FANUC I/O Unit–MODEL A

CONNECTION AND MAINTENANCE MANUAL

MARMGIOMA12801E REV. F

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If you have a controller labeled R-J3*i*C, you should read R-J3*i*C as R-30*i*A.

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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

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

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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.

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

In this manual we have tried as much as possible to describe all the various matters.
However, we cannot describe all the matters which must not be done, or which cannot be done, because there are so many possibilities.
Therefore, matters which are not especially described as possible in this manual should be regarded as "impossible".

Safety

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

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

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

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

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

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

CONSIDERING SAFETY FOR YOUR ROBOT INSTALLATION

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

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

Keeping People 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 Robotics training course(s) related to your application. Never permit untrained personnel to operate the robots.
- Install a lockout device that uses an access code to prevent unauthorized persons from operating the robot.
- Use anti–tie–down logic to prevent the operator from bypassing safety measures.
- Arrange the workcell so the operator faces the workcell and can see what is going on inside the cell.
- Clearly identify the work envelope of each robot in the system with floor markings, signs, and special barriers. The work envelope is the area defined by the maximum motion range of the robot, including any tooling attached to the wrist flange that extend this range.
- Position all controllers outside the robot work envelope.

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

Staying Safe While Teaching or Manually Operating the Robot

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

- Never wear watches, rings, neckties, scarves, or loose clothing that could get caught in moving machinery.
- Know whether or not you are using an intrinsically safe teach pendant if you are working in a hazardous environment.

- Before teaching, visually inspect the robot and work envelope to make sure that no potentially hazardous conditions exist. The work envelope is the area defined by the maximum motion range of the robot. These include tooling attached to the wrist flange that extends this range.
- The area near the robot must be clean and free of oil, water, or debris. Immediately report unsafe working conditions to the supervisor or safety department.
- FANUC Robotics recommends that no one enter the work envelope of a robot that is on, except for robot teaching operations. However, if you must enter the work envelope, be sure all safeguards are in place, check the teach pendant DEADMAN switch for proper operation, and place the robot in teach mode. Take the teach pendant with you, turn it on, and be prepared to release the DEADMAN switch. Only the person with the teach pendant should be in the work envelope.

WARNING

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

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

WARNING

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

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

Staying Safe During Automatic Operation

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

- Make sure all safety provisions are present and active.

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

Staying Safe During Inspection

When inspecting the robot, be sure to

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

Staying Safe During Maintenance

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

- Never enter the work envelope while the robot or a program is in operation.
- Before entering the work envelope, visually inspect the workcell to make sure no potentially hazardous conditions exist.

- Never wear watches, rings, neckties, scarves, or loose clothing that could get caught in moving machinery.
- Consider all or any overlapping work envelopes of adjoining robots when standing in a work envelope.
- Test the teach pendant for proper operation before entering the work envelope.
- If it is necessary for you to enter the robot work envelope while power is turned on, you must be sure that you are in control of the robot. Be sure to take the teach pendant with you, press the DEADMAN switch, and turn the teach pendant on. Be prepared to release the DEADMAN switch to turn off servo power to the robot immediately.
- Whenever possible, perform maintenance with the power turned off. Before you open the controller front panel or enter the work envelope, turn off and lock out the 3–phase power source at the controller.
- Be aware that when you remove a servomotor or brake, the associated robot arm will fall if it is not supported or resting on a hard stop. Support the arm on a solid support before you release the brake.

⚠WARNING

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

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

⚠WARNING

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

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

KEEPING MACHINE TOOLS AND EXTERNAL DEVICES SAFE

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

Programming Safety Precautions

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

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

Mechanical Safety Precautions

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

- Make sure the workcell is clean and free of oil, water, and debris.
- Use 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

Described below are the safety precautions regarding the FANUC I/O Unit-MODEL A. The safety precautions must be observed in order to use the FANUC I/O Unit-MODEL A safely.
Because installing, and performing exchange and daily maintenance operations on, the FANUC I/O Unit-MODEL A may incur diverse dangers, you cannot be involved in such work unless you have been sufficiently trained for safety.
Some of the safety precautions may not apply to your FANUC I/O Unit-MODEL A because it has no corresponding function. If this is the case, skip reading those precautions.
As for safety precautions regarding machine tools, refer to the respective machine manuals provided by the machine tool builders.
Before starting to operate machines for check purposes, be sure to read the manuals provided by the machine tool builders and FANUC and sufficiently understand their descriptions.

Contents

DEFINITION OF WARNING, CAUTION, AND NOTE

This manual includes safety precautions for protecting the user and preventing damage to the machine. Precautions are classified into Warning and Caution according to their bearing on safety. Also, supplementary information is described as a Note. Read the Warning, Caution, and Note thoroughly before attempting to use the machine.

⚠ WARNING
Applied when there is a danger of the user being injured or when there is a damage of both the user being injured and the equipment being damaged if the approved procedure is not observed.

⚠ CAUTION
Applied when there is a danger of the equipment being damaged, if the approved procedure is not observed.

NOTE
The Note is used to indicate supplementary information other than Warning and Caution.

* Read this manual carefully, and store it in a safe place.
* This manual is subject to change for product improvement, alteration of the product specifications, and improvement in the user-friendliness of the manual. See “Revision Record” at the end of the manual.

WARNINGS AND CAUTIONS REGARDING MOUNTING, WIRING, AND EXCHANGING

⚠ WARNING

1 Before starting mounting, wiring, and exchanging, be sure to shut off externally supplied power. Otherwise, electrical shocks, breakdown, and blowout may occur. If the FANUC I/O Unit-MODEL A is turned off but other units are not, for example, it is likely that power may be supplied to units connected to the FANUC I/O Unit-MODEL A, resulting in the units being damaged and workers getting electrical shocks when the units are exchanged.
2 Be sure to ground your FANUC I/O Unit-MODEL A in accordance with your national grounding standards (protective grounding class C or stricter). Otherwise, electrical shocks, malfunction, and breakdown may occur.
3 In unit exchange, a new unit should have the same specifications and parameter settings as in the unit to be removed. (For details, reference the section or item of the respective units.) Operating the newly installed unit without observing this caution will cause the machine to behave unexpectedly, possibly leading to a damaged workpiece or machine or injury.
4 Wiring work for the FANUC I/O Unit-MODEL A must be done only after it has been installed. Otherwise, electrical shocks can occur.
5 Be careful not to damage cables. Otherwise, electrical shocks can occur.
6 When working, wear suitable clothes with safety taken into account. Otherwise, injury and electrical shocks can occur.
7 Do not touch the electronic circuitry in any module directly with the hand. Static electricity can damage the module and cause burn injury.
8 Do not work with your hands wet. Otherwise, electrical shocks and damage to electrical circuits can occur.
9 Be sure to attach a terminal cover to each terminal board. Otherwise, electrical shocks and malfunction can occur.
10 Only those who have pragmatic information regarding handling of control units are allowed to install, wire, use, and maintain the FANUC I/O Unit-MODEL A. Incorrect handling of this equipment can lead to electrical shocks, fire, breakdown, and malfunction. Do not install, wire, use, or maintain the FANUC I/O Unit-MODEL A unless you have sufficient knowledge of how to handle control units and of electricity.

⚠ CAUTION

Failing to observe any caution stated below can lead to fire, breakdown, blowout, and malfunction.

1 Always use PC boards and modules developed for use on the FANUC I/O Unit-MODEL A.
2 Do not use any unit or component if it was found to be damaged or deformed when it was unpacked. Otherwise, fire, malfunction, and failure can occur.
3 Do not attach the FANUC I/O Unit-MODEL A to any flammable object or install it near any flammable object.
4 Do not allow any foreign matter (such as a screw, metal chip, or coolant) to get in the FANUC I/O Unit-MODEL A.
5 Handle the FANUC I/O Unit-MODEL A gently because it is a precision device. Be careful not to drop it or give a high impact to it.
6 Allow space for natural convection cooling above and below the FANUC I/O Unit-MODEL A so that each module in it can release heat.
7 When installing the FANUC I/O Unit-MODEL A, pay attention to its mass and the tension of cables to be attached to it.
8 Always use wires whose length, diameter, heat resistance, and flex resistance match their use.
9 When making a cable assembly, crimp, press-mount, or solder the wires, using the tool specified by the cable manufacturer. An improper cable connection can lead to a broken wire, short circuit, fire, and malfunction. Do not connect any untreated wire (such as only twisted) strands directly to a terminal board.
10 When fastening the FANUC I/O Unit-MODEL A and its wires, tighten their screws with the specified torque. Otherwise, the FANUC I/O Unit-MODEL A may fall, break down, or malfunction or wires may be short-circuited. Do not forget to attach screws.
11 Before wiring modules, check their voltage rating and pin arrangement and be sure to meet the requirements. If a module is connected to a power supply having a different voltage rating or is wired incorrectly, fire or failure can occur.
12 When detaching a cable from the FANUC I/O Unit-MODEL A, hold the connector rather than the cable. When attaching a cable, be sure to fit its connector to the connector pins securely. For connectors having a lock mechanism, be sure to lock them securely. An improper connection can lead to a broken wire, short circuit, fire, and malfunction.
13 Lay signal wires away from power wires as stated in this manual.
14 As for the shielding wires of the cables specified herein, securely ground them, using, for example, cable clamps.
15 Use single-point grounding for multiple units so that no noise current will flow through the ground line among them. However, both ends grounding or both ends opening may be more effective for some environments in which the units are used. Select the grounding type whichever is applicable to surrounding noise.
16 In taking an anti-noise measure regarding wiring work, an empirical approach is needed to a large degree. It is necessary to take action using a well managed organization according to manuals and other written information.

WARNINGS AND CAUTIONS REGARDING DESIGNING

⚠ WARNING

1 When designing, be sure to observe all rules stated in this document and any related manuals. Otherwise, it is likely that failure and malfunction may occur.
2 When using any FANUC product in a manner in which their use may incur significant hazard to human life and assets, previously make sure that the system containing the FANUC product has been designed in such a way that it can warn of any danger and its redundant design assures of a satisfactory safety and that the FANUC product is installed and powered properly for its intended use in the system.
3 Failures in the I/O units of the FANUC I/O Unit-MODEL A as well as input power abnormality and communication failures can hamper the normal operation of these I/O units. Design each I/O unit in such a way that the machine can operate safely, for example, by providing an external safety circuit to the I/O units so that no accident will occur even if the I/O units fail to operate normally.
Using the dual check safety function makes it possible to detect a single fault in a portion related to safety. For details of the dual check safety function, refer to the document on the dual safety function of your CNC unit.
4 The DO function of each I/O unit has been designed in such a way that, if a system alarm is issued in the CNC unit that controls the FANUC I/O Unit-MODEL A or the power of the CNC unit or the FANUC I/O Unit-MODEL A is turned off, the DO function of all the I/O units is turned off. However, it is not guaranteed that the DO function is surely turned off. So, it is requested that, if a signal regarding safety is involved, a safety circuit external to each I/O unit must be configured.
5 If the load current of an output module exceeds its rating for a long time for any reason, it is likely that smoke and fire may occur. So, it is recommended to provide an external safety circuit including a fuse etc.
6 Do not use the power supply for driving relays to perform interlock with external loads.

⚠ WARNING

7 Coolants containing sulfur or chlorine at a high activation level, an oil-free coolant called synthetic, and water-soluble coolants at a high alkali level, in particular, can largely affect the FANUC I/O Unit-MODEL A. Please note that the following trouble is likely to occur.

- Coolants containing sulfur or chlorine at a high activation level
  Some coolants containing sulfur or chlorine are at an extremely high activity level. If such a coolant adheres to the FANUC I/O Unit-MODEL A, it reacts chemically with a material, such as resin of the equipment, possibly leading to corrosion or deterioration. If it gets in the FANUC I/O Unit-MODEL A, it corrodes metals, such as copper and silver, used as component materials, possibly leading to a defective component.
- Synthetic-type coolants having a high permeability
  Some synthetic-type coolants whose lubricating component is, for example, PAG (polyalkylene glycol) have an extremely high permeability. If such a coolant is used even in equipment having a high closeness, it can readily flow into the equipment through, for example, gaskets. It is likely that, if the coolant gets in the FANUC I/O Unit-MODEL A, it may deteriorate its insulation and damage its components.
- Water-soluble coolants at a high alkali level
  Some coolants whose pH is increased using alkanolamine are so strongly alkali that its standard dilution will lead to pH10 or higher. If such a coolant spatters over the surface of the FANUC I/O Unit-MODEL A, it reacts chemically with a material, such as resin, possibly leading to corrosion or deterioration.

⚠ CAUTION

1 Install the FANUC I/O Unit-MODEL A in such a place that neither cutting chip nor coolant will spatter to them. Otherwise, damage or malfunction may occur.
2 When using the FANUC I/O Unit-MODEL A, observe its rated voltage and current described in this manual. Otherwise, fire, malfunction, and failure can occur.
3 Keep in mind that, if the FANUC I/O Unit-MODEL A is used outside its specification described in this manual or altered by the user, its functions and performance will not be guaranteed.

WARNINGS REGARDING DAILY MAINTENANCE

⚠ WARNING

1 Before replacing a blown fuse, it is necessary to remove the cause of the blown fuse. So, do not replace fuses unless you have been well informed of maintenance work and safety.
2 Some modules of the FANUC I/O Unit-MODEL A have radiating fins. They can remain very hot for a while after power has been removed from the FANUC I/O Unit-MODEL A, making you get burned if you touch them. Before starting to work on them, wait and make sure they are cool.
3 To maintain a normal condition of the system and protect it from trouble, perform daily and periodical checks on it and do the sweeping. If you notice an apparent hardware fault, such as abnormal noise, abnormal odor, smoke, ignition, or abnormal heat, in the hardware while power is being supplied to it, shut it off at once and contact a FANUC branch office nearby or your FANUC service representative. These faults can cause fire, breakdown, blowout, and malfunction.

PREFACE

Applicable models

This manual describe the following products.
The abbreviations listed below may be used in the body text of this manual.

Name of products	Abbreviation
FANUC I/O Unit-MODEL A	I/O Unit-A

Applicable CNCs

Name of products	Abbreviation
FANUC Power Mate	Power Mate
FANUC Series 0 (MODEL C)	Series 0-C
FANUC Series 15	Series 15
FANUC Series 16	Series 16
FANUC Series 18	Series 18
FANUC Series 20	Series 20
FANUC Series 21	Series 21
FANUC SYSTEM F-MODEL D Mate	F-D Mate
FANUC Power Mate *i*	Power Mate *i*
FANUC Series 0*i*	Series 0*i*
FANUC Series 15*i*	Series 15*i*
FANUC Series 16*i*	Series 16*i*
FANUC Series 18*i*	Series 18*i*
FANUC Series 20*i*	Series 20*i*
FANUC Series 21*i*	Series 21*i*
FANUC Series 30*i*	Series 30*i*
FANUC Series 31*i*	Series 31*i*
FANUC Series 32*i*	Series 32*i*
FANUC Series 35*i*	Series 35*i*
Power Mate *i* , Series 0*i* / 15*i* / 16*i* / 18*i* / 20*i* / 21*i* / 30*i* / 31*i* / 32*i* / 35*i*	*i* series CNC

Other related models

Name of products	Abbreviation
FANUC I/O Unit-MODEL B	I/O Unit-B

Abbreviations of manufacturer names used herein

This manual uses the following abbreviations for manufacturers of products such as connectors.

Manufacturer name	Abbreviation
Daito Communication Apparatus Co., Ltd.	Daito
Fujitsu Limited	Fujitsu
HIROSE ELECTRIC CO., LTD.	HIROSE ELECTRIC
HONDA TSUSHIN KOGYO CO., LTD.	HONDA TSUSHIN
Molex Incorporated	Molex
Nihon Weidmüller Co., Ltd.	Weidmüller
SORIAU JAPAN	SORIAU JAPAN
Tyco Electronics AMP K.K.	Tyco Electronics

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II. MAINTENANCE

I. CONNECTION

1 FANUC I/O Link *i* AND FANUC I/O Link

I/O Link *i* and I/O Link are a serial interface with a purpose to transfer I/O signals (bit data) between CNC, cell controller, the I/O Unit-MODEL A, the Power Mate and so on at high-speed. Master and slave stations are involved in I/O Link *i* and I/O Link control. The master is the CNC unit, and a slave is I/O Unit-A.
With the I/O Link *i*, the communication transfer rate is increased, compared to the I/O Link. More signals and slaves (groups) can be connected.

Comparison in specification between I/O Link *i* and I/O Link

Item	I/O Link	I/O Link *i*
Transfer cycle	2ms	2ms (normal mode) 0.5ms (high-speed mode) Note 4
Maximum number of I/O signals (per channel)	1024/1024	2048/2048 (normal mode) 512/512 (high-speed mode) Note 4
Maximum number of I/O signals (per group)	256/256	512/512
Maximum number of groups (per channel)	16 groups	24 groups (normal mode) 5 groups (high-speed mode) Note 4
Maximum number of slave connection of I/O unit-A (per group)	Master: F-D Mate 4 units (4 base) Master: Other than the F-D Mate 2 units (2 base)	1 unit

* The transfer cycle herein refers to the cycle of master-slave DI/DO transfers. As for the actual delay time, it is necessary to consider the delay time of the driver and receiver of slaves and the ladder scan period.

* I/O Link *i* can handle both normal and high-speed modes together. Refer to the FANUC Series 30*i*/31*i*/32*i*-MODEL B PMC PROGRAMMING MANUAL for explanations about how to set the high-speed mode.

With some *i* series CNC models, it is possible to use up to two I/O Link *i* interface channels and up to three I/O Link interface channels. Either I/O Link *i* or I/O Link can be selected as channels 1 and 2 while only I/O Link can be selected as channel 3. Which I/O link (I/O Link *i* or I/O Link) to use as channel 1 or 2 can be specified using parameters. The initial parameter setting states that I/O Link be used as channels 1 and 2. Refer to the FANUC Series 30i/31i/32i-MODEL B PMC PROGRAMMING MANUAL for descriptions of the parameter setting.
With I/O Link *i*, it is possible to use up to 2048/2048 I/O points per channel. With I/O Link, it is possible to use up to 1024/1024 I/O points per channel.
The maximum number of I/O points that can be used throughout the system is 4096/4096. I/O Link *i* and I/O Link can be combined on a channel-by-channel basis as long as the total number of I/O points in the system is not exceeded.

[Examples of usable combinations]

Channel 1	Channel 2	Channel 3	Total points (DI / DO)
I/O Link *i*	I/O Link *i*	—	4096 / 4096
I/O Link *i*	I/O Link	—	3072 / 3072
I/O Link *i*	I/O Link	I/O Link	4096 / 4096
I/O Link	I/O Link	I/O Link	3072 / 3072

NOTE
1 The total number of I/O points that can be used varies from one model to another.
2 If a channel is used with I/O Link *i*, all units connected to the channel must be those which support I/O Link *i*. Do not connect any unit dedicated to I/O Link *i* to any channel used with I/O Link.
3 If you want to have the I/O Unit-A support I/O Link *i*, use the interface module AIF01D that supports I/O Link *i*. Using the AIF01D makes it possible to use all existing base units and DI/DO modules.
4 The I/O Unit-A does not support the high-speed mode of I/O Link *i*.

1.1 HAVING THE I/O Unit-A SUPPORT I/O Link *i*

Using the I/O Unit-MODEL A with I/O Link *i* needs the interface module AIF01D.
Using the AIF01D makes it possible to use all existing base units and I/O modules (Note) with I/O Link *i*.

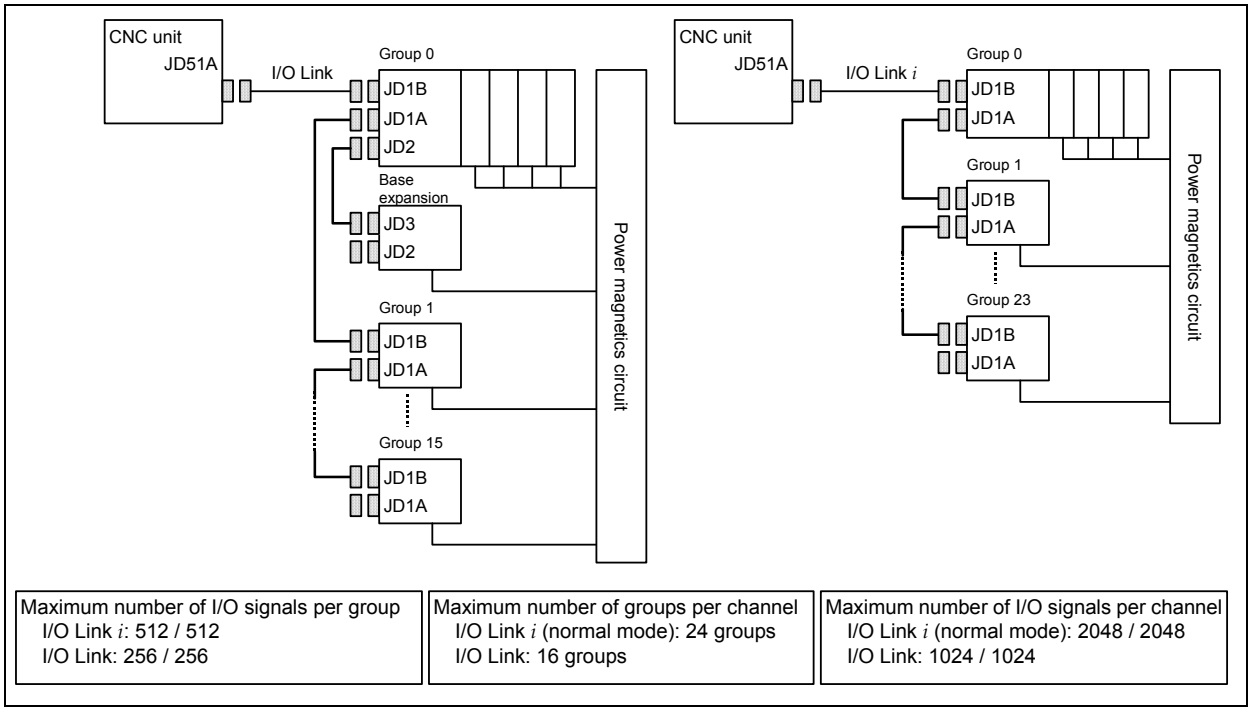
NOTE
The high-speed counter modules whose unit drawing number is A03B-0819-C053 or A03B-0807-C053 are dedicated to I/O Link. *See Chapter 8.

The AIF01D differs from the AIF01A (conventional model) in the points listed below. Before using it, be sure to check them.

	AIF01D	**AIF01A**
Communication method	I/O Link *i*	I/O Link
Power connector	Manufactured by Tyco Electronics D-3500 (*) Gold-coated	Manufactured by SOURIAU JAPAN SMS3PNS-5
Base expansion	Impossible	Up to one unit

See Chapter 4 of this connection manual for detailed descriptions of the interface module.
Also see Chapters 5 to 9 of the manual for descriptions of each I/O module.

1.2 CONFIGURATION



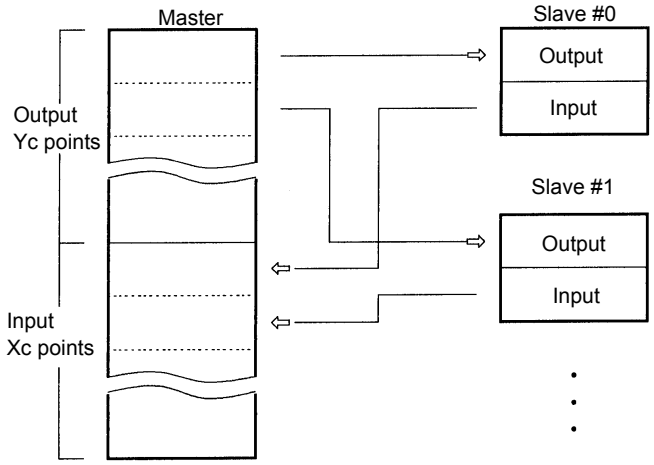
(1) I/O Link *i* and I/O Link are each comprised of one master and several slaves.
(2) Any slave can be connected to any group. However, different slave types cannot be mixed in one group.
(3) With I/O Link, up to two units (two bases) can be connected to one group.
(4) With I/O Link *i*, only one unit (one base) can be connected to one group (no base expansion is allowed).

1.3 ALLOCATION OF I/O POINTS

I/O Link *i* and I/O Link each have the following number of I/O points per channel or group as viewed from the master.

Communication method	Number of I/O signals per channel (Xc / Yc)	Number of I/O signals per group (Xg / Yg)
I/O Link *i*	2048 / 2048	512 / 512
I/O Link	1024 / 1024	256 / 256

Assigning this I/O to each slave enables periodic I/O data transfer to be performed between the master and slaves.



Each slave can occupy as many I/O points as determined for it. For the I/O Link *i* or I/O Link, the total number of I/O points occupied by all slaves per channel must meet:

Number of input points ≤ Xc
Number of output points ≤ Yc

Number of actual I/O points may differ from that of the occupied ones.
How to determine the number of I/O points to be allotted to each slave and restrictions for allocation are shown in the followings.
(For the allocation method for I/O points, refer to the PMC PROGRAMMING MANUAL.)

(1) Sum the numbers of the I/O points for all slaves connected with a single I/O Link *i* or I/O Link. The sum must satisfy the following restriction :
Number of input points ≤ Xc (per one channel)
Number of output points ≤ Yc (per one channel)

(2) Number of the occupied I/O points per one group must satisfy the following restriction :
Number of input points ≤ Xg (per one group)
Number of output points ≤ Yg (per one group)

(3) Determine the number of I/O points for the I/O Unit-A using the following.
[Output points]

Sum of the actual output points in a group	Occupied output points
0 to 32	⇒ 32 points
40 to 64	⇒ 64 points
72 to 128	⇒ 128 points
136 to 256	⇒ 256 points

NOTE
Count AOA05E as 8 points AOA12F as 16 points.

[Input points]

Sum of the actual output points in a group	Occupied output points
0 to 32	⇒ 32 points
40 to 64	⇒ 64 points
72 to 128	⇒ 128 points
136 to 256	⇒ 256 points

However, as result of the calculation above, when the number of input points is not larger than that of the output points in a single group, the number of input points is assumed to be equal to that of the output points.

Example 1 :

When the following modules are used in the group No. 0.

AOD32C 3 AID32A 5
AOA12F 2 AIA16G 3

[Output points]

$32 \times 3 + 16 \times 2 = 128 \Rightarrow$ 128 points

[Input points]

$32 \times 5 + 16 \times 3 = 208 \Rightarrow$ 256 points

Example 2:

When the following modules are used in the group No.2

AOD16C 7 AID16C 4
AOA05E 9 AIA16G 3

[Output points]

$16 \times 7 + 8 \times 9 = 184 \Rightarrow$ 256 points

[Input points]

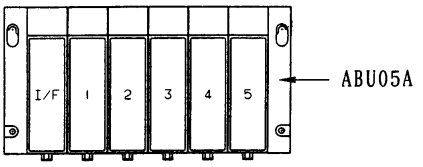
$16 \times 4 + 16 \times 3 = 112 \Rightarrow$ 128 points

In this case, as the number of input points is not larger than that of the output points, the number of input points is assumed to be equal to that of the output points, in other words, 256 points.

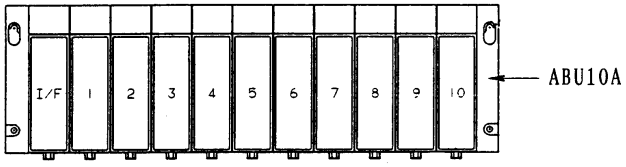
NOTE
If no base expansion has been performed, an attempt to allocate I/O points for base expansion results in an I/O Link error.

2 I/O Unit CONFIGURATION

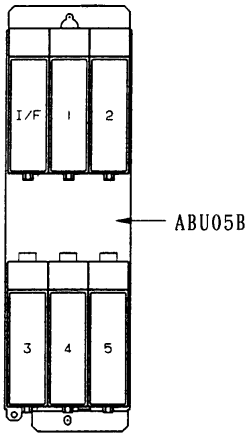
5-slot horizontal base unit (ABU05A)



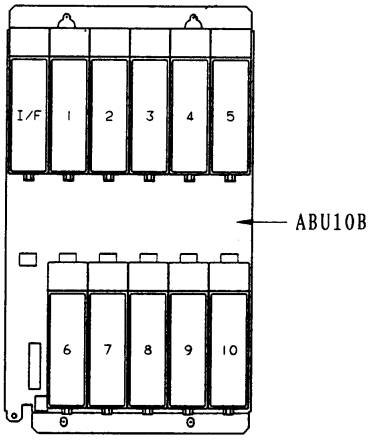
10-slot horizontal base unit (ABU10A)



5-slot vertical base unit (ABU05B)



10-slot vertical base unit (ABU10B)



NOTE
I/F : Interface module (AIF01A, AIF01A2, AIF01B, AIF02C, or AIF01D)
1 to 10 : I/O modules

3 INSTALLATION

3.1 ENVIRONMENT FOR INSTALLATION

3.1.1 Environmental Conditions inside the Cabinet

The peripheral units and the CNC unit have been designed on the assumption that they are housed in closed cabinets. In this manual "cabinet" refers to the following:

- Cabinet manufactured by the machine tool builder for housing the CNC unit or peripheral units;
- Operation pendant, manufactured by the machine tool builder, for housing the LCD/MDI unit or operator's panel.
- Equivalent to the above.

The environmental conditions when installing these cabinets shall conform to the following table. Section 3.2 describes the installation and design conditions of a cabinet satisfying these conditions.

Ambient temperature	Operating	0°C to 55°C
	Storage, Transport	-20°C to 60°C
	Temperature change	0.3°C/minute or less
Humidity	Normal	75%RH or less, no condensation
	Short period (less than 1 month)	95%RH or less, no condensation
Vibration	Operating	0.5G or less A FANUC evaluation test is performed under the following conditions. 10 to 58Hz : 0.075mm (amplitude) 58 to 500Hz : 1G Vibration directions : X, Y, and Z directions Scanning frequency : 10 cycles IEC60068-2-6 compliant
	Non-operating	1.0G or less
Meters above sea level	Operating	Up to 1000 m (Note)
	Non-operating	Up to 12000 m
Environment		Prevent coolant, lubricant, and chippings from being applied directly to on the control

NOTE

If the CNC is installed 1000 m or higher above sea level, the allowable upper ambient temperature of the CNC in the cabinet is changed as follows.

Assume that the allowable upper ambient temperature of the CNC in the cabinet installed 1000 m or higher above sea level decreases by 1.0°C for every 100 m rise in altitude.

Example)

The upper allowable ambient temperature of the CNC in the cabinet installed 1750 m above sea level is:

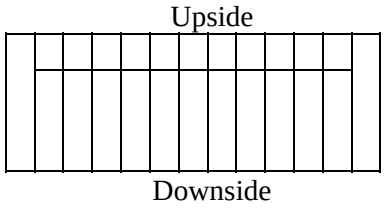
55°C – (1750-1000)/100 × 1.0°C = 47.5°C

Therefore, the allowable ambient temperature range is from 0°C to 47.5°C.

3.2 DESIGNING CONDITION FOR A CABINET

When designing a cabinet to contain the I/O Unit-A, take the same care as taken for the cabinet containing the CNC control unit and other units. For details, refer to the CNC CONNECTION MANUAL.
In addition, when mounting the I/O Unit, conform to the followings in view of maintenance, environmental durability, noise resistance and the like.

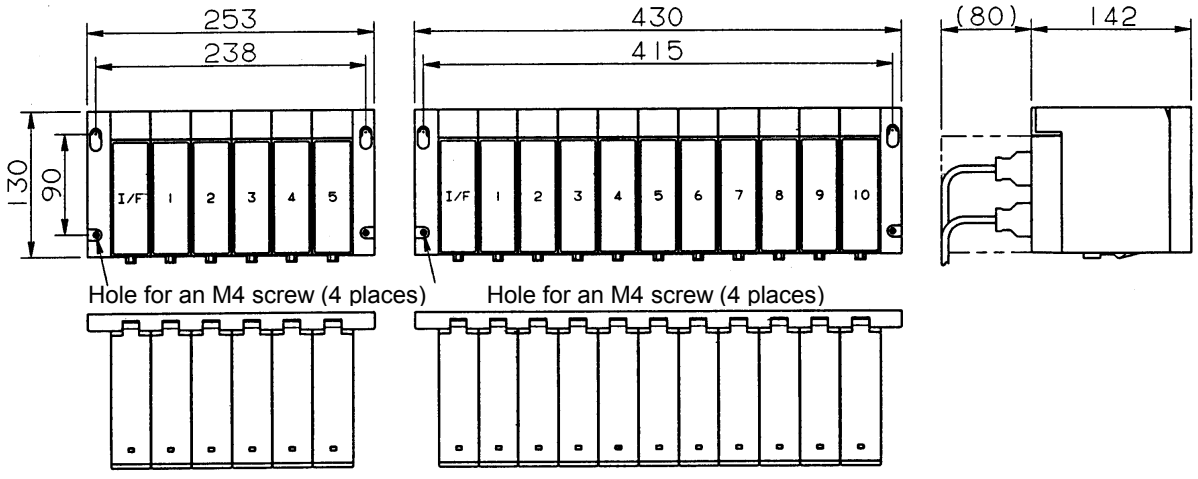
(1) In order to ventilate inside the module well, mount the I/O Unit in the direction shown in the figure below.



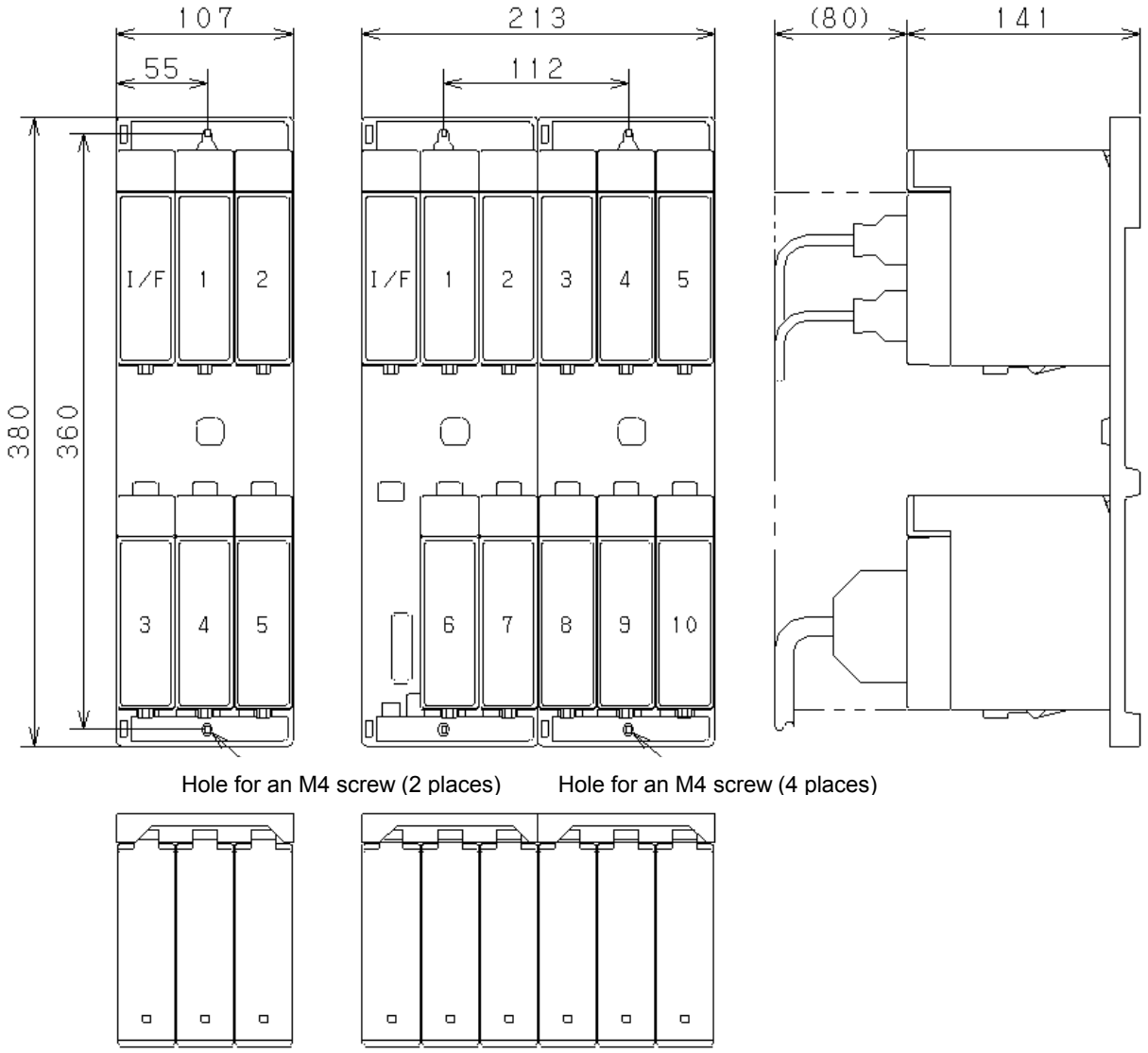
(2) Separate each I/O Unit at least 100 mm vertically from the other units so as to ensure effective ventilation and make it easy to attach/detach wires and modules.
(3) Do not put equipments which generate a large amount of heat under the I/O Unit.
(4) Low-level signals are transferred through the signal cables K1X and K2X. (For these cables, see the general connection diagram.) Lay out these cables apart from the wires for AC power source and the I/O wires of the I/O module by 100 mm or more.
(5) Make sure that there is no protruding portion such as a screw on the mounting surface of the I/O Unit.
(6) See Section 3.4, “HEAT VALUE AND WEIGHT OF EACH MODULE” for heat values of I/O Unit.

3.3 OUTER DIMENSION OF I/O Unit

Horizontal base units (ABU05A and ABU10A)



Vertical base units (ABU05B and ABU10B)



* The ABU05B and ABU10B units that were shipped early on are housed in a metal case.
The distances between mounting holes for the metal case and their size are the same as for the plastic case used for the current units. However, the width of the metal case differs from that of the plastic case as listed below.

	ABU05B		ABU10B	
	Plastic case	**Metal case**	**Plastic case**	**Metal case**
Width	107mm	110mm	213mm	217mm

3.4 HEAT VALUE AND WEIGHT OF EACH MODULE

	Module name		Basic heat value (W)	Heat value per one I/O point (W)	Weight (g)
	ABU10A		-	-	600
	ABU10B		-	-	740
	ABU05A		-	-	350
	ABU05B		-	-	380
	AIF01A		1.2	-	300
	AIF01A2		1.2	-	300
	AIF01B		1.2	-	270
	AIF02C		1.2	-	300
	AIF01D		1.2	-	220
*1	AID32A1		1.2	0.23	250
*2	AID32B1		1.2	0.23	250
	AID32H1		1.2	0.23	250
	AID16C		0.1	0.21	300
	AID16K		0.1	0.21	300
	AID16D		0.1	0.21	300
	AID16L		0.1	0.21	300
	AID16DM		0.1	0.21	290
	AID16LM		0.1	0.21	290
*3	AID32E1		0.1	0.23	220
	AID32E2		0.1	0.23	220
*4	AID32F1		0.1	0.23	220
	AID32F2		0.1	0.23	220
	AIA16G		0.1	0.21	300
*5	AOD32A1		0.3	-	220
	AOD08C		0.1	$0.04+0.4\times IL^2$	380
	AOD08D		0.1	$0.04+0.6\times IL^2$	380
	AOD08DP		0.1	$0.04+0.1\times IL^2$	310
	AOD16C		0.1	$0.04+1.4\times IL^2$	300
	AOD16D		0.1	$0.04+1.4\times IL^2$	320
	AOD16DM		0.1	$0.04+0.32\times IL^2$	270
	AOD16D2		0.1	$0.04+0.1\times IL^2$	320
	AOD16D3		0.1	$0.04+0.1\times IL^2$	320
	AOD16DP		0.1	$0.04+1.8\times IL^2$	310
*6	AOD32C1		0.1	$0.01+0.8\times IL^2$	220
	AOD32C2		0.1	$0.01+0.8\times IL^2$	220
*7	AOD32D1		0.1	$0.01+0.8\times IL^2$	200
	AOD32D2		0.1	$0.01+0.8\times IL^2$	200
	AOA05E		0.1	$0.13+1.5\times IL$	370
	AOA08E		0.1	$0.13+1.5\times IL$	370
	AOA12F		0.1	$0.11+1.5\times IL$	320
	AOR08G		0.1	$0.3+0.1\times IL^2$	300
	AOR16G		0.1	$0.3+0.1\times IL^2$	350
	AOR16H2		0.1	$0.3+0.1\times IL^2$	250
	AIO40A	Input	0.2	0.23	350
		Output		$0.01+1.3\times IL$	
	AAD04A		3.1	-	350
	AAD04B		3.1	-	370
	ADA02A		3.1	-	350
	ADA02B		3.1	-	350
	ACT01A		4.1	-	220
	ATI04A		4.0	-	260
	ATI04B		4.0	-	260

Module name	Basic heat value (W)	Heat value per one I/O point (W)	Weight (g)
ATB01A	-	-	100
ATB01B	-	-	120

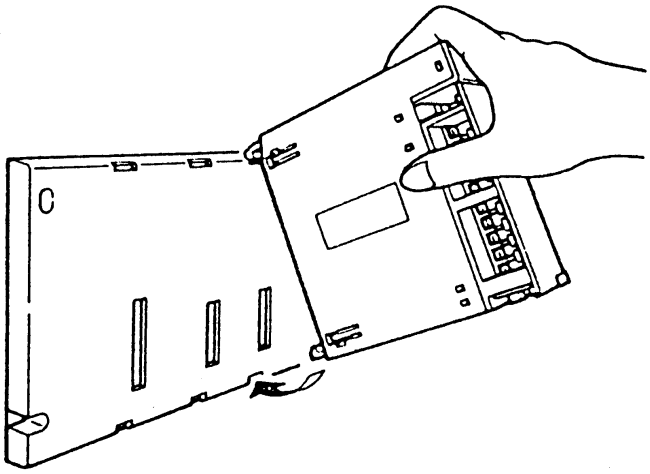
- Total 'Heat value per 1 I/O point' for simultaneous ON points plus 'Basic heat value' is the heat value of the module.
- IL : Load current of output
- *1 to *7 : "AxD32x" produced to the old specification is equivalent to "AxD32x1" (with additional "1" at the end) produced to the current specification. (Example: Old specification AID32E → AID32E1)

3.5 MOUNTING AND DISMOUNTING MODULES

Interface modules and various types of I/O modules can be mounted to and dismounted from the base unit easily as shown below.

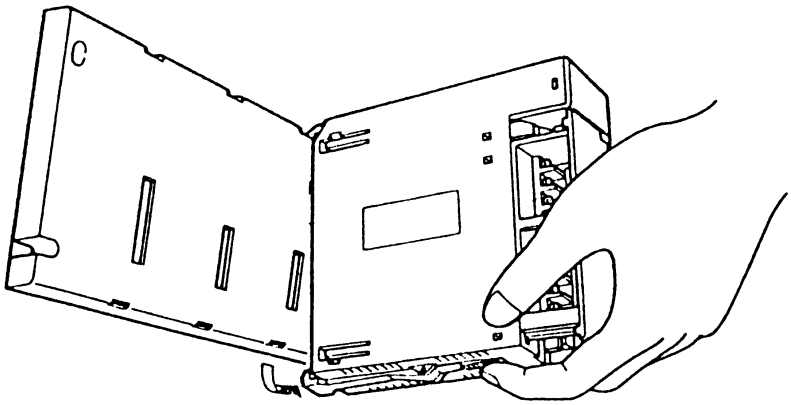
Mounting

Hang the hook at the top of the module on the groove in the upper side of the base unit, and make the connector of the module engage with that of the base unit. Push the module in the lower groove of the base unit till the stopper in the lower side of the module stops.



Dismounting

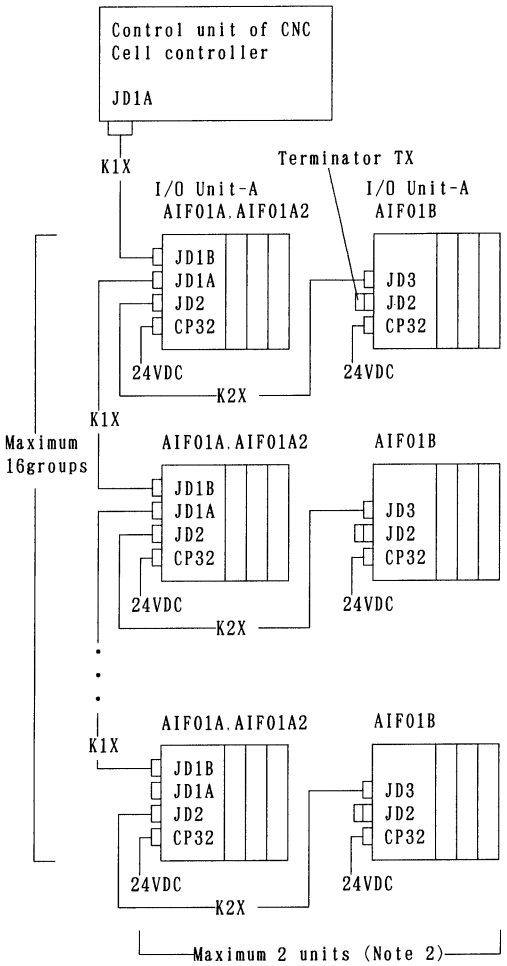
Release the stopper by pushing the lever at the bottom of the module, and then push the module upwards.



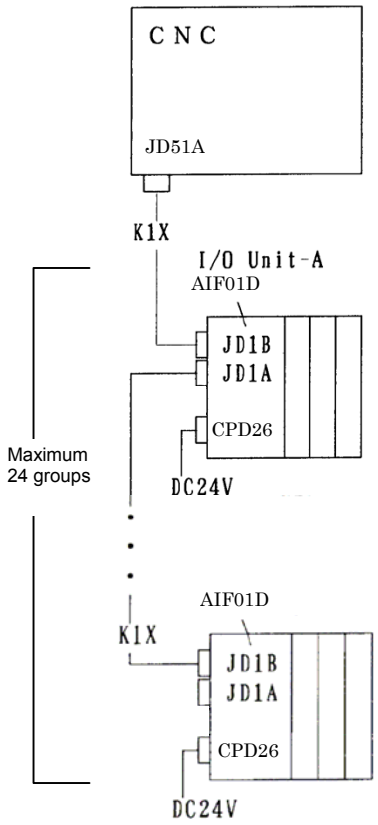
4 CONNECTION

4.1 GENERAL CONNECTION DIAGRAM

Connection diagram of I/O Link



Connection diagram of I/O Link *i*



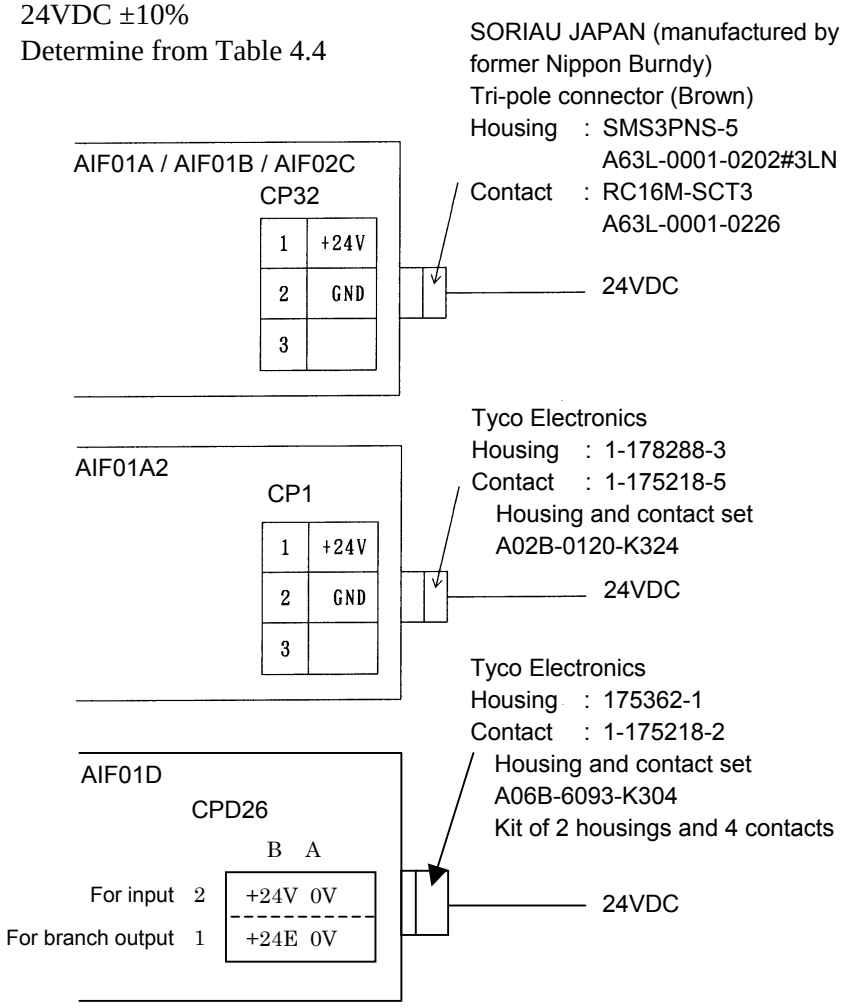
NOTE

1 Number of I/O Units and connecting method are restricted depending on the allocation of the I/O points. Refer to the section 1.3,"Allocation of I/O points."
2 In case of communication method is I/O Link, one group consists of up to two I/O units. If the master unit is the F-D Mate, however, one group consists of up to four I/O units. If the master unit is the F-D Mate, one group can consist of up to four I/O Units.
3 In case of communication method is I/O Link *i*, one group consists of up to one I/O unit only. (No base expansion is allowed.)
4 Cable K1X can be an optical fiber cable by using the optical I/O Link adapter. See chapter 10.
5 Terminator TX is required for connector JD2 of the AIF01B that is the last unit to be connected in the group. If no AIF01B is in use, no terminator has to be attached to the JD2 connector of the AIF01A or AIF01A2.
6 If you want to have the I/O Unit-A support I/O Link *i*, use the interface module AIF01D. Doing so makes it possible to the use existing base units and DI/DO modules.
However, the high-speed counter modules whose unit drawing number is A03B-0819-C053 or A03B-0807-C053 are dedicated to I/O Link. (See Chapter 8.)
7 Usable power connectors vary depending on which interface module is used. Before using interface modules, be sure to check their power connectors.

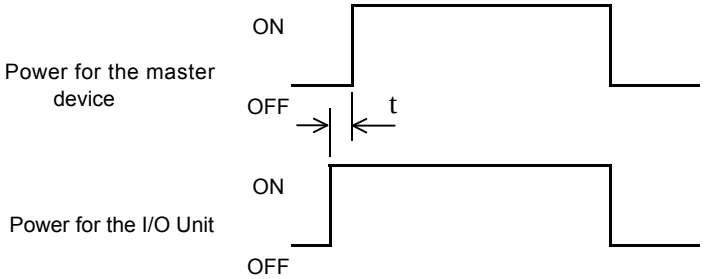
4.2 CONNECTING INPUT POWER SOURCE

Connect the following power source with the connector CP32, CP1, or CPD26 of the interface module (AIF01A, AIF01A2, AIF01B, AIF02C, or AIF01D).

- Voltage: 24VDC ±10%
- Current: Determine from Table 4.4



NOTE
The contacts in the AIF01D connector kit A06B-6093-K304 are coated with gold. No tin-coated contact is usable with the AIF01D.



t : -500 ms (Turn ON of the power for I/O Unit can be late 500 ms or less.)

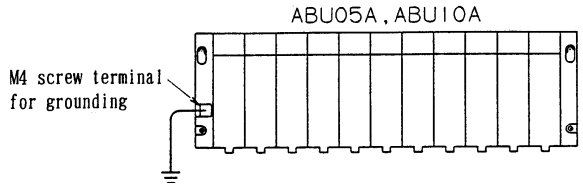
NOTE

1 Turn ON the power for the I/O Unit just when or before the power for the CNC or the cell controller is turned ON. When the CNC or cell controller power is turned OFF, make sure to turn the power to the I/O Unit OFF as well. Failing to observe this power ON/OFF sequence may result in an error occurring in the CNC unit or an I/O unit not being recognized normally.
2 For system safety, configure an external circuit so that the load is supplied with power only after the I/O unit is supplied with power. Supplying power to the load before the I/O unit may lead to an accident due to an incorrect output or malfunction of an output module or the like when the I/O unit is turned on.
3 Always shut off the power to the load before the I/O unit. Otherwise, it is likely that a machine breakdown or accident may occur.

4.3 GROUNDING

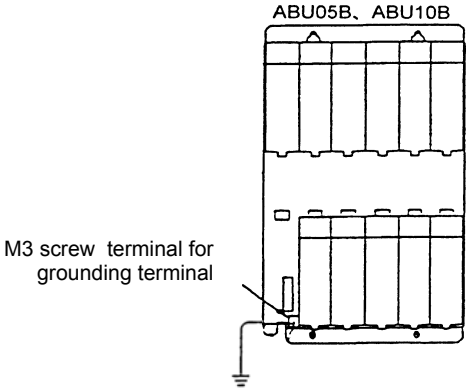
Connect the grounding terminal of the base unit (ABU05A, ABU05B, ABU10A, or ABU10B) to ground.

(1) Horizontal type base unit

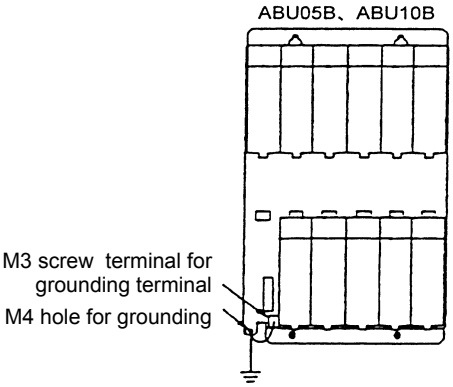


Use a wire of 2 mm^2 or more for grounding.

(2) Vertical type base unit
(a) For plastic case



(b) For metal case (early shipment)



NOTE

1 Connect the screw terminal for grounding terminal to the grounding hole portion.

2 Use dedicated grounds as much as possible.
Observe your national grounding standards (protective grounding class C or stricter). If possible, use a dedicated ground to isolate it from that for other units.
If no dedicated ground is available for the unit, it can share a common ground with other units.
However, absolutely avoid having the unit share a ground with high-power equipment such as motors and inverters. Ground them at their respective grounds so that they will not mutually affect others.
Do not ground the unit at a point where many units are grounded in order to prevent electrical shocks.

3 Use single-point grounding so that no noise will be induced on the grounding line between units. In some cases, however, both ends grounding or both ends opening may be more effective depending on the environment where the unit is used. Select one of the grounding types, whichever is appropriate, depending on what the ambient noise is like.

4.4 REQUIRED CURRENT

Interface module

Module name	Required current (mA) of+24V	
	A	B
AIF01A	50	
AIF01A2	50	
AIF01B	50	
AIF02C	50	
AIF01D	50	

Input module

Module name	Required current (mA) of+24V	
	A	B
AID32A1	20+0.5×n	30+7.5×n
AID32B1	20+0.5×n	30+7.5×n
AID32H1	20+0.5×n	30+7.5×n
AID16C	5	
AID16K	5	
AID16D	5	
AID16L	5	
AID16DM	5	
AID16LM	5	
AID32E1	5	
AID32E2	5	
AID32F1	5	
AID32F2	5	
AIA16G	5+1.5×n	

Output module

Module name	Required current (mA) of+24V	
	A	B
AOD32A1	14	
AOD08C	5+2×n	
AOD08D	5+2×n	
AOD08DP	5+2×n	
AOD16C	5+2×n	
AOD16D	5+2×n	
AOD16DM	5+2×n	
AOD16D2	5+2×n	
AOD16D3	5+2×n	
AOD16DP	5+2×n	
AOD32C1	5+0.5×n	
AOD32C2	5+0.5×n	
AOD32D1	5+0.5×n	
AOD32D2	5+0.5×n	
AOA05E	5+5.5×n	
AOA08E	5+5.5×n	
AOA12F	5+4.5×n	
AOR08G	5	10×n
AOR16G	5	10×n
AOR16H2	5	10×n

Special module

Module name		Required current (mA) of+24V	
		A	B
AIO40A	Input	20+0.5×n	30+7.5×n
	Output	5+0.5×n	
AAD04A		5	130
AAD04B		5	130
ADA02A		6	120
ADA02B		6	130
ACT01A		170+0.3×α	
ATI04A		62.5	100
ATI04B		62.5	100

n: Number of the input and output points (for each module) which turn ON simultaneously
α: +5-V current (mA) output to the outside

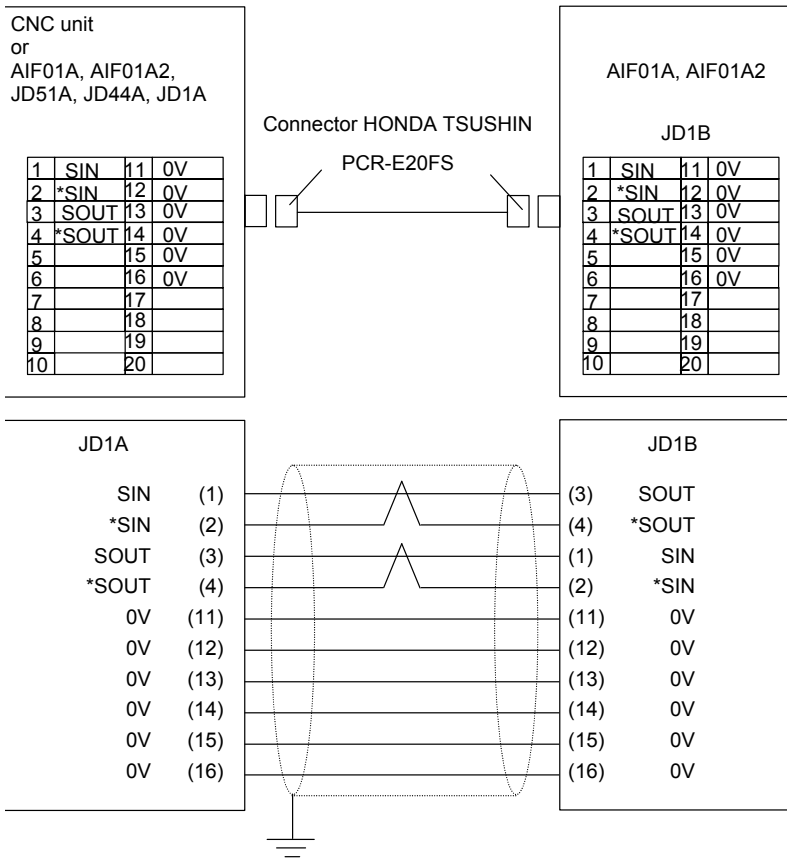
- Add the sums of the columns A and B for the modules to be used. The sum is the required current.(Unit: mA)
- For each base unit, keep the sum of column A and the sum of column B to within 500 mA and 1,500 mA, respectively.

NOTE
Do not use the unit in such a way that the total of the maximum power consumptions of its modules may exceed the capacity of the power source for it.

4.5 INTERFACE MODULE (AIF01A, AIF01A2, AIF01B)

Details of the cables K1X, K2X and the terminator shown in the general connection diagram are as follows.

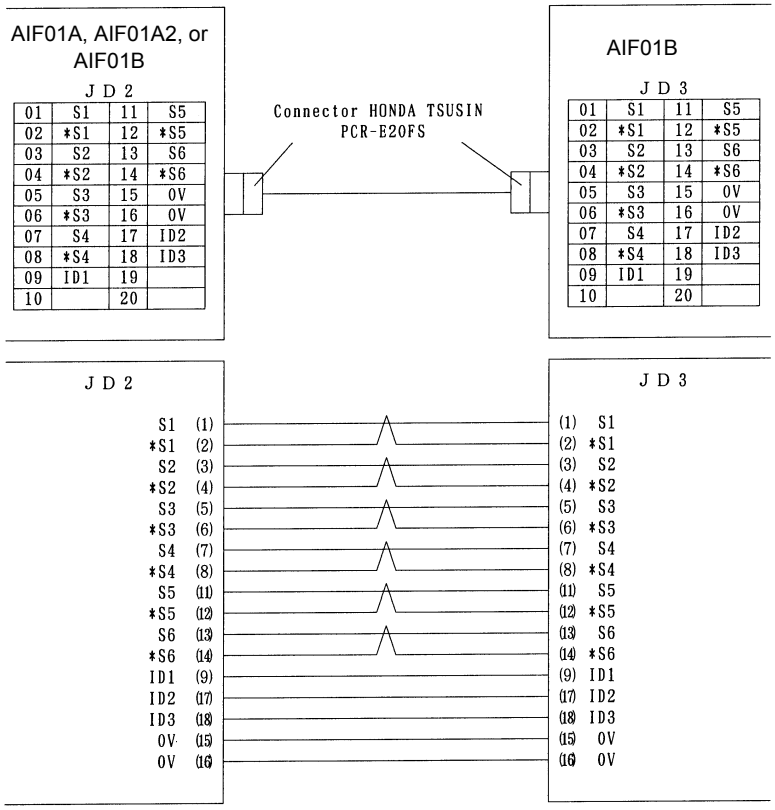
(1) Cable K1X



- Make sure to use twisted pair wires for signal SIN and *SIN, and signals SOUT and *SOUT.
- Recommended cable material: A66L-0001-0284#10P (twisted pair/shielded)
- Shielding wires should be connected with the grounding plate of the cabinet at the JD1A side using a cable clamp. (Refer to the CONNECTION MANUAL for the CNC unit.)
- Maximum cable length: 10 m (15 m if used to connect I/O devices within the same cabinet)
- In the following cases, make sure to use an optical I/O Link adapter and an optical fiber cable.(See Chapter 10)
  - When the cable is more than 10 meters long.
  - When the cable runs between different cabinets and there is no appropriate ground wire between the cabinets.
  - When there is concern that the cable is influenced by strong noise.
- When an optical I/O Link adapter is used: Cable to be used between the interface module (AIF01A) and the optical adapter is dissimilar to this cable. (See Chapter 10.)

NOTE
1 The AIF01A and AIF01A2 are dedicated to I/O Link. They cannot be used with I/O Link *i*.
2 The +5V pin enclosed in () is intended to supply power to an optical adapter for connection through an optical fiber cable. When using no optical adapter, do not connect the +5V pin.
3 The pins enclosed in [ ] are used by the JD44A or JD51A for channel 2 or 3 connection. Do not connect anything to them.
4 Do not connect anything to pins to which no signal is assigned.

(2) Cable K2X



01	S1	11	S5
02	*S1	12	*S5
03	S2	13	S6
04	*S2	14	*S6
05	S3	15	0V
06	*S3	16	0V
07	S4	17	ID2
08	*S4	18	ID3
09	ID1	19	
10		20	

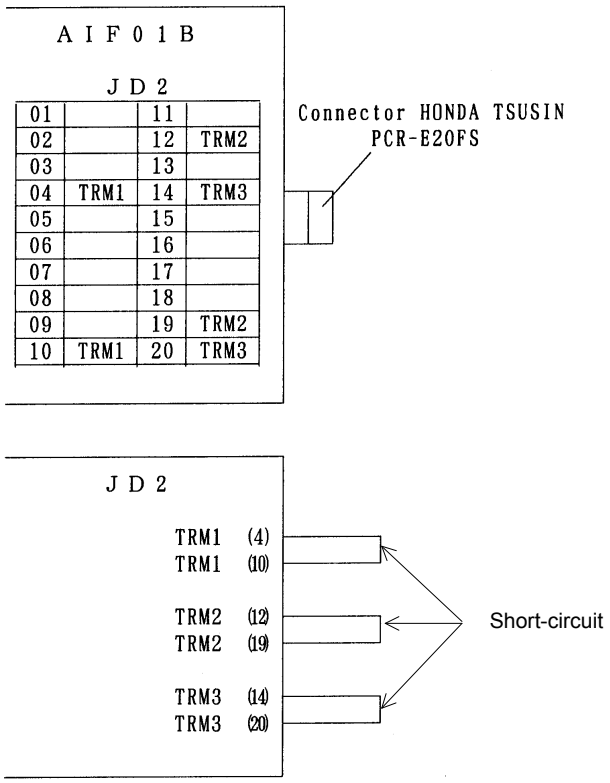
01	S1	11	S5
02	*S1	12	*S5
03	S2	13	S6
04	*S2	14	*S6
05	S3	15	0V
06	*S3	16	0V
07	S4	17	ID2
08	*S4	18	ID3
09	ID1	19	
10		20	

J D 2		J D 3	
S1	(1)	(1)	S1
*S1	(2)	(2)	*S1
S2	(3)	(3)	S2
*S2	(4)	(4)	*S2
S3	(5)	(5)	S3
*S3	(6)	(6)	*S3
S4	(7)	(7)	S4
*S4	(8)	(8)	*S4
S5	(11)	(11)	S5
*S5	(12)	(12)	*S5
S6	(13)	(13)	S6
*S6	(14)	(14)	*S6
ID1	(9)	(9)	ID1
ID2	(17)	(17)	ID2
ID3	(18)	(18)	ID3
0V	(15)	(15)	0V
0V	(16)	(16)	0V

- Connect the signals with a same name.
- Make sure to use twisted pair wires for the following signals:
  S1 and * S1, S2 and *S2, S3 and *S3
  S4 and * S4, S5 and *S5, S6 and *S6
- Do not connect the pins No.10, No.19 and No.20 as they are used internally.
- Recommended cable material: A66L-0001-0284#10P (twisted pair/shielded)
- Maximum cable length: 2m

NOTE
The AIF01B is dedicated to I/O Link. It cannot be used with I/O Link *i*.

(3) Terminator TX
Ordering information : A03B-0807-K806



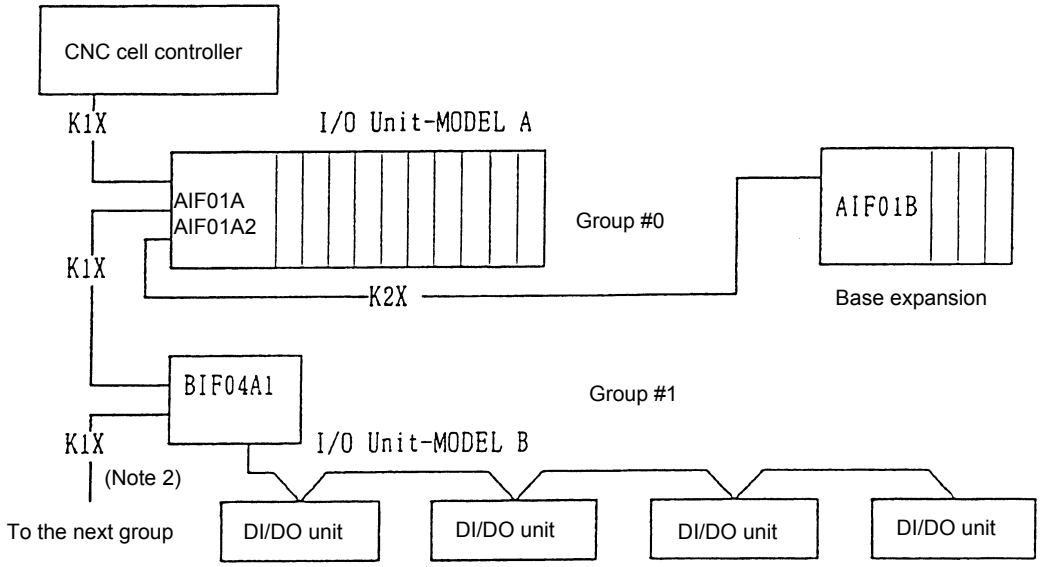
- If no AIF01B is in use, the TX terminator does not have to be attached to the JD2 connector of the AIF01A or AIF01A2.
- If at least one AIF01B is in use, attach the terminator to the JD2 connector of the last AIF01B in the same group.
- Short-circuit the TRM1s, the TRM2s and the TRM3s one another respectively in a manner that a TRM1 is with another TRM1 and so on.

4.6 INTERFACE MODULE (AIF02C) CONNECTION

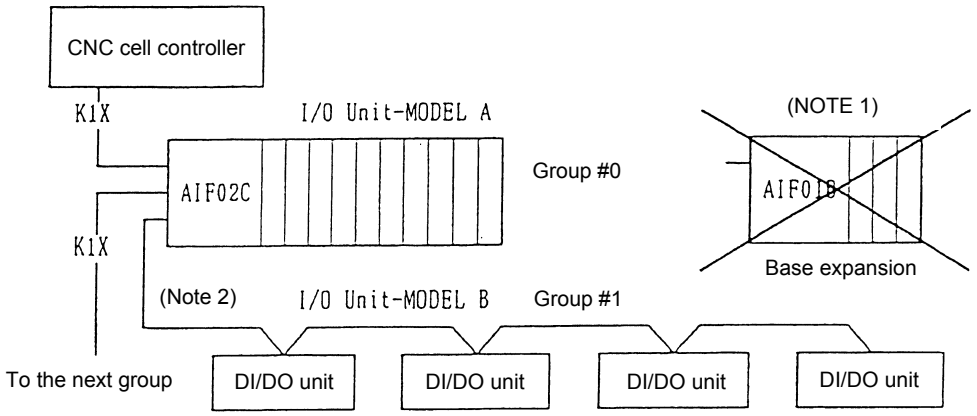
4.6.1 Overview

One interface module (AIF02C) can control communication with both I/O Unit-A and Unit-B, when it is connected to the I/O Link.
The following examples show a configuration in which two conventional separate interface modules, I/O Unit-A and I/O Unit-B, are used and a configuration in which the AIF02C is used.

(1) Configuration example in which separate interface modules are used



(2) Configuration example in which AIF02C is used



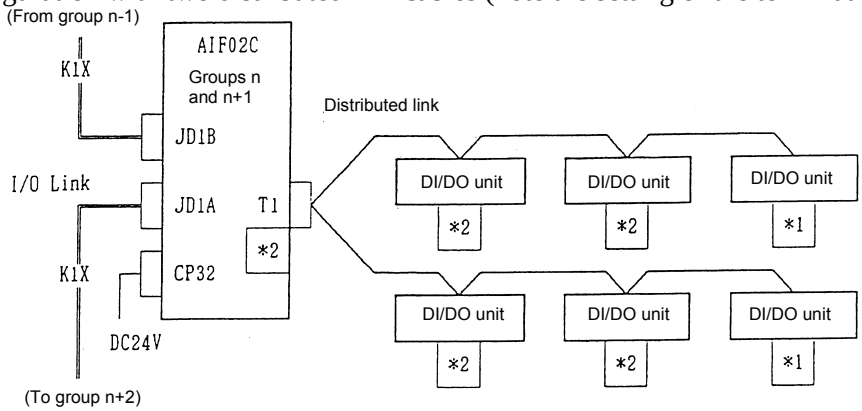
In this way, using the AIF02C eliminates the necessity for the interface unit (BIF04A1) for I/O Unit-B, which has conventionally been used separately; this configuration is suitable for a small I/O Unit-B system. Note the following points.

NOTE
1 The AIF02C is dedicated to I/O Link. It cannot be used with I/O Link *i*.
2 The AIF02C cannot be used for base expansion.
3 The BIF04A1 can branch to a maximum of eight communication lines.
The AIF02C can branch only to a maximum of two distributed link cables.

4.6.2 Connection

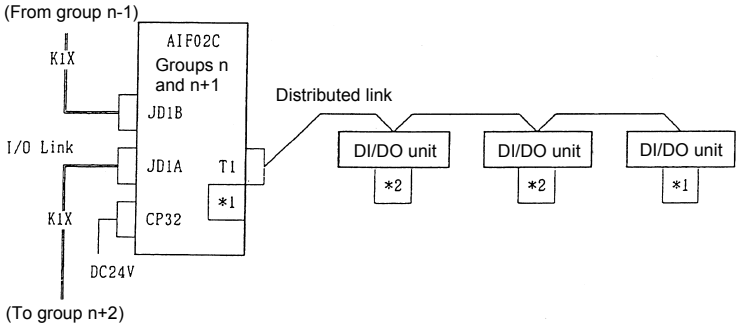
(1) Connection diagram

[a] Configuration with two distributed link cables (note the setting of the terminating resistor.)



NOTE
*1 Set the terminating resistor DIP switch to ON.
*2 Set the terminating resistor DIP switch to OFF.

[b] Connection with one distributed link cable (note the setting of the terminating resistor.)



NOTE
*1 Set the terminating resistor DIP switch to ON.
*2 Set the terminating resistor DIP switch to OFF.

(2) Connection with the I/O Link

The AIF02C occupies two groups on the I/O Link.
When groups #n and #n+1 are used, for example, the smaller-numbered group, #n, is assigned to the I/O Unit-A, and the larger-numbered group, #n+1, is assigned to the I/O Unit-B.

[a] Connection of the I/O Link cable
Connect the I/O Link cable from the previous group to JD1B. Connect JD1A to the I/O Link cable leading to the next group. Use the K1X I/O Link signal cable, the same I/O Link signal cable type as that for the AIF01A.

[b] Number of occupied I/O points on the I/O Link
The nominal number of occupied I/O points may differ from the actual number of I/O points.

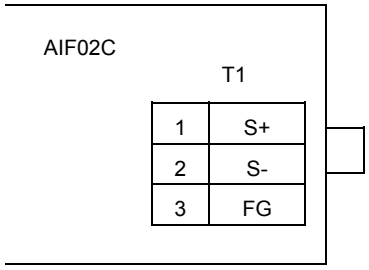
For the details of the number of I/O points occupied by the I/O Unit-B, refer to Section, "Number of points occupied on the interface unit I/O Link," of the FANUC I/O Unit-B MODEL Connection Manual (B-62163E).

(3) Connection with the distributed link (I/O Unit-B)

[a] Number of distributed communication lines

"T1" can connect to two communication lines (twisted-pair wires).
So, it is possible to branch to up to two lines.
To branch to more lines, you should use the I/O Unit-B interface unit (BIF04A1), which enables branching to up to eight communication lines.

[b] Terminal board "T1," used for connection with the distributed link cable
The distributed link cable is connected to "T1."



<1> Use twisted-pair wires as the distributed link cable.
<2> The distributed link cable is polarity-sensitive. Match the signal polarity of the AIF02C with that of the basic unit.
<3> The terminal board has M3 screws with a terminal cover.

Refer to Section, "Connecting a Distributed Link," and Subsection, "Connecting the communications cable," of the FANUC I/O Unit-MODEL B Connection Manual (B-62163E) for details.

4.6.3 Setting with the DIP Switch

In the AIF02C, distributed link settings can be made with the DIP switch on the back of the module.
The settings and corresponding signals are shown below.

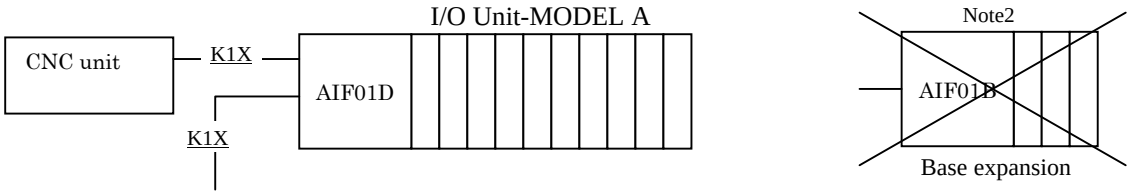
1	Unused
2	
3	
4	EDSP
5	Q
6	H
7	URDY
8	R

(1) EDSP (error display method selection)
Normally, set EDSP to the ON position.
(2) Q and H (communication speed setting)
Normally, set both Q and H to the OFF positions.
(3) URDY (setting of the power on/off information for the unit)
Normally, set URDY to the OFF position.
(4) R (terminating resistor setting)
The ON position means that a terminating resistor must be installed. The OFF position means that no terminating resistor need be installed.
When only one communication cable is connected to the AIF02C, terminate it and the basic unit at the end of the communication cable with a resistor.
When two communication cables are connected to the AIF02C, terminate the basic unit connected to the end of each communication cable with a resistor. Do not connect a terminating resistor to the AIF02C. (Refer to Subsection 4.6.2, "Connection.")

Refer to Subsection, "DIP switch setting," of the FANUC I/O Unit-MODEL B CONNECTION MANUAL (B-62163E).

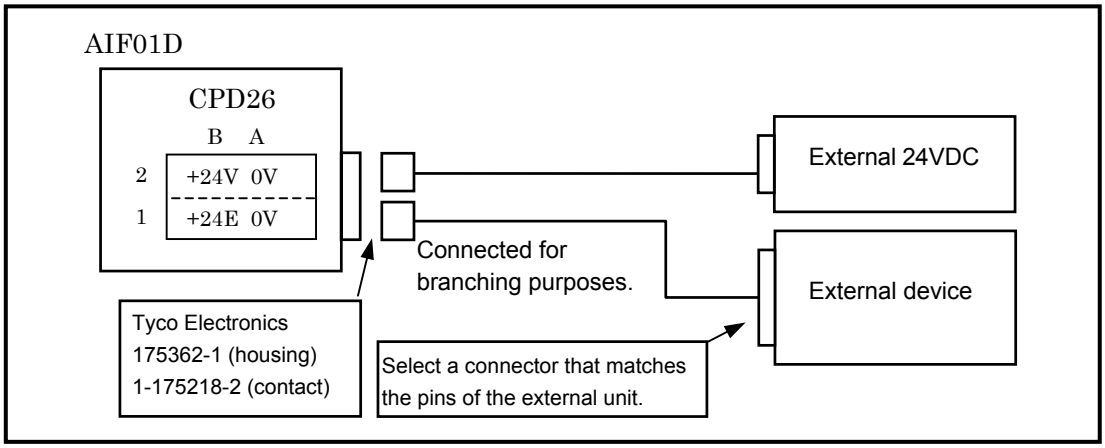
4.7 INTERFACE MODULE (AIF01D) CONNECTION

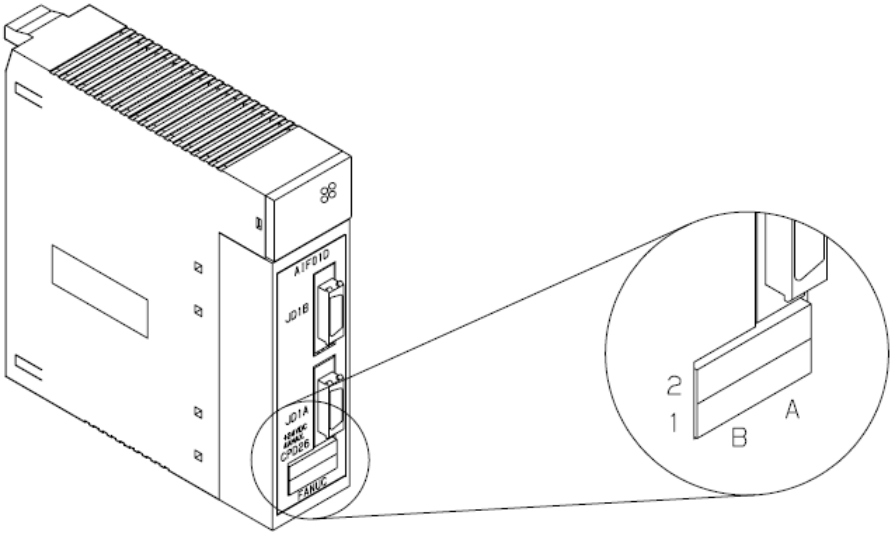
Connecting the interface module (AIF01D) to I/O Link *i* enables communication control to be performed for the I/O Unit-A. Shown below is an example configuration in which the AIF01D is in use.



NOTE
1 The AIF01D is dedicated to I/O Link *i*. It cannot be used with I/O Link.
2 With the AIF01D, no base expansion is allowed.

A voltage of 24 VDC input to the CPD26 (2A, 2B) can be output from the CPD26 (1A, 1B) for branching purposes. The CPD26 connection is shown below. The external 24 VDC power supply must supply the current capacity consumed by the I/O Unit-A and that used via the CPD26 (1A, 1B) to the CPD26 (2A, 2B).

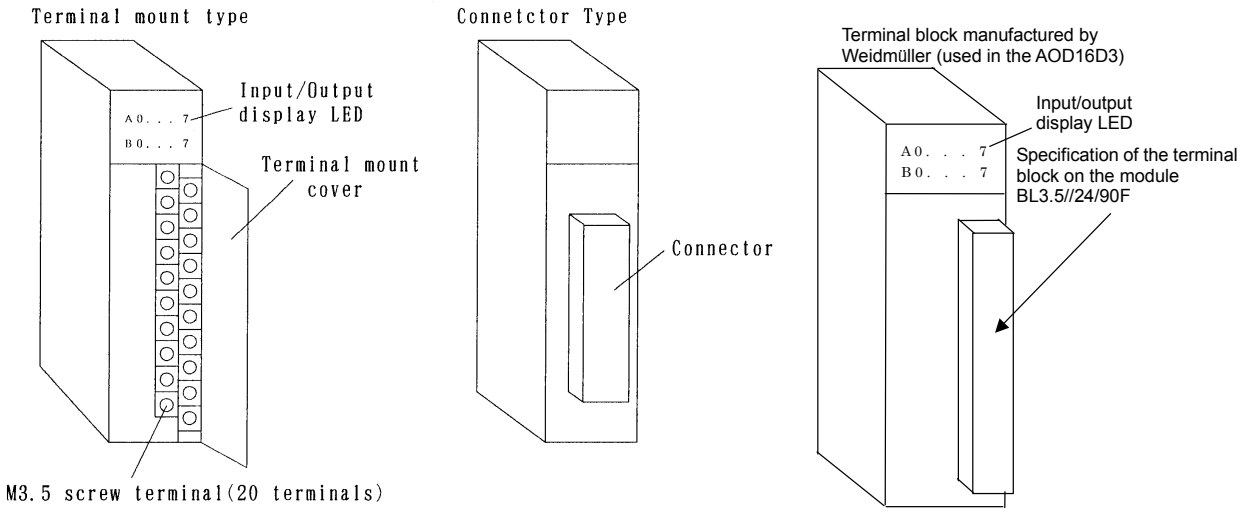




NOTE
The CPD26 (1A, 1B) can supply up to 2 ADC.

4.8 CONNECTING WITH I/O MODULES

From the point of view of an external connecting method, there are two types of I/O modules such as one with a terminal block and one with a connector.

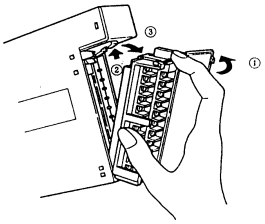


The following three different connectors can be used on the connector-type module.

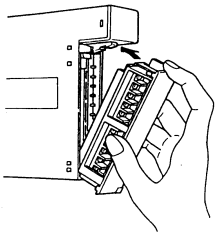
Specification of the connector on the module	Module name
Manufactured by HONDA TSUSHIN MR-50RMA (male)	AID32A1
	AID32B1
	AID32H1
	AID32E1
	AID32F1
	AOD32A1
	AOD32C1
	AOD32D1
	AIO40A
Manufactured by HIROSE ELECTRIC HIF3BB-50PA-2.54DS	AID32E2
	AID32F2
	AOD32C2
	AOD32D2
	AOR16H2
Manufactured by HIROSE ELECTRIC HIF4-40P-3.18DS	AOD16D2

(1) Connect with each module following the connection diagrams of Sections 4.2 and 5.3.
(2) The terminal block is a removable type.

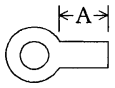
[Dismounting the terminal block]
<1> Open the cover of the terminal block.
<2> Push up the latch at the top of the terminal block.
<3> Drag out the tab at the top of the terminal block and pull it out. The terminal block will be removed from the module.



[Mounting the terminal block]
<1> Insert the protruding portion at the bottom of the terminal block in the groove of the module side.
<2> Push the terminal block using the engaging point of the protruding portion and the groove as an axis and mount it in the module firmly.
<3> Open the cover of the terminal block and check to make sure the latch at the top of the terminal block is firmly set.



(3) Cautionary points when wiring terminal block type
- Wiring material : AWG22 to 18 (0.3 to 0.75 mm^2)
  It is recommended to use as thin a wire as possible provided that the wire diameter matches the intended use.
- Crimp style terminal : M3.5
  Crimp style terminal with no insulation sleeve and a short distance "A", as illustrated in the drawing below, is recommended.



DAIDO SOLDERLESS TERMINAL	1.25-S3.5
NICHIFU	1.25-3.5S etc.

- Mark tube : Use a short mark tube as possible and cover crimped part with the mark tube.
- Recommended tightening torque : 1 to 1.4 N·m

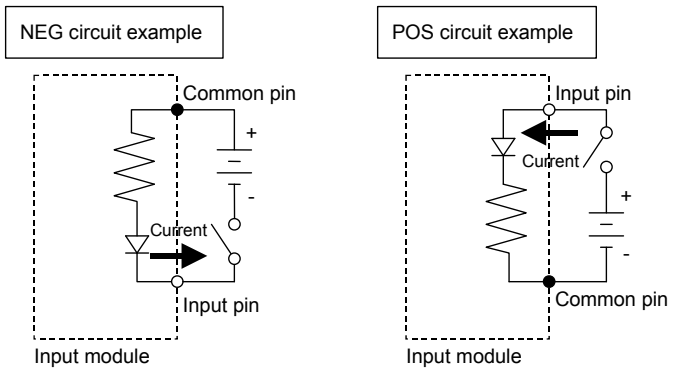
(4) Wiring to the terminal block manufactured by Weidmüller
- Wire with a cross section of 0.08 to 1.5 mm^2 (VDE)/AWG28 to AWG14 (UL/CSA)
- Recommended tightening torque: 0.8 N·m
- Size conformable when a ferrule (rod terminal) is used: 0.5 to 1.5 mm^2
  Peeling length: 6 mm

5 DIGITAL INPUT/OUTPUT MODULES

5.1 LIST OF MODULES

(1) Digital input modules

Input type	Module name	Rated voltage	Rated current	Polarity (Note 1)	Response time (maximum)	Points	External connection (Note 2)	LED display	Additional function
Non-insulation type DC input	AID32A1	24VDC	7.5mA	Both	20msec	32	Connector A	Not provided	
	AID32B1	24VDC	7.5mA	Both	2msec	32	Connector A	Not provided	
	AID32H1	24VDC	7.5mA	Both	2msec 20msec	8 24	Connector A	Not provided	
Insulation type DC input	AID16C	24VDC	7.5mA	NEG	20msec	16	Terminal block	Provided	
	AID16K	24VDC	7.5mA	NEG	2msec	16	Terminal block	Provided	
	AID16D	24VDC	7.5mA	POS	20msec	16	Terminal block	Provided	
	AID16L	24VDC	7.5mA	POS	2msec	16	Terminal block	Provided	
	AID16DM	24VDC	7mA	POS	20msec	16	Terminal block	Provided	DI common monitoring function (Note 5)
	AID16LM	24VDC	7mA	POS	2msec	16	Terminal block	Provided	
	AID32E1	24VDC	7.5mA	Both	20msec	32	Connector A	Not provided	
	AID32E2	24VDC	7.5mA	Both	20msec	32	Connector B	Not provided	
	AID32F1	24VDC	7.5mA	Both	2msec	32	Connector A	Not provided	
	AID32F2	24VDC	7.5mA	Both	2msec	32	Connector B	Not provided	
AC input	AIA16G	100 to 120VAC	10.5mA (120VAC)	-	ON: 35msec OFF: 45msec	16	Terminal block	Provided	



NOTE
1 Polarity
NEGative : (Current source type, source type, or Nch)
Regard to be ON when input is at Low level.
POSitive : (Current sink type, sink type, or Pch)
Regard to be ON when input is High level.
2 Connectors (Section 5.4 shows a connector signal arrangement diagram as viewed from the front of the module.)
Connector A : HONDA TSUSHIN MR-50RMA connector (male)
It is recommended that the MR-50LW (housing) and MR50-FH (soldering-type connector) or MRP-50F01 (crimp connector) + MRP-F112 (contact) be used on the cable.
Connector B : HIROSE ELECTRIC HIF3BB-50PA-2.54DS
It is recommended that the HIF3BB-50D-2.54R (press-mount connector) be used on the cable.
3 For the details of the specifications for each module, refer to the section 5.3.
4 The maximum current of the DC input module includes the permissible rush current.
5 The I/O Link *i* status alarms are supported.

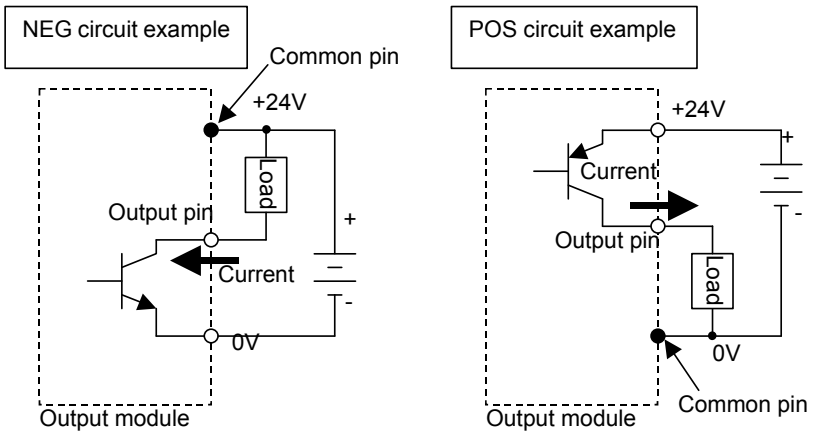
(2) Digital output modules

Output type	Module name	Rated voltage	Maximum current	Polarity *1	Points	Points/ common	External connection *2	LED display	Output protection	Function to detect abnormalities
Non-insulation type DC output	AOD32A1	5 to 24VDC	0.3A	NEG	32	8	Connector A	Not provided	Not provided	
Insulation type DC output	AOD08C	12 to 4VDC	2A	NEG	8	8	Terminal block	Provided	Fuse	
	AOD08D		2A	POS	8	8	Terminal block	Provided	Fuse	
	AOD08DP		2A	POS	8	8	Terminal block	Provided	Output protection device	Provided
	AOD16C		0.5A	NEG	16	8	Terminal block	Provided	Not provided	
	AOD16D		0.5A	POS	16	8	Terminal block	Provided	Not provided	
	AOD16D2		2A	POS	16	4	Connector C	Provided	Not provided	
	AOD16D3		2A	POS	16	4	Terminal block B	Provided	Fuse	
	AOD16DP		0.3A	POS	16	8	Terminal block	Provided	Output protection device	
	AOD16DM		0.3A	POS	16	8	Terminal block	Provided	Output protection device	Provided *5
	AOD32C1		0.3A	NEG	32	8	Connector A	Not provided	Not provided	
	AOD32C2		0.3A	NEG	32	8	Connector B	Not provided	Not provided	
	AOD32D1		0.3A	POS	32	8	Connector A	Not provided	Not provided	
	AOD32D2		0.3A	POS	32	8	Connector B	Not provided	Not provided	

Output type	Module name	Rated voltage	Maximum current	Polarity *1	Points	Points/ common	External connection *2	LED display	Output protection	Function to detect abnormalities
AC output	AOA05 E	100 to 240VAC	2A	-	5	1	Terminal block	Provided	Fuse	
	AOA08E		1A	-	8	4	Terminal block	Provided	Fuse	
	AOA12F	100 to 120VAC	0.5A	-	12	6	Terminal block	Provided	Fuse	
RELAY output	AOR08G	Maximum 250VAC / 30VDC	4A	-	8	1	Terminal block	Provided	Not provided	
	AOR16G		2A	-	16	4	Terminal block	Provided	Not provided	
	AOR16H2	30VDC	2A	-	16	4	Connector B	Provided	Not provided	

(3) Digital input/output hybrid module

Input/output type	Module name	Rated voltage	Specification	Polarity *1	Points	Points/ common	External connection *2	LED display	Output protection	Additional function
Non-insulation type DC input	AIO40A	24VDC	Current rating: 7.5 mA Response time: 20 ms (maximum)	Both	24	24	Connector A (shared by input and output signals)	Not provided	Not provided	
Non-insulation type DC output		24VDC	Maximum current: 0.2 A/point and 2A for common	NEG	16	16				



⚠ WARNING

1 If the load current of a module with no built-in fuse exceeds its rating continuously for a long time, it is likely that smoke or ignition may occur. In order to prevent burnout, it is recommended to use a fuse rated twice the output rating at every external terminal.
2 Some modules have a built-in fuse for each common. However, no such output module can be protected from overload. Be sure to use them within their rating. In order to protect modules from overload, it is recommended to attach an external fuse to each of them.
3 It is likely that, if a short circuit occurs, an external fuse (even if provided) for an output module may fail to protect its components. If an external load is short-circuited, ask for repair.
4 As for modules having an output protection element, the protection function is intended to protect the components internal to the modules rather than external units.
5 No protection function of modules can protect their internal components in all cases. Once any protection function has worked, remove the cause promptly. If an absolute maximum rating is exceeded, for example, it is likely that protection functions may not work or an IC may break down before the related protection function works, depending on the way or situation in which the modules are used.
6 If an output protection function is defective, it is likely that, if the load current exceeds its rating continuously for a long time, smoke or ignition may occur.

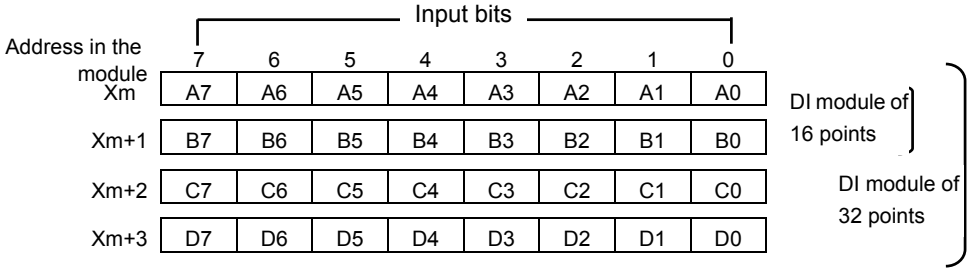
NOTE

1 Polarity
NEGative : (Current sink type) Output is at Low level when ON.
POSitive : (Current source type) Output is at High level when ON.
2 Connector and terminal block B
(Section 5.4 shows a connector signal arrangement diagram as viewed from the front of the module.)
Connector A : HONDA TSUSHIN MR-50RMA connector (male)
It is recommended that the MR-50LW (housing) and MR50-FH (soldering-type connector) or MRP-50F01 (crimp connector) + MRP-F112 (contact) be used on the cable.
Connector B : HIROSE ELECTRIC HIF3BB-50PA-2.54DS
It is recommended that the HIF3BB-50D-2.54R (press-mount connector) be used on the cable.
Connector C : HIROSE ELECTRIC HIF4-40P-3.18DS
It is recommended that the HIF4-40D-3.18R (press-mount connector) be used on the cable.
Terminal block B : Weidmüller BL3.5/24/90F
The terminal block for the cable comes with the module.
3 For the details of the specifications for each module, refer to the section 5.3.
4 The maximum current of the DC output module includes the permissible rush current.
5 The I/O Link i status alarms are supported.

5.2 CORRESPONDENCE BETWEEN I/O SIGNALS AND ADDRESSES IN A MODULE

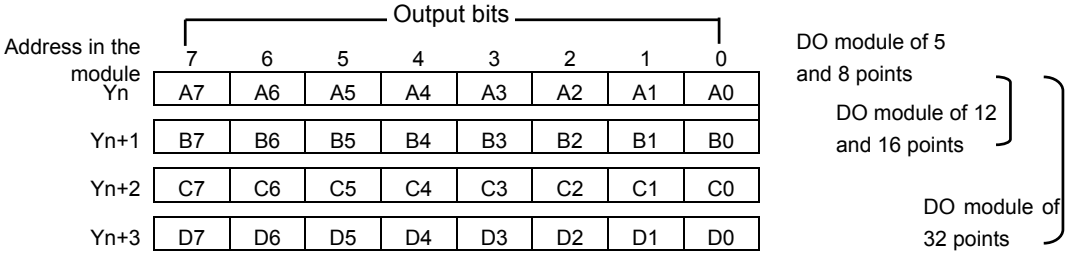
The term "address in a module" refers to an address allocated within each DI/DO module and relative to the start address (Xm, Yn) of the module.

5.2.1 Module with 16/32 Digital Inputs (DI)



When a contact connected to an input of an input module is closed, the corresponding input signal becomes "1".

5.2.2 Module with 5/8/12/16/32 Digital Outputs (DO)

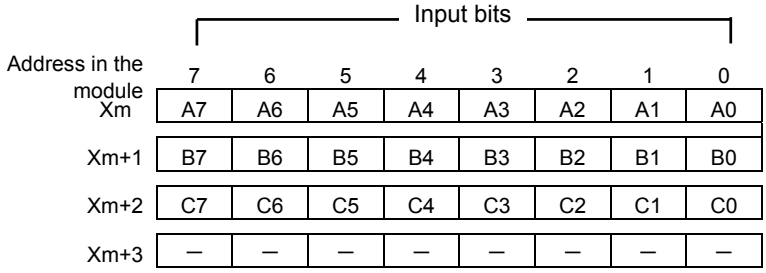


When the output signal from an output module is "1", the corresponding output contact (or transistor) is closed.

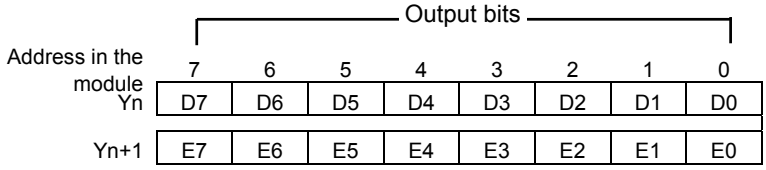
5.2.3 AIO40A Module (Hybrid Module with 24 Input and 16 Output Points)

The allotment of this module requires 4 input and 2 output bytes.
Input byte 4 (Xm + 3) is invalid.

Input section



Output section

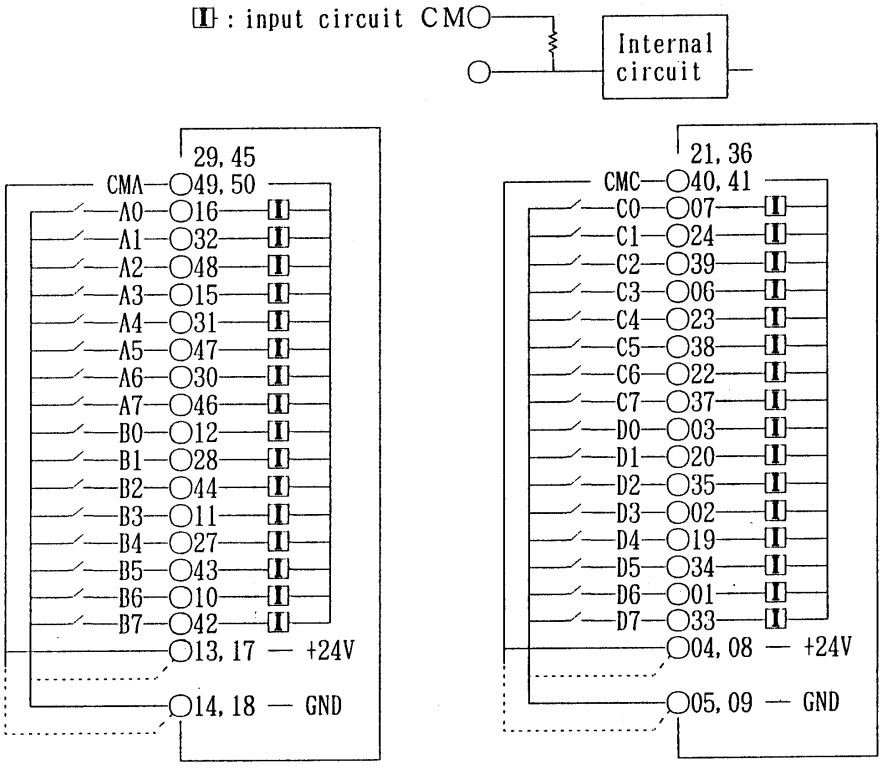


5.3 SPECIFICATION FOR EACH MODULE

Specifications for the module are shown in the following pages.

5.3.1 AID32A1 (Non-insulation Type) - Input Module

Item		Specifications	
Points/module		32 points	
Points/common		16 points/common	
Sink/source current		Both directions	
Input voltage		24VDC +10%, −20%	
Input current		7.5mA (average)	
ON voltage, current		Min. 18VDC, min. 6mA	
OFF voltage, current		Max. 6VDC, max. 1.5mA	
Response time	OFF→ON	Max.20ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.20ms	
Input display		Not provided	
External connection		Connector (HONDA TSUSHIN MR-50RMA) (male)	
Terminal connection and circuitry			

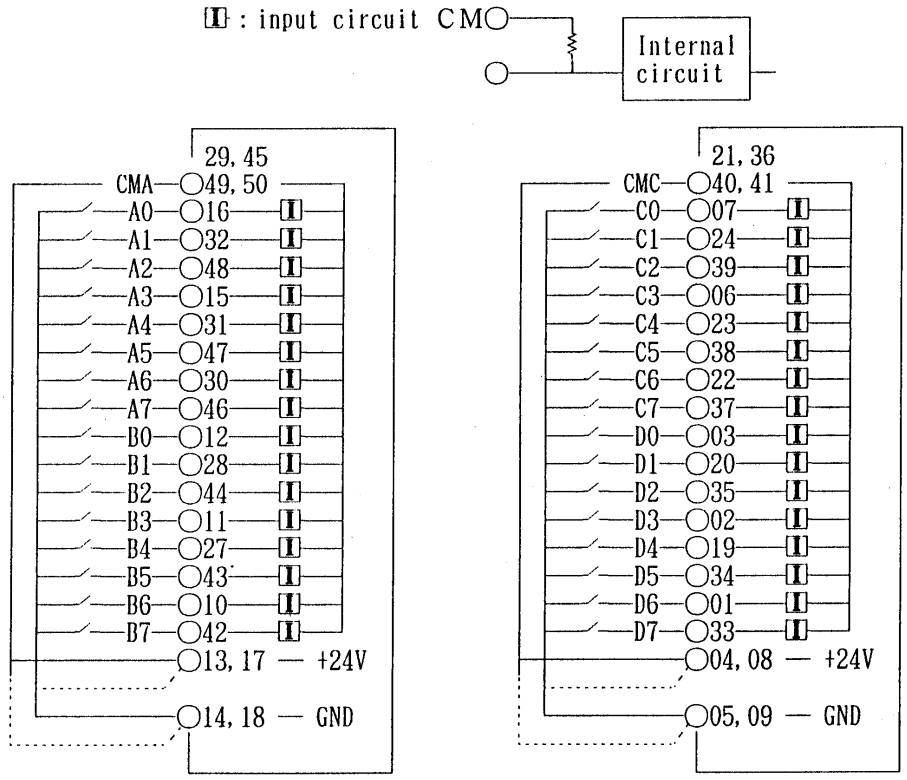


+24V or GND can be selected for input common as above fig.

NOTE
1 Make sure to connect all common (CMA, CMC) pins.
2 This module outputs +24 V on pins 13, 17, 04, and 08.

5.3.2 AID32B1 (Non-insulation Type) - Input Module

Item		Specifications	
Points/module		32 points	
Points/common		16 points/common	
Sink/source current		Both directions	
Input voltage		24VDC +10%, −20%	
Input current		7.5mA (average)	
ON voltage, current		Min. 18VDC, min. 6mA	
OFF voltage, current		Max. 6VDC, max. 1.5mA	
Response time	OFF→ON	Max.2ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.2ms	
Input display		Not provided	
External connection		Connector (HONDA TSUSHIN MR-50RMA) (male)	
Terminal connection and circuitry			

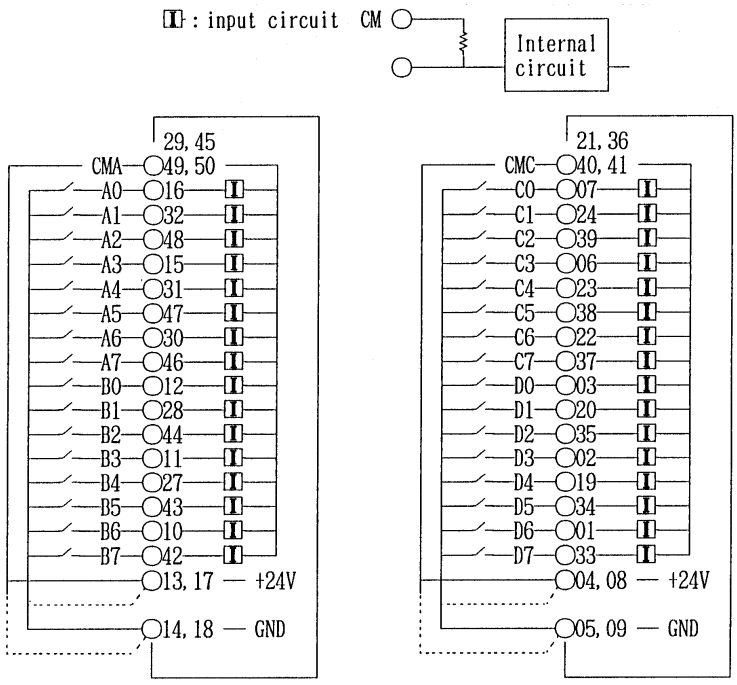


+24V or GND can be selected for input common as above fig.

NOTE
1 Make sure to connect all common (CMA, CMC) pins.
2 This module outputs +24 V on pins 13, 17, 04, and 08.

5.3.3 AID32H1 (Non-insulation Type) - Input Module

Item		Specifications	
Points/module		32 points	
Points/common		16 points/common	
Sink/source current		Both directions	
Input voltage		24VDC +10%, −20%	
Input current		7.5mA (average)	
ON voltage, current		Min. 18VDC, min. 6mA	
OFF voltage, current		Max. 6VDC, max. 1.5mA	
Response time	OFF→ON	Max.2ms (A0 to A7) Max.20ms (B0 to D7)	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.2ms (A0 to A7) Max.20ms (B0 to D7)	
Input display		Not provided	
External connection		Connector (HONDA TSUSHIN MR-50RMA) (male)	
Terminal connection and circuitry			

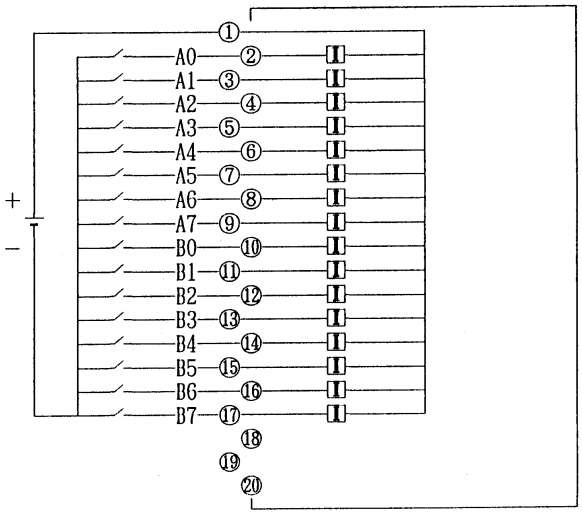


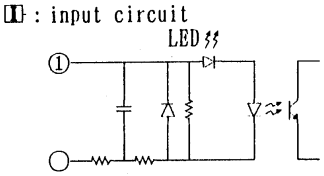
+24V or GND can be selected for input common as above fig.

NOTE
1 Make sure to connect all common (CMA, CMC) pins.
2 This module outputs +24 V on pins 13, 17, 04, and 08.

5.3.4 AID16C - Input Module

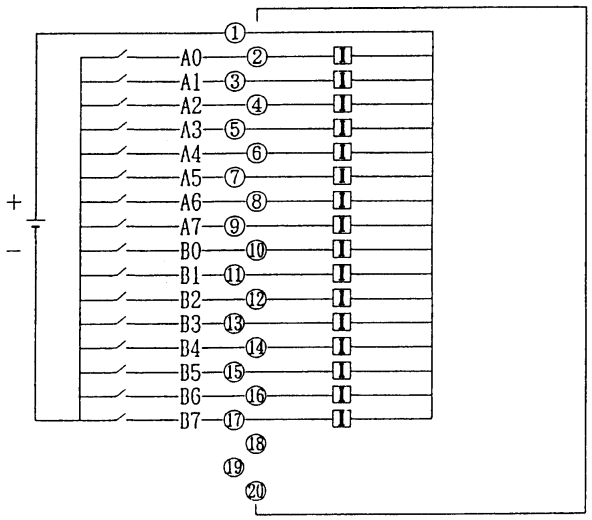
Item		Specifications	
Points/module		16 points	
Points/common		16 points/common	
Sink/source current		Source current type	
Input voltage		24VDC +10%, −20%	
Input current		7.5mA (average)	
ON voltage, current		Min. 15VDC, min. 4mA	
OFF voltage, current		Max. 5VDC, max. 1.5mA	
Response time	OFF→ON	Max.20ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.20ms	
Input display		LED display	
External connection		Terminal block connector (20 terminals, M3.5 screw terminal)	
Terminal connection and circuitry			

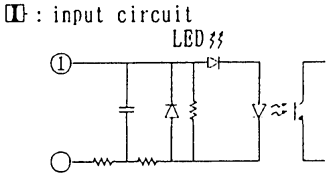




5.3.5 AID16K - Input Module

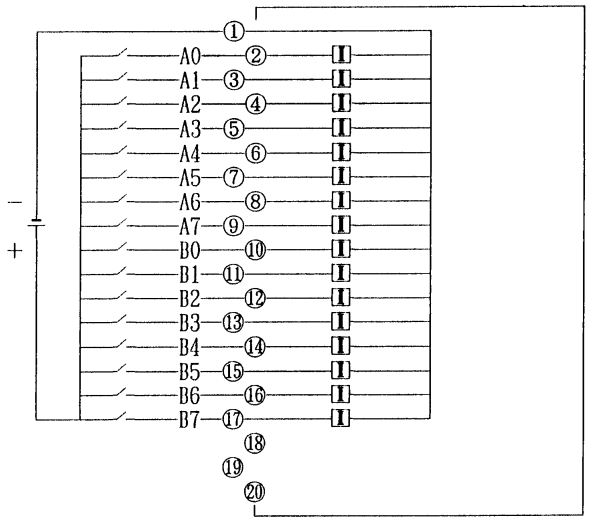
Item		Specifications	
Points/module		16 points	
Points/common		16 points/common	
Sink/source current		Source current type	
Input voltage		24VDC +10%, −20%	
Input current		7.5mA (average)	
ON voltage, current		Min. 15VDC, min. 4mA	
OFF voltage, current		Max. 5VDC, max. 1.5mA	
Response time	OFF→ON	Max.2ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.2ms	
Input display		LED display	
External connection		Terminal block connector (20 terminals, M3.5 screw terminal)	
Terminal connection and circuitry			

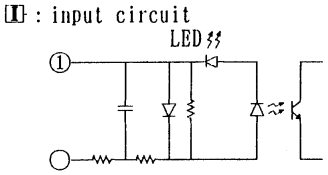




5.3.6 AID16D - Input Module

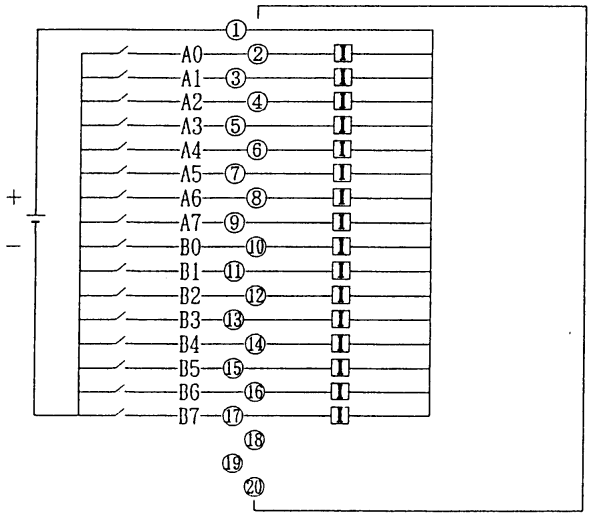
Item		Specifications	
Points/module		16 points	
Points/common		16 points/common	
Sink/source current		Sink current type	
Input voltage		24VDC +10%, −20%	
Input current		7.5mA (average)	
ON voltage, current		Min. 15VDC, min. 4mA	
OFF voltage, current		Max. 5VDC, max. 1.5mA	
Response time	OFF→ON	Max.20ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.20ms	
Input display		LED display	
External connection		Terminal block connector (20 terminals, M3.5 screw terminal)	
Terminal connection and circuitry			

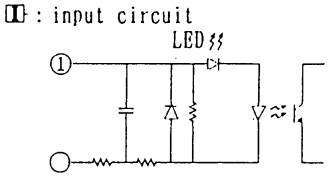




5.3.7 AID16L - Input Module

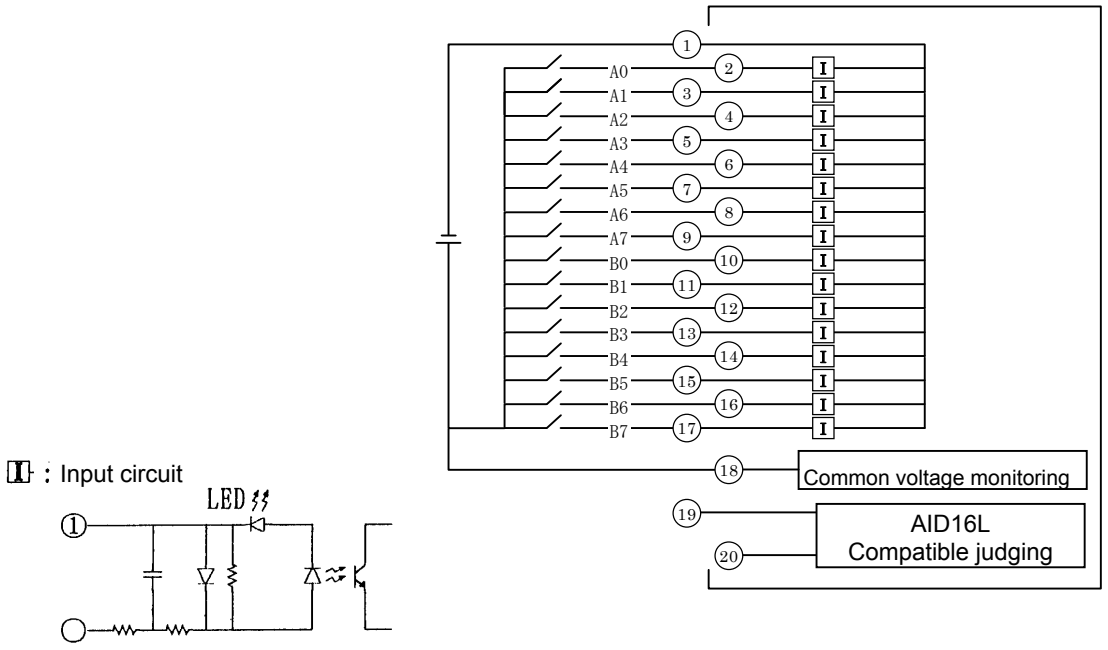
Item		Specifications	
Points/module		16 points	
Points/common		16 points/common	
Sink/source current		Sink current type	
Input voltage		24VDC +10%, −20%	
Input current		7.5mA (average)	
ON voltage, current		Min. 15VDC, min. 4mA	
OFF voltage, current		Max. 5VDC, max. 1.5mA	
Response time	OFF→ON	Max.2ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.2ms	
Input display		LED display	
External connection		Terminal block connector (20 terminals, M3.5 screw terminal)	
Terminal connection and circuitry			





5.3.8 AID16DM - Input Module

Item		Specifications	
Points/module		16 points	
Points/common		16 points/common	
Sink/source current		Sink current type	
Input voltage		24VDC +10%, −20%	
Input current		7mA (average)	
ON voltage, current		Min. 15VDC, min. 4mA	
OFF voltage, current		Max. 5VDC, max. 1.5mA	
Response time	OFF→ON	Max.20ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.20ms	
Input display		LED display	
External connection		Terminal block connector (20 terminals, M3.5 screw terminal)	
Number of occupied input/output points		I/O Link I/O Link *i*	Input 3 bytes (including one byte of DI common monitoring information) Input 2 bytes (DI common monitoring information is transferred to the system relay area)
Terminal connection and circuitry			



• Operation modes

With this module, strapping pins <19> and <20> on the terminal board disables the DI common monitoring function. If you want to use the module in the same manner as for the 16-point DC input module (AID16D) having no DI common monitoring function, strap pins <19> and <20> on the terminal board.

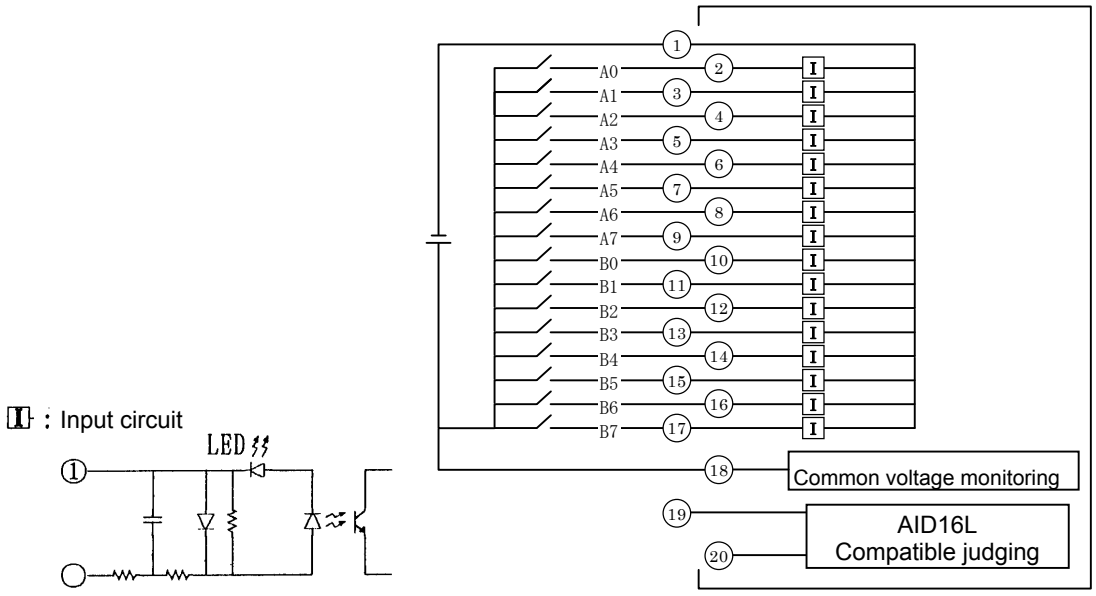
(19) pin and (20) pin	Operation mode
Open	DI common monitoring function: effective
Short	DI common monitoring function: invalid (equivalent to AID16L)

NOTE

When using the module with the DI common monitoring function enabled, do not connect anything to pin <19> or <20>.

5.3.9 AID16LM - Input Module

Item		Specifications	
Points/module		16 points	
Points/common		16 points/common	
Sink/source current		Sink current type	
Input voltage		24VDC +10%, −20%	
Input current		7mA (average)	
ON voltage, current		Min. 15VDC, min. 4mA	
OFF voltage, current		Max. 5VDC, max. 1.5mA	
Response time	OFF→ON	Max.2ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.2ms	
Input display		LED display	
External connection		Terminal block connector (20 terminals, M3.5 screw terminal)	
Number of occupied input/output points		I/O Link I/O Link *i*	Input 3 bytes (including one byte of DI common monitoring information) Input 2 bytes (DI common monitoring information is transferred to the system relay area)
Terminal connection and circuitry			



• Operation modes

With this module, strapping pins <19> and <20> on the terminal board disables the DI common monitoring function. If you want to use the module in the same manner as for the 16-point DC input module (AID16L) having no DI common monitoring function, strap pins <19> and <20> on the terminal board.

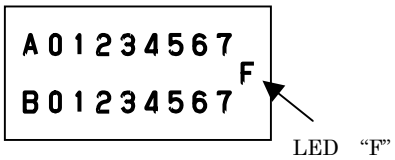
(19) pin and (20) pin	Operation mode
Open	DI common monitoring function: effective
Short	DI common monitoring function: invalid (equivalent to AID16L)

NOTE

When using the module with the DI common monitoring function enabled, do not connect anything to pin <19> or <20>.

• DI common monitoring function

Supplying DI common power to pin <18> causes this module to monitor the common power. The table below lists what is monitored and how the CNC behaves.



Surveillance item	Contents	LED "F"
Low common voltage	The common voltage is below the minimum input voltage rating. Alternatively, pin <18> is open or its wire is broken.	—
Common voltage moment drop	The common voltage became instantaneously lower than the minimum input voltage rating but resumed its normal state.	Once a voltage moment drop has occurred, the LED remains ON until the power to I/O Unit-A is turned OFF.

How the CNC behaves when the DI common monitoring function explained above works varies depending on the communication method in use, as follows:

Communication method	Behavior of the CNC
I/O Link *i*	A status alarm is issued.
I/O Link	A specified bit assigned in the DI area becomes 1.

* Refer to the manual of your CNC for descriptions of the status alarm.

• AID16DM/AID16LM allotment and address map

When the DI common monitoring function described above is used with I/O Link, it is necessary to allocate one byte for DI common alarm information. When it is used with I/O Link *i*, it is unnecessary because the DI common alarm information is automatically transferred as status alarms to the system relay area. No DI common alarm information is transferred to the DI area even if a byte is allocated.

For I/O Link Input: 3 bytes

Address	Bit and terminal name								Data
	7	6	5	4	3	2	1	0	
Xm	A7	A6	A5	A4	A3	A2	A1	A0	DI data 16 bits
Xm+1	B7	B6	B5	B4	B3	B2	B1	B0	
Xm+2	*	*	*	*	*	*	E1	E0	DI common alarm

*＝Don't care

- The DI common monitoring bits have the following meanings.
  E0（Bit0）: When "1", it means the DI common voltage is abnormal.
  E1（Bit1）: When "1", it means a DI common voltage moment drop occurred.
- Bit 0 (E0) returns to "0" when the common voltage becomes normal.
- Bit 1 (E1) holds "1" since the occurrence of a voltage moment drop until the power is turned OFF.

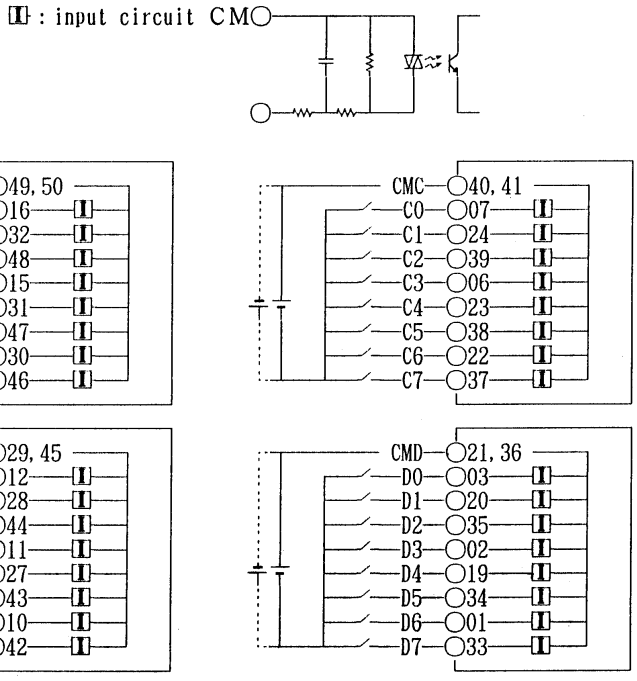
For I/O Link *i* Input: 2 bytes

Address	Bit and terminal name								Data
	7	6	5	4	3	2	1	0	
Xm	A7	A6	A5	A4	A3	A2	A1	A0	DI data 16 bits
Xm+1	B7	B6	B5	B4	B3	B2	B1	B0	
System relay area	*	*	*	*	*	*	E1	E0	DI common alarm

* Refer to the manual of your CNC for descriptions of the status alarm (system relay area).

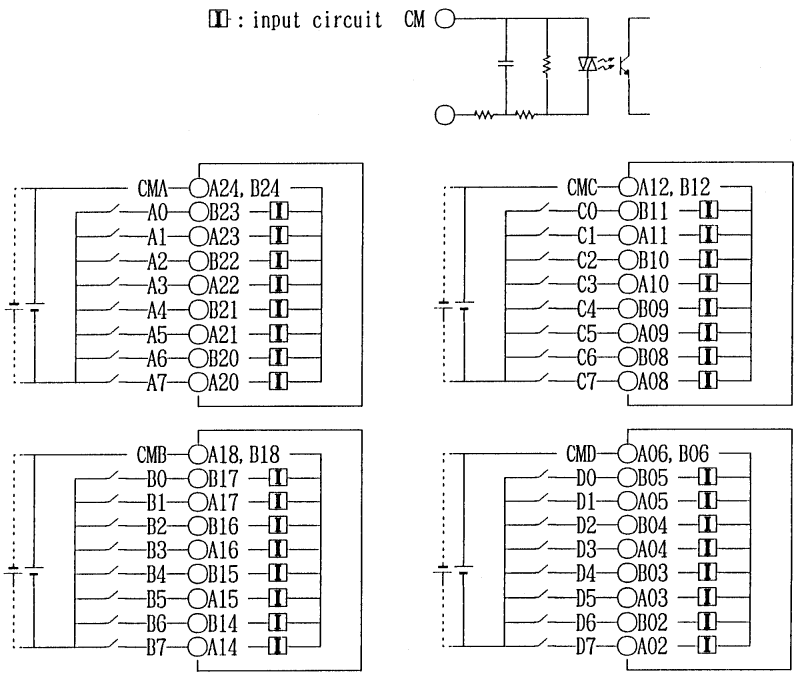
5.3.10 AID32E1 - Input Module

Item		Specifications	
Points/module		32 points	
Points/common		8 points/common	
Sink/source current		Both directions	
Input voltage		24VDC +10%, −20%	
Input current		7.5mA (average)	
ON voltage, current		Min. 15VDC, min. 4.5mA	
OFF voltage, current		Max. 6VDC, max. 2mA	
Response time	OFF→ON	Max.20ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.20ms	
Input display		Not provided	
External connection		Connector (HONDA TSUSHIN MR-50RMA) (male)	
Terminal connection and circuitry			



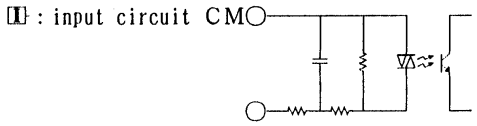
5.3.11 AID32E2 - Input Module

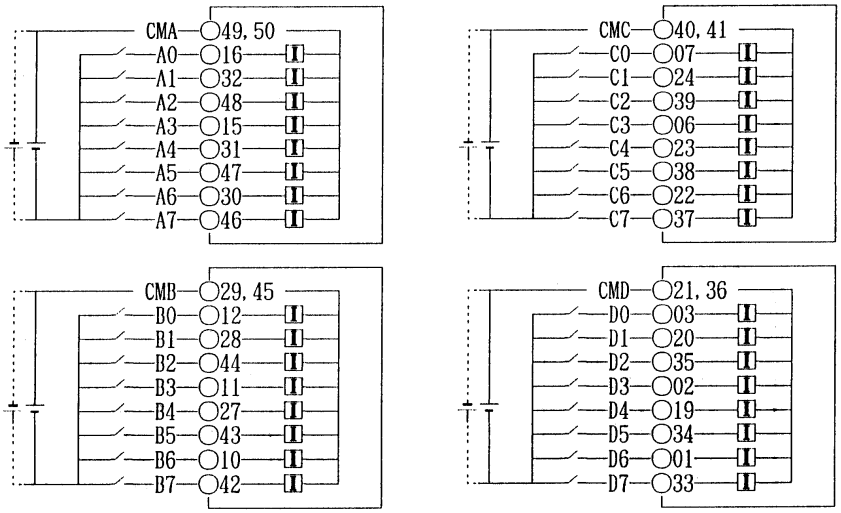
Item		Specifications	
Points/module		32 points	
Points/common		8 points/common	
Sink/source current		Both directions	
Input voltage		24VDC +10%, −20%	
Input current		7.5mA (average)	
ON voltage, current		Min. 15VDC, min. 4.5mA	
OFF voltage, current		Max. 6VDC, max. 2mA	
Response time	OFF→ON	Max.20ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.20ms	
Input display		Not provided	
External connection		Connector (HIROSE ELECTRIC HIF3BB-50PA-2.54DS in accordance with MIL standard)	
Terminal connection and circuitry			



5.3.12 AID32F1 - Input Module

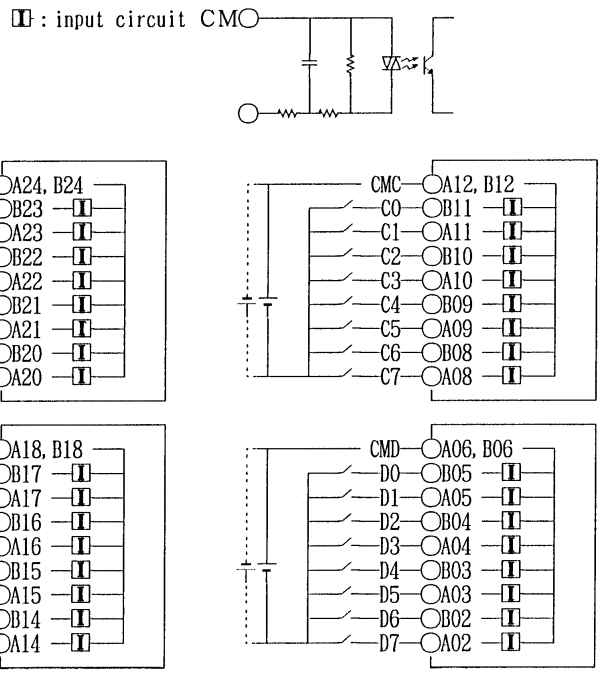
Item		Specifications	
Points/module		32 points	
Points/common		8 points/common	
Sink/source current		Both directions	
Input voltage		24VDC +10%, −20%	
Input current		7.5mA (average)	
ON voltage, current		Min. 15VDC, min. 4.5mA	
OFF voltage, current		Max. 6VDC, max. 2mA	
Response time	OFF→ON	Max.2ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.2ms	
Input display		Not provided	
External connection		Connector (HONDA TSUSHIN MR-50RMA) (male)	
Terminal connection and circuitry			





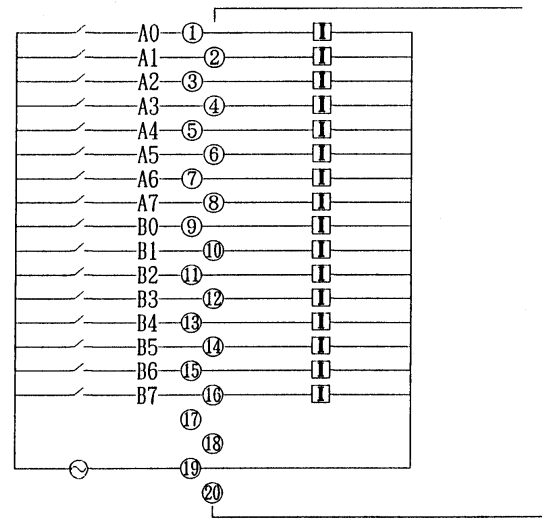
5.3.13 AID32F2 - Input Module

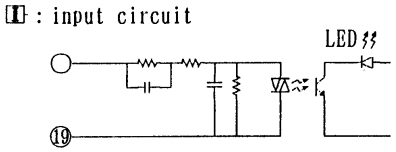
Item		Specifications	
Points/module		32 points	
Points/common		8 points/common	
Sink/source current		Both directions	
Input voltage		24VDC +10%, −20%	
Input current		7.5mA (average)	
ON voltage, current		Min. 15VDC, min. 4.5mA	
OFF voltage, current		Max. 6VDC, max. 2mA	
Response time	OFF→ON	Max.2ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.2ms	
Input display		Not provided	
External connection		Connector (HIROSE ELECTRIC HIF3BB-50PA-2.54DS in accordance with MIL standard)	
Terminal connection and circuitry			



5.3.14 AIA16G - Input Module

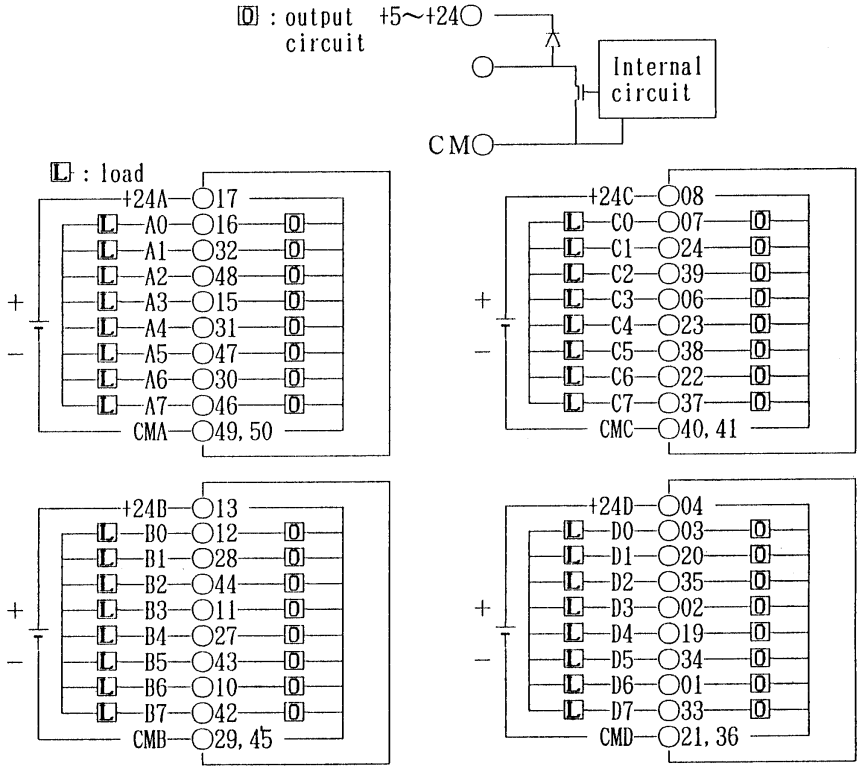
Item		Specifications	
Points/module		16 points	
Points/common		16 points/common	
Sink/source current		100 to 115VAC ±15%	
Input voltage		132Vrms, 50/60 Hz	
Input current		10.55mArms (115VAC, 50Hz)	
ON voltage, current		Min. 74Vrms, min. 6mArms	
OFF voltage, current		Max. 20Vrms, max. 2.2mArms	
Response time	OFF→ON	Max.35ms	This is the value from input to output in the module. The actual value is
	ON→OFF	Max.45ms	determined by adding it to the scanning time depending on each system.
Input display		LED display	
External connection		Terminal block connector (20 terminals, M3.5 screw terminal)	
Common		16 points/common	
Terminal connection and circuitry			





5.3.15 AOD32A1 (Non-insulation Type) - Output Module

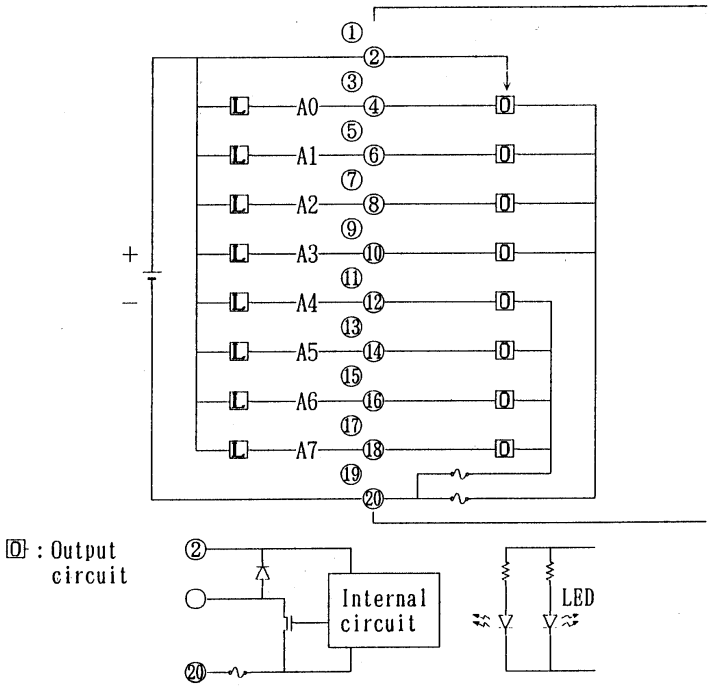
Item		Specifications
Points/module		32 points
Points/common		8 points/common
Sink/source current		Sink current type
Rated load voltage		5 to 24VDC +20%, −15%
Maximum load current		0.3A (however 2A/common)
Maximum voltage drop when ON		0.24V (load current ×0.8Ω)
Maximum leak current when OFF		0.1mA
Response time	OFF→ON	Max.1ms
	ON→OFF	Max.1ms
Input display		Not provided
External connection		Connector (HONDA TSUSHIN MR-50RMA) (male)
Terminal connection and circuitry		



NOTE
For the common (CMA, CMB, CMC, CMD) , make sure to use both of them.

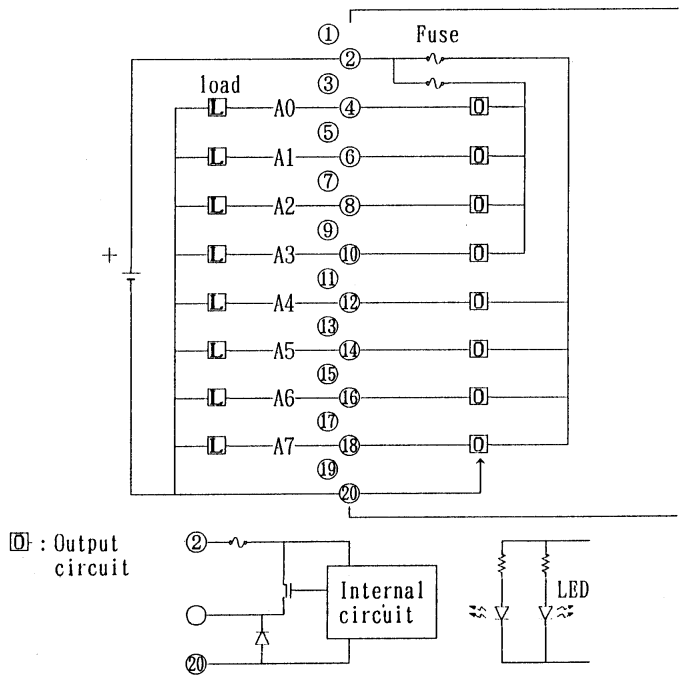
5.3.16 AOD08C - Output Module

Item		Specifications	
Points/module		8 points	
Points/common		8 points/common	
Sink/source current		Sink current type	
Rated load voltage		12 to 24VDC +20%, −15%	
Maximum load current		2A (however 4A/fuse)	
Maximum voltage drop when ON		0.8V (load current ×0.4Ω)	
Maximum leak current when OFF		0.1mA	
Response time	OFF→ON	Max.2ms	This is the value from input to output in the module. The actual value is
	ON→OFF	Max.2ms	determined by adding it to the scanning time depending on each system.
Input display		LED display	
External connection		Terminal block connector (20 terminals, M3.5 screw terminal)	
Fuse		5A, 1 piece for each output A0-A3 and A4-A7.	
Terminal connection and circuitry			



5.3.17 AOD08D - Output Module

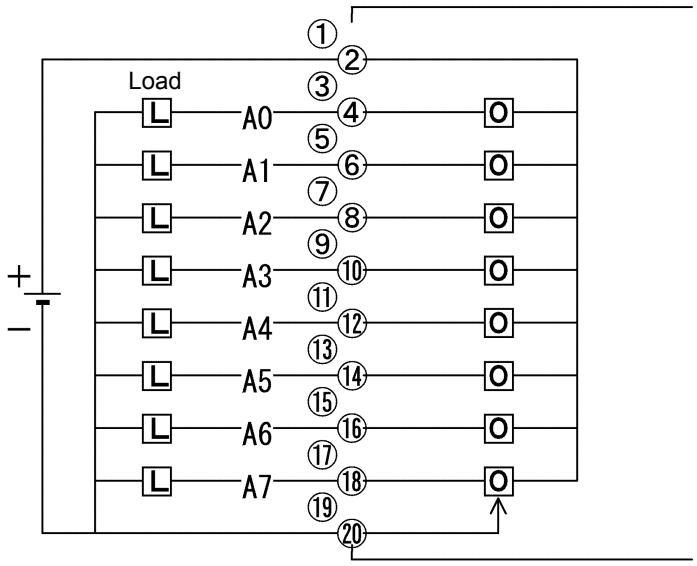
Item		Specifications	
Points/module		8 points	
Points/common		8 points/common	
Sink/source current		Source current type	
Rated load voltage		12 to 24VDC +20%, −15%	
Maximum load current		2A (however 4A/fuse)	
Limit of load		Refer to load reduction curve (Fig. 5.3(a))	
Maximum voltage drop when ON		1.2V (load current ×0.6Ω)	
Maximum leak current when OFF		0.1mA	
Response Time	OFF→ON	Max.2ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.2ms	
Output display		LED display	
External connection		Terminal block connector (20 terminals, M3.5 screw terminal)	
Fuse		5A, 1 piece for each output A0-A3 and A4-A7.	
Terminal connection and circuitry			



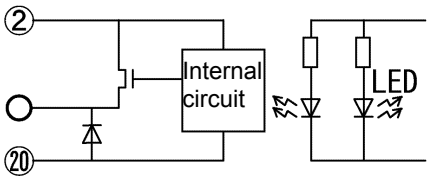
⚠ CAUTION
Be sure to wire pin <20> as shown above. Keeping the pin open prevents this module from operating normally, possibly leading to a serious accident.

5.3.18 AOD08DP - Output Module

Item		Specifications	
Points/module		8 points	
Points/common		8 points/common	
Sink/source current		Source current type	
Rated load voltage		12 to 24VDC +20%, −15%	
Maximum load current		2A (however 8A/common)	
Output current limit		2.8A (Min.)	
Maximum voltage drop when ON		0.18V (load current ×0.09Ω)	
Maximum leak current when OFF		0.1mA	
Response Time	OFF→ON	Max.2ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.2ms	
Output display		LED display	
External connection		Terminal block connector (20 terminals, M3.5 screw terminal)	
Terminal connection and circuitry			



O : Output circuit

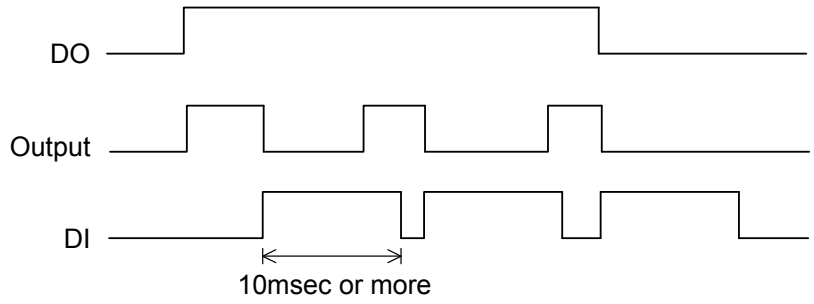


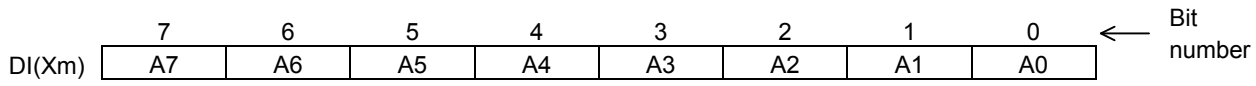
⚠ CAUTION
Be sure to wire pin <20> as shown above. Keeping the pin open prevents this module from operating normally, possibly leading to a serious accident.

- AOD08DP output protection

The internal circuit of this output module can detect a load overcurrent and driver temperature. To be specific, if the load current increases abnormally, for example, because of a wiring ground fault, the internal limiter of the driver suppresses the output current. If this condition lasts long, the driver can get abnormally hot, thus causing the protection circuit to turn off the output. After the output is turned off and the driver temperature becomes lower, the protection function is automatically reset to turn on the output; this OFF/ON operations are repeated.
When the overheat protection circuit works to turn off the output, the LED "F" on the front of the module lights red.
If the protection circuit turns off the output, the output module can detect which DO has encountered the abnormality, using a DI. This function can be allocated to any DI address (1 byte). If an abnormality is detected, the DI bit corresponding to the DO of interest switches between "1" and "0". The DI bit stays "1" for at least 10 ms.
If the protection function worked, turn off the power for both the DO and system, and remove the cause of the overload.

The following timing chart shows how the output and DI behave when the output protection function works.



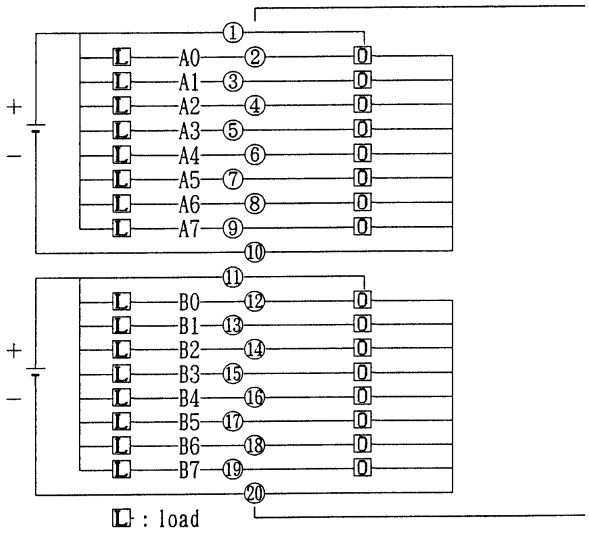


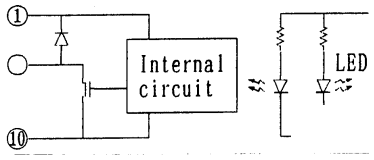
The DI bit having the same bit number as the DO (A0 to A7) bit where an abnormality was detected becomes "1".

> ⚠ **CAUTION**
> An overcurrent prolonged, for example, because of a wiring ground fault may lead to the break-down of a module. To avoid this failure, build a sequence program that can turn off the DO corresponding to the bit number of the DI bit which has been set to "1" because of a failure detected on the driver.

5.3.19 AOD16C - Output Module

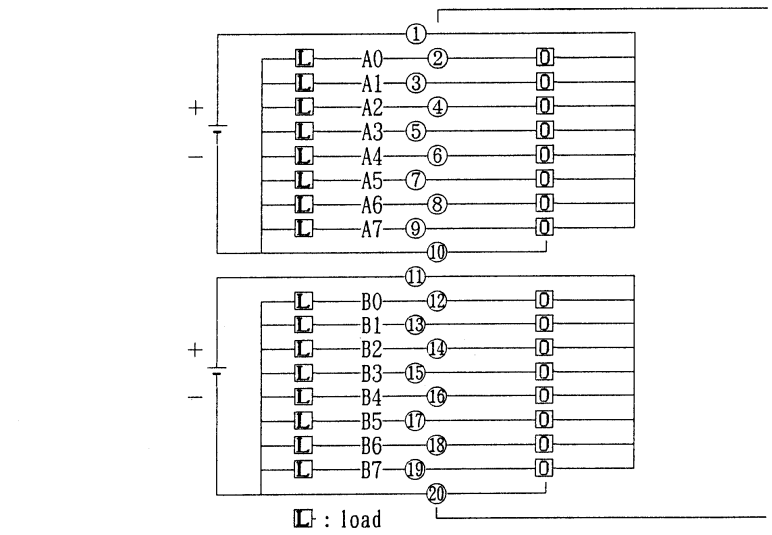
Item		Specifications	
Points/module		16 points	
Points/common		8 points/common	
Sink/source current		Sink current type	
Rated load voltage		12 to 24VDC +20%, −15%	
Maximum load current		0.5A (however 2A/common)	
Maximum voltage drop when ON		0.7V (load current ×1.4Ω)	
Maximum leak current when OFF		0.1mA	
Response time	OFF→ON	Max.2ms	This is the value from input to output in the module. The actual value is
	ON→OFF	Max.2ms	determined by adding it to the scanning time depending on each system.
Output display		LED display	
External connection		Terminal block connector (20 terminals, M3.5 screw terminal)	
Terminal connection and circuitry			





5.3.20 AOD16D - Output Module

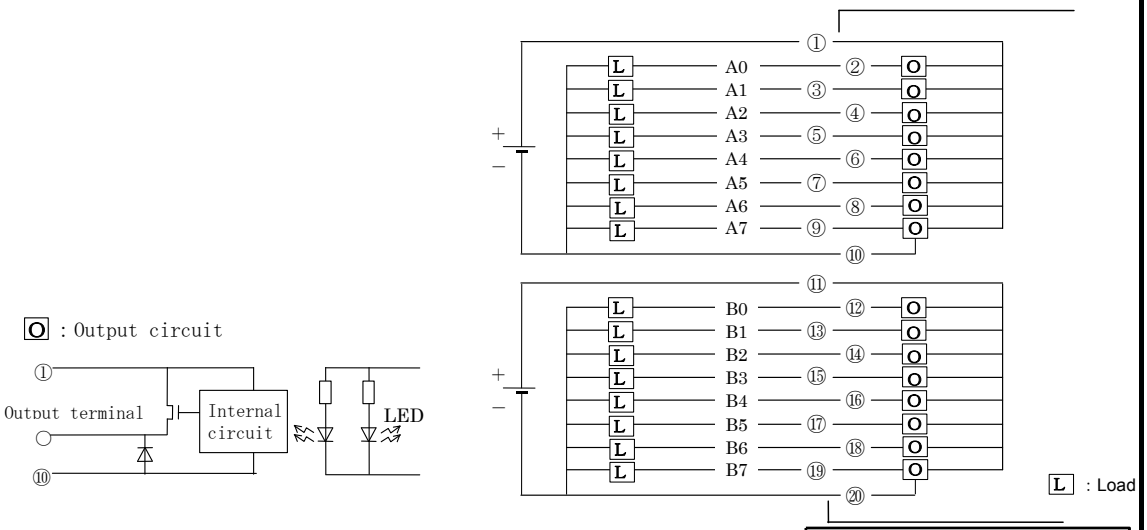
Item		Specifications	
Points/module		16 points	
Points/common		8 points/common	
Sink/source current		Source current type	
Rated load voltage		12 to 24VDC +20%, −15%	
Maximum load current		0.5A (however 2A/common)	
Maximum voltage drop when ON		0.7V (load current ×1.4Ω)	
Maximum leak current when OFF		0.1mA	
Response time	OFF→ON	Max.2ms	This is the value from input to output in the module. The actual value is
	ON→OFF	Max.2ms	determined by adding it to the scanning time depending on each system.
Output display		LED display	
External connection		Terminal block connector (20 terminals, M3.5 screw terminal)	
Terminal connection and circuitry			

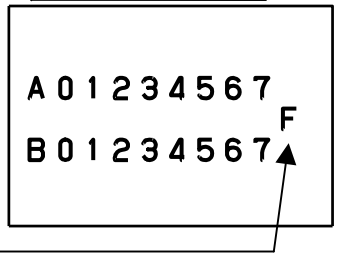


⚠ CAUTION
Be sure to wire pins <10> and <20> as shown above. Keeping the pin open prevents this module from operating normally, possibly leading to a serious accident.

5.3.21 AOD16DM - Output Module

Item		Specifications	
Points/module		16 points	
Points/common		8 points/common	
Sink/source current		Sink current type	
Rated load voltage		12 to 24VDC +20%, −15%	
Maximum load current		0.5A (however 2A/common)	
Maximum voltage drop when ON		0.16V (load current ×0.32Ω)	
Maximum leak current when OFF		0.1mA	
Response time	OFF→ON	Max.2ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.2ms	
Output display		LED display	
External connection		Terminal block connector (20 terminals, M3.5 screw terminal)	
Number of occupied input/output points		I/O Link: output 2 bytes, input 3 bytes (the input 3 bytes indicate the abnormal detection information) I/O Link *i*: output 2 bytes (abnormal detection information is transferred to the system relay area)	
Terminal connection and circuitry			





- Abnormal detection functions
  The abnormal detection functions of this output module includes output protection functions, such as overheat, overcurrent, and short-circuit protection functions, as well as the DO common monitoring function. Information is sent to the CNC when an abnormal detection function works.
- If an output protection function works, the LED "F" on this module lights.
- The DO common monitoring function works if the DO common voltage (load voltage) becomes lower than its rating.
- If an abnormal detection function has worked, turn off the power to the DO and system, and then remove the cause of the alarm.

⚠ CAUTION
Be sure to wire pins <10> and <20> as shown above. Keeping the pin open prevents this module from operating normally, possibly leading to a serious accident.

• Behavior of the CNC when an abnormal detection function works

How the CNC behaves when the overheat, overcurrent, or short-circuit protection function or the DO common monitoring function works varies depending on the communication method in use, as follows:

Communication method	Behavior of the CNC
I/O Link *i*	A status alarm is issued.
I/O Link	A specified bit assigned in the DI area becomes 1.

* Refer to the manual of your CNC for descriptions of the status alarm.

• AOD16DM allotment and address map

When the abnormal detection function described above is used with I/O Link, it is necessary to allocate input three byte for abnormal detection information. When it is used with I/O Link *i*, it is unnecessary because the abnormal detection information is automatically transferred as status alarms to the system relay area. No abnormal detection information is transferred to the DI area even if a byte is allocated.

For I/O Link Output: 2 bytes, Input: 3 bytes

Address	Bit and terminal name								Data
	7	6	5	4	3	2	1	0	
Yn	A7	A6	A5	A4	A3	A2	A1	A0	DO data 16 bits
Yn+1	B7	B6	B5	B4	B3	B2	B1	B0	

Address	Bit and terminal name								Data
	7	6	5	4	3	2	1	0	
Xm	A7	A6	A5	A4	A3	A2	A1	A0	DO alarm 16 bits
Xm+1	B7	B6	B5	B4	B3	B2	B1	B0	
Xm+2	*	*	*	*	*	*	E1	E0	DO common alarm

*＝Don't care

- Each DO alarm bit indicates whether the outputs of the respective DO output bits are protected. "1" corresponds to the protected state.
  (Example) Bit 5 (B5) at address Xm+1 represents alarm information for output B5 at address Yn+1.
  Each DO alarm bit returns to "0" when the respective alarm conditions are removed.
- The DO common alarm bits have the following meanings.
  E0 (Bit0) When "1", it means an abnormal voltage has occurred on the DO (A0 to A7) common.
  E1 (Bit1) When "1", it means an abnormal voltage has occurred on the DO (B0 to B7) common.
  EachDO common alarm bit returns to "0" when an abnormal voltage is removed.

For I/O Link *i* Output: 2 bytes

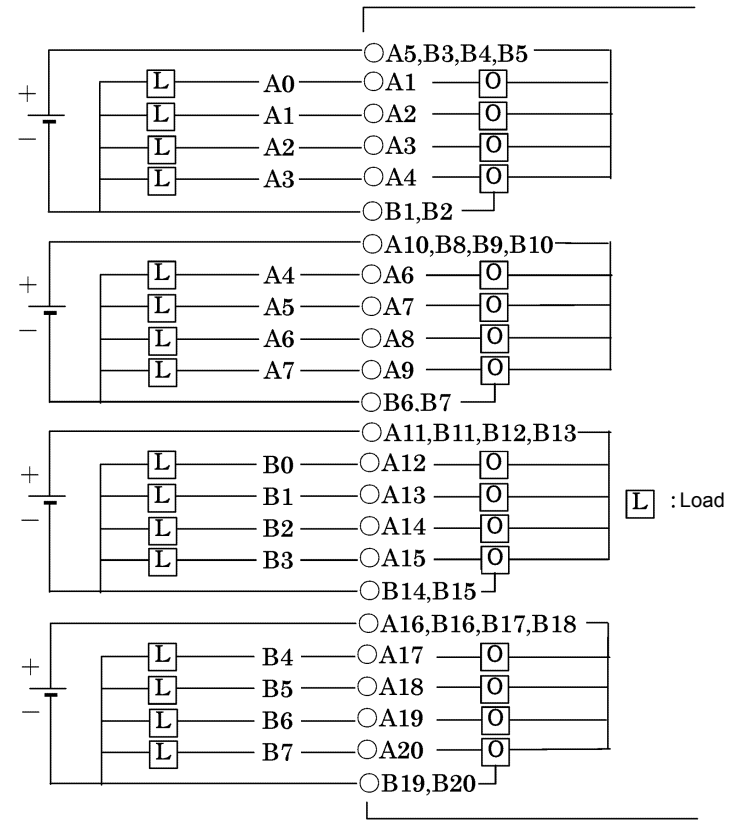
Address	Bit and terminal name								Data
	7	6	5	4	3	2	1	0	
Yn	A7	A6	A5	A4	A3	A2	A1	A0	DO data 16 bits
Yn+1	B7	B6	B5	B4	B3	B2	B1	B0	

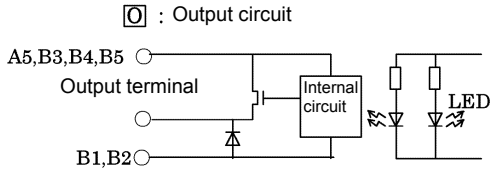
Address	Bit and terminal name								Data
	7	6	5	4	3	2	1	0	
System relay area	A7	A6	A5	A4	A3	A2	A1	A0	DO alarm 16 bits
	B7	B6	B5	B4	B3	B2	B1	B0	
	*	*	*	*	*	*	E1	E0	DO common alarm

* Refer to the manual of your CNC for descriptions of the status alarm (system relay area).

5.3.22 AOD16D2 - Output Module

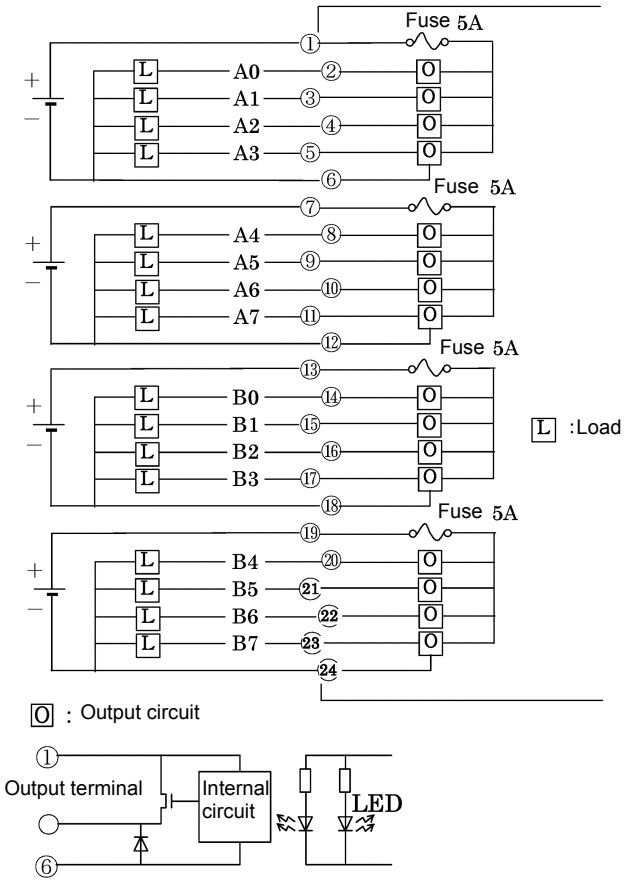
Item		Specifications	
Points/module		16 points	
Points/common		4 points/common	
Sink/source current		Source current type	
Rated load voltage		12 to 24VDC +20%, −15%	
Maximum load current		2A (4A/common)	
Maximum voltage drop when ON		0.4V (load current ×0.2Ω)	
Maximum leak current when OFF		0.1mA	
Response time	OFF→ON	Max.2ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.2ms	
Output display		LED display	
External connection		Connector (HIROSE ELECTRIC HIF4-40P-3.18DS)	
Terminal connection and circuitry			





⚠ CAUTION
Be sure to wire pins B1, B2, B6, B7, B14, B15, B19, and B20 as shown above. Keeping the pin open prevents this module from operating normally, possibly leading to a serious accident.

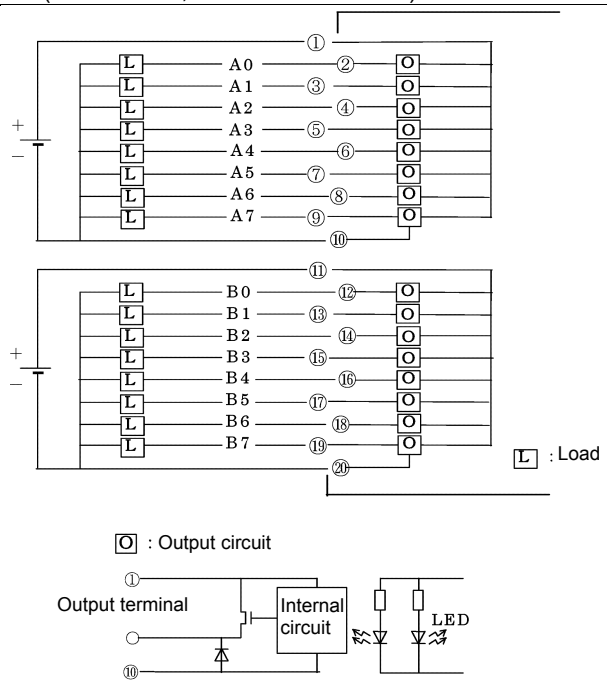
5.3.23 AOD16D3 - Output Module

Item		Specifications	
Points/module		16 points	
Points/common		4 points/common	
Sink/source current		Source current type	
Rated load voltage		12 to 24VDC +20%, −15%	
Maximum load current		2A (4A/common)	
Maximum voltage drop when ON		0.4V (load current ×0.2Ω)	
Maximum leak current when OFF		0.1mA	
Response time	OFF→ON	Max.2ms	This is the value from input to output in the module. The actual value is
	ON→OFF	Max.2ms	determined by adding it to the scanning time depending on each system.
Output display		LED display	
External connection		24-pin terminal block (BL3.5/24/90F) manufactured by Weidmüler Conformable wire (maximum): 1.5 mm^2 (VDE)/AWG 14 (UL/CSA) Note: The terminal block for the cable comes with this module.	
Fuse		One 5A fuse for each of output sets A0 to A3, A4 to A7, B0 to B3, and B4 to B7 MP50 (A60L-0001-0046#5.0) manufactured by Daito. Ordering information for a 4-fuse set: A03B-0819-K104	
Terminal connection and circuitry			

⚠ CAUTION
Be sure to wire pins 6, 12, 18, and 24 as shown above. Keeping the pin open prevents this module from operating normally, possibly leading to a serious accident.

5.3.24 AOD16DP - Output Module

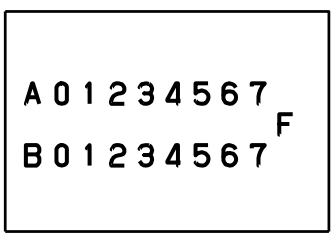
Item		Specifications	
Points/module		16 points	
Points/common		8 points/common	
Sink/source current		Source current type	
Rated load voltage		12 to 24VDC +20%, −15%	
Maximum load current		0.3A (2.4A/common) 0.5A (2A/common) See the "Load reduction curve" shown in Fig. 5.3 (f).	
Maximum voltage drop when ON		0.63V (load current ×1.25Ω)	
Maximum leak current when OFF		40μA	
Response time	OFF→ON	Max.2ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.2ms	
Output display		LED display	
External connection		Connector (20 terminals, M3.5 screw terminal)	
Terminal connection and circuitry			



• Output protection

The internal circuit of this output module can detect a load overcurrent. To be specific, if the load current increases abnormally, for example, because of a cable ground fault or an internal DO driver is abnormally heated for some reason, the protection circuit for the DO driver (4-point unit) works to keep the output of the DO driver turned off until the cause is removed. When the overheat protection function works, the LED "F" on the module lights.

If a protection function works, turn off the power to the system, and then remove the cause of overload.

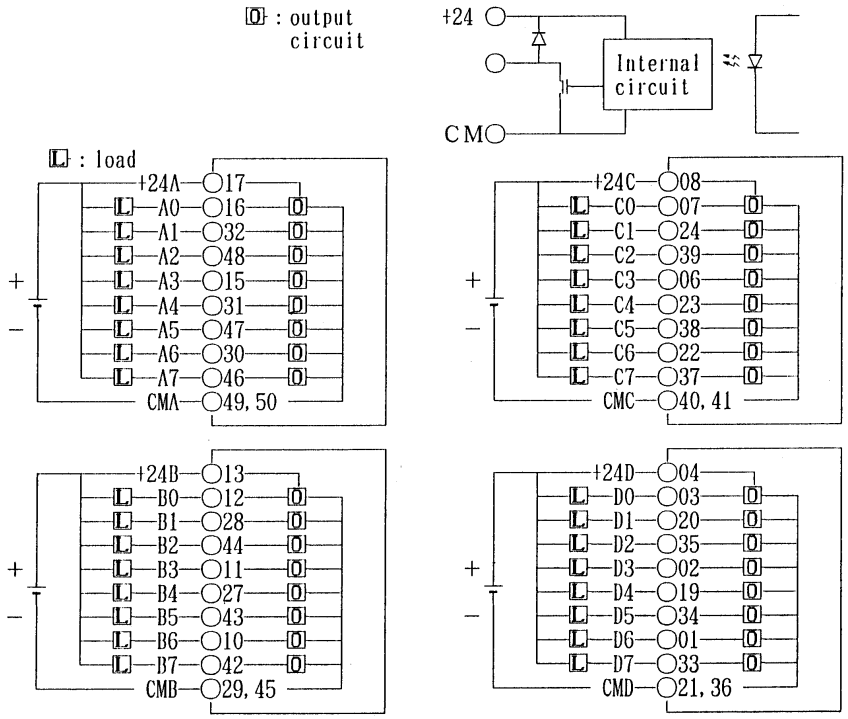


⚠ CAUTION

Be sure to wire pins <10> and <20> as shown above. Keeping the pin open prevents this module from operating normally, possibly leading to a serious accident.

5.3.25 AOD32C1 - Output Module

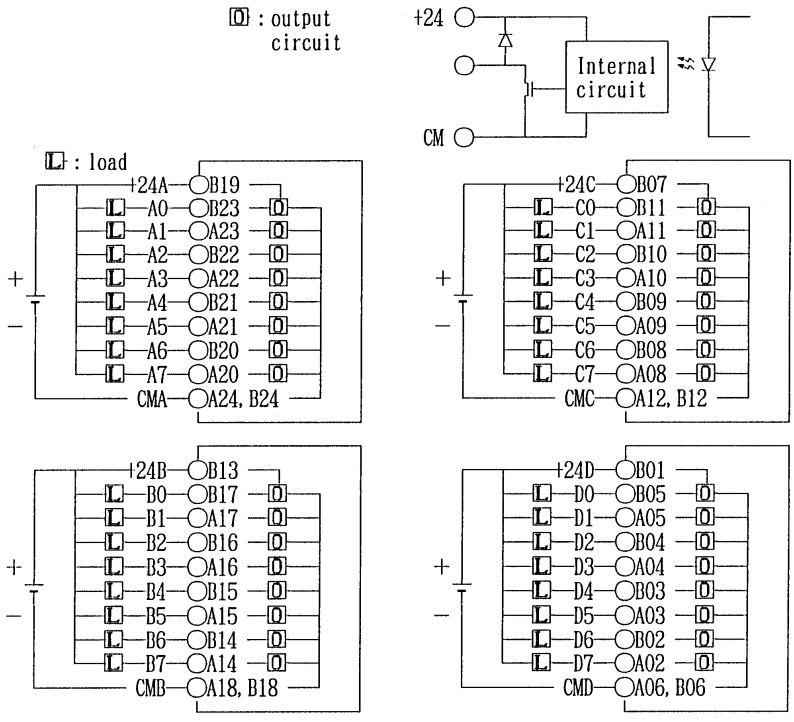
Item		Specifications	
Points/module		32 points	
Points/common		8 points/common	
Sink/source current		Sink current type	
Rated load voltage		12 to 24VDC +20%, −15%	
Maximum load current		0.3A (however 2A/common)	
Maximum voltage drop when ON		0.24V (load current ×0.8Ω)	
Maximum leak current when OFF		0.1mA	
Response time	OFF→ON	Max.2ms	This is the value from input to output in the module. The actual value is
	ON→OFF	Max.2ms	determined by adding it to the scanning time depending on each system.
Output display		Not provided	
External connection		Connector (HONDA TSUSHIN MR-50RMA) (male)	
Terminal connection and circuitry			



NOTE
For the common (CMA, CMB, CMC, CMD), make sure to use both of them.

5.3.26 AOD32C2 - Output Module

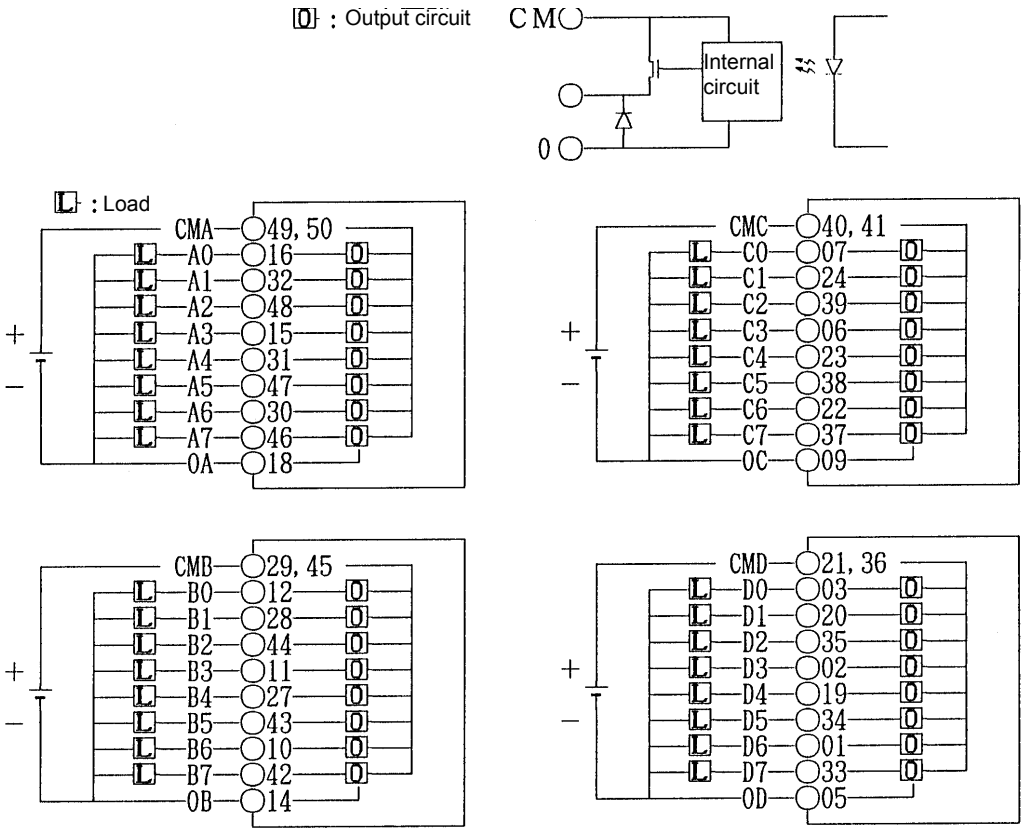
Item		Specifications	
Points/module		32 points	
Points/common		8 points/common	
Sink/source current		Sink current type	
Rated load voltage		12 to 24VDC +20%, −15%	
Maximum load current		0.3A (however 2A/common)	
Maximum voltage drop when ON		0.24V (load current ×0.8Ω)	
Maximum leak current when OFF		0.1mA	
Response time	OFF→ON	Max.2ms	This is the value from input to output in the module. The actual value is
	ON→OFF	Max.2ms	determined by adding it to the scanning time depending on each system.
Output display		Not provided	
External connection		Connector (HIROSE ELECTRIC HIF3BB-50PA-2.54DS in accordance with MIL standard)	
Terminal connection and circuitry			



NOTE
For the common (CMA, CMB, CMC, CMD), make sure to use both of them.

5.3.27 AOD32D1 - Output Module

Item		Specifications	
Points/module		32 points	
Points/common		8 points/common	
Sink/source current		Source current type	
Rated load voltage		12 to 24VDC +20%, −15%	
Maximum load current		0.3A (however 2A/common)	
Maximum voltage drop when ON		0.24V (load current ×0.8Ω)	
Maximum leak current when OFF		0.1mA	
Response time	OFF→ON	Max.2ms	This is the value from input to output in the module. The actual value is
	ON→OFF	Max.2ms	determined by adding it to the scanning time depending on each system.
Output display		Not provided	
External connection		Connector (HONDA TSUSHIN MR-50RMA) (male)	
Terminal connection and circuitry			

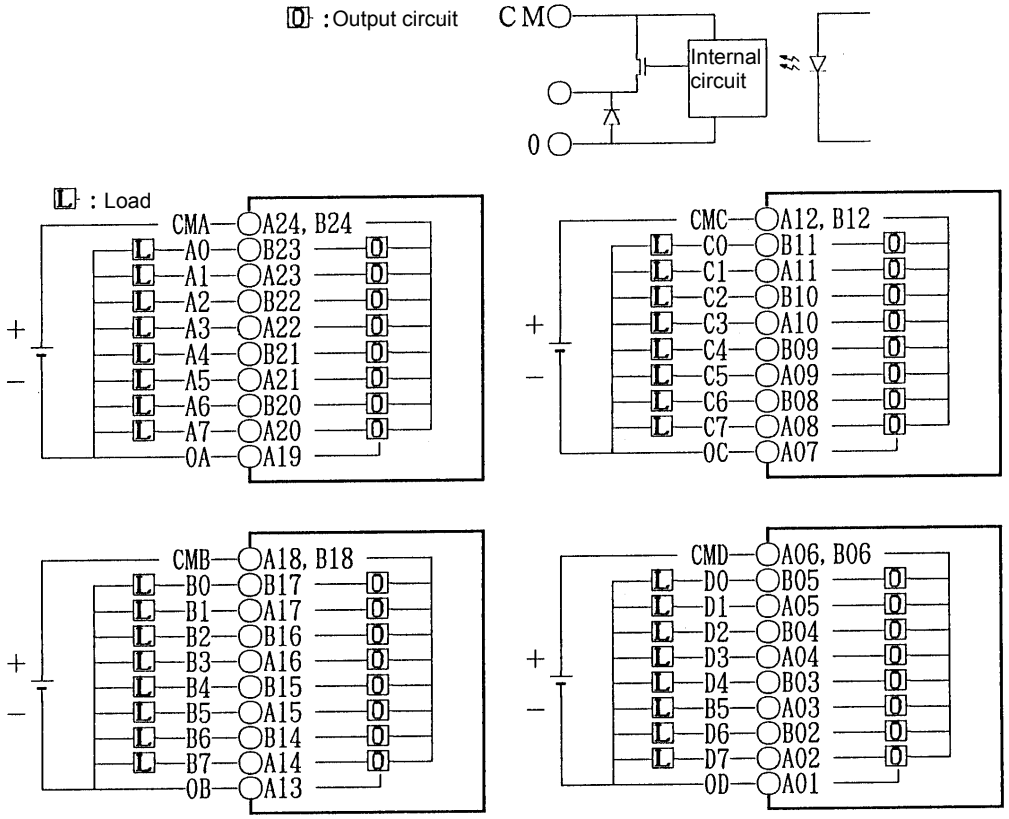


⚠ CAUTION
Be sure to wire pins 5, 9, 14, and 18 as shown above. Keeping the pin open prevents this module from operating normally, possibly leading to a serious accident.

NOTE
For the common (CMA, CMB, CMC, CMD), make sure to use both of them.

5.3.28 AOD32D2 - Output Module

Item		Specifications	
Points/module		32 points	
Points/common		8 points/common	
Sink/source current		Source current type	
Rated load voltage		12 to 24VDC +20%, −15%	
Maximum load current		0.3A (however 2A/common)	
Maximum voltage drop when ON		0.24V (load current ×0.8Ω)	
Maximum leak current when OFF		0.1mA	
Response time	OFF→ON	Max.2ms	This is the value from input to output in the module. The actual value is
	ON→OFF	Max.2ms	determined by adding it to the scanning time depending on each system.
Output display		Not provided	
External connection		Connector (HIROSE ELECTRIC HIF3BB-50PA-2.54DS in accordance with MIL standard)	
Terminal connection and circuitry			

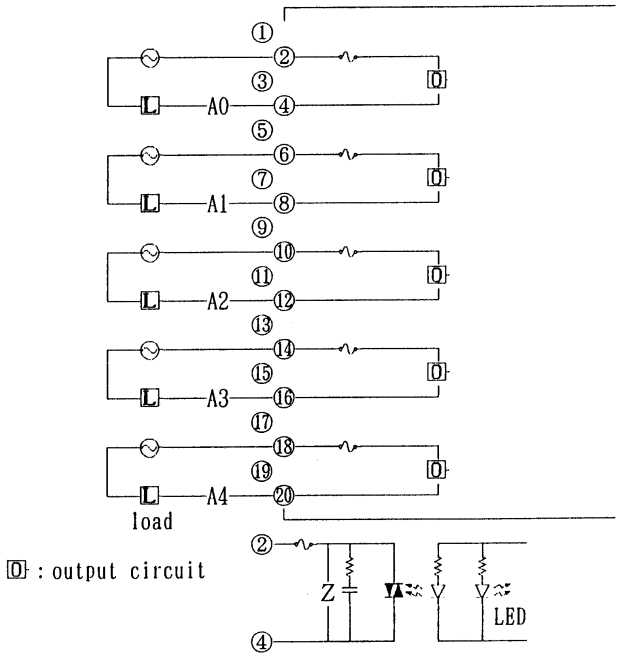


⚠ CAUTION
Be sure to wire pins A01, A07, A13, and A19 as shown above. Keeping the pin open prevents this module from operating normally, possibly leading to a serious accident.

NOTE
For the common (CMA, CMB, CMC, CMD), make sure to use both of them.

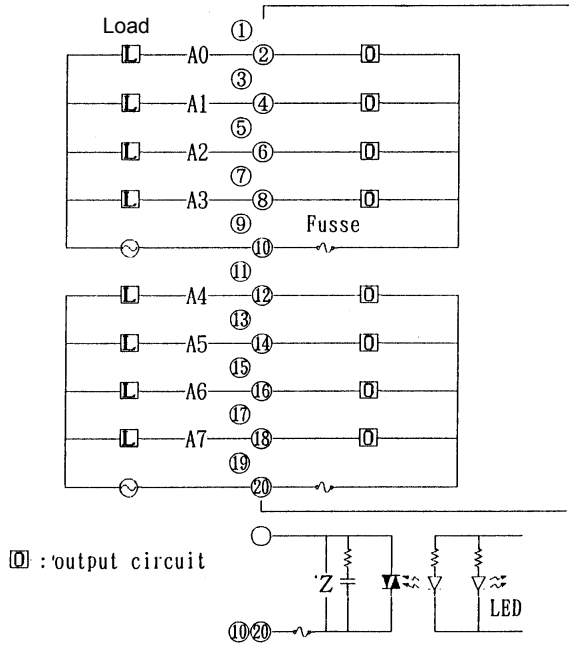
5.3.29 AOA05E - Output Module

Item		Specifications	
Points/module		5 points	
Points/common		1 points/common	
Rated load voltage		100 to 230VAC ±15%, 47 to 63Hz	
Maximum load current		2A/point (however 5A/module)	
Maximum rush current		25A (1 period)	
Limit of load		Refer to load reduction curve (Fig. 5.3 (b))	
Maximum voltage drop when ON		1.5Vrms	
Maximum leak current when OFF		3.0mA (115VAC), 6.0mA (230VAC)	
Response time	OFF→ON	Max.1ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Half of the load frequency or less	
Output display		LED display	
External connection		Terminal block connector (20 terminals, M3.5 screw terminal)	
Fuse		3.2A, 1 piece for each output A0 to A4	
Terminal connection and circuitry			



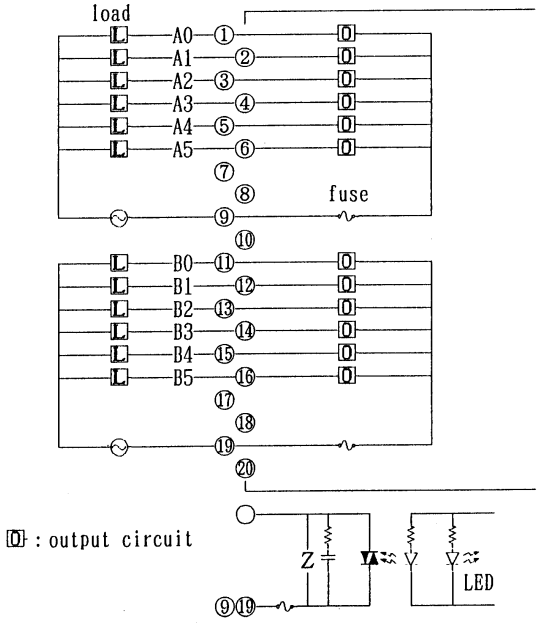
5.3.30 AOA08E - Output Module

Item		Specifications	
Points/module		8 points	
Points/common		4 points/common	
Rated load voltage		100 to 230VAC ±15%, 47 to 63Hz	
Maximum load current		1A/point (however 2A/common)	
Maximum in rush current		10A (1 period)	
Maximum voltage drop when ON		1.5Vrms	
Maximum leak current when OFF		3.0mA (115VAC), 6.0mA (230VAC)	
Response time	OFF→ON	Max.1ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Half of the load frequency or less	
Output display		LED display	
External connection		Terminal block connector (20 terminals, M3.5 screw terminal)	
Fuse		3.2A, 1 piece for each output A0 to A3 and A4 to A7	
Terminal connection and circuitry			



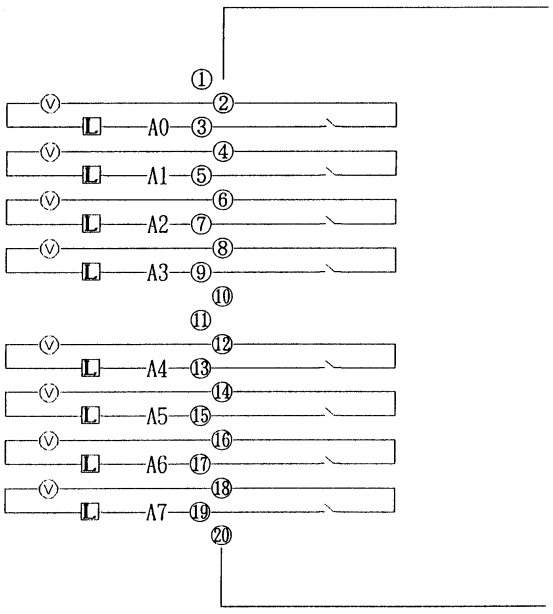
5.3.31 AOA12F - Output Module

Item		Specifications	
Points/module		12 points	
Points/common		6 points/common	
Rated load voltage		100 to 115VAC ±15%, 47 to 63Hz	
Maximum load current		0.5A/point (however, 2A/common)	
Maximum in rush current		5A (1 period)	
Limit of load		Refer to load reduction curve (Fig. 5.3 (c))	
Maximum voltage drop when ON		1.5Vrms	
Maximum leak current when OFF		1.5mA (115VAC)	
Response time	OFF→ON	Max.1ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Half of the load frequency or less	
Output display		LED display	
External connection		Terminal block connector (20 terminals, M3.5 screw terminal)	
Fuse		3.2A, 1 piece for each output A0 to A5 and B0 to B5	
Terminal connection and circuitry			



5.3.32 AOR08G - Output Module

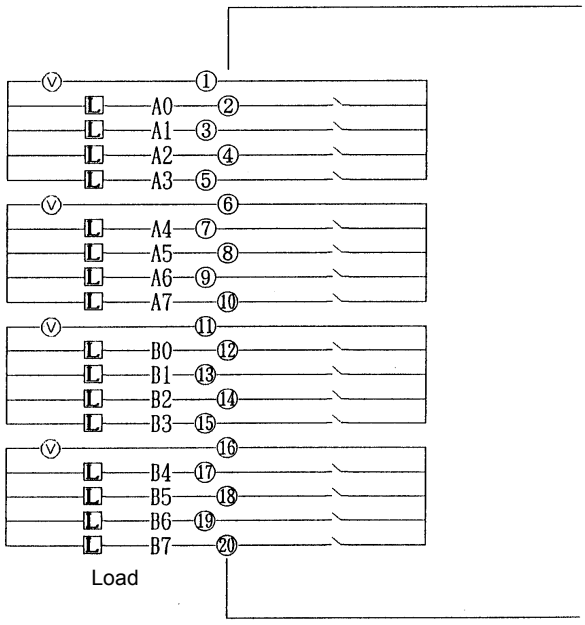
Item		Specifications	
Points/module		8 points	
Points/common		1 points/common	
Maximum load		30VDC/250VAC, 4A (resistance load)	
Minimum load		5VDC, 10mA	
Limit of load		Refer to load reduction curve (Fig. 5.3 (d))	
Response time	OFF→ON	Max.15ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.15ms	
Output display		LED display	
External connection		Terminal block connector (20 terminals, M3.5 screw terminal)	
Relay life	Mechanical	Min. 20,000,000 times	
	Electrical	Min. 100,000 times (resistance load)	
Terminal connection and circuitry			



Ⓥ : Direct current power or alternating current power

5.3.33 AOR16G - Output Module

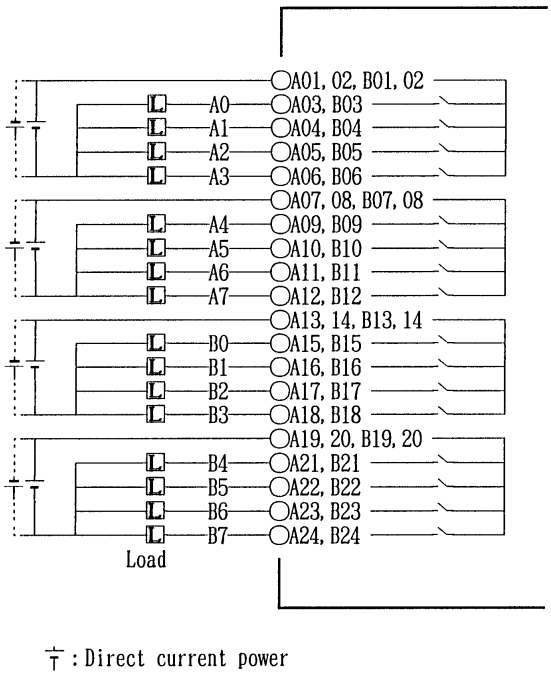
Item		Specifications	
Points/module		16 points	
Points/common		4 points/common	
Maximum load		30VDC/250VAC, 2A (resistance load)	
Minimum load		5VDC, 10mA	
Maximum current		4A/common	
Limit of load		Refer to load reduction curve (Fig. 5.3 (e))	
Response time	OFF→ON	Max.15ms	This is the value from input to output in the module. The actual value is
	ON→OFF	Max.15ms	determined by adding it to the scanning time depending on each system.
Output display		LED display	
External connection		Terminal block connector (20 terminals, M3.5 screw terminal)	
Relay life	Mechanical	Min. 20,000,000 times	
	Electrical	Min. 100,000 times (resistance load)	
Terminal connection and circuitry			



Ⓥ: Direct current power or alternating current power

5.3.34 AOR16H2 - Output Module

Item		Specifications	
Points/module		16 points	
Points/common		4 points/common	
Maximum load		30VDC, 2A (resistance load)	
Minimum load		5VDC, 10mA	
Maximum current		4A/common	
Limit of load		Refer to load reduction curve (Fig. 5.3 (e))	
Response time	OFF→ON	Max.15ms	This is the value from input to output in the module. The actual value is
	ON→OFF	Max.15ms	determined by adding it to the scanning time depending on each system.
Output display		LED display	
External connection		Connector (HIROSE ELECTRIC HIF3BB-50PA-2.54DS in accordance with MIL standard)	
Relay life	Mechanical	Min. 20,000,000 times	
	Electrical	Min. 100,000 times (resistance load)	
Terminal connection and circuitry			



⏚ : Direct current power

5.3.35 AIO40A - Input/output Module

- Input specifications

Item		Specifications	
Points/module		24 points	
Points/common		24 points/common	
Sink/source current		Both directions	
Input voltage		24VDC +10%, −20%	
Input current		7.5mA (average)	
ON voltage, current		Min. 18VDC, min. 6mA	
OFF voltage, current		Max. 6VDC, max. 1.5mA	
Response time	OFF→ON	Max.20ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.20ms	
Input display		Not provided	
External connection		Connector (HONDA TSUSHIN MR-50RMA, shared by output signals) (male)	

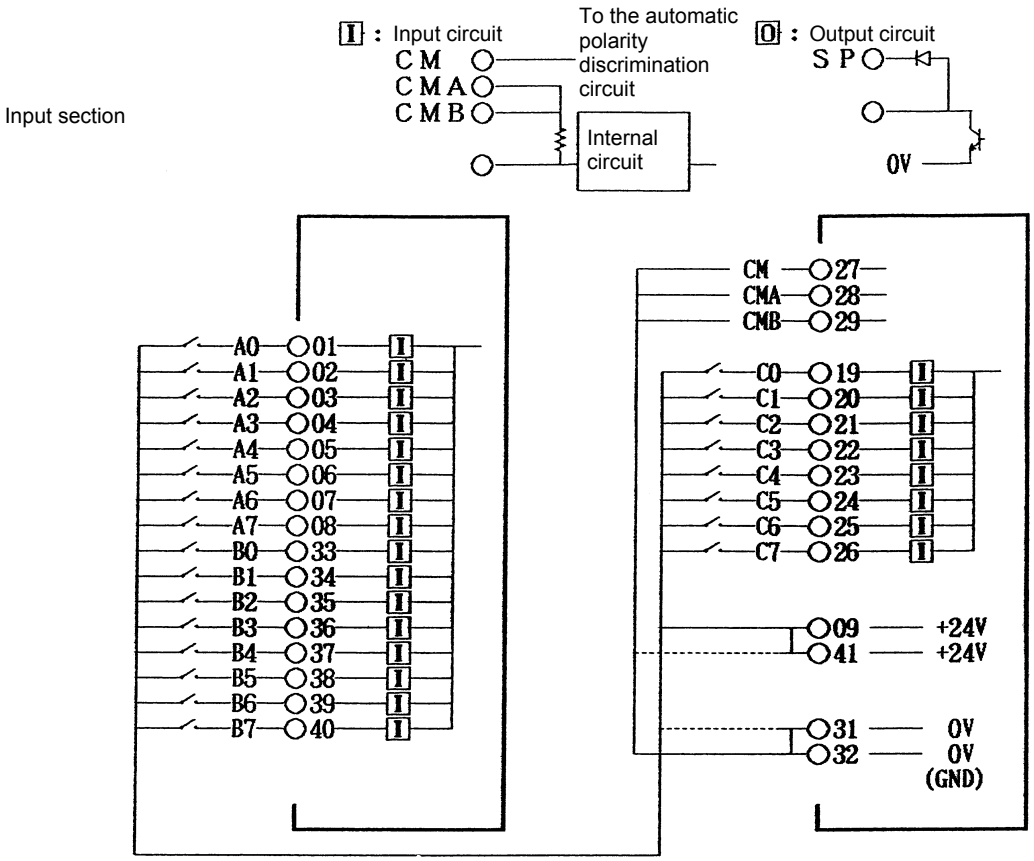
- Output specifications

Item		Specifications	
Points/module		16 points	
Points/common		16 points/common	
Sink/source current		Sink current type	
Rated load voltage		24VDC +20%, −15%	
Maximum load current		0.2A (however 2A/common)	
Maximum in rush current		0.2A	
Limit of load		• If the output current per point is 0.1 A or lower, all of the 16 points E0 to E7 and F0 to F7 can be turned on at a time. • If the output current per point is higher than 0.1 A but not higher than 0.2 A, do not turn on more than 3 points at a time.	
Maximum voltage drop when ON		1.5V	
Maximum leak current when OFF		1.0mA (30VDC)	
Response time	OFF→ON	Max.1ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.1ms	
Output display		Not provided	
External connection		Connector (HONDA TSUSHIN MR-50RMA, shared by input signals) (male)	

•Input/output module

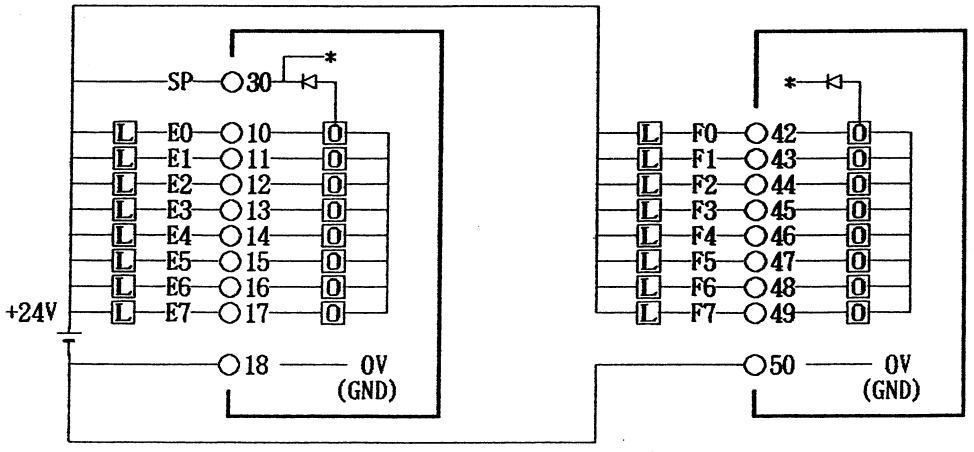
Terminal connection and circuitry

Input section



Either 24 V or 0 V can be selected as an input common potential as shown above.
(Solid line: 24-V common. Dotted line: 0-V common.)

Output section

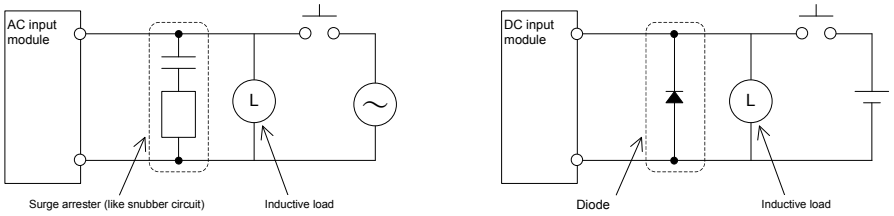


5.4 CAUTIONS REGARDING EACH INPUT/OUTPUT MODULE

5.4.1 Cautions Regarding Input Modules

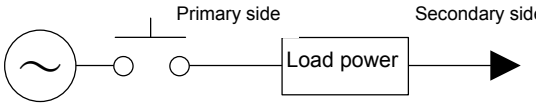
1 Quick response type input modules have a low input filter time constant. So, contact chattering may cause these input modules to read incorrect inputs. Restrict their use to connection with no-contact devices and pay attention to noise sufficiently.

2 If an input contact is connected to an input module and inductive load in parallel, a surge voltage that occurs across the load when the contact becomes off may cause the input module to malfunction. If this is the case, attach a surge arrester to the load in parallel to suppress the surge voltage.



5.4.2 Cautions Regarding Output Modules

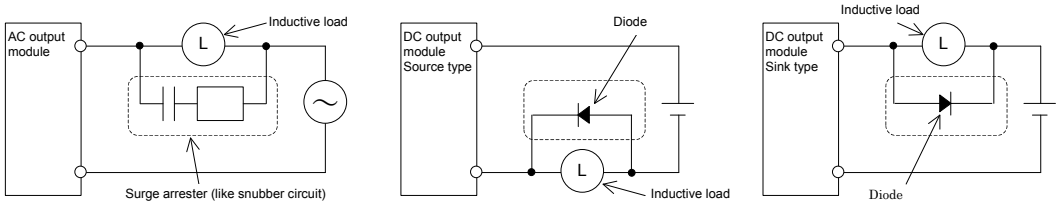
1 Even if the sequence program has turned off an output module, its internal stray capacity may cause an output current to flow instantaneously through it when a voltage is applied abruptly to the load. In order to evade this symptom, use the configuration that the load power is turned on/off on the primary side, as shown below.



2 Be sure to connect the power supply and common pins. Otherwise, current flow may get in the output circuit, resulting in the output being turned on.

3 Measures for inductive loads

- Do not turn on/off the output module repeatedly within a short period of time. The maximum permissible ON/OFF frequency is: ON for at least 1 second and OFF for at least 1 second.
- If the output load is inductive, connect a protection circuit like a surge killer or diode to the load in parallel. Note, however, that, connection of a protection circuit may cause a delay in recovery time. If this is a problem, use a CR snubber circuit instead of a surge killer or diode.
- If the output module is used to control an inductive load like a lamp load, it is likely that output turn-on rush current may damage the output element. Do not even instantaneously fail to observe the current and voltage ratings.



4 The number of output points that can be turned on at the same time varies depending on the output voltage and ambient temperature. Getting out of the specification range may cause a module failure or smoke. See the load reduction curve charts (Subsection 5.4.4) for each output module.

5.4.3 Cautions Regarding Relay Modules

1 Relays have a limited service life because their contacts are worn away. The service life of relays varies depending on the environment in which they are used. Pay attention to the environment and avoid exceeding the service life. If it is anticipated that the service life of a relay in a module will expire, replace the module. If the service life of a relay expires, the module output becomes abnormal because of a poor connection, leading to a possible machine breakdown and accident.
2 If a high open/close frequency is involved, use a DC or AC output module.
3 Cause the contacts of each relay to open at least once a year.
4 Provide a contact protection circuit for each relay in order to extend their contact life, suppress noise, and prevent chars or nitric acid from developing due to arcs. An incorrect contact protection circuit leads to an adverse result and causes contacts to be welded readily.
5 When connecting a capacitive load on the machine side, be sure to connect a current limiting resistor to the capacitive load in series to observe the current and voltage ratings always (not even instantaneously fail).
6 Providing a contact protection circuit may cause a delay in a recovery time.
7 Even if a rush current lasts for a relatively long time, avoid shutting off a relay when the rush current is flowing. Otherwise, its contacts may be welded.
8 When a lamp having a high amperage, in particular, is turned on or off, it is recommended to previously perform a confirmation test on a real load.
9 When using a relay output to control an inductive or capacitive load, for example, directly to light a lamp, provide a protective resistor between the output terminals in order to observe the current and voltage ratings always (not even instantaneously fail). Otherwise, a rush current may damage the relay.
10 The relay output module incorporates no fuse. In order to prevent burnout, it is recommended to use a fuse rated twice the output rating at every external terminal.
11 Transfer phenomenon of relay contacts
   - An arc that occurs when a contact is opened and closed causes the materials of the contact poles to melt, resulting in the molten material of one pole transferred to the other pole. As the number of times that the contact is opened and closed increases, concave and convex portions develop on the poles and eventually lock with one another, causing the contact to behave as if contact welding had occurred.
   - Transfer phenomenon of relay contacts can occur even if the relay is used within the contact rating. Check for a surge voltage and rush current. Consider using, for example, a surge killer or current limiting resistor to suppress any surge voltage or rush current.
12 Using the relay module in an atmosphere containing silicon gas, sulfidizing gas, or organic gas may cause contact surfaces to corrode or be covered with film that develops on them, leading to a poor connection. Do not use the relay module in such an atmosphere. Take an effective measure for such an atmosphere, for example, by replacing the relay module with a DC or AC module.

5.4.4 Derating

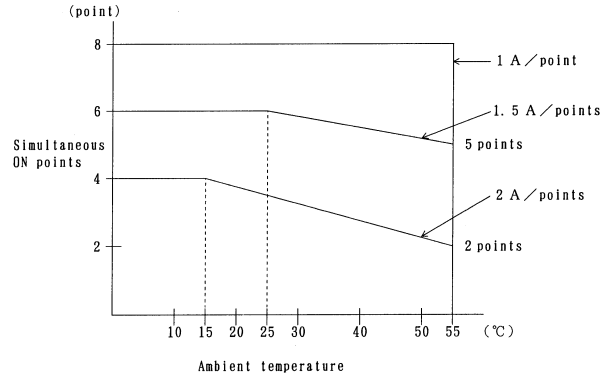


Fig.5.3 (a) AOD08D Load reduction curve

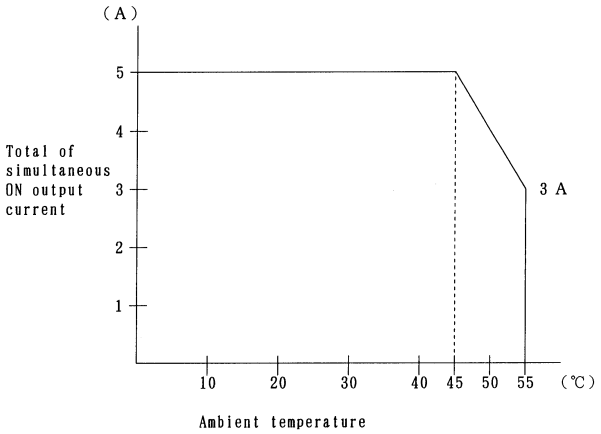


Fig.5.3 (b) AOA05E Load reduction curve

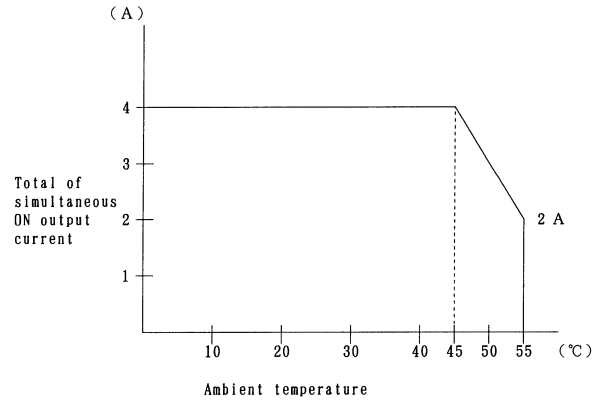


Fig.5.3 (c) AOA12F Load reduction curve

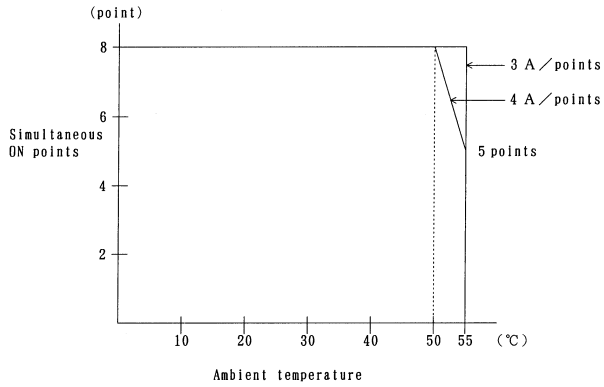


Fig.5.3 (d) AOR08G Load reduction curve

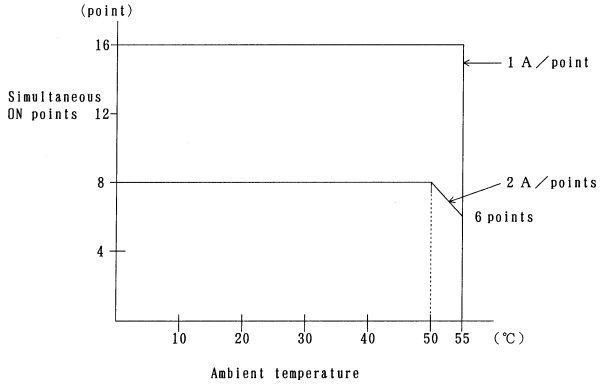


Fig.5.3 (e) AOR16G, AOR16H2 Load reduction curve

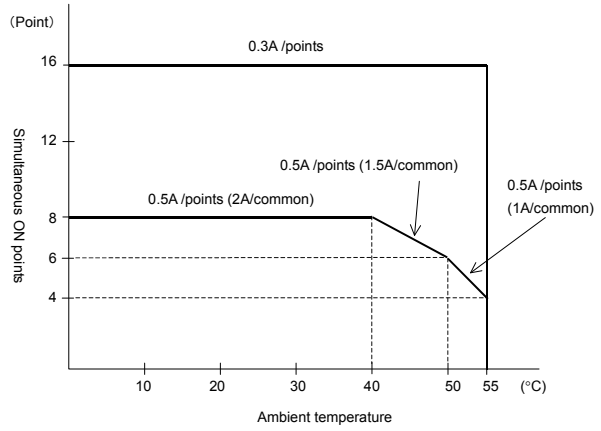


Fig.5.3 (f) AOD16DP Load reduction curve

NOTE
Ambient temperature means the temperature surrounding the I/O Unit and not that surrounding the cabinet containing the I/O Unit.

5.5 DETAILS OF I/O Unit CONNECTORS (HONDA TSUSHIN/HIROSE ELECTRIC) AND TERMINAL BLOCK (WEIDMÜLLER)

Given below are the details (signal arrangement diagrams as viewed from the front of the module) of the connector pins and AOD16D3 terminal block for the I/O Units (32-point input module, 32-point output module, and 24-point input/16-point output hybrid module) explained in Section 5.3.

5.5.1 Modules Using the MR-50RMA Connector Manufactured by Honda Tsushin

- AID32A1/AID32B1/AID32H1 (32-point DC input module)

33	D7			01	D6
34	D5			02	D3
35	D2	19	D4	03	D0
36	CMC	20	D1	04	+24V
37	C7	21	CMC	05	GND
38	C5	22	C6	06	C3
39	C2	23	C4	07	C0
40	CMC	24	C1	08	+24V
41	CMC	25		09	GND
42	B7	26		10	B6
43	B5	27	B4	11	B3
44	B2	28	B1	12	B0
45	CMA	29	CMA	13	+24V
46	A7	30	A6	14	GND
47	A5	31	A4	15	A3
48	A2	32	A1	16	A0
49	CMA			17	+24V
50	CMA			18	GND

- AID32E1/AID32F1 (32-point DC input module)

33	D7			01	D6
34	D5			02	D3
35	D2	19	D4	03	D0
36	CMD	20	D1	04	
37	C7	21	CMD	05	
38	C5	22	C6	06	C3
39	C2	23	C4	07	C0
40	CMC	24	C1	08	
41	CMC	25		09	
42	B7	26		10	B6
43	B5	27	B4	11	B3
44	B2	28	B1	12	B0
45	CMB	29	CMB	13	
46	A7	30	A6	14	
47	A5	31	A4	15	A3
48	A2	32	A1	16	A0
49	CMA			17	
50	CMA			18	

- AOD32A1/AOD32C1 (32-point DC output module)

33	D7			01	D6
34	D5			02	D3
35	D2	19	D4	03	D0
36	CMD	20	D1	04	+24V-D
37	C7	21	CMD	05	
38	C5	22	C6	06	C3
39	C2	23	C4	07	C0
40	CMC	24	C1	08	+24V-C
41	CMC	25		09	
42	B7	26		10	B6
43	B5	27	B4	11	B3
44	B2	28	B1	12	B0
45	CMB	29	CMB	13	+24V-B
46	A7	30	A6	14	
47	A5	31	A4	15	A3
48	A2	32	A1	16	A0
49	CMA			17	+24V-A
50	CMA			18	

- AOD32D1 (32-point DC output module)

33	D7			01	D6
34	D5			02	D3
35	D2	19	D4	03	D0
36	CMD	20	D1	04	
37	C7	21	CMD	05	0V-D
38	C5	22	C6	06	C3
39	C2	23	C4	07	C0
40	CMC	24	C1	08	
41	CMC	25		09	0V-C
42	B7	26		10	B6
43	B5	27	B4	11	B3
44	B2	28	B1	12	B0
45	CMB	29	CMB	13	
46	A7	30	A6	14	0V-B
47	A5	31	A4	15	A3
48	A2	32	A1	16	A0
49	CMA			17	
50	CMA			18	0V-A

- AIO40A (24-point DC input/16-point DC output hybrid module)

33	B0			01	A0
34	B1			02	A1
35	B2	19	C0	03	A2
36	B3	20	C1	04	A3
37	B4	21	C2	05	A4
38	B5	22	C3	06	A5
39	B6	23	C4	07	A6
40	B7	24	C5	08	A7
41	+24V	25	C6	09	+24V
42	F0	26	C7	10	E0
43	F1	27	CM	11	E1
44	F2	28	CMA	12	E2
45	F3	29	CMA	13	E3
46	F4	30	SP	14	E4
47	F5	31	0V	15	E5
48	F6	32	0V	16	E6
49	F7			17	E7
50	0V			18	0V

5.5.2 Modules Using the HIF3BB-50PA-2.54DS Connector Manufactured by Hirose Electric

- AID32E2/AID32F2 (32-point DC input module)

A01		**B01**	
A02	**D7**	**B02**	**D6**
A03	**D5**	**B03**	**D4**
A04	**D3**	**B04**	**D2**
A05	**D1**	**B05**	**D0**
A06	**CMD**	**B06**	**CMD**
A07		**B07**	
A08	**C7**	**B08**	**C6**
A09	**C5**	**B09**	**C4**
A10	**C3**	**B10**	**C2**
A11	**C1**	**B11**	**C0**
A12	**CMC**	**B12**	**CMC**
A13		**B13**	
A14	**B7**	**B14**	**B6**
A15	**B5**	**B15**	**B4**
A16	**B3**	**B16**	**B2**
A17	**B1**	**B17**	**B0**
A18	**CMB**	**B18**	**CMB**
A19		**B19**	
A20	**A7**	**B20**	**A6**
A21	**A5**	**B21**	**A4**
A22	**A3**	**B22**	**A2**
A23	**A1**	**B23**	**A0**
A24	**CMA**	**B24**	**CMA**
A25		**B25**	

- AOD32C2 (32-point DC output module)

A01		B01	+24V-D
A02	D7	B02	D6
A03	D5	B03	D4
A04	D3	B04	D2
A05	D1	B05	D0
A06	CMD	B06	CMD
A07		B07	+24V-C
A08	C7	B08	C6
A09	C5	B09	C4
A10	C3	B10	C2
A11	C1	B11	C0
A12	CMC	B12	CMC
A13		B13	+24V-B
A14	B7	B14	B6
A15	B5	B15	B4
A16	B3	B16	B2
A17	B1	B17	B0
A18	CMB	B18	CMB
A19		B19	+24V-A
A20	A7	B20	A6
A21	A5	B21	A4
A22	A3	B22	A2
A23	A1	B23	A0
A24	CMA	B24	CMA
A25		B25	

- AOD32D2 (32-point DC output module)

A01	0V-D	B01	
A02	D7	B02	D6
A03	D5	B03	D4
A04	D3	B04	D2
A05	D1	B05	D0
A06	CMD	B06	CMD
A07	0V-C	B07	
A08	C7	B08	C6
A09	C5	B09	C4
A10	C3	B10	C2
A11	C1	B11	C0
A12	CMC	B12	CMC
A13	0V-B	B13	
A14	B7	B14	B6
A15	B5	B15	B4
A16	B3	B16	B2
A17	B1	B17	B0
A18	CMB	B18	CMB
A19	0V-A	B19	
A20	A7	B20	A6
A21	A5	B21	A4
A22	A3	B22	A2
A23	A1	B23	A0
A24	CMA	B24	CMA
A25		B25	

- AOR16H2 (16-point relay output module)

A01	CMA	B01	CMA
A02	CMA	B02	CMA
A03	A0	B03	A0
A04	A1	B04	A1
A05	A2	B05	A2
A06	A3	B06	A3
A07	CMB	B07	CMB
A08	CMB	B08	CMB
A09	A4	B09	A4
A10	A5	B10	A5
A11	A6	B11	A6
A12	A7	B12	A7
A13	CMC	B13	CMC
A14	CMC	B14	CMC
A15	B0	B15	B0
A16	B1	B16	B1
A17	B2	B17	B2
A18	B3	B18	B3
A19	CMD	B19	CMD
A20	CMD	B20	CMD
A21	B4	B21	B4
A22	B5	B22	B5
A23	B6	B23	B6
A24	B7	B24	B7
A25		B25	

5.5.3 Modules Using the HIF4-40P-3.18DS Connector Manufactured by Hirose Electric

- AOD16D2 (16-point DC output module)

A01	A0	B01	0V-A
A02	A1	B02	0V-A
A03	A2	B03	CMA
A04	A3	B04	CMA
A05	CMA	B05	CMA
A06	A4	B06	0V-B
A07	A5	B07	0V-B
A08	A6	B08	CMB
A09	A7	B09	CMB
A10	CMB	B10	CMB
A11	CMC	B11	CMC
A12	B0	B12	CMC
A13	B1	B13	CMC
A14	B2	B14	0V-C
A15	B3	B15	0V-C
A16	CMD	B16	CMD
A17	B4	B17	CMD
A18	B5	B18	CMD
A19	B6	B19	0V-D
A20	B7	B20	0V-D

5.5.4 Modules Using the Terminal Block BL3.5/24/90F Manufactured by Weidmüller

- AOD16D3 (16-point DC output module)

01	CMA
02	A0
03	A1
04	A2
05	A3
06	0V-A
07	CMB
08	A4
09	A5
10	A6
11	A7
12	0V-B
13	CMC
14	B0
15	B1
16	B2
17	B3
18	0V-C
19	CMD
20	B4
21	B5
22	B6
23	B7
24	0V-D

6 ANALOG INPUT MODULE

6.1 12-BIT ANALOG INPUT MODULE (AAD04A)

6.1.1 Specifications

Item	Specifications
Number of input channel	4 channel/module
Analog input	• Voltage input -10VDC to+10VDC(input resistance 4.7MΩ) • Current input -20mADC to+20mADC(input resistance 250Ω) Caution) Which method to use, voltage input or current input, can be selected by connecting the corresponding input to the terminal block.
Digital output	12 bit binary (complementary representation of "2".)
Input/output correspondence	<table><tr><th>Analog input</th><th>Digital output</th></tr><tr><td>+10V</td><td>+2000</td></tr><tr><td>+5V or + 20mA</td><td>+1000</td></tr><tr><td>0V or 0mA</td><td>0</td></tr><tr><td>-5V or -20mA</td><td>-1000</td></tr><tr><td>-10V</td><td>-2000</td></tr></table>
Resolution	5mV or 20μA
Total precision	Voltage input ±0.5%(For full scale) Current input ±1%(For full scale)
Conversionary time	Max.2ms (Note)
Maximum input voltage/current	±15V, ±30mA
Isolation	Photocoupler isolated (between the input signal and the base) However, not isolated between input channels
Output connecting	Removable terminal block (20 terminals, M3.5 screw terminal)
Required input points	64 points

NOTE
Conversion time means that only in a module. Actual response speed is determined by adding the scanning time depending on each system to this conversion time.

6.1.2 Correspondence between Input Signals and Addresses in a Module

In the analog input module AAD04A, the 4-channel analog input signals are cyclically A-D converted in order, and the converted digital data are written in the following addresses. Therefore, in the PMC program, it is possible at any time to know the values for the analog input signals by referring to the following addresses.

Address in module	Bits 7	6	5	4	3	2	1	0	
0	D07-0	D06-0	D05-0	D04-0	D03-0	D02-0	D01-0	D00-0	Channel 0
1	X-0	X-0	X-0	X-0	D11-0	D10-0	D09-0	D08-0	
2	D07-1	D06-1	D05-1	D04-1	D03-1	D02-1	D01-1	D00-1	Channel 1
3	X-1	X-1	X-1	X-1	D11-1	D10-1	D09-1	D08-1	
4	D07-2	D06-2	D05-2	D04-2	D03-2	D02-2	D01-2	D00-2	Channel 2
5	X-2	X-2	X-2	X-2	D11-2	D10-2	D09-2	D08-2	
6	D07-3	D06-3	D05-3	D04-3	D03-3	D02-3	D01-3	D00-3	Channel 3
7	X-3	X-3	X-3	X-3	D11-3	D10-3	D09-3	D08-3	

D00-n and D11-n correspond to the weights of 2^0 and 2^{11} respectively. Here, D11-n corresponds to the sign bit in the complementary representation of "2."
In addition, in X-n is written the same value as that in D11-n.

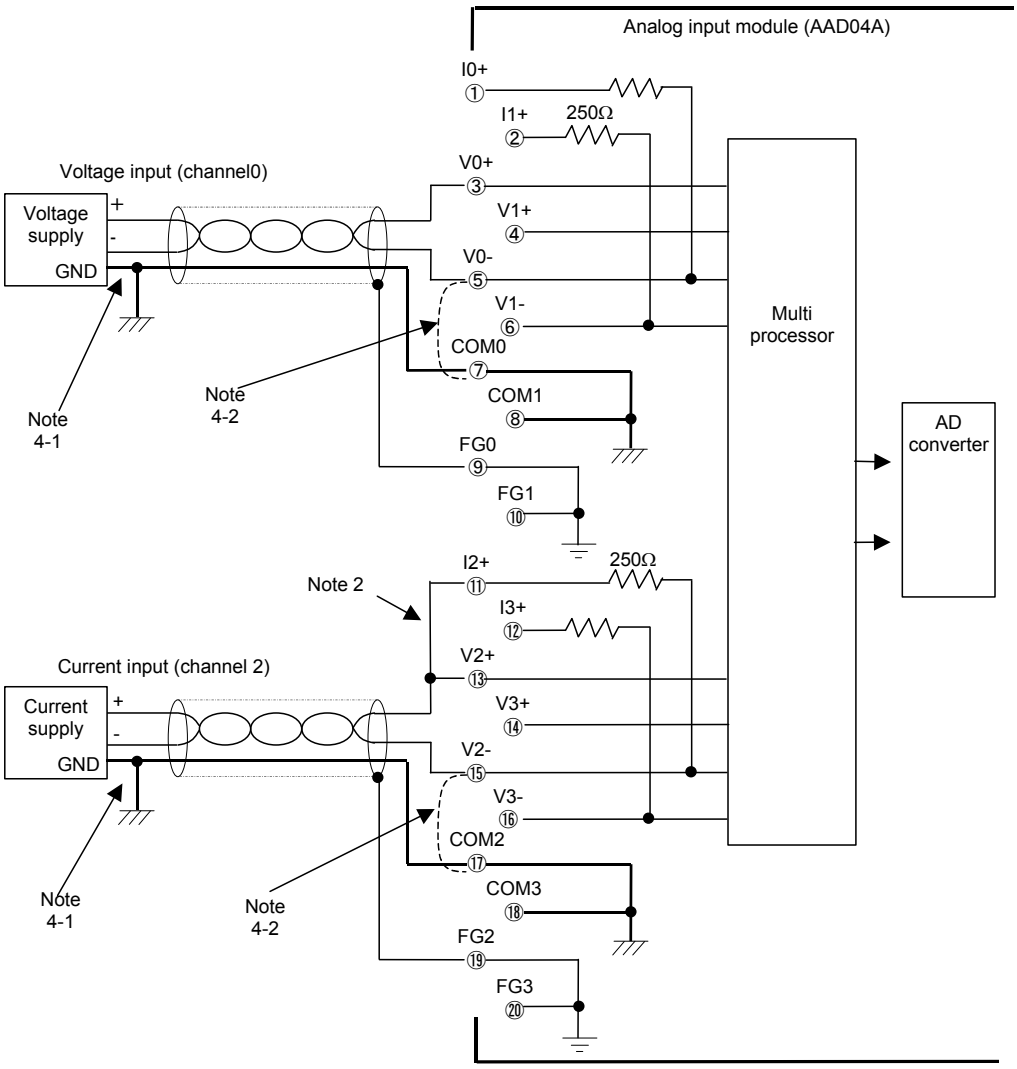
NOTE
1 I/O Link requires that the start address of each I/O module be even-numbered. Moreover, when an A-D converted value is referred to in a PMC program, make sure to read the data in unit of a word (16 bits).
2 I/O Link *i* does not care whether the start address of this module is even- or odd-numbered.
3 Note that on the PMC-N, -NA, and -QA (PMC for the Series 15 (Series 15 preceding the *i* series) and F-D Mate), the high-order one byte and low-order one byte of a word (16 bits) are interchanged with each other as described below.

Addresses for word-unit operation in the PMC-N, NA, and QA

Analog input module → PMC

	Address in the module	High-order byte	Low-order byte
Channel 0	0	D07-0 to D00-0	X-0,D11-0 to D08-0
Channel 1	+2	D07-1 to D00-1	X-1,D11-1 to D08-1
Channel 2	+4	D07-2 to D00-2	X-2,D11-2 to D08-2
Channel 3	+6	D07-3 to D00-3	X-3,D11-3 to D08-3

6.1.3 Connecting with Analog Input Module



NOTE

1 Though the example above shows the connection of channels 0 and 2, it is just the same with the channel 1 (I1+, V1+, V1-, COM1 and FG1) and the channel 3 (I3+, V3+, V3-, COM3 and FG3).
2 Either voltage input or current input can be specified for each channel. When current input is specified, make sure to short-circuit in + and Vn+ (n: 0 to 3).
3 Use shielded cables of twisted pair for connecting.
4 Fix a reference voltage by connecting the COMn (where n is 0, 1, 2, or 3) terminal of this module to the common line (GND) of the voltage or current source to be used as shown above.
5 If the voltage or current source has a terminal shared by the external output (terminal OUT-) and ground (GND), the Vn- and COMn (where n is 0, 1, 2, or 3) of this module can be connected to each other as shown above.
6 The shielding wires are ground in the AAD04A. However, both ends grounding or both ends opening may be more effective depending on the environment where the unit is used. Select one of the grounding types, whichever is appropriate, depending on what the ambient noise is like.

6.2 16-BIT ANALOG INPUT MODULE (AAD04B)

6.2.1 Specifications

Item	Specifications
Number of input channel	4 channel/module
Analog input	• Voltage input -10VDC to+10VDC(input resistance 4.7MΩ) • Current input -20mADC to+20mADC(input resistance 250Ω) Caution) Which method to use, voltage input or current input, can be selected by connecting the corresponding input to the terminal block.
Digital output	16 bit binary (complementary representation of "2".)
Input/output correspondence	<table><tr><th colspan="2">Analog input</th><th rowspan="2">Digital output</th></tr><tr><th>Voltage input</th><th>Current input</th></tr><tr><td>+10V</td><td>-</td><td>+32000</td></tr><tr><td>+5V</td><td>+20mA</td><td>+16000</td></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>-5V</td><td>-20mA</td><td>-16000</td></tr><tr><td>-10V</td><td>-</td><td>-32000</td></tr></table>
Resolution	Voltage input: 0.3125mV Current input: 1.25μA
Total precision	Voltage input: ±0.5%(For full scale) Current input: ±1%(For full scale)
Conversionary time	Max.2ms (Note)
Maximum input voltage/current	±15V, ±30mA
Isolation	Photocoupler isolated (between the input signal and the base) However, not isolated between input channels
Output connecting	Removable terminal block(20 terminals, M3.5 screw terminal)
Required input points	64 points
Name assigned to module	“AD04A” or “/8”

NOTE
Conversion time means that only in a module. Actual response speed is determined by adding the scanning time depending on each system to this conversion time.

6.2.2 Correspondence between Input Signals and Addresses in a Module

In the analog input module AAD04B, the 4-channel analog input signals are cyclically A-D converted in order, and the converted digital data are written in the following addresses. Therefore, in the PMC program, it is possible at any time to know the values for the analog input signals by referring to the following addresses.

Address in module	Bits 7	6	5	4	3	2	1	0	
0	D07-0	D06-0	D05-0	D04-0	D03-0	D02-0	D01-0	D00-0	Channel 0
1	D15-0	D14-0	D13-0	D12-0	D11-0	D10-0	D09-0	D08-0	
2	D07-1	D06-1	D05-1	D04-1	D03-1	D02-1	D01-1	D00-1	Channel 1
3	D15-1	D14-1	D13-1	D12-1	D11-1	D10-1	D09-1	D08-1	
4	D07-2	D06-2	D05-2	D04-2	D03-2	D02-2	D01-2	D00-2	Channel 2
5	D15-2	D14-2	D13-2	D12-2	D11-2	D10-2	D09-2	D08-2	
6	D07-3	D06-3	D05-3	D04-3	D03-3	D02-3	D01-3	D00-3	Channel 3
7	D15-3	D14-3	D13-3	D12-3	D11-3	D10-3	D09-3	D08-3	

D00-n and D15-n correspond to the weights of 2^0 and 2^{15} respectively. Here, D15-n corresponds to the sign bit in the complementary representation of "2." (where n represents one of the channel numbers 0 to 3)

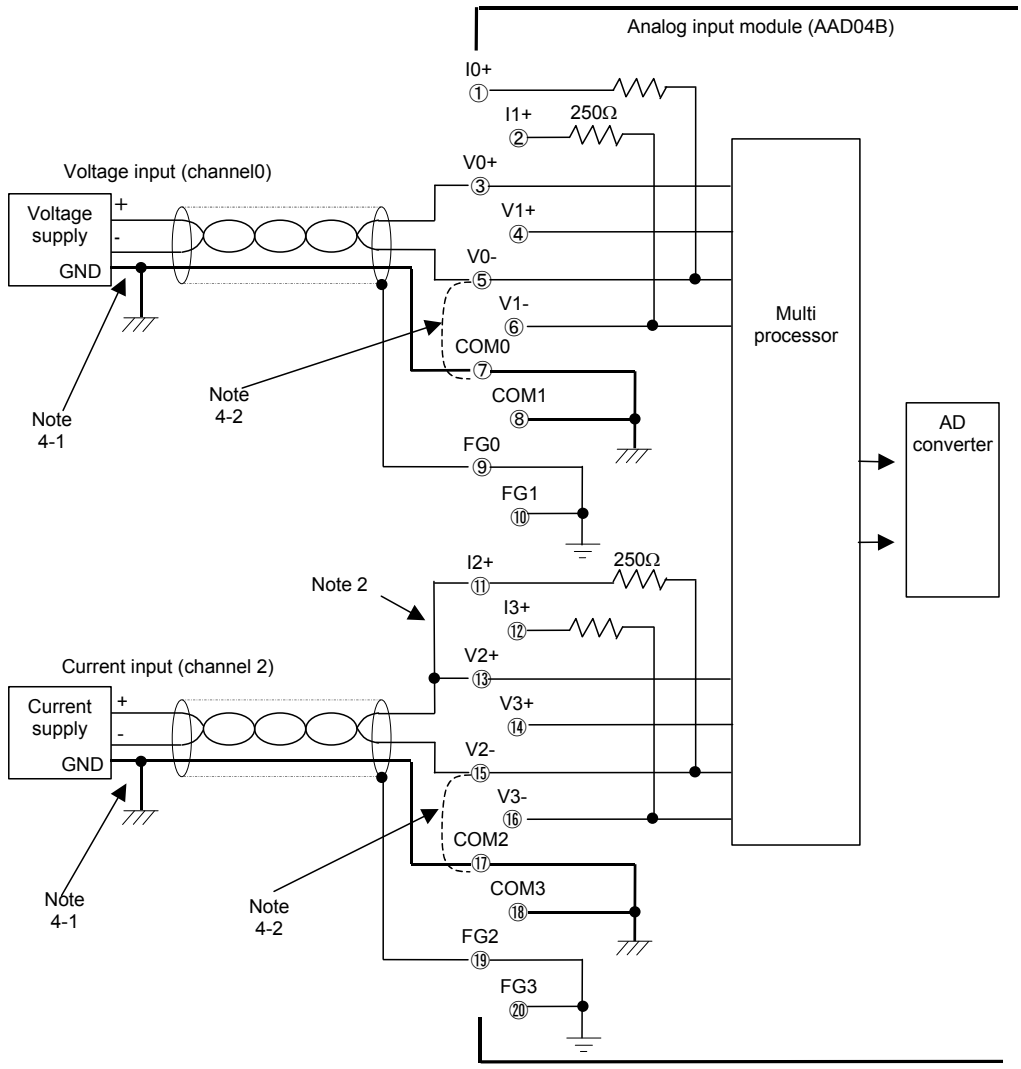
NOTE
1 I/O Link requires that the start address of each I/O module be even-numbered. Moreover, when an A-D converted value is referred to in a PMC program, make sure to read the data in unit of a word (16 bits).
2 I/O Link *i* does not care whether the start address of this module is even- or odd-numbered.
3 This module has a very high resolution. When A-D converted values are input to a system for reference by the PMC program, they may disperse largely depending on the system. If this is the case, the dispersion of input values can be suppressed by obtaining their moving average in the PMC program or lowering the resolution by masking the lowest-order bit if possible.
4 Note that on the PMC-N, -NA, and -QA (PMC for the Series 15 (Series 15 preceding the *i* series) and F-D Mate), the high-order one byte and low-order one byte of a word (16 bits) are interchanged with each other as described below.

Addresses for word-unit operation in the PMC-N, NA, and QA

Analog input module → PMC

	Address in the module	High-order byte	Low-order byte
Channel 0	0	D07-0 to D00-0	D15-0 to D08-0
Channel 1	+2	D07-1 to D00-1	D15-1 to D08-1
Channel 2	+4	D07-2 to D00-2	,D15-2 to D08-2
Channel 3	+6	D07-3 to D00-3	D15-3 to D08-3

6.2.3 Connecting with Analog Input Module



NOTE

1 Though the example above shows the connection of channels 0 and 2, it is just the same with the channel 1 (I1+, V1+, V1-, COM1 and FG1) and the channel 3 (I3+, V3+, V3-, COM3 and FG3).
2 Either voltage input or current input can be specified for each channel. When current input is specified, make sure to short-circuit in + and Vn+ (n: 0 to 3).
3 Use shielded cables of twisted pair for connecting.
4 Fix a reference voltage by connecting the COMn (where n is 0, 1, 2, or 3) terminal of this module to the common line (GND) of the voltage or current source to be used as shown above.
5 If the voltage or current source has a terminal shared by the external output (terminal OUT-) and ground (GND), the Vn- and COMn (where n is 0, 1, 2, or 3) of this module can be connected to each other as shown above.
6 The shielding wires are ground in the AAD04B. However, both ends grounding or both ends opening may be more effective depending on the environment where the unit is used. Select one of the grounding types, whichever is appropriate, depending on what the ambient noise is like.

7 ANALOG OUTPUT MODULE

7.1 12-BIT ANALOG OUTPUT MODULE (ADA02A)

7.1.1 Specification

Item	Specification
Number of output channels	2 channels/module
Digital input	12-bit binary (2's complement representation)
Analog output	-10VDC to +10VDC(external load resistance: 10KΩ or more) (Note 1) 0mADC to +20mADC(external load resistance: 400Ω or less)
Input/output correspondence	<table><tr><th>Digital input</th><th>Analog output</th></tr><tr><td>+2000</td><td>+10V</td></tr><tr><td>+1000</td><td>+5V or +20mA</td></tr><tr><td>0</td><td>0V or 0mA</td></tr><tr><td>-1000</td><td>-5V</td></tr><tr><td>-2000</td><td>-10V</td></tr></table>
Resolution	5mV or 20μA
Comprehensive accuracy	Voltage output: ±0.5% (For the full scale) Current output: ±1% (For the full scale)
Converting time	1msec or less (Note 2)
Insulation	Photocoupler insulation (between output signal and base). However, non-insulation between output channels.
External connection	At removable terminal block (20 terminals, M3.5 screw terminals)
Number of occupied output points	32 points

NOTE
1 Which method to use, voltage input or current input, can be selected by connecting the corresponding input to the terminal block.
2 The converting time is the one only inside the module. The actual response time is added a scan time that is determined by the system.
3 If this module is connected to any unit that requires a separate power supply, turn on the I/O Unit-A before that unit. Turning on that unit before the I/O Unit-A may lead to an accident dew to incorrect output or malfunction.

7.1.2 Correspondence between Output Signals and Addresses in a Module

In the analog output module ADA02A, a 12-bit digital value is written into each of the following addresses to output the desired voltage/current to its corresponding analog output.

Address in module	Bits 7	6	5	4	3	2	1	0	
0	D07-0	D06-0	D05-0	D04-0	D03-0	D02-0	D01-0	D00-0	Channel 0
1	-	-	-	-	D11-0	D10-0	D09-0	D08-0	
2	D07-1	D06-1	D05-1	D04-1	D03-1	D02-1	D01-1	D00-1	Channel 1
3	-	-	-	-	D11-1	D10-1	D09-1	D08-1	

D00-n corresponds to the 2^0 weight, while D11-n corresponds to the 2^{11} weight.
However, D11-n corresponds to the code bit 2's complement representation.

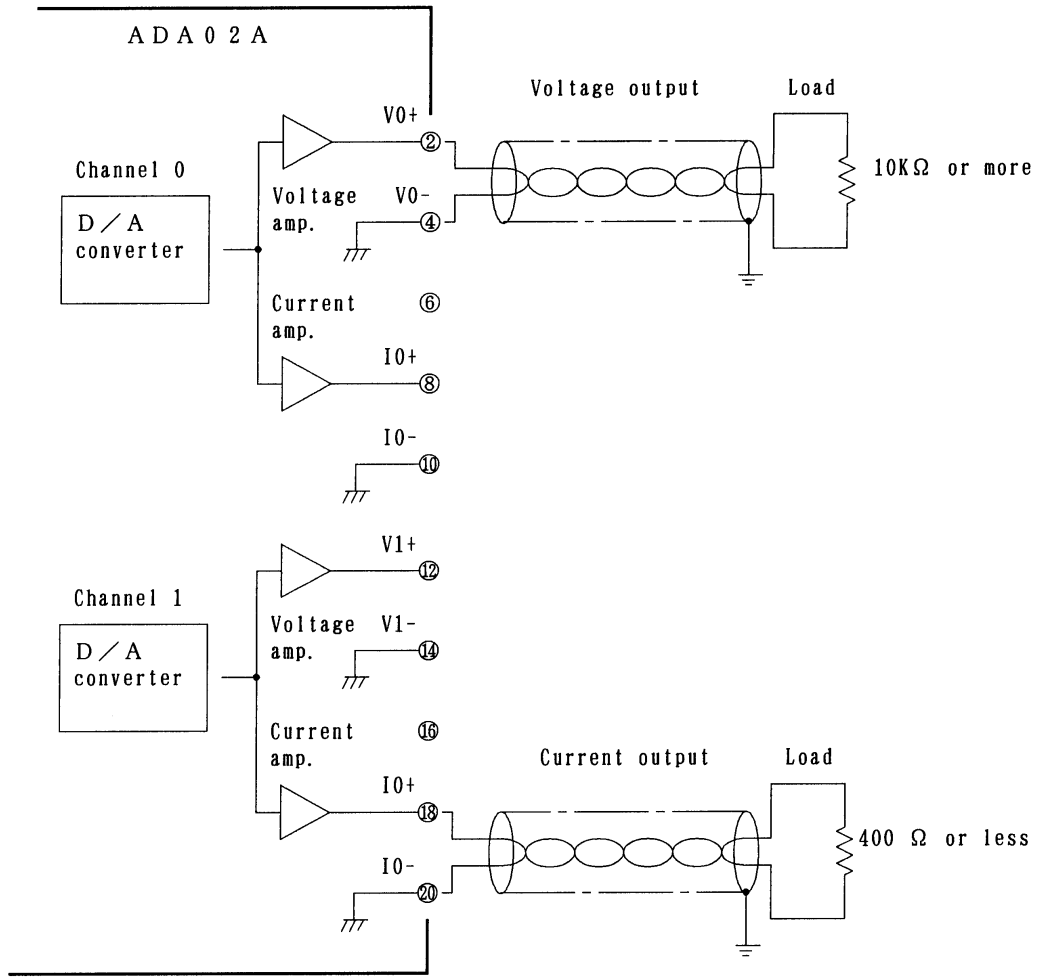
NOTE
1 I/O Link requires that the start address of each I/O module be even-numbered. To write a value that is to be converted from digital to analog into a PMC program, be sure to write it in words (16 bits).
2 I/O Link *i* does not care whether the start address of this module is even- or odd-numbered.
3 Note that on the PMC-N, -NA, and -QA (PMC for the Series 15 (Series 15 preceding the *i* series) and F-D Mate), the high-order one byte and low-order one byte of a word (16 bits) are interchanged with each other as described below.

Addresses for word-unit operation in the PMC-N, NA, and QA

PMC → 12-bit analog output module

	Module in address	High-order byte	Low-order byte
Channel 0	0	D07-0 to D00-0	D11-0 to D08-0
Channel 1	+2	D07-1 to D00-1	D11-1 to D08-1

7.1.3 Connection to Analog Output Module



NOTE
1 Use a 2-core twisted shielded cable as the connection cable
2 Ground the shielding wire of the cable only at one point on the load side (single-point grounding). However, both ends grounding or both ends opening may be more effective depending on the environment where the unit is used. Select one of the grounding types, whichever is appropriate, depending on what the ambient noise is like.

7.2 14-BIT ANALOG OUTPUT MODULE (ADA02B)

7.2.1 Specification

Item	Specification
Number of output channels	2 channels/module
Digital input	14-bit binary (2's complement representation)
Analog output	•Voltage output -10 VDC to +10 VDC (external load resistance of 10 kΩ or higher) (Note 1) •Current output 0 mADC to +20 mADC (external load resistance of 400Ω or lower)
Input/output correspondence	<table><tr><th rowspan="2">Digital input</th><th colspan="2">Analog output</th></tr><tr><th>Voltage output</th><th>Current output</th></tr><tr><td>+8000</td><td>+10V</td><td>+20mA</td></tr><tr><td>+4000</td><td>+5V</td><td>+10mA</td></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>-4000</td><td>-5V</td><td>-</td></tr><tr><td>-8000</td><td>-10V</td><td>-</td></tr></table>
Resolution	Voltage output: 1.25 mV Current output: 2.5 μA
Overall precision	Voltage output: ±0.5% (of the full scale) Current output: ±1% (of the full scale)
Converting time	1 msec or shorter (Note 2)
Insulation	Photocoupler-based insulation between output signal and base, but no insulation between output channels
External connection	Removable terminal block (20 terminals, M3.5 screw terminal)
Number of occupied output points	32 points
Name assigned to module	“DA02A” or “/4”

NOTE
1 Which method to use, voltage input or current input, can be selected by connecting the corresponding input to the terminal block.
2 The converting time is that inside the module. The actual response time is added the scan time that is determined by the system.
3 If this module is connected to any unit that requires a separate power supply, turn on the I/O Unit-A before that unit. Turning on that unit before the I/O Unit-A may lead to an accident dew to incorrect output or malfunction.

7.2.2 Correspondence between Output Signals and Addresses in the Module

In the ADA02B analog output module, a 14-bit digital value is written to each of the following address to output the desired voltage/current from its corresponding analog output.

Address in module	Bits 7	6	5	4	3	2	1	0	
0	D07-0	D06-0	D05-0	D04-0	D03-0	D02-0	D01-0	D00-0	Channel 0
1	-	-	D13-0	D12-0	D11-0	D10-0	D9-0	D8-0	
2	D07-1	D06-1	D05-1	D04-1	D03-1	D02-1	D01-1	D00-1	Channel 1
3	-	-	D13-1	D12-1	D11-1	D10-1	D9-1	D8-1	

D00-n (where n is 0 or 1) corresponds to a weight of 2^0, and D13-n to a weight of 2^{13}. However, D13-n corresponds to the sign bit of a two's complement representation.

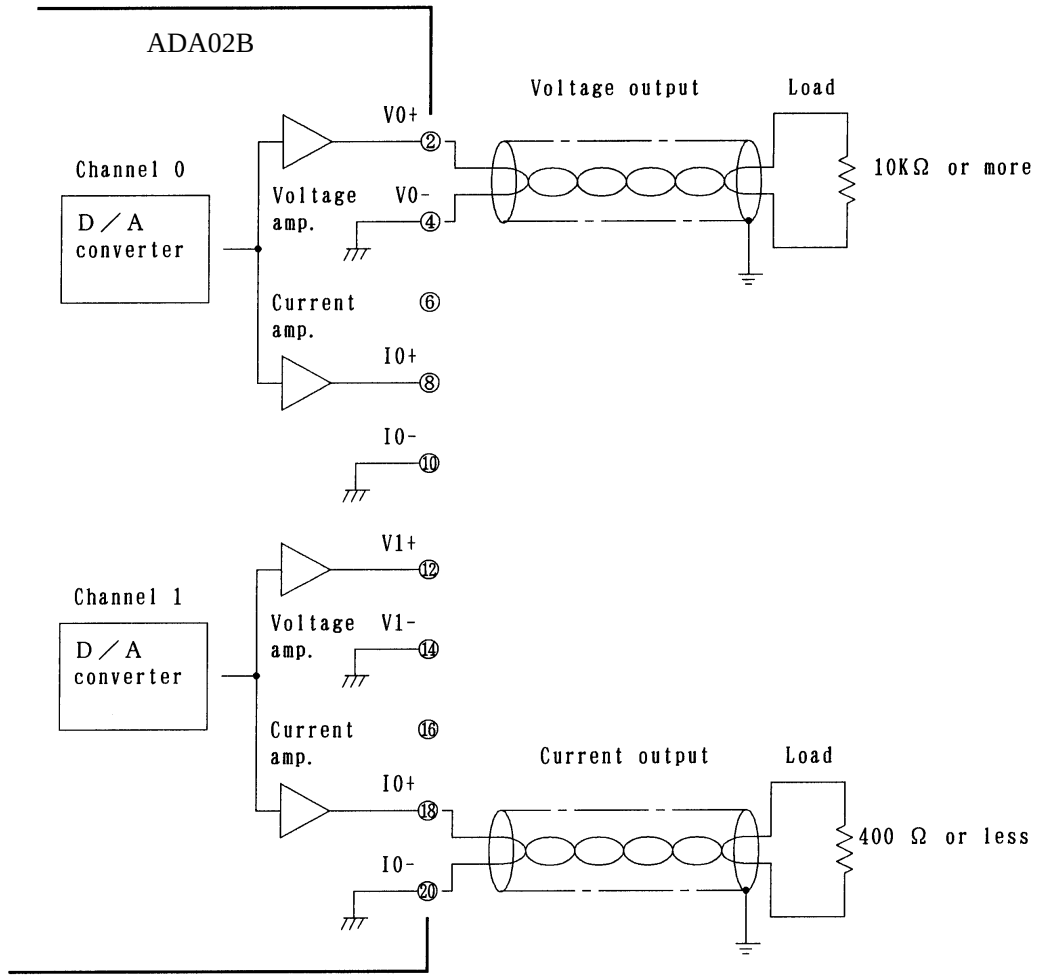
NOTE
1 I/O Link requires that the start address of each I/O module be even-numbered. To write a value that is to be converted from digital to analog into a PMC program, be sure to write it in words (16 bits).
2 I/O Link *i* does not care whether the start address of this module is even- or odd-numbered.
3 Note that on the PMC-N, -NA, and -QA (PMC for the Series 15 (Series 15 preceding the *i* series) and F-D Mate), the high-order one byte and low-order one byte of a word (16 bits) are interchanged with each other as described below.

Addresses for word-unit operation in the PMC-N, NA, and QA

PMC → 14-bit analog output module

	Module in address	High-order byte	Low-order byte
Channel 0	0	D07-0 to D00-0	D13-0 to D08-0
Channel 1	+2	D07-1 to D00-1	D13-1 to D08-1

7.2.3 Connection between the Analog Output Module and Load



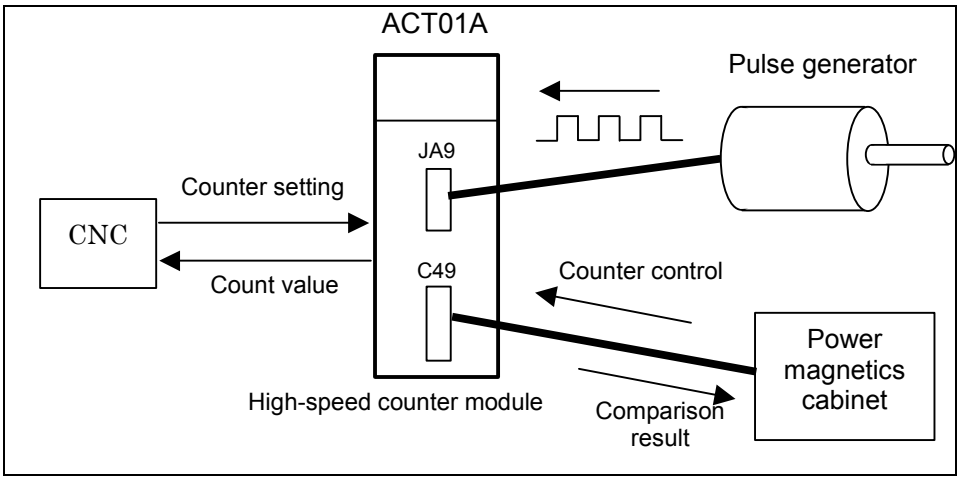
NOTE

1 Use a shielded 2-conductor twisted pair cable for the connection between the analog output module and load.
2 Ground the shielding wire of the cable only at one point on the load side (single-point grounding). However, both ends grounding or both ends opening may be more effective depending on the environment where the unit is used. Select one of the grounding types, whichever is appropriate, depending on what the ambient noise is like.

8 HIGH-SPEED COUNTER MODULE

8.1 OUTLINE OF HIGH-SPEED COUNTER MODULE

The high-speed counter module consists of a counter which counts the pulses sent from a pulse generator such as a position detector in the machine tool and comparison registers for comparing preset values with counter data. The module can read the counter data and output the results of comparison to the machine.



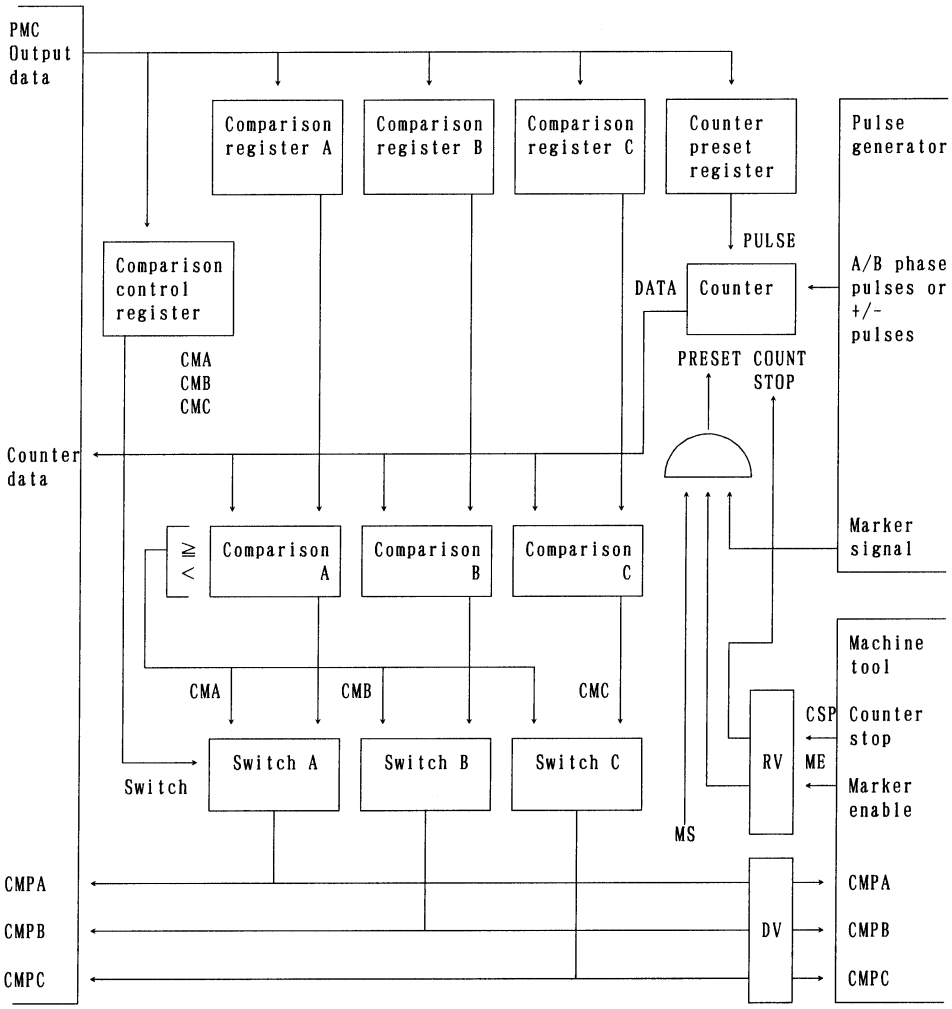
NOTE
1 The FANUC manual pulse generator cannot be connected because it is not of line driver output type.
2 The high-speed counter modules whose unit drawing number is A03B-0819-C053 or A03B-0807-C053 are dedicated to I/O Link. For I/O Link *i*, use the high-speed counter module whose unit drawing number is A03B-0819-C064.

The high-speed counter module can run in two different modes, mode A and mode B. These two modes differ in the way data is compared.

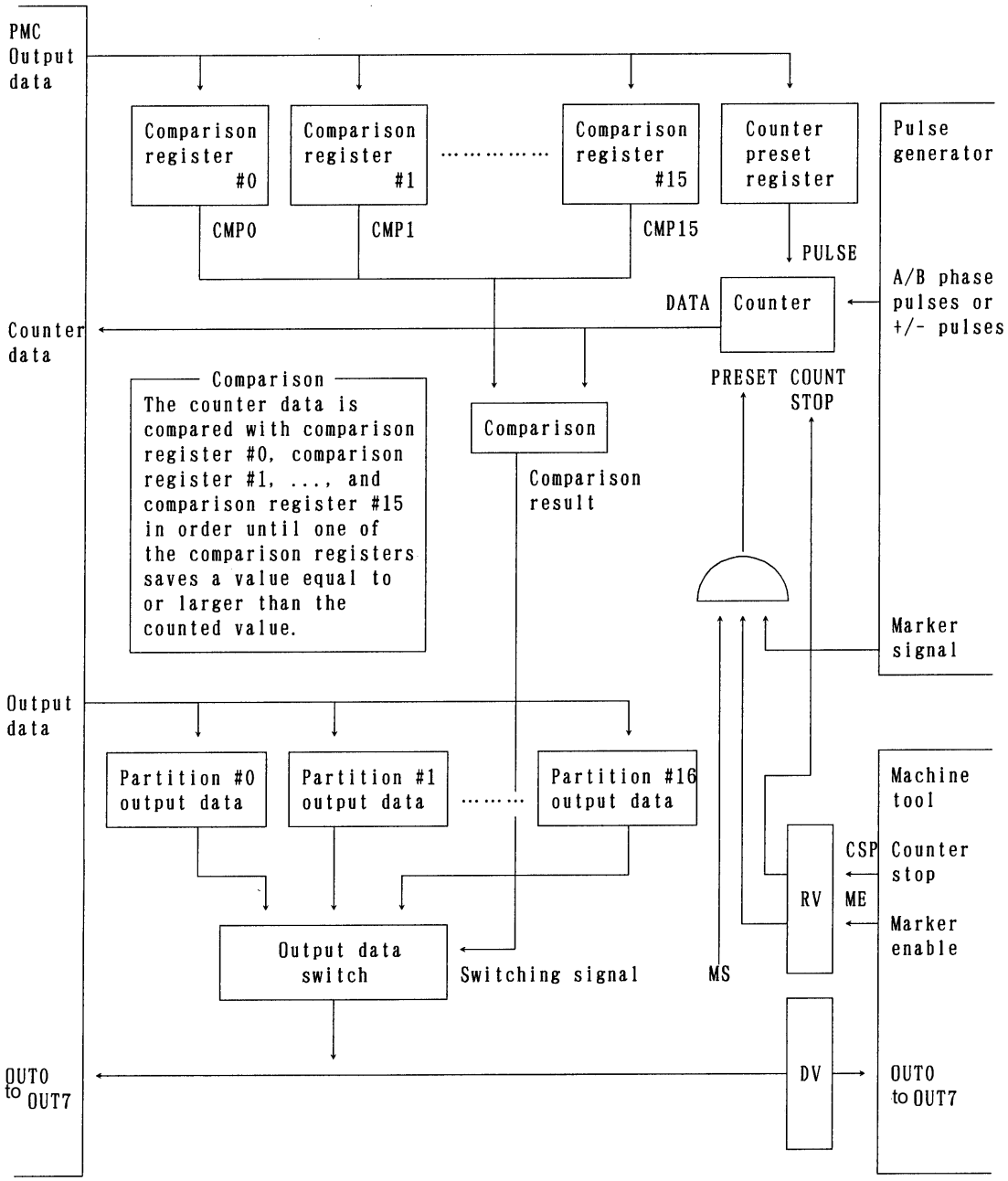
	Mode A	**Mode B**
Number of comparison registers	3	16
Comparison output (PMC)	1bit	8bit
Comparison output (SSR)	1bit	8bit
PMC occupation area	Input 4 bytes Output 4 bytes	Input 8 bytes Output 4 bytes

Shown below are configuration diagrams, briefing either mode.

A. Mode A


PMC
Output
data
Comparison
register A
Comparison
register B
Comparison
register C
Counter
preset
register
Pulse
generator
PULSE
Comparison
control
register
DATA
Counter
A/B phase
pulses or
+/-
pulses
CMA
CMB
CMC
PRESET
COUNT
STOP
Counter
data
Marker
signal
≧
<
Comparison
A
Comparison
B
Comparison
C
Machine
tool
CMA
CMB
CMC
CSP
Counter
stop
Switch A
Switch B
Switch C
RV
ME
Marker
enable
Switch
MS
CMPA
CMPB
CMPC
DV
CMPA
CMPB
CMPC

B. Mode B


PMC Output data
Comparison register #0
Comparison register #1
Comparison register #15
Counter preset register
Pulse generator
CMP0
CMP1
CMP15
PULSE
A/B phase pulses or +/- pulses
DATA
Counter
Counter data
Comparison
The counter data is compared with comparison register #0, comparison register #1, ..., and comparison register #15 in order until one of the comparison registers saves a value equal to or larger than the counted value.
Comparison
Comparison result
PRESET
COUNT
STOP
Marker signal
Output data
Partition #0 output data
Partition #1 output data
Partition #16 output data
Machine tool
CSP
Counter stop
RV
ME
Marker enable
Output data switch
Switching signal
MS
DV
OUT0 to OUT7
OUT0 to OUT7

8.2 SPECIFICATIONS OF HIGH-SPEED COUNTER MODULE

8.2.1 Pulse Counter

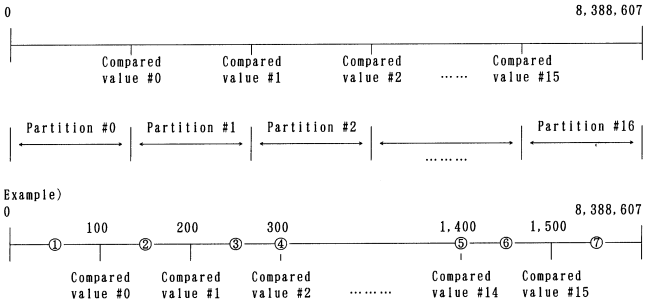
(1) Binary up/down counter (1)
(2) Counter capacity
0 to 8,388,607
(3) Counter data
The pulse counter can preset data and read count data.

8.2.2 Comparison Function

(1) Mode A
A. Comparison register (23 bits)
Comparison registers A, B, and C are provided. The values to be compared are preset in the comparison registers.
B. Comparison output
The results (CMPA, CMPB, and CMPC) of comparing the count data in the pulse counter with the data set in the comparison registers are output.
C. Comparison output values
The comparison output values are set as listed in the table below. The values depend on the states of CMA, CMB, and CMC, the comparison mode signals from the PMC.

	Counter value ≤ comparison register value	**Counter value > comparison register value**
CMA=0 CMB=0 CMC=0	CMPA=0 CMPB=0 CMPC=0	CMPA=1 CMPB=1 CMPC=1
CMA=1 CMB=1 CMC=1	CMPA=1 CMPB=1 CMPC=1	CMPA=0 CMPB=0 CMPC=0

(2) Mode B
A. Comparison register (23 bits)
There are 16 comparison registers #0,#1, ...,#15. The values to be compared are preset in the comparison registers. The preset value in a comparison register having a larger register number should be larger than that in a comparison register having a smaller register number, as follows:
Value in register #0 < value in register #1< ... < value in register #14 < value in register 15
B. Comparison output
The results (OUT0 to OUT7) of comparing the count data in the pulse counter with the data set in the comparison registers are output.
C. Comparison output values
The count data in the pulse counter is compared with the values in the comparison registers in sequential order from register 0 until the count data is equal to or less than the value in a comparison register. This enables a partition to be made which includes the count data. Then the output data for the partition (which is previously preset) is output. Eight output points (OUT0 to OUT7) are provided.
If the count data is equal to the value in a comparison register, the data in the partition having the same number as the register number is output.



Assume that, when count data is in partition #n, the data to be output is set to respective values in hexadecimal as listed below.

Output data from partition #0 = 0H
Output data from partition #1 = 1H
Output data from partition #2 = 2H
Output data from partition #3 = 3H
Output data from partition #4 = 4H
Output data from partition #5 = 5H
Output data from partition #6 = 6H
Output data from partition #7 = 7H
Output data from partition #8 = 8H
Output data from partition #9 = 9H
Output data from partition #10 = 10H
Output data from partition #11 = 11H
Output data from partition #12 = 12H
Output data from partition #13 = 13H
Output data from partition #14 = 20H
Output data from partition #15 = 21H
Output data from partition #16 = FFH

The output data is set as listed in the table below, depending on the counter values in ① to ⑦ above.

	Partition	OUT								
		7	6	5	4	3	2	1	0	HEX value
①	0≤Counter value≤100	0	0	0	0	0	0	0	0	0h
②	100<Counter value≤200	0	0	0	0	0	0	0	1	1h
③	200<Counter value≤300	0	0	0	0	0	0	1	0	2h
④		0	0	0	0	0	0	1	0	2h
⑤	Comparison value in partition 14<Counter value≤1400	0	0	1	0	0	0	0	0	20h
⑥	1400<Counter value≤1500	0	0	1	0	0	0	0	1	21h
⑦	1500<Counter value≤8,388,607	1	1	1	1	1	1	1	1	FFh

NOTE

1 Preset an increasingly larger value in each of the compare registers (#0, #1, ..., #15) as the register number becomes larger.
Unless this condition is satisfied, it is likely that no normal compensation may take place, leading to an abnormal compare output.

2 When using 15 or less partitions, it is not necessary to set all of 16 partitions.
Example)
Count value
0 to 100 Partition #0
101 to 1000 Partition #1
1001 to Partition #2
In this case, partition #3 and later do not need to be set.

8.2.3 Pulse Interface

The following three types of pulses are entered in the high-speed counter module.

A. Phase A/B pulses: The phase difference between these detection pulses is 90°

B. +/- pulses: These detection pulses are separated in the positive and negative directions.

Select either type of the detection pulse.

C. Marker signal: Used to preset data in the pulse counter.

(1) Phase A/B pulse interface
The phase A/B pulses are selected when the PSEL signal is open.

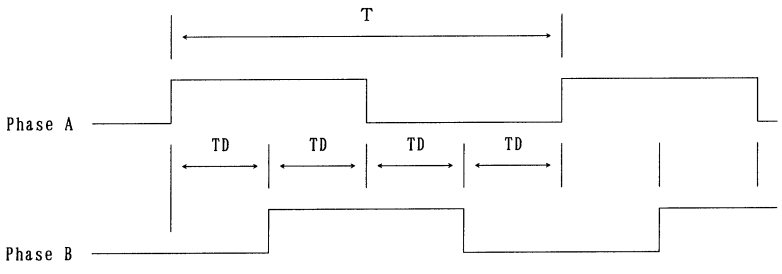
A. Interface IC
The signal of the pulse generator connected to the high-speed counter module is equivalent to that of the line driver SN75113. It also equivalent to that of the AM26LS31. The signals involved are the equilibrium transmission signals shown below.

(The PB and MKS signals are the same, respectively, as PA and *PB. The *MKS signal is the same as *PA.)

For the receiver of this module, the voltage rating is 0 to 5 V, Voh = 2.0 V or higher, and Vol = 0.8 V or lower. The pulse generator to be connected to the module must have a driver that meets these voltage requirements.

If you want to use a commercial rotary encoder as the pulse generator, select "line driver type output" that meets the above voltage requirements. The other output types (such as open-collector output or voltage output type) cannot be used.

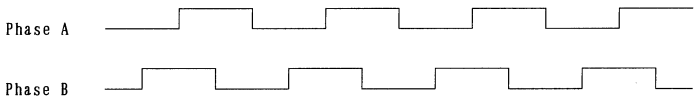
B. Maximum frequency =125KHz



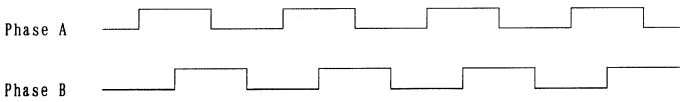
Tmin. =8μS (minimum period)
TDmin. =1.2μS (minimum time between edges)

C. Count and direction
A counter multiplied by four compared to phase A and B pulses is provided. It counts positive when phase A advances before phase B and it counts negative when phase B advances before phase A.

Positive count
Advance of phase A before phase B



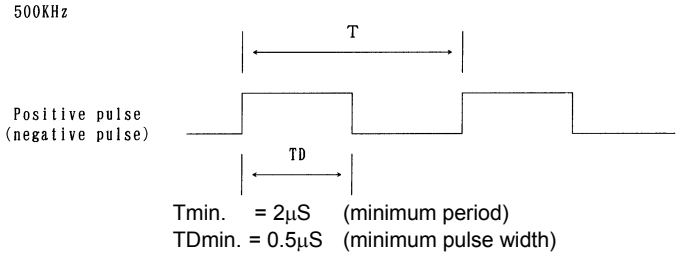
Negative count
Advance of phase B before phase A



(2) Positive/negative pulse interface
Positive and negative pulses are selected when the PSEL signal is connected to 0 VDC.

A. Interface IC
See Paragraph A, "Interface IC", in Item (1), "Phase A/B pulse interface".

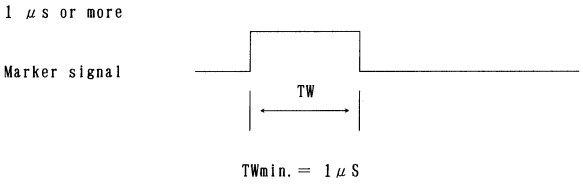
B. Maximum frequency



(3) Marker signal

A. Interface IC
Use differential drivers (SN75113 or equivalent) at the output ports of the pulse generator.

B. Minimum pulse width



8.2.4 External Contact Input

The pulse counter module uses insulating receivers (having a voltage rating of 24 VDC) at the input ports. The following two types of signal inputs are provided.

(1) Marker enable signal input (ME)
The contact of the marker enable signal is closed to make the marker signal valid.
This enables data to be preset in the counter.

(2) Count stop signal input (CSP)
The contact of the count stop signal is closed to stop the count operation.

8.2.5 External Contact Output

Solid state relays (SSR) are used for the contacts.

(1) Mode A
The comparison mode signal outputs A, B, C (CMPA, CMPB, and CMPC) are provided in mode A. These outputs indicate the results of comparing the comparison registers A, B, and C with the pulse counter. The comparison output values are determined depending on whether the control mode signals (CMA, CMB, and CMC) from the PMC are set to 1 or 0.

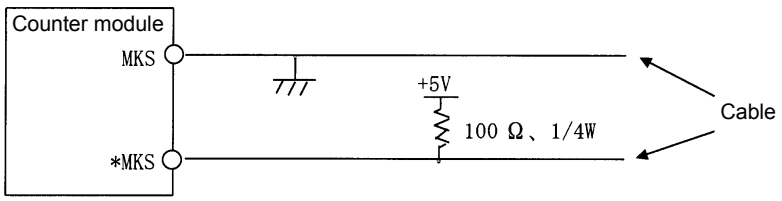
(2) Mode B
The results of comparing comparison register #0, comparison register #1, ..., comparison register #15 with the pulse counter are provided in mode B. The comparison output indicates the values in the output data registers for the partitions in which the count data is located. Eight output points are provided. (See Section 8.2.2 (2))

8.2.6 Marker Processing

(1) Mode A
A. Synchronization with marker
The counter value is set to the data in the counter preset register at the rising edge of the first marker signal with the MS signal output from the PMC set to 1 and the contact of the marker enable signal input (ME) from the machine closed.
B. Marker hold
The MH signal is set to 1 at the rising edge of the first marker signal with the MS signal output from the PMC set to 1 and the contact of the marker enable signal input (ME) from the machine closed. The MH signal is reset when the marker hold reset (MHR), an output signal from the PMC, is set to 1 or the MS signal output from the PMC is set to 0.

(2) Mode B
A. Synchronization with marker
When the MS signal output from the PMC is 1 and the contact of the marker enable (ME) signal input from the machine is closed, the counter is set to the data in the counter preset register at the rising edge of the first marker signal.
B. Maker hold
When the MS signal output from the PMC is 1 and the contact of the marker enable (ME) signal input from the machine is closed, the MH signal is set to 1 at the rising edge of the marker signal. The MH signal is reset when the MS signal output from the PMC is set to 0.

(3) Pin treatment when no marker signal is used
If you use (that is, preset) no marker signal, treat the corresponding pin as shown below. Otherwise, a broken-wire alarm will be raised. The counter keeps running even after a broken-wire alarm is raised, though.



If the treatment shown above cannot prevent a broken-wire alarm from being raised, make sure that the GND terminal of the pulse generator is connected to the LGND (0V) pin of the JA9 connector.

8.2.7 LED indicators

The high-speed counter module has the following indicators.

(1) OK indicator
See below Table.

(2) ALM0 and ALM1 indicators
See below Table.

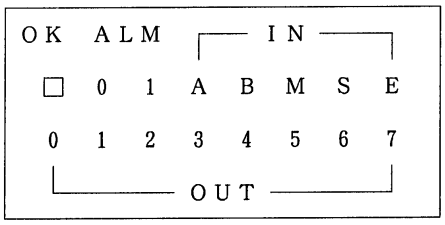
(3) Phase A and B pulses (positive and negative pulses) input signal indicators (A and B)
The phase A pulse input signal indicator is on when the phase A pulse input is active.
The phase B pulse input signal indicator is on when the phase B pulse input is active.
If the pulse remains "1" (high) only for a short time and has a long period, it is difficult to recognize a blinking LED.

(4) Marker signal indicator (M)
The marker signal indicator is on while the marker signal (MP) from the pulse generator is active.

(5) Count stop signal indicator (S)
The count stop signal indicator is on when the contact of the count stop signal input sent from the machine is closed.

(6) Marker enable signal indicator (E)
The marker enable signal indicator is on when the contact of the marker enable signal input sent from the machine is closed.

(7) Comparison result output indicators (OUT0, OUT1, OUT2, OUT3, OUT4, OUT5, OUT6, and OUT7)
A. Mode A
The indicators OUT0, OUT1, and OUT2 correspond to the signals CMPA, CMPB, and CMPC. OUT1 goes on when CMPA goes on, OUT2 goes on when CMPB goes on, and OUT3 goes on when CMPC goes on.
B. Mode B
The indicators OUT0-OUT7 go on corresponding to when the output data OUT0-OUT7 resulting from the comparisons between the count data and comparison resisters are set to 1.



LED indicator panel

OK	ALM0	ALM1	Explanation of alarm
●	●	○	Disconnection alarm
○	●	○	Self-diagnosis alarm, RAM error
○	○	●	Self-diagnosis alarm, ROM error
○	●	●	Watch dog alarm
●	○	○	Normal operation

● : On
○ : Off

The state of the OK, ALM0, or ALM1 is not held.

8.3 PMC INTERFACE

8.3.1 Mode A

(1) PMC I/O area
In mode A, four input bytes and four output bytes are used as the I/O area. The bytes in the I/O area have the following names. The input and output directions are specified on the basis of the PMC. The operation mode is set to mode A at power-on.

(a) Output data (sent from PMC to high-speed counter module)

0	**CTRL (control)**
+1	**DTOH (higher 8-bit data)**
+2	**DTOM (middle 8-bit data)**
+3	**DTOL (lower 8-bit data)**

(b) Input data (entered from high-speed counter module to PMC)

0	**CNTS (counter H and status)**
+1	**CNTM (middle 8 bits of counter)**
+2	**CNTL (lower 8 bits of counter)**
+3	**STTS (status)**

(2) PMC outputs (entered from PMC to high-speed counter module)
The PMC outputs are separated into control output CTRL and data outputs DTOH, DTOM, and DTOL. As with normal DOs, the control outputs of bit 3 to bit 7 are controlled independently. The control outputs of bit0 to bit2 constitute the SELECT indicating the target data specified by DTOH, DTOM, and DTOL.

(a) Control output

CTRL

7	6	5	4	3	2	1	0
MHR	**MS**		**CE**	**PRS**	**SELECT**		

PRS Preset
CE Count enable
MS Marker synchronization
MHR Marker hold reset

(b) Details of DTOH, DTOM, and DTOL
The SELECT bits indicate the target data.

SELECT	
0	CCTR (comparison control)
1	Counter preset data
2	Comparison register A
3	Comparison register B
4	Comparison register C
7	Change to mode B

NOTE
1 Change to mode B: See Subsection 8.3.2, "Mode B".
2 Detail of CCTR
DTOH

7	6	5	4	3	2	1	0
					CMC	CMB	CMA

The DTOM and DTOL are ignored.

(3) PMC inputs (entered from high-speed counter module to PMC)

The inputs to the PMC include the status and counter data. The data is shown below.

0	CNTS (counter H and status)
+1	CNTM (middle 8 bits of counter)
+2	CNTL (lower 8 bits of counter)
+3	STTS (status)

NOTE
1 Details of CNTS

7	6	5	4	3	2	1	0
TRA	Counter H (most significant 7 bits)						

TRA : Transfer A
2 Details of STTS

7	6	5	4	3	2	1	0
TRB	ALM	CSP	ME	MH	CMPC	CMPB	CMPA

CMPA : Comparison output A
CMPB : Comparison output B
CMPC : Comparison output C
MH : Marker hold
ME : Marker enable
CSP : Count stop
ALM : Alarm (disconnection or watch dog alarm)
TRB : Transfer B

8.3.2 Mode B

Change to mode B
The operation mode is set to mode A at power-on. The following data is output to the counter module and the mode changes from A to B. The mode cannot change from B to A.

0	CTRL : 0FH (SELECT = 7, PRS = 1)
+1	DTOH : 01H
+2	DTOM : 00H
+3	DTOL : 00H

(1) PMC I/O area
In mode B, eight input bytes and four output bytes are used as the I/O area. The bytes in the I/O area have the following names. The input and output directions are specified on the basis of the PMC.

(a) Output data (sent from PMC to high-speed counter module)

0	CTRL (control)
+1	DTOH (higher 8-bit data)
+2	DTOM (middle 8-bit data)
+3	DTOL (lower 8-bit data)

(b) Input data (entered from high-speed counter module to PMC)

0	CNTS (counter H and status)
+1	CNTM (middle 8 bits of counter)
+2	CNTL (lower 8 bits of counter)
+3	STTS (status)
+4	OUTD
+5	MODD
+6	Unused
+7	Unused

(2) PMC outputs (outputs from PMC)

The PMC outputs are separated into control output (CTRL) and data outputs (DTOH, DTOM, and DTOL). As with normal DOs, the control outputs of bit 5 to bit 7 are controlled independently. The control outputs of bit 0 to bit 4 constitute SELECT indicating the target data specified by DTOH, DTOM, and DTOL.

(a) Control outputs

CTRL

7	6	5	4	3	2	1	0
MS	CE	PRS	SELECT				

PRS Preset
CE Count enable
MS Marker synchronization

(b) Details of DTOH, DTOM, and DTOL

Enter the comparison value and preset value (24 bits) to the DTOH, DTOM, and DTOL.
Enter a comparison result (8 bits) output for each partition, respectively, to the DTOH, DTOM, and DTOL.

SELECT	Target data	
0	Comparison data : Specify a comparison value (24 bits) for partition #0.	
1	Comparison data : Specify a comparison value (24 bits) for partition #1.	
2	Comparison data : Specify a comparison value (24 bits) for partition #2.	
3	Comparison data : Specify a comparison value (24 bits) for partition #3.	
4	Comparison data : Specify a comparison value (24 bits) for partition #4.	
5	Comparison data : Specify a comparison value (24 bits) for partition #5.	
6	Comparison data : Specify a comparison value (24 bits) for partition #6.	
7	Comparison data : Specify a comparison value (24 bits) for partition #7.	
8	Comparison data : Specify a comparison value (24 bits) for partition #8.	
9	Comparison data : Specify a comparison value (24 bits) for partition #9.	
10	Comparison data : Specify a comparison value (24 bits) for partition #10.	
11	Comparison data : Specify a comparison value (24 bits) for partition #11.	
12	Comparison data : Specify a comparison value (24 bits) for partition #12.	
13	Comparison data : Specify a comparison value (24 bits) for partition #13.	
14	Comparison data : Specify a comparison value (24 bits) for partition #14.	
15	Comparison data : Specify a comparison value (24 bits) for partition #15.	
16	Comparison output data (8 bits) for partition #0 to #2	Partition #0: DTOH
		Partition #1: DTOM
		Partition #2: DTOL

SELECT	Target data	
17	Comparison output data (8 bits) for partition #3 to #5	Partition #3: DTOH
		Partition #4: DTOM
		Partition #5: DTOL
18	Comparison output data (8 bits) for partition #6 to #8	Partition #6: DTOH
		Partition #7: DTOM
		Partition #8: DTOL
19	Comparison output data (8 bits) for partition #9 to #11	Partition #9: DTOH
		Partition #10: DTOM
		Partition #11: DTOL
20	Comparison output data (8 bits) for partition #12 to #14	Partition #12: DTOH
		Partition #13: DTOM
		Partition #14: DTOL
21	Comparison output data (8 bits) for partition #15 and #16	Partition #15: DTOH
		Partition #16: DTOM
22	Counter preset data (24 bits)	

(The numbers of DTOH, DTOM, and DTOL indicate the output data for the partitions specified by the numbers.)

(c) PMC inputs (inputs to PMC)
The inputs to the PMC include the status and counter data. The data is shown below.

0	**CNTS (counter H and status)**
+1	**CNTM (middle 8 bits of counter)**
+2	**CNTL (lower 8 bits of counter)**
+3	**STTS (status)**
+4	**OUTD**
+5	**MODD**
+6	**Not used**
+7	**Not used**

NOTE

1 Detail of CNTS

7	6	5	4	3	2	1	0
TRA	Counter H (most significant 7 bits)						

TRA : Transfer A

2 Detail of STTS

7	6	5	4	3	2	1	0
TRB	**ALM**	**CSP**	**ME**	**MH**			

MH : Marker hold
ME : Marker enable
CSP : Count stop
ALM : Alarm (disconnection or watch dog alarm)
TRB : Transfer B

NOTE

3 Detail of OUTD

7	6	5	4	3	2	1	0
OUT7	OUT6	OUT5	OUT4	OUT3	OUT2	OUT1	OUT0

OUT0 : Bit 0 of comparison output
OUT1 : Bit 1 of comparison output
OUT2 : Bit 2 of comparison output
OUT3 : Bit 3 of comparison output
OUT4 : Bit 4 of comparison output
OUT5 : Bit 5 of comparison output
OUT6 : Bit 6 of comparison output
OUT7 : Bit 7 of comparison output

4 Detail of MODD

7	6	5	4	3	2	1	0
							MOD0

MOD0 : Set to 1 after the mode changes to B.

8.3.3 Details of PMC Interface Signals

(1) PMC inputs (inputs from PMC)

(a) TRA and TRB
The counter data is valid when TRA is equal to TRB and invalid when TRA is not equal to TRB.

(b) CMPA, CMPB, and CMPC (comparison output signals A, B, and C, only in mode A)
The CMPA, CMPB, and CMPC signals are output signals resulting from the comparison between the comparison registers A, B, and C and the counter data, respectively. The output levels of CMPA, CMPB, and CMPC are determined by the comparison mode signals CMA, CMB, and CMC.
When CMA, CMB, and CMC are 0, and the counter data is larger than the values in comparison registers A, B, and C, CMPA, CMPB, and CMPC are set to 1.
When CMA, CMB, and CMC are 1, and the counter data is equal to or less than the values in comparison registers A, B, and C, CMPA, CMPB, and CMPC are set to 1.

(c) OUT0 to OUT7 (comparison output signal 0 to comparison output signal 7, only in mode B)
OUT0 - OUT7 correspond to bit 0 to bit 7 in the comparison result output of a single byte.

(d) MH (marker hold signal)
The marker hold signal MH is set to 1 at the rising edge of the marker signal when the marker enable signal is 1. The marker hold signal is reset when MHR=1 or MS=0. (In mode B, the marker hold signal MH is reset only when MS=0.)

(e) ME (marker enable signal)
The marker enable signal ME enables the marker signal as follows:
ME=1: Marker signal enabled
ME=0: Marker signal disabled

(f) CSP (count stop signal)
The counter stops counting when the contact for the external input signal CSP is closed.

(g) ALM (alarm signal)
The alarm signal ALM is set to 1 if the signal line for the count pulse or the marker signal is disconnected or short-circuited.
ALM is also set to 1 if a watchdog alarm occurs due to a failure in the CPU in the module.

(2) PMC outputs (outputs from PMC)

(a) SELECT (selection signal)
The SELECT signal selects the register in which data will be set. That is, the signal specifies the register for presetting data. The SELECT signal should be set when or before the PRS signal is reversed.

(b) PRS (preset signal)
The PRS signal presets data in registers. If data is set in DTOH, DTOM, and DTOL and then PRS is reversed, the data is set in the register specified by SELECT. Reversing the PRS signal means that PRS changes from level 0 to level 1 or vise versa.
DTOH, DTOM, DTOL, and SELECT should not be changed within two scans after the PRS is reversed. Also, the PRS must not reversed again within this period.
When SELECT=1, data is set in both the counter preset register and the counter.
Data is set by setting the first PRS to 1 after power-on or after the mode changes to B.

(c) CE (count enable signal)
The CE signal determines whether the counter counts. When the CE is set to 1 and the external input signal CSP closes the contact, the counter retains its value, instead of counting. When CE = 1 and the CSP external input contact is open, the counter counts input pulses. Presetting the counter requires maintaining CE = 0.

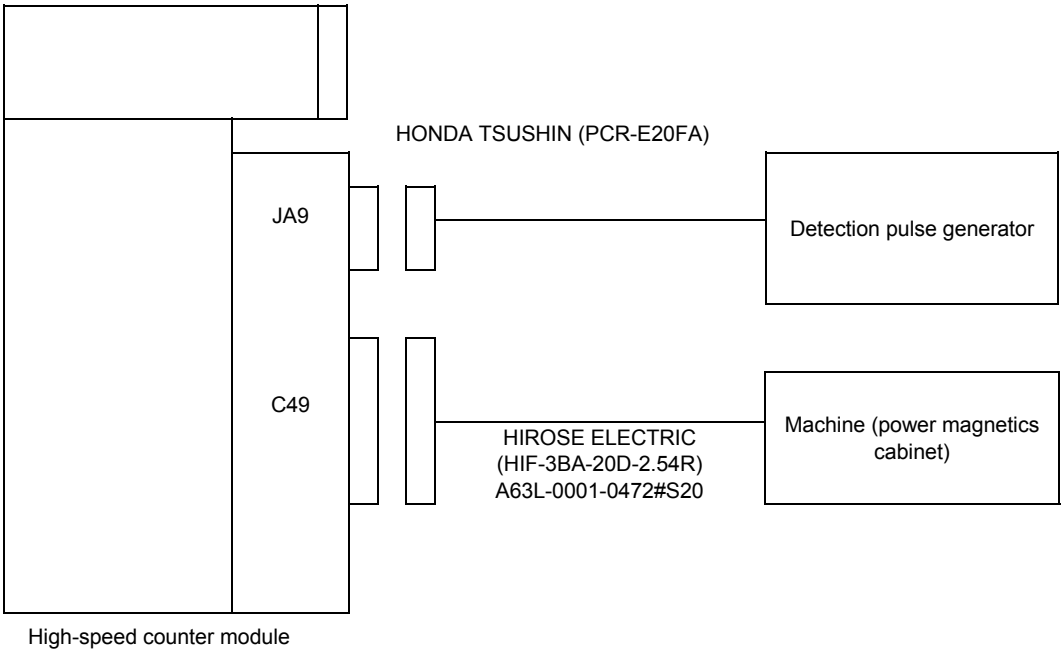
(d) MS (marker synchronization signal)
The MS signal determines whether marker synchronization is provided. When the MS is 1 and the contact of external input signal ME is closed, the counter is preset to the value in the counter preset register at the rising edge of the first marker signal.
For mode A, after presetting:
<1> Set MS bit ($0 \rightarrow 1$) again, or
<2> Reset MHR bit ($1 \rightarrow 0$).
When either of the above conditions is satisfied, marker synchronization is established again.
(Note that item <2> is unusable for mode B.)

(e) MHR (marker hold reset signal, only in mode A)
The MHR signal resets the marker hold (MH) signal which is output to the PMC. The MHR is set to 1 to reset the marker hold signal.

(f) CMA, CMB, and CMC (comparison mode signals A, B, and C, only in mode A)
The CMA, CMB, and CMC signals specify the levels of the comparison outputs A, B, and C (CMPA, CMPB, and CMPC), respectively.
When CMA, CMB, and CMC are 0, and the value of the counter is larger than the values in comparison registers A, B, and C, CMPA, CMPB, and CMPC are set to 0.
When CMA, CMB, and CMC are 1, and the value of the counter is equal to or less than the values in comparison registers A, B, and C, CMPA, CMPB, and CMPC are set to 1.

8.4 TOTAL CONNECTION OF HIGH-SPEED COUNTER MODULE

8.4.1 Connection Diagram



8.4.2 Connector Signal List

JA9

9	+5V	10		19		20	+5V
7	LGND	8	PSEL	17		18	+5V
5	MKS	6	*MKS	18		16	LGND
3	PBS	4	*PBS	13		14	LGND
1	PAS	2	*PAS	11		12	LGND

PAS Phase A pulse input signal (Negative pulse input signal) (positive)
*PAS Phase A pulse input signal (Negative pulse input signal) (negative)
PBS Phase B pulse input signal (Positive pulse input signal) (positive)
*PBS Phase B pulse input signal (Positive pulse input signal) (negative)
MKS Marker signal (positive)
*MKS Marker signal (negative)
PSEL Pulse select signal
+5V 5V (output from this module)
LGND 0V

8.4.2.1 C49 signal (for mode A)

C49

	A	B
01	ME	
02	CSP	
03	COM1	
04		
05		
06	CMP A	
07	CMP B	
08	CMP C	
09		
10	COM2	

ME Marker enable signal input
CSP Counter stop signal input
CMP A Comparison result output
CMP B Comparison result output
CMP C Comparison result output
COM1 Common signal for ME and CSP
COM2 Common signal for comparison result output CMP A to comparison result output CMP C

8.4.2.2 C49 signal (for mode B)

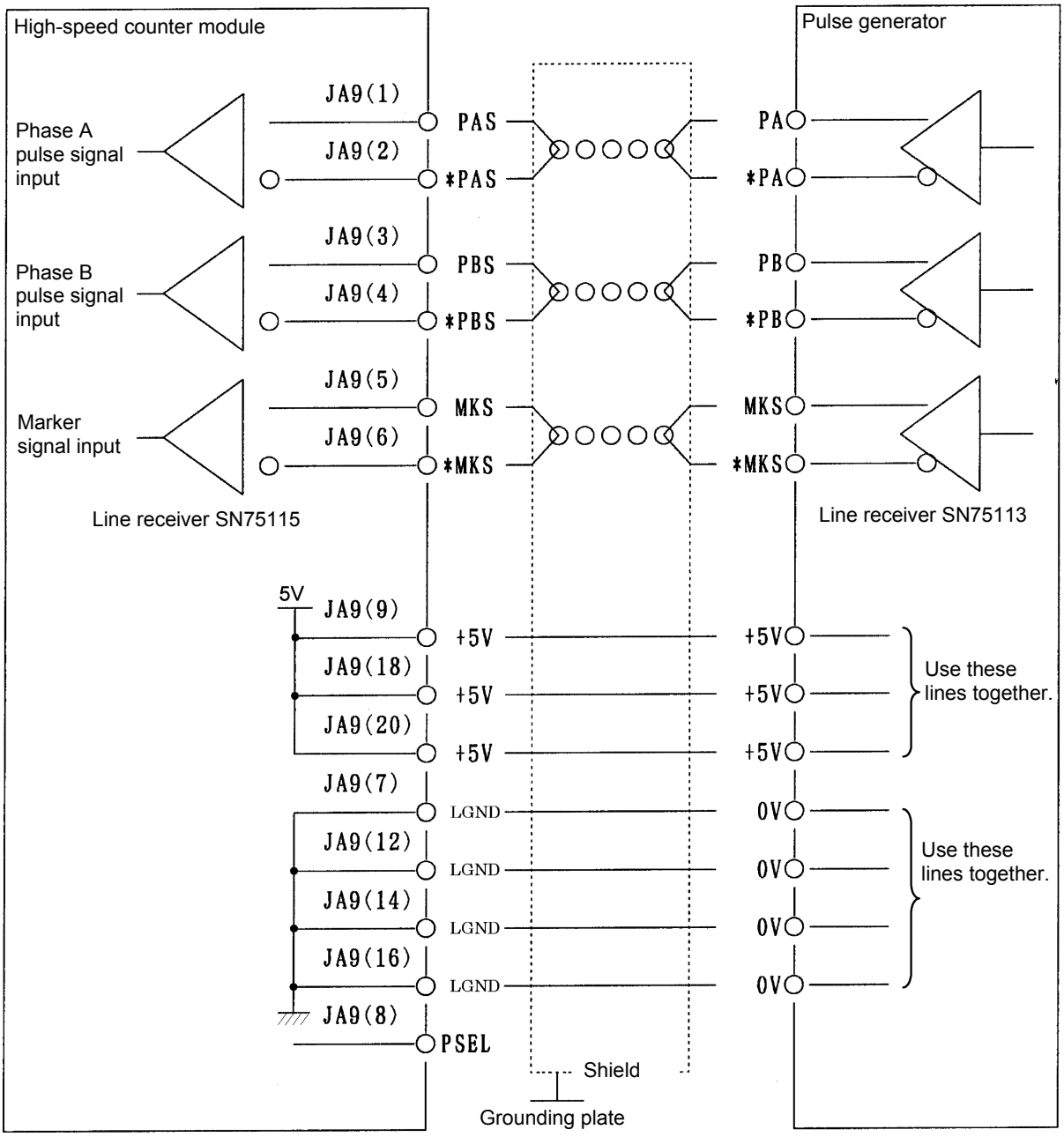
C49

	A	B
01	ME	
02	CSP	
03	COM1	
04		
05		
06	OUT0	OUT4
07	OUT1	OUT5
08	OUT2	OUT6
09	OUT3	OUT7
10	COM2	COM3

ME Marker enable signal input
CSP Counter stop signal input
OUT0 Comparison result output
OUT1 Comparison result output
OUT2 Comparison result output
OUT3 Comparison result output
OUT4 Comparison result output
OUT5 Comparison result output
OUT6 Comparison result output
OUT7 Comparison result output
COM1 Common signal for ME and CSP
COM2 Common signal for comparison result output 0 to comparison result output 3
COM3 Common signal for comparison result output 4 to comparison result output 7

8.5 CONNECTION WITH PULSE GENERATOR

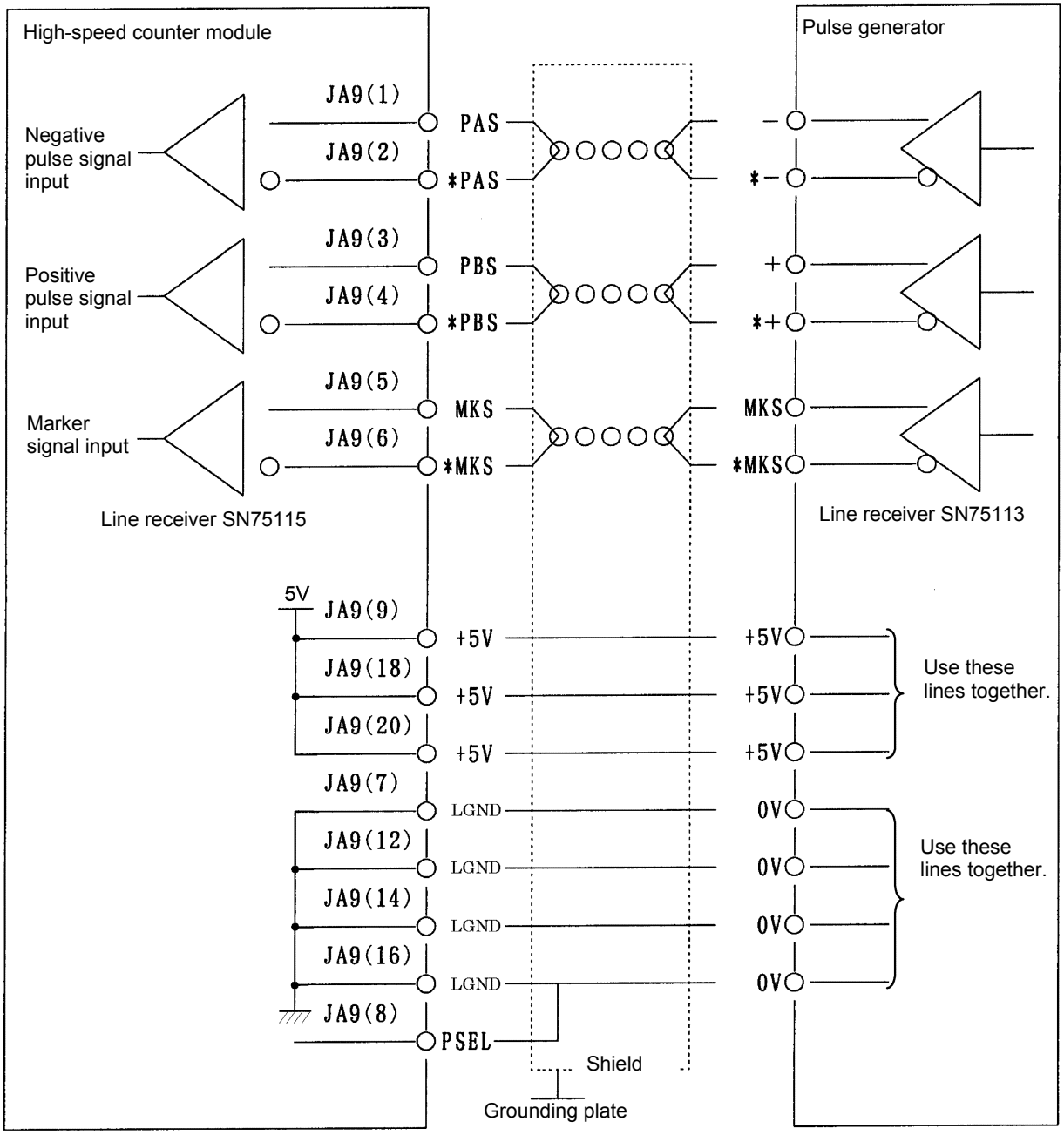
8.5.1 Use of Phase A and B Pulses



(*) The maximum current rating for each 5-V output is 300 mA.

Recommended cable
A66L-0001-0286 (#20AWG×7, #24AWG×3 Pairs)

8.5.2 Use of Positive/Negative Pulses

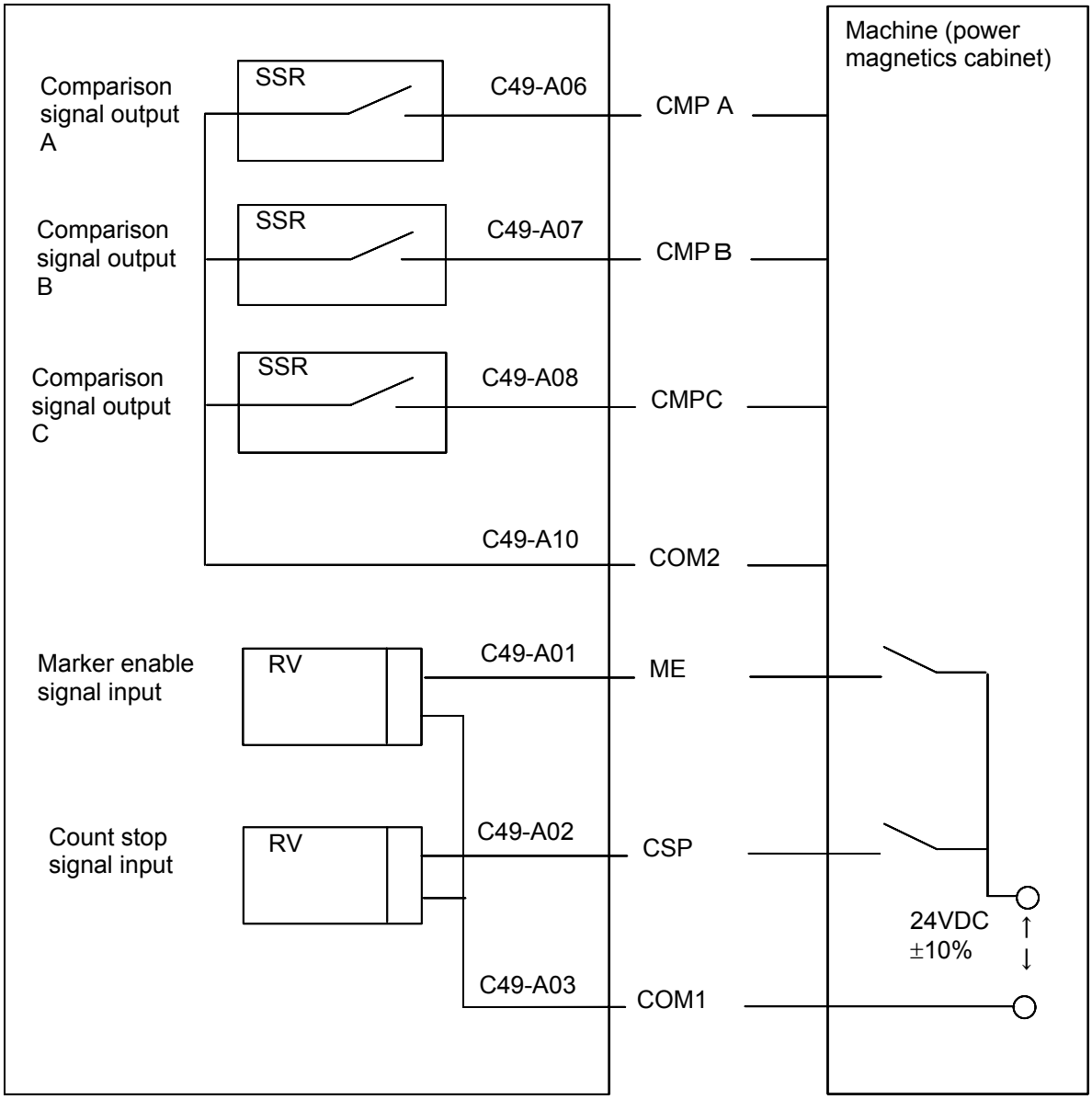


(*) The maximum current rating for each 5-V output is 300 mA.

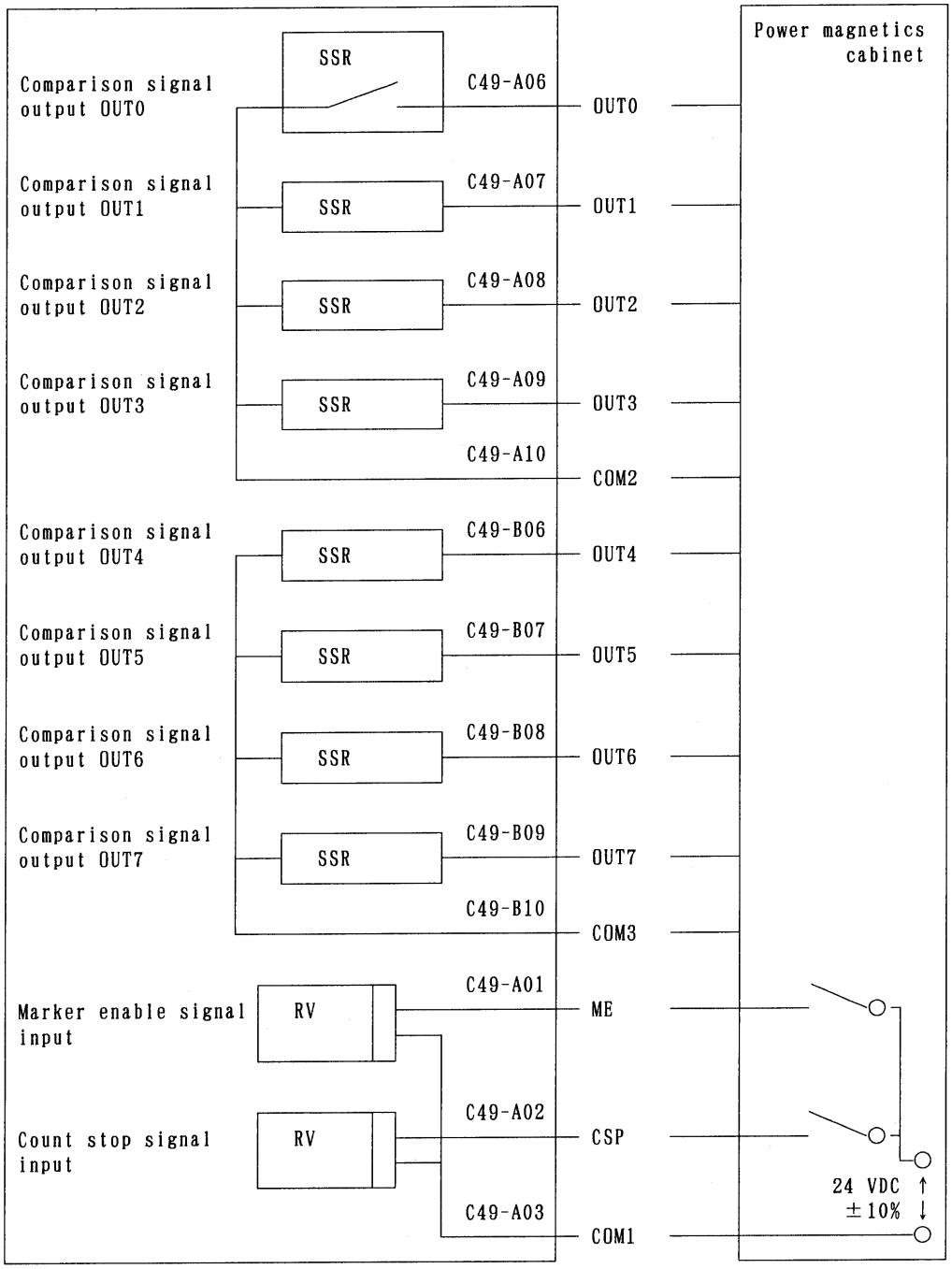
Recommended cable
A66L-0001-0286 (#20AWG×8, #24AWG×3 Pairs)

8.6 CONNECTION WITH MACHINE (POWER MAGNETICS CABINET)

8.6.1 Use in Mode A



8.6.2 Use in Mode B



8.7 I/O SIGNALS CONVENTIONS

8.7.1 Solid State Relay Output Signals (OUT0 to OUT7)

The solid state relay output signals drive relays in the machine (power magnetics cabinet) side and indicator LEDs.

(1) Solid state relays

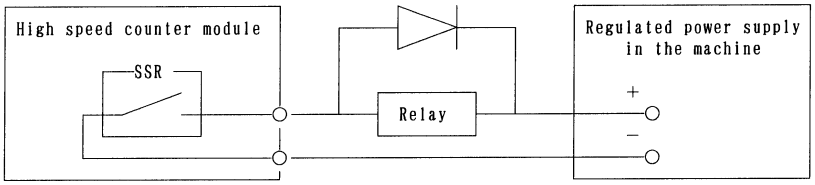
(a) Maximum load current at output-on
250 mA: Up to three outputs set to on
125 mA: Eight outputs set to on

(b) Saturation voltage at output-on
Not more than 6 × IL [V] (IL: load current)

(c) Withstand voltage at output-off
30 VDC max. even for instantaneous voltage

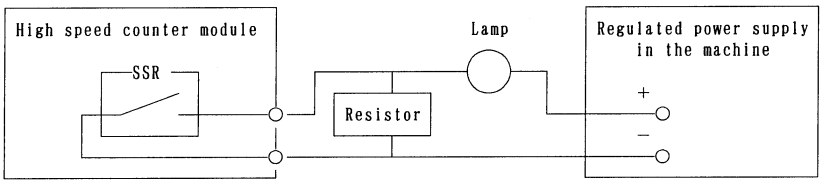
(d) Leak current at output-off
Not more than 100μA

(2) Output circuit



(3) Always install surge arresters when inductive loads such as relays are connected in the machine. Insert the surge arresters as near the load as possible (less than 20 cm). When capacitive loads are used in the machine, insert current limiting resistors in series with the loads to prevent the instantaneous current and voltage from exceeding the rated values.

(4) If a lamp is turned on by a solid state relay output, the resulting surge current may damage the solid state relay. Thus, as shown in the figure below, provide a protective resistor to prevent the instantaneous current and voltage from exceeding the rated values.



8.7.2 DC Input Signals (ME and CSP)

The DC input signals (such as relay contact signal) are sent from the machine (control circuit) to the high-speed counter module.

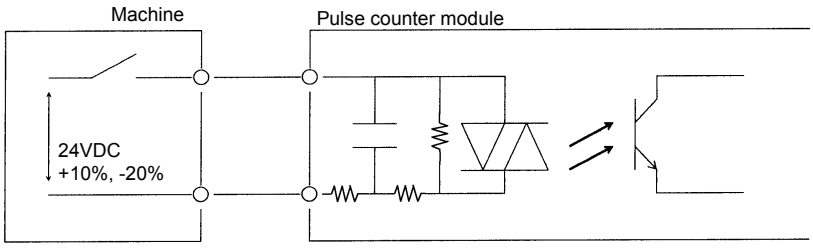
(1) Input conditions
On voltage and current: 15 VDC or more, 4.5 mA or more
Off voltage and current: 6 VDC or less, 2 mA or less
Response time: 20 ms or less

(2) Voltage and polarity
Voltage : 24 VDC +10%, -20%
Polarity : Positive or negative polarity available (The power is not supplied from the high-speed counter module.)

(3) Logical correspondence

Contact	Logic
Open	0
Closed	1

(4) Receiver circuit of DC input signal



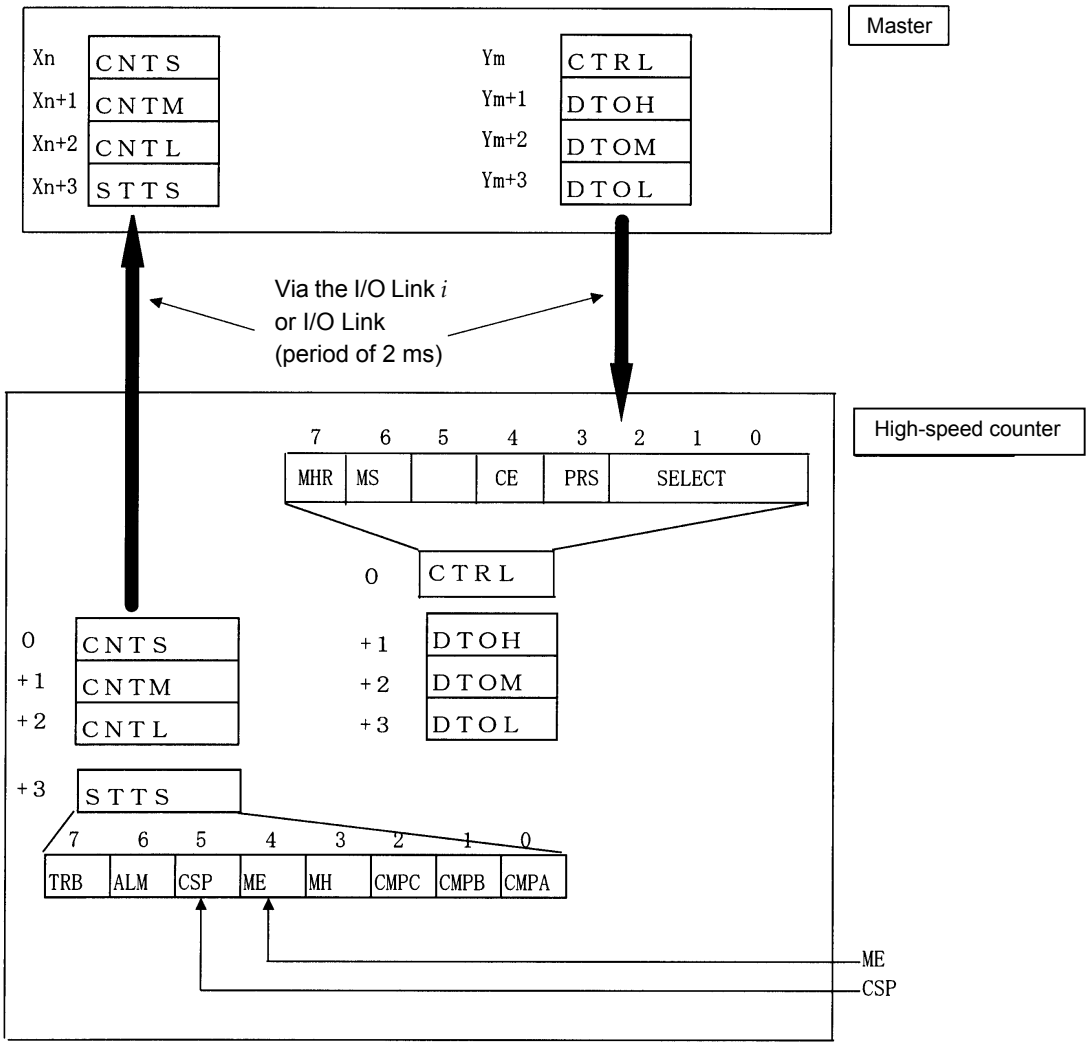
8.7.3 +5-V Output from JA9 Connector

- A voltage of +5 V on the JA9 connector of this module is the output of the counter module (300 mA maximum).
  It is necessary to satisfy Table 4.4 in Section 4.4, "Required Current", though.
  Example:
  Assuming that 100 mA is supplied from the +5-V pin of the JA9 connector:$170 + 0.3 \times 100 = 200$
  Thus, the required current is 200 mA.

8.8 SUPPLEMENT

8.8.1 Configuration of Mode A

How mode A is configured is shown below. The contents of the CNTS, CNTM, CNTL, and STTS on a high-speed counter module are sent to the X area assigned on the master via the I/O Link *i* or I/O Link. The contents of the Y area assigned on the master are sent to CTRL, DTOH, DTOM, and DTOL on the high-speed counter module, via the I/O Link *i* or I/O Link.



8.8.2 Counter Presetting and Counting

(1) Presetting a counter value (using the external signal MKS)
To preset a counter value, using the MKS signal, follow this procedure:
(a) Reset the MH (marker hold) signal.
(b) Preset a value in the counter at the rising edge of the MKS signal.
The MH signal is set at the same time the counter is preset with data.

(a) Resetting the MH signal
For mode A, both methods, (i) and (ii), are usable. For mode B, method (ii) is usable.
(i) Resetting the MS bit (bit 6) of the CTRL (control) register to 0 ..... Control example 1
(ii) Setting the MHR bit (bit 7) of the CTRL register to 1 ..... Control example 2

	Condition				Status	
	MHR of CTRL	MS of CTRL	ME of external signal	MKS of external signal	ME of STTS	MH of STTS
(i)	×	0	×	×	×	Changes to 0.
(ii)	1	×	×	×	×	Changes to 0.

- The cross × in the above table means that the corresponding bit can be either 0 or 1.
  (The ME bit of the STTS register corresponds to the state of the external signal ME.)

(b) Presetting a counter value
For both methods, (i) and (ii), the presetting is completed within 100 μs after the MKS has arisen.

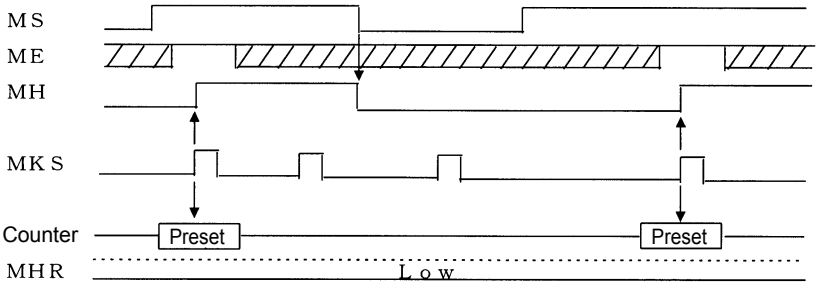
	Condition				Status	
	MHR of CTRL	MS of CTRL	ME of external signal	MKS of external signal	ME of STTS	MH of STTS
(i), (ii)	0	1	Contact "Closed"	First ↑ state	1	1

- Contact "Closed" in the above table means that 24 V is applied to the ME pin.

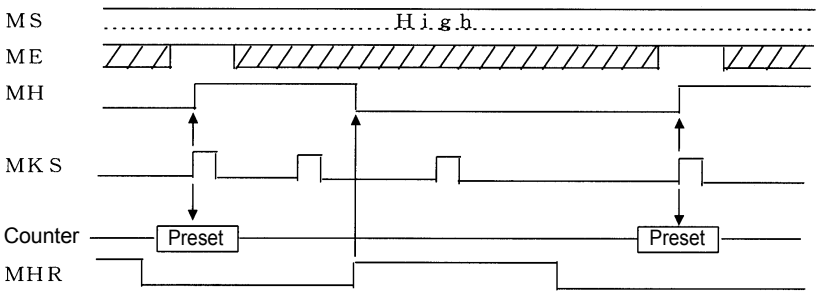
(2) Presetting a counter value (operating the PRS bit by ladder)
<1> Load the 3 low-order CTRL bits (SELECT) with 001 by ladder.
<2> Preset the DTOH, DTOM, and DTOL by ladder.
<3> Invert the PRS bit by ladder.
(If the PRS is 0, set it to 1. If it is 1, reset it to 0.)

NOTE
1 Once the PRS bit has been inverted, do not change the content of the DTOH, DTOM, DTOL, or CTRL within the period of two ladder cycle scans.
Also do not invert the PRS bit again within the same period.
2 It takes about 5 ms for the counter to be preset since the inversion of the PRS bit.

Control example 1:
(Hatching ▨ means that the bit can be either 0 or 1.)



Control example 2:
(Hatching ▨ means that the bit can be either 0 or 1.)



(3) Count

The following table lists the conditions for counting by this module.

	Condition			Status
	CE of CTRL	CSP of external signal	PSEL of external signal	CSP of STTS
Count (A/B phase pulse)	1	Contact "Open"	Open	Reset to 0.
Count (+/- pulse)	1	Contact "Open"	Connected to 0 V	Reset to 0.

- Contact "Open" in the above table means that the CSP pin is open (0 or NEG).

NOTE

The count value does not become negative. The highest-order bit of the CNTS register is the TRA bit (see Subsection 8.8.4).
Count-down: +1(00 0001H)→0(00 0000H)→+8,388,607(7F FFFFH) → +8,388,606(7F FFFEH)

(4) Stopping counting

The following table lists the condition for this module to stop counting.

	Condition			Status
	CE of CTRL	CSP of external signal	PSEL of external signal	CSP of STTS
Count stop method 1	0	×	×	×
Count stop method 2	×	Contact “Closed”	×	Reset to 1.

- Contact “Closed” in the above table means that 24 V is applied to the CSP pin (1 or POS).
- The cross × in the above table means that the corresponding bit can be either 0 or 1.
  (The × state of the CSP pin of the STTS register corresponds to the state of the external signal CSP.)

8.8.3 Setting Data

[Example of setting]

CTRL
DTOH
DTOM
DTOL

7	6	5	4	3	2	1	0
				PRS	SELECT		

Example 1 :

To preset the counter preset register with a specific value (the counter is also set to preset value), follow the steps below.

(1) Preset the DTOH, DTOM, and DTOL with a desired value.
(2) Set SELECT to 001.
(3) Reverse the setting of the PRS (from 0 to 1 or from 1 to 0).
(4) Wait for two scanning periods.
    - Another method for presetting the counter is to use the MKS external signal (see Subsection 8.8.2). It takes a maximum of 5 ms to preset using the first method, while it takes only a maximum of 100 μs to preset using the MKS external signal.

Example 2 :

To set the comparison control register with the setting (0 or 1) of CMA, CMB, and CMC, follow the steps below.

(1) Set DTOH bits 0, 1, and 2 to the desired data.
(2) Set SELECT to 000.
(3) Reverse the setting of the PRS (from 0 to 1 or from 1 to 0).
(4) Wait for two scanning periods.

Example 3 :

To set comparison register B to a desired comparison value, follow the steps below.

(1) Set DTOH, DTOM, and DTOL to the desired comparison value.
(2) Set SELECT to 011.
(3) Reverse the setting of the PRS (from 0 to 1 or from 1 to 0).
(4) Wait for two scanning periods.

The result of comparing comparison registers A, B, and C with the pulse counter is output via OUT0 to OUT2 of connector C49 of this counter module (A → OUT0, B → OUT1, and C → OUT2).
Their output status is output via OUT0 to OUT2 of the LED indication panel (A → OUT0, B → OUT1, and C → OUT2).
The result of comparison can be confirmed by checking STTS bits 0, 1, and 2 (CMPA, CMPB, and CMPC) with the PMC.

8.8.4 Reading Data

The CNTS and STTS are two of the four input bytes. The most significant bit, TRA, of the CNTS and the most significant bit, TRB, of the STTS can be used to determine whether the count data is correct. **If both TRA and TRB are 0 or 1, the count data is correct.** The time during which the TRA and TRB bits have a different value from each other is about 2 msec.
In almost all cases, both TRA and TRB will be 0 or 1 when you view the diagnostic display. (Do not determine that the data has not changed because of the fact that the TRA and TRB do not become 0 or 1 alternately.) **Note that the count data does not take a negative value**.

(CNTS)

TRA	Counter H

(STTS)

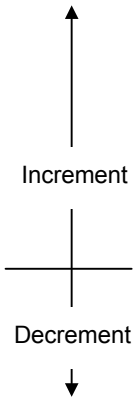
TRB	ALM	CSP	ME	MH	CMPC	CMPB	CMPA

TRA	TRB	Validity
0	0	Correct
0	1	Incorrect
1	0	Incorrect
1	1	Correct

The TRA and TRB bits provide timing signals used to check count data. The count data is 3 bytes. After sent to the host via the I/O Link, its 2 bytes (CNTS and CNTM bytes) are first written to memory. If the count data is accessed at this moment, it does not represent a true value because the CNTL remains in the previous state. Both the TRA and TRB bits become 0 or 1 only after all 4 bytes (3 count data bytes + 1 STTS byte) are written to memory.

The counter assumes the following data when it is incremented or decremented.

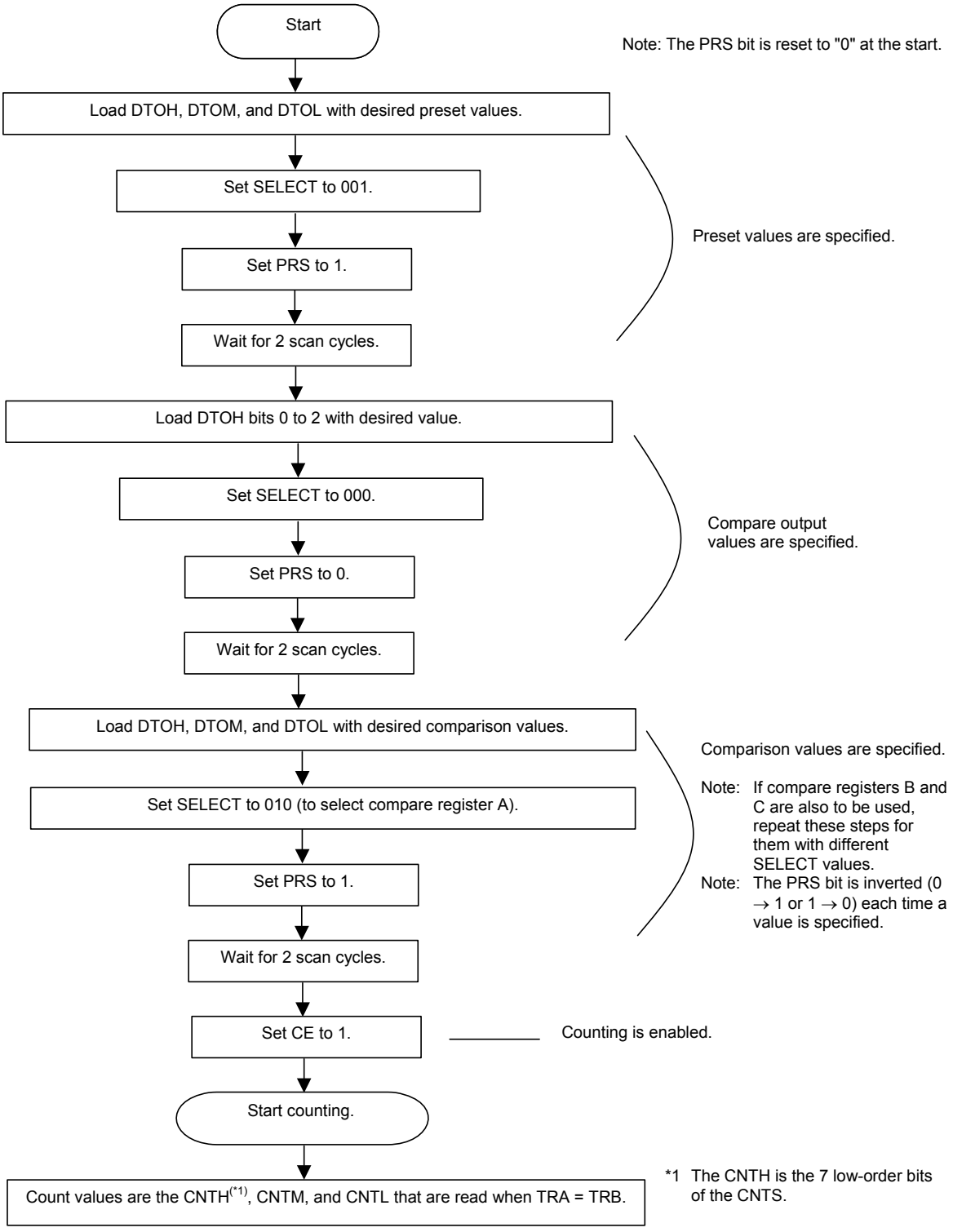
Contents of [CNTS	CNTM	CNTL]
□0000000	00000000	00000010
□0000000	00000000	00000001
□0000000	00000000	00000000
□1111111	11111111	11111111
to		
□0000000	00000000	00000011
□0000000	00000000	00000010
□0000000	00000000	00000001
□0000000	00000000	00000000
□1111111	11111111	11111111
□1111111	11111111	11111110
□1111111	11111111	11111101



The square □represents the TRA. (The most significant bit is the TRA. It is not a sign bit.)

8.9 EXAMPLE OF STARTING UP ACT01A

8.9.1 Mode A Startup Flowchart



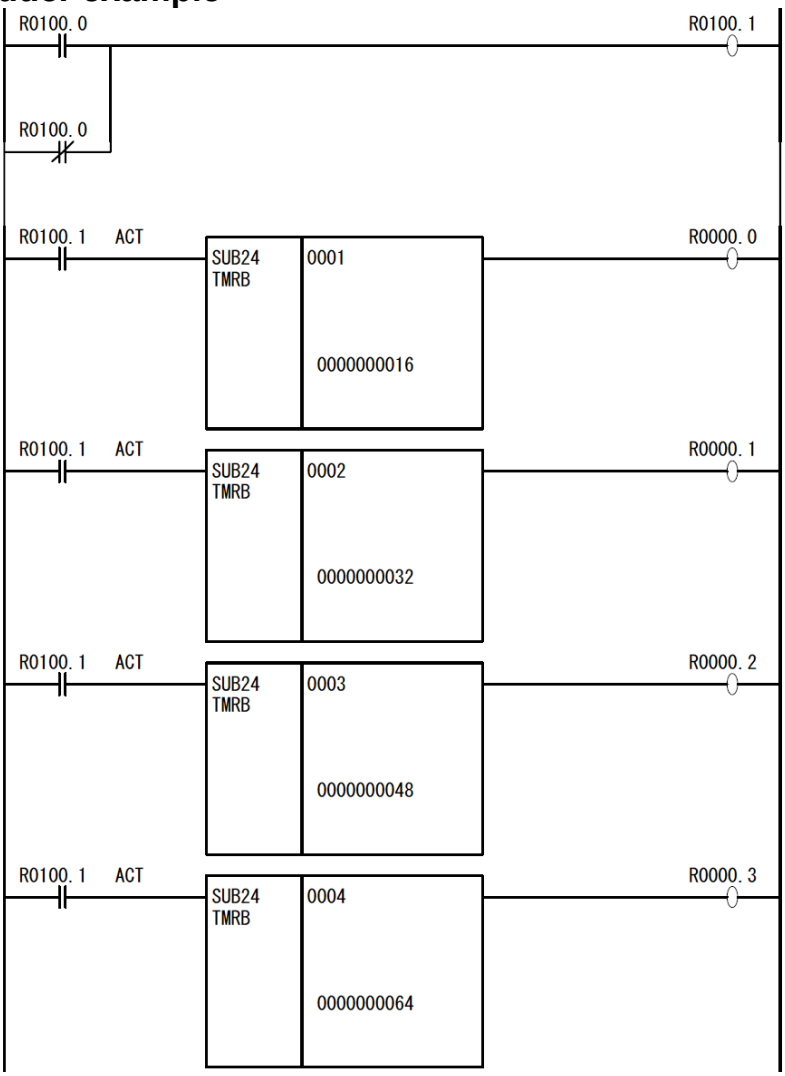
8.9.2 Example of Mode A Ladder

Allotment

Address	Group	Base	Slot	Module name	Address	Group	Base	Slot	Module name
X0000					Y0000	0	0	01	/2
X0001					Y0001	0	0	01	/2
X0002					Y0002	0	0	02	/2
X0003					Y0003	0	0	02	/2
X0004					Y0004				
X0005					Y0005				
X0006					Y0006				
X0007					Y0007				
X0008					Y0008				
X0009					Y0009				
X0010	0	0	05	/4	Y0010	0	0	05	/4
X0011	0	0	05	/4	Y0011	0	0	05	/4
X0012	0	0	05	/4	Y0012	0	0	05	/4
X0013	0	0	05	/4	Y0013	0	0	05	/4
X0014					Y0014				
X0015					Y0015				

The ACT01A is allocated to X0010 to X0013 and Y0010 to Y0013. Y0000 to Y0003 are the addresses used to confirm count values.

Ladder example



R0100.1 is used as a normally ON coil.

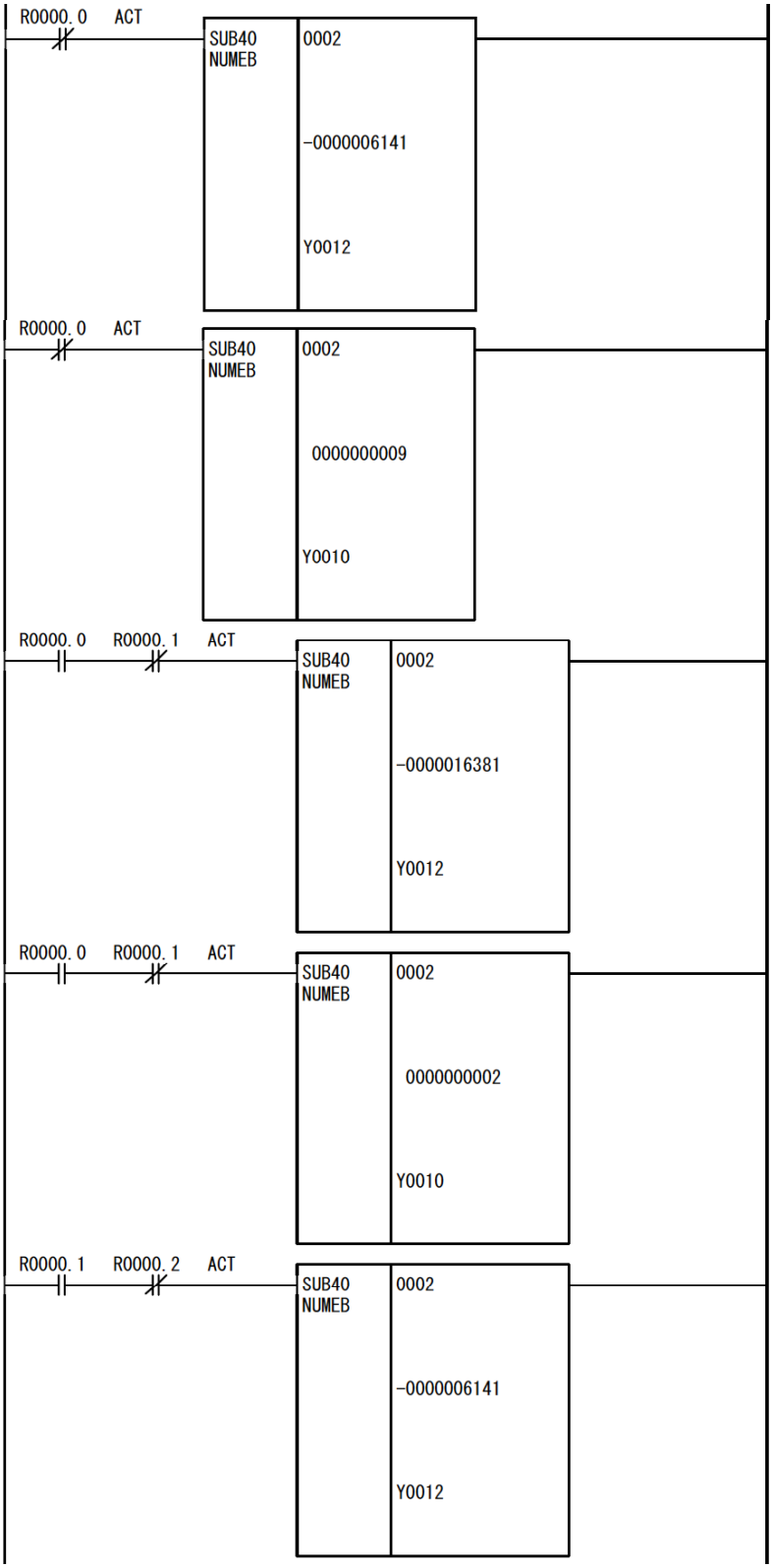
The timer is used to generate a timing signal at intervals of 16 ms (2 scan cycles).

R0000.0 is turned on 16 ms (2 scan cycles) after RUN.

R0000.1 is turned on 32 ms (4 scan cycles) after RUN.

R0000.2 is turned on 48 ms (6 scan cycles) after RUN.

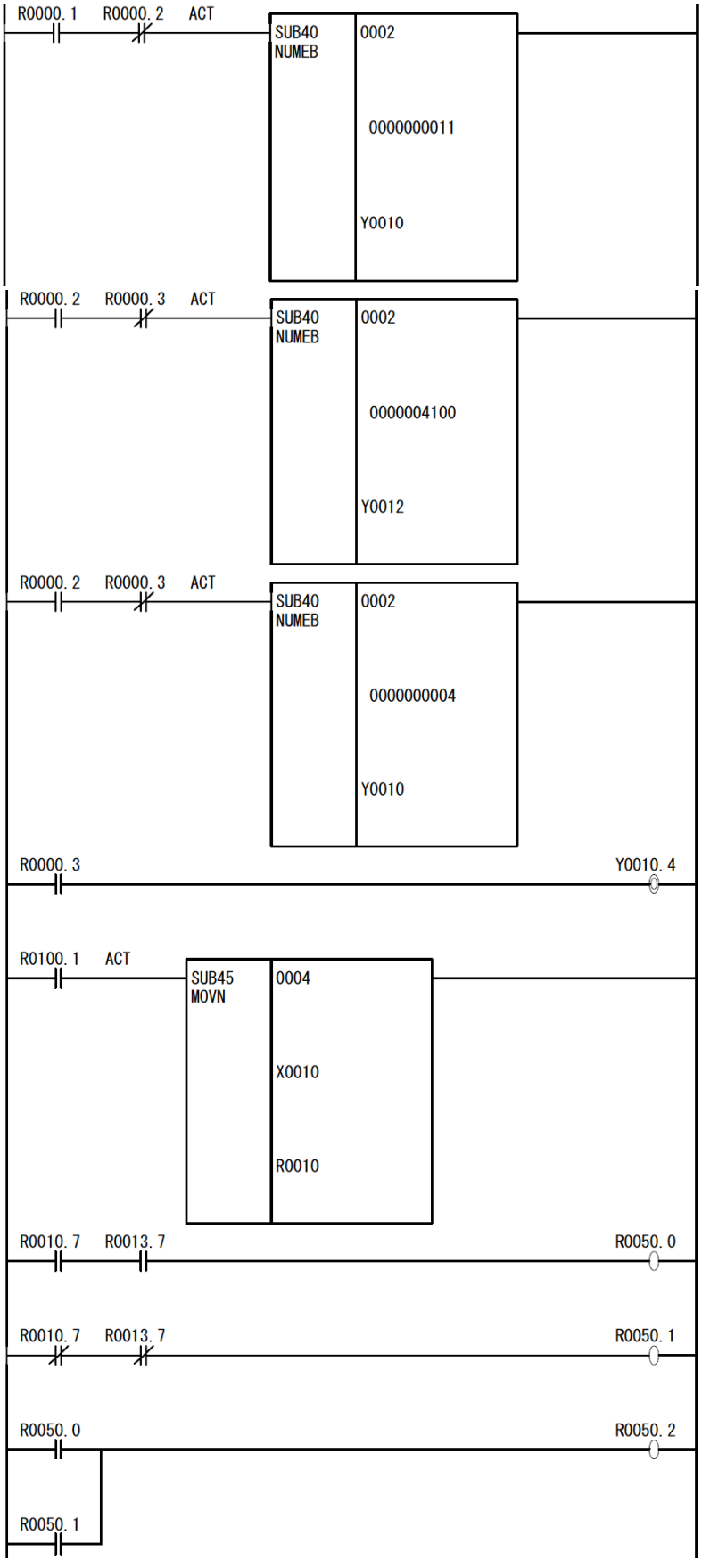
R0000.3 is turned on 64 ms (8 scan cycles) after RUN.



A preset value is specified right after RUN.
A preset value of +1000 is used here.
If +1000 → 0003E8h, the following are written:
Y0011: DTOH ← 00h
Y0012: DTOM ← 03h
Y0013: DTOL ← E8h
If Y0012 to Y0013 have 1-word data, E803h → -6141 is written.
In addition, if SELECT = 001 and PRS = 1, Y0010:00001001 is set to 9 (Y0011 is 0).

Compare register A is loaded with a comparison value 2 scan cycles after RUN.
A preset value of +960 is used here.
If +960 → 0003C0h, the following are written:
Y0011: DTOH ← 00h
Y0012: DTOM ← 03h
Y0013: DTOL ← C0h
If Y0012 to Y0013 have 1-word data, C003h → -16381 is written.
In addition, if SELECT = 010 and PRS = 0, Y0010:00000010 is set to 2 (Y0011 is 0).

Compare register B is loaded with a comparison value 4 scan cycles after RUN.
A preset value of +1000 is used here.
If +1000 → 0003E8h, the following are written:
Y0011: DTOH ← 00h
Y0012: DTOM ← 03h
Y0013: DTOL ← E8h
If Y0012 to Y0013 have 1-word data, E803h



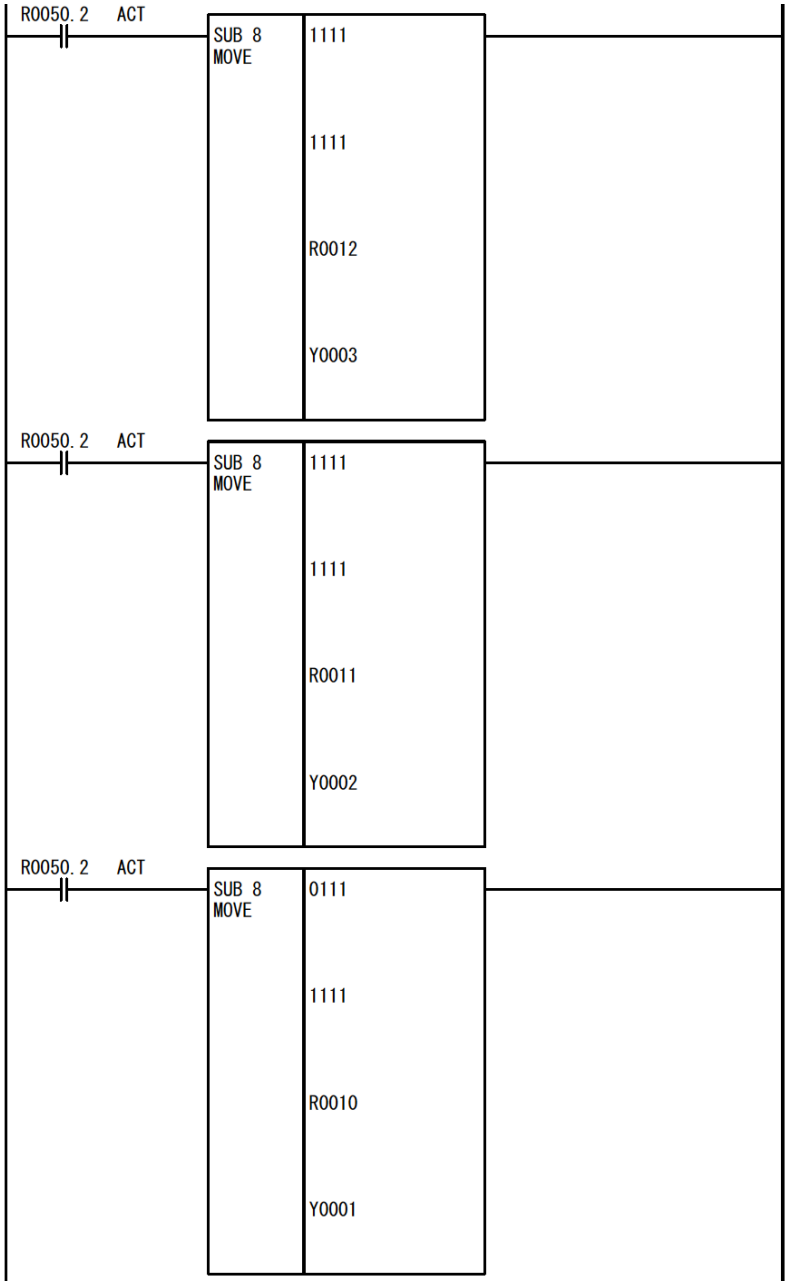
In addition, if SELECT = 011 and PRS = 1, Y0010:00001011 is set to 11 (Y0011 is 0).

Compare register C is loaded with a comparison value 6 scan cycles after RUN. A preset value of +1040 is used here.
If +1040 → 000410h, the following are written:
Y0011: DTOH ← 00h
Y0012: DTOM ← 04h
Y0013: DTOL ← 10h
If Y0012 to Y0013 have 1-word data, 1004h → +4100 is written.
In addition, if SELECT = 100 and PRS = 0, Y0010:00000100 is set to 4 (Y0011 is 0).

The counter is enabled 8 scan cycles after RUN.

X0010 to X0013 are sent to R0010 to R0013 to maintain data consistency.

A timing signal indicating TRA = TRB is generated.
If TRA = TRB = 1 or TRA = TRB = 0, R50.2 becomes 1.

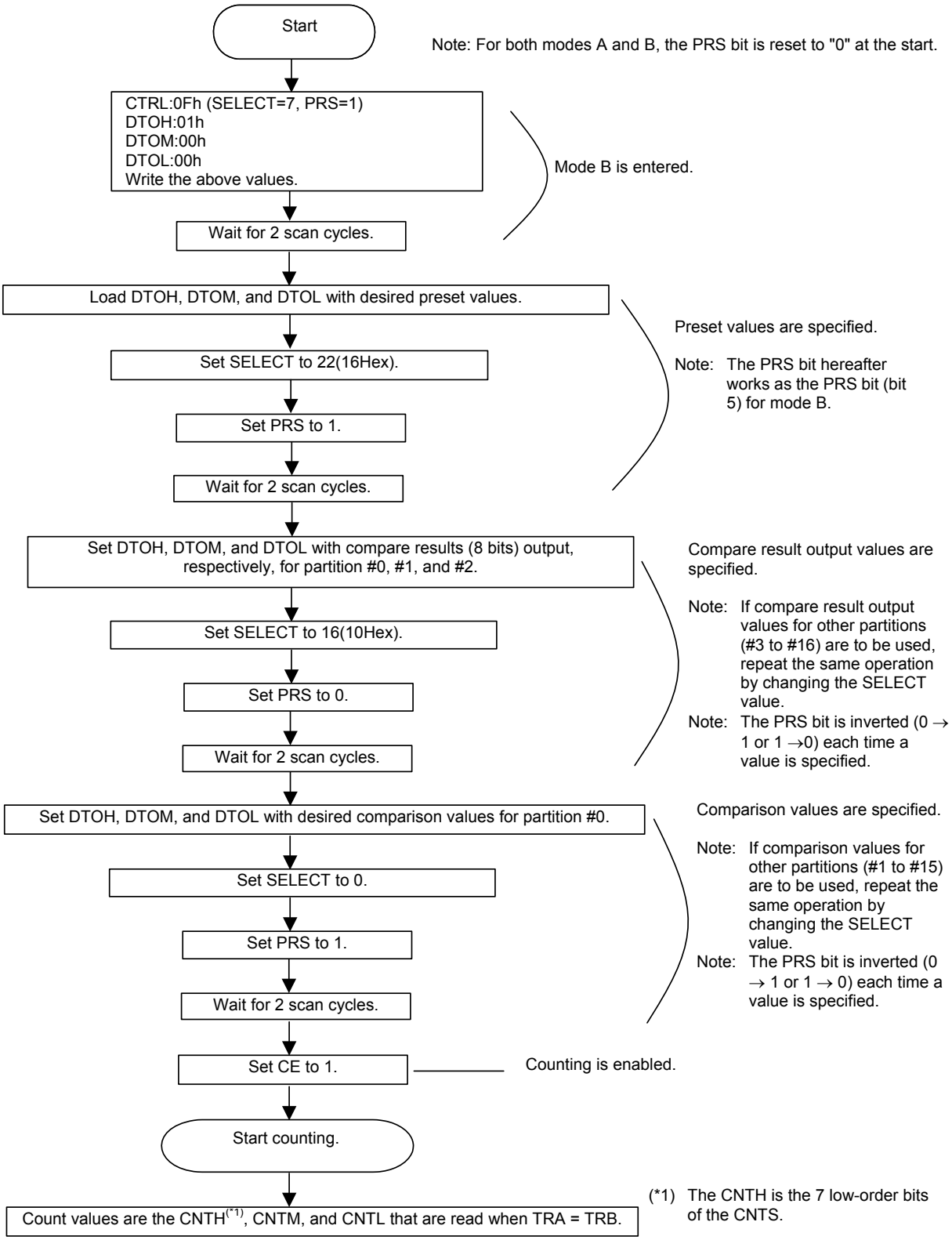


The counter value is output to Y0001 to Y0003 when TRA = TRB.
CNTH→Y0001
CNTM→Y0002
CNTL→Y0003
The highest-order bit (TRA) is masked because CNTH is 7-bit data.

NOTE

1 This sample ladder does not specify what the compare output is. To have it specify, perform the same operation as for setting the compare register by changing the SELECT value. Note that it is necessary to invert the PRS bit (0 → 1 or 1 → 0) each time a value is specified.
2 The compare output value and comparison value can be specified in any order until CE = 1 (counter enable).

8.9.3 Mode B Startup Flowchart



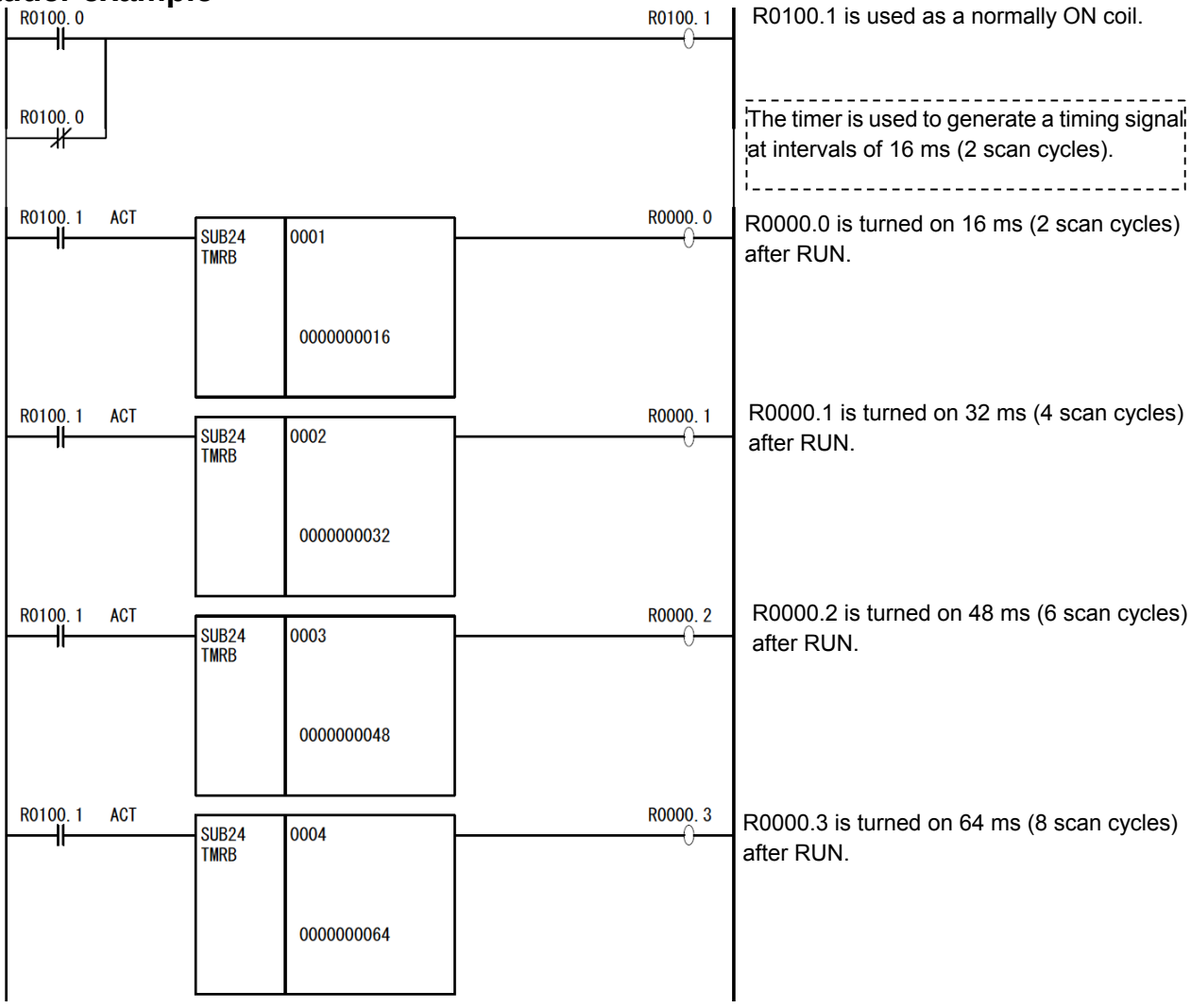
8.9.4 Example of Mode B Ladder

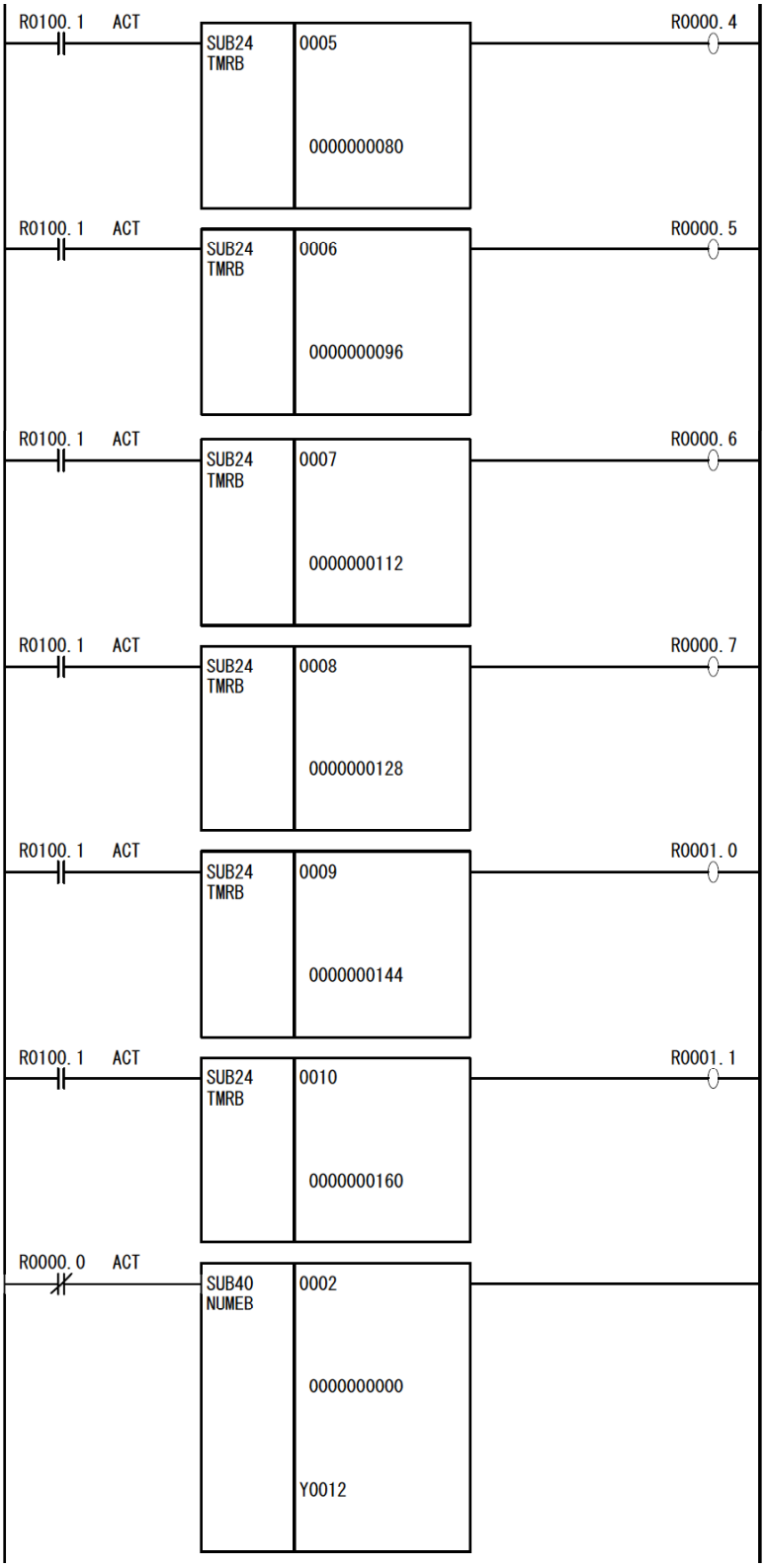
Allotment

Address	Group	Base	Slot	Module name	Address	Group	Base	Slot	Module name
X0000					Y0000	0	0	01	/2
X0001					Y0001	0	0	01	/2
X0002					Y0002	0	0	02	/2
X0003					Y0003	0	0	02	/2
X0004					Y0004				
X0005					Y0005				
X0006					Y0006				
X0007					Y0007				
X0008					Y0008				
X0009					Y0009				
X0010	0	0	05	/8	Y0010	0	0	05	/4
X0011	0	0	05	/8	Y0011	0	0	05	/4
X0012	0	0	05	/8	Y0012	0	0	05	/4
X0013	0	0	05	/8	Y0013	0	0	05	/4
X0014	0	0	05	/8	Y0014				
X0015	0	0	05	/8	Y0015				
X0016	0	0	05	/8	Y0016				
X0017	0	0	05	/8	Y0017				
X0018					Y0018				

The ACT01A is allocated to X0010 to X0017 and Y0010 to Y0013. Y0000 to Y0003 are the addresses used to confirm count values.

Ladder example





R0000.4 is turned on 80 ms (10 scan cycles) after RUN.

R0000.5 is turned on 96 ms (12 scan cycles) after RUN.

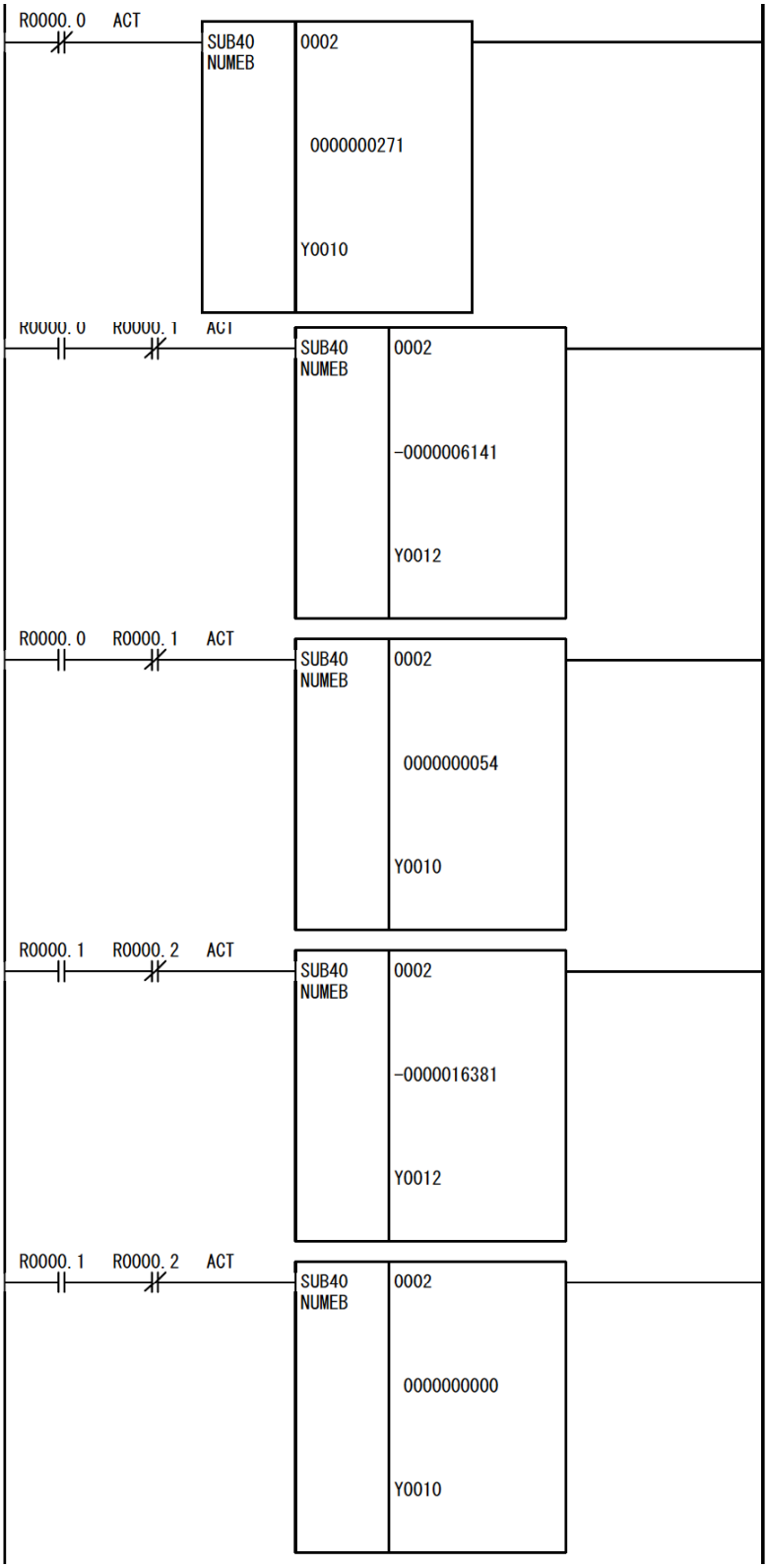
R0000.6 is turned on 112 ms (14 scan cycles) after RUN.

R0000.7 is turned on 128 ms (16 scan cycles) after RUN.

R0001.0 is turned on 144 ms (18 scan cycles) after RUN.

R0001.1 is turned on 160 ms (20 scan cycles) after RUN.

Mode B is entered right after RUN.
The following are written:
CTRL: 0Fh (SELECT = 7 and PRS = 1)
DTOH: 01h
DTOM: 00h
DTOL: 00h



Continued from mode B writing

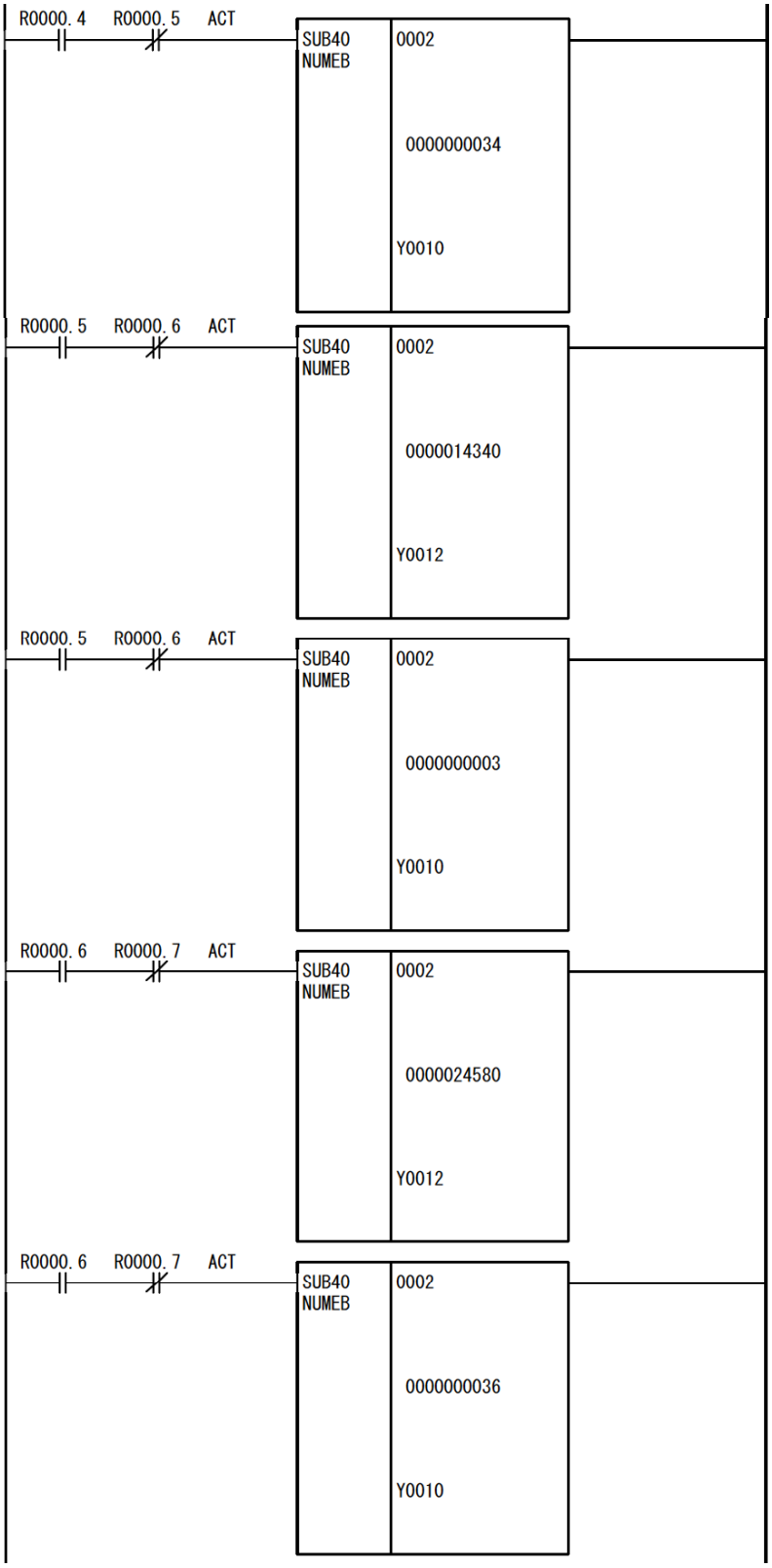
A preset value is specified 2 scan cycles after RUN.
A preset value of +1000 is used here.
If +1000 → 0003E8h, the following are written:
Y0011: DTOH ← 00h
Y0012: DTOM ← 03h
Y0013: DTOL ← E8h
If Y0012 to Y0013 have 1-word data, E803h → -6141 is written.
In addition, if SELECT = 22(16h) and PRS = 1, Y0010:00110110 is set to 36h → +54 (Y0011 is 0).

A comparison value for partition #0 is specified 4 scan cycles after RUN.
A comparison value of +960 is used here. (A range from 0 to +960 becomes partition #0.)
If +960 → 0003C0h, the following are written:
Y0011: DTOH ← 00h
Y0012: DTOM ← 03h
Y0013: DTOL ← C0h
If Y0012 to Y0013 have 1-word data, C003h → -16381 is written.
In addition, if SELECT = 0 and PRS = 0, Y0010 is set to 0 (Y0011 is 0).

An output value for partition #0 to #2 is specified 6 scan cycles after RUN.
To be specific, the following are output.
Partition #0: Y0011 ← 00h
Partition #1: Y0012 ← FFh
Partition #2: Y0013 ← 55h
If Y0012 to Y0013 have 1-word data, 55FFh → +22015 is written.
In addition, if SELECT = 16(10h) and PRS = 1, Y0010=0011000 is set to 30h → +48 (Y0011 is 0).

A comparison value for partition #1 is specified 8 scan cycles after RUN.
A comparison value of +1000 is used here. (A range from +960 to +1000 becomes partition #1.)
If +1000 → 0003E8h, the following are written:
Y0011: DTOH ← 00h
Y0012: DTOM ← 03h
Y0013: DTOL ← E8h
If Y0012 to Y0013 have 1-word data, E803h → -6141 is written.
In addition, if SELECT = 1 and PRS = 0, Y0010 is set to 00000001 (Y0011 is 0).

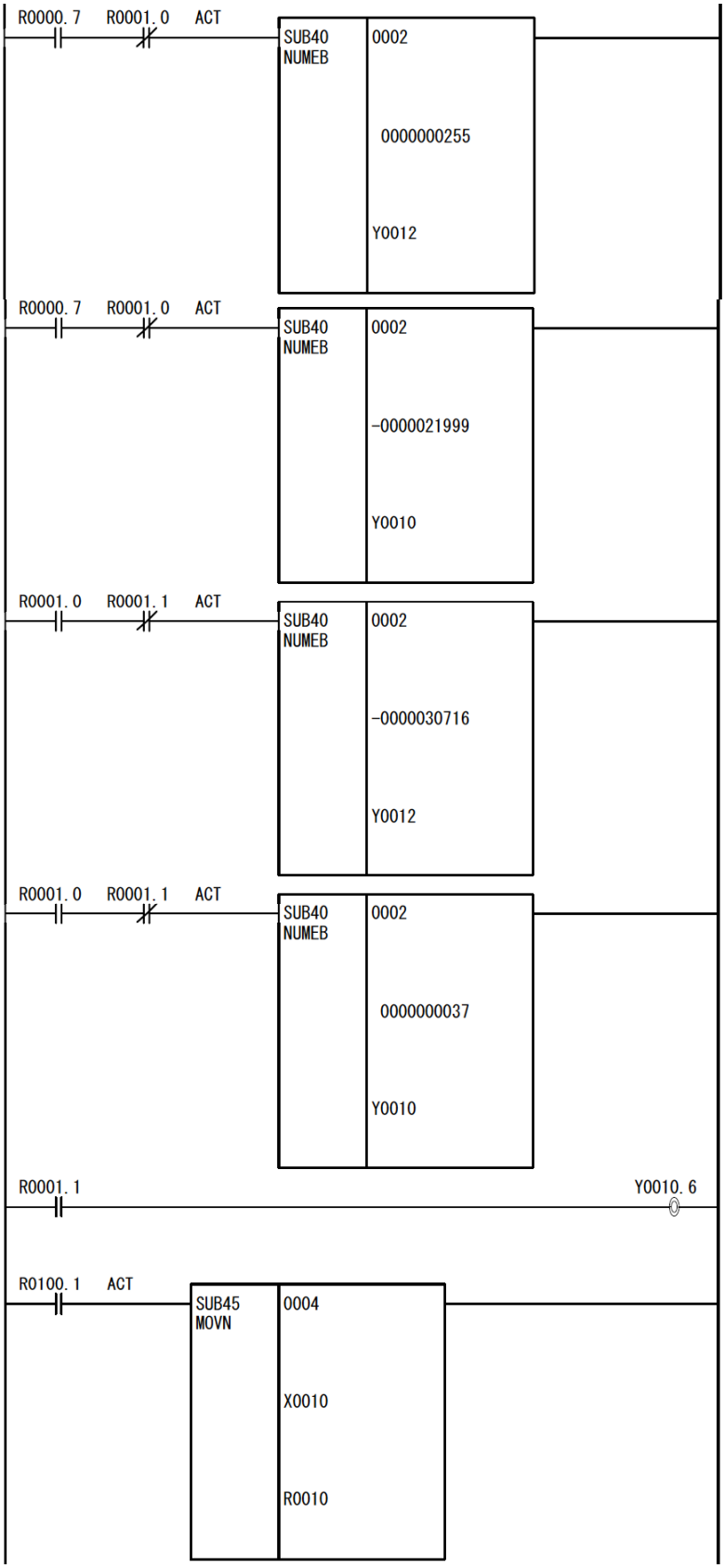
A comparison value for partition #2 is specified 10 scan cycles after RUN.
A comparison value of +1040 is used here. (A range from +1000 to +1040 becomes partition #2.)
If +1040 → 000410h, the following are written:
Y0011: DTOH ← 00h
Y0012: DTOM ← 04h
Y0013: DTOL ← 10h
If Y0012 to Y0013 have 1-word data, 1004h → +4100 is written.



In addition, if SELECT = 2 and PRS = 1, Y0010=00100010 is set to 22h → +34 (Y0011 is 0).

A comparison value for partition #3 is specified 12 scan cycles after RUN.
A comparison value of +1080 is used here. (A range from +1040 to +1080 becomes partition #3.)
If +1080 → 000438h, the following are written:
Y0011: DTOH ← 00h
Y0012: DTOM ← 04h
Y0013: DTOL ← 38h
If Y0012 to Y0013 have 1-word data, 3804h → +14340 is written.
In addition, if SELECT = 3 and PRS = 0, Y0010=00000011 is set to +3 (Y0011 is 0).

A comparison value for partition #4 is specified 14 scan cycles after RUN.
A comparison value of +1120 is used here. (A range from +1080 to +1120 becomes partition #4.)
If +1120 → 000460h, the following are written:
Y0011: DTOH ← 00h
Y0012: DTOM ← 04h
Y0013: DTOL ← 60h
If Y0012 to Y0013 have 1-word data, 6004h → +24580 is written.
In addition, if SELECT = 4 and PRS = 1, Y0010=00100100 is set to 24h → +36 (Y0011 is 0).

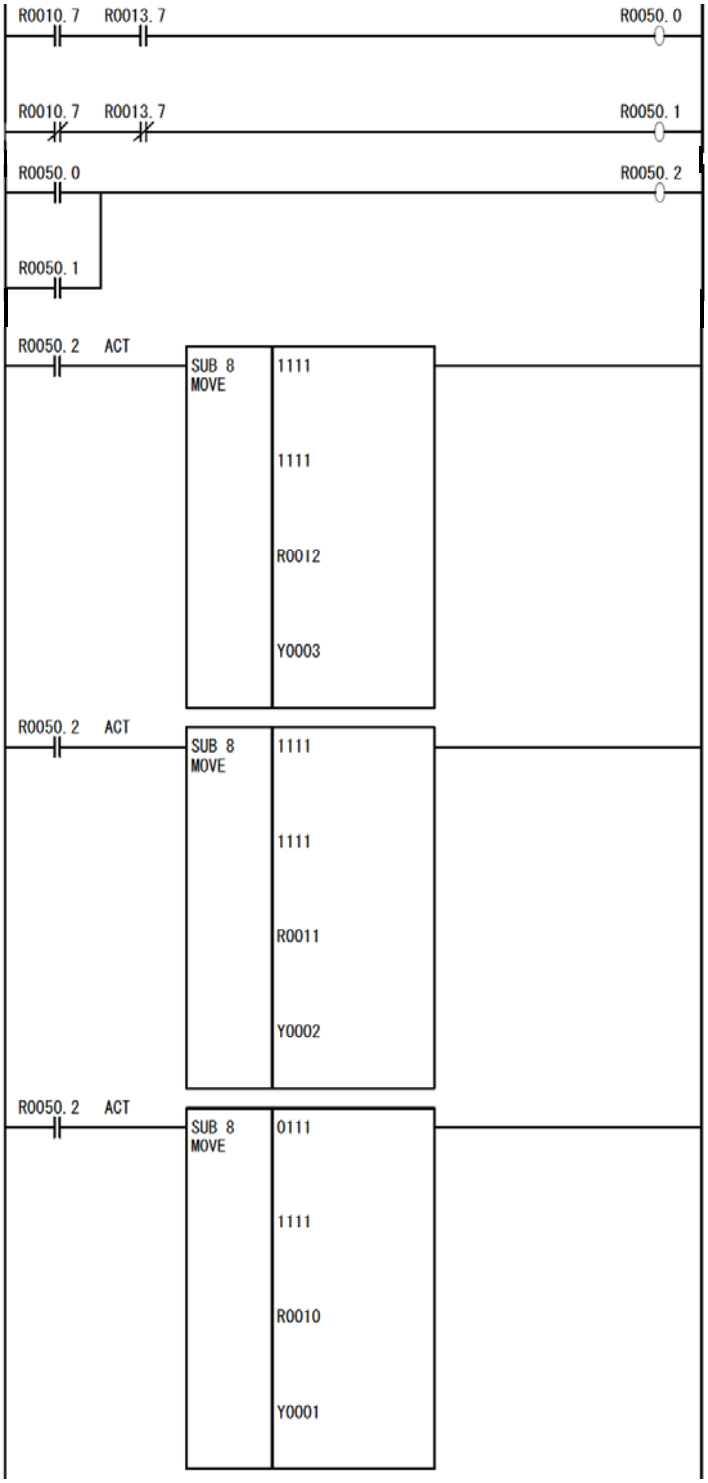


An output value for partition #3 to #5 is specified 16 scan cycles after RUN.
To be specific, the following are output.
Partition #3: Y0011 ← AAh
Partition #4: Y0012 ← FFh
Partition #5: Y0013 ← 00h
If Y0012 to Y0013 have 1-word data, 00FFh → +255 is written.
In addition, if SELECT = 17(11h) and PRS = 0, 1-word data AA11h → -21999 is written to Y0010 to Y0011 because Y0010 = 0001001 = 11h and Y0011 = AAh.

A comparison value for partition #5 is specified 18 scan cycles after RUN.
A comparison value of +1160 is used here. (A range from +1120 to +1160 becomes partition #5.)
If +1160 → 000488h, the following are written:
Y0011: DTOH ← 00h
Y0012: DTOM ← 04h
Y0013: DTOL ← 88h
If Y0012 to Y0013 have 1-word data, 8804h → -30716 is written.
In addition, if SELECT = 5 and PRS = 1, Y0010=00100101 is set to 25h → +37 (Y0011 is 0).

The counter is enabled 20 scan cycles after RUN.

X0010 to X0013 are sent to R0010 to R0013 to maintain data consistency.



A timing signal indicating TRA = TRB is generated. If TRA = TRB = 1 or TRA = TRB = 0, R50.2 becomes 1.

The counter value is output to Y0001 to Y0003 when TRA = TRB.
CNTH → Y0001
CNTM → Y0002
CNTL → Y0003
The highest-order bit (TRA) is masked because CNTH is 7-bit data.

NOTE

1 This sample ladder does not set a comparison value or output value for partition #6 and above. If comparison and output values for these partitions are to be used, repeat the same operation as for partition #6 and below by changing the SELECT value.
Be sure to invert the PRS bit (0 → 1 or 1 → 0) each time a value is specified.

2 The comparison and compare output values for each partition can be specified in any order until CE = 1 (counter enable).

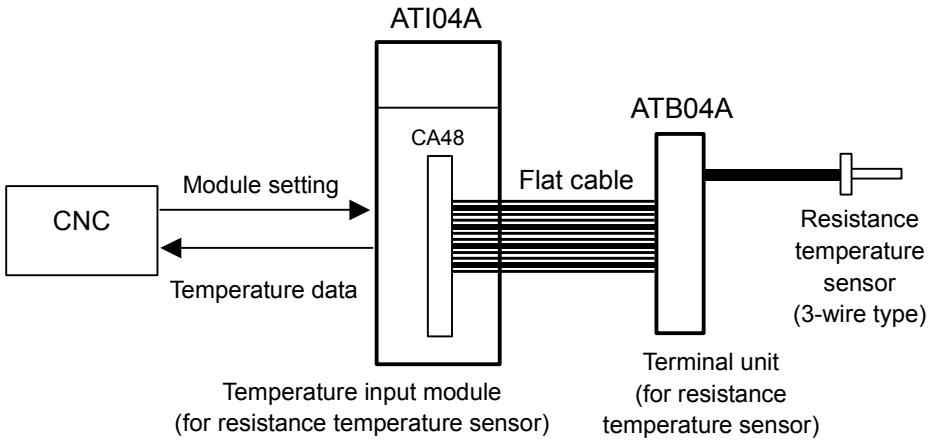
9 TEMPERATURE INPUT MODULE

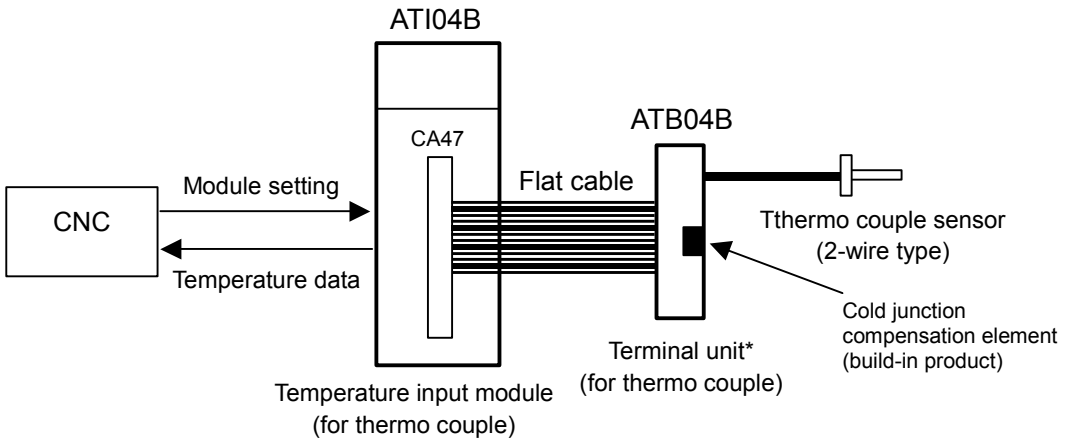
9.1 OVERVIEW

A temperature input module is used to measure the temperature of machine tools and similar equipment. The temperature input module can be either of the following, depending on the type of the sensor used.

- Thermoresistance-type temperature input module: ATI04A
- Thermocouple-type temperature input module: ATI04B

These modules can measure temperature on up to four channels. For the thermoresistance-type temperature input module, either JPt100Ω or Pt100Ω can be selected. For the thermocouple-type temperature input module, either K or J thermocouple input can be selected. This selection is made using the PMC user program (ladder).





NOTE
The terminal unit for thermo couple is necessary for the temperature input module for thermo couple because the module requires the cold junction compensation element.

9.2 TEMPERATURE INPUT MODULE SPECIFICATION

Input signal types and number of input channels	• Types ATI04A Three-wire thermoresistance (JPt100Ω) Three-wire thermoresistance (Pt100Ω) ATI04B J thermocouple (can also be used with the tip grounded) K thermocouple (can also be used with the tip grounded) • Number of input channels 2/4, for all for which the input is the same
Input signal switching method	• User program (ladder)
Temperature measurement range and precision	• Thermoresistance type (ATI04A) -50 to 300.0°C Resolution 0.1°C Overall precision ±1%FS • Thermocouple type (ATI04B) 0 to 600.0°C Resolution 0.1°C Overall precision ±1%FS
Data sampling period setting (Note)	• 0.3 s per two channels • 0.5 s per four channels to 10 s per four channels (4 s per four channels is assumed if no specification is made)
System failure check	• Self-diagnosis A watchdog timer is used. • Abnormal temperature (including sensor input disconnection) Failure information about each abnormal channel is sent to the PMC.
Interface with the PMC	• PMC → temperature module Information format: Binary or bit Signals: 32 points • Temperature module → PMC Information format: Binary or bit Signals: 32 points
External connection	Connector (Hirose Electric : HIF3BA-34PA-2.54DS)

NOTE
The actual response time is the sum of the time required for the signal to pass the filter and the scan time that is determined depending on the system1

9.3 PMC INTERFACE

9.3.1 PMC I/O Area

This temperature module uses an input/output area consisting of four bytes for input and the same number of bytes for output. Each byte of the input/output area has the following meanings. The terms "input" and "output" are used in reference to the PMC. When input/output addresses are assigned to the module, "/4" is used as the module name.

(1) Output (PMC → temperature module)

Addresses in the module		
0	DO07 to DO00	Period for 4-channel automatic measurement mode (lower 8 bits)
+1	DO15 to DO08	Period for 4-channel automatic measurement mode (higher 8 bits)
+2	DO23 to DO16	Module setting data and timing data
+3	DO31 to DO24	Module setting data and timing data

(2) Input (temperature module → PMC)

Addresses in the module		
0	DI07 to DI00	CH1 temperature data, CH3 temperature data, or abnormality data (lower 8 bits)
+1	DI12 to DI08	CH1 temperature data, CH3 temperature data, or abnormality data (higher 5 bits)
	DI15 to DI13	Status signal
+2	DI23 to DI16	CH2 temperature data, CH4 temperature data, or abnormality data (lower 8 bits)
+3	DI28 to DI24	CH2 temperature data, CH4 temperature data, or abnormality data (higher 5 bits)
	DI31 to DI29	Status signal

NOTE

If you are using the PMC-N, NA, or QA (PMC for the Series 15 (Series 15 preceding the *i* series) and F-D Mate), all addresses up to those listed above can be used without modifying them if the data is manipulated in byte (8-bit) units. When manipulating data in word (16-bit) units, note that the byte addresses are transposed as shown below.

Addresses for word-unit operation in the PMC-N, NA, and QA

PMC → Temperature module Addresses in the module	High-order bits	Low-order bits
0	DO07 to DO00	DO15 to DO08
+2	DO23 to DO16	DO31 to DO24

Temperature module → PMC Addresses in the module	High-order bits	Low-order bits
0	DI07 to DI00	DI15 to DI08
+2	DI23 to DI16	DI31 to DI24

9.3.2 Measurement Mode

This temperature module can operate in any of the following three measurement modes. The mode to use can be selected using a user program (ladder).

(1) 2-channel measurement mode
This mode uses two channels, CH1 and CH2, for measurement. Data on each channel is updated every 0.3 s.

(2) 4-channel automatic measurement mode
This mode uses four channels, CH1 to CH4, for measurement. Input switching from CH1 and CH2 data to CH3 and CH4 data and vice versa is performed automatically. Data on each channel is updated at a specified interval, say, every 0.5 to 10 s.

(3) 4-channel manual measurement mode
This mode uses four channels, CH1 to CH4, for measurement. The PMC can reference CH1 and CH2 data or CH3 and CH4 data at the desired timing.

9.3.3 Details of Output Signals (PMC → Temperature Module)

DO07	DO06	DO05	DO04	DO03	DO02	DO01	DO00
DO15	DO14	DO13	DO12	DO11	DO10	DO09	DO08
	DO22			DO19	DO18	DO17	DO16
					DO26	DO25	DO24

(1) Before setting the module setting data bit (NC READY (DO16)) to "1", set the following bits.

DO00 (LSB) to DO15 (MSB):
Channel switching period for 4-channel automatic measurement mode
These bits are set with a binary number representing the channel switching period for the 4-channel automatic measurement mode. They need not be set for the 2-channel mode.
The period can be varied in a range between 0.5 s and 10 s. When setting the bits, use a value ten times the desired period.
(Example) 2 s → 20 (14h)
The valid data range is between 5 and 100 (64h). Any value out of this range is regarded as being 40 (28h), that is, 4 s. If nothing is specified, a period of 4 s is again assumed.

DO17 : Module type
This bit is set according to the type of the temperature module being used.
0 : Thermocouple-type module (ATI04B)
1 : Thermoresistance-type module (ATI04A)

DO18 : Sensor type
This bit is set according to the type of the temperature sensor being used.
- ATI04A
  0 : Pt
  1 : JPt
- ATI04B
  0 : K
  1 : J

DO19 : Reserved for future use
This bit must always be set to "0".

DO24 : Number of channels
This bit is used to specify the number of channels to be measured.
0 : 2 channels
1 : 4 channels (if 1 is selected, DO25 must also be used.)

DO25 : 4-channel mode specification

This bit is used to select the 4-channel mode to be used.

0 : Automatic measurement (the period is specified using DO00 to DO15.)

1 : Manual measurement (a request is issued using DO22 and DO26 at every data read.)

2) Timing data

DO16 : NC READY

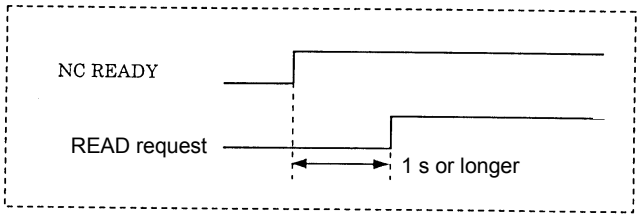
When the power is switched on, this bit is set to "1" to cause the module setting data to be set in the temperature module.

The NC READY bit is enabled only once after the power is switched on. To rewrite the module setting data, switch the power off and then on again.

DO22 : READ request

This bit serves as the timing signal used in 4-channel manual measurement mode. Setting the bit to "1" issues a request for temperature data. When the input signal data READY signal becomes "1", read the temperature data.

This bit need not be set for 2-channel mode.



NOTE

After setting the NC READY bit to "1", wait for one second, and then set the READ request to "1".

DO26 : Channel select

This bit is used to specify channel switching for 4-channel manual measurement mode.

0: Channels 1 and 2

1: Channels 3 and 4

NOTE

See Section 9.5, "Timing Charts," for concrete explanations about how to handle the timing data.

9.3.4 Details of Input Signals (Temperature Module → PMC)

(1) Status signals and CH1 temperature data, CH3 temperature data, or abnormality data

DI07	DI06	DI05	DI04	DI03	DI02	DI01	DI00

DI15	DI14	DI13	DI12	DI11	DI10	DI09	DI08

- Status signals

DI13 : Abnormality sign bit

1 : This bit is set to "1" when the temperature input is abnormal. DI00 to DI12 are used to describe the abnormality.

0 : DI00 to DI12 are used to indicate the temperature data.

DI14 : CH1 data READY

1 : Read the CH1 temperature data from DI00 to DI12 when this bit is set to "1".

DI15 : CH3 data READY
1 : Read the CH3 temperature data from DI00 to DI12 when this bit is set to "1".

- CH1 temperature data, CH3 temperature data, or abnormality data
  DI00 (LSB) to DI12 (MSB):
  These bits indicate temperature input data (CH1/CH3) or abnormality data.

Temperature input data

The temperature input data is in binary. It is ten times the actual temperature.
Example
(83EDh → 1005 → 100.5°C)
└The highest three bits are status signals.

For the thermoresistance-type module (ATI04A), the DI12 bit is a sign bit. (Negative data is represented in two's complement.)
Example
(9F9Ch → -10.0°C)
└The highest three bits are status signals.

Abnormality data

If an abnormality occurs in the input data or in the module, the DI13 bit (status signal) becomes "1", resulting in the display changing from temperature input data to abnormality data. Abnormality data is assigned to these bits as listed below:
DI00 : CH1 input out of scale--the current temperature falls outside the measurable range.
DI01 : CH1 input burn-out--the cable or connector has been detached.
DI02 : CH3 input out of scale--the current temperature falls outside the measurable range.
DI03 : CH3 input burn-out--the cable or connector has been detached.
DI04 : Cold-junction abnormality (only for thermocouple-type input module)—
The ambient temperature of the terminal unit is out of the measurable range (0°C to 55°C). Alternatively, a wire between the temperature input module and the terminal unit is broken or short-circuited, or the cold-junction compensation element is damaged.
DI05 : System error--the internal circuit is abnormal.
DI06 : Wrong module--other than the correct module has been installed.

(2) Status signals, CH2 temperature data, CH4 temperature data, or abnormality data

DI23	DI22	DI21	DI20	DI19	DI18	DI17	DI16
DI31	DI30	DI29	DI28	DI27	DI26	DI25	DI24

- Status signals
  DI129 : Abnormality sign bit
  1 : This bit becomes "1" when the temperature input becomes abnormal. DI16 to DI28 are used to describe the abnormality.
  0 : DI16 to DI28 are used to indicate the temperature data.

  DI30 : CH2 data READY
  1 : Read the CH2 temperature data from DI16 to DI28 when this bit is set to "1".

  DI31 : CH4 data READY
  1 : Read the CH4 temperature data from DI16 to DI28 when this bit is set to "1".
- CH2 temperature data, CH4 temperature data, or abnormality data
  DI16 (LSB) to DI28 (MSB):
  These bits indicate temperature input data (CH2/CH4) or abnormality data.

Temperature input data

The temperature input data is in binary. It is ten times the actual temperature.
Example

(41F3h → 0499 → 49.9°C)
└— The highest three bits are status signals.

For a thermoresistance-type module (ATI04A), the DI28 bit is a sign bit. (Negative data is represented in two's complement.)
Example

(5FFBh → -0.5°C)
└— The highest three bits are status signals.

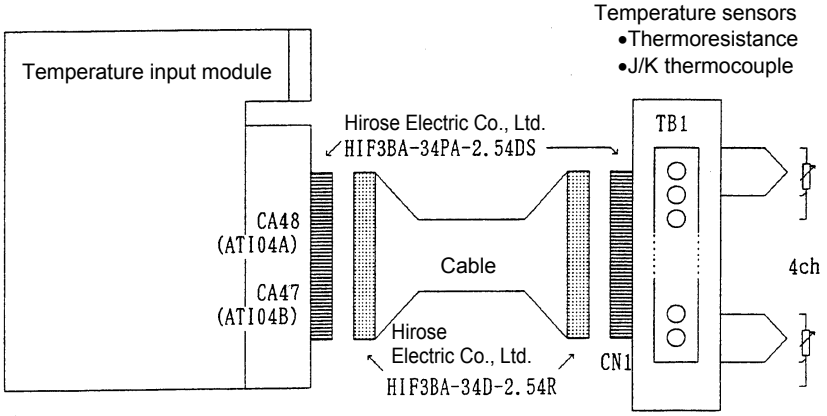
Abnormality data

If an abnormality occurs in the input data or the module, the DI29 bit (status signal) is set to "1", resulting in the display changing from temperature input data to abnormality data. Abnormality data is assigned to these bits as listed below:

DI16 : CH2 input out of scale--the current temperature falls outside the measurable range.
DI17 : CH2 input burn-out--the cable or connector has been detached.
DI18 : CH4 input out of scale--the current temperature falls outside the measurable range.
DI19 : CH4 input burn-out--the cable or connector has been detached.
DI20 : Cold-junction abnormality (only for thermocouple-type input module)—
The ambient temperature of the terminal unit is out of the measurable range (0°C to 55°C). Alternatively, a wire between the temperature input module and the terminal unit is broken or short-circuited, or the cold-junction compensation element is damaged.
DI21 : System error--the internal circuit is abnormal.
DI22 : Wrong module--other than the correct module has been installed.

9.4 COMPLETE CONNECTION OF TEMPERATURE INPUT MODULE

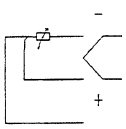
9.4.1 Temperature Input Module Connection Diagram



Terminal unit
(There are two types of terminal board units, the first for a thermoresistance-type module and the second for a thermocouple-type module.)
See Section 9.7 for explanations about the dimensions of the terminal unit.

9.4.2 Connector Signal Lists

(1) Thermoresistance input module
ATI04A



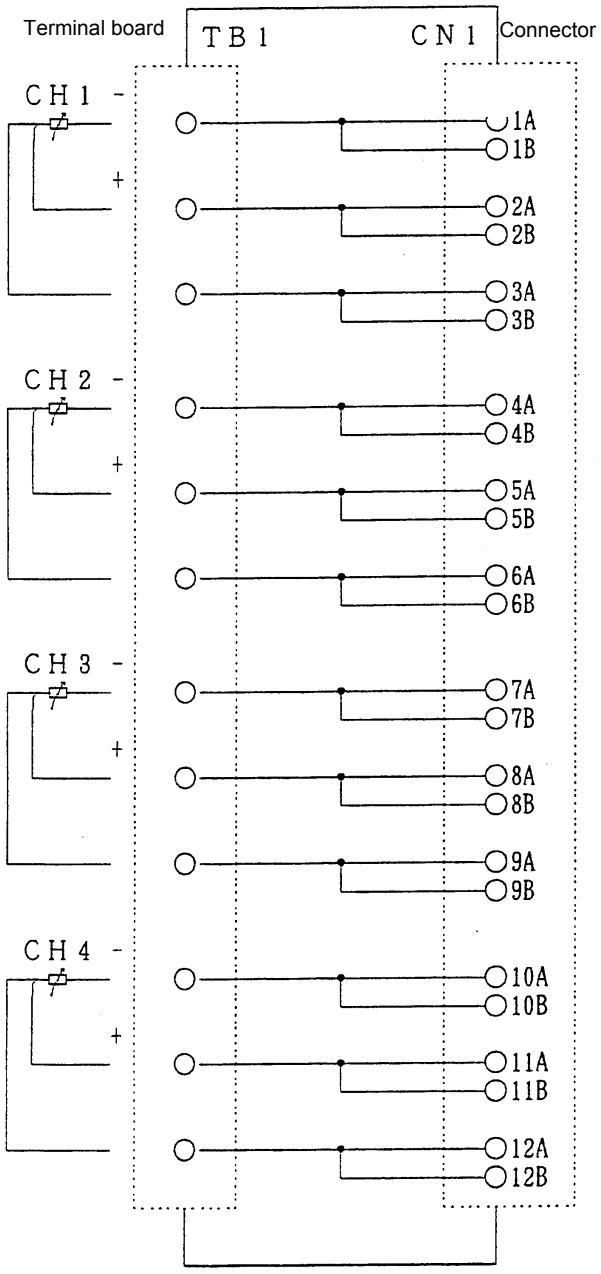
Channel	Pin No.	Pin No.
Channel 1 -	1A	1B
Channel 1 +	2A	2B
Channel 1 +	3A	3B
Channel 2 -	4A	4B
Channel 2 +	5A	5B
Channel 2 +	6A	6B
Channel 3 -	7A	7B
Channel 3 +	8A	8B
Channel 3 +	9A	9B
Channel 4 -	10A	10B
Channel 4 +	11A	11B
Channel 4 +	12A	12B
Unusable	13A	13B
Unusable	14A	14B
Unusable	15A	15B
Unusable	16A	16B
Unusable	17A	17B

(2) Thermocouple input module
ATI04B

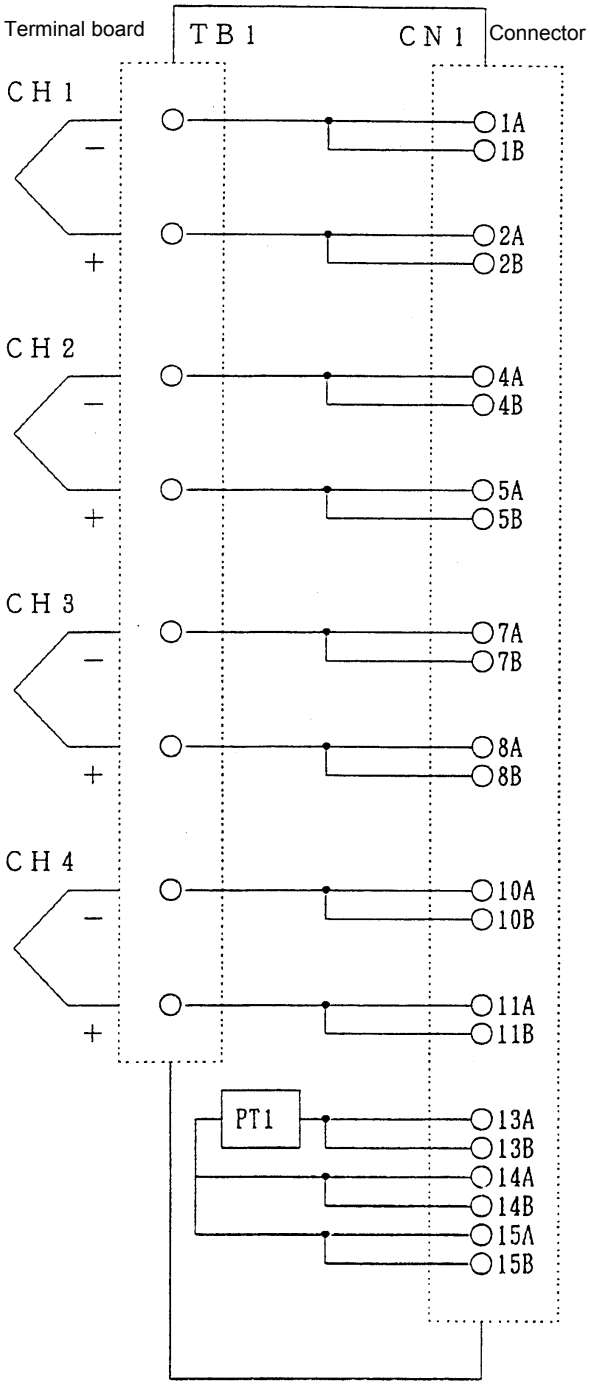
Channel	Pin No.	Pin No.
Channel 1 -	1A	1B
Channel 1 +	2A	2B
Unusable	3A	3B
Channel 2 -	4A	4B
Channel 2 +	5A	5B
Unusable	6A	6B
Channel 3 -	7A	7B
Channel 3 +	8A	8B
Unusable	9A	9B
Channel 4 -	10A	10B
Channel 4 +	11A	11B
Unusable	12A	12B
Cold-junction compensation element A	13A	13B
Cold-junction compensation element B1	14A	14B
Cold-junction compensation element B2	15A	15B
Unusable	16A	16B
Unusable	17A	17B

9.4.3 Terminal Unit Connection Diagram

For thermoresistance-type module (ATB01A)



For thermocouple-type module (ATB01B)

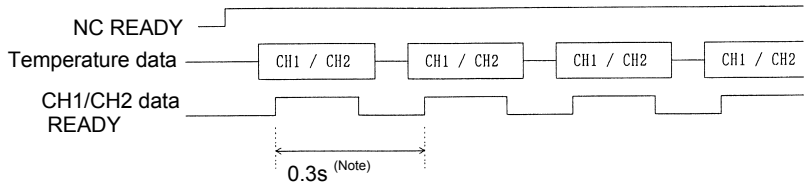


NOTE

The thermocouple module ATB01B incorporates a cold-junction compensation device (PT1). It is essential to temperature measurement with a thermocouple. Use the ATB01B whenever the ATI04B is used.

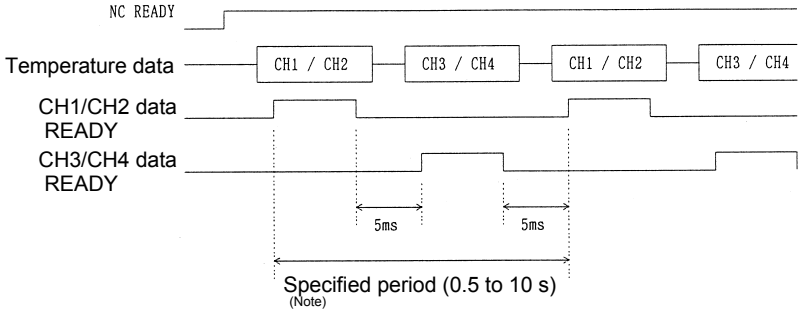
9.5 TIMING CHARTS

(1) 2-channel mode



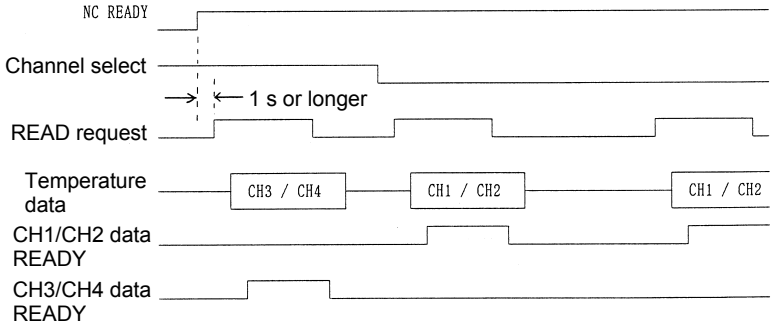
NOTE
The actual response time is the sum of the time required to pass the filter and the scan time that is determined depending on the system.

(2) 4-channel automatic measurement mode



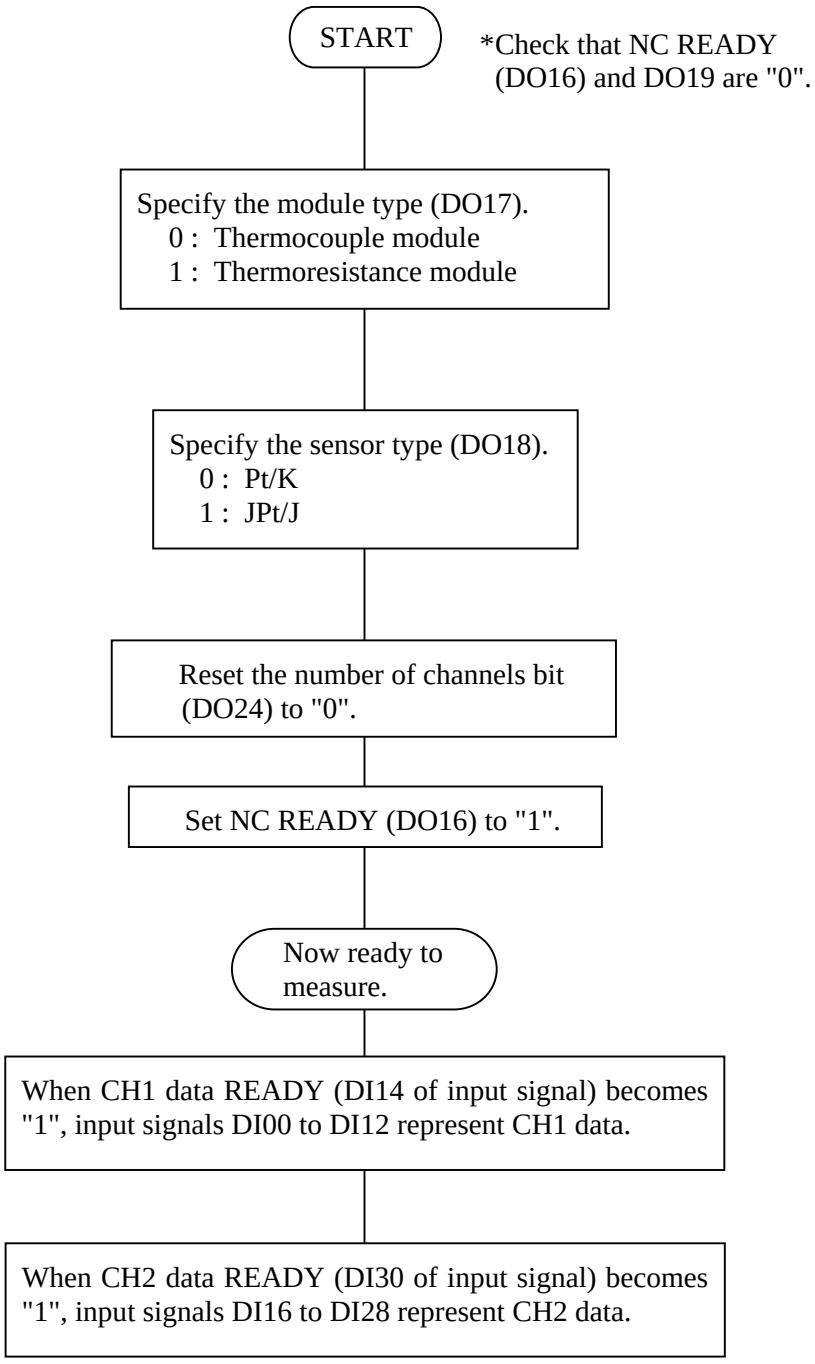
NOTE
The actual response time is the sum of the time required to pass the filter and the scan time that is determined depending on the system.

(3) 4-channel manual measurement mode



9.6 MEASUREMENT EXAMPLES

(1) 2-channel mode
(a) Flowchart

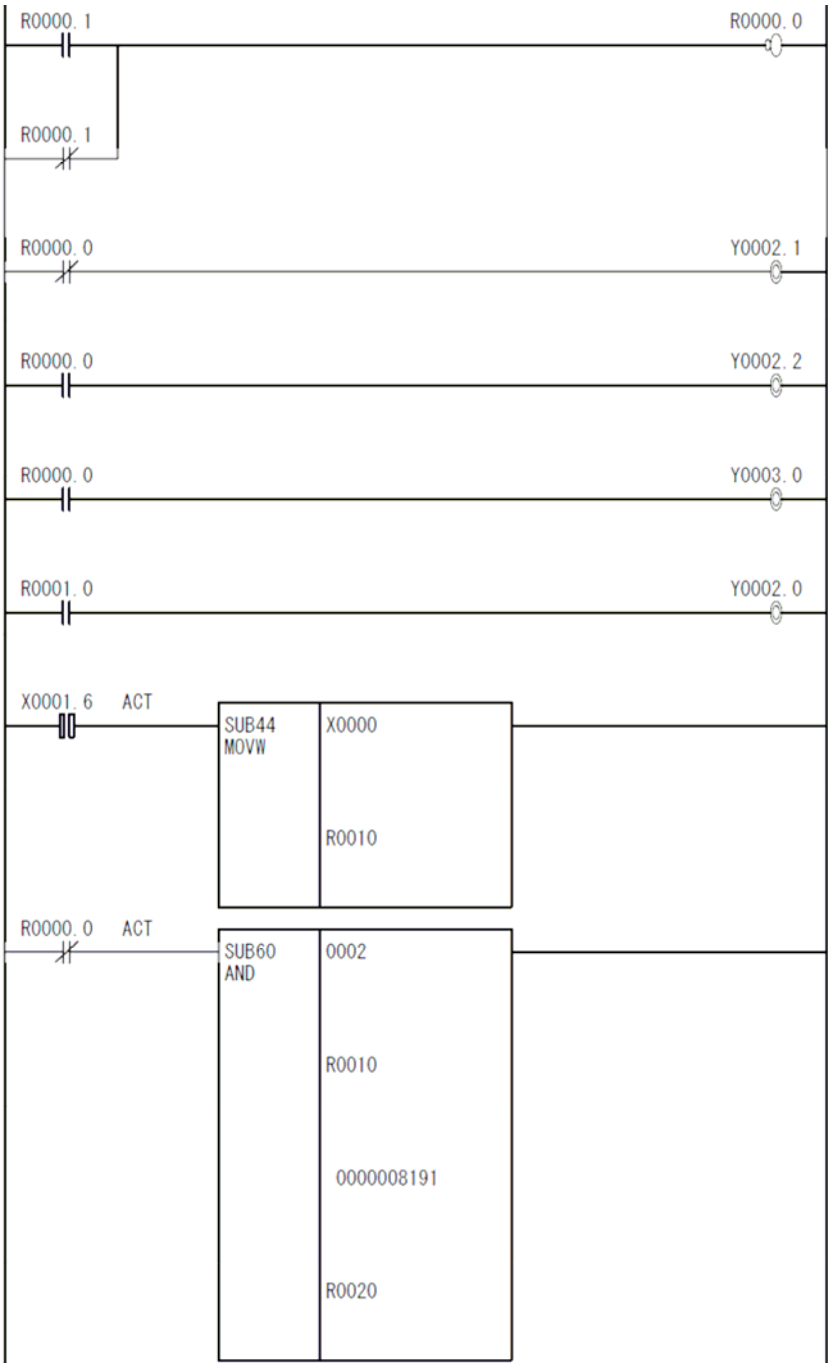


(b) Ladder example

The following measurement and ladder examples apply when a thermoresistance module with Pt sensor is used for measurement.

PMC measurement

Address	Group	Base	Slot	Module name	Address	Group	Base	Slot	Module name
X0000	0	0	01	/4	Y0000	0	0	01	/4
X0001	0	0	01	/4	Y0001	0	0	01	/4
X0002	0	0	01	/4	Y0002	0	0	01	/4
X0003	0	0	01	/4	Y0003	0	0	01	/4
X0004					Y0004				
X0005					Y0005				
X0006					Y0006				



Use R0000.0 as a full-time OFF coil.

Specify the module (thermoresistance-type module).

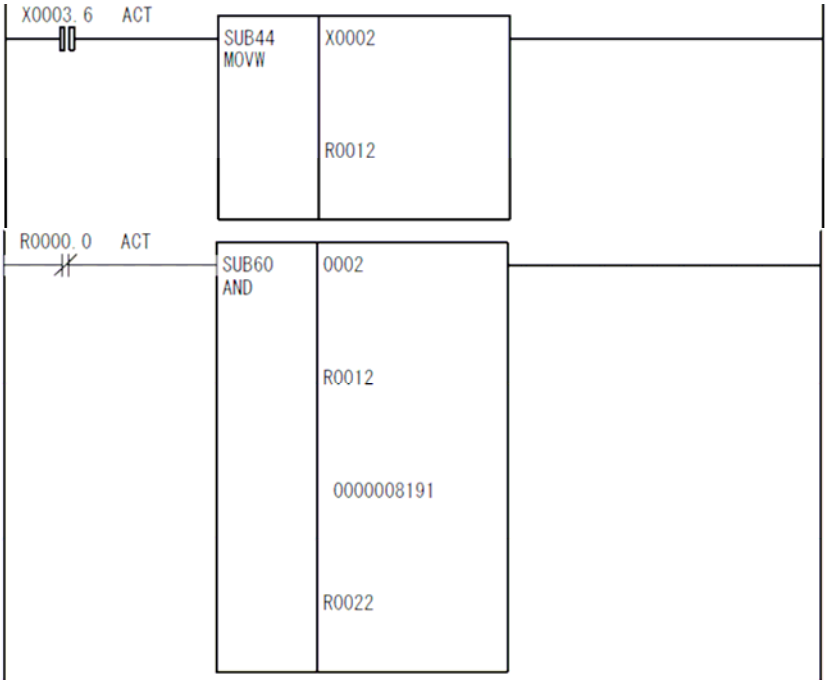
Specify the sensor (Pt).

Specify the number of channels (two channels).

NC READY (When R1.0 becomes "1", NC READY becomes "1" to start measurement.)

When CH1 data READY is "1", CH1 temperature data is sent to R10 to R11.

Mask three bits of the status signal (1FFFh (8191) is ANDed with R10 and R11) and transfer the temperature data of CH1 to R20 and R21.



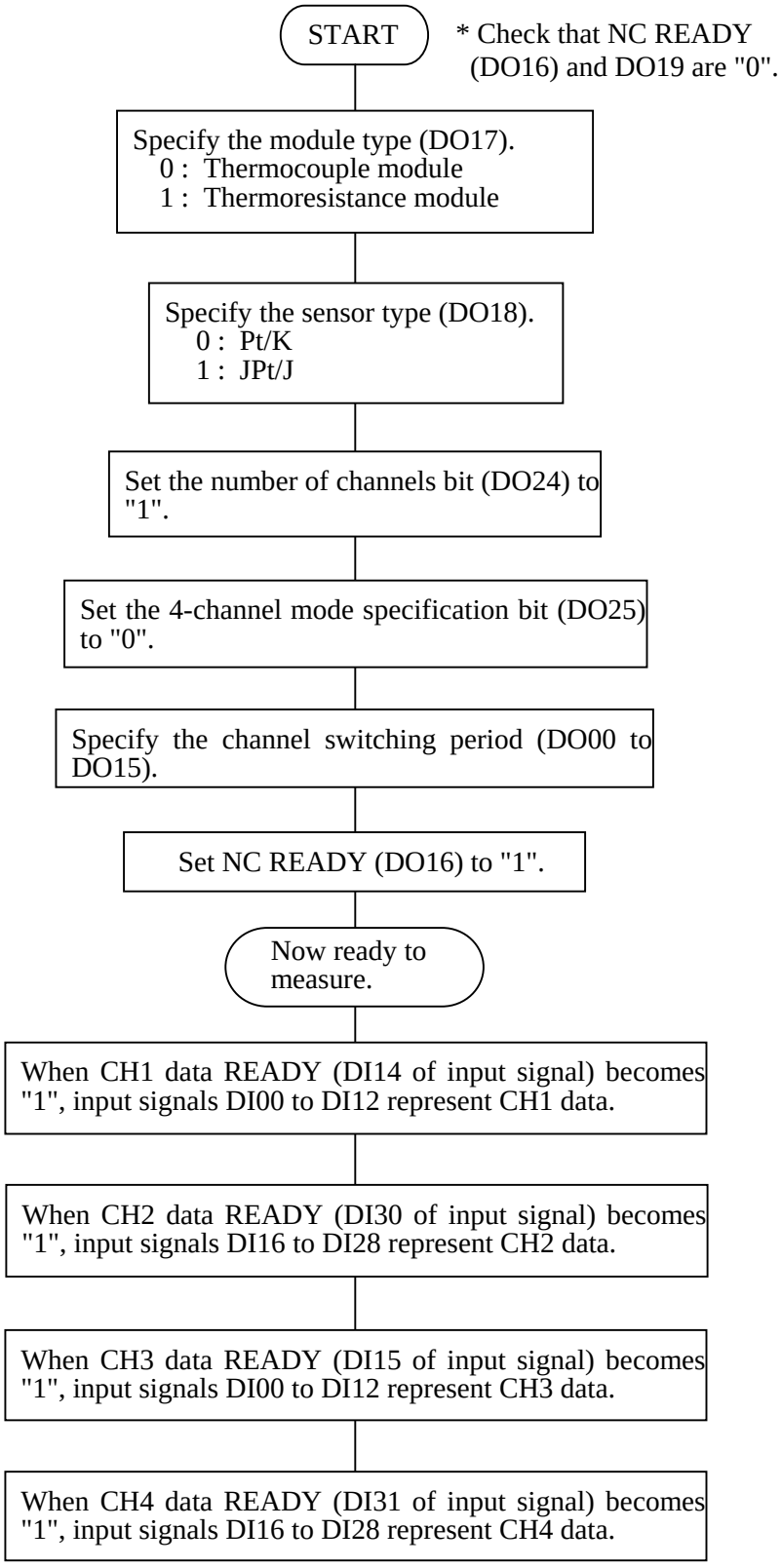
When CH2 data READY is "1", CH2 temperature data is sent to R12 to R13.

Mask three bits of the status signal (1FFFh (8191) is ANDed with R12 and R13) and transfer the temperature data of CH2 to R22 and R23.

NOTE
Set the ladder scan time to 0.25 s or less.
This example of ladder use is for the second level.

(2) 4-channel automatic measurement mode

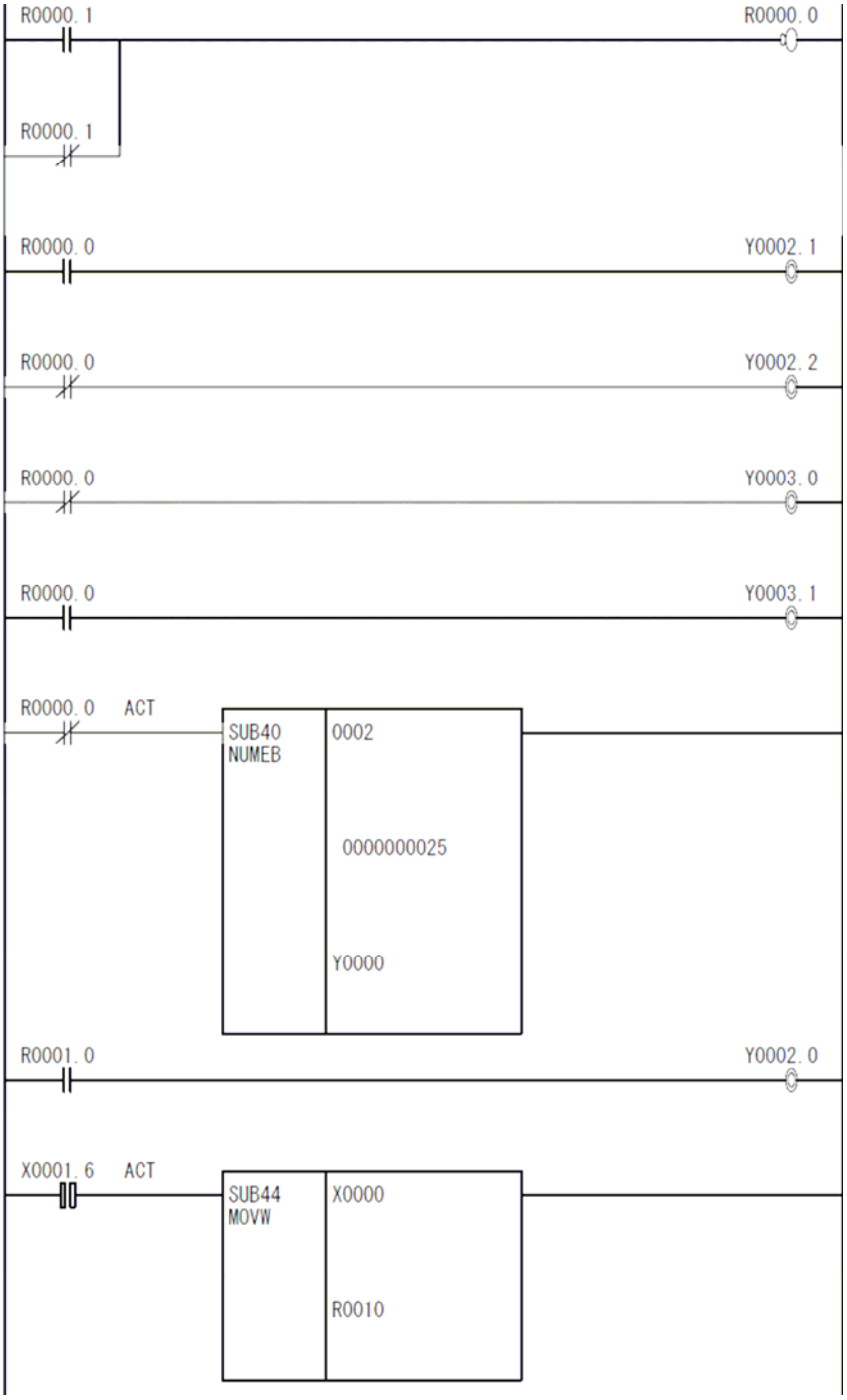
(a) Flowchart



(b) Ladder example

The following measurement and ladder examples apply when a J thermocouple module is used for measurement.
PMC assignment

Address	Group	Base	Slot	Module name	Address	Group	Base	Slot	Module name
X0000	0	0	01	/4	Y0000	0	0	01	/4
X0001	0	0	01	/4	Y0001	0	0	01	/4
X0002	0	0	01	/4	Y0002	0	0	01	/4
X0003	0	0	01	/4	Y0003	0	0	01	/4
X0004					Y0004				
X0005					Y0005				
X0006					Y0006				



Use R0000.0 as a full-time OFF coil.

Specify the module.
(thermocouple-type module)

Specify the sensor (J thermocouple).

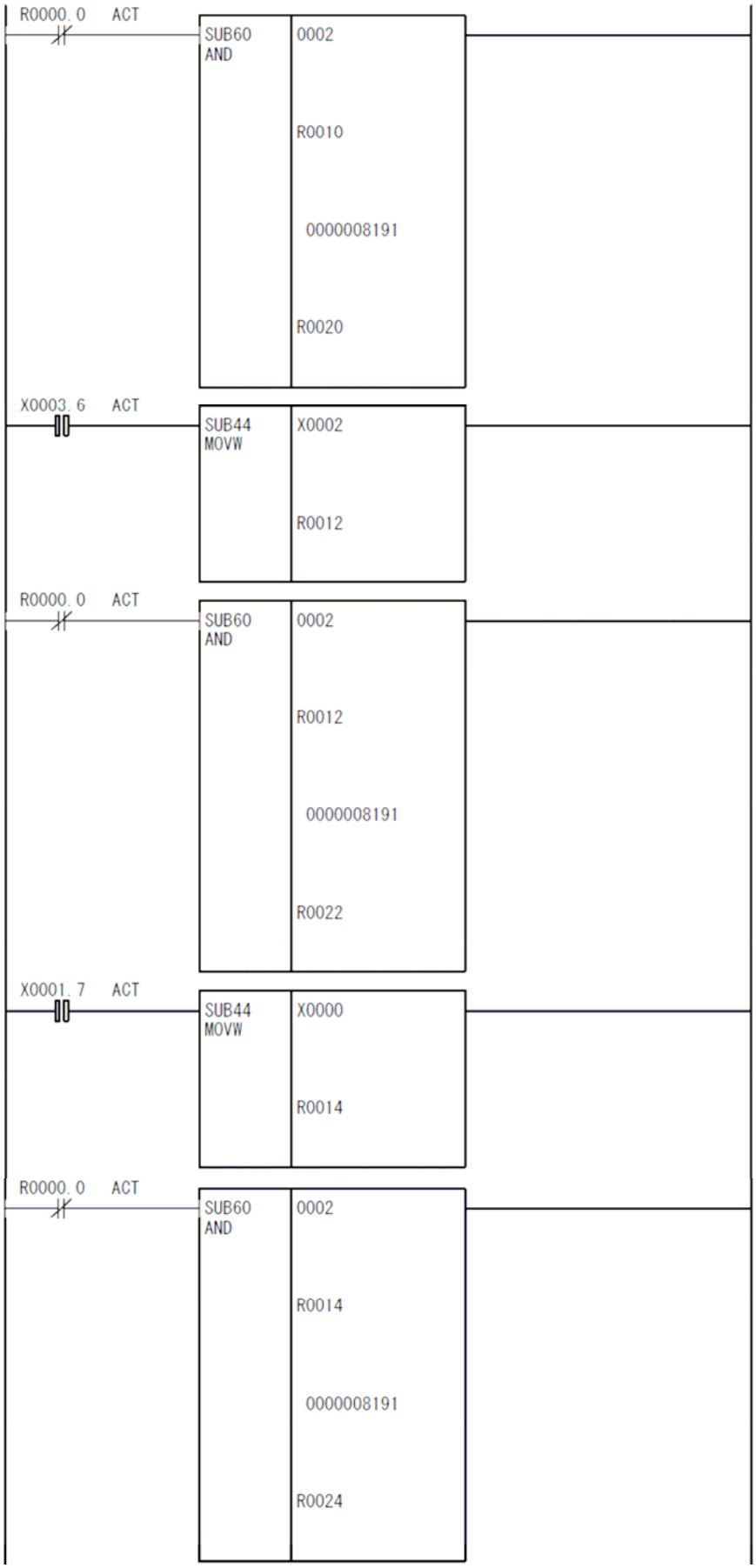
Specify the number of channels (four channels).

Specify a 4-channel mode (automatic measurement).

Specify the channel switching period for 4-channel automatic measurement.
Specify 25 to provide a period of 2.5 s.

NC READY (When R1.0 is set to "1", NC READY becomes "1" to start measurement.)

When CH1 data READY is set to "1", CH1 temperature data is sent to R10 to R11.



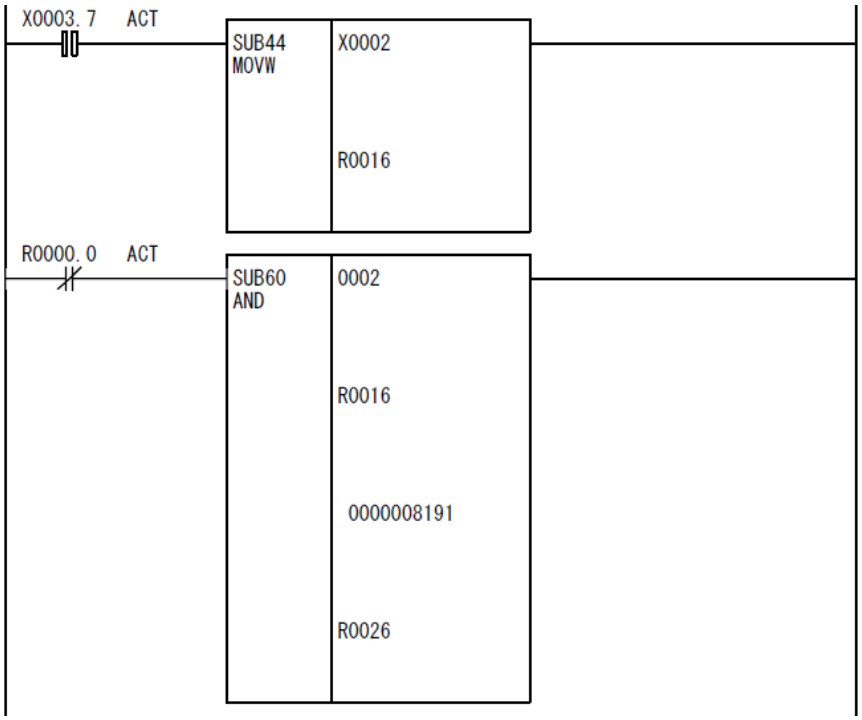
Mask three bits of the status signal (1FFFh (8191) is ANDed with R10 and R11) and transfer the temperature data of CH1 to R20 and R21.

When CH2 data READY is "1", CH2 temperature data is sent to R12 to R13.

Mask three bits of the status signal (1FFFh (8191) is ANDed with R12 and R13) and transfer the temperature data of CH2 to R22 and R23.

When CH3 data READY is "1", CH3 temperature data is sent to R14 to R15.

Mask three bits of the status signal (1FFFh (8191) is ANDed with R14 and R15) and transfer the temperature data of CH3 to R24 and R25.



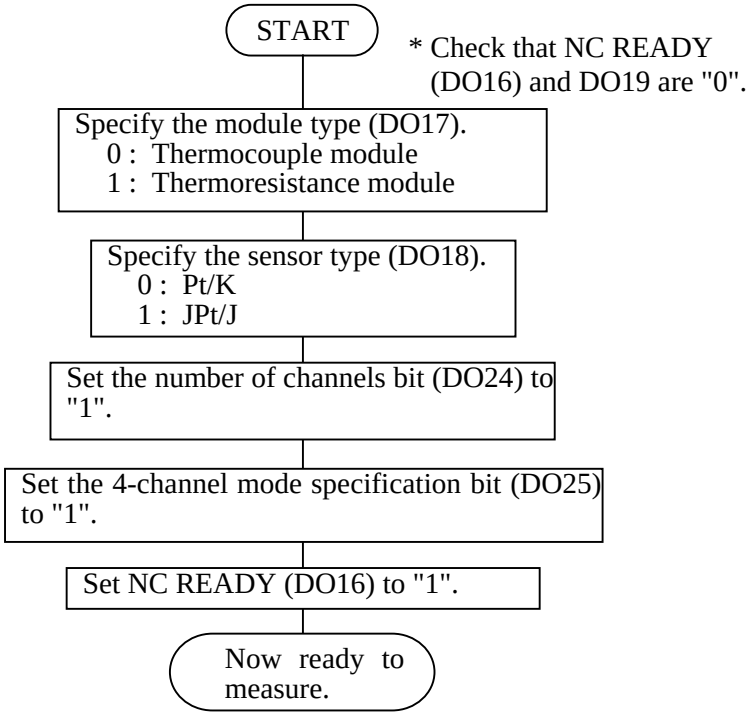
When CH4 data READY is "1", CH4 temperature data is sent to R16 to R17.

Mask three bits of the status signal (1FFFh (8191) is ANDed with R16 and R17) and transfer the temperature data of CH4 to R26 and R27.

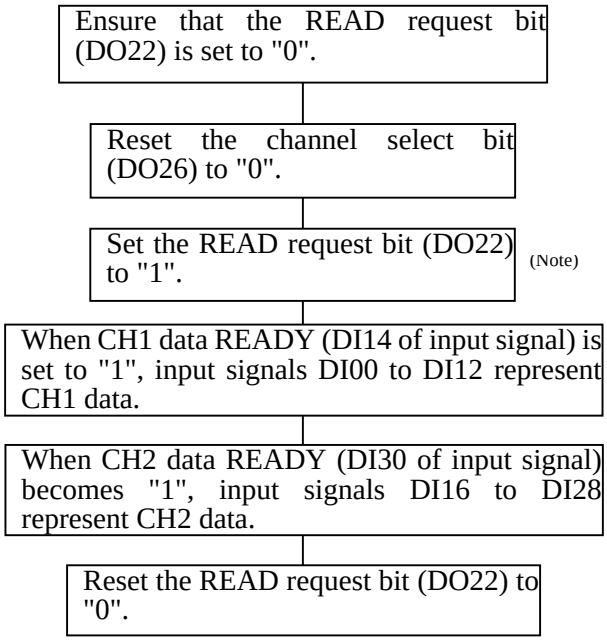
NOTE
This example of ladder use is for the second level.
R0.0 is used as a normally open relay.

(3) 4-channel manual measurement mode

(a) Flowchart



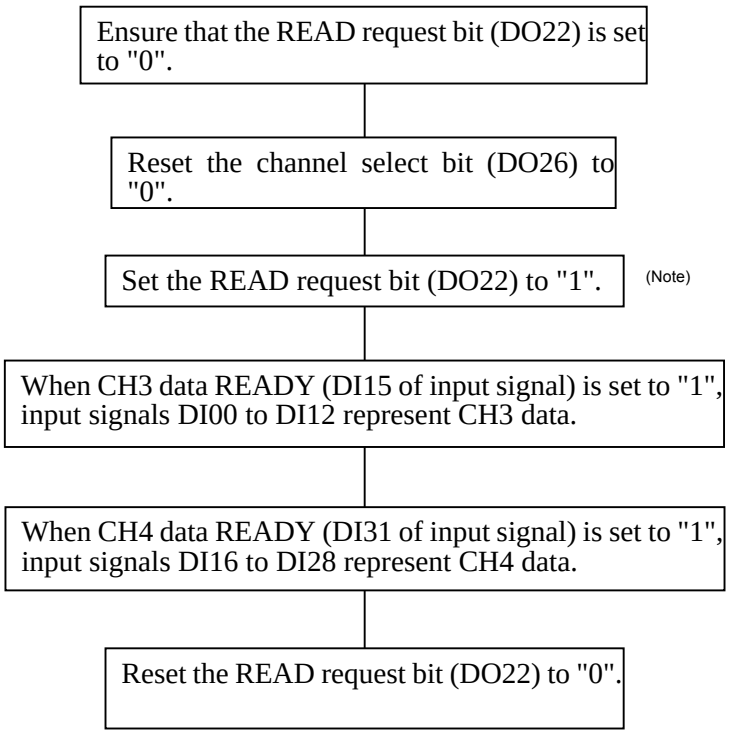
* Reading CH1 and CH2 data



NOTE

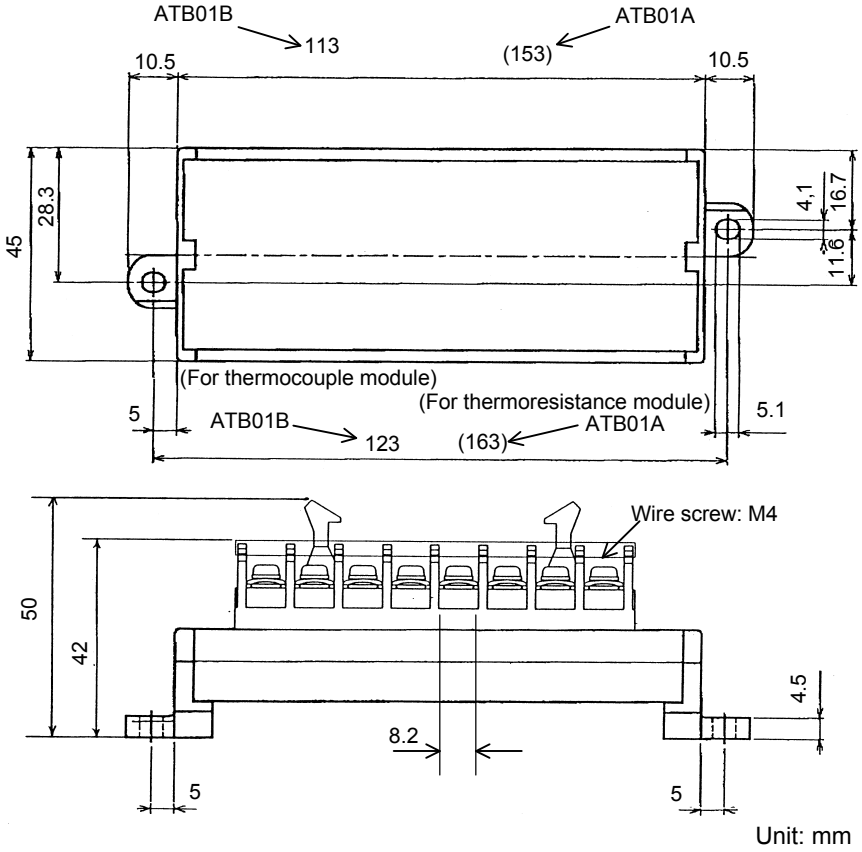
After setting NC READY to "1", wait for one second, and then set the READ request to "1".

* Reading CH3 and CH4 data



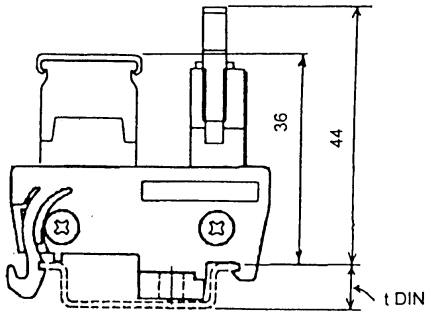
NOTE
1 After setting the NC READY bit to "1", wait for one second, and then set the READ request bit to "1".
2 To create the ladder for 4-channel manual measurement, refer to the above flowchart or timing chart.

9.7 TERMINAL UNIT DIMENSIONS



Unit: mm

To use a DIN rail, add its height (tDIN) to the dimension shown below.



Unit: mm

10 OPTICAL ADAPTER

The signal cable K1X shown in the general connection diagram (in section 4.1) can be extended to the maximum length of 200 m with optical fiber cables using an optical adapter for I/O Link *i* or optical adapter for I/O Link.
Note that the optical adapter types differ between I/O Link *i* and I/O Link.

NOTE
1 For the cable K2X, the optical adapter for I/O Link *i* or optical adapter for I/O Link. cannot be applied to.
2 In the following cases, make sure to use an optical fiber cable for K1X. For cabling within the same cabinet, however, this applies only when the cable is 15 m or longer.
- When the cable is more than 10 meters long.
- When the cable K1X runs between different cabinets and it is impossible to connect the cabinets with a wire of 5.5 mm^2 or thicker.
- When there is concern that the cable K1X is influenced by strong noise.
  For example;
  When there is a strong electromagnetic noise source beside the cable K1X such as a welding machine and the like.
  When a noise generating cable such as a power cable and the like runs for a long distance in parallel with the cable K1X.

10.1 SPECIFICATIONS OF THE OPTICAL ADAPTER FOR I/O Link

The optical adapters for I/O Link include a standard type (A13B-0154-B001) and a high-speed type (A13B-0154-B004).
If one channel of I/O Link consists of 6 or more optical connection stages, use the high-speed type for it.

Specification	Type	Maximum transmission distance	Maximum number of connectable stages	Relay by optical fiber junction adapters	Mass
A13B-0154-B001	Standard type	200m	5	None	Approx. 100g
		100m	5	Up to one point	
A13B-0154-B004	High-speed type	100m	16	Impossible	

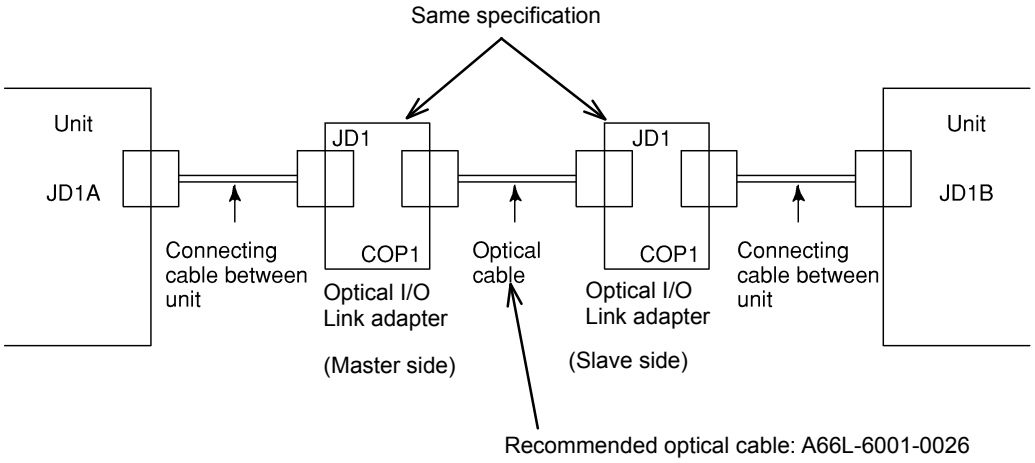
NOTE
1 The optical adapter (A13B-0154-B001 to A13B-0154-B004) for I/O Link is dedicated to I/O Link. It cannot be used with I/O Link *i*.
2 It is impossible to use high-speed and standard types together on one I/O Link line.
3 When the high-speed type optical adapter for I/O Link is used, it is impossible to use optical fiber junction adapters.

10.2 SPECIFICATIONS OF THE OPTICAL ADAPTER FOR I/O Link *i*

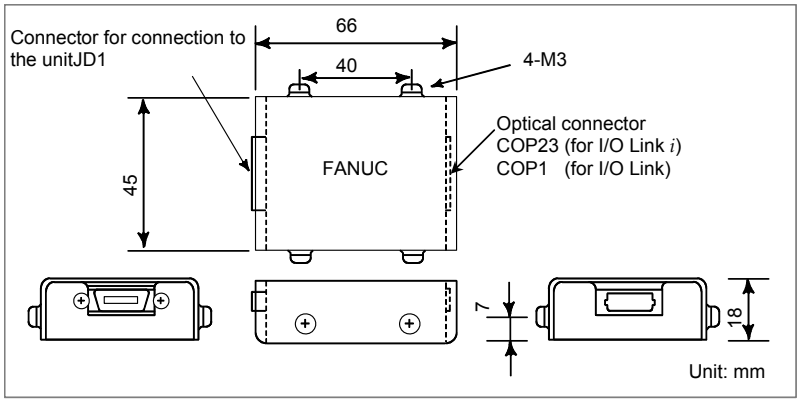
Specification	Transfer mode	Maximum transmission distance	Maximum number of connectable stages	Relay by optical fiber junction adapters	Mass
A13B-0154-B101	Standard mode	200m	5	None	Approx. 100g
		100m	16	Up to one point	
	High-speed mode	100m	10	Up to one point	

Only one optical adapter type (A13B-0154-B101) is available for I/O Link *i*. It can be used for both standard and high-speed transfer modes.

NOTE
1 The optical adapter (A13B-0154-B101) for I/O Link is dedicated to I/O Link *i*. It cannot be used with I/O Link.
2 The I/O Unit-A supports no high-speed mode.

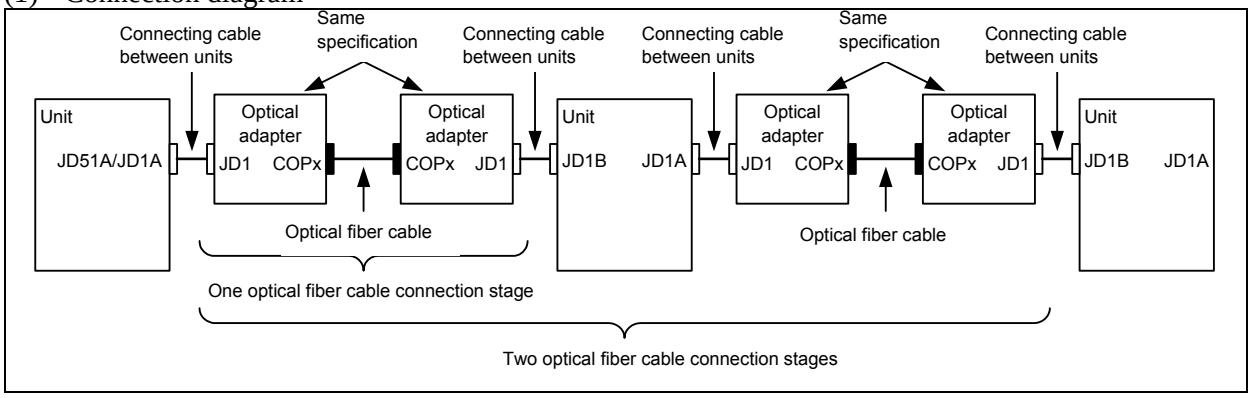


10.3 EXTERNAL DIMENSION OF OPTICAL ADAPTER



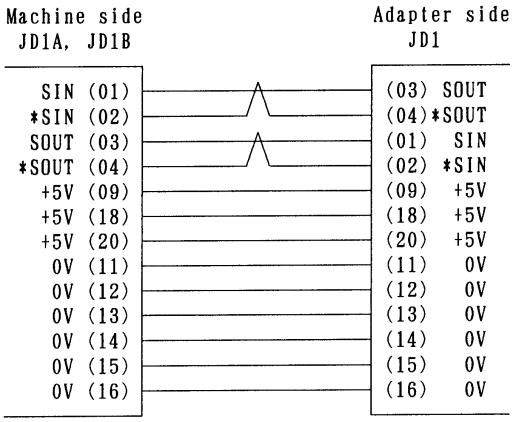
10.4 CONNECTION OF OPTICAL ADAPTER

(1) Connection diagram



(2) Interunit connecting cables K3X

01	SIN	11	0V
02	*SIN	12	0V
03	SOUT	13	0V
04	*SOUT	14	0V
05		15	0V
06		16	0V
07		17	
08		18	+5V
09	+5V	19	
10		20	+5V



(a) Recommended connector for cable side:
PCR-E20FA (manufactured by HONDA TSUSHIN)
FI30-20S (manufactured by HIROSE ELECTRIC)
FCN-247J020-G/E (manufactured by Fujitsu)
52622-2011 (manufactured by Molex)
(b) Recommended cable (with material): A66L-0001-0284#10P
(c) Cable length: Max.2m (when the recommended cable is used)

(3) Optical cable
<1> Specification (Be sure to use the optical cable conforming to this specification.):
- A66L-6001-0026

<2> Cable length:
See Sections 10.1 and 10.2 for the descriptions of the specifications of each optical adapter.

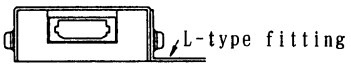
NOTE
1 The maximum permissible length of the interunit connection cable is 2 m (when a recommended cable is used). Make the cable as short as possible.
2 The pins enclosed in [ ] are used by the JD44A or JD51A for channel 2 or 3 connection. Do not connect anything to them.
3 Do not connect anything to pins to which no signal is assigned.

10.5 POWER SOURCE OF OPTICAL ADAPTER

Power is supplied to the optical adapter from the CNC or I/O Unit through the cable K3X of I/O Link or I/O Link *i*. Use a cable having wires for power supply.
When you use the optical adapter for I/O Link *i*, please add 50mA per an adapter to required current.

10.6 INSTALLATION CONDITIONS OF OPTICAL ADAPTER

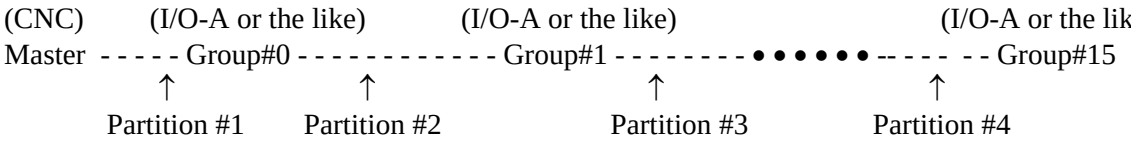
(1) As this adapter is not a closed type, install it in the same closed type cabinet as used for the NC control unit.
(2) Make sure to ground the case using the case fixing screw of the adapter.
(3) As the adapter is light, it is not necessary to fix it with screws. However, keep it from getting contact with other circuits lest it should be short-circuited. In addition, when fixing the adapter in a cabinet and the like, fix it with a L-type fitting using the case fixing screws (M3) of the adapter.



10.7 CAUTIONS FOR USING OPTICAL ADAPTERS

10.7.1 When Using Optical Adapters in Configuring I/O Link *i* or I/O Link

The following restrictions are applied when optical adapters are used in configuring I/O Link *i* or I/O Link.



Restriction on the number of optical adapters used per I/O Link channel

- When using the standard-type optical adapter for I/O Link:
  Up to 5 partitions (I/O Link master -- group #0 -- group #1 -- ... -- group #15) can be configured with optical adapter.
  Use electrical cables for the K1X in the other partitions.
- When using the high-speed type optical adapter for I/O Link:
  The high-speed type performs optical-electrical conversion faster than the standard-type.
  All (16) partitions (master -- group #0 -- group #1 -- ... -- group #15) can be configured with optical adapter.

Restriction on the number of optical adapters used per I/O Link *i* channel

- When using optical adapters for I/O Link *i* in the normal communication mode:
  Up to 16 (for the high-speed mode, up to 10) I/O Link *i* partitions can be configured using optical adapters.
  Use electrical cables for the K1X in the other partitions.

NOTE
1 If an optical fiber cable is used with /O Link *i* or I/O Link, the optical adapters connected to each end of the optical fiber cable must be those designed to the same specifications.

NOTE

2 When 6 or more I/O Link partitions are configured using optical adapters, I/O Link cannot operate normally if a standard-type optical adapter is used even in one partition.
When using optical adapters in 6 or more partitions, do not use the standard-type optical adapter; use only the high-speed type optical adapter.

Parts required in configuring one partition using an optical adapter
(1) When configuring 5 or fewer partitions with optical adapter for I/O Link
Two standard-type optical adapters for I/O Link
Two unit-to-unit connecting cables (K3X)
One optical fiber cable
(2) When configuring six or more partitions with optical fibers
Two high-speed type optical adapters for I/O Link
Two unit-to-unit connecting cables (K3X)
One optical fiber cable
(3) When configuring 16 or fewer partitions with optical adapter for I/O Link *i*
Two optical adapters for I/O Link *i*
Two unit-to-unit connecting cables (K3X)
One optical fiber cable

3 The I/O Unit-A does not support the high-speed mode of I/O Link *i*.

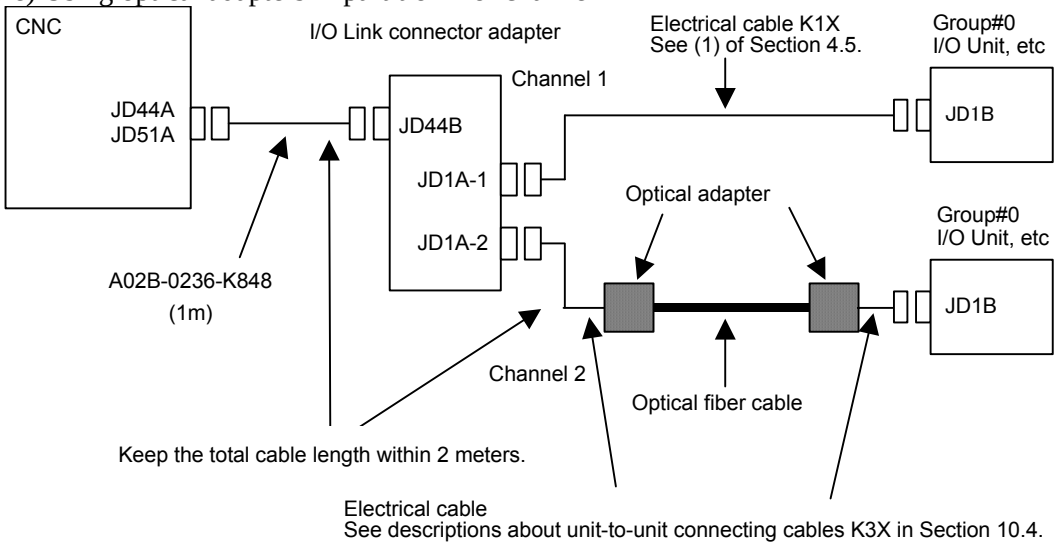
10.7.2 When Using Two I/O Link *i* or I/O Link Channels

Using two I/O Link *i* or I/O Link channels requires using the I/O Link connector adapter.
When optical adapters are used, optical fiber cables can be used in all partitions (all partitions of channels 1 and 2) ahead of the I/O Link connector adapter. No optical fiber cable can be used between the CNC (JD44A or JD51A) and I/O Link connector adapter (JD44B). Use a 1-meter electrical cable (A02B-0236-K848).

NOTE

Do not have the cable length from the CNC (JD44A or JD51A) to the I/O Link connector adapter and then to the optical adapter exceed 2 meters in total.

(Example) Using optical adapters in partition 1 of channel 2

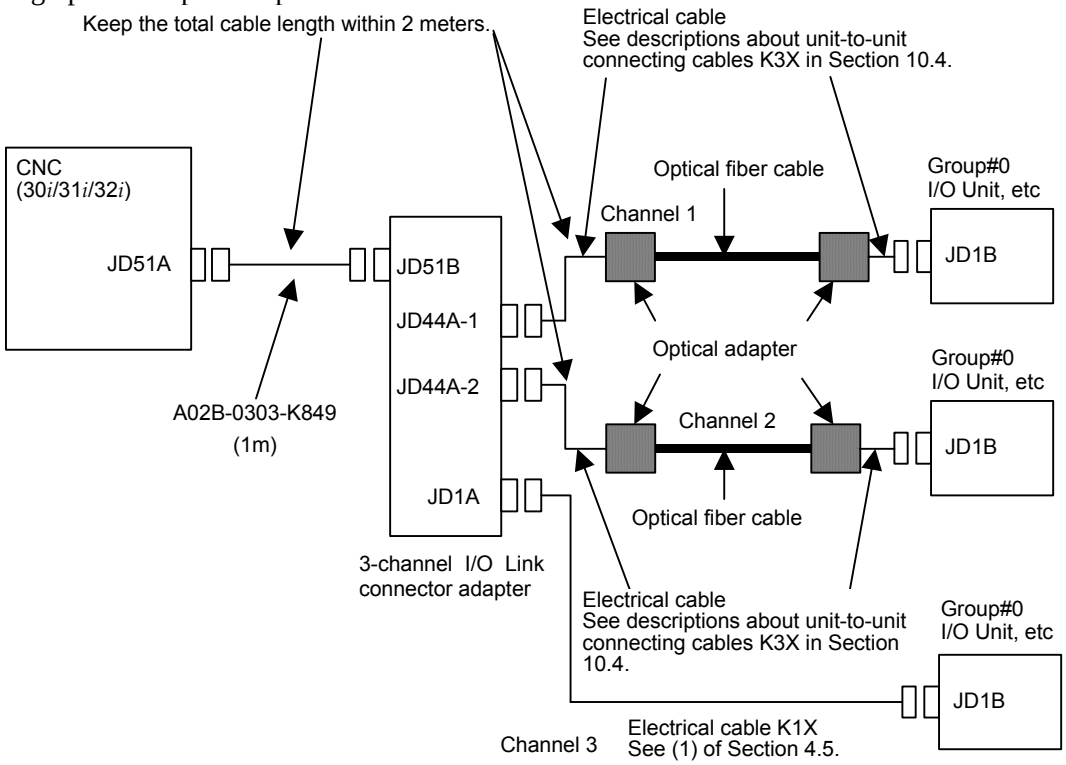


10.7.3 When Using Three I/O Link *i* or I/O Link Channels

Using three I/O Link *i* or I/O Link channels requires using the 3-channel I/O Link connector adapter. When optical adapters are used, optical fiber cables can be used in all partitions (all partitions of channels 1, 2, and 3) ahead of the I/O Link connector adapter. No optical fiber cable can be used between the CNC (JD51A) and I/O Link connector adapter (JD51B). Use a 1-meter electrical cable (A02B-0303-K849).

NOTE
Do not have the cable length from the CNC (JD51A) to the I/O Link connector adapter and then to the optical adapter exceed 2 meters in total.

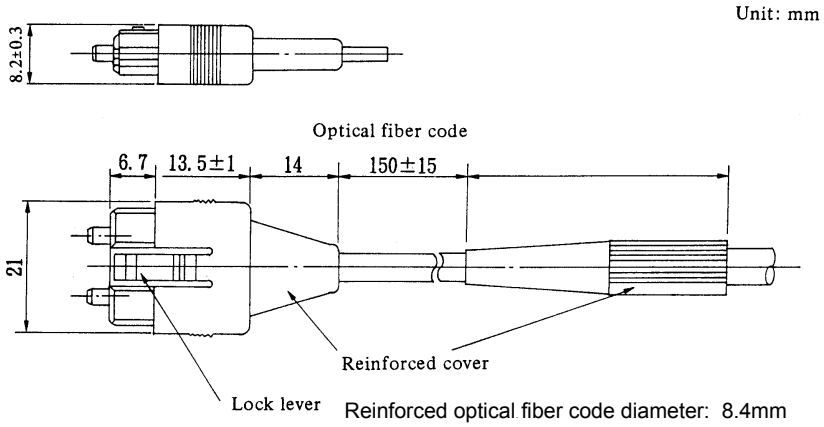
(Example)
Using optical adapters in partition 1 of each of channels 1 and 2



10.8 OPTICAL FIBER CABLE

An optical fiber cable is used to connect between the optical connector of an optical adapter and that of another optical adapter. Unlike the conventional power cables, optical fiber cables need special care in installation and handling. No optical fiber cable can be used on movable parts.

10.8.1 External View of Optical Fiber Cable

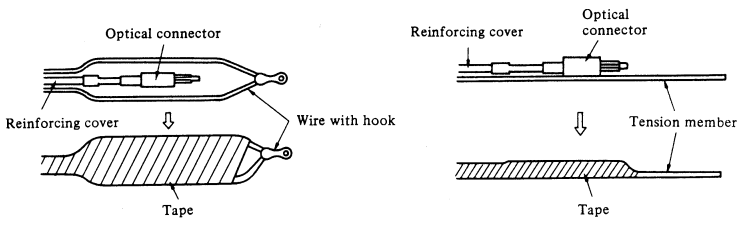


Reinforced optical fiber code diameter: 8.4mm
Tensile strength: Optical fiber code: 25kg
Optical fiber code-connector: 2kg
Reinforcing cover: 150kg
Bending radious of optical fiber code with reinforcing cover: 50mm

(1) Standard length of an optical fiber cable is 10, 15, 20, 30, 50, 100, and 200 meters.
(2) No machine tool builder is allowed to cut or joint optical fiber cables.
(3) If it needs to relay on cabling, use optical fiber junction adapter. Up to the relay points are allowed on a transmission line.

10.8.2 Notice of Optical Fiber Cable Handling

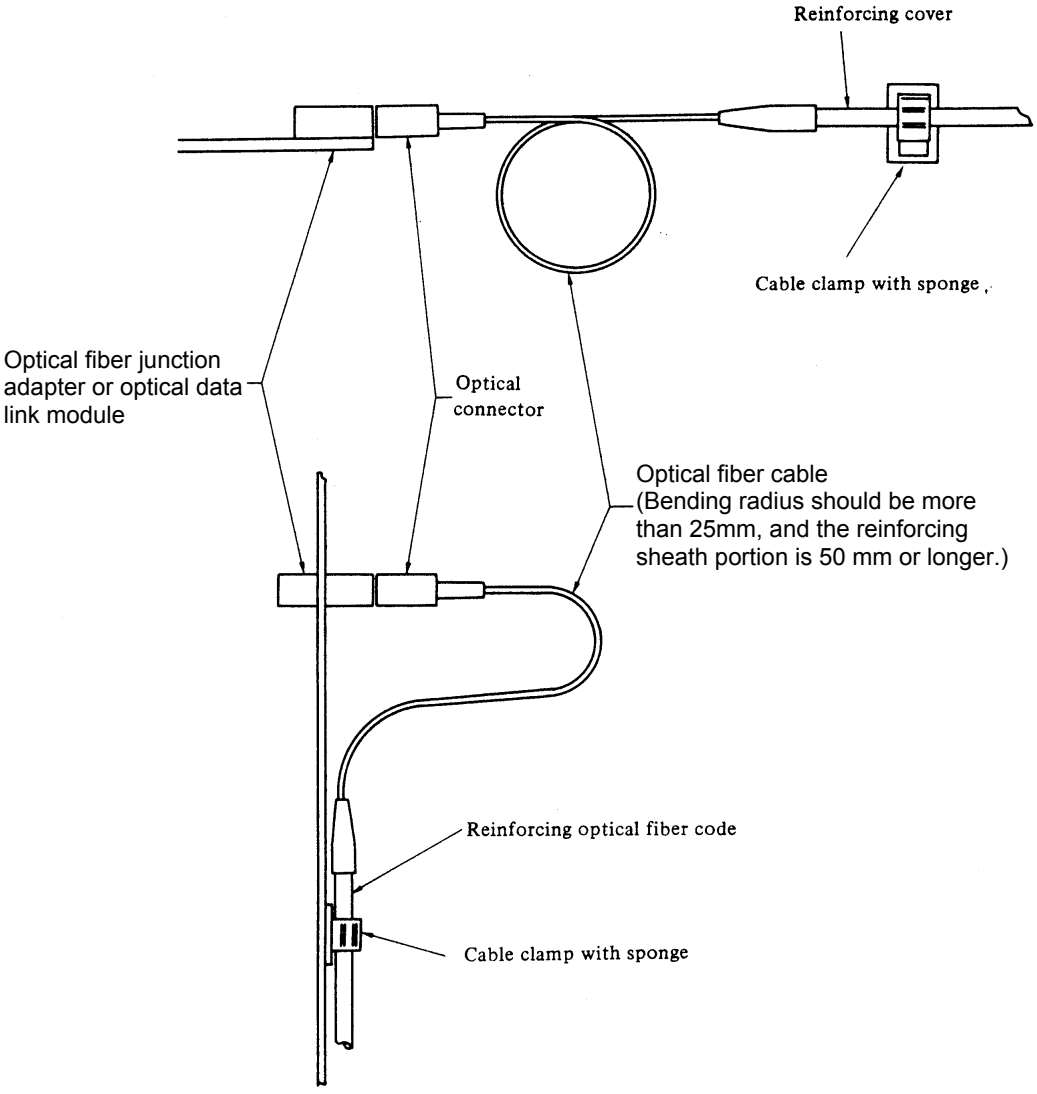
(1) Even though reinforcing cover used on the optical fiber code has enough mechanical strength, be sure not to be damaged by heavy materials drop.
(2) Detaching and attaching of optical connector should always be made by touching connector. Optical fiber code should not be touched when replacement.
(3) Optical connector is automatically locked with upper side lock levels after being connected. It is impossible to pull out the connector without releasing the lock levers.
(4) Optical connector cannot be connected oppositely. Be sure the connector direction when connection is done.
(5) Optical connector should be processed as follows before laying of optical fiber cable.
Fix a reinforcing cover to a wire with hook or tension member by a tape.
At laying hook the wire or pull the tension member taking enough care that optical connector does not receive pulling strength.



(6) Reinforcing cover is fixed to cable lamp so that optical fiber cable could not weigh directly the connecting part of connector.
(7) Notice that optical connector's chip is clear.
The attached protect cap must be always put on when optical connector is not used.
Remove dirty with a clear tissue or absorbent cotton (cotton with ethyl alcohol is applicable). No other organic solvent than ethyl alcohol cannot be used.

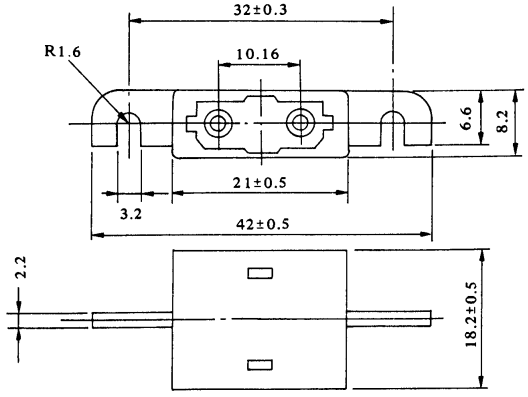
10.8.3 Optical Fiber Cable Clamping Method

When reinforcing cover is fixed at cable clamp with sponge, enough sag at optical fiber code as shown below is necessary so that connecting part of optical should not be weighed directly by optical fiber cable.

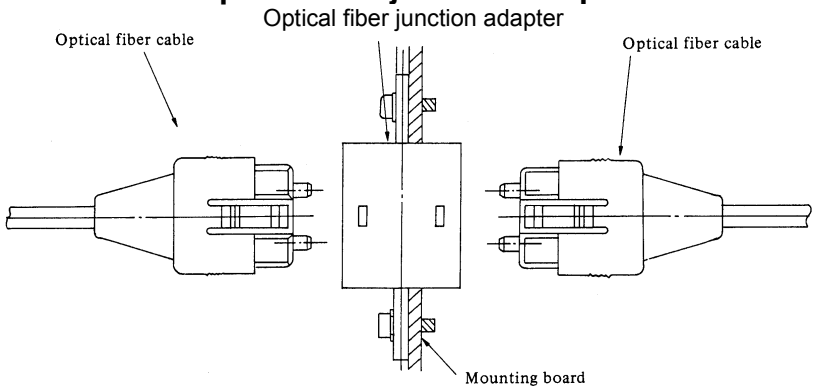


10.8.4 Relay Using an Optical Fiber Junction Adapter

(1) External view of an optical fiber junction adapter



(2) Example of the use of an optical fiber junction adapter



Specification: A02B-0094-K841

NOTE
1 Up to one relay points are permitted.
2 No optical fiber junction adapter can be used with the high-speed optical adapter for I/O Link.

(3) Installing the optical fiber junction adapter

The optical fiber junction adapter should be installed within a cabinet, as a rule. If it is impossible to avoid installing it within a cabinet, protect the adapter and the optical fiber cable portions (such as connectors and cords) not covered with reinforcement coating from the outside air by, for example, covering them with packing.

(4) Environmental resistance of the optical fiber junction adapter

- The optical fiber junction adapter is not waterproof. Even when optical fiber cables are attached to both ends of the adapter, there are very small gaps in the linked portions, so water resistance cannot be expected.
- When optical fiber cables are attached to both ends of the junction adapter installed in a normal environment (such as within a cabinet), it is unlikely that dust will penetrate between the adapter and optical fiber cable to the degree that it may hamper normal optical linkage. If one or both ends of the adapter are left open, dust and dirt may accumulate even when the adapter is in a normal environment (such as within a cabinet). The dust and dirt on the adapter ends is likely to hamper normal optical linkage when the optical fiber cables are attached. In such a case, clean the junction adapter and the optical connector using the optical fiber junction adapter cleaning method described below.
- Do not allow cutting fluid to splash over the adapter or those optical cable portions (such as connectors and cords) that are not covered with reinforcement coating. If the inside of the adapter and fiber end surfaces are contaminated with cutting fluid, a malfunction may occur.

(5) Cleaning

If the optical fiber junction adapter, optical adapter, and optical fiber cable are soiled, clean them according to the following procedures.

- Cleaning the optical fiber junction adapter and optical adapter
  First, clean the entire housing by wiping it with a cloth moistened with, or by washing it in ethyl alcohol. Similarly, wash the two sleeves in the adapter or wipe them with a cotton swab or the like.
- Cleaning optical fiber cables
  For the optical fiber cables, it is important to clean the connectors at their ends. Any soiling on the optical fiber cable end surfaces will hamper optical transmission, resulting in a malfunction. Wipe the optical fiber cable end surfaces (that is, the ferrule end surfaces) thoroughly with a soft, clean cloth (like gauze) moistened with ethyl alcohol, in the same way as described above.

The use of cotton swabs may prove convenient. The fiber end surfaces of low-loss optical fiber cables are lower than the ferrules. To remove any soiling from the fiber end surfaces completely, push the cotton swab or gauze into the depressions all the way through while rotating the ferrule. If the ferrules and optical connectors are contaminated with oily substances, and they may extend over a cleaned fiber end surface when it is attached to the optical-to-electrical conversion module, it is a good idea to wash them before wiping the optical fiber cable end surfaces, using the procedure stated above.

10.8.5 Maximum Transmission Distance by Optical Fiber Junction Cable

Maximum transmission distance by optical fiber junction cable is shown below:
The maximum transmission distance varies depending on the number of relay points supported by optical fiber junction adapters. When the high-speed type optical adapter for I/O Link is in use, no optical fiber junction adapter can be used.

I/O Link

Optical adapter	Relay points	Max. trans. distance
Standard type	0	200m
	1	100m (total)
High-speed type	0	100m
	1	Not applicable

I/O Link *i*

Communication method	Relay points	Max. trans. distance
Normal mode	0	200m
	1	100m
High-speed mode	1	100m

11 I/O Link DUMMY UNIT

11.1 OVERVIEW

If a slave unit (such as the FS0, Power Mate, I/O Unit-MODEL A, or connection unit) is removed from the FANUC I/O Link (Note), the group number for those that followed the removed slave unit changes. So, it becomes necessary to change the PMC assignment. However, connecting a FANUC I/O Link dummy unit in place of the removed slave unit makes it unnecessary to change PMC assignment.

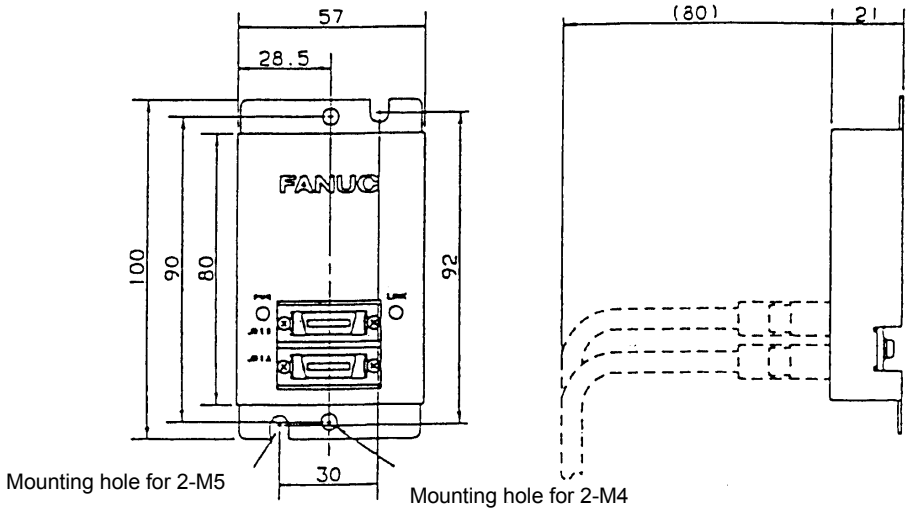
This chapter describes the electrical and structural specifications that apply to the FANUC I/O Link dummy unit when it is connected to the FANUC I/O Link.

NOTE
1 The I/O Link dummy unit is dedicated to I/O Link. It cannot be used with I/O Link *i*.
2 Some *i* series CNC models can manage the group numbers of I/O Link slaves by parameter setting. For details, refer to the PMC Programming Manual "Selectable I/O Link Assignment Function".

11.2 SPECIFICATION: A13B-0167-B001

11.3 EXTERNAL DIMENSIONS

Units: mm



11.4 LED INDICATORS

(1) PWR: Lights when the FANUC I/O Link dummy unit is supplied with power.
(2) LINK: Lights when the FANUC I/O Link is performing communication.

11.5 WEIGHT

(1) Main unit: Approximately 120 g

11.6 POWER REQUIREMENTS

Power is supplied to the I/O Link dummy unit from the CNC or I/O Unit through the cable K3X of I/O Link. Use a cable having wires for power supply.

Required current: 180 mA (maximum)

11.7 INSTALLATION CONDITIONS

This unit is not hermetically sealed. So, it must be installed in a cabinet that is hermetically sealed to the same level as a cabinet for the NC. The cabinet must be installed in a location where the following environmental requirements are satisfied.

(1) Ambient temperature
Operating: 0 to 55°C
Storage and transportation: -20 to 60°C
(2) Humidity
Normal: 75% or less (relative)
Short-period (within one month): 95% (maximum)
(3) Vibration
Operating: 0.5 G or less

11.8 CONNECTION DIAGRAMS

11.8.1 When not Connecting FANUC I/O Link Dummy Units in Series

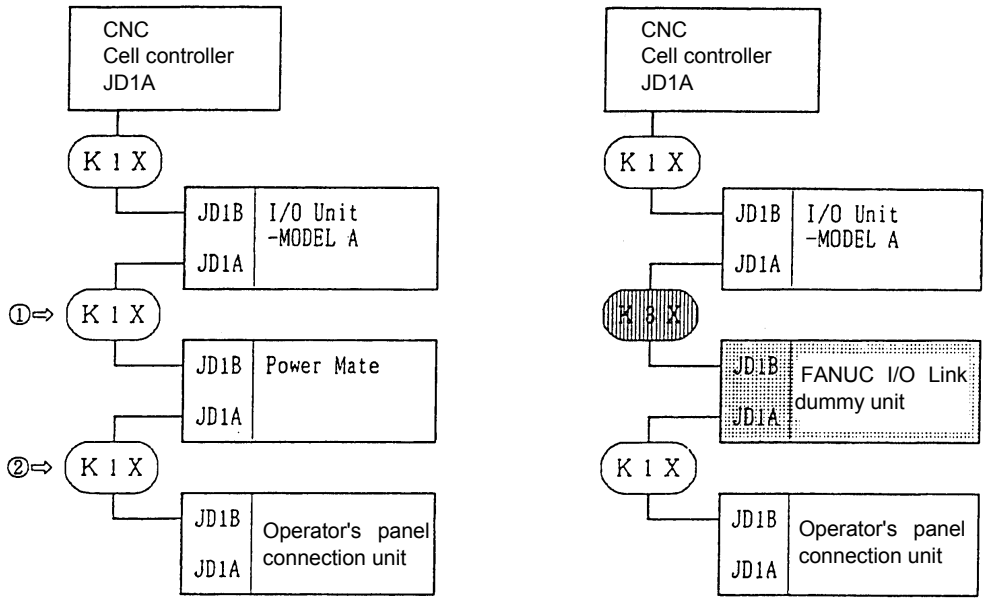


Fig. 11.8.1 Example of Using the FANUC I/O Link Dummy Unit (in Place of the Power Mate)

(1) Replacing a cable
The FANUC I/O Link dummy unit is supplied with power from the preceding or following group via a K3X cable. So, the K1X cable at either JD1A or JD1B of the dummy unit must be replaced with the K3X cable (① or ② in Fig. 11.8.1).

> ⚠ **CAUTION**
> Do not attach a K3X cable to JD1A and JD1B simultaneously.

(2) Cable length
K1X cable: 10 m (maximum) (for cabling within the same cabinet, up to 15 m)
K3X cable: 2 m (maximum)

11.8.2 Connecting FANUC I/O Link Dummy Units in Series

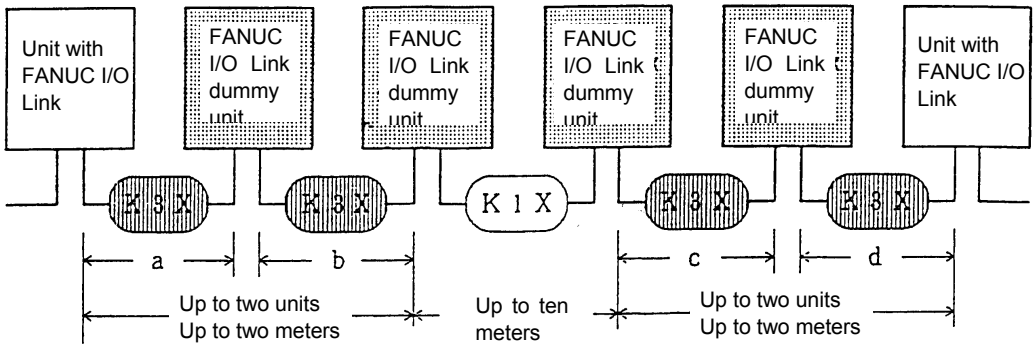


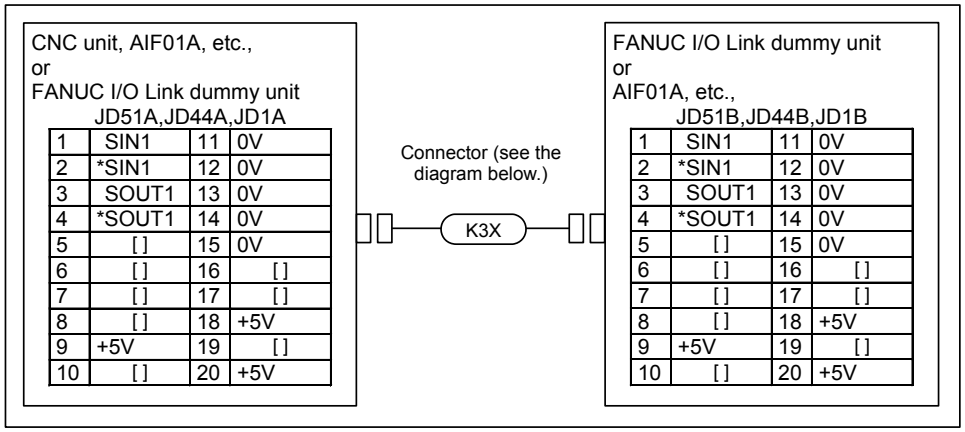
Fig. 11.8.2

(1) Number of FANUC I/O Link dummy units that can be used in succession
Up to two FANUC I/O Link dummy units can be connected via a K3X cable to a unit that supplies power to them. (See Fig. 11.8.2.)
(2) Cable length
K1X cable: 10 m (maximum) (for cabling within the same cabinet, up to 15 m)
K3X cable: 2 m (maximum) in total ($a + b \leq 2$ m and $c + d \leq 2$ m)

11.8.3 Grounding

Ground the case of the FANUC I/O Link dummy unit.

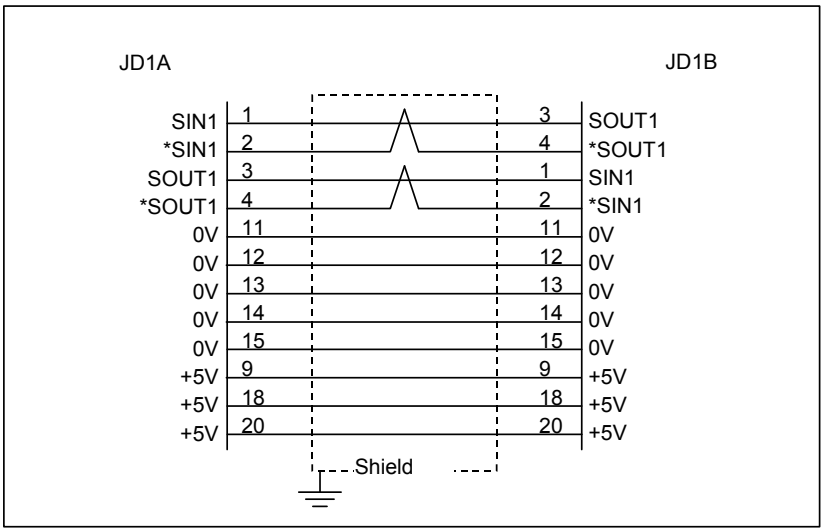
11.8.4 K3X Cable



1	SIN1	11	0V
2	*SIN1	12	0V
3	SOUT1	13	0V
4	*SOUT1	14	0V
5	[ ]	15	0V
6	[ ]	16	[ ]
7	[ ]	17	[ ]
8	[ ]	18	+5V
9	+5V	19	[ ]
10	[ ]	20	+5V

1	SIN1	11	0V
2	*SIN1	12	0V
3	SOUT1	13	0V
4	*SOUT1	14	0V
5	[ ]	15	0V
6	[ ]	16	[ ]
7	[ ]	17	[ ]
8	[ ]	18	+5V
9	+5V	19	[ ]
10	[ ]	20	+5V

NOTE
The pins enclosed in [ ] are used by the JD44A, JD44B, JD51A, or JD51B for channel 2 or 3 connection. Do not connect anything to them.



- Cable connector

Manufacturer	Pin		Housing
	Soldering type	Crimping type	
Honda Tsushin	PCR-E20FS	PCR-E20FA	PCR-V20LA
Hirose Electric	FI-40-20S	FI-30-20S	FI-20-CV2
Fujitsu	-	FCN-247J020-G/E	FCN-240C020-Y/S

- Use twisted-pair wires for the SIN, *SIN, SOUT, and *SOUT signals.
- Recommended wires : A66L-0001-0284#10P (twisted-pair wires with common shielding)
- Maximum cable length : 2 m (when recommended wires are used)
- Do not connect a wire to an idle pin.
- Connect the cable shielding to the grounding plate of the cabinet via a metal cable clamp at JD1A. (See the applicable CNC unit connection manual.)

12 TWO-CHANNEL I/O Link CONNECTOR ADAPTER

12.1 OVERVIEW

With some *i* series CNC models, it is possible to use up to two I/O Link *i* interface channels and up to three I/O Link interface channels. These channels make it possible to increase the number of I/O points to 4096/4096.
This chapter explains how to connect a 2-channel I/O Link connector adapter required in using the 2-channel function for I/O Link *i* or I/O Link.

NOTE
For the CNCs that can use this function, refer to the connection manual (hardware) of each CNC.
For information on how to use this function, the PMC models that can use this function, the series and edition of the PMC management software, and the series and edition of the CNC management software, refer to the FANUC PMC LADDER LANGUAGE PROGRAMMING MANUAL.

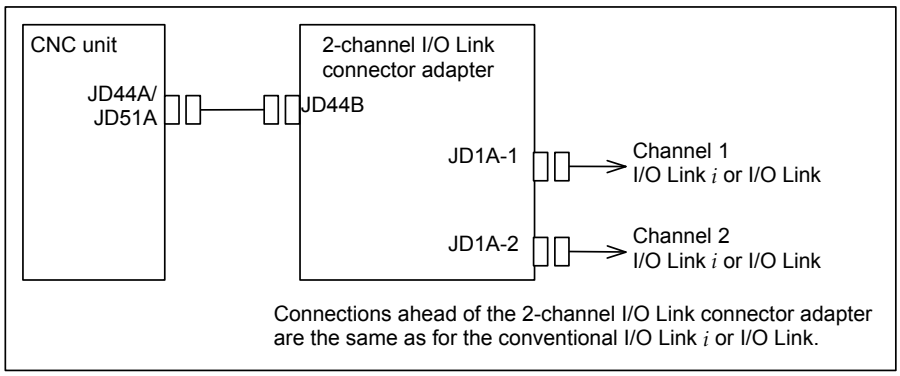
12.2 SPECIFICATION: A20B-1007-0680

Weight: 60g

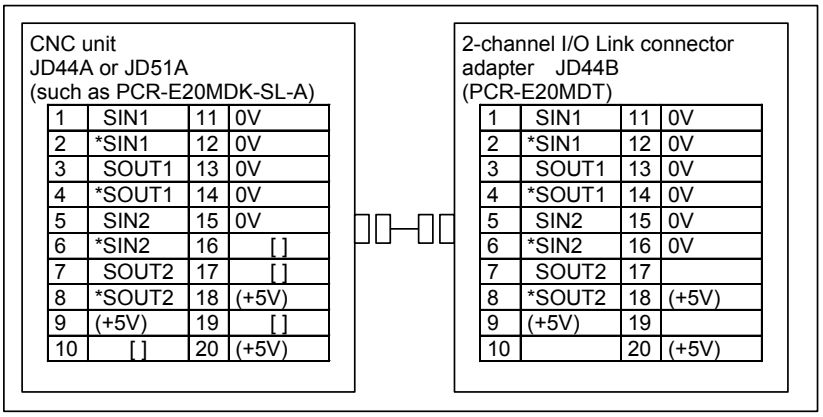
12.3 CONNECTION FOR USE OF TWO I/O Link *i* or I/O Link CHANNELS

When using the second channel, make a branch from I/O Link *i* or I/O Link with the 2-channel I/O Link connector adapter.

Connection



12.4 CONNECTING THE CNC WITH TWO-CHANNEL I/O Link CONNECTOR ADAPTER

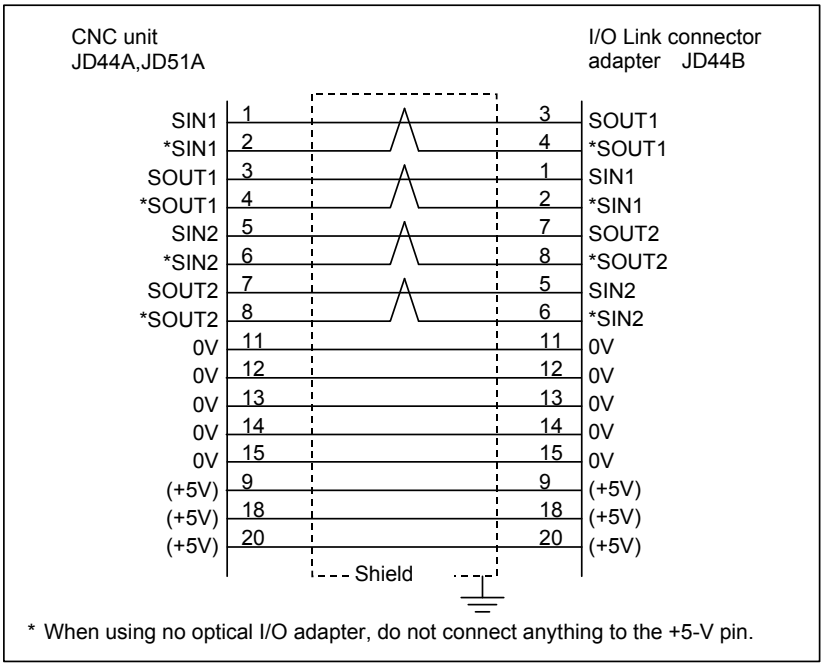


1	SIN1	11	0V
2	*SIN1	12	0V
3	SOUT1	13	0V
4	*SOUT1	14	0V
5	SIN2	15	0V
6	*SIN2	16	[ ]
7	SOUT2	17	[ ]
8	*SOUT2	18	(+5V)
9	(+5V)	19	[ ]
10	[ ]	20	(+5V)

1	SIN1	11	0V
2	*SIN1	12	0V
3	SOUT1	13	0V
4	*SOUT1	14	0V
5	SIN2	15	0V
6	*SIN2	16	0V
7	SOUT2	17	
8	*SOUT2	18	(+5V)
9	(+5V)	19	
10		20	(+5V)

NOTE
1 The +5V pin enclosed in () is intended to supply power to an optical adapter for connection through an optical fiber cable. When using no optical adapter, do not connect the +5V pin.
2 The pins enclosed in [ ] are used by the JD51A for channel 3 connection. Do not connect anything to them.
3 Do not connect anything to pins to which no signal is assigned.

12.5 CABLING

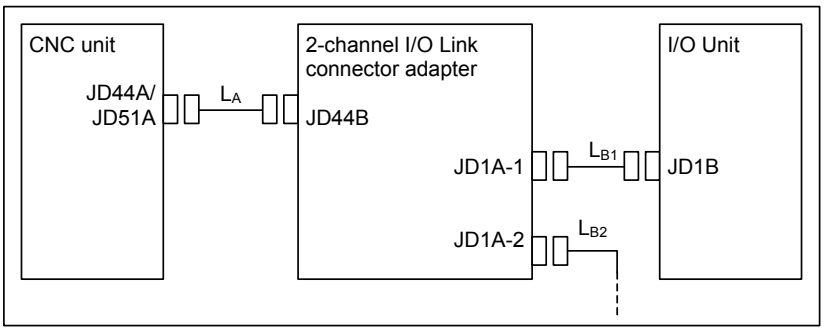


Recommended cable-end connector: PCR-E20FA (manufactured by HONDA TSUSHIN)
FCN-247J020-G/E (manufactured by Fujitsu)
52622-2011 (manufactured by Molex)
Recommended cable (wire): A66L-0001-0284#10P

12.6 CONNECTING THE TWO-CHANNEL I/O Link CONNECTOR ADAPTER TO I/O UNITS

The 2-channel I/O Link connector adapter can be connected to diverse I/O Units in the same manner as for the conventional FANUC I/O Link.

12.7 CABLE LENGTH

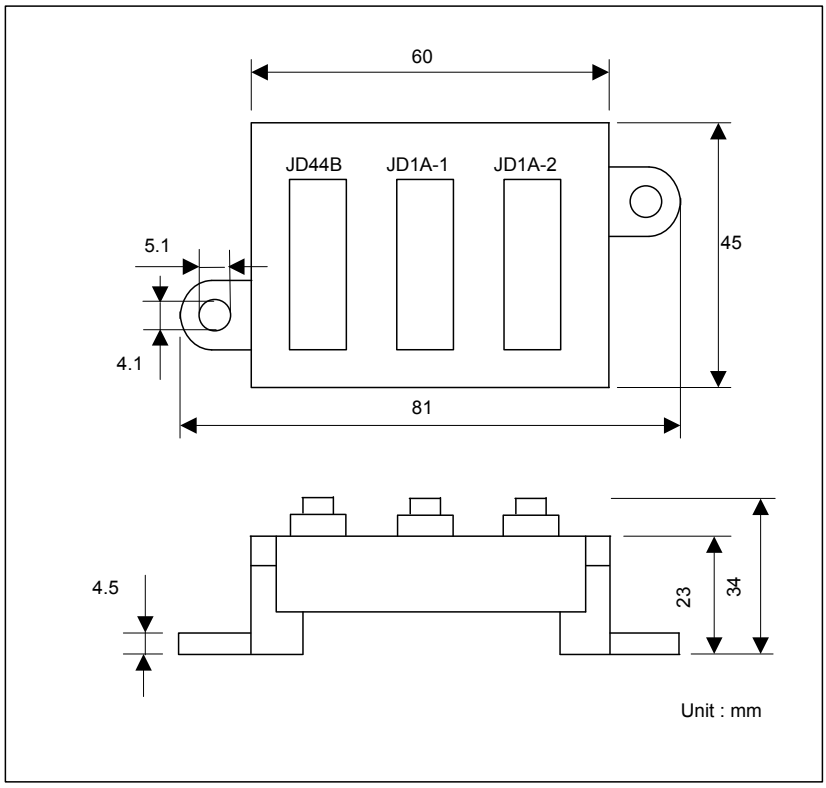


The sum ($L_A + L_B$) of the cable length L_A between the CNC unit (JD44A) and 2-channel I/O Link connector adapter (JD44B) and the cable length LB between the I/O Link connector adapter (JD1A-1 or JD1A-2) and I/O Unit (JD1B) shall not be longer than 10 m. For cabling within the same cabinet, the sum can be up to 15 m.

12.8 INSTALLING TWO-CHANNEL I/O Link CONNECTOR ADAPTER

The two-channel I/O Link connector adapter needs to be installed in the cabinet containing the CNC unit.

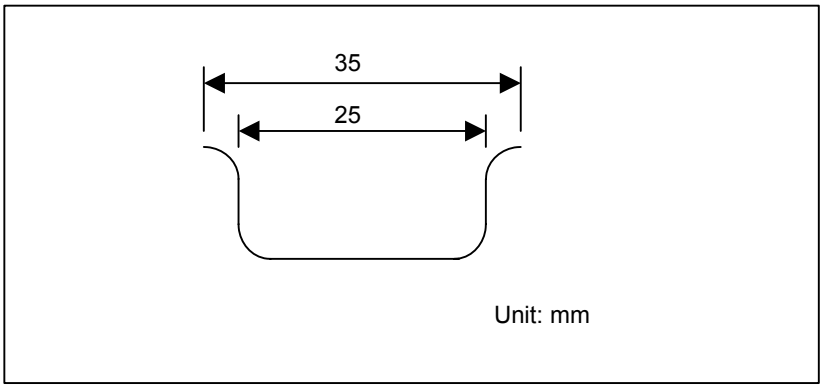
12.9 OUTSIDE DIMENSIONS OF TWO-CHANNEL I/O Link CONNECTOR ADAPTER



Allow a space of about 10 cm above the adapter so that cables can be laid and connected.

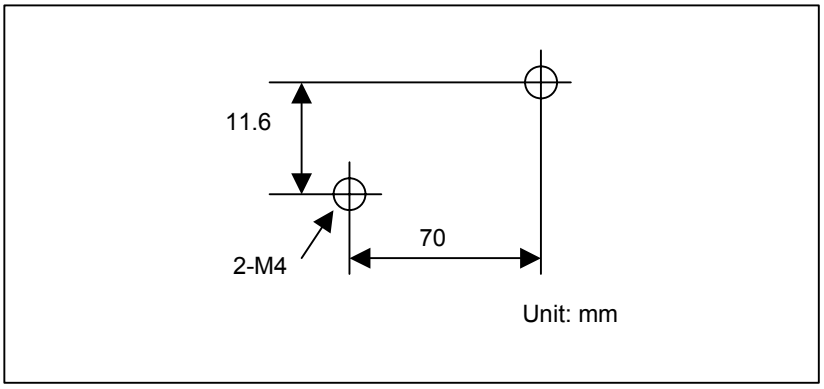
12.10 MOUNTING TWO-CHANNEL I/O Link CONNECTOR ADAPTER

Mounting on the DIN rail



Recommended DIN rail

Using screws



Mounting hole dimension and layout diagram

13 THREE-CHANNEL I/O Link CONNECTOR ADAPTER

13.1 OVERVIEW

With some *i* series CNC models, it is possible to use up to two I/O Link *i* interface channels and up to three I/O Link interface channels. These channels make it possible to increase the number of I/O points to 4096/4096.
This chapter explains how to connect a 3-channel I/O Link connector adapter required in using the 3-channel function for I/O Link *i* or I/O Link.

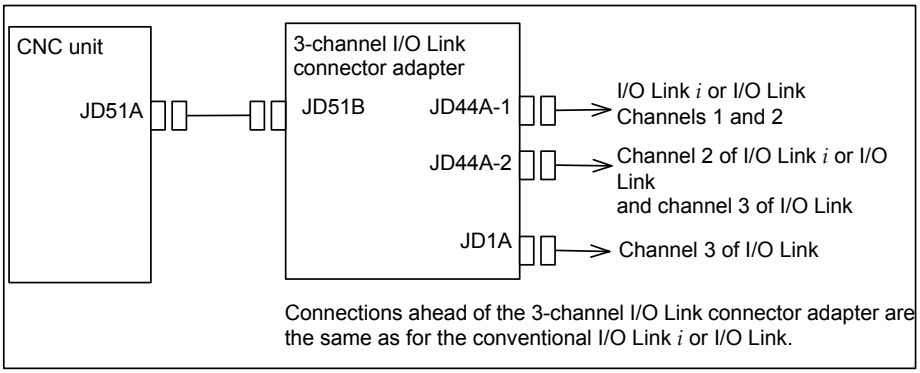
NOTE
For the CNCs that can use this function, refer to the connection manual (hardware) of each CNC.
For information on how to use this function, the PMC models that can use this function, the series and edition of the PMC management software, and the series and edition of the CNC management software, refer to the FANUC PMC LADDER LANGUAGE PROGRAMMING MANUAL.

13.2 SPECIFICATION: A20B-1008-0360

Weight: 90g

13.3 CONNECTION FOR USE OF THREE FANUC I/O Link CHANNELS

Connection



13.4 CONNECTING THE CNC WITH THREE-CHANNEL I/O Link CONNECTOR ADAPTER

CNC unit
JD51A
(such as PCR-E20MDK-SL-A)

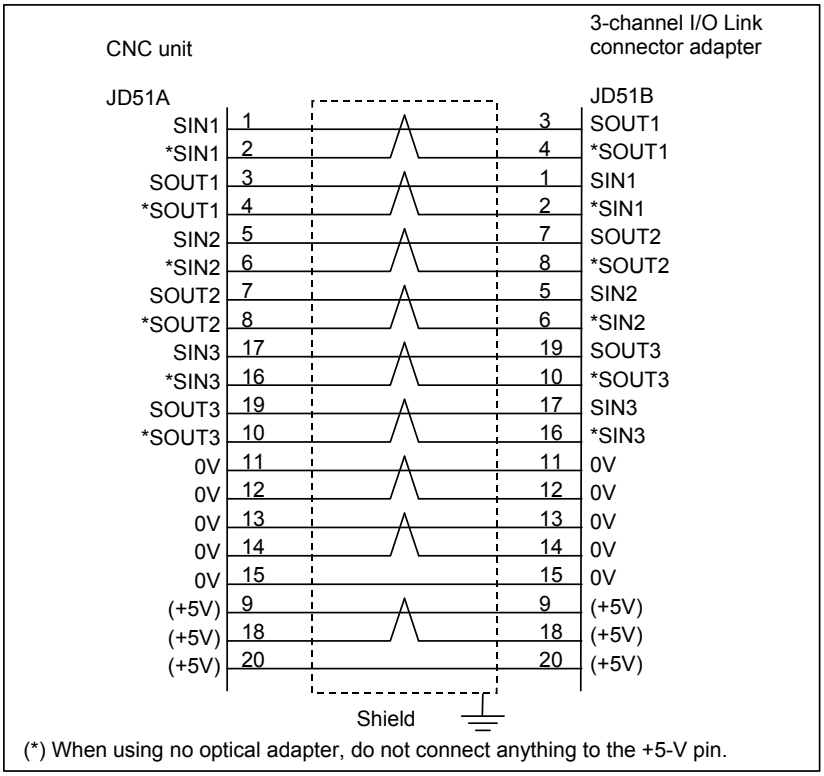
1	SIN1	11	0V
2	*SIN1	12	0V
3	SOUT1	13	0V
4	*SOUT1	14	0V
5	SIN2	15	0V
6	*SIN2	16	*SIN3
7	SOUT2	17	SIN3
8	*SOUT2	18	(+5V)
9	(+5V)	19	SOUT3
10	*SOUT3	20	(+5V)

3-channel I/O Link connector adapter JD51B
(PCR-E20MDT)

1	SIN1	11	0V
2	*SIN1	12	0V
3	SOUT1	13	0V
4	*SOUT1	14	0V
5	SIN2	15	0V
6	*SIN2	16	*SIN3
7	SOUT2	17	SIN3
8	*SOUT2	18	(+5V)
9	(+5V)	19	SOUT3
10	*SOUT3	20	(+5V)

NOTE
The +5V pin enclosed in () is intended to supply power to an optical adapter for connection through an optical fiber cable. When using no optical adapter, do not connect the +5V pin.

13.5 CABLING



Recommended cable-end connector:
PCR-E20FA (manufactured by HONDA TSUSHIN)
FCN-247J020-G/E (manufactured by Fujitsu)
52622-2011 (manufactured by Molex)
Recommended cable (wire):
A66L-0001-0284#10P

13.6 ALLOCATING THREE-CHANNEL I/O Link CONNECTOR ADAPTER SIGNALS

3-channel I/O Link connector adapter JD44A-1
(PCR-E20MDT)

1	SIN1	11	0V
2	*SIN1	12	0V
3	SOUT1	13	0V
4	*SOUT1	14	0V
5	SIN2	15	0V
6	*SIN2	16	0V
7	SOUT2	17	
8	*SOUT2	18	(+5V)
9	(+5V)	19	
10		20	(+5V)

JD44A-2
(PCR-E20MDT)

1	SIN2	11	0V
2	*SIN2	12	0V
3	SOUT2	13	0V
4	*SOUT2	14	0V
5	SIN3	15	0V
6	*SIN3	16	0V
7	SOUT3	17	
8	*SOUT3	18	(+5V)
9	(+5V)	19	
10		20	(+5V)

JD1A
(PCR-E20MDT)

1	SIN3	11	0V
2	*SIN3	12	0V
3	SOUT3	13	0V
4	*SOUT3	14	0V
5		15	0V
6		16	0V
7		17	
8		18	(+5V)
9	(+5V)	19	
10		20	(+5V)

13.7 CONNECTING THE THREE-CHANNEL I/O Link CONNECTOR ADAPTER TO I/O UNITS

The 3-channel I/O Link connector adapter can be connected to each I/O Unit in the same manner as for the I/O Link *i* or I/O Link. However, note the following points:

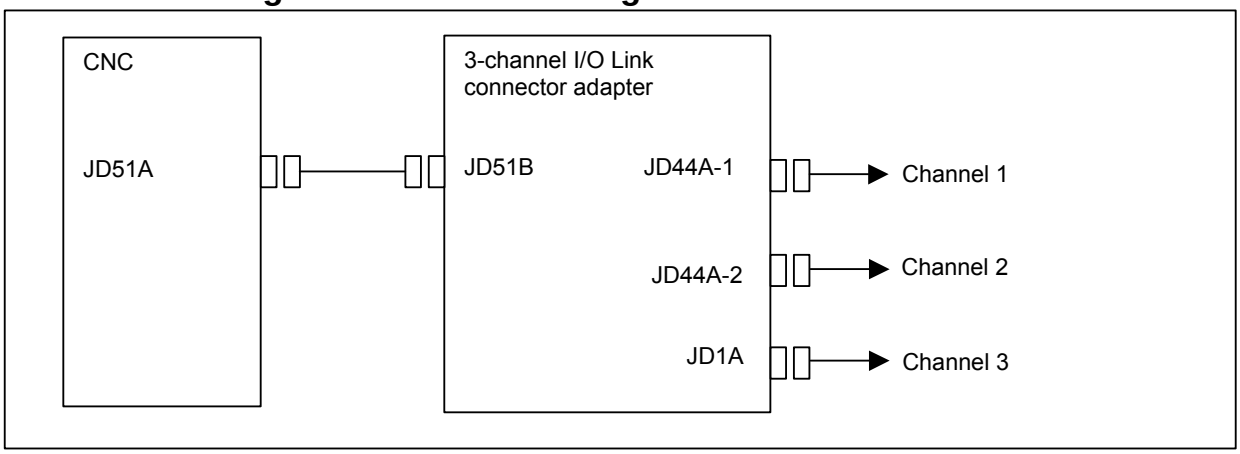
Signals on channels 1 and 2 of I/O Link *i* and I/O Link are allocated to the JD44A-1. Signals on channel 2 of I/O Link *i* and I/O Link and those on channel 3 of I/O Link are allocated to the JD44A-2.
The JD1A connector is dedicated to I/O Link channel 3.

(1) To branch out the 3-channel signals, an ordinary I/O Link cable is connected to each of the JD44A-1, JD44A-2, and JD1A. In this case, the JD44A-1, JD44A-2, and JD1A correspond, respectively, to channels 1, 2, and 3.

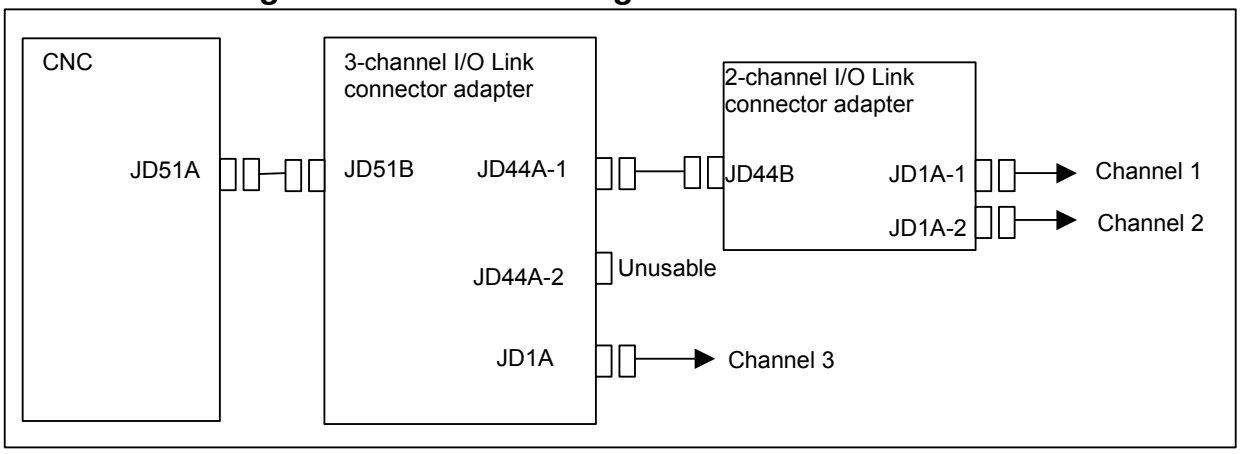
(2) To extend channels 1 and 2 together, the 2-channel I/O Link connector adapter is connected to the JD44A-1 to separate channels 1 and 2 from each other after the adapter.
To use channel 3, connect it to the JD1A; the JD44A-2 cannot be used.

(3) To extend channels 2 and 3 together, the 2-channel I/O Link connector adapter is connected to the JD44A-2 to separate channels 2 and 3 from each other after the adapter.
To use channel 1, connect it to the JD44A-1; the JD1A cannot be used.

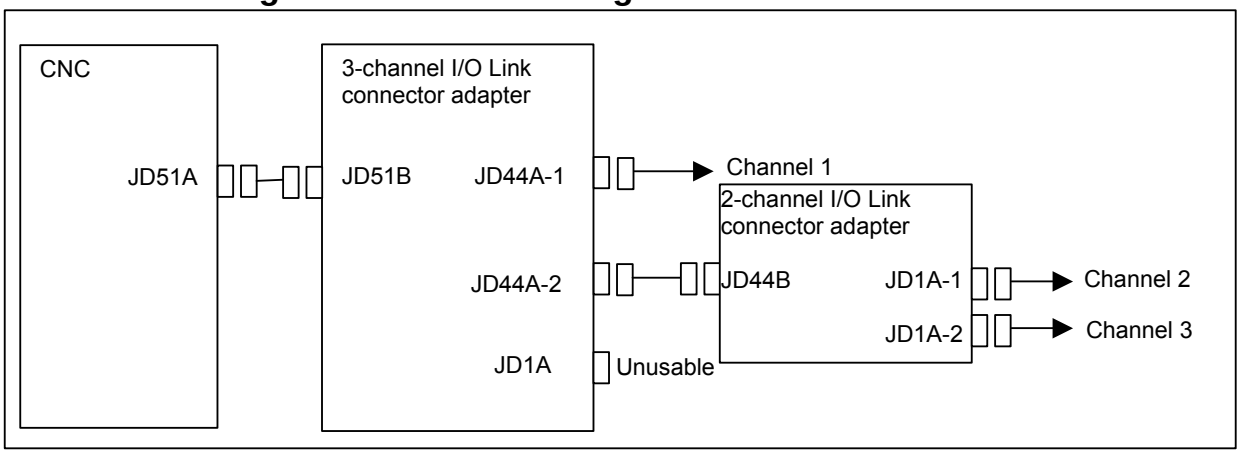
(1) When branching out the 3-channel signals



(2) When extending channels 1 and 2 together



(3) When extending channels 2 and 3 together



13.8 CONNECTING THREE-CHANNEL I/O Link CONNECTOR ADAPTER TO TWO-CHANNEL I/O Link CONNECTOR ADAPTER

3-channel I/O Link connector adapter JD44A-1/ JD44A-2 (such as PCR-E20MDK-SL-A)

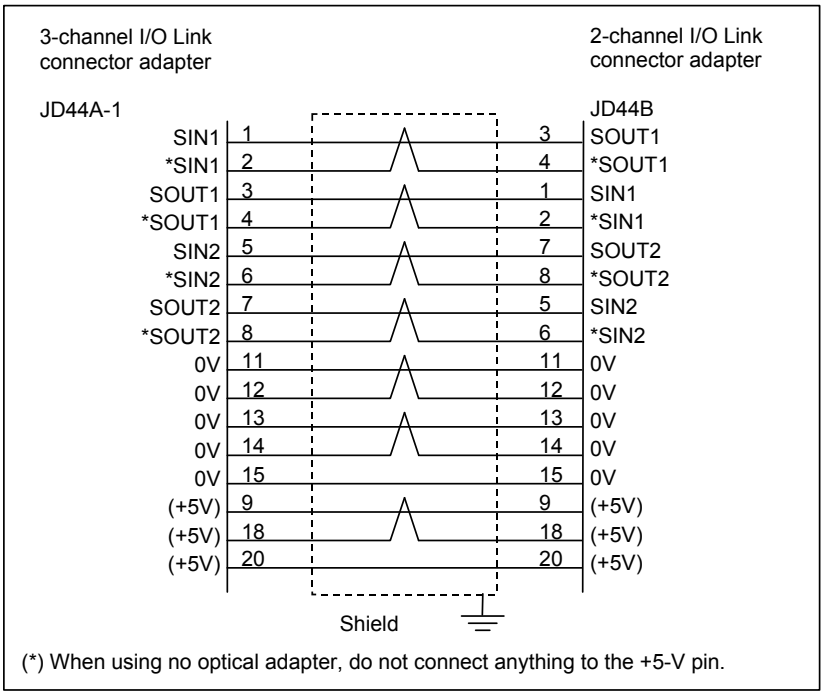
1	SIN1	11	0V
2	*SIN1	12	0V
3	SOUT1	13	0V
4	*SOUT1	14	0V
5	SIN2	15	0V
6	*SIN2	16	
7	SOUT2	17	
8	*SOUT2	18	(+5V)
9	(+5V)	19	
10		20	(+5V)

2-channel I/O Link connector adapter JD44B (PCR-E20MDT)

1	SIN1	11	0V
2	*SIN1	12	0V
3	SOUT1	13	0V
4	*SOUT1	14	0V
5	SIN2	15	0V
6	*SIN2	16	
7	SOUT2	17	
8	*SOUT2	18	(+5V)
9	(+5V)	19	
10		20	(+5V)

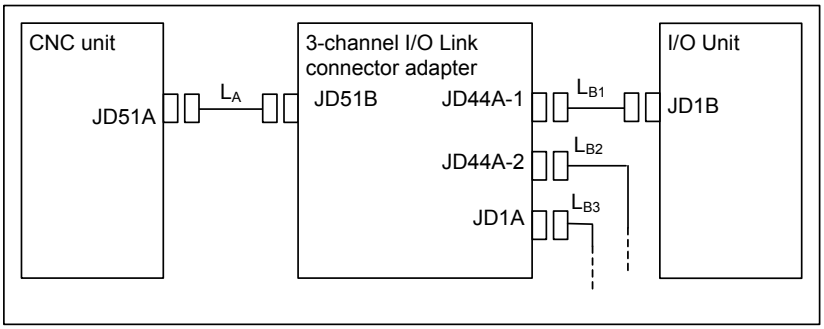
NOTE
1 The +5V pin enclosed in () is intended to supply power to an optical adapter for connection through an optical fiber cable. When using no optical adapter, do not connect the +5V pin.
2 Do not connect anything to pins to which no signal is assigned.

Cabling



Recommended cable-end connector:
PCR-E20FA (manufactured by HONDA TSUSHIN)
FCN-247J020-G/E (manufactured by Fujitsu)
52622-2011 (manufactured by Molex)
Recommended cable (wire):
A66L-0001-0284#10P

13.9 CABLE LENGTH

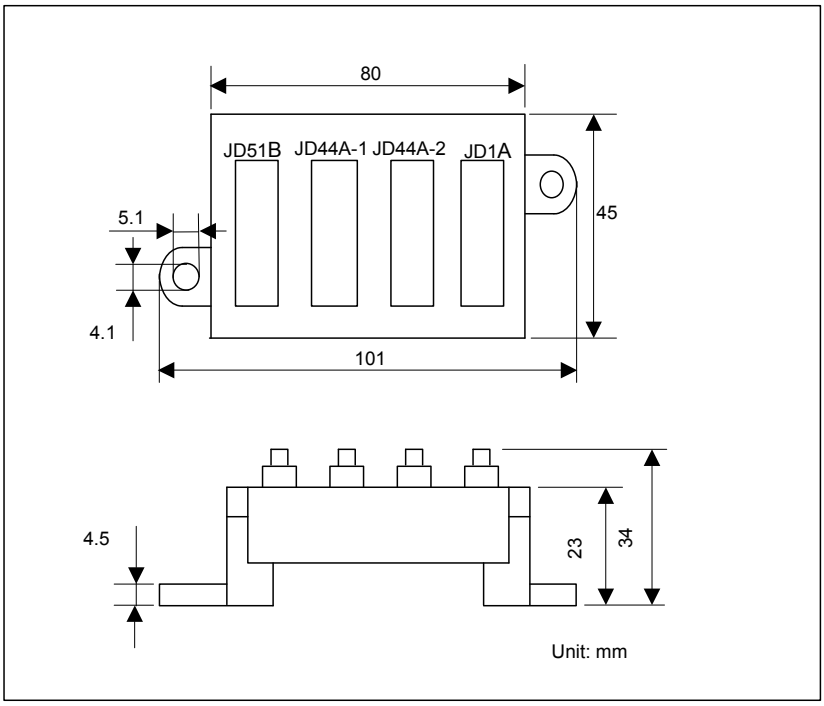


The sum ($L_A + L_B$) of the cable length L_A between the CNC unit (JD51A) and I/O Link connector adapter (JD51B) and the cable length LB between the I/O Link connector adapter (JD44A-1, JD44A-2, or JD1A) and I/O Unit (JD1B) shall not be longer than 10 m. For cabling within the same cabinet, the sum can be up to 15 m.

13.10 INSTALLING THREE-CHANNEL I/O Link CONNECTOR ADAPTER

The three-channel I/O Link connector adapter needs to be installed in the cabinet containing the CNC unit.

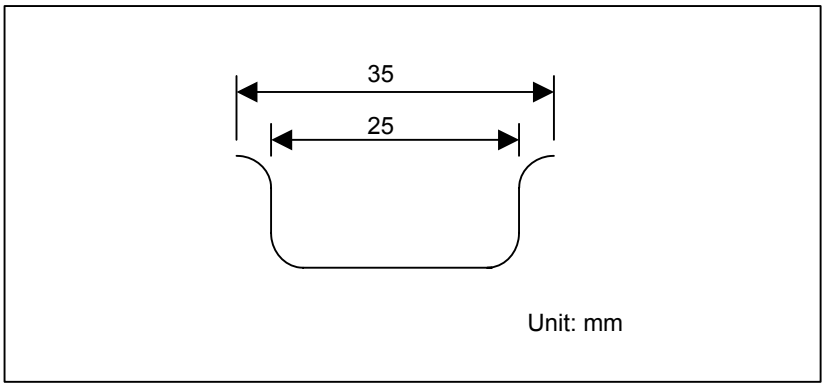
13.11 OUTSIDE DIMENSIONS OF THREE-CHANNEL I/O Link CONNECTOR ADAPTER



Allow a space of about 10 cm above the adapter so that cables can be laid and connected.

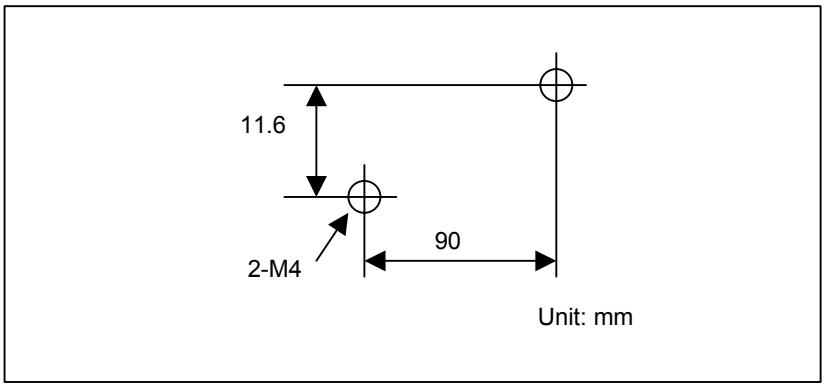
13.12 MOUNTING THREE-CHANNEL I/O Link CONNECTOR ADAPTER

Mounting on the DIN rail



Recommended DIN rail

Using screws



Mounting hole dimension and layout diagram

14 SAFETY FOR USING AC

IF AC output module or AC input module is used, Section 14.1 is recommended for safety. When using it for a machine directed to the European market, carefully observe the descriptions in Section 14.1 [as per EN50178].

14.1 ENVIRONMENT FOR INSTALLATION

14.1.1 Installation Category (Overvoltage Category)

Install the unit in the environment of Installation Category II (Overvoltage Category II) or better. [EN50178]
The available impulse surge level to the ground that appears in the power source is 2.5kV maximum.
(100VAC system power source is needed in AC input module According to the standard, the available impulse surge level to the ground is 1.5kV for this power source (voltage of which is 150VAC or less). However, for this module, the available impulse surge level to the ground that appears in the power source is 2.5 kV.)
Generally, an isolation transformer used for the main power source is regarded as an effective surge filter.

The class of the 16-point relay output module (AOR16G) is set to installation category (overvoltage category) I.
(Keep any impulse voltage to ground that may appear on the AC power to within 1.5 kV.)

The class for the 8-point relay output module (AOR08G), AC output module, and AC input module is set to installation category (overvoltage category) II.

⚠ WARNING
Connect the same phase of a power source to the commons of the AC input and AC output modules. Otherwise, burnout or fire may occur.

NOTE
1 The AC output module incorporates a 3.2 A fuse per common. It is assumed that, if the load is short-circuited, the fuse blows to protect the triac. However, be sufficiently careful not to cause a short circuit because no little damage occurs to the triac when the fuse blows.
2 If external AC input lines run through a long omnibus cable, inter-wire mutual capacitances may cause induced current to flow from live lines to open lines, leading to an ON state. If this is the case, a typical measure might be to lower the input impedance by attaching a bleeder resistance between the input pins.
3 If a reed switch is used as the input contact of the AC input module, the reed switch must be one having a permissible current capacity of 1 A or higher. Otherwise rush current may cause the contact to be welded.

14.1.2 Pollution Degree

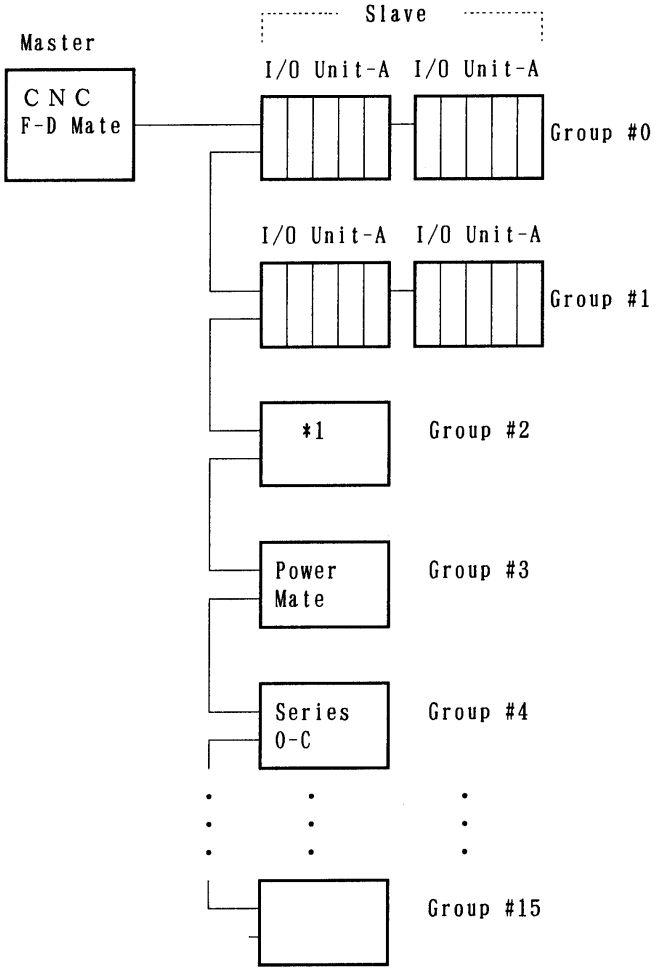
Install the unit in the environment of pollution degree 2 or better. [EN50178]
In cabinet of IP-54 or better (described in Section 3.1), it can be considered as pollution degree 2 or better usually. The IP degree required is depended on the circumstances of machine tool, so select the adequate degree in accordance with such environment.

II. MAINTENANCE

1 OVERVIEW

1.1 SYSTEM CONFIGURATION

I/O Unit-A is connected to a CNC and cell controller through a high-speed serial interface, I/O Link *i* or I/O Link.



(*1) Operator's panel connection unit

(1) The I/O Link *i* or I/O Link consists of a master and slaves.
Master: Series0-C, Series15/16/18/20/21, Series15*i*/16*i*/18*i*/20*i*/21*i*/30*i*/31*i*/32*i*/35*i*/0*i*, Power Mate-D/H, Power Mate *i*-D/H, F-D Mate
Slave: I/O Unit-A, I/O Unit-B, Power Mate, operator's panel connection unit, and Series 0-C, and so on

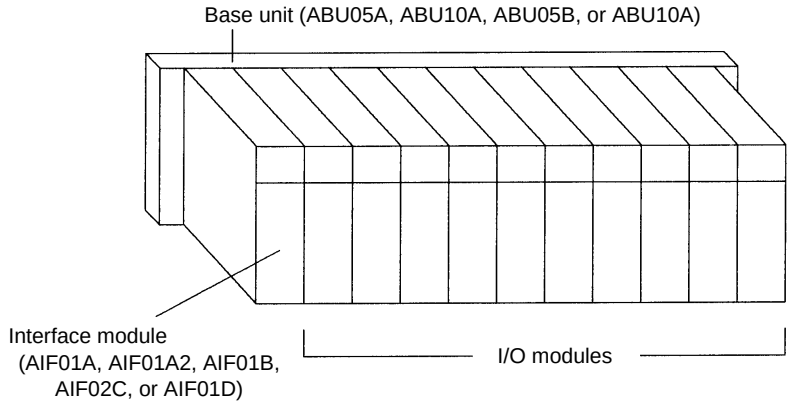
(2) One I/O Link can connect to up 16 groups of slaves. If the master is not a CNC, one slave group can contain up to 2 of I/O Unit A (2 base units). If the master is the F-D Mate, however, one group can contain up to 4 I/O Units.

(3) One I/O Link *i* can connect to up to 24 slave groups.
Only one I/O Unit-A (one base) can connect to one group.

(4) I/O Link *i* allows no base expansion.

1.2 I/O Unit-A CONFIGURATION

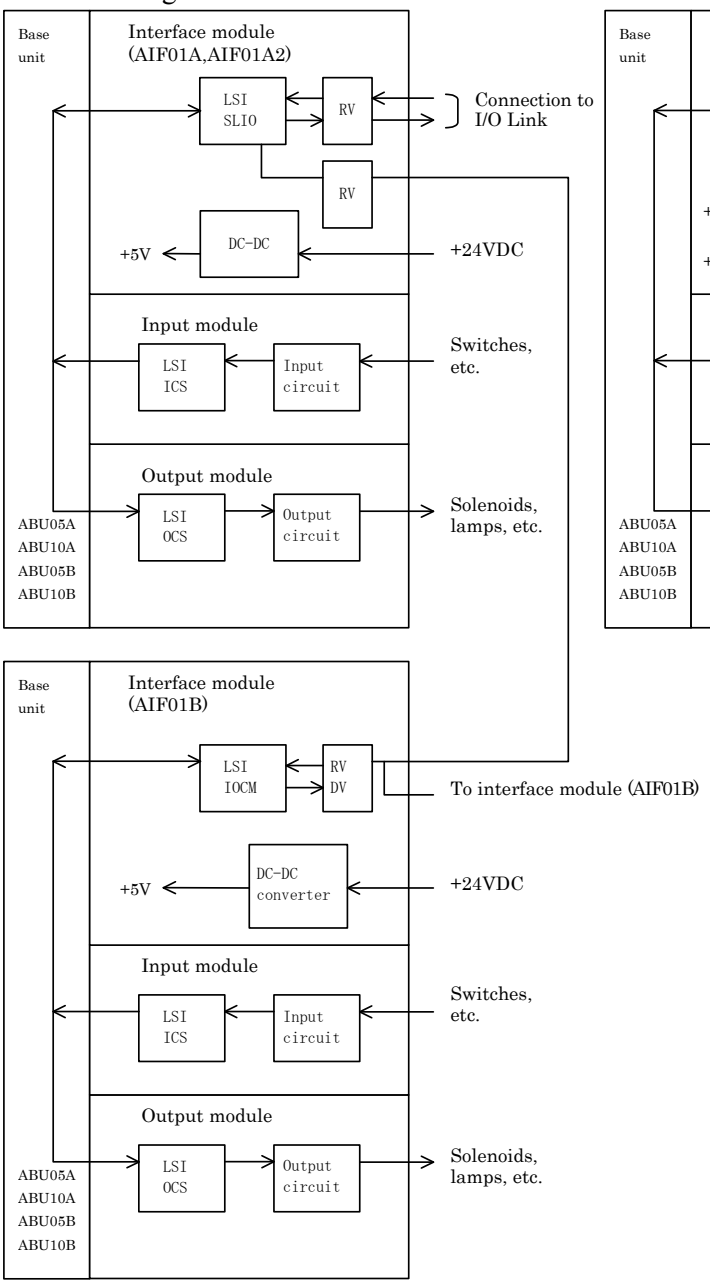
An I/O Unit-A consists of a base unit, interface module, and I/O modules.



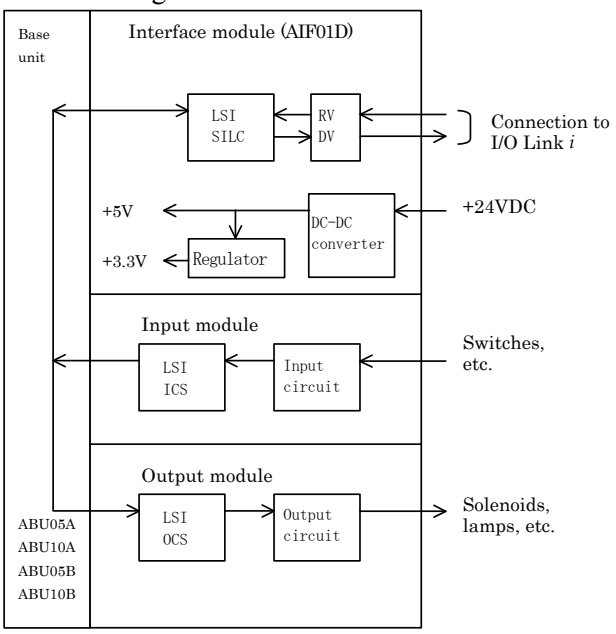
Interface module
(AIF01A, AIF01B, or AIF02C)

1.3 BLOCK DIAGRAM

Block diagram for I/O Link



Block diagram for I/O Link *i*



1.4 I/O Unit-MODEL A CONFORMING TO UL/C-UL

The units conforming to the UL/C-UL standard have different drawing numbers.
The following table lists the units conforming to the UL/C-UL standard and those not.

	I/O Unit-MODEL A conforming to the UL/C-UL standard	I/O Unit-MODEL A not conforming to the UL/C-UL standard
Unit drawing number	A03B-0819-Jxxx	A03B-0807-Jxxx
Unit specification (interface, dimensions, and weight)	Same specification	
Plastic case	Fire retardancy: 94V-0 (material less likely to burn)	Fire retardancy: 94HB
Unit nameplate	The nameplates for the base unit and interface module bear a UL mark.	The nameplates have no UL mark.

- Refer to Section 1.5, "LIST OF UNITS", in Part II for individual unit drawings.
- It is possible to use units conforming to the UL/C-UL standard and those not conforming together.

UL File No. E193565

1.5 LIST OF UNITS

1.5.1 Units Conforming to UL/C-UL Standard: Ordering Information A03B-0819-Jxxx

Name				Unit conforming to UL/C-UL standard		
				Ordering information	**Unit drawing number**	**Drawing number for printed circuit board in unit**
Base unit	10 slots	Horizontal type	ABU10A	A03B-0819-J001	A03B-0819-C001	A20B-9001-0040
		Vertical type	ABU10B	A03B-0819-J004	A03B-0819-C004	A20B-2003-0100
	5 slots	Horizontal type	ABU05A	A03B-0819-J002	A03B-0819-C002	A20B-9001-0020
		Vertical type	ABU05B	A03B-0819-J003	A03B-0819-C003	A20B-2000-0510
Interface module		Power supply connector: SORIAU JAPAN 3-pin (former Burndy)	AIF01A	A03B-0819-J011	A03B-0819-C011	A20B-8000-0410
		Power supply connector: Tyco Electronics 3-pin	AIF01A2	A03B-0819-J014	A03B-0819-C014	A20B-8000-0411
		Power supply connector: SORIAU JAPAN 3-pin (former Burndy)	AIF01B	A03B-0819-J012	A03B-0819-C012	A20B-8000-0420
		Power supply connector: SORIAU JAPAN 3-pin (former Burndy)	AIF02C	A03B-0819-J013	A03B-0819-C013	A20B-8000-0710
		Power supply connector: Tyco Electronics 4 (2+2)-pin, gold-coated	AIF01D	A03B-0819-J015	A03B-0819-C015	A20B-8002-0780

Name				Unit conforming to UL/C-UL standard		
				Ordering information	Unit drawing number	Drawing number for printed circuit board in unit
DC input module	Non-insulations	32 points, 20ms, HONDA 50-pin	AID32A1	A03B-0819-J101	A03B-0819-C101	A20B-8002-0450 or -9000-0970
		32 points, 2ms, HONDA 50-pin	AID32B1	A03B-0819-J102	A03B-0819-C102	A20B-8002-0451 or -9000-0971
		32 points, 20 ms and 2 ms intermixed, HONDA 50-pin	AID32H1	A03B-0819-J111	A03B-0819-C111	A20B-8002-0452 or -9000-0972
	Insulations	16 points, NEG, 20ms, terminal block	AID16C CE:X	A03B-0819-J103	A03B-0819-C103	A20B-8002-0380 or -9000-0931
		16 points, NEG, 2ms, terminal block	AID16K CE:X	A03B-0819-J113	A03B-0819-C113	A20B-8002-0381 or -9000-0932
		16 points, POS, 20ms, terminal block	AID16D	A03B-0819-J104	A03B-0819-C104	A20B-8002-0370 or -9000-0901
		16 points, POS, 2ms, terminal block	AID16 L	A03B-0819-J114	A03B-0819-C114	A20B-8002-0371 or -9000-0902
		16 points, POS, 20ms, terminal block with diagnosis functions	AID16DM	A03B-0819-J116	A03B-0819-C116	A20B-8002-0790
		16 points, POS, 2ms, terminal block with diagnosis functions	AID16LM	A03B-0819-J117	A03B-0819-C117	A20B-8002-0791
		32 points, 20ms, HONDA 50-pin	AID32E1	A03B-0819-J105	A03B-0819-C105	A20B-8002-0150
		32 points, 20ms, HIROSE 50-pin	AID32E2	A03B-0819-J110	A03B-0819-C110	A20B-8002-0160
		32 points, 2ms, HONDA 50-pin	AID32F1	A03B-0819-J106	A03B-0819-C106	A20B-8002-0151
		32 points, 2ms, HIROSE 50-pin	AID32F2	A03B-0819-J109	A03B-0819-C109	A20B-8002-0161
AC input module		16 points, 100 to 115VAC terminal block	AIA16G	A03B-0819-J107	A03B-0819-C107	A20B-8000-0341
DC output module	Non-insulations	32 points, NEG, 0.3A HONDA 50-pin	AOD32A1 CE:X	A03B-0819-J162	A03B-0819-C162	A20B-8002-0460 or -9001-0110
	Insulations	8 points, NEG, 2A, terminal block	AOD08C CE:X	A03B-0819-J151	A03B-0819-C151	A20B-8002-0420 or -9001-0210
		8 points, POS, 2A, terminal block	AOD08D	A03B-0819-J152	A03B-0819-C152	A20B-8002-0410 or -9001-0220
		8 points, POS, 2A, output protection, terminal block	AOD08DP	A03B-0819-J183	A03B-0819-C183	A20B-8002-0060
		16 points, NEG, 0.5A, terminal block	AOD16C CE:X	A03B-0819-J153	A03B-0819-C153	A20B-8002-0400 or -9000-0941
		16 points, POS, 0.5A, terminal block	AOD16D	A03B-0819-J154	A03B-0819-C154	A20B-8002-0390 or -9000-0921
		16 points, POS, 0.5A, terminal block with diagnosis functions	AOD16DM	A03B-0819-J186	A03B-0819-C186	A20B-8002-0800
		16 points, POS, 2A HONDA 40-pin	AOD16D2	A03B-0819-J171	A03B-0819-C171	A20B-8002-0570
		16 points, POS, 2A Weidmüller 24-pin connector	AOD16D3	A03B-0819-J185	A03B-0819-C185	A20B-8002-0520

CE:X.....CE marking is not supported.

Name				Unit conforming to UL/C-UL standard		
				Ordering information	Unit drawing number	Drawing number for printed circuit board in unit
DC output module	Insulations	16 points, POS, 0.3A, output protection, terminal block	AOD16DP	A03B-0819-J182	A03B-0819-C182	A20B-8002-0070
		32 points, NEG, 0.3A HONDA 50-pin connector	AOD32C1 CE:X	A03B-0819-J155	A03B-0819-C155	A20B-8002-0430 or -9001-0070
		32 points, NEG, 0.3A HIROSE 50-pin connector	AOD32C2 CE:X	A03B-0819-J172	A03B-0819-C172	A20B-8002-0440 or -9001-0530
		32 points, POS, 0.3A HONDA 50-pin connector	AOD32D1	A03B-0819-J156	A03B-0819-C156	A20B-8000-0440
		32 points, POS, 0.3A HIROSE 50-pin connector	AOD32D2	A03B-0819-J167	A03B-0819-C167	A20B-8000-0510
AC output module		5 points, 2A, 100 to 230VAC terminal block	AOA05E	A03B-0819-J157	A03B-0819-C157	A20B-8000-0470
		8 points, 1A, 100 to 230VAC terminal block	AOA08E	A03B-0819-J158	A03B-0819-C158	A20B-8000-0480
		12 points, 0.5A, 100 to 115VAC, terminal block	AOA12F	A03B-0819-J159	A03B-0819-C159	A20B-8000-0321
Relay output module		8 points, 4A, terminal block	AOR08G	A03B-0819-J160	A03B-0819-C160	A20B-8002-0470 or -9001-0200
		16 points, 2A, terminal block	AOR16G	A03B-0819-J161	A03B-0819-C161	A20B-8000-0101
		16 points, 2A, HIROSE 50-pin	AOR16H2	A03B-0819-J165	A03B-0819-C165	A20B-8000-0500
DC input/output hybrid module		DI: 24 points DO: 16 points, NEG HONDA 50-pin	AIO40A CE:X	A03B-0819-J200	A03B-0819-C200	A20B-9001-0240 or -8002-0540
Analog input module		12bit, terminal block	AAD04A	A03B-0819-J051	A03B-0819-C051	A20B-8000-0450
		16bit, terminal block	AAD04B	A03B-0819-J063	A03B-0819-C063	A20B-8002-0590
Analog output module		12bit, terminal block	ADA02A	A03B-0819-J052	A03B-0819-C052	A20B-8000-0460
		14bit, terminal block	ADA02B	A03B-0819-J060	A03B-0819-C060	A20B-8001-0980
High-speed counter module (Note)			ACT01A	A03B-0819-J053	A03B-0819-C053	A20B-8000-0540 or -8000-0541
				A03B-0819-J064	A03B-0819-C064	A20B-8000-0541
Temperature input module		Pt/JPt	ATI04A	A03B-0819-J056	A03B-0819-C056	A74L-0001-0083#PT
		J/K	ATI04B	A03B-0819-J057	A03B-0819-C057	A74L-0001-0083#JK
		Terminal unit for ATI04A	ATB01A	A03B-0819-J350	A03B-0819-C350	A20B-1005-0920
		Terminal unit for ATI04B	ATB01B	A03B-0819-J351	A03B-0819-C351	A20B-1005-0930

NOTE
The high-speed counter module whose ordering information and unit drawing number are, respectively, A03B-0819-J053 and A03B-0819-C053 is dedicated to I/O Link. (See Chapter 8 of Part I, “CONNECTION”.)

CE:X ..... CE marking is not supported.

1.5.2 Other Units

Name		Ordering information	Drawing number for printed circuit board in unit
Optical adapter for I/O Link	Standard type	A13B-0154-B001	A20B-1004-0240
	High-speed type	A13B-0154-B004	A20B-1004-0242
Optical adapter for I/O Link *i*		A13B-0154-B101	A20B-2004-0600
Optical fiber junction adapter		A02B-0094-K841	-

Name	Ordering information	Drawing number for printed circuit board in unit
I/O Link dummy unit	A13B-0167-B001	A20B-8000-0940
2-channel I/O Link connector adapter	A20B-1007-0680	A20B-1007-0680
3-channel I/O Link connector adapter	A20B-1008-0360	A20B-1008-0360

1.5.3 Early Units (Units not Conforming to UL/C-UL: Ordering Information A03B-0807-Jxxx)

The modules listed below are those produced before the factory was UL-approved.
The module's basic performance does not differ between A03B-0807-Jxxx and A03B-0819-Jxxx.
The units with the new ordering information A03B-0819-Jxxx are housed in cases made of material less likely to burn.

Name				Early unit		
				Early ordering information	Early-unit drawing number	Drawing number for printed circuit board in early unit
Base unit	10 slots	Horizontal type	ABU10A	A03B-0807-J001	A03B-0807-C001	A20B-9001-0040
		Vertical type	ABU10B	A03B-0807-J004	A03B-0807-C004	A20B-2003-0100 or -2000-0550
	5 slots	Horizontal type	ABU05A	A03B-0807-J002	A03B-0807-C002	A20B-9001-0020
		Vertical type	ABU05B	A03B-0807-J003	A03B-0807-C003	A20B-2000-0510
Interface module			AIF01A	A03B-0807-J011	A03B-0807-C011	A20B-8000-0410
			AIF01B	A03B-0807-J012	A03B-0807-C012	A20B-8000-0420
			AIF02C	A03B-0807-J013	A03B-0807-C013	A20B-8000-0710
DC input module	Non-insulations	32 points, 20ms, HONDA 50-pin	AID32A1	A03B-0807-J101	A03B-0807-C101	A20B-9000-0970
		32 points, 2ms, HONDA 50-pin	AID32B1	A03B-0807-J102	A03B-0807-C102	A20B-9000-0971
		32 points, 20 ms and 2 ms intermixed, HONDA 50-pin	AID32H1	A03B-0807-J111	A03B-0807-C111	A20B-9000-0972
	Insulations	16 points, NEG, 20ms, terminal block	AID16C	A03B-0807-J103	A03B-0807-C103	A20B-9000-0931
		16 points, NEG, 2ms, terminal block	AID16K	A03B-0807-J113	A03B-0807-C113	A20B-9000-0932
		16 points, POS, 20ms, terminal block	AID16D	A03B-0807-J104	A03B-0807-C104	A20B-9000-0901
		16 points, POS, 2ms, terminal block	AID16 L	A03B-0807-J114	A03B-0807-C114	A20B-9000-0902
		32 points, 20ms, HONDA 50-pin	AID32E1	A03B-0807-J105	A03B-0807-C105	A20B-8002-0150 or -9001-0010
		32 points, 20ms, HIROSE 50-pin	AID32E2	A03B-0807-J110	A03B-0807-C110	A20B-8002-0160 or -9001-0280
		32 points, 2ms, HONDA 50-pin	AID32F1	A03B-0807-J106	A03B-0807-C106	A20B-8002-0151 or -9001-0011
		32 points, 2ms, HIROSE 50-pin	AID32F2	A03B-0807-J109	A03B-0807-C109	A20B-8002-0161 or -9001-0281
AC input module		16 points, 100 to 115VAC terminal block	AIA16G	A03B-0807-J107	A03B-0807-C107	A20B-8000-0341

Name				Early unit		
				Early ordering information	Early-unit drawing number	Drawing number for printed circuit board in early unit
DC output module	Non-insulations	32 points, NEG, 0.3A, HONDA 50-pin	AOD32A1	A03B-0807-J162	A03B-0807-C162	A20B-9001-0110
	Insulations	8 points, NEG, 2A, terminal block	AOD08C	A03B-0807-J151	A03B-0807-C151	A20B-9001-0210 or -9000-0951
		8 points, POS, 2A, terminal block	AOD08D	A03B-0807-J152	A03B-0807-C152	A20B-9001-0220 or -9000-0911
		16 points, NEG, 0.5A, terminal block	AOD16C	A03B-0807-J153	A03B-0807-C153	A20B-9000-0941
		16 points, POS, 0.5A, terminal block	AOD16D	A03B-0807-J154	A03B-0807-C154	A20B-9000-0921
		16 points, POS, 2A, HIROSE 40-pin	AOD16D2	A03B-0807-J171	A03B-0807-C171	A20B-8002-0570 or -9001-0490
		16 points, POS, 0.3A, output protection, terminal block	AOD16DP	A03B-0807-J182	A03B-0807-C182	A20B-8002-0070
		32 points, NEG, 0.3A, HONDA 50-pin	AOD32C1	A03B-0807-J155	A03B-0807-C155	A20B-9001-0070
		32 points, NEG, 0.3A, HIROSE 50-pin	AOD32C2	A03B-0807-J172	A03B-0807-C172	A20B-9001-0530
		32 points, POS, 0.3A, HONDA 50-pin	AOD32D1	A03B-0807-J156	A03B-0807-C156	A20B-8000-0440
		32 points, POS, 0.3A, HIROSE 50-pin	AOD32D2	A03B-0807-J167	A03B-0807-C167	A20B-8000-0510
AC output module		5 points, 2 A , 100 to 230VAC terminal block	AOA05E	A03B-0807-J157	A03B-0807-C157	A20B-8000-0470 or -8000-0251
		8 points, 1 A , 100 to 230VAC terminal block	AOA08E	A03B-0807-J158	A03B-0807-C158	A20B-8000-0480 or -8000-0381
		12 points, 0.5 A , 100 to 115VAC terminal block	AOA12F	A03B-0807-J159	A03B-0807-C159	A20B-8000-0321
Relay output module		8 points, 4 A , terminal block	AOR08G	A03B-0807-J160	A03B-0807-C160	A20B-9001-0200 or -9000-0961
		16 points, 2 A , terminal block	AOR16G	A03B-0807-J161	A03B-0807-C161	A20B-8000-0101
		16 points, 2 A , HIROSE 50-pin	AOR16H2	A03B-0807-J165	A03B-0807-C165	A20B-8000-0500
Analog input module		12bit, terminal block	AAD04A	A03B-0807-J051	A03B-0807-C051	A20B-8000-0450
Analog output module		12bit, terminal block	ADA02A	A03B-0807-J052	A03B-0807-C052	A20B-8000-0460
		14bit, terminal block	ADA02B	A03B-0807-J060	A03B-0807-C060	A20B-8001-0980
High-speed counter module (Note)			ACT01A	A03B-0807-J053	A03B-0807-C053	A20B-8000-0540
Temperature input module		Pt/JPt	ATI04A	A03B-0807-J056	A03B-0807-C056	A74L-0001-0083#PT
		J/K	ATI04B	A03B-0807-J057	A03B-0807-C057	A74L-0001-0083#JK
		Terminal unit for ATI04A	ATB01A	A03B-0807-J350	A03B-0807-C350	A20B-1005-0920
		Terminal unit for ATI04B	ATB01B	A03B-0807-J351	A03B-0807-C351	A20B-1005-0930

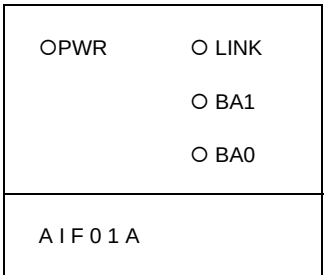
NOTE

The high-speed counter module whose ordering information and unit drawing number are, respectively, A03B-0819-J053 and A03B-0819-C053 is dedicated to I/O Link. (See Chapter 8 of Part I, “CONNECTION”.)

2 INDICATION

The interface modules and the I/O modules with up to 16 input/output points have LEDs to indicate their states.

2.1 INTERFACE MODULE (AIF01A, AIF01A2) LED INDICATORS



Marking	Name	Description
PWR	Power-on	On: The interface module is supplied with power of 24 VDC.
LINK	Link	On: The I/O Link is operating properly. Normally, this LED lights several to ten-odd seconds after the master is turned on.
BA1 BA0	Base address	These LEDs indicate which base unit the inter-face module is transferring data with. If a failure occurs (the LINK LED is turned on, then off), BA0 or BA1, whichever is operating, is turned on.

BA1	BA0	Base number
○	○	Base #0
○	●	Base #1
●	○	Base #2
●	●	Base #3

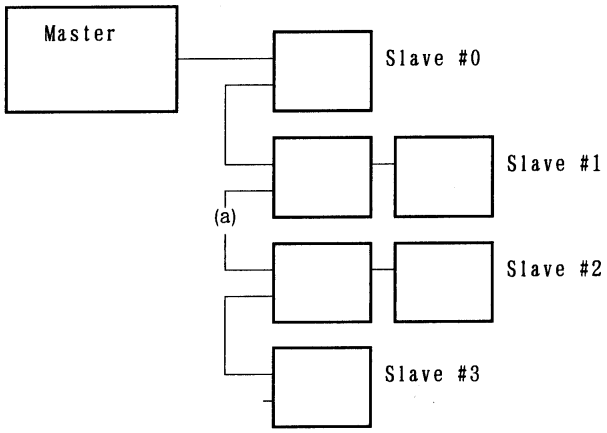
○ : Off
● : On

Failures, their causes, and required actions

(1) PWR is off.
- ① Power (24 VDC) is not supplied or the supply voltage is abnormal.
  - ⇒ Supply power of 24 VDC ± 10%.
- ② A The fuse in the interface module has blown.
  - ⇒ Eliminate the cause that made the fuse to blow, then replace the fuse with a spare. (See Chapter 3.) The following may cause the fuse to blow:
  - A sum of power requirements for all input modules exceeds the rating. (Refer to Section 4.4 in Part I.)
  - A voltage of +24 VDC, supplied from input module AID32A1, AID32B1 or AID32H1 to the outside, is short-circuited to the cabinet or the like.
  - The interface module or any of the I/O modules is defective.
- ③ An I/O module is defective.
  - ⇒ Remove the I/O modules sequentially to pinpoint the defective one. Then, replace it with a spare.
- ④ An interface module is defective.
  - ⇒ Replace it with a spare.

(2) LINK has never been turned on since power is supplied.
① If PWR is off, go to item 1).
② The attempted power turn-on sequence was incorrect.
⇒ The slaves (I/O Unit-A, Power Mate, Series 0, etc.) must be supplied with power at the same time or before the master (CNC or F-D Mate) is supplied with power. (Refer to Section 4.2 in Part I.)
If an attempt is made to supply power to a slave on an interface module after the master is turned on, LINK on the interface module is not turned on provided that the interface module corresponds to that slave or to any slave ahead of that slave (one on the far side with respect to the master).
③ I/O Link cables are broken or short-circuited.
⇒ With reference to Note below, check the cables, and take an appropriate action.
④ Any device on the I/O Link is defective.
⇒ With reference to Note below, find a defective device, and take an appropriate action. If an I/O Unit seems to be defective, replace interface module with a spare.

NOTE
How to pinpoint a failure in the I/O Link in event of items ② to ④.
Check the LEDs on the master to find out which group contains slaves whose I/O Link is established with the master. (Refer to the maintenance manual for the master.)



For example, if the master is linked to slaves (slave #0 and #1) that belong to separate groups, the timing of turning on slave #2 is bad, the cable is broken or short-circuited at point (a), slave #2 is defective.

If the master is not linked to any slave, the master may be defective.

NOTE
Some *i* series CNC models check the number of I/O Link slaves. If there is a group that is not recognized, I/O Link is not established with all groups.
Recognized groups can be checked on the PMC diagnosis screen of each CNC.

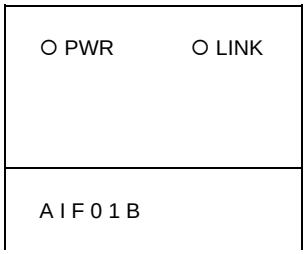
(3) LINK is turned on once, then off.
① One of the devices on the I/O Link is turned off.
⇒ Turn off all devices, then turn them on.

② The DI/DO assignment for the master is invalid.
⇒ When I/O Unit bases 1 to 3 (units under control of interface module AIF01B) are not connected, if DI/DO units are assigned to these bases, LINK is turned on, but turned off immediately.
Correct the DI/DO assignment.

③ The I/O Link cable is broken or short-circuited.
⇒ Check the cable, and take an appropriate action.

④ Any device on the I/O Link is defective.
⇒ With reference to the maintenance manual for the master, find a defective device, and take an appropriate action. If an I/O Unit seems defective, replace the interface module (AIF01A, AIF01A2, or AIF01B) installed in the base unit indicated by BA1 or BA0.

2.2 INTERFACE MODULE (AIF01B) LED INDICATORS



Marking	Name	Description
PWR	Power-on	On: The interface module is supplied with power of 24 VDC.
LINK	Link	On: The I/O Link is operating properly. Normally, this LED lights several to ten-odd seconds after the master is turned on.

Failures, their causes, and required actions

(1) PWR is off.
① Power (24 VDC) is not supplied or the supply voltage is abnormal.
⇒ Supply power of 24 VDC ±10%.
② The fuse in the interface module has blown.
⇒ Eliminate the cause that made the fuse to blow, then replace the fuse with a spare. (See Chapter 3.) The following may cause the fuse to blow:
- A sum of power requirements for all input modules exceeds the rating. (Refer to Section 4.4 in Part I.)
- A voltage of +24 VDC, supplied from input module AID32A1, AID32B1 or AID32H1 to the outside, is short-circuited to the cabinet or the like.
- The interface module or any of the I/O modules is defective.

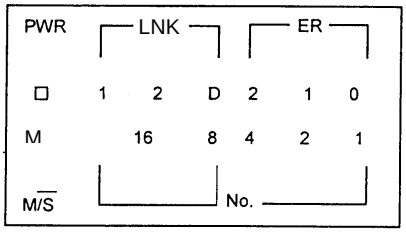
③ An I/O module is defective.
⇒ Remove the I/O modules sequentially to pinpoint the defective one. Then, replace it with a spare.
④ An interface module is defective.
⇒ Replace it with a spare.

(2) LINK has never been turned on since power is supplied.
① If PWR is off, go to item 1).
② If LINK on the AIF01A or AIF01A2 in the same group is off, go to Section 2.1.
③ The signal cable between I/O Units in the same group is broken or short-circuited.
⇒ Check the cable, and take an appropriate action.
④ An interface module is defective.
⇒ Replace it with a spare.

(3) LINK is turned on once, then turned off.
① See section 2.1.

2.3 INTERFACE MODULE (AIF02C) LED INDICATORS

The LED indicator panel of the AIF02C is shown below. Each of its components are described in the following paragraphs.



2.3.1 PWR Indicator

This LED lights when the power is switched on.

2.3.2 LNK Indicators

(1) LNK-1 : Lights when the I/O Link for the I/O Unit-A is operating normally.
(2) LNK-2 : Lights when the I/O Link for the I/O Unit-B is operating normally.
(3) LNK-D : Lights when the distributed link with the I/O Unit-B is operating normally. (The indicator dims if only a few base units are connected.)

2.3.3 ER Indicators

An ER indicator lights if an error occurs on the distributed link.
See the tables on the next subsection for details.

2.3.4 LED Indicators

(1) When the unit No. (1 to 16) is off (o-on and ×-off)

M/S	ER2	ER1	ER0	Error	Description	Major cause of error
○	×	×	○	Interface unit peripheral error	The interface unit is abnormal.	Interface unit failure
○	×	○	×	Interface unit RAM parity error	The interface unit is abnormal.	Interface unit failure
○	○	×	×	I/O Link error reception	An error has occurred in a unit connected to the I/O Link.	Failure in a unit connected to the I/O Link
○	○	×	○	I/O Link framing error	The I/O Link communication end signal is abnormal.	-
○	○	○	×	I/O Link CRC error	I/O Link communication data is abnormal.	-
○	○	○	○	Interface unit watchdog timer error	Communication from the I/O Link host has stopped.	-

(2) When the unit No. (1 to 16) is on (o-on and ×-off)

M/S	ER2	ER1	ER0	Error	Description	Major cause of error
×	×	×	○	Basic unit peripheral error	The basic unit is abnormal.	Basic unit failure
○	×	○	×	Basic unit number error	A unit with an invalid unit number has responded to the interface unit.	-
×	×	○	○	Basic unit reception data count error	The number of communication bytes has exceeded four.	Two or more units have the same unit number, or the unit of interest is not provided with a terminating resistor.
×○ (*1)	○	×	×	Basic unit framing error	The communication end signal is abnormal.	Two or more units have the same unit number, or the unit of interest is not provided with a terminating resistor.
×○ (*1)	○	×	○	Basic unit DMI error	The communication waveform has been distorted.	Two or more units have the same unit number, or the unit of interest is not provided with a terminating resistor.
×○ (*1)	○	○	×	Basic unit CRC error	The communication data is abnormal.	Two or more units have the same unit number, or the unit of interest is not provided with a terminating resistor.
×	○	○	○	Basic unit watchdog timer error	Communication with the interface unit has stopped.	-

NOTE (*1)
If M/S lights, it means that the interface module (AIF02C) detected the error.
If it does not light, it means that the basic unit of the I/O Unit-B detected the error.

2.3.5 M/S Indicator

If an error occurs on a distributed link, the M/S indicator indicates whether the error was detected in the interface module or basic error side.

On: The error has been detected on the interface module side.
Off: The error has been detected on the basic unit side.

2.3.6 No. Indicators

If an error occurs on a distributed link, the No. indicators indicate the basic unit No. where the error is detected. The sum of the values for which a lamp lights corresponds to the basic unit No.

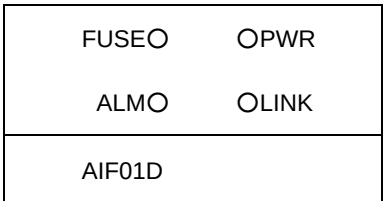
Example)

No.					Unit No.
16	8	4	2	1	
×	×	×	×	○	1
×	×	○	×	○	5
×	○	×	○	×	10
○	×	○	×	×	20

○-On
×-Off

2.4 INTERFACE MODULE (AIF01D) LED INDICATORS

The LED indicator panel of the AIF01D is shown below. Each of its components are described in the following paragraphs.



Marking	Name	Description
PWR	Power-on	On: The interface module is supplied with power of 24 VDC.
LINK	Link	The states of the LED (whether the LED stays on, blinks, or stays off) indicate the communication states of the group. See Subsection 2.4.2, “LINK Indicator” for details of the indication by the LED.
FUSE	Fuse	On : The fuse of the group has blown.
ALM	Alarm	The states of the LED (whether the LED stays on, blinks, or stays off) indicate the types of alarms that have occurred in the group. See Subsection 2.4.4, “ALM Indicator” for details of the alarms indicated by the LED.

2.4.1 PWR Indicator

The PWR indicator lights when the power is on.

2.4.2 LINK Indicator

The indications of the LINK LED indicator vary depending on what the present operation mode is and whether communication is in progress, as listed below.

Operation mode	LED indication	Meaning	Remarks
I/O Link	The indicator is unusable because it is dedicated to I/O Link *i*.		
I/O Link *i*	Off	Power-off	
	On	Power-on	
	Blinks (1:1)	Communication in progress Standard	On = Approx. 0.5 sec Off = Approx. 0.5 sec
	Blinks (3:1)	Communication in progress Dual check safety in use	On = Approx. 1.5 sec Off = Approx. 0.5 sec
	Blinks (high-speed1:1)	Communication not in progress Watchdog alarm occurrence	On = Approx. 0.25 sec Off = Approx. 0.25 sec

2.4.3 FUSE Indicator

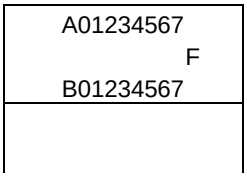
The FUSE indicator lights when a fuse has blown.
After removing the cause of the blown fuse, replace the fuse. (See Chapter 3.)

2.4.4 ALM Indicator

The indications of the ALM LED indicator vary depending on what the present operation mode is and the types of alarms that have occurred, as listed below.

Operation mode	LED indication	Meaning	Remarks
I/O Link	The indicator is unusable because it is dedicated to I/O Link *i*.		
I/O Link *i*	Off	Normal state or power is OFF.	
	On	The parity alarm, external input alarm, or dual check safety alarm has occurred.	
	Blinks (1:1)	A broken wire has occurred between the group of interest and the subsequent group.	On = Approx. 0.5 sec Off = Approx. 0.5 sec
	Blinks (3:1)	A power failure (such as a power moment drop) has occurred in the group subsequent to the group of interest.	On = Approx. 1.5 sec Off = Approx. 0.5 sec
	Blinks (1:3)	The status alarm has occurred.	On = Approx. 0.5 sec Off = Approx. 1.5 sec
	Blinks (high-speed1:1)	An alarm has occurred due to a command from the master.	On = Approx. 0.25 sec Off = Approx. 0.25 sec

2.5 LED INDICATORS ON THE INPUT/OUTPUT MODULES (HAVING 16 OR FEWER INPUT/OUTPUT POINTS)



Label	Name	Description
A0 to 7 B0 to 7	Input/output indicator	On : The corresponding input or output is on.
F	Fuse alarm	On : A fuse incorporated in the output module has blown.

NOTE

1 For the output protection module (AOD08DP or AOD16DP), the LED lights when the protection function is operating.
For details, see the page on which the specifications of the each module are described.

2 For the output module with a diagnosis function (AOD16DM), the LED lights when the protection function is operating.
For details, see the page on which the specifications of this module are described.

3 For the input modules with a diagnosis function (AID16DM and AID16LM), the LED lights if a common voltage moment drop occurs.
For details, see the page on which the specifications of each module are described.

2.6 LED DISPLAY OF THE HIGH-SPEED COUNTER MODULE

Refer to Subsection 8.2.7 in the Part I, “Connection.”

3 FUSES

The modules listed below have built-in fuses. If a fuse blows, remove the cause, then replace the fuse with a spare.

Module	Indication	Rating	Fuse specification
Interface module AIF01A	PWR is off.	3.2A	A60L-0001-0290#LM32
Interface module AIF01A2	PWR is off.	3.2A	A60L-0001-0290#LM32
Interface module AIF01B	PWR is off.	3.2A	A60L-0001-0290#LM32
Interface module AIF02C	PWR is off.	3.2A	A60L-0001-0290#LM32
Interface module AIF01D	PWR is off. FUSE is on.	3.2A	A60L-0001-0290#LM32
Output module with 8 DC points AOD08C	F is on.	5A	A60L-0001-0260#5R00
Output module with 8 DC points AOD08D	F is on.	5A	A60L-0001-0260#5R00
Output module with 16 DC points AOD08D3	F is on.	5A	A60L-0001-0046#5.0
Output module with 5 AC points AOA05E	F is on.	3.15A	A60L-0001-0276#3.15
Output module with 8 AC points AOA08E	F is on.	3.15A	A60L-0001-0276#3.15
Output module with 12 AC points AOA12F	F is on.	3.15A	A60L-0001-0276#3.15

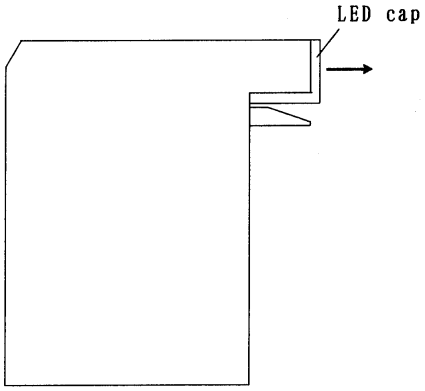
The fuses are on the PC boards in the modules.

4 REMOVING PC BOARDS

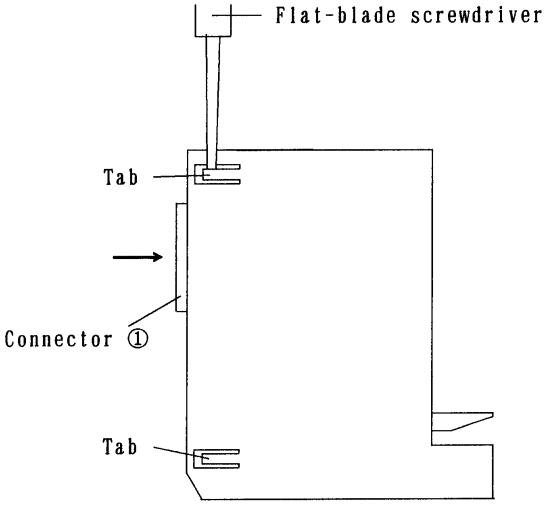
4.1 HOW TO REMOVE TERMINAL BOARD-TYPE I/O MODULE PC BOARDS

① Remove the terminal board. (Refer to 4.5 in Part I.)

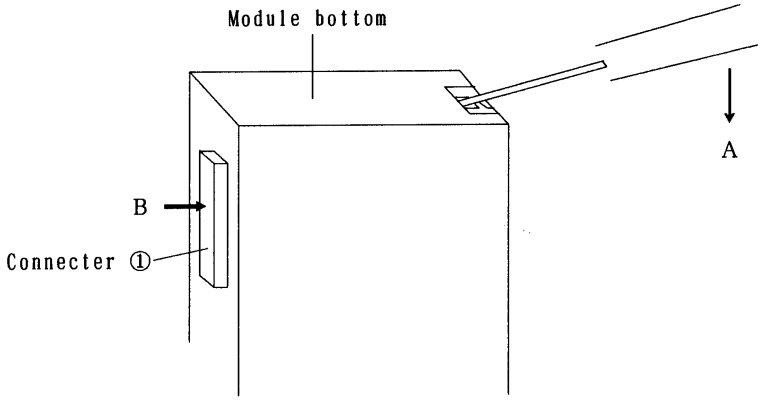
② Pull the LED cap in the direction of the arrow to remove it.



③ While pressing connector ① in the direction of the arrow, raise the tabs (two) on the module case with a flat-blade screwdriver.

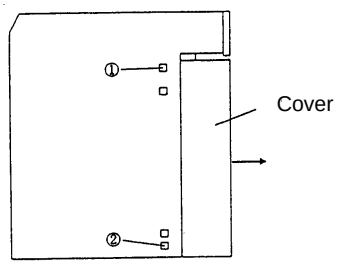


④ Put the tip of a flat-blade screwdriver into the gap between the module case and terminal board connector, as shown below. While pressing the screwdriver in the direction of arrow A, push connector ① in the direction of arrow B, and the PC board will come out.

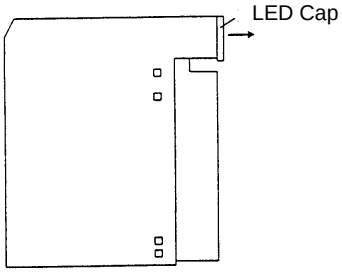


4.2 HOW TO REMOVE INTERFACE AND CONNECTOR-TYPE I/O MODULE PC BOARDS

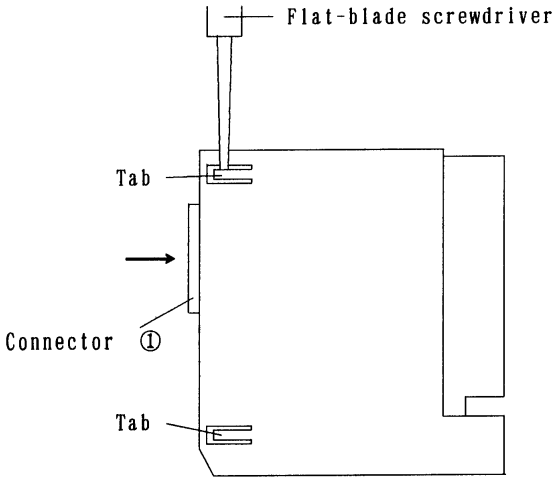
① While pulling the cover in the direction of the arrow, press points ① and ② (on each side) with a flat-blade screwdriver to remove the cover.



② Pull the LED cap in the direction of the arrow to remove it.



③ While pressing connector ① in the direction of the arrow, raise the tabs (2 places for connector-type input/output modules and the AIF01D and 4 places for interface modules other than the AIF01D (both sides)) with a flat-screwdriver, then push connector ① in the direction of the arrow, and e PC board will come out.



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REVISION RECORD

Edition	Date	Contents
06	Jan., 2011	• Addition of descriptions regarding safety • Addition of descriptions of I/O L*i*nk *i* • Addition of descriptions of modules supporting the I/O L*i*nk *i* abnormal detection function
05	Feb., 2009	• Total revision
04	May, 2005	• Total revision
03	Feb., 2000	• Addition of “I/O Link dummy unit” • Addition of Inter face module (AIF02C) • Addition of Input module (AID16K, AID16L) • Addition of High-resolution type analog output module (ADA02B) • Addition of “Temperature input module” • Modification of “High speed counter module”
02	Apr., 1992	• Addition of high speed counter module- Addition of Optical fiber Cable
01	Dec., 1990	