# FANUC Robot series R-30iA/R-30iB CONTROLLER

# PROFINET I/O OPERATOR'S MANUAL

### MAROCPNET03081E REV. D

This publication contains proprietary information of FANUC Robotics America Corporation furnished for customer use only. No other uses are authorized without the express written permission of FANUC Robotics America Corporation.

FANUC Robotics America Corporation 3900 W. Hamlin Road Rochester Hills, Michigan 48309–3253 If you have a controller labeled R-J3iC, you should read R-30iA as R-J3iC throughout this manual.

#### **Copyrights and Trademarks**

This new publication contains proprietary information of FANUC Robotics America Corporation furnished for customer use only. No other uses are authorized without the express written permission of FANUC Robotics America Corporation.

The descriptions and specifications contained in this manual were in effect at the time this manual was approved for printing. FANUC Robotics America Corporation, hereinafter referred to as FANUC Robotics, reserves the right to discontinue models at any time or to change specifications or design without notice and without incurring obligations.

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

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



#### A WARNING

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

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

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

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

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

## Copyright ©2012 by FANUC Robotics America Corporation All Rights Reserved

The information illustrated or contained herein is not to be reproduced, copied, downloaded, translated into another language, published in any physical or electronic format, including internet, or transmitted in whole or in part in any way without the prior written consent of FANUC Robotics America Corporation.

AccuStat®, ArcTool®, iRVision®, KAREL®, PaintTool®, PalletTool®, SOCKETS®, SpotTool®, SpotWorks®, and TorchMate® are Registered Trademarks of FANUC Robotics.

FANUC Robotics reserves all proprietary rights, including but not limited to trademark and trade name rights, in the following names:

AccuAir<sup>TM</sup>, AccuCal<sup>TM</sup>, AccuChop<sup>TM</sup>, AccuFlow<sup>TM</sup>, AccuPath<sup>TM</sup>, AccuSeal<sup>TM</sup>, ARC Mate<sup>TM</sup>, ARC Mate Sr.<sup>TM</sup>, ARC Mate System 1<sup>TM</sup>, ARC Mate System 2<sup>TM</sup>, ARC Mate System 3<sup>TM</sup>, ARC Mate System 4<sup>TM</sup>, ARC Mate System 5<sup>TM</sup>, ARCWorks Pro<sup>TM</sup>, AssistTool<sup>TM</sup>, AutoNormal<sup>TM</sup>, AutoTCPTM, BellToolTM, BODYWorksTM, Cal MateTM, Cell FinderTM, Center Finder<sup>TM</sup>, Clean Wall<sup>TM</sup>, DualARM<sup>TM</sup>, LR Tool<sup>TM</sup>, MIG Eye<sup>TM</sup>, MotionParts<sup>TM</sup>, MultiARM<sup>TM</sup>, NoBots<sup>TM</sup>, Paint Stick<sup>TM</sup>, PaintPro<sup>TM</sup>, PaintTool 100<sup>TM</sup>, PAINTWorks<sup>TM</sup>, PAINTWorks IITM, PAINTWorks IIITM, PalletMateTM, PalletMate PCTM, PalletTool PCTM, PayloadIDTM, RecipToolTM, RemovalToolTM, Robo Chop<sup>TM</sup>, Robo Spray<sup>TM</sup>, S-420i<sup>TM</sup>, S-430i<sup>TM</sup>, ShapeGen<sup>TM</sup>, SoftFloat<sup>TM</sup>, SOFT PARTS<sup>TM</sup>, SpotTool+<sup>TM</sup>, SR Mate<sup>TM</sup>, SR ShotTool<sup>TM</sup>, SureWeld<sup>TM</sup>, SYSTEM R-J2 Controller<sup>TM</sup>, SYSTEM R-J3 Controller<sup>TM</sup>, SYSTEM R-J3*i*B Controller<sup>TM</sup>, SYSTEM R-J3*i*C Controller<sup>TM</sup>, SYSTEM R-30*i*A Controller<sup>TM</sup>, SYSTEM R-30*i*B Controller<sup>TM</sup>, TCP Mate<sup>TM</sup>, TorchMate<sup>TM</sup>, TripleARM<sup>TM</sup>, TurboMove<sup>TM</sup>, visLOC<sup>TM</sup>, visPRO-3D<sup>TM</sup>, visTRACTM, WebServerTM, WebTPTM, and YagToolTM.

#### **©FANUC CORPORATION 2012**

- No part of this manual may be reproduced in any form.
- All specifications and designs are subject to change without notice.

#### **Patents**

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

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

 $\begin{array}{l} 4,630,567\ 4,639,878\ 4,707,647\ 4,708,175\ 4,708,580\ 4,942,539\ 4,984,745\\ 5,238,029\ 5,239,739\ 5,272,805\ 5,293,107\ 5,293,911\ 5,331,264\ 5,367,944\\ 5,373,221\ 5,421,218\ 5,434,489\ 5,644,898\ 5,670,202\ 5,696,687\ 5,737,218\\ 5,823,389\ 5,853,027\ 5,887,800\ 5,941,679\ 5,959,425\ 5,987,726\ 6,059,092\\ 6,064,168\ 6,070,109\ 6,086,294\ 6,122,062\ 6,147,323\ 6,204,620\ 6,243,621\\ 6,253,799\ 6,285,920\ 6,313,595\ 6,325,302\ 6,345,818\ 6,356,807\ 6,360,143\\ 6,378,190\ 6,385,508\ 6,425,177\ 6,477,913\ 6,490,369\ 6,518,980\ 6,540,104\\ 6,541,757\ 6,560,513\ 6,569,258\ 6,612,449\ 6,703,079\ 6,705,361\ 6,726,773\\ 6,768,078\ 6,845,295\ 6,945,483\ 7,149,606\ 7,149,606\ 7,211,978\ 7,266,422\\ 7,399,363 \end{array}$ 

#### **FANUC CORPORATION Patent List**

4,571,694 4,626,756 4,700,118 4,706,001 4,728,872 4,732,526 4,742,207 4,835,362 4,894,596 4,899,095 4,920,248 4,931,617 4,934,504 4,956,594 4,967,125 4,969,109 4,970,370 4,970,448 4,979,127 5,004,968 5,006,035 5,008,834 5,063,281 5,066,847 5,066,902 5,093,552 5,107,716 5,111,019 5,130,515 5,136,223 5,151,608 5,170,109 5,189,351 5,267,483 5,274,360 5,292,066 5,300,868 5,304,906 5,313,563 5,319,443 5,325,467 5,327,057 5,329,469 5,333,242 5,337,148 5,371,452 5,375,480 5,418,441 5,432,316 5,440,213 5,442,155 5,444,612 5,449,875 5,451,850 5,461,478 5,463,297 5,467,003 5,471,312 5,479,078 5,485,389 5,485,552 5,486,679 5,489,758 5,493,192 5,504,766 5,511,007 5,520,062 5,528,013 5,532,924 5,548,194 5,552,687 5,558,196 5,561,742 5,570,187 5,570,190 5,572,103 5,581,167 5,582,750 5,587,635 5,600,759 5,608,299 5,608,618 5,624,588 5,630,955 5,637,969 5,639,204 5,641,415 5,650,078 5,658,121 5,668,628 5,687,295 5,691,615 5,698,121 5,708,342 5,715,375 5,719,479 5,727,132 5,742,138 5,742,144 5,748,854 5,749,058 5,760,560 5,773,950 5,783,922 5,799,135 5,812,408 5,841,257 5,845,053 5,872,894 5,887,122 5,911,892 5,912,540 5,920,678 5,937,143 5,980,082 5,983,744 5,987,591 5,988,850 6,023,044 6,032,086 6,040,554 6,059,169 6,088,628 6,097,169 6,114,824 6,124,693 6,140,788 6,141,863 6,157,155 6,160,324 6,163,124 6,177,650 6,180,898 6,181,096 6,188,194 6,208,105 6,212,444 6,219,583 6,226,181 6,236,011 6,236,896 6,250,174 6,278,902 6,279,413 6,285,921 6,298,283 6,321,139 6,324,443 6,328,523 6,330,493 6,340,875 6,356,671 6,377,869 6,382,012 6,384,371 6,396,030 6,414,711 6,424,883 6,431,018 6,434,448 6,445,979 6,459,958 6,463,358 6,484,067 6,486,629 6,507,165 6,654,666 6,665,588 6,680,461 6,696,810 6,728,417 6,763,284 6,772,493 6,845,296 6,853,881  $6.888,089\ 6.898,486\ 6,917,837\ 6,928,337\ 6,965,091\ 6,970,802\ 7,038,165$ 7,069,808 7,084,900 7,092,791 7,133,747 7,143,100 7,149,602 7,131,848 7,161,321 7,171,041 7,174,234 7,173,213 7,177,722 7,177,439 7,181,294 7,181,313 7,280,687 7,283,661 7,291,806 7,299,713 7,315,650 7,324,873 7,328,083 7,330,777 7,333,879 7,355,725 7,359,817 7,373,220 7,376,488 7,386,367 7,464,623 7,447,615 7,445,260 7,474,939 7,486,816 7,495,192 7,501,778 7,502,504 7,508,155 7,512,459 7,525,273 7,526,121

#### **Conventions**

## **A**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.

## ACAUTION

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

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

### Original Instructions

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

- No part of this manual may be reproduced in any form.
- All specifications and designs are subject to change without notice.

The products in this manual are controlled based on Japan's "Foreign Exchange and Foreign Trade Law". The export from Japan may be subject to an export license by the government of Japan.

Further, re-export to another country may be subject to the license of the government of the country from where the product is re-exported. Furthermore, the product may also be controlled by re-export regulations of the United States government.

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

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.

## **A**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:

## **A**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.

## **A**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.

## 

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.

#### A CAUTION

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

Paint robots are operated in three modes:

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

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

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

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

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

#### **Paint System Safety Features**

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

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

The paint system includes the following safety features:

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

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



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

- Overtravel by robot axes is prevented by software limits. All of the major and minor axes are governed by software limits. 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.



Observe all safety rules and guidelines to avoid injury.

## **A**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.

#### **A** 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
- 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.



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**

Thank you for purchasing FANUC Robot.

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

Before using the functions related to robot operation, read the relevant operator's manual to become familiar with those functions.

If any description in this chapter differs from that in the other part of this manual, the description given in this chapter shall take precedence.

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

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

## 1 WORKING PERSON

The personnel can be classified as follows.

#### Operator:

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

Programmer or teaching operator:

- Operates the robot
- Teaches robot inside the safety fence

#### Maintenance engineer:

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

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

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

# 2 DEFINITION OF WARNING, CAUTION AND NOTE

To ensure the safety of user and prevent damage to the machine, this manual indicates each precaution on safety with "Warning" or "Caution" according to its severity. Supplementary information is indicated by "Note". Read the contents of each "Warning", "Caution" and "Note" before attempting to use the oscillator.

#### **↑** WARNING

Applied when there is a danger of the user being injured or when there is a danger 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

Notes are used to indicate supplementary information other than Warnings and Cautions.

• Read this manual carefully, and store it in a sales place.

## **3** WORKING PERSON SAFETY

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

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

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

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

The controller is designed to receive this interlocking signal of the door switch. When the gate is opened and this signal received, the controller stops the robot (Please refer to "STOP TYPE OF ROBOT" in SAFETY PRECAUTIONS for detail of stop type). For connection, see Fig.3 (a) and Fig.3 (b).

(4) Provide the peripheral devices with appropriate grounding (Class A, Class B, Class C, and Class D).

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

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

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

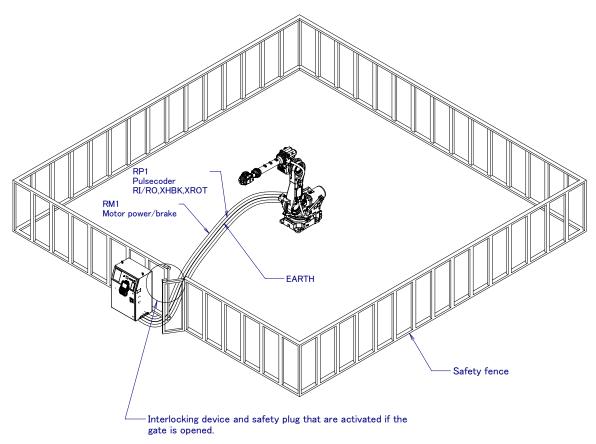


Fig. 3 (a) Safety fence and safety gate

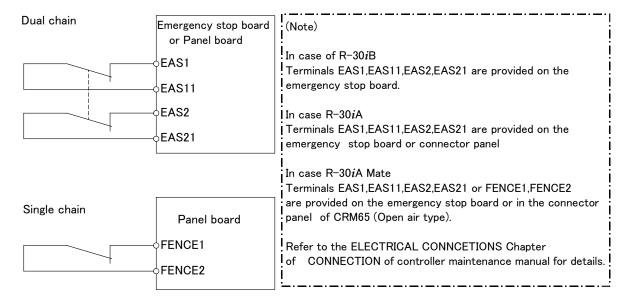


Fig. 3 (b) Limit switch circuit diagram of the safety fence

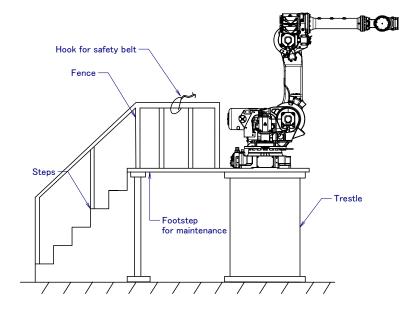


Fig.3 (c) Footstep for maintenance

## 3.1 OPERATOR SAFETY

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

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

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

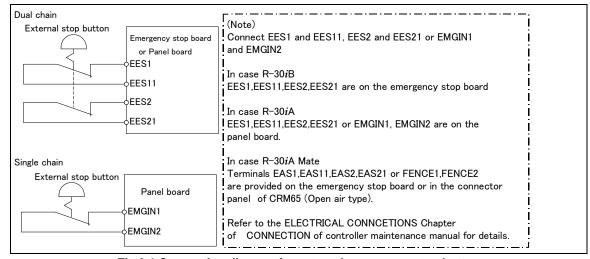


Fig.3.1 Connection diagram for external emergency stop button

## 3.2 SAFETY OF THE PROGRAMMER

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

- (1) Unless it is specifically necessary to enter the robot work area, carry out all tasks outside the area.
- (2) Before teaching the robot, check that the robot and its peripheral devices are all in the normal operating condition.
- (3) If it is inevitable to enter the robot work area to teach the robot, check the locations, settings, and other conditions of the safety devices (such as the EMERGENCY STOP button, the DEADMAN switch on the teach pendant) before entering the area.
- (4) The programmer must be extremely careful not to let anyone else enter the robot work area.
- (5) Programming should be done outside the area of the safety fence as far as possible. If programming needs to be done in the area of the safety fence, the programmer should take the following precautions:
  - Before entering the area of the safety fence, ensure that there is no risk of dangerous situations in the area.
  - Be prepared to press the emergency stop button whenever necessary.
  - Robot motions should be made at low speeds.
  - Before starting programming, check the entire system status to ensure that no remote instruction to the peripheral equipment or motion would be dangerous to the user.

Our operator panel is provided with an emergency stop button and a key switch (mode switch) for selecting the automatic operation mode (AUTO) and the teach modes (T1 and T2). Before entering the inside of the safety fence for the purpose of teaching, set the switch to a teach mode, remove the key from the mode switch to prevent other people from changing the operation mode carelessly, then open the safety gate. If the safety gate is opened with the automatic operation mode set, the robot stops (Please refer to "STOP TYPE OF ROBOT" in SAFETY PRECAUTIONS for detail of stop type). After the switch is set to a teach mode, the safety gate is disabled. The programmer should understand that the safety gate is disabled and is responsible for keeping other people from entering the inside of the safety fence. (In case of R-30*i*A Mate Controller standard specification, there is no mode switch. The automatic operation mode and the teach mode is selected by teach pendant enable switch.)

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

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

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

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

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

In case of R-30iB/R-30iA controller or CE or RIA specification of R-30iA Mate controller

Mode	Teach pendant enable switch	Software remote condition	Teach pendant	Operator panel	Peripheral device
	On	Local	Not allowed	Not allowed	Not allowed
AUTO mode	OII	Remote	Not allowed	Not allowed	Not allowed
	Off	Local	Not allowed	Allowed to start	Not allowed
		Remote	Not allowed	Not allowed	Allowed to start
	On	Local	Allowed to start	Not allowed	Not allowed
T1, T2 mode	On	Remote	Allowed to start	Not allowed	Not allowed
	Off	Local	Not allowed	Not allowed	Not allowed
	Oll	Remote	Not allowed	Not allowed	Not allowed

T1,T2 mode: DEADMAN switch is effective.

In case of standard specification of R-30*i*A Mate controller

Teach pendant enable switch	Software remote condition	Teach pendant	Peripheral device
On	Ignored	Allowed to start	Not allowed
Off	Local	Not allowed	Not allowed
	Remote	Not allowed	Allowed to start

- (6) (Only when R-30*i*B/R-30*i*A Controller or CE or RIA specification of R-30*i*A Mate controller is selected.) To start the system using the operator's panel, make certain that nobody is the robot work area and that there are no abnormal conditions in the robot work area.
- (7) When a program is completed, be sure to carry out a test operation according to the procedure below.
  - (a) Run the program for at least one operation cycle in the single step mode at low speed.
  - (b) Run the program for at least one operation cycle in the continuous operation mode at low speed.
  - (c) Run the program for one operation cycle in the continuous operation mode at the intermediate speed and check that no abnormalities occur due to a delay in timing.
  - (d) Run the program for one operation cycle in the continuous operation mode at the normal operating speed and check that the system operates automatically without trouble.
  - (e) After checking the completeness of the program through the test operation above, execute it in the automatic operation mode.
- (8) While operating the system in the automatic operation mode, the teach pendant operator should leave the robot work area.

## 3.3 SAFETY OF THE MAINTENANCE ENGINEER

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

- (1) During operation, never enter the robot work area.
- (2) A hazardous situation may arise when the robot or the system, are kept with their power-on during maintenance operations. Therefore, for any maintenance operation, the robot and the system should be put into the power-off state. If necessary, a lock should be in place in order to prevent any other person from turning on the robot and/or the system. In case maintenance needs to be executed in the power-on state, the emergency stop button must be pressed.
- (3) If it becomes necessary to enter the robot operation range while the power is on, press the emergency stop button on the operator panel, or the teach pendant before entering the range. The

- maintenance personnel must indicate that maintenance work is in progress and be careful not to allow other people to operate the robot carelessly.
- (4) When entering the area enclosed by the safety fence, the maintenance worker must check the entire system in order to make sure no dangerous situations exist. In case the worker needs to enter the safety area whilst a dangerous situation exists, extreme care must be taken, and entire system status must be carefully monitored.
- (5) Before the maintenance of the pneumatic system is started, the supply pressure should be shut off and the pressure in the piping should be reduced to zero.
- (6) Before the start of teaching, check that the robot and its peripheral devices are all in the normal operating condition.
- (7) Do not operate the robot in the automatic mode while anybody is in the robot work area.
- (8) When you maintain the robot alongside a wall or instrument, or when multiple workers are working nearby, make certain that their escape path is not obstructed.
- (9) When a tool is mounted on the robot, or when any moving device other than the robot is installed, such as belt conveyor, pay careful attention to its motion.
- (10) If necessary, have a worker who is familiar with the robot system stand beside the operator panel and observe the work being performed. If any danger arises, the worker should be ready to press the EMERGENCY STOP button at any time.
- (11) When replacing a part, please contact FANUC service center. If a wrong procedure is followed, an accident may occur, causing damage to the robot and injury to the worker.
- (12) When replacing or reinstalling components, take care to prevent foreign material from entering the system.
- (13) When handling each unit or printed circuit board in the controller during inspection, turn off the circuit breaker to protect against electric shock.

  If there are two cabinets, turn off the both circuit breaker.
- (14) A part should be replaced with a part recommended by FANUC. If other parts are used, malfunction or damage would occur. Especially, a fuse that is not recommended by FANUC should not be used. Such a fuse may cause a fire.
- (15) When restarting the robot system after completing maintenance work, make sure in advance that there is no person in the work area and that the robot and the peripheral devices are not abnormal.
- (16) When a motor or brake is removed, the robot arm should be supported with a crane or other equipment beforehand so that the arm would not fall during the removal.
- (17) Whenever grease is spilled on the floor, it should be removed as quickly as possible to prevent dangerous falls.
- (18) The following parts are heated. If a maintenance worker needs to touch such a part in the heated state, the worker should wear heat-resistant gloves or use other protective tools.
  - Servo motor
  - Inside the controller
  - Reducer
  - Gearbox
  - Wrist unit
- (19) Maintenance should be done under suitable light. Care must be taken that the light would not cause any danger.
- (20) When a motor, reducer, or other heavy load is handled, a crane or other equipment should be used to protect maintenance workers from excessive load. Otherwise, the maintenance workers would be severely injured.
- (21) The robot should not be stepped on or climbed up during maintenance. If it is attempted, the robot would be adversely affected. In addition, a misstep can cause injury to the worker.
- (22) When performing maintenance work in high place, secure a footstep and wear safety belt.
- (23) After the maintenance is completed, spilled oil or water and metal chips should be removed from the floor around the robot and within the safety fence.
- (24) When a part is replaced, all bolts and other related components should put back into their original places. A careful check must be given to ensure that no components are missing or left not mounted.
- (25) In case robot motion is required during maintenance, the following precautions should be taken:

- Foresee an escape route. And during the maintenance motion itself, monitor continuously the whole system so that your escape route will not become blocked by the robot, or by peripheral equipment.
- Always pay attention to potentially dangerous situations, and be prepared to press the emergency stop button whenever necessary.
- (26) The robot should be periodically inspected. (Refer to the robot mechanical manual and controller maintenance manual.) A failure to do the periodical inspection can adversely affect the performance or service life of the robot and may cause an accident
- (27) After a part is replaced, a test operation should be given for the robot according to a predetermined method. (See TESTING section of "Controller operator's manual".) During the test operation, the maintenance staff should work outside the safety fence.

# 4 SAFETY OF THE TOOLS AND PERIPHERAL DEVICES

## 4.1 PRECAUTIONS IN PROGRAMMING

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

## 4.2 PRECAUTIONS FOR MECHANISM

- (1) Keep the component cells of the robot system clean, and operate the robot in an environment free of grease, water, and dust.
- (2) Don't use unconfirmed liquid for cutting fluid and cleaning fluid.
- (3) Employ a limit switch or mechanical stopper to limit the robot motion so that the robot or cable does not strike against its peripheral devices or tools.
- (4) Observe the following precautions about the mechanical unit cables. When theses attentions are not kept, unexpected troubles might occur.
  - Use mechanical unit cable that have required user interface.
  - Don't add user cable or hose to inside of mechanical unit.
  - Please do not obstruct the movement of the mechanical unit cable when cables are added to outside of mechanical unit.
  - In the case of the model that a cable is exposed, Please do not perform remodeling (Adding a protective cover and fix an outside cable more) obstructing the behavior of the outcrop of the cable.
  - Please do not interfere with the other parts of mechanical unit when install equipments in the
- (5) The frequent power-off stop for the robot during operation causes the trouble of the robot. Please avoid the system construction that power-off stop would be operated routinely. (Refer to bad case example.) Please execute power-off stop after reducing the speed of the robot and stopping it by hold stop or cycle stop when it is not urgent. (Please refer to "STOP TYPE OF ROBOT" in SAFETY PRECAUTIONS for detail of stop type.) (Bad case example)

- Whenever poor product is generated, a line stops by emergency stop.
- When alteration was necessary, safety switch is operated by opening safety fence and power-off stop is executed for the robot during operation.
- An operator pushes the emergency stop button frequently, and a line stops.
- An area sensor or a mat switch connected to safety signal operate routinely and power-off stop is executed for the robot.
- (6) Robot stops urgently when collision detection alarm (SRVO-050) etc. occurs. The frequent urgent stop by alarm causes the trouble of the robot, too. So remove the causes of the alarm.

## 5 SAFETY OF THE ROBOT MECHANISM

## 5.1 PRECAUTIONS IN OPERATION

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

## **5.2** PRECAUTIONS IN PROGRAMMING

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

## 5.3 PRECAUTIONS FOR MECHANISMS

terminated.

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

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

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

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

# 6 SAFETY OF THE END EFFECTOR

## **6.1** PRECAUTIONS IN PROGRAMMING

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

# 7 STOP TYPE OF ROBOT

The following three robot stop types exist:

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

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

The following processing is performed at Power-Off stop.

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

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

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

The following processing is performed at Controlled stop.

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

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

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

The following processing is performed at Hold.

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

#### **⚠ WARNING**

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

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

There are the following 3 Stop patterns.

Stop pattern	Mode	Emergency stop button	External Emergency stop	FENCE open	SVOFF input	Servo disconnect
	AUTO	P-Stop	P-Stop	C-Stop	C-Stop	P-Stop
Α	T1	P-Stop	P-Stop	-	C-Stop	P-Stop
	T2	P-Stop	P-Stop	-	C-Stop	P-Stop
	AUTO	P-Stop	P-Stop	P-Stop	P-Stop	P-Stop
В	T1	P-Stop	P-Stop	-	P-Stop	P-Stop
	T2	P-Stop	P-Stop	-	P-Stop	P-Stop
	AUTO	C-Stop	C-Stop	C-Stop	C-Stop	C-Stop
С	T1	P-Stop	P-Stop	-	C-Stop	P-Stop
	T2	P-Stop	P-Stop	-	C-Stop	P-Stop

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

Disable

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

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

(\*) R-30*i*B does not have servo disconnect.

		R-30i	R-30 <i>i</i> A Mate				
Option	Standard (Single)	Standard (Dual)	RIA type	CE type	Standard	RIA type	CE type
Standard	B (*)	Α	Α	Α	A (**)	Α	Α
Stop type set (Stop pattern C) (A05B-2500-J570)	N/A	N/A	С	С	N/A	С	С

<sup>(\*)</sup> R-30*i*A standard (single) does not have servo disconnect.

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

### "Controlled stop by E-Stop" option

When "Controlled stop by E-Stop" (A05B-2600-J570) option (In case of R-30iA/R-30iA Mate, it is Stop type set (Stop pattern C) (A05B-2500-J570)) is specified, the stop type of the following alarms becomes Controlled stop but only in AUTO mode. In T1 or T2 mode, the stop type is Power-Off stop which is the normal operation of the system.

Alarm	Condition
SRVO-001 Operator panel E-stop	Operator panel emergency stop is pressed.
SRVO-002 Teach pendant E-stop	Teach pendant emergency stop is pressed.
SRVO-007 External emergency stops	External emergency stop input (EES1-EES11, EES2-EES21) is open. (R-30 <i>i</i> A/R-30 <i>i</i> B controller)
SRVO-194 Servo disconnect	Servo disconnect input (SD4-SD41, SD5-SD51) is open. (R-30 <i>i</i> A controller)
SRVO-218 Ext.E-stop/Servo Disconnect	External emergency stop input (EES1-EES11, EES2-EES21) is open. (R-30iA Mate/R-30iB controller)
SRVO-408 DCS SSO Ext Emergency Stop	In DCS Safe I/O connect function, SSO[3] is OFF.
SRVO-409 DCS SSO Servo Disconnect	In DCS Safe I/O connect function, SSO[4] is OFF.

<sup>(\*\*)</sup> R-30iA Mate Standard does not have servo disconnect, and the stop type of SVOFF input is Power-Off stop.

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

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

In case of R-30*i*A or R-30*i*A Mate, this function is available only in CE or RIA type hardware.

When this option is loaded, this function cannot be disabled.

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



#### **↑** WARNING

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

120919

# TABLE OF CONTENTS

SA	FETY	PRECAUTIONS	s-1
1	INTR	RODUCTION	1
_	1.1	OVERVIEW	
	1.2	ORDER INFORMATION	
	1.2	1.2.1 Software	
		1.2.2 Hardware	
		1.2.3 PROFINET Board Firmware	
		1.2.4 GSDML File	
	1.3	REQUIERMENTS	
	1.4	RESTRICTIONS	
	1.5	READ BEFORE ROBOT SOFTWARE UPDATE	8
	1.6	I/O DATA ASSIGNMENT	9
	1.7	ADVANCED FEATURES	9
2	HAR	DWARE AND INSTALLATION	10
_	2.1	PROFINET BOARD CP1616	
	2.2	PROFINET BOARD CP1604	_
	2.3	THE SWITCH FUNCTION OF CP1604 WITH EXTERNAL POWER S	
	0		
3	SFT	UP PROFINET I/O	15
	3.1	INTRODUCTION	
	3.2	SETTING IP ADDRESS AND DEVICE NAME OF PROFINET BOAR	
	0.2	3.2.1 Selection of Network Interface Board	
		3.2.2 Setting IP Address and Device Name	
	3.3	MAKING PROFINET PROJECT BY CONFIGURATION TOOL	18
		3.3.1 SIMATIC NCM PC Manager	
		3.3.2 SIMATIC NCM PC Config	
		3.3.3 NetPro	
	3.4	SETUP SCREENS	
		3.4.1 Setup General Screen	
		3.4.2 Setup I/O Controller Screen	
		3.4.2.2 Analog list screen	
		3.4.2.3 Analog detail screen	26
		3.4.3 Setup I/O Device Screen	
		3.4.3.1 Module list screen	
		3.4.3.2 Module Detail Screen	
		3.4.4.1 Configuration detail screen	
	3.5	DOWNLOAD OF PROJECT IN SUSPEND MODE	
	3.6	READ IN MODE	
	3.7	OPERATION MODE	
4	STA.	TUS SCREEN	35
•	4.1	STATUS MODULE LIST SCREEN	
	4.2	STATUS MODULE DETAIL SCREEN	

5	DEVI	CE SWITCHING TP INSTRUCTION	37
6	TROI	JBLESHOOTING	38
	6.1	ERROR CODES	
	6.2	INFORMATION ABOUT I/O CONTROLLER	
ΑPI	PEND	DIX	
Α	ADV	ANCED FEATURES	47
	A.1	OVERVIEW	47
		A.1.1 Important Notice	
		A.1.2 System Variables	
	A.2	IMPROVED ERROR MESSAGE	
		A.2.1 Detailed Alarm Indication	
		A.2.2 Monitoring IOCS/IOPS	
	A.3	A.2.3 Device Return Notification	
	A.3 A.4	DOWNLOAD SCREEN AT CONTROLLED START	
		I/O ROUTER	
	A.5 A.6	PROFINET SAFETY	
В	I/O D	EVICE SETUP BY GSDML	54
_	B.1	OVERVIEW	
	B.2	SETUP PROCEDURE IN TP SCREENS	
	<b>D.</b> 2	B.2.1 Removing I/O Controller I/O Assignment	
		B.2.2 Setup I/O Device Modules Based on GSDML	
	B.3	SETUP PROCEDURE ON CONFIGURATION SOFTWARE	57
	B.4	STARTING I/O DEVICE	59
	B.5	MODULE INFORMATION FOR DATA ACCESS POINT	59
С	ROB	OT SOFTWARE UPDATE	63
	C.1	OVERVIEW	63
	C.2	USING EXISTING CONFIGURATION	
	C.3	MAKING NEW CONFIGURATION	
	C.4	SYSTEM VARIABLES AND SOFTWARE UPDATE	
		C.4.1 Compatibility Bit for Identification as I/O Device	
		C.4.2 I/O Device Module Database	66
		C.4.3 Other System Variables	66

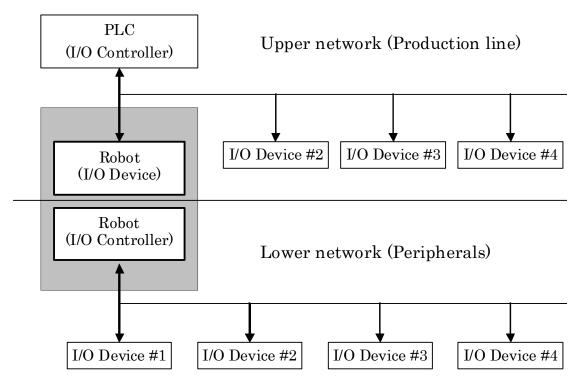
B-82864EN/04 1.INTRODUCTION

# 1 INTRODUCTION

## 1.1 OVERVIEW

PROFINET I/O is an open network for automation, based on industrial Ethernet. The robot controller can communicate with other PROFINET devices, such as PLC or peripheral devices by PROFINET real-time communication (RT is supported, IRT is not supported).

The following is an example of PROFINET I/O network. There are I/O controllers that control network, and I/O Devices that are connected to I/O Controller. The robot controller works as an I/O Device to communicate with PLC. On the other hand, the robot controller works as an I/O Controller to communicate with peripheral devices.



This documents aims to explain how to setup and use the robot controller as a PROFINET I/O Controller and I/O Device, and the screens and the error codes of PROFINET interface function.

1.INTRODUCTION B-82864EN/04

# 1.2 ORDER INFORMATION

## 1.2.1 Software

Table 1.2.1 Software ordering specification

Ordering specification	Option software	Description
A05B-2600-J930 (R-30 <i>i</i> B) A05B-2500-J930 (R-30 <i>i</i> A)	PROFINET I/O	This option software is necessary for using PROFINET I/O function. For R-30 <i>i</i> A, please use V7.70P30 or later for any new installation with PROFINET I/O function. PROFINET function has been changed since it was first released on V7.30P17. There are some features that require newer software. R-30 <i>i</i> B supports all features supported by "V7.70P22" if not otherwise specified.
A05B-2600-J931 (R-30 <i>i</i> B) A05B-2500-J931 (R-30 <i>i</i> A)	PROFINET Safety	This option software is for safety communication on PROFINET. This option software requires PROFINET I/O option software. This function has been supported since V7.70P22 in R-30 <i>i</i> A.

#### **NOTE**

For PROFINET safety function, the firmware version of PROFINET board must be V2.5.2 or later in R-30*i*A, the firmware version must be V2.5.2.2(1) or later in R-30*i*B.

## NOTE

For PROFINET safety function in R-30*i*B, PROFINET board (CP1604) must be used.

## NOTE

For PROFINET Safety function that exchanges safety signals on PROFINET I/O Device, please read "R-30*i*A/R-30*i*A Mate controller Dual Check Safety Function (ISO 13849-1:2006 compliant) operator's manual (B-83104EN)" or "R-30*i*B controller Dual Check Safety Function operator's manual (B-83184EN) in addition to this manual.

#### **NOTE**

For V7.30P, boot software must be V7.30P17 or later. Install all software to update boot software before installing PROFINET board.

## 1.2.2 Hardware

PROFINET I/O function needs two hardware, motherboard (FANUC hardware), and PROFINET board (Siemens hardware). There are PCI type PROFINET board (CP1616), and PC104+ type PROFINET board (CP1604). CP1616 and CP1604 are the products of Siemens. CP1604 is supported by V7.70P22 or later and R-30*i*B. Please also refer to 1.2.3 for PROFINET board firmware.

## NOTE

For PROFINET safety function in R-30*i*B, PROFINET board (CP1604) must be used.

B-82864EN/04 1.INTRODUCTION

## **NOTE**

There are some requirements when the external power is supplied to PROFINET board. Please refer to 1.3 for more details.

#### PROFINET motherboard

There are motherboard for full slot, and wide-mini slot. The motherboard is selected by the type of PROFINET board.

Table 1.2.2(a) Hardware ordering specification for motherboard (R-30iB)

Ordering Specification	Description
A05B-2600-J075	PROFINET motherboard Wide-mini slot size. This board is used with CP1604.
A05B-2600-J060	PROFINET motherboard Full slot size. This board is used with CP1616.

Table 1.2.2(b) Hardware ordering specification for motherboard (R-30iA)

Ordering Specification	Description
A05B-2500-J075	PROFINET motherboard Wide-mini slot size. This board is used with CP1604.
A05B-2500-J063	PROFINET motherboard Full slot size. This board is used with CP1616.

## **PROFINET BOARD(CP1604)**

CP1604 can be installed to R-30*i*A/R-30*i*B with A-cabinet and also R-30*i*A/R-30*i*B with B-cabinet. PROFINET motherboard Wide-mini slot size is needed to install CP1604 to the backplane of R-30*i*A/R-30*i*B (wide-mini slot). CP1604 is supported by V7.70P22 or later and R-30*i*B.

The current order number is 6GK1 160-4AA00.

## **PROFINET BOARD(CP1616)**

CP1616 can be installed to R-30*i*A/R-30*i*B with B-cabinet. CP1616 can't be installed to R-30*i*A/R-30*i*B with A-cabinet. PROFINET motherboard Full slot size is needed to install CP1616 to the backplane of R-30*i*A/R-30*i*B (full slot). In R-30*i*B, the motherboard can be installed only on the full slot next to the main board (slot 2).

The current order number is 6GK1 161-6AA02. It replaces the two former, discontinued order number, 6GK1 161-6AA00 and 6GK1 161-6AA01.

## 1.2.3 PROFINET Board Firmware

PROFINET board firmware is stored on PROFINET board, and provides the features of PROFINET to the robot software. The firmware version is important as well as the order number of hardware because some PROFINET features are not provided by old firmware. Therefore, the robot software version, PROFINET board order number, and the firmware version are written together here. The GSDML file name for a specific firmware version is also written. Please refer to 1.2.4 for more detail of GSDML file.

## **NOTE**

Use NCM/STEP7 V5.5 or later as configuration software for V2.5.2 firmware.

## For new installation (R-30*i*B)

For any new installation of R-30*i*B with PROFINET function, and new hardware, please use the following order information.

Table 1.2.3 (a) Ordering information for new installation using CP1604 (R-30iB)

Ordering item	Ordering information
Robot software	Version V8.10P06 or later
Motherboard (Wide-mini)	Ordering specification : A05B-2600-J075
PROFINET board	CP1604 with order number : 6GK1 160-4AA00
PROFINET board firmware	V2.5.2.2(1) or later
GSDML file	GSDML-V2.25-Fanuc-A05B2600J930-20120627.xml

Table 1.2.3 (b) Ordering information for new installation using CP1616 (R-30iB)

Ordering item	Ordering information
Robot software	Version V8.10P06 or later.
Motherboard (Full Slot)	Ordering specification: A05B-2600-J060
PROFINET board	CP1616 with order number : 6GK1 161-6AA02
PROFINET board firmware	V2.5.2.2(1) or later
GSDML file	GSDML-V2.25-Fanuc-A05B2600J930-20120627.xml

## **NOTE**

For PROFINET safety function, the firmware version board must be V2.5.2 or later in R-30*i*A, the firmware version must be V2.5.2.2(1) or later in R-30*i*B.

#### NOTE

For PROFINET safety function in R-30*i*B, PROFINET board (CP1604) must be used.

## For new installation (R-30iA)

For any new installation of R-30*i*A with PROFINET function, and new hardware, please use the following order information.

Table 1.2.3 (c) Ordering information for new installation using CP1604 (R-30iA)

Ordering item	Ordering information
Robot software	Version V7.70P30 or later
Motherboard (Wide-mini)	Ordering specification: A05B-2500-J075
PROFINET board	CP1604 with order number : 6GK1 160-4AA00
PROFINET board firmware	V2.5.2 or later
GSDML file	GSDML-V2.25-Fanuc-J930-20120113.xml

Table 1.2.3 (d) Ordering information for new installation using CP1616 (R-30*i*A)

Ordering item	Ordering information
Robot software	Version V7.70P30 or later
Motherboard (Full Slot)	Ordering specification: A05B-2500-J063
PROFINET board	CP1616 with order number : 6GK1 161-6AA02
PROFINET board firmware	V2.5.2 or later

B-82864EN/04 1.INTRODUCTION

Ordering item	Ordering information
GSDML file	GSDML-V2.25-Fanuc-J930-20120113.xml

The CP1616 with two former order number, 6GK1 161-6AA00 and 6GK1 161-6AA01 can be used but the firmware must be updated to V2.5.2 or later. The GSDML file is provided by FANUC. Please contact FANUC for the GSDML file.

#### NOTE

For PROFINET safety function, the firmware version board must be V2.5.2 or later in R-30*i*A, the firmware version must be V2.5.2.2(1) or later in R-30*i*B.

#### **NOTE**

The firmware version before V2.3.2 does not work with 6GK1 161-6AA02.

#### **NOTE**

The firmware version before V2.2 does not work with 6GK1 161-6AA01.

## NOTE

If the robot software version is V7.63, please contact FANUC for valid combination of software, hardware, firmware and GSDML file.

## For existing installation (R-30iA)

The followings are the information for existing installations of R-30iA.

#### NOTE

For V7.70P22 or later, both CP1604 and CP1616 are supported. Please use the firmware V2.5.2 or later, and GSDML-V2.2-Fanuc-J930-20120113.xml. For ordering specification and information, please refer to "For new installation (R-30*i*A)" above.

#### NOTE

For the robot software version V7.30P35 or later, V7.40P20 or later, V7.50P10 or later, V7.70P01-V7.70P21, The CP1616 with order number, 6GK1 161-6AA02 can be used for new hardware or replacement, however the firmware must be downgraded to V2.4.1 or later (V2.4.x; but not V2.5.x). The CP1616 with two former order number, 6GK1 161-6AA00 and 6GK1 161-6AA01 can be used but the firmware must be V2.3.1 or later (V2.3.x or V2.4.x).

## **NOTE**

Please follow the procedure below to downgrade the firmware from V2.5.2 if the order number is 6GK1 161-6AA01 or 6GK1 161-6AA02.

- 1) Download V2.5.0 to the PROFINET board in SUSPEND mode.
- 2) Cycle power the robot controller.
- 3) Download the required firmware to the PROFINET board in SUSPEND mode.

1.INTRODUCTION B-82864EN/04

### **NOTE**

For V7.50P14 or later, GSDML file for V7.50, GSDML-V2.2-Fanuc-J930-20100831.xml can be used. Please refer to 1.2.4 for required setting.

## NOTE

For the robot software version V7.30P35 or later, V7.40P20 or later, V7.50P10-V7.50P13, V7.70P01-V7.70P21, please use GSDML-V2.2-Siemens-CP16xx-20100709-142000.xml as GSDML file.

#### NOTE

For robot software before V7.30P35, V7.40P20 or V7.50P10, only 6GK1 161-6AA00 with firmware version V2.1.3 or V2.1.4 can be used. Please use GSDML-V2.2-Siemens-CP16xx-20100709-142000.xml as GSDML file.

## 1.2.4 GSDML File

GSDML file is used by configuration software. GSDML file provides the information of the device as a PROFINET I/O Device. GSDML file defines identification as an I/O Device by vendor ID and device ID. Please refer to table 1.2.4 (b), table 1.2.4 (e) for more detail.

FANUC provides the following GSDML files for recent robot software versions. These GSDML files comply with the PROFINET normative, and have been proven by the successful PROFINET I/O Device conformance test. Please contact FANUC for the GSDML files.

The followings are the information in using the GSDML file for robot provided by FANUC. Please read them carefully.

## **NOTE**

The GSDML file for robot by FANUC is a third-party GSDML file. Siemens configuration tool may need the update for "I/O device coupling with I/O devices of third-party vendor" (available from Siemens) to configure I/O coupling of the robot (as a third-party I/O Device), and PC-Station (as an I/O Controller).

### NOTE

PROFINET XML-viewer, which is available from Siemens, is useful to see the content of the GSDML file.

#### **NOTE**

Vendor ID is a unique number for a device manufacturer. 0x01B7 = 439 corresponds to FANUC. 0x002A = 42 corresponds to Siemens.

## R-30iB GSDML information

Table 1.2.4 (a) GSDML file of robot provided by FANUC (R-30iB)

File name	Robot software version
GSDML-V2.25-Fanuc-A05B2600J930-20120627.xml	V8.10P06 or later

B-82864EN/04 1.INTRODUCTION

Table 1.2.4 (b) Vendor ID and Device ID (R-30iB)

	V8.10P06 or later
Vendor ID	0x01B7
Device ID	0x0002

## R-30*i*A GSDML information

Table 1.2.4 (c) GSDML file of robot provided by FANUC (R-30iA)

File name	Robot software version
GSDML-V2.25-Fanuc-J930-20120113.xml	V7.70P22 or later
GSDML-V2.2-Fanuc-J930-20100831.xml	V7.50P14 or later

#### NOTE

For V7.50P14 or later, please change \$PNIO\_CFG.\$CUSTOM from 0 to 1, and cycle power the robot controller to use the GSDML file on V7.50. This is recommended when compatibility with V7.50P13 or before is not required. This setting changes the vendor ID and the device ID parameters in the robot controller to match the GSDML file. If this setting is not done, the GSDML file can't be used, but the same GSDML file as V7.50P13 or before can be used for resolving compatibility issue. In this case, legacy vendor ID and device ID are used. Please refer to table 1.2.4 (e) for the values of vendor ID and device ID.

For the software version with V7.30, V7.40, V7.50P01-13 and V7.70P01-21, please use the following GSDML file available from Siemens.

Table 1.2.4 (d) GSDML file of robot for existing installation (R-30iA)

File name	Robot software version
GSDML-V2.2-Siemens-CP16xx-20100709-142000.xml	V7.30, V7.40, V7.50P01-13 and V7.70P01-21

The vendor ID and the device ID depend on the software version according to the GSDML file.

Table 1.2.4 (e) Vendor ID and Device ID (R-30iA)

V7.30, V7.40, V7.50P01-13 and V7.70P01-21		V7.50P14 or later, V7.70P22 or later	
Vendor ID	0x002A	0x01B7	
Device ID	0x0003	0x0001	

## 1.3 REQUIERMENTS

- a) This function needs motherboard (available from FANUC), and PROFINET board (CP1604 or CP1616, available from Siemens).
- b) To configure PROFINET board, PC that Siemens configuration tool is installed is needed. One of the following PC configuration tool is required to perform setup.
  - NCM PC : Configuration software bundled with CP1604/CP1616.
  - STEP7: Configuration software for Siemens PLC

1.INTRODUCTION B-82864EN/04

### NOTE

Use NCM/STEP7 V5.5 or later as configuration software for V2.5.2 firmware.

c) The software version must be V7.70P22 or later in R-30*i*A with A-cabinet to use CP1604 because CP1616 can't be installed to the robot controller with A-cabinet.

d) The software version must be V7.70P22 or later to use PROFINET Safety (F-Device) in R-30*i*A. The software version must be V8.10P06 or later to use PROFINET Safety (F-Device) in R-30*i*B. PROFINET board (CP1604) must be used for PROFINET Safety (F-Device) in R-30*i*B.

## NOTE

For PROFINET Safety function that exchanges safety signals on PROFINET I/O Device, please read "R-30*i*A/R-30*i*A Mate controller Dual Check Safety Function (ISO 13849-1:2006 compliant) operator's manual (B-83104EN)" or "R-30*i*B controller Dual Check Safety Function operator's manual (B-83184EN) in addition to this manual.

e) There are some requirements when the external power is supplied to PROFINET board.

#### NOTE

The watchdog function of CP1604/CP1616 must be disabled by setting the system variable, \$PNIO\_CFG.\$WD\_ENABLE from 1 to 0 when the external power is supplied to PROFINET board. Cycle power is required to activate the change.

### NOTE

The software version must be V7.70P27 or later in R-30*i*A when the external power is supplied to PROFINET board.

#### **NOTE**

The firmware must be V2.5.2.1 or later when I/O Router function is used and the external power is supplied to PROFINET board.

## 1.4 RESTRICTIONS

- 1 This function cannot be used in R-30*i*A Mate.
- 2 Total digital I/O size of I/O Controller and I/O Device is 2048 points for each.
- 3 Total analog I/O size of I/O Controller and I/O Device is 50 channels for each.
- 4 PROFINET can coexist with TCP/IP, but TCP/IP via PROFINET board is not supported. Connect Ethernet cable to the Ethernet port of the main board of the robot controller to use TCP/IP.
- 5 Start up the robot controller in SUSPEND start up mode when firmware of PROFINET board is to be loaded. If the software version is V7.70P22 or later, the firmware can be downloaded at Controlled Start (Please refer to Appendix A.4).
- 6 PROFINET Safety function only supports F-Device. It doesn't support F-Host.

# 1.5 READ BEFORE ROBOT SOFTWARE UPDATE

This section is for R-30*i*A. PROFINET I/O function was changed greatly in V7.70P22. If the robot software with PROFINET I/O function is to be updated from V7.70P01-21 to V7.70P22 or later, please read the following information, and refer to Appendix C before update.

B-82864EN/04 1.INTRODUCTION

## **NOTE**

Please use V7.70P25 or later if legacy vendor ID and device ID must be used, for example, to solve compatibility problem, because V7.70P22-24 always use new vendor ID and device ID. Please refer to table 1.2.4 (e) for the values of vendor ID and device ID. Refer to Appendix C.2 and Appendix C.4.1 for more detail.

## NOTE

Vendor ID and device ID are changed in V7.70P22 as written in table 1.2.4 (e). Therefore the robot as I/O Device is identified as another device if the robot software is updated from V7.70P01-21 to V7.70P22 or later.

## NOTE

Restoring PNIO.SV from V7.70P01-21 to V7.70P22 or later overwrites the internal database that contains the module ID of V2.5 data access point by old database. This can be recovered by changing some system variables. Refer to Appendix C for more detail.

## 1.6 I/O DATA ASSIGNMENT

The following rack and slot number are used for referring PROFINET I/O in the robot controller.

 Function
 Rack
 Slot

 PROFINET I/O Controller
 99
 1

 PROFINET I/O Device
 100
 1

Table 1.6 Rack and Slot number of PROFINET I/O

The direction of data in PROFINET network is decided by the direction viewed from I/O Controller. For example, Input Data is input of I/O Controller, but it is output of I/O Device. On the other hand, Output Data is output of I/O Controller, but it is input of I/O Device. When the robot controller is I/O Device, DI/AI is mapped to Output Data of PROFINET, and DO/AO is mapped to Input Data of PROFINET.

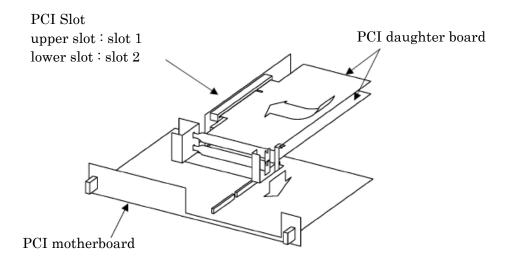
# 1.7 ADVANCED FEATURES

Some features are added and usable since V7.70P22. R-30*i*B supports all features supported by V7.70P22. Please refer to Appendix A for more detail.

# 2 HARDWARE AND INSTALLATION

# **2.1** PROFINET BOARD CP1616

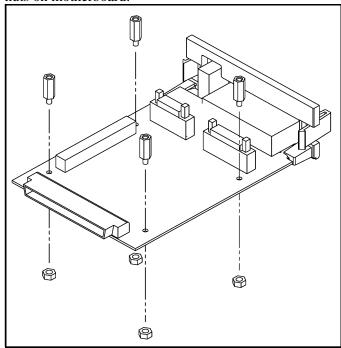
The figure below shows how to install Siemens CP1616. Install Siemens CP1616 to slot 1 of PCI motherboard.



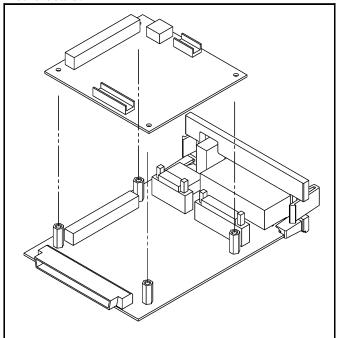
# 2.2 PROFINET BOARD CP1604

The following figures show how to install Siemens CP1604.

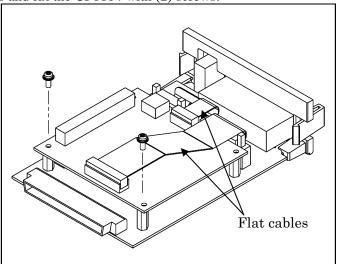
1. Fix (4) studs with (4) nuts on motherboard.



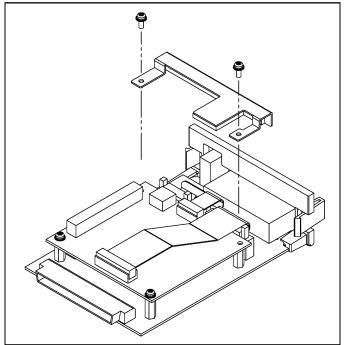
2. Install the CP1604 on motherboard.



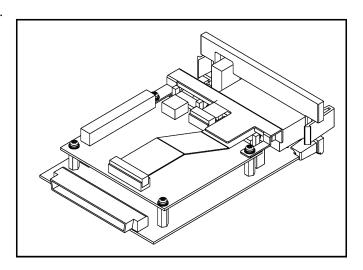
3. Connect (2) flat cables and fix the CP1604 with (2) screws.



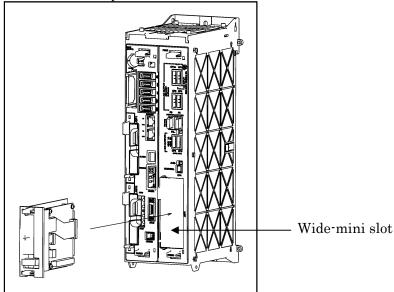
4. Fix a plate with (2) screws.



## 5. Complete assembly.



6. Install motherboard into wide-mini slot of backplane.



# 2.3 THE SWITCH FUNCTION OF CP1604 WITH EXTERNAL POWER SUPPLY

The external power supply (+24V) allows the integrated real-time switch to function even when the robot controller is turned off.

#### NOTE

The switch function of the CP1604 is available even when the robot controller is turned off as long as it was turned on briefly at least once and the external power supply is connected.

### **NOTE**

There are some requirements when the external power is supplied to PROFINET board. Please refer to 1.3 for more details.

Table 2.3 Specification of external power supply

Table 2.0 Openineation of external power supply			
Requirements			
Voltage range of the 24V supplies 18 to 32 V DC			
Connection			
WAGO connector	Manufacture specification: 734-102 FANUC specification: A63L-0002-0154#102		
Current consumption of the external 24V voltage			
At 18V DC supply Max. 300mA			
At 32V DC supply Max. 200mA			

The following figure shows the connector for external power supply.

The connector for external power supply allows two separate external 24V power supply to be fed in.

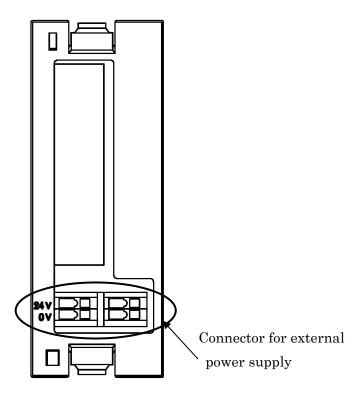


Fig. 2.3 Connector for external power supply

# 3 SETUP PROFINET I/O

## 3.1 INTRODUCTION

This section describes briefly the steps of setup PROFINET I/O. One of the following PC configuration tool is required to perform setup.

- NCM PC : Configuration software bundled with CP1604/CP1616.
- STEP7 : Configuration software for Siemens PLC
- Plug an Ethernet cable to PROFINET board and configure IP address and device name by the configuration tool. This step is needed for new PROFINET board at least once.
- 2 Create a project by the configuration tool and make PROFINET network configuration. IP address and device name of the robot controller must be equal to those set in step 1. This project will be downloaded later to PROFINET board and/or PLC.
- 3 Setup PROFINET I/O function by PROFINET setup screens of the robot controller .

The following settings are made in this step.

- Enable/Disable of I/O Controller
- Enable/Disable of I/O Device
- Mapping of PROFINET data to I/O of the robot controller (when I/O Controller is enabled).
- The module configuration in module list/detail screen (when I/O Device is enabled).
- When settings are made, change the start up mode to SUSPEND and cycle power the robot controller.
- The robot controller starts up by SUSPEND mode. PROFINET board stops in this state to enable project download. If I/O Controller is enabled, download the project to PROFINET board. If I/O Device is enabled, download the project to PLC.
- When download finishes, change the start up mode to READ IN. PROFINET function of the robot controller starts immediately. The robot controller as I/O Controller reads in current configuration. If any configuration of I/O Controller or I/O Device in the robot controller does not match the configuration in the project, error will occur.

## **⚠** WARNING

Changing start up mode from SUSPEND immediately takes effect, that is, PROFINET function of the robot controller starts immediately. Please verify the safety is assured and make sure if it is safe to start PROFINET I/O data exchange before changing the start up mode from SUSPEND.

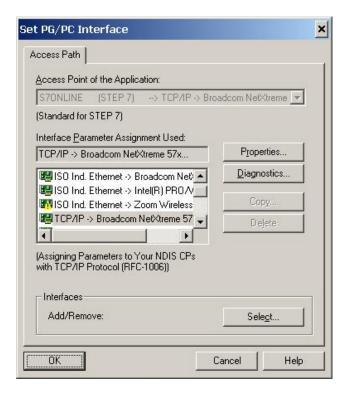
- 7 Cycle power the robot controller if the robot software version is V7.50P01-22, V7.63P01-08, V7.70P01-29 or V8.10P01-06. Refer to 6.2 for more detail.
- 8 If there is any error, check the setting and the project to solve the error. To download project again, change the start up mode to SUSPEND and cycle power the robot controller and go back to step 5.
- If there is no error or all error is resolved, change the start up mode to OPERATION and cycle power the robot controller.
- 10 The robot controller starts up with the configuration read in at step 6 when the robot controller starts up in OPERATION mode.
- 11 If the robot controller starts up without error, setting of PROFINET is completed.

# 3.2 SETTING IP ADDRESS AND DEVICE NAME OF PROFINET BOARD

This section describes the operation of configuration tool (NCM PC or STEP 7).

## 3.2.1 Selection of Network Interface Board

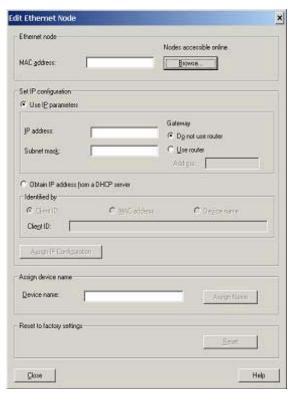
- 1 Start "SIMATIC NCM PC Manager" from start menu, for example.
- 2 Click "Set PG/PC Interface" of "Option" tool bar.
- Wait for a while, and the window like below appears.



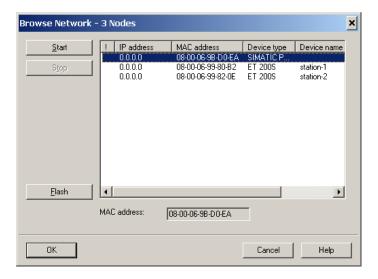
4 Select network interface board that is used for PROFINET connection among the items whose name start by TCP/IP or TCP/IP(Auto).

## 3.2.2 Setting IP Address and Device Name

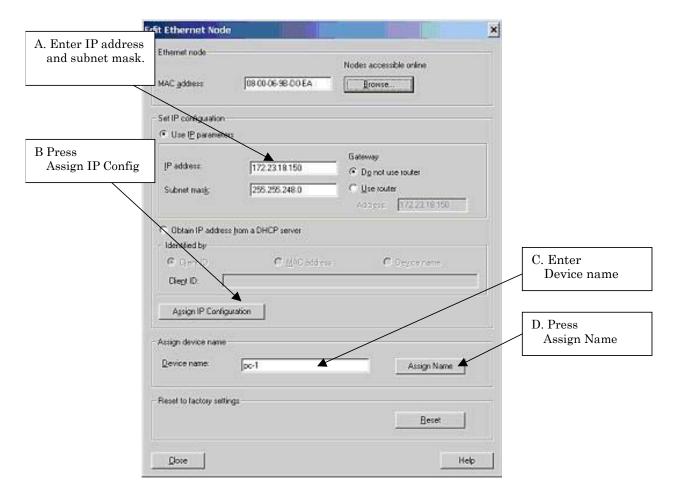
- 1 Start "SIMATIC NCM PC Manager" from start menu, for example.
- 2 Click "Edit Ethernet Node" from "PLC" tool bar. The window like below appears after a while.



3 Press "Browse" button. The configuration tool will search all devices connected to the Ethernet. The window like below appears after a while.



- 4 Find out PROFINET board and select it. Then press "OK".
- 5 The window like below appears. IP address and device name can be set from this window.
- 6 Enter IP address and subnet mask. Press "Assign IP Configuration".



7 Enter device name and press "Assign Name" button.

#### **NOTE**

Device name cannot be modified if PROFINET board has been configured as I/O Controller. In this case, press "Reset" button in the "Reset to factory setting" field to initialize PROFINET board.

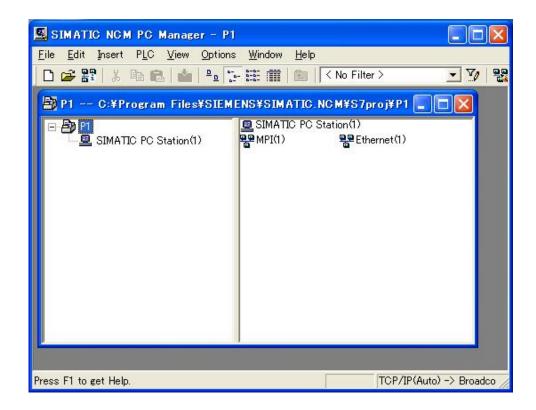
8 This procedure is completed. Press "Close" button to close the window.

# 3.3 MAKING PROFINET PROJECT BY CONFIGURATION TOOL

This section describes the outline of how to set up PROFINET I/O Controller by using NCM PC configuration tool. Please refer to the start up of the operation manual of NCM PC or STEP7 for the details.

## 3.3.1 SIMATIC NCM PC Manager

First of all, start "SIMATIC NCM PC Manager" to create new project. After a project is created, the window like below shows up. Right click the window and select "Insert New Object". Add "SIMATIC PC Station" and "Industrial Ethernet".



The left window displays the hierarchy of the project. "SIMATIC PC Station" has been added. The right window displays the components of the selected level of the hierarchy. Clicking a component will open other configuration software such as "NetPro" or "SIMATIC NCM PC Config/HW Config" for detailed configuration of the component.

#### Example 1)

Select the top level in the left window. Double click "Industrial Ethernet", and NetPro will open.

#### Example 2)

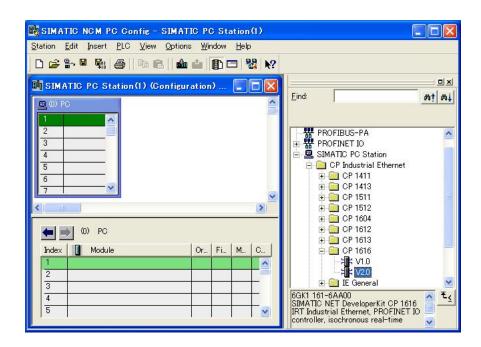
Select "SIMATIC PC Station". Double click "Configuration", and "SIMATIC NCM PC Config" will open.

## 3.3.2 SIMATIC NCM PC Config

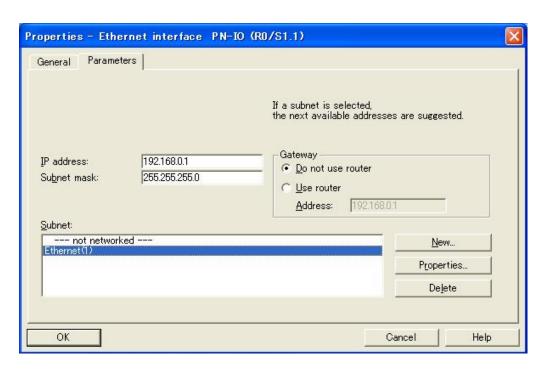
"SIMATIC NCM PC Config" is used for setting up the configuration of PROFINET module. PROFINET board must be added to "SIMATIC PC Station" by this software.

This section explains the procedure of setup by using CP1616 V2.0 as an example. However, the version should be chosen according to the firmware version of PROFINET board when actual configuration is to be made.

- 1 Starts "SIMATIC NCM PC Config" or "HW Config" according to the example 2 of 3.3.1.
- 2 Select the top of empty row of PC.
- 3 Click "CP Industrial Ethernet" in the right window to show the lower level.
- 4 Select V2.0 under "CP1616", and the top row of PC becomes green, which means the selected component can be inserted here.

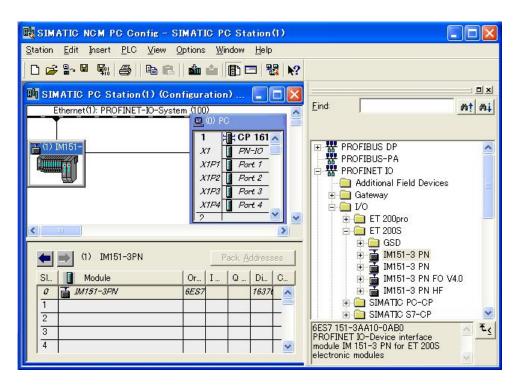


5 Double click V2.0, and the windows like below shows up.



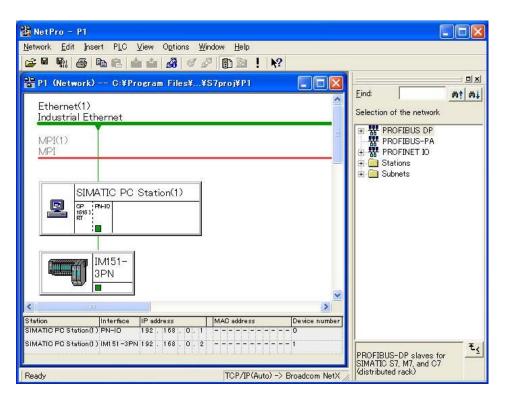
- 6 Check IP address and subnet mask are correct.
- 7 Select the network to connect CP1616 in the "Subnet" field.
- Press "OK" to close the window, and an Ethernet cable shows up inside the left window. CP1616 has been connected to the Ethernet.
- 9 After modification finishes, do "Save and Compile" to apply the changes.

By the similar procedure, it is possible to add the device here that communicates with CP1616. Click the Ethernet cable that shows up in step 8, and click "IM151-3 PN" under "PROFINET I/O->I/O->ET200S", for example. Then "IM151-3 PN" module is added like the figure below. Then add the input/output modules to the remaining rows of "IM151-3 PN".



## 3.3.3 **NetPro**

NetPro can setup the configuration of PROFINET network. "NetPro" can be opened according to the example 1 of 3.3.1. The figure below shows the network after adding "IM151-3 PN" module according to 3.3.2.



# 3.4 SETUP SCREENS

## 3.4.1 Setup General Screen

Use this screen to select start up mode, and to change Enable/Disable of I/O Controller and I/O Device. Press F3 key to show up the pop-up menu to open other screens. Press F10 key (press NEXT and then press F5) to clear I/O assignment.

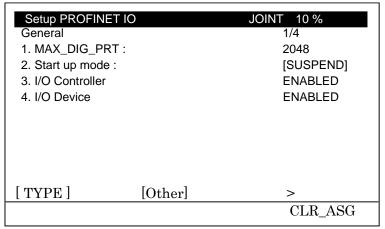


Fig. 3.4.1 Setup general screen

## **⚠** WARNING

Changing start up mode from SUSPEND immediately takes effect, that is, PROFINET function of the robot controller starts immediately. Please verify the safety is assured and make sure if it is safe to start PROFINET I/O data exchange before changing the start up mode from SUSPEND.

## **⚠** WARNING

Cycle power the robot controller after changing start up mode to READ IN if the robot software version is V7.50P01-22, V7.63P01-08, V7.70P01-29 or V8.10P01-06. Please refer to 6.2 for more detail.

## NOTE

The comment of modules is erased when the network configuration is read in. To recover the comment, please write it down before changing start up mode to READ IN.

#### **NOTE**

I/O Controller has initial setting of input/output size for DIO and AIO. If I/O Controller is not used, set 0 to "Number of digital input/output" for DIO and "Number of analog input/output" for AIO in setup I/O Controller screen (refer to 3.4.2). Find the assignment with rack 99, slot 1 in digital I/O config screen and analog I/O config screen under I/O menu and delete them. Cycle power the robot controller to apply the change.

### **NOTE**

I/O Device doesn't have any initial setting. I/O Device setting must be made by Module list/detail screens (refer to 3.4.3.1 and 3.4.3.2). The input/output size for DIO and AIO is calculated from the process data size of modules in I/O Device setting, and is displayed in setup I/O Device screen (refer to 3.4.3).

Table 3.4.1 Setup general screen items

#	Item	Adjustable	Description
		values	
1	MAX_DIG_PRT	-	This item displays \$MAX_DIG_PRT
2 (a)	Start up mode	SUSPEND	SUSPEND: (setup stage)
		READ IN	PROFINET board does not start automatically.
		OPERATION	One can download project to PROFINET board.
			READ IN: (setup stage)
			PROFINET board starts automatically and
			network configuration of I/O Controller is read in
			from PROFINET board.
			OPERATION: (production stage)
			PROFINET board starts automatically and
			network configuration of I/O Controller is checked
			if it is matched to the stored one. If it does not
			match, error message shows up and
			communication does not start.
3 (a)	I/O Controller	ENABLE	Enable/Disable of I/O Controller
		DISABLE	
4 (a)	I/O Device	ENABLE	Enable/Disable of I/O Device
		DISABLE	

<sup>(</sup>a) Need to cycle power to have the change applied.

Function key	Words	Description of function keys	
F3	Other	Selection of setup screens	
F10	CLR_ASG	Clear I/O assignments Clear ALL I/O assignments?	

# 3.4.2 Setup I/O Controller Screen

The items 2-5 specify the size of digital I/O and analog I/O of PROFINET. Items 6-9 specify the start address of PROFINET data that are mapped to digital I/O or analog I/O. The areas specified by the size (item 2-5) and the start addresses (item 6-9) are mapped to digital I/O or analog I/O. The address of PROFINET data can be displayed and modified by configuration tools, such as NCM PC or STEP 7. Press F3 key to show up the pop-up menu to open other screens. Press F4 key to open arc welding I/O screen. Press F5 key to open analog I/O list screen. Press F10 key to clear I/O assignment.

Setup PROFINET IO	JOINT 10 %	
I/O Controller	1/5	
1. Error one shot :	DISABLED	
2. Number of digital input:	1024	
3. Number of digital output :	1024	
4. Number of analog input :	25	
5. Number of analog output :	25	
6. Digital input offset address:	0	
7. Digital output offset address:	0	
8. Analog input offset address: 512		
Analog output offset address:	512	
[TYPE] [Other] arc analog	>	
	CLR_ASG	

Fig.3.4.2 Setup I/O controller screen

Table 3.4.2 Setup I/O controller screen items

#	Item	Adjustable values	Description
1	Error one shot	ENABLE DISABLE	If it is ENABLE, pressing reset button can erase network error of I/O Controller even if it is present.
2 (a)	Number of digital input	0-2048	Number of DI mapped as rack 99. The value must be multiple of 8.
3 (a)	Number of digital output	0-2048	Numbers of DO mapped as rack 99. The value must be multiple of 8.
4 (a)	Number of analog input	0-25	Number of Al mapped as rack 99.
5 (a)	Number of analog output	0-25	Number of AO mapped as rack 99.
6(a)	Digital input offset address	0-9998	The start address of PROFINET data mapped to DI (rack 99).
7(a)	Digital output offset address	0-9998	The start address of PROFINET data mapped to DO (rack 99).
8(a)	Analog input offset address	0-9998	The start address of PROFINET data mapped to AI (rack 99).
9(a)	Analog output offset address	0-9998	The start address of PROFINET data mapped to AO (rack 99).

(a) Need to cycle power to have the change applied

Function key	Words	Description of function keys	
F3	Other	Selection of setup screens	
F4	arc	Arc welding signal screen	
F5	analog	Analog list screen	
F10	CLR_ASG	Clear I/O assignments	
		Clear ALL I/O assignments?	

## NOTE

The data of a PROFINET I/O module can be allocated to only a single type of I/O (digital, analog, arc welding). It must be placed within the area specified by the start address and the size for a type of I/O and it must not be placed across the border of any areas, otherwise it is not allocated to any I/O. In such case, PRIO-630 appears at start up with PRIO-631 or PRIO-632 to inform which data is not allocated.

## 3.4.2.1 Arc welding signal screen

The setting of arc welding signals, such as WI/WO or WSTK, that are used by Arctool can be modified in this screen. This screen can be used only when the application is Arctool. Press PREV to go back to I/O Controller screen.

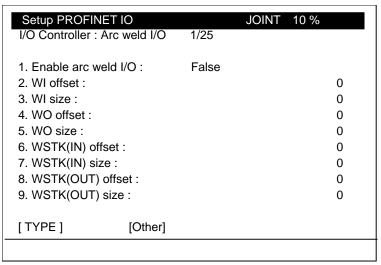


Fig. 3.4.2.1 Arc welding signal screen

Table 3.4.2.1 Arc welding signal screen items

#	Item	Adjustable values	Description
1 (a)	Enable arc weld I/O	False True	Specify if WI/WO and WSTK are available. It can be "True" only if arc tool is ordered.
2,4,6,8 (a)	WI/WO/WSTK offset	0-9998	Address where WI/WO/WSTK starts.
3,5,7,9 (a)	WI/WO/WSTK size	0-40	Number of WI/WO/WSTK mapped as rack 99. The value must be multiple of 8.

<sup>(</sup>a) Need to cycle power to have the change applied.

Function key	Words	Description of function keys	
F3	Other	Selection of setup screens	

### NOTE

The data of a PROFINET I/O module can be allocated to only a single type of I/O (digital, analog, arc welding). It must be placed within the area specified by the start address and the size for a type of I/O and it must not be placed across the border of any areas, otherwise it is not allocated to any I/O. In such case, PRIO-630 appears at start up with PRIO-631 or PRIO-632 to inform which data is not allocated.

## 3.4.2.2 Analog list screen

There are analog list screens for AO and AI. These screens show the mapping of analog I/O of the robot controller and the address of PROFINET data. The comment of analog I/O is also displayed in this screen. Press PREV to go back to I/O Controller screen. Press F2 key to open analog detail screen. Press F5 key to switch AO and AI.

Setup PROFINET IO	JO	INT 10 %
I/O Controller : List AO		1/25
NO Addr Comme	nt	
AO[1] 512 [	]	
AO[2] 514 [	]	
AO[3] 516 [	]	
AO[4] 518 [	]	
AO[ 5] 520 [	]	
AO[ 6] 522 [	]	
AO[7] 524 [	]	
AO[ 8] 526 [	]	
AO[9] 528 [	]	
[TYPE] detail	[Other]	I/O

Fig. 3.4.2.2 Analog list screen(AO)

Table 3.4.2.2 Analog list screen items

#	Item	Adjustable values	Description
1	No	None	Analog output number
2	Addr	None	Address in bytes, where the value for this AI/AO is
			located (Address must be equal to NCM or STEP7).
3	Comment	None	Comment of this analog output (the same as AI/AO
		String[24]	screen). Display only.

(a) Need to cycle power to have the change applied.

Function key	Words	Description of function keys	
F2	detail	Go to detail screen	
F3	Other	Selection of setup screens	
F5	I/O	Switch AO and AI.	

# 3.4.2.3 Analog detail screen

There are analog detail screens for AO and AI. The setting of bit shift operation and valid bits can be modified in this screen. Use default setting if the value of analog signal is to be used as original value.

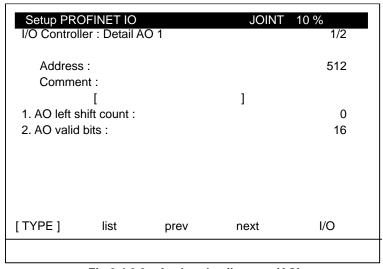


Fig.3.4.2.3 Analog detail screen(AO)

	Table 5.4.2.3 Analog detail screen items					
#	Item	Adjustable values	Description			
	Address		Address in bytes, where the value for this AI/AO is located (Address must be equal to NCM or STEP7). Display only			
	Comment	None String[24]	Comment of this analog output (the same as Al/AO screen). Display only.			
1 (a)	Al right shift count AO left shift count	0 1-16	Number of bit shift count.			
2 (a)	AI/AO valid bits	16	Number of valid bits.			

Table 3.4.2.3 Analog detail screen items

(a) Need to cycle power to have the change applied.

Function key	Words	Description of function keys	
F2	list	Go to list screen	
F3	prev	Go to previous analog port	
F4	next	Go to next analog port	
F5	I/O	Switch AO and AI.	

# 3.4.3 Setup I/O Device Screen

This screen is a top screen for I/O Device setting. The robot controller as PROFINET I/O Device is a modular device, that is, it is composed of up to 17 modules. The configuration of modules is made in the module list/detail screens. To enter module list screen, move cursor to the second line, "Module", and press Enter. This screen shows the amount of digital and analog I/O used by the robot controller as PROFINET I/O Device.

Setup PROFIN	ET IO	JOINT 10 %
I/O Device		1/2
1. Error one sho	ot:	DISABLED
2. Modules		<detail></detail>
<ol><li>Number of di</li></ol>	gital inputs :	128
4. Number of di	gital outputs :	128
5. Number of ar	nalog inputs :	0
6. Number of ar	nalog outputs :	0
[TYPE]	[Other]	>
		CLR_ASG

Fig. 3.4.3 Setup I/O device screen

Table 3.4.3 Setup I/O device items

	Table 5.4.5 Setup I/O device items						
#	Item	Adjustable values	Description				
1	Error one shot	ENABLE DISABLE	If it is ENABLE, pressing reset button can erase network error of I/O Controller even if it is present. Use this only during setup.				
2	Modules	None	Moves to "Module list" sub screen by pressing enter key with the cursor on this item.				
3	Number of digital inputs	None	Displays sum of digital input number of modules, which are to be mapped to rack 100. Calculated according to setting. Not actual value.				

#	ltem	Adjustable values	Description
4	Number of digital outputs	None	Displays sum of digital output number of modules, which are to be mapped to rack 100. Calculated according to setting. Not actual value.
5	Number of analog inputs	None	Displays sum of analog input number of modules, which are to be mapped to rack 100. Calculated according to setting. Not actual value.
6	Number of analog outputs	None	Displays sum of analog output number of modules, which are to be mapped to rack 100. Calculated according to setting. Not actual value.

(a) Need to cycle power to have the change applied.

Function key	Words	Description of function keys	
F3	Other	Selection of setup screens	

#### **NOTE**

Appendix B provides an example of I/O Device setting and usage of Setup I/O Device screen and Module list/detail screens when I/O Controller is disabled.

## 3.4.3.1 Module list screen

The robot controller as PROFINET I/O Device is composed of up to 17 modules. There is no module defined by default, therefore modules location (slot, subslot) and module identifier (modId, subslotId) must be specified by module list/detail screens. There are device access point (always slot 0), input modules, output modules, and input/output modules. Please refer to the GSDML file for the parameters of modules. Select a submodule and press F2 Detail to enter the parameters of the submodule. Press PREV to go back to setup I/O Device screen.

Setu	p Pl	ROF	FINET IO		JOINT	10 %	
I/O D	evic	e : l	Modules			1	/17
No SI	No Slot Sub Comment						
0	0	1	[CP1616 V2.5				]
1	1	1	[				]
2	2	1	[				]
3	0	0	[				]
4	0	0	[				]
5	0	0	[				]
6	0	0	[				]
7	0	0	[				]
8	0	0	[				]
9	0	0	[				]
[TYPE] detail [Other] >				>			
	DEL_ALL						

Fig. 3.4.3.1 Module list screen

Table 3.4.3.1 Module list screen

#	Item	Adjustable values	Description
1	Slot	None 0-16	Displays slot number Slot number is up to 16.
2	Sub	None 0-1	Displays sub slot number
3	Comment	String[24]	Explanation of the module

(a) Need to cycle power to have the change applied.

Function key	Words	Description of function keys
F2	detail	Go to Module Detail screen of the selected submodule.
F3	Other	Selection of setup screens.
F7	DEL_ALL	Delete all module settings.  Delete ALL modules?

#### **NOTE**

Appendix B provides an example of I/O Device setting and usage of Setup I/O Device screen and Module list/detail screens when I/O Controller is disabled.

## **NOTE**

The module in slot = 0 must be device access point. Choose the device access point without "Migration" subcategory when only I/O Device is enabled in the robot controller. Choose the device access point with "Migration" subcategory when both of I/O Controller and I/O Device are enabled in the robot controller.

## 3.4.3.2 Module Detail Screen

Enter the parameters of the module that consists of the robot controller as PROFINET I/O Device in this screen. Slot and subslot specify the location of the module within 17 slots. ModId and subslotId specify the type of module. Please see the following properties in the GSDML file for ModId and SubslotId.

Item name	Property name in GSDML file (use PROFINET-XML viewer to open the file)	
Modld	Module Ident Number	
SubslotId	Submodule Ident Number	

When module ID is entered, internal database is searched to find out the module. If there is a match, data size and module I/O type are automatically set. Enter slot, subslot and subslotId by manual. Choose data type from digital and analog.

The parameters of module (except for data type) must be equal to those of project made by configuration tool. Otherwise, error will occur and the communication will not establish.

Setup PROFIN	IET IO		1IOL	NT 10 %
I/O Device : Mo	dule 1			1/6
1. Slot :				1
2. Subslot:				1
Comment:				
3. [			]	
4. Modld(hex):				0x00000027
5. SubslotId(he	x):			0x0000001
Module I/C			DO	
6. Data size :			[16 Bytes]	
7. Data type:			[Digital]	
[TYPE]	list	prov	novt	
[ITPE]	iist	prev	next	

Fig. 3.4.3.2 Module detail screen

Table 3.4.3.2 Module detail screen

	14410 01 11012 111044110 4104111 0010011				
#	Item	Adjustable values	Description		
1(a)	Slot	0-16	Slot number of the module		
			Slot number is up to 16.		

#	Item	Adjustable values	Description
2(a)	Sub	0-1	Sub slot number of the module
3	Comment	String[24]	Explanation of the module
4(a)	Modld	LONG	Module Id of the module
			Enter the value by decimal number.
5(a)	SubslotId	LONG	Subslot Id of the module
			Enter the value by decimal number.
	Module I/O type	DI, DO, AI, AO,	The type of I/O of the module decided by the direction of
		NONE	data and the data type (item 7).
6(a)	Data size	0, 1, 4, 16 Bytes (b)	Choose from 0, 1, 4, and 16 Bytes (b)
7(a)	Data type	Digital	Choose from digital and analog.
		Analog	It specifies if the process data is assigned to DI/DO or
			AI/AO. 1Byte module can't be assigned to analog. It
			doesn't have any effect on PROFINET I/O exchange.

- (a) Need to cycle power to have the change applied.
- (b) For V7.50P14 or later, V7.70P22 or later, R-30iB, please see the GSDML file for robot by FANUC.

Function key	Words	Description of function keys
F2	list	Go to module list screen
F3	prev	Go to previous module
F4	next	Go to next module

#### **NOTE**

Appendix B provides an example of I/O Device setting and usage of Setup I/O Device screen and Module list/detail screens when I/O Controller is disabled.

#### NOTE

The module in slot = 0 must be device access point. Choose the device access point without "Migration" subcategory when only I/O Device is enabled in the robot controller. Choose the device access point with "Migration" subcategory when both of I/O Controller and I/O Device are enabled in the robot controller.

# 3.4.4 Setup Configuration List Screen

This screen displays the configuration of I/O Controller that has been read in when the start up mode is READ IN. After the configuration is read in, device can be activated or deactivated by changing the item of E/D when TP is enabled. The comment of device can be entered in this screen. If the comment is set to the first device of a station, the comment will be shown next to the TP switching instruction when the instruction is taught in a TP program. Some error message displays the comment as well as error location.

Setup PR	OFINET IO		JOINT	10 %
				1/256
St Slot S	ub Comment			
E 1 2	1 [		]	
E 1 5	1 [		]	
E 1 6	1 [		]	
E 1 8	1 [		]	
E 2 2	1 [		]	
E 2 3	1 [		]	
E 2 4	1 [		]	
E 2 6	1 [		]	
D 0 0	] 0		]	
D 0 0	] 0		]	
[TYPE]	detail	[Other]		

Fig. 3.4.4 Setup Configuration list screen

Table 3.4.4 Setup Configuration list screen

#	Item	Adjustable values	Description
1	E/D	Enable Disable	Module can be activated/deactivated from here. Press F4 Enable to enable the module. Press F5 Disable to disable the module.
2	St	None 0-999	Displays station number
3	Slot	None 0-999	Displays slot number
4	Sub	None 0-999	Displays sub slot number
5	Comment	String[24]	Explanation of the module

(a) Need to cycle power to have the change applied.

Function key	Words	Description of function keys
F2	detail	Go to config detail screen
F3	Other	Selection of setup screens

## **NOTE**

The comment of modules is erased when the network configuration is read in. To recover the comment, please write it down before changing start up mode to READ IN.

# 3.4.4.1 Configuration detail screen

This screen shows the detail of the module within the configuration of I/O Controller that has been read in when the start up mode is READ IN. After the configuration is read in, device can be activated or deactivated by changing the status to enable or disable when TP is enabled. The comment of device can be entered in this screen.

To show error message when the device is deactivated, set the second item to ON.

Setup PROFINET IO	JOINT 10 %
I/O Controller : Module 1	1/11
1. Status :	Enable
2. Show error when deactivated:On	
3. Station:	1
4. Slot :	2
5. Subslot :	1
Comment :	
6. [	]
7. Address :	0
8. Length:	1
9. IO data type :	IN
10. Data type :	0
11. Com type:	0
[TYPE] list prev next	

Fig. 3.4.4.1 Configuration detail screen

Table 3.4.4.1 Configuration detail screen

#	Item	Adjustable values	Description
1	Status	Enable Disable	Module can be activated/deactivated from here. Press F4 Enable to enable the module. Press F5 Disable to disable the module.
2	Show error when deactivated	Off On	When the setting is On, error message will show up when the device is disconnected unless it is deactivated by configuration screen or TP instruction.
3	Station	LONG	Station number of the module
4	Slot	LONG	Slot number of the module
5	Sub	LONG	Sub slot number of the module
6	Comment	String[24]	Explanation of the module
7	Address	LONG	Process data address of the module specified by configuration tool (NCM or STEP7).
8	Length	LONG	Process data length of the module
9	I/O data type		Shows data type is input or output
10	Data type		
11	Com type		

(a) Need to cycle power to have the change applied.

Function key	Words	Description of function keys
F2	list	Go to config list screen
F3	prev	Go to previous module
F4	next	Go to next module

## NOTE

The comment of modules is erased when the network configuration is read in. To recover the comment, please write it down before changing start up mode to READ IN.

#### 3.5 DOWNLOAD OF PROJECT IN SUSPEND MODE

It is required to download a project to PROFINET board by configuration tool. If there is any other PROFINET I/O Controller in the network, the project must be downloaded to the stations, too. Change start up mode to "READ IN" when download is completed.

#### **↑** WARNING

Changing start up mode from SUSPEND immediately takes effect, that is, PROFINET function of the robot controller starts immediately. Please verify the safety is assured and make sure if it is safe to start PROFINET I/O data exchange before changing the start up mode from SUSPEND.

#### NOTE

When the robot controller starts up with start up mode other than SUSPEND, project cannot be downloaded to PROFINET board.

#### NOTE

When the robot controller starts up with SUSPEND start up mode, PROFINET board is stopped. Start up mode must be SUSPEND when firmware of PROFINET board is updated.

#### **NOTE**

Cycle power the robot controller after firmware update. If the external power supply of PROFINET board is connected, remove it before cycle power and connect it again after power up.

#### 3.6 **READ IN MODE**

The robot controller tries to establish PROFINET communication when start up mode is changed from "SUSPEND" mode to "READ IN" mode or when it starts up with "READ IN" mode. If there is wrong setting or the configuration does not match to the downloaded project, error will occur.

If there is no error, current configuration will be read in to the robot controller and PROFINET communication will establish, but PRIO-623 with STOP severity will be posted to prohibit robot motion. To release PRIO-623, change start up mode to OPERATION and cycle power the robot controller.

The configuration read in will be stored and used when start up mode is OPERATION. On the other hand, if the robot controller starts up with "READ IN" mode, configuration will be read in and last configuration will be overwritten. The setting in 3.4.4 and 3.4.4.1 are initialized.



#### **↑** WARNING

Cycle power the robot controller after changing start up mode to READ IN if the robot software version is V7.50P01-22, V7.63P01-08, V7.70P01-29 or V8.10P01-06. Please refer to 6.2 for more detail.

#### **⚠** WARNING

Please confirm if the communication is OK and I/O data is exchanged correctly before changing start up mode to OPERATION.

#### NOTE

The comment of modules is erased when the network configuration is read in. To recover the comment, please write it down before changing start up mode to READ IN.

## 3.7 OPERATION MODE

The robot controller starts up with the stored configuration, and check if it matches to the current configuration. Therefore use OPERATION mode after PROFINET setting is completed.

The setting of "Show error when deactivated" (see 3.4.4.1) will be used in OPERATION mode. If the device with the setting = ON is disconnected, error message will show up unless the device is deactivated by configuration screen or TP instruction. The device switching status is recovered at HOT start in OPERATION mode.

B-82864EN/04 4.STATUS SCREEN

# 4 STATUS SCREEN

## 4.1 STATUS MODULE LIST SCREEN

This screen shows the list of modules of I/O Device that communicate with the robot controller. The list is based on current PROFINET configuration, and therefore it can be different with the list of setup configuration list screen when start up mode is OPERATION.

				IET IO		JOINT 10 %
1/				odule lis	-	1/256
	St	Slot	Sub	Addr	Len	RS_I RS_O
E	1	2	1	0	1	0000 0000
Е	1	5	1	2	1	0000 0000
E	1	6	1	0	1	0000 0000
Е	1	8	1	2	1	0000 0000
E	2	2	1	4	1	0000 0000
E	2	3	1	6	1	0000 0000
E	2	4	1	4	1	0000 0000
E	2	6	1	6	1	0000 0000
D	0	0	0	0	0	0000 0000
D	0	0	0	0	0	0000 0000
[ ]	[TYPE] detail					

Fig. 4.1 Status module list screen

Table 4.1 Status module list screen

#	ltem	Values	Description
1	E/D	ENABLE DISABLE	Shows if the module is activated or not.
2	Station	None 0-999	Displays station number
3	Slot	None 0-999	Displays slot number
4	Sub	None 0-999	Displays sub slot number
5	Address	None 0-99999	Displays process data address
6	Length	None 0-999	Displays process data length
7	RS_I		Remote status of Input data
8	RS_O		Remote status of Output data

Function key	Words	Description of function keys	
F2	detail	Go to module detail screen	

4.STATUS SCREEN B-82864EN/04

## 4.2 STATUS MODULE DETAIL SCREEN

Status PROFINET IO	JOINT 10 %
I/O Controller : Module 1	1/11
1. Status :	Enable
2. Station:	1
3. Slot :	2
4. Subslot :	1
5. Address :	0
6. Length:	0
7. IO data type:	0
8. Data type :	0
9. Com type :	0
[TYPE] list prev next	

Fig. 4.2 Status module detail screen

Table 4.2 Status module detail screen

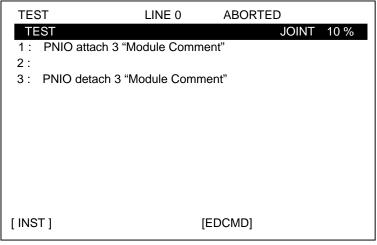
	144.0 112 044.40 11.044.10 4.044.11 00.001.1			
#	Item	Values	Description	
1	Status	Enable	Shows if the module is activated or not.	
		Disable		
2	Station	LONG	Station number of the module	
3	Slot	LONG	Slot number of the module	
4	Sub	LONG	Sub slot number of the module	
5	Address	LONG	Process data address of the module specified by	
			configuration tool (NCM or STEP7).	
6	Length	LONG	Process data length of the module	
7	I/O data type		Shows data type is input or output	
8	Data type			
9	Com type			

Function key	Words	Description of function keys	
F2	list	Go to module list screen	
F3	prev	Go to previous module	
F4	next	Go to next module	

# 5

## **DEVICE SWITCHING TP INSTRUCTION**

Device switching TP instruction is used to activate or deactivate PROFINET I/O device, such as a peripheral I/O module on detachable hand or tool. Specify the operation (attach or detach) and the station number in the instruction. The device switching status is recovered at HOT start in OPERATION mode.



TP instruction to activate and deactivate module

Instruction	argument	Description
PNIO attach station no.		Activate the specified module and wait until it is activated, or timeout
		occurs. Module comment of the first module of the station is brought
		from config list/detail screen and displayed after module no.
PNIO detach	station no.	Deactivate the specified module and wait until it is deactivated or
		timeout occurs. Module comment of the first module of the station is
		brought from config list/detail screen and displayed after module no.

# 6 TROUBLESHOOTING

## **6.1** ERROR CODES

The error message starts with "PNIO(D)" is related to I/O Device. The error message starts with "PNIO(C)" is related to I/O Controller. Some error cannot be reset by reset button until the cause of the error is resolved. If the error has to be reset, for example, when robot has to move for setup, change "ERROR ONE SHOT" setting to enable temporarily. This error code list includes the message for advanced features, which only shows up in specific versions.

#### PRIO-600 WARN "PNIO board not installed"

Cause :PROFINET board is not installed.

Remedy: Check motherboard or PROFINET board are inserted firmly.

#### PRIO-601 SYST "PNIO watchdog alarm"

Cause :PROFINET software on the robot controller is not working.

Remedy: Cycle power the robot controller. Please contact FANUC if this error occurs repeatedly.

### PRIO-602 WARN "PNIO system error(ID=%x)(%d)"

Cause :System error.

Remedy: Please contact FANUC. Report the value in the error message.

#### PRIO-603 WARN "%s"

Cause :System error.

Remedy: Please contact FANUC. Report the error message

#### PRIO-604 WARN "PNIO SYSTEM error"

Cause :System error.

Remedy: Open alarm history screen because this error may show up together with another error message. Please contact FANUC, and report the error message.

#### NOTE

When PROFINET Safety is used, PRIO-604 may show up with PRIO-603 "PROFIsafe hard fail", "CRC check error" or "status check error". Then, first of all, check whether the configuration of safety PLC and the setting of robot controller match. Check the size of safety input/output in DCS PROFINET Safety screen, configure the safety PLC again, and cycle power the robot controller. If the problem persists, the error is probably due to a hardware problem. Please contact FANUC.

### PRIO-605 WARN "PNIO(D) open error %04x"

Cause: Failed to start PROFINET I/O Device function. This error message may show up during remote configuration by PC configuration tool. This error message may show up when the robot controller is used only as I/O Device and its IP address is supposed to be set by I/O Controller (such as PLC), but the I/O Controller has not started.

Remedy: The value in the error message is error code from PROFINET board. The value might be one of the followings. If the value is not in the list, or if the error is not resolved, write down the value in the error message and contact FANUC and report the value.

#### V7.30, V7.40, V7.50P01-P13 and V7.70P01-P21

Error Code	Meaning	Remedy
0x030D	Config in update	Cycle power the robot controller. Check if IP address and device name of PROFINET board have been set correctly.
0x030E	No communication to PROFINET board	Cycle power the robot controller.

#### V7.50P14 or later, V7.63, V7.70P/22 or later, R-30iB

Error Code	Meaning	Remedy
0x0309	Wrong calling sequence	Wait for a while, or press reset. Then the robot controller tries to start I/O Device again.
0x030D	Config in update PROFINET board might be stopped by PC configuration tool for remote configuration.	If the robot controller is used only as I/O Device, start the I/O Controller which is supposed to set the IP address. Finish remote configuration and start PROFINET board by PC configuration tool, and then press reset. Then the robot controller tries to start I/O Device again.
0x030E	No communication to PROFINET board PROFINET board might be stopped by PC configuration tool for remote configuration.	Finish remote configuration and start PROFINET board by PC configuration tool, and then press reset. Then the robot controller tries to start I/O Device again.

## PRIO-606 STOP "PNIO(D) abort indication %x"

Cause :PROFINET I/O communication is aborted by I/O Controller.

Remedy: This is just notification.

#### PRIO-607 STOP "PNIO(D) offline indication %x"

Cause :PROFINET I/O communication is stopped by I/O Controller.

Remedy: This is just notification.

#### PRIO-608 STOP "PNIO(D) mismatch slot %d %d"

Cause :Reported module with slot number and subslot number does not match the configuration

of project file downloaded to I/O Controller.

Remedy: Check the setting in setup module detail screen. Check the project file.

#### PRIO-609 STOP "PNIO: Need reset for restart"

Cause :PROFINET board is stopped by PC configuration tool when I/O Controller is enabled.

Remedy: Start PROFINET board by PC configuration tool and then press reset.

#### PRIO-610 WARN "PNIO(C) open error %04x"

Cause :Failed to start PROFINET I/O Controller function. This error message may show up

when PROFINET board is stopped by PC configuration tool.

Remedy: The value in the error message is error code from PROFINET board. The value might be one of the followings. If the value is not in the list, or if the error is not resolved, write down the value in the error message and contact FANUC and report the value.

V7.30, V7.40, V7.50P01-P13 and V7.70P01-P21

	, ,	
Error Code	Meaning	Remedy
0x0304	No configuration is available	Download configuration to PROFINET board in SUSPEND mode.
0x030D	Config in update	Cycle power the robot controller.
0x030E	No communication to PROFINET board	Cycle power the robot controller.

#### V7.50P14 or later, V7.63, V7.70P/22 or later, R-30iB

Error Code	Meaning	Remedy
0x0304	No configuration is available	Download XDB project file to PROFINET board in
		controlled start, or download configuration to PROFINET
		board in SUSPEND mode.
0x0309	Wrong calling sequence	Press reset. Then the robot controller tries to start I/O
		Controller again.
0x030D	Config in update	Finish remote configuration and start PROFINET board by
	PROFINET board might be stopped	PC configuration tool, and then press reset. Then the robot
	by PC configuration tool for remote	controller tries to start I/O Controller again.
	configuration.	
0x030E	No communication to PROFINET	Finish remote configuration and start PROFINET board by
	board	PC configuration tool, and then press reset. Then the robot
		controller tries to start I/O Controller again.

#### PRIO-611 WARN "PNIO(C) alarm indication %x"

Cause : Alarm is indicated by PROFINET board.

Remedy: This is just notification.

#### PRIO-612 WARN "PNIO(C) offline indication"

Cause :Operating mode is changed to offline.

Remedy: This is just notification.

#### PRIO-613 WARN "PNIO(C) clear indication"

Cause :Operating mode is changed to clear

Remedy: This is just notification.

#### PRIO-614 STOP "PNIO watchdog start failed"

Cause :System error.

Remedy: Please contact FANUC. Report the error message

#### PRIO-615 WARN "PNIO can't find the station"

Cause :Specified station number is not found when switching TP instruction is executed.

Remedy: Check the station number.

#### PRIO-616 STOP "PNIO attach/detach Timeout"

Cause :Switching TP instruction has been timeout. Remedy :Check if the target station is connected well.

#### PRIO-617 STOP "PNIO(D) mod plug failed %x %x"

Cause :I/O Device function failed because the specified module is wrong.

Remedy :Check the module specified by two numbers, the former is slot number, the latter is subslot number.

#### PRIO-618 STOP "PNIO(D) submod plug failed %x %x"

Cause :I/O Device function failed because the specified submodule is wrong.

Remedy :Check the module specified by two numbers, the former is slot number, the latter is subslot number.

#### PRIO-619 STOP "PNIO(C) mismatch st %d slot %d %d"

Cause :The stored configuration of the module that is specified by station number, slot number and subslot number does not match to the current configuration when the start up mode is OPERATION.

Remedy: Check the parameters of the module that is specified by station number, slot number and subslot number.

#### PRIO-620 STOP "PNIO(C) station %d deactivated"

Cause :The device whose "Show error when deactivated" setting is ON is deactivated.

Remedy: Check the station specified the station number, and activate it.

#### PRIO-621 STOP "PNIO(D) device is not running"

Cause :The start up of I/O Device has not completed or terminated by error.

Remedy: Disable I/O Device if I/O Device function is not used in setup general screen. If I/O Device function is used, check if any error related to I/O Device is present. Check if I/O Controller that is supposed to communicate with the robot controller is running. This error can be released when the setting of I/O Device is correct and communication to the I/O Controller establishes.

#### PRIO-622 STOP "PNIO(C) controller is not running"

Cause :The start up of I/O Controller has not completed or terminated by error.

Remedy: Disable I/O Controller if I/O Controller function is not used. If I/O Controller function is used, check if any error related to I/O Controller is present. This error can be released when the setting of I/O Controller is correct and communication to the I/O Devices establishes.

#### PRIO-623 STOP "PNIO(C) not in operation mode"

Cause :The start up of I/O Controller has completed but the start up mode is not OPERATION. Remedy :Change the start up mode to OPERATION, and cycle power the robot controller.

#### PRIO-624 STOP "PNIO(C) mod number mismatch"

Cause :The stored configuration is different from the current configuration in the number of modules when the start up mode is OPERATION.

Remedy: Check if the project downloaded to PROFINET board matches the current configuration, and if the configuration was read in by the robot controller in READ IN mode.

#### PRIO-625 WARN "PNIO(C) read in complete"

Cause :PROFINET network configuration has been read in successfully when start up mode is READ IN.

Remedy: This is just notification of completion of read in. Check PROFINET I/O Controller communication and I/O data exchange before changing start up mode to OPERATION.

#### PRIO-626 WARN "PNIO: please power OFF/ON"

Cause :PROFINET setting was changed and it is required to turn off/on the power to enable the change.

Remedy: Please cycle power the robot controller.

#### PRIO-628 STOP "PNIO(C) group is not recovered"

Cause: The device switching status cannot be recovered.

Remedy: Restore each device by configuration screen or TP instruction.

### PRIO-629 WARN "Restore group manually"

Cause: The device switching status cannot be recovered.

Remedy: Restore each device by configuration screen or TP instruction.

#### PRIO-630 WARN "PNIO(C) mod data out of area"

Cause :The data of a PROFINET I/O module is not placed inside of the area specified by the start address and the size for any type of I/O, or it is placed across the border of some of the areas. In this case, the data is not allocated to any I/O.

Remedy: If the data need to be allocated to I/O of the robot controller, change the configuration in the robot controller, NCM/PC or STEP7 according to the information with PRIO-631 or PRIO-632.

#### **NOTE**

The data of a PROFINET I/O module can be allocated to only a single type of I/O (digital, analog, arc welding). It must be placed within the area specified by the start address and the size for a type of I/O and it must not be placed across the border of any areas, otherwise it is not allocated to any I/O. In such case, PRIO-630 appears at start up with PRIO-631 or PRIO-632 to inform which data is not allocated.

#### PRIO-631 WARN "IN: address (%d - %d)"

Cause :PRIO-631 appears with PRIO-630 to inform which data is not allocated.

Remedy: The first number is the start address of the input data from a PROFINET I/O module to the robot. The second number is the last address of the data. Check the configuration in the robot controller.

#### PRIO-632 WARN "OUT: address (%d - %d)"

Cause :PRIO-632 appears with PRIO-630 to inform which data is not allocated.

Remedy: The first number is the start address of the output data from the robot to a PROFINET I/O module. The second number is the last address of the data. Check the configuration in the robot controller.

#### PRIO-633 STOP "PNIO: Updating Firmware"

Cause: Firmware update of PROFINET board has started.

Remedy: Wait until firmware update is completed. Never turn off the robot controller during the download, otherwise the firmware might be erased and PROFINET board is not operational until it is recovered. In such case, please refer to Appendix A.4 for the procedure of recovery.

#### PRIO-634 STOP "PNIO: FW. updated"

Cause :Firmware update of PROFINET board has completed successfully.

Remedy: Cold start the robot controller.

### PRIO-635 STOP "PNIO: FW. update failed"

Cause: Firmware update of PROFINET board has failed.

Remedy: Download can be retried. In case the firmware is erased, please refer to Appendix A.4 for the procedure of recovery.

#### PRIO-636 STOP "PNIO: XDB downloaded"

Cause :XDB project file is downloaded to PROFINET board.

Remedy: This is just an information

## PRIO-637 STOP "PNIO: Can't open file"

Cause :The specified file can't be opened.

Remedy: Make sure the file name with device path (such as MC:) is correct.

#### PRIO-638 STOP "PNIO: Not enough memory"

Cause: There is not enough memory in COMM processor for this operation.

Remedy: Please contact FANUC.

#### PRIO-639 WARN "PNIO: Unsupported feature"

Cause : Configuration of unsupported feature is found.

Remedy: Please see the cause code to know what is not supported. Change the configuration by remote configuration tool.

### PRIO-640 WARN "IOPS=bad:api %x,st %d, %d,%d"

Cause :I/O producer status of the specified module of PROFINET I/O has turned to BAD. The figures in the message are API number, station number, slot number, and subslot number.

Remedy: Check the specified module.

#### PRIO-641 WARN "IOPS=good:api %x,st %d, %d,%d"

Cause :I/O producer status of the specified module of PROFINET I/O has turned to GOOD. The figures in the message are API number, station number, slot number, and subslot number.

Remedy: This is only notification of recovery.

#### PRIO-642 WARN "Alarm %x:api %x,st %d, %d,%d"

Cause :An alarm indication of PROFINET I/O has come. The figures in the message are alarm

type, API number, station number, slot number, and subslot number.

Remedy: Check the alarm data of the specified module.

#### PRIO-643 WARN "PNIO(C) station %d activated"

Cause: The device specified by the alarm message is activated.

Remedy: This is just notification.

## PRIO-644 WARN "PNIO msg too long ch=%d(%d/%d)"

Cause :The length of a PROFINET message from PROFINET board exceeds the limit.

Remedy: Check if the limit parameter is adequate. Locate the event that causes this alarm.

#### PRIO-645 WARN "PNIO: many unread alarm ind."

Cause :The number of unread alarm indication gets too large. Alarm indication interface function is enabled but probably there is no KAREL program that reads it out. Alarm indication should be read out because it uses memory while it is kept unread.

Remedy: Disable alarm indication interface function by setting bit2,3 of \$PNIO\_CFG2.\$USHORT4 to 0. For example, if \$PNIO\_CFG2.\$USHORT is 63 (0x3F), set 51 (0x33). Cycle power is needed to apply the change. Or create a KAREL program that reads out alarm indication. Please refer to Appendix A for more details.

#### PRIO-646 WARN "IOCS=bad:api %x,st %d, %d,%d"

Cause :I/O consumer status of the specified module of PROFINET I/O has turned to BAD. The figures in the message are API number, station number, slot number, and subslot number.

Remedy: Check the specified module.

#### PRIO-647 WARN "IOCS=good:api %x,st %d, %d,%d"

Cause :I/O consumer status of the specified module of PROFINET I/O has turned to GOOD.

The figures in the message are API number, station number, slot number, and subslot

number.

Remedy: This is only notification of recovery.

#### PRIO-648 STOP "PNIO(C) Too many devices"

Cause :Too many devices exist in PROFINET project.

Remedy: Decrease the number of stations, I/O modules and interface modules.

## 6.2 INFORMATION ABOUT I/O CONTROLLER

When I/O Controller function is used, READ IN is done to read in the network configuration after downloading the project to PROFINET board firmware. Then the order of modules in network configuration read in by the first READ IN and those of the following READ IN may differ.

If the robot software version is V7.50P01-22, V7.63P01-08, V7.70P01-29 or V8.10P01-06, the robot software is affected by this, therefore it is required to cycle power the robot controller after the first READ IN to do the second READ IN at next power on.

If the start up mode is changed to OPERATION after the first READ IN (without the required cycle power), the following problem may occur.

- 1. The enable/disable status of device is not recovered correctly at HOT start.

  The station disabled before power off gets to enable, and another station gets to disable.
- 2. The comment of module where alarm indication comes from is not displayed correctly. The comment of other module may be displayed.

The same problem may occur when PROFINET board is changed, or PNIO.SV is restored.

To know if the condition of the problem occur is true or not, compare the order of modules in the setup configuration list screen (refer to 3.4.4) with that in the status module list screen (refer to 4.1). If they don't match, the problem may occur. As a workaround of the problem, please follow the procedure below to do READ IN again.

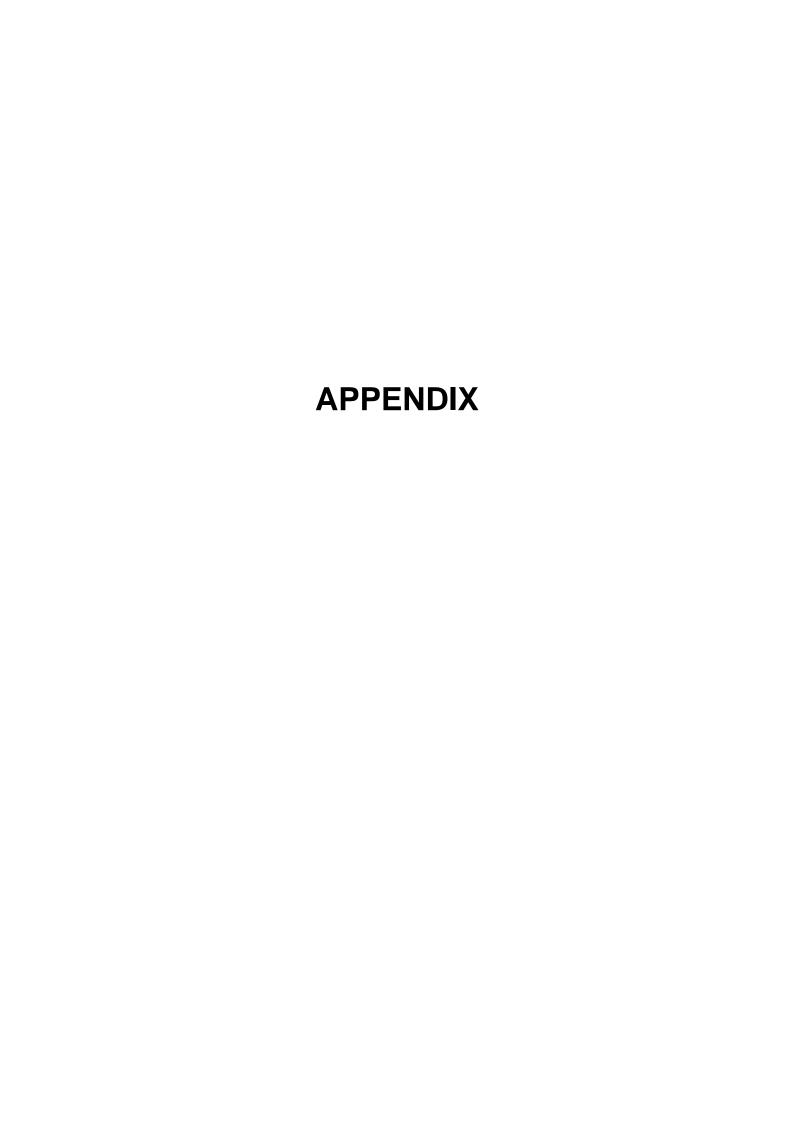
#### **Procedure 6.2: Retry of READ IN**

1. Write down the comment of modules in the setup configuration list screen.

#### NOTE

The comment of modules is erased when the network configuration is read in. To recover the comment, please write it down before changing start up mode to READ IN.

- 2. Change the start up mode to READ IN in the setup general screen, and then cycle power the robot controller.
- 3. Change the start up mode to OPERATION in the setup general screen, and then cycle power the robot controller.
- 4. Verify that the order of modules in the setup configuration list screen and that in the status module list screen match.
- 5. Restore the comments that were written down.





## **ADVANCED FEATURES**

## A.1 OVERVIEW

## A.1.1 Important Notice

Important information about advanced features are listed here, please read them at first.

#### **NOTE**

Alarm indication interface (refer to Appendix A.3) function needs a KAREL program that reads out alarm indication. Customer must make the KAREL program by themselves. This function must be disabled if the KAREL program doesn't exist (refer to Appendix A.1.2). Otherwise, alarm indication uses memory while it is kept unread. PRIO-645 warns this status. This function is disabled by default in V7.70P26 or later, and R-30*i*B.

#### NOTE

A part of new alarms show up just for event notification. If this is not desirable, suppress the alarms by system variables. Please refer to Appendix A.1.2 for more detail.

#### **NOTE**

For PROFINET safety function, the firmware version of PROFINET board must be V2.5.2 or later in R-30*i*A, the firmware version must be V2.5.2.2(1) or later in R-30*i*B.

#### NOTE

For PROFINET safety function in R-30*i*B, PROFINET board (CP1604) must be used.

## A.1.2 System Variables

There are system variables that control advanced features. Each bit corresponds to a function of an advanced feature. If the bit is set (1), the feature is enabled. If the bit is not set (0), the feature is disabled.

Example)

If the bit 0, 1, 4, 5 are ON, the value is 1+2+16+32 = 51.

#### \$PNIO\_CFG2.\$USHORT4

Bit	Dec	Meaning	Refer to	
0	1	IOPS monitoring enable (GOOD->BAD)	A.2.2	
1	2	IOPS monitoring enable (BAD->GOOD)	· · ·	
		This bit is considered only when the bit 0 is ON.		
2	4	Alarm indication interface for diagnostic alarm/disappear	A.3	
3	8	Alarm indication interface for other alarm/disappear	A.3	
		This bit is considered only when the bit 2 is ON.		
4	16	IOCS monitoring for output device (GOOD->BAD)	A.2.2	

Bit	Dec	Meaning	Refer to
5	32	OCS monitoring for output device (BAD->GOOD) A.2.2	
		This bit is considered only when the bit 4 is ON.	
6-15	-	Reserved (usually these bits should be OFF)	

#### \$PNIO CFG2.\$USHORT5

Bit	Dec	Meaning	Refer to
0	1	Device return notification	A.2.3
1	2	Device return notification by switching function A.2.3	
		This bit is considered only when the bit 0 is ON.	
2-15	-	Reserved (usually these bits should be OFF)	

## A.2 IMPROVED ERROR MESSAGE

## A.2.1 Detailed Alarm Indication

#### **EXPLANATION**

This function is for I/O Controller function. While I/O Controller function exchanges process data with I/O Devices in its configuration list, an alarm may occurs in some of the I/O Devices. I/O Controller function receives alarm indication from the I/O Device via PROFINET board. I/O Controller displays the alarm type and the location by new alarm PRIO-642.

#### REQUIREMENTS

The software version is V7.70P22 or later, and R-30iB.

#### **FUNCTION**

New alarm PRIO-642 shows the alarm type and the location of alarm indication from I/O Device. The figures in the message are alarm type, API number, station number, slot number, and subslot number.

PRIO-642 WARN "Alarm %x:api %x,st %d, %d,%d"

If the alarm is belong to a subslot, the comment strings of the subslot is displayed together. If not, the comment strings of the station is displayed instead.

#### **NOTE**

For the coding of alarm type, please refer to table 387 in page 10463 of "Technical Specification for PROFINET Version2.3 – Date October 2010 OrderNo.: 2.722".

## A.2.2 Monitoring IOCS/IOPS

#### **EXPLANATION**

This function is for I/O Controller function. I/O Controller function receives the I/O consumer/producer status of process data from I/O Device. New alarms, PRIO-640, PRIO-641, PRIO-646, and PRIO-647, show up when the status changes.

#### **REQUIREMENTS**

The software version is V7.70P22 or later, and R-30*i*B.

#### **FUNCTION**

I/O Controller function monitors I/O producer status (IOPS) of DI module. When it changes from GOOD to BAD, PRIO-640 shows up. On the other hand, when it changes from BAD to GOOD, PRIO-641 shows up. The figures in the message are API number, station number, slot number, and subslot number. Each of these monitoring can be enabled or disabled by the system variable (refer to Appendix A.1.2).

PRIO-640 WARN "IOPS=bad:api %x,st %d, %d,%d" PRIO-641 WARN "IOPS=good:api %x,st %d, %d,%d"

When the reset button is pressed, PRIO-640 is displayed again if IOPS is still BAD. PRIO-640 will be displayed if an input module with IOPS=BAD is attached. PRIO-641 doesn't appear again by pressing reset button. PRIO-641 doesn't show up if an input module with IOPS=GOOD is attached because IOPS=GOOD is expected.

I/O Controller function monitors I/O consumer status (IOCS) of DO module. When it changes from GOOD to BAD, PRIO-646 shows up. On the other hand, when it changes from BAD to GOOD, PRIO-647 shows up. The figures in the message are API number, station number, slot number, and subslot number. Each of these monitoring can be enabled or disabled by the system variable (refer to Appendix A.1.2).

PRIO-646 WARN "IOCS=bad:api %x,st %d, %d,%d" PRIO-647 WARN "IOCS=good:api %x,st %d, %d,%d"

When the reset button is pressed, PRIO-646 is displayed again if IOCS is still BAD. PRIO-646 will be displayed if an output module with IOCS=BAD is attached. PRIO-647 doesn't appear again by pressing reset button. PRIO-647 doesn't show up if an output module with IOCS=GOOD is attached because IOCS=GOOD is expected.

### A.2.3 Device Return Notification

#### **EXPLANATION**

This function is for I/O Controller function. I/O Controller function posts new PRIO-643 alarm when a station is activated. KAREL program, for example, can monitor PRIO-643 to know the station is activated.

#### REQUIREMENTS

The software version is V7.70P22 or later, and R-30*i*B.

#### **FUNCTION**

I/O Controller function posts new PRIO-643 alarm when a station is activated. The figure in the error message is the station number. PRIO-643 doesn't show up at all when the bit 0 of \$PNIO\_CFG2.\$USHORT5 is 0. PRIO-643 doesn't show up by execution of PNIO attach TP instruction when the bit 1 of \$PNIO CFG2.\$USHORT5 is 0. Please refer to Appendix A.1.2.

PRIO-643 WARN "PNIO(C) station %d activated"

## A.3 ALARM INDICATION INTERFACE

#### **EXPLANATION**

This function is for I/O Controller function. In addition to PRIO-642 (refer to Appendix A.2.1), this function provides KAREL program with the interface for reading out alarm indication for diagnostic purpose in the data format specified by PROFINET specification. This function requires a user KAREL

program that monitors alarm indication and reads out it by KAREL variable. If the user KAREL program is not made, this function should be disabled (refer to Appendix A.1.2).

#### REQUIREMENTS

The software version is V7.70P22 or later, and R-30*i*B. This function needs a KAREL program that reads out alarm indication, which is created by customer.

#### **FUNCTION**

PRIO-642 shows up when I/O Controller function receives an alarm indication from an I/O Device. Then the diagnostic data in alarm indication is stored to the memory of the robot controller. It can be read via KAREL variable named PNIOALM.VR, which can be displayed in Data screen. The diagnostic data is queued (FIFO), and can be read one by one. The following KAREL variables are used as the interface to a user KAREL program.

Table A.3 The KAREL variable of PNIOALM.VR

Name	Meaning and function	
\$NUM_DIAG	The number of alarm indications that have not been read out.	
\$READ	This item makes the user KAREL program aware of alarm indication.	
	0: No alarm indication is made.	
	1: An alarm indication is made, and its data is copied to \$DATA.	
	2: The user KAREL program sets \$READ=2 after processing the alarm indication. The	
	next alarm indication is read out from the queue if it is present.	
\$LENGTH	The data length of the alarm indication in \$DATA.	
\$TYPE	The alarm type of the alarm indication.	
	Please refer to table 387 in page 10463 of "Technical Specification for PROFINET	
	Version2.3 – Date October 2010 OrderNo.: 2.722".	
\$API	The API of the module of the I/O Device.	
\$STATION	The station number of the module of the I/O Device.	
\$SLOT	The slot number of the module of the I/O Device.	
\$SUBSLOT	The subslot number of the module of the I/O Device.	
\$SPEC	This item is valid when \$TYPE=1 (diagnosis).	
	This is the value of the alarm specifier that indicates which type of diagnostic data is	
	present. Please refer to table 388-392 in the page 10463-10466 of "Technical	
	Specification for PROFINET Version2.3 – Date October 2010 OrderNo.: 2.722".	
\$USI	This item is valid when \$TYPE=1 (diagnosis).	
	This is the value of the user structure identifier that indicates which type of diagnostic	
	structure follows. Please refer to table 512 in the page 10522 of "Technical Specification"	
	for PROFINET Version2.3 – Date October 2010 OrderNo.: 2.722".	
\$DATA	The diagnostic data in the alarm indication. The data format is defined by the PROFINET	
	normative. Please refer to DiagnosisItem in Table 383 in the page 10442, and	
	ChannelDiagnosisData, ExtChannelDiagnosisData, QualifiedChannelDiagnosisData, and	
	MaintenanceItem in the page 10450 of "Technical Specification for PROFINET Version2.3	
	- Date October 2010 OrderNo.: 2.722".	
	\$DATA is erased when no alarm indication is made.	
	The use of \$DATA is up to a user KAREL program, for example, the KAREL program may	
	decode \$DATA to monitor if a specific error is present, or if Maintenance	
	Required/Demanded bit is ON or OFF.	

The user KAREL program checks \$READ periodically. \$READ is 0 as long as no alarm indication is made. \$READ gets to 1 when an alarm indication is made. The content of the alarm indication has been copied to other variables of PNIOALM.VR.

The user KAREL program can read these variables. The user KAREL program is supposed to set \$READ to 2 when it has finished reading these variables. As long as \$READ is 1, these variables are not overwritten by next alarm indication. If next alarm indication comes when \$READ is 1, it is stored in memory of the robot controller and \$NUM\_DIAG is incremented by 1.

When the user KAREL program changes \$READ to 2, \$READ gets to 0 if there is no next alarm indication at present. Otherwise, \$READ gets to 1, \$NUM\_DIAG is decremented by 1, and the content of next of next alarm indication has been copied to the variables of PNIOALM.VR.

## A.4 DOWNLOAD SCREEN AT CONTROLLED START

#### **EXPLANATION**

PROFINET download screen (only available at controlled start) provides the download function of XDB file and PROFINET board firmware from the device (such as MC:) instead of direct downloading from PC. XDB file is used for I/O controller function.

#### REQUIREMENTS

The software version is V7.70P22 or later, and R-30*i*B. Start up mode should be changed to READ IN after downloading XDB file to read in the network configuration of I/O Controller function.

#### **FUNCTION**

PROFINET download screen is available only at controlled start (MENU->Next page->Next page->1. PROFINET). The file to be downloaded must be transferred to the device before downloading. Please refer to the procedure A.4.1, A.4.2 and A.4.3.

Setup PROFINET IO	JOINT 10 %
Download	1/4
Download XDB file     XDB file are as a second and a second are as a second are a second ar	
XDB file name 2. [ MC:pcst_1.xdb	1
3. Download firmware	1
Firmware file name	
4. [ MC:fw16xx-2.5.0.0.19.fwl	]
[ TYPE ]	

Fig. A.4 Download screen

Table A.4 Download screen items

#	Item	Adjustable	Description	
		values		
1	Download XDB file	None	Press Enter here to start XDB download.	
2	XDB file name	String	The name of XDB file with device path.	
3	Download firmware	None	Press Enter here to start firmware download.	
4	Firmware file name	String	The name of firmware file with device path.	

#### Procedure A.4.1: Download of XDB file

To download XDB project file, please follow the procedure below.

1. Set the start up mode to SUSPEND or READ IN before controlled start.

#### NOTE

The comment of modules is erased when the network configuration is read in. To recover the comment, please write it down before changing start up mode to READ IN.

- 2. Open the setup PROFINET donwload screen. Check the XDB file name displayed in the screen. If the file name is not equal to the XDB file to be downloaded, change the file name. The file name must be specified with device path.
- 3. Move cursor to "Download XDB file", and press Enter.
- 4. Dialogue with a message like "This operation may take 2 minutes" shows up. Answer "Yes" to proceed.
- 5. Wait for the completion of download. Don't turn off the robot controller during the download.
- 6. The result of download shows up in the screen when download has finished or failed.
- 7. Change the start up mode to READ IN after cold start to read in the network configuration of I/O Controller function. Cycle power the robot controller after changing start up mode to READ IN if the robot software version is V7.50P01-22, V7.63P01-08, V7.70P01-29 or V8.10P01-06. Refer to 6.2 for more detail.

#### Procedure A.4.2: Download of firmware

To download firmware, please follow the procedure below.

- 1. Open the setup PROFINET donwload screen. Check the firmware file name displayed in the screen. If the file name is not equal to the firmware file to be download, change the file name. The file name must be specified with device path.
- 2. Move cursor to "Download firmware", and press Enter.
- 3. Dialogue with a message like "This operation may take 7 minutes" shows up. Answer "Yes" to proceed.
- 4. Wait for the completion of download. Never turn off the robot controller during the download, otherwise firmware in PROFINET board might be erased, and PROFINET board is no longer operational until firmware is not recovered.
- 5. The result of download shows up in the screen when download has finished or failed.
- 6. Cold start the robot controller.

#### **NOTE**

If the external power supply of PROFINET board is connected, remove it before cold start and connect it again after power up.

#### Procedure A.4.3 : Recovery in case the firmware of PROFINET board is erased

In case of the failure of firmware download by a corrupted firmware file, or the robot controller is turned off during firmware download, the firmware of PROFINET board might be erased. Then the PROFINET board is no longer operational until the firmware is recovered. To recover the firmware, prepare the firmware that can be downloaded successfully, and follow the procedure below. The firmware download can be tried again after firmware recovery.

- 1. Set \$PNIO\_DL.\$NO\_FIRM\_ST to 1. Please note that the system variable will return to 0 at next start up of the robot controller.
- 2. Perform "Controlled Start" of the robot controller.
- 3. Open the setup PROFINET download screen (MENU->Next page->Next page->1. PROFINET), and follow the procedure A.4.2 to download the firmware. Please note that PROFINET board is not operational until firmware is downloaded, for example, downloading of XDB file would fail.

## A.5 I/O ROUTER

#### **EXPLANATION**

This function can be used when both I/O Device and I/O Controller are enabled. The process data of I/O Controller function can be referred from I/O Device function. In short, PLC in upper network can read the process data of an I/O Device in the lower network. This is I/O Router function of PROFINET board. For the detailed information about I/O Router function, please refer to the chapter 4. "I/O Routing" of

"CP1604/CP1616 Operating Instructions" 10/2011 (available from Siemens). Among the type of I/O routing, reading module-oriented and writing module-oriented are supported, but writing bit-oriented is not supported.

#### REQUIREMENTS

The software version is V7.70P22 or later, and R-30*i*B. The configuration software of Siemens must be STEP7 V5.5 or later, and the update for "I/O device coupling with I/O devices of third-party vendor" (available from Siemens) must be applied.

#### **FUNCTION**

This function is configured by STEP7 Siemens configuration software. Transfer modules (DI or DO) are used instead of standard I/O modules. Please see the Migration data access point section of the GSDML file for robot by FANUC about the supported transfer modules. The setup PROFINET module list/detail screen setting procedure is the same as standard I/O modules.

## A.6 PROFINET SAFETY

#### **EXPLANATION**

This function is for I/O Device function. PROFINET Safety is another software option that provides the functionality of PROFINET Safety F-Device function of PROFIsafe V2. This manual only writes about the requirement and the title of document that should be referred to. The GSDML file for robot by FANUC defines the supported safety modules.

#### REQUIREMENTS

The software version is V7.70P22 or later, and R-30*i*B. PROFINET Safety option is ordered. The firmware version of PROFINET board must be V2.5.2 or later in R-30*i*A, the firmware version must be V2.5.2.2(1) or later in R-30*i*B. The configuration software of Siemens must be STEP7 V5.5 or later. The GSDML file for robot by FANUC is used. For R-30*i*B, PROFINET board (CP1604) must be used.

#### NOTE

For PROFINET Safety function that exchanges safety signals on PROFINET I/O Device, please read "R-30*i*A/R-30*i*A Mate controller Dual Check Safety Function (ISO 13849-1:2006 compliant) operator's manual (B-83104EN)" or "R-30*i*B controller Dual Check Safety Function operator's manual (B-83184EN) in addition to this manual.

# B I/O DEVICE SETUP BY GSDML

## **B.1** OVERVIEW

This chapter provides an example of how to sett up I/O Device function of the robot controller by using the GSDML file for robot provided by FANUC. In this example, the robot controller is R-30*i*A, and the robot software version is V7.70P22. I/O Device is enabled but I/O Controller is disabled. The I/O size is DI 128 (16Bytes) and DO 128 (16Bytes). The GSDML file name is GSDML-V2.25-Fanuc-J930-20120113.xml. The PROFINET board is CP1616. The configuration tool is STEP7 V5.5.

#### **NOTE**

The procedure written in this chapter is only an example. It focuses on the way of setting. The operator must read the manual of the configuration tool for actual operation.

## **B.2** SETUP PROCEDURE IN TP SCREENS

## **B.2.1** Removing I/O Controller I/O Assignment

By default, the input/output size of I/O Controller is defined, and DIO and AIO are assigned by these values (if \$IO\_AUTO\_CFG is true). If I/O Controller is disabled, these DIO and AIO are not used at all. If necessary, remove these setting by the following operation.

1. Go to setup I/O Controller screen. Set 0 to "Number of digital input/output", and "Number of analog input/output". Please refer to 3.4.2.

Setup PRO	FINET IO	JOINT 10 %
I/O Controlle	er	1/5
1. Error one shot :		DISABLED
2. Number o	f digital input :	0
3. Number o	f digital output :	0
4. Number o	f analog input :	0
5. Number o	f analog output :	0
6. Digital input offset address:		0
7. Digital output offset address:		0
8. Analog input offset address:		512
9. Analog output offset address:		512
[TYPE]	[Other] arc analog	>
		CLR_ASG

2. Go to digital/analog I/O screen, and press F2 CONFIG to display the assignment. Search the I/O assignment of PROFINET by the rack and slot number in the table below to delete the I/O signals for I/O Controller. Please cycle power the robot controller to enable changes.

Function	Rack	Slot
PROFINET I/O Controller	99	1

## B.2.2 Setup I/O Device Modules Based on GSDML

As described in 3.4.3, the robot controller as PROFINET I/O Device is composed of up to 17 modules. The parameters of each module must be entered one by one in setup module list/detail screens. This example aims to show which information in the GSDML file is used, and how to enter the parameters in the screens.

Please open GSDML-V2.25-Fanuc-J930-20120113.xml by PROFINET XML-Viewer. Information of modules is written in the GSDML file. The following values are to be entered in module detail screen.

Item name	Property name in GSDML file (use PROFINET-XML viewer to open the file)
ModId	Module Ident Number
SubslotId	Submodule Ident Number

There are definitions of data access point modules in the GSDML file. First of all, it is necessary to decide which device access point is used. Select device access point by the firmware version, and whether it has migration subcategory. To use V2.5 firmware as only I/O Device in this example, use CP1616 V2.5 without migration subcategory.

Device Access Point ID=DAP 17: V2.5		
Module Ident Number	0x00000017	
Category	CP1616PS	
Software Version	V2.5	
Submodule Ident Number	0x00010001	

#### **NOTE**

The module in slot = 0 must be device access point. Choose the device access point without "Migration" subcategory when only I/O Device is enabled in the robot controller. Choose the device access point with "Migration" subcategory when both of I/O Controller and I/O Device are enabled in the robot controller.

Usable modules are listed in data access point section. There are links to the I/O module property. For example, 16 bytes modules are the following.

Module ID=ID_Mod_07: 16bytes		
Module Ident Number	0x00000026	
Category	DI/DO	
Submodule Ident Number	0x0001	

Module ID=ID_Mod_08: 16bytes		
Module Ident Number	0x00000027	
Category	DI	
Submodule Ident Number	0x0001	

Module ID=ID_Mod_09: 16bytes		
Module Ident Number	0x00000028	
Category	DO	
Submodule Ident Number	0x0001	

In this example, there is one 16 bytes DI module and one 16 bytes DO module. The parameters of these modules are entered by the procedure like below.

1 Move cursor to No. 0 in Module list screen, and press F2 detail to enter detail screen.

Se	tup P	RO	FINET IO		JOINT	10 %	
	I/O Device : Modules 1/17			/17			
No	Slot S	Sub	Comment				
0	0	1	[CP1616 V2.5				]
1	1	1	[				]
2	2	1	[				]
3	0	0	[				]
4	0	0	[				]
5	0	0	[				]
6	0	0	[				]
7	0	0	[				]
8	0	0	[				]
9	0	0	[				]
[ TYF	PE]		detail	[Other]		>	
		DE	L_ALL				

Enter the values as follows by decimal number for data access point module. Slot 0, Subslot 1, ModId 23 (=0x17), SubslotId 65537 (=0x00010001)

Device Access Point ID=DAP 17: V2.5		
Module Ident Number	0x00000017	
Category	CP1616PS	
Software Version	V2.5	
Submodule Ident Number	0x00010001	

Please note that ModId is displayed by hexadecimal number but the value must be specified by the decimal number (0x17 = 16 x 1 + 7 = 23) in setting the value. Please check the displayed value becomes 0x00000017 after pressing enter key.

Setup PROFINE	T IO		IOL	NT 10 %	
I/O Device : Mod					1/6
1. Slot :					1
2. Subslot : Comment :					1
3. [			]		
4. Modld(hex):	4. Modld(hex) :			0x00000	017
5. SubslotId(hex)	5. SubslotId(hex) :			0x00010	001
Module I/O type :				NO	ONE
6. Data size :	• •			[	]
7. Data type :				[	]
[TYPE]	list	prev	next		

- Press F4 next, to go to the detail screen of the next module.
- 4 Enter the values as follows for 16 bytes DI module.

Slot 1, Subslot 1, ModId 39 (=0x27), SubslotId 1

Module ID=ID_Mod_08: 16bytes		
Module Ident Number	0x00000027	
Category	DI	
Submodule Ident Number 0x0001		

When 39 set is to ModId, and the displayed value becomes 0x00000027.

- 5 Press F4 next, to go to the detail screen of the next module.
- Enter the values as follows for 16 bytes DO module. Slot 2, Subslot 1, ModId 40 (=0x28), SubslotId 1

Module ID=ID_Mod_09: 16bytes		
Module Ident Number	0x00000028	
Category	DO	
Submodule Ident Number	0x0001	

When 40 set is to ModId, and the displayed value becomes 0x00000028.

Press "PREV" twice to return "Setup I/O Device screen". The total number of digital for I/O Device has been changed. Number of digital input/output will be 128.

Setup PROFIN	IET IO	JOINT 10 %
I/O Device		1/2
1. Error one sho	ot:	DISABLED
2. Modules		<detail></detail>
3. Number of di	gital inputs :	128
4. Number of di	gital outputs :	128
5. Number of ar	nalog inputs :	0
6. Number of ar	nalog outputs :	0
[TYPE]	[Other]	>
		CLR_ASG

#### **NOTE**

By default, the first 18 digital inputs and 20 digital outputs of PROFINET I/O Device are assigned to UOP (UI/UO) if there are enough digital inputs/outputs and UOP auto assignment is enabled.

8 To enable changes, cycle power the robot controller.

## **B.3** SETUP PROCEDURE ON CONFIGURATION SOFTWARE

STEP7 project must be created to configure PLC to communicate with the robot controller (I/O Device). The outline of how to create a project and download it to PLC is explained here. In this example, PLC is SIMATIC S7-300 (PS-307 5A, CPU317F-2PN/DP V2.6 without any I/O modules), and default names are used to refer objects.

#### Procedure B.3.3 (a): Creating a project

- a. Start "SIMATIC Manager" from start menu, for example.
- b. Open "File" tool bar and select "New".
- c. Enter Project Name. Press OK.
- d. Right Click the project window.
- e. Insert New Object->Industrial Ethernet. The default name is Ethernet(1).
- f. Insert New Object->SIMATIC 300 Station. The default name is SIMATIC 300(1).

#### Procedure B.3.3 (b): Enter PLC Configuration

- a. Click "SIMATIC 300(1)" icon under the project icon in the project window (left pane).
- b. Double click "Hardware" in the project window (right pane).
- c. HW Config window will show up.
- d. There is a list in the right pane of HW Config window. Move there and search

SIMATIC 300->Rack-300->Rail and double click it, then small window with many slots appears.

e. Select slot1. Double click the following in the list in the right pane of HW Config window. SIMATIC 300->PS-300->PS 307 5A (for example).

(You have to choose correct PS module instead of 5A.)

- f. Select slot2. Double click the following.
  - SIMATIC 300->CPU317->CPU317F-2PN/DP->6ES7-2FK13-0AB0->V2.6 (for example)

(You have to choose correct CPU module instead of that in the example.)

- g. New window appears. Enter IP address and subnet mask of PLC. Select "Ethernet(1)" as subnet. Press OK. The window is closed.
- h. In this example, all modules has been added. Open "Station" tool bar, and select "Save and Compile". Some questions may appear. Answer them properly.

#### Procedure B.3.3 (c): Install GSDML file of FANUC robot

- a. Open "Option" tool bar of HW Config, and select "Install GSD File".
- b. Press "Browse" to select the folder where the GSDML file is stored.
- c. Select "GSDML-V2.25-Fanuc-J930-20120113.xml", and press "Install".
- d. Press "Yes" to proceed.
- e. The message "Installation was completed successfully" shows up.
- f. Finish STEP7 by closing all windows("SIMATIC Manager", "NetPro", "HW Config" etc).
- g. Start STEP7 again, and open the project.

#### Procedure B.3.3 (d): Connect the robot controller to PLC in the project

- a. Open SIMATIC Manager
- b. Click project in the left pane of SIMATIC Manager window.
- c. Double click "Ethernet(1)".
- d. NetPro window will show up.
- e. Click "PN-IO" in "SIMATIC 300(1)" to select it. (If you forgot doing "Save and Compile", PN-IO does not show up.)
- f. There is also a list in the right pane of NetPro window like HW Config window.

Select the following in the list, and double click it.

PROFINET I/O->Additional Field Device->I/O->FANUC Robot Controller->CP1616PS->6GK 161-6AA00->V2.5

(If you forgot selecting "PN-IO", error message will appear. Go back to step e and try again.)

- g. Robot icon will appear.
- h. Right click the robot and select "Object Properties".
- i. Enter device name. Set the device name you set in CP1616 beforehand.

Device name must match to that set to CP1616.

(For your information, the name of GSDML file is displayed under device name.)

- j. Select device number.
- k. Remove the check in "Assign IP address via IO Controller".
- 1. Open "Network" tool bar, and select "Save and Compile".

#### Procedure B.3.3 (e): Configure modules of robot controller

In this example, one 16 bytes DI module and one 16 bytes DO module are configured. The module configuration must match that in setup module screen of the robot controller.

- a. Double click robot icon in NetPro window.
- b. Select slot 1 of CP1616 in the left-side down window.
- c. Select the following in the list in the right pane of HW Config window, and double click it. PROFINET I/O->Additional Field Device->I/O->FANUC Robot Controller->CP1616PS->6GK 161-6AA00->V2.5->DI->16 bytes
- d. Select the following in the list in the right pane of HW Config window, and double click it.

PROFINET I/O-> Additional Field Device->I/O->FANUC Robot Controller->CP1616PS->6GK 161-6AA00->V2.5->DO->16 bytes

e. In this example, all modules has been added. Open "Station" tool bar, and select "Save and Compile". Some questions may appear. Answer them properly.

#### Procedure B.3.3 (f): Download the project to PLC

Be sure to set the start up mode of the robot controller to SUSPEND mode before downloading.

- a. Move to NetPro window.
- b. Select "SIMATIC 300(1)"
- c. Right click it, and select Download->Selected Stations.
- d. Dialogue may show up. Choose station to download. You don't have to change PLC to Run mode at this time.

#### **B.4** STARTING I/O DEVICE

The next step will start PROFINET I/O exchange if PROFINET board is configured properly by downloading the project. Please read the warning below for the safety of person and equipment.



#### **⚠ WARNING**

Changing start up mode from SUSPEND immediately takes effect, that is, PROFINET function of the robot controller starts immediately. Please verify the safety is assured and make sure if it is safe to start PROFINET I/O data exchange before changing the start up mode from SUSPEND.

Change start up mode from SUSPEND to READ IN. The robot controller tries to start I/O Device communication.



#### **⚠ WARNING**

Cycle power the robot controller after changing start up mode to READ IN if the robot software version is V7.50P01-22, V7.63P01-08, V7.70P01-29 or V8.10P01-06. Please refer to 6.2 for more detail.

If both of PLC and the robot controller are configured well, connection will be established when PLC is changed to RUN mode. Please make sure if no error is present, and I/O exchange is OK. If any error occurs, please check the parameters set in the robot controller and in STEP7 project match, or check device name of PROFINET board matches.

Change the start up mode to OPERATION after I/O exchange is verified. Please cycle power the robot controller after changing start up mode to OPERATION. The robot controller works as READ IN mode until next power up.

#### **B.5** MODULE INFORMATION FOR DATA ACCESS POINT

The information of modules written in the data access point section of the GSDML file is stored to the array of system variable \$PNIO\_DB. An element of the array corresponds to the module ID information for a PROFINET board (CP1604, CP1616) and with or without Migration subcategory. The initial value of \$PNIO\_DB from V7.70P22 is written here.

#### NOTE

The device access point without "Migration" subcategory is used when only I/O Device is enabled. The device access point with "Migration" subcategory is used when both of I/O Controller and I/O Device are enabled.

#### NOTE

The module ID of safety modules and transfer modules are not stored in any system variables.

#### NOTE

The module ID of DI/DO, DI and DO modules with more than 16bytes exist but are not used in V7.50P13 or before, and V7.70P21 or before.

### **Data Access Point for CP1604 V2.5 without Migration**

Table B.5 (a) Data Access Point for CP1604 V2.5 without Migration

Variable	Value	Description
\$PNIO_DB[1].\$BASE_MODID	24	Module ID of data access point
\$PNIO_DB[1].\$IO_MOD1	32	Module ID of DI/DO 1Byte
\$PNIO_DB[1].\$I_MOD1	33	Module ID of DO 1Byte
\$PNIO_DB[1].\$O_MOD1	34	Module ID of DI 1Byte
\$PNIO_DB[1].\$IO_MOD4	35	Module ID of DI/DO 4Bytes
\$PNIO_DB[1].\$I_MOD4	36	Module ID of DI 4Bytes
\$PNIO_DB[1].\$O_MOD4	37	Module ID of DO 4Bytes
\$PNIO_DB[1].\$IO_MOD16	38	Module ID of DI/DO 16Bytes
\$PNIO_DB[1].\$I_MOD16	39	Module ID of DI 16Bytes
\$PNIO_DB[1].\$O_MOD16	40	Module ID of DO 16Bytes
\$PNIO_DB[1].\$IO_MOD20	53	Module ID of DI/DO 32Bytes
\$PNIO_DB[1].\$I_MOD20	54	Module ID of DI 32Bytes
\$PNIO_DB[1].\$O_MOD20	55	Module ID of DO 32Bytes
\$PNIO_DB[1].\$IO_MOD64	41	Module ID of DI/DO 64Bytes
\$PNIO_DB[1].\$I_MOD64	48	Module ID of DI 64Bytes
\$PNIO_DB[1].\$O_MOD64	49	Module ID of DO 64Bytes
\$PNIO_DB[1].\$ULONG1	288	Module ID of DI/DO 128Bytes
\$PNIO_DB[1].\$ULONG2	289	Module ID of DI 128Bytes
\$PNIO_DB[1].\$ULONG3	290	Module ID of DO 128Bytes

#### Data Access Point for CP1604 V2.5 with Migration

Table B.5 (b) Data Access Point for CP1604 V2.5 with Migration

Variable	Value	Description
\$PNIO_DB[2].\$BASE_MODID	22	Module ID of data access point
\$PNIO_DB[2].\$IO_MOD1	32	Module ID of DI/DO 1Byte

Variable	Value	Description
\$PNIO_DB[2].\$I_MOD1	33	Module ID of DO 1Byte
\$PNIO_DB[2].\$O_MOD1	34	Module ID of DI 1Byte
\$PNIO_DB[2].\$IO_MOD4	35	Module ID of DI/DO 4Bytes
\$PNIO_DB[2].\$I_MOD4	36	Module ID of DI 4Bytes
\$PNIO_DB[2].\$O_MOD4	37	Module ID of DO 4Bytes
\$PNIO_DB[2].\$IO_MOD16	38	Module ID of DI/DO 16Bytes
\$PNIO_DB[2].\$I_MOD16	39	Module ID of DI 16Bytes
\$PNIO_DB[2].\$O_MOD16	40	Module ID of DO 16Bytes
\$PNIO_DB[2].\$IO_MOD20	53	Module ID of DI/DO 32Bytes
\$PNIO_DB[2].\$I_MOD20	54	Module ID of DI 32Bytes
\$PNIO_DB[2].\$O_MOD20	55	Module ID of DO 32Bytes
\$PNIO_DB[2].\$IO_MOD64	41	Module ID of DI/DO 64Bytes
\$PNIO_DB[2].\$I_MOD64	48	Module ID of DI 64Bytes
\$PNIO_DB[2].\$O_MOD64	49	Module ID of DO 64Bytes
\$PNIO_DB[2].\$ULONG1	288	Module ID of DI/DO 128Bytes
\$PNIO_DB[2].\$ULONG2	289	Module ID of DI 128Bytes
\$PNIO_DB[2].\$ULONG3	290	Module ID of DO 128Bytes

# Data Access Point for CP1616 V2.5 without Migration Table B.5 (c) Data Access Point for CP1616 V2.5 without Migration

Variable	Value	Description
\$PNIO_DB[3].\$BASE_MODID	23	Module ID of data access point
\$PNIO_DB[3].\$IO_MOD1	32	Module ID of DI/DO 1Byte
\$PNIO_DB[3].\$I_MOD1	33	Module ID of DO 1Byte
\$PNIO_DB[3].\$O_MOD1	34	Module ID of DI 1Byte
\$PNIO_DB[3].\$IO_MOD4	35	Module ID of DI/DO 4Bytes
\$PNIO_DB[3].\$I_MOD4	36	Module ID of DI 4Bytes
\$PNIO_DB[3].\$O_MOD4	37	Module ID of DO 4Bytes
\$PNIO_DB[3].\$IO_MOD16	38	Module ID of DI/DO 16Bytes
\$PNIO_DB[3].\$I_MOD16	39	Module ID of DI 16Bytes
\$PNIO_DB[3].\$O_MOD16	40	Module ID of DO 16Bytes
\$PNIO_DB[3].\$IO_MOD20	53	Module ID of DI/DO 32Bytes
\$PNIO_DB[3].\$I_MOD20	54	Module ID of DI 32Bytes
\$PNIO_DB[3].\$O_MOD20	55	Module ID of DO 32Bytes
\$PNIO_DB[3].\$IO_MOD64	41	Module ID of DI/DO 64Bytes
\$PNIO_DB[3].\$I_MOD64	48	Module ID of DI 64Bytes

Variable	Value	Description
\$PNIO_DB[3].\$O_MOD64	49	Module ID of DO 64Bytes
\$PNIO_DB[3].\$ULONG1	288	Module ID of DI/DO 128Bytes
\$PNIO_DB[3].\$ULONG2	289	Module ID of DI 128Bytes
\$PNIO_DB[3].\$ULONG3	290	Module ID of DO 128Bytes

# Data Access Point for CP1616 V2.5 with Migration Table B.5 (d) Data Access Point for CP1616 V2.5 with Migration

Variable	Value	Description
\$PNIO_DB[4].\$BASE_MODID	21	Module ID of data access point
\$PNIO_DB[4].\$IO_MOD1	32	Module ID of DI/DO 1Byte
\$PNIO_DB[4].\$I_MOD1	33	Module ID of DO 1Byte
\$PNIO_DB[4].\$O_MOD1	34	Module ID of DI 1Byte
\$PNIO_DB[4].\$IO_MOD4	35	Module ID of DI/DO 4Bytes
\$PNIO_DB[4].\$I_MOD4	36	Module ID of DI 4Bytes
\$PNIO_DB[4].\$O_MOD4	37	Module ID of DO 4Bytes
\$PNIO_DB[4].\$IO_MOD16	38	Module ID of DI/DO 16Bytes
\$PNIO_DB[4].\$I_MOD16	39	Module ID of DI 16Bytes
\$PNIO_DB[4].\$O_MOD16	40	Module ID of DO 16Bytes
\$PNIO_DB[4].\$IO_MOD20	53	Module ID of DI/DO 32Bytes
\$PNIO_DB[4].\$I_MOD20	54	Module ID of DI 32Bytes
\$PNIO_DB[4].\$O_MOD20	55	Module ID of DO 32Bytes
\$PNIO_DB[4].\$IO_MOD64	41	Module ID of DI/DO 64Bytes
\$PNIO_DB[4].\$I_MOD64	48	Module ID of DI 64Bytes
\$PNIO_DB[4].\$O_MOD64	49	Module ID of DO 64Bytes
\$PNIO_DB[4].\$ULONG1	288	Module ID of DI/DO 128Bytes
\$PNIO_DB[4].\$ULONG2	289	Module ID of DI 128Bytes
\$PNIO_DB[4].\$ULONG3	290	Module ID of DO 128Bytes

# C ROBOT SOFTWARE UPDATE

## C.1 OVERVIEW

This chapter is applicable for R-30*i*A. PROFINET I/O function was greatly changed for PROFINET conformance in V7.70P22, and I/O Device identification, such as vendor ID and device ID, was also changed. This is an improvement but it might bring a problem when the robot software with PROFINET function is updated from V7.70P01-21 to V7.70P22 or later. For example,

- When I/O Device is enabled, PLC identifies the robot controller as different I/O Device and doesn't start PROFINET I/O exchange because of the change of vendor ID and device ID.
- Restoring PNIO.SV after robot software update will overwrite the setting for V7.70P22 or later.

The user has two options. The one is using existing configuration as before and keeping the change by software update as small as possible. Please refer to Appendix C.2 for this option. Another option is doing configuration again for improved PROFINET function, and, if necessary, recovering the setting for V7.70P22 or later. Please refer to Appendix C.3 for this option. In addition to Appendix C.2 and Appendix C.3, please refer to Appendix C.4 for the system variables related to this topic.

As for the network configuration of I/O Controller, it must be read in again. Please see the following.

#### NOTE

The network configuration of I/O Controller is stored in the robot controller when the start up mode is OPERATION. It can be restored by PNIO.SV, however it must be discarded if the robot software is updated to V7.70P22 or later. Change the start up mode to READ IN and cycle power the robot controller. Then verify I/O Controller data exchange works before changing the start up mode to OPERATION.

#### NOTE

The comment of modules is erased when the network configuration is read in. To recover the comment, please write it down before changing start up mode to READ IN.

## C.2 USING EXISTING CONFIGURATION

The user may want to update the robot software, and expect that PROFINET function works as it is without any configuration change in PLC etc. Please use V7.70P25 or later in this case. This is possible for I/O Device function by using the same vendor ID and device ID before software update, however new features, such as PROFINET Safety and I/O Router cannot be used at all because these function needs the GSDML file for robot provided by FANUC. Even if this option is taken, the network configuration must be read in again for I/O Controller function.

#### NOTE

Please use V7.70P25 or later if legacy vendor ID and device ID must be used, for example, to solve compatibility problem, because V7.70P22-24 always use new vendor ID and device ID. Please refer to table 1.2.4 (e) for the values of vendor ID and device ID.

#### **Procedure C.2: Using existing configuration**

This procedure assumes that PROFINET function works before the software update, and start up mode is OPERATION. In addition, PNIO.SV before software update is supposed to be restored after software update.

- 1. Backup all files in File screen before update. Please write down the comment of modules in setup Config list screen to recover it because it is erased during this procedure.
- 2. Update the robot software.
- 3. After the software is updated, start up the robot controller by controlled start.
- 4. Restore PNIO.SV.
- 5. Change \$PNIO\_CFG.\$CUSTOM from 0 to 1 to use legacy vendor ID and device ID.
- 6. Change \$PNIO\_CFG.\$UBYTE18 from 0 to 1.
- 7. Change \$PNIO\_CFG.\$UBYTE19 from 0 to 152.
- 8. Change \$PNIO\_CFG.\$UBYTE20 from 0 to 3.
- 9. Cold start the robot controller.
- 10. If I/O Controller is installed, change the start up mode to READ IN, and cycle power the robot controller.
- 11. Verify PROFINET I/O data exchange.
- 12. Change the start up mode to OPERATION.

#### **↑** WARNING

Cycle power the robot controller after changing start up mode to READ IN if the robot software version is V7.50P01-22, V7.63P01-08, V7.70P01-29 or V8.10P01-06. Please refer to 6.2 for more detail.

#### NOTE

Restoring PNIO.SV before software update will change the internal database, and the module information of recent access point, however the information of recent access point is not used in using existing configuration.

## C.3 MAKING NEW CONFIGURATION

The user may want to update the robot software to V7.70P22 or later, and use improved PROFINET function. In this case, the GSDML file for robot by FANUC must be used. Therefore, when I/O Device is enabled, existing PLC configuration must be modified and downloaded to PLC. In addition, the module ID of data access point (slot 0, subslot 1) must be changed in setup module detail screen. Please refer to Appendix B for detailed procedure for I/O Device. If I/O Controller is enabled, the configuration for I/O Controller must be done by using the PC station with the PROFINET board and the firmware version, and downloaded to PROFINET board again. The network configuration of I/O Controller must be read in again.

#### NOTE

The firmware of PROFINET board must be updated to V2.5.2 or later.

#### **NOTE**

Use NCM/STEP7 V5.5 or later as configuration software for V2.5.2 firmware.

#### **NOTE**

The GSDML file for robot provided by FANUC is a third-party GSDML file. Siemens configuration tool may need the update for "I/O device coupling with I/O devices of third-party vendor" (available from Siemens) to configure I/O coupling of the robot (as a third-party I/O Device), and PC-Station (as an I/O Controller).

The user may want to restore PNIO.SV but this operation will override the information of recent data access point. Some system variables must be recovered by manual. Please see the procedure below.

#### Procedure C.3: Recovery of system variable for V7.70P22 or later

This procedure assumes that PNIO.SV before software update is supposed to be restored after software update. This procedure overrides the information of old data access point by V2.5 data access point.

- 1. Backup all files in File screen before update. Please write down the comment of modules in setup Config list screen to recover it because it is erased during this procedure.
- 2. Update the robot software.
- 3. After the software is updated, start up the robot controller by controlled start.
- 4. Restore PNIO.SV.
- 5. Change \$PNIO CFG.\$UBYTE18 from 0 to 1.
- 6. Change \$PNIO\_CFG.\$UBYTE19 from 0 to 152.
- 7. Change \$PNIO\_CFG.\$UBYTE20 from 0 to 3.
- 8. If I/O Contorller is enabled, refer to Appendix B.5 for the value of system variables for the data access point that must be recovered. Consider the type of PROFINET board etc. in selecting it.
- 9. Enter the values to \$PNIO\_DB[1] by manual. This will override old information.
- 10. Change \$PNIO\_CFG.\$START\_MODE to 0.
- 11. Cold start the robot controller.
- 12. Continue I/O Device and I/O Controller setting.

#### **↑** WARNING

Cycle power the robot controller after changing start up mode to READ IN if the robot software version is V7.50P01-22, V7.63P01-08, V7.70P01-29 or V8.10P01-06. Please refer to 6.2 for more detail.

## C.4 SYSTEM VARIABLES AND SOFTWARE UPDATE

## C.4.1 Compatibility Bit for Identification as I/O Device

\$PNIO\_CFG.\$CUSTOM is a 32-bit system variable. The bit 0 (1) of \$PNIO\_CFG.\$CUSTOM is used as a compatibility bit for vendor ID and device ID information in the software V7.70P25 or later. If the bit is OFF, vendor ID and device ID for the GSDML file for robot by FANUC are always used regardless of system variable. If the bit is ON, vendor ID and device ID can be changed by the following system variables.

Table C.4.1 System variable for vendor ID and device ID

Variable	Description	V7.70P21 or before	V7.70P22 or later
\$PNIO_CFG.\$DEV_VID	Vendor ID	42	439
\$PNIO_CFG.\$DEV_DID	Device ID	3	1

#### **NOTE**

Vendor ID and device ID must be equal to those of the GSDML file.

#### **NOTE**

PROFINET XML-viewer, which is available from Siemens, is useful to see the content of the GSDML file.

#### **NOTE**

Please use V7.70P25 or later if legacy vendor ID and device ID must be used, for example, to solve compatibility problem because V7.70P22-24 always use new vendor ID and device ID.

## C.4.2 I/O Device Module Database

\$PNIO\_DB is an array of system variable that stores module ID used by module list/detail screen. Each element stores the module ID of a data access point, and the module ID of DI/DO module of the data access point.

\$PNIO\_DB is saved to PNIO.SV. Restoring PNIO.SV after robot software update to V7.70P22 or later will override the recent database. If necessary, for example, to use the GSDML file for robot provided by FANUC, the value must be recovered by manual. The information of unused data access point can be overridden. Please refer to Appendix B.5 for the module information of data access point for CP1604 V2.5 and CP1616 V2.5.

## C.4.3 Other System Variables

Some system variables are internally used. The following system variables must be recovered by manual if PNIO.SV is restored after robot software update to V7.70P22 or later.

Table C.4.3 Other system variables to be recovered by manual

Tubic of the Curior Cyclom furnations to the received by manual		
Variable	Value	
\$PNIO_CFG.\$UBYTE18	1	
\$PNIO_CFG.\$UBYTE19	152	
\$PNIO_CFG.\$UBYTE20	3	

# **INDEX**

<a></a>	OVERVIEW1,47,54,63
ADVANCED FEATURES9,47	<p></p>
ALARM INDICATION INTERFACE49	PROFINET BOARD CP160410
Analog detail screen26	PROFINET BOARD CP161610
Analog list screen25	PROFINET Board Firmware3
Arc welding signal screen25	PROFINET SAFETY53
<c></c>	< <i>R</i> >
Compatibility Bit for Identification as I/O Device65	READ BEFORE ROBOT SOFTWARE UPDATE8
Configuration detail screen31	READ IN MODE
Configuration detail screen	Removing I/O Controller I/O Assignment54
<d></d>	REQUIERMENTS
Detailed Alarm Indication48	RESTRICTIONS8
Device Return Notification49	ROBOT SOFTWARE UPDATE
DEVICE SWITCHING TP INSTRUCTION37	10201 201 1 11112 0121112 1111111111111
DOWNLOAD OF PROJECT IN SUSPEND MODE33	<s></s>
DOWNLOAD SCREEN AT CONTROLLED START.51	SAFETY PRECAUTIONSs-1
	Selection of Network Interface Board16
<e></e>	Setting IP Address and Device Name17
ERROR CODES38	SETTING IP ADDRESS AND DEVICE NAME OF
	PROFINET BOARD16
<g></g>	Setup Configuration List Screen30
GSDML File6	Setup General Screen
.11.	Setup I/O Controller Screen23
<h>&gt;</h>	Setup I/O Device Modules Based on GSDML55
Hardware	Setup I/O Device Screen27
HARDWARE AND INSTALLATION10	SETUP PROCEDURE IN TP SCREENS54
< <i>l&gt;</i>	SETUP PROCEDURE ON CONFIGURATION
I/O DATA ASSIGNMENT9	SOFTWARE57
I/O Device Module Database	SETUP PROFINET I/O15
I/O DEVICE SETUP BY GSDML54	SETUP SCREENS
I/O ROUTER52	SIMATIC NCM PC Config
Important Notice47	SIMATIC NCM PC Manager
IMPROVED ERROR MESSAGE48	Software
INFORMATION ABOUT I/O CONTROLLER44	STARTING I/O DEVICE59 STATUS MODULE DETAIL SCREEN36
INTRODUCTION1,15	
	STATUS MODULE LIST SCREEN
< <i>M</i> >	System Variables
MAKING NEW CONFIGURATION64	SYSTEM VARIABLES AND SOFTWARE UPDATE 65
MAKING PROFINET PROJECT BY	STSTEM VARIABLES AND SOLT WARE OF DATE OF
CONFIGURATION TOOL18	<t></t>
Module Detail Screen29	THE SWITCH FUNCTION OF CP1604 WITH
MODULE INFORMATION FOR DATA ACCESS	EXTERNAL POWER SUPPLY13
POINT59	TROUBLESHOOTING38
Module list screen	
Monitoring IOCS/IOPS48	<u></u>
<n></n>	USING EXISTING CONFIGURATION63
NetPro21	
<0>	
OPERATION MODE34	
ORDER INFORMATION	
Other System Variables	

REVISION RECORD

# **REVISION RECORD**

Edition	Date	Contents
04	Oct, 2012	Revised as the manual for R-30 <i>i</i> A/R-30 <i>i</i> B controller.
		Appendix A, B, C are added.
03	Mar, 2012	Order information is updated.
		V2.5.2 firmware is supported.
02 Mar.	M 0040	V2.3.1 firmware is supported.
	Mar.,2010	The device switching status is recovered at HOT start.
01	Jan.,2008	

B-82864EN/04

\* B - 8 2 8 6 4 E N / 0 4 \*