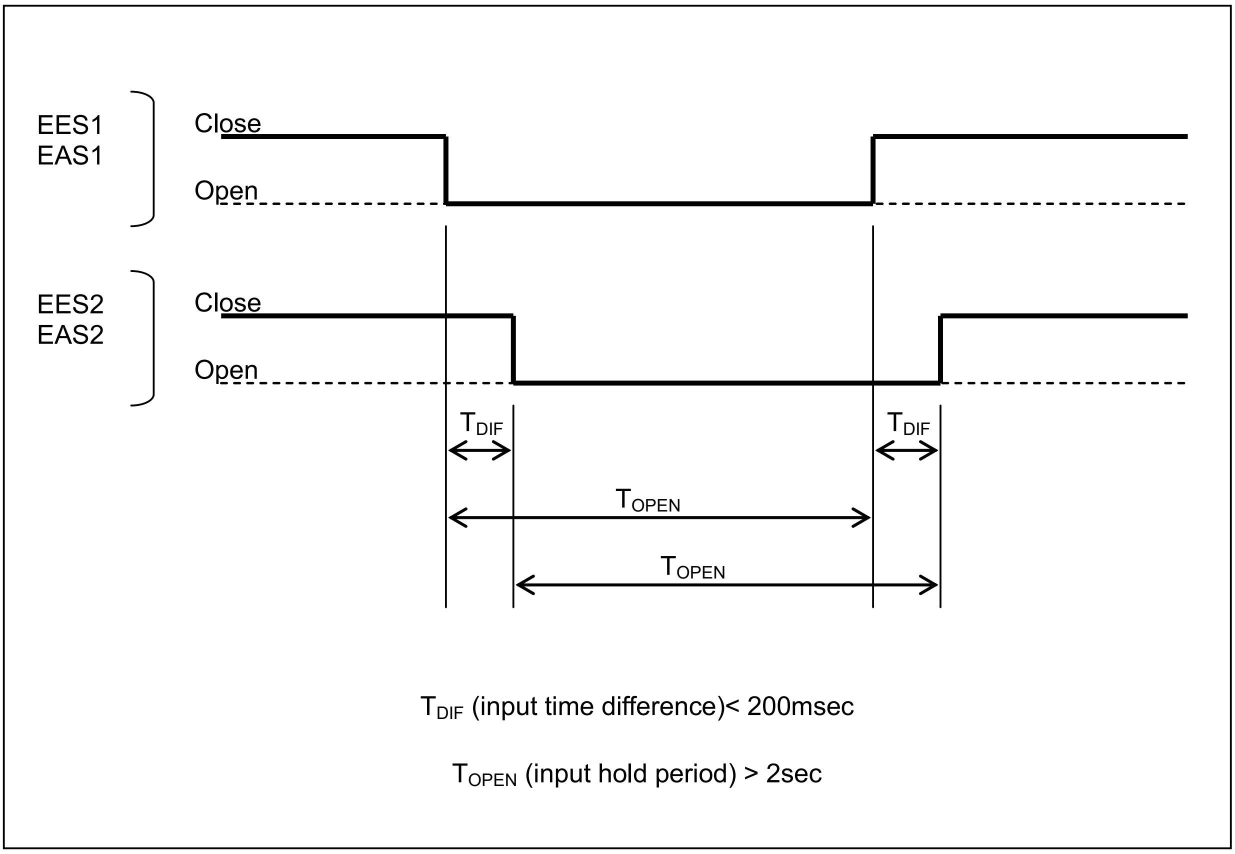


Fig.3.3.4(c) Input timing of duplicate safety signals

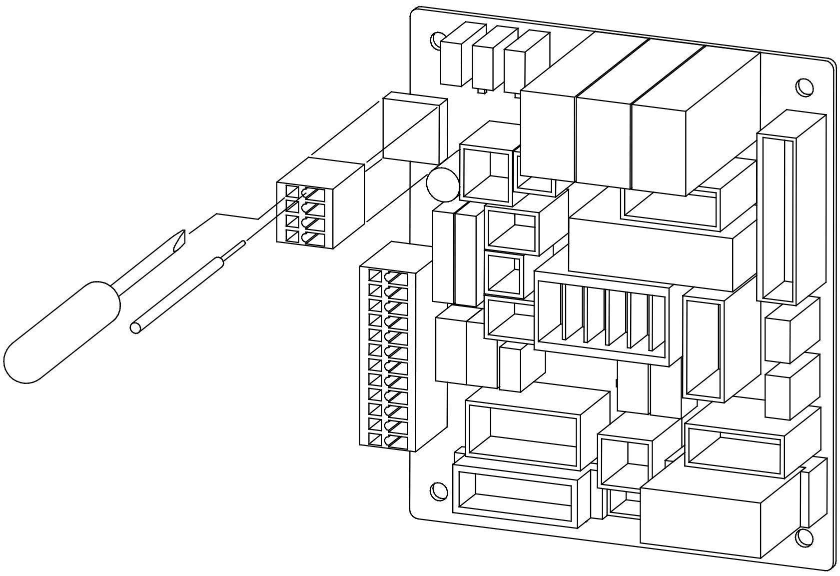
Connecting external on/off and external emergency stop signal input/output wires

	FANUC's specification	Manufacturer's specification (WAGO)	Remark
4-pole terminal block (TBOP19)	A63L-0002-0154#104	734-104	
12-pole terminal block (TBOP20)	A63L-0002-0154#112	734-112	
Jumper pin	A63L-0002-0154#402F	734-402F	
Operation lever	A63L-0002-0154#230-M	734-230	2 pieces of 734-230 and operation manual are included in FANUC's specification

1. Detach the plug connector block from the emergency stop 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 emergency stop board.

> ⚠ **CAUTION**
> Do not insert a wire into the wire hole of a plug connector or pull it out with the plug connector block mounted on the emergency stop board; otherwise, the emergency stop board may be damaged.

FANUC recommends the lever (A05B-2600-K030) for connecting the signal wire to the plug connector block instead of Flat-blade screwdriver.



3.3.5 Connecting the Auxiliary Axis Brake (CRR65 A/B)

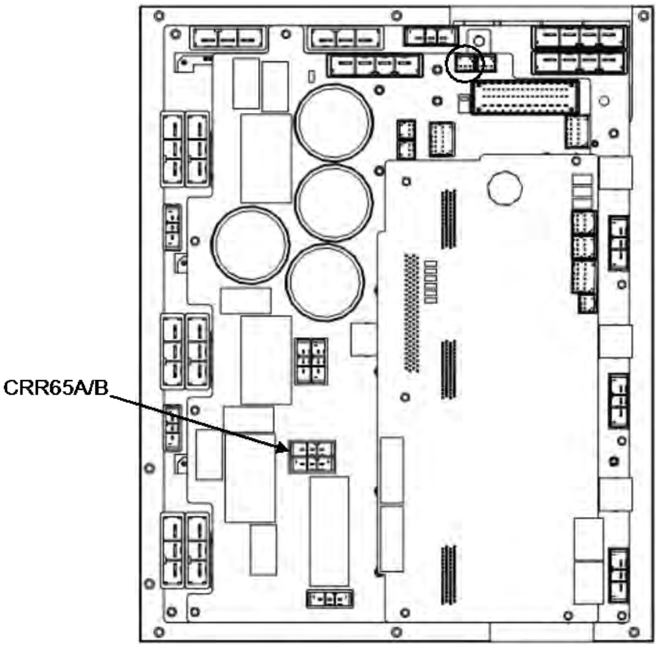


Fig.3.3.5 6-axis servo amplifier

CRR65 A/B

A1	BKA1	B1	BKA2
A2		B2	
A3	COMMON	B3	COMMON

Specification

	TE Connectivity Specification	FANUC Specification
Rece-housing	1-178128-3	A63L-0001-0460#032KSX
Rece-contact (AWG16-20)	175218-2	A63L-0001-0456#ASL

3.3.6 Connecting the Auxiliary Axis Over Travel (CRM68)

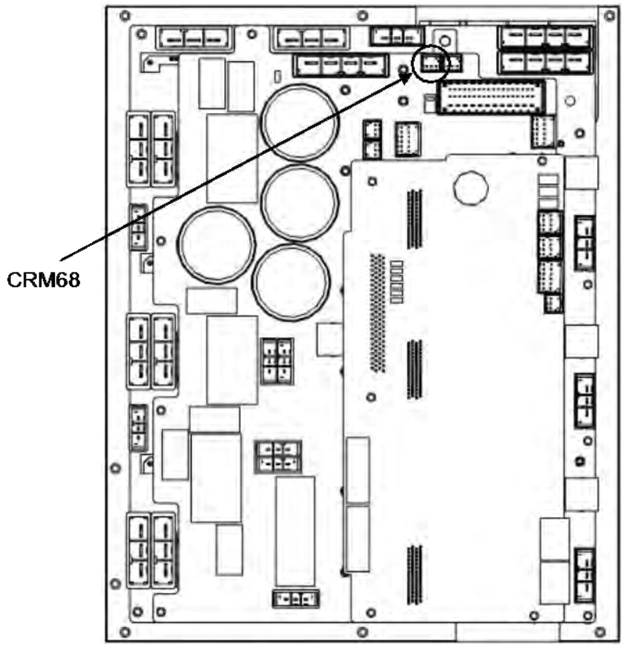


Fig.3.3.6 6-axis servo amplifier

CRM68

A1	AUXOT1
A2	AUXOT2
A3	

Specification

	TE Connectivity Specification	FANUC Specification
Rece-housing	1-1318120-3	A63L-0001-0812#R03SX
Rece-contact (AWG18-22)	1318107-1	A63L-0001-0812#CRM

4 PERIPHERAL DEVICE, ARC WELDING, AND EE INTERFACES

R-30*i*B Mate/R-30*i*B Mate Plus I/O peripheral device interfaces include printed circuit boards and a unit selected according to the applications. Table 4 lists details of the printed-circuit boards and units. Figure 4 shows the locations of these boards and units.

Table 4 Peripheral device interface types

No.	Name	Drawing number	Peripheral device interface				Remarks
			CRMA15		CRMA16		
			DI	DO	DI	DO	
1a	Main board A (R-30*i*B Mate)	A05B-2650-H001	20	8 (Source)	8	16 (Source)	Standard
	Main board A (R-30*i*B Mate Plus)	A05B-2680-H001					
1b	Main board B (R-30*i*B Mate)	A05B-2650-H002	20	8 (Source)	8	16 (Source)	Vision, Force sensor I/F
	Main board B (R-30*i*B Mate Plus)	A05B-2680-H002					
1c	Main board C (R-30*i*B Mate)	A05B-2650-H003	20	8 (Source)	8	16 (Source)	Vision, Force sensor I/F PMC, HDI
	Main board C (R-30*i*B Mate Plus)	A05B-2680-H003					

No.	Name	Drawing number	Peripheral device interface				Remarks
			CRMA52A		CRMA52B		
			DI	DO	DI	DO	
2	Process I/O board MA	A05B-2650-J060	10	8 (Source)	10	8 (Source)	Option

No.	Name	Drawing number	Peripheral device interface				Remarks
			CRW11				
			WI	WO	D/A	A/D	
3	Process I/O board MB	A05B-2650-J061	5	4(Sink)	2	0	Option

No.	Name	Drawing number	Remarks
4	Connector converter board	A05B-2650-J070	This option board converts peripheral device interfaces CRMA15 and CRMA16 of the main board to the MR connector manufactured by Honda Tsushin Kogyo Co., LTD.
5	Terminal converter board	A05B-2650-J071	This option board converts peripheral device interfaces CRMA15 and CRMA16 of the main board to the terminal blocks manufactured by Phoenix Contact GmbH & Co. KG.

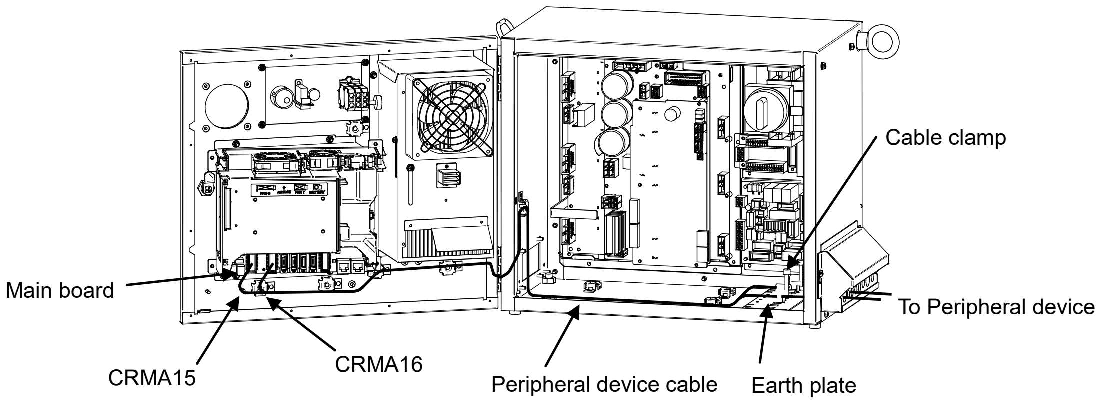
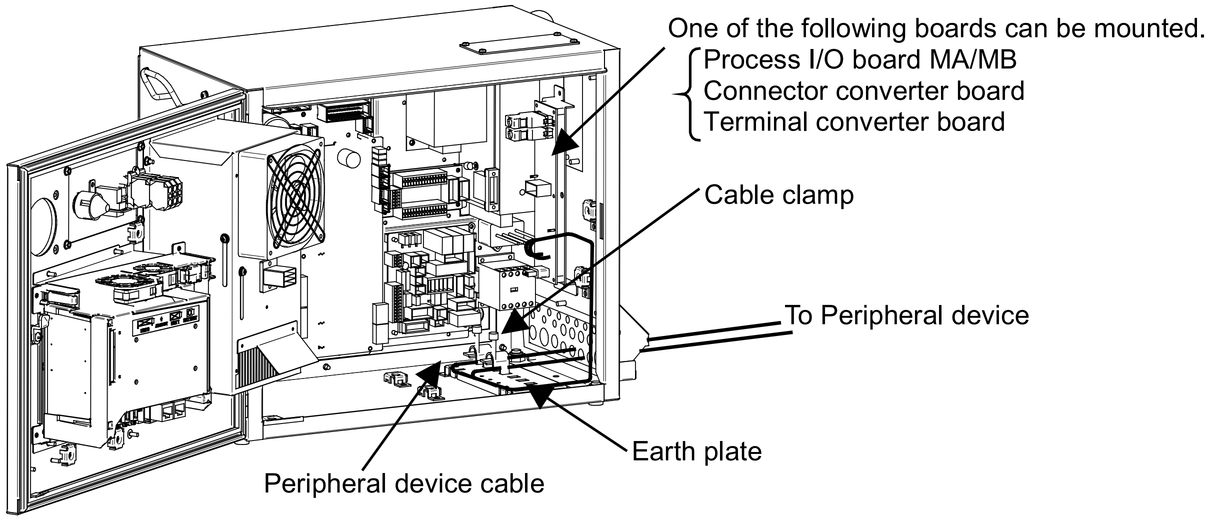


Fig.4(a) Connecting the peripheral device cable (CRMA15, CRMA16)



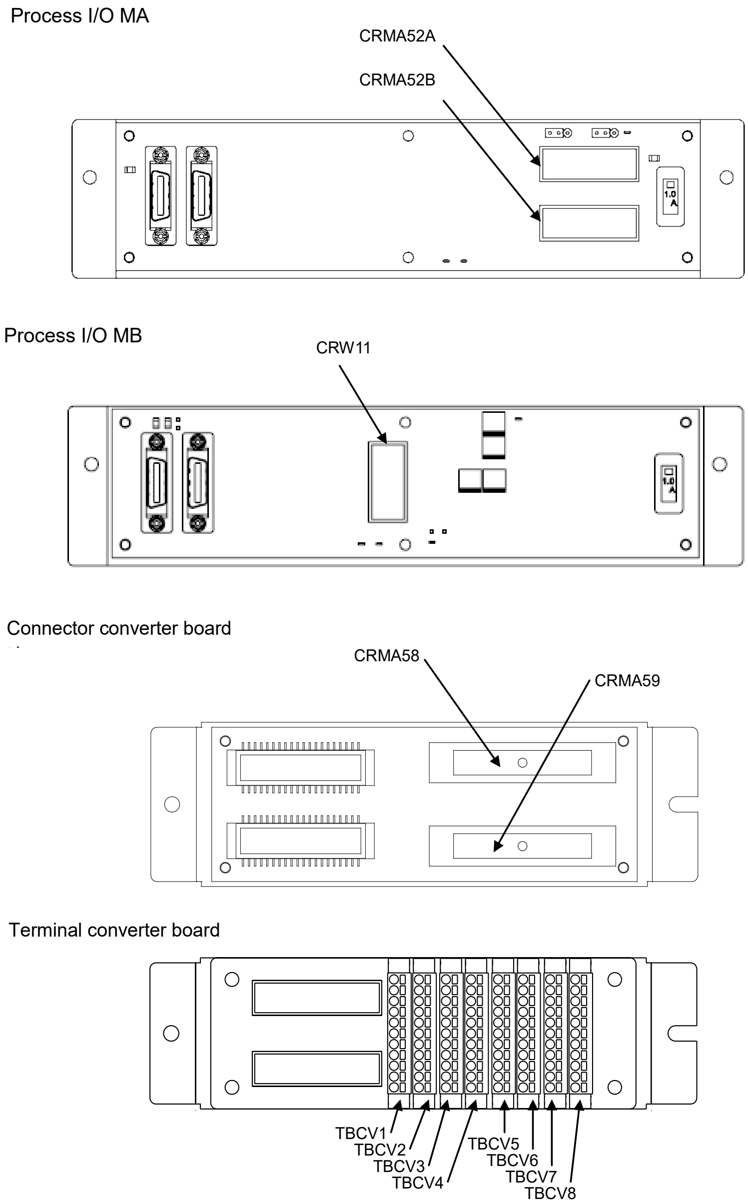


Fig.4(b) Connecting the peripheral device cable
(Process I/O board MA/MB, Connector converter board, Terminal converter board)

4.1 PERIPHERAL DEVICE INTERFACE BLOCK DIAGRAM

Following are a block diagram of the peripheral device interface and the specifications.

4.1.1 In Case of Main Board (CRMA15, CRMA16)

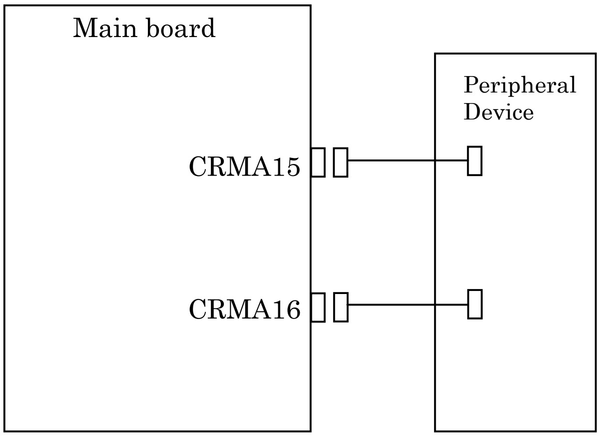
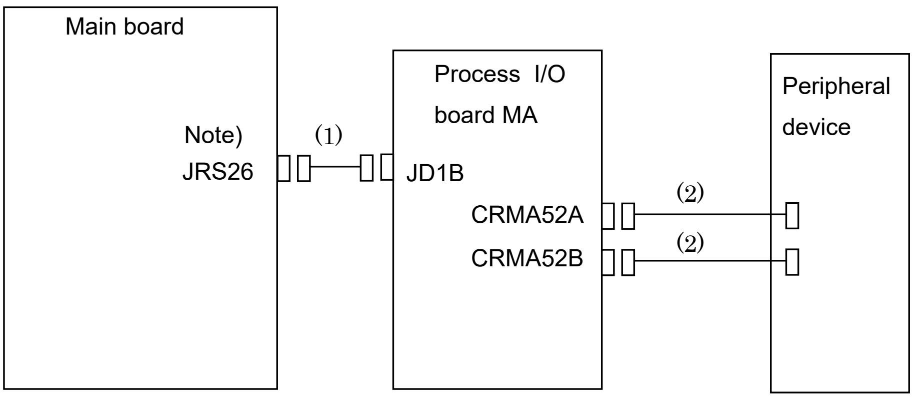


Fig.4.1.1 Block diagram of connecting peripheral device cable

Name	Drawing number	Remarks
Peripheral device connection cable (For main board)	A05B-2650-J100	Length: 10m (CRMA15) Length: 10m (CRMA16)
	A05B-2650-J101	Length: 20m (CRMA15) Length: 20m (CRMA16)

4.1.2 In the Case of the Process I/O Board MA

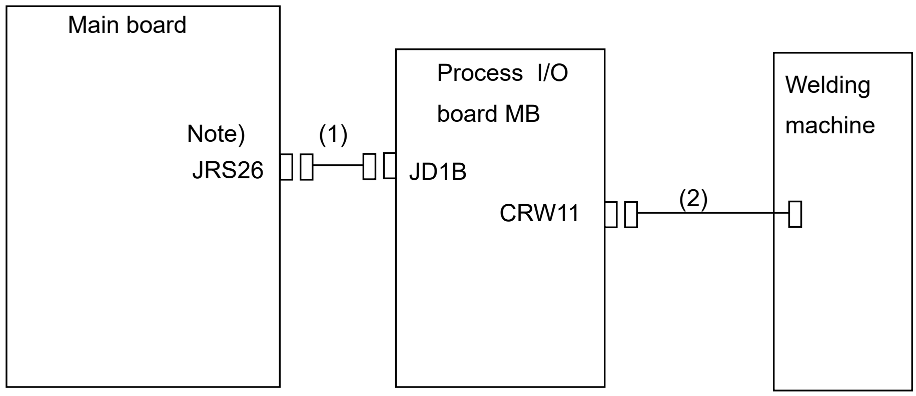


> **NOTE**
> The connection depends on whether the R-30*i*B Mate/R-30*i*B Mate Plus is the I/O link master or an I/O link slave. For details, see Section 3.2.1

Fig.4.1.2 Block diagram of the process I/O MA

Component	Drawing number	Remark
(1) I/O link cable	-	Included in the process I/O board MA
(2) Peripheral device cable (For process I/O MA)	A05B-2650-J150	Connection length 10m (one): CRMA52
	A05B-2650-J151	Connection length 20m (one): CRMA52

4.1.3 In the Case of the Process I/O Board MB

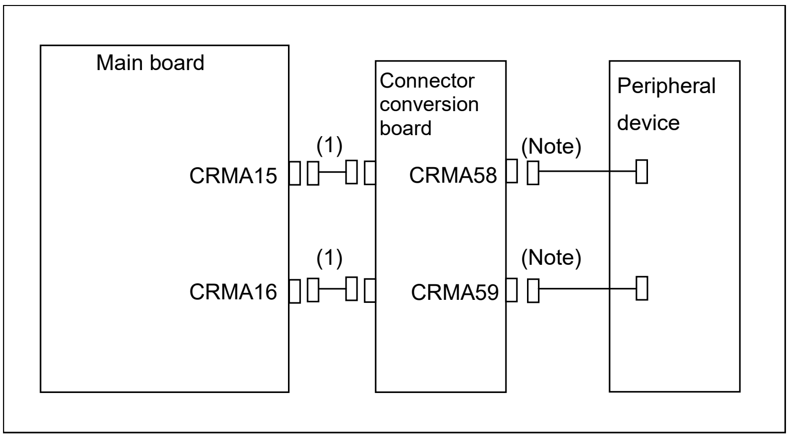


> **NOTE**
> The connection depends on whether the R-30*i*B Mate/R-30*i*B Mate Plus is the I/O link master or an I/O link slave. For details, see Section 3.2.1

Fig.4.1.3 Block diagram of the process I/O MB

No.	Component	Drawing number	Remark
(1)	I/O link cable	-	Included in the process I/O board MB
(2)	Welding machine connection cable (FANUC interface/elbow type)	A05B-2650-J160	Connection length 3m (one): CRW11
		A05B-2650-J161	Connection length 7m (one): CRW11
		A05B-2650-J162	Connection length 14m (one): CRW11

4.1.4 In the Case of the Connector Conversion Board

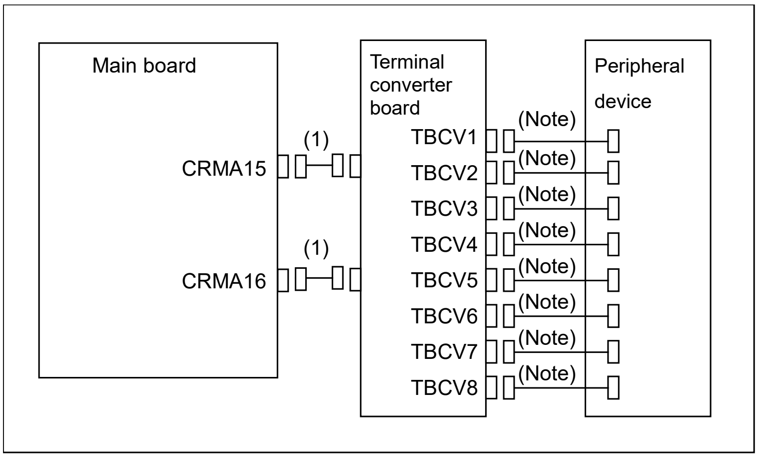


> **NOTE**
> This cable is not provided by FANUC. The customer needs to make it. For details on the connection method, see "4.3.2. Connection between the Connector Converter Board and Peripheral Devices".

Fig.4.1.4 Connection diagram of the connector conversion board

No.	Component	Drawing number	Remark
(1)	Connection cable	-	Included in the I/O connector conversion board.

4.1.5 In the Case of the Terminal Converter Board



> **NOTE**
> This cable is not provided by FANUC. The customer needs to make it. For details on the connection method, see "Connection between the Terminal Converter Board and Peripheral Devices".

Fig.4.1.5 Connection diagram of the terminal converter board

No.	Component	Drawing number	Remark
(1)	Connection cable	-	Included in the terminal converter board.

4.2 I/O SIGNALS OF MAIN BOARD

There are 28 data inputs (DI) and 24 data outputs (DO) on main board.
Table 4.2 shows I/O signals of main board.

Table 4.2 I/O Signals of main board (1/2)

Connector number	Signal name	Description	Remarks
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	RESET	External reset	
CRMA16-A6	START	Start	
CRMA16-B6	ENBL	Operation enabled	
CRMA16-A7	PNS1	Program number	
CRMA16-B7	PNS2		
CRMA16-A8	PNS3		
CRMA16-B8	PNS4		

Table 4.2 I/O Signals of main board (2/2)

Connector number	Signal name	Description	Remarks
CRMA15-A15	DO101	Peripheral device status	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	

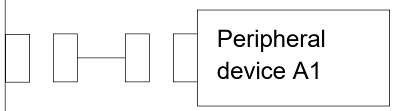
4.3 INTERFACE FOR PERIPHERAL DEVICES

4.3.1 Connection between the Main Board (CRMA15, CRMA16) and Peripheral Devices

Peripheral device control interface A1 (source type DO)

CRMA15

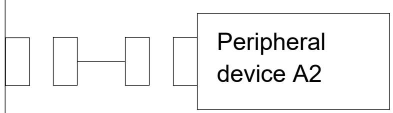
	A	B
01	24F	24F
02	24F	24F
03	SDICOM1	SDICOM2
04	0V	0V
05	DI101	DI102
06	DI103	DI104
07	DI105	DI106
08	DI107	DI108
09	DI109	DI110
10	DI111	DI112
11	DI113	DI114
12	DI115	DI116
13	DI117	DI118
14	DI119	DI120
15	DO101	DO102
16	DO103	DO104
17	DO105	DO106
18	DO107	DO108
19	0V	0V
20	DOSRC1	DOSRC1



Peripheral device control interface A2 (source type DO)

CRMA16

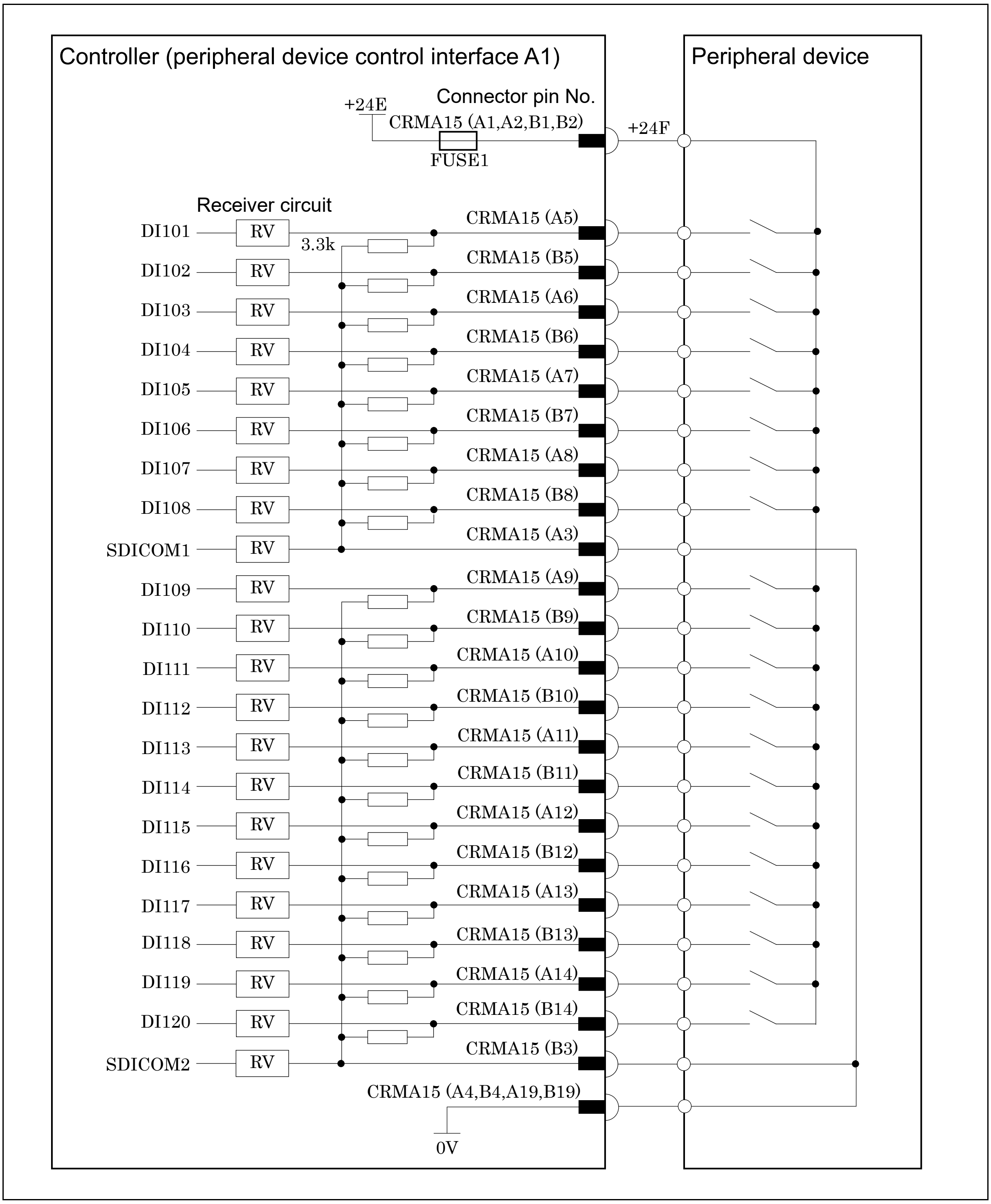
	A	B
01	24F	24F
02	24F	24F
03	SDICOM3	
04	0V	0V
05	XHOLD	RESET
06	START	ENBL
07	PNS1	PNS2
08	PNS3	PNS4
09		
10	DO109	DO110
11	DO111	DO112
12	DO113	DO114
13	DO115	DO116
14	DO117	DO118
15	DO119	DO120
16	CMDENBL	FAULT
17	BATALM	BUSY
18		
19	0V	0V
20	DOSRC2	DOSRC2



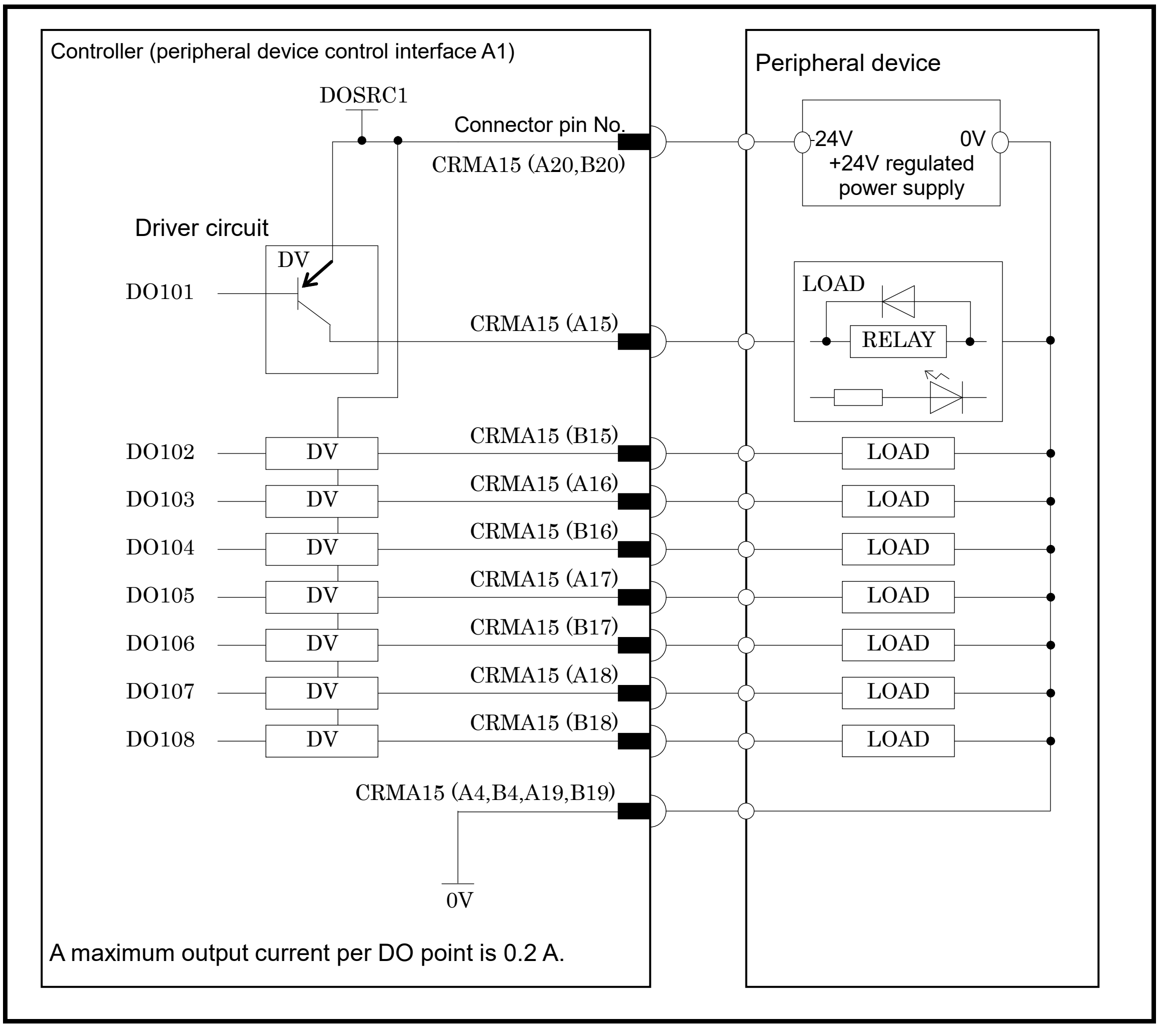
SDICOM1 to 3 signal are common selection signal for SDI.
When +24F common is used, connect to 0V.
When 0V common is used, connect to +24F.
SDICOM1 → Selects a common for DI101 to DI108.
SDICOM2 → Selects a common for DI109 to DI120.

SDICOM3 → Selects a common for XHOLD, RESET, START, ENBL, PNS1 to PNS4.

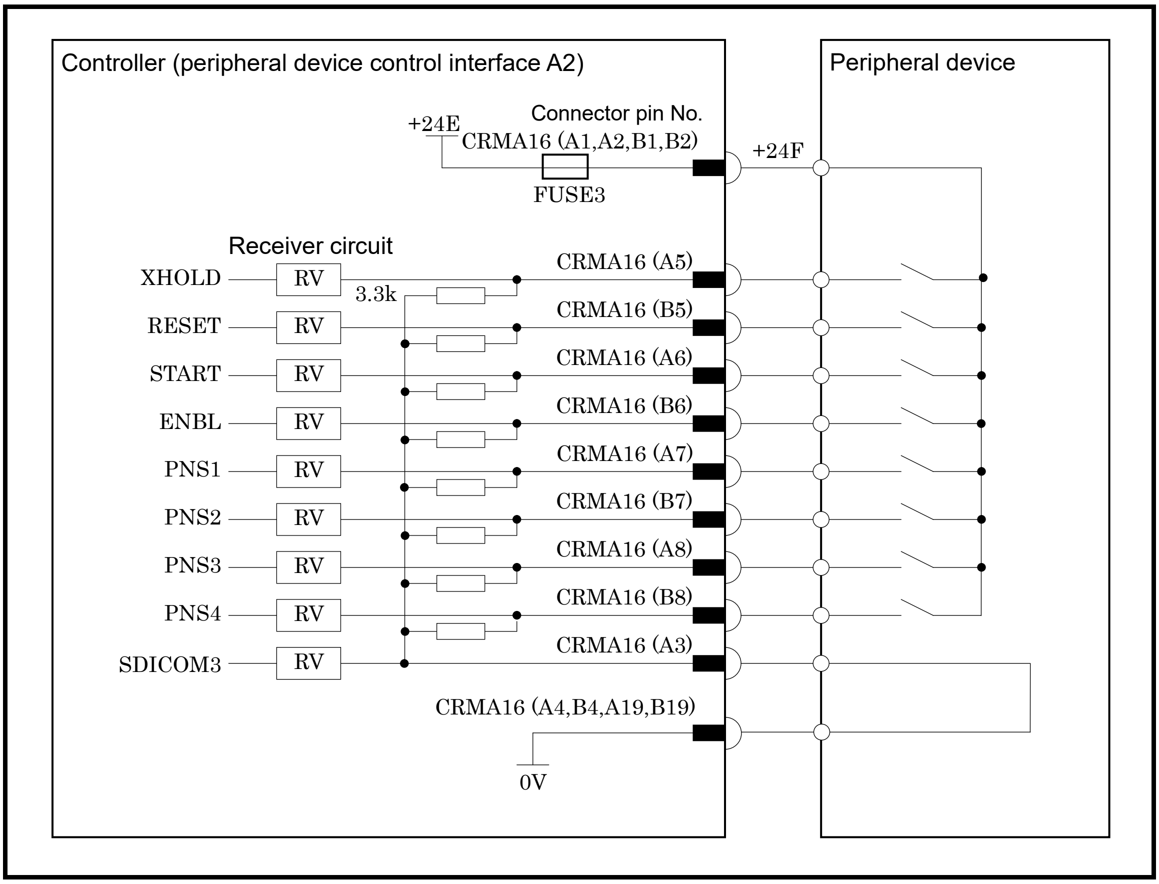
NOTE
1 The peripheral device connection cables are optional.
2 The DOSRC1 and DOSRC2 pins of the CRMA15 and CRMA16 are pins for supplying power to drivers. (None of these pins can be left open.)



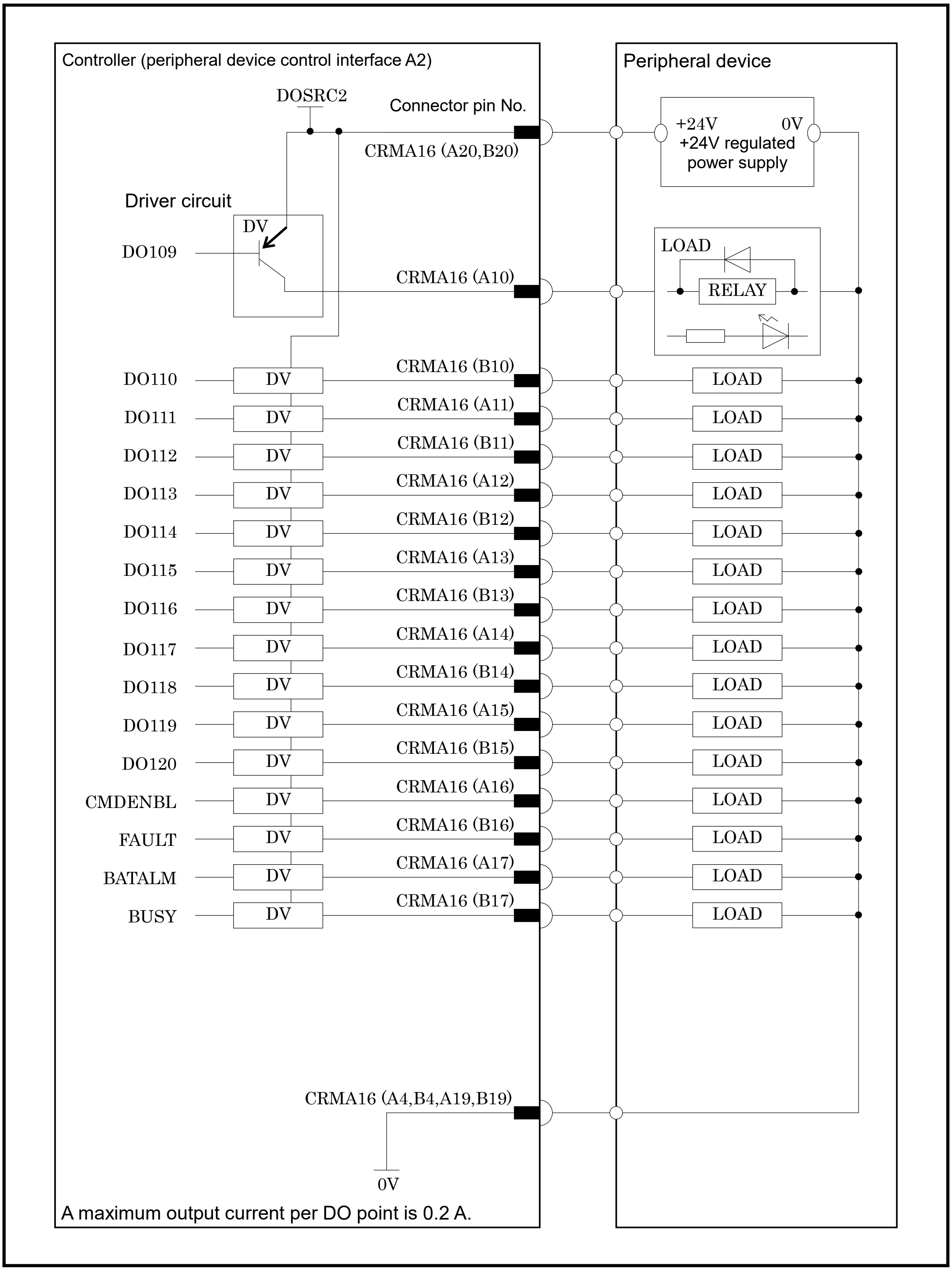
NOTE
In this diagram, common voltage of input devices is +24V.



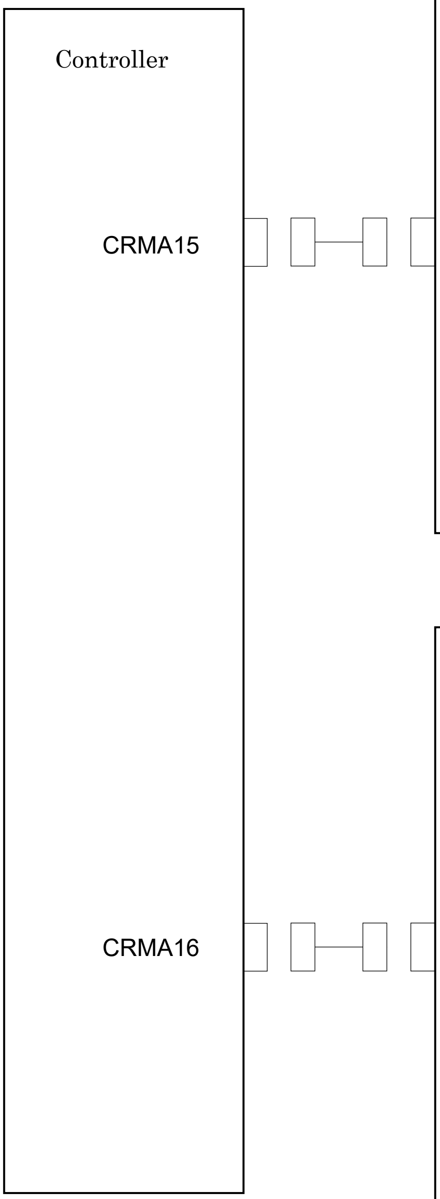
Controller (peripheral device control interface A1)
DOSRC1
Connector pin No.
CRMA15 (A20,B20)
Driver circuit
DV
DO101
CRMA15 (A15)
DO102
DO103
DO104
DO105
DO106
DO107
DO108
CRMA15 (B15)
CRMA15 (A16)
CRMA15 (B16)
CRMA15 (A17)
CRMA15 (B17)
CRMA15 (A18)
CRMA15 (B18)
CRMA15 (A4,B4,A19,B19)
0V
A maximum output current per DO point is 0.2 A.
Peripheral device
24V
0V
+24V regulated power supply
LOAD
RELAY



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


Controller (peripheral device control interface A2)
DOSRC2
Connector pin No.
CRMA16 (A20,B20)
Driver circuit
DV
DO109
CRMA16 (A10)
DO110
CRMA16 (B10)
DO111
CRMA16 (A11)
DO112
CRMA16 (B11)
DO113
CRMA16 (A12)
DO114
CRMA16 (B12)
DO115
CRMA16 (A13)
DO116
CRMA16 (B13)
DO117
CRMA16 (A14)
DO118
CRMA16 (B14)
DO119
CRMA16 (A15)
DO120
CRMA16 (B15)
CMDENBL
CRMA16 (A16)
FAULT
CRMA16 (B16)
BATALM
CRMA16 (A17)
BUSY
CRMA16 (B17)
CRMA16 (A4,B4,A19,B19)
0V
A maximum output current per DO point is 0.2 A.
Peripheral device
+24V
0V
+24V regulated power supply
LOAD
RELAY

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



Peripheral device A1

01	DI101			33	DO101
02	DI102	19	SDICOM1	34	DO102
03	DI103	20	SDICOM2	35	DO103
04	DI104	21		36	DO104
05	DI105	22	DI117	37	DO105
06	DI106	23	DI118	38	DO106
07	DI107	24	DI119	39	DO107
08	DI108	25	DI120	40	DO108
09	DI109	26		41	
10	DI110	27		42	
11	DI111	28		43	
12	DI112	29	0V	44	
13	DI113	30	0V	45	
14	DI114	31	DOSRC1	46	
15	DI115	32	DOSRC1	47	
16	DI116			48	
17	0V			49	24F
18	0V			50	24F

Peripheral device A2

01	XHOLD			33	CMDENBL
02	RESET	19	SDICOM3	34	FAULT
03	START	20		35	BATALM
04	ENBL	21	DO120	36	BUSY
05	PNS1	22		37	
06	PNS2	23		38	
07	PNS3	24		39	
08	PNS4	25		40	
09		26	DO117	41	DO109
10		27	DO118	42	DO110
11		28	DO119	43	DO111
12		29	0V	44	DO112
13		30	0V	45	DO113
14		31	DOSRC2	46	DO114
15		32	DOSRC2	47	DO115
16				48	DO116
17	0V			49	24F
18	0V			50	24F

4.3.2 Connection between the Connector Converter Board and Peripheral Devices

The connector interface of the optional connector conversion board is shown below. For electrical connection, see Section 4.3.1.

Controller

Peripheral device control interface C1
(Honda Tsushin Kogyo MR-50/Femaile)
CRMA58

01	DI101			33	DO101
02	DI102	19	SDICOM1	34	DO102
03	DI103	20	SDICOM2	35	DO103
04	DI104	21		36	DO104
05	DI105	22	DI117	37	DO105
06	DI106	23	DI118	38	DO106
07	DI107	24	DI119	39	DO107
08	DI108	25	DI120	40	DO108
09	DI109	26		41	
10	DI110	27		42	
11	DI111	28		43	
12	DI112	29	0V	44	
13	DI113	30	0V	45	
14	DI114	31	DOSRC1	46	
15	DI115	32	DOSRC1	47	
16	DI116			48	
17	0V			49	24F
18	0V			50	24F

Peripheral deviceC1

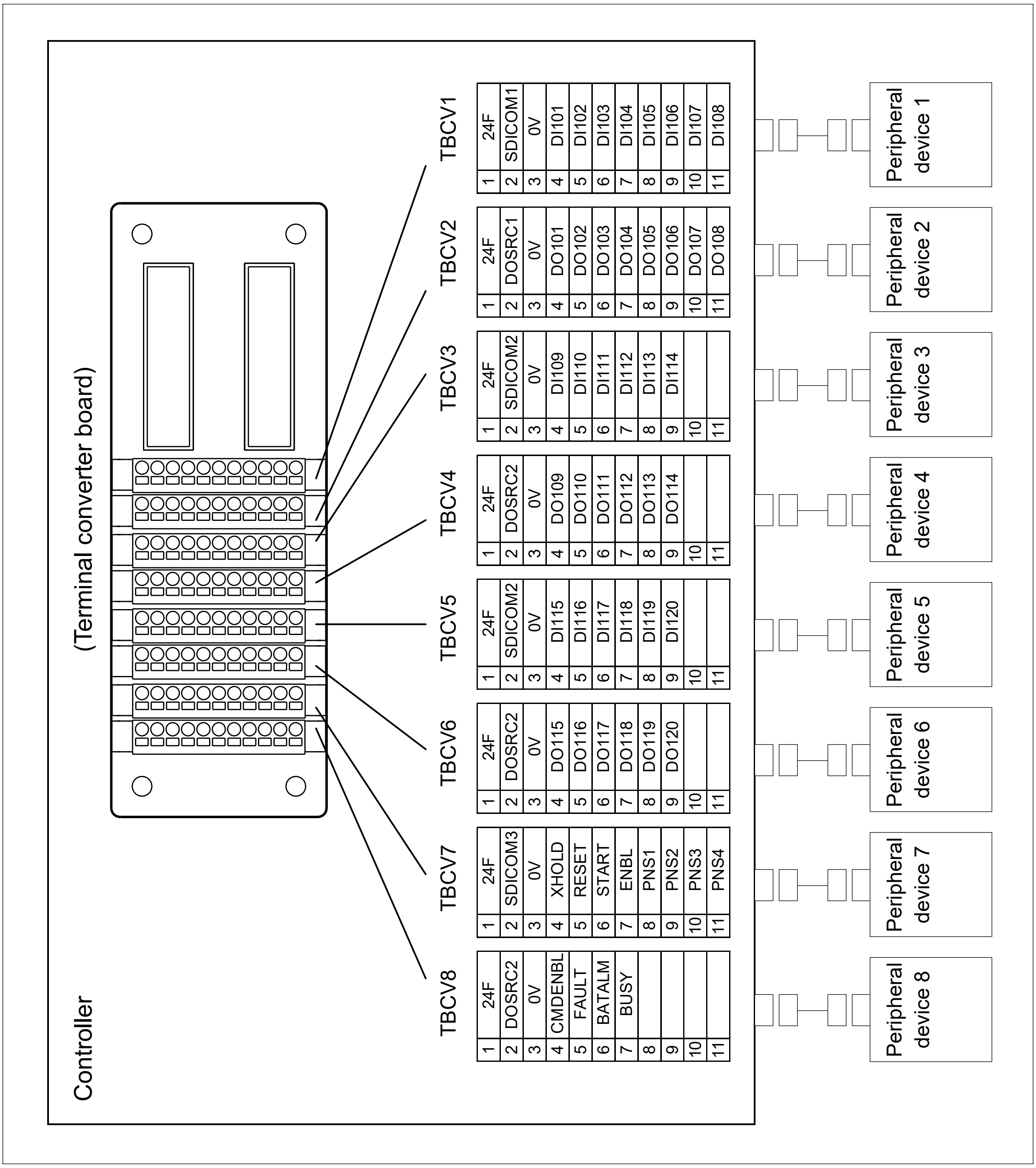
Peripheral device control interface C2
(Honda Tsushin Kogyo MR-50/Femaile)
CRMA59

01	XHOLD			33	CMDENBL
02	RESET	19	SDICOM3	34	FAULT
03	START	20		35	BATALM
04	ENBL	21	DO120	36	BUSY
05	PNS1	22		37	
06	PNS2	23		38	
07	PNS3	24		39	
08	PNS4	25		40	
09		26	DO117	41	DO109
10		27	DO118	42	DO110
11		28	DO119	43	DO111
12		29	0V	44	DO112
13		30	0V	45	DO113
14		31	DOSRC2	46	DO114
15		32	DOSRC2	47	DO115
16				48	DO116
17	0V			49	24F
18	0V			50	24F

Peripheral deviceC2

4.3.3 Connection between the Terminal Converter Board and Peripheral Devices

The terminal block interface of the optional terminal converter board is shown below. For electrical connection, see Section 4.3.1.



	Manufacturer	Manufacturer's specification	Remark
11-pole terminal block (TBCV1-8)	Phoenix Contact	FMC 1,5/11-ST-3,5-RF AU	Refer to appendix F

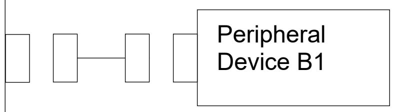
4.3.4 Connection between the Process I/O Board MA and Peripheral Devices

Controller

Peripheral device control interface B1 (source type DO)

CRMA52A

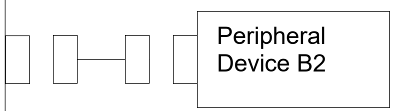
	A	B
01	24F	24F
02	DI121	DI122
03	DI123	DI124
04	DI125	DI126
05	DI127	DI128
06	DI129	DI130
07		
08	DO121	DO122
09	DO123	DO124
10	DO125	DO126
11	DO127	DO128
12		
13	0V	0V
14	0V	0V
15	DOSRC3	DOSRC3



Peripheral device control interface B2 (source type DO)

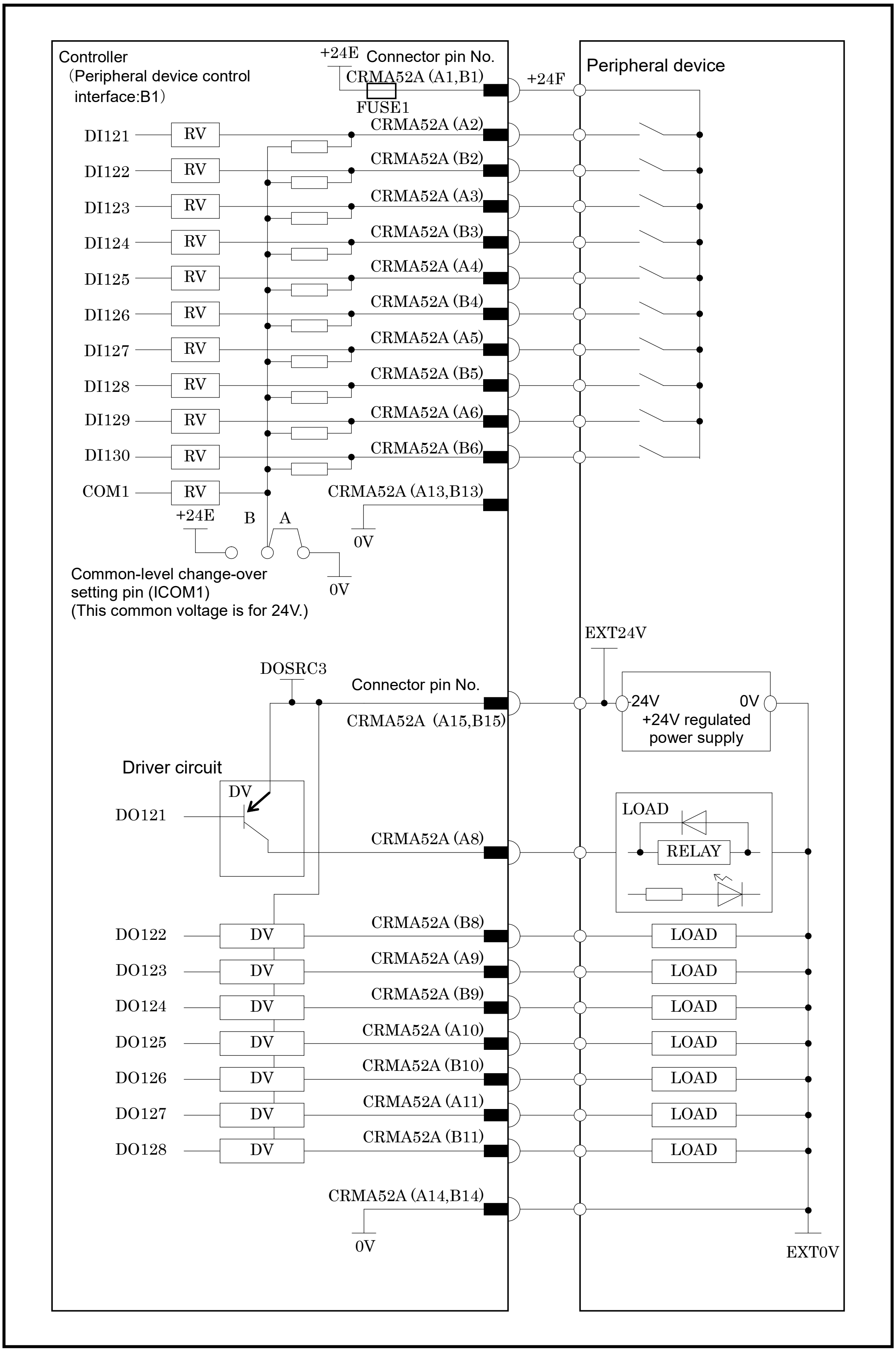
CRMA52B

	A	B
01	24F	24F
02	DI131	DI132
03	DI133	DI134
04	DI135	DI136
05	DI137	DI138
06	DI139	DI140
07		
08	DO129	DO130
09	DO131	DO132
10	DO133	DO134
11	DO135	DO136
12		
13	0V	0V
14	0V	0V
15	DOSRC3	DOSRC3

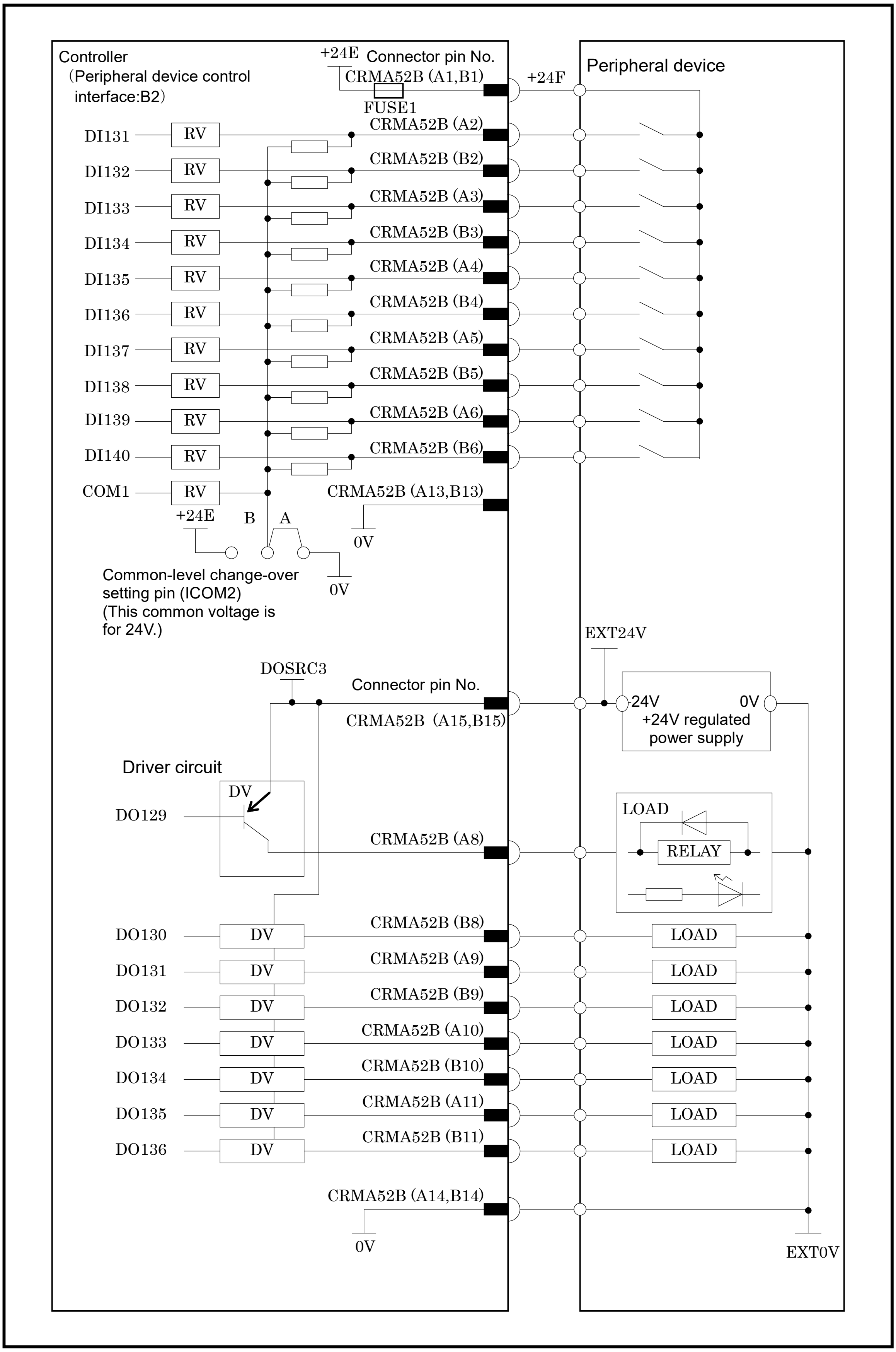


NOTE

1. The peripheral device connection cable is optional.
2. The DOSRC3 pin of CRMA52A and CRMA52B supply power to the drivers (connect all pins).

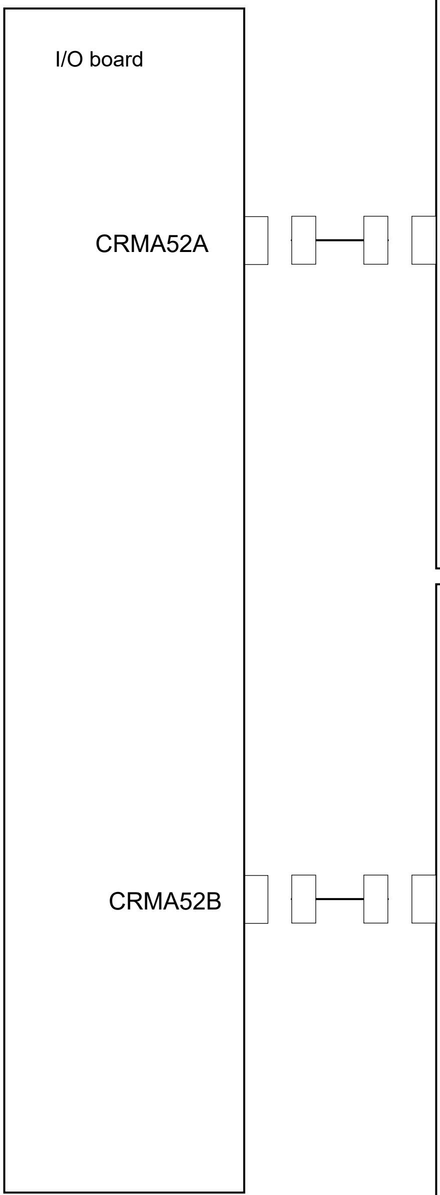


NOTE
In this diagram, common voltage of input device is 24V.



NOTE
In this diagram, common voltage of input device is 24V.

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



Peripheral device A3

01	DI121			33	DO121
02	DI122	19		34	DO122
03	DI123	20		35	DO123
04	DI124	21		36	DO124
05	DI125	22		37	DO125
06	DI126	23		38	DO126
07	DI127	24		39	DO127
08	DI128	25		40	DO128
09	DI129	26		41	
10	DI130	27		42	
11		28		43	
12		29	0V	44	
13		30	0V	45	
14		31	DOSRC3	46	
15		32	DOSRC3	47	
16				48	
17	0V			49	+24F
18	0V			50	+24F

Peripheral device A4

01	DI131			33	DO129
02	DI132	19		34	DO130
03	DI133	20		35	DO131
04	DI134	21		36	DO132
05	DI135	22		37	DO133
06	DI136	23		38	DO134
07	DI137	24		39	DO135
08	DI138	25		40	DO136
09	DI139	26		41	
10	DI140	27		42	
11		28		43	
12		29	0V	44	
13		30	0V	45	
14		31	DOSRC3	46	
15		32	DOSRC3	47	
16				48	
17	0V			49	+24F
18	0V			50	+24F

NOTE
Refer to the previous page about details of connection.

4.4 INTERFACE FOR WELDING MACHINES

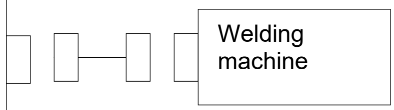
4.4.1 Connection between the Process I/O Board MB and Welding Machines

Controller

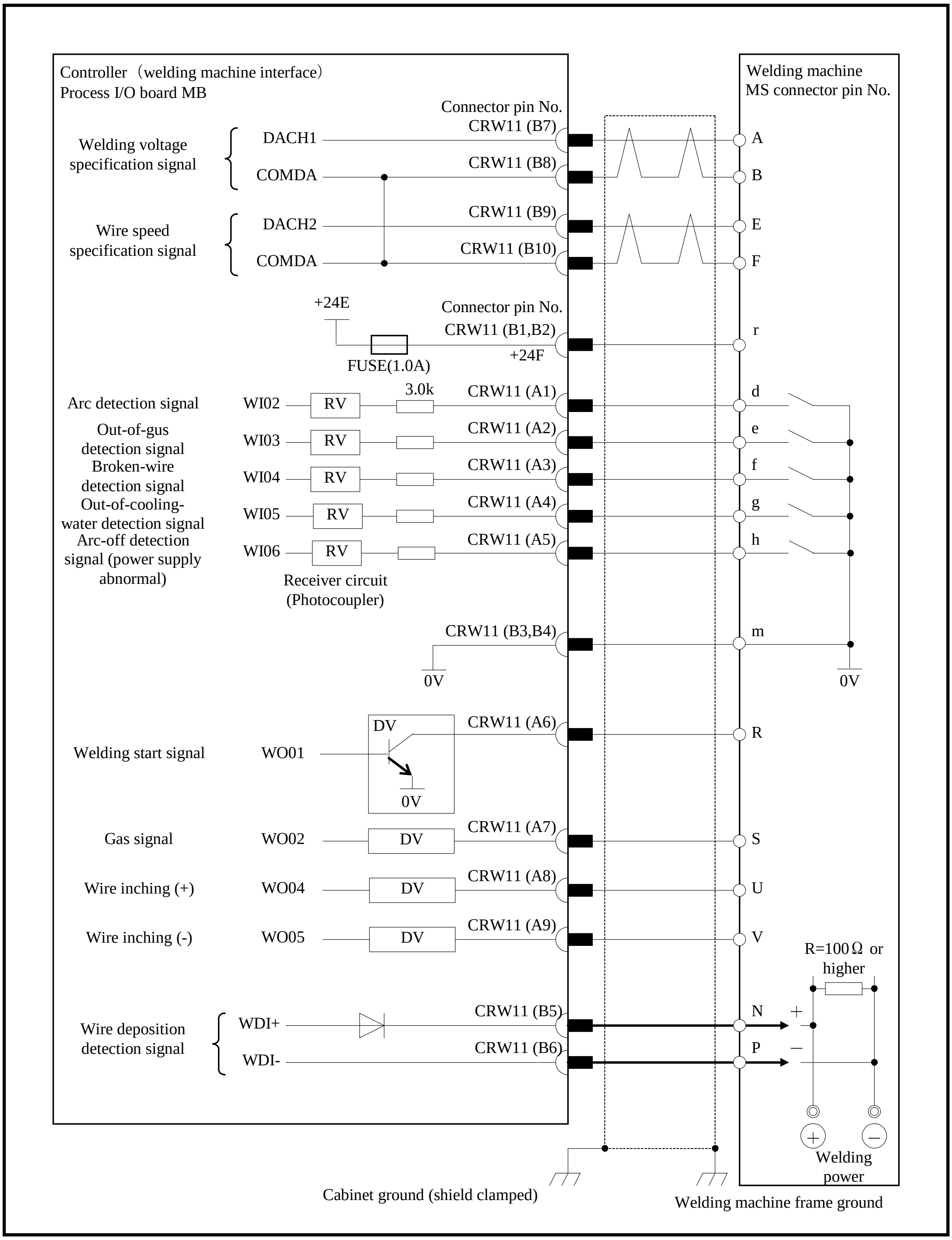
Welding machine interface

CRW11

	A	B
01	WI02	24F
02	WI03	24F
03	WI04	0V
04	WI05	0V
05	WI06	WDI+
06	WO01	WDI-
07	WO02	DACH1
08	WO04	COMDA
09	WO05	DACH2
10		COMDA



> **NOTE**
> 1 The welding machine connection cable is optional.



Pin-to-pin connection between CRW11 connector and welding machine connector (FANUC interface) (analog output, welding wire deposition detection, WI/WO connection)

4.5 EE INTERFACE

4.5.1 Connection between the Robot and End Effector

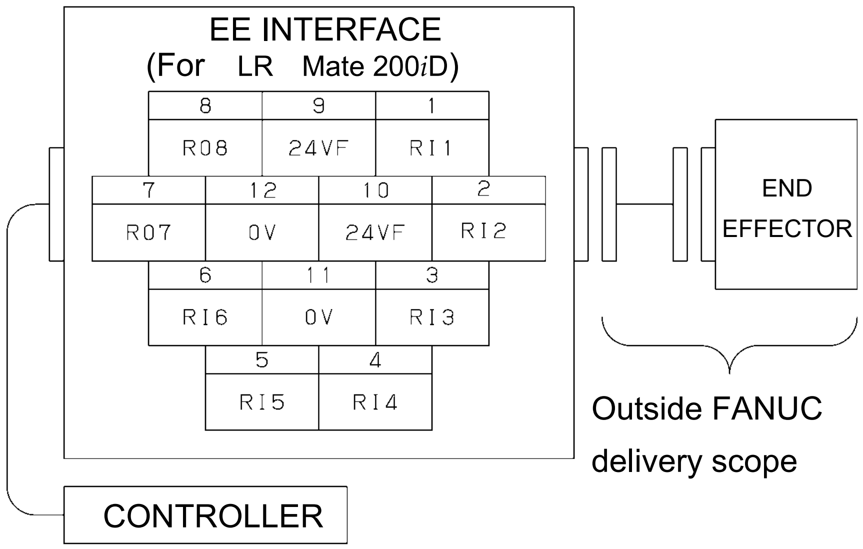


Fig.4.5.1(a) Connection of End effector (In case of LR Mate 200*i*D)

> **NOTE**
> RO1 to RO6 are used as the on/off signals of the solenoid valve option.
> For details, refer to the operator's manual of each robot.

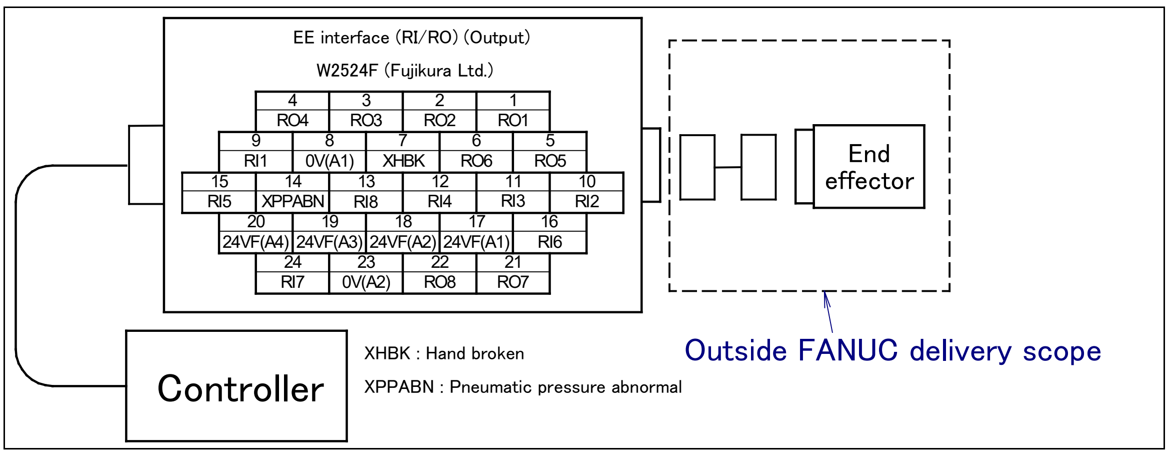
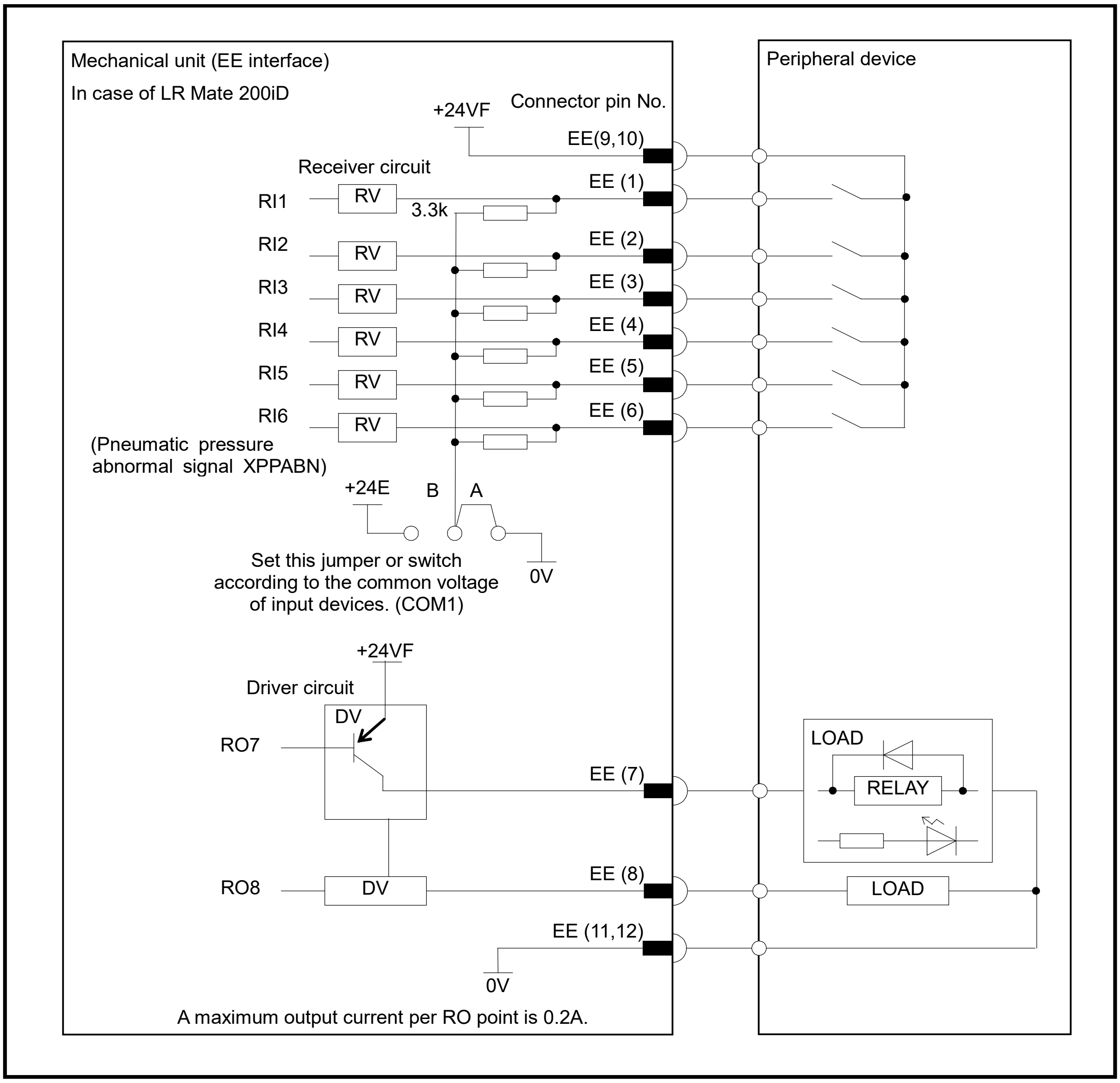


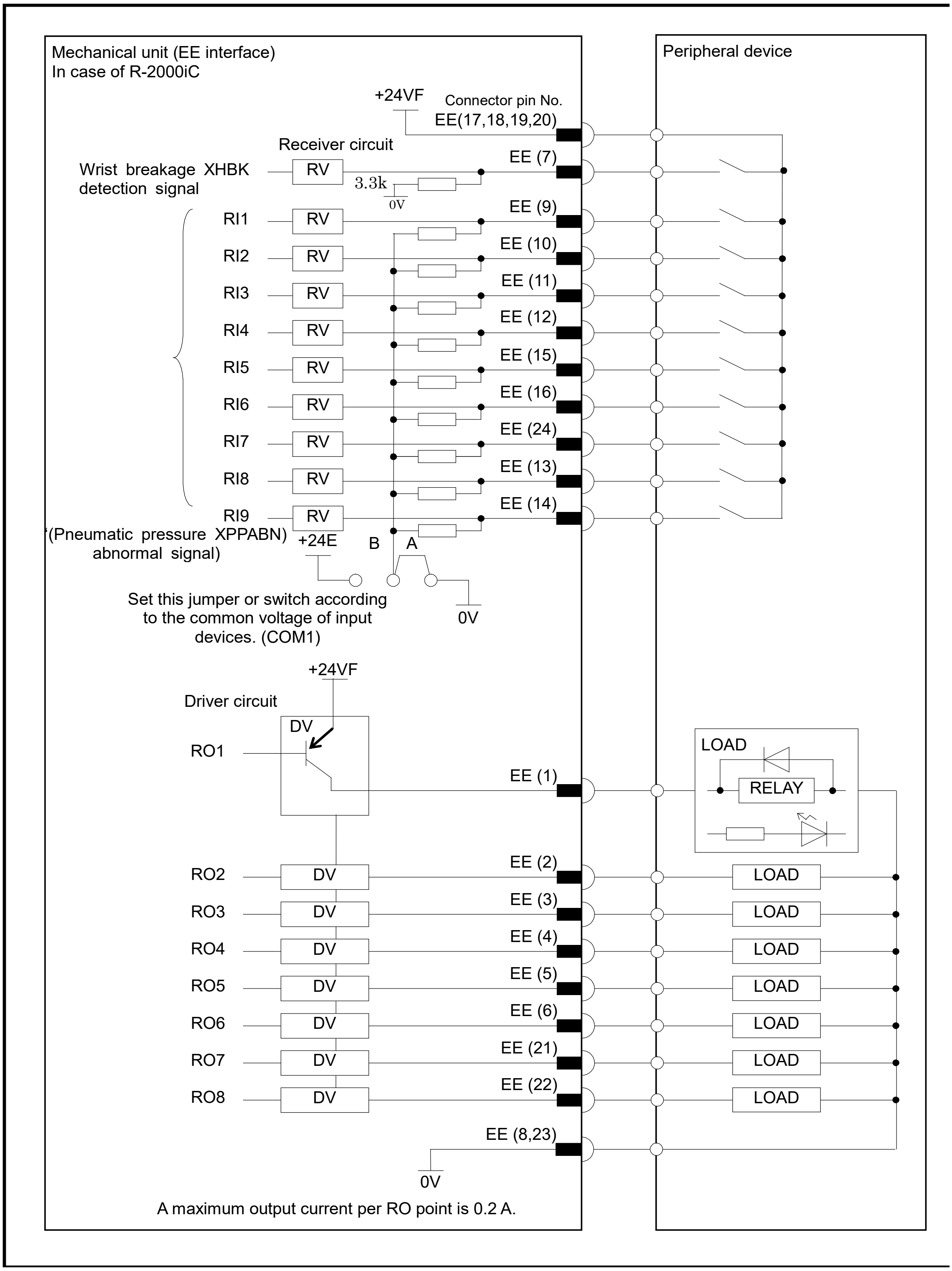
Fig.4.5.1(b) Connection of End effector (In case of R-2000*i*C)

> **NOTE**
> EE interface depends on the option of the robot. Refer to the operator's manual of each robot.



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 6-axis servo amplifier.



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 6-axis servo amplifier.

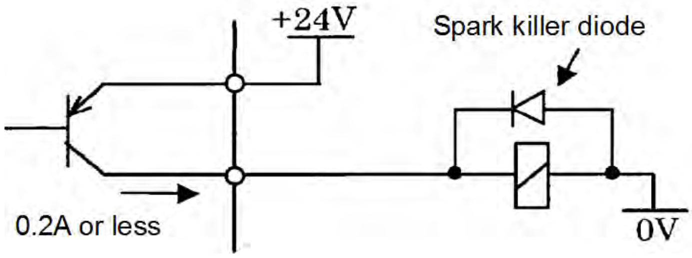
4.6 DIGITAL I/O SIGNAL SPECIFICATIONS

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

4.6.1 Peripheral Device Interface A

(1) Output signals in peripheral device interface A (Source type DO)

(a) Example of connection



(b) Electrical specifications

Maximum load current when driver is on:	200mA (including momentary level)
Saturation voltage when driver is on:	1.0V max.
Dielectric strength:	24V ±20% (including momentary level)
Leakage current when driver is off:	100μA

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

Power supply voltage: +24V ±10%

Power supply current: For each printed circuit board of this type (Total sum of maximum load currents including momentary levels + 100mA 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 unit is turned off or later

(d) Spark killer diode

Rated peak reverse voltage: 100V or more

Rated effective forward current: 1A 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 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

Do not use the +24V power supply of the robot.

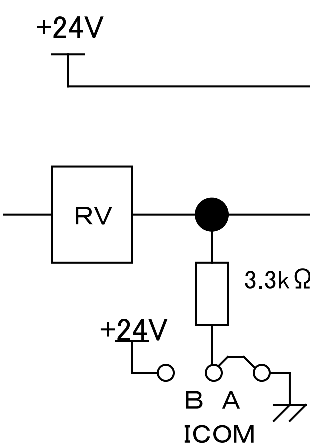
When adding a relay, solenoid, or the like directly to the circuit, connect a diode for counter electromotive voltage protection in parallel to the load.

When using a load, such as a lamp, that generates surge current when it is turned on, install a protection resistor.

(g) Applicable signals
Output signals of main board I/O board CRMA15 and CRMA16
CMDENBL, FAULT, BATALM, BUSY, DO101 to DO120

Output signals of Process I/O board CRMA52A and CRMA52B
DO01 to DO16

(2) Input signals in peripheral device interface A
(a) Example of connection

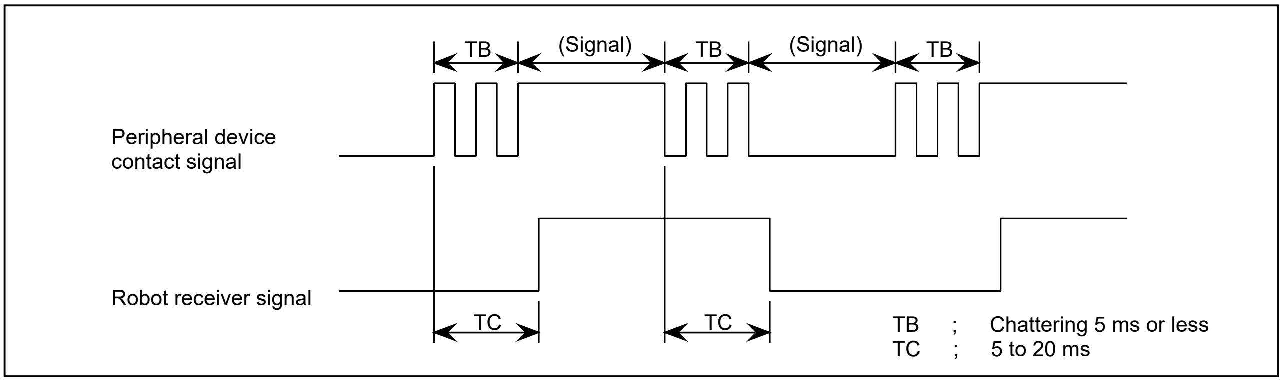


(b) Electrical specifications of the receiver

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

Voltage and Current:	DC24V, 0.1A
	(Use a contact which minimum load is 5mA or 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

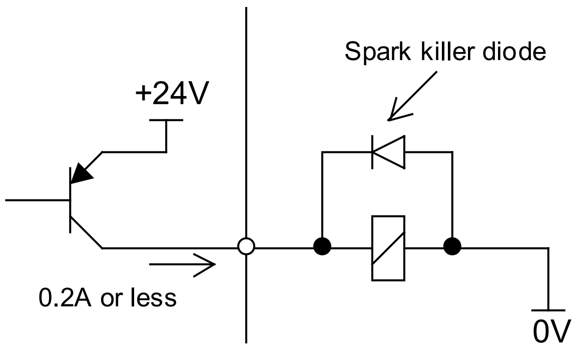


(d) Note on use
Apply the +24 V power at the robot to the receiver.
However, the above signal specifications must be satisfied at the robot receiver.

(e) Applicable signals
Input signals of main board CRMA15 and CRMA16
XHOLD, FAULT RESET, START, HOME, ENBL
DI101 to DI120
Input signals of Process I/O board CRMA52A and CRMA52B
DI01 to DI20

4.6.2 EE Interface

(1) Output signals in EE interface
(a) Example of connection



(b) Electrical specifications

Maximum load current when driver is on:	200mA (including momentary level)
Saturation voltage when driver is on:	1.0V max.
Dielectric strength:	24V ±20% (including momentary level)
Leakage current when driver is off:	100μA

(c) Power supply to output signals
The +24V power supply on the robot side can be used if the total current level, including the current of the welding interface, is 0.7A or less.

(d) 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 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.

(e) 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.
When using a load, such as a lamp, that generates surge current when it is turned on, install a protection resistor.

(f) Applicable signals
RO1 to RO8

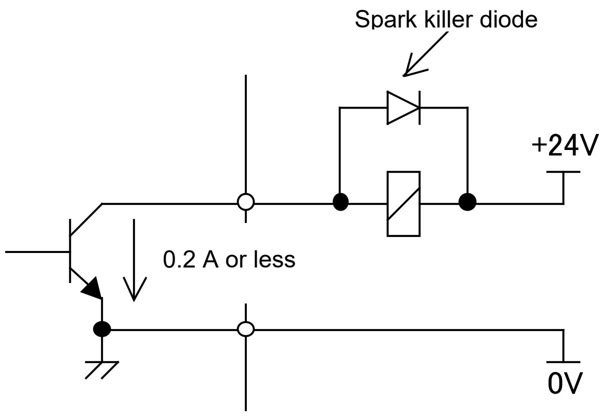
(2) Input signal in peripheral device interface
The input signals are the same as those of other I/O boards. (Refer to Subsection 4.5.1 in CONNECTIONS.)

(a) Applicable signals
RI1 to RI8, XHBK, XPPABN

4.6.3 I/O Signal Specifications for ARC-Welding Interface (A-cabinet/Process I/O Board MB)

(1) Specification for arc welding machine interface digital output signals

(a) Example of connection



(b) Electrical specifications

Rated voltage:	24VDC
Maximum applicable voltage:	30VDC
Maximum load current:	200mA (including momentary level)
Transistor type:	Open-collector NPN
Saturation voltage when the circuit is on:	Approximately 1.0V

(c) Spark killer diode

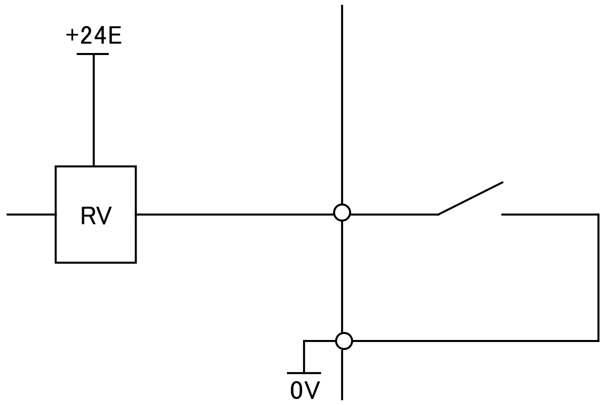
Rated peak-to-peak reverse withstand voltage:	100V or higher
Rated effective forward current:	1A or more

(d) Caution for use
The arc welding machine interface can use the +24V power supply of the robot unless the sum of its sink current and that of the EE interface exceeds 0.7A. When using a relay or solenoid directly as a load, connect the load and a back electromotive force voltage prevention diode in parallel.
When using a load, such as a lamp, that generates surge current when it is turned on, install a protection resistor.

(e) Applicable signals
Arc welding machine interface output signals
[WO1, 2,4,5]

(2) Specification for arc welding machine interface digital input signals

(a) Example of connection

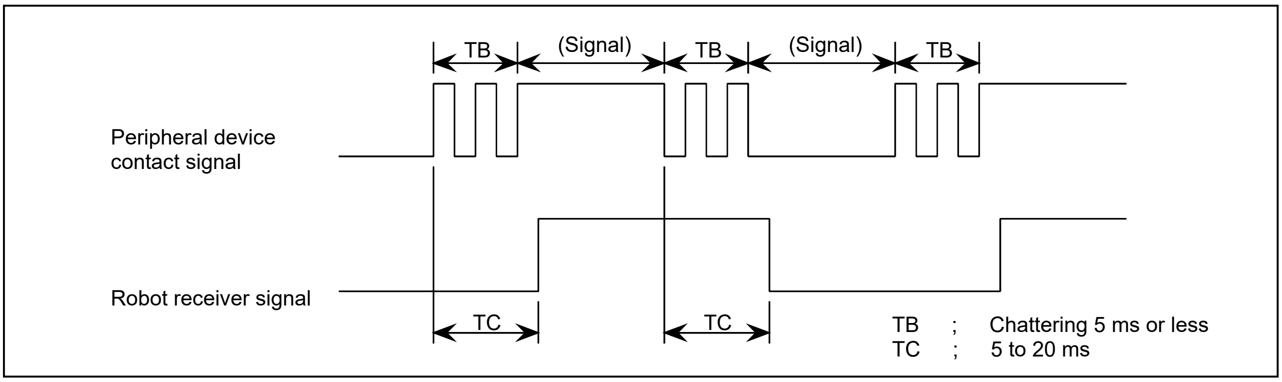


(b) Electrical specifications of the receiver

Type:	Grounded voltage receiver	
Rated input voltage:	Contact close	+20V to +28V
	Contact open	0V to +4V
Maximum applied input voltage:	+28VDC	
Input impedance:	3.0kΩ (approx.)	
Response time:	5ms to 20ms	

(c) Specifications of the peripheral device contact

Voltage and Current:	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.

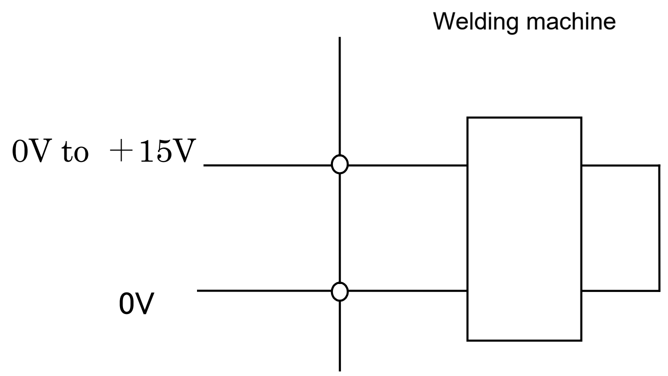
(e) Applicable signals

Arc welding machine interface input signals

[WI2 to 6]

(3) Specification for arc welding machine interface analog output signals (welding voltage and wire feed speed specification signals)

(a) Example of connection



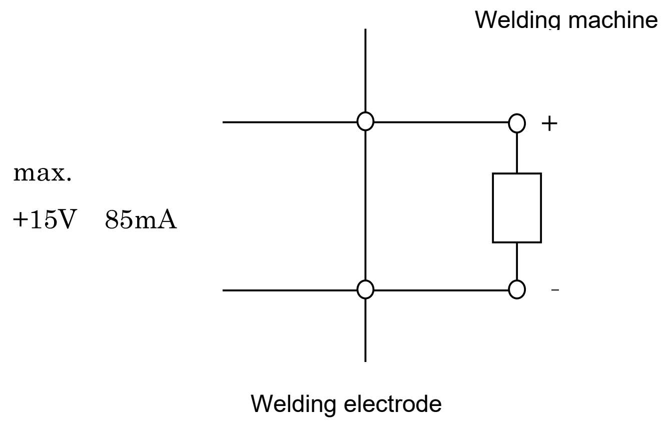
(b) Caution for use

Input impedance: 3.3kΩ or higher

Install a high-frequency filter.

(Wire deposit detection: WDI+ and WDI-)

(a) Example of connection



(Wire deposition detection: WDI+, WDI-)

(b) Caution for use

The resistance between the + and - terminals of the welding machine must be 100 Ω or higher.

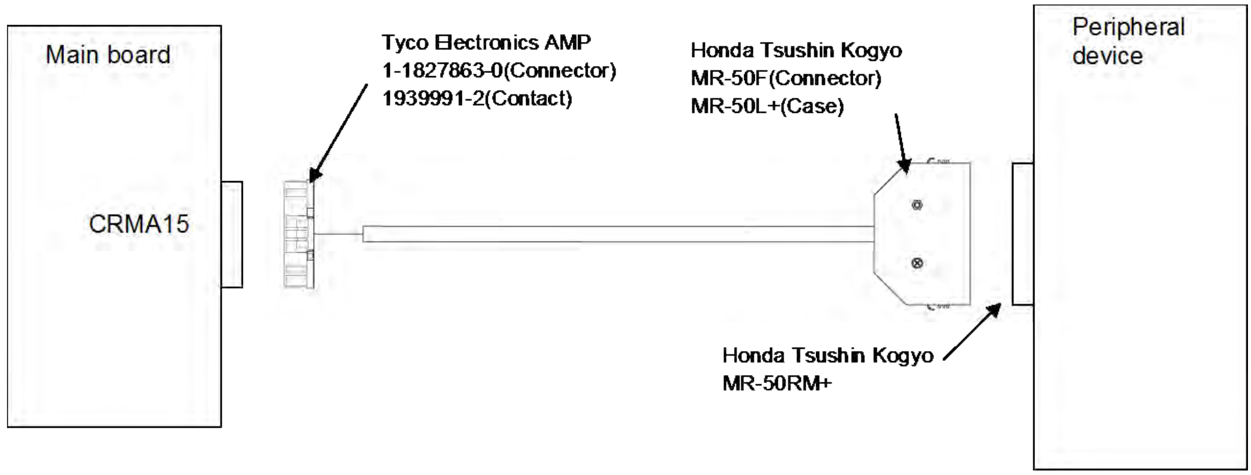
The TIG welding deposition detection circuit must be isolated from the welding circuit (high frequency).

This circuit can withstand up to 80 V.

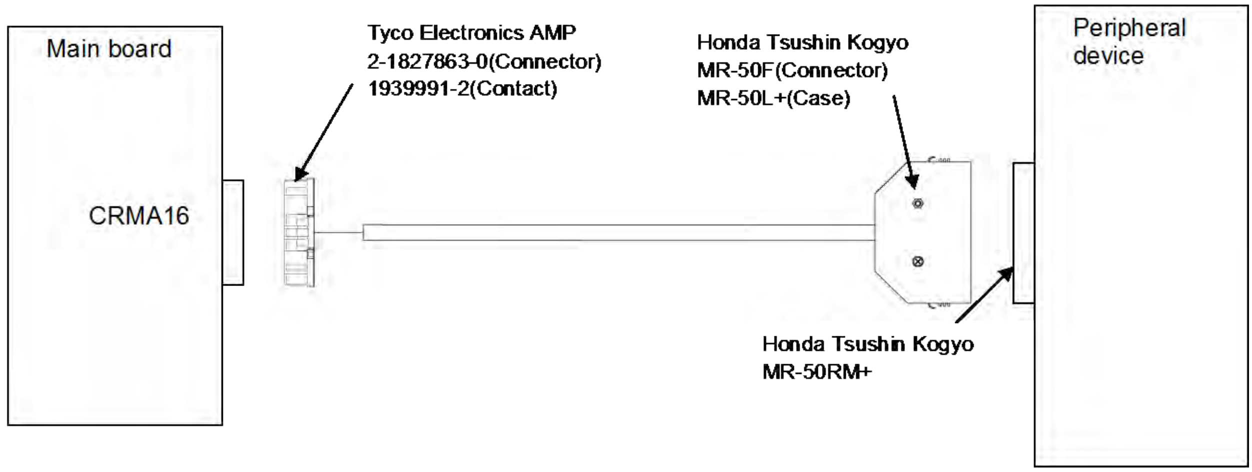
4.7 SPECIFICATIONS OF THE CABLES USED FOR PERIPHERAL DEVICES AND WELDERS

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.)

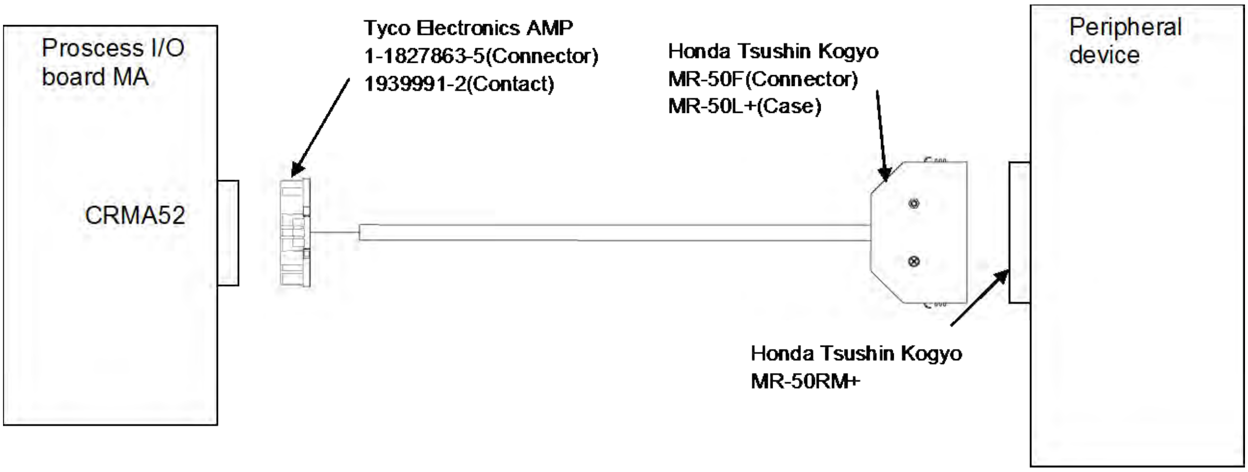
4.7.1 Peripheral Device Interface A1 Cable (CRMA15: Tyco Electronics AMP, 40 pins)



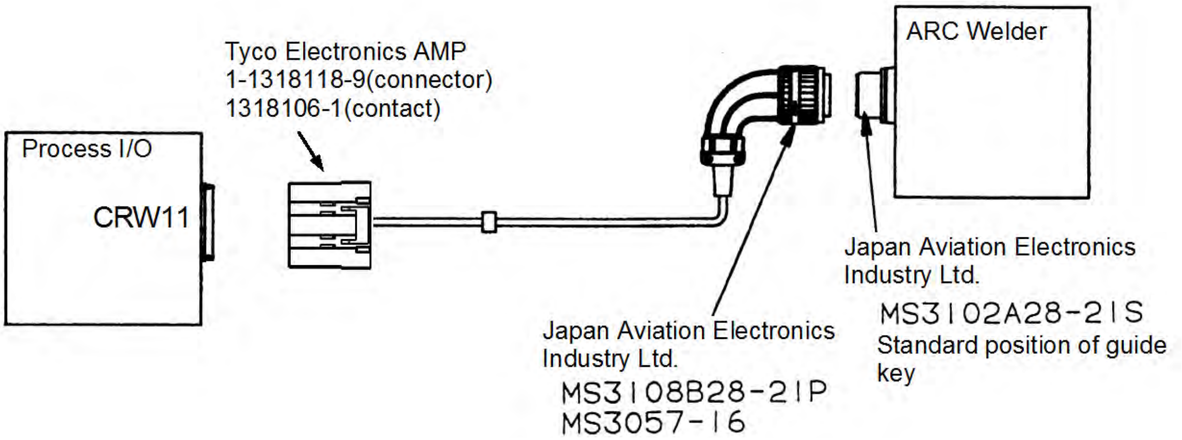
4.7.2 Peripheral Device Interface A2 Cable (CRMA16: Tyco Electronics AMP, 40 pins)



4.7.3 Peripheral Device Interface B1 and B2 Cables (CRMA52; Tyco Electronics AMP, 30 pin)



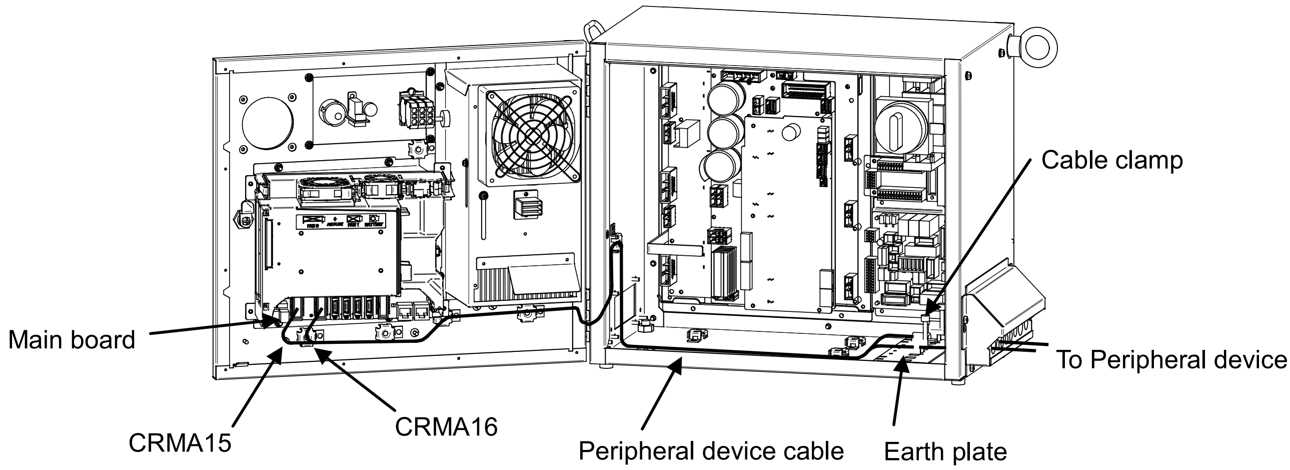
4.7.4 ARC Weld Connection Cables (CRW11; Tyco Electronics AMP, 20 pin)

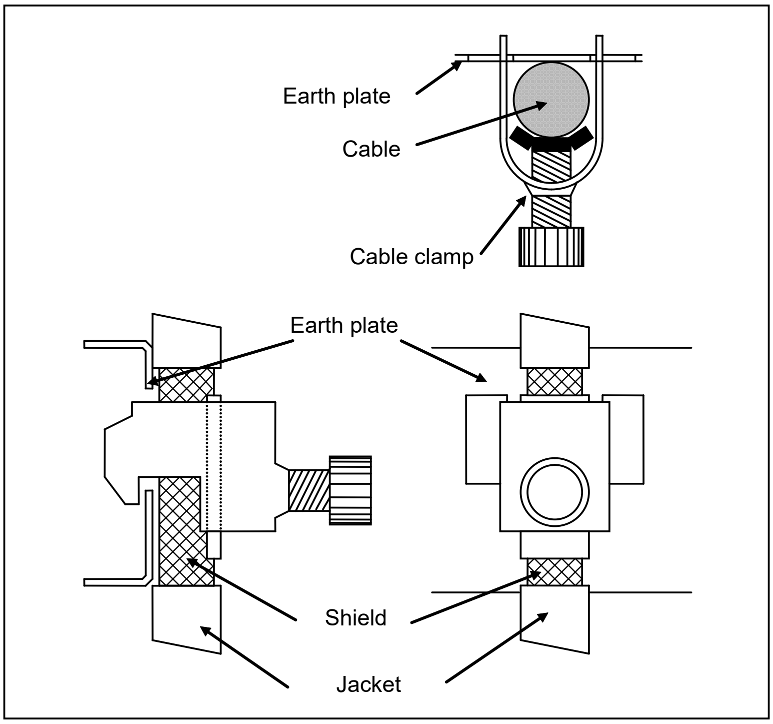


4.8 CABLE CONNECTION FOR THE PERIPHERAL DEVICES, END EFFECTORS, AND ARC WELDERS

4.8.1 Peripheral Device Connection Cable

Fig.4.8.1 shows the connection of the peripheral device cable in the cabinet.



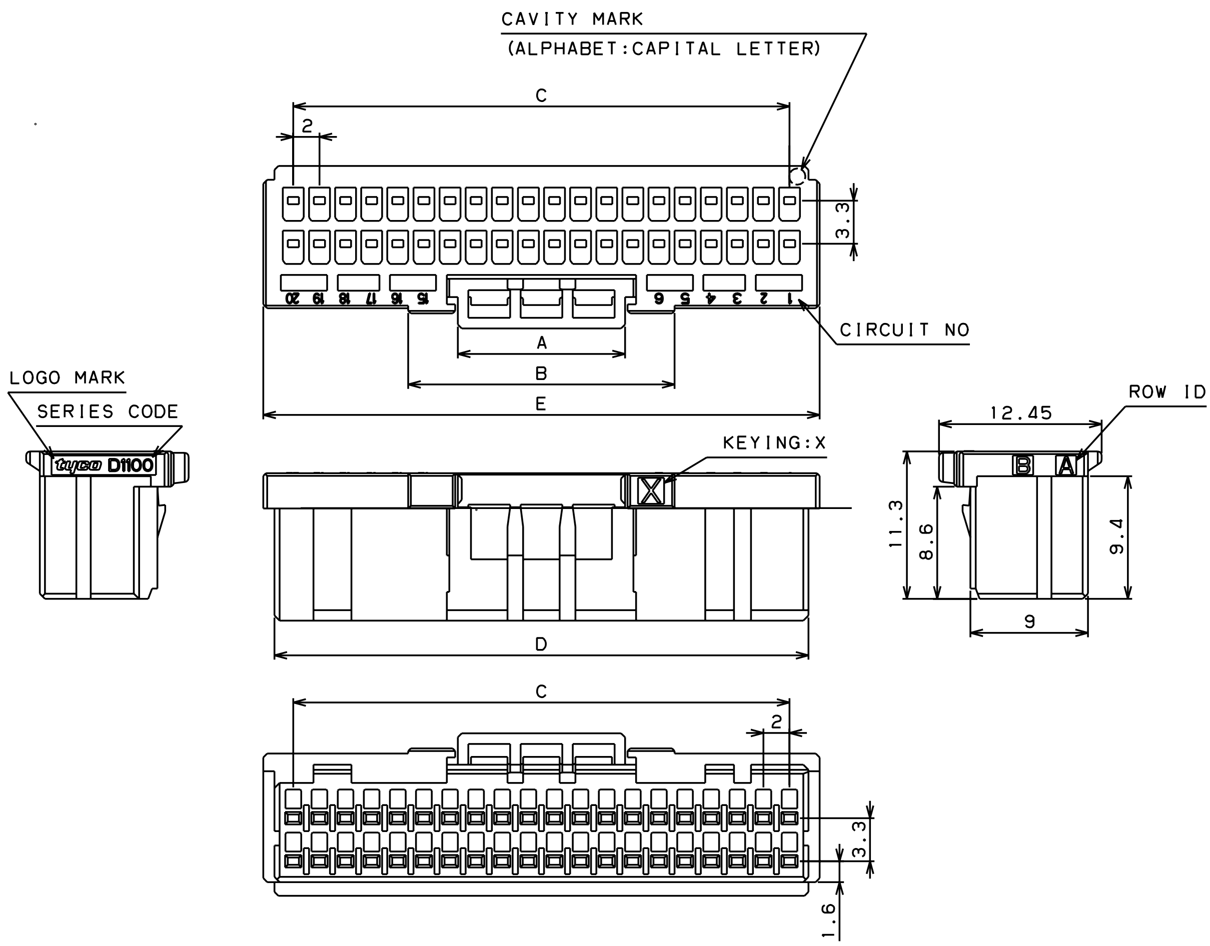


> **NOTE**
> For protection against the noise, cut part of the jacket of the connection cable to expose the shield, and fasten this part to the earth plate with the cable clamp.

Fig.4.8.1 Peripheral Device Cable Connection

4.8.2 Peripheral Device Cable Connector

(1) The connector for peripheral device cables (Robot controller side).

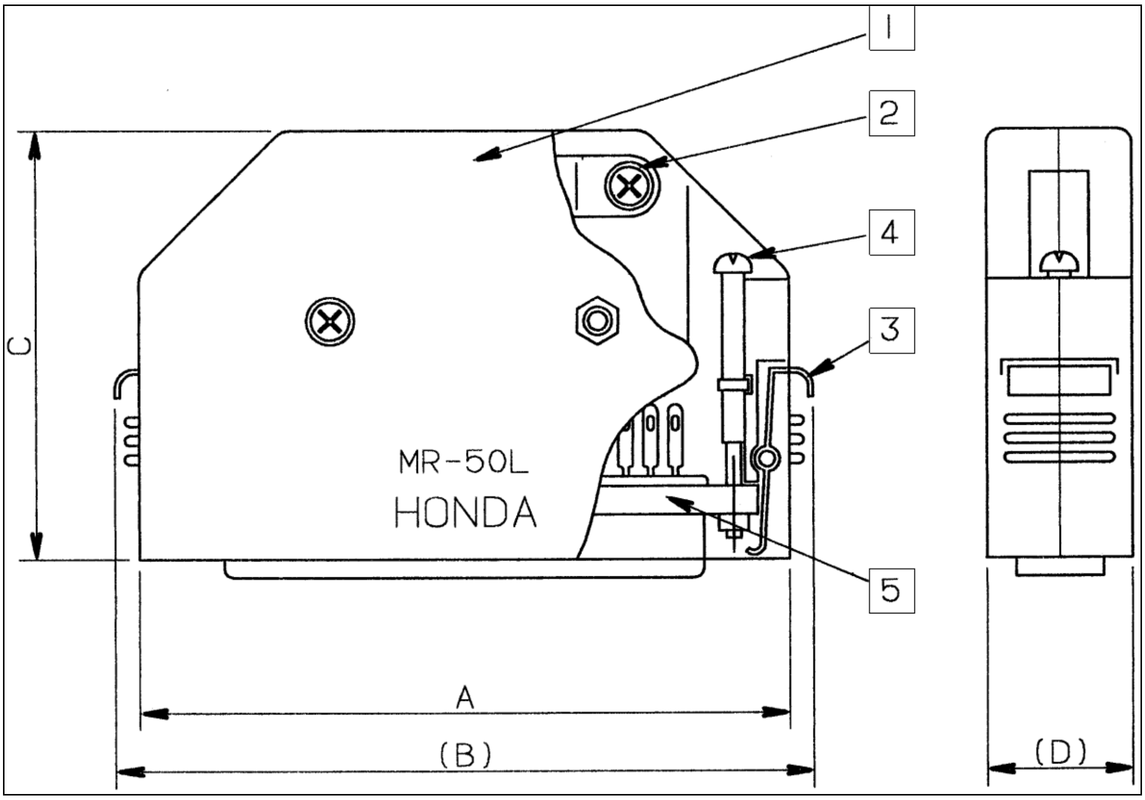


Connector specifications	Applicable interface	Dimensions A	B	C	D	E	Remark
1-1827863-0 (Connector)	CRMA15	12.8	20.4	38.0	40.9	42.6	Tyco Electronics AMP 40 pins (X-key)
2-1827863-0 (Connector)	CRMA16						Tyco Electronics AMP 40 pins (Y-key)
1939991-2 (Contact)	CRMA15 CRMA16						Tyco Electronics AMP

Maintenance tool
Hand tool (for crimping contact) 2119141-1:A05B-2550-K064
Extraction tool 1891526-1:A05B-2550-K061

Fig.4.8.2 (a) Peripheral device cable connector

(2) The connector for peripheral device cables (Peripheral device side).

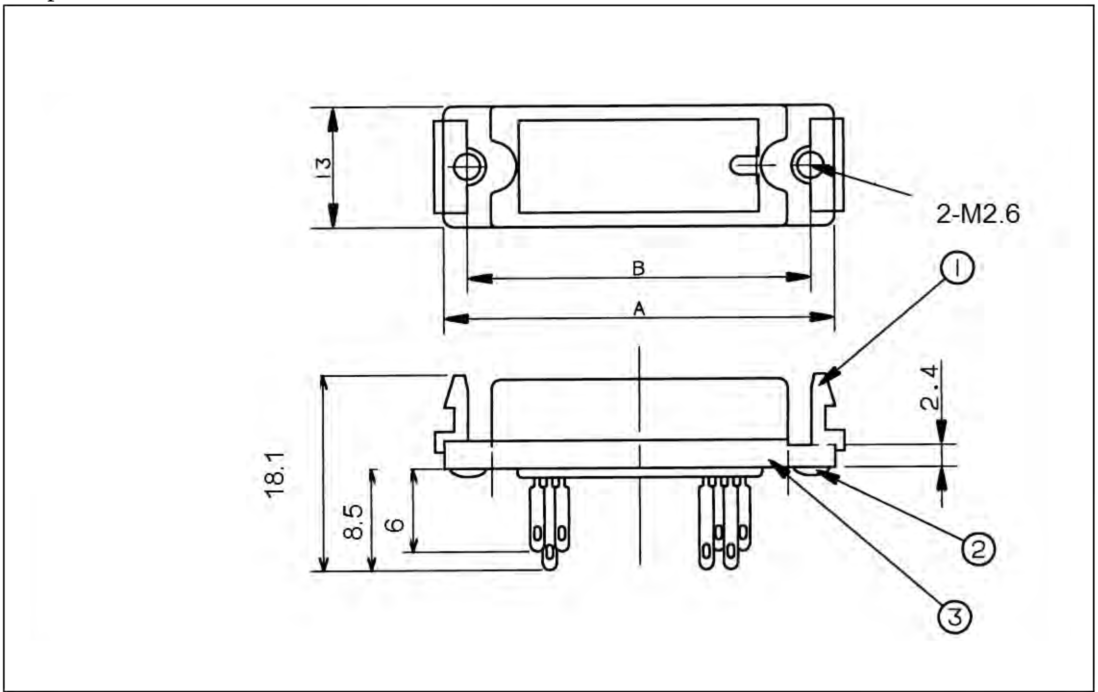


Connector specifications	Applicable interface	Dimensions				Remark
		A	(B)	C	(D)	
MR-50F(Connector) MR-50L+(Case)	Peripheral Device	67.9	73.5	44.8	18	Honda Tsushin Kogyo, 50 pins (F) Solder type

Symbol	Name
1	Connector cover
2	Cable clamp screw
3	Connector clamp spring
4	Connector clamp screw
5	Connector

Fig.4.8.2 (b) Peripheral device cable connector

(3) Peripheral device connector



Connector specifications	Applicable device	Dimensions		Remark
		A	B	
MR-50RM+	Peripheral Device	61.4	56.4	Honda Tsushin Kogyo, 50 pins (F) Solder type

Symbol	Name
(1)	Connector clamp screw
(2)	Screw M2.6 x 8
(3)	Connector

Fig.4.8.2 (c) Peripheral device connector

4.8.3 Recommended Cables

(1) Peripheral device connection cable
Connect a peripheral device using a completely shielded, heavily protected cable conforming to the specifications in Table 4.8.3 (a).
Allow an extra 50 cm for routing the cable in the controller.
The maximum cable length is 30 m.

Table 4.8.3 (a) Recommended Cable (for Peripheral Device Connection)

Number of wires	Wire specifications (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
20	A66L-0001-0041	ϕ1.05	7/0.18 AWG24	1.5	ϕ10.5	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 4.8.3 (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 4.8.3 (b) Recommended Cable (for End Effector Connection)

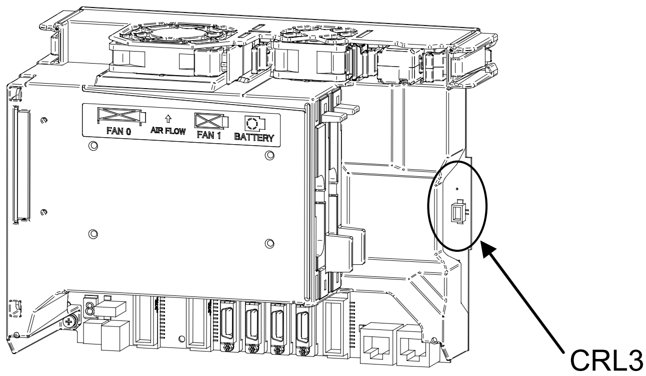
Number of wires	Wire specifications (FANUC specifications)	Conductor		Sheath thickness (mm)	Effective outside diameter (mm)	Electrical characteristics	
		Diameter (mm)	Configuration			Conductor resistance (Ω/km)	Allowable current (A)
6	A66L-0001-0143	ϕ1.1	40/0.08 AWG24	1.0	ϕ5.3	91	3.7
20	A66L-0001-0144	ϕ1.1	40/0.08 AWG24	1.0	ϕ8.6	91	2.3
24	A66L-0001-0459	ϕ0.58	40/0.08 AWG24	1.0	ϕ8.3	93	2.3

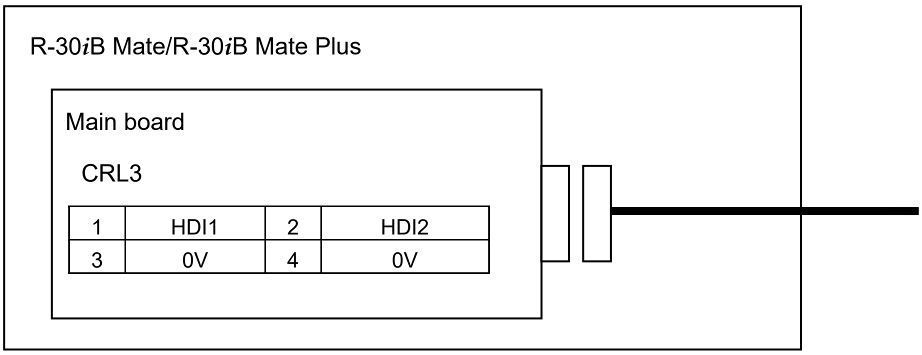
NOTE
For protection against the noise, cut part of the jacket of the connection cable to expose the shield, and fasten this part to the earth plate with the cable clamp.

4.9 CONNECTION OF HDI

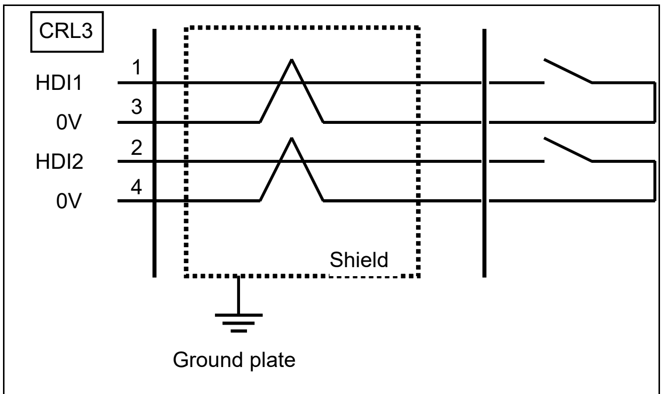
4.9.1 Connecting HDI

The HDI signals are used in combination with special application software. The HDI signals cannot be used as general-purpose DIs.





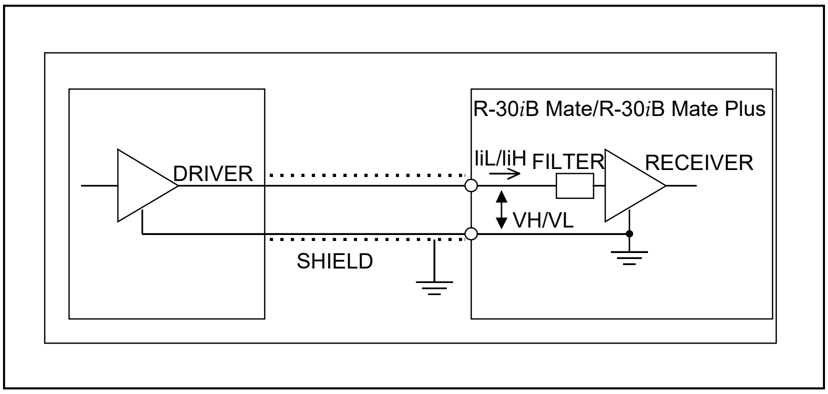
Cable connections



> **NOTE**
> For protection against the noise, cut part of the jacket of the connection cable to expose the shield, and fasten this part to the earth plate with the cable clamp.

4.9.2 Input Signal Rules for the High-speed Skip (HDI)

Circuit configuration



Absolute maximum rating

Input voltage range Vin: -3.6 to +10 V

Input characteristics

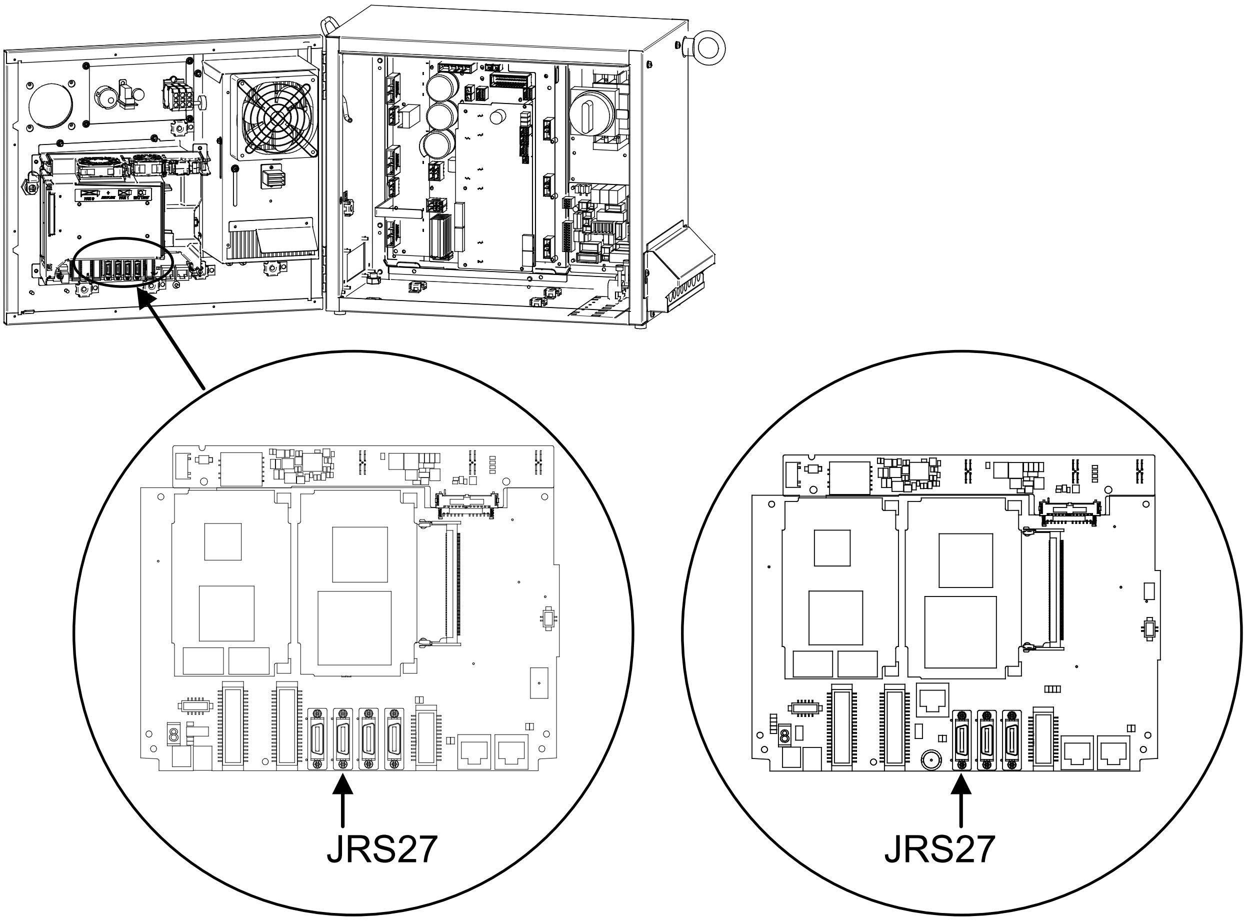
Unit	Symbol	Specification	Unit	Remark
High level input voltage	VH	3.6 to 11.6	V	
Low level input voltage	VL	0 to 1.0	V	
High level input current	IiH	2 (max)	mA	Vin=5 V
		11 (max)	mA	Vin = 10 V
Low level input current	IiL	-8.0 (max)	mA	Vin = 0 V
Input signal pulse duration		20 (min)	μs	
Input signal delay or variations		20 (max)	μs	

> **NOTE**
> 1 The plus (+) sign of IiH/IiL represents the direction of flow into the receiver. The minus (-) sign of IiH/IiL represents the direction of flow out of the receiver.
> 2 The high-speed skip signal is assumed to be 1 when the input voltage is at the low level and 0 when it is at the high level.

4.10 CONNECTING THE COMMUNICATION UNIT

4.10.1 RS232C Interface

4.10.1.1 Interface



(R-30*i*B Mate) **(R-30*i*B Mate Plus)**

JRS27

1	RD (RXDA)	11	SD (TXDA)	Honda Tsushin Kogyo CONNECTOR: PCR-E20FS COVER: PCR-V20LA, or compatible connector
2	SG (0V)	12	SG (0V)	
3	DR (DSRA)	13	ER (DTRA)	
4	SG (0V)	14	SG (0V)	
5	CS (CTSA)	15	RS (RTSA)	
6	SG (0V)	16	SG (0V)	
7		17		
8		18		
9		19	+24V (24V-3)	
10	+24V (24V-3)	20		

NOTE
1 +24 V can be used as the power supply for FANUC RS-232-C equipment.
2 Do not connect anything to those pins for which signal names are not indicated.

4.10.1.2 RS232C interface signals

Generally signals as follows are used in RS232C interface.

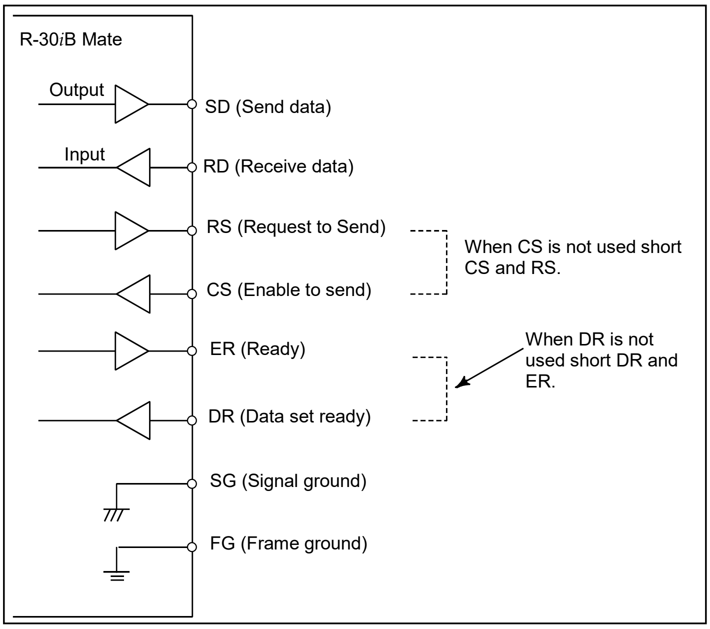
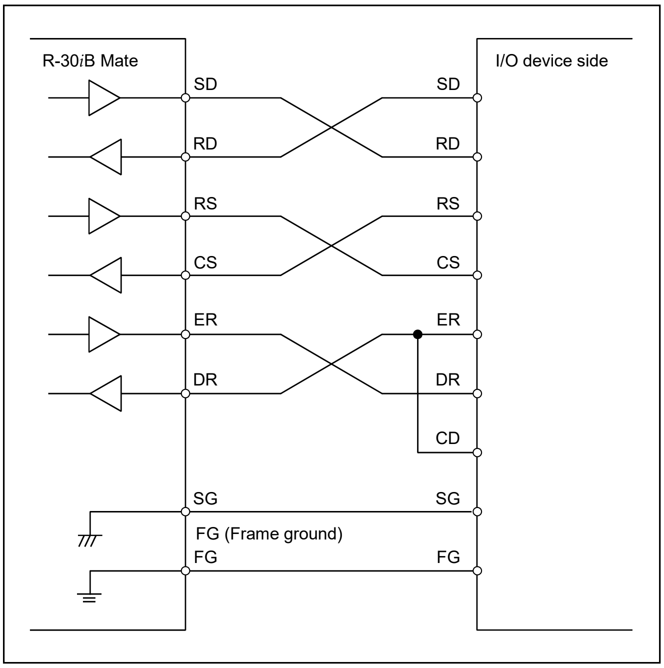


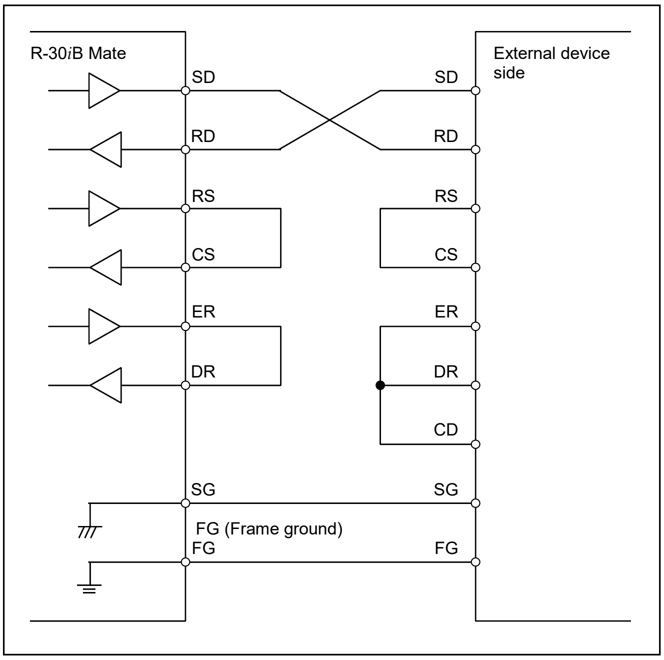
Fig.4.10.1.2 RS232C interface

4.10.1.3 Connection between RS232C interface and I/O device

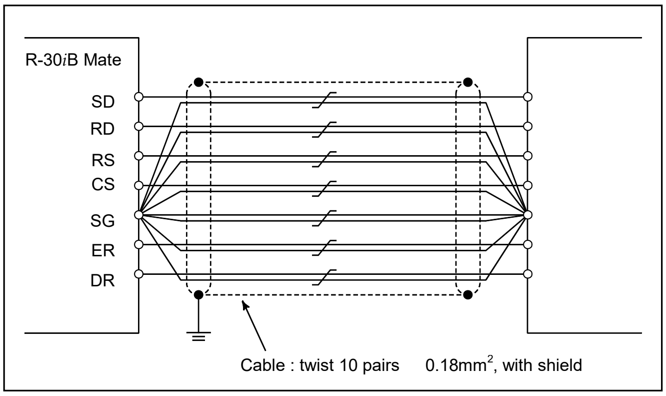
The figure below shows a connection with the handshaking of the ER/DR, RS/CS signals.



- The figure below shows a connection without the handshaking of the RS/CS, ER/DR signals.



Cable connection



Pair each signal with SG.

> **NOTE**
> For protection against the noise, cut part of the jacket of the connection cable to expose the shield, and fasten this part to the earth plate with the cable clamp.

4.10.2 Ethernet Interface

This section describes information relating to the physical Ethernet connection.

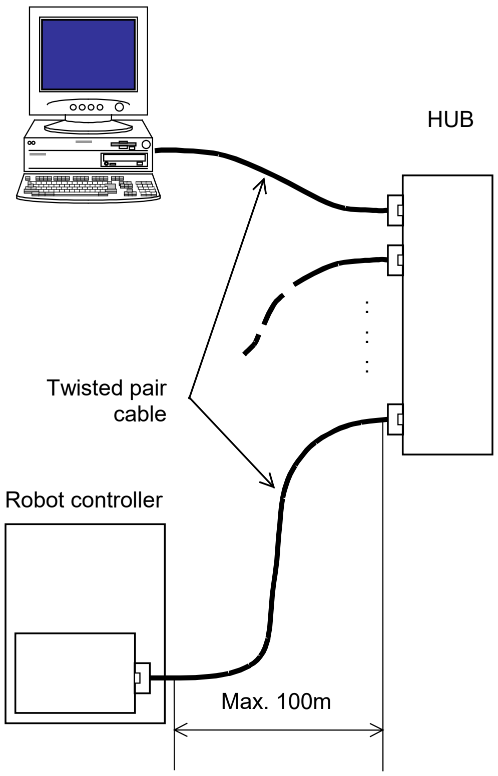
> ⚠ **CAUTION**
>
> 1 Before connecting or disconnecting the Ethernet cable, make sure that the power to the robot controller is turned off.
>
> 2 Please inquire of each manufacturer (of hub, transceiver, cable etc.) about the construction of network or the condition of using the equipment. When configuring 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 robot, conduct a communications test before you actually start operating the robot. We cannot ensure operation that is influenced by network trouble caused by a device other than the robot controller.

4.10.2.1 Connection to Ethernet

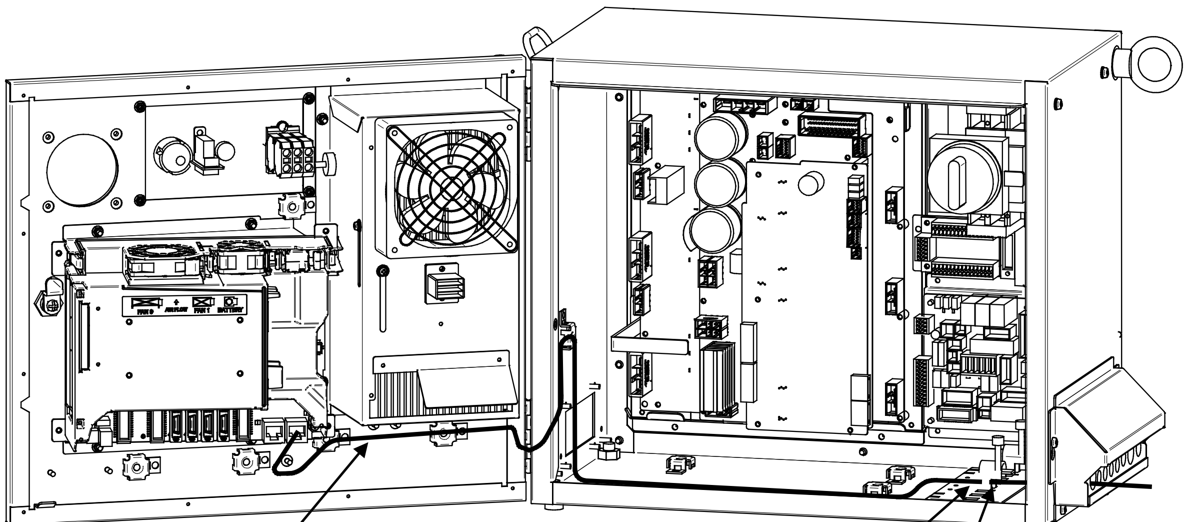
The robot controller is provided with a 100BASE-TX interface and 1000BASE-T (Only R-30***i***B Mate Plus) interface.
Prepare a hub for connecting the controller to the Ethernet trunk. The following shows an example of a general connection.

To connect the control unit to the CD38C (for R-30*i*B Mate Plus) Ethernet interface in a half duplex communication mode, use a hub which satisfies the following conditions:
- Supports 100BASE-TX/1000BASE-T.
- Has an auto-negotiation function.
- Supports store-and-forward switching.
- Supports flow control.

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 robot controller. Be sure to install such devices in a dust-proof cabinet.



4.10.2.2 Routing of the Ethernet cable



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 controller even if the Ethernet cable is pulled directly. This clamp is also used to ground the cable shield.

4.10.2.3 100BASE-TX connector (CD38A, CD38B) / 1000BASE-T Connector (CD38C) pin assignments

CD38A,CD38B (R-30*i*B Mate, R-30*i*B Mate Plus)

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

CD38C (1000BASE-T, R-30*i*B Mate Plus only)

Pin No.	Signal name	Description
1	MDI0+	Bi-directional Data 0+
2	MDI0-	Bi-directional Data 0-
3	MDI1+	Bi-directional Data 1+
4	MDI2+	Bi-directional Data 2+
5	MDI2-	Bi-directional Data 2-
6	MDI1-	Bi-directional Data 1-
7	MDI3+	Bi-directional Data 3+
8	MDI3-	Bi-directional Data 3-

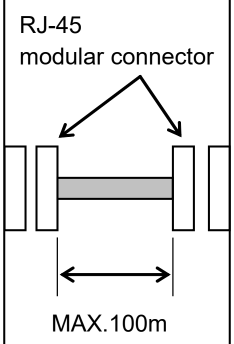
4.10.2.4 Twisted-pair cable specification

Cable Connection

The cable used for connection between the 100BASE-TX/1000BASE-T interface, CD38, of the controller and the hub is connected as follows:

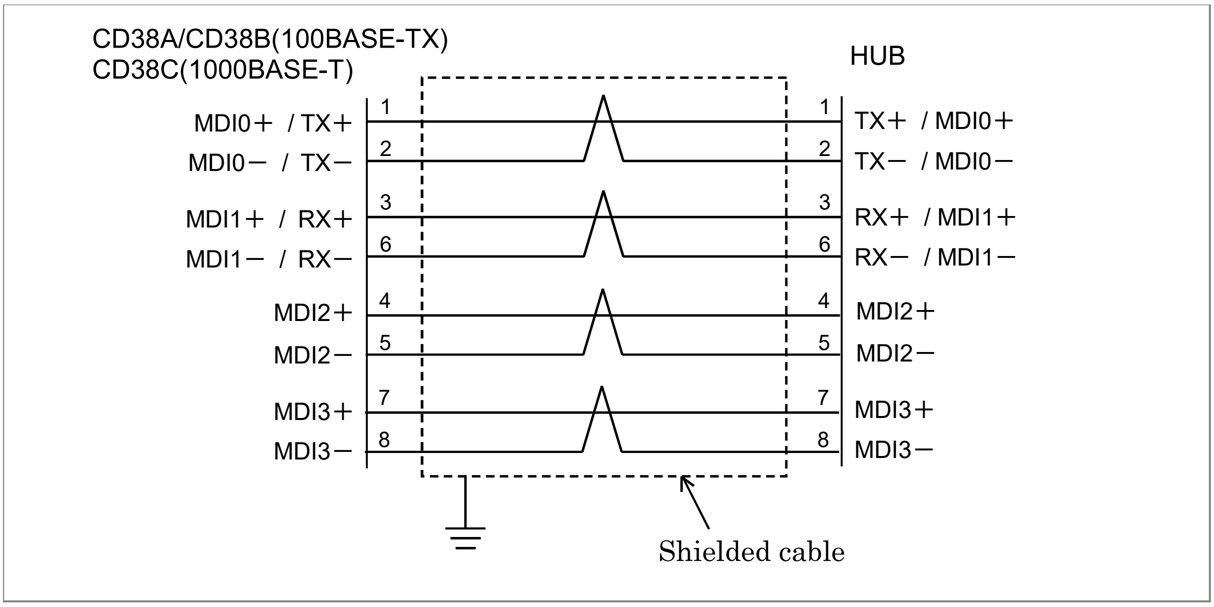
R-30*i*B Mate/R-30*i*B Mate Plus
CD38A,CD38B (R-30*i*B Mate/R-30*i*B Mate Plus)
CD38C (R-30*i*B Mate Plus)

Pin No.	100BASE-TX (CD38A/CD38B)	1000BASE-T (CD38C)
1	TX+	MDI0+
2	TX-	MDI0-
3	RX+	MDI1+
4		MDI2+
5		MDI2-
6	RX-	MDI1-
7		MDI3+
8		MDI3-

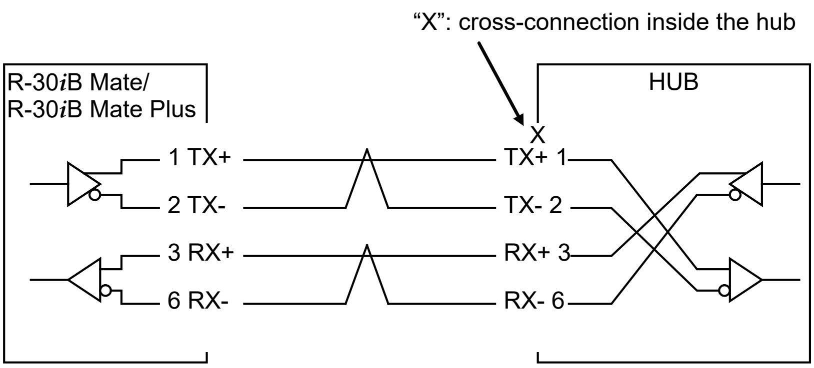


HUB

Pin No.	100BASE-TX	1000BASE-T
1	TX+	MDI0+
2	TX-	MDI0-
3	RX+	MDI1+
4		MDI2+
5		MDI2-
6	RX-	MDI1-
7		MDI3+
8		MDI3-



- 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.



(1) Cable Materials

> ⚠ **CAUTION**
> Unshielded cable (UTP cable) is commercially available as 100BASE-TX/ 1000BASE-T twisted-pair cable: You should, however, use shielded Category 5(100BASE-TX) / 5e(1000BASE-T) twisted-pair cable (STP cable) to improve the resistance to electrical noise in an FA environment.

Recommended Cables (Non-flexible cable, 100BASE-TX)

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

Inquiries

Manufacturer		Contact address
FURUKAWA ELECTRIC CO., LTD. Sales Headquarters		2-6-1 Marunouchi, Chiyoda-ku. Tokyo 100-8322 TEL: 03-3286-3126 FAX: 03-3286-3979
NISSEI ELECTRIC CO., LTD. Machida Branch		3F MU Bldg., 1-9-1 Minami-narise, Machida City, Tokyo 194-0045 TEL: 0427-29-2531 FAX: 0427-29-3375
	Overseas Sales Office	IWATANI International Corporation Tokyo Head Office 21-8 Nishi-shinbashi 3-chome, Minato-ku, TOKYO, 105-8458, JAPAN 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 used for moving parts.

Recommended cable (for movable parts, dedicated to FANUC)

Manufacturer	Specification	Remarks
Oki Electric Cable Co., Ltd.	AWG26 4P TPMC-C5E (S-HFR) K	CAT5e (1Gbps capable, For 1000BASE-T)
Oki Electric Cable Co., Ltd.	AWG26 4P TPMC-C5-F (SB)	CAT3, CAT5 (100Mbps capable, For 100BASE-TX)
Shinko Electric Industrial Co., Ltd.	FNC-118	CAT3, CAT5 (100Mbps capable, For 100BASE-TX)

Specification

1. Manufacture: Oki Electric Cable Co., Ltd.
   Manufacture’s model number: AWG26 4P TPMC-C5E(S-HFR) K

- Electrical characteristic:
  Complying with EIA/TIA 568B.2 Category 5e.
- Structure:
  Common-shield braided cable with drain wire. The conductors of the cable are AWG26 annealed-copper strand wire, with a sheath 0.6 mm thick and an outer diameter of 6.8 mm.
- Fire resistance:
  UL1581 VW-1
- Oil resistance:
  As per Fanuc’s internal standard (Equivalent to conventional oil-resistant electrical cable)
- Flexing resistance:
  Sliding: 3 millions or more sliding cycles with a bending radius of 50 mm.
  bending: 300 thousands or more bending cycles with a bending radius of 20 mm
  Twisting: 5 millions or more sliding cycles. (+/- 180degrees)
- UL style No. :
  AWM20276（80℃/30V/VW-1）

2. Manufacture: Oki Electric Cable Co., Ltd.
   Manufacture’s model number: AWG26 4P TPMC-C5-F (SB)
   Manufacture: SHINKO ELECTRIC INDUSTRIES CO., LTD.
   Manufacture’s model number: FNC-118

- 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 ±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.

Inquiries

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

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.

(2) 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.

Non-Flex	Specification	Manufacturer	Remarks
Solid wire	5-569530-3	TE Connectivity	
Solid wire	MS8-RSZT-EMC	SK KOHKI CO., LTD.	Special tools required
Twisted-pair cable	5-569552-3	TE Connectivity	
Twisted-pair cable	TM11AP-88P	HIROSE ELECTRIC CO., LTD.	Special tools required

Flex	Specification	Manufacturer	Remarks
AWG26 4P TPMC-C5-F (SB) AWG26 4P TPMC-C5E (S-HFR) K, or FNC-118	TM21CP-88P (03)	HIROSE ELECTRIC CO., LTD.	Note

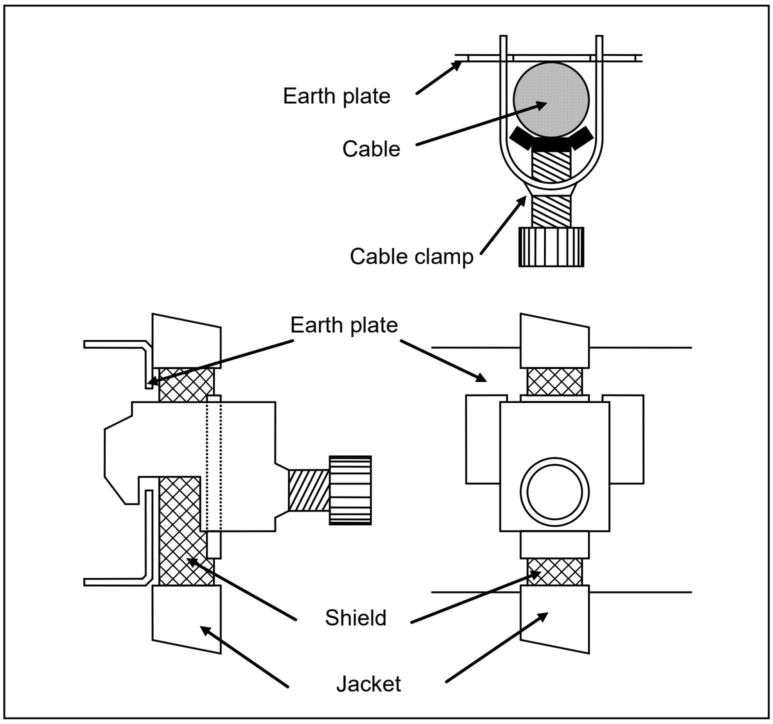
NOTE

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.)

4.10.2.5 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 earth plate with the cable clamp.
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.

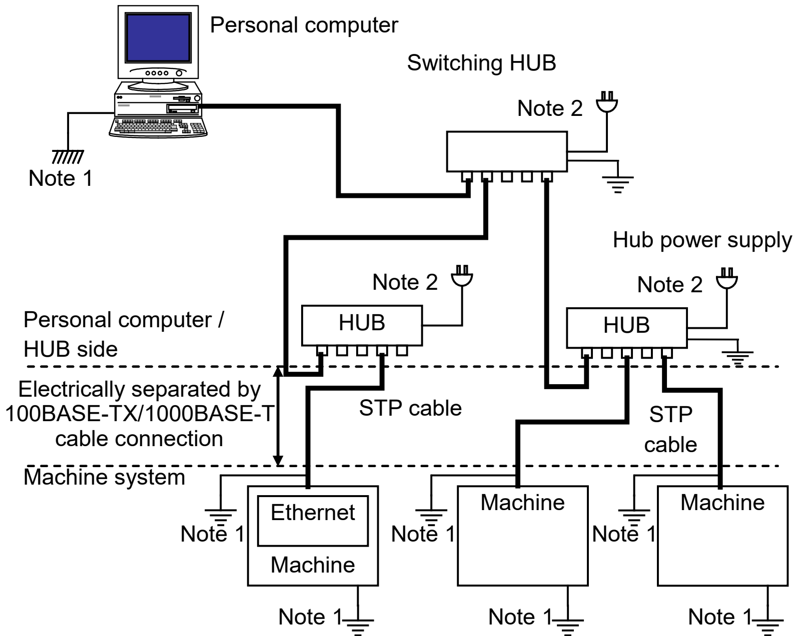
NOTE

1 To secure fast response, FL-net communication is not provided with a retransmission process at intervals of several seconds, unlike normal Ethernet communication. It is, therefore, necessary to provide more noise resistance than that provided by general Ethernet wiring work.

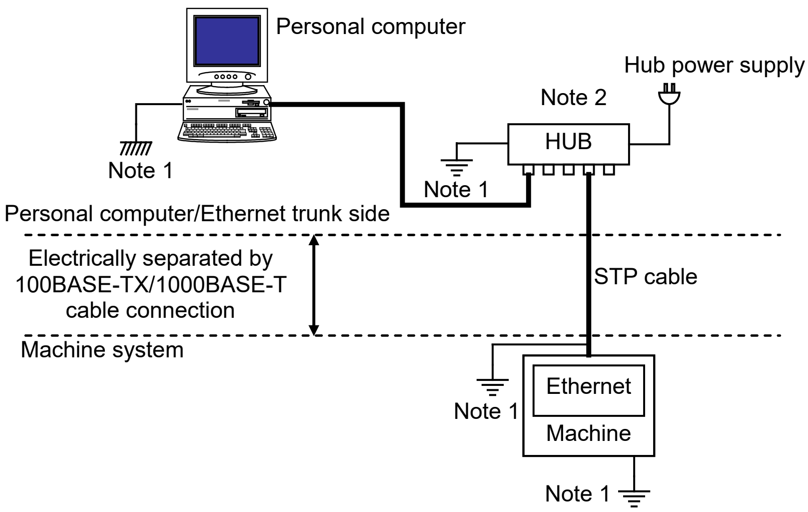
2 After the laying of cables, conduct satisfactory communication tests not only before system operation but after system operation from the viewpoint of noise prevention measures.

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



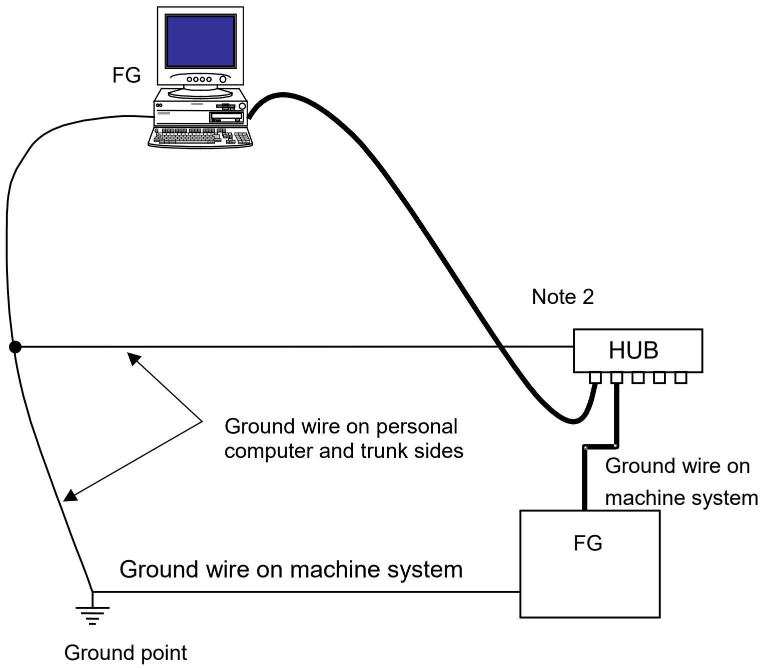
Small-Scale Network

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 $5.5mm^2$ 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/1000BASE-T. 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/1000BASE-SX/LX (Optical fiber media).



Wiring on a single ground point

4.10.2.6 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 (100BASE-TX) or 40m (1000BASE-T) for a movable cable recommended by FANUC).	
	Connection	For a twisted-pair cable of 100BASE-TX, the following pins shall be paired:	
		1) Pin No. 1 (TX+) – pin No. 2 (TX-)	
		2) Pin No. 3 (RX+) – pin No. 6 (RX-)	
		For a twisted-pair cable of 1000BASE-T, the following pins shall be paired:	
		1) Pin No. 1 (MDI0+) – pin No. 2 (MDI0+)	
		2) Pin No. 3 (MDI1+) – pin No. 6 (MDI1+)	
		3) Pin No. 4 (MDI2+) – pin No. 5 (MDI2+)	
		4) Pin No. 7 (MDI3+) – pin No. 8 (MDI3+)	
	Separation	The Ethernet cables shall be bound separately from the following cables or covered with an electromagnetic shield(Note) :	
		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.	

NOTE

Covering a group with an electromagnetic shield means that shielding is provided between groups with grounded steel plates.

5 TRANSPORTATION AND INSTALLATION

This chapter describes the transportation and installation for the controller.

5.1 TRANSPORTATION

The controller is transported by a crane. Attach a sling to eyebolts at the top of the controller.

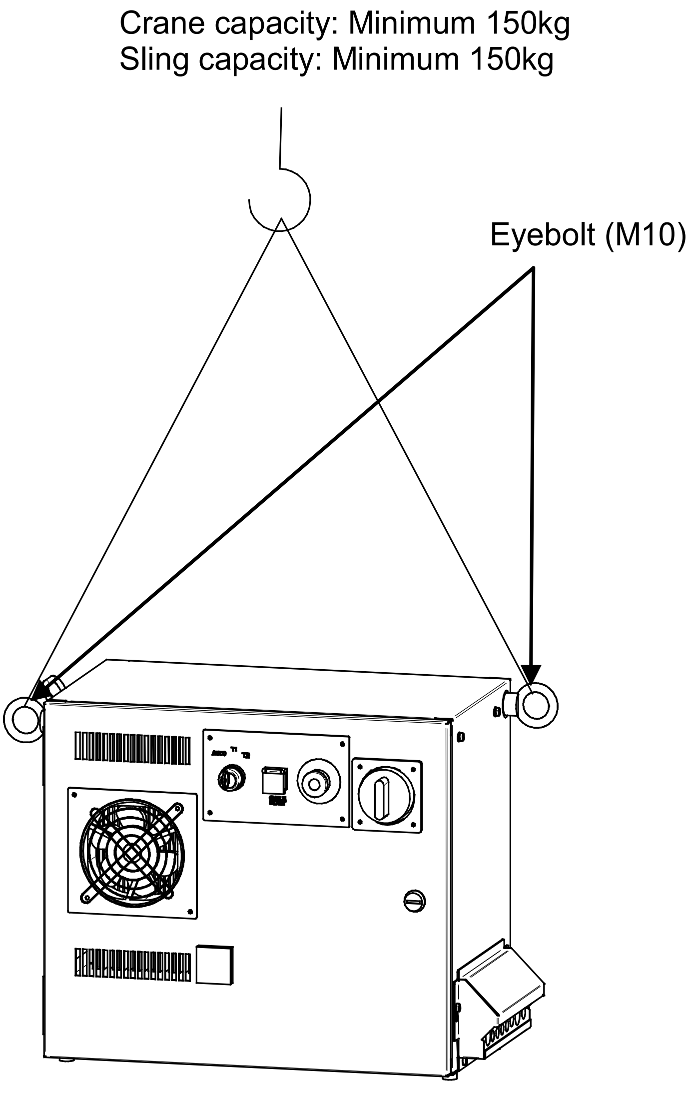


Fig.5.1 Transportation

5.2 INSTALLATION

5.2.1 Installation Method

Following is the installation method for cabinet.
When installing the controller, allow the space for maintenance shown in the following figure.

	Munsell	Color
Body	5GY3.5/0.5	Gray
Door	3.0GY8.2/0.9	White
Op. panel	N1.5	Black

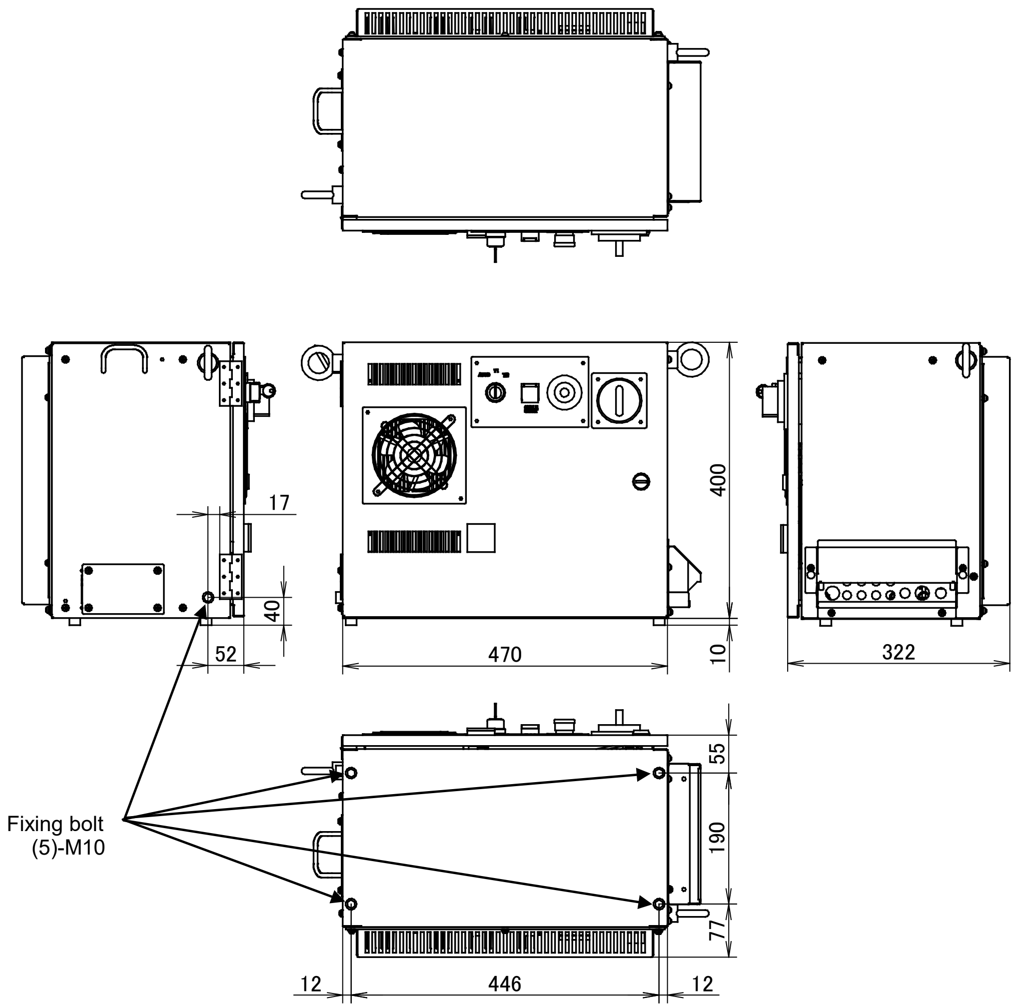


Fig.5.2.1(a) External dimensions (Small size)

	Munsell	Color
Body	5GY3.5/0.5	Gray
Door	3.0GY8.2/0.9	White
Op. panel	N1.5	Black

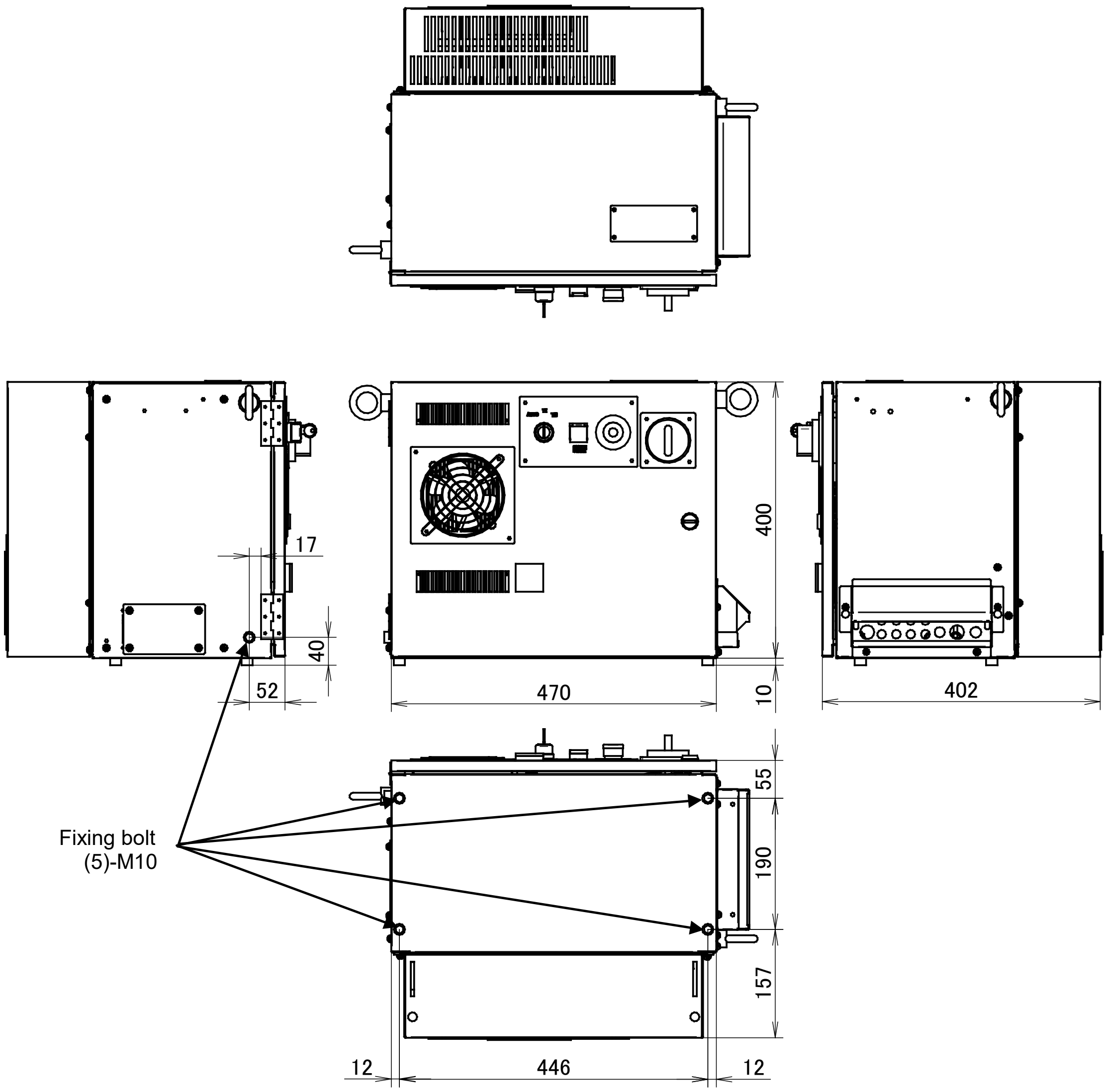


Fig.5.2.1(b) External dimensions (Medium / Large size)

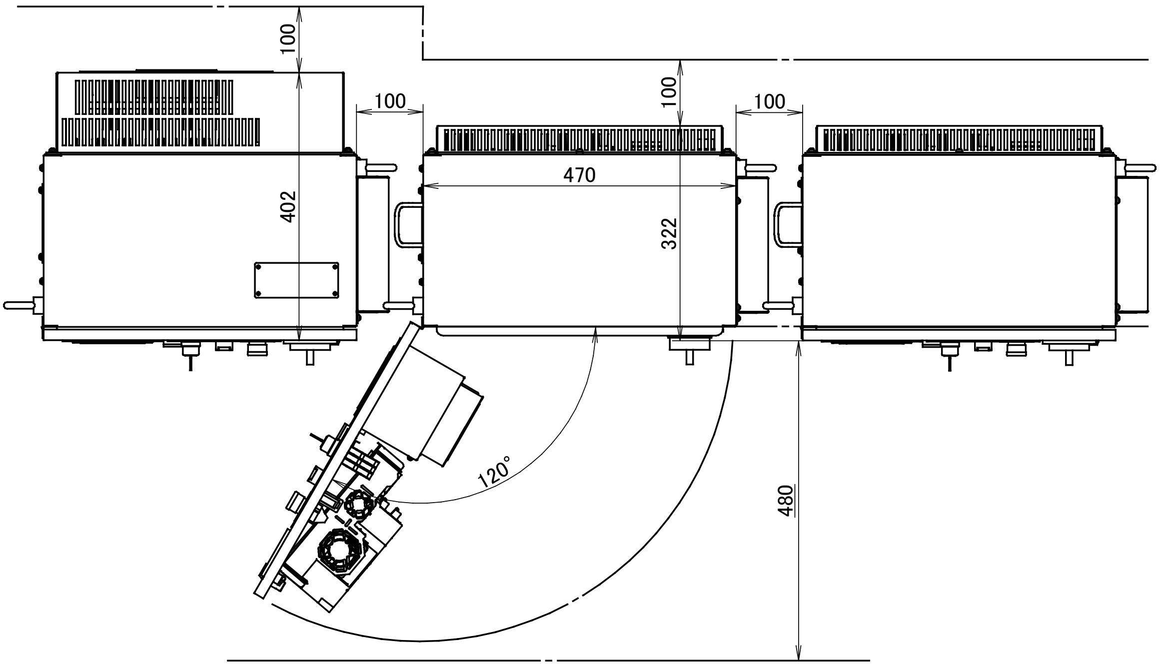


Fig.5.2.1 (c) Installation dimension

> **NOTE**
> Keep this area for maintenance and the radiation of heat.

5.2.2 Assemble at Installation

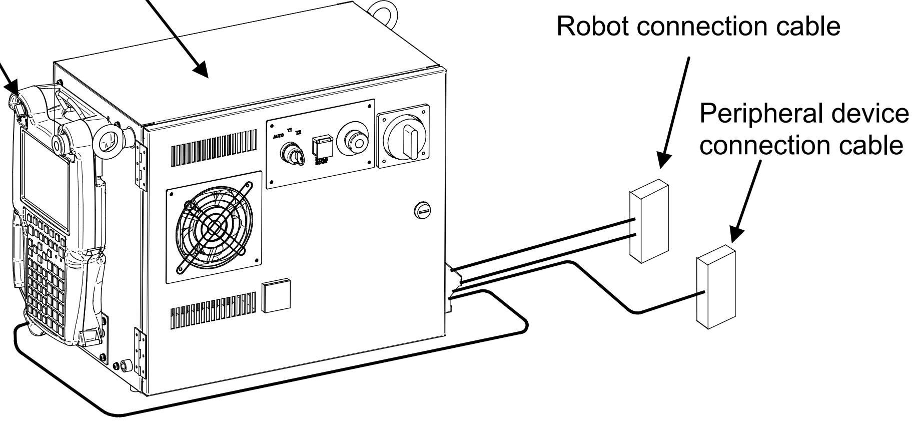


Fig.5.2.2 Assemble at installation

5.3 INSTALLATION OF TEACH PENDANT HOOK (OPTION)

Following is external dimensions for Teach Pendant HOOK (Ordering specification: A05B-2650-K050).

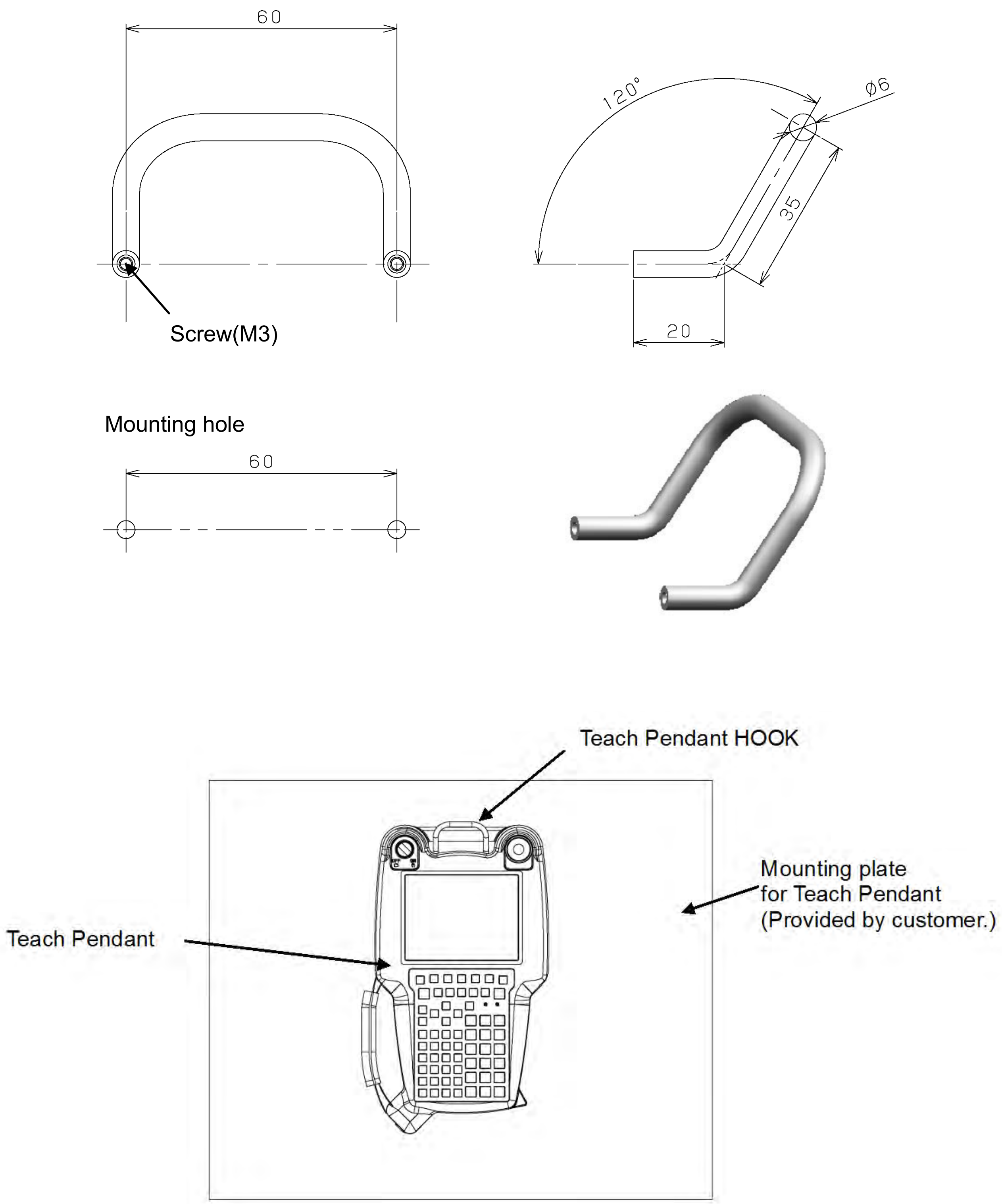


Fig.5.3 External dimensions of Teach Pendant HOOK

5.4 INSTALLATION CONDITION

Item	Model	Specification/condition
Rated Voltage	All models	200-230VAC 50/60Hz Single phase
		200-230VAC 50/60Hz 3 phase
Tolerant fluctuation	All models	Tolerant voltage fluctuation: +10% -15% Tolerant frequency fluctuation: ±1Hz
Input power source capacity	R-2000*i*C, R-1000*i*A, M-710*i*C, M-3*i*A, M-2*i*A	12kVA
	ARC Mate 120*i*C, M-20*i*A, M-20*i*B	3kVA
	ARC Mate 100*i*C, ARC Mate 100*i*D, M-10*i*A, M-10*i*D, ARC Mate 0*i*B, R-0*i*B	2kVA
	LR Mate 200*i*C, LR Mate 200*i*D, ARC Mate 50*i*D, CR-4*i*A, CR-7*i*A	1.2kVA
	M-1*i*A	1kVA
Average power consumption	R-2000*i*C, R-1000*i*A, M-710*i*C, M-3*i*A, M-2*i*A	2.5kW
	ARC Mate100*i*C, ARC Mate 120*i*C, M-10*i*A,M-20*i*A, M-20*i*B, ARC Mate 0*i*B, R-0*i*B	1kW
	LR Mate 200*i*C, LR Mate 200*i*D, ARC Mate 50*i*D, CR-4*i*A, CR-7*i*A	0.5kW
	M-1*i*A	0.2kW
Permissible ambient temperature	All models	Operating 0℃ to 45°C Storage, Transport -20°C to 60°C Temperature change 0.3°C/minute or less
Permissible ambient humidity	All models	Normal: 75%RH or less, no condensation Short period (less than 1 month): 95%RH or less, no condensation
Atmosphere	All models	An additional protective provision is necessary if the machine is installed in an environment in which there are relatively large amounts of contaminants (dust, dielectric fluid, organic solvent, acid, corrosive gas, salt, etc.).
Installation Category	All models	Installation Category Ⅲ, Pollution Degree 3, IEC60664-1 and IEC61010-1
Vibration acceleration	All models	4.9m/s^2 (0.5G) or less When using the robot in a location subject to serious vibration, consult with your FANUC sales representative.
Altitude	All models	Operating: Up to 1000m Non-operating: Up to 12000m
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	All models	40kg

Item	Model	Specification/condition
Degree of protection	All models	IP54
	Teach pendant	

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.

NOTE
In case of CE controller

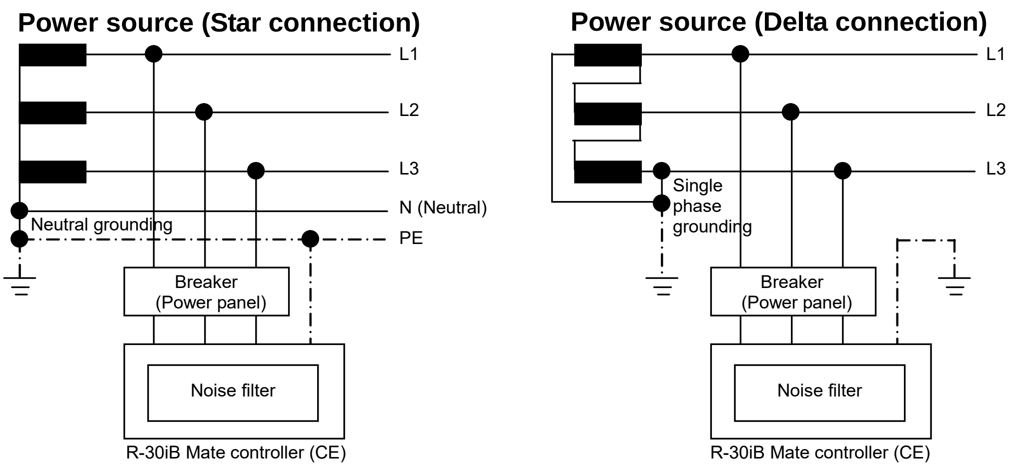
R-30*i*B Mate controller is a group 1, class A product according to IEC55011.
This means that this product does not generate and/or use intentionally radio-frequency energy, in the form of electromagnetic radiation, inductive and/or capacitive coupling, for the treatment of material or inspection / analysis purpose and that it is suitable for use in all establishments other than domestic and those directly connected to a low voltage power supply network which supplies buildings used for domestic purposes.
There may be potential difficulties in ensuring electromagnetic compatibility in environments other than industrial, due to conducted as well as radiated disturbances.
This product must not be used in residual areas.
This product may cause interference if used in residential areas. Such use must be avoided unless the user takes special measures to reduce electromagnetic emissions to prevent interference to the reception of radio and television broadcasts.

In case that an earth leakage breaker in the power panel tripped (CE/3 phase)

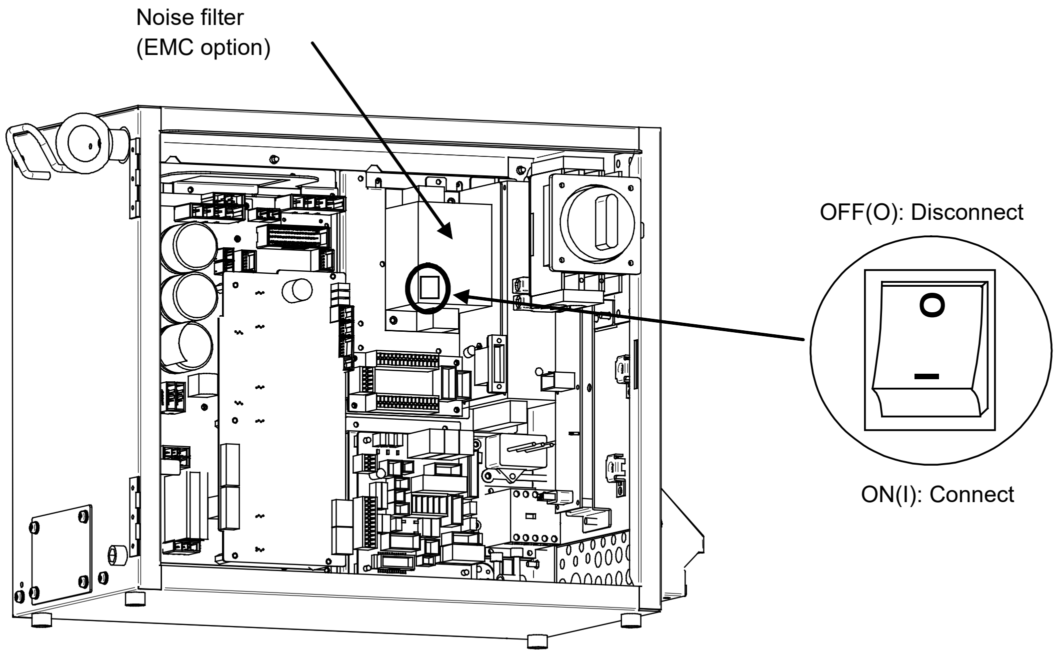
A noise filter is installed in the R-30*i*B Mate/ R-30*i*B Mate Plus controller (CE/3 phase). The noise filter is designed to connect to star connection / neutral grounding power system (TN-power system, NOTE.1). In case that the controller is connected to delta connection / single-phase grounding power 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 are connected to one leakage breaker.
(2) Install isolated transformer between input power and controller.
(3) 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) R-30*i*B Mate/ R-30*i*B Mate Plus controller (CE) 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.



5.5 ADJUSTMENT AND CHECKS AT INSTALLATION

Adjust the robot according to the following procedure at installation.

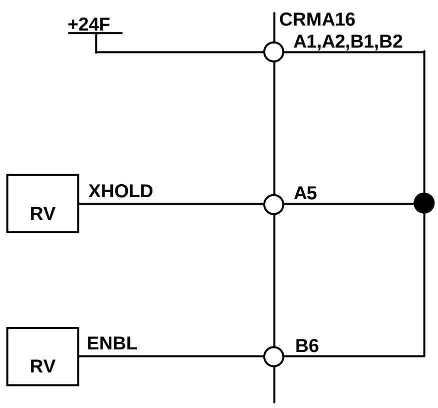
No.	Description
1	Visually check the inside and outside of the controller.
2	Check the screw terminals for proper connection.
3	Check that the connectors and printed circuit boards are firmly connected.
4	Connect controller and mechanical unit cables.
5	The breaker off and connect the input power cable.
6	Check the input power voltage.
7	Press the EMERGENCY STOP button on the operator panel and turn on the controller.
8	Check the interface signals between controller and robot mechanical unit.
9	Check the parameters. If necessary, set them.
10	Release the EMERGENCY STOP button on the operator panel.
11	Check the movement along each axis in manual jog mode.
12	Check the signals of EE interface.
13	Check the peripheral device control interface signals.

5.6 RESETTING OVERTRAVEL AND EMERGENCY STOP AT INSTALLATION

An overtravel and emergency stop occur when the robot is operated for the first time after it is installed and the mechanical and controllers are wired. This section describes how to reset the overtravel and emergency stop.
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 can also be in an emergency stop state if the peripheral device control interface is not connected.

5.6.1 Peripheral Device Interface Processing

If signals XHOLD and ENBL are not used, connect these signals as follows.



5.6.2 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 condition.
3) Still hold down the shift key, and jog to bring all axes into the movable range.

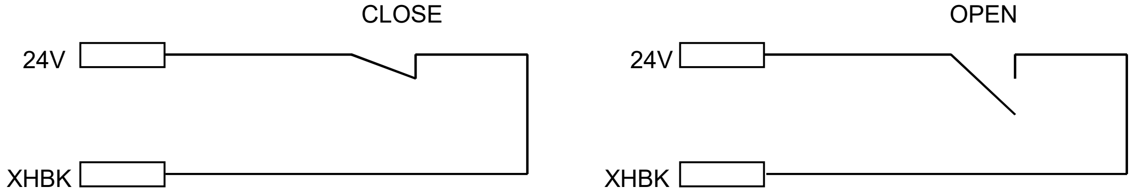
5.6.3 How to Disable/Enable HBK

1) Press the [MENU] key 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	No (*2)	Impossible	SRVO-302
4	Disable	OPEN	No	Possible	At cold start, SRVO-300

NOTE

1 Robot EE connector



2 The moment the HBK circuit is closed, alarm "Servo 302" occurs. HBK setting needs to be valid manually. When the HBK setting is valid and the HBK circuit is opened, causing alarm "Servo 006".

3 If the power is turned off and on again under the condition stated in *2, status 4 is entered, so the alarm condition is removed.

5.6.4 How to Disable/Enable Pneumatic Pressure Alarm (PPABN)

1) Press the [MENU] key 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 SPECIFICATION LIST

Name	Ordering Specification	FANUC Specification	Note
Main board	A05B-2650-H001	A20B-8200-0790	Standard, Ethernet 1ch
	A05B-2650-H002	A20B-8200-0791	Ethernet 2ch, Vision I/F, Force sensor
	A05B-2650-H003	A20B-8200-0792	Ethernet 2ch, Vision I/F, Force sensor, PMC, HDI
	A05B-2650-H004	A20B-8201-0420	Standard, Ethernet:1ch For I/O Link *i* slave
	A05B-2650-H005	A20B-8201-0421	Ethernet:2ch, Vision I/F, Force sensor I/F For I/O Link *i* slave
	A05B-2650-H006	A20B-8201-0422	Ethernet:2ch, Vision I/F, Force sensor I/F, PMC, HDI For I/O Link *i* slave
	A05B-2680-H001 (R-30*i*B Mate Plus)	A20B-8201-0750	Standard, Ethernet:2ch For I/O Link *i* slave
	A05B-2680-H002 (R-30*i*B Mate Plus)	A20B-8201-0751	Ethernet:3ch, Vision I/F, Force sensor I/F For I/O Link *i* slave
	A05B-2680-H003 (R-30*i*B Mate Plus)	A20B-8201-0752	Ethernet:3ch, Vision I/F, Force sensor I/F, PMC, HDI For I/O Link *i* slave
CPU card	A05B-2600-H020	A20B-3300-0686 A17B-3301-0106	Standard / SDRAM 32Mbyte
	A05B-2600-H021	A20B-3300-0687 A17B-3301-0107	Standard / SDRAM 64Mbyte
	A05B-2600-H022	A20B-3300-0688 A17B-3301-0108	Standard / SDRAM 128Mbyte
	A05B-2600-H023	A20B-3300-0683 A17B-3301-0103	High speed / SDRAM 32Mbyte
	A05B-2600-H024	A20B-3300-0684 A17B-3301-0104	High speed / SDRAM 64Mbyte
	A05B-2600-H025	A20B-3300-0685 A17B-3301-0105	High speed / SDRAM 128Mbyte
	A05B-2600-H026	A17B-3301-0109	Standard / SDRAM 32Mbyte For I/O Link *i* slave
	A05B-2600-H027	A17B-3301-0110	Standard / SDRAM 64Mbyte For I/O Link *i* slave
	A05B-2600-H028	A17B-3301-0111	Standard / SDRAM 128Mbyte For I/O Link *i* slave
	A05B-2600-H029	A17B-3301-0112	High speed / SDRAM 32Mbyte For I/O Link *i* slave
	A05B-2600-H030	A17B-3301-0113	High speed / SDRAM 64Mbyte For I/O Link *i* slave
	A05B-2600-H031	A17B-3301-0114	High speed / SDRAM 128Mbyte For I/O Link *i* slave
	A05B-2670-H020 (R-30*i*B Mate Plus)	A17B-3301-0250	Standard / DRAM 1GB For I/O Link I slave

Name	Ordering Specification	FANUC Specification	Note
Axis control card	A05B-2600-H040	A20B-3300-0664	6-axis
		A20B-3300-0774	
	A05B-2600-H041	A20B-3300-0663	12-axis
		A20B-3300-0773	
	A05B-2600-H042	A20B-3300-0662	18-axis
		A20B-3300-0772	
	A05B-2600-H043	A20B-3300-0661	24-axis
		A20B-3300-0771	
	A05B-2600-H044	A20B-3300-0660	36-axis
		A20B-3300-0770	
	A05B-2670-H040 (R-30*i*B Mate Plus)	A20B-3300-0819	6-axis
	A05B-2670-H041 (R-30*i*B Mate Plus)	A20B-3300-0818	12-axis
	A05B-2670-H042 (R-30*i*B Mate Plus)	A20B-3300-0817	18-axis
	A05B-2670-H043 (R-30*i*B Mate Plus)	A20B-3300-0816	24-axis
	A05B-2670-H044 (R-30*i*B Mate Plus)	A20B-3300-0815	36-axis
FROM/SRAM module	A05B-2600-H060	A20B-3900-0283	FROM 32M/ SRAM 1M
		A20B-3900-0297	
	A05B-2600-H061	A20B-3900-0284	FROM 32M/ SRAM 2M
		A20B-3900-0298	
	A05B-2600-H062	A20B-3900-0285	FROM 32M/ SRAM 3M
		A20B-3900-0299	
	A05B-2600-H063	A20B-3900-0286	FROM 64M/ SRAM 1M
	A05B-2600-H064	A20B-3900-0287	FROM 64M/ SRAM 2M
	A05B-2600-H065	A20B-3900-0288	FROM 64M/ SRAM 3M
	A05B-2600-H066	A20B-3900-0280	FROM 128M/ SRAM 1M
	A05B-2600-H067	A20B-3900-0281	FROM 128M/ SRAM 2M
	A05B-2600-H068	A20B-3900-0282	FROM 128M/ SRAM 3M
	A05B-2600-H069 (R-30*i*B Mate Plus)	A20B-3900-0293	FROM 256M/ SRAM 1M
	A05B-2600-H070 (R-30*i*B Mate Plus)	A20B-3900-0295	FROM 256M/ SRAM 2M
	A05B-2600-H071 (R-30*i*B Mate Plus)	A20B-3900-0296	FROM 256M/ SRAM 3M
Battery	A05B-2650-K030	A98L-0031-0028	For memory backup
Fan board	A05B-2650-H001	A20B-8200-0669	
	A05B-2650-H002		
	A05B-2650-H003		
Emergency stop board		A20B-2005-0150	
		A20B-2103-0170	For R-30*i*B Mate Plus
4-pole terminal block (TBOP19)		A63L-0002-0154#104	Manufacturer’s specification (WAGO):734-104
12-pole terminal block (TBOP20)		A63L-0002-0154#112	Manufacturer’s specification (WAGO):734-112
Jumper pin		A63L-0002-0154 #402F	Manufacturer’s specification (WAGO):734-402F

Name	Ordering Specification	FANUC Specification	Note
Operation lever	A05B-2600-K030	A63L-0002-0154 #230-M	Manufacturer's specification (WAGO):734-230 2 pieces of 734-230 and operation manual are included in FANUC's specification
Process I/O board MA	A05B-2650-J060	A20B-2004-0381	DI/DO=20/16(Source type)
Process I/O board MB	A05B-2650-J061	A20B-2101-0731	WI/WO=5/4(Sink type), D/A=2
Peripheral device cable (Process I/O MA)	A05B-2650-J150		Connected length: 10m (one): CRMA52
	A05B-2650-J151		Connected length: 20m (one): CRMA52
Welding machine connection cable (FANUC I/F/elbow type) (Process I/O MB)	A05B-2650-J160		Connected length: 3m (one): CRW11
	A05B-2650-J161		Connected length: 7m (one): CRW11
	A05B-2650-J162		Connected length: 14m (one): CRW11
Connector conversion board	A05B-2650-J070	A20B-2004-0411	CRMA15,CRMA16, Honda MR50 connector
Terminal conversion board	A05B-2650-J071	A20B-1009-0690	CRMA15,CRMA16, PHOENIX CONTACT terminal
6-axis servo amplifier	A05B-2652-H031	A06B-6400-H102	
	A05B-2654-H030	A06B-6400-H002	
	A05B-2657-H030		
	A05B-2652-H030	A06B-6400-H003	
	A05B-2651-H030	A06B-6400-H005	
	A05B-2661-H030		
Discharge resistor	A05B-2650-C100		
	A05B-2650-C101		
CRR65A/B connector Rece-housing		A63L-0001-0460 #032KSX	Auxiliary Axis Brake Manufacturer's specification (TE connectivity): 1-178128-3
CRMA96 connector Rece-contact (AWG16-20)		A63L-0001-0456 #ASL	Auxiliary Axis Brake Manufacturer's specification (TE connectivity): 175218-2
CRM68 connector Rece-housing		A63L-0001-0812 #R03SX	Auxiliary Axis Over Travel Manufacturer's specification (TE connectivity): 1-1318120-3
CRM68 connector Rece-contact (AWG18-22)		A63L-0001-0812 #CRM	Auxiliary Axis Over Travel Manufacturer's specification (TE connectivity): 1318107-1
Peripheral device cable (For Main board)	A05B-2650-J100		Connected length: 10m (one): CRMA15 Connected length: 10m (one): CRMA16
	A05B-2650-J101		Connected length: 20m (one): CRMA15 Connected length: 20m (one): CRMA16
Brake release unit connection cable		A660-2005-T559	M-710*i*C, R-1000*i*A, R-2000*i*C, M-2*i*A, M-3*i*A
		A660-2006-T881	M-10*i*A, M-20iD, M-20*i*A, M-20*i*B, ARC Mate 100*i*C, ARC Mate 100iD, ARC Mate 120*i*C ARC Mate 0*i*B, R-0*i*B, LR Mate 200*i*D, ARC Mate 50*i*D, CR-4*i*A, CR-7*i*A
		A660-2006-T474	M-1*i*A, LR Mate 200*i*C
		A660-2005-T711	Aux. Axis
Sensor I/F unit	A05B-2650-C200		CR-4*i*A, CR-7*i*A

B TOTAL CONNECTION DIAGRAM

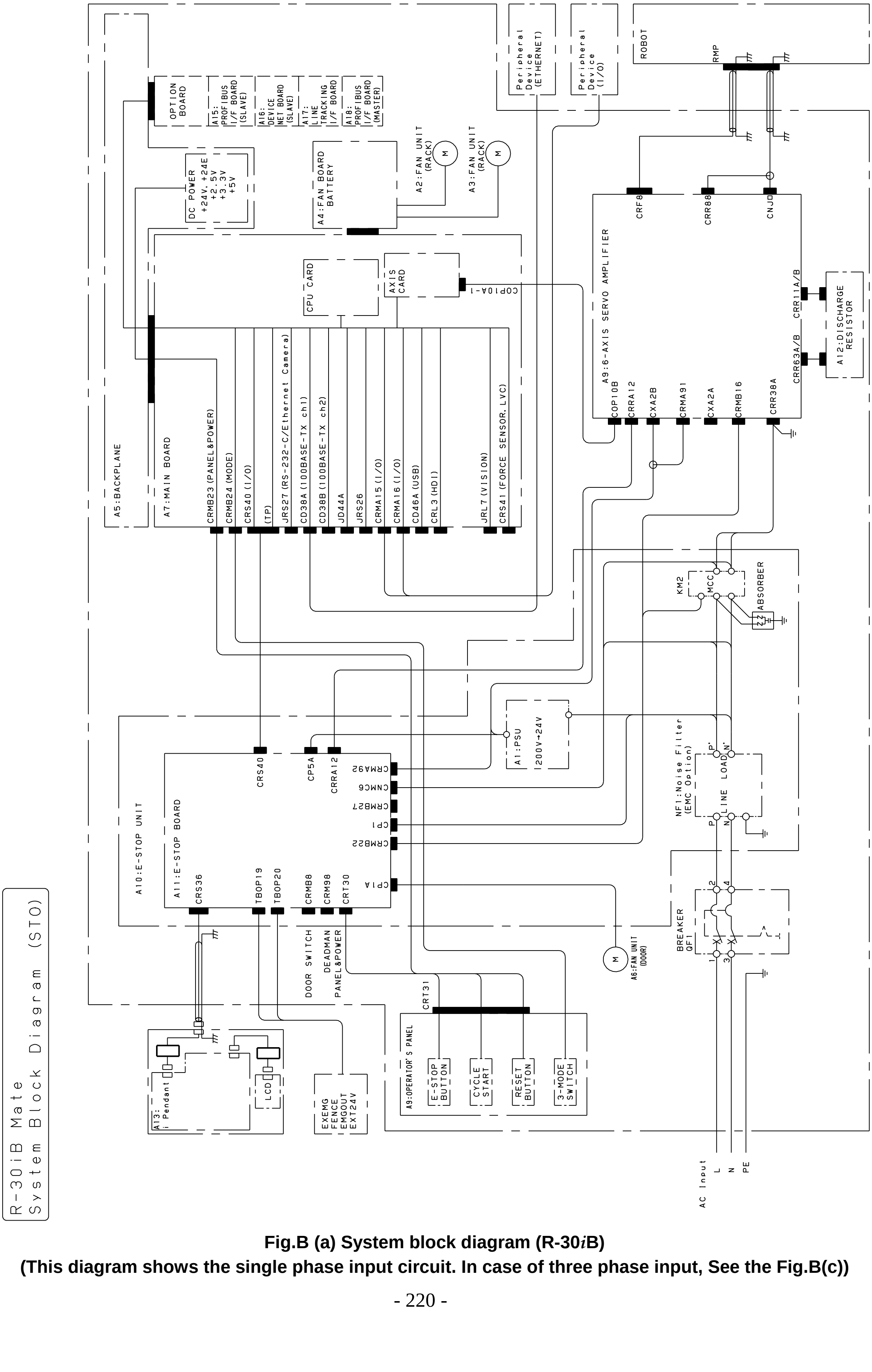


Fig.B (a) System block diagram (R-30*i*B)

(This diagram shows the single phase input circuit. In case of three phase input, See the Fig.B(c))

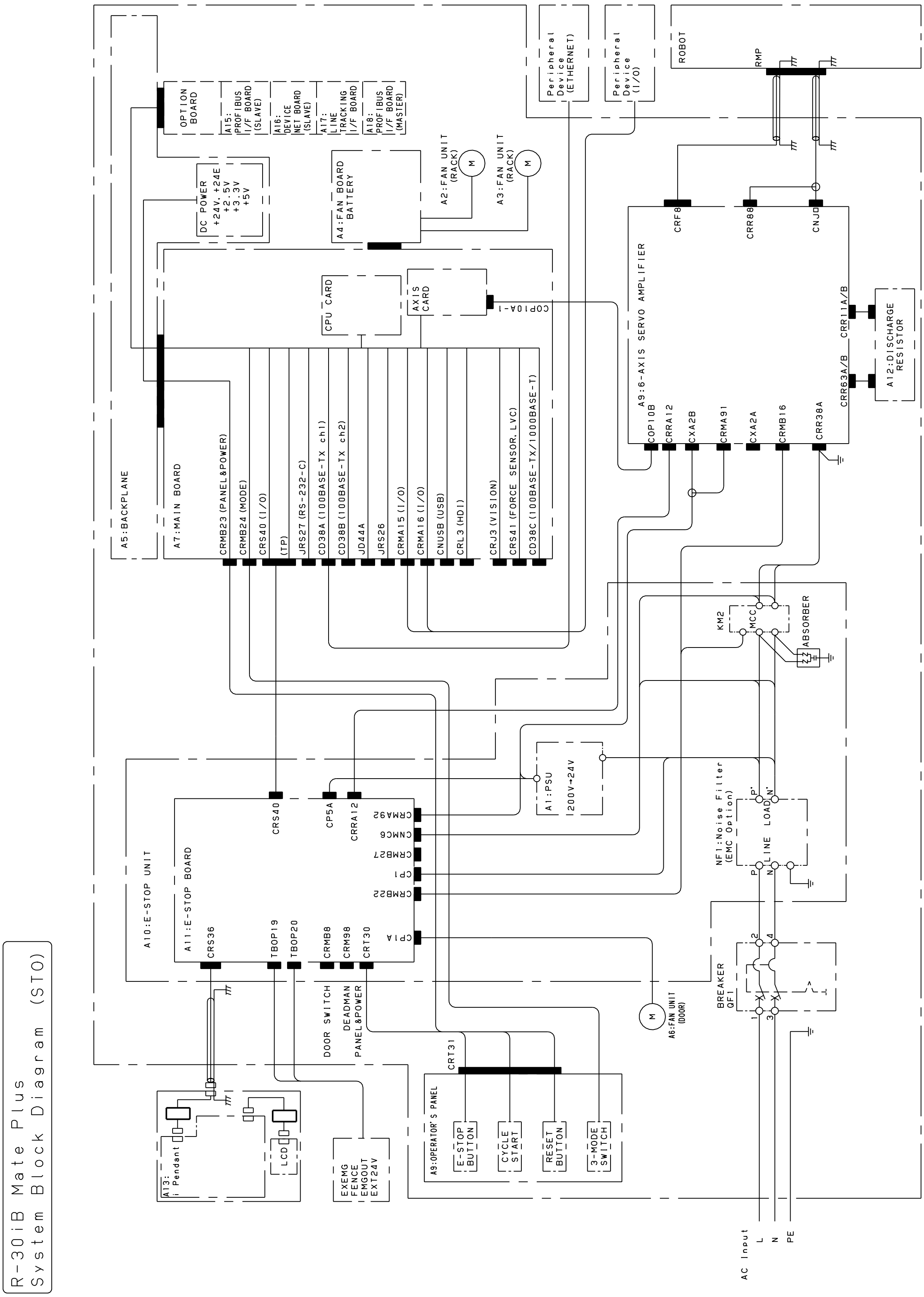


Fig.B (b) System block diagram (R-30*i*B Mate Plus)

(This diagram shows the single phase input circuit. In case of three phase input, See the Fig.B(e))

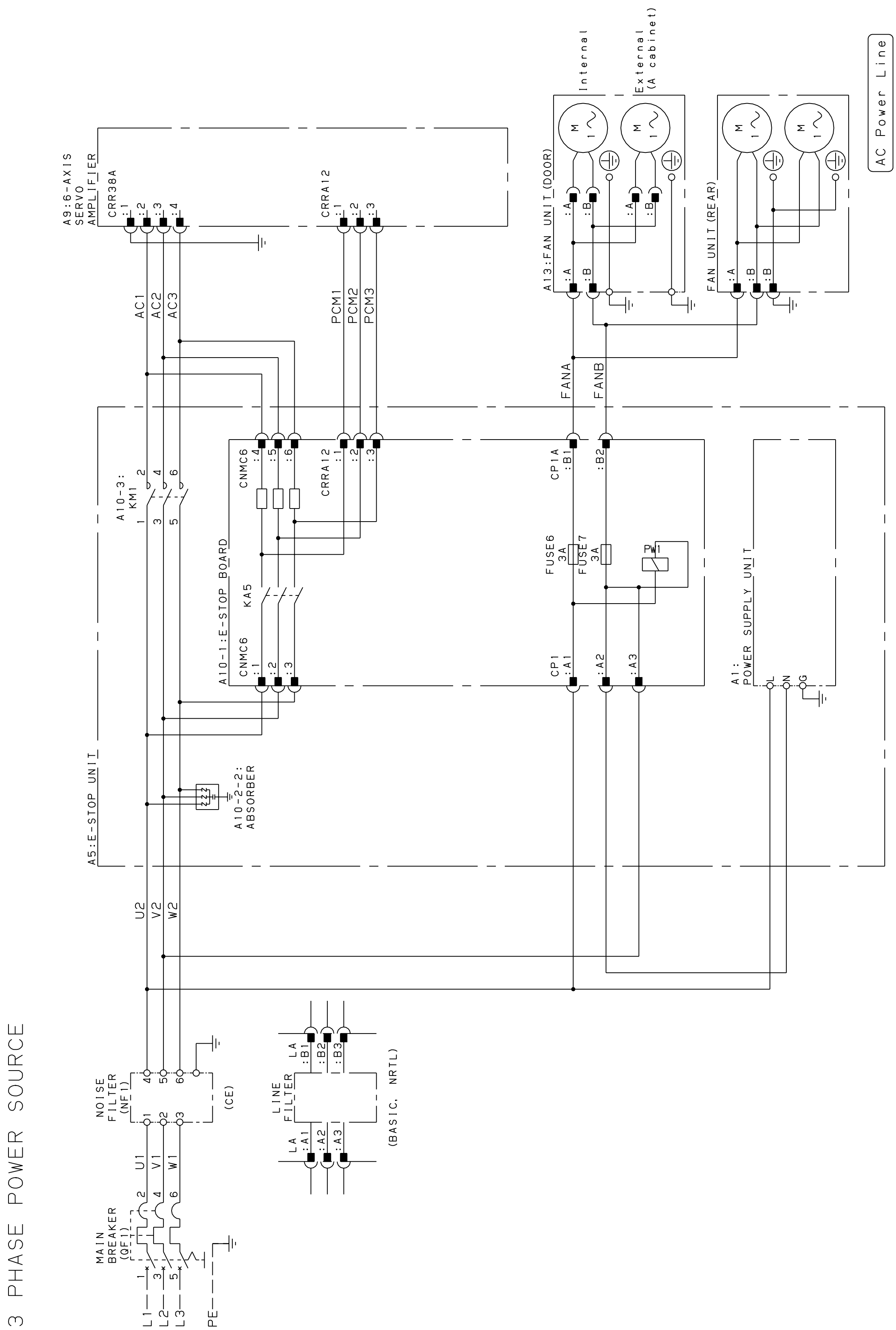


Fig.B(c) AC power line connection diagram (R-30*i*B Mate, in case of three phase input)

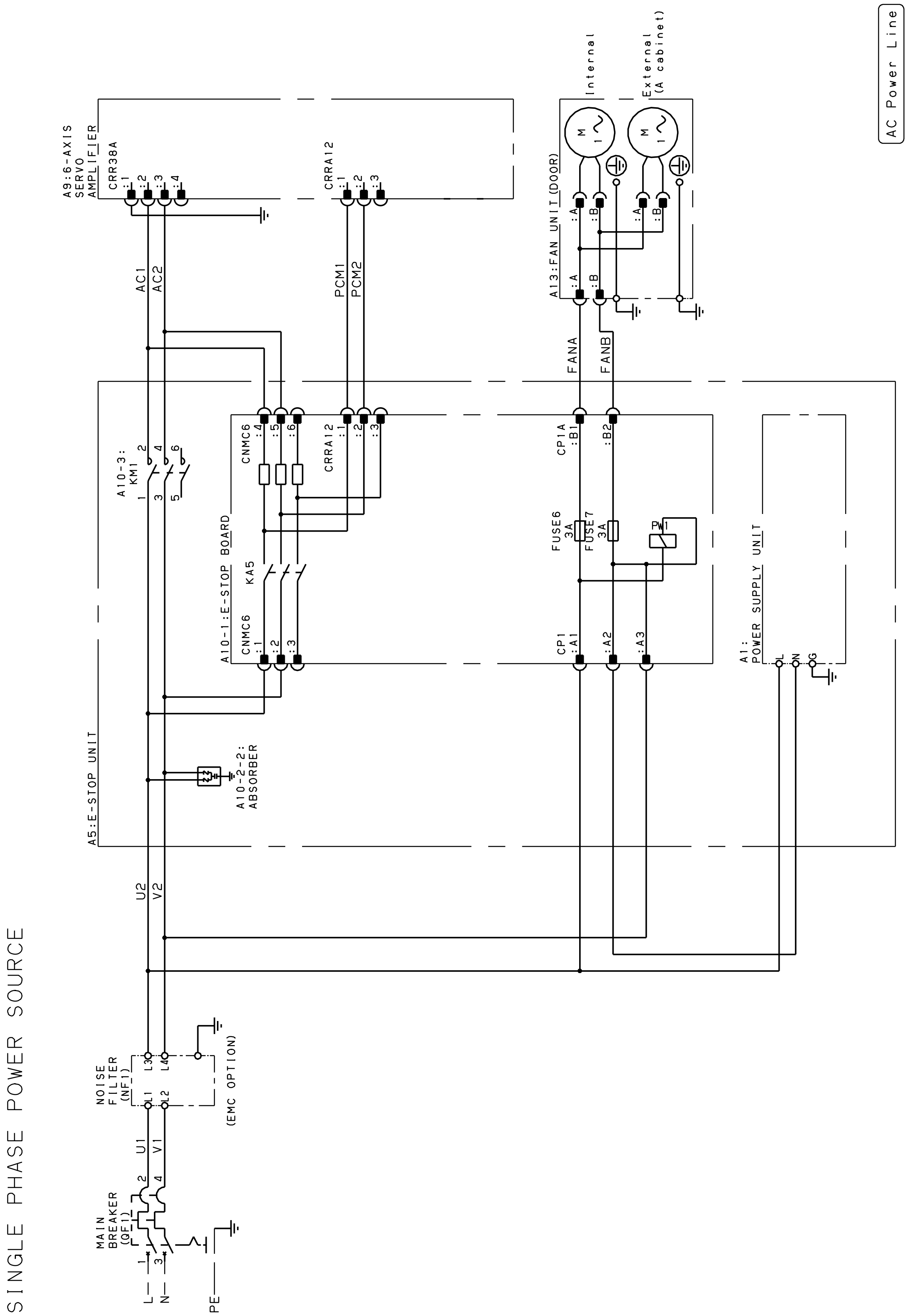


Fig.B(d) AC power line connection diagram (R-30*i*B Mate, in case of single phase input)

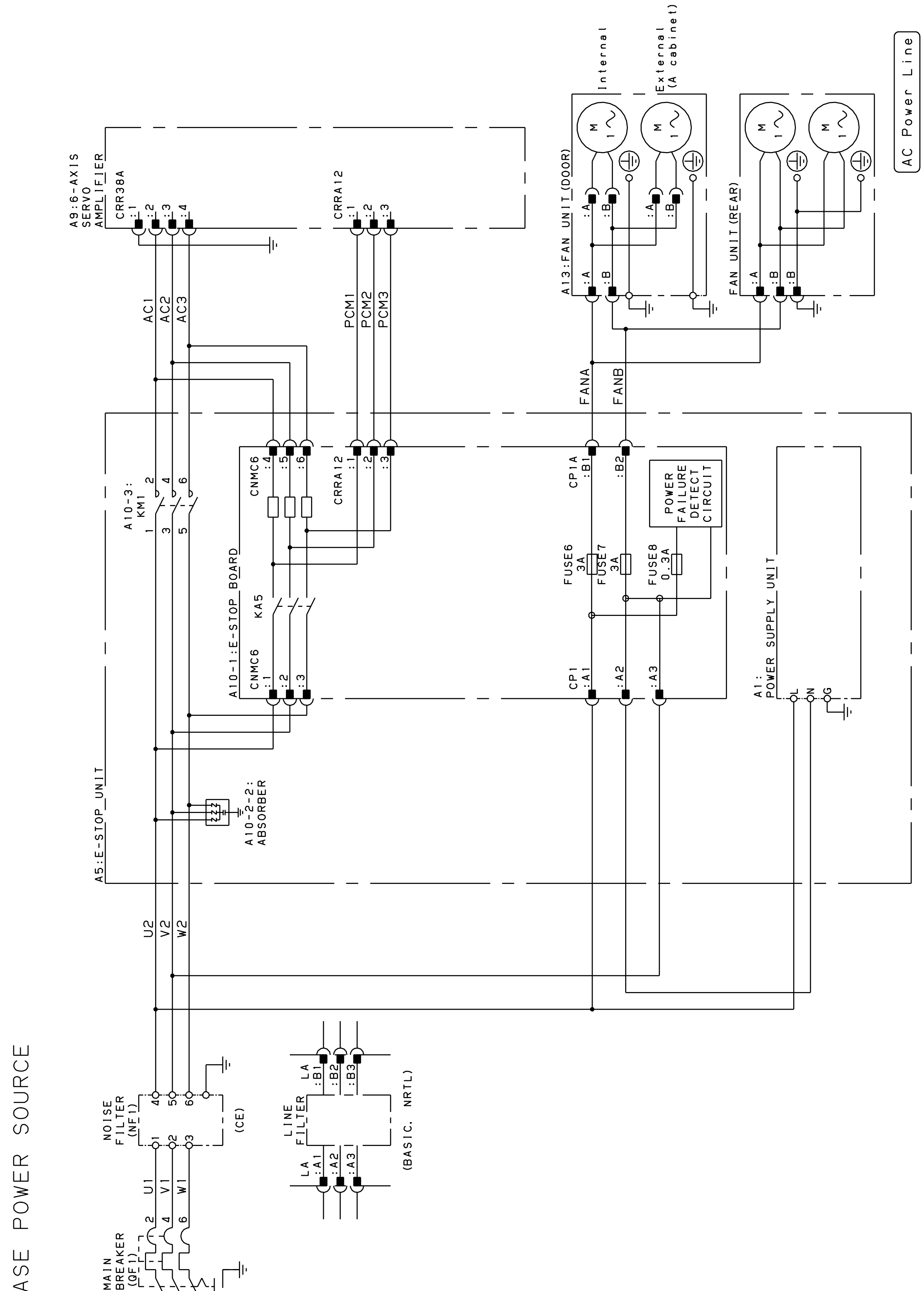


Fig.B(e) AC power line connection diagram (R-30*i*B Mate Plus, in case of three phase input)

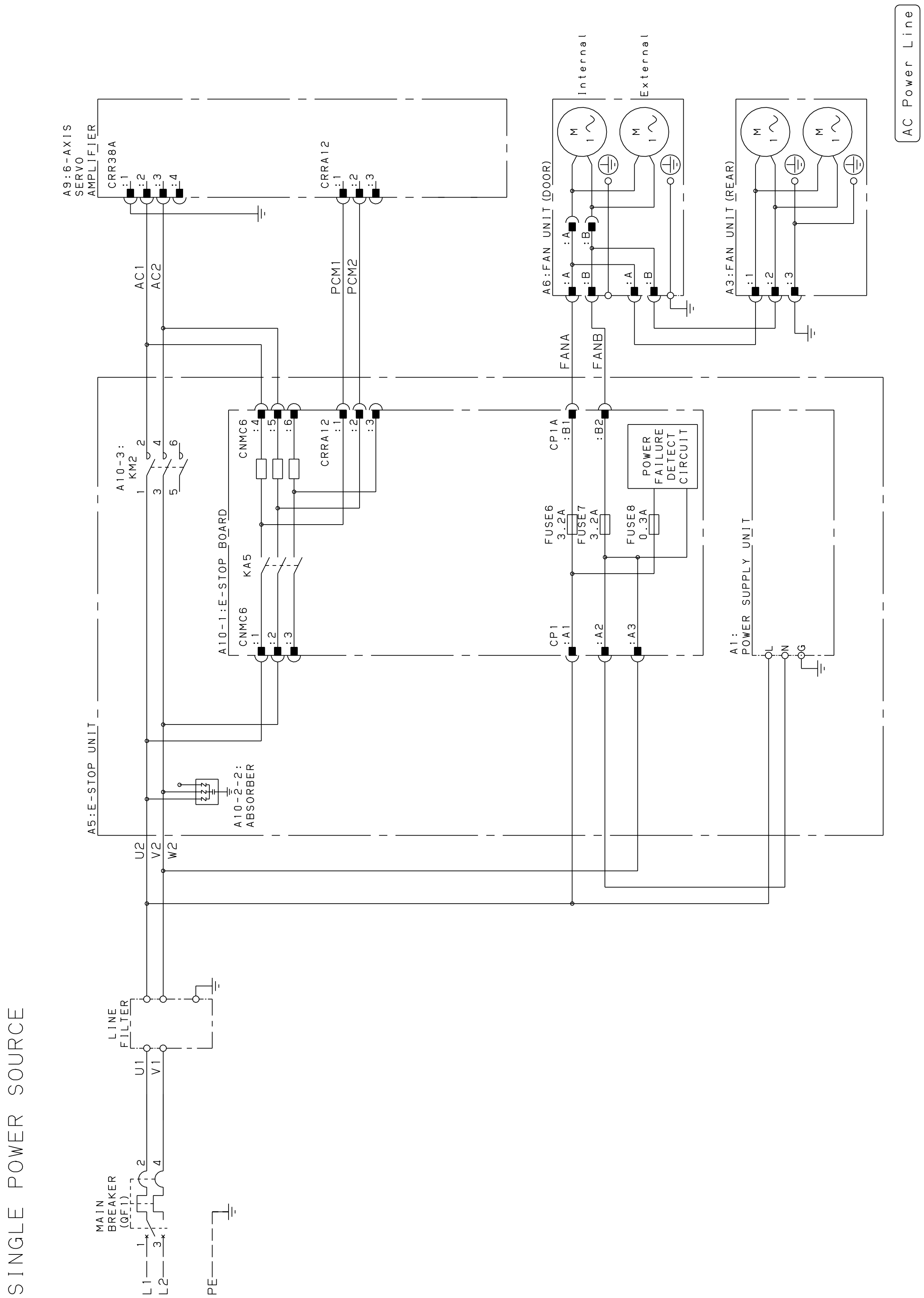


Fig.B(f) AC power line connection diagram (R-30*i*B Mate Plus, in case of single phase input)

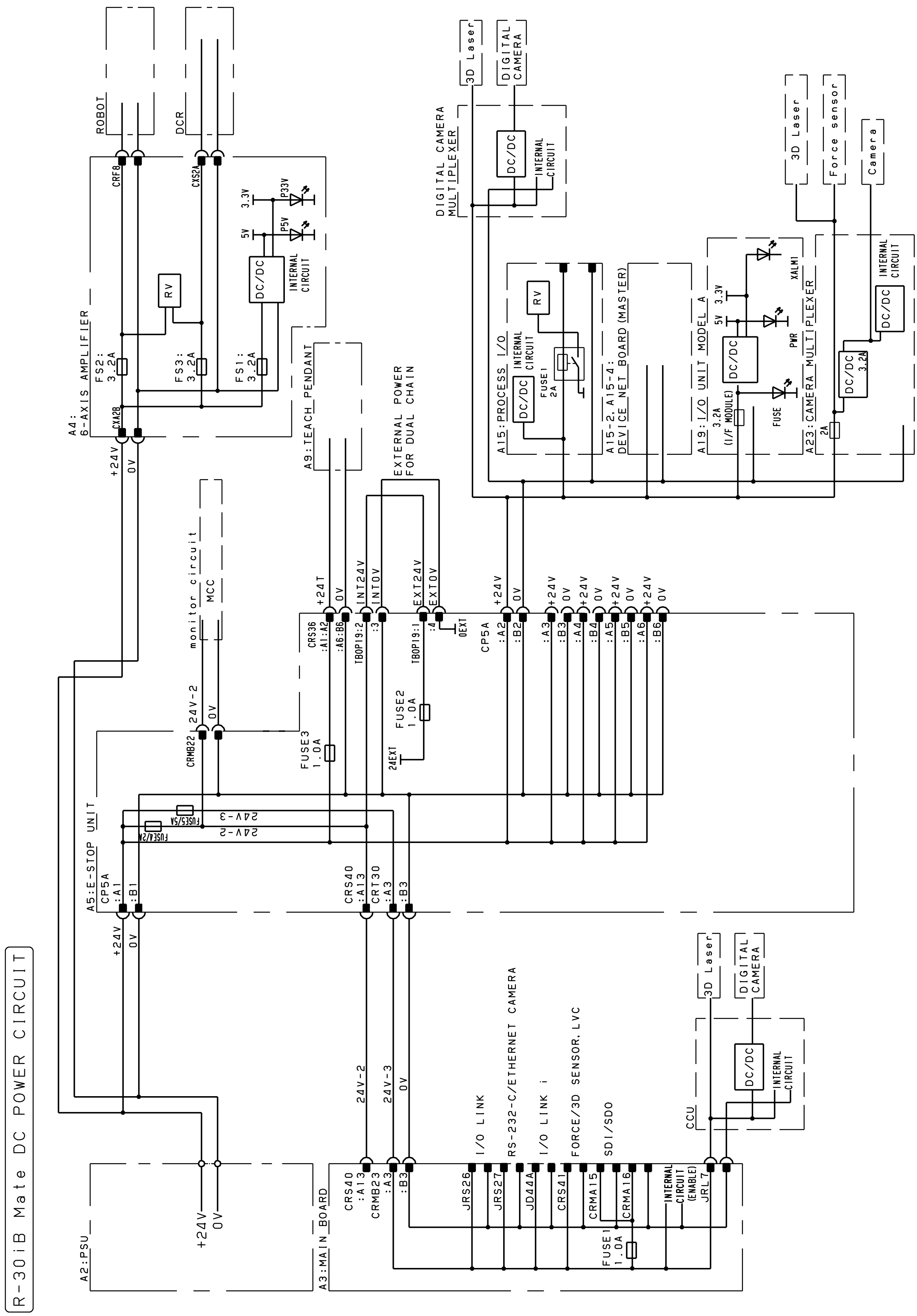


Fig.B(g) DC power line connection diagram (R-30*i*B Mate)

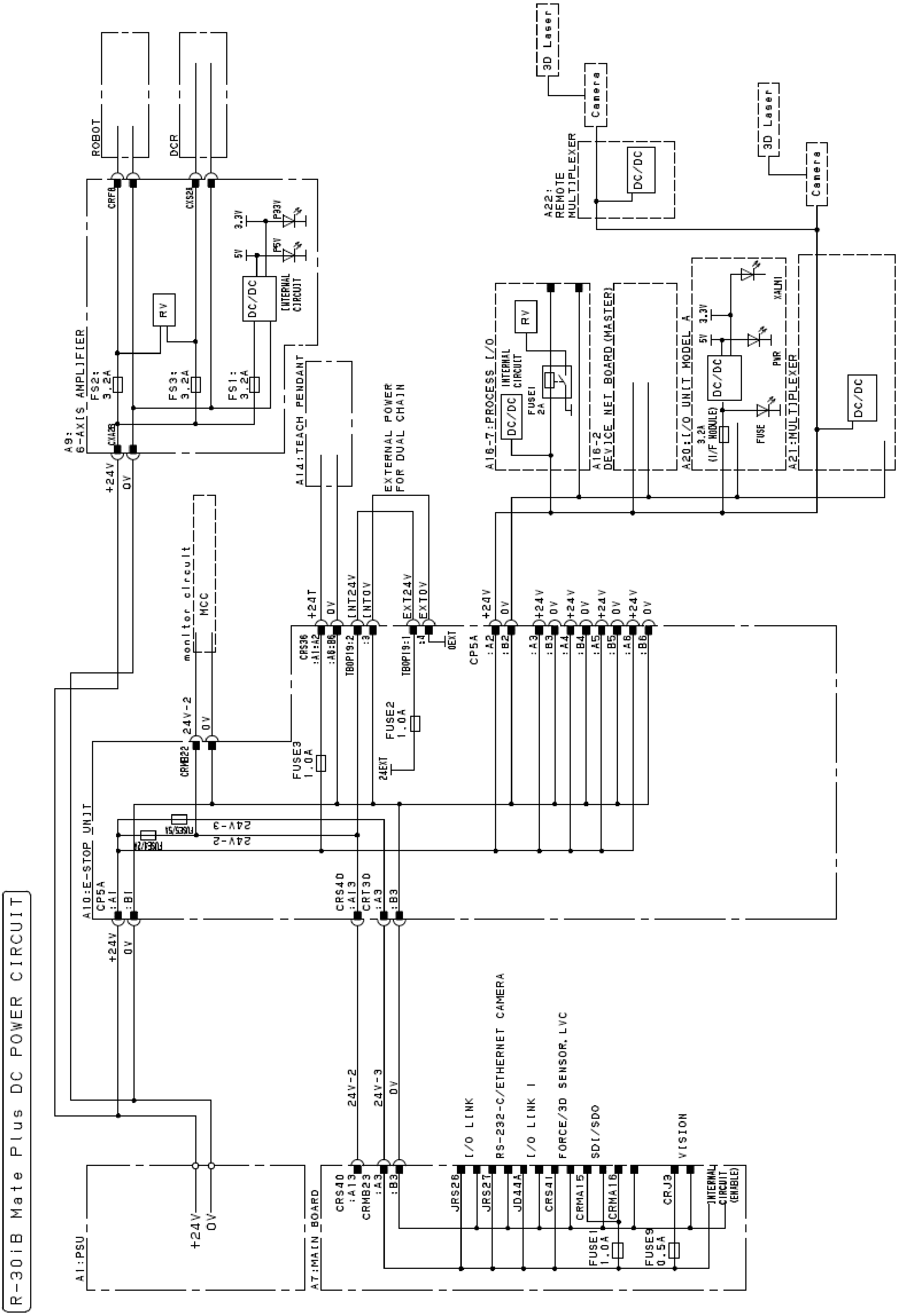


Fig.B(h) DC power line connection diagram (R-30*i*B Mate Plus)

E-STOP CIRCUIT <R-30iB Mate>
Dual check safety
Single MCC with STO (Single Phase)

DI:Simple DI
PI:Photo coupler DI
Not showing the diodes to protect from reverce electric power.

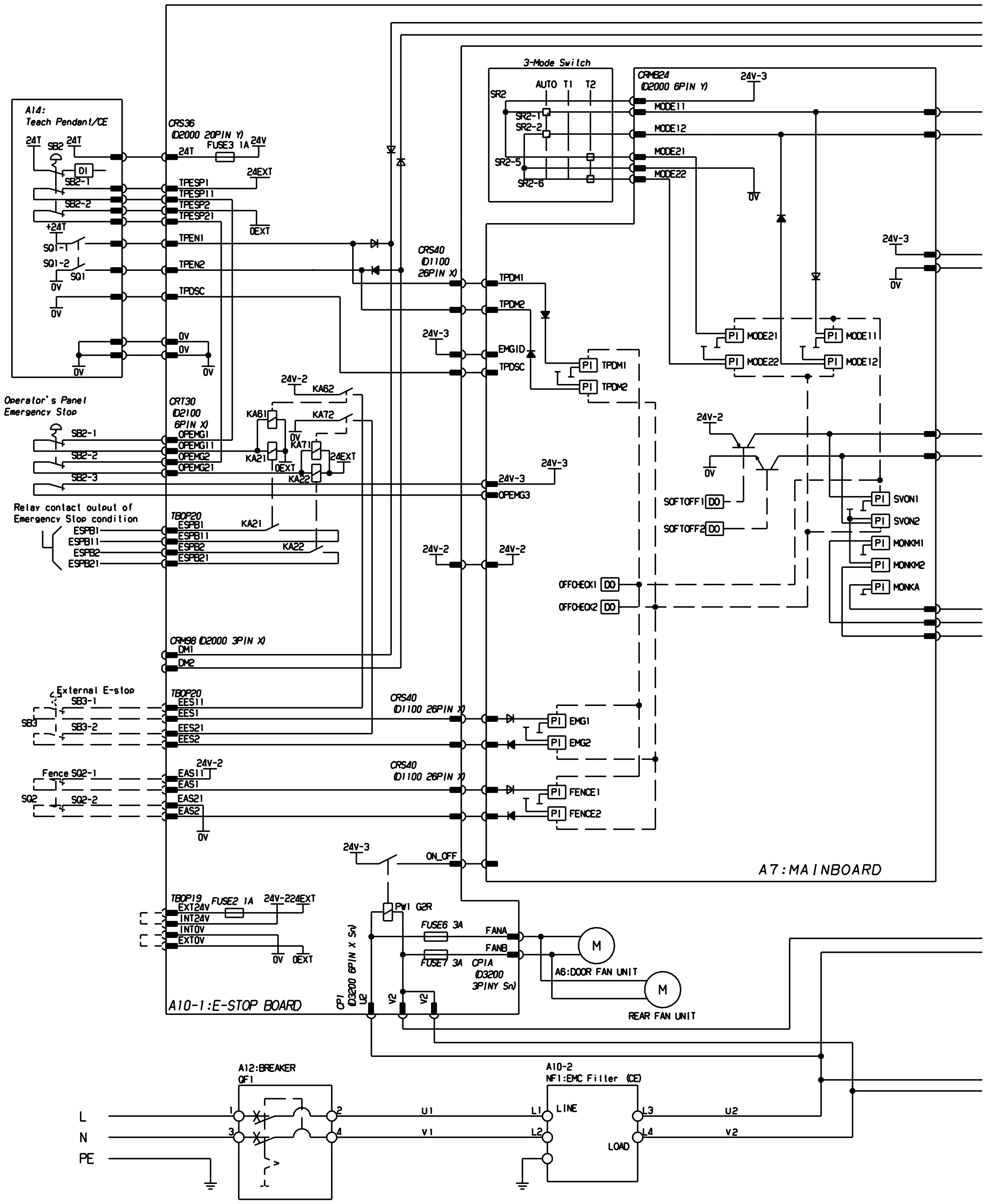
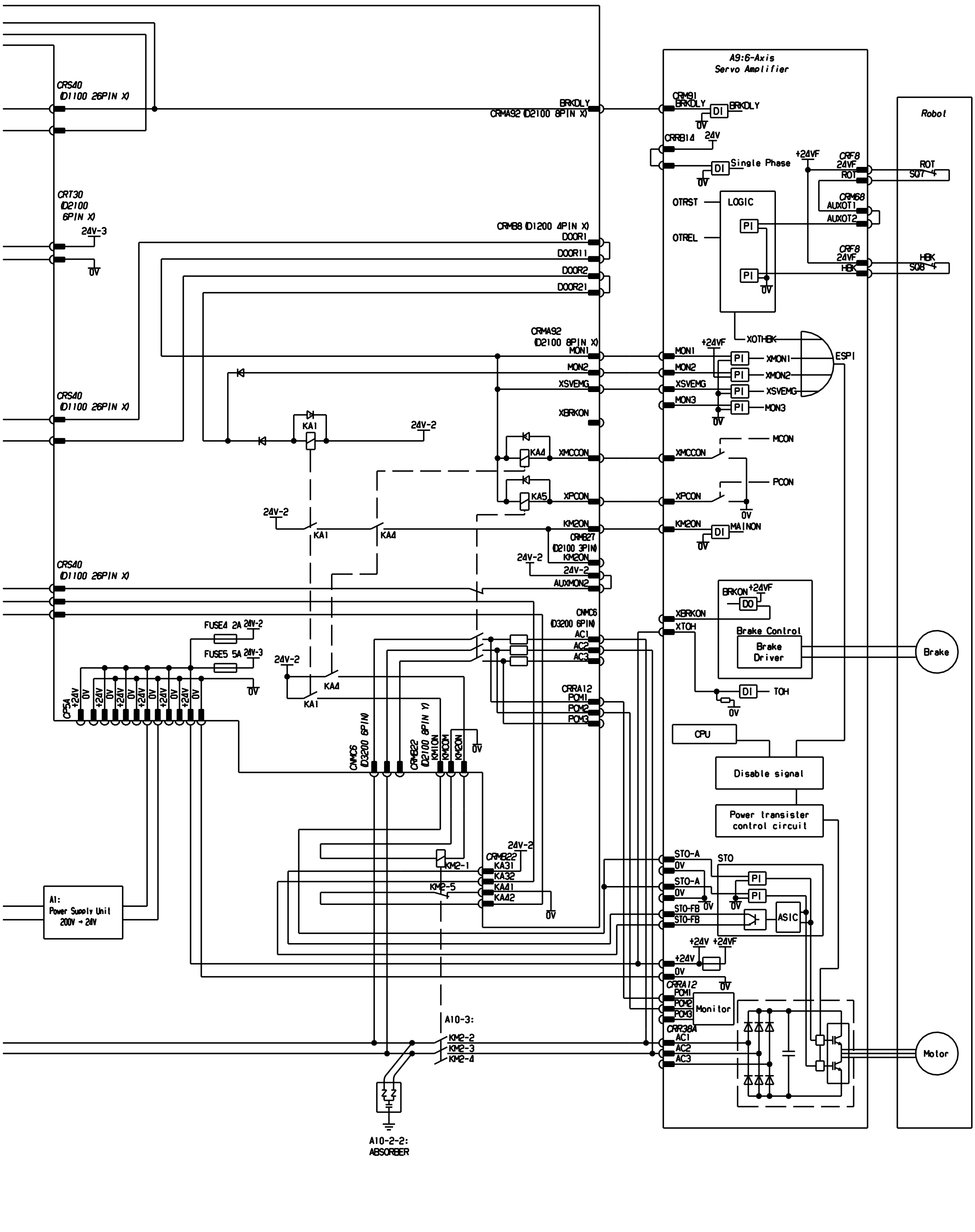


Fig.B(i) R-30*i*B Mate Emergency stop circuit connection diagram
(This diagram shows the single phase input circuit. In case of three phase input, See the Fig.B(b))


A9:6-Axis
Servo Amplifier
Robot
CRS40
(D1100 26PIN X)
BRKDLY
CRMA92 (D2100 8PIN X)
CRM91
BRKDLY
DI
0V
CRRB14
24V
Single Phase
+24VF
CRF8
24VF
ROT
SQ7
CRM68
AUXOT1
AUXOT2
OTRST
LOGIC
OTREL
PI
HBK
SQ8
CRT30
(D2100
6PIN X)
24V-3
CRM88 (D1200 4PIN X)
DOOR1
DOOR11
DOOR2
DOOR21
CRMA92
(D2100 8PIN X)
MON1
MON2
XSVEMG
MON3
XOTHBK
XMON1
XMON2
ESP1
XBRKON
KA1
24V-2
KA4
XMCCON
MCON
KA5
XPCON
PCON
KM2ON
MAINON
CRMB27
(D2100 3PIN)
AUXMON2
BRKON
DO
Brake Control
Brake
Driver
Brake
CNMC6
(D3200 6PIN)
AC1
AC2
AC3
XTOH
TOH
FUSE4 2A
FUSE5 5A
CRRA12
POM1
POM2
POM3
CP5A
+24V
CPU
Disable signal
Power transister
control circuit
CRMB22
(D2100 8PIN Y)
KM1ON
KMCOM
KM2ON
KM2-1
KA31
KA32
KA41
KA42
KM2-5
STO-A
STO
STO-FB
ASIC
A1:
Power Supply Unit
200V → 24V
Monitor
CRR38A
A10-3:
KM2-2
KM2-3
KM2-4
Motor
A10-2-2:
ABSORBER

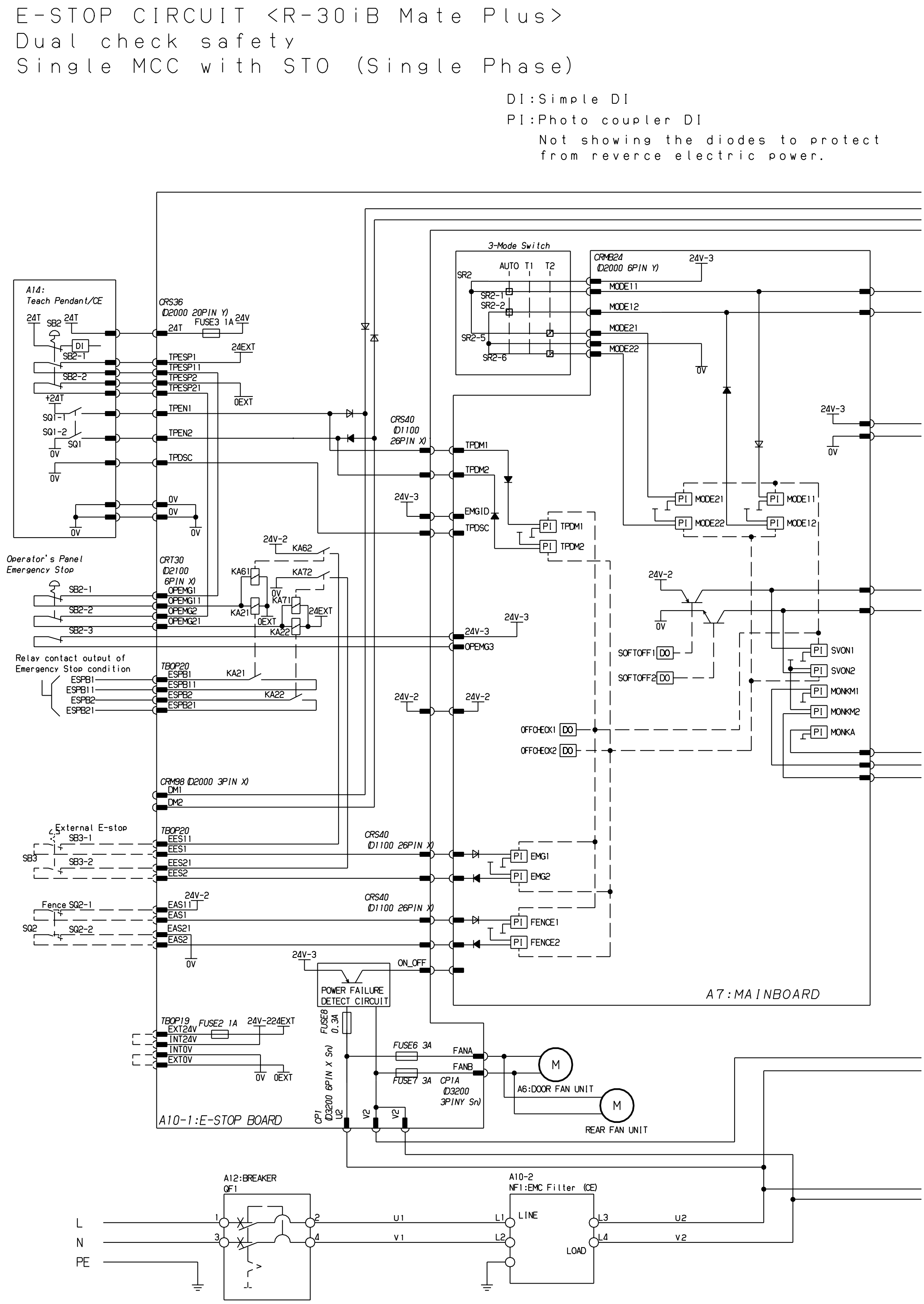
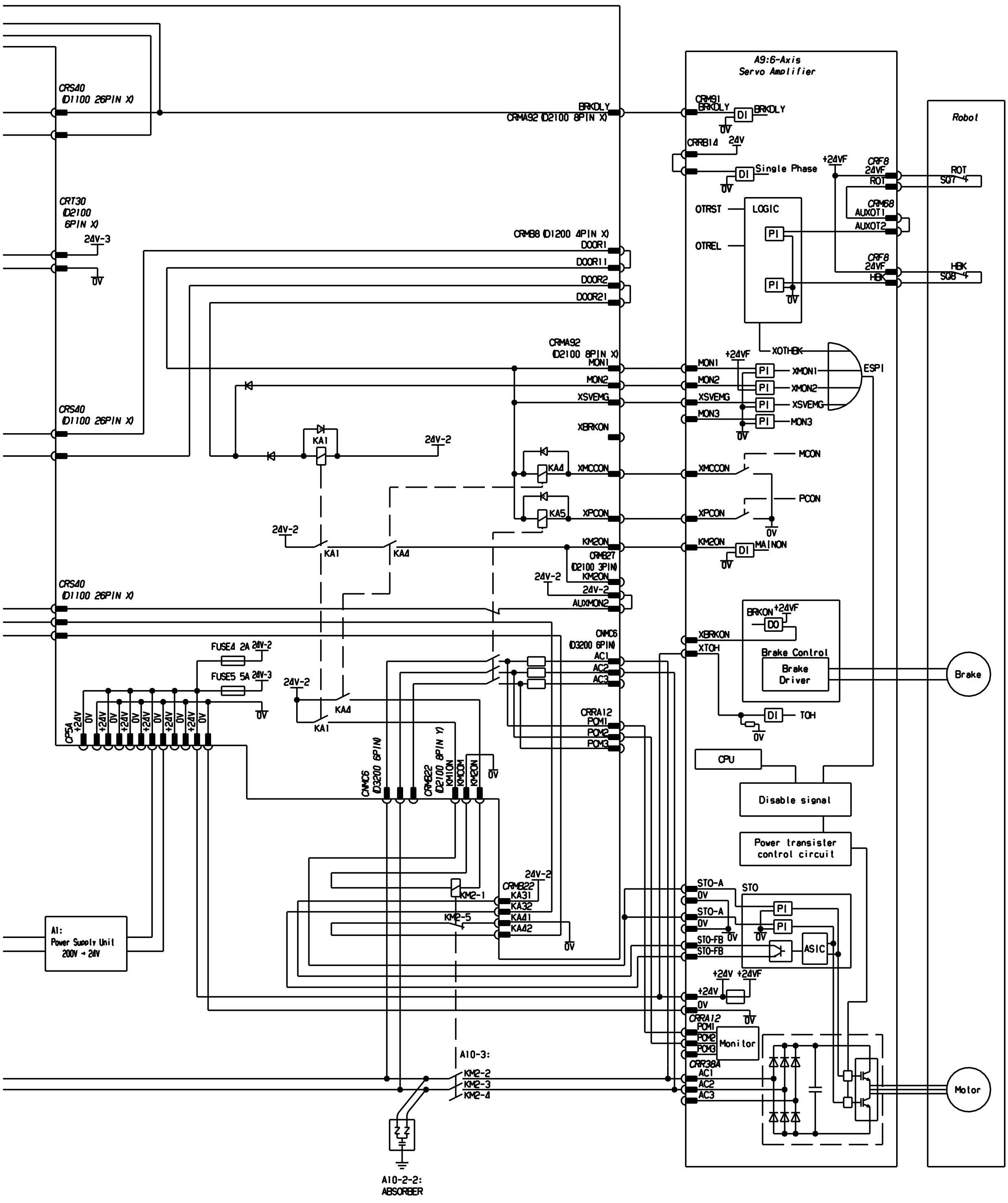


Fig.B(j) R-30*i*B Mate Plus Emergency stop circuit connection diagram
(This diagram shows the single phase input circuit. In case of three phase input, See the Fig.B(d))


A9:6-Axis
Servo Amplifier
Robot
CRS40
(D1100 26PIN X)
BRKDLY
CRMA92 (D2100 8PIN X)
CRM91
DI
0V
CRRB14
24V
Single Phase
+24VF
CRF8
24VF
ROT
SQ7
CRT30
(D2100
6PIN X)
24V-3
CRM68
AUXOT1
AUXOT2
OTRST
LOGIC
OTREL
PI
CRM88 (D1200 4PIN X)
DOOR1
DOOR11
DOOR2
DOOR21
HBK
SQ8
XOTHBK
ESP1
XMON1
XMON2
XSVEMG
MON3
MON1
MON2
XBRKON
KA1
24V-2
KA4
XMCCON
MCON
KA5
XPCON
PCON
KM2ON
MAINON
CRMB27
(D2100 3PIN)
AUXMON2
CNMC6
(D3200 6PIN)
AC1
AC2
AC3
BRKON
DO
Brake Control
Brake
Driver
Brake
XTOH
TOH
FUSE4 2A
FUSE5 5A
CP5A
+24V
CRRA12
PCM1
PCM2
PCM3
CPU
Disable signal
Power transister
control circuit
CRMB22
(D2100 8PIN Y)
KM1ON
KMCOM
KM2-1
KA31
KA32
KA41
KA42
KM2-5
STO-A
STO
STO-FB
ASIC
A1:
Power Supply Unit
200V → 24V
Monitor
CRR38A
A10-3:
KM2-2
KM2-3
KM2-4
Motor
A10-2-2:
ABSORBER

R-30iB Mate E-STOP Board Connector Table

CRS36
D2100D (Y)
TEACH PENDANT

A1	+24T	B1	TPESP21
A2	+24T	B2	TPESP2
A3	TPEN2	B3	TPESP11
A4	TPEN1	B4	TPESP1
A5	TPDSC	B5	0V
A6	0V	B6	0V
A7	XTXTP	B7	TXN_TP
A8	TXTP	B8	TXP_TP
A9	XRXTP	B9	RXN_TP
A10	RXTP	B10	RXP_TP

CRS40
D1100D (X)
MAIN BOARD I/F

A1	RXTP	B1	TXTP
A2	XRXTP	B2	XTXTP
A3	RXP_TP	B3	TXP_TP
A4	RXN_TP	B4	TXN_TP
A5		B5	0V
A6	MODE11	B6	MONKM1
A7	TPDM1	B7	MONKM2
A8	TPDM2	B8	MONKMA
A9	EAS1	B9	TPDSC
A10	EAS2	B10	EMGID
A11	EES1	B11	SVON1
A12	EES2	B12	SVON2
A13	24V-2	B13	ON_OFF

CRT30
D2100D (X)
E-STOP BUTTON

A1	OPEMG1	B1	OPEMG11
A2	OPEMG2	B2	OPEMG21
A3	24V-3	B3	0V

CRMA92
D2100D (X)
6-AXIS SERVO AMPLIFIER

A1	MON2	B1	BRKON
A2	XSVEMG	B2	BKDLY
A3	XMCCON	B3	MON1
A4	XPCON	B4	KM2ON

CRMB8
D1200D (X)
DOOR SWITCH

A1	SVON1	B1	SVON11
A2	SVON2	B2	SVON21

CRMB22
D2100D (Y)
MCC I/F

A1	KA31	B1	KA32
A2	KA41	B2	KA42
A3		B3	0V
A4	KM1ON	B4	KM2ON

CRMB27
D2100S (Y)
MULTI ARM/AUX. AXIS

1	AUXMON2
2	24V-2
3	KM2ON_DO

CRM98
D2100S (X)
DEADMAN SW. OUTPUT

1	DM1
2	DM2
3	

CP1
D3200 (X)
AC200V INPUT

1	V2IN
2	V2OUT
3	U2

CP1A
D3200 (Y)
FANU UNIT POWER

1	FANA
2	FANB
3	

CP5A
D3500
DC24V

A1	24V	B1	0V
A2	24V	B2	0V
A3	24V	B3	0V
A4	24V	B4	0V
A5	24V	B5	0V
A6	24V	B6	0V

CRRA12
D3200 (Z)
AC200V MONITOR

1	PCM1
2	PCM2
3	PCM3

CNMC6
D3200 (X)
PRE-CHARGE IN/OUT

1	U2
2	V2
3	W2
4	AC1
5	AC2
6	AC3

TBOP19
EXTERNAL DC24V

1	EXT24V
2	INT24V
3	INT0V
4	EXT0V

TBOP20
EXTERNAL E-STOP/FENCE

1	EES1
2	EES11
3	EES2
4	EES21
5	EAS1
6	EAS11
7	EAS2
8	EAS21
9	ESPB1
10	ESPB11
11	ESPB2
12	ESPB21

Fig.B(k) Emergency stop board connector table (R-30*i*B Mate)

R-30iB Mate Plus E-STOP Board
Connector Table

CRS36
D2100D (Y)
TEACH PENDANT

A1	+24T	B1	TPESP21
A2	+24T	B2	TPESP2
A3	TPEN2	B3	TPESP11
A4	TPEN1	B4	TPESP1
A5	TPDSC	B5	0V
A6	0V	B6	0V
A7	XTXTP	B7	TXN_TP
A8	TXTP	B8	TXP_TP
A9	XRXTP	B9	RXN_TP
A10	RXTP	B10	RXP_TP

CRS40
D1100D (X)
MAIN BOARD I/F

A1	RXTP	B1	TXTP
A2	XRXTP	B2	XTXTP
A3	RXP_TP	B3	TXP_TP
A4	RXN_TP	B4	TXN_TP
A5		B5	0V
A6	MODE11	B6	MONKM1
A7	TPDM1	B7	MONKM2
A8	TPDM2	B8	MONKMA
A9	EAS1	B9	TPDSC
A10	EAS2	B10	EMGID
A11	EES1	B11	SVON1
A12	EES2	B12	SVON2
A13	24V-2	B13	ON_OFF

CRT30
D2100D (X)
E-STOP BUTTON

A1	OPEMG1	B1	OPEMG11
A2	OPEMG2	B2	OPEMG21
A3	24V-3	B3	0V

CRMA92
D2100D (X)
6-AXIS SERVO AMPLIFIER

A1	MON2	B1	BRKON
A2	XSVEMG	B2	BKDLY
A3	XMCCON	B3	MON1
A4	XPCON	B4	KM2ON

CRMB8
D1200D (X)
DOOR SWITCH

A1	SVON1	B1	SVON11
A2	SVON2	B2	SVON21

CRMB22
D2100D (Y)
MCC I/F

A1	KA31	B1	KA32
A2	KA41	B2	KA42
A3		B3	0V
A4	KM1ON	B4	KM2ON

CRMB27
D2100D (Y)
MULTI ARM/AUX. AXIS

1	AUXMON2
2	24V-2
3	KM2ON_DO

CRM98
D2100D (X)
DEADMAN SW. OUTPUT

1	DM1
2	DM2
3	

CP1/CP1A
D3200 (XY)
CP1 :AC200V INPUT (ROW A. X-KEY)
CP1A:FAN UNIT POWER (ROW B. Y-KEY)

A1	V2IN	B1	FANA
A2	V2OUT	B2	FANB
A3	U2	B3	

CP5A
D3500
DC24V

A1	24V	B1	0V
A2	24V	B2	0V
A3	24V	B3	0V
A4	24V	B4	0V
A5	24V	B5	0V
A6	24V	B6	0V

CRRA12
D3200 (Z)
AC200V MONITOR

1	PCM1
2	PCM2
3	PCM3

CNMC6
D3200 (X)
DEADMAN SW. OUTPUT

1	U2
2	V2
3	W2
4	AC1
5	AC2
6	AC3

TBOP19
EXTERNAL DC24V

1	EXT24V
2	INT24V
3	INT0V
4	EXT0V

TBOP20
EXTERNAL E-STOP/FENCE

1	EES1
2	EES11
3	EES2
4	EES21
5	EAS1
6	EAS11
7	EAS2
8	EAS21
9	ESPB1
10	ESPB11
11	ESPB2
12	ESPB21

Fig.B(l) Emergency stop board connector table (R-30*i*B Mate Plus)

MAIN BOARD

JRS26
PCR20
I/O Link (CH.1)

11	0V	1	RXSLCB
12	0V	2	XRXSLCB
13	0V	3	TXSLCB
14	0V	4	XTXSLCB
15	0V	5	RXSLCC
16	0V	6	XRXSLCC
17		7	TXSLCC
18	5V	8	XTXSLCC
19	24V-3	9	5V
20	5V	10	24V-3

JRS27
PCR20
RS232-C, ETHERNET CAMERA

11	TXDA	1	RXDA
12	0V	2	0V
13	DTRA	3	DSRA
14	0V	4	0V
15	RTSA	5	CTSA
16	0V	6	0V
17	CAMTX+	7	CAMRX+
18	CAMTX-	8	CAMRX-
19	24V-3	9	
20		10	24V-3

JRL7
PCR20
VISION

11	CAMDO2	1	XVD
12	0V	2	0V
13	CAMDO3	3	XHD
14	0V	4	0V
15	CAMDI1	5	XTRIG
16	CAMDI2	6	0V
17	CAMDI0	7	VIDEOIN
18	CAMDO0	8	0V
19	P12V	9	24V-3
20	CAMDO1	10	0V

JD44A
PCR20
I/O Link i (CH.2)

11	0V	1	(Reserve)
12	0V	2	(Reserve)
13	0V	3	(Reserve)
14	0V	4	(Reserve)
15	0V	5	RXSLCS
16	0V	6	XRXSLCS
17		7	TXSLCS
18	5V	8	XTXSLCS
19	24V-3	9	5V
20	5V	10	24V-3

CRS40
D1100D (X)
E-STOP BOARD I/F

A1		B1	
A2		B2	
A3	RXP_TP	B3	TXP_TP
A4	RXN_TP	B4	TXN_TP
A5		B5	0V
A6	MODE11	B6	MONKM1
A7	TPDM1	B7	MONKM2
A8	TPDM2	B8	MONKMA
A9	EAS1	B9	TPDSC
A10	EAS2	B10	EMGID
A11	EES1	B11	SVON1
A12	EES2	B12	SVON2
A13	24V-2	B13	ON_OFF

CRS41
DF11-10DS-2C (HIROSE)
FORCE/3D SENSOR, LVC

1	SDATA	2	XSDATA
3	RV_LVC	4	XRV_LVC
5	24V-3	6	0V
7	DV_LVC	8	XDV_LVC
9	5V	10	0V

CRMB23
D2100D (X)
OP. PANEL SWITCH

A1	BUSY	B1	RESET
A2	START	B2	OPEMG3
A3	24V-3	B3	INOV

CRMB24
D1200D (Y)
MODE SWITCH

A1	MODE11	B1	MODE21
A2	MODE12	B2	MODE22
A3	24V-3	B3	0V

CRL3
DF11-4DS-2C (HIROSE)
HDI

1	XHDI0	2	XHDI1
3	0V	4	0V

CRMA15
DI/DO

	A	B
1	24F	24F
2	24F	24F
3	SDICOM1	SDICOM2
4	0V	0V
5	DI101	DI102
6	DI103	DI104
7	DI105	DI106
8	DI107	DI108
9	DI109	DI110
10	DI111	DI112
11	DI113	DI114
12	DI115	DI116
13	DI117	DI118
14	DI119	DI120
15	DO101	DO102
16	DO103	DO104
17	DO105	DO106
18	DO107	DO108
19	0V	0V
20	DOSRC1	DOSRC1

CRMA16
DI/DO

	A	B
1	24F	24F
2	24F	24F
3	SDICOM3	
4	0V	0V
5	DI121	DI122
6	DI123	DI124
7	DI125	DI126
8	DI127	DI128
9		
10	DO109	DO110
11	DO111	DO112
12	DO113	DO114
13	DO115	DO116
14	DO117	DO118
15	DO119	DO120
16	DO121	DO122
17	DO123	DO124
18		
19	0V	0V
20	DOSRC2	DOSRC2

CD38A
Ethernet 100Base-TX

1	TXA+
2	TXA-
3	RXA+
4	
5	
6	RXA-
7	
8	

CD38B
Ethernet 100Base-TX

1	TXB+
2	TXB-
3	RXB+
4	
5	
6	RXB-
7	
8	

Fig.B(m) Main board connector table (R-30*i*B Mate)

MAIN BOARD

JRS26
PCR20
I/O Link (CH.1)

11	0V	1	RXSLCB
12	0V	2	XRXSLCB
13	0V	3	TXSLCB
14	0V	4	XTXSLCB
15	0V	5	RXSLCC
16	0V	6	XRXSLCC
17		7	TXSLCC
18	5V	8	XTXSLCC
19	24V-3	9	5V
20	5V	10	24V-3

JRS27
PCR20
RS232-C

11	TXDA	1	RXDA
12	0V	2	0V
13	DTRA	3	DSRA
14	0V	4	0V
15	RTSA	5	CTSA
16	0V	6	0V
17		7	
18		8	
19	24V-3	9	
20		10	24V-3

CRJ3
SENSOR INTERFACE
(VIDEO INTERFACE)

1	CAMERA

JD44A
PCR20
I/O Link I (CH.2)

11	0V	1	(Reserve)
12	0V	2	(Reserve)
13	0V	3	(Reserve)
14	0V	4	(Reserve)
15	0V	5	RXSLCS
16	0V	6	XRXSLCS
17		7	TXSLCS
18	5V	8	XTXSLCS
19	24V-3	9	5V
20	5V	10	24V-3

CRS40
D1100D (X)
E-STOP BOARD I/F

A1		B1	
A2		B2	
A3	RXP_TP	B3	TXP_TP
A4	RXN_TP	B4	TXN_TP
A5		B5	0V
A6	MODE11	B6	MONKM1
A7	TPDM1	B7	MONKM2
A8	TPDM2	B8	MONKMA
A9	EAS1	B9	TPDSC
A10	EAS2	B10	EMGID
A11	EES1	B11	SVON1
A12	EES2	B12	SVON2
A13	24V-2	B13	ON_OFF

CRS41
DF11-10DS-2C (HIROSE)
FORCE/3D SENSOR, LVC

1	SDATA	2	XSDATA
3	RV_LVC	4	XRV_LVC
5	24V-3	6	0V
7	DV_LVC	8	XDV_LVC
9	5V	10	0V

CRMB23
D2100D (X)
OP. PANEL SWITCH

A1	BUSY	B1	RESET
A2	START	B2	OPEMG3
A3	24V-3	B3	INOV

CRMB24
D1100D (Y)
MODE SWITCH

A1	MODE11	B1	MODE21
A2	MODE12	B2	MODE22
A3	24V-3	B3	0V

CRL3
DF11-4DS-2C (HIROSE)
HDI

1	XHDI0	2	XHDI1
3	0V	4	0V

CRMA15
DI/DO

	A	B
1	24F	24F
2	24F	24F
3	SDICOM1	SDICOM2
4	0V	0V
5	DI101	DI102
6	DI103	DI104
7	DI105	DI106
8	DI107	DI108
9	DI109	DI110
10	DI111	DI112
11	DI113	DI114
12	DI115	DI116
13	DI117	DI118
14	DI119	DI120
15	DO101	DO102
16	DO103	DO104
17	DO105	DO106
18	DO107	DO108
19	0V	0V
20	DOSRC1	DOSRC1

CRMA16
DI/DO

	A	B
1	24F	24F
2	24F	24F
3	SDICOM3	
4	0V	0V
5	DI121	DI122
6	DI123	DI124
7	DI125	DI126
8	DI127	DI128
9		
10	DO109	DO110
11	DO111	DO112
12	DO113	DO114
13	DO115	DO116
14	DO117	DO118
15	DO119	DO120
16	DO121	DO122
17	DO123	DO124
18		
19	0V	0V
20	DOSRC2	DOSRC2

CD38A
Ethernet
100Base-TX

1	TPTXA+
2	TPTXA-
3	TPRXA+
4	NCA1
5	NCA1
6	TPRXA-
7	NCA2
8	NCA2

CD38B
Ethernet
100Base-TX

1	TPTXB+
2	TPTXB-
3	TPRXB+
4	NCB1
5	NCB1
6	TPRXB-
7	NCB2
8	NCB2

CD38C
Ethernet
100Base-TX/
1000Base-T

1	TDPA
2	TDMA
3	TDPB
4	TDPC
5	TDMC
6	TDMB
7	TDPD
8	TDMD
9	FG
10	FG

Fig.B(n) Main board connector table (R-30*i*B Mate Plus)

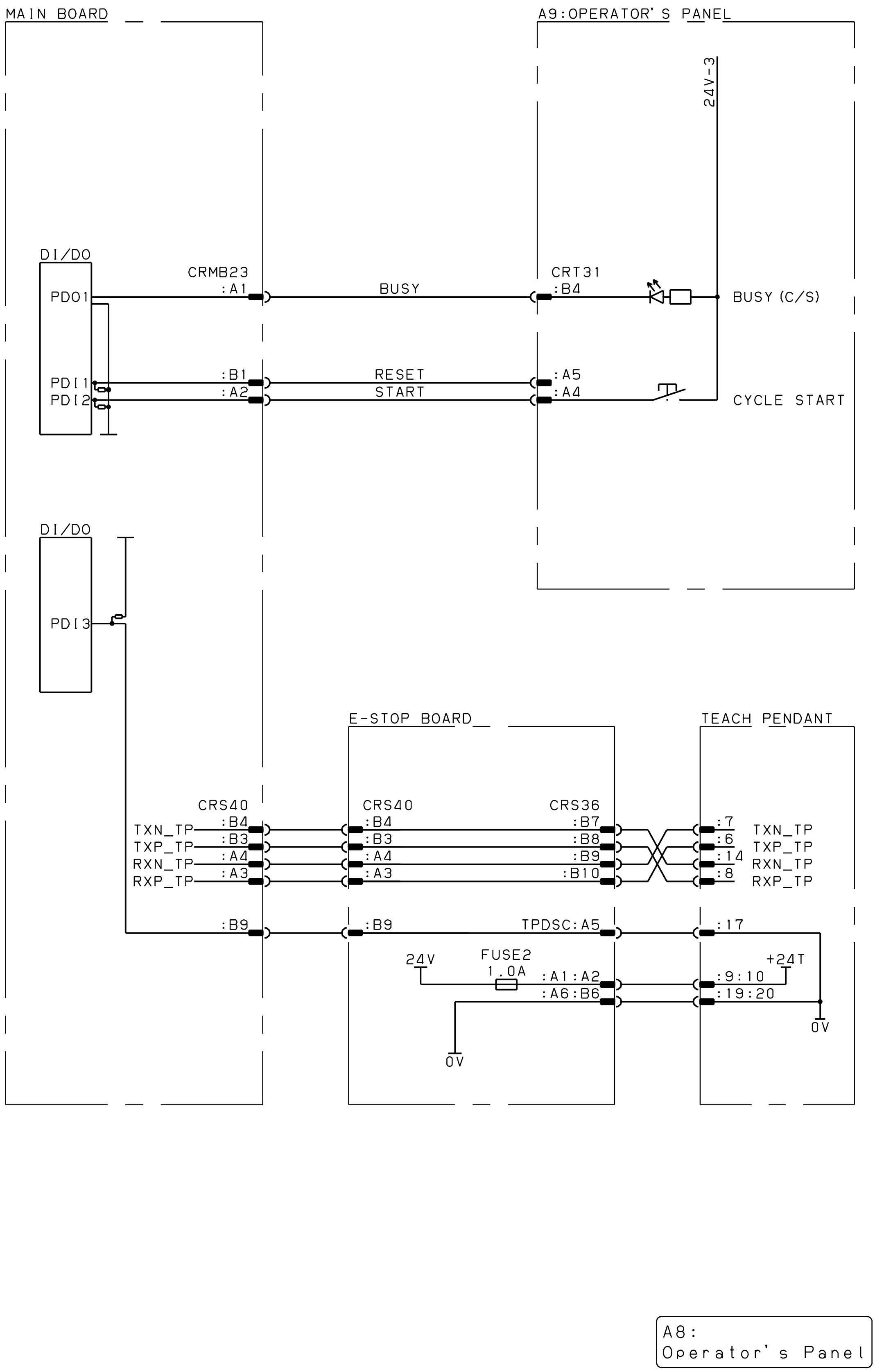


Fig.B(o) Operator's panel connection diagram

Operator's panel
Connector Table

CRT31
D2100D (X)
OP. PANEL SWITCH

A1	OPEMG1	B1	OPEMG11
A2	OPEMG2	B2	OPEMG21
A3	24V-3	B3	OPEMG3
A4	START	B4	BUSY
A5	RESET	B5	
A6		B6	

Teach pendant
Connector Table

CONNECTOR ON THE TEACH PENDANT

		4		3		2		1			
10	+24T	9	+24T	8	RXP_TP	7	TXN_TP	6	TXP_TP	5	DRAIN
16	TPESP21	15	TPESP2	14	RXN_TP	13	TPESP11	12	TPESP1	11	TPEN1
		20	0V	19	0V	18	TPEN2	17	TPDSC		

Line filter
Connector Table

LA
D5200 (XX)

A1	U1	B1	U2
A2	V1	B2	V2
A3	W1	B3	W2

Fig.B(p) Operator's panel/Teach pendant connector table

Servo Amplifier Connector Table

CRF8
D-2600

1	A	B	C
1	XPRQ1	PRQ1	5V
2	XPRQ2	PRQ2	5V
3	XPRQ3	PRQ3	5V
4	XPRQ4	PRQ4	5V
5	XPRQ5	PRQ5	5V
6	XPRQ6	PRQ6	5V
7	S+	S-	0V
8	RI1	RI2	0V
9	RI3	RI4	0V
10	RI5	RI6	0V
11	RI7	RI8	0V
12	RI9	RO1	0V
13	RO2	RO3	
14	RO4	RO5	
15	RO6	RO7	
16	RO8	XHBK	
17	24VF	XROT	
18	24VFIN	0V	

CNJ1A
D5200 (X)

1	2	3
J1U1	J1V1	J1W1

CNJ2A
D5200 (X)

1	2	3
J2U1	J2V1	J2W1

CNJ3A
D5200 (X)

1	2	3
J3U1	J3V1	J3W1

CNJ4
D4200 (X)

1	2	3
J4U1	J4V1	J4W1

CNJ5
D4200 (X)

1	2	3
J5U1	J5V1	J5W1

CNJ6
D4200 (X)

1	2	3
J6U1	J6V1	J6W1

CRRA11A
D3200 (Y)

1	DCRA1
2	
3	DCRA2

CRR63A
D2100 (X)

1	DCTHA1
2	DCTHA2
3	DCEXSTA

CRR63B
D2100 (X)

1	DCTHB1
2	DCTHB2
3	DCEXSTB

CNGA
D5200 (Y)

1	2	3
J1G1	J2G1	J3G1

CNGC
D4200 (Y)

1	2	3
J4G1	J5G1	J6G1

COP10B

1	FSSB1
2	FSSB2

COP10A

1	FSSB1
2	FSSB2

CRRB14
D2100 (Y)

1	XSINGLPH
2	0V
3	

CRMA91
D2100D (X)

A1	BRKDLY	B1	XOTHBK
A2	BRKONTM	B2	DCPASC
A3	XSVEMG	B3	MON1
A4	MON2	B4	
A5	XPCHON	B5	XMCCON
A6	KM2ON	B6	XTON

CRMB16
D2100D (Z)

A1	FBSTO1	B1	FBSTO2
A2	XTOA1	B2	24V
A3	XTOA2	B3	0V
A4	XTOB1	B4	24V
A5	XTOB2	B5	0V
A6	STOABNML	B6	0V

CRS23
D2100 (Y)

1	S2+
2	S2-
3	0V

CRRA13
D5200 (Y)

1	DCP
2	DCP
3	DCN
4	DCN

CRM68
D2100 (X)

1	AUXOT1
2	AUXOT2
3	

CRRA12
D3200 (Z)

1	PCM1
2	PCM2
3	PCM3

CRR38A
D5200 (X)

1	PE
2	AC1
3	AC2
4	AC3

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	

CXA2B
D2100D (X)

A1	24V	B1	24V
A2	0V	B2	0V
A3	MIFB	B3	XEXEPS
A4	XESP	B4	XMIFB

CXA2A
D2100D (X)

A1	24V	B1	24V
A2	0V	B2	0V
A3	MIFA	B3	
A4	XESP	B4	XMIFA

CRR88
D3200M (YY)

A1	BK (J1, J2)	B1	BKC
A2	BK (J3)	B2	BKC
A3	BK (J456)	B3	BKC

CRR65A/CRR65B
D3200M (XX)

A1	BK (J7)	B1	BK (J8)
A2		B2	
A3	BKC	B3	BKC

Fig.B(q) 6-Axis Servo amplifier connector table

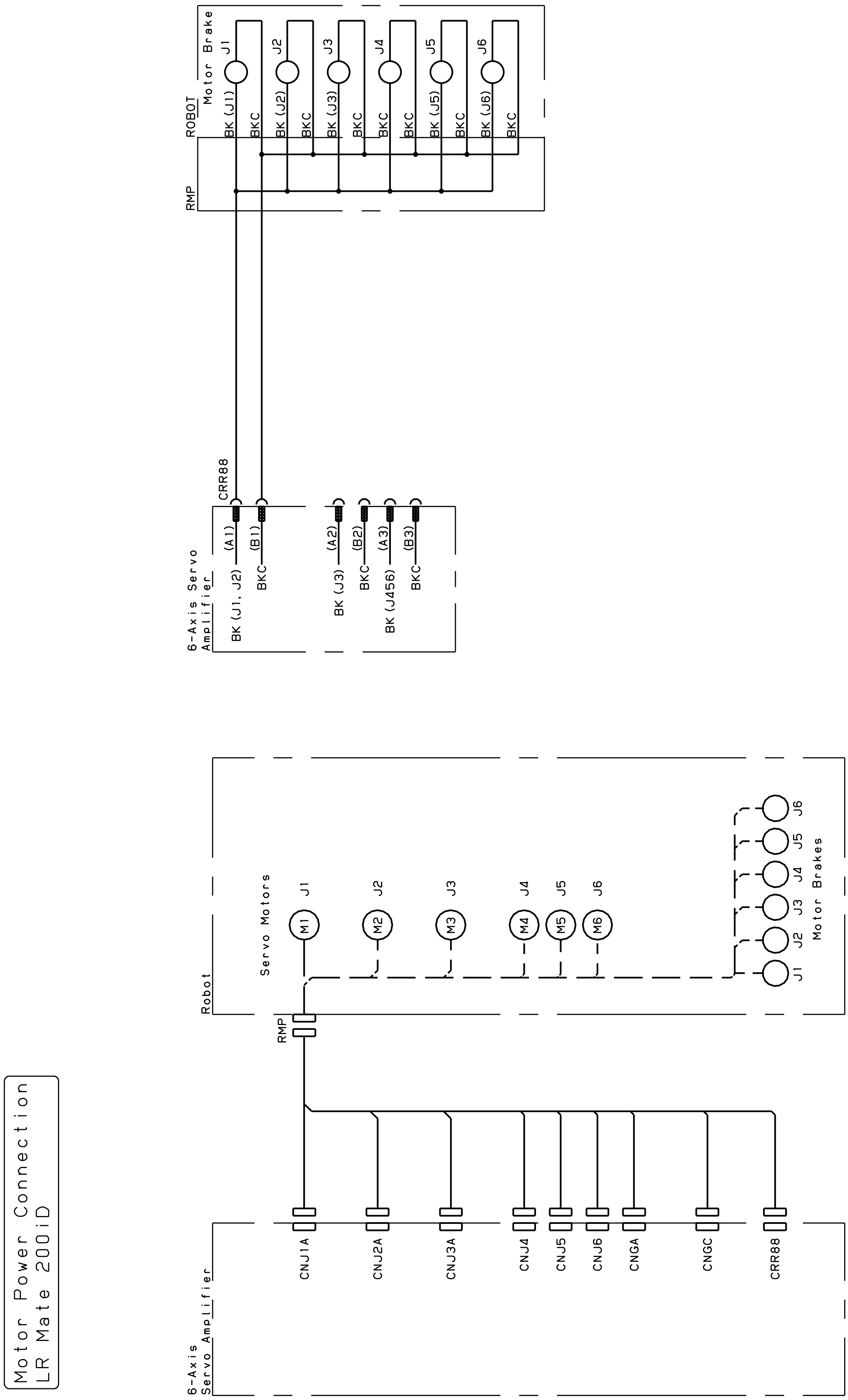


Fig.B (r) Motor power connection
LR Mate 200*i*C, LR Mate 200*i*D (6-Axis) ARC Mate 50*i*D, M-1*i*A(6-Axis), CR-4*i*A, CR-7*i*A

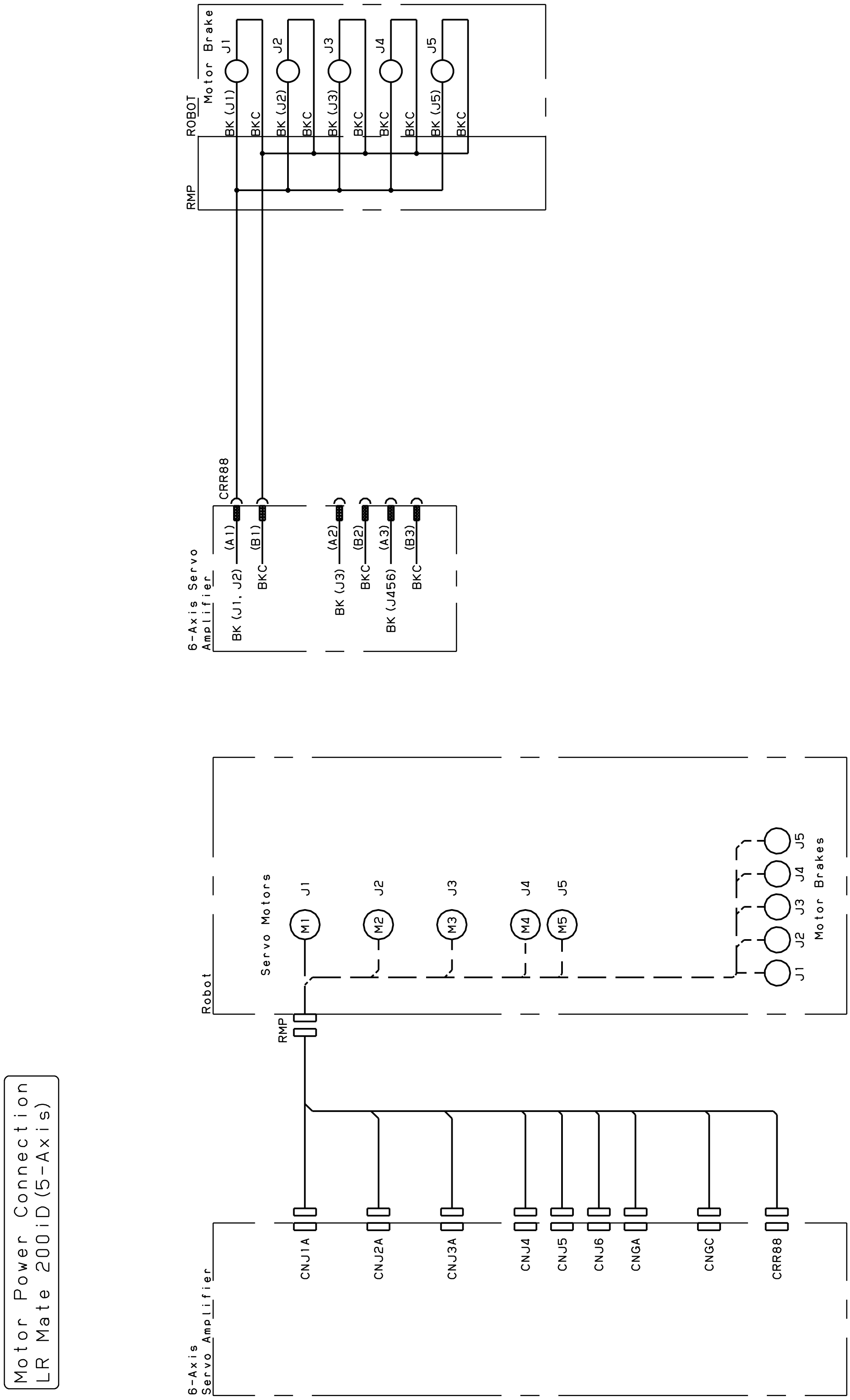


Fig.B(s) Motor power connection
LR Mate 200*i*D (5-Axis)

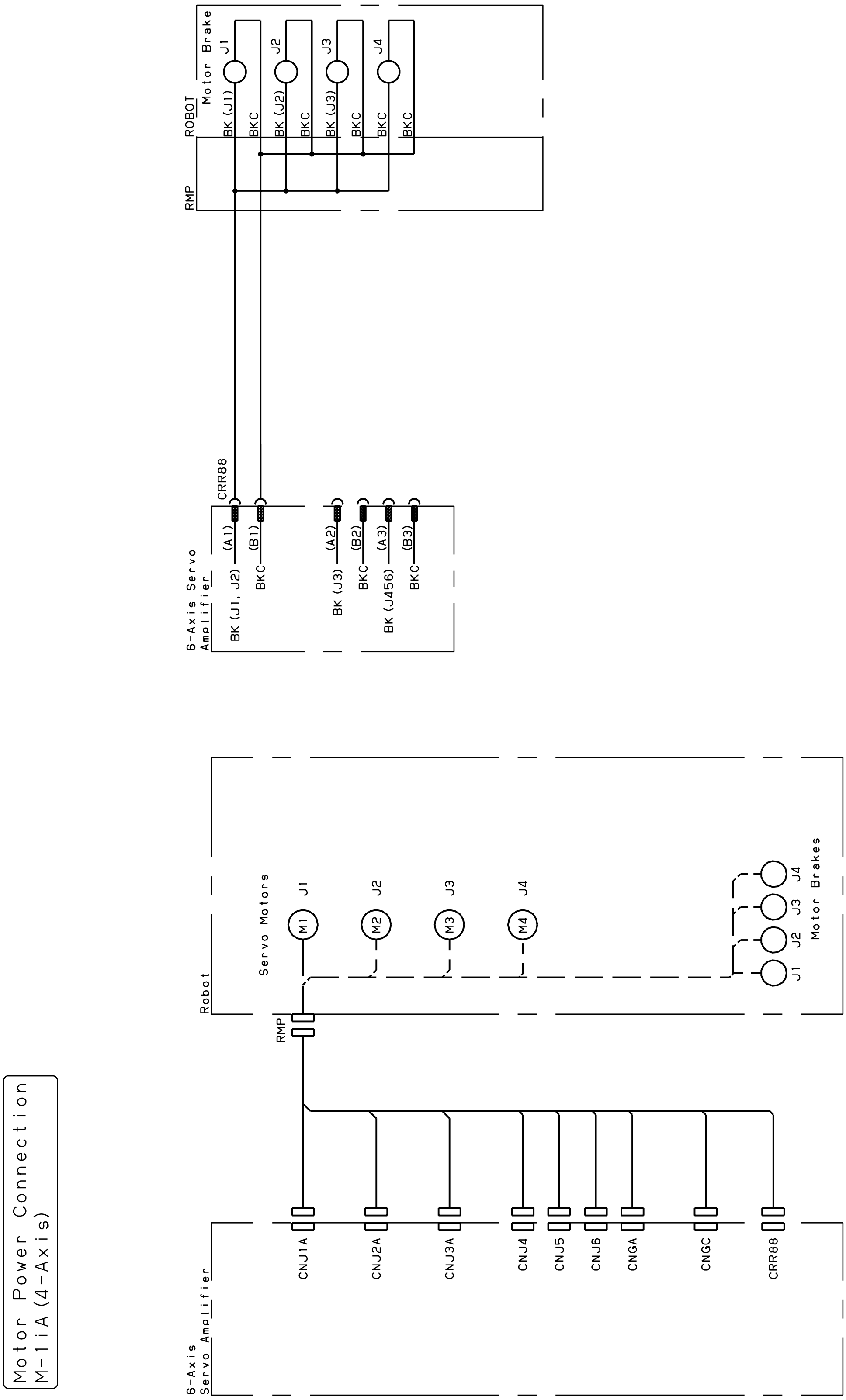


Fig.B(t) Motor power connection
M-1*i*A (4-Axis)

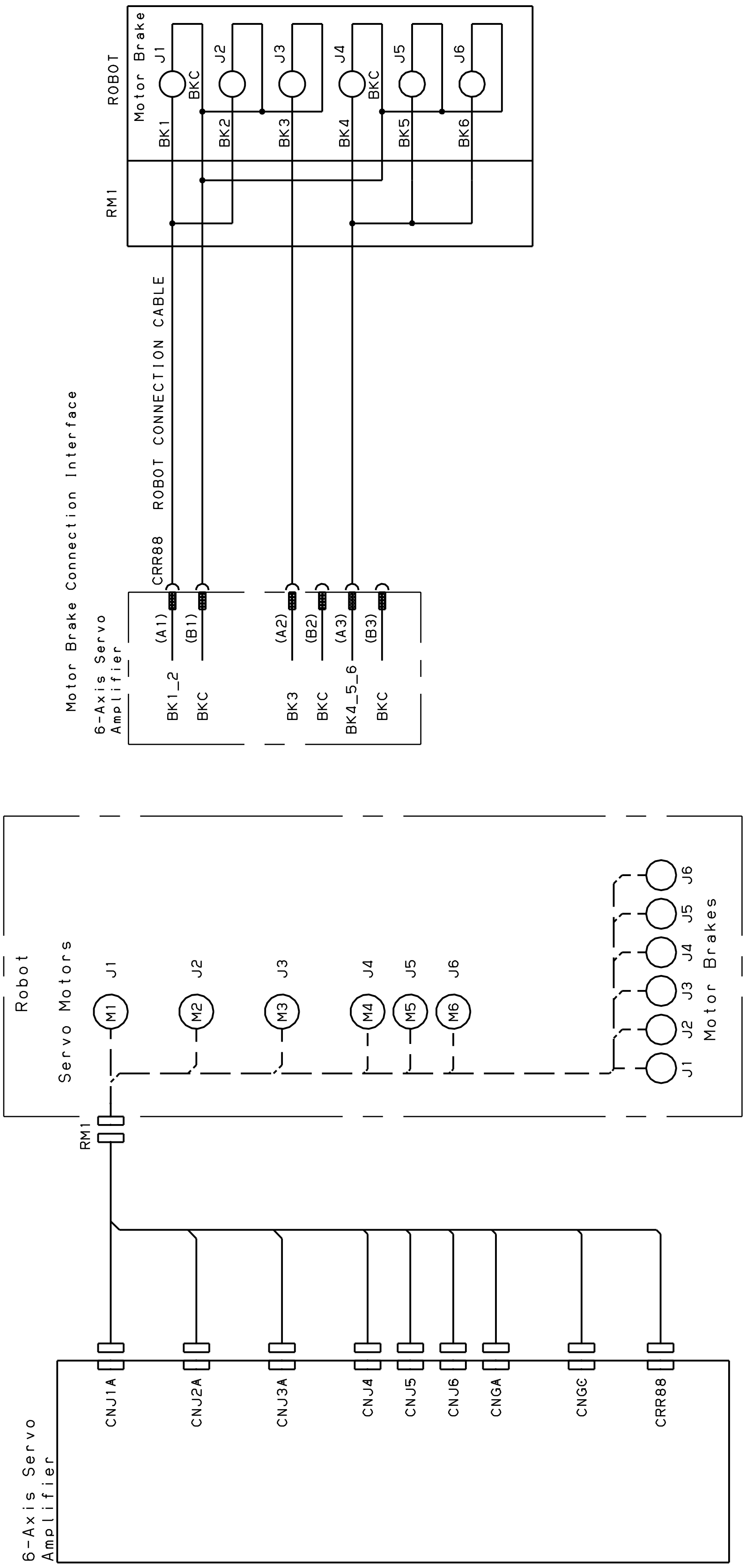


Fig.B(u) Motor power connection
R-2000*i*C, R-1000*i*A, M-710*i*C, M-2*i*A, M-3*i*A

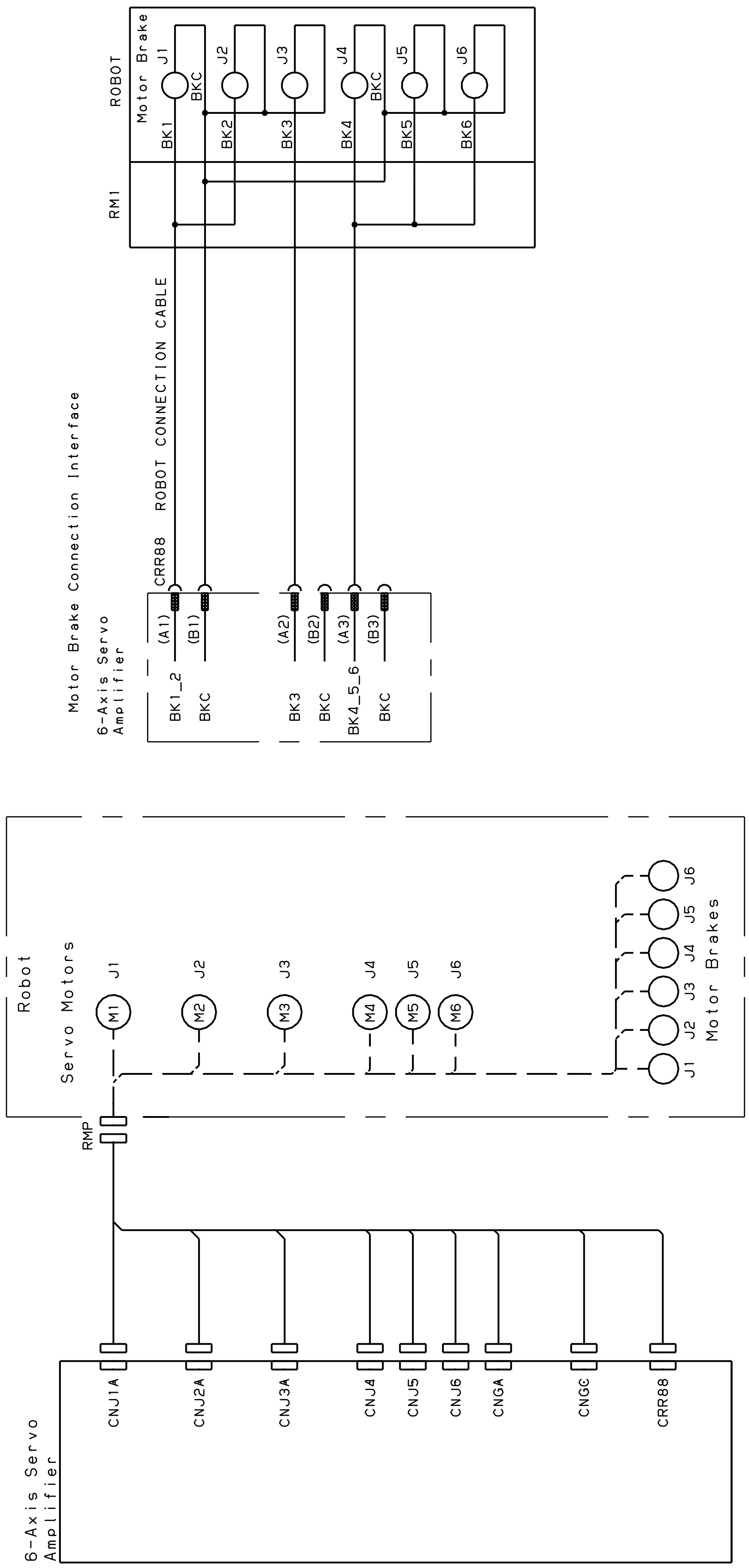


Fig.B(v) Motor power connection
ARC Mate 100*i*C, ARC Mate 100iD, ARC Mate 120*i*C, M-10*i*A, M-10iD, M-20*i*A, M-20*i*B, ARC Mate 0*i*B, R-0*i*B

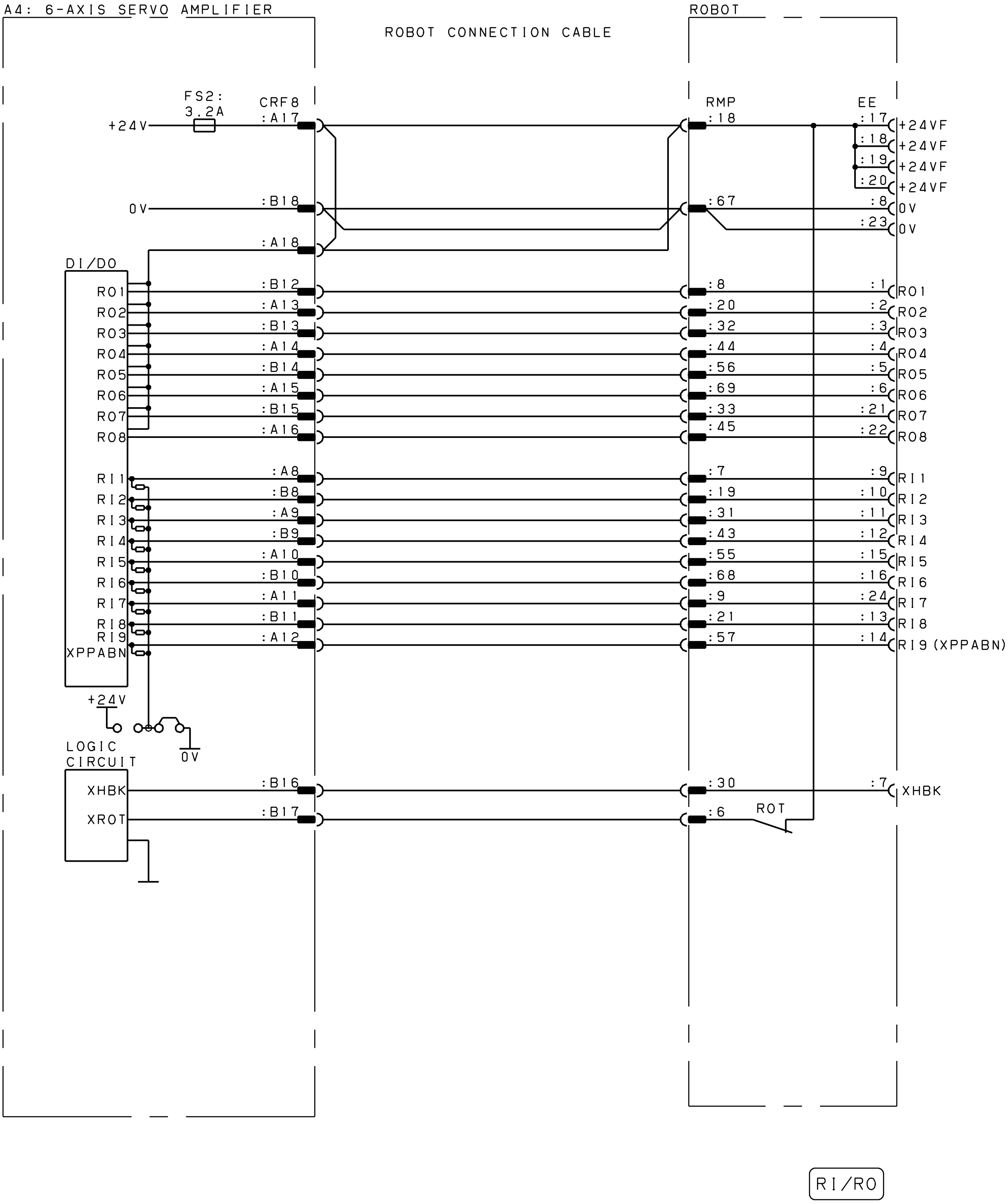


Fig.B(w) RI/RO connection diagram
(LR Mate 200*i*D, ARC Mate 50*i*D, ARC Mate 100*i*C, ARC Mate 100iD, ARC Mate 120*i*C,
M-10*i*A, M-10iD, M-20*i*A, M-20*i*B, ARC Mate 0*i*B, R-0*i*B, CR-4*i*A, CR-7*i*A)
(There are many type EE connector of mechanical unit. The detail is shown on the mechanical unit manual.)

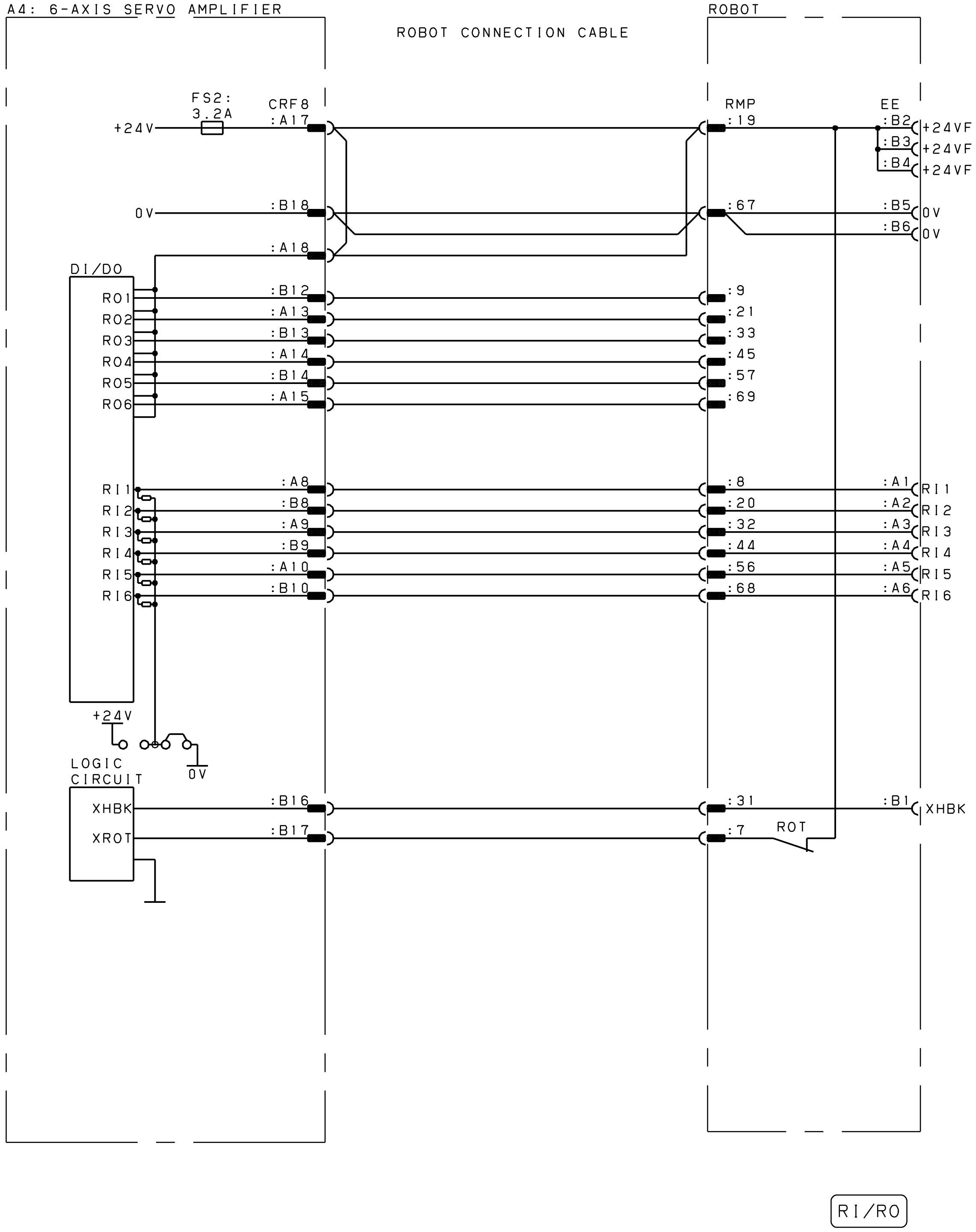


Fig.B(x) RI/RO connection diagram (M-1*i*A)
(There are many type EE connector of mechanical unit. The detail is shown on the mechanical unit manual.)

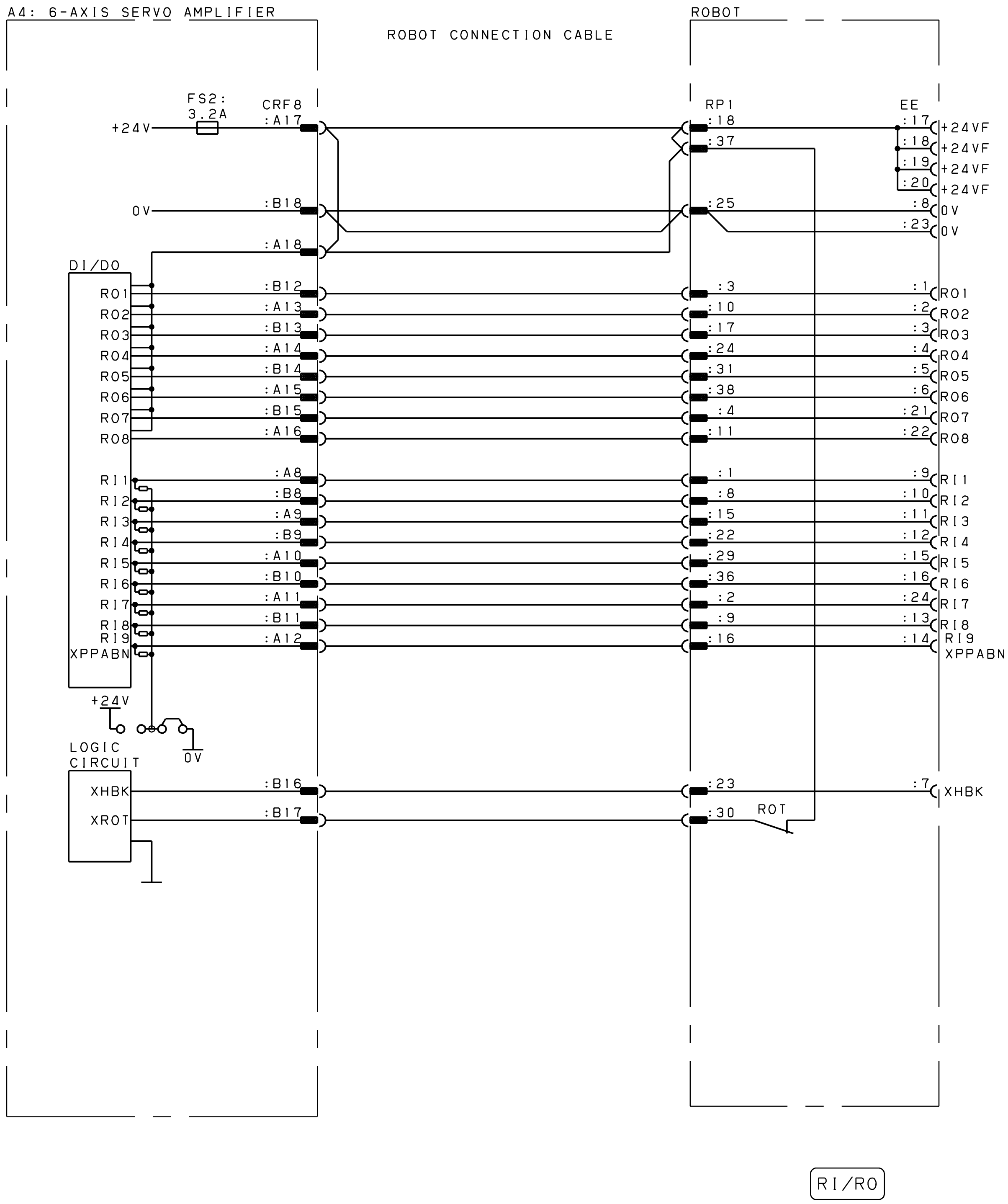


Fig.B(y) RI/RO connection diagram (R-2000*i*C, R-1000*i*A, M-710*i*C)
(There are many type EE connector of mechanical unit. The detail is shown on the mechanical unit manual.)

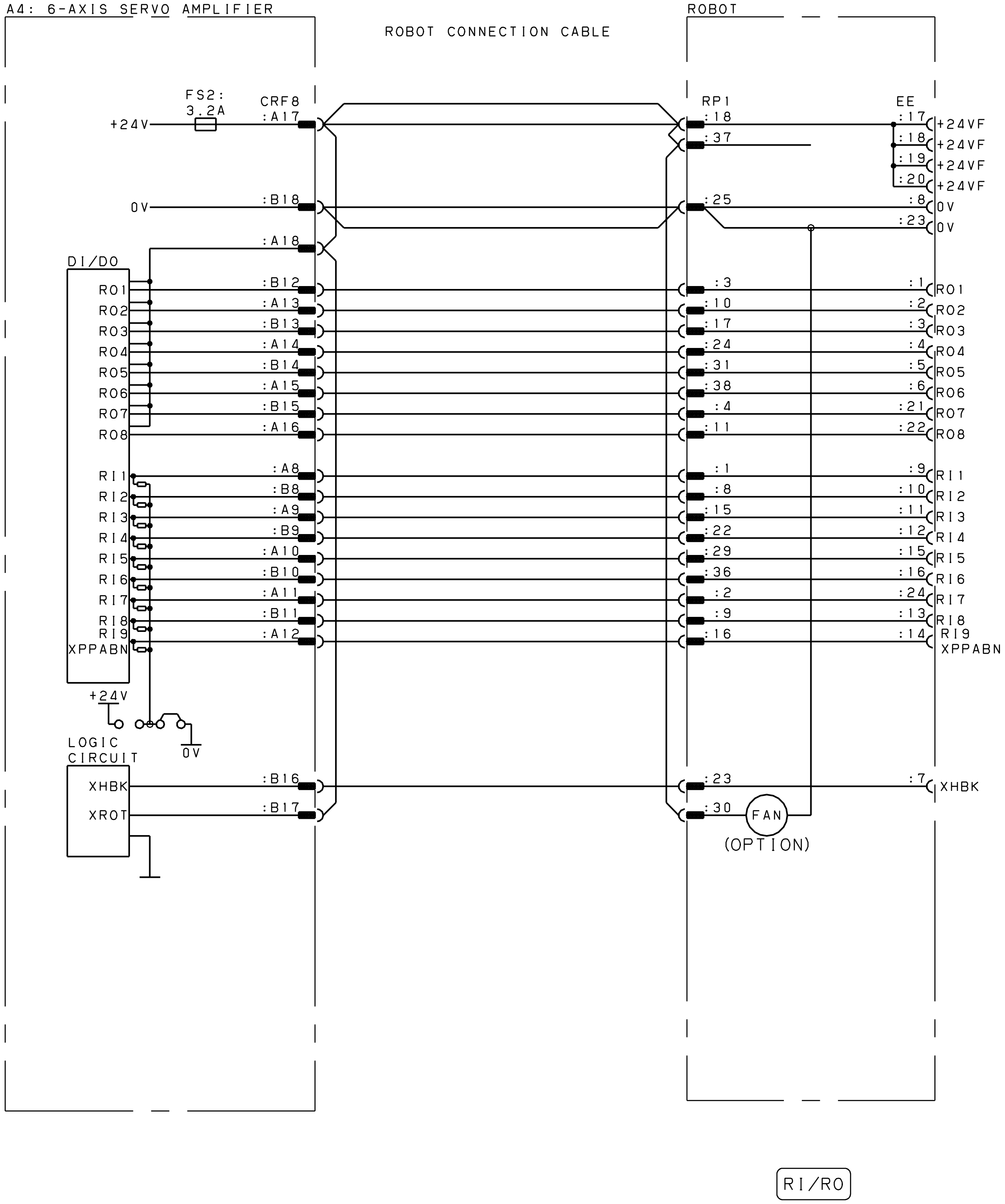


Fig.B(z) RI/RO connection diagram (M-2*i*A, M-3*i*A)
(There are many type EE connector of mechanical unit. The detail is shown on the mechanical unit manual.)

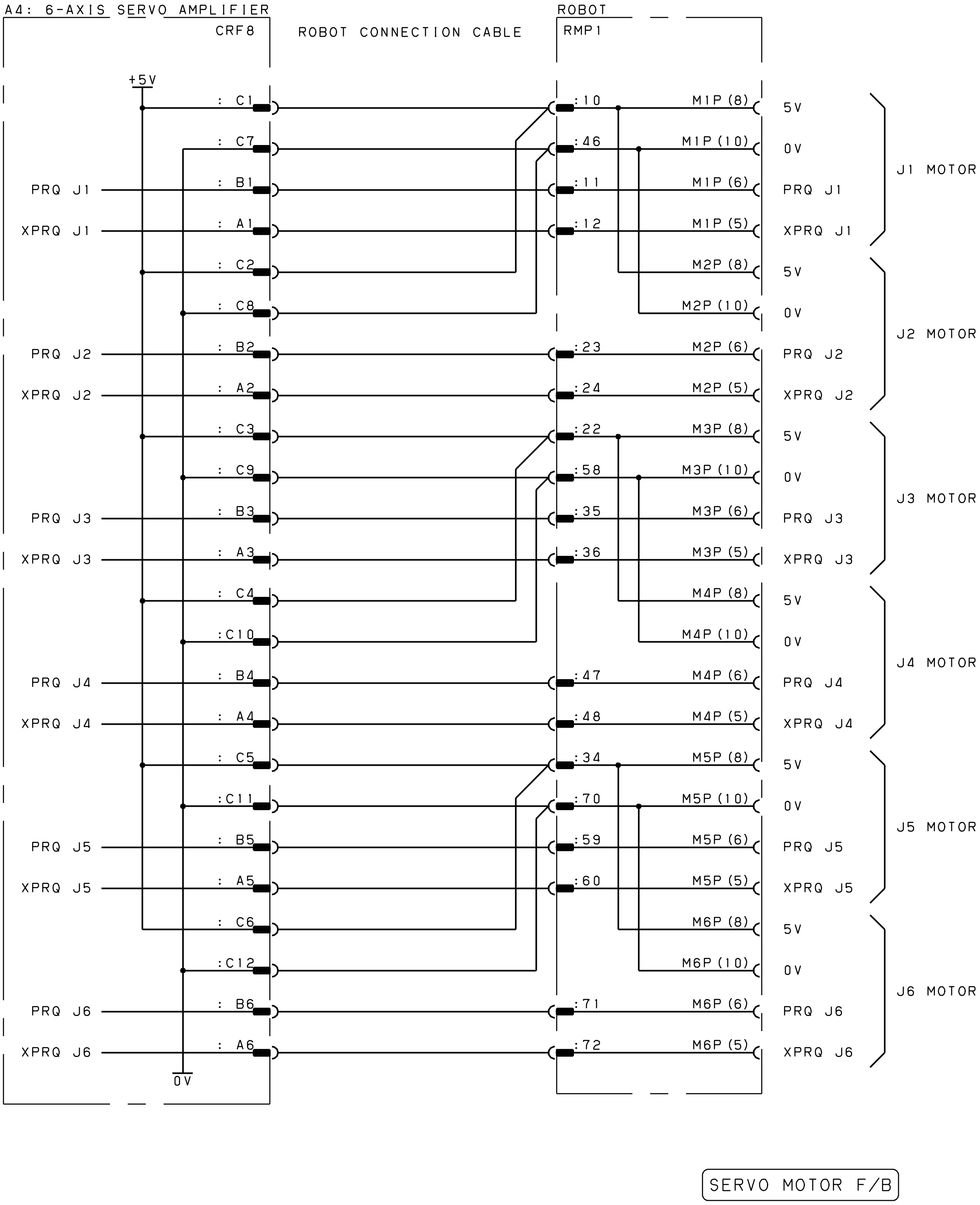
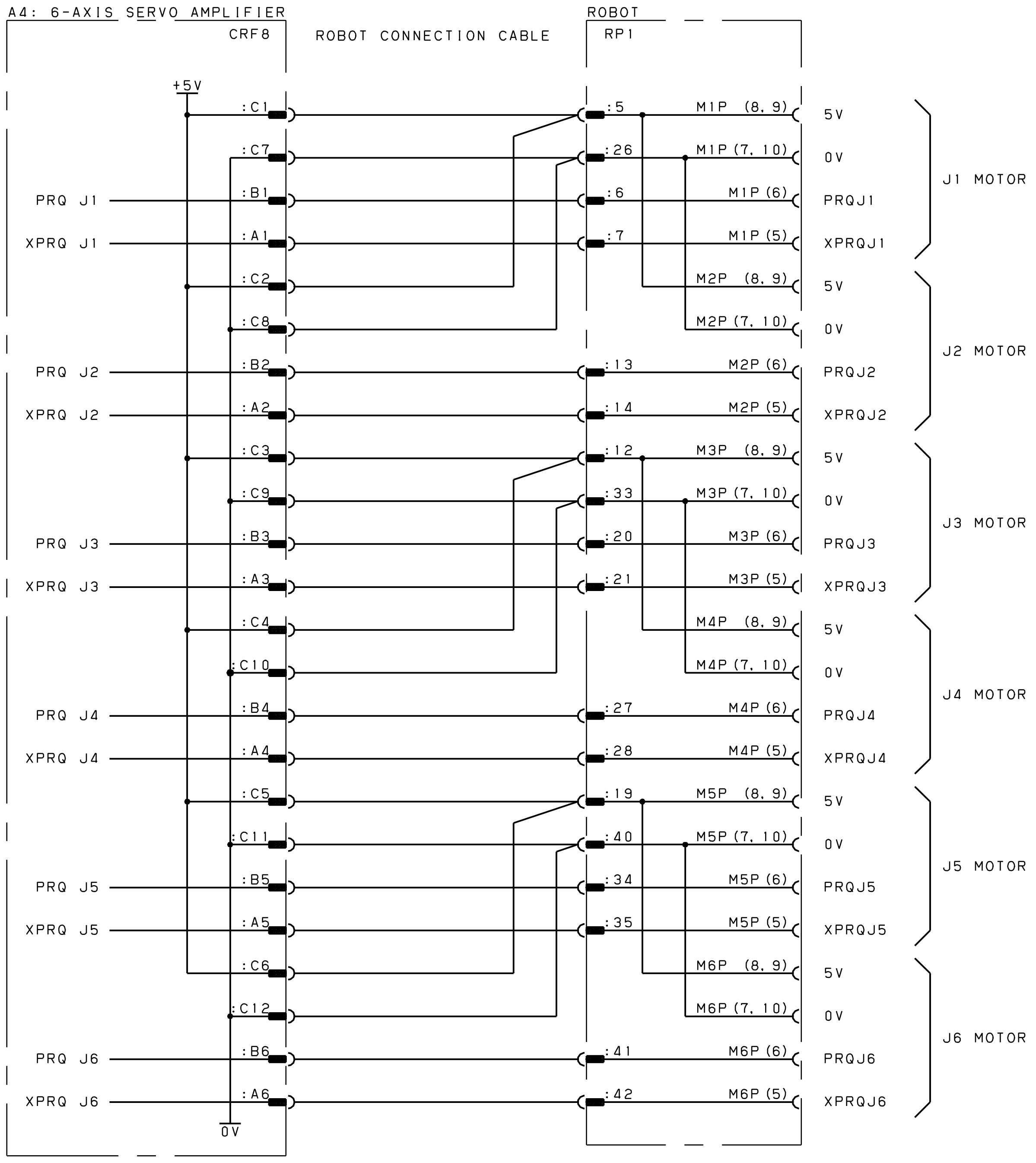


Fig.B(aa) Pulsecoder signal connection diagram
(LR Mate 200*i*D, ARC Mate 50*i*D, ARC Mate 100*i*C, ARC Mate 100iD, ARC Mate 120*i*C, M-10*i*A, M-10iD, M-20*i*A, M-20*i*B, ARC Mate 0*i*B, R-0*i*B, CR-4*i*A, CR-7*i*A)



SERVO MOTOR F/B

Fig.B(ab) Pulsecoder signal connection diagram
(R-2000*i*C, R-1000*i*A, M-710*i*C, M-2*i*A, M-3*i*A)

RMP
(Pulsecoder Feedback Signal & RI/RO)
(MOTOR Power & Brake)

1	BK (J1)	13	BK (J2)	25	BK (J3)	37	BK (J4)	49	BK (J5)	61	BK (J6)
2	BKC	14	BKC	26	BKC	38	BKC	50	BKC	62	BKC
3	J1U1	15	J2U1	27	J3U1	39	J4U1	51	J5U1	63	J6U1
4	J1V1	16	J2V1	28	J3V1	40	J4V1	52	J5V1	64	J6V1
5	J1W1	17	J2W1	29	J3W1	41	J4W1	53	J5W1	65	J6W1
6	J1G1	18	J2G1	30	J3G1	42	J4G1	54	J5G1	66	J6G1
7	XROT	19	24VF (OT)	31	XHBK	43	24VF	55	0V	67	0V
8	RI1	20	RI2	32	RI3	44	RI4	56	RI5	68	RI6
9	RO1	21	RO2	33	RO3	45	RO4	57	RO5	69	RO6
10	5V (J1)	22	5V (J2, J3)	34	5V (J456)	46	0V (J1)	58	0V (J2, J3)	70	0V (J456)
11	PRQJ1	23	PRQJ2	35	PRQJ3	47	PRQJ4	59	PRQJ5	71	PRQJ6
12	XPRQJ1	24	XPRQJ2	36	XPRQJ3	48	XPRQJ4	60	XPRQJ5	72	XPRQJ6

Mechanical Unit Interface
LR Mate 200*i*C (M-1*i*A)

RMP
(Pulsecoder Feedback Signal & RI/RO)
(MOTOR Power & Brake)

1	BK (J1)	13	BK (J2)	25	BK (J3)	37	BK (J4)	49	BK (J5)	61	BK (J6)
2	J1U1	14	J2U1	26	J3U1	38		50		62	BKC
3	J1V1	15	J2V1	27	J3V1	39	J4U1	51	J5U1	63	J6U1
4	J1W1	16	J2W1	28	J3W1	40	J4V1	52	J5V1	64	J6V1
5	J1G1	17	J2G1	29	J3G1	41	J4W1	53	J5W1	65	J6W1
6	XROT	18	24VF	30	XHBK	42	J4G1	54	J5G1	66	J6G1
7	RI1	19	RI2	31	RI3	43	RI4	55	RI5	67	0V
8	RO1	20	RO2	32	RO3	44	RO4	56	RO5	68	RI6
9	RI7	21	RI8	33	RO7	45	RO8	57	RI9 (XPPABN)	69	RO6
10	5V (J1, J2)	22	5V (J3, J4)	34	5V (J5, J6)	46	0V (J1, J2)	58	0V (J3, J4)	70	0V (J5, J6)
11	PRQJ1	23	PRQJ2	35	PRQJ3	47	PRQJ4	59	PRQJ5	71	PRQJ6
12	XPRQJ1	24	XPRQJ2	36	XPRQJ3	48	XPRQJ4	60	XPRQJ5	72	XPRQJ6

Mechanical Unit Interface
(LR Mate 200*i*D, ARC Mate 50*i*D, ARC Mate 100*i*C,
ARC Mate 100iD, ARC Mate 120*i*C, M-10*i*A, M-10iD, M-20*i*A,
M-20*i*B, ARC Mate 0*i*B, R-0*i*B, CR-4iA, CR-7iA)

Fig.B(ac) Mechanical unit interface

RP1
(Pulsecoder Feedback Signal & RI/RO)

1	RI1	8	RI2	15	RI3	22	RI4	29	RI5	36	RI6
2	RI7	9	RI8	16	RI9	23	XHBK	30	24VF (FAN)	37	24VF-3
3	RO1	10	RO2	17	RO3	24	RO4	31	RO5	38	RO6
4	RO7	11	RO8	18	24VF-1 24VF-2	25	0V-1 0V-2	32	S2+	39	S2-
5	5V-1 5V-2	12	5V-3 5V-4	19	5V-5 5V-6	26	0V-3 0V-4	33	0V-5 0V-6	40	0V-7 0V-8
6	PRQJ1	13	PRQJ2	20	PRQJ3	27	PRQJ4	34	PRQJ5	41	PRQJ6
7	XPRQJ1	14	XPRQJ2	21	XPRQJ3	28	XPRQJ4	35	XPRQJ5	42	XPRQJ6

RM1
(MOTOR Power & Brake)

1		14	J1V1	24	J1W1	34	
2	J1U1	15	J1V1	25	J1W1	35	J1G1
3	J1U1	16	J2V1	26	J2W1	36	J1G1
4	J2U1	17	J2V1	27	J2W1	37	J2G1
5	J2U1	18	J3V1	28	J3W1	38	J2G1
6	J3U1	19	J3V1	29	J3W1	39	J3G1
7	J3U1	20	J4V1	30	J4W1	40	J3G1
8	J4U1	21	J5V1	31	J5W1	41	J4G1
9	J5U1	22	J6V1	32	J6W1	42	J5G1
10	J6U1	23	BK1_2 (J2)	33	BK3	43	J6G1
11	BK1_2 (J1)					44	BK4_5_6 (J4)
12	BKC (J1, J2, J3)					45	BK4_5_6 (J5)
13	BKC (J4, J5, J6)					46	BK4_5_6 (J6)

Mechanical Unit Interface
M-2iA, M-3iA

RP1
(Pulsecoder Feedback Signal & RI/RO)

1	RI1	8	RI2	15	RI3	22	RI4	29	RI5	36	RI6
2	RI7	9	RI8	16	RI9	23	XHBK	30	XROT	37	24VF-3
3	RO1	10	RO2	17	RO3	24	RO4	31	RO5	38	RO6
4	RO7	11	RO8	18	24VF-1 24VF-2	25	0V-1 0V-2	32	S2+	39	S2-
5	5V-1 5V-2	12	5V-3 5V-4	19	5V-5 5V-6	26	0V-3 0V-4	33	0V-5 0V-6	40	0V-7 0V-8
6	PRQJ1	13	PRQJ2	20	PRQJ3	27	PRQJ4	34	PRQJ5	41	PRQJ6
7	XPRQJ1	14	XPRQJ2	21	XPRQJ3	28	XPRQJ4	35	XPRQJ5	42	XPRQJ6

RM1
(MOTOR Power & Brake)

1		14	J1V1	24	J1W1	34	
2	J1U1	15	J1V1	25	J1W1	35	J1G1
3	J1U1	16	J2V1	26	J2W1	36	J1G1
4	J2U1	17	J2V1	27	J2W1	37	J2G1
5	J2U1	18	J3V1	28	J3W1	38	J2G1
6	J3U1	19	J3V1	29	J3W1	39	J3G1
7	J3U1	20	J4V	30	J4W	40	J3G1
8	J4U	21	J5V	31	J5W	41	J4G
9	J5U	22	J6V	32	J6W	42	J5G
10	J6U	23	BK2	33	BK3	43	J6G
11	BK1					44	BK4
12	BKC					45	BK5
13	BKC					46	BK6

Mechanical Unit Interface
(R-2000*i*C, R-1000*i*A, M-710*i*C)

Fig.B(ad) Mechanical unit interface

C SPECIFICATIONS OF PERIPHERAL DEVICE INTERFACE

C.1 SIGNAL

The following table lists the I/O signals used for the peripheral device interface in the R-30*i*B Mate/ R-30*i*B Mate Plus controller.

Input signals (Refer to C.3.1)

Signal	Description
*IMSTP	Instantaneous stop signal
*HOLD	Hold signal
*SFSPD	Safety speed signal
CSTOPI	Cycle stop signal
FAULT_RESET	Alarm release signal
START	Cycle start signal
HOME	Return to home position
ENBL	Enabling signal
RSR1/PNS1	Robot service request/program number select signal (*1)
RSR2/PNS2	Robot service request/program number select signal (*1)
RSR3/PNS3	Robot service request/program number select signal (*1)
RSR4/PNS4	Robot service request/program number select signal (*1)
RSR5/PNS5	Robot service request/program number select signal (*1)
RSR6/PNS6	Robot service request/program number select signal (*1)
RSR7/PNS7	Robot service request/program number select signal (*1)
RSR8/PNS8	Robot service request/program number select signal (*1)
PNSTROBE	PNS strobe signal
PROD_START	Automatic operation start signal
DI01	General-purpose input signal
DI02	General-purpose input signal
DI03	General-purpose input signal
DI04	General-purpose input signal
DI05	General-purpose input signal
DI06	General-purpose input signal
DI07	General-purpose input signal
DI08	General-purpose input signal
DI09	General-purpose input signal
DI10	General-purpose input signal
DI11	General-purpose input signal
DI12	General-purpose input signal
DI13	General-purpose input signal
DI14	General-purpose input signal
DI15	General-purpose input signal
DI16	General-purpose input signal
DI17	General-purpose input signal
DI18	General-purpose input signal
DI19	General-purpose input signal
DI20	General-purpose input signal
DI21	General-purpose input signal
DI22	General-purpose input signal

NOTE
*1: RSR: Robot Service Request (RSR5 to RSR8 are optional)
PNS: Program Number Select Input (optional)
Whether RSR is used or PNS is used can be preset.

Output signals (Refer to C.3.2)

Signal	Description
CMDENBL	Command acceptance enabled signal
SYSRDY	System ready signal
PROGRUN	Program run signal
PAUSED	Program paused signal
HELD	Held signal
FAULT	Alarm signal
ATPERCH	Reference point signal
TPENBL	Teach pendant enabled signal
BATALM	Battery alarm signal
BUSY	Operating signal
ACK1/SNO1	RSR acknowledge/Selected program number signal
ACK2/SNO2	RSR acknowledge/Selected program number signal
ACK3/SNO3	RSR acknowledge/Selected program number signal
ACK4/SNO4	RSR acknowledge/Selected program number signal
ACK5/SNO5	RSR acknowledge/Selected program number signal
ACK6/SNO6	RSR acknowledge/Selected program number signal
ACK7/SNO7	RSR acknowledge/Selected program number signal
ACK8/SNO8	RSR acknowledge/Selected program number signal
SNACK	PNS acknowledge signal
______	Not used (for future expansion)
DO01	General-purpose output signal
DO02	General-purpose output signal
DO03	General-purpose output signal
DO04	General-purpose output signal
DO05	General-purpose output signal
DO06	General-purpose output signal
DO07	General-purpose output signal
DO08	General-purpose output signal
DO09	General-purpose output signal
DO10	General-purpose output signal
DO11	General-purpose output signal
DO12	General-purpose output signal
DO13	General-purpose output signal
DO14	General-purpose output signal
DO15	General-purpose output signal
DO16	General-purpose output signal
DO17	General-purpose output signal
DO18	General-purpose output signal
DO19	General-purpose output signal
DO20	General-purpose output signal

C.2 SETTING COMMON VOLTAGE

All process I/O boards have a jumper to set the common voltage of input signals to 0 V or 24 V. The system automatically adjusts the polarity by software according to the status of this pin. Therefore, you can operate the system without being concerned about the setting of the common voltage.

To ensure safety, the common reference voltage of the following four signals, is remains at +24V.

*IMSTP
*HOLD
*SFSPD
CSTOPI

C.3 I/O SIGNALS

C.3.1 Input Signals

This section describes the specifications of each input signal.

(1) Instantaneous stop signal (input) *IMSTP
Effective: At any time
Function: Use the normally closed switch because it is a reverse signal. The system turns off power to the servo unit when the *IMSTP is open (turned off). Do not use *IMSTP as safety relevant signal. For safety purpose, use the external emergency stop signal.

(2) Alarm release signal (input) FAULT RESET
Effective: In the alarm status
Function: The FAULT RESET signal releases the alarm status. If the servo unit has been turned off, it also turns on the unit. At the same time, the alarm display on the teach pendant (the top line) is cleared.
Description: This signal releases only the alarm status. It does not re-start execution of the program. The robot will keep running if the signal is triggered "ON" during operation.

(3) Hold signal (input) *HOLD
Effective: At any time
Function: Use the normally-closed switch because it is a reverse signal. The *HOLD signal has the same function as the hold button on the teach pendant. It halts the current program and stops the operation of the robot. While this signal is being input, the held signal (output) HELD is turned on and the robot cannot be operated.

(4) Start signal (input) START
Effective: When the command acceptance enabled signal (output) CMDENBL is turned on. See the description of CMDENBL in Section C.3.2 (1) for details.
Function: This input signal starts the selected program at the falling edge when the signal is turned off after being turned on. Its function differs according to the setting of parameter $SHELL_CFG. $CONT_ONLY.
- If parameter $SHELL_CFG.$CONT_ONLY is set to DISABLED, the START signal starts the program which has been selected from the teach pendant. By default, the program starts from the current cursor position.
- If parameter $SHELL_CFG.$CONT_ONLY is set to ENABLED, the START signal only resumes the execution of the temporarily held program. To execute an inactivated program from the start, input the PROD_START signal.

(5) Cycle stop signal (input) CSTOPI

Effective: At any time

Function:

- If parameter $SHELL_CFG.$USE_ABORT is set to DISABLED, the CSTOPI signal releases the program from the wait status caused by an RSR. It does not stop the execution of the current program and allows it to continue processing (by default).
- If parameter $SHELL_CFG.$USE_ABORT is set to ENABLED, the CSTOPI signal immediately cancels the execution of the current program. The program returns to the status in which it was before execution, and the information for the subprogram to return to the main program is lost. At the same time, this signal also releases the program from the wait status caused by RSR.

(6) Enabling signal (input) ENBL

Effective: At any time

Function: If the ENBL signal is turned off, the operation of the robot or the activation of a program is inhibited, and the execution of the current program is suspended.

(7) Safety speed signal (input) *SFSPD

Effective: At any time

Function:

- Use the normally-closed switch because it is a reverse signal. Usually this switch should be connected to safety fence. It must be set normally on.
- Since the *SFSPD signal is counted as a remote condition, such input signals as RSR and START to the peripheral device interface cannot take effect unless this signal is turned on.
- If this signal is turned from on to off during robot operation, the execution of the current program is suspended. At the same time, the overriding value is switched to a preset value (parameter $SCR. $FENCEOVER.)
- As long as this signal is off, the overriding value cannot be increased beyond the preset value ($SCR.$SFJOGOVLIM: For jog, $SCR. $SFRUNOVLIM : For test execution.)

(8) Robot service request signal (input) RSR1/RSR2/RSR3/RSR4

Effective: When the command acceptance enabled signal (output) CMDENBL is turned on. See the description of CMDENBL in Section C.3.2 (1) for details.

Function:

- The user can choose between RSR and PNS (optional), although they cannot be used simultaneously.
- Four input signals, RSR1 to RSR4, are used.
- If a signal is input to an RSR input, a specified program is started. The program number can be set by a menu.
- If another program has already started processing, the newly activated program enters the wait status. As soon as the current program terminates, the waiting program starts processing.
- By using an RSR instruction, each RSR in a program can be enabled or disabled.
- A menu is provided to register the program number of a specified program when each RSR is input. (Refer to the application manual for details of the menu).

```
+----------------------------------------+
|                                        |
|////////////////////////////////////////|
|                                  1/8   |
|  1 Job selection:                RSR   | RSR or PNS
|  2 RSR1 program number:             12 | 0..9999
|  3 RSR2 program number:             23 | 0..9999
|  4 RSR3 program number:              5 | 0..9999
|  5 RSR4 program number:             64 | 0..9999
|  6 Base number:                    100 | 0..9999
|  7 Acknowledge:                Enabled | Enabled or disabled
|  8 Acknowledge pulse width:   250 msec | 0..9999msec
=                                        =
|                                        |
|[ TYPE ]                                |
+----------------------------------------+
```

- When an RSR is input, the program whose program name consists of the specified program number plus a base value is started. For example, if a signal is input to RSR2 when program number 23 is registered in RSR2, the program to be started is the one with the program name calculated from the expression RSR + (RSR2 program number + base number), i.e., RSR0123.
  The base number is stored in parameter $SHELL_CFG.$JOB_BASE, and can be changed in a program with a parameter instruction. (For example, $SHELL_ CFG. $JOB_BASE =100). In this way, the combination of programs which can be started by RSRs can be changed.
- Whether the system should output an acknowledge signal to an RSR can be selected from the menu. If so specified, a pulse is output from the signal corresponding to the RSR, one of signals ACK1 to ACK4, when the input of the RSR is accepted. From the same menu, the width of the pulse can also be specified.
  It is possible to accept other RSRs while outputting an acknowledge signal.
- Input of a CSTOPIT signal can clear the program queue waiting for execution after acceptance of RSRs.

(9) PNS/PNSTROBE (input)

Signal name: PNS: Program number select

PNSTROBE: Strobe input for PNS

Effective: When the command acceptance enabled signal (output) CMDENBL is turned on. See the description of CMDENBL in Section C.3.2 (1) for details.

Function:

- The PNS/PNSTROBE signal selects whether the RSR function is used or the PNS function (optional) is used. If the PNS function is enabled, the RSR function cannot be used.
- The eight signals PNS1 to PNS8 are used to specify a program at the instant the strobe signal PNSTROBE rises.
- A menu is provided to specify the information about PNS.

```
+-----------------------------------------+
|                                         |
|/////////////////////////////////////////|
|                                    1/3  |
|  1 Job selection:                  PNS  | RSR or PNS
|  2 Base number:                    100  | 0..9999
|  3 Acknowledge pulse width:   250 msec  | 0..9999msec
|                                         |
|                                         |
|                                         |
|                                         |
=                                         =
|                                         |
|[ TYPE ]                                 |
+-----------------------------------------+
```

If a number other than zero is entered to PNS input, a program is selected whose program number is the entered value plus the base number. For example, if the PNS value is 23, the program to be started has the program name calculated from the expression
PNS + (entered PNS value + base number), i.e., PNS0123.
If zero is entered to PNS input, it is cleared as if no selection has been made.

- A PNS signal, which can only select a program, cannot execute the selected program. The execution of the selected program can only be started after input of automatic operation start signal PROD_START.
- For safety, the selected program cannot be changed from the teach pendant unless PNSTROBE is turned off.
- If a program is selected by PNS, the program number is output to selected program number signal (output) SNO, and a pulse is output to program selection acknowledge signal SNACK. Using these signals, peripheral devices can confirm the correct program has been selected. For the timing of these signals, see the sections describing SNO and SNACK.
- The following operations are effective for the program selected by PNS. You can:
  - Start up a program by input of automatic operation start signal PROD_START
  - Restart the program that has been suspended.
    Inputting the START signal restarts the program selected by PNS when $SHELL_CFG.$CONT_ ONLY is set to ENABLED.
  - Input of CSTOPI cancels execution of the pro-grams selected by PNS when $SHELL_CFG.$USE_ ABORT is set to ENABLED.

(10) Automatic operation start signal (input) PROD_START
Effective: When the command acceptance enabled signal (output) CMDENBL is turned on. See the description of CMDENBL in Section C.3.2 (1) for details.
Function: This input signal executes the selected program at the falling edge when the signal is turned off after being turned on.

C.3.2 Output Signals

This section describes the specifications of output signals for the peripheral device interface.

(1) Command acceptance enabled signal (output) CMDENBL
Turned on: When the remote conditions are satisfied and the system is not in the alarm status.
Turned off: When the remote conditions are not satisfied or the system is in the alarm status. The remote conditions are satisfied when all of the following are satisfied.

- The teach pendant is in the DISABLED status.
- The remote/local setting is set to REMOTE.
- Parameter $RMT_MASTER is set to 0 (external interface).

- Signal *SFSPD is set to on, or in the normal status.

(2) System ready signal (output) SYSRDY
Turned on: When power is applied to the motor of the robot.
Turned off: When power is not applied to the motor of the robot.

(3) Program run signal (output) PROGRUN
Turned on: When the program is being executed.
Turned off: When the program is not being executed.

(4) Held signal (output) HELD
This signal is used to check the status of the hold input.
Turned on: When the hold button on the teach pendant (or input) is being pressed down (or turned on).
Turned off: When the hold button on the teach pendant (or input) is not being pressed down (or is turned off).

(5) Program paused signal (output) PAUSED
This signal is used together with output signal PROGRUN to determine whether a program can be restarted while it is being held.
Turned on: When a program is held and has not been restarted yet. While this signal is on, the program can be restarted and retains information such as that to return from a subprogram to the main program.
Turned off: When a program is being executed or is ready to start. If signal PROGRUN is on, the program is being executed. If signal PROGRUN is off, the program has not been executed and can be started from this status.

(6) Alarm status signal (output) FAULT
Turned on: When the system is in the alarm status (or an alarm which can stop a program execution is detected.) The indicator lamp does not go on in warning.
Turned off: When the alarm status is released by an alarm release operation.

(7) Reference point signal (output) ATPERCH
Turned on: When the robot is in the reference position specified in the parameter. (The reference point No.1 in reference point setup screen.)
Turned off: When the robot is not in the reference position specified in the parameter. (The reference point No.1 in reference point setup screen.) Up to three reference positions can be specified, but this signal is output when the robot is in the first reference position. For the other two reference positions, general-purpose signals can be assigned to output as such. (They can be set from the setup screen.)

(8) Teach pendant enabled signal (output) TPENBL
Turned on: When the teach pendant is enabled.
Turned off: When the teach pendant is disabled.

(9) Battery alarm signal (output) BATALM
Turned on: When the voltage of the battery for the CMOS memory backup drops below the reference.
Turned off: When the voltage of the battery for the CMOS memory backup is at the normal level.

(10) Operating signal (output) BUSY
Turned on: When a program is being executed or is being processed from operation panels such as the teach pendant. (This has the same function as that of the BUSY lamp on the teach pendant.)

Turned off: When a program is not being executed nor is being processed from operation panels such as the teach pendant.

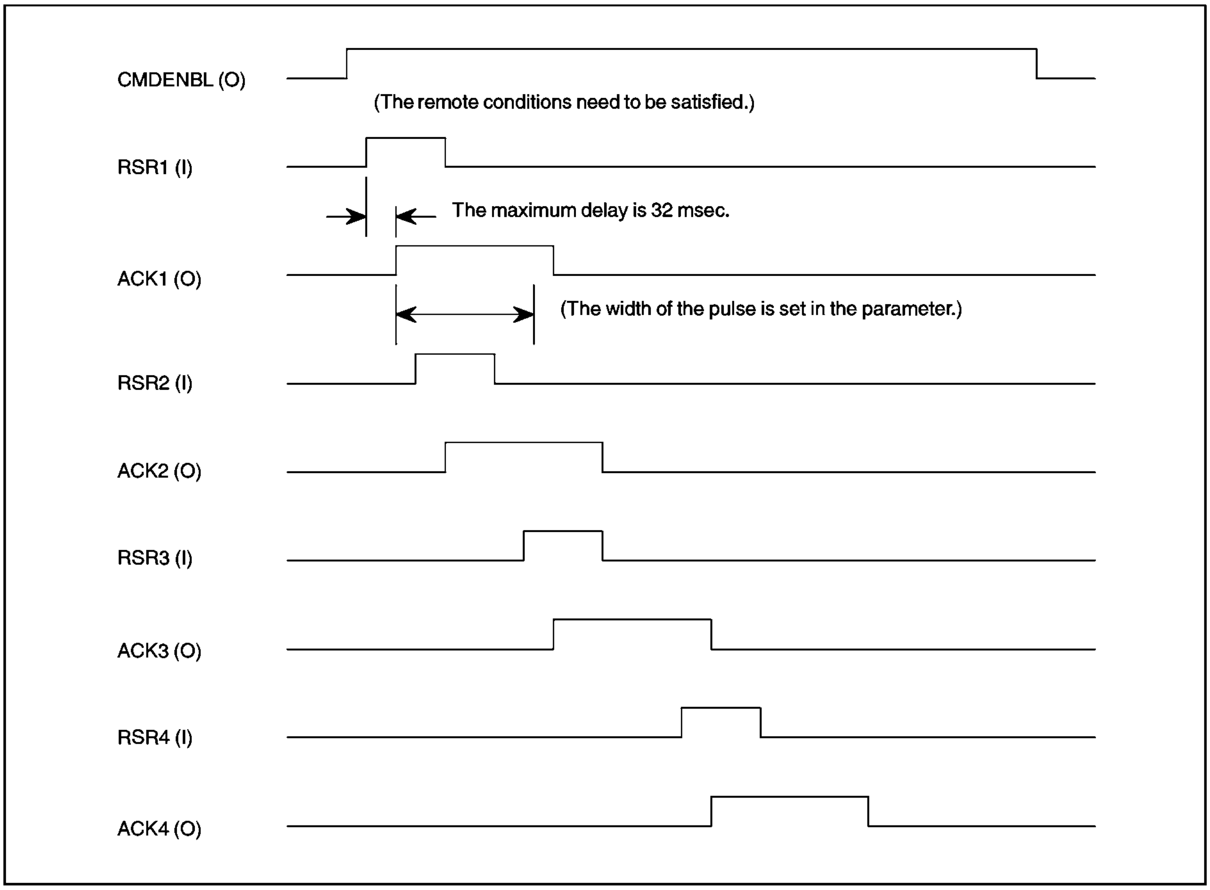
(11) RSR acknowledge signals (output) ACK1/ACK2/ACK3/ACK4

These signals are used together with the RSR function. They can be specified to be enabled or disabled from the RSR setup menu.

Turned on: When one of the signals from RSR1 to RSR4 is input and accepted. A pulse whose width is specified from the menu is output to acknowledge the signal.

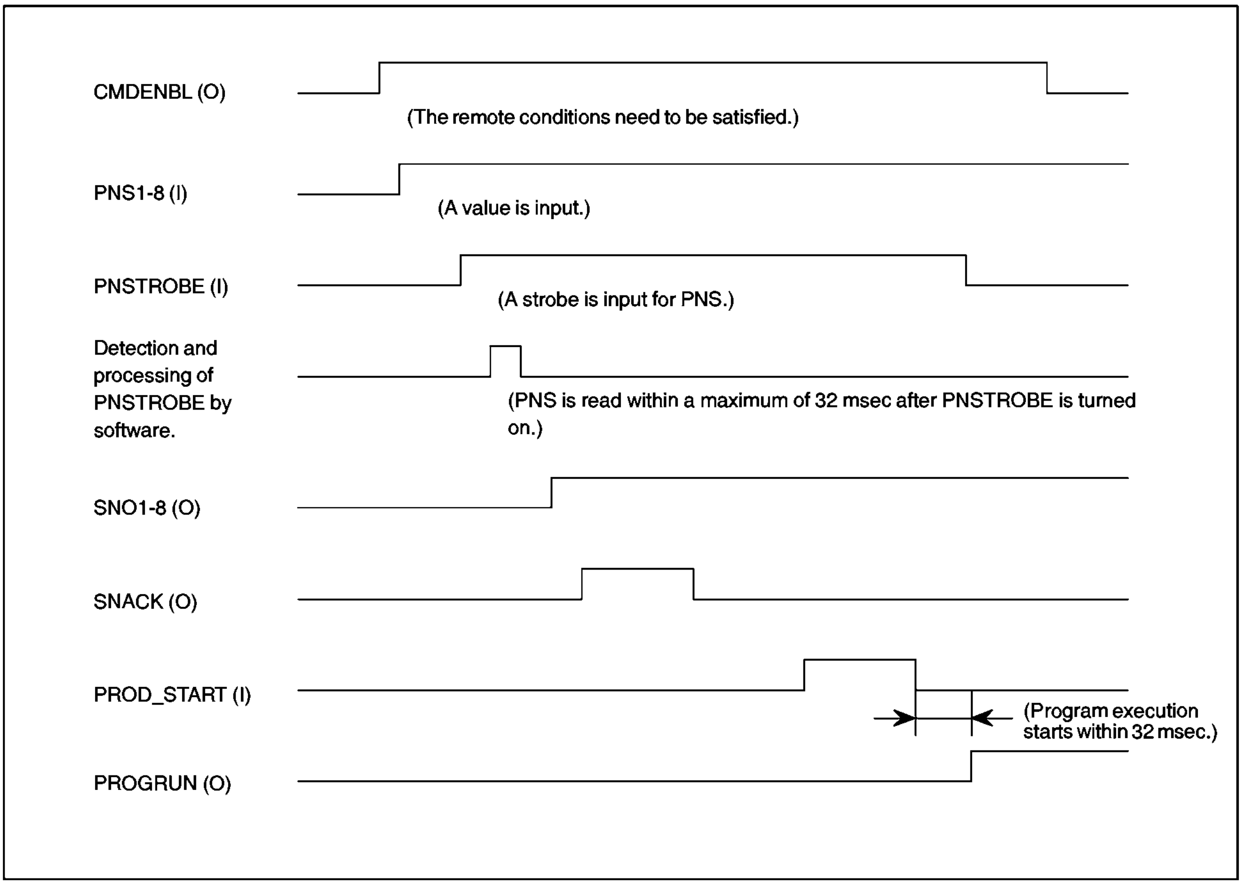
Turned off: Normally. Since these signals are always output as pulses, they are normally in the off status.

The following chart shows the timing of the RSR input and ACK output.



* Other RSR signals can be accepted even when the ACK signal is being output.

(12) PNS acknowledge signal (output) SNO/SNACK
These signals are used together with the PNS function.
Turned on: Whenever the PNS function is enabled. The selected program number is displayed in binary code (SN01 to SN08) on the teach pendant. If the number cannot be represented as an eight-bit number, it becomes zero. After selecting a program by PNS, a pulse is output from signal SNACK as a part of the PNS operation. The width of the pulse can be specified from the menu. See the timing chart below.



C.4 SPECIFICATIONS OF DIGITAL INPUT/OUTPUT

C.4.1 Overview

This section describes the external specifications of digital and analog input/output in the R-30*i*B controller.

C.4.2 Input/Output Hardware Usable in the R-30*i*B Mate Controller

The R-30*i*B Mate/R-30*i*B Mate Plus controller can use up to 512 digital input and output points or an equivalent number of analog input and output points. One analog input/output point uses the resources equivalent to those used by 16 digital I/O points.
The R-30*i*B can use a total of up to 512 I/O points.

The R-30*i*B controller can use the following I/O hardware.
- Process I/O printed board
- I/O unit model A

The process I/O board and the I/O unit model A can be used together.

C.4.3 Software Specifications

(1) RI/RO
These are signals sent to the connector at the wrist of the robot.
They cannot be assigned (redefined) and are fixed.
The standard format is eight inputs and eight outputs. The number of points that can be used for the connector at the wrist depends on the individual robot.

(2) DI/DO
The signal No. that is determined at hardware can be changed by software operation.

(3) Analog I/O
An analog I/O signal can access the analog I/O port (optional) on the process I/O board or the I/O port on the analog I/O module (used together with the I/O unit model A).
It reads and writes the digital value converted from the analog value of the I/O voltage. It means that the value does not always represent the real I/O voltage.

(4) Group I/O
Group I/O is a function, which can input or output multiple DI/DO signals as binary codes. Any number of continuous signals of up to 16 bits can be set for its use. It can be set in the menu DETAILS on the group I/O screen.

D OPTICAL FIBER CABLE

The R-30*i*B Mate/ R-30*i*B Mate Plus uses fiber optic cables for communication between the main board and servo amplifiers. Observe the following cautions when handling these fiber optic cables. Handle fiber optic cables with utmost care, especially when installing the unit.

(1) Protection during storage
When the electrical/optical conversion module (mounted on the printed) circuit board and the fiber optic cable are not in use, their mating surfaces must be protected with the lid and caps with which they are supplied. If left uncovered, the mating surfaces are likely to become dirty, possibly resulting in a poor cable connection.

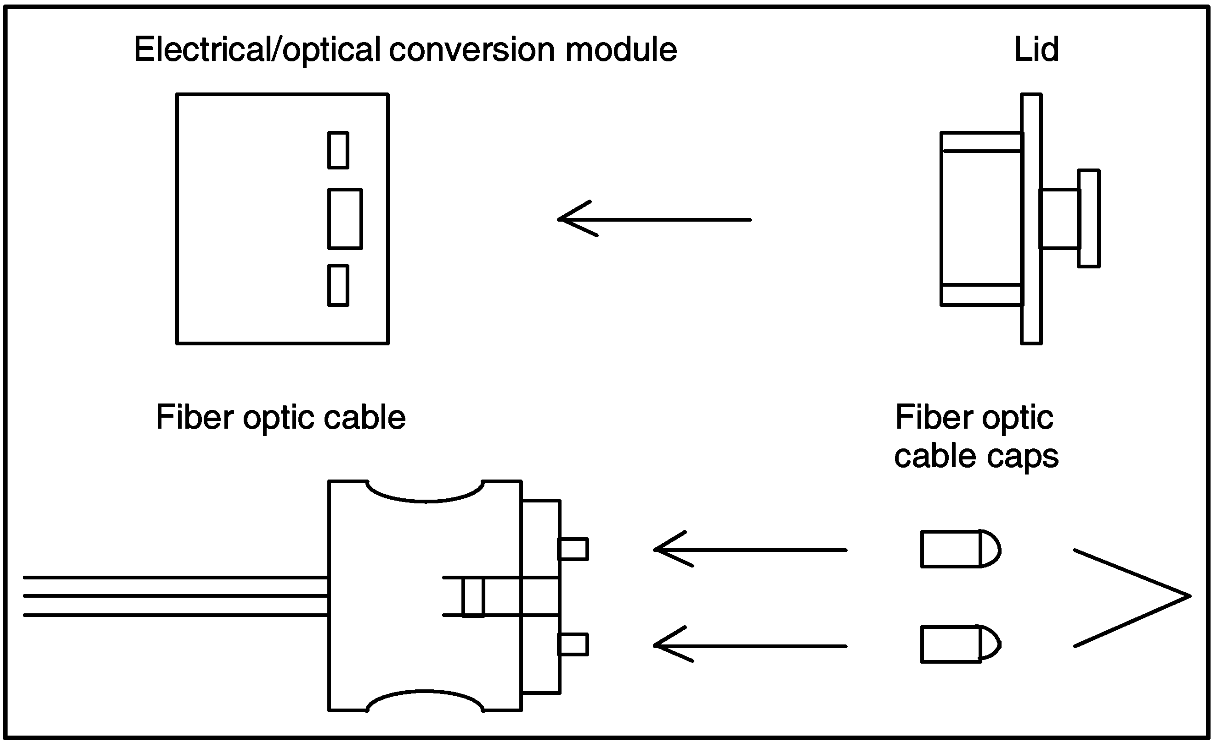


Fig.D (a) Protection of electrical/optical conversion module and fiber optic cable (when not in use)

(2) Fiber optic cable
External type

Fiber optic cord diameter:	ϕ 2.2 mm x 2 cords
Diameter of cable with reinforced cover:	ϕ 7.6 mm
Tensile strength:	
Cable with reinforced cover:	75 kg
Fiber optic cord:	7 kg per cord
Between fiber optic cord and connector:	2 kg
Minimum bending radius of fiber optic cord:	25 mm
Minimum bending radius of cable with reinforced cover:	50 mm
Bending resistance (cable with reinforced cover):	10 million bending cycles at room temperature (when the bending radius is 100 mm)
Flame resistance:	Equivalent to UL VW-1
Operating temperature:	-20 to 70ºC

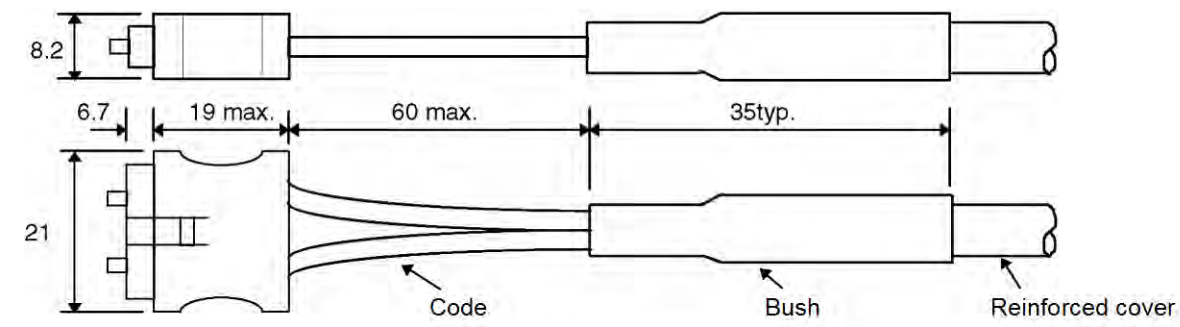


Fig.D (b) External dimensions of external optical cable Unit: mm

Internal type

Fiber optic cord diameter:	ϕ 2.2 mm x 2 cords
Tensile strength:	
Fiber optic cord:	7 kg per cord
Between fiber optic cord and connector:	2 kg
Minimum bending radius of fiber optic cord:	25 mm
Flame resistance:	Equivalent to UL VW-1
Operating temperature:	-20 to 70ºC

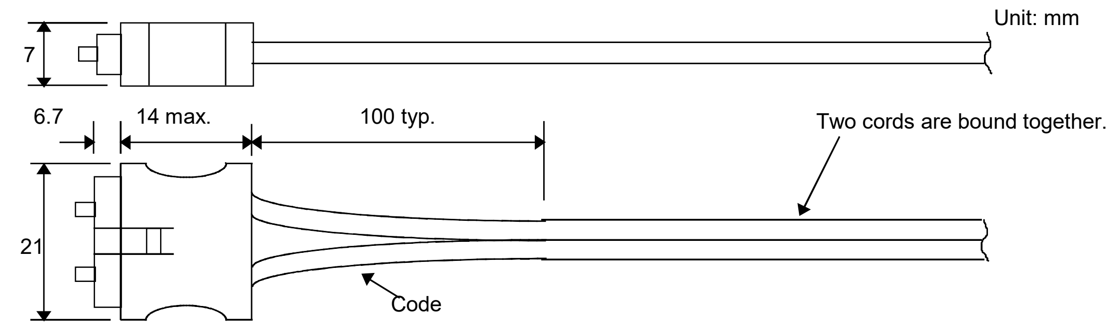


Fig.D (c) External dimensions of internal optical cable Unit: mm

- After it is connected, the optical connector is automatically locked by the lock levers on its top. To remove the connector, release the lock levers and pull the connector. (Do not pull on the fiber optic cord itself.)
- Although optical connectors cannot be connected in other than the correct orientation, always take note of the connector's orientation before making the connection.
- Take care to keep both parts of the optical connector (cable side and PCB side) clean. If they become dirty, wipe them with tissue paper or absorbent cotton to remove dirt. The tissue paper or absorbent cotton may be moistened with ethyl alcohol. Do not use any organic solvent other than ethyl alcohol.
- Fix the reinforcing cover by using a cable clamp, as shown in Fig. D(d), to prevent the weight of the fiber optic cable from being applied directly to the connecting part of the optical connector.
- Although the reinforcing cover of the external optical cable has sufficient mechanical strength, be careful not to drop heavy objects on the cable.

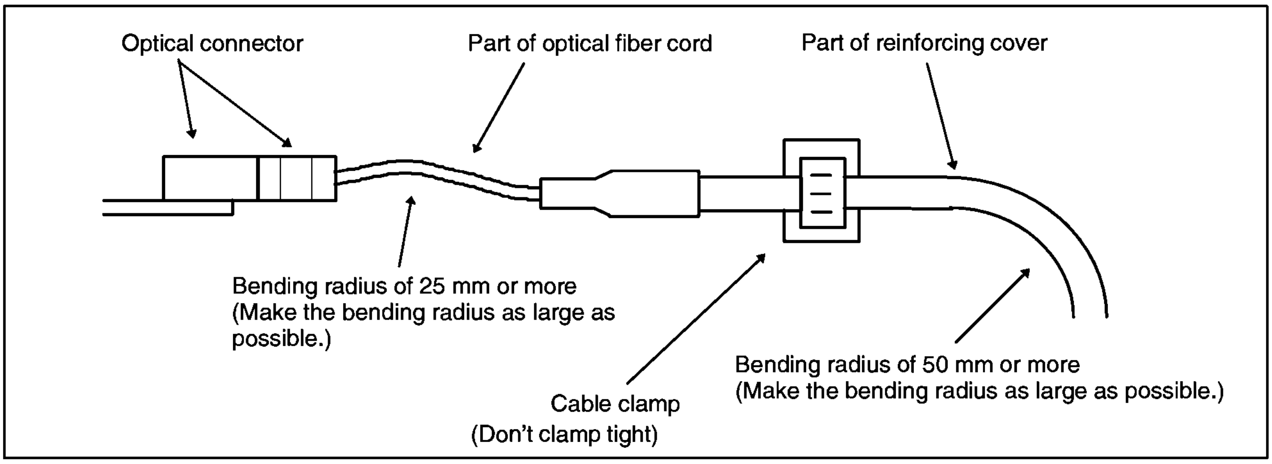


Fig.D (d) Fixing the cable with a clamp

- Any superfluous portion of the cable might be wound into loops. Should this prove necessary, make sure the diameter of each loop is at least 150 mm (for an external cable). Winding the cable into smaller loops can produce sharp curves that exceed the specified bend radius limit. Such bending can result in transmission loss, ultimately leading to a communication failure.
- When using a cable tie as a cable clamp, follow the instructions given below. Also, take care not to apply a bending force to one particular part of the cable when fixing it with a clamp. Failing to clamp the cable correctly might cut or damage it.

External cable:

Do not clamp the uncovered portion of the cable with a cable tie. When clamping the cable by the reinforcing cover, the clamping force is not an important factor to consider. However, ensure that the clamping force is as small as possible to ensure that the reinforcing cover is not deformed by the clamping.

If possible, the clamping force should be 5kg (111bs) or less.

Internal cable:

Lightly clamp the optical cable with a cable tie so that the cable shield is not deformed. Desirable clamping force is 1 to 2 kg (make sure that no force is applied to the cable).

Optical fiber cable for FSSB

Type	Specification	Max. length
Outside of cabinet	A66L-6001-0026#L to	50m (Slave to Slave:40m)
Inside of cabinet	A66L-6001-0023#L to	10m

E BRAKE RELEASE UNIT

E.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.

E.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 E.2 (a). Confirm the input voltage of the unit to refer to the input voltage label put to the unit (Fig.E.4).
(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 E.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 E.2 (b).

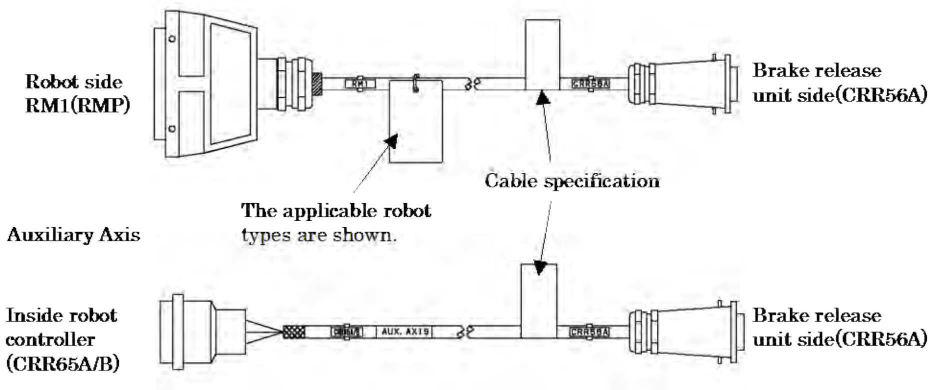


Fig.E.2 Brake release unit connection cable

Table E.2 (b) Specification of brake release unit connection cable

Controller	Applicable robot types	Specification of cable
R-30*i*B Mate	M-710*i*C, R-1000*i*A, R-2000*i*C, M-2*i*A, M-3*i*A,	A660-2005-T559
	M-10*i*A, M-10iD, M-20*i*A, M-20*i*B, ARC Mate 100*i*C, ARC Mate 100iD, ARC Mate 120*i*C, ARC Mate 0*i*B, R-0*i*B, M-1*i*A, LR Mate 200*i*D, ARC Mate 50*i*D	A660-2006-T881
	Aux. Axis	A660-2005-T711

E.3 OPERATION

E.3.1 In Case of Operating to the Robot

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 RM1 (RMP) connector from Robot, and connect the Brake Release Unit connection cable to the Robot. Keep the connection of Robot connection cable except RM1 (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 E.3.1) Two axes or more cannot be operated at the same time.

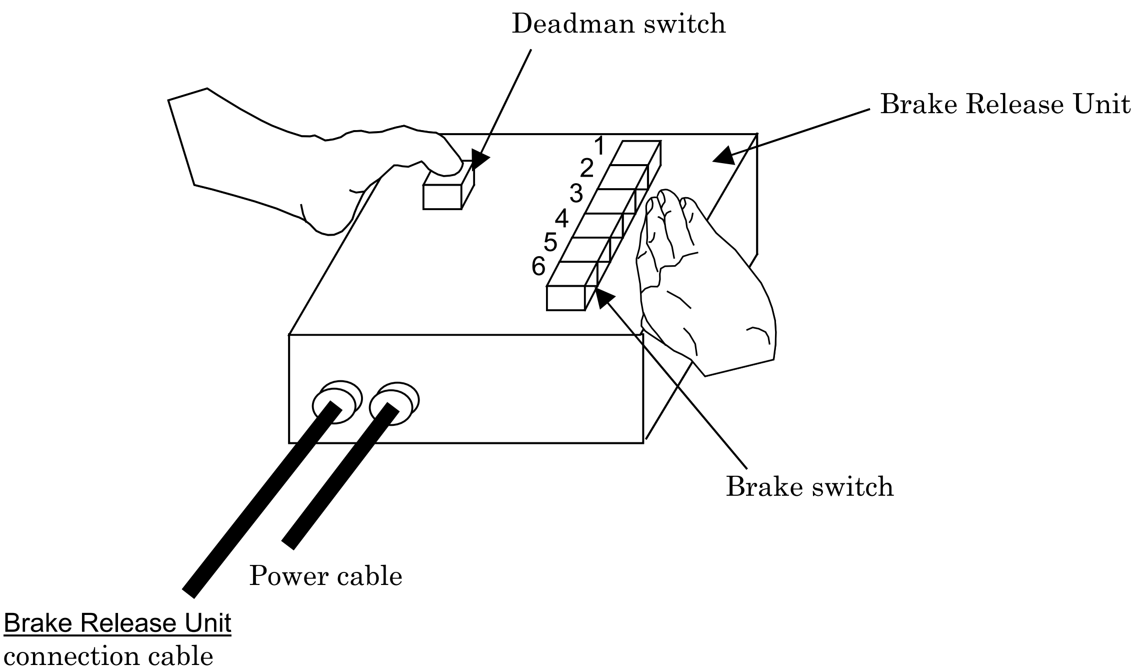


Fig.E.3.1 (a) Brake Release Unit

Table E.3.1 The relation between brake switch and robot axis

Robot Type	Brake Unit Button					
	1	2	3	4	5	6
Robots except below	J1	J2	J3	J4	J5	J6
LR Mate 200*i*D (5-Axis)	J1	J2	J3	-	J4	J5
In case of the auxiliary Axis	J1	-	-	-	-	-

- Refer to Fig.E.3.2 for the auxiliary axis.

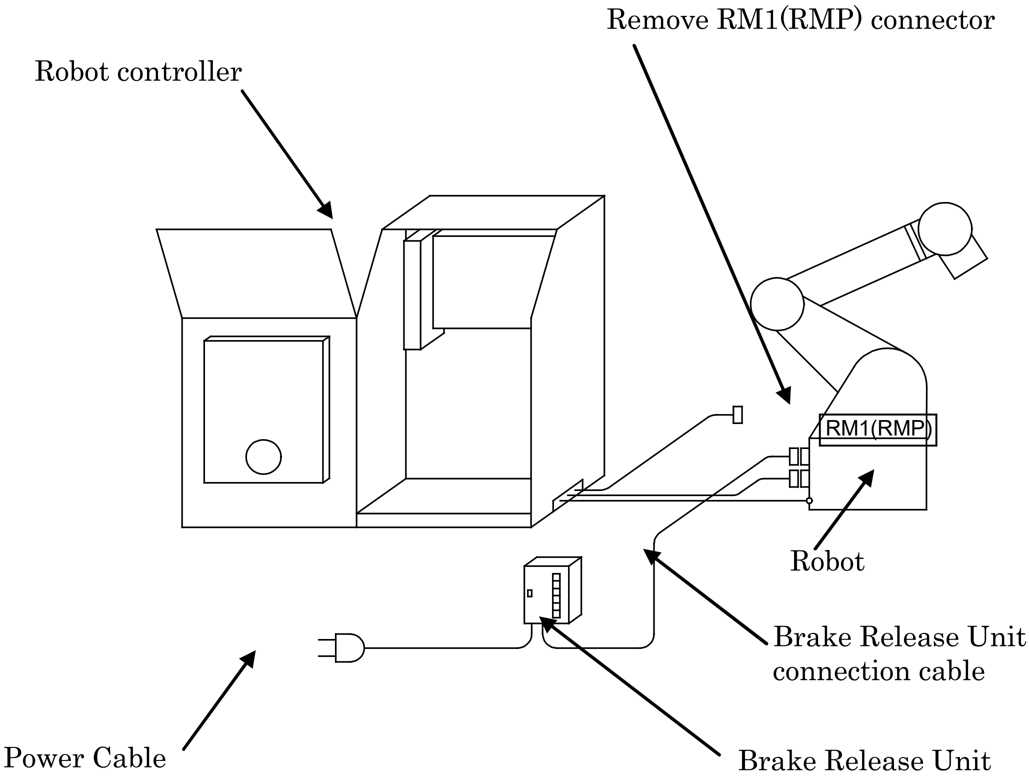


Fig.E.3.1 (b) How to connect Brake Release Unit(In case of operating to the Robot)

E.3.2 In Case of Operating to the Auxiliary Axis

Operate the brake release unit according to the following procedures.

(1) Support the auxiliary Axis by mechanical means to prevent it from falling down or rising up when the brake is released.
(2) Connect the Brake Release Unit connection cable to Brake Release Unit.
(3) Disconnect the aux. axis brake connector (CRR65A/B), and connect the CRR65A/B connector to the Brake Release Unit connection cable. Keep the connection of all cables of aux. axis motor (power, Pulsecoder, brake).
(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', then brake will be released.

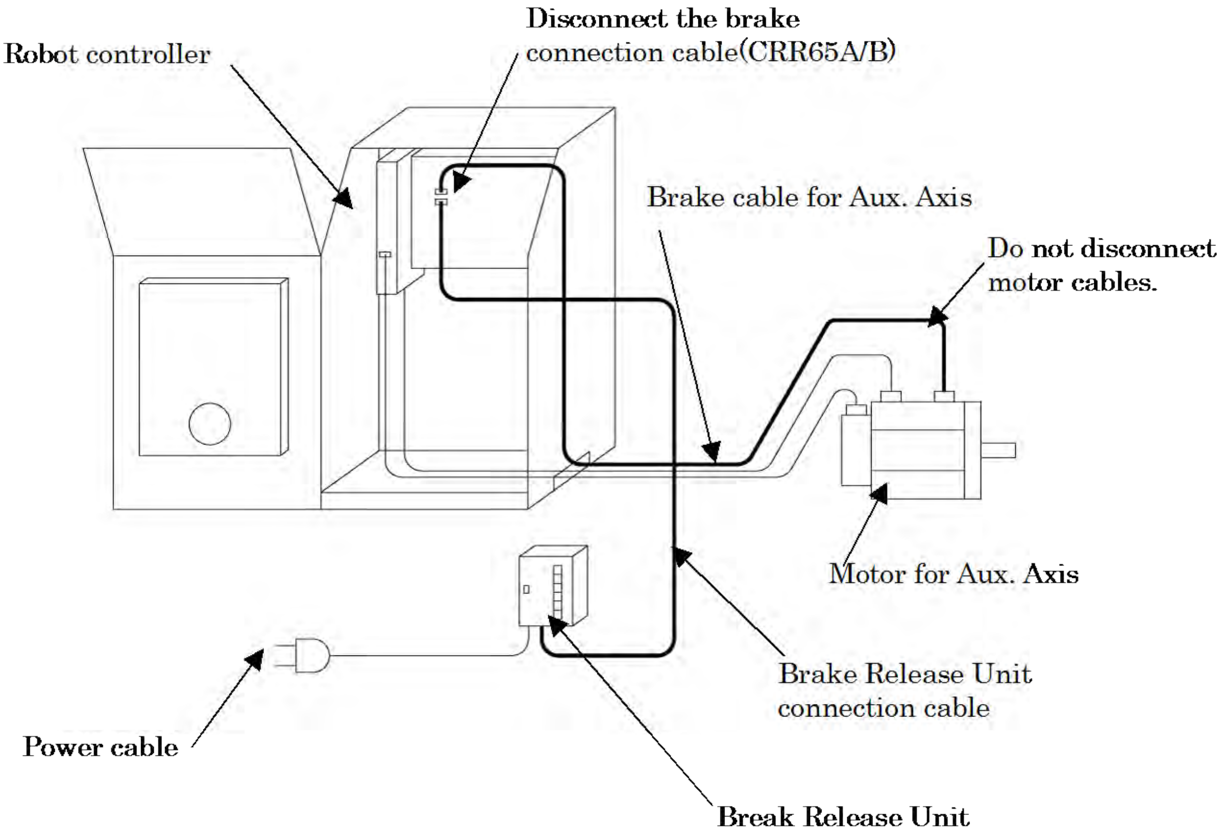
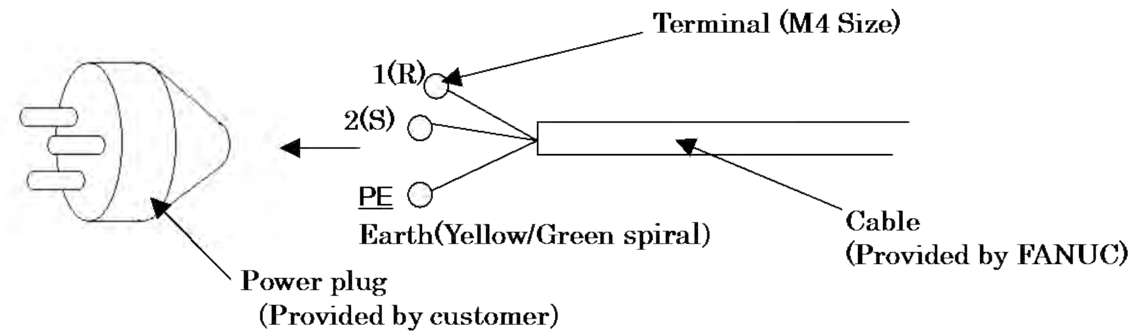


Fig.E.3.2 How to connect Brake Release Unit (In case of operating to the Aux. Axis)

E.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.



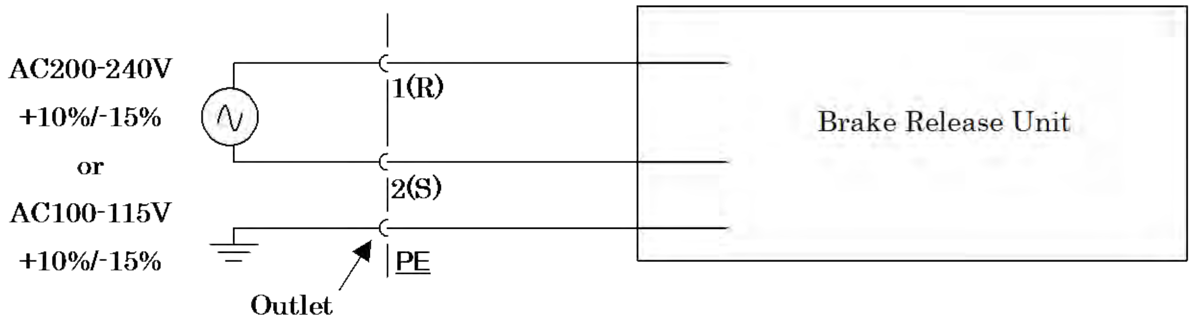


Fig.E.4 How to connect the plug to the power cable

> ⚠ **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.

E.5 DIMENSION

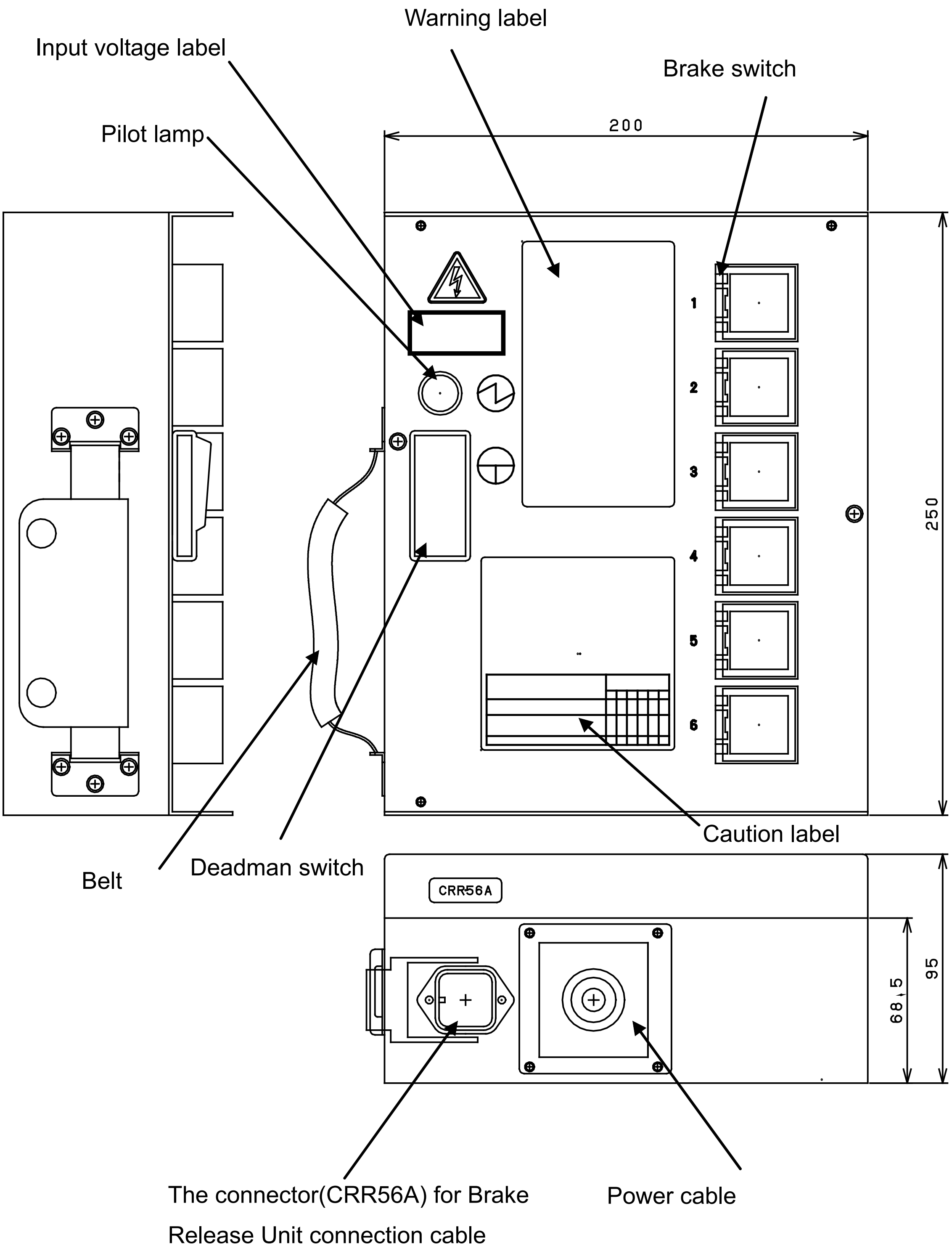


Fig.E.5 (a) Dimension of Brake Release Unit (Front view)

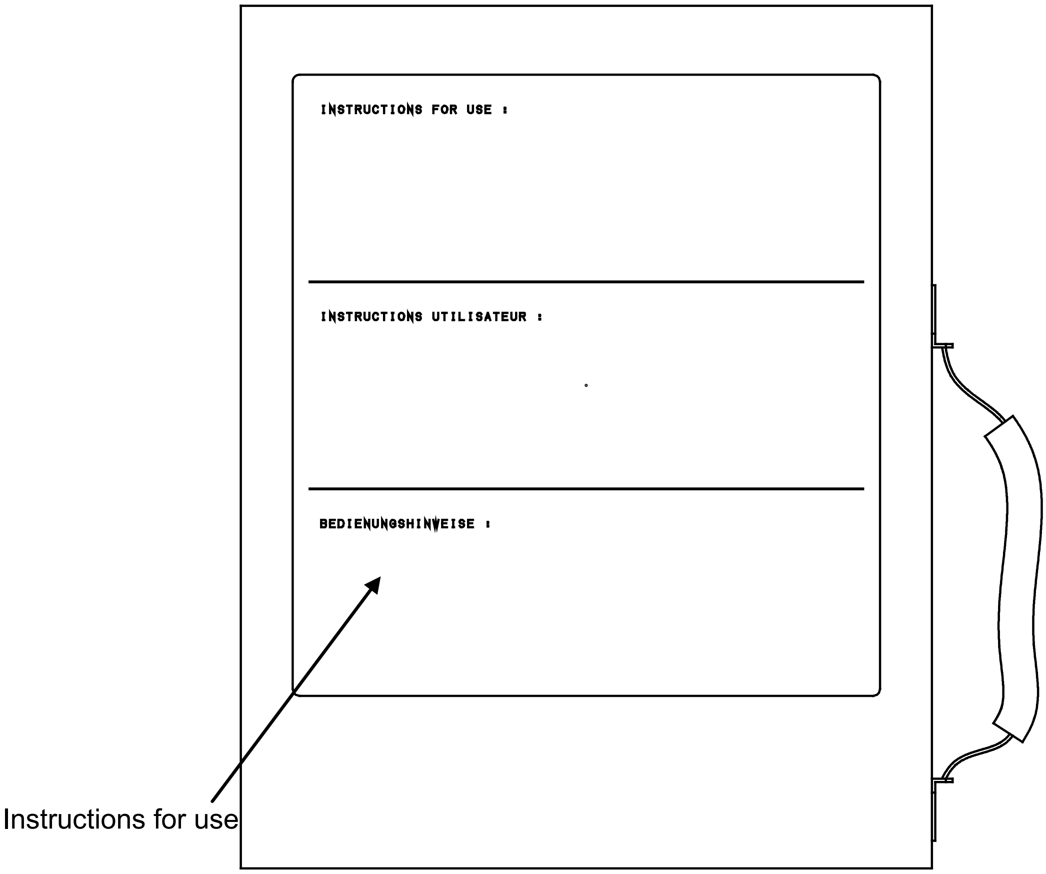


Fig.E.5 (b) Dimension of Brake Release Unit (Rear view)

E.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
Rating: 2A

> ⚠ **WARNING**
> When the fuse is replaced, the power cable of brake release unit must be disconnected.

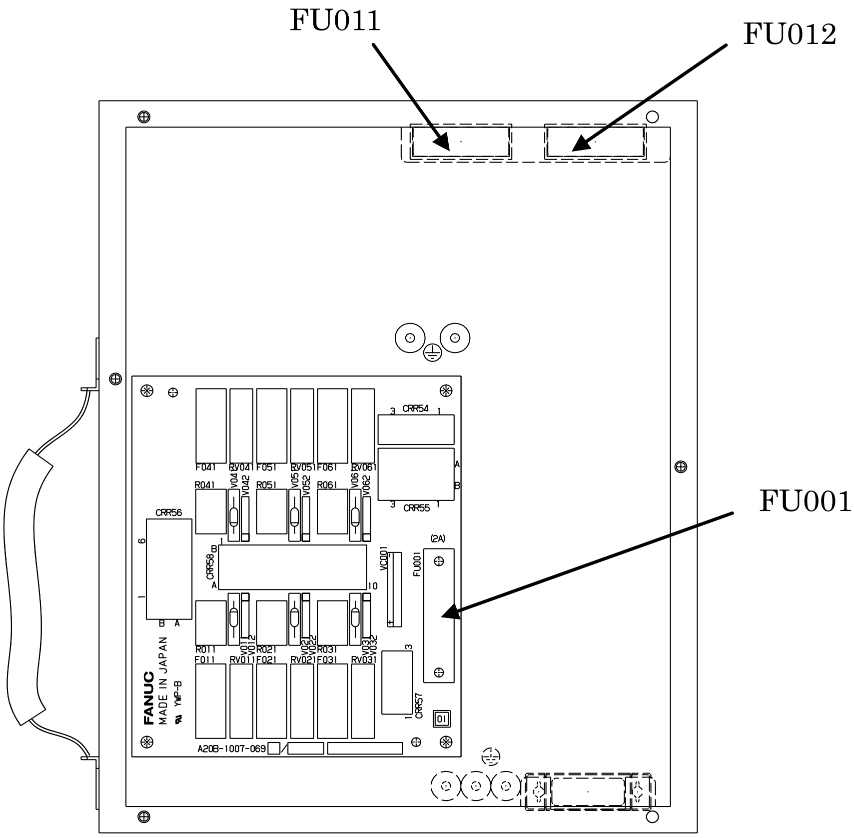


Fig.E.6 The location of fuses

E.7 SPECIFICATIONS

Input power supply

AC100-115V, 50/60Hz±1Hz, single phase, +10%/-15%, 1A
AC200-240V, 50/60Hz±1Hz, single phase, +10%/-15%, 1A

Weight

Brake Release Unit (AC 100V): 2.3 kg
Brake Release Unit (AC 200V): 3.5 kg

F TEACH PENDANT DISCONNECT FUNCTION (OPTION)

This appendix shows an instruction for Teach pendant disconnect function (Option).

F.1 CONFIGURATION

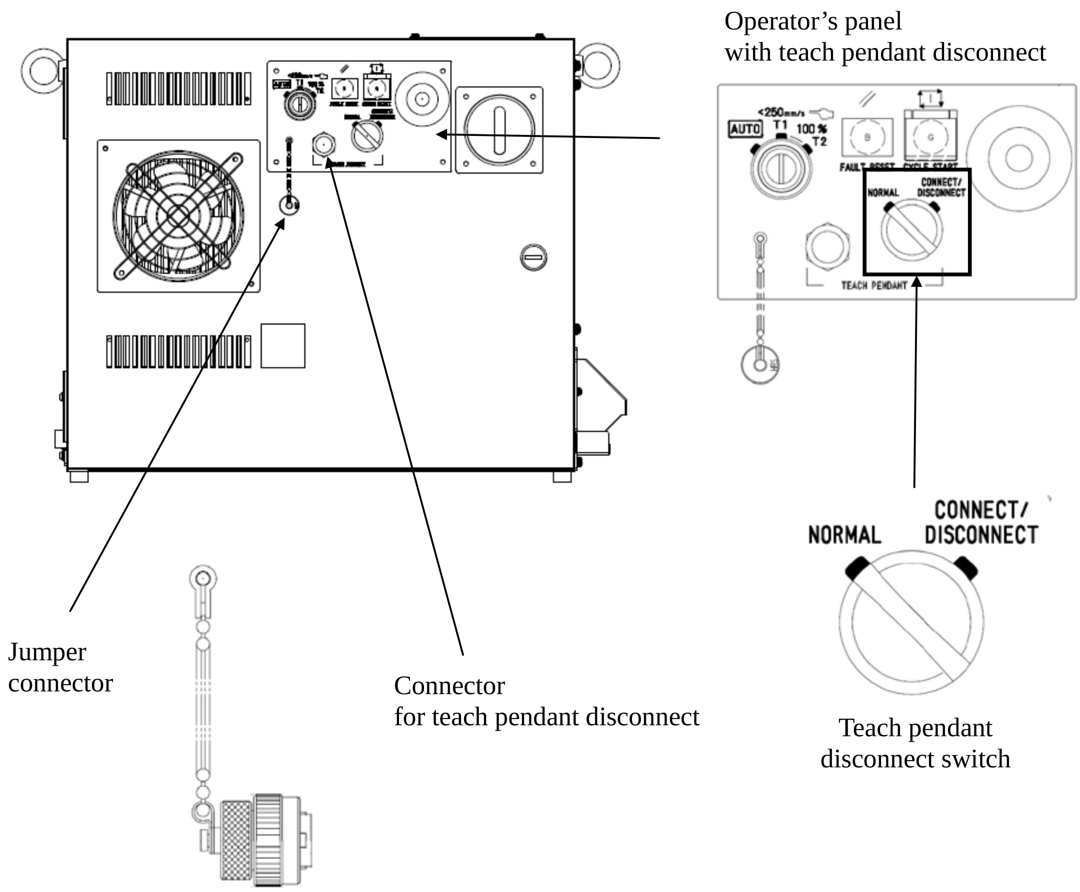


Fig.F.1 Teach pendant disconnect function

F.2 PROCEDURE OF TEACH PENDANT DISCONNECT

F.2.1 Teach Pendant Disconnect

(1) Set AUTO mode.
(2) Turn the disconnect switch to “Connect/Disconnect” position. (Robot stops because Operator’s panel E-stop Alarm occurs and Power LED of the teach pendant is OFF.)
(3) Disconnect the teach pendant cable.
(4) Connect the jumper connector.
(5) Turn the disconnect switch to “Normal” position.
(6) Administrator should store the teach pendant and the teach pendant cable in the storage in order to avoid incorrect operation.

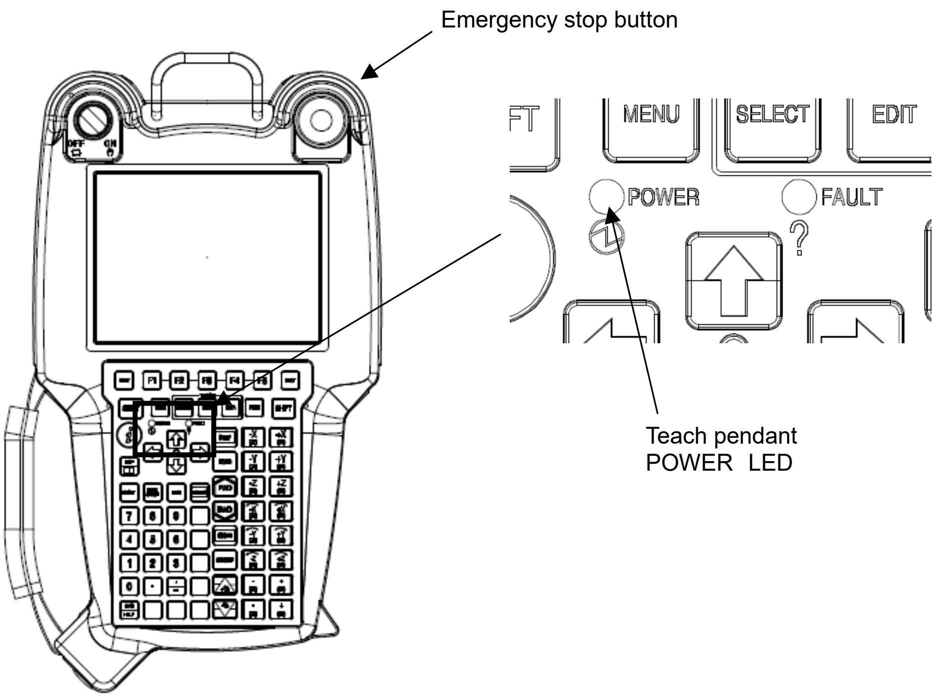
F.2.2 Teach Pendant Connect

(1) Set AUTO mode.
(2) Turn the disconnect switch to "Connect/Disconnect" position. (Robot stops because Operator's panel E-stop Alarm occurs.)
(3) Disconnect the jumper connector.
(4) Connect the teach pendant cable with the teach pendant.
(5) Turn the disconnect switch to "Normal" position.

⚠WARNING

When the LED (POWER) on the teach pendant turned on, this teach pendant is connected to the robot controller and emergency stop button of the teach pendant is active.

When the LED (POWER) on the teach pendant turned off, This teach pendant is not connected to robot controller and emergency stop button of the teach pendant is not active.

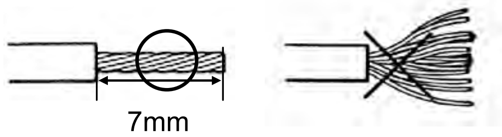


G INSTRUCTION FOR TERMINAL BLOCK

G.1 EXTERNAL EMERGENCY STOP SIGNAL INPUT/OUTPUT TERMINAL BLOCK

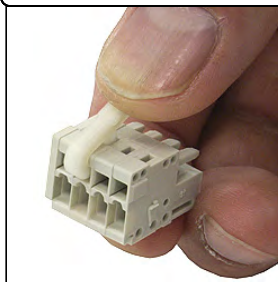
Stripping of Wire

Available wire size AWG 28 -14 (0.08 - 1.5mm^2)



- Please check a strip length carefully.
- Please readjust a loose end.

Handling of the lever

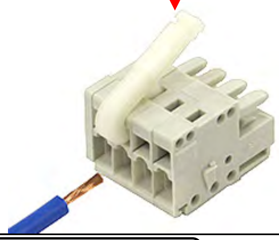


- Hold the connector, and push down the lever by finger.
- Don't handle the lever after fit the connector into PCB, otherwise PCB will be damaged by handling stress.

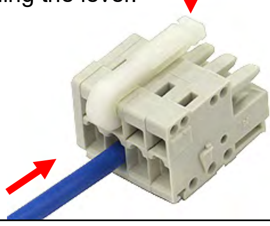
Operating Lever
Item No. **734-230**

Wiring

1. Push down the lever.

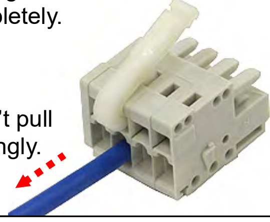


2.Insert a wire into the wire hole with holding the lever.

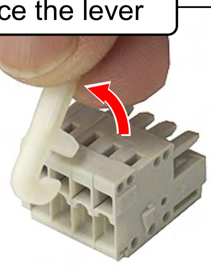


3.Release an operating tool. Pull a wire slightly to check if connecting has been done completely.

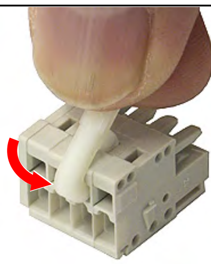
★Don't pull strongly.



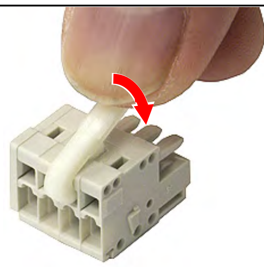
Replace the lever



1.Pull of the lever.



2.Hook the lever to the rectangle hole.

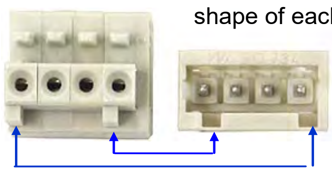


3.Push down the lever until click in.

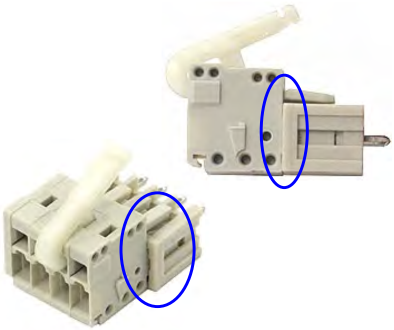
Fit to header

1.Push in the connector to the header.

★Be careful to fit the shape of each other.

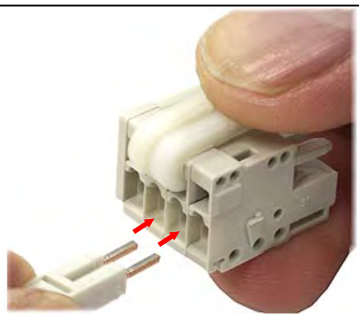


2.Please check if the latch is hooked to header.



Installation of Jumper

1. Attach two levers to the connector.



2.Hold down levers at the same time, then put the jumper into the connector.

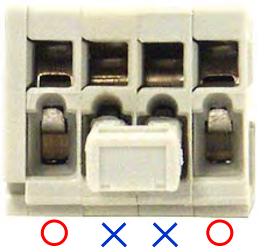
★ Please confirm that the jumper is fully inserted.

Availability of wires

Without jumpers

Max wire size 1.0mm^2 (AWG18) (with Ferrule)

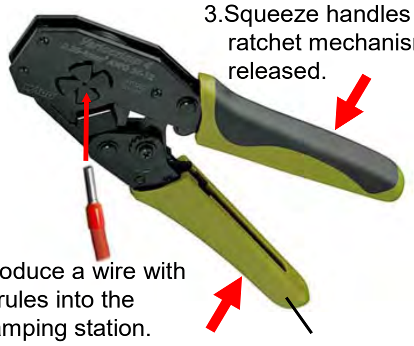
With jumpers



The wire cannot connect, when attached the jumper.

Installation of Ferrules

1.Put a wire through the hole of ferrules.

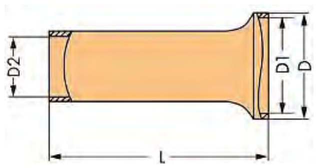


2.Introduce a wire with ferrules into the cramping station.

3.Squeeze handles until ratchet mechanism is released.

4.Please check if the wire crimped correctly.

Specifications of Ferrules



WAGO Item No.	Sleeve for mm^2 (AWG)	Color	Stripped length(mm)	L (mm)	L1	D	D1	D2
216-301	0.25 (24)	Yellow	9.5	12.5	8.0	2.5	2.0	0.8
216-302	0.34 (24)	Turquoise	9.5	12.5	8.0	2.5	2.0	0.8
216-201	0.5 (22)	White	9.5	13.5	8.0	3.0	2.5	1.1
216-202	0.75 (20)	Gray	10.0	14.0	8.0	3.3	2.8	1.3
216-203	1.0 (18)	Red	10.0	14.5	8.0	3.6	3.0	1.5

Pack-unit 100

★ **CAUTION!** Please make sure to use WAGO 206-204 to crimp the ferrules.

G.2 TERMINAL CONVERTER BOARD TERMINAL BLOCK

Available wire

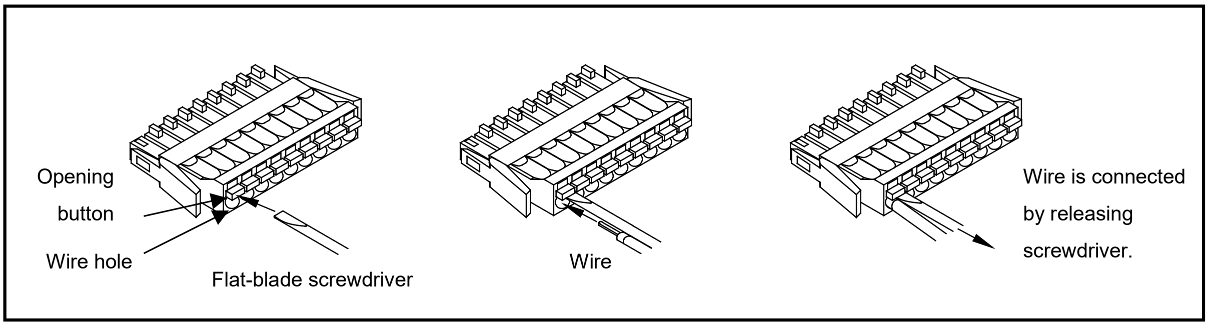
Solid conductor 0.2-1.5mm^2
Stranded conductor 0.2-1.5mm^2
Stripping length: 10(±0.5) mm

Ferrule is preferable to prevent breaking of wire and short of terminals.
Stranded conductor with ferrule: 0.25-0.75 mm^2

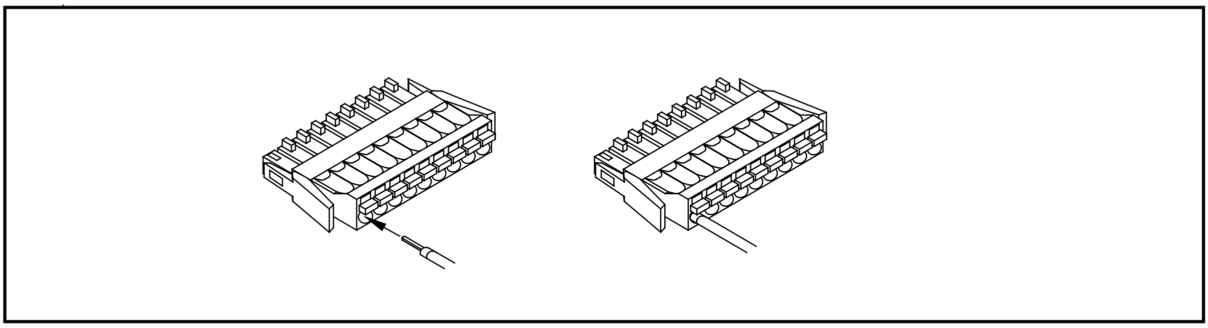
Wiring

There are two ways of wiring.

1. Insert a wire into wire hole with the opening button pushed by a flat-blade screwdriver.
   Release the screwdriver.



2. Push a wire into wire hole.



Disconnection

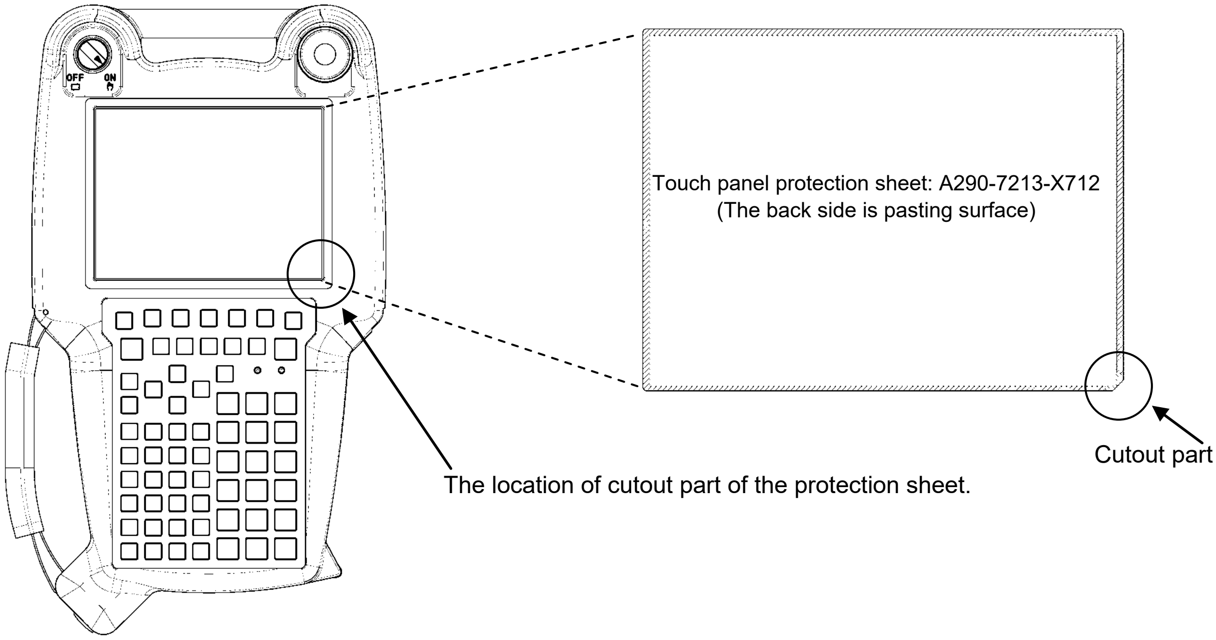
Pull out a wire from wire hole with the opening button pushed by a flat-blade screwdriver.

H REPLACING THE PROTECTION SHEET

This appendix shows an instruction for replacing the protection sheet of the *i*Pendant with touch panel.

Replacement procedure

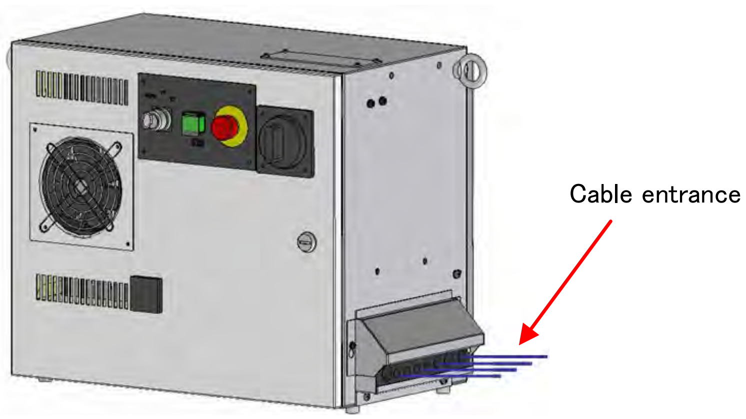
1. Remove old protect sheet.
2. Peel clear sheets pasted on both side of the new protect sheet.
3. Paste the protect sheet so that the cutout part is placed on the lower right portion.



I SEALING OF THE CABLE ENTRANCE OF THE CABINET

I.1 CABLE ENTRANCE FOR Mate-CABINET

The external cables are connected through the cable entrance located on the rear surface of controller. The cable entrance consists of a hood, frame and Cable Seal Block with multiple circular shaped holes for cable sealing. There are different types of Cable Seal Block; the type used is determined by the controller and robot configuration. When all customer supplied cables are connected through the cable entrance, it may be necessary to increase the cable diameter of some cables to maintain an adequate seal at the cable entrance. It is also necessary to confirm Cable Seal Block has enough holes for all system and option cables. The number of available sealing holes for customer supplied cables varies depending on robot type and options. Reference the following illustrations.



⚠ CAUTION

If the cable diameter is not suitable for the hole size of Cable Seal Block, controller problems may occur because of insufficient environmental sealing of controller.

Without proper cable entrance sealing, airborne contaminates, both non-conductive and conductive may enter the interior of the controller. Foreign particulate entering the controller can have an impact on controller operation and reliability.

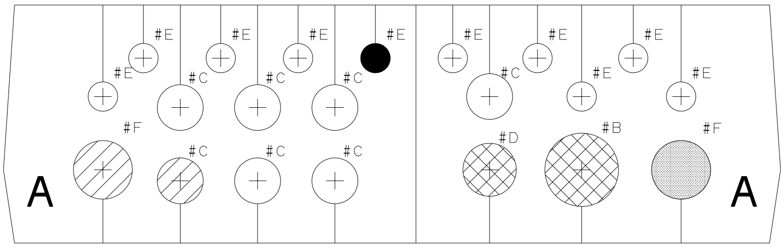
When customer supplied cables are connected through the cable seal entrance, the diameter of these cables should be adjusted to a suitable cable diameter to ensure proper controller cabinet sealing. Reference the following illustrations.

I.2 HOLES OF CABLE SEAL BLOCK FOR CABLE ENTRANCE

The cutout of Cable Seal block at the cable Entrance is shown as follows（Rear side view）.

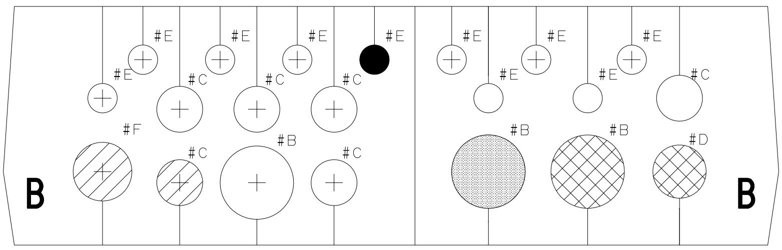
Cable Seal Block Type A (A230-0659-X013#A) ：

LR Mate 200*i*C,LR Mate 200*i*D, M-1*i*A



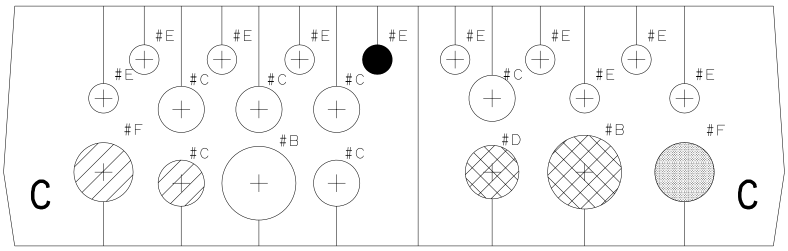
Cable Seal Block Type B (A230-0659-X013#B) :

ARC Mate 100*i*C, ARC Mate 100iD, ARC Mate 120*i*C, M-10*i*A, M-10iD, M-20*i*A, M-20*i*B, ARC Mate 0*i*B



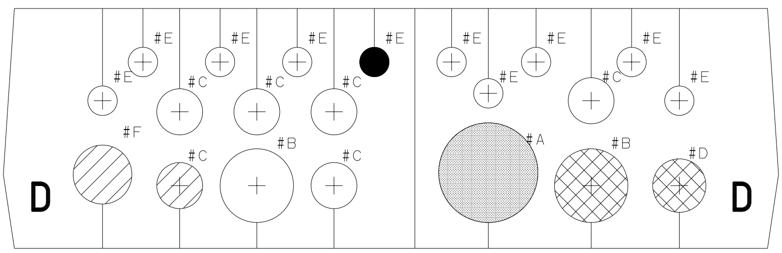
Cable Seal Block Type C (A230-0659-X013#C) :

ARC Mate50*i*D



Cable Seal Block Type D (A230-0659-X013#D) :

R-2000*i*C, R-1000*i*A, M-710*i*C



Robot power (RM1)   Robot plusecoder (RP1)

Teach pendant cable   Power cable

Hole type	Diameter (mm)	Cable Seal Block type								Application（Include options）
		Type A		Type B		Type C		Type D		
		Qty	For Options	Qty	For Options	Qty	For Options	Qty	For Options	
#A	ϕ27	0	0	0	0	0	0	1	0	Power Cable(RM1)
#B	ϕ20	1	0	3	1	2	1	2	1	Pulse coder cable Thick, Flex(RP1) Power cable(RM1) Aux. cabinet connection cable（AC）
#C	ϕ12.5	7	6	6	5	6	5	6	5	I/O, Power cable Link tracking, DeviceNet Thick cable Aux. cabinet connection cable（DC）
#D	ϕ14.5	1	0	1	0	1	0	1	0	Pulse coder cable STD/Non-Flex(RP1)
#E	ϕ8.5	10	9	10	9	10	9	10	9	Camera, EtherNet DeviceNet Thin cable Teach pendant cable Aux. cabinet connection cable（Optical）
#F	ϕ16.0	2	0	1	0	2	0	1	0	Power cable, Power cable(RM1)

I.3 SUITABLE CABLE DIAMETER

The suitable cable diameter for option cables are shown on the following table.

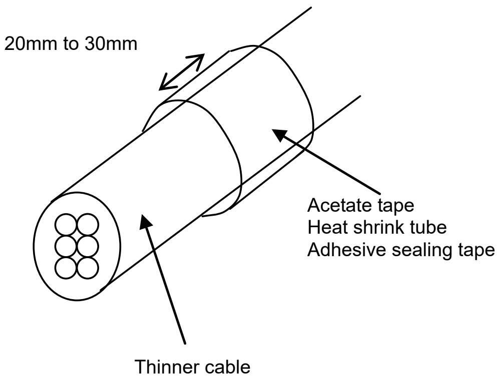
Hole type	Nominal (mm)	Tolerance (mm)	Suitable diameter (mm)	Qty			
				Cable Seal Block Type A	Cable Seal Block Type B	Cable Seal Block Type C	Cable Seal Block Type D
#B	ϕ20	±1	ϕ19−ϕ21	0	1	1	1
#C	ϕ12.5	±1	ϕ11.5−ϕ13.5	6	5	5	5
#E	ϕ8.5	±1	ϕ7.5−ϕ9.5	9	9	9	9

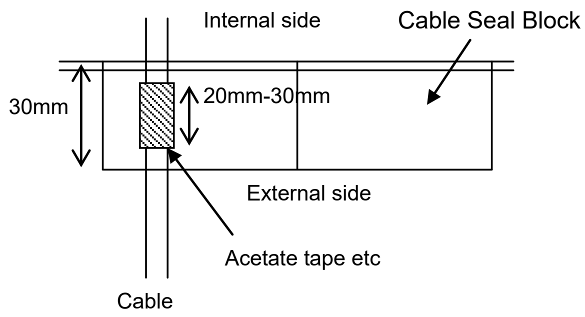
NOTE

The holes for options(#B,#C,#E) are used for all options(Aux. axis, I/O, Network, Sensor). So confirm that the available holes are enough for all option cables.

I.4 ADJUST THE CABLE DIAMETER

To maintain proper sealing of controller enclosure, it may be necessary to adjust some cable diameters to work with an available cable port diameter. If the diameter of any cable is smaller than an available sealing port in the Cable Seal Block, increase the cable diameter to an appropriate diameter by applying acetate tape, adhesive sealing tape or heat shrink tubing over the cable jacket. If a foam type sealing tape is used, adjust the diameter to the compression state of foam for a particular cable diameter. The finished diameter of all cables should maintain an interference fit with Cable Seal Block. All unused cable ports must be plugged to ensure controller is sealed against contaminants. Sealing frame and hood must also be properly installed.





INDEX

REVISION RECORD

Edition	Date	Contents
07	Aug.,2017	• Addition of LR Mate 200*i*C/5WP, M-10*i*D/12, ARC Mate 100*i*D, CR-7*i*A/L, CR-7*i*A, CR-4*i*A • Addition of R-30*i*B Mate Plus • Correction of errors.
06	Mar.,2016	• Addition of M-20*i*B/25, M-710*i*C/20M • Addition of figure of process I/O board MA, MB. • Correction of errors.
05	Jul.,2015	• Addition of M-10*i*A/8L, ARC Mate 100*i*C/8L • Addition of specification of FROM/SRAM module
04	Apr.,2015	• Addition of M-10*i*A/7L/12S, M-20*i*A/12L, ARC Mate 100*i*C/7L/12S, ARC Mate 120*i*C/12L, R-2000*i*C/125L/165R/210R, M-710*i*C/45M/12L • Correction of errors.
03	Dec.,2013	• Addition of R-2000iC
02	Sep.,2013	• Addition of M-1*i*A, M-2*i*A, M-3*i*A, M-10*i*A, M-20*i*A, ARC Mate 50*i*D, ARC Mate 100*i*C, ARC Mate 120*i*C, ARC Mate 0*i*B, R-0*i*B, R-1000*i*A, M-710*i*C
01	Dec.,2012	

B-83525EN/07

B-83525EN/07