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SECTION 1

INTRODUCTION

The Motoman UPJ and JRC controller represent state-of-the-art technology in robotics today. The Motoman UPJ has six individual axes: Sweep, Lower arm, Upper arm, Rotate, Bend, and Twist.

The JRC controller coordinates the operation of the UPJ robot with external equipment such as grippers, conveyors, positioning tables, etc. The JRC processes input and output signals, maintains variable data, and performs numeric processing to convert to and from different coordinate systems. Furthermore, it provides main logic functions, servo control, program and constant data memory, and power distribution. Please read this manual thoroughly to familiarize yourself with the many aspects of the UPJ robot and JRC controller.

Motoman supports several different vision systems for use with the JRC controller. The vision system documented in this manual may not be the one you received with your JRC system. Please refer to the vision documentation shipped with your system for maintenance and operation instructions.

1.1 About this Document

This manual provides system information for UPJ robot and JRC controller and contains the following sections:

SECTION 1 – INTRODUCTION
Provides general information about the structure of this manual, a list of reference documents, and customer service information.

SECTION 2 – SAFETY
Provides information regarding the safe use and operation of the UPJ robot.

SECTION 3 — UPJ INSTRUCTIONS
Provides detailed information about the UPJ robot, including installation, wiring, specifications, parts lists, and maintenance.

SECTION 4 — JRC BEGINNER’S GUIDE
This section provides general equipment set-up and guides the user through running the robot with the teach pendant.

SECTION 5 — JRC SET-UP MANUAL
Provides basic information about the installation, initial operation, and calibration of the UPJ robot and JRC controller.

SECTION 6 — JRC INSTALLATION AND MAINTENANCE GUIDE
Provides general information about the JRC controller including system setup, inspections, diagnosis, and configuration, as well as specifications, parts lists, and maintenance.

SECTION 7 — JRC ERROR CODES
Provides a detailed list of error codes that will appear on the teach pendant, operating panel, or PC screen if an error occurs. These tables include recovery instructions.

1.2 Reference to Other Documentation

For additional information refer to the following:

• Programmer’s Manual (P/N 146283-2 )
• WinCaps II Guide (P/N 146287-1 )
• Vendor manuals for system components not manufactured by Motoman.
1.3 **Customer Service Information**

If you are in need of technical assistance, contact the Motoman service staff at (937) 847-3200. Please have the following information ready before you call:

- Robot Type (UPJ, etc.)
- Application Type (assembly, handling, etc.)
- Software Version (5.101A, etc.)
- Robot Serial Number (located on the back side of the robot arm)
- Robot Sales Order Number (located on back side of JRC controller)
SECTION 2
SAFETY

2.1 Introduction

It is the purchaser's responsibility to ensure that all local, county, state, and national codes, regulations, rules, or laws relating to safety and safe operating conditions for each installation are met and followed.

We suggest that you obtain and review a copy of the ANSI/RIA National Safety Standard for Industrial Robots and Robot Systems. This information can be obtained from the Robotic Industries Association by requesting ANSI/RIA R15.06. The address is as follows:

Robotic Industries Association
900 Victors Way
P.O. Box 3724
Ann Arbor, Michigan 48106
TEL: (734) 994-6088
FAX: (734) 994-3338

Ultimately, the best safeguard is trained personnel. The user is responsible for providing personnel who are adequately trained to operate, program, and maintain the robot cell. The robot must not be operated by personnel who have not been trained!

We recommend that all personnel who intend to operate, program, repair, or use the robot system be trained in an approved Motoman training course and become familiar with the proper operation of the system.

This safety section addresses the following:

- Standard Conventions (Section 2.2)
- General Safeguarding Tips (Section 2.3)
- Mechanical Safety Devices (Section 2.4)
- Installation Safety (Section 2.5)
- Programming Safety (Section 2.6)
- Operation Safety (Section 2.7)
- Maintenance Safety (Section 2.8)
2.2 Standard Conventions

This manual includes information essential to the safety of personnel and equipment. As you read through this manual, be alert to the four signal words:

- **DANGER**
- **WARNING**
- **CAUTION**
- **NOTE**

Pay particular attention to the information provided under these headings which are defined below (in descending order of severity).

### DANGER!

Information appearing under the DANGER caption concerns the protection of personnel from the immediate and imminent hazards that, if not avoided, will result in immediate, serious personal injury or loss of life in addition to equipment damage.

### WARNING!

Information appearing under the WARNING caption concerns the protection of personnel and equipment from potential hazards that can result in personal injury or loss of life in addition to equipment damage.

### CAUTION!

Information appearing under the CAUTION caption concerns the protection of personnel and equipment, software, and data from hazards that can result in minor personal injury or equipment damage.

**NOTE:** Information appearing in a NOTE caption provides additional information which is helpful in understanding the item being explained.
2.3 General Safeguarding Tips

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot must become familiar with the operation of this equipment. All personnel involved with the operation of the equipment must understand potential dangers of operation. General safeguarding tips are as follows:

- Improper operation can result in personal injury and/or damage to the equipment. Only trained personnel familiar with the operation of this robot, the operator's manuals, the system equipment, and options and accessories should be permitted to operate this robot system.
- Do not enter the robot cell while it is in automatic operation. Programmers must have the teach pendant when they enter the robot cell.
- Improper connections can damage the robot. All connections must be made within the standard voltage and current ratings of the robot I/O (Inputs and Outputs).
- The robot must be placed in Emergency Stop (E-STOP) mode whenever it is not in use.
- In accordance with ANSI/RIA R15.06, section 6.13.4 and 6.13.5, use lockout/tagout procedures during equipment maintenance. Refer also to Section 1910.147 (29CFR, Part 1910), Occupational Safety and Health Standards for General Industry (OSHA).

2.4 Mechanical Safety Devices

The safe operation of the robot, positioner, auxiliary equipment, and system is ultimately the user's responsibility. The conditions under which the equipment will be operated safely should be reviewed by the user. The user must be aware of the various national codes, ANSI/RIA R15.06 safety standards, and other local codes that may pertain to the installation and use of industrial equipment. Additional safety measures for personnel and equipment may be required depending on system installation, operation, and/or location. The following safety measures are available:

- Safety fences and barriers
- Light curtains
- Door interlocks
- Safety mats
- Floor markings
- Warning lights

Check all safety equipment frequently for proper operation. Repair or replace any non-functioning safety equipment immediately.
2.5 Installation Safety

Safe installation is essential for protection of people and equipment. The following suggestions are intended to supplement, but not replace, existing federal, local, and state laws and regulations. Additional safety measures for personnel and equipment may be required depending on system installation, operation, and/or location. Installation tips are as follows:

- Be sure that only qualified personnel familiar with national codes, local codes, and ANSI/RIA R15.06 safety standards are permitted to install the equipment.
- Identify the work envelope of each robot with floor markings, signs, and barriers.
- Position all controllers outside the robot work envelope.
- Whenever possible, install safety fences to protect against unauthorized entry into the work envelope.
- Eliminate areas where personnel might get trapped between a moving robot and other equipment (pinch points).
- Provide sufficient room inside the workcell to permit safe teaching and maintenance procedures.

2.6 Programming Safety

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot must become familiar with the operation of this equipment. All personnel involved with the operation of the equipment must understand potential dangers of operation. Programming tips are as follows:

- Any modifications to the JRC controller can cause severe personal injury or death, as well as damage to the robot! Making any changes without the written permission of Motoman will VOID YOUR WARRANTY!
- Some operations require standard passwords and some require special passwords. Special passwords are for Motoman use only. YOUR WARRANTY WILL BE VOID if you use these special passwords.
- Back up all programs and jobs onto a floppy disk whenever program changes are made. To avoid loss of information, programs, or jobs, a backup must always be made before any service procedures are done and before any changes are made to options, accessories, or equipment.
- Improper operation can result in personal injury and/or damage to the equipment. Only trained personnel familiar with the operation, manuals, electrical design, and equipment interconnections of this robot should be permitted to operate the system.
- Inspect the robot and work envelope to be sure no potentially hazardous conditions exist. Be sure the area is clean and free of water, oil, debris, etc.
- Be sure that all safeguards are in place.
- Check the E-STOP button on the teach pendant for proper operation before programming.
- Carry the teach pendant with you when you enter the workcell.
- Be sure that only the person holding the teach pendant enters the workcell.
- Test any new or modified program at low speed for at least one full cycle.
2.7 Operation Safety

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot must become familiar with the operation of this equipment. All personnel involved with the operation of the equipment must understand potential dangers of operation. Operation tips are as follows:

- Be sure that only trained personnel familiar with the operation of this robot, the operator's manuals, the system equipment, and options and accessories are permitted to operate this robot system.
- Check all safety equipment for proper operation. Repair or replace any non-functioning safety equipment immediately.
- Inspect the robot and work envelope to ensure no potentially hazardous conditions exist. Be sure the area is clean and free of water, oil, debris, etc.
- Ensure that all safeguards are in place.
- Improper operation can result in personal injury and/or damage to the equipment. Only trained personnel familiar with the operation, manuals, electrical design, and equipment interconnections of this robot should be permitted to operate the system.
- Do not enter the robot cell while it is in automatic operation. Programmers must have the teach pendant when they enter the cell.
- The robot must be placed in Emergency Stop (E-STOP) mode whenever it is not in use.
- This equipment has multiple sources of electrical supply. Electrical interconnections are made between the controller, external servo box, and other equipment. Disconnect and lockout/tagout all electrical circuits before making any modifications or connections.
- All modifications made to the controller will change the way the robot operates and can cause severe personal injury or death, as well as damage the robot. This includes controller parameters, program logic, position points, and I/O (Input and Output) modifications. Check and test all changes at slow speed.
2.8 Maintenance Safety

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot must become familiar with the operation of this equipment. All personnel involved with the operation of the equipment must understand potential dangers of operation. Maintenance tips are as follows:

- Do not perform any maintenance procedures before reading and understanding the proper procedures in the appropriate manual.
- Check all safety equipment for proper operation. Repair or replace any non-functioning safety equipment immediately.
- Improper operation can result in personal injury and/or damage to the equipment. Only trained personnel familiar with the operation, manuals, electrical design, and equipment interconnections of this robot should be permitted to operate the system.
- Back up all your programs and jobs onto a floppy disk whenever program changes are made. A backup must always be made before any servicing or changes are made to options, accessories, or equipment to avoid loss of information, programs, or jobs.
- Do not enter the robot cell while it is in automatic operation. Programmers must have the teach pendant when they enter the cell.
- The robot must be placed in Emergency Stop (E-STOP) mode whenever it is not in use.
- Be sure all safeguards are in place.
- Use proper replacement parts.
- This equipment has multiple sources of electrical supply. Electrical interconnections are made between the controller, external servo box, and other equipment. Disconnect and lockout/tagout all electrical circuits before making any modifications or connections.
- All modifications made to the controller will change the way the robot operates and can cause severe personal injury or death, as well as damage the robot. This includes controller parameters, program logic, position points, and I/O (Input and Output) modifications. Check and test all changes at slow speed.
- Improper connections can damage the robot. All connections must be made within the standard voltage and current ratings of the robot I/O (Inputs and Outputs).
MOTOMAN-UPJ
INSTRUCTIONS
YR-UPJ3-A00
YR-UPJ3-B00

Upon receipt of the product and prior to initial operation, read these instructions thoroughly, and retain for future reference.

MOTOMAN INSTRUCTIONS
MOTOMAN-UPJ INSTRUCTIONS
JRC BEGINNER’S GUIDE
JRC SETTING-UP MANUAL
JRC INSTALLATION & MAINTENANCE GUIDE
JRC WINCAPS II GUIDE
JRC PROGRAMMER’S MANUAL
JRC ERROR CODE TABLES
MANDATORY

• This instruction manual is intended to explain operating instructions and maintenance procedures primarily for the MOTOMAN-UPJ.

CAUTION

• Some drawings in this manual are shown with the protective covers or shields removed for clarity. Be sure all covers and shields are replaced before operating this product.

• The drawings and photos in this manual are representative examples and differences may exist between them and the delivered product.

• YASKAWA may modify this model without notice when necessary due to product improvements, modifications, or changes in specifications. If such modification is made, the manual number will also be revised.

• If your copy of the manual is damaged or lost, contact a YASKAWA representative to order a new copy. The representatives are listed on the back cover. Be sure to tell the representative the manual number listed on the front cover.

• YASKAWA is not responsible for incidents arising from unauthorized modification of its products. Unauthorized modification voids your product's warranty.
NOTES FOR SAFE OPERATION

Read this manual carefully before installation, operation, maintenance, or inspection of the YASNAC JRC.

In this manual, the Notes for Safe Operation are classified as “WARNING”, “CAUTION”, “MANDATORY”, or “PROHIBITED”.

WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury to personnel.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury to personnel and damage to equipment. It may also be used to alert against unsafe practices.

MANDATORY

Always be sure to follow explicitly the items listed under this heading.

PROHIBITED

Must never be performed.

Even items described as “CAUTION” may result in a serious accident in some situations. At any rate, be sure to follow these important items.

NOTE

To ensure safe and efficient operation at all times, be sure to follow all instructions, even if not designated as “CAUTION” and “WARNING”. 
Terminology and Definitions

**Maximum space**: Refers to the volume of space encompassing the maximum designed movements of all robot parts including the end-effector, workpiece and attachments. (Quoted from the RIA* Committee Draft.)

**Restricted space**: Refers to the portion of the maximum space to which a robot is restricted by limiting devices (i.e., mechanical stops). The maximum distance that the robot, end-effector, and workpiece can travel after the limiting device is actuated defines the boundaries of the restricted space of the robot. (Quoted from the RIA Committee Draft.)

**Motion space**: Refers to the portion of the restricted space to which a robot is restricted by software motion limits. The maximum distance that the robot, end-effector, and workpiece can travel after the software motion limits are set defines the boundaries of the motion space of the robot.

**Operating space**: Refers to the portion of the restricted space that is actually used by the robot while performing its task program. (Quoted from the RIA Committee Draft.)

**Task program**: Refers to a set of instructions for motion and auxiliary functions that define the specific intended task of the robot system. (Quoted from the RIA Committee Draft.)

(*RIA: Robotic Industries Association)
Installation Precautions

Insuring the proper installation environment

The robot and the robot controller have not been designed to withstand explosions, dust-proof, nor are they splash-proof. Therefore, they should not be installed in any environment where:

1. there are flammable gases or liquids,
2. there are any shavings from metal processing or other conductive material flying about,
3. there are any acidic, alkaline or other corrosive gases,
4. there is cutting or grinding oil mist,
5. it may likely be submerged in fluid,
6. there is sulfuric cutting or grinding oil mist, or
7. there are any large-sized inverters, high output/high frequency transmitters, large contactors, welders, or other sources of electrical noise.

When using the robot controller in an environment exposed to mist, put it in an optional protective box.

Service space

The robot and peripheral equipment should be installed so that sufficient service space is maintained for safe teaching, maintenance, and inspection.

Control devices outside the robot's restricted space

The robot controller, teach pendant, and operating panel should be installed outside the robot's restricted space and in a place where you can observe all of the robot's movements when operating the robot controller, teach pendant, or operating panel.

Positioning of gauges

Pressure gauges, oil pressure gauges and other gauges should be installed in an easy-to-check location.

Protection of electrical wiring and hydraulic/pneumatic piping

If there is any possibility of the electrical wiring or hydraulic/pneumatic piping being damaged, protect them with a cover or similar item.

Positioning of emergency stop switches

Emergency stop switches should be provided in a position where they can be reached easily should it be necessary to stop the robot immediately.

1. The emergency stop switches should be red.
2. Emergency stop switches should be designed so that they will not be released after pressed, automatically or mistakenly by any other person.
3. Emergency stop switches should be separate from the power switch.
Positioning of operating status indicators

Operating status indicators should be positioned in such a way where workers can easily see whether the robot is on temporary halt or on an emergency or abnormal stop.

Setting-up the safety fence or enclosure

A safety fence or enclosure should be set up so that no one can easily enter the robot's restricted space. If it is impossible, utilize other protectors as described in the following "Positioning of rope or chain."

1. The fence or enclosure should be constructed so that it cannot be easily moved or removed.
2. The fence or enclosure should be constructed so that it cannot be easily damaged or deformed through external force.
3. Establish the exit/entrance to the fence or enclosure. Construct the fence or enclosure so that no one can easily get past it by climbing over the fence or enclosure.
4. The fence or enclosure should be constructed to ensure that it is not possible for hands or any other parts of the body to get through it.
5. Take any one of the following protections for the entrance/exit of the fence or enclosure:
   • Place a door, rope or chain across the entrance/exit of the fence or enclosure, and fit it with an interlock that ensures the emergency stop device operates automatically if it is opened or removed.
   • Post a warning notice at the entrance/exit of the fence or enclosure stating "In operation--Entry forbidden" or "Work in progress--Do not operate" and ensure that workers follow these instructions at all times.

When making a test run, before setting up the fence or enclosure, place an overseer in a position outside the robot's restricted space and one in which he/she can see all of the robot's movements. The overseer should prevent workers from entering the robot's restricted space and be devoted solely to that task.
| **Positioning of rope or chain** | If it is not possible to set up the safety fence or enclosure described in "Setting-up the safety fence or enclosure," hang a rope or chain around the perimeter of the robot's restricted space to ensure that no one can enter the restricted space.  
1. Ensure the support posts cannot be moved easily.  
2. Ensure that the rope or chain's color or material can easily be discerned from the surrounds.  
3. Post a warning notice in a position where it is easy to see stating "In operation--Entry forbidden" or "Work in progress--Do not operate" and ensure that workers follow these instructions at all times.  
4. Set the exit/entrance, and follow the instructions given in "Setting-up the safety fence or enclosure," 3 through 5. |
| **Setting the robot's motion space** | The area required for the robot to work is called the robot's operating space.  
If the robot's motion space is greater than the operating space, it is recommended that you set a smaller motion space to prevent the robot from interfering or disrupting other equipment. |
| **No robot modification allowed** | Never modify the robot unit, robot controller, teach pendant or other devices. |
| **Cleaning of tools** | If your robot uses welding guns, paint spray nozzles, or other end-effectors requiring cleaning, it is recommended that the cleaning process be carried out automatically. |
| **Lighting** | Sufficient illumination should be assured for safe robot operation. |
| **Protection from objects thrown by the end-effector** | If there is any risk of workers being injured in the event that the object being held by the end-effector is dropped or thrown by the end-effector, consider the size, weight, temperature and chemical nature of the object and take appropriate safeguards to ensure safety. |
Precautions while robot is running

**WARNING**

Touching the robot while it is in operation can lead to serious injury. Please ensure the following conditions are maintained and that the cautions listed onwards are followed when any work is being performed.

- **Do not enter the robot’s restricted space when the robot is in operation or when the motor power is on.**

- **As a precaution against malfunction, ensure that an emergency stop device is activated to cut the power to the robot motor upon entry into the robot’s restricted space.**

- **When it is necessary to enter the robot’s restricted space to perform teaching or maintenance work while the robot is running, ensure that the steps described in “Ensuring safety of workers performing jobs within the robot’s restricted space” are taken.**

---

**Creation of working regulations and assuring worker adherence**

When entering the robot’s restricted space to perform teaching or maintenance inspections, set "working regulations" for the following items and ensure workers adhere to them.

1. Operating procedures required to run the robot.
2. Robot speed when performing teaching.
3. Signaling methods to be used when more than one worker is to perform work.
4. Steps that must be taken by the worker in the event of a malfunction, according to the contents of the malfunction.
5. The necessary steps for checking release and safety of the malfunction status, in order to restart the robot after robot movement has been stopped due to activation of the emergency stop device.
6. Apart from the above, any steps below necessary to prevent danger from unexpected robot movement or malfunction of the robot.
   • Display of the control panel (See the following "Display of operation panel.")
   • Assuring the safety of workers performing jobs within the robot's restricted space (See the following "Ensuring safety of workers performing jobs within the robot’s restricted space.")
   • Maintaining worker position and stance Position and stance that enables the worker to confirm normal robot operation and to take immediate refuge if a malfunction occurs.
   • Implementation of measures for noise prevention
   • Signaling methods for workers of related equipment
   • Types of malfunctions and how to distinguish them

Please ensure "working regulations" are appropriate to the robot type, the place of installation and to the content of the work.

Be sure to consult the opinions of related workers, engineers at the equipment manufacturer and that of a labor safety consultant when creating these "working regulations."

---

Display of operation panel

To prevent anyone other than the worker from accessing the start switch or the changeover switch by accident during operation, display something to indicate it is in operation on the operating panel or teach pendant. Take any other steps as appropriate, such as locking the cover.

Ensuring safety of workers performing jobs within the robot's restricted space

When performing jobs within the robot's restricted space, take any of the following steps to ensure that robot operation can be stopped immediately upon a malfunction.

1. Ensure an overseer is placed in a position outside the robot’s restricted space and one in which he/she can see all robot movements, and that he/she is devoted solely to that task.
   • An emergency stop device should be activated immediately upon a malfunction.
   • Do not permit anyone other than the worker engaged for that job to enter the robot’s restricted space.

2. Ensure a worker within the robot’s restricted space carries the portable emergency stop switch so he/she can press it (the robot stop button on the teach pendant) immediately if it should be necessary to do so.
<table>
<thead>
<tr>
<th>Inspections before commencing work such as teaching work such as teaching</th>
<th>Before starting work such as teaching, inspect the following items, carry out any repairs immediately upon detection of a malfunction and perform any other necessary measures.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Check for any damage to the sheath or cover of the external wiring or to the external devices.</td>
</tr>
<tr>
<td>2.</td>
<td>Check that the robot is functioning normally or not (any unusual noise or vibration during operation).</td>
</tr>
<tr>
<td>3.</td>
<td>Check the functioning of the emergency stop device.</td>
</tr>
<tr>
<td>4.</td>
<td>Check there is no leakage of air or oil from any pipes.</td>
</tr>
<tr>
<td>5.</td>
<td>Check there are no obstructive objects in or near the robot's restricted space.</td>
</tr>
</tbody>
</table>

| Release of residual air pressure | Before disassembling or replacing pneumatic parts, first release any residual air pressure in the drive cylinder. |

| Precautions for test runs | Whenever possible, have the worker stay outside of the robot's restricted space when performing test runs. |

<table>
<thead>
<tr>
<th>Precautions for automatic operation</th>
<th>1. At start-up Before the robot is to be started up, first check the following items as well as setting the signals to be used and perform signaling practice with all related workers. • Check that there is no one inside the robot's restricted space. • Check that the teach pendant and tools are in their designated places. • Check that no lamps indicating a malfunction on the robot or related equipment are lit.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>Check that the display lamp indicating automatic operation is lit during automatic operation.</td>
</tr>
<tr>
<td>3.</td>
<td>Steps to be taken when a malfunction occurs Should a malfunction occur with the robot or related equipment and it is necessary to enter the robot's restricted space to perform emergency maintenance, stop the robot’s operation by activating the emergency stop device. Take any necessary steps such as placing a display on the starter switch to indicate work is in progress to prevent anyone from accessing the robot.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Precautions in repairs</th>
<th>1. Do not perform repairs outside of the designated range.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>Under no circumstances should the interlock mechanism be removed.</td>
</tr>
<tr>
<td>3.</td>
<td>When opening the robot controller's cover for battery replacement or any other reasons, always turn the robot controller power off and disconnect the power cable.</td>
</tr>
<tr>
<td>4.</td>
<td>Use only spare tools authorized by YASKAWA.</td>
</tr>
</tbody>
</table>
Daily and Periodical Inspections

- Be sure to perform daily and periodical inspections. Before starting jobs, always check that there is no problem with the robot and related equipment. If any problems are found, take any necessary measures to correct them.
- When carrying out periodical inspections or any repairs, maintain records and keep them for at least 3 years.

Management of Floppy Disks

- After finishing teaching or making any changes, always save the programs and data onto floppy disks.
  Making back-ups will help you recover if data stored in the robot controller is lost due to the expired life of the back-up battery.
- Write the names of each of the floppy disks used for storing task programs to prevent incorrect disks from loading into the robot controller.
- Store the floppy disks where they will not be exposed to dust, humidity and magnetic field, which could corrupt the disks or data stored on them.
Definition of Terms Used Often in This Manual

The MOTOMAN manipulator is the YASKAWA industrial robot product. The manipulator usually consists of the controller, the operating panel (option), the teaching pendant (option), and supply cables.

In this manual, the equipment is designated as follows:

<table>
<thead>
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<th>Equipment</th>
<th>Manual Designation</th>
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<tr>
<td>JRC Controller</td>
<td>JRC</td>
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<tr>
<td>JRC Operating Panel (Option)</td>
<td>Operating Panel</td>
</tr>
<tr>
<td>JRC Teaching Pendant (Option)</td>
<td>Teaching Pendant</td>
</tr>
</tbody>
</table>
AN EXPLANATION OF WARNING LABELS

The following warning labels are attached to the manipulator. Always follow the warnings on the labels. Also, an identification label with important information is placed on the body of the manipulator. Prior to operating the manipulator, confirm the contents.
1 Receiving
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      3.2.1 When the Manipulator and Mounting Fixture are
             Installed on a Common Installation Base .......... 3-3
      3.2.2 When the Manipulator is Mounted Directly on the Floor .. 3-4
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1 Receiving

1.1 Checking Package Contents

When the package arrives, check the contents for the following standard items (Any additional options ordered should be checked as well.):

- Manipulator
- JRC
- Power supply cables between controller and manipulator

**CAUTION**

- Confirm that the manipulator and the JRC have the same order number. Special care must be taken when more than one manipulator is to be installed.

If the numbers do not match, manipulators may not perform as expected and cause injury or damage.
1.2 Checking the Order Number

Check that the order number of the manipulator corresponds to the JRC. The order number is located on a label as shown below.

---

**THE MANIPULATOR AND THE CONTROLLER SHOULD HAVE SAME ORDER NUMBER.**

ORDER No. □□□□□□□□

Check that the manipulator and the JRC have the same order number.

---

(a) JRC (Top View)  
(b) Manipulator (Top View)

---

Fig. 1 Location of Order Number Labels
2 Transporting

2.1 Using the Crane

As a rule, when removing the manipulator from the package and moving it, a crane should be used. The manipulator should be lifted using wire rope threaded through attached eyebolts. Be sure the manipulator is fixed with jigs before transporting, and lift it in the posture as shown in "Fig. 2 Transporting Position."

---

**CAUTION**

- **Sling applications and crane or forklift operations must be performed by authorized personnel only.**

  Failure to observe this caution may result in injury or damage.

- **Avoid excessive vibration or shock during transporting.**

  The system consists of precision components, so failure to observe this caution may adversely affect performance.
2.2 Using the Forklift

When using a forklift, the manipulator should be fixed on a pallet with shipping bolts and jigs as shown in "Fig. 3 Using the Forklift." Insert claws under the pallet and lift it. The pallet must be strong enough to support the manipulator. Transporting of the manipulator must be performed slowly in order to avoid overturning or slippage.

**Fig. 3 Using the Forklift**

- Check that the eyebolts are securely fastened.
- The weight of the manipulator is approximately 25kg including the shipping bolts and jigs. Use a wire rope strong enough to withstand the weight.
- Attached eyebolts are designed to support the manipulator weight. Do not use them for anything other than transporting the manipulator.
- Mount the shipping bolts and jigs for transporting the manipulator.
- Avoid exerting force on the arm or motor unit when transporting, use caution when using transporting equipment other than a crane or forklift, as injury may occur.
3 Installation

WARNING

• Sling applications and crane or forklift operations must be performed by authorized personnel only.

   Failure to observe this warning may result in injury or damage.

• Avoid excessive vibration or shock during transporting.

   The system consists of precision components, so failure to observe this warning may adversely affect performance.

• Install the safeguards.

   Failure to observe this warning may result in injury or damage.

• Install the manipulator in a location where the fully extended arm and tool will not reach the wall, safeguards, or the JRC.

   Failure to observe this warning may result in injury or damage.

• Do not start the manipulator or even turn ON the power before it is firmly anchored.

   The manipulator may overturn and cause injury or damage.

• When mounting the manipulator on the ceiling or wall, the base section must have sufficient strength and rigidity to support the weight of the manipulator. Also, it is necessary to consider countermeasures to prevent the manipulator from falling.

   Failure to observe these warnings may result in injury or damage.

• The common installation base must be strong and rigid enough to support the manipulator.

   Failure to observe this warning may result in injury or damage.
3.1 Safety Guard Installation

To insure safety, be sure to install safety guards. They prevent unforeseen accidents with personnel and damage to equipment. The following is quoted for your information and guidance. (ISO10218)

Responsibility for Safeguarding
The user of a manipulator or robot system shall ensure that safeguards are provided and used in accordance with Sections 6, 7, and 8 of this standard. The means and degree of safeguarding, including any redundancies, shall correspond directly to the type and level of hazard presented by the robot system consistent with the robot application. Safeguarding may include but not be limited to safeguarding devices, barriers, interlock barriers, perimeter guarding, awareness barriers, and awareness signals.

CAUTION

- **Do not install or operate a manipulator that is damaged or lacking parts.**
  Failure to observe this caution may cause injury or damage.

- **Before turning ON the power, check to be sure that the eyebolts have been removed.**
  Failure to observe this caution may result in damage to the driving parts.
3.2 Mounting Procedures for Manipulator Base

The manipulator should be firmly mounted on a base or foundation strong enough to support the manipulator and jigs, and withstand repulsion forces during acceleration and deceleration. Construct a solid foundation with the appropriate thickness to withstand maximum repulsion forces of the manipulator as shown in Table 1. During installation, if the flatness is not right, the manipulator shape may change and its functional ability may be compromised. The flatness for installation must be kept at 0.5mm or less. Mount the base in either of the following ways: "3.2.1 When the Manipulator and Mounting Fixture are Installed on a Common Installation Base" or "Fig. 3.2.2 When the Manipulator is Mounted Directly on the Floor."

Table 1  Maximum Repulsion Forces of the Manipulator

<table>
<thead>
<tr>
<th>Torque Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal rotating maximum</td>
<td>100N • m</td>
</tr>
<tr>
<td>(S-axis moving direction)</td>
<td>(10.2 kgf • m)</td>
</tr>
<tr>
<td>Vertical rotating maximum</td>
<td>200N • m</td>
</tr>
<tr>
<td>(LU-axis moving direction)</td>
<td>(20.4 kgf • m)</td>
</tr>
</tbody>
</table>

3.2.1 When the Manipulator and Mounting Fixture are Installed on a Common Installation Base

The common installation base should be rugged and durable to prevent shifting of the manipulator or the mounting fixture. It is recommended that the thickness of the common installation base is 20mm or more, the anchor bolt is M8 or more. There are 4 mounting holes in the manipulator base. Affix the manipulator securely with hexagon socket head cap bolts M8 (35mm long recommended). Tighten the bolts and anchor bolts securely so that they will not work loose during operation. See "Fig. 4 Mounting on the Common Installation Base " for the method.
3.2.2 When the Manipulator is Mounted Directly on the Floor

The floor should be strong enough to support the manipulator. Construct a solid foundation with the appropriate thickness to withstand maximum repulsion forces of the manipulator. As a rough standard, when there is a concrete thickness (floor) is 150mm or more, the manipulator base can be fixed directly to the floor with anchor bolts M8. Before mounting the manipulator, however, check that the floor is level and that all cracks, etc. are repaired. A non-concrete floor or a floor less than 150mm thick is insufficient for mounting, even if the floor is concrete.

![Fig. 5 Direct Mounting on the Floor](image)
3.3 Mounted Type

The manipulator can be mounted in three different ways: floor-mounted (standard), wall-mounted, and ceiling-mounted types are available. For wall- and ceiling-mounted types, the three points listed below are different from the floor-mounted types.

- S-axis Working Range
- Affixing the Manipulator Base
- Precautions to Prevent the Manipulator from Falling

3.3.1 S-axis Working Range

When performing a wall installation, the S-axis working range must be ±25°.

3.3.2 Affixing the Manipulator Base

When performing a wall or ceiling installation, be sure to use four hexagon socket head cap bolts M8. Use a torque of 4.1kg•m when screwing in the bolts.

3.3.3 Precautions to Prevent the Manipulator from Falling

When performing wall or ceiling installations, for safety purposes, take measures to keep the manipulator from falling. Refer to "Fig. 6 When Using Ceiling and Wall-Mounted Types" for details.

![Fig. 6 When Using Ceiling and Wall-Mounted Types](image_url)

**NOTE** When using wall-mounted or ceiling mounted types, contact your Yaskawa representative.
3.4 Location

When the manipulator is installed, it is necessary to satisfy the undermentioned environmental conditions:

- 0° to +40°C (Ambient temperature)
- 20 to 80%RH (no moisture, non-condensing)
- Free from dust, soot, or water
- Free from corrosive gases or liquid, or explosive gases
- Free from excessive impact or vibration (less than 4.9 m/s² (0.5G))
- Free from large electrical noise (plasma)
- The flatness for installation is 0.5mm or less
4  Wiring

WARNING

• **Ground resistance must be 100 Ω or less.**

  Failure to observe this warning may result in fire or electric shock.

• **Before wiring, make sure to turn the primary power supply OFF, and put up a warning sign. (ex. DO NOT TURN THE POWER ON.)**

  Failure to observe this warning may result in fire or electric shock.

CAUTION

• **Wiring must be performed by authorized or certified personnel.**

  Failure to observe this caution may result in fire or electric shock.
4.1  Grounding

Follow the local regulations for grounding line size. A line of 5.5 mm² or more is recommended. Refer to "Fig. 7  Grounding Method." to connect the ground line directly to the manipulator.

**NOTE**
- Do not use this line in common with other ground lines or grounding electrodes for other electric power, motor power, welding devices, etc.
- Where metal ducts, metallic conduits, or distributing racks are used for cable laying, ground in accordance with Electric Equipment Technical Standards.

4.2  Cable Connection

There are two cables for the power supply; a signal cable for detection (1BC) and a power cable (2BC). Connect these cables to the manipulator base connectors and the JRC, respectively. Refer to "Fig. 8  Power Supply Cables."

4.2.1  Connection to the Manipulator

Before connecting the cables to the manipulator, verify the numbers on both cables and the manipulator base connectors. When connecting, adjust the cable connector positions to the main key positions of the manipulator, and insert cables in the order of 1BC and 2BC, and then push down the lever until hearing a "click."
4.2.2 Connection to the JRC

Before connecting the cables to the JRC, verify the names on both cables and the JRC base connectors. When connecting, insert cables in the order of ENCODER and MOTOR.

**CAUTION**

- **Do not cover the cable or allow it to tangle. Keep the cable as straight as possible.**

Failure to observe this caution may result in preventing heat of the cable from being discharged.

---

Fig. 8 Power Supply Cables
4.2 Cable Connection

Fig. 9  Power Supply Cable Connection to the Manipulator
5 Basic Specifications

5.1 Basic Specifications

Table 2 Basic Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Model</th>
<th>MOTOMAN-UPJ</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5-axis (YR-UPJ3-A00)</td>
<td>6-axis (YR-UPJ3-B00)</td>
</tr>
<tr>
<td>Operation Mode</td>
<td>Vertically Articulated</td>
<td></td>
</tr>
<tr>
<td>Degree of Freedom</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Payload</td>
<td>3 kg</td>
<td></td>
</tr>
<tr>
<td>Repetitive Positioning Accuracy</td>
<td>± 0.03 mm</td>
<td></td>
</tr>
<tr>
<td>Motion Range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S-Axis (turning)</td>
<td>± 160°</td>
<td></td>
</tr>
<tr>
<td>L-Axis (lower arm)</td>
<td>+ 90°, - 85°</td>
<td></td>
</tr>
<tr>
<td>U-Axis (upper arm)</td>
<td>+ 175°, - 55°</td>
<td></td>
</tr>
<tr>
<td>R-Axis (wrist roll)</td>
<td>–</td>
<td>± 170°</td>
</tr>
<tr>
<td>B-Axis (wrist pitch/yaw)</td>
<td>± 120°</td>
<td></td>
</tr>
<tr>
<td>T-Axis (wrist twist)</td>
<td>± 360°</td>
<td></td>
</tr>
<tr>
<td>Maximum Speed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S-Axis</td>
<td>3.49 rad/s, 200°/s</td>
<td></td>
</tr>
<tr>
<td>L-Axis</td>
<td>2.62 rad/s, 150°/s</td>
<td></td>
</tr>
<tr>
<td>U-Axis</td>
<td>3.32 rad/s, 190°/s</td>
<td></td>
</tr>
<tr>
<td>R-Axis</td>
<td>–</td>
<td>5.24 rad/s, 300°/s</td>
</tr>
<tr>
<td>B-Axis</td>
<td>5.24 rad/s, 300°/s</td>
<td></td>
</tr>
<tr>
<td>T-Axis</td>
<td>7.33 rad/s, 420°/s</td>
<td></td>
</tr>
<tr>
<td>Allowable Moment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R-Axis</td>
<td>–</td>
<td>5.39N•m (0.55kgf•m)</td>
</tr>
<tr>
<td>B-Axis</td>
<td>5.39N•m (0.55kgf•m)</td>
<td></td>
</tr>
<tr>
<td>T-Axis</td>
<td>2.94N•m (0.3kgf•m)</td>
<td></td>
</tr>
<tr>
<td>Allowable Moment of Inertia (GD²/4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R-Axis</td>
<td>–</td>
<td>0.1kg•m²</td>
</tr>
<tr>
<td>B-Axis</td>
<td></td>
<td>0.1kg•m²</td>
</tr>
<tr>
<td>T-Axis</td>
<td></td>
<td>0.03kg•m²</td>
</tr>
<tr>
<td>Mass</td>
<td>23 kg</td>
<td>25 kg</td>
</tr>
<tr>
<td>Ambient Conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td>0 to + 40°C</td>
<td></td>
</tr>
<tr>
<td>Humidity</td>
<td>20 to 80% RH (non-condensing)</td>
<td></td>
</tr>
<tr>
<td>Vibration</td>
<td>Less than 4.9 m/s² (0.5G)</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>• Free from corrosive gasses or liquids, or explosive gases</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Free from water and dust</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Free from excessive electrical noise (plasma)</td>
<td></td>
</tr>
<tr>
<td>Power Capacity</td>
<td>0.5kVA</td>
<td></td>
</tr>
</tbody>
</table>

*1 SI units are used in this table. However, gravitational unit is used in ( ).
*2 Conformed to ISO9283
*3 Refer to “6.1 Allowable Wrist Load” for details on the allowable moment of inertia.
5.2 Part Names and Working Axes

Fig. 10 Part Names and Working Axes

5.3 Manipulator Base Dimensions

Fig. 11 Manipulator Base Dimensions (mm)
5.4 Dimensions and Working Envelope

Fig. 12 Dimensions and Working Envelope
5.5  B-axis Working Range

The working range of the B-axis maintaining a constant angle to the center of the U-arm is shown in "Fig. 13  B-axis Working Range ."

5.6  Alterable Working Range

The working range of the S-axis can be altered according to the operating conditions as shown in "Table. 3  S-axis Working Range ." If alteration is necessary, contact your Yaskawa representative in advance.

<table>
<thead>
<tr>
<th>Item</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-axis Working Range</td>
<td>±160°(standard)</td>
</tr>
<tr>
<td></td>
<td>±120°</td>
</tr>
<tr>
<td></td>
<td>±90°</td>
</tr>
<tr>
<td></td>
<td>±60°</td>
</tr>
<tr>
<td></td>
<td>±25°</td>
</tr>
</tbody>
</table>

**NOTE** If alteration of S-axis working range is necessary, contact your Yaskawa representative in advance.
6 Allowable Load for Wrist Axis and Wrist Flange

6.1 Allowable Wrist Load

The allowable wrist load of YR-UPJ3-A00 and YR-UPJ3-B00 is 3kg including the weight of the gripper. If force is applied to the wrist instead of the load, force on R-, B-, and T-Axes should be within the value shown in "Fig. 4 Moment and Total Moment of Inertia." Contact your Yaskawa representative for further information or assistance.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Moment N(\cdot)m (kgf(\cdot)m)*1</th>
<th>GD(^2/4) Total Moment of Inertia kg(\cdot)m(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-axis *2</td>
<td>5.39 (0.55)</td>
<td>0.1</td>
</tr>
<tr>
<td>B-axis</td>
<td>5.39 (0.55)</td>
<td>0.1</td>
</tr>
<tr>
<td>T-axis</td>
<td>2.94 (0.3 )</td>
<td>0.03</td>
</tr>
</tbody>
</table>

*1 ( ): Gravitational unit

*2 R-axis only for YR-UPJ3-B00

When the volume load is small, refer to the moment arm rating shown in "Fig. 14 Moment Arm Rating."

The allowable total moment of inertia is calculated when the moment is at the maximum. Contact your Yaskawa representative when only inertia moment, or load moment is small and inertia moment is large. Also, when the load mass is combined with an outside force, contact your Yaskawa representative.

![Fig. 14 Moment Arm Rating](image-url)
The wrist flange dimensions are shown in "Fig. 15 Wrist Flange." It is recommended that the attachment be mounted inside the fitting. The fitting depth of the inside and outside fittings must be 5mm or less.

**Fig. 15 Wrist Flange**

**NOTE**
Wash off anti-corrosive paint (yellow) on the wrist flange surface with thinner or light oil before mounting the tools.
7 System Application

7.1 Mounting Equipment

When peripheral equipment is attached to the U-axis, the following conditions should be observed.

Fig. 16 Clamp and Tapped Holes

Tapped holes M8 x 16mm, (Pitch: 1.25 mm) (3 holes)
7.2 User Cable and Air Duct

User cables (0.2mm² x 10 cables) and four air hoses are used in the manipulator for the drives of the peripheral devices mounted on the upper arm as shown in "Fig. 17 User Cable and Air Duct." The connector pins (1 to 10) are assigned as shown in "Fig. 17 User Cable and Air Duct." Wiring must be performed by user.

- The allowable current for cables: 2.5A or less for each cable
- The maximum pressure for the air hose: 490kPa (5kgf/cm²) or less (2.5mm dia.).

![Diagram of User Cable and Air Duct]

The same pin number (1 to 10) of two connectors is connected in the internal cable of single 0.2mm².
High reliability connectors which can be easily removed are used with each connector part. For the number and location of connectors, see "Fig. 18 Location of Connectors" and "Table. 5 List of Connector Types." "Fig. 19 (a) Internal Connection Diagram" and "Fig. 19 (b) Internal Connection Diagram" show the internal connections between the inside of the manipulator and the JRC.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type of Connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Connector for user cable on base</td>
<td>HR10A-10R-12P (HR10A-10P-12S: Optional)</td>
</tr>
<tr>
<td>U-arm for user cable on base</td>
<td>HR10A-10R-12S (HR10A-10P-12P: Optional)</td>
</tr>
</tbody>
</table>

Fig. 18 Location of Connectors

Table. 5 List of Connector Types
9 Maintenance and Inspection

### WARNING

- **Before maintenance or inspection, be sure to turn the main power supply OFF, and put up a warning sign.** (ex. DO NOT TURN THE POWER ON.)

  Failure to observe this warning may result in electric shock or injury.

### CAUTION

- **Maintenance and inspection must be performed by specified personnel.**

  Failure to observe this caution may result in electric shock or injury.

- **For disassembly or repair, contact your Yaskawa representative.**

- **Do not remove the motor, and do not release the brake.**

  Failure to observe this caution may result in injury from unexpected turning of the manipulator’s arm.

- **The battery must be connected before removing detection connector when performing maintenance and inspection.**

  Failure to observe this caution may result in the loss of home position data.

9.1 Inspection Schedule

Proper inspections are essential not only to assure that the mechanism will be able to function for a long period, but also to prevent malfunctions and assure safe operation. Inspection intervals are displayed in the levels shown in "Table. 6 Inspection Items." Conduct periodical inspections according to the inspection schedule in "Table. 6 Inspection Items."

In "Fig. 6 Inspection Items," the inspection items are classified into three types of operation: operations which can be performed by personnel authorized by the user, operations which can be performed by personnel being trained, and operations which can be performed by service company personnel. Only specified personnel are to do inspection work.

- **NOTE** The inspection interval must be based on the servo power supply on time.
9.1 Inspection Schedule

Table 6 Inspection Items

<table>
<thead>
<tr>
<th>Items</th>
<th>Schedule</th>
<th>Method</th>
<th>Operation</th>
<th>Inspection Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Daily</td>
<td>1000 H Cycle</td>
<td>6000 H Cycle</td>
<td>12000 H Cycle</td>
</tr>
<tr>
<td>Working area and manipulator</td>
<td>O</td>
<td>Visual</td>
<td>Clean the work area if dust or spatter is present. Check for damage and outside cracks.</td>
<td>O</td>
</tr>
<tr>
<td>L. and U-axis joint parts</td>
<td>O</td>
<td>Visual</td>
<td>Check for grease leakage.</td>
<td>O</td>
</tr>
<tr>
<td>Base mount- ing bolts</td>
<td>O</td>
<td>Spanner</td>
<td>Tighten loose bolts. Replace if necessary.</td>
<td>O</td>
</tr>
<tr>
<td>Cover mounting screws</td>
<td>O</td>
<td>Screwdriver, Wrench</td>
<td>Tighten loose bolts. Replace if necessary.</td>
<td>O</td>
</tr>
<tr>
<td>Base connectors</td>
<td>O</td>
<td>Manual</td>
<td>Check for loose connectors.</td>
<td>O</td>
</tr>
<tr>
<td>LU (R) BT- axes timing belt</td>
<td>O</td>
<td>Manual</td>
<td>Check for belt tension and wear.</td>
<td>O</td>
</tr>
<tr>
<td>Internal cables in manipulator (SLUR-axes leads) (BT-axes leads)</td>
<td>O</td>
<td>Visual, Multimeter</td>
<td>Check for conduction between the main connector of base and intermediate connector with manually shaking the wire. Check for wear of protective spring.</td>
<td>O</td>
</tr>
<tr>
<td>Battery in manipulator</td>
<td>O</td>
<td>Multiplier</td>
<td>Replace the battery when the battery alarm occurs or the manipulator drove for 36000H.</td>
<td>O</td>
</tr>
<tr>
<td>S-axis speed reducer</td>
<td>O</td>
<td>Grease gun</td>
<td>Check for malfunction. (Replace if necessary.) Supply grease. See Par. &quot;9.2.2 Grease Replenishment for S-axis Speed Reducer.&quot;</td>
<td>O</td>
</tr>
</tbody>
</table>
### Table. 6 Inspection Items

<table>
<thead>
<tr>
<th>Items</th>
<th>Schedule</th>
<th>Method</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Daily H Cycle</td>
<td>1000 H Cycle</td>
<td>6000 H Cycle</td>
</tr>
<tr>
<td>1.</td>
<td>R-axis speed reducer (only for B00)</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>2.</td>
<td>BT-axes speed reducers, and T-axis gear</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>3.</td>
<td>Overhaul</td>
<td>O</td>
<td></td>
</tr>
</tbody>
</table>

*1 When checking for conduction with multimeter, connect the battery to “BAT” and “OBT” of connectors on the motor side for each axis, and then remove connectors on detector side for each axis from the motor. Otherwise, the home position may be lost. (Refer to “9.2.9 Notes for Maintenance.”)

*2 Internal cables (S-, L-, U-, B-, and T-axis) in manipulator to be replaced at 24000H inspection.

*3 For the grease, refer to “Table. 6 Inspection Parts and Grease Used.”

*4 Inspection No. correspond to the numbers in “Fig. 20 Inspection Parts and Inspection Numbers.”

---

Fig. 20 Inspection Parts and Inspection Numbers
### Table. 7 Inspection Parts and Grease Used

<table>
<thead>
<tr>
<th>No.</th>
<th>Grease Used</th>
<th>Inspected Parts</th>
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<tr>
<td>9, 10, 11, 12</td>
<td>Harmonic Grease SK-1A</td>
<td>S-, L-, U-, R-, B-, and T-axis speed reducers</td>
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<td></td>
<td>T-axis gear</td>
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The numbers in the above table correspond to the numbers in "Fig. 6 Inspection Items."
9.2 Notes on Maintenance Procedures

9.2.1 Battery Replacement

The battery is mounted on the 2 places as shown in "Fig. 21 (a) Battery Location."
If the battery alarm occurs in the JRC, replace the battery according to the following procedure:

Fig. 21 (a) Battery Location

Fig. 21 (b) Battery Connection (S-, L-, and U-axis Side)
1. Turn the JRC main power supply OFF.
2. Remove the connector base, and grease tube from the union.
3. Remove the battery mounting screw on the support.
4. Remove the plastic tape (insulation tape) protecting the connection part of the battery in the manipulator.
5. Connect the new battery.
6. Remove the old battery.

**NOTE**

Remove the old battery after connecting the new one so that the encoder absolute data does not disappear.

7. Protect the connection part of the battery in the manipulator with plastic tape (insulation tape).
8. Mount the battery with the screws, connect the grease tube to the union, and then mount the connector base.

**NOTE**

Do not pinch the cable when the base connector is installed.
9.2.2 Grease Replenishment for S-axis Speed Reducer

1. Remove the plug in the So air flow.

**NOTE** If grease is added without removing the plug, the internal pressure will be higher and may damage the motor. It is absolutely necessary to remove the plug.

2. Inject the grease into the Si grease inlet using a grease gun.

   **Grease type:** Harmonic grease SK-1A  
   **Amount of grease:** 10cc

   **NOTE** The grease is not exhausted from the air flow. Do not inject excessive grease.

3. Reinstall the plug in the air flow.
9.2 Notes on Maintenance Procedures

9.2.3 Grease Replenishment for L-axis Speed Reducer

**Fig. 23 L-axis Speed Reducer Diagram**

**NOTE** For ceiling mounted manipulators, the exhaust port and the grease inlet are inverted.

1. Remove the plug in the plug in the Lo air flow.

**NOTE** If grease is added without removing the plug in the Lo air flow, the internal pressure will be higher and may damage the motor. It is absolutely necessary to remove the plug in the Lo air flow.

2. Inject grease into the Li grease inlet using a grease gun.

**NOTE** The grease is not exhausted from the air flow. Do not inject excessive grease.

3. Reinstall the plug in the air flow.

Grease type: Harmonic grease SK-1A

Amount of grease: 15cc
9.2.4 Grease Replenishment for U- and R-axis Speed Reducers

1. Remove the cover, and remove the plug in the Uo air flow and the plug in the Ro air flow.

   **NOTE** If grease is added without removing the plug in the Uo air flow and the plug in the Ro air flow, the internal pressure will be higher and may damage the motor. It is absolutely necessary to remove the plug in the Uo air flow and the plug in the Ro air flow.

2. Inject grease into the Ui grease inlet and Ri grease inlet using a grease gun.

   **NOTE** The grease is not exhausted from the air flow. Do not inject excessive grease.

   Grease type: Harmonic grease SK-1A
   Amount of grease: 10cc for Ui
   10cc for Ri

3. Reinstall the plug in the Uo air flow and the plug in the Ro air flow.
9.2.5 Grease Replenishment for B- and T-axis SpeedReducers

Fig. 25 B- and T-axis Speed Reducer Diagram

1. Remove the cover, and remove the plug in the Bo air flow and the plug in the To air flow.

If grease is added without removing the plug in the Bo air flow and the plug in the To air flow, the internal pressure will be higher and may damage the motor. It is absolutely necessary to remove the plug in the Bo air flow and the plug in the To air flow.

2. Remove the plug in the Ti grease inlet, and mount a G Nipple A-MT6X1.
3. Inject grease into the Bi and Ti grease inlets using a grease gun.

| Grease type: Harmonic grease SK-1A |
| Amount of grease: 10cc for Bi |
| 5cc for Ti |

The grease is not exhausted from the air flow. Do not inject excessive grease.

4. Reinstall the plug in the Bo air flow, the plug in the To air flow, and the cover.
5. Remove the G Nipple in the Ti grease inlet, and remount the plug.
9.2.6 Notes for Maintenance

Connect the battery with reference to the following figure before removing the encoder connector (with WARNING label).

![Encoder Connector Diagram](image)

**WARNING**

Connect battery to encoder to save the data before removing connector.

Fig. 26 Encoder Connector Diagram
9.2 Notes on Maintenance Procedures
10 Recommended Spare Parts

It is recommended that the following parts and components be kept in stock as spare parts for the MOTOMAN-UPJ. The spare parts list for the MOTOMAN-UPJ is shown below. Product performance cannot be guaranteed when using spare parts from any company other than Yaskawa. The spare parts are ranked as follows:

- Rank A: Expendable and frequently replaced parts
- Rank B: Parts for which replacement may be necessary as a result of frequent operation
- Rank C: Drive unit

For replacing parts in Rank B or Rank C, contact your Yaskawa representative.

Table. 8 Spare Parts for the MOTOMAN-UPJ

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<tr>
<th>Rank</th>
<th>Parts No.</th>
<th>Name</th>
<th>Type</th>
<th>Manufacturer</th>
<th>Qty</th>
<th>Qty per Unit</th>
<th>Remarks</th>
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<td>HW9470917-B</td>
<td>Yaskawa Electric Corporation</td>
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<td>1</td>
<td>For SLU-axes</td>
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<td></td>
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<td>S-, L-, and U-axis AC Servomotors</td>
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# 11.1 S-axis Driving Unit

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11.2 L-axis Driving Unit
### 11.2 L-axis Driving Unit

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JRC
BEGINNER’S GUIDE

Upon receipt of the product and prior to initial operation, read these instructions thoroughly, and retain for future reference.

MOTOMAN INSTRUCTIONS

MOTOMAN-□□□ INSTRUCTIONS
JRC BEGINNER’S GUIDE
JRC SETTING-UP MANUAL
JRC INSTALLATION & MAINTENANCE GUIDE
JRC WINCAPS II GUIDE
JRC PROGRAMMER’S MANUAL
JRC ERROR CODE TABLES
Preface

Thank you for purchasing this high-speed, high-accuracy handling robot.

Before operating your robot, read this manual carefully to safely get the maximum benefit from your robot in your handling operations.

Robot series and/or models covered by this manual

Vertical articulated, MOTOMAN

Important

To ensure operator safety, be sure to read the precautions and instructions in "SAFETY PRECAUTIONS," pages 1 through 8.
How the documentation set is organized

The documentation set consists of the following six books. If you are unfamiliar with this robot series, please read all six books and understand them fully before operating your robot.

BEGINNER’S GUIDE - this book -
Introduces you to the robot. Taking an equipment setup example, this book guides you through running your robot with the teach pendant, making a program in WINCAPSII, and running your robot automatically.

INSTALLATION & MAINTENANCE GUIDE
Provides an explanation of the robot outline, instructions for installing the robot components, and maintenance & inspection procedures.

SETTING-UP MANUAL
Describes how to set-up or teach your robot with the teach pendant or operating panel.

WINCAPSII GUIDE (that comes with WINCAPSII)
Provides instructions on how to use the teaching system installed on the PC, connected to the robot and its controller, for developing and managing programs.

PROGRAMMER’S MANUAL
Describes the PAC programming language, steps to develop programs in PAC, and command specifications.

ERROR CODE TABLES
List error codes that will appear on the teach pendant, operating panel, or PC screen if an error occurs in the robot series or WINCAPSII. These tables provide detailed description and recovery ways.
How this book is organized

This book is just one part of the documentation set. This book consists of SAFETY PRECAUTIONS, parts one through five, and appendices.

SAFETY PRECAUTIONS

Defines safety terms, safety related symbols and provides precautions that should be observed. Be sure to read this section before operating your robot.

Part 1 Running the Robot with the Teach Pendant

Describes how to run the robot with the teach pendant in manual mode, how to create a simple program with the teach pendant, and how to teach the robot.

Part 2 Running the Robot with the Operating Panel

Describes how to run the robot with the operating panel in manual mode, how to confirm the teaching position.

Part 3 Creating a Program on a PC in WINCAPSII

Provides instructions for setting up WINCAPSII on a PC, creating and compiling a program, and uploading the compiled program to the robot controller.

It also describes machine lock which is required for simulations to be performed in Part 3.

Part 4 Simulating the Robot Motion on a PC with the Program Created

Describes how to check the programmed operation by using the simulator on a PC.

Part 5 Running the Robot Using Programs

Provides procedures for running your robot actually according to programs and describes palletizing which is one of the main applications on robots. It also describes how to make use of PAC libraries which greatly improve the efficiency of task program development.

Part 6 Features of Robots

Describes compliance controls and other functions of the robots.

Appendices

Appendix-1 Glossary
Appendix-2 Names of the robot controller parts
Appendix-3 Names of the teach pendant parts
Appendix-4 Menu tree of the teach pendant
SAFETY PRECAUTIONS

Be sure to observe all of the following safety precautions.

Strict observance of these warning and caution indications are a MUST for preventing accidents, which could result in bodily injury and substantial property damage. Make sure you fully understand all definitions of these terms and related symbols given below, before you proceed to the text itself.

| WARNING | Alerts you to those conditions, which could result in serious bodily injury or death if the instructions are not followed correctly. |
| CAUTION | Alerts you to those conditions, which could result in minor bodily injury or substantial property damage if the instructions are not followed correctly. |

Terminology and Definitions

**Maximum space:** Refers to the volume of space encompassing the maximum designed movements of all robot parts including the end-effector, workpiece and attachments. (Quoted from the RIA* Committee Draft.)

**Restricted space:** Refers to the portion of the maximum space to which a robot is restricted by limiting devices (i.e., mechanical stops). The maximum distance that the robot, end-effector, and workpiece can travel after the limiting device is actuated defines the boundaries of the restricted space of the robot. (Quoted from the RIA Committee Draft.)

**Motion space:** Refers to the portion of the restricted space to which a robot is restricted by software motion limits. The maximum distance that the robot, end-effector, and workpiece can travel after the software motion limits are set defines the boundaries of the motion space of the robot.

**Operating space:** Refers to the portion of the restricted space that is actually used by the robot while performing its task program. (Quoted from the RIA Committee Draft.)

**Task program:** Refers to a set of instructions for motion and auxiliary functions that define the specific intended task of the robot system. (Quoted from the RIA Committee Draft.)

(*RIA: Robotic Industries Association)
1. Introduction

This section provides safety precautions to be observed during installation, teaching, inspection, adjustment, and maintenance of the robot.

2. Installation Precautions

2.1 Insuring the proper installation environment

The robot and the robot controller have not been designed to withstand explosions, dust-proof, nor are they splash-proof. Therefore, they should not be installed in any environment where:

1. there are flammable gases or liquids,
2. there are any shavings from metal processing or other conductive material flying about,
3. there are any acidic, alkaline or other corrosive gases,
4. there is cutting or grinding oil mist,
5. it may likely be submerged in fluid,
6. there is sulfuric cutting or grinding oil mist, or
7. there are any large-sized inverters, high output/high frequency transmitters, large contactors, welders, or other sources of electrical noise.

When using the robot controller in an environment exposed to mist, put it in an optional protective box.

2.2 Service space

The robot and peripheral equipment should be installed so that sufficient service space is maintained for safe teaching, maintenance, and inspection.

2.3 Control devices outside the robot's restricted space

The robot controller, teach pendant, and operating panel should be installed outside the robot's restricted space and in a place where you can observe all of the robot's movements when operating the robot controller, teach pendant, or operating panel.

2.4 Positioning of gauges

Pressure gauges, oil pressure gauges and other gauges should be installed in an easy-to-check location.

2.5 Protection of electrical wiring and hydraulic/pneumatic piping

If there is any possibility of the electrical wiring or hydraulic/pneumatic piping being damaged, protect them with a cover or similar item.
2.6 Positioning of emergency stop switches

Emergency stop switches should be provided in a position where they can be reached easily should it be necessary to stop the robot immediately.

(1) The emergency stop switches should be red.

(2) Emergency stop switches should be designed so that they will not be released after pressed, automatically or mistakenly by any other person.

(3) Emergency stop switches should be separate from the power switch.

2.7 Positioning of operating status indicators

Operating status indicators should be positioned in such a way where workers can easily see whether the robot is on temporary halt or on an emergency or abnormal stop.

2.8 Setting-up the safety fence or enclosure

A safety fence or enclosure should be set up so that no one can easily enter the robot's restricted space. If it is impossible, utilize other protectors as described in Section 2.9.

(1) The fence or enclosure should be constructed so that it cannot be easily moved or removed.

(2) The fence or enclosure should be constructed so that it cannot be easily damaged or deformed through external force.

(3) Establish the exit/entrance to the fence or enclosure. Construct the fence or enclosure so that no one can easily get past it by climbing over the fence or enclosure.

(4) The fence or enclosure should be constructed to ensure that it is not possible for hands or any other parts of the body to get through it.

(5) Take any one of the following protections for the entrance/exit of the fence or enclosure:

1) Place a door, rope or chain across the entrance/exit of the fence or enclosure, and fit it with an interlock that ensures the emergency stop device operates automatically if it is opened or removed.

2) Post a warning notice at the entrance/exit of the fence or enclosure stating "In operation--Entry forbidden" or "Work in progress--Do not operate" and ensure that workers follow these instructions at all times.

When making a test run, before setting up the fence or enclosure, place an overseer in a position outside the robot's restricted space and one in which he/she can see all of the robot's movements. The overseer should prevent workers from entering the robot's restricted space and be devoted solely to that task.
2.9 Positioning of rope or chain

If it is not possible to set up the safety fence or enclosure described in Section 2.8, hang a rope or chain around the perimeter of the robot's restricted space to ensure that no one can enter the restricted space.

1. Ensure the support posts cannot be moved easily.
2. Ensure that the rope or chain's color or material can easily be discerned from the surrounds.
3. Post a warning notice in a position where it is easy to see stating "In operation--Entry forbidden" or "Work in progress --Do not operate" and ensure that workers follow these instructions at all times.
4. Set the exit/entrance, and follow the instructions given in Section 2.8, (3) through (5).

2.10 Setting the robot's motion space

The area required for the robot to work is called the robot's operating space.

If the robot's motion space is greater than the operating space, it is recommended that you set a smaller motion space to prevent the robot from interfering or disrupting other equipment.

Refer to the "INSTALLATION & MAINTENANCE GUIDE" Chapter 4.

2.11 No robot modification allowed

Never modify the robot unit, robot controller, teach pendant or other devices.

2.12 Cleaning of tools

If your robot uses welding guns, paint spray nozzles, or other end-effectors requiring cleaning, it is recommended that the cleaning process be carried out automatically.

2.13 Lighting

Sufficient illumination should be assured for safe robot operation.

2.14 Protection from objects thrown by the end-effector

If there is any risk of workers being injured in the event that the object being held by the end-effector is dropped or thrown by the end-effector, consider the size, weight, temperature and chemical nature of the object and take appropriate safeguards to ensure safety.
3. Precautions while robot is running

**Warning**

Touching the robot while it is in operation can lead to serious injury. Please ensure the following conditions are maintained and that the cautions listed from Section 3.1 onwards are followed when any work is being performed.

1) Do not enter the robot's restricted space when the robot is in operation or when the motor power is on.

2) As a precaution against malfunction, ensure that an emergency stop device is activated to cut the power to the robot motor upon entry into the robot's restricted space.

3) When it is necessary to enter the robot's restricted space to perform teaching or maintenance work while the robot is running, ensure that the steps described in Section 3.3 "Ensuring safety of workers performing jobs within the robot's restricted space" are taken.

### 3.1 Creation of working regulations and assuring worker adherence

When entering the robot's restricted space to perform teaching or maintenance inspections, set "working regulations" for the following items and ensure workers adhere to them.

1) Operating procedures required to run the robot.

2) Robot speed when performing teaching.

3) Signaling methods to be used when more than one worker is to perform work.

4) Steps that must be taken by the worker in the event of a malfunction, according to the contents of the malfunction.

5) The necessary steps for checking release and safety of the malfunction status, in order to restart the robot after robot movement has been stopped due to activation of the emergency stop device.

6) Apart from the above, any steps below necessary to prevent danger from unexpected robot movement or malfunction of the robot.

1) Display of the control panel (See Section 3.2 on the following page)

2) Assuring the safety of workers performing jobs within the robot's restricted space (See Section 3.3 on the following page)

3) Maintaining worker position and stance

   Position and stance that enables the worker to confirm normal robot operation and to take immediate refuge if a malfunction occurs.
4) Implementation of measures for noise prevention
5) Signaling methods for workers of related equipment
6) Types of malfunctions and how to distinguish them

Please ensure "working regulations" are appropriate to the robot type, the place of installation and to the content of the work.

Be sure to consult the opinions of related workers, engineers at the equipment manufacturer and that of a labor safety consultant when creating these "working regulations".

3.2 Display of operation panel

To prevent anyone other than the worker from accessing the start switch or the changeover switch by accident during operation, display something to indicate it is in operation on the operating panel or teach pendant. Take any other steps as appropriate, such as locking the cover.

3.3 Ensuring safety of workers performing jobs within the robot's restricted space

When performing jobs within the robot's restricted space, take any of the following steps to ensure that robot operation can be stopped immediately upon a malfunction.

(1) Ensure an overseer is placed in a position outside the robot's restricted space and one in which he/she can see all robot movements, and that he/she is devoted solely to that task.
   ① An emergency stop device should be activated immediately upon a malfunction.
   ② Do not permit anyone other than the worker engaged for that job to enter the robot's restricted space.

(2) Ensure a worker within the robot's restricted space carries the portable emergency stop switch so he/she can press it (the robot stop button on the teach pendant) immediately if it should be necessary to do so.

3.4 Inspections before commencing work such as teaching

Before starting work such as teaching, inspect the following items, carry out any repairs immediately upon detection of a malfunction and perform any other necessary measures.

(1) Check for any damage to the sheath or cover of the external wiring or to the external devices.
(2) Check that the robot is functioning normally or not (any unusual noise or vibration during operation).
(3) Check the functioning of the emergency stop device.
(4) Check there is no leakage of air or oil from any pipes.
(5) Check there are no obstructive objects in or near the robot's restricted space.

3.5 Release of residual air pressure

Before disassembling or replacing pneumatic parts, first release any residual air pressure in the drive cylinder.
### 3.6 Precautions for test runs

Whenever possible, have the worker stay outside of the robot's restricted space when performing test runs.

### 3.7 Precautions for automatic operation

1. **At start-up**
   - Before the robot is to be started up, first check the following items as well as setting the signals to be used and perform signaling practice with all related workers.
   - 1) Check that there is no one inside the robot's restricted space.
   - 2) Check that the teach pendant and tools are in their designated places.
   - 3) Check that no lamps indicating a malfunction on the robot or related equipment are lit.
2. Check that the display lamp indicating automatic operation is lit during automatic operation.
3. **Steps to be taken when a malfunction occurs**
   - Should a malfunction occur with the robot or related equipment and it is necessary to enter the robot's restricted space to perform emergency maintenance, stop the robot's operation by activating the emergency stop device. Take any necessary steps such as placing a display on the starter switch to indicate work is in progress to prevent anyone from accessing the robot.

### 3.8 Precautions in repairs

1. **Do not perform repairs outside of the designated range.**
2. **Under no circumstances should the interlock mechanism be removed.**
3. **When opening the robot controller's cover for battery replacement or any other reasons, always turn the robot controller power off and disconnect the power cable.**
4. **Use only spare tools authorized by YASKAWA.**

### 4. Daily and periodical inspections

1. **Be sure to perform daily and periodical inspections.** Before starting jobs, always check that there is no problem with the robot and related equipment. If any problems are found, take any necessary measures to correct them.
2. **When carrying out periodical inspections or any repairs, maintain records and keep them for at least 3 years.**
5. Management of floppy disks

(1) After finishing teaching or making any changes, always save the programs and data onto floppy disks. Making back-ups will help you recover if data stored in the robot controller is lost due to the expired life of the back-up battery.

(2) Write the names of each of the floppy disks used for storing task programs to prevent incorrect disks from loading into the robot controller.

(3) Store the floppy disks where they will not be exposed to dust, humidity and magnetic field, which could corrupt the disks or data stored on them.
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Part 1
Running the Robot with the Teach Pendant

In Part 1, you will:

- Learn how to handle and operate the teach pendant.
- Practice the following with the teach pendant:
  - Performing safe and precise manual operation (in Joint, X-Y, and Tool modes)
  - Creating and editing programs
  - Performing safe teaching
  - Making a safe teach check
  - Starting up and stopping programs safely

Lesson 1 Running the Robot in Manual Mode
1.1 Basic teach pendant operations
1.2 Running the robot manually with the teach pendant

Lesson 2 Running the Robot Using a Simple Program
2.1 Creating a simple program from the teach pendant
2.2 Teaching
2.3 Teach check
2.4 Running the robot in Auto mode

Part 1 Practice Problems
Equipment Setup Example

The figure below shows an example of equipment setup with the robot included as part of the production line. This robot performs palletizing operations.

![Robot unit, Hand, Pallet, Conveyor](image)

Process flow from program creation to checking of robot motion

Shown below is the process flow starting with program creation and continuing as far as checking of the robot motion.

```
Start

Enter program codes from the teach pendant

Compile the program into run-time format

Any errors?

Y

Load the program

Perform teaching

Run the robot teach check and auto run

End

N

Lesson 2.1

Lesson 2.1

Lesson 2.1

Lesson 2.2

Lessons 2.3 and 2.4
```
Lesson 1  Running the Robot in Manual Mode

1.1  Basic teach pendant operations

**Holding the teach pendant and the deadman switch**

When operating the teach pendant, grasp it as shown below. The teach pendant has two deadman switches, so it is possible to hold the teach pendant in the following 2 ways:

![Deadman switch](image)

**Tip**

The deadman switch is provided to stop the robot automatically and safely when the operator can no longer operate the robot correctly due to unforeseen circumstances such as the operator suffering a blackout or dying while running the robot manually with the teach pendant. If a situation such as this arises, the strength with which the operator is pressing the deadman switch will either decrease or increase markedly. The deadman switch is a 3-position switch which is able to recognize and react to the following 3 operating statuses:

1) When the switch is not being pressed or is being pressed lightly  
   → Switch: OFF

2) When the switch is being pressed with correct pressure  
   → Switch: ON

3) When the switch is being pressed too strongly  
   → Switch: OFF

Unless the switch is ON, the robot cannot run nor is it possible to drive the robot. In order to ensure safety, the robot is designed so that in manual mode the deadman switch should be held down, for example, when the operator presses any of the arm traverse keys.
Basic make-up of the teach pendant

When the controller power is turned ON, the top screen shown below appears on the teach pendant.

➀ Mode selector switch
This switches operation modes between Auto, Manual and Teach check modes.

➁ Jog dial
This makes adjusting values easier.

➂ Status bar
This always displays the current operation mode and robot status.

➃ Touch panel
The LCD screen of the teach pendant is also a touch panel. By touching the buttons or data entry areas displayed on the screen, it is possible to perform operations and make selections.

Caution: Touch the LCD screen with your fingers only, never with the tip of a pen or any pointed object. Otherwise, the LCD will be damaged.

➄ Arm traverse keys
These keys drive the robot arm manually in a designated direction. It is also necessary to hold down the deadman switch at the same time.

➅ Function keys
F1 to F6 are normally displayed on the screen. This can be switched to display F7 to F12 when required by pressing the SHIFT key.

➆ Cursor keys
These are used to move the cursor on the display screen and entry screen.

Refer to Appendix 3 for details on each section of the teach pendant.
1.2 Running the robot manually with the teach pendant

First of all, you will practice turning the robot controller and motor ON and running the robot manually with the teach pendant.

**Step 1** Checking that it is safe to proceed
- Check that the robot is installed correctly.
- Check that there is no one within the robot’s restricted space.

**Step 2** Turning the robot controller ON

1. Flip the controller power switch upward.
2. The top screen will appear on the teach pendant soon after.

The power lamp (furthest left one of the 3 pilot lamps) will light and the remaining 2 lamps will flash momentarily.
Step 3  Placing the robot in Manual mode

① Set the mode selector switch to MANUAL.

In the leftmost area of the status bar, an icon indicating Manual mode will be displayed.

Step 4  Setting the speed and acceleration

① Press [SPEED].

The [Set Speed] window appears.

The SPEED box should be selected, however if either the ACCEL or DECEL box has been selected, use the UP and DOWN cursor keys to select the SPEED box.

② Press [F2 10%]. (The SPEED value can also be changed with the Jog dial.)
(SPEED will be set at 10% and ACCEL and DECEL at 1%.)

③ Press [OK].

Remarks

At the beginning, leave these settings as they are, as you will be running the robot slowly to ensure safety. The settings can be changed later on, after you have become accustomed to running the robot with the teach pendant.
Step 5  
**Turning the motor ON**

① Press [MOTOR].

The motor power is turned ON and the [MOTOR] lamp comes on.

The SPEED display will become 10%.

Step 6  
**Moving each arm of the robot manually**

Caution

When this operation is performed, the robot arm will move. Any workers should leave the robot’s restricted space.

① Press [F2 Arm].
The arm corresponding with the operation of the J1 to J6 arm traverse keys will move. In the Current Robot Position window the angle of each axis will be displayed.

② While observing the robot, press the arm traverse keys with the deadman switch held down.
Step 7  Selecting Manual mode and running the robot manually

In Manual mode, you may select any of these three modes: Joint mode, X-Y mode and Tool mode.

- **<Joint mode>**
  Allows you to drive each of the six joints independently.

- **<X-Y mode>**
  Allows you to drive the robot flange linearly along the X, Y, or Z axis, respectively. If you use the RX, RY, or RZ key, the robot arm rotates on each axis of the virtual work coordinates defined on the center of the flange surface without changing the center position of the flange surface.

- **<Tool mode>**
  Allows you to drive the robot flange linearly along the X, Y, or Z axis, respectively. If you use the RX, RY, or RZ key, the robot arm rotates on each axis of the tool coordinates.

In this lesson, you will practice running the robot in X-Y mode.

1. Press [M-MOD].

2. In the [Select Operation Mode] window, select “X-Y” (use the UP and DOWN cursor keys or the Jog dial).

3. Press [OK].
   The top screen will appear.
Press the P (position variable) button to show the current robot position. You may press the shift key and [F7 Show P] in the menu bar, instead of the P button. (This is necessary to run the robot in X-Y mode.)

The Current Robot Position window appears.

The P lamp comes on and the screen changes to one where the current robot position is expressed in position variables.
Run the robot by pressing the arm traverse keys with the deadman switch held down.

Arm traverse keys
1. Motion in X direction
2. Motion in Y direction
3. Motion in Z direction
4. Rotation around X axis
5. Rotation around Y axis
6. Rotation around Z axis

Deadman switch

① Motion along the X-axis
② Motion along the Y-axis
③ Motion along the Z-axis
④ Rotation around T-axis
⑤ Rotation around Y-axis
⑥ Rotation around Z-axis
Lesson 2  Running the Robot Using a Simple Program

In order to run the robot in a designated way, it is necessary to create a program and teach the positions you want the robot arm to move to.

In this lesson, you will practice moving the robot arm from P1 to P2 as shown below. This will be described in the following order.

2.1 Creating a simple program from the teach pendant
2.2 Teaching (teaching of P1 and P2)
2.3 Teach check
2.4 Running the robot with automatic operation
2.1 Creating a simple program from the teach pendant

First, you will enter codes of a simple program using the teach pendant.

Creating and editing of programs should be done in the Manual mode. If you take the following procedure immediately after performing the previous lesson, the robot is now in the Manual mode, so proceed as is. If not, you need to place the robot in Manual mode before proceeding.

Refer to the PROGRAMMER'S MANUAL for a detailed description on writing programs.

Step 1 Opening a program edit window

To create a new program, it is necessary to open the window for editing programs on the teach pendant screen.

1. Press [F1 Program] on the top screen.

2. Press [F1 NewProg.].

3. Press [OK].
Next, type the file name of the program (here we will use PRO1) to be created.

Step 2 Entering program codes

In this step, you will create a program to move from P1 to P2. Enter the program codes listed in the table below.

<table>
<thead>
<tr>
<th>Coding List for &quot;PRO1&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROGRAM PRO1</td>
</tr>
<tr>
<td>TAKEARM</td>
</tr>
<tr>
<td>SPEED 100</td>
</tr>
<tr>
<td>MOVE L, P1</td>
</tr>
<tr>
<td>MOVE L, P2</td>
</tr>
<tr>
<td>GIVEARM</td>
</tr>
<tr>
<td>END</td>
</tr>
</tbody>
</table>

This ends the preparation for program editing.
1. In the “Program: PRO1” window, move the cursor to the 3rd line using the cursor keys or jog dial.

2. Press [F5 EditLine].

3. Delete the apostrophe (’) from the head of the line using the cursor keys and [Del].

4. Press [OK].

The screen shows the program edit window [Program: PRO1] again where the 3rd line has been modified.
Enter "SPEED 100" from the keyboard. This is displayed in this window.

Press [OK].

The program edit window "Program: PRO1" appears where "SPEED 100" is displayed in the 4th line.
The display will return to the Program List window.

★Caution★

① If you do not want to save the changes made, press [Cancel] instead of [OK] and the display will return to the program edit screen without the changes being saved.

② To create a new program, go back to Step 1.

③ After completing entry of all codes, press [F6 Save.].

④ Enter all of the program codes given on p.16 in the same way used to enter "SPEED 100".

⑤ Press [OK] to save the newly entered program.
Step 3  Compiling the program into run-time format

After editing a program, you need to compile it; that is, transform the edited program into run-time format which is executable by the robot controller.

During compiling, syntax errors will be detected if contained in the edited program. You need to correct all syntax errors since programs containing them cannot be loaded or executed.

① Select "PRO1" in the Program List window.
   (You may select it by using the cursor keys or jog dial, or by touching the screen directly.)

② Press [F12 Config.].

③ Select "Make the specified program active".

④ Press [OK].
When compiling is complete, the screen will return to the [Program List] window.

★Caution★

① If you press [Cancel] instead of [OK] at this point, the screen will return to the [Program List] window without performing the compiling operation.

② There is one other way with which you may compile programs into run-time format.

Press [F6 Aux.] in the [Program List] window to call up the [Auxiliary Functions (Programs)] window. In the window, press [F12 Compile]. With this method, you may continue on to load programs after compiling.
Step 4  **Loading the program**

You need to load the compiled program so that the robot controller can execute it.

Even if compiled programs are transferred from the PC connected to the robot controller, they cannot execute. They need to be loaded to the memory area where the program can be executed.

1. Display the top screen. (If any other screen is displayed, press [Cancel] as many times as necessary until the top screen appears.)


The [Settings (Main)] window appears.

3. Press [F1 Load].

4. Press [OK].
If you load a project using local variables different from those used in the previous project, the error message "Local variable initialized" appears. Press [OK] to continue.

Now, the program is ready to execute. Press [Cancel] to return to the top screen.

This completes the creation of the program to run the robot.
2.2 Teaching

Teaching refers to a method of programming in which you guide a robot through its motions using the teach pendant. In teaching, the robot is taught its motion.

In programming, you may specify positions as constants. However, in order to make the robot accurately learn the relative positional relationship between itself and objective point, you need to move the robot actually on site. Consequently, you write positions as variables in programming and assign actual values to those variables by on-site teaching.

The program created in Lesson 2.1 contains two position variables P1 and P2. This section gives you how to teach the robot values for P1 and P2.

Step 1 Teaching the robot position P1

While holding down the deadman switch, press the appropriate arm traverse keys to move the robot arm to the desired position that you want to assign to P1.
Step 2  Assigning the taught value to [Variable P1]

1. Press [F4 Var.].

2. Select the variable type in the [Select Variable Type] window. At this point, press [F4 Pos.] to assign a value to a position variable. (It is also possible to touch [Pos.] in the window.)

Tip

A variable refers to a program identifier for a storage location which can contain any number or characters and which may vary during the program. The following types of variables are supported:

- I. (Integer): Integer variable (range: -2147483648 to +2147483647)
- F. (Float): Floating-point variable (range: -3.402823E+38 to +3.402823E+38)
- D. (Double): Double-precision variable (range: -1.7976931348623157D+308 to +1.7976931348623157D+308)
- V. (Vector): Vector variable (X, Y, Z)
- P. (Pos): Position variable (X, Y, Z, RX, RY, RZ, FIG)
- J. (Joint): Joint variable (J1, J2, J3, J5, J6)
- T. (Trans): Homogeneous transform matrix variable (Px, Py, Pz, 0x, 0y, 0z, Ax, Ay, Az, FIG)
- S. (String): Character string variable (which can contain a character string of up to 247 characters)
The [Position Variables] window shows seven types of data for each variable name. If you select and highlight any one of them, for example, any in the [Var name P1] box, then it means that the [Var name P1] is selected.

1. Select the [P1] box using the cursor keys or jog dial.
2. Check that the [Var name P1] is selected.
3. Press [F6 Get Pos.].
4. Check the system message and if all is correct, press [OK].
Step 3  Teaching robot position P2 and assigning it to [Var name P2]

The current position will be read into variable P1.

This completes the teaching of P1 and P2.
2.3 Teach check

"Teach check" refers to checking the teaching results by running the program manually. You may take the teach check procedure in Teach check mode.

**Step 1 Placing the robot in Teach check mode**

1. Set the mode selector switch to the TEACHCHECK position.
2. Press [F1 Program] on the top screen.

The Program List window appears.
The PRO1 coding list appears in the program edit window "Program: PRO1".

1. Select "PRO1" in the Program List window. (Selection can be made using the cursor keys or jog dial, or by touching the screen directly.)

2. Press [Display.] to call up the PRO1 program codes.

3. Press [F6 StpStart]. (This is also possible with the right cursor.)
During teach check, always keep one hand free and ready to press the STOP key.

In Teach check mode, keep both the deadman switch and OK key depressed until the execution is completed. If either of them is released, the robot comes to a halt instantly.

Perform the procedure above repeatedly to execute all codes in PRO1, checking that each motion is safe.
Step 2  Cycle check

Next, check the program you have just checked with Step check, this time with Cycle check. The Cycle check executes the selected program from the current program line to the end as a single cycle.

1. Press [F4 CycStart].

This system message appears.
During teach check, always keep one hand free and ready to press the STOP key.

In Teach check mode, keep both the deadman switch and OK key depressed until the execution is completed. If either of them is released, the robot comes to a halt instantly.

As the program starts to execute cycle check so that the robot runs, the highlighted section on the coding list window will proceed in order.

When the program has been executed through to the end, it will stop.
2.4 Running the robot in Auto mode

After the teach check, now you will run the program in Auto mode according to the program PRO1 that you edited in the last section.

Caution: For programs that will be executed for the first time in Auto mode, set the reduced ratio of the programmed speed at 10% or less. In Auto mode, the robot may run at full speed, while in Manual mode or Teach check mode the robot speed is automatically reduced to 10% of the full speed.

**Step 1  Placing the robot in Auto mode**

1. Set the mode selector switch to AUTO.
2. In the leftmost area of the status bar, an icon indicating Auto mode will be displayed.
3. Press [F1 Program].

**Step 2  Selecting the program to be executed**

In the [Program List] window, select the program to be run in Auto mode.

1. Select "PRO1" in the Program List window.
   (You may select it by using the cursor keys or jog dial, or by touching the screen directly.)
Step 3

**Single-step run**

If you want to display the program during a single-step run, press [F11 Display] beforehand.

**Caution**

During program running, always keep one hand free and ready to press the STOP key.

The PRO1 program will start a single-step run in Auto mode.

Perform the procedure above repeatedly through to the end of the program, checking that each motion is safe.
Step 4 Single-cycle run

After running a single-step run, start a single-cycle run.

During program running, always keep one hand free and ready to press the STOP key.

Once the program has been run to the end, it will stop.

The elapsed time on display refers to the length of time from the start to end of the program including temporary stop time caused by Step stop or Halt.
Step 5 Continuous run

Start a continuous run of the program.

① Check that the program to be run is selected.

② Press [F4 Start].

The selection screen for [Single-cycle] and [Continuously] is displayed.

③ Select [Continuously].

④ Press [OK].
Program PRO1 will execute continuously.
(You may stop continuous run by Halt (Stop) or Step stop.)

★Caution★
During program running, always keep one hand free and ready to press the STOP key.

This completes the procedures required to run the robot with the teach pendant.
Part 1 Practice Problems

Exercise: Create a program for moving a workpiece from point A to point B, then perform an operation check.

Assuming that:
- I/O assignment No. 64 (system output) … Close hand
  No. 65 (system output) … Open hand
- Speed ratio when collecting and putting a workpiece: 30%
  Speed ratio for other motions: 80%
- Each of the approach and depart distances: 50mm
- Interpolation control: PTP

Answer:

```
0001  '!TITLE "P&P"
0002  PROGRAM PRO10
0003    TAKEARM
0004    APPROACH P, P5, 50, S=80
0005    MOVE P, P5, S=30
0006    DELAY 500
0007    RESET IO[65]
0008    SET IO[64]
0009    DEPART P, 50, S=80
0010    APPROACH P, P6, 50, S=80
0011    MOVE P, P6, S=30
0012    DELAY 500
0013    RESET IO[65]
0014    SET IO[64]
0015    DEPART P, 50, S=80
0016    GIVEARM
0017    END
```
Part 2
Running the Robot with the Operating Panel

In Part 2, you will:

- Learn how to handle and operate the operating panel.
- Practice the following with the operating panel.
  - Performing safe and precise manual operation (in joint X-Y, and Tool modes)
  - Performing safe teaching
  - Confirming the teaching position

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Lesson 3  Running the Robot in Manual Mode

3.1 Basic operating panel operations

**Holding the operating panel and the deadman switch**

The deadman switch is installed in the operating panel. Grip the operating panel so that you can operate the deadman switch by the finger.

★ **Tip** ★

The deadman switch is provided to stop the robot automatically and safely when the operator can no longer operate the robot correctly due to unforeseen circumstances such as the operator suffering a blackout or dying while running the robot manually with the operating panel. If a situation such as this arises, the strength with which the operator is pressing the deadman switch will either decrease or increase markedly. The deadman switch is a 3-position switch which is able to recognize and react to the following 3 operating statuses:

1) When the switch is not being pressed or is being pressed lightly
   → Switch: OFF

2) When the switch is being pressed with correct pressure
   → Switch: ON

3) When the switch is being pressed too strongly
   → Switch: OFF

Unless the switch is ON, the robot cannot run nor is it possible to drive the robot. In order to ensure safety, the robot is designed so that in manual mode the deadman switch should be held down, for example, when the operator presses any of the arm traverse keys.
3.2 Running the robot manually with the operating panel

**Step 1** Checking that it is safe to proceed
- Check that the robot is installed correctly.
- Check that there is no one within the robot’s restricted space.

**Step 2** Turning the robot controller ON

![Diagram of the robot controller](image)

1. Flip the controller power switch upward.
2. The power lamp (furthest one of the 3 pilot lamps) will light and the remaining 2 lamps will flash momentarily.

**Step 3** Placing the robot in Manual mode
1. Set the mode select switch to MANUAL.
2. Confirm that the LED of the Operating Panel shows Manual mode.

**Step 4** Setting the speed and acceleration
1. Press the SHIFT key.
   - The SHIFT lamp comes on.
2. Press the SP key.
   - The LCD shows the following.
   ```
   SP
   ```
3. Use the numerical keys to enter the desired value.
   ```
   SP30
   ```
   To cancel the new entry, press the Cancel key.
4. Check the newly entered value and press the OK key.
Step 5  | **Turning the motor ON**  
①Press the MOTOR key.

Step 6  | **The motor power is turned ON and the MOTOR lamp comes on.**

⚠️ **Caution**  
When this operation is performed, the robot arm will move. Any workers should leave the robot's restricted space.
①While observing the robot, press the arm traverse keys with the deadman switch held down.
Lesson 4  Teaching the Robot

Step 1  Placing the robot in Manual mode
① Set the mode selector switch to MANUAL.
② Confirm that the LED of the Operating Panel shows Manual mode.

Step 2  Placing the robot in Function Select mode
① Press the SHIFT key.
   The SHIFT lamp comes ON.
② Press the BRAKE, CONTINUE, ST-STOP keys.
   Function Select mode is set.

Step 3  Selecting the variable type for the robot position
① Press ↑ or ↓ keys to select the functions
② Press the OK key to select the function
③ Select [Set CurPos P] to get the current position in the P variable.
   Select [Set CurPos T] to get the current position in the T variable.
   Select [Set CurPos J] to get the current position in the J variable.

Step 4  Selecting the variable number for the robot position
① Input the variable number with the numerical keys.
② Press the OK key to register the variable number.
   The operation returns to the Step 3 by pressing the Cancel key.

Step 5  Getting the robot position
① The LCD shows [SetCurrentPos?].
② Press the OK key to complete registering the position.
   The LCD shows [SetVarVal OK].
Lesson 5  Confirming the Teaching Position

Step 1  Placing the robot in Manual mode
① Set the mode selector switch to MANUAL.
② Confirm that the LED of the Operating Panel shows Manual mode.

Step 2  Placing the robot in Function Select mode
① Press the SHIFT key.
   The SHIFT lamp comes ON.
② [Press the BRAKE, CONTINUE, ST-STOP keys.
   Function Select mode is set.

Step 3  Selecting the variable type for the robot motion
① Press ↑ or ↓ keys to select the functions
② Press the OK key to select the function
③ Select [Move to PVar] to move the robot in the P variable.
   Select [Move to JVar] to move the robot in the J variable.
   Select [Move to TVar] to move the robot in the T variable.

Step 4  Selecting the variable number for the robot motion
① Input the variable number with the numerical keys.
② Press the OK key to register the variable number.
   The operation returns to the Step 3 by pressing the Cancel key.

Step 5  Selecting the robot motion mode
① The LCD shows the [MvP23[PTP]].
② Press ↑ or ↓ keys to select the motion mode (PTP/CP).
③ Press the OK key. The LCD shows [Are You sure ?].

Step 6  Moving the robot to the variable teaching position
① The robot moves while the OK key is pressed.
Part 3
Creating a Program on a PC in WINCAPSII

In Part 3, you will:

Start up the PC teaching system WINCAPSII on a personal computer and actually create and compile a program. You will then upload the compiled program to the robot controller.

Further, in Part 2, you will also place the robot controller in machine lock. This is in preparation for Part 3 where you will simulate the programmed robot motion on the PC screen without actually running the robot.

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Lesson 6  Setting Up the Robot Controller with the Teach Pendant

6.1  Placing the robot controller in machine lock

You will now place the robot controller in machine lock. This enables you to simulate the programmed robot motion on the PC screen without actually running the robot in Part 4.

Step 1  Turning the motor OFF

Step 2  Placing the robot in machine lock

★Caution★

Before placing the robot controller in machine lock, ensure that the motor power is OFF; that is, check that the [MOTOR] lamp is off.

★Tip★

[Ver. 1.4 or later]

If the machine is locked, you may restrict I/O output. For details, refer to the SETTING-UP MANUAL, Section 5.5 “Displaying I/O Signals and Simulating Robot Motion.”

The dummy input icon on the status bar changes according to the I/O output restriction condition.

👨‍💻: No I/O output restricted    🦁: I/O output restricted
6.2 Setting the communications port of the robot controller

To enable the robot controller to communicate with the personal computer, you need to set up the communications port.

This subsection describes the most popular connection using the RS-232C.

**Step 1 Setting the communication permission**

1. Press [F6 Set].
2. Press [F5 Set Com.].
3. Press [F1 Permit].
4 Select the [COM2 (RS232C)] row.

5 Press [F5 Change].

6 Select [Read/write].

7 Press [OK].

The [COM2 (RS232C)] column changes to [Read/write].

8 Press [OK].
Step 2 Setting the transmission rate

1. Press [F2 Serial IF].

2. Select the [COM2 (RS232C)] row.

3. Press [F5 Change].

4. Select [19200 BPS].

5. Press [OK].

6. Press [OK].
⑦ Press [Cancel].
(The display returns to the [Communications Setting Menu].)

⑧ Press [Cancel].
(The display returns to the top screen.)
Lesson 7  Starting up WINCAPSII and Creating a System Project

In this lesson, you will start up WINCAPSII with a PC and register a new system project. This is necessary in order to enter, edit and verify the program. You will also make settings for the communications port of the PC.

7.1  Starting the System Manager

WINCAPSII consists of the following functional modules:

• PAC Program Manager
• Variable Manager
• DIO Manager
• Arm Manager
• Vision Manager
• Log Manager
• Communications Setting Manager

System Manager enables overall control of these functional modules. All functions in WINCAPSII may be called up from the System Manager.

To use the PC teaching system, first start the System Manager as follows:

**Step 1  Selecting System Manager**

1. From the Start button, access [System Manager] in the WINCAPSII folder.

**Caution**

• When starting System Manager first time after installation, you need to specify the file name of the program bank. The "Create a New Program Bank" dialog may appear as necessary. Refer to the WINCAPSII GUIDE, Chapter 5, Subsection 5.6.2.3 "Updating the program bank."

• When starting the System Manager for the first time, the Create New Project dialogue box appears because no system project has been defined yet. In this case, you must first perform "7.2 Registering a new system project" before proceeding to Step 2.
Step 2  Selecting the user level

1. Select the user level from the pop-up menu.
2. Type the password if necessary.
3. Press [OK].
4. Click [No].

★Point★

Shown below are the startup buttons of the functional modules on the tool bar.

The System Manager starts and the [System Manager] window appears. The buttons with icons are for starting each functional module.
7.2 Registering a new system project

WINCAPSII controls more than one robot program in units of a project. To run a single robot, a set of combined programs will usually be used. Therefore, it is convenient to manage these programs as a set in one project.

For creating a robot program, first you should register a new project.

**Caution:** When starting the System Manager for the first time, the [Create New Project] dialog box will appear, so first carry out "New Project Registration" before proceeding to Step 2 of "7.1 Starting the system manager".

**Step 1** Selecting "New Project" from [File] menu

1. Click here.

**Step 2** Registering a new project

1. Select YR-UPJ3-B00
2. Select 0-Standard.
3. Enter the desired project name. (In this example, enter "IRA-000").
4. Specify the folder name.
5. Click [OK].
7.3 Setting the communications port of the PC

Make the WINCAPSII communications settings the same as those of the robot controller.

**Step 1** Calling up the [ROBOTalk Manager] dialog box

1. Click on the [Communications Setting] button.

**Caution** If you have not yet entered the password, the [Password] dialog box will appear. You need to select the user level and enter the password. (Refer to "7.1 Starting the system manager").

**Step 2** Setting the communication device and optional settings

2. Click the [ROBOTalk] tab.
3. Click here to select RS232C.
4. Make optional settings with these switches. In this example, set the Timeout at 4000 msec, Retry at 5 times and Communication Retry at 5 times.

**Caution** If timeout occurs during data transmission, adjust the timeout to a longer period.

**Step 3** Setting the RS232C communications options

5. Click on the [RS232C] tab.
6. Click on [Normal]. The Optional Settings box changes to normal settings.
7. Click on [OK]. The settings become effective and the [ROBOTalk Manager] closes.
★Caution★ When making settings other than the normal settings, ensure the settings match the specifications of the robot controller or PC being used.

★Caution★ If [OK] is disabled, set the [Connect] button for all managers to OFF. If any of the managers is connected, it will not be possible to change the communications settings.

Once performed, the WINCAPSII communications settings will remain effective until you change them again. You do not need to perform the settings each time you start WINCAPSII. Just click on [Yes] in response to the [Resume connection?] dialog message that appears when WINCAPSII is started up. If you click on [No], no automatic settings will be made.
Lesson 8  Defining Macros

In this lesson you will create macro definition files by defining names and applications of variables and I/Os.

Step 1  Creating a variable macro definition file

1. Click on the Variable Manager button to start up the Variable Manager.

2. The [Variable Manager] window appears.

3. Click on the [Type P] tab.

4. Double click on each box and enter the usage and macro names of the variables. In this example, enter position variables P10 to P13.

5. Click on [Make Macro Definition File].

6. Press [OK]. The macro definition file is now created.

7. Click here to exit Variable Manager.
Step 2 Making an I/O macro definition file

1. Click on the DIO Manager button to start up the DIO Manager.

2. Double click on each box and enter the usage and macro names of the I/Os.

3. Click on [Make Macro Definition File].

4. Press [OK]. The I/O macro definition file is now created.

5. Click [Close] to exit DIO Manager.
Lesson 9  Inputting and Editing Programs

9.1  Sample program

Before starting the program input procedure, take a look over the coding list sample below. Read through the process to get an understanding of the motion, while referring to the comments to the right.

Coding List "PRO1"

```plaintext
'!TITLE "Pick & Place"
#INCLUDE "dio_tab.h"  'Reads the DIO macro definition file.
#INCLUDE "var_tab.h"  'Reads the variable macro definition file.

PROGRAM pro1
    TAKEARM
    SET IO[ioComplete]
    MOVE P, P[pHome], S=50
    SPEED 100
    APPROACH P,P[pPick],200
    MOVE P,P[pPick]
    GOSUB *ChuckItem
    DEPART P,200
    APPROACH P,P[pPlace1],200
    MOVE P,P[pPlace1]
    GOSUB *UnchuckItem
    DEPART P,200
    SET IO[ioComplete]
    GIVEARM
END

' ===== Parts chuck =====
*ChuckItem:
    SET IO[ioChuck]
    RESET IO[ioUnChuck]
    RETURN

' ===== Parts chuck =====
*UnchuckItem:
    RESET IO[ioChuck]
    SET IO[ioUnChuck]
    RETURN
```

'Acquires arm semaphore.

'PTP control to home position at 50% internal speed

'Changes to 100% speed.

'Issues a motion complete signal.

'Releases arm semaphore.
9.2 Opening the program edit window

To input and edit task programs, use the Program Manager which is called up from the System Manager.

**Step 1** Starting PAC Program Manager

![Image of PAC Program Manager window]

1. Click on the PAC Program Manager button to start the PAC Program Manager.

**Step 2** Opening the program edit window

![Image of new edit window]

2. Click on the [New Program] button.

A new edit window appears.
9.3 Inputting program codes

Step 1  Typing the program title

1. Type the program title. (In this example, type “Pick & Place”.)

Step 2  Typing the program name

2. Type the program name. (In this example, type “pro1”.)

Step 3  Inputting the program codes

3. Input the “Pick & Place” program codes.
9.4 Using the command builder

You may input program codes to the program edit window by using the keyboard, just as with a word processor. However, the Program Manager is provided with the command builder function, allowing you to enter commands with ease. This section describes how to enter commands using the command builder.

Step 1 Selecting the command builder

Step 2 Using the command builder

- Select [Command Builder] from the [Tools] menu.
- Click on the [Class Selection] list in the [Command Builder] window and select "Input/output control" statements from the list.
- Using the scroll bar in the Input/output control statements, scroll down to display the [RESET] command.
- Click on the [RESET] command.
- Double click on the [I/O variable] Set Value box.
- Type "ioUnchuck" in the [I/O variable] Set Value box using the keyboard.
Step 3 Editing program codes for ease of clarity

Caution To save the edited program, proceed to the procedure described in the following section "9.5 Saving the program".
9.5 Saving the program

In this section, you will save PRO1, the program created in the previous section "9.4 Using the command builder".

**Step 1 Selecting [Save]**

1. Select [Save] from the [Program] menu.

**Step 2 Entering the file name**

2. Enter the file name in the [File name] box. In this example, enter "pro1" as the file name. (The extension is attached automatically.)

3. Click [Save]. The program source file "pro1.pac" is saved.

The file name of the [PAC Manager] window changes to "pro1.pac". This completes the inputting and saving procedure of program "pro1".
Lesson 10  Compiling the Program into Run-time Format

To execute a program written in PAC language, it is necessary to convert (compile) it into run-time format so it is executable by the robot controller. The compiled program is referred to as an execution program.

Step 1  Compiling the program into run-time format

All the programs included in the currently selected project are converted to execution programs. The record of the compiling process is displayed in the message pane of the [PACManager] window.

Step 2  Checking that no error has occurred

If an error is showing, return to "Lesson 9 Inputting and Editing Programs" and check for syntax errors.
Lesson 11  Uploading the Program (PC → Robot controller)

At present, the execution program complied in Lesson 10 is still in the PC. To run the program, it is necessary to transmit (upload) it to the robot controller.

Since you have already made communications settings on both the robot controller and PC in Lesson 6.2 and Lesson 7.3, respectively, you may now upload the program to the robot controller.

**Step 1** Establishing communications link between the Program Manager and robot controller

1. From the File menu, select [Transfer Project.]

**Step 2** Selecting the program to be uploaded

"Local" refers to the PC side and "Remote" to the robot controller side.

2. Click on [Select All].
Step 3  Uploading the selected program

The program file is now uploaded to the robot controller.
Part 4  Simulating the Robot Motion on a PC with the Program Created

In Part 4, you will:

Run the program, which you have created on a PC and uploaded to the robot controller, in machine lock in order to simulate the robot motion on the PC screen.

Simulation allows you to verify the program before actually running the robot, helping you improve safety and the efficiency of program development.

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Lesson 12
Preparing the PC for Simulation

You will start up WINCAPSII Arm Manager, which is necessary in order to simulate the robot motion on the PC screen.

Lesson 13
Assigning the Current Position Values to Position Variables

You will assign the values to the position variable representing where the robot arm is to move to.
(1) Move the robot arm to the specified position with manual operation.
(2) Read in the current position to the position variable.
(3) Modify the value assigned to the position variable if necessary.

Lesson 14
Test-running the Program

Start a single-cycle run and check the robot motion.

Lesson 15
Monitoring and Manipulating the I/Os

Continue the program to the next step by manipulating the I/Os being used by the interlock in the program.

Lesson 16
Monitoring and Manipulating Variables

Check the contents of the variables being used by the program.

Lesson 17
Continuous Run for Testing

Run the program with Continuous Run.
Lesson 12  Preparing the PC for Simulation

You will start Arm Manager and establish the communications link with the robot controller.

12.1 Starting Arm Manager

You need to start Arm Manager in order to display the simulated robot images. The Arm Manager is called up from the System Manager.

Step 1

1. Click the [Arm] button.

12.2 Establishing the communications link with the robot controller in Arm Manager

You establish the communications link with the robot controller so that the PC may always exchange data with the robot controller.

Step 1

1. Click on the [Connect] button. (The [Connect] button appears depressed.)

2. Click on the [Monitor] button. (The [Monitor] button appears depressed.)

The communications link is established between Arm Manager and the robot controller, enabling data exchange between them. The current robot position is displayed in the [Current Robot Position] window.
Lesson 13 Assigning the Current Position Values to Position Variables

Before running the program, it is necessary to determine the values to be assigned to the respective position variables "pHome", "pPick", "pPlace1" and "pPlace2" for the program which you created in "Lesson 9 Entering and Editing Programs" of Part 3 "Creating a Program on a PC in WINCAPSII". In this lesson you will enter the values from the teach pendant through "Point Teaching".

★Caution★ Refer to "Lesson 8 Defining Macros" for each of the position variable numbers for "pHome", "pPick", "pPlace1" and "pPlace2".

13.1 Simulating the robot motion manually

While monitoring the simulation images displayed in Arm Manager, move the robot arm manually to the position values assigned to the "pHHome" position variable, according to the procedure given below.

**Step 1** Placing the robot in Manual mode and displaying the current robot position

1. Set the mode selector switch to the MANUAL position to switch to Manual mode.

2. Press [LOCK].

Step 2 Moving the robot arm

While monitoring the robot simulation image, move the robot arm to “pHome” using the deadman switch and the arm traverse keys so that the following values will apply:

- J1: Approx. 40°
- J2: 0° (no move)
- J3: Approx. 100°
- J4: 0° (no move)
- J5: Approx. 70°
- J6: 0° (no move)

Step 3 Checking the current position

Check the position of each axis in the [Current Robot Position] window.
13.2 Getting the current position into a position variable

Let's get the current position, to which the robot arm has moved in Arm Manager, into a position variable.

There are the following three ways to get the current position into a position variable:

1. Using the [Position Variables] window on the teach pendant
2. Using the program edit window (coding list) on the teach pendant, in which you get the current position into a position variable defined in the specified program
3. Using the operating panel

[1] Using the [Position Variables] window on the teach pendant

Step 1 Calling up the [Position Variables] window

2. On the [Select Variable Type] window, press [F4 Pos.].

The [Position Variables] window appears.
Step 2  Getting the current position into a position variable

Using the jog dial or cursor keys, select "P10" box.

Press [F6 Get Pos.].

Step 3  Getting other arm positions into position variables

Press [OK].
This gets the current position of the robot arm into position variable P[10].

Press [Cancel] twice.
The display returns to the [Robot Current Position] window.

Go back to Step 2 "Moving the robot arm" in Lesson 13.1.

As in Steps 1 and 2, get other arm positions.
[2] Using the program edit window (coding list) on the teach pendant, in which you get the current position into a position variable defined in the specified program

**Step 1**
Calling up the Program List window

- Set the mode selector switch MANUAL.

- On the top screen, press [F1 Program] to call up the [Program List] window.

**Step 2**
Selecting the target program

- Select the target program.

- Press [Display.] or [F5 Edit.] to show the coding list.

**Step 3**
Selecting the program line containing the target variable

- Select the line containing the target variable.

- Press [GetPos.].
Step 4  Getting the current position into a variable contained in the line

If the program line contains a single variable candidate, the system message will appear as shown below.

1. Press [OK]. This gets the current position into the variable.

If the program line contains more than one variable candidate, the system message will appear as shown below. Select the desired variable.

2. Select the desired variable by using the cursor keys or jog dial.
3. Press [OK]. This gets the current position into the selected variable.

If a variable(s) contained in the selected program line is not appropriate, no variable will be displayed as a candidate for teaching.

Only the heading three variables in the program line will be displayed as a candidate.
[3] Using the operating panel

Step 1  Switching to the Manual mode

Turn the mode switch to the MANUAL position and check that its LED comes on.

Step 2  Entering the function selection mode

Press the SHIFT key and check that its LED comes on.
Then press the BRAKE release/STEP-STOP key to make the operating panel enter the function selection mode.

Step 3  Choosing the get-position function

Use the ▲ and ▼ cursor keys to choose the desired function.

To get the current position into: Choose:

- Position variable  [F7: Set CurPos P]
- Joint variable  [F8: Set CurPos J]
- Trans. variable  [F9: Set CurPos T]

After choosing the desired function, press the OK key.
Step 4  Choosing a target variable number

Use the numerical keys to enter a variable number into which you want to get the current position.
Press the OK key. (To cancel the number you entered, press the Cancel key. The LCD returns to Step 3.)

Step 5  Getting the current position

The LCD shows [SetCurrentPos?].
Press the OK key. (To cancel the operation, press the Cancel key. The LCD returns to Step 4.)
Upon completion of getting of the current position, the LCD shows [Set VarVal OK].
13.3 Editing position variables

You may edit position variables as required. As a simple example, you will modify the value assigned to a position variable.

The teach pendant displays the Position Variables window as shown below.

**Step 1**

**Selecting Position Variables**

1. Using the jog dial or the cursor keys, select the [X] column of position variable "P13".

2. Press [F5 Change.]. The numeric keypad appears as shown below.

**Step 2**

**Modifying the value assigned to "P12"**

1. Using the numerical keys on the numeric keypad, enter a new value.
   As an error will result if you enter too different a value, enter "319" which is close to the original value.

2. Press [OK]. "319" is entered into the [X/T] column of position variable "P13".

**Returning to the top screen**

3. Press [Cancel] 3 times to return to the top screen. This completes the editing of position variables.
Lesson 14  Test-running the Program

You will test-run program "PRO1" by a single-cycle run.

14.1 Loading the program

Even if you load a compiled program from the PC to the robot controller, the controller cannot execute it. The program needs to be loaded to the memory area where it can be executed.

**Step 1  Displaying the load screen**


**Step 2  Loading the project**

1. Press either the [F1 Load!] button or [Load!].
Returning to the top screen

③ Check the system message and press [OK].

Upon completion of loading, the screen returns to the [Setting (Main)] window.

⑤ Press [Cancel] to return to the top screen.
14.2 Starting the program

Now you will place the robot controller in machine lock and start the loaded program by a single-cycle run in order to simulate the robot motion on the PC screen.

The program will come to a halt and wait for part supply confirmation I/O signals; however, proceed to the following step as you will manipulate I/Os in Lesson 15.

**Step 1**  
Displaying the Program List window in Teach Check mode

1. Set the mode selector switch to TEACHCHECK. (The robot controller enters the Teach Check mode.)
2. Check that the mode icon at the top left of the screen has changed to ![icon].
3. Press [LOCK] to place the robot in machine lock. Check that the [LOCK] LED has come on.

**Step 2**  
Selecting the program to start it

5. Select the "PRO1" line.
6. Press [F4 CycStart].
7. Check the system message.
8. Press [OK]. "PRO1" runs a single-cycle.
Lesson 15  Monitoring and Manipulating the I/Os

Cycle-started program "PRO1" is now on halt, waiting for the macro I/O "ioParts" for confirming parts supply.

In this lesson, to test the program, you will use the I/O Manager for monitoring and manipulating the I/Os to continue program execution.

Note: Refer to "Lesson 8 Defining Macros" for the I/O numbers of "ioParts".

15.1 Starting the DIO Manager and establishing the communications link with the robot controller

You will start the DIO Manager and establish the communications link with the robot controller so that the PC may always exchange data with the robot controller.

Step 1  Starting the DIO Manager

Click on the [I/O] button in the System Manager window. The [DIO Manager] window appears.

Step 2  Connecting with the robot controller to start continuous monitoring

Click the [Connect] button in the DIO Manager window. The [Connect] button appears depressed.

Click on the [Monitor] button. The communications link is established between the DIO Manager and robot controller, enabling data exchange between them. The [Monitor] button appears depressed.
15.2 Monitoring the I/Os

You will monitor the I/Os with the DIO Manager.

The DIO Manager can show the I/O status in three types of display formats—table type, oscilloscope type, and panel type. In this lesson, use the table type display to check "ioParts" on I/O No. 34.

The table type display is just like a list and appears initially when you open the [DIO Manager] window. If the display is in any other display type, select the table type from the [Variable Scope] list.

**Step 1** Displaying the I/Os

1. Scroll down the [DIO Manager] window to display I/O No. 34. (Use the scroll bar at the right side of the window to scroll.)

**Step 2** Setting the monitor type

2. Click the [Continuous Monitor] button in the [DIO Manager] window to set the monitor to OFF. (It is not possible to change the set contents while the monitor is set to ON.)

3. Double-click on the [Monitor] box of I/O No. 34 that is displayed in the DIO Manager window. The setting in the [Monitor] box changes from "OFF" to "ON" making it now possible to monitor I/O No. 34.

4. Click on the [Continuous Monitor] button to set the monitor to ON. The "State" of I/O No. 34 is displayed as "ON" or "OFF", according to the changes made to the I/O.

In this example, the "ioParts" for I/O No. 34 is displayed as "OFF".
15.3 Turning the I/O dummy switches ON/OFF

In DIO Manager, you may falsely turn the I/Os on or off. The program PRO1 "PICK & PLACE" is waiting for I/O No. 34 "ioParts" to turn ON and will not proceed to the next step in this status. By managing the I/O falsely, you may perform the operation test.

**Step 1**

**Stopping monitoring**

1. In the [DIO Manager] window, check that the [Monitor] box for I/O No. 34 is set to "ON".

2. Click here to set the [Continuous Monitor] to "OFF".

**Step 2**

**Setting the dummy switch**

3. Double-click the [Dummy SW] box of I/O No. 34 in the [DIO Manager] window to set it "ON".

4. Double-click the [State] box of I/O No. 34 to set it "ON".

5. To enable the dummy I/O:
   - Click the [Dummy I/O] button in the DIO Manager window.
   - The [Dummy I/O] button appears depressed.

The program recognizes I/O No. 34 "ioParts" as being "ON", so it proceeds onto the next step. If no problem is detected, the program will run through to the end and stop.
Lesson 16  Monitoring and Manipulating Variables

The Variable Manager allows you to monitor variables.
In this lesson, you will examine the integer variable [0] of macro "iParts", which is used in the operation count.

NOTE: Refer to "Lesson 8 Defining Macros" for the variable number 0 of "iOParts".

16.1 Starting the variable manager and establishing the communications link with the robot controller

Start the Variable Manager and connect communications so that data exchange is constantly performed with the robot controller.

**Step 1  Start the Variable Manager**

1. Click on the Variable button in the [System Manager] window.

   - The [Variable Manager] window appears.

2. Click on the [Connect] button to establish the communications link with the robot controller.
   - The [Connect] button appears depressed.

3. Click on the [Continuous Monitor] button to start continuous monitor.
   - The [Continuous Monitor] button appears depressed.

The above process has established the communications link so that the PC may always exchange data with the robot controller.
16.2 Monitoring variables

Establishing the communications link with the robot controller allows you to monitor the variables used in the robot controller.

Step 1  Displaying the variables

Scroll down the [Variable Manager] window to display integer variable [0]. To do so, use the scroll bar at the right side of the window.

The [Value] column for integer variable [0] reflects the changes made to the variable.
Lesson 17  Continuous Run for Testing

Up to the previous lesson, you have checked the PRO1 with a single-cycle run. Continuous run makes the robot perform the programmed motion repeatedly. If I/O No. 34 "ioParts" is kept at ON with the dummy switch, continuous run is possible even if no actual entry is given to I/O No. 34.

Before actually running the robot, place the robot controller in machine lock and conduct a continuous run for testing while monitoring the simulated robot images in the Arm Manager. Here we will assume that I/O No. 34 "ioParts" remains ON from the preceding section.

17.1  Continuous run

Start the Variable Manager and establish the communications link with the robot controller so that the Variable Manager may always exchange data with the robot controller.

Step 1  Displaying the Program List window in Auto mode

1. Set the mode selector switch to AUTO.
2. Check that the mode icon at the top left of the screen has changed to [ ].
3. Press [F1 Program] on the top screen to display the [Program List] window.

Step 2  Selecting a program to be executed

4. Select the "PRO1" line.
5. Press [F4 Start.].
Step 3 Continuous run

The "Single-cycle" and "Continuously" selection screen appears.

Select [Continuously] and press [OK]. "PRO1" will start a continuous run.

17.2 Continuous monitoring of the I/Os

In this section, you will monitor the I/O status during the continuous run with the DIO Manager. The DIO Manager has three types of I/O display formats--table type, oscilloscope type, and panel type.

When the [Monitor] button is pressed, the I/O status with the [Monitor] box "ON" is displayed continuously in real time.

You will monitor the I/Os used in the program.

The DIO Manager that was opened in Lesson 16 should have remained open. If closed, however, click on the [Variable] button in the System Manager to start it.

Table Type

The table type I/O display format is similar to the list that initially appears when you open the DIO Manager.

If the display is other than the table type, select the table type from the [Display Switch] list.

Scroll down the [DIO Manager] window to display I/O Nos. 34 to 36. (Use the scroll bar at the right side of the window to scroll.)

Double-click on the [Monitor] boxes for I/O Nos. 34 to 36 displayed in the [DIO Manager] window to set them to "ON". The [State] box display changes to "ON" or "OFF" according to the changes made to the I/O.
Oscilloscope Type
You can visually monitor the I/O status with [Monitor] turned "ON" just as you watch an oscilloscope in the table type display of the [DIO Manager] window.

Proceed with the following operation, continuing on from that described in the previous lesson.

Panel Type
With the DIO Manager, the I/O statuses can also be displayed as a panel type display.
Here you will display the I/O statuses of which the [Monitor] is "ON" in the table type format.
17.3 Stopping the running program

Up to this point, you have checked continuous run of "PRO1". Before continuing onto Part 4, stop the running program.

1. Press [STOP]
   The program stops instantly and the [Status] box of the program changes from "Running" to "Cont.Stp."

2. Press [SHIFT] and then [F7 ProgRst.].

3. The Reset Program window appears. Choose "Reset this program" and press [OK].

The [Status] box shows "On halt" and the programmed operation stops.
Part 5
Running the Robot Using Programs

In Part 5, you will:

- Run the robot using a program.
- Learn palletizing, which is one of the main applications on 4-axis robots, and related programming.
- Learn how to effectively use PAC libraries, which are the easiest way to develop robot programs.

Lesson 18 Running the Robot in Practice

18.1 Releasing machine lock  
18.2 Setting robot speed and acceleration  
18.3 Turning the drive motor ON  
18.4 Teaching  
18.5 Starting programs  
18.6 Changing the robot speed  
18.7 Stopping the robot in continuous running  
   ▪ Making the program [Continue Stop] and [Continue Start]  
   ▪ Stopping the program completely ([Program Reset])

Lesson 19 Palletizing

19.1 What is Palletizing  
19.2 Simplified Palletizing

Lesson 20 Using Libraries Effectively

20.1 Program bank  
20.2 Importing programs

Lesson 21 Terminating the Session

21.1 Terminating WINCAPSII and shutting down the PC  
21.2 Turning the robot controller OFF
Lesson 18  Running the Robot in Practice

You learnt how to check program operation in Parts 1 to 4. In Lesson 18, let's practice running the robot using programs.

First of all, you should perform a safety check. Then set the robot at a low speed and run it slowly to check its motion.

You should also test-run the robot using dummy I/O signals. In this lesson you will connect the actual hardware to the robot controller and check its motion.

Refer to the INSTALLATION & MAINTENANCE GUIDE for details on setting up your hardware.

18.1 Releasing machine lock

Step 1

1. Press [LOCK].
2. Check that the green LED on the [LOCK] button comes on.

This releases machine lock.
18.2 Setting robot speed and acceleration

Step 1

1. Press [SPEED].

Step 2

2. Press [F2 10%].

The set values appear in the [SPEED], [ACCEL], and [DECEL] fields.

3. Press [OK] to accept these settings.

The [Set Speed] window appears.

This completes the procedure for setting the speed and acceleration of the robot.
18.3 **Turning the drive motor ON**

**Step 1**

1. Press [MOTOR].
2. Check that the LED on the [MOTOR] button comes on.

The power to the motor is now on.
18.4 Teaching

You entered values for the position variable values in Lesson 13 "Assigning the Current Position Values to Position Variables", but positioning in the Arm Manager will not necessarily be exact. You will need to perform repositioning here by using the robot in practice, and assigning accurate values to the position variables.

You will follow almost same as that described in Lesson 13 "Assigning the Current Position Values to Position Variables"; however, here you have to enter actual values observing the current robot position and figure, not to seek the position representing the target values.

**Step 1** Selecting Manual mode and displaying the current robot position

1. Set the mode selector switch to MANUAL to switch the robot to Manual mode.

2. Press [MOTOR].


**Step 2** Moving the robot arm

The [Current Robot Position] window appears. Leave position display in Joint mode.

4. Move the robot arm up to [pHome] position using the arm traverse keys, while watching the robot motion.

5. Press [F4 Var.].
Step 3  Displaying position variables

- Press [F4 Pos.].

Step 4  Getting the current robot position into position variables

- Select the right column in [P10] by using the jog dial or cursor keys.
- Press [F6 Get Pos.].
- Check the system message and press [OK]. This gets the current position into position variable [P10].
Step 5  Getting other position values into position variables


Repeat Steps 2 to 4 to get the position data to [P11], [P12] and [P13] into other three variables [pPlace1], [pPlace2] and [P13], respectively.

Step 6  Returning to the top screen

After finishing all of the above procedures, press [Cancel] to return to the top screen.
18.5 Starting programs

You will now actually run the robot using a program.

Caution: Always keep one hand free, ready to press the STOP key.

**Step 1** Switching to Auto mode to display the program list window

1. Set the mode selector switch to AUTO to switch the robot to Auto mode.
2. Press [F1 Program].
4. Select the [PRO1] line.
5. Press [F4 Start].

**Step 2**

   - The task program [PRO1] will start in single cycle.

**Step 3**

If you select [Continuously] instead of [Single-cycle], the robot will start in the continuous mode.

If operation in single cycle mode is successful, try operation in the continuous start mode.
18.6 Changing the robot speed

Let the robot run faster by gradually changing the speed settings if you have been successful in both the single cycle run and continuous run.

**Step 1**

1. Press [SPEED].

**Step 2**

1. Turn the jog dial to select the desired speed. When a value is set in the [SPEED] column, default values will be automatically entered in the [ACCEL] and [DECEL] columns.
2. Press [OK].

Robot speed, acceleration and deceleration are now set.
18.7 Stopping the robot in continuous running

If you stop the robot during continuous running by pressing the [STOP] button, the robot will change to [Continue Stop] status. In this state you can restart the program from the line where the program stopped.

If you want to abort the program completely, you need to perform [Program Reset].

**Caution:** In emergencies, press the Robot Stop button.

### Making the program [Continue Stop] and [Continue Start]

#### Step 1

**Making the task program [Continue Stop]**

1. Press [STOP].

The program stops immediately and [Cont. Stp.] will appear in the [Status] column.

#### Step 2

**Making the program [Continue Start]**

2. Press the Shift button.
Now you are ready to restart the program.

③ Press [F10 Continue].

④ Press [OK].

The program restarts and [Running] appears in the [Status] column.
■ Stopping the program completely ([Program Reset])

Step 1 Making the program [Continue Stop]

1. Press [STOP].

The program stops immediately and [Cont. Stp.] appears in the [Status] column.

Step 2 Resetting the program ([Program Reset])

2. Press the Shift button.

Shift
The program(s) is (are) now aborted.

1. Press [F7 ProgRst.].
2. Select the program you want to abort.
   - If you select [Reset this program], only the current program will be aborted.
   - If you select [Reset all programs], all programs will be aborted.
3. Press [OK].
4. The program(s) is (are) aborted and [On halt] is displayed in the [Status] column.
Lesson 19  Palletizing

19.1 What is palletizing?

Palletizing refers to placing parts in/removing parts from a partitioned pallet (shown below) in programmed order.

You can easily use library programs for palletizing. To use these programs you have to only know the number of partitions provided in the pallet and the positions of each of the 4 corners of the pallet, and teach this information to the robot.

The palletizing programs update the partition information as each position is called to enable the robot to know which partition it should place the next part in/remove the next part from.

Figure 19-1  Partitioned pallet
Palletizing Program "PRO1"

Using the library, you can find a typical procedure to build a program in program "PRO1" under the title "Palletizing template 2," although there would actually be many different possible programs for palletizing depending on the applications and the circumstances in which they are being used.

Use this "palletizing template 2" effectively as your template by adding/deleting the items necessary for your applications.

Listed below is a sample template program named "PRO1."

This sample template assumes that

- the palletizing points should be at P50 to P55, and
- the program to be built would control the robot to move to the position P50 which is the work pick-up position, to run the palletizing program "0", to move to the position P51 which is the work piece mount position, to unchuck the work piece, to check end of the pallet, to replace the pallet if end of work signal detected and if needed, and to end the program if no work piece remains.

When you create "New Project" by selecting "Palletizing" in "Device Type," the system manager will automatically register the "Palletizing template 2" with program name "PRO1" and the "Palletizing initialization template 1" with program name "PRO2."

```
' !TITLE "Palletizing Template 2"

#DEFINE pltIndex    0    ' Index of palletizing program
   ' Able to select any number between 0 and 30.
#DEFINE ChuckNG    40    ' Number of pick-up check IO
   ' Able to select any positive integer.

PROGRAM PRO1
   ' Rename PRO1 as desired.
   MOVE P, P50    ' Move to the position P50.
   ' Move to the palletizing position P50.
   IF IO[ChuckNG] = ON THEN
      CALL pltDecCnt(pltIndex)    ' Check status of previous picking-up.
      ' Subtract by 1 for the total counter.
   END IF
   CALL pltMove(pltIndex)    ' Execute palletizing 0.
   MOVE P, P51    ' Move to the mount position P51.
   ' Move to the palletizing position P51.
   '<--- Insert unchucking or other operations here --->
   CALL pltGetPLT1END(pltIndex,0)    ' Acquires the end of 1st pallet signal on I[0].
      ' Second index "0" is the column/row number of "I" checked in the next line.
   IF I[0] THEN
      '<--- Insert pallet replacing or other operations here --->
      CALL pltResetPLT1END(pltIndex)    ' Clears the end of 1st pallet signal.
   END IF
END
```

Figure 19-2 Program [PRO1], "Palletizing Template 2"
Palletizing parameters

Figure 19-3, 19-4, 19-5 and Table 19-1 show the parameters needed for palletizing.

PAC language retains these parameters as value sets of variables.
Table 19-1 Parameters needed for palletizing

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Name</th>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palletizing number</td>
<td>Index of palletizing</td>
<td></td>
<td>None (Integer)</td>
</tr>
<tr>
<td>N</td>
<td>No. of row parts</td>
<td>Number of partitions from P1 to P3</td>
<td>Count (Integer)</td>
</tr>
<tr>
<td>M</td>
<td>No. of column parts</td>
<td>Number of partitions from P1 to P2</td>
<td>Count (Integer)</td>
</tr>
<tr>
<td>K</td>
<td>No. of stacked pallets</td>
<td>Number of stacked pallets</td>
<td>Count (Integer)</td>
</tr>
<tr>
<td>H1</td>
<td>Approach clearance</td>
<td>Approach clearance where the robot approaches a pallet</td>
<td>mm (Single precision FPT)</td>
</tr>
<tr>
<td>H2</td>
<td>Depart clearance</td>
<td>Departure clearance where the robot departs from a pallet</td>
<td>mm (Single precision FPT)</td>
</tr>
<tr>
<td>H3</td>
<td>Height of a pallet</td>
<td>Height of a pallet</td>
<td>mm (Single precision FPT)</td>
</tr>
</tbody>
</table>

Where H1 and H2 satisfy the conditions below.

\[
H1 > (\{H3 \times K-1\})+5 \\
H2 > (\{H3 \times K-1\})+5
\]

P1 P2 P3 P4 Positions of the 4 corners of the pallet as shown in Figure 19-3.

It is not possible to exchange the relative positioning of any of the corners.

The robot maintains its orientation from where the position P1 was taught previously, for all points in the program.

N  Number of partitions in row
Expresses the number of partitions in each row of the pallet.
If this is 3, it reflects 3 rows as in the example in Figure 19-3.

M  Number of partitions in column
This expresses the number of partitions in each column of the pallet.
If this is 5, it reflects 5 rows as in the example in Figure 19-4.

K  Number of stacked pallets
This expresses the number of pallets in the pallet stack.
If this is 3, it reflects 3 stacked pallets as in the example on Figure 19-5.

H1  Approach clearance
Expresses the length of the approach path as the robot approaches the pallets.
A program applies the single approach path length at every call of the same palletizing program.

H2  Departure path clearance
Expresses the length of the departure path as the robot departs from the pallets.
A program applies the single departure path length at every call of the same palletizing program.

H3  Pallet unit heights
Expresses height of each pallet.
For every pallet added to a stack, a plus unit value is added.
For every pallet removed from a stack, a minus unit value is added.
If the stack is not changed, 0 is added.
**Caution:** H1 and H2 shall satisfy the conditions below.

\[
\begin{align*}
H1 &> \{H3 \times (K-1)\} + 5 \\
H2 &> \{H3 \times (K-1)\} + 5
\end{align*}
\]

If not, an error will occur during initializing. These restrictions ensure the robot does not crush the pallet in operation by ensuring the robot approaches or departs from the stacked pallets at 5 mm higher than the topmost pallet in a stack.

As shown in Figure 19-6, changing stack height does not affect the approach/departure points of the robot in same palletizing program.

![Figure 19-6](image)

**Figure 19-6** Relationship between the stack height and approach/departure points

**Four corner points P1, P2, P3 and P4**

These points represent the parts position for each of the 4 corner partitions of the pallet. Figure 19-7 depicts in what order the robot palletizes these parts.

![Figure 19-7](image)

**Figure 19-7** Palletizing order
Setting palletizing parameters

To set the parameter values such as the number of row and column partitions and the number of pallets in a stack, first call the "pltInitialize" module from the program library.

If you select [1-palletizing] in [Device type] in the [New project] dialog box when you want to create "New system project," the System Manager will automatically register the program "PRO2" titled "Palletizing initialization template 1" in the library. Since this program is to call "pltInitialize" module, modify the values of the indexes in the CALL statement to the ones you want to use.

```
"TITLE "Palletizing initialization template 1"
#DEFINE pltIndex 0

PROGRAM PRO4
  CALL pltInitialize(pltIndex, 3, 5, 3, 50, 50, 10, 52, 53, 54, 55) 'Initializing palletizing No. 0.
END
```

**Figure 19-8 Library program "Palletizing initialization template 1"**

**Figure 19-9 Parameters of "pltInitialize"**

You can also find descriptions on the above parameters in the "Command builder" tool provided in the PAC Manager of WINCAPSII.
Palletizing Counter

In palletizing, the robot counts the number of partitions as they change and retains the counts in the variables.

There are four types of counters; number of partitions in the row (N), number of partitions in the column (M), number of stacked pallets (K) and total (cnt).

These counters are defined in “pltKernl” which is the kernel program for controlling palletizing operation.

The library program “pltMove” adds 1 to the total counter every time a palletizing operation is completed and aligns the values of the other counters.

The library program “pltDecCnt” subtracts 1 from the total counter every time it is called and aligns each counter.

You can create up to 30 palletizing programs as the initial setting. Therefore, the system may provide 31 sets of the palletizing counters.

Count Rules

The palletizing counter adds 1 to the total counter every time “pltMove” is run and aligns the counts of the other counters so as to ensure the next pallet position.

If adding 1 to the total counter, the position of the pallet column indicated by the column counter (M) moves to the next column. If the pallet column position indicated by the column counter (M) reaches the end and becomes the maximum count, then the row counter (N) counts up by 1 to indicate the next row of the pallet and the column counter (M) becomes its minimum value. If the position of the row counter (N) reaches the end of the pallet row partition and becomes the maximum value, the stacked pallet counter (K) counts up by 1 and the row counter (N) becomes the set minimum value.

If you halt a palletizing program during operation and restart it, the robot moves to the next partition because the value of the counter variable is added to.

The system retains the contents of the palletizing counter even if the power is turned off. Unless you initialize the system after restarting, the robot will proceed to palletize from the previous counter value.

Caution: When you compile a new task program and load its run time module the system will automatically initialize the values of all variables.
If counts are N=3, M=5 and K=3,
position a is at (N=1, M=1 and K=1)
position b is at (N=2, M=2 and K=2)
position c is at (N=3, M=4 and K=3)

**Figure 19-10** Relationship between palletizing position and counters

### Initializing the Counters

When you replace any pallets or do not want to use any partitions, you need to initialize all of the counters.

The systems substitute 1 into all of the counters to initialize them.

If you use the library program "pltResetAll" you can initialize all the palletizing counters at once.

For example, if you want to initialize all counters for pallet number 1, write as follows.

```
CALL pltResetAll(1)
```

If you want to initialize each palletizing counter independently, use the library programs "pltLetN1," "pltLetM1," "pltLetK1" and "pltLetCnt."

For example, if want to initialize the N counter for pallet number 1, write as follows.

```
CALL pltLetN1(1,1)
```

**Caution:** The second argument is the value to substitute into the N counter. You can also choose any number instead of 1.

### Ending palletizing program process

Upon finishing the palletizing for one of the stacked pallets or for the whole pallet stack, the palletizing program sets a stacked pallet end flag or whole pallet stack end flag, respectively.

To obtain the one stacked pallet finish flag status, use the library program "pltGetPLT1END." To obtain the whole pallet stack finish flag status, use the library program "pltGetPLTEND."

To reset the one stacked pallet finish flag to (0), use the library program "pltResetPLT1END." To reset the whole pallet stack finish flag to (0), use the library program "pltResetPLTEND."
19.2 Simplified Palletizing

Palletizing is explained in the “16.1 What is palletizing?”. For simpler palletizing, this section provides you with a simplified palletizing template using a palletizing library.

Simplified Palletizing Program "PRO1"

PROGRAM PRO1
TAKEARM

'------- Get palletizing positions from P[40] -------
'Order of parameters N,M,Stacked pallet height mm,P1,P2,P3,P4,Palletizing points numbers,
Palletizing counter, Stacked-pallets counter
CALL xdGetPalt(3, 5, 20,P[52],P[53],P[54],P[55],P[40],I[10],I[11])

'------------ Palletizing ----------------
APPROACH P,P[40],@0 50  'Approaching P[40] 50mm upwards
MOVE L,@0 P[40]                  'Move down to P[40]
DEPART L,50                          'Move up by 50mm

'------------ Count up counters ------------
I[10] = I[10] + 1                       'Increment palletizing counter by one
if I[10] > (3 * 5) then
    I[10] = 1
    'then reset palletizing counter to initial value
    'Increment stacked-pallets counter by one
    I[10] = 1
    'then reset stacked-pallets counter to initial value
END IF
END IF

END
**Simplified palletizing program "PRO1"**

In palletizing explained in the “16.1 What is palletizing?”, you need to execute the pltInitialize library before starting palletizing.

This simplified palletizing program requires no execution of that library. Just executing PRO1 will start palletizing operation.

In simplified palletizing, you need to specify addition and resetting of the palletizing counter and stacked-pallets counter, while in conventional palletizing those counters are automatically controlled inside libraries.

**Variables used in PRO1**

- Palletizing target position variable (Position variable, P40 in this example)
- Palletizing counter variable (Integer variable, I10 in this example)
- Stacked-pallets counter (Integer variable, I11 in this example)
- Corner partition variables (Position variables, P52 to P55 in this example)

**What to do before execution of PRO1**

Before start of PRO1, you need to:

- Assign the initial value "1" to each of the palletizing counter I10 and stacked-pallets counter I11 and
- Teach the positions of four corner partitions in the pallet to corner partition variables P1 to P4.

On the following pages are detailed explanation of each part of the program PO1.

---

(1) Program name

```
' PROGRAM PRO1
TAKEARM
```

Change the program name

(2) Call library

```
'------- Get palletizing positions from P[40] -------
'Order of parameters N,M,Stacked pallet height mm,P1,P2,P3,P4,Palletizing points numbers
'Palletizing counter, Stacked-pallets counter
   CALL xdGetPalt (3, 5, 20,P[52],P[53],P[54],P[55],P[40],I[10],I[11])
```
Setting the following parameters to the called library will assign the target position to the palletizing target position variable specified by the 8th parameter.

1st parameter  No. of rows, which should be 1 or greater.
   (3 rows in this example)

2nd parameter  No. of columns, which should be 1 or greater.
   (5 columns in this example)

3rd parameter  Height of stacked pallets in mm.
   Specify a positive value when increasing the layers of pallets; a negative value when decreasing them.
   (20 mm specified in this example)

4th to 7th parameters  Position variables to which four corner partition positions of the pallet are assigned.
   (P52 to P55 in this example)

8th parameter  Palletizing target position variable to which the target position will be assigned. This position may be calculated from the current counter values.
   (P40 in this example)

9th parameter  Palletizing counter, which should be 1 or greater and M*N or less. According to this value, the corner partition positions may be specified.

10th parameter  Stacked-pallets counter, which should be 1 or greater.
   According to this value, the layer number may be specified.

As a result of execution of "(2) Call library," the palletizing target position is assigned to P40. Then some operations should be carried out to P40.

Usually, during those operation, chuck and unchuck processes will be inserted.
This part of the PRO1 counts up the palletizing counter and stacked-pallets counter and checks the completion of palletizing operation for a layer of pallets.

Unlike usual palletizing programs, the simplified palletizing program uses integer variables (I10 and I11 in this example) as a palletizing counter and stacked-pallets counter.

According to the values assigned to I10 and I11, the "(2) Call library" calculates the palletizing target position and assigns it to P40.
For a single layer of pallet, you may simplify the program further as shown below.

```plaintext
'------- Count up counters------------------
I[10] = I[10] + 1  'Increment palletizing counter by one

if I[10] > (3 * 5) then  'If palletizing a layer of pallets (3 rows x 5 columns) finishes
    I[10] = 1             'then reset palletizing counter to initial value
    if I[11] >= 5 then    'If palletizing 5 layers of pallets finishes
        I[10] = 1        'then reset stacked-pallets counter to initial value
    END IF
END IF
```

Delete these lines for a single layer of pallet.
Relationship between the palletizing positions and counter values in the simplified palletizing program

If each pallet consists of 3 rows x 5 columns (N=3, M=5), palletizing counter is I10 and stacked-pallets counter is I11, then

Position a: I10=1, I11=1
Position b: I10=7, I11=4
Position c: I10=14, I11=5
Applications of the simplified palletizing program
--- Special-purpose palletizing examples ---

(1) Alternate checker-pattern palletizing

Alternate checker-pattern palletizing refers to palletizing to every other partitions as illustrated below. Programming for this is very easy.

- Count up palletizing counter

\[
I[10] = I[10] + 1 \quad \text{‘Increment palletizing counter by one}
\]

- Count up palletizing counter

\[
I[10] = I[10] + 2 \quad \text{‘Increment palletizing counter by 2}
\]

You need to assign “1” to palletizing counter I[10] with the teach pendant beforehand.

You need to assign “2” to palletizing counter I[10] with the teach pendant beforehand.
(2) Skipped palletizing

Skipped palletizing skips arbitrary partitions in palletizing.

The above palletizing operation seems complicated, but you may easily program such palletizing just by changing the palletizing counter value that will pass to the library.

PROGRAM PRO1
TAKEARM

'-------- Get palletizing positions from P[40] ------
'Order of parameters N,M,Stacked pallet height mm,P1,P2,P3,P4,Palletizing points numbers
'Palletizing counter, Stacked-pallets counter
   CALL xdGetPalt(3, 5, 20,P[52],P[53],P[54],P[55],P[40],I[10],I[11])

PROGRAM PRO1
TAKEARM
SELECT CASE I[10]
   CASE 2     'If palletizing counter I[10]=2
      I[10] = 3     'then set the counter to 3
   CASE 8,9   'If palletizing counter I[10]=8 or 9
      I[10] = 10   'then set the counter to 10
   CASE 11    'If palletizing counter I[10]=11
      I[10] = 12   'then set the counter to
END SELECT

'-------- Get palletizing positions from P[40] ------
'Order of parameters N,M,Stacked pallet height mm,P1,P2,P3,P4,Palletizing points numbers
'Palletizing counter, Stacked-pallets counter
   CALL xdGetPalt(3, 5, 20,P[52],P[53],P[54],P[55],P[40],I[10],I[11])
Lessons

Lesson 20 Using Libraries Effectively

You can assemble existing programs into a project in any of the following three ways.

- **Program bank:**
  You can add any programs registered in the program bank to your new project.

- **Importing programs:**
  You can register any programs into your new project folder by copying programs already created for another program project.

- **Adding programs:**
  You can register any programs already created for other program projects into your new project. In this case, the projects it is registered with share the program.

You can effectively apply existing programs to your new project using any of the methods above. Some examples to do so follow.
20.1 Program bank

Let's add the program "dioSetAndWait" from the program bank to your new project.

Step 1  Searching the program bank

1. Select [Program Bank] from the Tool menu in the [PAC Manager window].

Step 2  Choosing the class

2. Click the class selection box. The class selection pull-down menu appears.

3. Select [Input/output].

Step 3  Choosing a program to be added

The program name list box shows the titles of programs registered in the [Input/output Class].

4. Select [dioSetAndWait] displayed in the list.
Step 4  Adding the program to a new project

❼ Click [Add to Project].

 dioSetAndWait is registered in the new project and the [Edit] window appears.

⃝ Click here to close the [Program Bank] window.
The window will close.
20.2 Importing programs

Let's import two programs, "pro1" and "pro2" into your new project. If you have installed WINCAPSII in "Typical," these programs will be in the directory C:\ProgramFiles\Wincaps2\Sample\modelcase\

Step 1

① Select [Import] from the Program menu, in the [PAC Manager] window.

The [Add Program] dialog window is displayed.

② Click the [Previous] button.

The [Tutorial] folder of the current system folder is displayed in the window.

③ Select the [Sample] folder and click [Open].

Step 2

The [Wincaps2] folder is displayed in the [Look in] window, showing the directory holding programs you are seeking.

④ Select the [Modelcase] folder and click [Open].

Step 3

The [Look in] window display changes to the [Sample] folder.
Step 4

The [Look in] window display changes to the [Modelcase] folder.

⑤ Select the icons for the "PRO1.pac" and "PRO2.pac" files, and click [Open].

Step 5

The two programs have been newly added to the list in the [PAC Manager] window.

⑥ Double-click [PRO1.pac] in the list in the [PAC Manager] window.

★ Tip ★

You can also open the program edit window by selecting [Show] in [Action] menu after clicking [PRO1.pac] to select it.

Step 6

The program edit window for [PRO1.pac] is displayed.

⑦ Check that there are no mistakes in the contents of the edit window.

⑧ Check that there are no mistakes in the contents of the edit window for the other program, [PRO2.pac], by repeating steps 4 to 5.

⑨ Click here to close the program edit window.
Let's close this session of Part 5 in both the PC and robot controller.

21.1 Terminating WINCAPSII and shutting down the PC

Step 1

If needed, close the OS, such as Windows95, and shut down the PC.

Step 2

① Click the closing box in the upper right corner of the [System Manager] window. All WINCAPSII software on the PC will be exited.
21.2 Turning the robot controller OFF

Step 1

① Flip the power switch downward to turn the robot controller OFF.
Part 6
Features of Robots

In Part 6, you will:

Learn the useful and advantageous features of robots such as compliance control. These features are effective for reducing installation costs and improving the efficiency of the preparation work and practical work.

Lesson 22 Compliance Control 126
  22.1 Current limit function for individual axes 126
  22.2 Tip compliance function 127

Lesson 23 Other Features 128
Lesson 22  Compliance Control

Compliance control provides compliance for robots by software. This feature may absorb misalignment errors encountered when parts are mated during assembly operations or loaded into fixture and prevent robots or workpieces from undergoing excessive force.

Two types of compliance control are available: one is a current limit function that sets compliance to individual joints, and the other is a tip compliance function that sets compliance to individual elements of the coordinates formed at the end of the robot flange (the mechanical interface coordinates).

**NOTE:** The current limit function is available for Ver 1.2 or later. The tip compliance function is available for Ver.1.4 or later.

### 22.1 Current limit function for individual axes

This function provides compliance for individual axes by limiting the drive torque (current) of each axis motor. It prevents excessive force from applying to robots or workpieces or avoids robot stops caused by an overload or overcurrent error.

#### Absorbing misalignment errors in handling parts

**Concept of current limit function**

- **Enabling/disabling the current limit function**

You may enable or disable the current limit function by executing the current limit library, SetCurLmt or ResetCurLmt, respectively. For details, refer to the PROGRAMMER’S MANUAL.
22.2 Tip compliance function

This function sets compliance to the individual elements of coordinates at the end of the robot flange (tip) by controlling the drive torque (current) of each axis motor based on the force limit at the tip. You may select the base coordinates, tool coordinates, or work coordinates to be applied. This function is used to make the robot follow an external force in a specified direction(s) or to make the robot touch an object for height check.

Following an external force or touching an object for height check

Concept of tip compliance control

■ Making the tip compliance function active from the teach pendant

This is one of the extended functions. You need to make extended functions active from the teach pendant. Once made active, the setting will be retained after the controller power is turned off.

■ Enabling/disabling the tip compliance function

You may enable or disable the tip compliance function by executing the compliance control library, SetCompControl or ResetCompControl, respectively. For details, refer to the PROGRAMMER'S MANUAL.
Lesson 23 Other Features

In addition to compliance control, robots have the following features. Refer to the PROGRAMMER’S MANUAL for more details.

<table>
<thead>
<tr>
<th>Name</th>
<th>Outline of the features and commands</th>
<th>Related commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interference area check</td>
<td>An output signal is issued from the specified I/O port when the robot arm end is within the designated area. These commands are useful to confirm the original position and the working position.</td>
<td>AREA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SETAREA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RESETAREA</td>
</tr>
<tr>
<td>Interrupt stop feature</td>
<td>When any interrupt signal of the system I/O port is ON, the current operation command is terminated and the next operation command is processed. This command is useful when you want to change the robot stop position through external input. However, the distance until the robot stops depends upon the speed setting of the operation command and the actual speed of the robot.</td>
<td>INTERRUPT ON/OFF</td>
</tr>
<tr>
<td>Parallel execution function of operation/non-operation command</td>
<td>The non-operation command can be executed during the execution of an operation command. This command is useful to shorten the cycle time.</td>
<td>IOBLOCK ON/OFF</td>
</tr>
<tr>
<td>Multi-task feature</td>
<td>More that one program can be run concurrently. It is possible to shorten cycle time by checking the external interlock and executing vision commands in other programs.</td>
<td>RUN</td>
</tr>
<tr>
<td></td>
<td></td>
<td>KILL</td>
</tr>
<tr>
<td></td>
<td></td>
<td>etc.</td>
</tr>
<tr>
<td>Program debugging facilities</td>
<td>It is possible to display messages and sound a beeper. This is useful for debugging user programs.</td>
<td>PRINTMSG</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PRINTDBG</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BUZZER</td>
</tr>
<tr>
<td>Optimal payload setting feature</td>
<td>This makes it possible to set acceleration speed appropriate to the mass of the workpiece and end-effector. This makes it possible to shorten cycle time.</td>
<td>aspACLD</td>
</tr>
<tr>
<td></td>
<td></td>
<td>aspChange</td>
</tr>
</tbody>
</table>
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Appendix-1 Glossary

A

ABOVE
One of the elbow figures of 6-axis robot. (⇔ BELOW)

ABSOLUTE MOTION
The motion to move to the motion target position set by teaching. (⇔ relative motion)

ADDRESS SETTING (IP address)
To set the controller IP address. It is required in Ethernet communication.

APPROACH VECTOR
Positive directional vector of Z-axis on the mechanical interface coordinates.

AREA
The number of white and black pixels in a window when an image data is binarized. (Vision terms)

ARM CONFIGURATION MACRO DEFINITION FILE
The file which contains the macro definition information of the arm setting data.

ARM FIGURE
The figure determined by the value of the 1st through the 3rd axes of 6-axis robot. There are two kinds of figures; RIGHTY and LEFTY.

ARM FILE
The file in which the information peculiar to the robot is recorded. The arm manager uses the file.

ARM MANAGER
The software which simulates the robot movement.

ARM SEMAFORE
The privilege of robot control. The task which has the privilege can operate the robot.

AUTOMATIC ROBOT RUN
To run the robot by executing a program.

B

BASE
The portion to install the 1st axis of the robot.

BASE COORDINATES
The three dimensional orthogonal coordinate system which has the origin on the robot base.

BASE MOUNTING SURFACE
The junction surface of the base and the installation frame.

BELOW
One of the elbow figures of 6-axis robot. (⇔ ABOVE)

BINARIZATION
To change the brightness of each pixel to either white (0) or black (1) by the threshold value (binarization level).

BINARIZATION LEVEL
The threshold value of binarization. (Vision terms)

BRAKE-OFF (releasing brakes)
To release the brake of each axis.

BRAKE-ON (locking brakes)
To apply the brake of each axis.

BRIGHTNESS
The numerical value (0-255) which shows the brightness of each pixel. (Vision terms)

BRIGHTNESS INTEGRAL VALUE
The value which is the sum of the brightness of all the pixels in the window. (Vision terms)

C

CALSET
Calibration of the relation between the actual robot position and the positional information of the controller.
CALSET OF A SINGLE AXIS
To perform CALSET on the specified axis only.

CENTER OF GRAVITY
The balance point on which the object weight balances on a plane. (Vision terms)

COMMAND AREA
A group of I/O ports which specify the I/O command type.

COMMAND EXECUTION I/O SIGNAL
The input/output signal fixed to the system in order to inform the execution of I/O command and the execution status to the outside.

COMMAND PROCESSING COMPLETE
The output signal to inform the completion of I/O command processing to the outside.

COMMAND
The instruction written in a program. The controller reads commands in the sequence written in a program, interprets commands and executes.

COMMENT
Explanatory notes in a program to make the program easy to understand. The controller does not execute comment.

COMMUNICATION LOG
The record of the communication condition between the PC and the robot.

COMPATIBLE MODE
The mode in which the I/O allocation is set to be compatible with the conventional series of robots. It is switched by software.

CONTINUOUS START
The start method to execute a program in iteration. The operation continues until it is forced to stop.

CONTROL LOG
The record of the specified value, the encoder value, the current value and the load ratio. They are recorded by each motion axis.

CONVENTIONAL LANGUAGE
The robot language used in robot conventionally.

CP CONTROL
Compensation control to make the path from the current position to the motion target position a straight line or a circle. (⇔ PTP control)

CURRENT POSITION
The current position of the origin of the tool coordinates.

CYCLE STOP
The stop method to stop a program after one cycle execution.

D VARIABLE (Double-precision variable)
The variable which has a value of double precision real number (15 digits of effective precision).

DAILY INSPECTION
The inspection before the daily work.

DATA AREA
A group of I/O ports to specify the necessary data for I/O command.

DEADMAN SWITCH
The switch which moves robot as long as any of the arm traverse keys is pressed simultaneously for safety. The robot stops immediately when either the arm traverse key or the deadman switch is released.

DEFINING INTERFERENCE AREA
To define the interference area. It is set either with the teach pendant, in WINCAPSII or with the program command.

DEFINING TOOL COORDINATES
To define tool coordinates. Origin offset amount and rotational angle amount around each axis are defined in reference to the mechanical interface coordinates. TOOL1 through TOOL63 can be defined.
DIO MANAGER
The software which monitors I/O condition and manages I/O allocation.

DISCRIMINATION ANALYSIS METHOD
The method to set the binarization level from the histogram using statistical method. (Vision terms)

DOUBLE
One of the 6th axis figures of 6-axis robot. (⇒ SINGLE)

DOUBLE4
One of the 4th axis figures of 6-axis robot. (⇒ SINGLE4)

EDGE
Transition point of brightness. (Vision terms)

ELBOW FIGURE
The figure determined by the 2nd and the 3rd axis value of 6-axis robot. There are two kinds of elbow figures; ABOVE and BELOW.

ENABLE AUTO
The signal to enable auto mode in ON condition. Manual mode and teach check mode are possible in OFF condition.

ENCODER VALUE CHECK MOTION
The motion which judges that the target position is reached when the encoder value becomes within the specified pulse range toward the motion target position set by teaching.

END MOTION
The motion which judges that the target position is reached when the specified position of the servo coincides with the motion target position set by teaching.

ERROR CODE
Four digits hexadecimal code which describes error causes/conditions occurred in the robot or in WINCAPSII. Refer to the error code table for the meaning of each error code.

ERROR LOG
Record of the error content and occurred time.

ETERNET BOARD
One of the controller optional boards. It is used to communicate with WINCAPSII through TCP/IP protocol.

EXECUTION PROGRAM
The program converted to the data format intelligible to the robot.

EXTERNAL ACCELERATION
The acceleration value set with the teach pendant. Percentage value to the maximum acceleration is inputted.

EXTERNAL AUTOMATIC RUN
To execute a program from the external device.

EXTERNAL DECELERATION
The deceleration value set with the teach pendant. Percentage value to the maximum acceleration is inputted.

EXTERNAL MODE
The mode in which robot operation is possible from the external device.

EXTERNAL SPEED
The speed set with the teach pendant. Percentage value to the maximum speed is inputted.

F VARIABLE (Floating-point variable)
The variable which has a value of single precision real number (7 digits of effective precision).

FIG
The number which denotes the robot figure.

FIGURE
The possible status of each axis (joint) of the robot. Multiple figures are possible for the same position and posture.

FIGURE COMPONENT
The component which determine figure. There are five components in 6-axis robot; arm, elbow, wrist, the 6th axis and the 4th axis.
FIRST ARM
The robot arm nearest to the base.

FLIP
One of the wrist figures of 6-axis robot. (⇔ NONFLIP)

FUNCTION KEYS
The buttons provided under the pendant screen. Function names are displayed on the lower part of the screen and executes the function upon pressing the button.

GLOBAL VARIABLE
The variable available for any task.

HALT
The stop method to stop the program immediately. The motor power is not turned off.

HAND (end-effector)
The portion to hold the work. The same as tool.

HISTOGRAM
The occurrence ratio of the brightness value in a window. (Vision terms)

I VARIABLE (Integer variable)
The variable which has an integer value.

I/O
The input and/or output signal.

I/O COMMAND
The process command given by the external device through the I/O port. The robot controller processes according to this command.

INITIALIZATION FLOPPY DISK
The disk in which the initial setting of the robot at the factory shipment is recorded. It is used to recover to the initial condition when an error occurs in the controller memory.

INSTALLATION FRAME
The platform to install the robot.

INTERFERENCE AREA
The area provided by the user to watch if the tool interferes with the installation. If the origin of the tool coordinates enters into this area, output signal is issued from the specified I/O port.

INTERNAL ACCELERATION
The acceleration set in a program.

INTERNAL AUTOMATIC RUN
To execute a program from the operating panel or the teach pendant.

INTERNAL DECELERATION
The deceleration set in a program.

INTERNAL MODE
The mode in which robot run and teaching are possible using the operating panel or the teach pendant.

INTERNAL SPEED
The speed set in a program.

INTERRUPT SKIP
The input signal which halts the operation of the current step when it is ON during the execution of a robot command and starts the execution of the next step.

J VARIABLE (Joint variable)
The variable denoted by the value of each axis.

JOG DIAL
The dial on the pendant which is used to move cursor or to select a path on the input screen.

JOINT MODE
The mode in which the robot is manually operated on each axis.
LABELING
To number the binarized white and black area. (Vision terms)

LEFTY
One of the arm figures of 6-axis robot. (⇔ RIGHTY)

LIBRARY
The collection of programs for reuse. They are registered and utilized using the program bank of WINCAPSII.

LOAD
To read programs, arm data, etc. from the floppy disk into the robot controller.

LOAD CAPACITY
The mass of the sum of the tool and the work which the robot can hold.

LOCAL VARIABLE
The variable which is utilized within a task.

LOG
The record about operations, motions, etc. of the robot. There are four kinds of logs; error log, operation log, control log and communication log.

LOG MANAGER
The software which copies and manages the record of operations, errors, etc. of the robot in personal computer.

MACHINE LOCK
The state of simulating motion by the robot controller without actual robot motion.

MACRO
The definition of names with 12 characters in regard to variable numbers and port numbers. Names are replaced with numbers in program execution.

MACRO DEFINITION FILE
The file which defines macro.

MANUAL ROBOT OPERATION
Robot operation by the user using the operation keys of the teach pendant or the operating panel.

MECHANICAL END
The mechanical motion limit set by the mechanical stopper. (⇔ Software limit)

MECHANICAL INTERFACE
The junction surface of the flange and the tool. Mechanical interface (JIS)

MECHANICAL INTERFACE COORDINATES
Three dimensional orthogonal coordinate system which has the origin on the center of the flange.

MECHANICAL STOPPER
The mechanism to restrict the motion of the robot axes physically.

MENU TREE
The description of the functional menu of function keys in tree form. It is listed on the operational guide.

MODE METHOD
The method to set binarization level in the valley when the histogram is two hills distribution.

MODE SWITCH
The switch on the pendant. It can switch the robot run mode.

MONITOR
To display the current status of the robot.

MOTION SPACE
The range in which the robot can operate.

MULTITASKING
The state in which multiple programs are executed virtually simultaneously. It is realized in the way that CPU of the robot controller executes each program in a short interval by turns.
NLIM
The negative directional end value of the software limit. (⇔ PLIM)

NONFLIP
One of the wrist figures of 6-axis robot. (⇔ FLIP)

NORMAL MODE
The standard allocation mode of I/O.

NORMAL VECTOR
Positive directional vector of X-axis on the mechanical interface coordinates.

OPERATING MODE
The mode in which the robot is operated manually. Three are three modes; each axis mode, X-Y mode and TOOL mode.

OPERATION LOG
The record of operations about the use of the teach pendant or the operating panel.

OPERATING PANEL
The fixed operating panel connected to the controller. It has no teaching function.

OPTIMAL LOAD CAPACITY SETTING FUNCTION
The function which sets the optimal speed and acceleration in response to the load condition or the posture of the robot.

ORIENT VECTOR
Positive directional vector of Y-axis on the mechanical interface coordinates.

OVERHEAD VERSION
The robot specified to install as it hangs from the ceiling setting the base above and the arm below. As the installation space is not needed on the working platform, working space could be wider.

Operator
One of the user levels of WINCAPS II. Important parameters cannot be changed. Password input is not necessary.

PTYLE METHOD
The binarization level setting method to make the area of the object and the area of the black (or white) portion to be the same. (Vision terms)

P VARIABLE (Position variable)
The variable denoted by the position, the posture and the figure.

PAC (PAC)
New robot language used in robot. It is upward compatible from SLIM. (Industrial robot language of JIS)

PAC PROGRAM MANAGER
The software to support PAC program development. Editor, command builder and program bank functions are included.

PALLETIZING
To put in or take out parts, etc. to/from the pallet with partition.

PANEL OPERATION
To make ON/OFF operation of the internal I/O from the teach pendant screen.

PASS MOTION
The motion to pass near the motion target position set by teaching.

PENDANTLESS STATE
To run the robot from the external device when the operating panel or the teach pendant is not connected.

PITCH ANGLE
The rotational angle around Y-axis.

PIXEL
The point which forms the screen. (visual terms)
PLATE MECHANICAL INTERFACE
The portion to install tools located on the top end of the robot arm.

PLIM
The positive directional end value of the software limit. (⇔ NLIM)

POSITION DATA
The data of the base coordinates which describes the position of the robot flange center (the tool top end when the tool definition is effective) and the robot posture at the time.

POSTURE
The inclination of the tool determined by the roll, pitch and yaw angles in case of 6-axis robot.

POWERING OFF THE METER
To turn off the motor power of the robot.

POWERING OFF THE ROBOT CONTROLLER
To turn off the power of the robot controller.

POWERING ON THE METER
To turn on the motor power of the robot.

POWERING ON THE ROBOT CONTROLLER
To turn on the power of the robot controller.

PRINCIPAL AXISS
The axis which gives the minimum moment of inertia in case of rotating the object on a plane. (Vision terms)

PRINCIPAL AXIS ANGLE
The angle formed by the horizontal axis and the principal axis. (Vision terms)

PRIORITY
The sequence of task execution in order of importance. The program with higher priority is executed first.

PROGRAM RESET
The input signal to force program execution from the top of the program.

PROGRAM START
The input signal to start a program. When it is a step stop, execution begins from the next step and when it is a halt, execution begins from the following of the same step.

PROGRAM TRANSFER
To send/receive robot programs between the robot controller and WINCAPS II (PC).

PTP CONTROL
The control which moves the robot arm to the target position without compensation. The path may not necessarily be a straight line. (⇔ CP control)

Programmer
One of the user levels of WINCAPS II. All the common operations are possible. Password input is necessary to enter into this mode.

RANG
The angle which determines the relation of the robot standard position and the mechanical end.

RELATIVE MOTION
The motion to move from the current position for the motion amount set by teaching.

REMOTE OPERATION
To operate the robot arm which is displayed on the arm manager.

RIGHTY
One of the arm figures of 6-axis robot. (⇔ LEFTY)

ROBOT ERROR
The output signal which informs that an error condition occurred in the robot such as servo error, program error, etc.

ROBOT STOP
The stop method to stop programs immediately and power off the motor.

ROBOT WARNING
The output signal which informs that a slight error occurred during I/O command or servo processing.

ROLL ANGLE
The rotational angle around Z-axis.
RX COMPONENT
The amount of rotational angle around the X coordinate axis.

RY COMPONENT
The amount of rotational angle around the Y coordinate axis.

RZ COMPONENT
The amount of rotational angle around the Z coordinate axis.

SAVE
To save programs, arm data, etc. onto the floppy disk from the robot controller.

SEARCH
To search the space which coincides with a standardized image data (search model). (Vision terms)

SECOND ARM
The farther arm of the robot arms measured from the base.

SEMAPHORE
The task execution privilege which is used to synchronize among tasks or to do exclusive control among the tasks that must not be executed simultaneously.

SERVO ON
The signal to inform to the outside that the motor power is on.

SET COMMUNICATION
To set the usage conditions (communication speed, etc.) of each communication port of the robot controller.

SET COMMUNICATION PERMISSION
To set the usage permission of each communication port of the robot controller.

SINGLE
One of the 6th axis figures of 6-axis robot. (⇔ DOUBLE)

SINGLE-CYCLE START
The start method to make a program execute one cycle. The program stops after one cycle execution (to the last step of the program).

SINGLE-STEP START
The start method to make a program execute one step. The program stops after one step execution.

SINGLE4
One of the 4th axis figures of 6-axis robot. (⇔ DOUBLE4)

SINGULAR POINT
The position on the boundary of the two figures.

SNAPSHOT
The function to record the current status of the robot.

SOFTWARE LIMIT
The limit of the robot motion range determined by the software. (⇔ mechanical end)

STATUS AREA
A group of output signals to inform the result of I/O command processing. The status corresponding to the I/O command is set.

STEP CHECK
One step execution of a program in teach check mode.

STEP STOP
The stop method to stop a program after one step execution.

STOP KEY
One of the pendant buttons. Pressing the button makes all programs halt immediately.

STROBE SIGNAL
The input signal to instruct the start of I/O command processing.

SUBROUTINE
The program which describes a specific motion and is called from a portion of a main program.

SYSTEM I/O SIGNALS
The input/output signals fixed to the system in order to inform the run control or run condition to the outside.
SYSTEM MANAGER
The software which generally manages all the information of WINCAPS II.

SYSTEM PROJECT
Programs and related data groups which are managed by the system manager.

SYSTEM VARIABLE
The variable to check the system condition in a program.

T VARIABLE (Homogeneous transform matrix variable)
The variable denoted by the position vector, the orient vector, the approach vector and the figure.

TASK
The motion process formed by each program when multiple programs are managed their simultaneous execution.

TEACH CHECK
To check the motion by the program.

TEACHING
To input the necessary information for operation into the robot using the teach pendant.

TOOL
The portion of the robot which affects the work immediately. It is a synonym of end-effector (JIS).

TOOL COORDINATES
The coordinate system which sets the origin on the tool and offsets the origin of the mechanical interface coordinates to any point and rotates around each axis.

TOOL MODE
The manual operation mode on the tool coordinates.

TOOL0
A special form of tool definition that has origin offset zero, i.e. it implies the mechanical interface coordinates.

TYPE DECLARATION
To declare the type of variable in a program.

U

USER COORDINATES
The coordinate system which users can define.

USER I/O SIGNALS
The input/output signals controllable by the user program.

USER LEVEL
The class provided for users to keep data management security. Access to information or operation is restricted by each class.

V

VARIABLE TABLE
A group of data which are the pair of each port number and value retained by the controller.

VISUAL DEVICE
The device to provide the robot with necessary data by processing the images inputted from the camera.

VISUAL FUNCTION
The function to provide the robot control function with necessary data by processing the images inputted from the camera.

W

WINDOW
The space to process images. (Vision terms)

WORK COORDINATES
The three dimensional orthogonal coordinate system which sets the origin on the work to be processed by the robot.

WRIST FIGURE
The figure determined by the value of the 4th and the 5th axis of the 6-axis robot. There are two kinds of wrist figures; FLIP and NONFLIP.
X

X-Y MODE
The manual operation mode on the base coordinates.

Y

YAW ANGLE
The rotational angle around X-axis.

SYMBOLS

µ Vision
Visual device.
Appendix-2 Names of the robot controller parts

The figure and table given below show the names of the robot controller parts.
### Connector Names

<table>
<thead>
<tr>
<th>Connector No.</th>
<th>Marking</th>
<th>Name</th>
<th>Connector No.</th>
<th>Marking</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>CN1</td>
<td>RS232C</td>
<td>Serial interface connector</td>
<td>CN8</td>
<td>INPUT</td>
<td>Connector for user input or system input</td>
</tr>
<tr>
<td>CN2</td>
<td>CRT</td>
<td>Connector for CRT</td>
<td>CN9</td>
<td>HAND I/O</td>
<td>Connector for end-effector I/O</td>
</tr>
<tr>
<td>CN3</td>
<td>KEYBD</td>
<td>Connector for keyboard</td>
<td>CN10</td>
<td>OUTPUT</td>
<td>Connector for user output or system output</td>
</tr>
<tr>
<td>CN4</td>
<td>MOUSE</td>
<td>Connector for PS/2 mouse</td>
<td>CN11</td>
<td>INPUT AC</td>
<td>Power connector</td>
</tr>
<tr>
<td>CN5</td>
<td>PENDANT</td>
<td>Connector for pendant</td>
<td>CN12</td>
<td>MOTOR</td>
<td>Connector for motor</td>
</tr>
<tr>
<td>CN6</td>
<td>PRINTER</td>
<td>Connector for printer</td>
<td>CN13</td>
<td>ENCODER</td>
<td>Connector for encoder</td>
</tr>
<tr>
<td>CN7</td>
<td>I/O POWER</td>
<td>Power connector for I/O</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

⚠️ Caution: The robot controller connectors are of a screw-lock type or ring-lock type. Lock the connectors securely. If even one of the connectors is not locked, incomplete contact may result thereby causing an error.

Connecting or disconnecting the power connector or motor connector when the robot controller power switch is ON may cause damage to the internal circuits of the robot controller. Turn OFF the power switch before connecting or disconnecting these connectors.
Appendix-3 Names of the teach pendant parts

Deadman switches
(To run the robot, hold down either of these switches when pressing any of the arm traverse keys in Manual mode or pressing the OK key in Teach check mode.)

Bottom of the teach pendant
Task programs on halt
(Receiving programs from external equipment)
Task programs on halt
(Transmitting programs to external equipment)
Task program(s) running
Task program(s) running (Receiving programs from external equipment)
Task program(s) running (Transmitting programs to external equipment)

Dummy input not set
Dummy input set to a user-input port(s)

Ver. 1.4 or later
I/O output restricted

Internal Auto mode
External Auto mode
Manual mode
Teach check mode
No mode selected

Backup batteries working
Backup batteries low

Operation mode
Work coordinates
Tool coordinates
Speed indicator bar graph
Status bar
Shortcut button (which calls up the shortcut menu. Use this when you want to access other functions halfway through some processing.)
Menu bar
Function buttons

Top screen
Appendix-4 Menu tree of the teach pendant

Top Screen

[F1 Program] in Manual Mode

[F1 NewProg.]
[F2 Delete]
[F3 Copy]
[F4 Var.]

(The following menus (except F12) have submenus F1 to F7. Submenus marked with * are only for [F4 Pos.], [F5 Joint.], and [F10 Tran.].)

[F1 Integer.]
[F2 Float.]
[F3 Vector.]
[F4 Pos.]
[F5 Joint.]
[F8 Double.]
[F10 Tran.]
[F11 String.]
[F12 VarsUsed]

[F1 Next]
[F3 Jump To]
[F4 Move*]
[F5 Change.]
[F6 Get Pos.*]
[F7 Copy Var]

[F5 Edit.]

[F1 NewLine.]
[F2 Del Line]
[F3 CopyLine]
[F4 Paste]
[F5 EditLine]
[F6 Save.]
[F10 SyntaxErr]
[F11 BP]

[F1 User.]
[F2 Flow.]
[F3 Robot.]
[F4 Category]
[F5 Recent.]
[F6 Clr All]

[F6 Aux.]

[F1 Set PRJ.]
[F3 Options.]
[F5 BPSetting]
[F7 Continue]
[F8 SS Mode.]
[F9 StopBack.]
[F10 LoadMode]
[F12 Compile]

[F7 New PRJ]

[F10 SyntaxErr]

[F12 Config.]
The purpose of this manual is to provide accurate information in the handling and operating of the robot. Please feel free to send your comments regarding any errors or omissions you may have found, or any suggestions you may have for generally improving the manual.

In no event will YASKAWA be liable for any direct or indirect damages resulting from the application of the information in this manual.
Upon receipt of the product and prior to initial operation, read these instructions thoroughly and retain for future reference.

MOTOMAN INSTRUCTIONS

- MOTOMAN-□□□ INSTRUCTIONS
- JRC BEGINNER’S GUIDE
- JRC SETTING-UP MANUAL
- JRC INSTALLATION & MAINTENANCE GUIDE
- JRC WINCAPS II GUIDE
- JRC PROGRAMMER’S MANUAL
- JRC ERROR CODE TABLES
Preface

Thank you for purchasing this high-speed, high-accuracy handling robot. Before operating your robot, read this manual carefully to safely get the maximum benefit from your robot in your assembling operations.

Products covered by this manual

■ Robot
  - Vertical articulated robot

■ Robot controller
  JRC, Version 1.6** or earlier (See NOTE.)

NOTE: The version of your robot controller is written in the MAIN SOFTWARE Ver. column of the SETPRM LIST attached to the top of your robot controller. It may also be shown on the Version window of the teach pendant, which may be accessed by [F6 Set]—[F6 Maint.]—[F2 Version] from the top screen.

Important
To ensure operator safety, be sure to read the precautions and instructions in "SAFETY PRECAUTIONS," pages 1 through 8.
How the documentation set is organized

The documentation set consists of the following six books. If you are unfamiliar with this robot series, please read all books and understand them fully before operating your robot.

BEGINNER’S GUIDE

Introduces you to the MOTOMAN robot. Taking an equipment setup example, this book guides you through running your robot with the teach pendant, making a program in WINCAPSII, and running your robot automatically.

INSTALLATION & MAINTENANCE GUIDE

Provides an explanation of the robot outline, instructions for installing the robot components, and maintenance & inspection procedures.

SETTING-UP MANUAL - this book -

Describes how to set-up or teach your robot with the teach pendant or operating panel.

WINCAPSII GUIDE (that comes with WINCAPSII)

Provides instructions on how to use the teaching system installed on the PC, connected to the robot and its controller, for developing and managing programs.

PROGRAMMER’S MANUAL

Describes the PAC programming language, steps to develop programs in PAC, and command specifications.

ERROR CODE TABLES

List error codes that will appear on the teach pendant, operating panel, or PC screen if an error occurs in the robot series or WINCAPSII. These tables provide detailed description and recovery ways.
How this book is organized

This book is just one part of the documentation set. This book consists of SAFETY PRECAUTIONS and chapters one through five.

SAFETY PRECAUTIONS
Defines safety terms, safety related symbols and provides precautions that should be observed. Be sure to read this section before operating your robot.

Chapter 1  Teach Pendant and Operating Panel
This chapter describes how to connect the teach pendant and/or operating panel. It also provides descriptions of the names of keys, buttons, and switches on them.

Chapter 2  Preparations for Teaching
This chapter describes preparations necessary to make before starting teaching or running the robot from the teach pendant or operating panel.

The preparations include powering the robot controller and motor on/off, calibrating the robot, modifying the speed, inching selection, setting payload and its center of gravity, and setting the robot installation condition. Be sure to read this chapter before powering on the robot controller.

Chapter 3  General Introduction to Operation Modes and Machine Lock
This chapter describes the three operation modes of the robot: Manual mode, Teach check mode, and Auto mode. It also describes machine lock used for simulation.

Chapter 4  General Introduction to Coordinates and Figures
This chapter explains the coordinates used for the robot and figures of the shoulder, elbow, and wrist.

Chapter 5  Commands Assigned to Function Keys of the Teach Pendant
This chapter describes the variety of commands assigned to the function keys of the teach pendant. The first section illustrates the command menu tree. The following sections provide a detailed explanation of those commands, together with the access routes.
SAFETY PRECAUTIONS

Be sure to observe all of the following safety precautions.

Strict observance of these warning and caution indications are a MUST for preventing accidents, which could result in bodily injury and substantial property damage. Make sure you fully understand all definitions of these terms and related symbols given below, before you proceed to the text itself.

| WARNING | Alerts you to those conditions, which could result in serious bodily injury or death if the instructions are not followed correctly. |
| CAUTION | Alerts you to those conditions, which could result in minor bodily injury or substantial property damage if the instructions are not followed correctly. |

Terminology and Definitions

**Maximum space**: Refers to the volume of space encompassing the maximum designed movements of all robot parts including the end-effector, workpiece and attachments. (Quoted from the RIA* Committee Draft.)

**Restricted space**: Refers to the portion of the maximum space to which a robot is restricted by limiting devices (i.e., mechanical stops). The maximum distance that the robot, end-effector, and workpiece can travel after the limiting device is actuated defines the boundaries of the restricted space of the robot. (Quoted from the RIA Committee Draft.)

**Motion space**: Refers to the portion of the restricted space to which a robot is restricted by software motion limits. The maximum distance that the robot, end-effector, and workpiece can travel after the software motion limits are set defines the boundaries of the motion space of the robot.

**Operating space**: Refers to the portion of the restricted space that is actually used by the robot while performing its task program. (Quoted from the RIA Committee Draft.)

**Task program**: Refers to a set of instructions for motion and auxiliary functions that define the specific intended task of the robot system. (Quoted from the RIA Committee Draft.)

(*RIA: Robotic Industries Association)
1. **Introduction**

This section provides safety precautions to be observed during installation, teaching, inspection, adjustment, and maintenance of the robot.

2. **Installation Precautions**

2.1 **Insuring the proper installation environment**

The robot and the robot controller have not been designed to withstand explosions, dust-proof, nor are they splash-proof. Therefore, they should not be installed in any environment where:

1. there are flammable gases or liquids,
2. there are any shavings from metal processing or other conductive material flying about,
3. there are any acidic, alkaline or other corrosive gases,
4. there is cutting or grinding oil mist,
5. it may likely be submerged in fluid,
6. there is sulfuric cutting or grinding oil mist, or
7. there are any large-sized inverters, high output/high frequency transmitters, large contactors, welders, or other sources of electrical noise.

When using the robot controller in an environment exposed to mist, put it in an optional protective box.

2.2 **Service space**

The robot and peripheral equipment should be installed so that sufficient service space is maintained for safe teaching, maintenance, and inspection.

2.3 **Control devices outside the robot's restricted space**

The robot controller, teach pendant, and operating panel should be installed outside the robot's restricted space and in a place where you can observe all of the robot's movements when operating the robot controller, teach pendant, or operating panel.

2.4 **Positioning of gauges**

Pressure gauges, oil pressure gauges and other gauges should be installed in an easy-to-check location.

2.5 **Protection of electrical wiring and hydraulic/pneumatic piping**

If there is any possibility of the electrical wiring or hydraulic/pneumatic piping being damaged, protect them with a cover or similar item.
2.6 Positioning of emergency stop switches

Emergency stop switches should be provided in a position where they can be reached easily should it be necessary to stop the robot immediately.

(1) The emergency stop switches should be red.
(2) Emergency stop switches should be designed so that they will not be released after pressed, automatically or mistakenly by any other person.
(3) Emergency stop switches should be separate from the power switch.

2.7 Positioning of operating status indicators

Operating status indicators should be positioned in such a way where workers can easily see whether the robot is on temporary halt or on an emergency or abnormal stop.

2.8 Setting-up the safety fence or enclosure

A safety fence or enclosure should be set up so that no one can easily enter the robot's restricted space. If it is impossible, utilize other protectors as described in Section 2.9.

(1) The fence or enclosure should be constructed so that it cannot be easily moved or removed.
(2) The fence or enclosure should be constructed so that it cannot be easily damaged or deformed through external force.
(3) Establish the exit/entrance to the fence or enclosure. Construct the fence or enclosure so that no one can easily get past it by climbing over the fence or enclosure.
(4) The fence or enclosure should be constructed to ensure that it is not possible for hands or any other parts of the body to get through it.
(5) Take any one of the following protections for the entrance/exit of the fence or enclosure:

1) Place a door, rope or chain across the entrance/exit of the fence or enclosure, and fit it with an interlock that ensures the emergency stop device operates automatically if it is opened or removed.

2) Post a warning notice at the entrance/exit of the fence or enclosure stating "In operation--Entry forbidden" or "Work in progress--Do not operate" and ensure that workers follow these instructions at all times.

When making a test run, before setting up the fence or enclosure, place an overseer in a position outside the robot's restricted space and one in which he/she can see all of the robot's movements. The overseer should prevent workers from entering the robot's restricted space and be devoted solely to that task.
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.9</td>
<td><strong>Positioning of rope or chain</strong>&lt;br&gt; If it is not possible to set up the safety fence or enclosure described in Section 2.8, hang a rope or chain around the perimeter of the robot's restricted space to ensure that no one can enter the restricted space.&lt;br&gt;(1) Ensure the support posts cannot be moved easily.&lt;br&gt;(2) Ensure that the rope or chain’s color or material can easily be discerned from the surrounds.&lt;br&gt;(3) Post a warning notice in a position where it is easy to see stating &quot;In operation--Entry forbidden&quot; or &quot;Work in progress --Do not operate&quot; and ensure that workers follow these instructions at all times.&lt;br&gt;(4) Set the exit/entrance, and follow the instructions given in Section 2.8, (3) through (5).</td>
</tr>
<tr>
<td>2.10</td>
<td><strong>Setting the robot's motion space</strong>&lt;br&gt; The area required for the robot to work is called the robot's operating space.&lt;br&gt; If the robot's motion space is greater than the operating space, it is recommended that you set a smaller motion space to prevent the robot from interfering or disrupting other equipment.&lt;br&gt; Refer to the &quot;INSTALLATION &amp; MAINTENANCE GUIDE&quot; Chapter 4.</td>
</tr>
<tr>
<td>2.11</td>
<td><strong>No robot modification allowed</strong>&lt;br&gt; Never modify the robot unit, robot controller, teach pendant or other devices.</td>
</tr>
<tr>
<td>2.12</td>
<td><strong>Cleaning of tools</strong>&lt;br&gt; If your robot uses welding guns, paint spray nozzles, or other end-effectors requiring cleaning, it is recommended that the cleaning process be carried out automatically.</td>
</tr>
<tr>
<td>2.13</td>
<td><strong>Lighting</strong>&lt;br&gt; Sufficient illumination should be assured for safe robot operation.</td>
</tr>
<tr>
<td>2.14</td>
<td><strong>Protection from objects thrown by the end-effector</strong>&lt;br&gt; If there is any risk of workers being injured in the event that the object being held by the end-effector is dropped or thrown by the end-effector, consider the size, weight, temperature and chemical nature of the object and take appropriate safeguards to ensure safety.</td>
</tr>
</tbody>
</table>
3. Precautions while robot is running

**Warning**

Touching the robot while it is in operation can lead to serious injury. Please ensure the following conditions are maintained and that the cautions listed from Section 3.1 onwards are followed when any work is being performed.

1) Do not enter the robot's restricted space when the robot is in operation or when the motor power is on.

2) As a precaution against malfunction, ensure that an emergency stop device is activated to cut the power to the robot motor upon entry into the robot's restricted space.

3) When it is necessary to enter the robot's restricted space to perform teaching or maintenance work while the robot is running, ensure that the steps described in Section 3.3 "Ensuring safety of workers performing jobs within the robot's restricted space" are taken.

3.1 Creation of working regulations and assuring worker adherence

When entering the robot's restricted space to perform teaching or maintenance inspections, set "working regulations" for the following items and ensure workers adhere to them.

1) Operating procedures required to run the robot.

2) Robot speed when performing teaching.

3) Signaling methods to be used when more than one worker is to perform work.

4) Steps that must be taken by the worker in the event of a malfunction, according to the contents of the malfunction.

5) The necessary steps for checking release and safety of the malfunction status, in order to restart the robot after robot movement has been stopped due to activation of the emergency stop device.

6) Apart from the above, any steps below necessary to prevent danger from unexpected robot movement or malfunction of the robot.

1) Display of the control panel (See Section 3.2 on the following page)

2) Assuring the safety of workers performing jobs within the robot's restricted space (See Section 3.3 on the following page)

3) Maintaining worker position and stance

Position and stance that enables the worker to confirm normal robot operation and to take immediate refuge if a malfunction occurs.
4) Implementation of measures for noise prevention  
5) Signaling methods for workers of related equipment  
6) Types of malfunctions and how to distinguish them  

Please ensure "working regulations" are appropriate to the robot type, the place of installation and to the content of the work. Be sure to consult the opinions of related workers, engineers at the equipment manufacturer and that of a labor safety consultant when creating these "working regulations".

<table>
<thead>
<tr>
<th>3.2</th>
<th>Display of operation panel</th>
</tr>
</thead>
<tbody>
<tr>
<td>To prevent anyone other than the worker from accessing the start switch or the changeover switch by accident during operation, display something to indicate it is in operation on the operating panel or teach pendant. Take any other steps as appropriate, such as locking the cover.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3.3</th>
<th>Ensuring safety of workers performing jobs within the robot's restricted space</th>
</tr>
</thead>
</table>
| When performing jobs within the robot's restricted space, take any of the following steps to ensure that robot operation can be stopped immediately upon a malfunction.  
(1) Ensure an overseer is placed in a position outside the robot's restricted space and one in which he/she can see all robot movements, and that he/she is devoted solely to that task.  
① An emergency stop device should be activated immediately upon a malfunction.  
② Do not permit anyone other than the worker engaged for that job to enter the robot's restricted space.  
(2) Ensure a worker within the robot's restricted space carries the portable emergency stop switch so he/she can press it (the robot stop button on the teach pendant) immediately if it should be necessary to do so. |

<table>
<thead>
<tr>
<th>3.4</th>
<th>Inspections before commencing work such as teaching</th>
</tr>
</thead>
</table>
| Before starting work such as teaching, inspect the following items, carry out any repairs immediately upon detection of a malfunction and perform any other necessary measures.  
(1) Check for any damage to the sheath or cover of the external wiring or to the external devices.  
(2) Check that the robot is functioning normally or not (any unusual noise or vibration during operation).  
(3) Check the functioning of the emergency stop device.  
(4) Check there is no leakage of air or oil from any pipes.  
(5) Check there are no obstructive objects in or near the robot's restricted space. |

<table>
<thead>
<tr>
<th>3.5</th>
<th>Release of residual air pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before disassembling or replacing pneumatic parts, first release any residual air pressure in the drive cylinder.</td>
<td></td>
</tr>
</tbody>
</table>
3.6 Precautions for test runs
Whenever possible, have the worker stay outside of the robot's restricted space when performing test runs.

3.7 Precautions for automatic operation

(1) At start-up
Before the robot is to be started up, first check the following items as well as setting the signals to be used and perform signaling practice with all related workers.

1) Check that there is no one inside the robot's restricted space.

2) Check that the teach pendant and tools are in their designated places.

3) Check that no lamps indicating a malfunction on the robot or related equipment are lit.

(2) Check that the display lamp indicating automatic operation is lit during automatic operation.

(3) Steps to be taken when a malfunction occurs
Should a malfunction occur with the robot or related equipment and it is necessary to enter the robot's restricted space to perform emergency maintenance, stop the robot's operation by activating the emergency stop device. Take any necessary steps such as placing a display on the starter switch to indicate work is in progress to prevent anyone from accessing the robot.

3.8 Precautions in repairs

(1) Do not perform repairs outside of the designated range.

(2) Under no circumstances should the interlock mechanism be removed.

(3) When opening the robot controller's cover for battery replacement or any other reasons, always turn the robot controller power off and disconnect the power cable.

(4) Use only spare tools authorized by YASKAWA.

4. Daily and periodical inspections

(1) Be sure to perform daily and periodical inspections. Before starting jobs, always check that there is no problem with the robot and related equipment. If any problems are found, take any necessary measures to correct them.

(2) When carrying out periodical inspections or any repairs, maintain records and keep them for at least 3 years.
5. Management of floppy disks

(1) After finishing teaching or making any changes, always save the programs and data onto floppy disks. Making back-ups will help you recover if data stored in the robot controller is lost due to the expired life of the back-up battery.

(2) Write the names of each of the floppy disks used for storing task programs to prevent incorrect disks from loading into the robot controller.

(3) Store the floppy disks where they will not be exposed to dust, humidity and magnetic field, which could corrupt the disks or data stored on them.
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Chapter 1

Operating Devices (TP/OP/MP)

This chapter describes how to connect the teach pendant, operating panel, and mini-pendant to the robot controller. It also provides explanations of the names and functions of their keys, buttons, and switches which allows you to operate the robot.

**NOTE 1:** The operating panel should be secured to a safe place.

**NOTE 2:** Avoid letting the teach pendant, operating panel, or mini-pendant undergo strong shocks, impacts, or vibrations.

**NOTE 3:** Touch the teach pendant, operating panel, or mini-pendant with your fingers only, never with the tip of a pen or any pointed object. Otherwise, the LCD may be broken.
Chapter 1 Operating Devices (TP/OP/MP)

1.1 Connecting the Teach Pendant and/or Operating Panel
   1.1.1 Connecting the Teach Pendant
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1.2 Handling the Teach Pendant
   1.2.1 Holding the Teach Pendant and the Deadman Switch
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   1.2.3 Basic Operation of the Teach Pendant

1.3 Handling the Operating Panel
   [ 1 ] Operating panel functions
   [ 2 ] Operating procedure

1.4 Handling the Mini-Pendant
1.1 Connecting the Teach Pendant and/or Operating Panel

You may teach or operate the robot from the teach pendant (TP), operating panel (OP), or mini-pendant (MP). When the robot leaves the factory, none of them is connected to the robot controller (pendantless state) as shown in Subsection 1.1.4.

After unpacking the robot package, connect the teach pendant, operating panel, or mini-pendant to the robot controller where necessary. The teach pendant and operating panel can be connected to the robot controller together. The mini-pendant cannot be together with the teach pendant or operating panel; it can be single connected.
1.1.1 Connecting the Teach Pendant

Connect the teach pendant to connector CN5 of the robot controller as shown in Figure 1-1.

Connection type 1: Teach pendant only

Connection type 2: Operating panel connected with the teach pendant

Figure 1-1. Connecting the Teach Pendant
1.1.2 Connecting the Operating Panel

Connect the operating panel to connector CN5 of the robot controller as shown in Figure 1-2.

**Connection type 1: Operating panel only**
- **Mode switch**
  - Turn this switch to the MANUAL or AUTO position.
- **Pendantless connector**

**NOTE:** Be sure to secure the operating panel to a safe place such as equipment.
**NOTE:** When using the operating panel without the teach pendant connected, always insert the pendantless connector into the TP socket on the operating panel.

**Connection type 2: Operating panel connected with the teach pendant**
- **Teach pendant**
- **Mode switch**
  - To use the teach pendant, turn this switch to the TP position.
  - To use the operating panel, turn this switch to the MANUAL or AUTO position.

*Figure 1-2. Connecting the Operating Panel*
1.1.3 Pendantless State

If you disconnect the teach pendant or operating panel from the robot controller after teaching, connect the pendantless connector instead. In this pendantless state, you may run the robot automatically by controlling I/O signals from external equipment.

![Figure 1-3. Pendantless State](image)
1.2 Handling the Teach Pendant

1.2.1 Holding the Teach Pendant and the Deadman Switch

When operating the teach pendant, grasp it as shown below.

The teach pendant has two deadman switches, so it is possible to hold the teach pendant in the 2 ways.

![Figure 1-4. Holding the Teach Pendant](image)

★ Tip ★

The deadman switch is provided to stop the robot automatically and safely when the operator can no longer operate the robot correctly due to unforeseen circumstances such as the operator suffering a blackout or dying while running the robot manually with the teach pendant. If a situation such as this arises, the strength with which the operator is pressing the deadman switch will become either decrease or increase markedly. The deadman switch is a 3-position switch which is able to recognize and react to the following 3 operating statuses.

1) When the switch is not being pressed or is being pressed lightly
   → Switch: OFF

2) When the switch is being pressed with correct pressure
   → Switch: ON

3) When the switch is being pressed too strongly
   → Switch: OFF

If the switch is OFF or goes OFF, the robot cannot run or the running robot will stop, respectively.

In order to ensure safety, the robot is so designed that in manual mode the deadman switch should be held down for example when the operator presses any of the arm traverse keys.
1.2.2 Names of Keys, Buttons, and Switches on the Teach Pendant

Figure 1-5 (1) shows the names of keys, buttons, switches, and other sections of the teach pendant. On the LCD screen are function buttons, shortcut button, and icons which are shown in Figure 1-5 (2).

Before running the robot, learn the location of those keys, buttons, and switches, which will help you run the robot smoothly and safely. Some functions are newly added, so read this manual carefully even if you are familiar with the conventional YASKAWA MOTOMAN robot.

![Diagram of Teach Pendant with labels for LOCK key, MOTOR key, Mode switch, M-MOD key, SPEED key, Robot stop button, Jog dial, STOP key, Cancel key, OK key, Hand strap, Cursor keys, LCD screen, SHIFT key, Function keys, Arm traverse keys, and R-SEL (Robot selection) key.]

Figure 1-5 (1). Names of Keys, Buttons, and Switches on the Teach Pendant
Chapter 1 Teach Pendant and Operating Panel

Task programs on halt
(Receiving programs from external equipment)
Task programs on halt
(Transmitting programs to external equipment)
Task program(s) running
(Receiving programs from external equipment)
Task program(s) running (Transmitting programs to external equipment)

Dummy input not set
Dummy input set to a user-input port(s)

Ver. 1.4 or later
I/O output restricted

Internal Auto mode
External Auto mode
Manual mode
Teach check mode
No mode selected

Backup batteries working
Robot select button (The selected robot type appears)
Operation mode
Status bar (Shows the robot status.)
Shortcut button (which calls up the shortcut menu. Use this when you want to access other functions halfway through some processing.)
Menu bar

Shift button
(F7) (F8) (F9) (F10) (F11) (F12)
Function buttons (Used to perform the functions assigned.)

Figure 1-5 (2). Names of Keys Buttons, and Switches on the Teach Pendant
1.2.3 Basic Operation of the Teach Pendant

Top screen

Turning on the power to the teach pendant will display the top screen as shown in Figure 1-5. In the top of the screen is a status bar, which displays the current operation mode, task program status, backup battery states, robot status and other conditions. In the bottom of the screen is a menu bar that shows the functions assigned to the function keys. The middle of the screen displays a variety of windows.

Function keys and function buttons

The teach pendant has six function keys whose functions (F1 to F6 assigned) are usually displayed on the six buttons in the menu bar of the screen. Pressing the SHIFT key (or Shift button) switches the menu bar between "F1 to F6" and "F7 to F12." When those function keys are shifted, their functions (F7 to F12 assigned) are displayed on the six buttons.

Pressing the function keys is functionally equivalent to pressing their corresponding buttons in the menu bar.

- When the function keys (buttons) are not shifted:

  ![Function Keys and SHIFT Key](image1)

- When the function keys (buttons) are shifted:

  ![Function Keys and SHIFT Key](image2)

Figure 1-6. Function Keys and SHIFT Key

SHIFT key and shift mark

If the shift mark is ▲ (facing up and filled with black), it means that the current menu bar can be shifted. Pressing the SHIFT key will shift the menu bar from "F1 to F6" to "F7 to F12" and turn the shift mark to ▼ (facing down).

If the shift mark is △ (facing up and filled with gray), it means that the current menu bar cannot be shifted. Pressing the SHIFT key will result in no change in the menu display.
Chapter 1 Teach Pendant and Operating Panel

Cursor keys and jog dial
There are four cursor keys that are used to select the target data or increase/decrease values. Pressing up-, down-, left-, or right-arrow cursor key moves the cursor up, down, leftwards, or rightwards, respectively.

When the cursor movement direction is restricted to either up/down or leftwards/rightwards, the restricted direction keys are used to increase or decrease values.

The jog dial has the same functions as the cursor keys.

Touch panel
The LCD screen of the teach pendant acts as a touch panel. You may directly touch the screen to operate the touch buttons or select data entry areas.

CAUTION: Touch the screen with your fingers only. Pressing the screen with the tip of a pen or any pointed object will result in failures.

OK key and Cancel key
The OK key or Cancel key is usually used to allow input of a new entry or to discard it, respectively.

Those keys are also used to close the current window and return to the previous one. Pressing the OK key will save the new entry and exit from the current window; pressing the Cancel key will exit from the current window without saving new entry.
**SHORTCUT button**

The use of a shortcut allows you halfway through the current processing to carry out other processing. From any of the processing screens, you may call up the Shortcut Menu by pressing the SHORTCUT button.

On the Shortcut Menu, you may choose the desired processing.

**Step 1**
Press the SHORTCUT button.

**Step 2**
Press the desired function button on the Shortcut Menu. (Or press the corresponding function button on the menu bar or press the function key on the teach pendant.)

The screen will switch to the processing screen of the selected function.
1.3 Handling the Operating Panel

Figure 1-7 shows the names of keys and switches of the operating panel.
[ 1 ] Operating panel functions

With the operating panel, you may run the robot manually, start programs, edit variables, get robot arm positions into variables in teaching, and move the robot arm by specifying a desired variable. Choosing work coordinates or tool coordinates is also possible.

### Operating Panel Functions

<table>
<thead>
<tr>
<th>Version</th>
<th>Function:</th>
<th>Description</th>
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<tr>
<td>Ver.1.2 or later</td>
<td>Editing variables</td>
<td>You may edit variables by entering numerical values.</td>
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<tr>
<td></td>
<td>- Teaching the current position</td>
<td>- You may get the current position into P variables, J variable, and T variables. It is used for position teaching.</td>
</tr>
<tr>
<td></td>
<td>- Choosing work coordinates or tool coordinates</td>
<td>- You may choose work coordinates or tool coordinates.</td>
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<tr>
<td>Ver.1.6 or later</td>
<td>Operating the robot arm by specifying a desired variable</td>
<td>You may move the robot arm according to the specified variable. It is used to confirm variables you have preset in teaching.</td>
</tr>
</tbody>
</table>

![Operating Panel Diagram]

**Function selection mode key** (enabled when the SHIFT lamp light.)

**Motor key**

**Function selector** (to scroll down)

**Function selector** (to scroll up)
[2] Operating procedure

According to the procedure below, you may choose the desired function in Manual mode.

**Step 1**
Turn the mode selector switch to the MANUAL position.

**Step 2**
Press the SHIFT key.
The SHIFT lamp should come on.

**Step 3**
Press the function selection mode key to enter the selection mode.

The following display appears.

![Function Display]

**Step 4**
Press the following function selectors to scroll the display up or down.

The following display appears.

![Function Display]

F2: Chg VarVal F
Step 5

You may select any of the following functions:

- **[Chg VarVal I]** Edit integer variables by entering numerical values
- **[Chg VarVal F]** Edit floating-point variables by entering numerical values
- **[Chg VarVal D]** Edit double-precision variables by entering numerical values
- **[Chg VarVal V]** Edit vector variables by entering numerical values
- **[Chg VarVal P]** Edit position variables by entering numerical values
- **[Chg VarVal J]** Edit joint variables by entering numerical values
- **[Chg VarVal T]** Edit variables in homogeneous transform matrix by entering numerical values
- **[Set VarVal P]** Get the current position into a position variable
- **[Set VarVal J]** Get the current position into a joint variable
- **[Set VarVal T]** Get the current position into a variable in homogeneous transform matrix
- **[Move to Pvar]** Operate the robot by selecting a position variable
- **[Move to Jvar]** Operate the robot by selecting a joint variable
- **[Move to Tvar]** Operate the robot by selecting a variable in homogeneous transform matrix

When the desired function is displayed, press the OK key.

To exit from the function selection mode, press the Cancel key.

If any error occurs during the function selection procedure, the operating panel will automatically exit from the function selection mode.
1.4 Handling the Mini-Pendant

The figure below shows the names of keys and switches of the mini-pendant. When the power is applied, the mini-pendant displays the top screen on the LCD (see the next page). In the uppermost row of the top screen is a status bar which always displays the current operation mode, program status, connected robot model, motion mode, speed, and other information.

For the operating procedure, refer to Chapter 6.

NOTE: On almost all key tops are two function names printed. The upper functions are enabled when the keypad is not shifted; that is, the SHIFT lamp is off. The lower ones are enabled when it is shifted; that is, the lamp is on.

NOTE: The mini-pendant cannot be connected to the controller together with the teach pendant or operating panel. It can be single connected.
Top Screen of the Mini-Pendant

- **Robot model**: Currently selected robot model
- **I/O line information**
  - Dummy input not set
  - Dummy input set
- **Program status**
  - User task program on halt
  - Supervisory task on halt
  - User task program running
  - Supervisory task running
- **Operation mode**
  - Internal Auto mode
  - External Auto mode
  - Manual mode
  - Teach Check mode
  - No mode selected
- **Current motion mode**
- **Current coordinates**
- **Speed**
  - Shows external speed ratio.
- **Alphanumeric entry mode**
  - Shows "N" when the arm traverse keys are placed in alphanumeric entry mode.
  - As arm traverse keys
  - As a numeric keypad
This chapter describes preparations necessary to make before starting teaching or running the robot from the teach pendant, operating panel, or mini-pendant.

The preparations include turning the robot controller and motor on/off, calibrating the robot, modifying the speed, inching selection, setting payload and its center of gravity, and setting the robot installation condition.

Be sure to read this chapter before powering on the robot controller.

**NOTE 1:** This chapter uses the abbreviations (TP), (OP), (MP), and (WC) which inform you that operations marked with those abbreviations can be performed from the teach pendant, operating panel, mini-pendant, and in WINCAPSII, respectively.

**NOTE 2:** Avoid letting the teach pendant, operating panel, or mini-pendant undergo any strong shocks, impacts, or vibrations.

**NOTE 3:** Touch the teach pendant, operating panel, or mini-pendant with your fingers only, never with the tip of a pen or any pointed object. Otherwise, the LCD may be broken.
## Chapter 2 Preparations for Teaching

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2.1 Turning the Robot Controller ON (TP/OP/MP)

Turning the robot controller on enables you to operate the robot from the teach pendant, operating panel, or mini-pendant or run the robot automatically.

The robot controller supplies the robot unit with power and controls it.

Operating procedure

Step 1
Flip the power toggle switch provided on the robot controller upward.
The power lamp (the left one of the three pilot lamps) comes on. The other two pilot lamps (Auto mode lamp and error lamp) will flash for an instant.

If the teach pendant is connected to the robot controller, the top screen shown below appears on the pendant's display.
If the operating panel is connected to the robot controller, the LCD first shows the following:

```
1.1.1.1  OP PANEL
1.23 12/09/1998
```

(Version of operating panel module and updated date)

Next, during initialization of the robot controller hardware, the following appears:

```
Controller
Not Ready
```

Then during initialization of data transaction between the robot controller and operating panel, the following appears:

```
Initializing
```

Upon completion of the above sequence, the LCD shows nothing and the AUTO lamp flashes two times.

When the mini-pendant (MP) is connected to the robot controller, the LCD first shows the following:

```
AO! VMXYWOT 0100N
```

**CAUTION:** If you want to turn the controller power on immediately after turning it off, wait 10 seconds or more and check that all of the pilot lamps on the robot controller are no longer lit and the TP screen, OP display, and MP screen are turned off.
2.2 Turning the Robot Controller OFF (TP/OP/MP)

Turn the robot controller off when

(1) The necessary robot operation have been completed.
(2) Performing maintenance on the robot unit.
(3) Performing maintenance on the robot controller.
(4) Connecting or disconnecting visual equipment, Ethernet card, floppy disk drive, and others to or from the robot controller.
(5) Replacing the operating panel.
(6) Connecting or disconnecting the robot control cable between the robot unit and its controller.

⚠️ CAUTION: Be sure to turn the robot controller off before connecting or disconnecting the robot control cable between the robot unit and its controller. Connection/disconnection of the robot control cable while the robot controller power is on will damage the encoder interface circuitry in the robot controller.
Operating procedure

From the teach pendant

Step 1
If the MOTOR lamp is on, press the MOTOR key to turn the motor power off. The MOTOR lamp goes off.

Step 2
Flip the power toggle switch on the robot controller downwards. The power lamp (the left one of the three pilot lamps) goes off.
Chapter 2 Preparations for Teaching

From the operating panel

Step 1
If the MOTOR lamp is on, press the MOTOR key to turn the motor power off. The MOTOR lamp goes off.

Step 2
Turn down the power switch on the robot controller. The power lamp (the left one of the three pilot lamps) goes off.
From the mini-pendant

Step 1
If the MOTOR lamp is lit, press the MOTOR key to turn the motor off. The MOTOR lamp goes off.

Step 2
Flip the power toggle switch on the robot controller downwards. The power lamp (the left one of the three pilot lamps) goes off.
2.3 Deadman Switch(es) (TP/OP/MP)

The deadman switch activates a number of functions in the Manual mode or Teach check mode if it is held down. The teach pendant has two deadman switches as shown in Figure 2-1. The operating panel has a single deadman switch as shown in Figure 2-2.

![Figure 2-1. Deadman Switches on the Teach Pendant](image1)

![Figure 2-2. Deadman Switch on the Operating Panel](image2)
Hold down the deadman switch when
(1) You press any of the arm traverse keys in the Manual mode.
(2) You press the OK key after pressing the CycStart or StpStart button in the Teach check mode.
(3) You press [F5 ON/OFF] to turn output signals on or off without running task programs.
(4) You turn the selected user-input port on or off after setting dummy input to the port.

⚠️ CAUTION: Never keep the deadman switch(es) held down with adhesive tape or the like. Doing so may fail to stop the robot when running it in Manual mode. It is extremely DANGEROUS.

NOTE: A deadman switch is of a 3-position type as shown below. Releasing or pressing the switch past the midpoint depressed position will turn it off, stopping robot motion.

Released (OFF) ⇒ Pressed lightly (ON) ⇒ Pressed strongly (OFF)

Operating procedure
**From the teach pendant**

**Step 1** While holding down either one of the deadman switches, press any of the keys (e.g., arm traverse key).
You may hold the teach pendant in two ways as shown below. Press and hold down either deadman switch that you can access easily.

**Step 2** Release the deadman switch. (Or press it stronger.)
The robot will stop.
From the operating panel

Step 1
While holding down the deadman switch, press any of the keys (e.g., arm traverse key).

Step 2
Release the deadman switch. (Or press it more strongly.)
The robot will stop.
**From the mini-pendant**

**Step 1**
While holding down the deadman switch, press any of the keys (e.g., arm traverse key).

**Step 2**
Release the deadman switch. The robot will stop.
2.4 Turning the Motor ON (TP/OP/MP)

Turning the motor on enables you to run the robot.

⚠️ CAUTION: Before turning the motor on, be sure to confirm no person(s) is in the restricted space of the robot.

Turn the motor on when

(1) Running the robot in the Manual mode, Teach check mode, or Auto mode.

Operating procedure

- From the teach pendant

Step 1

Press the MOTOR key to turn the motor power on.

The MOTOR lamp comes on.

NOTE 1: If the "ERROR 2008 Robot Stop signal is on" appears when you turn the motor on, it means that the "Robot Stop" pin of input connector CN8 on the robot controller has not been short-circuited (not ON). Short-circuit the "Robot Stop" pin (refer to the INSTALLATION & MAINTENANCE GUIDE, Subsections 5.3.4.2 and 5.5.4.6).

NOTE 2: The motor cannot be turned on if the machine is locked. (Refer to Section 3.1.)

NOTE 3: You may turn the motor on even when a program is running in Auto mode. However, take extra care since the robot may suddenly move.
From the operating panel

Step 1
Press the MOTOR key to turn the motor power on.
The MOTOR lamp comes on.

NOTE 1: If the "ERROR 2008 Robot Stop signal is on" appears when you turn the motor on, it means that the "Robot Stop" pin of input connector CN8 on the robot controller has not been short-circuited (not ON). Short-circuit the "Robot Stop" pin (refer to the INSTALLATION & MAINTENANCE GUIDE, Subsections 5.3.4.2 and 5.5.4.6).

From the mini-pendant

Step 1
Refer to Subsection 6.2.1.
2.5 Turning the Motor OFF (TP/OP/MP)

Turn the motor off when

1. Anyone enters the restricted space of the robot.
2. Turning the robot controller off.
3. Running the robot manually.
4. Operating the floppy disk drive.
5. Modifying parameters.
6. Loading task programs.
7. Carrying out CALSET (selecting/deselecting joints to be calibrated).
8. Releasing brakes.

Operating procedure

- From the teach pendant

Step 1
Press the MOTOR key to turn the motor off.
The MOTOR lamp goes off.
**From the operating panel**

**Step 1**
Press the MOTOR key to turn the motor power off.
The MOTOR lamp goes off.

![Operating panel diagram](image)

**From the mini-pendant**

**Step 1**
Refer to Subsection 6.2.1.
2.6 Setting the Reduced Ratios of the Programmed Speed, Acceleration, and Deceleration (TP/OP/MP)

You may set the reduced ratios (%) of the programmed speed, acceleration, and deceleration, from the teach pendant or operating panel.

1. The default reduced ratios at powering on are 1%.

2. Once the reduced ratios are set, they will remain in effect until you turn the robot controller off or make new settings.

3. In Auto mode, the robot will run at the (programmed speed x reduced ratio (%)). If you set 80%, the robot will run at 80% of the programmed speed.

   In Manual mode or Teach check mode, the robot controller is designed to run the robot at 10% of the programmed speed. If you set 80% to speed, therefore, the robot will run at 10% x 80% of the programmed speed, that is, at 8%, as shown in Figure 2-3.

4. If you set the reduced ratio of the programmed speed, the robot controller automatically calculates the reduced ratios of the programmed acceleration and deceleration according to the formulas below.

   Reduced ratio for acceleration = (Reduced ratio for speed)² / 100
   Reduced ratio for deceleration = (Reduced ratio for speed)² / 100

   where, the calculated value will be rounded up to 1% if it is less than 1%.

   (Example) If the reduced ratio for speed is 20%
   Reduced ratio for acceleration = 20²/100 = 4%

   If you modify the automatically calculated ratios (%) manually from the teach pendant, the most recently modified ratios will take effect.

5. The minimal reduced ratio for speed is 0.1% and that for acceleration/deceleration is 0.0001%. If any value less than 1% is set, the teach pendant will display the value as 1% in the speed indicator bar graph of the status bar.

<table>
<thead>
<tr>
<th>Reduced ratio for speed (%)</th>
<th>Reduced ratio for acceleration (%)</th>
<th>Reduced ratio for deceleration (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>80%</td>
<td>4%</td>
<td>0.0001%</td>
</tr>
</tbody>
</table>

Figure 2-3. Differences in Auto Mode and in Manual/Teach Check Mode
Operating procedure

⚠️ CAUTION: At the start, set the speed to 20% or less. If you run the robot manually at high speeds from the beginning, you may mistakenly strike the robot against the surrounding objects.

⚠️ CAUTION: It is possible to set the reduced ratios of the programmed speed, acceleration, and deceleration even while the program is running. Doing so may suddenly change the robot speed. It is DANGEROUS.

### From the teach pendant

**Step 1**

Press the SPEED key.

The Set Speed window appears as shown in the next step.

**TIP:** You may call up the window by pressing [F2 Arm] on the top screen and pressing [F5 Speed].
Step 2

In the Set Speed window, check that the SPEED row is selected and then press [F5 Change.]

![Set Speed Window](image)

The numeric keypad appears as shown below.

**TIP:** If you use one of the F1 to F4 keys instead of [F5 Change.], you may directly enter any of the values displayed on the function buttons.

**TIP:** You may increase or decrease the value in units of 5% by using the right- or left-arrow cursor key, respectively. You may do it in units of 2% by using the jog dial.

Step 3

Use the numerical buttons on the numeric keypad to enter the desired value.

To cancel the newly entered value, press the CLR or BS button.

Check the entered value and press the OK button to enter it.

![Numeric Keypad](image)

The numeric keypad disappears.

To discard the new entry and return to the Set Speed window, press the CANCEL button on the numeric keypad instead of the OK button.
Step 4
In the Set Speed window, check the automatically calculated ratios of the acceleration and deceleration.

(1) If the ratios of acceleration and deceleration are OK, press the OK button and skip to Step 8.

(2) To set an arbitrary reduced ratio of acceleration, press the down-arrow cursor key to select the ACCEL row and then press [F5 Change.].

The numeric keypad appears as shown below.

**TIP:** If you use one of the F1 to F4 keys instead of [F5 Change.], you may directly enter any of the values displayed on the function buttons.

**TIP:** You may increase or decrease the value in units of 5% by using the right- or left-arrow cursor key, respectively. You may also increase or decrease the value in units of 1% by using the jog dial.

Step 5
Use the numerical buttons on the numeric keypad to enter the desired value.

To cancel the newly entered value, press the CLR or BS button.

Check the entered value and press the OK button to enter it.

The numeric keypad disappears.

To discard the new entry and return to the Set Speed window, press the CANCEL button on the numeric keypad instead of the OK button.
Step 6
In the Set Speed window, check the automatically calculated deceleration ratio.
(1) If the ratio of the deceleration is OK, press the OK button and skip to Step 8.
(2) To set an arbitrary reduced ratio of the deceleration, press the down-arrow cursor key to select the DECEL row and then press [F5 Change].

The numeric keypad appears as shown below.

**TIP:** If you use one of the F1 to F4 keys instead of [F5 Change.], you may directly enter any of the values displayed on the function buttons.

**TIP:** You may increase or decrease the value in units of 5% by using the right- or left-arrow cursor key, respectively. You may also increase or decrease the value in units of 1% by using the jog dial.

Step 7
Use the numerical buttons on the numeric keypad to enter the desired value.
To cancel the newly entered value, press the CLR or BS button.
Check the entered value and press the OK button to enter it.
(To discard the new entry and return to the Set Speed window, press the CANCEL button on the numeric keypad.)

The numeric keypad disappears.
Step 8

The top screen shown below appears. Check that the newly entered ratio is displayed in the rightmost area of the status bar.
Chapter 2  Preparations for Teaching

From the operating panel

Step 1
Press the SHIFT key.

The SHIFT lamp comes on.

Step 2
Press the SP key.
The LCD shows the following:

Step 3
Use the numerical keys to enter the desired value.
The LCD shows the following:

To cancel the new entry, press the Cancel key. The panel status returns to Step 1.

Step 4
Check the newly entered value and press the OK key.

NOTE: In the Manual mode or Auto mode also, you may set the robot speed. The permissible entry range is 1 to 100.

From the mini-pendant

Step 1
Refer to Subsection 6.2.6.
2.7 Inching Selection (TP)

You may inch the robot by a specified distance or angle each time you press any of the arm traverse keys in Manual mode. Once inching is selected, it takes effect until the robot controller is turned off or you switch the robot from inching to normal speed running.

When the robot controller is turned on, the default is normal speed running.

In Auto mode or Teach check mode, inching will not take effect. Even if inching is selected, switching from Manual mode to any other mode will automatically cause the robot to switch from inching to normal speed running. Switching back to Manual mode will cause the robot to switch back to inching.

Select inching when

Inching the robot in Manual mode.

Operating procedure

NOTE: Even if inching is selected, the robot will run at a normal speed if the robot is switched to an operation mode other than Manual mode.

■ From the teach pendant

Step 1

Press the SPEED key.

The Set Speed window appears as shown below.

TIP: You may call up the Set Speed window by pressing [F2 Arm] on the top screen and then pressing [F5 Speed].

Step 2

In the Set Speed window, press the Inching button.

The window shows the inching display.
Step 3  Check the inching values and press the OK button.

The display returns to the top screen where “Inch” is shown in the rightmost area of the status bar, as shown below.
2.8 Setting the Master Control Parameters of the Payload, Center of Gravity, and Control Set of Motion Optimization (TP/WC)

You may set the master control parameters of the mass of payload (end-effector and object to be mounted at the end of the robot arm), the payload center of gravity and control set of motion optimization. For details, refer to the PROGRAMMER’S MANUAL, Chapter 4, Section 4.7.

Set the master control parameters of the payload, center of gravity, and control set of motion optimization when

You have determined the mass of the payload (end-effector and object to be mounted at the end of the robot arm) and the payload center of gravity.

Operating procedure

This setting cannot be performed from the operating panel. Use the teach pendant or WINCAPSII. For details about the WINCAPSII, refer to the WINCAPSII GUIDE.

■ From the teach pendant

Step 1 On the top screen, press [F2 Arm].

The Current Robot Position window appears as shown below.
Step 2  Press [F6 Aux.].

The Auxiliary Functions (Arm) window appears as shown below.

Step 3  Press [F7 Config.].

The User Preferences window appears as shown in the next step.
Step 4
Select the "Mass of payload (g)" area by using the jog dial or [F1 BACK] to [F3 Jump To].
The selected area will become highlighted.
Then press [F5 Change].

The numeric keypad appears as shown below.

Step 5
Use numerical buttons on the numeric keypad to enter the desired value.
To cancel the newly entered value, press the CLR or BS button.
Check the entered value and press the OK button to establish it. To cancel entry made in this step and restore the previous setting, press the CANCEL button on the numeric keypad instead of the OK button.
The numeric keypad disappears.
The newly entered value is displayed in the "Mass of payload (g)" area, as shown below.

Press the OK button to establish the new settings. To cancel the new settings and return to the previous window, press the Cancel button.

Step 6
Select the "Payload center of gravity X (mm)" area by using the jog dial or [F1 BACK] to [F3 Jump To].
The selected area will become highlighted.
Then press [F5 Change].

The numeric keypad appears as shown in the next step.
Step 7

Use the numerical buttons on the numeric keypad to enter the desired value. To cancel the newly entered value, press the CLR or BS button.

Check the entered value and press the OK button to enter it. To cancel entry made in this step and restore the previous setting, press the CANCEL button on the numeric keypad instead of the OK button.

The numeric keypad disappears and the newly entered value is displayed in the "Payload center of gravity X (mm)" area, as shown below.

Press the OK button to establish the new settings. To cancel the new settings and return to the previous window, press the Cancel button.
Step 8
Select the "Payload center of gravity Y (mm)" area by using the jog dial or [F1 BACK] to [F3 Jump To].
The selected area will become highlighted.
Then press [F5 Change].

![Image of the numeric keypad]
The numeric keypad appears as shown below.

Step 9
Use the numerical buttons on the numeric keypad to enter the desired value.
To cancel the newly entered value, press the CLR or BS button.
Check the entered value and press the OK button to enter it. To cancel entry made in this step and restore the previous setting, press the CANCEL button on the numeric keypad instead of the OK button.

![Image of the numeric keypad with highlighted buttons]

Numeric keypad
The numeric keypad disappears and the newly entered value is displayed in the "Payload center of gravity Y (mm)" area, as shown below.

Press the OK button to establish the new settings. To cancel the new settings and return to the previous window, press the Cancel button.

---

**Step 10**

Select the "Payload center of gravity Z (mm)" area by using the jog dial or [F1 BACK] to [F3 Jump To].

The selected area will become highlighted.

Then press [F5 Change].

---

The numeric keypad appears as shown in the next step.
Step 11

Use the numerical buttons on the numeric keypad to enter the desired value.
To cancel the newly entered value, press the CLR or BS button.
Check the entered value and press the OK button to enter it. To cancel entry made in this step and restore the previous setting, press the CANCEL button on the numeric keypad instead of the OK button.

The numeric keypad disappears and the newly entered value is displayed in the "Payload center of gravity Z (mm)" area, as shown below.
Press the OK button to establish the new settings. To cancel the new settings and return to the previous window, press the Cancel button.
Step 12
Select the "Control set of motion optimization" area by using the jog dial or [F1 BACK] to [F3 Jump To].
The selected area will become highlighted.
Then press [F5 Change].

The numeric keypad appears as shown below.

Step 13
Use the numerical buttons on the numeric keypad to enter the desired value.
To cancel the newly entered value, press the CLR or BS button.
Check the entered value and press the OK button to enter it. To cancel entry made in this step and restore the previous setting, press the CANCEL button on the numeric keypad instead of the OK button.
The numeric keypad disappears and the newly entered value is displayed in the "Control set of motion optimization" area, as shown below.

Press the OK button to establish the new settings. To cancel the new settings and return to the previous window, press the Cancel button.

![Image showing the User Preferences window with new settings]

**Step 14**
Press the OK button on the User Preferences window as shown above.
The Auxiliary Functions (Arm) window appears.

**Step 15**
Press the Cancel key two times.
The display returns to the top screen.

The master control parameters set through the above procedure automatically apply to the local control parameters.
In WINCAPSII

Before proceeding to the following procedure, run the WINCAPSII System Manager. For details, refer to the WINCAPSII GUIDE, Chapters 1 to 3.

This section is intended for persons who have basic operating knowledge of Microsoft Windows95/98/NT4.0.

Step 1

Click the arm manager button in System Manager.

The Arm Manager window appears as shown below.

Step 2

On the Tools menu of Arm Manager, click Options.

The Options window appears as shown in the next step.

NOTE: If no password has been entered, the Password dialog box appears. Select user level and type password. For details on password entry, refer to the WINCAPSII GUIDE, Section 1.3.
Step 3 In the Options window, click the Config. tab to display the current conditions.

Step 4 Double-click the setting area of the "Control set of motion optimization" to prepare it to accept a new entry.
Step 5  Enter the desired value to the “Control set of motion optimization.”

The newly entered value appears in the setting area. To establish it, double-click any other line within this tab or press the OK button. If established, the value will be right justified. (This explanation applies also to the following procedures.)

Step 6  Double-click the setting area of the “Mass of payload (g)” to prepare it to accept a new entry.

Step 7  Enter the desired value.

The newly entered value is displayed in the setting area.
Step 8
Double-click the setting area of the "Payload center of gravity X (mm)" to prepare it to accept a new entry.

Step 9
Enter the desired value.

**NOTE:** For the setting values about the center of gravity of payload, refer to the definition given at the end of this section.

The newly entered value is displayed in the setting area.

Step 10
Double-click the setting area of the "Payload center of gravity Y (mm)" to prepare it to accept a new entry.

Step 11
Enter the desired value.

The newly entered value is displayed in the setting area.
Step 12  Double-click the setting area of the "Payload center of gravity Z (mm)" to prepare it to accept a new entry.

Step 13  Enter the desired value.
The newly entered value is displayed in the setting area.

Step 14  Click OK in the Config. window to close it.

Step 15  On the teach pendant, press the MOTOR key to turn the motor off.
The MOTOR lamp goes off.
Step 16
In Arm Manager, click the connect button.
The connect button appears depressed.

Step 17
Click the transfer button in Arm Manager.
The Transfer Environments Table window appears as shown below.

Step 18
Click the Select All button in the Transfer Environments Table window to select all items.
The selected items (all items in this example) will be marked with √.
Step 19
Click the Transmit button in the Transfer Environments Table window. The following dialog box appears.

![Arm Manager dialog box](image)

**NOTE:** If you click the <Receive button in the Transfer Environments Table window, WINCAPSII will receive the master control parameter values currently stored in the Arm Manager area of the robot controller. The local control parameters that are stored in the temporary area of the robot controller and may be modified in application programs cannot be transferred to WINCAPSII.

Step 20
Click the Yes (Y) button in the above dialog box to send the data to the robot controller.
DEFINITION: Payload Center of Gravity

Define the payload center of gravity in the TOOL0 coordinates in units of mm (refer to Figure 2-4).

- The origin of the TOOL0 coordinates is located in the center of the flange surface on the 6th axis.
- The X component is defined on the normal vector directed from the center of the flange to the center of the hole $\phi \ 6H7^{(0.012)}$dia.
- The Z component is defined on the approach vector directed from the center of the flange to the normal line of the flange center.
- As shown in Figure 2-5, the Y component is defined on the orientation vector directed along the Y axis (+) in the right-hand coordinates whose X axis is an normal vector and whose Z axis is an approach vector.

Figure 2-4. Payload Center of Gravity

Figure 2-5. Right-hand Coordinates
2.9 Setting the Robot Installation Condition (TP/WC)

You may set the robot installation condition as either floor-mount or overhead-mount.

Set the robot installation condition when
You have determined the mass of the payload (end-effector and object to be mounted at the end of the robot arm) and the payload center of gravity.

Operating procedure

**From the teach pendant**

**Step 1** On the top screen, press [F2 Arm].

The Current Robot Position window appears as shown below.

**Step 2** Press [F6 Aux.].

The Auxiliary Functions (Arm) window appears as shown in the next step.
Step 3  
Press [F7 Config.] on the Auxiliary Functions (Arm) window.

![User Preferences window](image)

The User Preferences window appears as shown below.

Step 4  
Select the "Floor-mount or Overhead-mount" area by using the jog dial or [F1 BACK] to [F3 Jump To].

The selected area will become highlighted.

Then press [F5 Change].

![User Preferences window with highlighted area](image)

The numeric keypad appears as shown in the next step.
Step 5

Use numerical buttons on the numeric keypad to enter the desired value. To cancel the newly entered value, press the CLR or BS button. Check the entered value and press the OK button to establish it. To cancel entry made in this step and restore the previous setting, press the CANCEL button on the numeric keypad instead of the OK button.

The numeric keypad disappears. The newly entered value is displayed in the "Mass of payload (g)" area, as shown below. Press the OK button to establish the new settings. To cancel the new settings and return to the previous window, press the Cancel button.

Step 6

In WINCAPSII, click the <Receive button in the Transfer Environments Table window. WINCAPSII will receive the master control parameters of the robot installation condition set with the teach pendant.
In WINCAPSII

Before proceeding to the following procedure, run WINCAPSII System Manager. For details, refer to the WINCAPSII GUIDE, Chapters 1 to 3.

This section is intended for persons who have basic operating knowledge of Microsoft Windows95/98/NT4.0.

Step 1  Click the arm manager button in System Manager.

The Arm Manager window appears as shown below.

Step 2  On the Tools menu of Arm Manager, click Options.

The Options window appears as shown in the next step.

NOTE: If no password has been entered, the Password dialog box appears. Select user level and type password. For details on password entry, refer to the WINCAPSII GUIDE, Section 1.3.
Step 3. On the Options window, click the Config. tab to display the conditions.

Step 4. Double-click the setting area of the “Floor-mount or Overhead-mount” to prepare it to accept a new entry.
Step 5 Enter the desired value (0 for floor-mount and 1 for overhead-mount). The newly entered value is displayed in the setting area.

Step 6 Click OK in the Options window to close it.

Step 7 On the teach pendant, press the MOTOR key to turn the motor off. The MOTOR lamp goes off.

CAUTION NEVER omit step 7. Turning the motor off is required for assuring safety in the following operation.
Step 8
In Arm Manager, click the connect button.
The connect button appears depressed.

Step 9
Click the transfer button in Arm Manager.
The Transfer Environments Table window appears as shown below.

Step 10
Click the Select All button in the Transfer Environments Table window to select all items.
All items will be marked with √.
Step 11
Click the Transmit> button in the Transfer Environments Table window.
The following dialog box appears.

![Arm Manager dialog box]

**NOTE:** If you click the <Receive button in the Transfer Environments Table window, WINCAPSII will receive the master control parameter values currently stored in the Arm Manager area of the robot controller. The local control parameters that are stored in the temporary area of the robot controller and may be modified in application programs cannot be transferred to WINCAPSII.

Step 12
Click the Yes (Y) button in the above dialog box to send the data to the robot controller.
## 2.10 Configuration List

The table below lists the items displayed in the User Preferences window of the teach pendant (Access: [F2 Arm]—[F6 Aux.]—[F7 Config.]) or in the Config. tab of the Options window in WINCAPS II (Access: [Arm Manager]—[Tools Menu]—[Options]—[Configuration]).

### Table 2-1. Configuration List (Example)

<table>
<thead>
<tr>
<th>No.</th>
<th>Items</th>
<th>Factory default</th>
<th>Powering-on default</th>
<th>Description</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Control set of motion optimization</td>
<td>0</td>
<td>0</td>
<td>0: OFF 1: PTP movement only 2: CP movement only 3: Both PTP and CP movement (Refer to the PROGRAMMER’S MANUAL, Section 4.6, &quot;Control Sets of Motion Optimization.&quot;)</td>
<td>Can be set with aspChange ().</td>
</tr>
<tr>
<td>8</td>
<td>Floor-mount, Overhead-mount, or Wall-mount</td>
<td>0</td>
<td>Last value at powering-off</td>
<td>0: Floor-mount 1: Overhead-mount 2: Wall-mount (Ver. 1.6 or later)</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Mass of payload (g)</td>
<td>Differs depend- ing upon models.</td>
<td>Last value at powering-off</td>
<td>Mass of end-effector and object to be mounted at the end of the robot arm.</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Payload center of gravity X (mm)</td>
<td>0</td>
<td>Last value at powering-off</td>
<td>X component of payload center of gravity (consisting of end-effector and object) (Refer to the PROGRAMMER’S MANUAL, Section 4.6, &quot;Control Sets of Motion Optimization.&quot;)</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Payload center of gravity Y (mm)</td>
<td>80</td>
<td>Last value at powering-off</td>
<td>Y component of payload center of gravity (consisting of end-effector and object) (Refer to the PROGRAMMER’S MANUAL, Section 4.6, &quot;Control Sets of Motion Optimization.&quot;)</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Payload center of gravity Z (mm)</td>
<td>100</td>
<td>Last value at powering-off</td>
<td>Z component of payload center of gravity (consisting of end-effector and object) (Refer to the PROGRAMMER’S MANUAL, Section 4.6, &quot;Control Sets of Motion Optimization.&quot;)</td>
<td></td>
</tr>
<tr>
<td>13 to 20</td>
<td>Encoder pulse count for positioning allowance (J1 to J8)</td>
<td>20</td>
<td>20</td>
<td>Convergence accuracy for specified axis (one of J1 to J8) at execution of a motion command with @E option</td>
<td>Can be set with mvSetPulseWidth ().</td>
</tr>
<tr>
<td>21</td>
<td>Positioning completion timeout (ms)</td>
<td>5600</td>
<td>5600</td>
<td>At execution of a motion command with @E option, if positioning is not completed within this specified time, a timeout will occur.</td>
<td>Can be set with mvSetTimeOut ().</td>
</tr>
<tr>
<td>22</td>
<td>Control log mode</td>
<td>1</td>
<td>Last value at powering-off</td>
<td>No. of control logs to be stored. Entry range: 1 to 3 (1250 x Set value) = No. of control logs</td>
<td>If many programs and/or variables are used, setting many control logs may cause an error at powering-on time. If such occurs, decrease the number of control logs.</td>
</tr>
<tr>
<td>No.</td>
<td>Items</td>
<td>Factory default</td>
<td>Powering-on default</td>
<td>Description</td>
<td>Comments</td>
</tr>
<tr>
<td>-----</td>
<td>--------------------------------------</td>
<td>-----------------</td>
<td>---------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>23</td>
<td>Control log sampling intervals</td>
<td>8</td>
<td>Last value at powering-off</td>
<td>Sampling intervals of control log. Entry range: 8, 16, 24, or 32 ms</td>
<td>If a value other than a multiple of 8 is set, the controller automatically modifies it to a multiple of 8.</td>
</tr>
<tr>
<td>24</td>
<td>Efficiency of gravity effect</td>
<td>0</td>
<td>Last value at powering-off</td>
<td>0: Gravity compensation feature disabled</td>
<td>Can be set with SetGravity or ResetGravity.</td>
</tr>
<tr>
<td>25</td>
<td>Curlmt function cancellation switch</td>
<td>0</td>
<td>Last value at powering-off</td>
<td>If lowest bit is 0: Resets the current limit setting when the motor is turned on</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>Changing accel mode</td>
<td>0 or 1</td>
<td>Last value at powering-off</td>
<td>0: Gain change function enabled 1: Gain change function disabled</td>
<td>The initial setting is 0 or 1 for 4-axis or 6-axis robots, respectively. Do not change the initial setting.</td>
</tr>
<tr>
<td>34</td>
<td>Motor power holding function</td>
<td>1</td>
<td>Last value at powering-off</td>
<td>Sets the motor power state when the Auto Enable switch is switched. 0: Turns the motor power OFF if it was ON 1: Keeps the current state of the motor power</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>Cycloid motion setting</td>
<td>0</td>
<td>Last value at powering-off</td>
<td>0: Cycloid motion disabled 1: Cycloid motion enabled</td>
<td>Can be set with Setcycloid or Resetcycloid.</td>
</tr>
<tr>
<td>No.</td>
<td>Items</td>
<td>Factory default</td>
<td>Powering-on default</td>
<td>Description</td>
<td>Comments</td>
</tr>
<tr>
<td>-----</td>
<td>-------</td>
<td>----------------</td>
<td>---------------------</td>
<td>-------------</td>
<td>----------</td>
</tr>
<tr>
<td>53 to 60</td>
<td>Gain reduce rate (J1 to J8)</td>
<td>Value proper to each robot</td>
<td>Last value at powering-off</td>
<td>Gain reduction rate for one of J1 to J8</td>
<td>Takes effect when the “Changing accel mode,” “Control method” and “High-inertia configuration” are set to 0. Do not change the initial value.</td>
</tr>
<tr>
<td>70</td>
<td>Pass motion setting</td>
<td>0</td>
<td>Last value at powering-off</td>
<td>When restarted after any stop operation during pass motion, the robot will make motion towards: 0: Target position specified after the pass motion (Default) 1: Target position specified before the pass motion</td>
<td></td>
</tr>
<tr>
<td>71</td>
<td>Positioning allowance of pass end</td>
<td>5</td>
<td>Last value at powering-off</td>
<td>Condition for preventing the robot from taking motion towards the target position specified before pass motion, when the robot is restarted. The condition should be set as a distance from the target position.</td>
<td>The condition refers to a distance from the target position at the command level, not the actual distance from the current robot end position.</td>
</tr>
<tr>
<td>78</td>
<td>Damper setting rate (X)</td>
<td>10000</td>
<td>10000</td>
<td>Damping ratio along the X-axis under compliance control</td>
<td>Can be set with SetDampRate or ResetDampRate.</td>
</tr>
<tr>
<td>79</td>
<td>Damper setting rate (Y)</td>
<td>10000</td>
<td>10000</td>
<td>Damping ratio along the Y-axis under compliance control</td>
<td>Cannot be modified with the teach pendant. (Ver. 1.4 or later)</td>
</tr>
<tr>
<td>80</td>
<td>Damper setting rate (Z)</td>
<td>10000</td>
<td>10000</td>
<td>Damping ratio along the Z-axis under compliance control</td>
<td></td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>No.</th>
<th>Items</th>
<th>Factory default</th>
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<th>Description</th>
<th>Comments</th>
</tr>
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<tbody>
<tr>
<td>81</td>
<td>Damper setting rate (RX)</td>
<td>10000</td>
<td>10000</td>
<td>Damping ratio around the X-axis under compliance control</td>
<td>Can be set with SetDampRate or ResetDampRate.</td>
</tr>
<tr>
<td>82</td>
<td>Damper setting rate (RY)</td>
<td>10000</td>
<td>10000</td>
<td>Damping ratio around the Y-axis under compliance control</td>
<td>Cannot be modified with the teach pendant.</td>
</tr>
<tr>
<td>83</td>
<td>Damper setting rate (RZ)</td>
<td>10000</td>
<td>10000</td>
<td>Damping ratio around the Z-axis under compliance control</td>
<td>(Ver. 1.4 or later)</td>
</tr>
<tr>
<td>84</td>
<td>Compliance control mode</td>
<td>1</td>
<td>1</td>
<td>If lowest bit is 0: Compliance speed control mode  If 2nd lowest bit is 1: Disables the gravity compensation feature under compliance control</td>
<td>Can be set with SetCompVMode, ResetCompV Mode, SetCompControl, or SetCompF Control.  Cannot be modified with the teach pendant. (Ver. 1.4 or later)</td>
</tr>
<tr>
<td>86</td>
<td>Untivibration setting</td>
<td>0</td>
<td>Last value at powering-off</td>
<td>1: Residual vibration reduction control mode</td>
<td>Can be set with SetVibControl or ResetVibControl.</td>
</tr>
<tr>
<td>87</td>
<td>Compliance control ON/</td>
<td>0</td>
<td>0</td>
<td>1: Under compliance control</td>
<td>Can be set with SetCompControl, SetCompF Control, or ResetComp Control.  Cannot be modified with the teach pendant. (Ver. 1.4 or later)</td>
</tr>
<tr>
<td>88</td>
<td>Coordinates for compliance control</td>
<td>0</td>
<td>0</td>
<td>0: Base coordinates  1: Tool coordinates  2: Work coordinates</td>
<td>Can be set with SetFrcCoord.  Cannot be modified with the teach pendant. (Ver. 1.4 or later)</td>
</tr>
<tr>
<td>89</td>
<td>Force limit rate (+X)</td>
<td>10000</td>
<td>10000</td>
<td>Force control rate along the +X axis under compliance control</td>
<td>Can be set with SetFrcCoord.</td>
</tr>
<tr>
<td>90</td>
<td>Force limit rate (+Y)</td>
<td>10000</td>
<td>10000</td>
<td>Force control rate along the +Y axis under compliance control</td>
<td>Cannot be modified with the teach pendant.</td>
</tr>
<tr>
<td>91</td>
<td>Force limit rate (+Z)</td>
<td>10000</td>
<td>10000</td>
<td>Force control rate along the +Z axis under compliance control</td>
<td>(Ver. 1.4 or later)</td>
</tr>
<tr>
<td>No.</td>
<td>Items</td>
<td>Factory default</td>
<td>Powering-on default</td>
<td>Description</td>
<td>Comments</td>
</tr>
<tr>
<td>-----</td>
<td>-------------------------------------------</td>
<td>-----------------</td>
<td>---------------------</td>
<td>-------------------------------------------------------</td>
<td>-----------------------------------------------</td>
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<tr>
<td>92</td>
<td>Force limit rate (+RX)</td>
<td>10000</td>
<td>10000</td>
<td>Force control rate around the +X axis under compliance control</td>
<td>Can be set with SetFrcCoord.</td>
</tr>
<tr>
<td>93</td>
<td>Force limit rate (+RY)</td>
<td>10000</td>
<td>10000</td>
<td>Force control rate around the +Y axis under compliance control</td>
<td>Cannot be modified with the teach pendant. (Ver. 1.4 or later)</td>
</tr>
<tr>
<td>94</td>
<td>Force limit rate (+RZ)</td>
<td>10000</td>
<td>10000</td>
<td>Force control rate around the +Z axis under compliance control</td>
<td></td>
</tr>
<tr>
<td>95</td>
<td>Force limit rate (-X)</td>
<td>10000</td>
<td>10000</td>
<td>Force control rate along the -X axis under compliance control</td>
<td>Can be set with SetFrcCoord.</td>
</tr>
<tr>
<td>96</td>
<td>Force limit rate (-Y)</td>
<td>10000</td>
<td>10000</td>
<td>Force control rate along the -Y axis under compliance control</td>
<td>Cannot be modified with the teach pendant. (Ver. 1.4 or later)</td>
</tr>
<tr>
<td>97</td>
<td>Force limit rate (-Z) (For 6-axis robot)</td>
<td>10000</td>
<td>10000</td>
<td>Force control rate along the -Z axis under compliance control</td>
<td></td>
</tr>
<tr>
<td>98</td>
<td>Force limit rate (-RX)</td>
<td>10000</td>
<td>10000</td>
<td>Force control rate around the -X axis under compliance control</td>
<td>Can be set with SetFrcCoord.</td>
</tr>
<tr>
<td>99</td>
<td>Force limit rate (-RY)</td>
<td>10000</td>
<td>10000</td>
<td>Force control rate around the -Y axis under compliance control</td>
<td>Cannot be modified with the teach pendant. (Ver. 1.4 or later)</td>
</tr>
<tr>
<td>100</td>
<td>Force limit rate (-RZ)</td>
<td>10000</td>
<td>10000</td>
<td>Force control rate around the -Z axis under compliance control</td>
<td></td>
</tr>
<tr>
<td>101</td>
<td>Compliance setting rate (X)</td>
<td>10000</td>
<td>10000</td>
<td>Compliance rate along the X-axis under compliance control</td>
<td>Can be set with SetCompRate.</td>
</tr>
<tr>
<td>102</td>
<td>Compliance setting rate (Y)</td>
<td>10000</td>
<td>10000</td>
<td>Compliance rate along the Y-axis under compliance control</td>
<td>Cannot be modified with the teach pendant. (Ver. 1.4 or later)</td>
</tr>
<tr>
<td>103</td>
<td>Compliance setting rate (Z)</td>
<td>10000</td>
<td>10000</td>
<td>Compliance rate along the Z-axis under compliance control</td>
<td></td>
</tr>
<tr>
<td>104</td>
<td>Compliance setting rate (RX)</td>
<td>10000</td>
<td>10000</td>
<td>Compliance rate around the X-axis under compliance control</td>
<td>Can be set with SetCompRate.</td>
</tr>
<tr>
<td>105</td>
<td>Compliance setting rate (RY)</td>
<td>10000</td>
<td>10000</td>
<td>Compliance rate around the Y-axis under compliance control</td>
<td>Cannot be modified with the teach pendant. (Ver. 1.4 or later)</td>
</tr>
<tr>
<td>106</td>
<td>Compliance setting rate (RZ)</td>
<td>10000</td>
<td>10000</td>
<td>Compliance rate around the Z-axis under compliance control</td>
<td></td>
</tr>
<tr>
<td>107</td>
<td>Compliance/positional error allowance (X)</td>
<td>100</td>
<td>100</td>
<td>Allowable deviation along the X-axis under compliance control</td>
<td>Can be set with SetCompErlAw.</td>
</tr>
<tr>
<td>108</td>
<td>Compliance/positional error allowance (Y)</td>
<td>100</td>
<td>100</td>
<td>Allowable deviation along the Y-axis under compliance control</td>
<td>Cannot be modified with the teach pendant. (Ver. 1.4 or later)</td>
</tr>
<tr>
<td>109</td>
<td>Compliance/positional error allowance (Z)</td>
<td>100</td>
<td>100</td>
<td>Allowable deviation along the Z-axis under compliance control</td>
<td></td>
</tr>
</tbody>
</table>
## Chapter 2 Preparations for Teaching

<table>
<thead>
<tr>
<th>No.</th>
<th>Items</th>
<th>Factory default</th>
<th>Powering-on default</th>
<th>Description</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>Compliance/positional error allowance (RX)</td>
<td>300</td>
<td>300</td>
<td>Allowable deviation around the X-axis under compliance control</td>
<td>Can be set with SetCompEralw.</td>
</tr>
<tr>
<td>111</td>
<td>Compliance/positional error allowance (RY)</td>
<td>300</td>
<td>300</td>
<td>Allowable deviation around the Y-axis under compliance control</td>
<td>Cannot be modified with the teach pendant.</td>
</tr>
<tr>
<td>112</td>
<td>Compliance/positional error allowance (RZ)</td>
<td>300</td>
<td>300</td>
<td>Allowable deviation around the Z-axis under compliance control</td>
<td></td>
</tr>
<tr>
<td>113</td>
<td>Force offset (X)</td>
<td>0</td>
<td>0</td>
<td>Force offset along the X-axis under compliance control</td>
<td>Can be set with SetFrcAssist.</td>
</tr>
<tr>
<td>114</td>
<td>Force offset (Y)</td>
<td>0</td>
<td>0</td>
<td>Force offset along the Y-axis under compliance control</td>
<td>Cannot be modified with the teach pendant.</td>
</tr>
<tr>
<td>115</td>
<td>Force offset (Z)</td>
<td>0</td>
<td>0</td>
<td>Force offset along the Z-axis under compliance control</td>
<td></td>
</tr>
<tr>
<td>116</td>
<td>Force offset (RX)</td>
<td>0</td>
<td>0</td>
<td>Offset moment around the X-axis under compliance control</td>
<td>Can be set with SetFrcAssist.</td>
</tr>
<tr>
<td>117</td>
<td>Force offset (RY)</td>
<td>0</td>
<td>0</td>
<td>Offset moment around the Y-axis under compliance control</td>
<td>Cannot be modified with the teach pendant.</td>
</tr>
<tr>
<td>118</td>
<td>Force offset (RZ)</td>
<td>0</td>
<td>0</td>
<td>Offset moment around the Z-axis under compliance control</td>
<td></td>
</tr>
<tr>
<td>120</td>
<td>Optimization initialize</td>
<td>0</td>
<td>Last value at powering-off</td>
<td>0: Will reset the control set of motion optimization to 0 when the power is turned OFF and ON (Default)</td>
<td>(Ver. 1.4 or later)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1: Will not reset the control set of motion optimization when the power is turned OFF and ON</td>
<td></td>
</tr>
<tr>
<td>121</td>
<td>Torque limit for compliance control (J1 to J8)</td>
<td>0</td>
<td>0</td>
<td>Current limit value for one of J1 to J8 under compliance control</td>
<td>Can be set with SetCompJLimit or ResetCompJLimit.</td>
</tr>
</tbody>
</table>
2.11 SUPPLEMENT Teaching and Confirming the Position with the Operating Panel

Getting the current position to the variable

Step 1  Set to Manual mode
Set the mode switch to the MANUAL position. Confirm that the LED of the Operating Panel shows Manual mode.

Step 2  Set to Function Select mode
Press the SHIFT key. Confirm that the SHIFT lamp comes on.
Press the BREAK/CONTINUE/ST-STOP keys.

Step 3  Select the variable for the robot position
Press ↑ or ↓ keys to select the functions.
Press the OK key to select the function.
Select [Set CurPos P] to get the current position in the P variable.
Select [Set CurPos T] to get the current position in the T variable.
Select [Set CurPos J] to get the current position in the J variable.

Step 4  Select the variable number for the robot position
Input the variable number with the numerical keys.
Press the OK key to register the variable number.
The operation returns to the Step 3 by pressing the Cancel key.

Step 5  Get the robot position
The LCD shows [SetCurrentPos?].
Press the OK key to complete registering the position.
The LCD shows [SetVarVal OK].
Confirming the teaching position

**Step 1** Set to Manual mode
Set the mode switch to the MANUAL position.
Confirm that the LED of the Operating Panel shows Manual mode.

**Step 2** Set to Function Select mode
Press the SHIFT key. Confirm that the SHIFT lamp comes on.
Press the BREAK/CONTINUE/ST-STOP keys.

**Step 3** Select the variable for the robot motion
Press ↑ or ↓ keys to select the functions.
Press the OK key to select the function.
Select [Move to PVar] to move the robot in the P variable.
Select [Move to TVar] to move the robot in the T variable.
Select [Move to JVar] to move the robot in the J variable.

**Step 4** Select the variable number for the robot motion
Input the variable number with the numerical keys.
Press the OK key to register the variable number.
The operation returns to the Step 3 by pressing the Cancel key.

**Step 5** Select the robot motion mode
The LCD shows the [MvP23[PTP]].
Press ↑ or ↓ keys to select the motion mode (PTP/CP).
Press the OK key. The LCD shows [Are You sure ?].

**Step 6** Move the robot to the variable teaching position
The robot moves while the OK key is pressed.
Chapter 3

General Introduction to Operation Modes and Machine Lock

This chapter describes the three operation modes of the robot: Manual mode, Teach check mode, and Auto mode. It also describes machine lock used for simulation.

NOTE 1: This chapter uses the abbreviations (TP), (OP), and (WC) which inform you that operations marked with those abbreviations can be performed from the teach pendant, operating panel, and in WINCAPSII, respectively.

NOTE 2: Avoid letting the teach pendant or operating panel undergo any strong shocks, impacts, or vibrations.

NOTE 3: Touch the teach pendant or operating panel with your fingers only, never with the tip of a pen or any pointed object. Otherwise, the LCD may be broken.

NOTE 4: In this chapter, the explanation about the mini pendant is omitted. Refer to Chapter 6 for operating the mini pendant.
Chapter 3 General Introduction to Operation Modes and Machine Lock

3.1 Operation Modes and Machine Lock

3.1.1 Switching Between Operation Modes (TP/OP)
Operating procedure.

- From the teach pendant
- From the operating panel

3.1.2 Machine Lock (TP)
Lock the machine when
Operating procedure.

- From the teach pendant

3.2 Manual Mode (TP/OP)

3.2.1 Running the Robot Manually
Run the robot manually when
6-axis robot
[ 1 ] Joint mode
5-axis robot
[ 2 ] Joint mode
6-axis robot
[ 3 ] X-Y mode
5-axis robot
[ 4 ] X-Y mode
6-axis robot
[ 5 ] Tool mode
5-axis robot
[ 6 ] Tool mode
[ 7 ] Tool Center Point Fixed Operation
Operating procedure.

- From the teach pendant
- From the operating panel

3.2.2 Managing Robot Controller Output Signals
Manage robot controller output signals when
Operating procedure.

- From the teach pendant
- From the operating panel

3.2.3 Using the Command Builder
Operating procedure.

- From the teach pendant
Command Builder

3.3 Teach Check Mode (TP)
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- From the teach pendant
[ 2 ] Step check

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  Switch the operation mode from Manual to Auto from the teach pendant or an external
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Select and start a supervisory task in the Program List window in Auto or Teach Check mode.

Terminating supervisory tasks.

Turn the robot controller off.

Press the STOP button in the Supervisor TASK Setting window.

Load or compile a project.

Error in a supervisory task itself.

Level 4 error or higher one.

Read or write from/onto a floppy disk.

Receive a file from WINCAPSII.

Make the supervisory task mode inactive to delete it from optional features.

3.4.9.3 Restrictions on the Use of Supervisory Tasks

[1] Restrictions on the normal program operation

[2] Rules for using a supervisory task

[3] Rules for a supervisory task mode in use

3.4.9.4 Supervisory task commands

References
The robot offers three operation modes—Manual mode, Teach check mode, and Auto mode. Manual mode allows you to run the robot manually from the teach pendant or operating panel. Teach check mode provides restricted automatic operation in which you may make a final check of programs with the teach pendant after teaching. Auto mode allows the robot to run automatically.

Manual mode, Teach check mode, and Auto mode are described in Sections 3.2, 3.3, and 3.4, respectively.

The teach pendant supports all of the above three modes. The operating panel supports Manual mode and Auto mode. The mode switch on the operating panel has three positions (MANUAL, AUTO, and TP). When you use the teach pendant connected to the operating panel, set the mode switch of the operating panel to the TP position.

In each of the above three operation modes, you may lock the robot (so called "machine lock") so that it is possible to perform simulations with the robot controller without running the robot practically.

When the robot is in machine lock, you may restrict the I/O output. For details, refer to Section 5.5, "Displaying I/O Signals and Simulating Robot Motion."
3.1.1 Switching Between Operation Modes (TP/OP)

Operating procedure

**From the teach pendant**

**Step 1**
Turn the mode switch to the desired mode position.

The selected mode icon appears in the leftmost area of the status bar.
- Internal Auto mode, \( \text{I} \) : External Auto Mode
- Manual mode, \( \text{M} \) : Teach check mode

**From the operating panel**

**Step 1**
Turn the mode switch to the desired mode position.

The selected mode lamp comes on.

**NOTE:** If the mode switch is set to the TP position, the operating panel shows the following on the LCD and no longer accepts entry except from the STOP and ROBOT STOP keys.
3.1.2 Machine Lock (TP)

Locking the machine allows you to perform simulations with the robot controller without running the robot practically.

**Lock the machine when**

1. Testing programs without running the robot practically.
2. Checking the cycle time.

**NOTE:** The cycle time calculated may be shorter than the actual one since End motion (@0 option) will apply when the machine is locked. For details, refer to the PROGRAMMER’S MANUAL, Subsection 3.2.5.

**Operating procedure**

- **From the teach pendant**

  **NOTE:** If the motor power is on, press the MOTOR key to turn the motor off (refer to Section 2.5). When the motor power is on, the machine cannot be locked.

**Step 1** Press the LOCK key.

The machine becomes locked and the LOCK lamp comes on.

According to the output restriction conditions of I/O signals, the dummy input icon on the status bar will change.

- : No I/O output restricted, : I/O output restricted

**Step 2** Press the LOCK key again.

The lock is released and the LOCK lamp goes off.
3.2 Manual Mode (TP/OP)

In Manual mode, you may run the robot manually or manage robot controller output signals manually from the teach pendant or operating panel.

**NOTE:** When running the robot manually, release the machine lock beforehand; otherwise, the robot controller will perform simulations without running the robot practically. Working with a PC teaching system, the robot may be locked even in Manual mode.

3.2.1 Running the Robot Manually

You may run the robot manually from the teach pendant or operating panel in any of the three modes—Joint mode, X-Y mode, and Tool mode.

**NOTE:** To run the robot manually, the system-input port "Enable Auto" on pin 4 of connector CN8 is required to be OFF (opened). (Refer to the INSTALLATION & MAINTENANCE GUIDE, Subsections 5.3.4.1 and 5.5.4.1.)

Run the robot manually when

(1) Moving the robot flange (the end of the robot arm) to access an object point.
(2) Moving the robot flange to a position where teach check should start.

**6-axis robot**

[ 1 ] Joint mode

As shown in Figure 3-1 (a), the Joint mode allows you to drive each of the six joints independently.

![Figure 3-1 (a). Movements in Joint Mode](image-url)
5-axis robot

[ 2 ] Joint mode

As shown in Figure 3-1 (b), the Joint mode allows you to drive each of the five joints independently.

Figure 3-1 (b). Movements in Joint Mode
6-axis robot

[3] X-Y mode

X-Y mode allows you to drive the robot arm in base coordinates (whose origin is defined at the center of the robot basement). Pressing the X, Y, or Z key in X-Y mode moves the robot flange linearly along the X, Y, or Z axis, respectively, as shown below.

If work coordinates (whose origin is defined at a corner of the cubic envelope of an object piece) is defined, the robot flange moves linearly in the work coordinates.

For details about base coordinates and work coordinates, refer to Chapter 4.

If you use the RX, RY, or RZ key in X-Y mode, the robot arm rotates on each axis of the virtual work coordinates defined on the center of the flange surface without changing the center position of the flange surface, as shown below.

Figure 3-2 (a). Movements in X-Y Mode
5-axis robot

[4] X-Y mode

X-Y mode allows you to drive the robot arm in base coordinates (whose origin is defined at the center of the robot basement). Pressing the X, Y, or Z key in X-Y mode moves the robot flange linearly along the X, Y, or Z axis, respectively, as shown below.

If work coordinates (whose origin is defined at a corner of the cubic envelope of an object piece) is defined, the robot flange moves linearly in the work coordinates.

For details about base coordinates and work coordinates, refer to Chapter 4.

The RX key does not work in X-Y mode. The robot wrist rotates around the fifth axis with the RY key and the sixth axis with the RZ key. The tool center point is constantly maintained when operating.

![Figure 3-2 (b). Movements in X-Y Mode](image)
6-axis robot

[ 5 ] Tool mode

Tool mode allows you to drive the robot arm in mechanical interface coordinates (whose origin is defined at the center of the flange surface) or in tool coordinates. For details about those coordinates, refer to Chapter 4.

Pressing the X, Y, or Z key in Tool mode moves the robot flange linearly along the Z, Y, or Z axis, respectively, as shown below.

If you use the RX, RY, or RZ key in Tool mode, the robot arm rotates on each axis of the tool coordinates.

NOTE: Figure 3-3 (a) shows the tool coordinates when TOOL0 is set. These are also called mechanical interface coordinates.

![Figure 3-3 (a). Movements in Tool Mode](image-url)
5-axis robot

[6] Tool mode

Tool mode allows you to drive the robot arm in mechanical interface coordinates (whose origin is defined at the center of the flange surface) or in tool coordinates. For details about those coordinates, refer to Chapter 4.

Pressing the X, Y, or Z key in Tool mode moves the robot flange linearly along the Z, Y, or Z axis, respectively, as shown below.

The RX key does not work in Tool mode. The robot wrist rotates around the fifth axis with the RY key and the sixth axis with the RZ key. The tool center point is constantly maintained when operating.

For detail, refer to [7] Tool Center Point Fixed Operation

Figure 3-3 (b). Movements in Tool Mode
[ 7 ] Tool Center Point Fixed Operation

This is an axis operation which changes only the robot pose without changing the position of the tool point (control point). It works in X-Y mode and TOOL mode. When tool center point fixed operation, the robot does not work in X, Y, and Z direction even if the X, Y, and Z keys are pressed.
Operating procedure

\textbf{CAUTION:} At the start, set the reduced ratio of the programmed speed to 20\% or less. If you run the robot manually at high speeds from the beginning, you may mistakenly strike the robot against the surrounding objects.

\textbf{NOTE:} In X-Y or Tool mode, if a pass runs through the vicinity of a singular point during manual operation, the robot will issue error code 6080s (Overspeed) and come to a halt. Avoid running a pass through the vicinity of a singular point.

\textbf{From the teach pendant}

\textbf{Step 1}  
Set the mode switch to the MANUAL position.

\textbf{Step 2}  
Press the MOTOR key to turn the motor on.

\textbf{Step 3}  
Press the M-MOD key.

The Select Operation Mode window appears as shown in the next step.
**Step 4**
Select the desired operation mode by using the cursor keys or touching the screen directly.
In the mode area of the status bar appears the selected operation mode.

![Select Operation Mode](image)

**Step 5**
While holding down the deadman switch, press one of the arm traverse keys to drive the robot arm. For details regarding the relationship between the arm traverse keys and driven axes, refer to Table 3-1.

![Robot Arm Control Panel](image)
Table 3-1(a). Arm Traverse Keys and Driven Axes (6 Axis Robot)

<table>
<thead>
<tr>
<th>No.</th>
<th>Operation mode</th>
<th>Axis</th>
<th>Arm traverse keys</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Joint mode</td>
<td>Joint 1</td>
<td>+ J1 X</td>
<td>- J1 X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Joint 2</td>
<td>+ J2 Y</td>
<td>- J2 Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Joint 3</td>
<td>+ J3 Z</td>
<td>- J3 Z</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Joint 4</td>
<td>+ J4 RX</td>
<td>- J4 RX</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Joint 5</td>
<td>+ J5 RY</td>
<td>- J5 RY</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Joint 6</td>
<td>+ J6 RZ</td>
<td>- J6 RZ</td>
</tr>
<tr>
<td>2</td>
<td>X-Y mode</td>
<td>X axis</td>
<td>+ J1 X</td>
<td>- J1 X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Y axis</td>
<td>+ J2 Y</td>
<td>- J2 Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Z axis</td>
<td>+ J3 Z</td>
<td>- J3 Z</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X axis as rotation center</td>
<td>+ J4 RX</td>
<td>- J4 RX</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Y axis as rotation center</td>
<td>+ J5 RY</td>
<td>- J5 RY</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Z axis as rotation center</td>
<td>+ J6 RZ</td>
<td>- J6 RZ</td>
</tr>
<tr>
<td>3</td>
<td>Tool mode</td>
<td>X axis</td>
<td>+ J1 X</td>
<td>- J1 X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Y axis</td>
<td>+ J2 Y</td>
<td>- J2 Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Z axis</td>
<td>+ J3 Z</td>
<td>- J3 Z</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X axis as rotation center</td>
<td>+ J4 RX</td>
<td>- J4 RX</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Y axis as rotation center</td>
<td>+ J5 RY</td>
<td>- J5 RY</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Z axis as rotation center</td>
<td>+ J6 RZ</td>
<td>- J6 RZ</td>
</tr>
<tr>
<td>No.</td>
<td>Operation mode</td>
<td>Axis</td>
<td>Arm traverse keys</td>
<td>Comments</td>
</tr>
<tr>
<td>-----</td>
<td>----------------</td>
<td>------------</td>
<td>--------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>For motion in the positive direction</td>
<td>For motion in the negative direction</td>
</tr>
<tr>
<td>1</td>
<td>Joint mode</td>
<td>Joint 1</td>
<td>+ J1 X</td>
<td>- J1 X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Joint 2</td>
<td>+ J2 Y</td>
<td>- J2 Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Joint 3</td>
<td>+ J3 Z</td>
<td>- J3 Z</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Joint 5</td>
<td>+ J5 RY</td>
<td>- J5 RY</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Joint 6</td>
<td>+ J6 RZ</td>
<td>- J6 RZ</td>
</tr>
<tr>
<td>2</td>
<td>X-Y mode</td>
<td>X axis</td>
<td>+ J1 X</td>
<td>- J1 X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Y axis</td>
<td>+ J2 Y</td>
<td>- J2 Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Z axis</td>
<td>+ J3 Z</td>
<td>- J3 Z</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Around 5th Axis</td>
<td>+ J5 RY</td>
<td>- J5 RY</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Around 6th Axis</td>
<td>+ J6 RZ</td>
<td>- J6 RZ</td>
</tr>
<tr>
<td>3</td>
<td>Tool mode</td>
<td>X axis</td>
<td>+ J1 X</td>
<td>- J1 X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Y axis</td>
<td>+ J2 Y</td>
<td>- J2 Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Z axis</td>
<td>+ J3 Z</td>
<td>- J3 Z</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Around 5th Axis</td>
<td>+ J5 RY</td>
<td>- J5 RY</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Around 6th Axis</td>
<td>+ J6 RZ</td>
<td>- J6 RZ</td>
</tr>
</tbody>
</table>

The robot arm moves in the currently selected work coordinates. The P and T displayed as the current robot position are coordinates of the tip of the end-effector in the selected work coordinates. The RY, RZ keys moves the robot arm with making the tool center point constant.

The robot arm moves in the currently selected tool coordinates. The P and T displayed as the current robot position are coordinates of the tip of the end-effector in the selected tool coordinates. The RY, RZ keys moves the robot arm with making the tool center point constant.
Chapter 3  General Introduction to Operation Modes and Machine Lock

- From the operating panel

**Step 1** Set the mode switch to the MANUAL position.
The MANUAL lamp comes on.

**Step 2** Press the MOTOR key to turn the motor on.
The MOTOR lamp comes on.

**Step 3** Press the M-MOD key to select the desired operation mode.

**NOTE:** The default when the robot controller is turned on is Joint mode.

**NOTE:** The most recently defined work coordinates or tool coordinates will apply and they cannot be changed from the operating panel.

**Step 4** While holding down the deadman switch, press one of the arm traverse keys to drive the robot arm. For details regarding the relationship between the arm traverse keys and driven axes, refer to Table 3-2.

**TIP:** You may press more than one arm traverse key at the same time.
Table 3-2(a). Arm Traverse Keys and Driven Axes (6 Axis Robot)

<table>
<thead>
<tr>
<th>No.</th>
<th>Operation mode</th>
<th>Axis</th>
<th>Arm traverse keys</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>For motion in the positive direction</td>
<td>For motion in the negative direction</td>
</tr>
<tr>
<td>1</td>
<td>Joint mode</td>
<td>Joint 1</td>
<td>+ J1 X</td>
<td>- J1 X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Joint 2</td>
<td>+ J2 Y</td>
<td>- J2 Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Joint 3</td>
<td>+ J3 Z</td>
<td>- J3 Z</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Joint 4</td>
<td>+ J4 RX</td>
<td>- J4 RX</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Joint 5</td>
<td>+ J5 RY</td>
<td>- J5 RY</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Joint 6</td>
<td>+ J6 RZ</td>
<td>- J6 RZ</td>
</tr>
<tr>
<td>2</td>
<td>X-Y mode</td>
<td>X axis</td>
<td>+ J1 X</td>
<td>- J1 X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Y axis</td>
<td>+ J2 Y</td>
<td>- J2 Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Z axis</td>
<td>+ J3 Z</td>
<td>- J3 Z</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X axis as rotation center</td>
<td>+ J4 RX</td>
<td>- J4 RX</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Y axis as rotation center</td>
<td>+ J5 RY</td>
<td>- J5 RY</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Z axis as rotation center</td>
<td>+ J6 RZ</td>
<td>- J6 RZ</td>
</tr>
<tr>
<td>3</td>
<td>Tool mode</td>
<td>X axis</td>
<td>+ J1 X</td>
<td>- J1 X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Y axis</td>
<td>+ J2 Y</td>
<td>- J2 Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Z axis</td>
<td>+ J3 Z</td>
<td>- J3 Z</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X axis as rotation center</td>
<td>+ J4 RX</td>
<td>- J4 RX</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Y axis as rotation center</td>
<td>+ J5 RY</td>
<td>- J5 RY</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Z axis as rotation center</td>
<td>+ J6 RZ</td>
<td>- J6 RZ</td>
</tr>
</tbody>
</table>
### Table 3-2(b). Arm Traverse Keys and Driven Axes (5 Axis Robot)

<table>
<thead>
<tr>
<th>No.</th>
<th>Operation mode</th>
<th>Axis</th>
<th>Arm traverse keys</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>For motion in the</td>
<td>For motion in the</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>positive direction</td>
<td>negative direction</td>
</tr>
<tr>
<td>1</td>
<td>Joint mode</td>
<td>Joint 1</td>
<td>+ J1 X</td>
<td>- J1 X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Joint 2</td>
<td>+ J2 Y</td>
<td>- J2 Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Joint 3</td>
<td>+ J3 Z</td>
<td>- J3 Z</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Joint 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Joint 5</td>
<td>+ J5 RY</td>
<td>- J5 RY</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Joint 6</td>
<td>+ J6 RZ</td>
<td>- J6 RZ</td>
</tr>
<tr>
<td>2</td>
<td>X-Y mode</td>
<td>X axis</td>
<td>+ J1 X</td>
<td>- J1 X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Y axis</td>
<td>+ J2 Y</td>
<td>- J2 Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Z axis</td>
<td>+ J3 Z</td>
<td>- J3 Z</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Around 5th Axis</td>
<td>+ J5 RY</td>
<td>- J5 RY</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Around 6th Axis</td>
<td>+ J6 RZ</td>
<td>- J6 RZ</td>
</tr>
<tr>
<td>3</td>
<td>Tool mode</td>
<td>X axis</td>
<td>+ J1 X</td>
<td>- J1 X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Y axis</td>
<td>+ J2 Y</td>
<td>- J2 Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Z axis</td>
<td>+ J3 Z</td>
<td>- J3 Z</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Around 5th Axis</td>
<td>+ J5 RY</td>
<td>- J5 RY</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Around 6th Axis</td>
<td>+ J6 RZ</td>
<td>- J6 RZ</td>
</tr>
</tbody>
</table>
3.2.2 Managing Robot Controller Output Signals

You may manually manage output signals from the robot controller (which is equipped with user-I/O ports and system-I/O ports), with the teach pendant or operating panel.

Manage robot controller output signals when
You need to turn output signals on or off without running programs.

Operating procedure

From the teach pendant

Step 1
Set the mode switch to the MANUAL position.

Step 2
Press [F4 I/O].

The I/O Monitor window appears as shown in the next step.
Step 3  Display a target output signal, by scrolling the screen with the cursor keys, jog dial, [F1 BACK], or [F2 NEXT].

**TIP:** You may press [F3 Jump To] to call up the numeric keypad where you may then enter the output port address. Doing so will directly call up the target output signal.

The I/O Monitor window appears as shown below.

Step 4  Select the target output signal by using the cursor keys or touching the screen directly.

Step 5  On the above window, press [F5 ON/OFF] (or OK key) to toggle the selected signal on or off.

The system message dialog box appears as shown below.
Step 6 Check the ON/OFF state of the target output signal, then press the OK button while holding down the deadman switch.
To manage other output signals, go back to Step 4.
To finish this procedure, press the Cancel button.

From the operating panel

Step 1 Set the mode switch to the MANUAL position.
The MANUAL lamp comes on.

Step 2 Press the ON or OFF key to turn a target output signal on or off, respectively.
The LCD shows the following:

<table>
<thead>
<tr>
<th>ON</th>
</tr>
</thead>
<tbody>
<tr>
<td>or</td>
</tr>
</tbody>
</table>

Step 3 Select the target output signal by using numerical keys.
Example: To turn on output port address 104, press the 1, 0, and 4 keys. Then the following appears on the LCD:

| ON 104 |

To cancel new entry, press the Cancel key.

Step 4 Check the ON/OFF state of the target output signal, then press the OK key while holding down the deadman switch.

| ON OK |
3.2.3 Using the Command Builder

The command builder facilitates program editing and entry using the teach pendant. The use of the command builder allows you to enter program codes with ease as described below.

- You may enter commands even if you do not remember complicated command names.
- When entering commands, you may easily enter the associated parameters.
- With the “Favorites” function, you may quickly enter frequent-to-use commands.

Operating procedure

Given below is an operating procedure for entering commands with the command builder.

- **From the teach pendant**

  **Step 1** Set the mode switch to the MANUAL position.

  **Step 2** Press [F1 Program].
  The Program List window appears as shown in the next step.

  **Step 3** Select the task program you want to edit, by using the cursor keys or jog dial or by touching the screen directly. Then press [F5 Edit].

The coding list of the selected program appears as shown in the next step.
Step 4: Move the cursor to the line after which you want to insert a new line, then press [F1 NewLine]. Or move the cursor to the line you want to edit, then press [F5 EditLine].

The program code entry window appears as shown below.

Step 5: Press [F4 Category].

The Category Selection window appears as shown in the next step.
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Step 6
In the Category Selection window, choose the category which contains a command(s) you want to enter, and then press the OK button to display the Commands selection screen shown in the next step.

If you choose "All commands" in the Category Selection window, all commands will appear in the Commands window.

If you choose "Favorites," a set of commands registered beforehand will be listed.

Tip
In step 5, on the Insert New Program Line window or on the Edit Program window:
- [F1 User.] is a shortcut key to the favorite command window (that can be called up by choosing the "Favorites" on the Category Selection window).
- [F2 Flow.] is a shortcut key to the flow control statement window (that can be called up by choosing the "Flow control statement" on the Category Selection window).
- [F3 Robot.] is a shortcut key to the robot control statement window (that can be called up by choosing the "Robot control statement" on the Category Selection window).
- [F5 Recent.] is a shortcut key to a list of commands in the most recently selected category.

Step 7
Scroll the Commands window that shows commands contained in the selected category and choose the desired command.
If you do not remember the name of the necessary command, press [F3 Alpha.]. The Alphabet Selection window will appear as shown below.

Choose a leading character of the desired command on the above window, and a command(s) starting with it will be automatically displayed.
Step 8

The parameter entry screen will appear as shown below, where you edit parameter values. (After editing, press the OK button, and the screen will return to the Commands window.)

Some parameter values may not be cleared. Therefore, even if no specification of the initial value is required such as DEFI NT ix=0, you need to enter for the initial value substitution area once.

If you do so, press the OK button and then delete unnecessary character strings in step 9.
Step 9
If it is necessary to modify other parameter values, choose the target parameter and repeat Step 8. Upon completion of parameter editing, press the OK button. The screen will return to the program code entry screen.

Step 10
Edit the program, e.g., by deleting unnecessary parameters, according to your needs. Then press the OK button, and the screen will return to the program coding list.
Command Builder

Operating flow of command builder

Select the desired category to show the associated commands.

Press OK to replace the current parameter value with the newly entered value.

Default values are automatically applied.

According to parameters, use the full key or numerical keys.

Press OK to replace the selected line with the newly entered line.

Screen 1: Program code entry screen
Screen 2: Category selection screen
Screen 3: Command selection screen
Screen 4: Parameter entry screen
Screen 5: Alphabet selection screen
Program code entry screen

On the program code entry screen, you may edit character strings to be inserted as a new program line or to be replaced with the current program line.

<table>
<thead>
<tr>
<th>Shortcut</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>[F1 User.]</td>
<td>Shortcut key to the favorite command window (that can be called up by choosing the &quot;Favorites&quot; on the Category Selection window).</td>
</tr>
<tr>
<td>[F2 Flow.]</td>
<td>Shortcut key to the flow control statement screen (that can be called up by choosing the &quot;Flow control statement&quot; on the Category Selection window).</td>
</tr>
<tr>
<td>[F3 Robot.]</td>
<td>Shortcut key to the robot control statement screen (that can be called up by choosing the &quot;Robot control statement&quot; on the Category Selection window).</td>
</tr>
<tr>
<td>[F4 Category]</td>
<td>Displays the Category Selection window.</td>
</tr>
<tr>
<td>[F5 Recent.]</td>
<td>Shortcut key to a list of commands in the most recently selected category.</td>
</tr>
<tr>
<td>[F6 Clr All]</td>
<td>Clears all characters being entered.</td>
</tr>
</tbody>
</table>
Category selection screen

On the category selection screen, you may choose the type of commands you want to enter for the command builder.

- To choose the desired category, use the job dial or cursor keys.
- After choosing the desired category, press the OK button, and the commands in the selected category will be listed in the Commands window that will be called up. If you press the Cancel button, the screen will switch to a list of commands in the most recently selected category.
- If you choose "All commands," all commands will be listed in the Commands window.
- If you choose "Favorites," a list of commands you have registered by using the Add button on the command selection screen will be listed in the Commands window.
Command selection screen

On the command selection screen, you may choose necessary commands from those listed in the Commands window and enter the associated parameter(s).

<table>
<thead>
<tr>
<th>Key</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>[F1 Back]</td>
<td>Displays the previous page of the command/parameter selection screen.</td>
</tr>
<tr>
<td>[F2 Next]</td>
<td>Displays the next page of the command/parameter selection screen.</td>
</tr>
<tr>
<td>[F3 Alpha.]</td>
<td>Calls up the Alphabet Selection window.</td>
</tr>
<tr>
<td>[F4 Category]</td>
<td>Calls up the Category Selection window.</td>
</tr>
<tr>
<td>[F5 Edit.]</td>
<td>Calls up the Parameters window if a parameter value is selected with the cursor.</td>
</tr>
<tr>
<td>[Add]</td>
<td>Adds the currently selected command to the Favorites category. When the Favorites category window is displayed, the Del button will appear instead of Add. Up to 256 commands may be registered. If no commands are registered, &quot;--Not registered--&quot; will appear in the Commands window of the Favorites category.</td>
</tr>
<tr>
<td>[Del]</td>
<td>Deletes the currently selected command from the Favorites category. When the categories other than the Favorites are selected, the Add button will be displayed instead of Del.</td>
</tr>
</tbody>
</table>
**[Ins]** Inserts a newly entered character string to the current cursor position.

**[Replace]** Replaces the contents of the program line currently selected for editing with a newly entered character string.

Parameter entry screen
On the parameter entry screen, you may enter or edit parameters of the selected command.

- According to the type of parameters selected, the full keypad or numerical keypad will appear.
- An initial value previously specified for each parameter will be displayed.
- If you press the OK button after editing character strings or numerical values, the screen will return to the command/parameter selection screen.
Alphabet selection window

In the alphabet selection window, you may quickly search necessary commands by entering an alphabet letter of a leading character.

- If you enter an alphabet letter, a command(s) starting with it will be automatically displayed.
- If there is more than one command starting with the selected alphabet letter, you need to choose the target command in the Commands window.
- If there is no command starting with the selected alphabet letter, a command next to the alphabet letter in the alphabet order will be selected.
3.3 Teach Check Mode (TP)

Teach check mode allows you to make a final check of programs (which have undergone teaching) with the teach pendant in automatic operation under the following restrictions:

- The maximum robot speed is 10% or less of the maximum speed defined in Auto mode.
- To run a task program, hold down both deadman switch and OK key.

Two types of teach check are available—Cycle check and Step check.

- **Cycle check** executes the selected task program from the current program line to the end by a single cycle; **Step check** executes the selected program from the current program line by a single step.

⚠️ **CAUTION**: Before starting teach check operation, be sure to confirm that all persons are out of the restricted space of the robot. The robot will automatically run.

**CAUTION**: Before proceeding to the teach check operation procedure, be sure to perform CAL operation and set the reduced ratios of the programmed speed, acceleration, and deceleration.

**NOTE**: Two or more task programs cannot execute concurrently in Teach check mode. Therefore, any motion command specifying concurrent execution of other programs will be ignored.

**Run the robot in Teach check mode when**

You want to run the robot automatically using a task program while physically near the robot, in order to check or modify the object points and passes you have defined in teaching, while ensuring safety.
[ 1 ] Cycle check

To monitor the program contents during cycle check, press [F11 Display.] (after pressing the shift key if necessary) on the top screen or press the Display. button at the bottom of the Program List window.

Operating procedure

■ From the teach pendant

Step 1

Set the mode switch to the TEACHCHECK position.
The teach check icon appears in the leftmost area of the status bar.

Step 2

Press [F1 Program].
The Program List window appears as shown below.

Step 3

Select the task program you want to check, by using the cursor keys or jog dial or by touching the screen directly.

The selected program will become highlighted.
Step 4 Press the MOTOR key to turn the motor on.
The MOTOR lamp comes on.

Step 5 On the screen shown in Step 3, press [F4 CycStart].
The system message dialog box appears as shown below.

Step 6 While holding down the deadman switch, press the OK key, and then keep both of them depressed until the execution is completed.
If you release either one of the deadman switch and OK key, the robot comes to a halt.
[2] Step check

To monitor the program contents during step check, press [F11 Display.] (after pressing the shift key if necessary) on the top screen or press the Display. button at the bottom of the Program List window.

Operating procedure

From the teach pendant

Step 1
Set the mode switch to the TEACHCHECK position.

Step 2
Press [F1 Program].

The Program List window appears as shown below.

Step 3
Select the task program you want to check, by using the cursor keys or jog dial or by touching the screen directly.

The selected program will become highlighted.
Step 4  Press the MOTOR key to turn the motor on. The MOTOR lamp comes on.

Step 5  On the screen shown in Step 3, press [F6 StpStart] (or the right-arrow cursor key). The system message dialog box appears as shown below.

Step 6  While holding down the deadman switch, press the OK key, and then keep both of them depressed until the execution is completed. If you release either one of the deadman switch and OK key, the robot comes to a halt.
[3] Step Back Function

This function steps backwards the current program executed by Step Start or Cycle Start, one instruction at a time.

The Step Back function is diagrammatically shown below.

Executing Step Back command steps backwards the program. During Step Back operation, only robot motion commands, TAKEARM, and GIVEARM (Refer to the PROGRAMMER’S MANUAL.) will be executed. Other commands will not be actually executed, and only the line number will step back. The settings relating to end-effectors, workpiece, and speed made when Step Start or Cycle Start was executed will be reflected on Step Back operation.

If control returns to TAKEARM, GIVEARM will be executed; if it returns to GIVEARM, TAKEARM will be executed.

If Step Start or Cycle Start is executed after Step Back, only robot motion commands, TAKEARM, and GIVEARM are executed until the step at which Step Back was executed (Tool, work and speed settings are as for Step Back). At subsequent steps, all commands will be executed.

Cursor color in the Program List window and in the coding table

- Neutral green in Step Back operation
- Green in Step Start and Step Start operation from Step Back until the Step Back started step
- Blue in cases other than the above two.

The triangle on the left of line number shows the direction of operation. Downward triangle indicates forward stepping and the upward triangle indicates backward stepping.
NOTE 1: Restrictions on Step Back

This function traces the commands when Step Start or Cycle Start is executed. Based on that data, the Step Back function executes those commands. However, there is a limit for recording data. A maximum of 100 commands can be recorded and when the limit is exceeded the old commands will be erased in sequence and new ones recorded.

The Step Back function can work only within a program, since data that has been recorded will be cleared if any other program is selected and executed. Note that programs that are called by CALL or GOSUB are not be treated as other programs, so the Step Back function can work within those programs.

If a specified line is executed, the control cannot return to the lines preceding the specified line.
NOTE 2: About Skipping Interrupt

Skip Interrupt (See Installation and Maintenance 5.3.4.5 Skip Interruption (Input) and 5.5.4.10 Skip Interruption (Input)) is ineffective during Step Start or Cycle Start between two consequent Step Back commands, except in the following situation.

- When the robot action is temporarily stopped during Step Start or Cycle Start (when the program list or the program list cursor is blue), and the same robot action command is executed after Step Back command.

```
0001 PROGRAM PRO1
0002 TAKEARM
0003 INTERRUPT ON
0004 Robot operation command
0005 Robot operation command
0006 Robot operation command
0007 INTERRUPT OFF
```

- Step run or cycle run
  - Cursor: Blue

- Step back from the position where movement is stopped
  - Cursor: Neutral

- Step run or Cycle run
  - Cursor: Green

Movement stop (Uncompleted operation).
Operating procedure

From the teach pendant

Step 1
Set the mode switch to the TEACHCHECK position.
Run a single step or a single cycle of the program.

Step 2
Press [F5 StepBack]
You may step backwards the program by using the left-arrow cursor key.

Step 3
You may step backwards the program by using the left-arrow cursor key.
The system message dialog box appears as shown below.
Step 4
While holding down the deadman switch, press the OK button. Only when both of them are depressed, commands will be executed. If you release either one of the deadman switch and OK button, the program immediately stops.

NOTE: When running the robot for checking, always be ready to press the STOP key.

Step 5
Repeat Steps 3 and 4 to step backwards the program.

Step 6
After Step Back, press [F6 StpStart] (or the right-arrow cursor key) or [F4 CycStart]. The screen shows the following state.

The cursor moves to the line that performs Step Start or Cycle Start and triangle shows the downward direction.
Step 7  Press [F6 StpStart] (or the right-arrow cursor key) or [F4 CycStart] again. The system message dialog box appears as shown below.

![System Message Dialog Box](image)

Step 8  While holding down the deadman switch, press the OK button. Only when both of them are depressed, commands will be executed. If you release either one of the deadman switch and OK button, the program immediately stops.

Step 9  Repeat steps 7 and 8, all the time confirming that the program is running safely.
Selecting Step Back Command

You may select step back command from these two options

1. Robot operation commands only
2. All commands

However, even if you select "All command", in actuality only Robot operation commands, TAKEARM and GIVEARM are executed.

Set the mode switch to the MANUAL position and set

[F1 Program] — [F6 Aux.] — [F9 StepBack] Set in StepBack Setting window. (These changes come into effect only when power supply is turned on next time.)

This function allows you to execute teach check from any line.

- You can execute cycle check and step check together.

This operation is necessary when

You want to confirm or correct the operation subsequent to the specified line, while executing teach check.

Note regarding line specification:

- If the specified line is a comment line or a blank line which cannot be executed, that line will be ignored and the first executable line from that line is considered.

- When CALL command is executed and CALL destination program is displayed in the teach pendant, the line specification related to the displayed program is not possible.
  
  Before specifying the line, select the corresponding program from program list.

- When you use local variable without declaring local variables or initializing variables or without executing commands for getting semaphore, or perform calculation and motor operation, error may occur.

NOTE: Local variables are preserved in memory when memory is released when user programs are transferred from WINCAPSII and compiled in teach pendant and commands declaring local variables like DIM or DEFINT are executed. The local variables once preserved remain in memory till the memory is released. Hence it is possible to use these variables by executing local variable declaration commands just once.

Even if the memory for local variable is preserved, if the local variables are not initialized (or value substituted), the values are considered indeterminate.

NOTE: Two or more task programs cannot execute concurrently in Teach check mode. Therefore, any motion command specifying concurrent execution of other programs will be ignored.
Executing Line Specification

From the teach pendant

The operating procedure given below is common to Cycle Check and Step Check.

**Step 1**

**Step 2**
Press [Display.] in the window, and the contents of the program appear as shown below.

![Program Display](image)

**Step 3**

![Numeric Keypad](image)
Step 4  From the numeric keypad, enter the desired number and press the OK button. The numeric keypad will disappear and the cursor will move to the specified line.

3.4 Auto Mode (TP/OP)

In Auto mode, you may run the robot automatically. You may do so by running the desired program in the robot controller from the teach pendant or operating panel, which is *internal automatic operation*. You may switch the control to external equipment to run the robot from external equipment, which is *external automatic operation*.

**CAUTION:** Before proceeding to automatic operation, be sure to perform CAL operation and set the reduced ratios of the programmed speed, acceleration, and deceleration.

**NOTE:** To place the robot in Auto mode, system-input port "Enable Auto" on pin 4 of input connector CN8 is required to be short-circuited (ON).

If you turn the mode switch of the teach pendant or operating panel to the AUTO position with the "Enable Auto" port opened (OFF), error message 21F3 appears. Confirm that no one is within the restricted space of the robot, short-circuit the "Enable Auto" port, remove the error, and then proceed to automatic operation. For details on "Enable Auto," refer to the INSTALLATION & MAINTENANCE GUIDE, Subsections 5.3.4.1 and 5.5.4.1.

3.4.1 Starting Internal Automatic Operation (TP/OP)

You may run the selected task program from the teach pendant or operating panel in any of the three types—Single-cycle run, Continuous run, and Single-step run, which are described in the table below.

<table>
<thead>
<tr>
<th>Types of Runs</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Single-cycle run</td>
<td>Executes the selected program from the beginning to the end once.</td>
</tr>
<tr>
<td>2 Continuous run</td>
<td>Executes the selected program continuously.</td>
</tr>
<tr>
<td>3 Single-step run</td>
<td>Executes the selected program from the current program line by a single step.</td>
</tr>
</tbody>
</table>

**CAUTION:** Before proceeding to internal automatic operation, be sure to read SAFETY PRECAUTIONS, Section 3.7 "Precautions for automatic operation" (on page 8) given at the beginning of this manual. Starting internal automatic operation will run the robot.

Perform internal automatic operation when

You check the robot motion or run the robot independently without using a sequencer or other external equipment.
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[ 1 ] Single-cycle run

Before proceeding to a single-cycle run, perform CAL operation and set the reduced ratios of the programmed speed, acceleration, and deceleration.

\[ \text{CAUTION:} \text{ At the start, set the reduced ratio of the programmed speed at 20\% or less. If you run the robot manually at high speeds from the beginning, you may mistakenly strike the robot against the surrounding objects.} \]

Operating procedure

- \textbf{From the teach pendant}

\textbf{Step 1} Set the mode switch to the AUTO position.

\textbf{Step 2} Press [F1 Program].

The Program List window appears as shown in the next step.
Step 3  Select the task program you want to run, by using the cursor keys or jog dial or by touching the screen directly.

The selected program will become highlighted.

Step 4  Press the MOTOR key to turn the motor on.

The MOTOR lamp comes on.

Step 5  Check that the program you have selected is highlighted, press [F4 Start].

The system message dialog box appears as shown in the next step.
Step 6  In the system message dialog box, press the OK button to select Single-cycle.

After completion of a single-cycle run, to run the program again, go back to Step 2.

**NOTE:** The elapsed time on display refers to the time length from the start to end of the program including temporary stop time caused by Step stop or Halt.
From the operating panel

Step 1  Set the mode switch to the AUTO position.
The AUTO lamp comes on.

Step 2  Press the PRO key.
The LCD shows the following:

```
PRO
```

Step 3  Select the program number you want to run, by using numerical keys.
Example: To run PRO15, press the 1 and 5 keys. Then the following appears on the LCD:

```
PRO15
```
To cancel new entry, press the Cancel key.

Step 4  Press the OK key.
The LCD shows the following:

```
PR015  Ste 2
RUNING TASK-0
```
If the selected program does not exist, the following appears on the LCD:

```
PROGRAM NOTHIN!
```

Step 5  Press the MOTOR key to turn the motor on.
The MOTOR lamp comes on.
Step 6
Press the CY-START key.
The LCD shows the following:

```
PR015  Stp 2
CYCLE START?
```

Step 7
Press the OK key.
The LCD shows the following and the robot starts running.

```
PR015  Pnd 8
RUNNING TASK=1
```

Upon completion of a single-cycle run, the robot will stop.

**NOTE:** After completion of a single-cycle run, to run the program again, repeat Steps 2 through 7.
[ 2 ] Continuous run

Before proceeding to a continuous run, perform CAL operation and set the reduced ratios of the programmed speed, acceleration, and deceleration.

⚠️ **CAUTION**: At the start, set the reduced ratio of the programmed speed at 20% or less. If you run the robot manually at high speeds from the beginning, you may mistakenly strike the robot against the surrounding objects.

**Operating procedure**

- **From the teach pendant**

  **Step 1**
  Set the mode switch to the AUTO position.

  **Step 2**
  Press [F1 Program].

  The Program List window appears as shown in the next step.
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Step 3  Select the program you want to run, by using the cursor keys or jog dial or by touching the screen directly.

![Program List]

The selected program will become highlighted.

Step 4  Press the MOTOR key to turn the motor on.

The MOTOR lamp comes on.

Step 5  On the above screen, press [F4 Start].

The system message dialog box appears as shown below.
Step 6

In the system message dialog box, select Continuously by using the cursor keys or jog dial or by touching the screen directly. Then press the OK button.

**NOTE:** The robot will continue to run unless you use any of robot stop, halt (or stop), step stop, and cycle stop. For details on those stop types, refer to Subsection 3.4.2.

**NOTE:** The elapsed time on display refers to the time length from the start to end of the program including temporary stop time caused by Step stop or Halt.

Before proceeding to a single-step run, perform CAL operation and set the reduced ratios of the programmed speed, acceleration, and deceleration.

⚠️ **CAUTION**: At the start, set the reduced ratio of the programmed speed at 20% or less. If you run the robot manually at high speeds from the beginning, you may mistakenly strike the robot against the surrounding objects.

Operating procedure

**From the teach pendant**

**Step 1**
Set the mode switch to the AUTO position.

**Step 2**
Press [F1 Program].

The Program List window appears as shown in the next step.
Step 3
Select the task program you want to run, by using the cursor keys or jog dial or by touching the screen directly.

![Program List](image)

The selected program will become highlighted.

Step 4
Press the MOTOR key to turn the motor on.
The MOTOR lamp comes on.

Step 5
On the above screen, press [F6 StpStart] (or the right-arrow cursor key).
The system message dialog box appears as shown below.

![System Message](image)
Step 6

In the system message dialog box, press the OK button. The selected program executes a single step.

**From the operating panel**

**Step 1**
Set the mode switch to the AUTO position. The AUTO lamp comes on.

**Step 2**
Press the PRO key. The LCD shows the following:

![LCD Display](image)

**Step 3**
Select the program number you want to run, using numerical keys. Example: To run PRO15, press the 1 and 5 keys. The following appears on the LCD:

![LCD Display](image)

To cancel the new entry, press the Cancel key.

**Step 4**
Press the OK key. The LCD shows the following:

![LCD Display](image)

If the selected program does not exist, the following appears on the LCD:

![LCD Display](image)

**Step 5**
Press the MOTOR key to turn the motor on. The MOTOR lamp comes on.
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Step 6  Press the ST-START key.
The LCD shows the following:

```
PRO15  Stp  2
ST P START?  
```

Step 7  Press the OK key.
The LCD shows the following and the robot runs a single step of the selected program.

```
PRO15  Pnd  3
RUNNING TASK=1
```

**NOTE:** After completion of a single-step run, to repeat a single-step run, repeat Steps 6 and 7.
### 3.4.2 Stopping Internal Automatic Operation (TP/OP)

You may stop internal automatic operation from the teach pendant or operating panel by any of Cycle stop, Step stop, Halt (Stop), and Robot stop, which are described in the table below.

#### Table 3-4. Four Types of Stops in Internal Automatic Operation

<table>
<thead>
<tr>
<th>Types of Stops</th>
<th>Explanation</th>
<th>When stopped</th>
<th>Restart</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1 Cycle stop</strong>&lt;br&gt;TP: [F3 CycStop]</td>
<td>Stops the robot after executing the last step of the task program.</td>
<td>ON ON</td>
<td>Last step&lt;br&gt;Select the program again, and you may start a single-step run or single-cycle run from the head of the program.</td>
</tr>
<tr>
<td><img src="image" alt="Cycle stop diagram" /></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2 Step stop</strong>&lt;br&gt;TP: [F3 StepStop] OP: ST-STOP key</td>
<td>Interrupts the running task program midway after executing the step in which the step stop key is pressed.</td>
<td>ON ON</td>
<td>Step executed&lt;br&gt;You may start a single-step run or single-cycle run from the step immediately following the current step.</td>
</tr>
<tr>
<td><img src="image" alt="Step stop diagram" /></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>3 Halt (Stop)</strong>&lt;br&gt;TP: [F1 Halt] or STOP key OP: STOP key</td>
<td>Immediately interrupts the running task program selected or all running task programs midway the moment [F1 Halt] or STOP key is pressed, respectively.</td>
<td>ON ON</td>
<td>Step in progress&lt;br&gt;You may start a single-step run or single-cycle run from the current step again.</td>
</tr>
<tr>
<td><img src="image" alt="Halt diagram" /></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>4 Robot stop</strong>&lt;br&gt;TP: ROBOT STOP key OP: ROBOT STOP key</td>
<td>Immediately stops all running task programs midway and turns the motor off the moment the robot stop button is pressed.</td>
<td>OFF OFF</td>
<td>Step in progress&lt;br&gt;Turn the motor on, and you may start a single-step run or single-cycle run from the head of the program again.</td>
</tr>
<tr>
<td><img src="image" alt="Robot stop diagram" /></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
[1]  Cycle stop (TP)

Cycle stop can only be triggered from the teach pendant.

Operating procedure

■ From the teach pendant

Step 1  Press [F3 CycStop].

The current program will execute up to the last step and then the robot will stop.
[ 2 ] Step stop (TP/OP)

Operating procedure

■ From the teach pendant

Step 1

Press [F2 StepStop].

The current program step in progress will execute and then the program will be interrupted.

⚠️ CAUTION: Before restarting the robot after a step stop, confirm that there is no risk of bump or accident in the subsequent robot motion. Restarting the robot after a Step stop as it was will execute the step immediately following the current step displayed on the teach pendant or operating panel.
- **From the operating panel**

**Step 1**

Press the ST-STOP key.

The LCD changes from

```
PROJ. Pnd. 6
RUNNING TASK-1
```

to

```
PROJ. SST 6
STEP STOP
```

The current program step in progress will execute and then the program will be interrupted.

⚠️ **CAUTION:** Before restarting the robot after a step stop, confirm that there is no risk of bump or accident in the subsequent robot motion. Restarting the robot after a Step stop as it was will execute the step immediately following the current step displayed on the teach pendant or operating panel.
[ 3 ] Halt (Stop) (TP/OP)

Operating procedure

■ From the teach pendant

Step 1 Press [F1 Halt] or STOP key.

NOTE: Pressing [F1 Halt] immediately stops the task program selected on the Program List window; pressing the STOP key immediately stops all task programs.

The current program step in progress will be immediately interrupted so that the robot comes to a halt.

⚠️ CAUTION: Before restarting the robot after a halt, confirm that there is no risk of bump or accident in the subsequent robot motion. Restarting the robot after a halt as it was will execute the interrupted step.
From the operating panel

Step 1
Press the STOP key.
The LCD changes from

```
PRO1  Pnd 6
RUNNING TASK-1
```

to

```
PRO1  Std 6
STEP STOP
```

All running programs will be immediately interrupted so that the robot comes to a halt.

⚠️ CAUTION: Before restarting the robot after a halt, confirm that there is no risk of bump or accident in the subsequent robot motion.

Operating procedure

From the teach pendant

Step 1
Press the ROBOT STOP button.

All running task programs will be immediately stopped so that the robot will stop.

⚠️ CAUTION: The robot stop procedure turns the motor off; however, the robot may move unexpectedly due to inertia.

⚠️ CAUTION: Before restarting the robot after a robot stop, confirm that there is no risk of bump or accident in the subsequent robot motion. Restarting the robot after a robot stop as it was will execute the selected program from its beginning.

From the operating panel

Step 1
Press the ROBOT STOP button.

The LCD changes from

```
PRO1 | Prm 8
RUNNING TASK=1
```

to

```
PRO1 | Stp 3
RUNNING TASK=0
```

All running programs will be immediately stopped so that the robot will stop.

⚠️ CAUTION: The robot stop procedure turns the motor off; however, the robot may move unexpectedly due to inertia.

⚠️ CAUTION: Before restarting the robot after a robot stop, confirm that there is no risk of bump or accident in the subsequent robot motion. Restarting the robot after a robot stop as it was will execute the selected program from its beginning.
3.4.3 Switching to External Automatic Operation (TP/OP)

You may switch from internal to external automatic operation from the teach pendant or operating panel. External automatic operation allows you to run the robot automatically from external equipment.

Switch to external automatic operation when
You run the robot automatically from external equipment.

Operating procedure

- *From the teach pendant*

  **Step 1**  Set the mode switch to the AUTO position.

  **Step 2**  Press the MOTOR key.

  The MOTOR lamp comes on.

  **Step 3**  Press the shift key on the top screen, and then press the called-up [F10 INT/EXT] instead of [F4 I/O].

  The system message dialog box appears as shown in the next step.
Step 4
Press the OK button in the system message dialog box shown below.

Internal automatic operation has been switched to external automatic operation.

**NOTE:** After having carried out Steps 1 through 4, pressing [F10 INT/EXT] toggles between external and internal automatic operation.
From the operating panel

Step 1
Set the mode switch to the AUTO position.

The AUTO lamp comes on.

Step 2
Press the EXT/INT key.

The LCD shows the following:

![EXTERN_MODE_OK](image)

To cancel new entry, press the Cancel key.

Step 3
Press the OK key.

The LCD shows the following and the INT OPR lamp goes off.

![EXTERN_MODE](image)

NOTE: Once external automatic operation is selected, the operating panel no longer accepts entry except from the EXT/INT key and STOP key.
3.4.4 Stopping External Automatic Operation (TP/OP)

You may stop external automatic operation from the teach pendant or operating panel using the same procedure as internal automatic operation. Refer to Subsection 3.4.2.

You may also stop external automatic operation from external equipment. For details, refer to the INSTALLATION & MAINTENANCE GUIDE, Subsections 5.3.3 and 5.5.3.
3.4.5 Continue Function

The Continue function can restart the robot operation from the current status when automatic operation is interrupted by any of:

"Halt (Stop)"
"Robot Stop" (set with parameters)
"Motor OFF"
"Error at Level 2."

This function is necessary when

The robot is stopped if the product is mishandled by robot during automatic operation and after rearranging the product further operation can be restarted using this function.

Structure of Continue Function

Continue function is divided into 2 functions as shown below.

"Auto Position Correction"
"Restart Operation"

Auto Position Correction

When Continue Start is executed, this function moves the robot to position when operation is stopped. User can make this function effective or ineffective by changing the parameters.

When Continue Start is again executed after manually rearranging the mishandled product and the robot position, this function checks the robot position and if robot is in valid area, restarts the operation that was halted.

If it is out of the valid area, error occurs. User may change valid area by changing parameters.

![Diagram of auto position correction](image)

When Continue Start is pressed, operation is restarted after moving the robot to halt position.
NOTE:
- This function will get executed even if Robot operation program is not run properly after pressing Continue Start.
- If CAL is not executed, error occurs.
- If motor power is OFF, error occurs.
- This function will get executed only after Continue Start.
  This function is not executed during "RUN" and "StpStart" of program

Operation Restart
This function restarts all the programs from the halt position. When operation is stopped, programs which are showing the status "Executing", "Executing (wait)", and "Awaiting" can be restarted, and programs which are showing status "Step Stop", "Temporarily stopping" and "Stopping" cannot be restarted.

Transferring Program Status (Before stopping)

All task programs are temporarily stopped.
When Continue Start is executed, programs which are showing status "Continue Stop" are restarted.

**NOTE:** In WINCAPSII, task status of Continue Stop becomes 6.

Continue Start

![Program List](image)

**User-changeable parameters**

You can change the following parameters relating to the Continue Function.

"**Robot Stop (Continue)**"

If this parameter is set to 1, Continue Start becomes effective after Robot Stop. Even if Robot Stop button is pressed, program status is not changed to "stopping." And when parameter is set to 0, Continue Start becomes ineffective.

"**Auto Position Correction**"

If this parameter is set to 1, auto position correction takes place during Continue Start. Set 0 if this function is to be made ineffective.

"**Valid range for Auto Position Correction 1 - 6 axis**"

This parameter shows the valid area for performing Auto Position Correction. The unit is degree.

You can set parameters from the teach pendant or in WINCAPSII.

**Parameters setting from the teach pendant (MANUAL mode)**

Access: Top screen

[F1 Program]—[F6 Aux.]—[F7 Continue]
NOTE:
Valid area of auto position correction arm is expressed by $10^3$.
In the above example, 10000 expresses 10 degrees.
Valid area is calculated from (Position when robot is stopped – Valid area) to (Position when robot is stopped + Valid area).

Parameter setting in WINCAPSII
Log on at Programmer level.
Select [File]—[Set Project]—[Interpreter] in PAC manager.
Change the parameters of Robot Stop (continue) and Auto Position Correction.
Select [Tool][Settings][Create trajectory] from Arm Manger.
Change the parameters of valid area as shown in screen.

Parameter setting in WINCAPS II

Transfer to controller.
For details see the WINCAPS II manual.

Conditions Necessary for Continue Start
You can start the operation only when there are no changes in program status after halt
(But, when the program is stopped during Cycle Run from the pendant by pressing 'Cycle Stop', and even though there are no changes in the status, Continue Start does not work properly.)

NOTE: During the execution of Continue Start, if program status is changed, error will occurred.

Operating Procedure of Continue Start
Continue Start can be executed from pendant, Operating Panel and IO.

From Pendant
Only the program whose status is [Continue Stop] can be executed by pressing "Continue Start."
**Continue Start from Pendant.**

**From Operating Panel**
Shift ON + Step Stop (Program above Step Stop in the above screen can be executed by Continue Start)

**IO standard mode**
Continue Start command

<table>
<thead>
<tr>
<th>Program operation</th>
<th>Data Area 1</th>
<th>Program No.</th>
<th>Status Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>0001</td>
<td>00000100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:**
If Continue Start signal is entered at the time of program start, program number will get ignored.

**IO compatibility mode**
Continue Start signal (No.6 of CN8) + program start signal (If program start signal is entered with Continue Start signal, continue start is executed.)

**NOTE:**
At the time of IO, if Continue Start is executed, error will occur except for the case when Continue Start permission signal is output.

Immediately after stopping all task programs, if Continue Start is executed even if Continue Start signal is ON, error will occur.
Others

The function which resets all the programs is added in the pendant. This key stops the programs. User can either stop the selected program or all programs by specifying "Selected" or "All Programs."

![Program Resetting from Pendant](image)

The dedicated output signal (Special Mode), that cates completion of 1 cycle, is OFF even during Continue Start.
3.4.6 SS (Safe Start) Function

In automatic operation, if the inaction status of robot exceeds a specific time because of awaiting signal from external device, then for the sake of safety, this function either carries out ‘Continue Stop’ or it makes the speed of restart operation slow for a pre-determined time.

This function is useful when

Ensuring further safety, as a part of safety function of the equipment.

Examples of processes unsafe for an operator when work is damaged by robot are given below.

(1) Work (product) is damaged.
(2) No output of signal from the sensor indicating presence of work.
(3) Robot is in a state of inaction and awaiting signal.
(4) The operator mistakes robot’s inaction as robot being in "Stop Operation"
(5) The worker rearranges the product that was damaged without first temporarily stopping the operation of the robot.
(6) Output of signal from the sensor indicating presence of work.
(7) The robot begins the next operation immediately at normal high speed.

These conditions can pose potential danger to the operator.

In this way, with the help of this function you can stop the process automatically or make the speed of next operation slow for a pre-determined time when the inaction period of the robot exceeds a specific time because of awaiting signal from external device and render conditions safe.

Note (For SS (Safe Start)):

- When you are using SS function, perform a preliminary test (including those of peripherals).
  Particularly, make sure that the there is no danger of the speed of the robot in SS function and the speed of the peripherals not matching and therefore causing mutual interference.
- This function is very much a part of safety function. Please read "For safe use" before actual designing or operation for safe use of the robot.


Chapter 3  General Introduction to Operation Modes and Machine Lock

Operation Mode

Types of mode

In SS function, there are two types of modes as given below.

(1) Stop Mode

When inaction period exceeds a specific period, ‘Continue Stop’ is executed in this mode.

(2) Slow mode

When inaction period exceeds a specific period, the speed of next operation is slow for a pre-determined time in this mode.

Stop mode

• Function

When inaction period exceeds a specific period, ‘Continue Stop’ is executed in this mode.

This specific time is called as "TC period." Also, period of robot inaction is called "Inaction Period." The time is counted from 0 from the moment when the external device temporarily stops the operation of arm or tool. When TC period is exceeded, Continue Stop is carried out.

From the time TC period is exceeded till the time ‘Continue Stop’ is executed, the mode is said to be ‘SS Mode’

• If the MOVE operation is started within the TC period, the time count of inaction period is stopped.

• After "Continue Stop", when operation is restarted and if again it goes into inaction status, inaction period count will be restarted from 0

• Example of operation

The figure below depicts the Stop Mode operation.

In this example, inaction period count is started after the end of MOVE operation of PRO1 and when TC time is exceeded, "Continue Stop" is executed.
Slow Mode

- **Function**
  When inaction period exceeds a specific period, the speed of next operation is slow for a pre-determined time in this mode.

  This fixed time is called "TS period." From the time TC period is exceeded till the end of TS period, the mode is said to be 'SS Mode'

- **Speed of slow operation is called "Slow speed."**

- **All operation commands which are run in SS modes run slow.**

- **When all the programs are stopped or all programs are closed in SS operation, the SS mode ends.**

- **Once the slow operation is started, icon that indicates the SS mode is displayed in the graph in Speed Setting window as shown below.**

In this figure, if ‘Continue Stop’ is executed only for PRO1, PRO3 will execute.
To prevent it, whenever TC time is elapsed, execute ‘Continue Stop’ for all programs.
Example of Operation

The following figure shows an example of Slow Mode operation.

In this example, after the end of MOVE1 operation of PRO1, the counting of inaction period is started and after TC period is exceeded, the mode switches to SS mode.

Then, the slow operation of MOVE1 of PRO2 is started. MOVE2 of PRO2 is carried out slowly because it is started in the TS period.

From MOVE2 of PRO1 onwards, the actions take place at original speed.
Setting procedure of SS function operation mode

(1) Set the mode selector switch to the MANUAL position.

(2) Turn the motor off.

(3) Press [F1] or select [Program] in the window.

The Program List window appears as shown below.
(4) In the Program List window, press [F6 Aux.].

The Auxiliary Functions (Program) window appears as shown below.

(5) Press [F8 SS Mode].

The Safety Start Setting window appears.

(6) Select the "Safety start mode" by using the cursor keys or jog dial or by touching the screen directly.

The "Safety start mode" will become highlighted.

(7) Set the desired value and press the OK button.

To disable the SS function : 0
Slow mode : 1
Stop mode : 2
Setting Time and Speed

You may set the TC period, TS period and Slow speed in either of the following two ways.

(1) By direct entry of values
   Set the TC time, TS time and slow speed from the teach pendant.
   This method should be used when you want to enable the SS function for all operations during automatic operation.

NOTE:

• The specified value is effective even if you turn the robot controller off.
• The most recently executed value will becomes the default thereafter.
By direct entry of values

Setting the TC period

(1) Follow steps (1) through (5) in "Setting procedure of SS function operation mode."

(6) Select the "TC time" by using the cursor keys or jog dial or by touching the screen directly.

The "TC time" will become highlighted.

(7) Enter an arbitrary TC period and press OK.

You may enter any value from 0 to 600 seconds. The factory default is 60 seconds.

**NOTE:** Setting "0" will disable the SS function. The SS function is kept disabled until you enter a value other than 0 to the TC time.
Setting the TS period

(1) Follow steps (1) through (5) in "Setting procedure of SS function operation mode."

(6) Select the "TS time" by using the cursor keys or jog dial or by touching the screen directly.

    The “TS time” will become highlighted.

(7) Enter any TS time and press OK.

    You may enter any value from 3 to 30 seconds. The factory default is 5 seconds.
Setting the Slow speed

(1) Follow steps (1) through (5) in "Setting procedure of SS function operation mode."

(6) Select the "Reduced speed for safety start" by using the cursor keys or jog dial or by touching the screen directly.

The "Reduced speed for safety start" will become highlighted.

(7) Enter the desired slow speed and press OK.

You can enter any value from 1% to 10%. The factory default is 10%.
Dedicated output in SS function

Function
Outputs in SS mode.
This function is enabled only if set in "Slow mode."

Port number
Compatibility mode : Connector No29 of CN10.
Standard mode : Connector No11 of CN10.

How it works
This function gives the indication to the operator that the operations are taking place in "SS mode" by ringing a buzzer or by making the LED ON when this signal is ON.

ON
When operation is in SS mode.

OFF
When TS time is exceeded and operation is not in SS mode.

NOTE: This signal is OFF even in slow operation if TS time is exceeded. The operations subsequent to signal OFF are carried out at original speed.
3.4.7 Break Point Function [TP] [Ver. 1.4 or later]

You may set a break point at any program step in programs. If a program is running and encounters a break point, it will immediately stop. The step where a break point is set cannot be executed.

You can set a break point only from the teach pendant. (The operating panel cannot be used for this purpose.)

<table>
<thead>
<tr>
<th>Max. number of break points that can be set</th>
<th>32 points in all programs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation modes in break points take effect</td>
<td>External automatic Cycle start</td>
</tr>
<tr>
<td></td>
<td>Internal automatic Cycle start</td>
</tr>
<tr>
<td></td>
<td>Teach check Cycle start</td>
</tr>
<tr>
<td>Requirements for setting break points</td>
<td>External automatic Highlighted step</td>
</tr>
<tr>
<td></td>
<td>Internal automatic Highlighted step</td>
</tr>
<tr>
<td></td>
<td>Manual Any step</td>
</tr>
<tr>
<td></td>
<td>Teach check Highlighted step</td>
</tr>
</tbody>
</table>

**Break point stop mode**

When a program encounters a break point step, you may choose either of the following two stop modes:

1. Immediate halt of that program in which the break point is set
2. Immediate halt of all running programs

**Program status when stopped at the break point**

When the program is stopped at the break point, the teach pendant screen will display the following 2 status.

1. Halt at BP (Break point): Only the program in which the break point is set is stopped (factory default)
2. Continue Stop at BP (Break point): Control stops the program at the program step where Continue Start is possible
   (Halt at the BP is functionally equivalent to Halt. Continue Stop at BP is functionally equivalent to Continue Stop.)

**Saving the break point settings**

All break points you have set will be saved even if the controller power is switched OFF, except for the following:

**Break points will be released when:**

- You clear the break point
- You clear all the break points
- The program is edited
- You delete the program
- You recompile the program with the teach pendant
- Data of PAC Manager is received from WINCAPS II
- The operation device is switched to the operating panel
Restarting after BP stop

Restart the program at the BP stopping step to proceed the robot operation. According to the BP stop status, the program will restart in either of the following two ways:

Halt at BP: Only the program in which the break point is set will be restart.
Continue Stop at BP: Programs will continue-start if possible.

When this operation needed

This operation is needed when you want to stop the program at any step in a program.

Setting a break point

■ From the teach pendant

Step 1
Set the mode selector switch to the MANUAL position.

Step 2
Press [F1 Program].

The Program List window appears, as shown in the next step.
Step 3
Select a program in which you want to set break points.
The selected program will become highlighted.

![Program List](image)

Step 4
Press [F5 Edit.] or [Display].
The program steps appears as shown below.

![Program Steps](image)
Step 5  Select a step where you want to set a break point. The selected step will become highlighted.

Step 6  Press [BP]. The BreakPoint Setting window appears as shown in the next step.

Step 7  Select "Set BreakPoint" and press the OK button.

A red circle will appear at the left side of line number where the break point is set.
Clearing the break point

- **From the teach pendant**

**Step 1**  To clear the break point already set, choose the program step following Steps 1 to 5 given in the above section. The next screen will appear.

The step, where the break point is set, is highlighted.

**Step 2**  Press [BP].

**Step 3**  Select "Reset BreakPoint" and press the OK button.

The red circle marked at the left side of the line number disappears and the break point will be cleared.
Setting the Break Point Stop mode

From the teach pendant

Step 1
Set the mode selector switch to the MANUAL position.

Step 2
Press [F1 Program] on the top screen.

Step 3
The Program List window appears as shown below.
Press [F6 Aux.].

The Auxiliary Functions (Program) window appears as shown in the next step.
Step 4  Press [F5 BP Setting].

The Select BreakPoint setting window appears as shown below.

Step 5  Select whether to Stop only a task on BP or to Stop all tasks, then press OK.
Executing BP (break point) stop operations

**Auto mode**

**Step 1**
Set a BP (break point) in any step you want to do so.
For the setting procedure, refer to Subsection 3.4.7 "Break Point Function."

**Step 2**
Start the program in which the BP (break point) is set.
For program starting, refer to Section 3.4 "Auto Mode."

**Step 3**
The program will halt at the step where the BP (break point) is set.

**Note 1** About Step Start
When the step to be executed after Step Start is the BP Stet Start, the program first Step Stops at that step. After that, if restarted, the program will temporarily stop at the BP step.
Teach check mode

In teach check mode, there are 2 types of BP setting display.

<table>
<thead>
<tr>
<th>Red circle</th>
<th>Step in which you can stop at BP by the BP setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gray circle</td>
<td>Step in which there is BP setting step, however it does not stop at the break point</td>
</tr>
<tr>
<td></td>
<td>• The command of Step Back is effective for only controlling the robot motion and this step cannot be executed when running any program referring to the historical record of robot motions.</td>
</tr>
<tr>
<td></td>
<td>• BP step at the time of step back</td>
</tr>
</tbody>
</table>

Step 1
Set a BP (break point) in any step.
For the setting, refer to 3.4.7 BreakPoint Function.

Step 2
Cycle Start the program in which the BP (break point) is set.
For program starting, refer to 3.3 Teach check mode.

Step 3
The program will halt at the step in which the BP (break point) is set showing the screen shown below.

Note 1
About StepStart
When the step to be executed after StepStarted is the BP-set step, first step stops at the BP-set step. After that, if you restarting it, the program temporarily stops at the BP.

Note 2
Any program steps with a gray-circled BP-set will not stop at the BP step after CycleStarted or StepStarted.
Clearing all break points

From the teach pendant

Step 1
Follow Steps 1 to 4 in Break Point setting.
(You can choose any program.)

Step 2
Press [BP]. The BreakPoint Setting window appears as shown below.

Step 3
Select "Clear All BreakPoints" and press the OK button.
Red circles marked on all break points will disappear and the break points will be cleared.
3.4.8 Changing Route in Restarting the Pass Motion
[Ver. 1.4 or later]

When stopped in the pass motion, for the route for the robot motion after restarting it, you can select one of the following two options.

(1) Move the robot end to the target position after restarting the pass motion without any change.

![Pass motion without any change (Traditional)](image)

(2) The new feature can execute the pass motion to the target position on the path previously defined (PTP control) or to the target position on the path newly defined after restarting.

![New pass motion, added in V 1.4](image)
Precautions for using the New Feature

(1) In spite of the interpolation method of pass motion command, the movement of robot to the target position before the pass motion, when restarting the robot runs in the PTP control mode. When the movement on the 2 straight lines is considered to be the pass motion, the end of robot moves on the plane, determined by the 2 straight lines, resulting in the route shown by the solid line (as shown in the following figure). When the robot is stopped or restarted during the pass motion, the route becomes the one that is shown by the broken line, however, the end is not moved on the plane, determined by the 2 straight lines, as in the original operation. The end moves on the plane or under the plane, depending on the stopping position. Besides, as the posture of the robot arm is also changed, be sure to run the robot after confirming that there is no interference with any surroundings.

![Diagram showing difference of robot end route depending on the stop process enabled or disabled](image)

(2) This function will become effective if the specified stop process is performed in the interval within the pass motion started and ended. When restarting, as the robot moves to the target position before pass motion started, the operation returning the robot end to the target position before pass motion started is sometimes performed even when the robot stops near the target position after the pass motion started.

(3) As the movement after restarting becomes the pass motion of the movement to the target position before pass started and movement to the target position after pass started, depending on the stop position, error may occur when restarting and the operation is incomplete.

(4) When the pass motion command is Step-run, movement to the target position is not possible even after restarting and the robot will proceed to execute next step of the program.
**Chapter 3  General Introduction to Operation Modes and Machine Lock**

**Changing the robot end route**
Perform the operations according to the following procedure. This setting can be made only from the teach pendant.

**Step 1**
Set the mode selector switch to the MANUAL position.
Press [F2 Arm] on the top screen.

The Current Robot Position window appears as shown below.

**Step 2**
Press [F6 Aux.].

The Auxiliary Functions (Arm) screen appears.
Step 3
Press [F7 Config].

The User Preferences window appears.

Step 4
Select [70: Pass Motion setting (0: Disabled, 1: Enabled)] using the jog dial or buttons from [F1 Back] to [F3 Jump To].
The selected line will become highlighted.
Press [F5 Change].

The numerical keypad will appear.
Step 5

Enter 0 or 1 from the numeric keypad.

If you enter 0, "(1) Move to the target position after starting the pass motion" will be performed; if you enter 1, "(2) Pass motion of movement to the target position before pass start (PTP control) and movement to the target position after pass start" will be performed, as mentioned in the beginning of this chapter (3.4.8).

To cancel the entered value, press the CLR or BS button.

Confirm the entered value. If it is right, press the OK button to fix it.

If you want to cancel this operation as it is, press the CANCEL button.

The numeric keypad disappears and [70: Pass Motion setting (0: Disabled, 1: Enabled)] is updated by the newly entered value.

Press the OK button. To cancel the value, press the Cancel button.

The setting procedure is now completed. In further operations, the set movement/motion will be executed.
3.4.9 Software PLC (Supervisory Task) [Ver. 1.7 or later]

3.4.9.1 Outline of Software PLC

System software version 1.7 newly supports programmable logic control software (software PLC) that runs as a supervisory task. The software PLC enables the robot controller to centralize control of an entire facility.

If defined as a supervisory task, a task program written in PAC can keep running independently of normal task programs and operation modes. You may define ten supervisory tasks (TSR0.PAC to TSR9.PAC) and operate them with the system software version 1.7 or later. It is useful to define programs described below as supervisory tasks.

For safety, names of supervisory tasks are restricted to TSR0.PAC to TSR9.PAC and any motion-control programs are prohibited in supervisory tasks.

Use the following as supervisory tasks:

(1) Customizing operation screens on the teach pendant, which can contain up to 500 buttons and 50 screens (Refer to the PROGRAMMER'S MANUAL, "Customizing TP Operation Screens.")

(2) Writing programs for automatic recovery process to be followed if an error occurs in facilities or robots

(3) Controlling facilities (As an alternative of sequencer for facility scale of 200 I/O points and approx. 100 steps in a rudder command)

Supervisory tasks feature:

(1) Written in PAC language. (Up to 10 programs may be defined and their names are fixed to TSR0.PAC to TSR9.PAC.)

(2) Arithmetic/logical operation commands, I/O get commands, program control commands only executable.

(3) Highest priority (101) over all other normal task programs (whose priority will be automatically changed to 102 or more)

(4) Limited occupation time frame (Uses 2 ms every 8 ms).

Supervisory task start condition parameters

(1) Supervisory task enable/disable parameter

"Not Use Supervisor TASK" or "Use Supervisor TASK" in the Supervisor TASK Setting window

(2) INIT run mode parameter, whether or not to involve motor on and CAL

"INIT:(not [MOTOR ON + CAL])" or "INIT:(MOTOR ON + CAL)" in the INIT Setting window

(3) External speed parameter (10 or 100) for INIT run mode

"INIT Set SPEED 10" or "INIT Set SPEED 100" in the INIT Setting (SPEED) window
Starting supervisory tasks

Supervisory tasks may be started by any of the following operations or events provided that:
- the supervisory task mode has been enabled (by selecting the "Use Supervisor TASK" in the Supervisory TASK Setting window) and
- any supervisory task program (TSR0 to TSR9) exists.

(1) Turning the robot controller on
(2) Switching the operation mode from Manual to Auto
(3) Pressing the START button in the Supervisor TASK Setting window
(4) Selecting and starting a supervisory task in the Program List window in Auto or Teach Check mode

If a supervisory task is initiated, the supervisory task icon will appear in the task bar as shown below.
Terminating supervisory tasks

Supervisory tasks will terminate if any of the following events occurs:

1. Turning the robot controller off
2. Pressing the STOP button in the Supervisor TASK Setting window
3. Loading or compiling a project
4. Error in a supervisory task itself
5. Level 4 error or higher one
6. Reading or writing from/onto a floppy disk
7. Receiving a file from WINCAPSII
8. Making the supervisory task mode inactive to delete it from optional features

Supervisory task commands

1. INIT (Initialize the robot controller)
   This command may turn the motor power on and execute CAL depending upon the INIT run mode setting.
3.4.9.2 Using Supervisory Tasks

[1] Making the supervisory task mode active

The supervisory task mode is an optional feature, so you need to make it active according to the procedure given below.

(1) Calling up the System Extension window

Access: [F6 Set]—[F7 Options]—[F8 Extension]—[F5 Input ID] from the top screen of the teach pendant

(2) Adding a supervisory task mode

Enter "1111" from the numeric keypad.
Press the OK button. The supervisory task mode will be added.

(3) Restarting the robot controller

Turn the controller off and then on. The supervisory task mode becomes active and you may make supervisory task settings.

On the top screen, press the SHIFT key and check that the S-TASK is displayed in F8 of the menu bar.

Press [F8 S-TASK]. The Supervisor TASK Setting window appears as shown below.
[ 2 ] Setting supervisory task parameters

(1) Supervisory task enable/disable parameter
This parameter enables or disables the supervisory task mode.
Access: [F8 S-TASK]—[F7 USE] from the top screen of the teach pendant
In the Supervisor TASK Setting window shown below, choose the desired setting and press the OK. To make no change, press the Cancel.

(2) INIT execution mode parameter
This parameter specifies whether or not the execution of the INIT command will involve turning on motors and performing CAL.
Access: [F8 S-TASK]—[F8 Mode] from the top screen of the teach pendant
In the INIT Setting (MOTOR ON + CAL) window shown below, choose the desired setting and press the OK. To make no change, press the Cancel.
(3) INIT external speed parameter

This parameter determines whether the external speed will be 10 or 100 at execution of INIT command.

Access: [F8 S-TASK]—[F9 Speed] from the top screen of the teach pendant

In the INIT Setting (SPEED) window shown below, choose the desired setting and press the OK. To make no change, press the Cancel.
[ 3 ] Starting supervisory tasks

Turn the robot controller on.
Supervisory tasks will start automatically provided that:
- the supervisory task mode has been enabled by selecting the "Use Supervisor TASK" in the Supervisory TASK Setting window and
- any supervisory task program (TSR0 to TSR9) exists.

**NOTE:** Under the above conditions, supervisory tasks will be started even in Manual or Teach Check mode.

To start no supervisory task, turn the controller on while holding down the deadman switch.

Switch the operation mode from Manual to Auto from the teach pendant or an external I/O.
Supervisory tasks will start automatically provided that:
- the supervisory task mode has been enabled by selecting the "Use Supervisor TASK" in the Supervisory TASK Setting window and
- any supervisory task program (TSR0 to TSR9) exists.

Switching the operation mode from an external I/O when the controller is placed in the external mode will also start supervisory tasks. Before doing this, make sure that no normal programs are running.

**NOTE:** Switching to Auto mode by using Enable Auto signal and Robot Error Clear signal will also start supervisory tasks.

Press the START button in the Supervisor TASK Setting window.
From the top screen of the teach pendant, choose [F8 S-TASK]—[F1 START] under the following conditions:
- the supervisory task mode has been enabled by selecting the "Use Supervisor TASK" in the Supervisory TASK Setting window and
- any supervisory task program (TSR0 to TSR9) exists.

Select and start a supervisory task in the Program List window in Auto or Teach Check mode.
From the Program List window, choose a desired supervisory task program(s) (TSR0 to TSR9) and start it, provided that any supervisory task program(s) exists.

If any of the following operations takes place or any of the following errors occurs when a supervisory task program is running, then the supervisory task will terminate.

**Turn the robot controller off**

**Press the STOP button in the Supervisor TASK Setting window**

Access: [F8 S-TASK]—[F6 STOP] from the top screen of the teach pendant

![Supervisor TASK Setting](image)

**Load or compile a project**

Access: [F6 Set]—[F1 Load!] from the top screen of the teach pendant or
Access: [F1 Program]—[F6 Aux.]—[F12 Compile] from the top screen of the teach pendant in Manual mode

**Error in a supervisory task itself**

If any error occurs in a supervisory task itself, the supervisory task currently running will terminate.

**Level 4 error or higher one**

If an error at level 4 or above occurs in supervisory tasks, user tasks, or robot controller system, then the supervisory task currently running will terminate.

**Read or write from/onto a floppy disk**

Reading data stored in a floppy disk to the robot controller or writing data stored in the robot controller to a floppy disk will terminate the currently running supervisory task.

Access: [F6 Set]—[F3 FD.]—[F1 Read.] from the top screen of the teach pendant
Access: [F6 Set]—[F3 FD.]—[F2 Write.] from the top screen of the teach pendant
Receive a file from WINCAPSII
Receiving an execution file or parameters from WINCAPSII will terminate the supervisory task currently running.

Make the supervisory task mode inactive to delete it from optional features
Access: [F6 Set]—[F7 Options.]—[F8 Extension]—[F4 Remove] from the top screen of the teach pendant
Note that the supervisory task setting remains enabled.
3.4.9.3 Restrictions on the Use of Supervisory Tasks

The purpose of a supervisory task is to centralize control of an entire facility. It involves placing some restrictions on the use of it.

[1] Restrictions on the normal program operation

(1) No motion commands or vision commands are executable in a supervisory task. To execute those commands, make a user program containing them and run it as a supervisory task.

(2) A supervisory task may support robot stop and start commands, but not support Temporary stop, Instantaneous stop, Step stop, or Break point stop. It also ignores the SUSPEND command.

(3) If you want to start a supervisory task only when the robot controller is turned on, then use internal I/Os to bypass the overlapped initiation of the supervisory task.

(4) If a supervisory task is started by any other supervisory task, then no priority options or cycle options are supported. This means that these supervisory tasks may conflict with each other.

(5) A supervisory task is so designed that it cannot be self-started repeatedly. To repeat it, use loop commands.

(6) In Teach Check mode, releasing the deadman switch will not stop running supervisory tasks.

(7) A supervisory task does not support Step check or Step back.

(8) A HOLD command for a supervisory task will be ignored.

(9) A normal task cannot manage any supervisory task by using KILL or SUSPEND command or other means.

(10) During execution of a supervisory task, you may make vision board settings. However, it may block the operation of the supervisory task.

(11) If an error occurs or an emergency stop signal is inputted, a supervisory task cannot run any normal task.
Chapter 3  General Introduction to Operation Modes and Machine Lock

[ 2 ]  Rules for using a supervisory task

(1) Avoid using the following commands in a loop to repeat them in a supervisory task. Otherwise, the supervisory task itself may not terminate. This is because a supervisory task has higher priority over normal task programs.

   INIT, RUN, KILL, SUSPEND commands

(2) Avoid simultaneous execution of RUN and SUSPEND commands or that of RUN and KILL commands to a same program in a supervisory task. Doing so may freeze the robot system, skip a Stop command, or cause any other failures. To recover from such states, you need to restart the robot controller.

(3) If a semaphore (priority order) is specified in a supervisory task, there is a possibility that a lower priority task may get a semaphore. This is because using a semaphore may cause a supervisory task to lose highest priority.

(4) If a supervisory task that repeats user tasks runs, then mode switching from the external equipment may become no longer possible.

   To recover from such states, stop the supervisory task from the teach pendant.
   To prevent such states,
   - design programs so that they will conditionally start according to Auto mode or External mode, or
   - design a supervisory task itself so that it will be terminated from external input.

Starting a user program during switching to External mode may issue an alarm. Correct the program so that it will conditionally start according to the mode, just as above.

[ 3 ]  Rules for a supervisory task mode in use

When a supervisory task mode is not in use, programs named TSR0 to TSR9 execute as normal task programs. To debug supervisory task programs, therefore, disable a supervisory task mode and use Teach Check mode or Break Point function.
3.4.9.4 Supervisory task commands

INIT

Function

Turns on motors, carries out CAL, and sets the speed according to the preset supervisor task parameters.

Syntax

INIT

Descriptions

(1) If the supervisor task mode is disabled ("Not Use Supervisor TASK" parameter is selected), then the INIT command causes no operation.

(2) If the supervisor task mode is enabled ("Use Supervisor TASK" parameter is selected), then the INIT command causes the following:

When the INIT run mode is set to "without motor on and CAL":
If the INIT speed has been set to 10 or 100, this command sets the external speed of the robot controller to 10 or 100, respectively.

When the INIT run mode is set to "with motor on and CAL":
If the INIT speed has been set to 10 or 100, this command sets the external speed of the robot controller to 10 or 100, respectively, turns motors on and carries out CAL.

Example

'!TITLE "Initialization"
PROGRAM TSR1
   INIT 'Turn motors on, execute CAL, 'and set the speed.
END

Notes

(1) Do not concurrently run robot motion programs and supervisory task programs that run only INIT commands. Doing so will enter the system in an infinite loop.

(2) During execution of an INIT command, the status display of running programs may show "On standby." Be careful with restart of those programs.

(3) Do not run INIT commands simultaneously in more than one supervisor task.
References

At the time of restart, you may switch between the enable and disable of movement to the target position before pass motion start, by setting the [71: Pass Motion End Range]. The [71: Pass Motion End Range] may be set by the distance to the target position.

The method of setting is same as the [70: Pass Motion setting (0: Disabled, 1: Enabled)]. Refer to the (1) to (5) process of setup changing method. It becomes enable when the value to be set is more than 1.

Relation between the movements based on the set distance and stopping position

When the [71: Pass Motion End Range] is set to L, and as shown in the figure, when the straight line movement from A to B and from B to C, is considered as the pass motion, if the stopping position is D, on restarting the robot is moved to B. However, when the stopping position is E, in stead of moving to B, the robot is directly moved to C.

Notes

The range of value for setting is shown roughly and no guarantee is given for the absolute position.

Sometimes even by changing the numeric value, the actual operation, based on the operating speed and the interpolation method may not change.
Chapter 4

General Introduction to Coordinates and Figures

This chapter explains the coordinates used for the robot and figures of the shoulder, elbow, and wrist.

**NOTE 1:** Avoid letting the teach pendant, operating panel, or mini pendant undergo any strong shocks, impacts, or vibrations.

**NOTE 2:** Touch the teach pendant, operating panel, or mini pendant with your fingers only, never with the tip of a pen or any pointed object. Otherwise, the LCD may be broken.
Chapter 4  General Introduction to Coordinates and Figures

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4.1 Coordinates, Interference Check Area, and Figures

4.1.1 Coordinates

This section describes the coordinates required for correct handling of the robot.

[ 1 ] Base coordinates

[1.1] Base (world) coordinates and work coordinates

The base coordinates are so-called world coordinates which refer to 3-dimensional Cartesian coordinates whose origin is at the center of the robot basement. It has components Xb, Yb, and Zb which are identical with X, Y, and Z in X-Y mode explained in Subsection 3.2.1, “Running the Robot Manually,” [ 2 ], Figure 3-2.

The work coordinates are defined relatively in base coordinates. The origin of the work coordinates should be laid at a corner of the cubic envelope of an object piece. It has components Xw, Yw, and Zw. You may define the work coordinates by the number of objects you want to handle in the same timeframe on the single robot.

Work coordinates are 3-dimensional Cartesian coordinates defined for each operation space of work. The origin can be anywhere. Work coordinates are expressed by the coordinate origin (X, Y, Z) corresponding to the base coordinates and the angles of rotation (Rx, Ry, Rz) around X axis, Y axis and Z axis of base coordinates. If work coordinates are not defined, base coordinates come into effect.

Figure 4-1. Base Coordinates and Work Coordinates
Position data refers to a set of data which includes seven components of base coordinates. Of these seven components, three are robot flange center coordinates (the end-effector tip coordinates if an end-effector is defined) and four are current robot attitude components, as shown below.

Position data allows you to represent the current position of the robot flange center and object points.

Position data:

- **X** Coordinate values (in mm) — Defines the position of the robot flange center or the end-effector center.
- **Y**
- **Z**
- **RX** Yaw angle: Rotation angle around X axis (in degrees)
- **RY** Pitch angle: Rotation angle around Y axis (in degrees)
- **RZ** Roll angle: Rotation angle around Z axis (in degrees)
- **FIG** Figure (Value: 0 to 31)

A set of X, Y, and Z coordinate values represents the position of the robot flange center (or tip of the end-effector if defined) expressed in base coordinates (Xb, Yb, and Zb) in units of mm.

As shown in Figure 4-3, the yaw, pitch, and roll angles, which are expressed by RX, RY, and RZ, refer to rotation angles around the respective axis of Xm, Ym, and Zm defined in mechanical interface coordinates (refer to Subsection 4.1.1, [2.1]) whose origin is at the center of the flange surface. These angles are expressed in units of degree.

With respect to the positive (+) direction on axes of the base coordinates, clockwise rotation is treated as positive (+).

You should always preserve the rotation order of RZ, RY, and RX. Changing it will cause the robot to take a different attitude in spite of the same rotation angle defined.

Figure represented by FIG value refers to a figure of robot arm joints. It is explained in Subsection 4.1.3, "Figures of the Shoulder, Elbow, and Wrist."
Figure 4-3. Roll, Pitch and Yaw Angles
(Rx, Ry, Rz) = (0, 0, 0)

(Rx, Ry, Rz) = (180, 90, 90)

(Rx, Ry, Rz) = (0, 0, 90)

(Rx, Ry, Rz) = (0, 90, 90)

(Rx, Ry, Rz) = (0, 90, 90)

Figure 4-4. Examples of roll, pitch and yaw angle rotation

Attitude: (Rx, Ry, Rz) = (0, 0, 0) → (Rx, Ry, Rz) = (180, 90, 90)
[1.3] Defining work coordinates

Two procedures, 3-point teaching and direct value entry, are available for defining work coordinates.

Defining work coordinates by 3-point teaching

[F2 Arm]—[F6 Aux.]—[F5 Work]—[F4 AutoCalc]

In this method coordinates are created by teaching three points, namely, the origin of work coordinates, a point on X-axis and a point on X-Y plane.

Defining work coordinates by direct value entry

[F2 Arm]—[F6 Aux.]—[F5 Work]—[F5 Change.]

Enter the coordinate origin (X, Y, Z) corresponding to the base coordinates and rotation angles (Rx, Ry, Rz) around the X-axis, Y-axis and Z-axis of base coordinates.
- **Defining work coordinates by 3-point teaching**

**Step 1**  
On the top screen of the teach pendant, press [F2 Arm].

**Step 2**  

**Step 3**  
Press [F5 Work] in the Auxiliary Functions (Arm) window. The Define Work Coordinates window appears as shown below.

```
YR-UPJ3-B00
F4
```

Select the coordinates by using the cursor or jog dial, and then press [F4 AutoCalc].

**Step 4**  
The Work coordinate automatic calculation window appears.

```
YR-UPJ3-B00
F5
```

To set a desired position variable name to each of the "Origin of work," "Point on X axis of work," and "Point on X-Y plane of work," first choose the "Origin of work" row and press [F5 Change].
Step 5

The numeric keypad will appear as shown below. Enter a desired position variable name for the "Origin of work" and press the OK button. The same way, set desired position variable names to the "Point on X axis of work" and "Point on X-Y plane of work."

Step 6

Call up the Position Variables assignment window ([F2 Arm]—[F4 Var.]—[F4 Position.]) shown below.

In the Position Variables assignment window, assign the value of the robot arm position to be taught to each of the three position variables you have set in Step 5.

(1) Place the cursor on the position variable to which you want to assign the robot arm position value.

(2) In Manual mode, move the tool end of the robot arm to the teaching point.

(3) Press [F6 Get Pos.] in order to read in the current position of the tool end to the selected position variable.

(4) Carry out (1) through (3) above for each of the "Origin of work," "Point on X axis of work," and "Point on X-Y plane of work."

NOTE

• Teach the "Origin of work" and "Point on X axis of work" precisely.
• Define work coordinates after establishing the tool definition.
Step 7 Press the Cancel button twice to return to the Work coordinate automatic calculation window.

Step 8 At the bottom of the Work coordinate automatic calculation window, the defined work coordinates are displayed. If they are satisfactory, press the OK button; if not, press the Cancel button.

Step 9 If you press the OK button in Step 8, the defined work coordinates will be entered into the target work number.
Defining work coordinates by direct value entry

**Step 1** On the top screen of the teach pendant, press [F2 Arm].

**Step 2** Press [F6 Aux.] in Current Robot Position window.

**Step 3** Press [F5 Work.] in Auxiliary Functions (Arm) window.
The Define Work Coordinates window appears.
Select the work coordinates to be defined using the cursor or jog dial.

**Step 4** Press [F5 Change.] in the Define Work Coordinates window.
The numeric keypad will appear as shown below.

![Numeric Keypad]

**Step 5** Using the numeric keypad, enter the desired numerical values. After checking the entered values, press the OK button.
[2] Tool Coordinates

A 6-axis robot has tool coordinates that make it easy to express the position and moving path of an end-effector mounted on the robot flange.

The tool coordinates are defined based on the mechanical interface coordinates. This section begins with an explanation of the mechanical interface coordinates.

[2.1] Mechanical interface coordinates

The mechanical interface coordinates refers to 3-dimensional Cartesian coordinates whose origin is at the center of the flange surface as shown in Figure 4-3. X, Y, and Z axes in mechanical coordinates are expressed as Xm, Ym, and Zm as shown in Figure 4-5.

The Xm, Ym, and Zm are identical with X, Y, and Z in Tool mode explained in Subsection 3.2.1, “Running the Robot Manually,” [3], Figure 3-3.

Figure 4-5. Definition of Mechanical Interface Coordinates

Unlike the work coordinates or base coordinates, the mechanical interface coordinates rotate as the robot flange rotates.

Figure 4-6. Rotation of Mechanical Interface Coordinates Following the Flange Rotation
[2.2] Difference in robot motion when driven in mechanical interface coordinates and base coordinates

In Manual mode, if you choose Tool mode and TOOL0 (Flange) on the teach pendant, the robot will run in mechanical interface coordinates. If you choose X-Y mode, WORK0 (Base) will be automatically selected so that the robot will run in base coordinates.

For details about TOOL0, refer to [2.5] in this section.

Figures 4-7 and 4-8 show the differences in robot motion when the robot is driven in mechanical interface coordinates and base coordinates, by using the X, Y, and Z keys and by using the RX, RY, and RZ keys, respectively.

<table>
<thead>
<tr>
<th>X-Y mode (in base coordinates)</th>
<th>Tool mode (in mechanical interface coordinates)</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Figure 4-7" /></td>
<td><img src="image2" alt="Figure 4-7" /></td>
</tr>
</tbody>
</table>

Figure 4-7. Robot Motion Manually Driven by X, Y, and Z Keys
### X-Y mode (in base coordinates)

<table>
<thead>
<tr>
<th>RX±</th>
<th>RX±</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Diagram" /></td>
<td><img src="image2" alt="Diagram" /></td>
</tr>
</tbody>
</table>

- Ym (Orientation vector)
- Zm (Approach vector)
- Parallel to Xb axis

### Tool mode (in mechanical interface coordinates)

<table>
<thead>
<tr>
<th>RX±</th>
<th>RX±</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3" alt="Diagram" /></td>
<td><img src="image4" alt="Diagram" /></td>
</tr>
</tbody>
</table>

- Ym (Orientation vector)
- Zm (Approach vector)

### RY±

<table>
<thead>
<tr>
<th>RY±</th>
<th>RY±</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image5" alt="Diagram" /></td>
<td><img src="image6" alt="Diagram" /></td>
</tr>
</tbody>
</table>

- Ym (Orientation vector)
- Zm (Approach vector)
- Parallel to Yb axis

### RZ±

<table>
<thead>
<tr>
<th>RZ±</th>
<th>RZ±</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image7" alt="Diagram" /></td>
<td><img src="image8" alt="Diagram" /></td>
</tr>
</tbody>
</table>

- Ym (Orientation vector)
- Zm (Approach vector)
- Parallel to Zb axis

NOTE: The + rotation is for clockwise and the -direction for counterclockwise with respect to the vector.

---

**Figure 4-8. Robot Motion Manually Driven by RX, RY, and RZ Keys**
[2.3] Tool coordinates
Based on mechanical interface coordinates, you may define tool coordinates by specifying the origin offset distance from the mechanical interface coordinates and the yaw/pitch/roll angles.

You may define up to 63 tool coordinates (TOOL1 to TOOL63). TOOL0 is defined by system for mechanical interface coordinates.

The X, Y, and Z axes in tool coordinates are expressed by Xt, Yt, and Zt, respectively, as shown in Figure 4-9.

![Figure 4-9. Mechanical Interface Coordinates and Tool Coordinates](image-url)
[2.4] Creating tool coordinates

You may create tool coordinates by entering necessary data from the teach pendant or by writing TOOL command in your program.

Figure 4-10 shows the necessary data to be set for creating tool coordinates.

The offset distance and the rotation angles should be specified, based on the mechanical interface coordinates. The rotation order should be RZ, RY, and RX.

Figure 4-11. Example: Creating Tool Coordinates
[2.5] TOOL0 (Mechanical interface coordinates)

TOOL0 is reserved for mechanical interface coordinates defined by the system. You cannot define these coordinates.

If expressed in the same way as shown in Figure 4-10, TOOL0 may be defined as shown in Figure 4-12.

Default settings for TOOL1 to TOOL63 are the same as TOOL0.

**NOTE:** If you specify undefined tool coordinates, the robot will run in TOOL0 coordinates.

```
X = 0
Y = 0  Offset distance components (in mm)
Z = 0
RX = 0
RY = 0  Axis rotation angles (in degree)
RZ = 0
```

Figure 4-12. Definition Data for TOOL0
[2.6] Advantages of tool coordinates

This section describes what advantages you may have by using tool coordinates.

In manual operation or in teaching

When running the robot in tool coordinates, you can directly handle the end-effector mounted on the flange, making teaching easier.

Figure 4-13 shows the comparison of robot moving paths between in mechanical interface coordinates and in tool coordinates.

<table>
<thead>
<tr>
<th>In mechanical interface coordinates (TOOL0)</th>
<th>In tool coordinates (TOOLn where n is any of 1 to 63)</th>
</tr>
</thead>
<tbody>
<tr>
<td>If $X$ key is pressed:</td>
<td>If $Z$ key is pressed:</td>
</tr>
<tr>
<td><img src="image1" alt="Diagram" /></td>
<td><img src="image2" alt="Diagram" /></td>
</tr>
<tr>
<td>Enables you to move the end-effector to your object point in teaching.</td>
<td></td>
</tr>
<tr>
<td>If $RX+$ key is pressed:</td>
<td>If $RZ+$ is pressed:</td>
</tr>
<tr>
<td><img src="image3" alt="Diagram" /></td>
<td><img src="image4" alt="Diagram" /></td>
</tr>
<tr>
<td>Enables you to rotate the end-effector around the Zt axis.</td>
<td></td>
</tr>
</tbody>
</table>

Figure 4-13. Example of Manual Robot Running in Tool Coordinates
In programmed running

(1) Using APPROACH or DEPART command

APPROACH or DEPART command controls the robot movement on the Z axis of the tool coordinates. You can arbitrarily define the Z-axis orientation in the tool coordinates, allowing you to easily control the end-effector. Figure 4-14 shows an example of the tool coordinates definition.

For details about APPROACH and DEPART commands, refer to the PROGRAMMER’S MANUAL, Section 12.1, "Motion Control."

Figure 4-14. Example of APPROACH (DEPART) Execution in Tool Coordinates
(2) Using ROTATEH command

ROTATEH command controls rotation around the Z axis of the tool coordinates. You can arbitrarily define the Z-axis orientation in the tool coordinates, allowing you to easily control the end-effector. Figure 4-15 shows an example of the tool coordinates definition.

For details about ROTATEH command, refer to the PROGRAMMER'S MANUAL, Section 12.1, "Motion Control."

![Diagram showing tool coordinates and approach vector](image-url)

**Figure 4-15. Example of ROTATEH Execution in Tool Coordinates**
[2.7] Tool definition

Tool definition refers to defining arbitrary tool coordinates by specifying the components listed in Table 4-1.

The offset distances (X, Y, and Z) are values in mm from the origin of the mechanical interface coordinates. The rotation angles (RX, RY, and RZ) are values in degree around the X, Y, and Z axes of the tool coordinates.

**Table 4-1. Components Required for Tool Coordinates Definition**

<table>
<thead>
<tr>
<th>Components</th>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>Offset distance on the X axis of the mechanical interface coordinates</td>
<td>mm</td>
</tr>
<tr>
<td>Y</td>
<td>Offset distance on the Y axis of the mechanical interface coordinates</td>
<td>mm</td>
</tr>
<tr>
<td>Z</td>
<td>Offset distance on the Z axis of the mechanical interface coordinates</td>
<td>mm</td>
</tr>
<tr>
<td>RX</td>
<td>Rotation angle around the X axis of the tool coordinates</td>
<td>degree</td>
</tr>
<tr>
<td>RY</td>
<td>Rotation angle around the Y axis of the tool coordinates</td>
<td>degree</td>
</tr>
<tr>
<td>RZ</td>
<td>Rotation angle around the Z axis of the tool coordinates</td>
<td>degree</td>
</tr>
</tbody>
</table>
Operating procedure for tool definition

According to the procedure below, you may define arbitrary tool coordinates from the teach pendant. In this example, TOOL1 is defined. The same procedure would apply to TOOL2 through TOOL63.

With this procedure, you may also display or modify the current tool coordinates.

■ From the teach pendant

Step 1

On the top screen of the teach pendant, press [F2 arm].

The Current Robot Position window will appear as shown below.

Step 2

Press [F6 Aux.].

The Auxiliary Functions (Arm) window will appear as shown in Step 3.
Step 3  Press [F4 Tool].

The Define Tool Coordinates window will appear as shown below.

Step 4  Select the X area of TOOL1 by using the cursor keys or jog dial. The X area of TOOL1 will become highlighted.

Then press [F5 Change].

The numeric keypad will appear as shown in Step 5.
Step 5  In the numeric keypad shown below, enter the desired offset distance on the X axis with the numerical buttons.

Step 6  Check the new entry (offset distance on the X axis), and then press the OK button. The new entry will be entered into the X area of TOOL1 as shown below.
Step 7  Repeat Steps 4 through 6 to enter offset values to the Y, Z, RX, RY, and RZ areas of TOOL1.

Step 8  Press the OK button to finish the procedure of the tool coordinates definition.

Precautions when defining tool coordinates

(1) The CHANGETOOL statement will take effect only in a program that has gotten robot control by successful execution of the TAKEARM statement.
   Execution of the TAKEARM statement will initialize the tool coordinates definition to TOOL0 (default that is the same as settings for the mechanical interface coordinates).

(2) From the step where CHANGETOOL statement is written in the programs, the defined tool coordinates will take effect. The definition will remain valid up to the step immediately preceding the step where new CHANGETOOL statement is written.

(3) If no CHANGETOOL statement is written in a program, TOOL0 (mechanical interface coordinates) will apply.

(4) Once you select tool coordinates on the Select Operation Mode window called up by the M-MOD key on the teach pendant, it will take effect in Tool mode until it will be changed.

(5) If TOOL number used for running the robot to the object point and attitude differs from TOOL number previously used in writing the current point and attitude, the resulting position and attitude of the robot flange will become different from the previous ones.
   For example, when programming, if you have written the object point and attitude using the APPROACH command in TOOL0 and you insert TOOLn (n is any of 1 through 63) in any step preceding the APPROACH command, then executing the program brings the center of the robot flange to a different point and attitude than those defined in TOOL0, depending upon the contents of those different tool definitions.

(6) The tool coordinates definitions made in program execution and in manual running are saved in the same memory location.
   If you switch the operation mode from Auto mode to Manual mode, the tool coordinates definition made in programming will remain in effect.

(7) You may at anytime check the current TOOL number in the status bar on the teach pendant. Refer to p. 4-27.

For details about commands and tool definitions, refer to the PROGRAMMER'S MANUAL, Section 12.1, "Motion Control, APPROACH" and Section 9.5, "Tool Coordinates, TOOL." Also refer to Subsection 4.1.1, [2.7] Tool coordinates definition in this chapter.
Sample program for switching defined tool coordinates

Execution of CHANGETOOL 0 will cancel the current tool coordinates definition and restore the default TOOL0 (mechanical interface coordinates).

TAKEARM statement automatically involves CHANGETOOL 0.

Figure 4-16 shows a sample program that switches the defined tool coordinates from TOOL1 to TOOL2. End-effector 1 and End-effector 2 used in this program are illustrated in Figures 4-17 and 4-18, respectively. The positional relationship between the robot unit, End-effector 1, and End-effector 2 is assumed as shown in Figure 4-19. End-effector 1 is placed at P1 and End-effector 2 is at P2.

```
PROGRAM TOOL Sample

Tool 1, (0, -49.7, 79.2, 45, 0, 0)  'Defines TOOL1.
Tool 2, (0, -65, 37.5, 90, 0, 0)  'Defines TOOL2.

TakeArm  'Executes CHANGETOOL0 automatically.

'Setting End-effector 1
Approach P, P1, 200
Move L, P1
Set IO[104]  'Sets End-effector 1.
Depart P, 200
ChangeTool 1  'Switches to TOOL1.

'Releasing End-effector 1
ChangeTool 0  'Restores the default TOOL0.
Approach P, P1, 200
Move L, P1
Reset IO[104]  'Restores End-effector 1.
Depart P, 200

'Setting End-effector 2
Approach P, P2, 200
Move L, P2
Set IO[105]  'Sets End-effector 2.
Depart P, 200
ChangeTool 2  'Switches to TOOL2.

See Figure 4-19.

See Figure 4-20.

See Figure 4-21.
```

Figure 4-16. Switching the Defined Tool Coordinates
In the sample program shown in Figure 4-16, End-effector 1 and End-effector 2 are defined as TOOL1 and TOOL2, respectively.

Execution of TAKEARM automatically specifies TOOL0, so the robot will move to P1 (where End-effector 1 is placed) on the flange surface basis. As illustrated in Figure 4-19, End-effector 1 will be mounted by “Set IO [104].” “Depart P,200” will make the robot apart from P1 and CHANGETOOL 1 switches the tool coordinates from TOOL0 to TOOL1.
To replace End-effector 1 with End-effector 2, first release End-effector 1 as follows.
"CHANGETOOL 0" will switch the current tool coordinates from TOOL1 to TOOL0. As shown in Figure 4-20, the robot will move to P1 on the flange surface basis and release End-effector 1 at P1.

As shown in Figure 4-21, in mechanical interface coordinates, the robot will move to P2 where End-effector 2 will be mounted. "Depart P,200" will make the robot apart from P2. Then TOOL0 will be switched to TOOL2.
Displaying the current tool coordinates

The current tool coordinates are always shown in the status line of the screen on the teach pendant, independent of the operation modes (Auto, Manual, and Teach check modes).
[2.8] End-effector samples and their tool coordinates definitions

Figure 4-22 shows end-effector samples (chuck and other tools). Figure 4-23 shows their tool coordinate definitions.

Figure 4-22. End-effector Types and Their Coordinate Origins
Chapter 4  General Introduction to Coordinates and Figures

The chuck is mounted in parallel with the orientation vector of the flange.  

The chuck is mounted in parallel with the orientation vector of the flange.

The chuck is mounted at an angle of $45^\circ$ to the orientation vector of the flange.

The chuck is mounted at right angles to the orientation vector of the flange.

Figure 4-23. Tool Coordinates Definition Examples
4.1.2 Interference Check Area

You may define an interference check area(s) to prevent the robot arm from interfering with other devices or facilities.

The interference check area may be defined based on the base coordinates and work coordinates shown below.

Figure 4-24.
[1] Notes on interference check area

(1) The center of the interference check area is always based on the base coordinates (WORK0).

(2) Even if work coordinates are changed, the interference check area does not change.
[2] Setting the center, angle and range of area

Two procedures, 2-point teaching and direct value entry, are available for defining an interference check area(s).

Defining an interference check area by 2-point teaching [F4: AutoCalc]

You may define an interference check area(s) by teaching a work coordinates number (where you want to set an interference check area) and two points—vertexes farthest and nearest to the origin of the base coordinates.

Figure 4-26. Defining an Interference Check Area by 2-point Teaching
Defining an interference check area by direct value entry [F5: Change.]

You may define an interference check area by entering an area origin point (X, Y, and Z) relative to the base coordinates, the rotation angles (Rx, Ry, and Rz) around the X-axis, Y-axis, and Z-axis of the base coordinates, and the vector.

Figure 4-27. Defining an Interference Check Area by Direct Value Entry
[ 3 ]  Defining an interference check area by 2-point teaching

Step 1  On the top screen of the teach pendant, press [F2 Arm].


Step 3  In the Auxiliary Functions (Arm) window, press [F6 Area], and the Define Area window appears as shown below.

![Define Area Window](image)

Select the desired work coordinates using the cursor or jog dial, and then press [F4 AutoCalc].

Step 4  The Interference area automatic generation window appears as shown below.

![Interference Area Window](image)

To set the reference work coordinates number (to be used for defining an interference check area) and unassigned position variable names to be used for farthest and nearest vertexes, select "Work coordinate," "Interference area vertex 1," or "Interference area vertex 2," respectively, by using the cursor keys or jog dial and then press [F5 Change.].
Step 5

The numeric keypad will appear as shown below. Enter the desired number and two position variable names to the "Work coordinate," "Interference area vertex 1," and "Interference area vertex 2," respectively.

![Numeric Keypad Image]

**NOTE:** For base coordinates, enter 0 to the "Work coordinate."

Step 6

Call up the Position Variables assignment window ([F2 Arm]—[F4 Var.]—[F4 Position]) shown below.

In the Position Variables assignment window, assign the value of the robot arm position to be taught to each of the two position variables you have entered for vertexes farthest and nearest to the origin of the base coordinates in Step 5.

1. Place the cursor on the position variables set for 2-point teaching.
2. In Manual mode, move the tool end of the robot arm to the teaching point.
3. Press [F6 Get Pos.] in order to read in the current position of the tool end to the selected position variable.
4. Carry out (1) through (3) above for each of the farthest and nearest vertexes.

![Position Variables Window Image]

**NOTE**
- Define an interface check area after defining tool coordinates and work coordinates.
- Before teaching the nearest and farthest vertexes, set the Manual mode in the work coordinates of the reference work coordinated number.
Step 7
Press the Cancel button twice to return to the Interference area automatic generation window.

Step 8
At the bottom of the Interference area automatic generation window, the defined interference check area is displayed. If its values are satisfactory, press the OK button; if not, press the Cancel button.

NOTE: The center of the interference check area is always based on the base coordinates (Work0). Therefore, the calculated center of position is not the center of the specified work coordinates.

Step 9
If you press the OK button in Step 8, the defined interference check area values will be entered into the target interference check area.
Defining an interference check area by direct value entry

**Step 1**
On the top screen of the teach pendant, press [F2 Arm].

**Step 2**
Press [F6 Aux.] in the Current Robot Position window

**Step 3**
Press [F6 Area] in the Auxiliary Functions (Arm) window.
The Define Area window appears.
Select an interference check area to be defined using the cursor keys or jog dial.

**Step 4**
Press [F5 Change.] in the Define Area window.
The numeric keypad will appear as shown below.

![Numeric Keypad](image)

**Step 5**
Using the numeric keypad, enter the desired numerical values. After checking the entered values, press the OK button.
[5] Making the defined interference check areas active or inactive

You may define up to eight interference check areas. Out of those defined areas, you may select areas to be actually used according to the procedure given below.

If you make many defined interference check areas active, the sampling interval will become long, resulting in delayed detection. Only the necessary areas should be made active.

Operating procedure

From the teach pendant

Step 1 On the top screen of the teach pendant, press [F2 Arm].


Step 3 Press [F6 Area.] in the Auxiliary Functions (Arm) window, and the following window will appear.
Step 4  Call up the defined interference check area to be modified with the cursor key or jog dial as shown below.

Then press [F6 Activate], and the Interference Area Detection Setting window will appear as shown below.

Step 5  Select Inactive or Active (in this example, select Active), then press the OK button.

The screen will return to the Define Area window as shown on the next page.
Step 6

The new setting (in this example, AREA 3 Active) will appear and the color of the square indicator for that setting will change (in this example, the indicator for Area 3 turns green).

Meaning of the square indicator color

- Green: Active
- Black: Inactive

Press the OK button.
Turning the specified I/O signal(s) on or off at the detection of area interference

If you make the following signal setting, the controller will turn the specified signal(s) on when the origin of the tool coordinates enters interference check area(s) defined and made active.

**NOTE:** Be careful when specifying I/O signal numbers. If you set a wrong I/O signal(s), the wrong signal will come ON when the origin of the tool coordinates enters interference check areas.

**Operating procedure**

- **From the teach pendant**
  
  **Step 1**
  On the top screen of the teach pendant, press [F2 Arm].

  **Step 2**

  **Step 3**
  Press [F6 Area.] in the Auxiliary Functions (Arm) window.

  **Step 4**
  Call up the defined interference check area to be modified with the cursor key or jog dial.

  **Step 5**
  In the Define Area window, select an entry field in the 1st column of the bottom line.

  Then press [F5 Change.]. The numeric keypad will appear as shown on the next page.
Step 6  From the numeric keypad, enter the desired value, and then press the OK button.

Step 7  The new setting will appear in the selected entry field. Press the OK button.
[7] Specifying a position variable name to which the current position value will be assigned at the detection of area interference

You may specify the name of a position variable to which the current position value will be assigned the moment the origin of the tool coordinates enters the interference check area.

**NOTE:** Be careful when specifying a position variable name(s). If you specify a wrong variable name(s), the value of the specified position variable will be changed when the origin of the tool coordinates enters the interference check area.

**Operating procedure**

- **From the teach pendant**

  **Step 1**  
  On the top screen of the teach pendant, press [F2 Arm].

  **Step 2**  

  **Step 3**  
  Press [F6 Area.] in the Auxiliary Functions (Arm) window.

  **Step 4**  
  Call up the defined interference check area to be modified with the cursor key or jog dial.

  **Step 5**  
  In the Define Area window, select an entry field in the 3rd column of the bottom line.

  Then press [F5 Change.]. The numeric keypad will appear as shown on the next page.
Step 6  From the numeric keypad, enter the desired position variable name, and then press the OK button.

Step 7  The new setting will appear in the selected entry field. Press the OK button.
[ 8 ] Interpreting a detected area interference as an error

You may make the controller interpret an area interference as an error. The moment the origin of the tool coordinates enters the interference check area, the controller interprets it as an error and cuts the motor power off immediately to prevent the arm from proceeding into the area further.

**NOTE:** Once this type of error occurs, the motor power is cut off so that the origin of the tool coordinates remains in the area coordinates. If you attempt to turn the motor power on under this state, an error will occur again and the motor power will be cut off. You need to disable this area interference interpretation function, turn the motor power on, move the origin of the tool coordinates out of the interference check area by manual operation, and then enable this function again.

**Operating procedure**

**From the teach pendant**

**Step 1**
On the top screen of the teach pendant, press [F2 Arm].

**Step 2**

**Step 3**
Press [F6 Area.] in the Auxiliary Functions (Arm) window.

**Step 4**
Call up the defined interference check area to be modified with the cursor keys or jog dial.

**Step 5**
In the Define Area window, select an entry field in the rightmost column of the bottom line.

Then press [F5 Change.]. The error detection disable/enable screen will appear as shown on the next page.
Step 6  Select Enable (or Disable), and then press the OK button.

Step 7  The new setting will appear in the selected entry field. Press the OK button.
Defining an interference check area in WINCAPSII

Operating procedure

*From the operating panel*

**Step 1**
Start WINCAPSII at programmer level and run Arm Manager.

**Step 2**
On the Tool menu, select Options. Then select the Area tab.
Step 3  In the Area table, modify the interference check area related parameters.

X, Y, Z: Origin of the interference check area
RX, RY, and RZ: Rotation angles of the interference check area
DX, DY, and DZ: Vectors of the interference check area
IO: I/O signal numbers which will turn on if the tip of the end-effector enters the interference check area.
POS: Name of a position variable (global variable) to which the position value of the tip of the end-effector will be assigned when the tip of the end-effector enters the area.
ERR: Determines whether a detected area interference will be interpreted as an error. (0: Not interpreted as an error, 1: Interpreted as an error)
ENABLE: Determines whether an area interference will be detected or not. (0: Detected, 1: Not detected)

Step 4  After making necessary settings, press the OK button.

Step 5  Connect Arm Manager. On the File menu, select Transfer.

Step 6  Select <Area> and press Transmit>. Immediately after the transmission, the new parameters will take effect.
[10] Escaping from the interference check area
[Ver. 1.4 or later]

In Ver. 1.3 or earlier, the robot needs to be manually moved out of the interference check area whenever the robot enters any of prohibited areas 0 to 7. Entering prohibited areas will result in error (ERROR2490 to 2497).

In Ver. 1.4 or later, if you set [2: Enable +ManMv] in the interference check area setting, then you may move the robot out of the interference check area from the teach pendant or the operating panel in the cases marked with "Available" in the table below.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Motor ON</td>
</tr>
<tr>
<td>Manual</td>
<td>Available</td>
</tr>
<tr>
<td>Teach check</td>
<td>N/A</td>
</tr>
<tr>
<td>Internal auto</td>
<td>N/A</td>
</tr>
<tr>
<td>External auto</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Setting [2:Enable + ManMv]

**Step 1**
On the top screen of the teach pendant, press [F2 Arm].

**Step 2**

**Step 3**
In the Auxiliary Functions (Arm) window, press [F6 Area].

**Step 4**
Using the cursor keys or jog dial, select the area you want to change.
Step 5
Select the rightmost column of the table. Press [F5 Change].

Step 6
Select [2: Enable+ManMv] and press OK.

Step 7
You can change all the settings in the window for values you want. If you change any of them, confirm them and press OK.
**Escaping procedure**

**Step 1** Error will occur when the robot enters the interference area.

![Interference area diagram](image)

**Step 2** Switch off AutoEnable to change the operation mode to Manual.

![Mode switch diagram](image)

**Step 3** Move the robot outside the interference area.

![Position of the robot end](image)

**Note 1.** Move the robot in the direction away from the interference point, although robots can move to the position anywhere commanded.

**Note 2.** If the robot enters an area of interference again, Error 2490-2497 (Prohibited area 0 - 7) will reoccur.

**Note 3.** If the areas of interference overlap, as shown in the figure below, error occurs first upon the robot end starting within the area 1 enters in the area 2. However, you can avoid this by aid of the method given above.

![Overlap interference areas](image)
4.1.3 Figures of the Shoulder, Elbow, and Wrist

[1] Available 32 Figures

A 6-axis robot can take different figures for its shoulder, elbow, wrist, 6th axis, and 4th axis for a single point and attitude (X, Y, Z, RX, RY, and RZ) at the end of the end-effector.

Figures 4-28 through 4-32 show how the robot can take different figures for its shoulder, elbow, wrist, 6th axis, and 4th axis, respectively.

Combining these different figures allows the robot to take 32 different figures for its single position and attitude, as listed in Table 4-2.

Figure 4-33 shows examples of eight possible combinations of the shoulder, elbow, and wrist figures in the V*-D series robot.

<table>
<thead>
<tr>
<th>Value</th>
<th>4th-Axis Figure</th>
<th>6th-Axis Figure</th>
<th>Wrist Figure</th>
<th>Elbow Figure</th>
<th>Shoulder Figure</th>
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<tbody>
<tr>
<td>0</td>
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<td>ABOVE</td>
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</tr>
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<td>SINGLE</td>
<td>FLIP</td>
<td>BELOW</td>
<td>LEFTY</td>
</tr>
<tr>
<td>4</td>
<td>SINGLE 4</td>
<td>SINGLE</td>
<td>NONFLIP</td>
<td>ABOVE</td>
<td>RIGHTY</td>
</tr>
<tr>
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<td>NONFLIP</td>
<td>ABOVE</td>
<td>LEFTY</td>
</tr>
<tr>
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<td>BELOW</td>
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</tr>
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<td>ABOVE</td>
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</tr>
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</tr>
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<tr>
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<td>DOUBLE</td>
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<td>BELOW</td>
<td>LEFTY</td>
</tr>
</tbody>
</table>
(1) Shoulder figure
A shoulder figure is defined by a set of the values of the 1st-, 2nd-, and 3rd-axis components.
The robot can take two different shoulder figures--Left-handed (LEFTY) and Right-handed (RIGHTY).

(2) Elbow figure
An elbow figure is defined by a set of the values of the 2nd- and 3rd-axis components.
The robot can take two different elbow figures--Over-handed (ABOVE) and Under-handed (BELOW).
(3) Wrist figure

A wrist figure is defined by a set of the values of the 4th- and 5th-axis components. The robot can take two different shoulder figures—Normal (NONFLIP) and Reversed (FLIP). The NONFLIP figure refers to a figure of the robot whose 4th axis is turned by 180 degrees without changing the wrist figure.

![Figure 4-30. Wrist Figure](image)

(4) 6th-axis figure

A 6th-axis figure is defined by the value of the 6th-axis component. The robot can take two different 6th-axis figures—SINGLE and DOUBLE. If the 6th axis rotates by $-180^\circ < \theta_6 \leq 180^\circ$ in mechanical interface coordinates, the figure is SINGLE; if it rotates by $180^\circ < \theta_6 \leq 360^\circ$ or $-360^\circ < \theta_6 \leq -180^\circ$, the figure is DOUBLE.

The robot takes quite different figures when $\theta_6$ is $180^\circ$ or $181^\circ$. Take special care when changing any position data for the 6th-axis figure. For example, supposing that you want to change the 6th-axis figure at $\theta_6=181^\circ$, the robot will take the 6th-axis figure at $\theta_6=-179^\circ$ if you make no figure modification.

![Figure 4-31. 6th-Axis Figure](image)
(5) 4th-axis figure

The 4th-axis figure is defined by the value of the 4th-axis component.

The robot can take two different 4th-axis figures—SINGLE 4 and DOUBLE 4. If the 4th axis rotates by $-180^\circ < \theta_4 \leq 180^\circ$ in mechanical interface coordinates, the figure is SINGLE 4; if it rotates by $180^\circ < \theta_4 \leq 185^\circ$ or $-185^\circ < \theta_4 \leq -180^\circ$, the figure is DOUBLE 4.

The robot takes quite different figures when $\theta_4$ is $180^\circ$ or $181^\circ$. Take special care when changing any position data for the 6th-axis figure. For example, supposing that you want to change the 4th-axis figure at $\theta_4 = 181^\circ$, the robot will take the 4th-axis figure at $\theta_4 = -179^\circ$ if you make no figure modification.

![4th-axis Figure](image-url)
<table>
<thead>
<tr>
<th>Figure-1</th>
<th>Figure-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEFTY, ABOVE, and NONFLIP</td>
<td>LEFTY, ABOVE, and FLIP</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Figure-3</th>
<th>Figure-4</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEFTY, BELOW, and NONFLIP</td>
<td>LEFTY, BELOW, and FLIP</td>
</tr>
</tbody>
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Figure 4-33. Possible Combinations of Robot Shoulder, Elbow, and Wrist Figures
\textbf{CAUTION:} When carrying out a command with CP control, if the robot figures at the start point differ from those saved in programming or teaching, be sure to check beforehand that no part of the robot will interfere with the surrounding equipment or facilities. This is because each joint of the robot will take currently suitable motions depending upon the current figures to make the tip of the end-effector reach an object point even if the robot position and attitude at the start point are the same as those in programming or teaching. However, the path of the end-effector is virtually the same although the figures may be different.

\textbf{CAUTION:} All of the 32 different figures may not be applicable to every position and attitude of the robot due to the robot structure. In some cases, only the LEFTY/ABOVE/NONFLIP figure may be applicable depending upon point and attitude. (In almost of all practical cases, the robot may not take all of the logically possible figures, but only two figures are possible--LEFTY/ABOVE/NONFLIP and LEFTY/ABOVE/FLIP. For the 4th-axis figure, the robot will take SINGLE 4.)
[ 2 ] Boundaries of Robot Figures

This section describes the boundary of each of the robot shoulder, elbow, wrist, and 6th-axis figures.

When judging the boundaries of the robot shoulder, elbow, and wrist, the system uses intersection point Pw of the two rotary axes of the 5th and 6th axes, as illustrated in Figure 4-34.

A boundary point in figures is called a singular point.

Any path defined by commands with CP control (e.g., MOVE, APPROACH, and DEPART) should not run through the vicinity of the singular point. Refer to the PROGRAMMER’S MANUAL, Section 3.3, "Interpolation Control." If the path runs through the vicinity of the singular point, the robot will issue ERROR6080s (Overspeed) or ERROR6070s (Over software motion limit) and then stop.
(1) LEFTY/RIGHTY (Shoulder figure)

The rotary axis of the 1st axis is defined as the boundary between LEFTY and RIGHTY. When viewed from the normal line on the side of the arm link, if point Pw exists in the left-hand side of the rotary axis of the 1st axis, the figure is LEFTY; if point Pw exists in the right-hand side, it is RIGHTY. In Figure 4-35, the boundary is drawn with alternate long and short dash lines.

**NOTE:** If point Pw exists on the rotary axis of the 1st axis, that is, on the boundary between LEFTY and RIGHTY, then it is called a singular point.

![Figure 4-35. Boundary between LEFTY and RIGHTY](image)
(2) ABOVE/BELOW (Elbow figure)

The centerline of the arm link (connecting the shoulder with elbow) is defined as the boundary between ABOVE and BELOW.

If point Pw exists in the + side of the centerline, the figure is ABOVE; if point Pw exists in the -side, it is BELOW. In Figures 4-36 and 4-37, the boundary is drawn with alternate long and short dash lines.

![Diagram of Arm with Centerline](Image1)

**Figure 4-36. Boundary between ABOVE and BELOW for LEFTY**

![Diagram of Arm with Centerline](Image2)

**Figure 4-37. Boundary between ABOVE and BELOW for RIGHTY**
(3) FLIP/NONFLIP (Wrist figure)

The rotary axis of the 4th axis is defined as the boundary between FLIP and NONFLIP. If the normal line on the flange surface tilts up the rotary axis of the 4th axis, the figure is FLIP; if it tilts down the rotary axis, it is NONFLIP. In Figures 4-38 and 4-39, the boundary is drawn with alternate long and short dash lines.

Figure 4-38. Boundary between FLIP and NONFLIP for LEFTY

Figure 4-39. Boundary between FLIP and NONFLIP for RIGHTY
(4) SINGLE/DOUBLE (6th-axis figure)

If the rotation angle ($\theta_6$) of the 6th axis is within the range of $-180^\circ < \theta_6 \leq 180^\circ$ around the Z axis in mechanical interface coordinates, the figure is SINGLE; if it is within the range of $180^\circ < \theta_6 \leq 360^\circ$ or $-360^\circ < \theta_6 \leq -180^\circ$, the figure is DOUBLE. Boundaries exist at $-180^\circ$ and $+180^\circ$.

Figure 4-40. Boundary between SINGLE and DOUBLE
This chapter describes the variety of commands assigned to the function keys of the teach pendant. The first section illustrates the command menu tree. The following sections provide a detailed explanation of those commands, together with the access routes.

**NOTE 1:** Avoid letting the teach pendant, operating panel, or mini pendant undergo any strong shocks, impacts, or vibrations.

**NOTE 2:** Touch the teach pendant, operating panel, or mini pendant with your fingers only, never with the tip of a pen or any pointed object. Otherwise, the LCD may be broken.
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5.1 Commands Menu

Using the keys, buttons, and switches on the teach pendant allows you to call up a variety of screens on the LCD, each of which has its exclusive commands menu. From the menu, you may choose commands by pressing the function keys.

5.1.1 Top Screen

The top screen shown below appears first when you turn the robot controller on. Starting with this screen, you may access the function menu commands.
5.1.2 Menu Tree

Top Screen

[F1 Program] in Manual Mode

[F1] NewProg.
[F2] Delete
[F3] Copy

(The following menus (except F12) have submenus F1 to F7. Submenus marked with * are only for [F4 Pos.], [F5 Joint.], and [F10 Tran].)

[F1] Integer.
[F2] Float.
[F4] Pos.
[F7] Tran.
[F8] Get Pos.*
[F9] String.
[F10] Copy Var
[F12 VarsUsed]


[F1] NewLine.
[F2] Del Line
[F3] CopyLine
[F4] Paste
[F5] EditLine
[F6] Save.
[F7] SyntaxErr
[F8] BP
[F9] Set PRJ.
[F10] Options.
[F11] BPSetting
[F12] Continue
[F13] SS Mode.
[F15] LoadMode
[F16] Compile


[F1] User.
[F4] Category
[F5] Recent.
[F6] Clr All

[F7] New PRJ

[F10] SyntaxErr

[F12] Config.

Next page
[F2  Arm]

[F3  OpeMode]
- [F1  Back]
- [F2  Next]
- [F5  Work No.]
- [F6  Tool No.]

(The following menus (except F12) have submenus F1 to F7.
Submenus marked with * are only for [F4 Position.], [F5 Joint.],
and [F10 Tran.].)

[F4  Var.]
- [F1  Integer.]
- [F2  Float.]
- [F3  Vector.]
- [F4  Position.]
- [F5  Joint.]
- [F8  Double.]
- [F10 Tran.]
- [F11 String.]
- [F12 VarsUsed]

[F5  Speed.]
- [F1  1%]
- [F2  10%]
- [F3  50%]
- [F4  100%]
- [F5  Change.]

(F4 to F7 have submenus F1 to F6.
Submenu marked with * is only for [F5 Work.] and [F6 Area.].
Submenu marked with ** is only for [F6 Area.].)

[F6  Aux.]
- [F4  Tool.]
- [F5  Work.]
- [F6  Area.]
- [F7  Config.]
- [F10 Overload]

[F11 CtrlLog.]
- [F1  StrtLog]
- [F2  StopLog]
- [F6  CtrlLog]
- [F7  SaveLog]
- [F12 DelLog]

[F7  Show P]
- [F8  Show J]
- [F9  Show T]
Chapter 5 Commands Assigned to Function Keys of the Teach Pendant

(F1 and F12 have submenus F1 to F5 except F4)
Chapter 5  Commands Assigned to Function Keys of the Teach Pendant

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[F2 Log.]  
[F1 Load!]  
[F1 Back]  
[F2 Next]  
[F3 Jump To]  
[F3 FD.]  
[F1 Read.]  
[F2 Write]  
[F5 Format.]  
[F4 CancAll]  
[F5 Sel/Canc]  
[F6 SelctAll]  
[F12 Aux.]  
[F11 CtrlLog.]  
[F4 Memoinfo]  
[F5 Set Com.]  
[F1 Permit.]  
[F2 SerialIF]  
[F3 Modem]  
[F4 Default]  
[F5 Change.]  
[F4 Address]  
[F5 Change.]  
[F5 Gateway]  
[F7 Hispeedf]  
[F5 Change.]  
[F6 Maint.]  
[F1 Total h]  
[F4 Cumu. o]  
[F5 Cumu. r]  
[F2 Version]  
[F3 Date.]  
[F4 Change]  
[F4 Battery]  
[F5 Change]  
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[F3 Protect]  
[F6 Language]  
[F8 Extision]  
[F4 Remove]  
[F11 ROBYTYPE]  
[F5 Input ID]  
[F12 Update.]  
[F8 Save!]  
[F9 SaveFile]  
[F10 Int/Ext]  
[F11 Unplug]
5.2 Displaying the Program List Window

Access: [F1 Program]

The [F1 Program] command on the top screen has different three menu hierarchies for Manual, Teach Check, and Auto modes as shown in Subsection 5.1.2.

Subsections 5.2.1, 5.2.2, and 5.2.3 describe the function of the [F1 Program] command in Manual, Teach Check, and Auto modes, respectively.
Chapter 5  Commands Assigned to Function Keys of the Teach Pendant

5.2.1 Showing the Program List Window in Manual Mode

Pressing [F1 Program] on the top screen in Manual mode will display the Program List window as shown below.

The Program List window has the following items:

- **[Program Name]** Lists program names declared by the PROGRAM statement.
- **[Name]** Shows the source file name of the listed program. The [Name] and [Program Name] are not always coincident with each other.
- **[Cmpild]** Shows whether the listed file has been compiled into run-time format. PAC files are usually compiled.
- **[Source]** Shows whether the source file of the listed program has been loaded to the robot controller. If loaded, it is displayed with "Yes."
- **[Modifd]** Shows whether the listed program is modified after compiled into run-time format. If the program only is uploaded from WINCAPSII to the robot controller, for example, "Yes" is displayed in this column.
- **[Use]** Shows whether the listed program is to be compiled. If you press [F12 Config.] and make the compile flag active, this column will display "Enable" and the program will be compiled in compilation.

The hierarchy of the [F1 Program] menu in Manual mode is given on the next page.
Creating a new program in Manual mode

Access: [F1 Program]—[F1 NewProg.]

Creates a new program.

(1) Press [F1 NewProg.] in the Program List window, and the system message dialog box will appear as shown below.

(2) Press the OK button in the system message dialog box to proceed, and the Enter Program Name window will appear as shown below.
(3) Enter the desired program name and then press the OK button. A new program edit window will appear as shown below where you may create a new program.
Deleting a program in Manual mode

Access: [F1 Program]—[F2 Delete]

Deletes an existing program selected in the Program List window.

(1) In the Program List window, select the program to be deleted.

(2) Press [F2 Delete], and the system message dialog box will appear as shown below.

(3) Press the OK button in the above system message dialog box to proceed. The system will delete the selected program and display the system message "Do you want to compile?".

(4) Press the OK button.

If you press the Cancel button, the program deletion will be cancelled and the screen will return to the Program List window.
Copying a program in Manual mode

Access: [F1 Program]—[F3 Copy]

Copies an existing program selected in the Program List window.

1) In the Program List window, select the program to be copied.

2) Press [F3 Copy], and the system message dialog box will appear as shown below.

3) Press the OK button to copy the selected program file. The system will automatically name the new file.
Displaying and modifying variable values in Manual mode

Access: [F1 Program]—[F4 Var.]

Displays values assigned to various types of variables, the number of variables used, and/or modifies them.

(1) Press [F4 Var.] in the Program List window, and the Select Variable Type window will appear as shown below.

(2) Select the desired variable type or the number of variables used. The corresponding window will display as described on pages 5-15 through 5-25.
Displaying and modifying integer variable values

Access: [F1 Program]—[F4 Var.]—[F1 Integer.]

Displays values assigned to integer variables and/or modifies them.

Pressing [F1 Integer.] will display the Integer Variables window as shown below.

<table>
<thead>
<tr>
<th>Function keys available</th>
</tr>
</thead>
<tbody>
<tr>
<td>[F1 Back]</td>
</tr>
<tr>
<td>Displays the previous page of the variables list.</td>
</tr>
<tr>
<td>[F2 Next]</td>
</tr>
<tr>
<td>Displays the next page of the variables list.</td>
</tr>
<tr>
<td>[F3 Jump To]</td>
</tr>
<tr>
<td>Displays the Jump To Variable Number window where you may type a variable name you want</td>
</tr>
<tr>
<td>to see with the numerical keys and press OK. Doing so will display the target variable</td>
</tr>
<tr>
<td>name.</td>
</tr>
<tr>
<td>[F5 Change.]</td>
</tr>
<tr>
<td>Displays the numeric keypad where you may enter a variable value you want to assign</td>
</tr>
<tr>
<td>with the numerical keys and then press OK. Doing so will assign the newly entered value</td>
</tr>
<tr>
<td>to the variable.</td>
</tr>
<tr>
<td>[F7 Copy Var]</td>
</tr>
<tr>
<td>Displays the Variable Number of Copy Destination window where you may enter a variable</td>
</tr>
<tr>
<td>name to which you want to copy a variable value and then press OK. Doing so will display</td>
</tr>
<tr>
<td>the system message &quot;Are you sure you want to copy the variable X into the Y.&quot; Selecting</td>
</tr>
<tr>
<td>Yes will copy the currently selected variable value to the specified variable name.</td>
</tr>
</tbody>
</table>
Displaying and modifying floating-point variable values
Access: [F1 Program]—[F4 Var.]—[F2 Float.]

Displays values assigned to floating-point variables and/or modifies them.

Pressing [F2 Float.] will display the Floating-point Variables window as shown below.

<table>
<thead>
<tr>
<th>Function keys available</th>
</tr>
</thead>
<tbody>
<tr>
<td>[F1 Back] Displays the previous page of the variables list.</td>
</tr>
<tr>
<td>[F2 Next] Displays the next page of the variables list.</td>
</tr>
<tr>
<td>[F3 Jump To] Displays the Jump To Variable Number window where you may type a variable name you want to see with the numerical keys and press OK. Doing so will display the target variable name.</td>
</tr>
<tr>
<td>[F5 Change.] Displays the numeric keypad where you may enter a variable value you want to assign with the numerical keys and then press OK. Doing so will assign the newly entered value to the variable.</td>
</tr>
<tr>
<td>[F7 Copy Var] Displays the Variable Number of Copy Destination window where you may enter a variable name to which you want to copy a variable value and then press OK. Doing so will display the system message “Are you sure you want to copy the variable X into the Y.” Selecting Yes will copy the currently selected variable value to the specified variable name.</td>
</tr>
</tbody>
</table>
Displaying and modifying vector variable values
Access: [F1 Program]—[F4 Var.]—[F3 Vector.]

Displays values assigned to vector variables and/or modifies them.

Pressing [F3 Vector.] will display the Vector Variables window as shown below.

Function keys available

<table>
<thead>
<tr>
<th>Key</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>[F1 Back]</td>
<td>Displays the previous page of the variables list.</td>
</tr>
<tr>
<td>[F2 Next]</td>
<td>Displays the next page of the variables list.</td>
</tr>
<tr>
<td>[F3 Jump To]</td>
<td>Displays the Jump To Variable Number window where you may type a variable name you want to see with the numerical keys and press OK. Doing so will display the target variable name.</td>
</tr>
<tr>
<td>[F5 Change.]</td>
<td>Displays the numeric keypad where you may enter a variable value you want to assign with the numerical keys and then press OK. Doing so will assign the newly entered value to the variable.</td>
</tr>
<tr>
<td>[F7 Copy Var]</td>
<td>Displays the Variable Number of Copy Destination window where you may enter a variable name to which you want to copy a variable value and then press OK. Doing so will display the system message &quot;Are you sure you want to copy the variable X into the Y.&quot; Selecting Yes will copy the currently selected variable value to the specified variable name.</td>
</tr>
</tbody>
</table>
Chapter 5  Commands Assigned to Function Keys of the Teach Pendant

**Displaying and modifying position variable values**

Access: [F1 Program]—[F4 Var.]—[F4 Pos.]

Displays values assigned to position variables and/or modifies them.

Pressing [F4 Pos.] will display the Position Variables window as shown below.

<table>
<thead>
<tr>
<th>Function keys available</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>[F1 Back]</td>
<td>Displays the previous page of the variables list.</td>
</tr>
<tr>
<td>[F2 Next]</td>
<td>Displays the next page of the variables list.</td>
</tr>
<tr>
<td>[F3 Jump To]</td>
<td>Displays the Jump To Variable Number window where you may type a variable name you want to see with the numerical keys and press OK. Doing so will display the target variable name.</td>
</tr>
<tr>
<td>[F4 Move]</td>
<td>Displays the system message &quot;Will move to the position specified by the variable xx.&quot; While holding down OK, the robot arm will move to the specified position. You may specify PTP or CP movement.</td>
</tr>
<tr>
<td>[F5 Change.]</td>
<td>Displays the numeric keypad where you may enter a variable value you want to assign with the numerical keys and then press OK. Doing so will assign the newly entered value to the variable.</td>
</tr>
<tr>
<td>[F6 Get Pos.]</td>
<td>Displays the system message &quot;Are you sure you want to read the current position into the variable xx?&quot; Pressing OK will enter the current position values into the selected variable name.</td>
</tr>
<tr>
<td>[F7 Copy Var]</td>
<td>Displays the Variable Number of Copy Destination window where you may enter a variable name to which you want to copy a variable value and then press OK. Doing so will display the system message &quot;Are you sure you want to copy the variable X into the Y.&quot; Selecting Yes will copy the currently selected variable value to the specified variable name.</td>
</tr>
</tbody>
</table>
Displaying and modifying joint variable values

Access: [F1 Program]—[F4 Var.]—[F5 Joint.]

Displays values assigned to joint variables and/or modifies them.

Pressing [F5 Joint.] will display the Joint Variables window as shown below.

![Joint Variables Window](image)

<table>
<thead>
<tr>
<th>Function keys available</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>[F1 Back]</td>
<td>Displays the previous page of the variables list.</td>
</tr>
<tr>
<td>[F2 Next]</td>
<td>Displays the next page of the variables list.</td>
</tr>
<tr>
<td>[F3 Jump To]</td>
<td>Displays the Jump To Variable Number window where you may type a variable name you want to see with the numerical keys and press OK. Doing so will display the target variable name.</td>
</tr>
<tr>
<td>[F4 Move]</td>
<td>Displays the system message &quot;Will move to the position specified by the variable xx.&quot; While holding down OK, the robot arm will move to the specified position. You may specify PTP or CP movement.</td>
</tr>
<tr>
<td>[F5 Change.]</td>
<td>Displays the numeric keypad where you may enter a variable value you want to assign with the numerical keys and then press OK. Doing so will assign the newly entered value to the variable.</td>
</tr>
<tr>
<td>[F6 Get Pos.]</td>
<td>Displays the system message &quot;Are you sure you want to read the current position into the variable xx?&quot; Pressing OK will enter the current position values into the selected variable name.</td>
</tr>
<tr>
<td>[F7 Copy Var]</td>
<td>Displays the Variable Number of Copy Destination window where you may enter a variable name to which you want to copy a variable value and then press OK. Doing so will display the system message &quot;Are you sure you want to copy the variable X into the Y.&quot; Selecting Yes will copy the currently selected variable value to the specified variable name.</td>
</tr>
</tbody>
</table>
**Displaying and modifying double-precision variable values**

Access: [F1 Program]—[F4 Var.]—[F8 Double.]

Displays values assigned to double-precision variables and/or modifies them.

Pressing [F8 Double.] will display the Double-precision Variables window as shown below.

<table>
<thead>
<tr>
<th>Function keys available</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>[F1 Back]</td>
<td>Displays the previous page of the variables list.</td>
</tr>
<tr>
<td>[F2 Next]</td>
<td>Displays the next page of the variables list.</td>
</tr>
<tr>
<td>[F3 Jump To]</td>
<td>Displays the Jump To Variable Number window where you may type a variable name you want to see with the numerical keys and press OK. Doing so will display the target variable name.</td>
</tr>
<tr>
<td>[F5 Change.]</td>
<td>Displays the numeric keypad where you may enter a variable value you want to assign with the numerical keys and then press OK. Doing so will assign the newly entered value to the variable.</td>
</tr>
<tr>
<td>[F7 Copy Var]</td>
<td>Displays the Variable Number of Copy Destination window where you may enter a variable name to which you want to copy a variable value and then press OK. Doing so will display the system message &quot;Are you sure you want to copy the variable X into the Y.&quot; Selecting Yes will copy the currently selected variable value to the specified variable name.</td>
</tr>
</tbody>
</table>
**Displaying and modifying variable values in homogeneous transform matrix**

**Access:** [F1 Program]—[F4 Var.]—[F10 Tran.]  
Displays values assigned to variables in homogeneous transform matrix and/or modifies them.

Pressing [F10 Tran.] will display the Tran Variables window as shown below.

<table>
<thead>
<tr>
<th>Function keys available</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>[F1 Back]</td>
<td>Displays the previous page of the variables list.</td>
</tr>
<tr>
<td>[F2 Next]</td>
<td>Displays the next page of the variables list.</td>
</tr>
<tr>
<td>[F3 Jump To]</td>
<td>Displays the Jump To Variable Number window where you may type a variable name you want to see with the numerical keys and press OK. Doing so will display the target variable name.</td>
</tr>
<tr>
<td>[F4 Move]</td>
<td>Displays the system message &quot;Will move to the position specified by the variable xx.&quot; While holding down OK, the robot arm will move to the specified position. You may specify PTP or CP movement.</td>
</tr>
<tr>
<td>[F5 Change.]</td>
<td>Displays the numeric keypad where you may enter a variable value you want to assign with the numerical keys and then press OK. Doing so will assign the newly entered value to the variable.</td>
</tr>
<tr>
<td>[F6 Get Pos.]</td>
<td>Displays the system message &quot;Are you sure you want to read the current position into the T variable XX?&quot; Pressing OK will enter the current position values into the selected variable name.</td>
</tr>
<tr>
<td>[F7 Copy Var]</td>
<td>Displays the Variable Number of Copy Destination window where you may enter a variable name to which you want to copy a variable value and then press OK. Doing so will display the system message &quot;Are you sure you want to copy the variable X into the Y.&quot; Selecting Yes will copy the currently selected variable value to the specified variable name.</td>
</tr>
</tbody>
</table>
Displaying and modifying string variable values

Access: [F1 Program]—[F4 Var.]—[F11 String.]

Displays values assigned to string variables and/or modifies them.

Pressing [F11 String.] will display the String Variables window as shown below.

<table>
<thead>
<tr>
<th>Function keys available</th>
</tr>
</thead>
<tbody>
<tr>
<td>[F1 Back] Displays the previous page of the variables list.</td>
</tr>
<tr>
<td>[F2 Next] Displays the next page of the variables list.</td>
</tr>
<tr>
<td>[F3 Jump To] Displays the Jump To Variable Number window where you may type a variable name you want to see with the numerical keys and press OK. Doing so will display the target variable name.</td>
</tr>
<tr>
<td>[F5 Change.] Displays the Enter Character String window (see the next page) where you may enter a character string you want to assign with the letter buttons and then press OK. Doing so will assign the newly entered string to the variable.</td>
</tr>
<tr>
<td>[F7 Copy Var] Displays the Variable Number of Copy Destination window where you may enter a variable name to which you want to copy a variable value and then press OK. Doing so will display the system message “Are you sure you want to copy the variable X into the Y.” Selecting Yes will copy the currently selected variable value to the specified variable name.</td>
</tr>
</tbody>
</table>
Pressing [F5 Change.] on the String Variables window will call up the Enter Character String window as shown below.

Use the letter buttons to enter a character string you want to assign to the currently selected string variable. Then press the OK button to fix the new string.
Chapter 5  Commands Assigned to Function Keys of the Teach Pendant

Displaying and modifying the number of variables used
Access: [F1 Program]—[F4 Var.]—[F12 VarsUsed.]

Displays the number of variables used for each type of variables and/or modifies them.

(1) Press [F12 VarsUsed.] to display the following window.

(2) Select the item whose number of variables you want to change, then press [F5 Change.]. The numeric keypad will appear.
(3) Enter the desired value and press the OK button. The newly entered value will appear in the selected item box.

![Image](image.png)

(4) Check the entered value and press the OK button.

The following system message will appear. Press the OK button, and compiling will start.

Upon successful completion of compiling and loading, the number of variables you have entered becomes effective.

![Image](image.png)

If you press the Cancel button in the above window, the entered value does not become effective until compiling and loading takes place next time.

**NOTE:** Regarding the number of global variables

In this controller, the number of variables used can be modified only when the execution program is loaded.

When the number of variables used is modified, depending on the compiler, first a file indicating the modification of the number of variables used is created and then the program is loaded. The new setting becomes effective from when loading is completed.
Editing a program in Manual Mode

Access: [F1 Program]—[F5 Edit.]

Edits a program you select in the Program List window.

(1) Select the program to be edited.

(2) Press [F5 Edit.], and the program edit window of the selected program will appear as shown below.

(3) Select the desired edit type (NewLine, Del Line, CopyLine, Paste, EditLine, Save., or SyntxErr) by pressing the corresponding function key. The corresponding window will display as described on pages 5-27 through 5-33.
**Inserting a new program line in Manual mode**

**Access:** [F1 Program]—[F5 Edit.]—[F1 NewLine.]

Insert a new program line immediately after the line selected in the Program List window.

1. Select the program line after which you want to insert a new program line.
2. Press [F1 NewLine.] in the program edit window, and the coding window will appear as shown below.

   ![Coding Window](image)

   - F1 F2 F3 F4 F5 F6

3. Enter a line of code by using the letter buttons.
4. Press the OK button to enter the new line into the program.
5. Press [F6 Save.].

   The system message “Do you want to save/compile this program?” appears.
6. Press the OK button to compile the edited program.

   If you press the Cancel button, the system message will disappear and the coding window with the new entry will remain displayed. In this state, if you press the OK key, the system will discard the new entry and return to the Program List window. If you press the Cancel key, the following system message appears: “This program has been modified. Are you sure you want to discard this modified program? OK: Discard this program, Cancel: Continue editing, F6: Save the modification”

### Function keys available

<table>
<thead>
<tr>
<th>Function key</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>[F1 User.]</td>
<td>Shortcut to the favorite command window (that can be called up by choosing the “Favorites” on the Category Selection window).</td>
</tr>
<tr>
<td>[F2 Flow.]</td>
<td>Shortcut to the flow control statement screen (that can be called up by choosing the “Flow control statement” on the Category Selection window).</td>
</tr>
<tr>
<td>[F3 Robot.]</td>
<td>Shortcut to the robot control statement screen (that can be called up by choosing the “Robot control statement” on the Category Selection window).</td>
</tr>
<tr>
<td>[F4 Category]</td>
<td>Displays the Category Selection window.</td>
</tr>
<tr>
<td>[F5 Recent.]</td>
<td>Shortcut to a list of commands in the most recently selected category.</td>
</tr>
<tr>
<td>[F6 ClrAll]</td>
<td>Clears all characters being entered.</td>
</tr>
</tbody>
</table>
Deleting a program line in Manual mode
Access: [F1 Program]—[F5 Edit.]—[F2 Del Line]

Deletes the program line you select in the program edit window.

1. Select the program line that you want to delete.
2. Press [F2 Del Line] in the program edit window, and the selected line will be erased.
3. Press [F6 Save.].
   The system message "Do you want to save and compile?" appears.
4. Select whether to compile or not, then press the OK button.
   If you press the Cancel button, the system message will disappear and the program edit window after the new entry will remain displayed. In this state, if you press the OK key, the system will discard the new entry and return to the Program List window. If you press the Cancel key, the following system message appears: "This program has been modified. Are you sure you want to discard this modified program? OK: Discard this program, Cancel: Continue editing, F6: Save the modification"
Copying a program line in Manual mode

Access: [F1 Program]—[F5 Edit.]—[F3 CopyLine]

Copies the program line selected in the program edit window (shown below), into the memory. The copied data will be used when [F4 Paste] command will execute.
**Pasting a program line in Manual mode**  
**Access:** [F1 Program]—[F5 Edit.]—[F4 Paste]

Pastes the program line (that you copied with [F3 CopyLine] into the memory) immediately following a line you select in the program edit window.

1. In the program edit window as shown below, select the program line after which you want to paste a copied line.
2. Press [F4 Paste].
3. Press [F6 Save.].
   The system message "Do you want to save/compile this program?" appears.
4. Press the OK button to compile the edited program.
   If you press the Cancel button, the system message will disappear and the program edit window with the new entry will remain displayed. In this state, if you press the OK key, the system will discard the new entry and return to the Program List window. If you press the Cancel key, the following system message appears: "This program has been modified. Are you sure you want to discard this modified program? OK: Discard this program, Cancel: Continue editing, F6: Save the modification"
Editing a line of program code in Manual mode
Access: [F1 Program]—[F5 Edit.]—[F5 EditLine]

Edits the line of program code selected in the program edit window.

(1) Select the program line that you want to edit.
(2) Press [F5 EditLine] in the program edit window, and the coding window will appear as shown below.

(3) Edit a line of code by using the letter buttons.
(4) Press the OK button to enter the edited line into the program.
(5) Press [F6 Save.].

The system message "Do you want to save/compile this program?" appears.
(6) Press the OK button to compile the edited program.

If you press the Cancel button, the system message will disappear and the program edit window with the new entry will remain displayed. In this state, if you press the OK key, the system will discard the new entry and return to the Program List window. If you press the Cancel key, the following system message appears: "This program has been modified. Are you sure you want to discard this modified program? OK: Discard this program, Cancel: Continue editing, F6: Save the modification"

<table>
<thead>
<tr>
<th>Function keys available</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>[F1 User.]</td>
<td>Shortcut to the favorite command window (that can be called up by choosing the &quot;Favorites&quot; on the Category Selection window).</td>
</tr>
<tr>
<td>[F2 Flow.]</td>
<td>Shortcut to the flow control statement screen (that can be called up by choosing the &quot;Flow control statement&quot; on the Category Selection window).</td>
</tr>
<tr>
<td>[F3 Robot.]</td>
<td>Shortcut to the robot control statement screen (that can be called up by choosing the &quot;Robot control statement&quot; on the Category Selection window).</td>
</tr>
<tr>
<td>[F4 Category]</td>
<td>Displays the Category Selection window.</td>
</tr>
<tr>
<td>[F5 Recent.]</td>
<td>Shortcut to a list of commands in the most recently selected category.</td>
</tr>
<tr>
<td>[F6 ClrAll]</td>
<td>Clears all characters being entered.</td>
</tr>
</tbody>
</table>
Saving and compiling an edited program in Manual mode

Access: [F1 Program]—[F5 Edit.]—[F6 Save.]

Saves and compiles an edited program. If the program is set to "Disable" in the Program List window, this command performs saving only; if it is set to "Enable," this command performs both saving and compiling.

During compiling, the following window is displayed.

![Compilation Window](image)

After compiling, the "Compile Log" will appear if the task program contains any errors. Fix the program until no syntax error will be detected, since the task program cannot execute if containing any error.

You may check anytime a compile log, by pressing [F1 Program]—[F10 SyntaxErr] in Manual mode.
**Displaying a compile log in Manual mode**

Access: [F1 Program]—[F5 Edit.]—[F10 SyntxErr]

Displays the compile log as shown below.

The compile log is useful when you correct syntax errors in programming. You must correct the program until no syntax errors are detected.

![Compile Log Image]

**Setting a break point(s) in Manual mode**

Access: [F1 Program]—[F5 Edit.]—[F11 BP]

Sets a break point(s) at a desired program step(s). If the set break point is encountered during execution of program, the program will immediately stop.

![Break Point Setting Image]
Providing auxiliary functions in Manual mode

Access: [F1 Program]—[F6 Aux.]

Provides the following auxiliary functions for project editing.
Setting project parameters in Manual mode

Access: [F1 Program]—[F6 Aux.]—[F1 Set PRJ.]

Sets the parameters of variables to be used by the project and makes project-related settings.

For details about parameters, refer to the PROGRAMMER’S MANUAL, Appendix 4, "Using Condition Parameters."

(1) Press [F1 Set PRJ.] in the Auxiliary Functions (Programs) window. The Project Parameter window will appear as shown below.

(2) Select the item to be modified and then press [F5 Change.]

The numeric keypad will appear as shown below.
(3) Enter the desired value(s) with the numerical buttons in the above window, and then press the OK button. The new settings will appear in the Project Parameter window.

(4) Check the new settings. If they are satisfactory, press the OK button, and the system message dialog box will appear as shown below. To clear the new settings, press the Cancel button in the Project Parameter window.

(5) The system message dialog box asks whether the new settings are to be applied to the current project. To apply the new settings to the current project immediately, press the OK button, making compilation start soon.

To apply those settings from subsequent project compilation, press the Cancel button.
Setting compiling options in Manual mode

Access: [F1 Program]—[F6 Aux.]—[F3 Options.]

Sets the compiling options.

For details about compiling options, refer to the WINCAPSII Guide, Chapter 5, Subsection 5.6.1.3, "Compiler."

(1) Press [F3 Options] in the Auxiliary Functions (Programs) window. The Compile Options window will appear as shown below.

(2) Select the item to be modified and then press [F5 Change.]
   The numeric keypad will appear as shown below.

(3) Enter the desired value(s) with the numerical buttons in the above table, and then press the OK button.
   The new settings will appear in the Compile Options window.

(4) Check the new settings. If they are satisfactory, press the OK button to make them take effect. To clear those settings, press the Cancel button.
**Setting the break point stop mode in Manual mode**

Access:  [F1 Program]—[F6 Aux.]—[F5 BP Settng]

Selects either of the following two BP stop modes to be applied when break points are encountered:

- Stop only the program on which the encountered break point is set
- Stop all running programs

1. Press [F5 BP Settng] in the Auxiliary Functions (Programs) window. The Select BreakPoint Setting window will appear as shown below.

2. Select the desired option.
3. Press the OK button to make the new setting effective. To cancel it, press the Cancel button.
Setting the resume-related parameters in Manual mode
Access: [F1 Program]—[F6 Aux.]—[F7 Continue]

Sets the resume-related parameters for Continue Start.

1. Press [F7 Continue] in the Auxiliary Functions (Programs) window. The Continue Parameters Setting window will appear as shown below.

   ![Continue Parameters Setting Window](image)

2. Select the item to be modified and then press [F5 Change.] The numeric keypad will appear as shown below.

   ![Numeric Keypad](image)

3. Enter the desired value(s) with the numerical buttons in the above table, and then press the OK button. The new settings will appear in the Continue Parameter Setting window.

4. Check the new settings. If they are satisfactory, press the OK button to make them take effect. To clear those settings, press the Cancel button.
Setting the safe start related parameters in Manual mode

Access: [F1 Program]—[F6 Aux.]—[F8 SS Mode.]

Sets the safe start related parameters.

(1) Press [F8 SS Mode.] in the Auxiliary Functions (Programs) window. The Safety Start Setting window will appear as shown below.

(2) Select the item to be modified and then press [F5 Change.]

The numeric keypad will appear as shown below.

(3) Enter the desired value(s) with the numerical buttons in the above table, and then press the OK button.

The new settings will appear in the Safety Start Setting window.

(4) Check the new settings. If they are satisfactory, press the OK button to make them take effect. To clear those settings, press the Cancel button.
Setting the step return options in Manual mode
Access: [F1 Program]—[F6 Aux.]—[F9 StpBack.]

Sets the step return options.

(1) Press [F9 StpBack.] in the Auxiliary Functions (Programs) window. The Step Back Setting window will appear as shown below.

(2) Select the desired option.

(3) Press the OK button to make the new setting effective. To cancel it, press the Cancel button.

Restarting the controller will make this setting go into effect.
Enabling/disabling the automatic loading of a project in Manual mode

Access: [F1 Program]—[F6 Aux.]—[F10 LoadMode]

Enables or disables the automatic loading of a project.

1. Press [F10 LoadMode] in the Auxiliary Functions (Programs) window. The Project Auto Load Setting window will appear as shown below.

2. Select the desired option.

3. Press the OK button to make the new setting effective. To cancel it, press the Cancel button.
   Restarting the controller will make this setting go into effect.
Compiling a project
Access: [F1 Program]—[F6 Aux.]—[F12 Compile]

Compiles a project or all programs which are set to "Enable" in the Program List window.

1. Press [F12 Compile.] in the Auxiliary Functions (Programs) window. The system message will appear as shown below.

2. To cancel compiling and return to the Auxiliary Functions (Programs) window, press the Cancel button.
   To start compiling, press the OK button.

3. Upon successful completion of project compilation, the system will automatically load the project and then return to the Auxiliary Functions (Programs) window.
If project compilation is not successful, the compile log window will appear as shown below. It displays syntax errors in the program. According to these error messages, modify your program.
Creating a new project in Manual mode

Access: [F1 Program]—[F7 New PRJ]

Erases all task programs stored in the robot controller and will then create a new project.

(1) Press [F7 New PRJ] in the Program List window. The system message dialog box will appear as shown below.

(2) Press the OK button.
**Displaying syntax errors in Manual mode**

**Access:** [F1 Program]—[F10 SyntxErr]

Displays syntax errors found in compilation.

The display of syntax errors is useful for fixing syntax errors contained in a program. You should fix the program until no syntax errors will display.

1. Press [F10 SyntxErr] in the Program List window. The Compile Log window will appear as shown below.

![Compile Log Window](image)
Enabling/disabling a selected program for compilation in Manual mode

Access: [F1 Program]—[F12 Config.]

Enables a selected program to get compiled or disables it from getting compiled.

In compilation, the system will first check the enable/disable flags of programs and then compile only those programs whose flags are set to "Enable."

If a project contains more than one program with a same name but only one of them is set to "Enable," then no compile error will occur.

If you edit and save programs whose flags are set to "Enable," the system will automatically compile them.

1) In the Program List window, select a program that you want or do not want to compile.

2) Press [F12 Config.] (or the Config. button located at the bottom of the Program List window). This switches the selected program between "Enable" and "Disable."
5.2.2 Showing the Program List Window in Teach Check Mode

Pressing [F1 Program] on the top screen in Teach check mode will display the Program List window as shown below.

![Program List window](image)

The Program List window has the following items:

- **[Program Name]** Lists program names declared by the PROGRAM statement.
- **[Status]** Shows the execution status of the listed program.
- **[LineNo.]** Shows the line being executed or on halt.
- **[RnTime]** Shows the run time that the listed program takes to run. Note that programs named PROxx (where xx is a numeral) only may show the run time.
  
  If the listed program runs continuously, the run time required for every cycle will appear.

- **[Priorty]** Shows the priority order for executing programs. The less the numeric value, the higher the priority.
- **[F/B]** Shows whether the listed program is currently executing forwards or backwards.

The hierarchy of the [F1 Program] menu in Teach check mode is given on the next page.
Halting the selected program in Teach check mode

Access: [F1 Program]—[F1 Halt]

Halts the task program selected in the Program List window.

Pressing [F1 Halt] in the Program List window (shown below) will immediately interrupt the selected program.

TIP: While pressing [F1 Halt] halts the selected program only, pressing the STOP key stops all task programs.
Causing a step stop in Teach check mode

Access: [F1 Program]—[F2 StepStop]

Interrupts the task program selected in the Program List window as shown below, after executing the current program step.
Causing a single-cycle run in Teach check mode

Access: [F1 Program]—[F4 CycStart]

Runs a single cycle of the program selected in the Program List window.

1. Select the program to be run in the Program List window (shown below).

2. Press [F4 CycStart], and the system message dialog box will appear as shown below.

3. While holding down the deadman switch, press the OK key. Make sure to keep both switches depressed until the execution completes.

**NOTE:** The elapsed time on display refers to the time length from the start to end of the program, including temporary stop time caused by Step stop or Halt.
Returning the selected program by a single step in Teach check mode

Access: [F1 Program]—[F5 StepBack]

Returns the program selected in the Program List window by a single step at a time.


(2) The system message appears as shown below.
  Holding down the deadman switch, press the OK button to move back the program by one step.
Chapter 5 Commands Assigned to Function Keys of the Teach Pendant

**Causing a single-step run in Teach check mode**

**Access:** [F1 Program]—[F6 StpStart]

Runs a single step of the program selected in the Program List window.

1. Select the program to be run in the Program List window (shown below).

![Program List Window](image)

2. Press [F6 StpStart], and the system message dialog box will appear as shown below.

![System Message Dialog Box](image)

3. While holding down the deadman switch, press the OK key. Make sure to keep both switches depressed until the execution completes.
Stopping the program(s) in Teach check mode

Access: [F1 Program]—[F7 ProgRst.]

Stops the program(s).

(1) Press [F7 ProgRst.] in the Program List window. The Reset Program window will appear as shown below.
(2) Select the program to be stopped and press the OK button. The task will be stopped.

NOTE: The currently running program also stops.
Setting the priority order of programs in Teach check mode
Access: [F1 Program]—[F9 Priorty.]

Sets the priority order of a program you select in the Program List window.

(1) Select the target program.
(2) Press [F9 Priorty.], and the numeric keypad will appear as shown below.

(3) Enter the priority order with the numerical buttons. (Entry range: 101 to 255)
(4) Press the OK button.
Displaying codes of the selected program in Teach check mode

Access: [F1 Program]—[F11 Display.]

Displays codes of the program selected in the Program List window.

(1) Select the target program.

(2) Press [F11 Display.], and the program code window will appear as shown below.

When the program code window is displayed, the following commands are still effective: [F1 Halt], [F2 StepStop], [F4 CycStart], [F6 StpStart], [F7 ProgRst.], [F9 Priorty.], and [F12 PrintDbg].
Displaying a debug window in Teach check mode

Access: [F1 Program]—[F12 PrintDbg]

Displays the debug window where you may view the result of executing the PRINTDBG command in PAC language.

This command allows you to check the execution result of a program or the intermediate result of the computation.

The debug window displays the last 40 lines of the execution result. Scroll the screen to show older data.

A red triangle marker indicates a current line being used by this command.

If a sample program shown below is executed, the debug window will display the results as shown below.

```
'!TITLE "PrintDbg test program"
PROGRAM TEST
   DIM COUNTER AS INTEGER
   FOR COUNTER = 1 TO 5
      PRINTDBG "Value =";COUNTER
      IF COUNTER = 3 THEN EXIT FOR
   NEXT

   PRINTDBG "Result = ";COUNTER
END
```

![Debug Window Screenshot]

(Caption: Displaying a debug window in Teach check mode, with a sample program shown.)
5.2.3 Showing the Program List Window in Auto Mode

Pressing [F1 Program] on the top screen in Auto mode will display the Program List window as shown below.

The Program List window has the following items:

[Program Name] Lists program names declared by the PROGRAM statement.

[Status] Shows the execution status of the listed program.

[LineNo.] Shows the line being executed or on halt.

[RnTime] Shows the run time that the listed program takes to run. Note that programs named PROxx (where xx is a numeral) only may show the run time.

If the listed program runs continuously, the run time required for every cycle will appear.

Note: From Ver. 1.4 upward the run time is displayed for each step when step run is carried out.

[Priorty] Shows the priority order for executing programs. The less the numeric value, the higher the priority.

The hierarchy of the [F1 Program] menu in Auto mode is given on the next page.
Chapter 5  Commands Assigned to Function Keys of the Teach Pendant

![Diagram showing function keys and their commands]

- **Top Screen**
  - [F1 Program]
    - in Auto Mode
      - [F1 Halt]
      - [F2 StepStop]
      - [F3 CycStop]
      - [F4 Start]
      - [F6 StpStart]
      - [F7 ProgRst]
      - [F9 Priority]
      - [F10 Continue]
      - [F11 Display]
      - [F12 PrintDbg]
  - [F1 Back]
  - [F2 Next]
  - [F6 ClrDisp]
Halting the selected program in Auto mode

Access: [F1 Program]—[F1 Halt]

Halts the task program selected in the Program List window.

Pressing [F1 Halt] in the Program List window (shown below) will immediately interrupt the selected program.

![Program List Window](image)

**TIP:** While pressing [F1 Halt] halts the selected program only, pressing the STOP key stops all task programs.
**Causing a step stop in Auto mode**

**Access:** [F1 Program]—[F2 StepStop]

Interrupts the program selected in the Program List window as shown below, after executing the current program step.
**Causing a cycle stop in Auto mode**

**Access:** [F1 Program]—[F3 CycStop]

Stops the task program selected in the Program List window as shown below, after executing the current program up to the last step.

![Program List](image)

**NOTE:** The elapsed time on display refers to the time length from the start to the end of the program, including temporary stop time caused by Step stop or Halt.
Running the selected program in Auto mode

Access: [F1 Program]—[F4 Start.]

Runs the task program selected in the Program List window, by a single cycle or continuously.

1. Select the program to be run in the Program List window (shown below).

![Program List](image)

2. Press [F4 Start.], and the system message dialog box will appear as shown below.

![System Message](image)

3. Select Single-cycle or Continuously, then press the OK button to proceed.

**NOTE:** The elapsed time on display refers to the time length from the start to the end of the program, including temporary stop time caused by Step stop or Halt.
Causing a single-step run in Auto mode

Access: [F1 Program]—[F6 StpStart]

Runs a single step of the task program selected in the Program List window.

(1) Select a program to be run in the Program List window (shown below).

(2) Press [F6 StpStart], and the system message dialog box will appear as shown below.

(3) Press the OK button to proceed.

**NOTE:** The elapsed time on display refers to the time length from the start to the end of the program, including temporary stop time caused by Step stop or Halt.
The actual elapsed time is +0.00 to +0.03 more than the elapsed time, to include the time required for starting and ending the step. [Ver. 1.4 or later]
Displaying the Reset Program window in Auto mode

Access: [F1 Program]—[F7 ProgRst.]

Displays the Reset Program windows.

(1) Press [F7 ProgRst.] in the Program List window. The Reset Program window will appear as shown below.

(2) Select the program to be stopped and press the OK button. The task will be stopped.

NOTE: The currently running program also stops.
Setting the priority order of programs in Auto mode
Access: [F1 Program]—[F9 Priorty.]

Sets the priority order of the task programs selected in the Program List window.

1. Select the target program.
2. Press [F9 Priorty.], and the numeric keypad will appear as shown below.

   ![Numeric keypad image]

   (3) Enter the priority order with the numerical buttons. (Entry range: 101 to 255)
   (4) Press the OK button.
Resuming selected program(s) in Auto mode

Access: [F1 Program]—[F10 Continue]

Resumes program(s) that has been stopped with "Cont.Stp." and selected in the Program List window.

(1) Select programs you want to resume and press [F10 Continue] in the Program List window.

**NOTE:** Programs that can be resumed show Continue Stop in the Status column. The system message will appear if programs that can resume are present.

(2) Press the OK button to resume the program you have selected.
To cancel resuming, press the Cancel button.
If programs that can be resumed do not exist, the system message will appear as shown below.
Displaying codes of the selected program in Auto mode

Access: [F1 Program]—[F11 Display.]

Displays codes of the program selected in the Program List window.

(1) Select the target program.
(2) Press [F11 Display.], and the program code window will appear as shown below.

When the program code window is displayed, the following commands are still effective: [F1 Halt], [F2 StepStop], [F3 Cyc Stop], [F4 Start], [F6 StpStart], [F7 ProgRst.], [F9 Priorty.], and [F12 PrintDbg].
Chapter 5  Commands Assigned to Function Keys of the Teach Pendant

Displaying a debug window in Auto mode

Access: [F1 Program]—[F12 PrintDbg]

Displays the debug window where you may view the result of executing the PRINTDBG command in PAC language.

This command allows you to check the execution result of a program or the intermediate result of the computation.

The debug window displays the last 40 lines of the execution result. Scroll the screen to show older data.

A red triangle marker indicates a current line being used by this command.

If a sample program shown below is executed, the debug window will display the results as shown below.

```pascal
'!TITLE "PrintDbg test program"
PROGRAM TEST
  DIM COUNTER AS INTEGER
  FOR COUNTER = 1 TO 5
    PRINTDBG "Value ="; COUNTER
    IF COUNTER = 3 THEN EXIT FOR
  NEXT

  PRINTDBG "Result = "; COUNTER
END
```

![Screenshot of debug window](image.png)
5.3 Displaying the Current Robot Position

Access: [F2 Arm]

Pressing [F2 Arm] on the top screen will display the Current Robot Position window as shown below.

When shifted

Pressing [F7 Show P] (or P button), [F8 Show J] (or J button), or [F9 Show T] (or T button) switches the expression of the current robot position to the position variable type, joint variable type, or homogeneous transform matrix variable type, respectively.

The J1 through J6 show where each axis is positioned within the motion space.

The hierarchy of the [F2 Arm] menu is given on the next page.
Chapter 5 Commands Assigned to Function Keys of the Teach Pendant

Top Screen

[F2 Arm]

[F1 Robot.]
[F3 OpeMode.]

[F1 Back]
[F2 Next]
[F5 Work No.]
[F6 Tool No.]

(The following menus (except F12) have submenus F1 to F7. Submenus marked with * are only for [F4 Position.], [F5 Joint.], and [F10 Tran.].)

[F4 Var.]
[F1 Integer.]
[F2 Float.]
[F3 Vector.]
[F4 Position.]
[F5 Joint.]
[F8 Double.]
[F10 Tran.]
[F11 String.]
[F12 Var.Uused]

[F7 Jump To]
[F4 Move]*
[F5 Change.]
[F6 Get Pos.]*
[F7 Copy Var]

[F5 Speed.]
[F1 1%]
[F2 10%]
[F3 50%]
[F4 100%]
[F5 Change.]

(F4 to F7 have submenus F1 to F6. Submenu marked with * is only for [F5 Work.] and [F6 Area.]. Submenu marked with ** is only for [F6 Area.].)

[F6 Aux.]
[F4 Tool.]
[F5 Work.]
[F6 Area.]
[F7 Config.]
[F10 Overload]

[F1 Back]
[F2 Next]
[F3 Jump To]
[F4 AutoCalc]*
[F5 Change.]
[F6 Activate]**

[F11 CtrlLog.]
[F1 StrtLog]
[F2 StopLog]
[F6 ClrLog]
[F7 SaveLog.]
[F12 DelLog.]

[F12 Exec CAL]

[F7 Show P]
[F8 Show J]
[F9 Show T]
[F12 Maint.]

(F1 and F2 have submenus F1 to F5 except F4.)

[F1 M Space.]
[F2 RAWG.]

[F1 Back]
[F2 Next]
[F3 Jump To]
[F5 Change.]

[F3 Brake.]

[F4 CancAll]
[F5 ON/OFF]
[F6 SelcAll]

[F6 CALSET.]
[F10 ENC info.]
[F11 ENC rat]
[F12 ENC set]
Selecting the robot type (reserved)

Access: [F2 Arm]—[F1 Robot.]

Selects the type of robot you have. This command is reserved for future use of eight-axis robots. It allows the control of the teach pendant to switch between six axes and two extended axes or between two 4-axis robots.

While the teach pendant has only six arm traverse keys, the robot controller can control up to 8 axes (e.g., controlling a single 6-axis robot plus two extended axes). To control more than six axes with those six keys of the teach pendant, you need to use this command and switch the control to the extended axes.

This command is functionally equivalent to the R-SEL key.

1. In the Current Robot Position window shown below, press [F1 Robot.].

2. The Select Robot window will appear as shown below. Select the type of your robot and then press the OK button.
Switching the operation modes, work coordinates and tool coordinates

Access: [F2 Arm]—[F3 OpeMode.]

Switches the operation modes, work coordinates and tool coordinates. This command is functionally equivalent to the M-MOD key.

(1) In the Current Robot Position window shown below, press [F3 OpeMode.].

(2) The Select Operation Mode window will appear as shown below. Select the desired operation mode, work coordinates and tool coordinates, and then press the OK button.
Displaying and modifying variable values

Access: [F2 Arm]—[F4 Var.]

Displays values assigned to various types of variables and the number of variables used and/or modifies them.

This command is functionally equivalent to [F1 Program]—[F4 Var.] in Manual mode.

Displaying and modifying integer variable values
[F2 Arm]—[F4 Var.]—[F1 Integer.]
Refer to page 5-15.

Displaying and modifying floating-point variable values
[F2 Arm]—[F4 Var.]—[F2 Float.]
Refer to page 5-16.

Displaying and modifying vector variable values
[F2 Arm]—[F4 Var.]—[F3 Vector.]
Refer to page 5-17.

Displaying and modifying position variable values
[F2 Arm]—[F4 Var.]—[F4 Pos.]
Refer to page 5-18.

Displaying and modifying joint variable values
[F2 Arm]—[F4 Var.]—[F5 Joint.]
Refer to page 5-19.

Displaying and modifying double-precision variable values
[F2 Arm]—[F4 Var.]—[F8 Double.]
Refer to page 5-20.

Displaying and modifying variable values in homogeneous transform matrix
[F2 Arm]—[F4 Var.]—[F10 Tran.]
Refer to page 5-21.

Displaying and modifying string variable values
[F2 Arm]—[F4 Var.]—[F11 String.]
Refer to page 5-22.

Displaying and modifying the number of variables used
[F2 Arm]—[F4 Var.]—[F12 VarsUsed.]
Refer to page 5-24.
Setting the reduced ratios of the programmed speed, acceleration, and deceleration

Access: [F2 Arm]—[F5 Speed.]

Sets the reduced ratios (percentage) of the programmed speed, acceleration, and deceleration, as well as selecting speed-running or inching. This command is functionally equivalent to the SPEED key.

(1) In the Current Robot Position window shown below, press [F5 Speed.].

(2) The Set Speed window will appear as shown below. Set the desired ratios of the programmed speed, acceleration and deceleration. Additionally, select speed-running or inching. Then press the OK button.

TIP: For the detailed operating procedure about setting of the reduced ratios, refer to Chapter 2, Section 2.7.
Providing auxiliary functions

Access: [F2 Arm]—[F6 Aux.]

Provides the auxiliary functions concerning coordinates definition, interference area definition, user preferences, overload anticipation, and CAL operation.

1. Press [F6 Aux.], and the Auxiliary Functions (Arm) window will appear as shown below.

(2) Select the desired auxiliary function by pressing the corresponding function key. The corresponding window will display as described on pages 5-79 through 5-90.
Defining tool coordinates

Access: [F2 Arm]—[F6 Aux.]—[F4 Tool.]

Defines tool coordinates.

(1) Press [F4 Tool.] in the Auxiliary Functions (Arm) window, and the following window will appear.

(2) In the above window, select the item to be defined and then press [F5 Change.]

The numeric keypad will appear as shown below.

(3) Enter the desired value with the numerical buttons in the above window, and then press the OK button.
**Defining work coordinates**

**Access:** [F2 Arm]—[F6 Aux.]—[F5 Work.]

Defines work coordinates.

1. Press [F5 Work.] in the Auxiliary Functions (Arm) window, and the following window will appear.

   ![Image of window](image1)

   **NOTE:** For automatic calculation of work coordinates, press [F4 AutoCalc]. For details, refer to the next page.

   The numeric keypad will appear as shown below.

   ![Numeric keypad](image2)

2. In the above window, select the item to be defined and then press [F5 Change.].

3. Enter the desired value with the numerical buttons in the above window, and then press the OK button.

   ![Input window](image3)
Calculating work coordinates automatically in Manual mode

Access: [F2 Arm]—[F6 Aux.]—[F5 Work.]—[F4 AutoCalc]

Calculates work coordinates automatically if you merely specify three points—Origin of work coordinates, point on the X axis of work coordinates and point on the X-Y plane of work coordinates.

For details regarding work coordinates definition, refer to Subsection 4.1.1, [1.3] and Subsection 4.2.1, [1.3] for 6-axis and 4-axis robots, respectively.

(1) Press [F4 AutoCalc] in the Define Work Coordinates window, and the following window appears.

If three points are on a straight line, the automatic calculation will fail to set work coordinates and the following window appears.
Defining an interference check area
Access: [F2 Arm]—[F6 Aux.]—[F6 Area.]

Defines an interference check area(s) or cube(s). If the end-effector comes in or goes out of the defined interference check area, the system interprets it as interference so that it may activate specified tasks preprogrammed if an I/O port address is set.

(1) Press [F6 Area.] in the Auxiliary Functions (Arm) window, and the following window will appear.

(2) In the above window, select the item to be defined and then press [F5 Change.].

**NOTE:** For automatic calculation of the interference check area, press [F4 AutoCalc]. For details, refer to the next page.

The numeric keypad will appear as shown below.

(3) Enter the desired value with the numerical buttons in the above window, and then press the OK button.
Calculating the coordinates of an interference check area automatically in Manual mode

Access: [F2 Arm]—[F6 Aux.]—[F6 Area.]—[F4 AutoCalc]

Calculates the coordinates of an interference check area(s) automatically if you merely specify three points—Work coordinates and two vertexes (farthest and nearest to the origin of the base coordinates) of the interference check area.
Setting the user preferences
Access: [F2 Arm]—[F6 Aux.]—[F7 Config.]

Sets or modifies the user preferences such as the control set of motion optimization, robot mounting style, mass of payload, and payload center of gravity (as master control parameters).

(1) Press [F7 Config.] in the Auxiliary Functions (Arm) window, and the following window will appear.

(2) In the above window, select the item to be defined and then press [F5 Change.]. The numeric keypad will appear as shown below.

(3) Enter the desired value with the numerical buttons in the above window, and then press the OK button.
Chapter 5 Commands Assigned to Function Keys of the Teach Pendant

Displaying anticipated overloads to the capacity of motors and brake resistance of the robot controller

Access: [F2 Arm]—[F6 Aux.]—[F10 Overload]

Displays anticipated overloads (percentages) to the capacity of joint-drive motors and to the brake resistance of the robot controller.

(1) Press [F10 Overload] in the Auxiliary Functions (Arm) window, and the following system message dialog box will appear.

(2) Press the OK button to close the dialog box.

When the system logs control data, it calculates anticipated overloads. To update the anticipated overloads, therefore, write program in which STARTLOG will execute at the start of the motion whose overloads should be anticipated, as shown in the sample program given on the next page.

The system will calculate anticipated overloads for a maximum of 10 seconds from the start of logging. If the time from the start (STARTLOG) of logging to the end (STOPLOG) is less than 10 seconds, the system will calculate overloads for that time.

If the time exceeds 10 seconds, the system will calculate them for the first 10 seconds. If a motion cycle whose overloads should be anticipated takes more than 10 seconds, therefore, you need to log control data for each of 10-second or less motion cycles to monitor anticipated overloads.

Anticipated overloads will not be updated until STARTLOG executes again.
(Sample program for logging)

PROGRAM PRO1 'Main program'

TAKEARM
CLEARLOG :Clears log data before STARTLOG
STARTLOG :Start of logging

CALL SUB1
CALL SUB2
STOPLOG :End of logging (If STOPLOG executes within 10 seconds from STARTLOG, the anticipated overloads for that time will appear.)

GIVEARM
END
Saving or deleting control log to/from the flash memory
Access: [F2 Arm]—[F6 Aux.]—[F11 CtrlLog.]

Saves or deletes control log preserved in the flash memory.

(1) Press [F11 CtrlLog.] in the Auxiliary Functions (Arm) window, and the following window appears.

<table>
<thead>
<tr>
<th>Function keys available</th>
</tr>
</thead>
<tbody>
<tr>
<td>[F1 StrtLog]</td>
</tr>
<tr>
<td>Starts keeping a control log.</td>
</tr>
<tr>
<td>[F2 StopLog]</td>
</tr>
<tr>
<td>Stops keeping a control log.</td>
</tr>
<tr>
<td>[F6 ClrLog]</td>
</tr>
<tr>
<td>Clears the current log so as to allow a new log.</td>
</tr>
<tr>
<td>[F7 SaveLog.]</td>
</tr>
<tr>
<td>Saves the current log stored in the work memory into the flash memory. If the controller is turned OFF, data stored in the work memory will be lost, but data in the flash memory will not. you may read out log data stored in the flash memory by specifying the log in WINCAPSII.</td>
</tr>
<tr>
<td>[F12 DelLog.]</td>
</tr>
<tr>
<td>Deletes the current log stored in the flash memory.</td>
</tr>
</tbody>
</table>
**Executing CAL operation**

Access: [F2 Arm]—[F6 Aux.]—[F12 Exec CAL]

Executes CAL operation.

(1) Press [F12 Exec CAL] in the Auxiliary Functions (Arm) window, and the following system message dialog box will appear.

(2) Check that the motor power is ON, and then press the OK button in the above dialog box to proceed.

The system message dialog box will appear as shown below.

(3) Press the OK button in the above dialog box.
Switching the expression of the current robot position to the position variable type

Access: [F2 Arm]—[F7 Show P]

Switches the expression of the current robot position to the position variable type.

Press [F7 Show P] in the Current Robot Position window, and the screen will switch as shown below where the current robot position is expressed in position variables.

This command is functionally equivalent to the P button provided in the upper right corner of the Current Robot Position window.
**Switching the expression of the current robot position to the joint variable type**

**Access:** [F2 Arm]—[F8 Show J]

Switches the expression of the current robot position to the joint variable type.

Press [F8 Show J] in the Current Robot Position window, and the screen will switch as shown below where the current robot position is expressed in joint variables.

This command is functionally equivalent to the J button provided in the upper right corner of the Current Robot Position window.
Switching the expression of the current robot position to the tran. variable type

Access: [F2 Arm]—[F9 Show T]

Switches the expression of the current robot position to the homogeneous transform matrix variable type.

Press [F9 Show T] in the Current Robot Position window, and the screen will switch as shown below where the current robot position is expressed in tran. variables.

This command is functionally equivalent to the T button provided in the upper right corner of the Current Robot Position window.
Displaying the Maintenance Functions (Arm) window

Access: 
[F2 Arm]—[F12 Maint.]

Displays the Maintenance Functions (Arm) window.

1. Press [F12 Maint.] in the Current Robot Position window, and the Maintenance Functions (Arm) window will appear as shown below.

2. Select the desired maintenance function. The corresponding window will display as described on pages 5-95 through 5-104.
**Setting the motion space (software motion limit)**

Access: [F2 Arm]—[F12 Maint.]—[F1 M Space.]

Sets the motion space or software motion limit.

1. Press [F1 M Space.] in the Maintenance Functions (Arm) window. The Motion Space (Software motion limit) window will appear as shown below.

2. Select the item to be modified and then press [F5 Change.]. The numeric keypad will appear.

3. Enter the desired value with the numerical buttons in the above window, and then press the OK button. The new entry will be entered into the Motion Space (Software motion limit) window.

4. Press the OK key.
   To cancel the new entry, press the Cancel key.
Setting the ready angle

Access: [F2 Arm]—[F12 Maint.]—[F2 RANG.]

Sets the ready angle (RANG).

1. Press [F2 RANG.] in the Maintenance Functions (Arm) window. The RANG window will appear as shown below.

2. Select the item to be modified and then press [F5 Change.]. The numeric keypad will appear.

3. Enter the desired value with the numerical buttons in the above window, and then press the OK button. The new entry will be entered into the RANG window.

4. Press the OK key.

To cancel the new entry, press the Cancel key. To return to the Maintenance Functions (Arm) window, press the OK or Cancel key.
Chapter 5  Commands Assigned to Function Keys of the Teach Pendant

*Releasing or locking brakes*

Access: [F2 Arm]—[F12 Maint.]—[F3 Brake.]

Releases and locks the play keys of all the axes.
**Selecting and deselecting joints to be calibrated**

**Access:** [F2 Arm]—[F12 Maint.]—[F6 CALSET.]

Selects and/or deselects joints to be calibrated.

1. Press [F6 CALSET.] in the Maintenance Functions (Arm) window. The Set CALSET window will appear as shown below.

![Set CALSET Window](image)

2. Select the target joint.

3. Press [F5 ON/OFF], and the indicator color of the selected joint will change from green to black if selected or from black to green if deselected.
   - **Green:** Joint selected for calibration
   - **Black:** Joint deselected

   To deselect all joints, press [F4 CanclAll]; to select them for calibration, press [F6 SelctAll].

4. Check the joint status, and then press the OK button to make the new entry take effect.

**Tip:** For details about the CALSET procedure, refer to the INSTALLATION & MAINTENANCE GUIDE, Chapter 4, "CALSET."
Displaying encoder information

Access: [F2 Arm]—[F12 Maint.]—[F10 ENC inf.]

Displays encoder information.

Pressing [F10 ENC inf.] in the Maintenance Functions (Arm) window will display the Encoder Information window as shown below.

The above window displays the system status of the robot controller and the joint status. If the status is normal, the indicator lights in green; if abnormal, it goes off.

Pressing the OK or Cancel button will return the screen to the Maintenance Functions (Arm) window.
Resetting the motor encoder data
Access: [F2 Arm]—[F12 Maint.]—[F11 ENC rst]

Resets the motor encoder data.
This command is intended for YASKAWA service personnel only. Do not use this command.
Setting ID data of motor encoders

Access: [F2 Arm]—[F12 Maint.]—[F12 ENC set]

Sets the ID data of motor encoders.

This command is intended for YASKAWA service personnel only. Do not use this command.
5.4 Displaying the Vision Menu

Access: [F3 Vision]

Pressing [F3 Vision] on the top screen will display the Set Vision menu as shown below.

The [F7 Window] and [F9 Analysis] are newly supported in Version 1.5 or later.

To use the vision function [F3 Vision], check that:
- An optional μVision board is integrated in the robot controller.
- The robot is placed in Manual mode.
- The vision semaphore is released by stopping the program temporarily.

The hierarchy of the [F3 Vision] menu is given on the next page.
Note: To use the vision function [F3 VISION], check that:

- An optional μVISION board is integrated in the robot controller.
- The robot is placed in Manual mode.
- The vision semaphore is released (TAKEVIS command in not acquired.)
Reading image signals from the specified camera into the vision board

Access: [F3 Vision]—[F1 Camera]

Sets the camera input parameters and reads image signals sent from the specified camera into the vision board.

(1) Press [F1 Camera] in the Set Vision window, and the Input Camera window will appear as shown below.

(2) Set the camera input parameters as follows:
   - Camera No.: Specify the connected camera number.
   - Table No.: Specify the number of the table that is looked up during input.
     - Table No. 0: Normal (Brightness 0 to 255)
     - Table No. 1: 70% brightness compression (Brightness 0 to 175)
     - Table No. 2: γ correction
     - Table No. 3: Reversal
     - Table No. 4: 70% brightness compression reversal
     - Table Nos. 5 to 15: User defined tables
   - Process No.: Specify the process screen number from which camera image signals will be read.

(3) Press [F1 Update] to read image signals from the specified camera.

<table>
<thead>
<tr>
<th>Function keys available</th>
</tr>
</thead>
<tbody>
<tr>
<td>[F1 Update] Updates camera input parameters and reads image signals from the camera. The Camera Input window remains open.</td>
</tr>
<tr>
<td>[F2 Live] Displays the image of the camera selected on the monitor by lookup table 0 (fixed).</td>
</tr>
<tr>
<td>[F5 Change] Displays the numeric keypad where you may modify the table number.</td>
</tr>
</tbody>
</table>
Displaying the specified image on the monitor

Access: [F3 Vision]—[F2 Display]

Sets the monitor display parameters and displays the specified image on the monitor.

(1) Press [F2 Display] in the Set Vision window, and the Screen Display window will appear as shown below.

(2) Set the monitor display parameters as follows:

- **Drawing:** Specify the screen to be drawn.
- **Camera & Process:** Specify the image to be displayed.
- **Table No.:** Specify the number of the table that is looked up during input.
  - **Table No. 0:** Normal (Brightness 0 to 255)
  - **Table No. 1:** 70% brightness compression (Brightness 0 to 175)
  - **Table No. 2:** \(\gamma\) correction
  - **Table No. 3:** Reversal
  - **Table No. 4:** 70% brightness compression reversal
  - **Table Nos. 5 to 15:** User defined tables

<table>
<thead>
<tr>
<th>Function keys available</th>
</tr>
</thead>
<tbody>
<tr>
<td>[F1 Update] Updates monitor display parameters and calls up</td>
</tr>
<tr>
<td>specified image on the monitor. The Screen Display window</td>
</tr>
<tr>
<td>remains open.</td>
</tr>
<tr>
<td>[F5 Change] Displays the numeric keypad where you may modify</td>
</tr>
<tr>
<td>the table number.</td>
</tr>
</tbody>
</table>
Clearing the drawing screen or process screen

Access: [F3 Vision]—[F3 CLS]

Clears data on the specified drawing screen or process screen.

1) Press [F3 CLS] in the Set Vision window, and the Clear Screen window will appear as shown below.

   ![Clear Screen Window]

2) Specify the Clear value.
   - **Clear:** Set the value with which clearing process should take place.
     Process screen will be filled with brightness of specified value.
     Drawing screen will be cleared by 0.
     Normally specify 0.

<table>
<thead>
<tr>
<th>Function keys available</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>[F3 Change]</strong></td>
</tr>
<tr>
<td>Displays the numeric keypad where you may modify the clear value.</td>
</tr>
<tr>
<td><strong>[F4 CanclAll]</strong></td>
</tr>
<tr>
<td>Cancels all the selections of the screen.</td>
</tr>
<tr>
<td><strong>[F5 Sel/Canc]</strong></td>
</tr>
<tr>
<td>Selects/cancels selection of the screen to be cleared.</td>
</tr>
<tr>
<td><strong>[F6 SelctAll]</strong></td>
</tr>
<tr>
<td>Selects all the screens.</td>
</tr>
</tbody>
</table>
Setting the drawing destination screen

Access: [F3 Vision]—[F4 Drawing]

Sets the drawing destination screen. The settings of the vision board appear as the selected values when the menu is selected.

(1) Press [F4 Drawing] in the Set Vision window, and the Set Drawing window will appear as shown below.

The drawing destination screen remains the same as the one specified in this menu, unless it is specified again by VISSCREEN when the programs is running.

When "VISSCREEN 1, 0, 1" is executed, the resultant screen will look like the one shown above.
Displaying the camera input screen and process screen

Access: [F3 Vision]—[F6 Monitor]

Displays a camera image and process screen image on the LCD of the teach pendant (TP).

The resolution is 256 x 240 bpi and the grayscale is 16 levels. The display rate is 2 frames per second for camera images.

When a camera image is displayed, process screen 3 is used as a caption memory (where camera images are temporarily stored). The temporary data of process screen 3 will be lost.

Camera images or process screen images on the LCD are temporarily in grayscale, which is normal. Once this menu screen is closed, the teach pendant screen revert to the original color display.

(1) Press [F4 Drawing] in the Set Vision window, and the Set Drawing window will appear as shown below.

<table>
<thead>
<tr>
<th>Function keys available</th>
</tr>
</thead>
<tbody>
<tr>
<td>[F1 Update]</td>
</tr>
<tr>
<td>Updates the teach pendant screen according to the settings.</td>
</tr>
<tr>
<td>[F2 Continue]</td>
</tr>
<tr>
<td>Performs continuous reading. If Camera 1 or 2 is selected, the images will be read at a rate of two frames per second (and updated once every 0.5 second).</td>
</tr>
<tr>
<td>[F3 Stop]</td>
</tr>
<tr>
<td>Stops continuous reading.</td>
</tr>
</tbody>
</table>
Browsing windows to be used in image analysis  [Ver. 1.5 or later]
Access: [F3 Vision]—[F7 Window]

Browses the parameter values of windows to be used in image analysis and allows you to monitor the frame of the specified window.

(1) Press [F7 Window] in the Set Vision window, and the Edit Window will display as shown below.

```
Parameters     Description
Window No.     Number assigned to a window (0 to 255)
Window type    Shape of a window (Square, line, circle, ellipse, or sector)
X origin       X-coordinate origin of a stored window (0 to 511)
Y origin       Y-coordinate origin of a stored window (0 to 480)
```

Other parameters differ depending upon window shapes. For further details regarding window shapes, refer to “WINDMAKE” in the PROGRAMMER'S MANUAL.

<table>
<thead>
<tr>
<th>Function keys available</th>
</tr>
</thead>
<tbody>
<tr>
<td>[F1 New] Creates, edits, and saves a new window (Edit mode)</td>
</tr>
<tr>
<td>[F2 Edit] Edits a window already stored (Edit mode)</td>
</tr>
<tr>
<td>[F3 Del] Deletes data of the selected window number.</td>
</tr>
<tr>
<td>The deleted data will be completely lost.</td>
</tr>
<tr>
<td>[F5 Change] Changes the window number.</td>
</tr>
<tr>
<td>[F7 Capture] Captures a camera image and displays it on the process screen.</td>
</tr>
<tr>
<td>[F8 Live] Switches to a camera image.</td>
</tr>
</tbody>
</table>
(2) Press OK to display the frame of the selected window.

During execution of "New," "Edit" or "Del," a progress bar will appear as shown below since it takes several seconds to retrieve necessary data from the µVision board.

![Window frame diagram]

Shown below is a frame example of a window number selected. (The colors are not the same as the original image colors).
Creating, editing and saving a new window (Edit mode) [Ver. 1.5 or later]

Access: [F3 Vision]—[F7 Window]—[F1 New]

Creates, edits and saves a new window.

(1) Press [F1 New] in the Edit Window, and the numeric keypad will appear as shown below.
(2) Enter the number of a new window to be created.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Window No.</td>
<td>Number assigned to a window (0 to 255)</td>
</tr>
<tr>
<td>Window type</td>
<td>Shape of a window (Square, line, circle, ellipse, or sector)</td>
</tr>
<tr>
<td>X origin</td>
<td>X-coordinate origin of a stored window (0 to 511)</td>
</tr>
<tr>
<td>Y origin</td>
<td>Y-coordinate origin of a stored window (0 to 480)</td>
</tr>
</tbody>
</table>

Other parameters differ depending upon window shapes. For further details regarding window shapes, refer to "WINDMAKE" in the PROGRAMMER’S MANUAL.

(3) Press OK. The system message will appear and then the following Edit Window will display.
<table>
<thead>
<tr>
<th>Function keys available</th>
</tr>
</thead>
<tbody>
<tr>
<td>[F1 1 pixel]</td>
</tr>
<tr>
<td>[F2 10 pixel]</td>
</tr>
<tr>
<td>[F3 50 pixel]</td>
</tr>
<tr>
<td>[F5 Change]</td>
</tr>
<tr>
<td>[F7 Capture]</td>
</tr>
<tr>
<td>[F8 Live]</td>
</tr>
</tbody>
</table>

(4) You may change the size of the window by modifying the parameters in the window and check the changed size on the monitor.
Editing and saving an existing window (Edit mode) [Ver. 1.5 or later]

Access: [F3 Vision]—[F7 Window]—[F2 Edit]

Edits and saves a new window.

(1) Press [F2 Edit] in the Edit Window, and the following window will appear.

![Edit Window Screenshot]

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Window type</td>
<td>Shape of a window (Square, line, circle, ellipse, or sector)</td>
</tr>
<tr>
<td>X origin</td>
<td>X-coordinate origin of a stored window (0 to 511)</td>
</tr>
<tr>
<td>Y origin</td>
<td>Y-coordinate origin of a stored window (0 to 480)</td>
</tr>
</tbody>
</table>

Other parameters differ depending upon window shapes. For further details regarding window shapes, refer to "WINDMAKE" in the PROGRAMMER'S MANUAL.

(2) Other operating procedure is the same as in [F1 New].

<table>
<thead>
<tr>
<th>Function keys available</th>
</tr>
</thead>
<tbody>
<tr>
<td>[F1 1 pixel]</td>
</tr>
<tr>
<td>[F2 10 pixel]</td>
</tr>
<tr>
<td>[F3 50 pixel]</td>
</tr>
<tr>
<td>[F5 Change]</td>
</tr>
<tr>
<td>[F7 Capture]</td>
</tr>
<tr>
<td>[F8 Live]</td>
</tr>
</tbody>
</table>
**Browsing the stored model data**

**Access:** [F3 Vision]—[F8 Model]

Browses the stored model data that is required in search function.


   ![Edit Model Window](image)

   **When shifted**

   ![Shifted Key](image)

   - **Model No.:** Stored model number (0 to 99)
   - **Origin X:** Origin of X coordinates of the stored model (16 to 485)
   - **Origin Y:** Origin of Y coordinates of the stored model (16 to 453)
   - **Width:** Width of the stored model (10 to 256)
   - **Height:** Height of the stored model (10 to 256)
   - **Offset X:** Offset X from origin (-511 to +511)
   - **Offset Y:** Offset Y from origin (-511 to +511)
   - **Offset angle:** Offset angle from the origin of angle (-360-360)
   - **Size:** File size of the stored model
   - **Remain:** Memory available for storing models

   Origin X and origin Y are not stored into registered data, so they are indicated by "***.

   When a new model is created, process screen 3 is used as a work area and hence the contents of the screen will change.
Chapter 5  Commands Assigned to Function Keys of the Teach Pendant

<table>
<thead>
<tr>
<th>Function keys available</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>[F1 Display]</td>
<td>Displays the image of the selected model number on the monitor.</td>
</tr>
<tr>
<td>[F2 New]</td>
<td>Creates and stores a new model (in Edit mode).</td>
</tr>
<tr>
<td>[F3 Delete]</td>
<td>Deletes the data of the selected model number. The deleted data is lost completely.</td>
</tr>
<tr>
<td>[F5 Change]</td>
<td>Allows you to modify model numbers.</td>
</tr>
<tr>
<td>[F7 CameraIN]</td>
<td>Inputs and displays the camera image on the process screen.</td>
</tr>
<tr>
<td>[F8 Camera]</td>
<td>Switches to camera image.</td>
</tr>
</tbody>
</table>

The offset from the angle origin is specified in 'Offset Angle'. As shown in the drawing, when [Offset Angle] is specified when there is an offset with respect to the angle origin, the offset value affects the resultant [Angle] of [SHMODEL].
During model editing, deleting, or creating, a progress bar will appear as shown below since it takes several seconds to retrieve necessary data from the vision board. The time required will vary depending upon the number of models stored.
Creating a new model
Access: [F3 Vision]—[F8 Model]—[F2 New]

Creates a new model and stores it.

(1) Press [F2 New] in the Edit Model window, and the following edit window will appear as shown below.

Model No.: Specify the number of a model to be created. (0 to 99)
Origin X: Specify the origin of X coordinates of a model to be created. (16 to 485)
Origin Y: Specify the origin of Y coordinates of a model to be created. (16 to 463)
Width: Specify the width of a model to be created. (10 to 256)
Height: Specify the height of a model to be created. (10 to 256)
Offset X: Specify offset X from origin (-511 to +511)
Offset Y: Specify offset Y from origin (-511 to +511)
Offset angle: Offset angle from the angle origin (-360 to 360).

(2) The allowable range of parameter values appears on the monitor screen. Taking those as reference, set the desired values.

<table>
<thead>
<tr>
<th>Function keys available</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>[F1 1 pixel]</td>
<td>Specifies the movement quantum at the rate of 1 pixel.</td>
</tr>
<tr>
<td>[F2 10 pixel]</td>
<td>Specifies the movement quantum at the rate of 10 pixels.</td>
</tr>
<tr>
<td>[F3 50 pixel]</td>
<td>Specifies the movement quantum at the rate of 50 pixels.</td>
</tr>
<tr>
<td>[F5 Change]</td>
<td>Allows you to modify model data.</td>
</tr>
</tbody>
</table>
**Analyzing images [Ver. 1.5 or later]**

**Access:** [F3 Vision]—[F9 Analysis]

Allows you to analyze images temporarily from the teach pendant without setting up corresponding programs.

<table>
<thead>
<tr>
<th>Types of image analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Image analysis functions</strong></td>
</tr>
<tr>
<td>Model search</td>
</tr>
<tr>
<td>Labeling</td>
</tr>
<tr>
<td>Edge finding</td>
</tr>
<tr>
<td>Area/Center of gravity/Major axis angle</td>
</tr>
<tr>
<td>QR code</td>
</tr>
<tr>
<td>Filter processing</td>
</tr>
<tr>
<td>Circle search</td>
</tr>
<tr>
<td>Corner search</td>
</tr>
</tbody>
</table>

(1) Press [F9 Analysis] in the Set Vision window, and the Image Analysis window will display as shown below.

![Image Analysis Window Diagram](image_url)
Chapter 5 Commands Assigned to Function Keys of the Teach Pendant

Window No. : Number of the target window to be processed.
Binary vision parameters : Specifies the upper and lower limits for binary vision.

<table>
<thead>
<tr>
<th>Function keys available</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>[F1 Capture]</td>
<td>Captures a camera image and displays it on the process screen.</td>
</tr>
<tr>
<td>[F2 Live]</td>
<td>Switches to a camera image.</td>
</tr>
<tr>
<td>[F3 Window]</td>
<td>Sets the shape and size of a temporary window.</td>
</tr>
<tr>
<td>[F4 Model]</td>
<td>Temporarily displays the image of the model to be searched in model search.</td>
</tr>
<tr>
<td>[F5 Change]</td>
<td>Changes parameter values.</td>
</tr>
<tr>
<td>[F7 Normal]</td>
<td>Switches to the normal vision where a grayscale image displays in 256-tone.</td>
</tr>
<tr>
<td>[F8 Binary]</td>
<td>Switches to the binary vision where a binary image displays in 2-tone.</td>
</tr>
</tbody>
</table>

(2) Select the desired image analysis.
Pressing [F8 Binary] will show a binary image based on the higher and lower threshold values you have entered. A camera live image may also display as a binary image in real-time.

Normal vision

Binary vision
**Setting or modifying vision board parameters**

Access: [F3 Vision]—[F11 Options]

Sets or modifies vision board parameters.


   ![Vision Parameters Window](image1)

   **Function keys available**

<table>
<thead>
<tr>
<th>Function Key</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>[F1 Back]</td>
<td>Displays the previous page of the parameter list.</td>
</tr>
<tr>
<td>[F2 Next]</td>
<td>Displays the next page of the parameter list.</td>
</tr>
<tr>
<td>[F3 Jump To]</td>
<td>Displays the setup data of the specified number.</td>
</tr>
<tr>
<td>[F5 Change.]</td>
<td>Displays the numeric keypad where you may enter a new parameter.</td>
</tr>
</tbody>
</table>

2. To modify the parameters, press [F5 Change.]. The numeric keypad will appear as shown below.

   ![Change Parameter](image2)
**Initializing the vision board**

Access: [F3 Vision]—[F12 Init.]  

Initializes the vision board to the default settings. This is equivalent to the powering-on reset. This function resets settings made in programs, such as temporary window data, drawing-related settings made in programs, image data in the process screen memory. Use this function if a vision board error occurs.

**NOTE:** You may initialize the vision board only in Manual mode.

**NOTE:** Never execute this command during setting in WINCAPSII or with the teach pendant. Doing so will initialize the vision board so that no correct setting may be made.

(1) Press [F12 Init.] in the Set Vision window, and the system message will appear as shown below.

---

![System Message](image)

---

5-119
5.5 Displaying I/O Signals and Simulating Robot Motion

Access: [F4 I/O]

Displays the I/O Monitor window where you may monitor I/O signals and/or simulate the robot motion with the I/O signals.

Pressing [F4 I/O] on the top screen will display the I/O Monitor window as shown below.

<table>
<thead>
<tr>
<th>Function keys available</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>[F1 Back]</td>
<td>Displays the previous page of the I/O signal list.</td>
</tr>
<tr>
<td>[F2 Next]</td>
<td>Displays the next page of the I/O signal list.</td>
</tr>
<tr>
<td>[F3 Jump To]</td>
<td>Displays the Jump to I/O No. window where you may type an I/O port address you want to see with the numerical keys and press OK. Doing so will display the target input or output signal.</td>
</tr>
<tr>
<td>[F4 Dummy IN]</td>
<td>Allows the selected system-input port to accept a dummy input. That input port will be marked with &quot;!&quot; and the dummy I/O icon will appear in the status bar of the top of the screen. This function is useful for testing programs.</td>
</tr>
<tr>
<td>[F5 ON/OFF]</td>
<td>Displays the system message &quot;Are you sure you want to turn the I/O xxxx on (or off)?&quot; Pressing the OK button will turn the selected input port on (or off).</td>
</tr>
<tr>
<td>[F6 Aux.]</td>
<td>Details are given on the next page.</td>
</tr>
<tr>
<td>[F10 ClrDummy]</td>
<td>Clears the dummy input setting.</td>
</tr>
</tbody>
</table>
Providing auxiliary functions

Access: [F4 I/O]—[F6 Aux.]

Provides the auxiliary functions concerning I/Os.

Pressing [F6 Aux.] in the I/O Monitor window will display the Auxiliary Function (I/O) window as shown below.

![Auxiliary Function (I/O) window]

Configuring hardware

Access: [F4 I/O]—[F6 Aux.]—[F1 Set H/W]

Configures hardware such as I/O assignment mode and DeviceNet expansion.

1. Press [F1 Set H/W] in the Auxiliary Function (I/O) window, and the I/O Hardware Settings window will appear as shown below.

![I/O Hardware Settings window]

2. Select the desired item and press [F5 Change.]. You may modify the setting.
Setting I/O output restrictions when machine is locked
[Ver. 1.4 or later]

Access: [F4 I/O]—[F6 Aux.]—[F7 I/O Lock]

Sets the I/O output restriction range when machine is locked.

(1) Press [F7 I/O Lock] in the Auxiliary Functions (I/O) window. The I/O Lock Setting
window appears as shown below.

(2) Select the desired I/O output restriction type and press the OK button.
Then, the Output Conditions Setting When Machine Lock is released window will
appear.

Choice

Enable All: All outputs are allowed with no I/O output restrictions even
when the machine is locked.

Disable GeneralOUT: Forbids all outputs of ports used for general output.

Disable SystemOUT: Forbids all outputs of ports used for specialized output.
However, ports 72, 73, 74 are not prohibited.

Disable All: Forbids all outputs of ports apart from ports 72, 73, 74 when
the machine is locked.

Note 1: In all case other than "Enable All," the actual I/O output is restricted when the
machine is locked. However, the I/O display of teach pendant is refreshed. according to
the program.

Note 2: I/O output is refreshed on clicking [OK] after modifying I/O lock settings..

Note 3: I/O lock settings are reset to "Disable All" every time the computer is switched
on.
(3) The output conditions set when freeing machine lock become valid when [OK] is pressed after selecting the output conditions set when freeing machine lock.

Note: The settings of /O output restrictions when machine is locked are reset to the original I/O conditions.
5.6 Displaying the Operation Panel

Access: [F5 OpePanel]

Displays the operation panel on the teach pendant screen.

Pressing [F5 OpePanel] on the top screen will display the Operation Panel window as shown below.

Touching a button on the panel will change its color between black (OFF) and green (ON). Switching on/off on the panel concurrently modifies the internal I/O values, 128 to 211.

<table>
<thead>
<tr>
<th>Function keys available</th>
</tr>
</thead>
<tbody>
<tr>
<td>[F1 Back]</td>
</tr>
<tr>
<td>[F2 Next]</td>
</tr>
</tbody>
</table>
5.7 Displaying the Settings (Main) Window

Access: [F6 Set]

Displays the Settings (Main) window.

(1) Press [F6 Set] on the top screen, and the following window will appear.

(2) Select the desired setting function. The corresponding window will display as described on pages 5-125 through 5-162.
**Loading a project**

**Access:** [F6 Set]—[F1 Load!]

Loads a project sent from the PC teaching system, enabling the robot controller to execute it.

1. Press [F1 Load!] in the Settings (Main) window, and the following system message dialog box will appear.

2. Press the OK button to start loading.
**Displaying the error log**

**Access:** [F6 Set]—[F2 Log.]

Displays the error log.

1. Press [F2 Log.] in the Settings (Main) window, and the Log window will appear as shown below.

![Error Log Window]

In the bottom line of the log list appears the error details of the selected error number.

The LineNo and Source areas show nothing.

2. To check older log, scroll the log list with the cursor keys, jog dial, [F1 BACK], or [F2 NEXT]. Or, press [F3 Jump To] to call up the numeric keypad where you enter the line number of the desired error log. Doing so will directly call up the target log.
**Displaying the FDD Access Menu**

**Access:** [F6 Set]—[F3 FD.]

Displays the FDD access menu from which you may access the optional FDD built in the robot controller.

To activate the FDD, the following conditions are necessary:
- The robot controller is placed in Manual mode.
- The motor power is turned off.
- No program is running.

**NOTE:** If you activate any of the FDD operations without loading a floppy disk in the FDD, the FDD will no longer be used until the robot controller will be turned off and then on again.

**NOTE:** Use highly reliable floppy disks. No defective sector checker is embedded in the FDD driver.

1. Press [F9 FD.] in the Settings (Main) window, and the FDD Access Menu will appear as shown below.

![FDD Access Menu](image)

2. Select the desired function. The corresponding window will display as described on pages 5-130 through 5-137.
Data which can be handled by the FDD

The table below lists data which the FDD is capable of handling.

When reading or writing data from/to floppy disks, you may select data to be handled according to the data type (program data, variables data, I/O data, arm data, visual-related data, log data, and executable data).

<table>
<thead>
<tr>
<th>Data Type</th>
<th>File Name (File Contents)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source program data</td>
<td>*.pac file (Source program file)</td>
<td>Only files set to &quot;Enable&quot; can be written to floppy disks.</td>
</tr>
<tr>
<td></td>
<td>*.h file (Header file)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>itpcnf.dat file (Interpreter table)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>paccnf.dat file (Program table)</td>
<td></td>
</tr>
<tr>
<td>Variables data</td>
<td>ivar.dat file (Integer variables)</td>
<td>When variable files are read from a floppy disk to the robot controller, the number of variables used in the robot controller will also be changed to the same number as that used in the floppy disk.</td>
</tr>
<tr>
<td></td>
<td>fvar.dat file (Floating-point variables)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>dvar.dat file (Double-precision variables)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>vvar.dat file (Vector variables)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>pvar.dat file (Position variables)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>jvar.dat file (Joint variables)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>tvar.dat file (Homogeneous transform matrix variables)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>svar.dat file (Character string variables)</td>
<td></td>
</tr>
<tr>
<td>I/O data</td>
<td>dioinf.dat file (I/O hardware settings)</td>
<td></td>
</tr>
<tr>
<td>Arm data</td>
<td>armcnf.dat file (Trajectory settings)</td>
<td>• Never read in arm data prepared for other robots.</td>
</tr>
<tr>
<td></td>
<td>srvcnf.dat file (Servo settings)</td>
<td>• Tool and work data modified by TOOL and WORK commands will not be updated when written onto the FD. If you need to write updated data, save system parameters (see p. 5-160) and then write data onto the FD.</td>
</tr>
<tr>
<td></td>
<td>spdcnf.dat file (Configuration data)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>toolcnf.dat file (Tool coordinates definition data)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>workcnf.dat file (Work coordinates definition data)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>areacnf.dat file (Area coordinates definition data)</td>
<td></td>
</tr>
<tr>
<td>Visual-related data</td>
<td>viscnf.dat file (Visual equipment settings)</td>
<td></td>
</tr>
<tr>
<td>Log data</td>
<td>comcnf.dat file (Communications settings)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ctrl.log file (Control log)</td>
<td>Write (to floppy disk) only.</td>
</tr>
<tr>
<td></td>
<td>error.txt file (Error log)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>opration.txt file (Operation log)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>version.txt file (Version information)</td>
<td></td>
</tr>
<tr>
<td>Executable data</td>
<td>*.nic file (Executable file)</td>
<td>If the total data size exceeds 1MB, writing to floppy disk not possible.</td>
</tr>
<tr>
<td>(Compiled)</td>
<td>*.map file (Cross-reference table)</td>
<td></td>
</tr>
</tbody>
</table>
Data exchange between the robot controller and WINCAPSII

Data (except for executable data) may be exchanged between the robot controller and WINCAPSII by means of floppy disks.

For the operating procedures in WINCAPSII, refer to the WINCAPSII Guide, Chapter 4, Subsections 4.3.4 and 4.3.5.

FD data modification not allowed

Never modify data stored in floppy disks from the robot controller. Any modification will make it impossible to access that FD data because FD data contains check codes used for checking data corruption and for accurate data read/write.
**Reading FD data to the robot controller**

**Access:** [F6 Set]—[F3 FD.]—[F1 Read.]

Reads data stored on a floppy disk to the robot controller.

1. Press [F1 Read.] in the FDD Access Menu, and the Select File to Read window will appear as shown below.

   ![Select File to Read Window](image)

2. Select data to be read from the floppy disk, and then press the OK button.
   
   ![CAUTION: Never read in arm data prepared for other robots. Doing so will cause the robot to malfunction. It is very DANGEROUS.](image)

   The FDD will start reading the FD data.

   **NOTE:** If data is split and stored into more than one floppy disk, insert those disks in an ascending order of the volume numbers (assigned when data has been written onto those disks).

3. After reading, be sure to restart the robot controller.

   If you read program data, refer to "Note for reading program data from FD" given on the next page.

   ![CAUTION: Without restarting, the robot may not run normally.](image)
Notes for reading program data from FD

When reading program data from the inserted floppy disk into the robot controller, the system will first remove all program data and executable data stored in the robot controller and then start reading program data from the floppy disk.

If selected data to be read contains program data but not executable data; therefore, you need to compile and load the read program data according to the steps below.

1) On the top screen of the teach pendant, press [F1 Program] to display the Program List window.

2) Press the Config. button in the bottom of the Program List or press [F12 Config.] in the menu bar. In the system message window shown below, select "All programs are active." to set all programs to "Enable" and then press the OK button to proceed.

3) On the top screen, press [F1 Program]—[F6 Aux.]—[F12 Compile] to compile all programs.

   The following system message appears. Press the OK button to proceed.

4) Restart the robot controller.
Notes for reading new variables data from FD

Reading new variables data from the inserted floppy disk will replace the current variable set stored in the robot controller with the variable set stored in the floppy disk. If the count of the current integer variables is 50 and that of integer variables stored in the floppy disk is 30, for example, the newly read variable set will contain 30 integer variables and 31st to 50th variables will be lost, after completion of this reading operation.
Writing data stored in the robot controller to FD
Access: [F6 Set]—[F3 FD.]—[F2 Write.]

Writes (Saves) data stored in the robot controller to a floppy disk.

(1) Press [F2 Write.] in the FDD Access Menu, and the Select File to Save window will appear as shown below.

(2) Select data to be written onto the floppy disk, then press the OK button to start writing.

The cause of failure writing a file and their countermeasures are given in the table below:

<table>
<thead>
<tr>
<th>Type of file</th>
<th>Reason</th>
<th>Countermeasure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program</td>
<td>The loaded executable data and PAC program may not be matching</td>
<td>If the executable data is vital, do not write the program on it. If the PAC program and the executable data are matching, see “The relation between executable data and program data” given two pages later.</td>
</tr>
<tr>
<td>Executable data</td>
<td>The executable data may not be in existence</td>
<td>Create the executable data by compiling or send the executable data over to the compiler from WINCAPSII or FD.</td>
</tr>
</tbody>
</table>
Notes for writing *program* data onto FD

When writing *program* data stored in the robot controller onto the inserted floppy disk, the system will write only program source files which are set to "Enable" in the Program List window.

In either of the following cases, program source files will be set to "Enable":

1) When a project is loaded in the robot controller. (All of the program source files used in the project will be set to "Enable.")
2) When you set the selected program(s) to "Enable" in the Program List window of the teach pendant.

If you want to write all program source files of the newly loaded project onto a floppy disk, do not change those files from "Enable" to "Disable" or do not edit programs after loading the project. For details refer to "Relationship between executable data and program data," cases 4) through 7) given on the next page.

If you want to write arbitrary program source files onto a floppy disk, select those files by setting programs to "Enable" or "Disable" according to the steps below.

1) On the top screen of the teach pendant, press [F1 Program] to display the Program List window.
2) Press the Config. button in the bottom of the Program List or press [F12 Config.] in the menu bar. In the system message window shown below, make the desired settings and press the OK button to proceed.
Relationship between executable data and program data

If there are discrepancies between executable data (compiled) and source program data (program source), the robot will not run as programmed.

The discrepancy will result when:

1) The PC sends executable data (executable file and cross-reference table) to the robot controller, but it does not send their source program data (except interpreter table and program table).

2) The PC sends source program data to the robot controller, but it does not send executable data.

3) Executable data is read from the floppy disk(s) into the robot controller but its source program data is not.

4) Any part of the source program is edited after compiling.

5) A new project is created.

6) A new program having the same name as already loaded program file is added.

7) Any program is deleted.

8) The Use state of any program(s) is switched between "Disable" and "Enable."

In the above cases except 1) and 3), you may make executable data and source program data coincident with each other by compiling and loading.

If data size is larger than the volume size of a floppy disk

The system will split data so that large data will be written onto more than one floppy disk. At the time, you follow the guidance messages on the teach pendant. Putting serial numbers on the floppy disks will make it easier to read the FD data into the robot controller.

Note that executable data cannot be split; therefore, it should always be saved on a single floppy disk. If you want to write source program data, variables data, and executable data onto floppy disk(s), use one floppy disk for source program data and variables data, and use the other floppy disk for executable data.
**Formatting a floppy disk**

Access: [F6 Set]—[F3 FD.]—[F5 Format.]

Formats a floppy disk inserted into the floppy disk drive.

1. Press [F5 Format.] in the FDD Access Menu, and the following system message will appear.

   ![System Message]

   **Will format the Floppy disk!**
   - Cancel
   - OK

2. Press the OK button to start formatting.
**Saving a control log to FD**

Access: [F6 Set]—[F3 FD.]—[F12 Aux.] —[F11 CtrlLog.]

 Determines whether a control log will also be saved to a floppy disk when you save data stored in the robot controller to the floppy disk.

A control log is large in data size and is not required as backup of facility data. So, enable this command only when you need to save a control log to a floppy disk.

(1) In the FDD Access Menu, press [F12 Aux.].
(2) Press [F11 CtrlLog.], and the following window will appear.
(3) Select "Disable" or "Enable," then press the OK button.
Displaying the memory information of the robot controller

Access: [F6 Set]—[F4 Mem Info]

Displays the memory information of the robot controller.

(1) Press [F4 Mem Info] in the Settings (Main) window, and the Controller Memory Information window will appear as shown below.

The window shows the used and total sizes of the Variables memory and Programs memory.

(2) To close the Controller Memory Information window, press the OK button.
Displaying the Communications Setting Menu

Access: [F6 Set]—[F5 Set Com.]

Displays the communications setting menu.

(1) Press [F5 Set Com.] in the Settings (Main) window, and the Communications Setting Menu will appear as shown below.

(2) Select the desired setting function. The corresponding window will display as described on pages 5-139 through 5-146.
Setting the communication permission

Access: [F6 Set]—[F5 Set Com.]—[F1 Permit.]

Sets the communication permission or the read/write permission for each communications port.

(1) Press [F1 Permit.] in the Communications Setting Menu, and the Communication Permission Settings window will appear as shown below.

NOTE: COM1 is occupied by the teach pendant, so its settings cannot be changed. COM2 is used for communication with the PC teaching system. COM3 and COM4 are reserved for future extension. Ethernet is used as Ethernet port.

(2) Select the target port and then press [F5 Change]. The Change Permission Settings window will appear as shown below.

NOTE: "Read only" or "Read/write" can be set to only any one of COM2, COM3, COM4, and Ethernet port.
TIP: In the Change Permission Settings window are three choices, defined as:

"Disable": Disables the selected communications port.

"Read only": Allows external equipment (such as PC teaching system) to read data from the robot controller.

"Read/write": Allows external equipment (such as PC teaching system) to exchange data with the robot controller.

(3) Select the desired item and press the OK button. The Communication Permission Settings window will reappear.

(4) Check the new entry, then press the OK button to make the new entry take effect. If you press the Cancel button instead of the OK button, the new entry will be cancelled.
Setting the transmission rates for RS-232C serial interface ports

Access: [F6 Set]—[F5 Set Com.]—[F2 Serial IF]

Sets the transmission rate for each of the RS-232C serial interface ports.

(1) Press [F2 Serial IF] in the Communications Setting Menu, and the Set RS-232C window will appear as shown below.

![Set RS-232C window]

**NOTE:** COM1 is occupied by the teach pendant, so its settings cannot be changed. COM2 is used for communication with the PC teaching system and its default transmission rate is 19,200 bps. COM3 and COM4 are reserved for future extension.

**NOTE:** The higher transmission rate may yield the higher transmission error rate.

(2) Select the target port and then press [F5 Change.]. The Select Transmission Rate window will appear as shown below.

![Select Transmission Rate window]
(3) Select the desired transmission rate, then press the OK button to close the Select Transmission Rate window.

(4) Check the new entry, then press the OK button to make the new entry take effect. If you press the Cancel button instead of the OK button, the new entry will be cancelled.

If you press [F4 Default.] in the Set RS-232C window, the following defaults will be restored:

The default of the COM1 (Teach pendant) cannot be changed.

<table>
<thead>
<tr>
<th>Port</th>
<th>Transmission rate (bps)</th>
<th>Parity</th>
<th>Data (character length)</th>
<th>Stop bit</th>
<th>CR/LF code</th>
</tr>
</thead>
<tbody>
<tr>
<td>COM1 (Teach pendant)</td>
<td>19200</td>
<td>None</td>
<td>8 bits</td>
<td>1 bit</td>
<td>CR</td>
</tr>
<tr>
<td>COM2 (RS-232C)</td>
<td>19200</td>
<td>None</td>
<td>8 bits</td>
<td>1 bit</td>
<td>CR</td>
</tr>
<tr>
<td>COM3</td>
<td>19200</td>
<td>None</td>
<td>8 bits</td>
<td>1 bit</td>
<td>CR</td>
</tr>
<tr>
<td>COM4</td>
<td>19200</td>
<td>None</td>
<td>8 bits</td>
<td>1 bit</td>
<td>CR</td>
</tr>
</tbody>
</table>
**Initializing modem**

**Access:** [F6 Set]—[F5 Set Com.]—[F3 Modem]

Initializes the modem connected to the selected modem port.

1. Press [F3 Modem] in the Communications Setting Menu, and the Set Modem window will appear as shown below.

2. Select the modem port with which the target modem is connected and then press the OK button to proceed. The following system message will appear.

3. Check the message and then press the OK button to start initializing the modem. The system message "Completed initializing the modem successfully." will appear.

4. Press the OK button to close the system message dialog box.
Chapter 5  Commands Assigned to Function Keys of the Teach Pendant

Setting the IP address of the robot controller
Access: [F6 Set]—[F5 Set Com.]—[F4 Address]

Sets the IP address of the robot controller.

(1) Press [F4 Address] in the Communications Setting Menu, and the Set Controller IP Address window will appear as shown below.

(2) Select the item to be set, and then press [F5 Change.].

(3) Enter the desired value with the numerical buttons in the above window, and then press the OK button to enter the new entry into the Set Controller IP Address window.

(4) Check the new entry, then press the OK button to make the new entry take effect. If you press the Cancel button instead of the OK button, the new entry will be cancelled. To close the Set Controller IP Address window, press the OK or Cancel button.
**Setting gateways**

**Access:** [F6 Set]—[F5 Set Com.]—[F5 Gateway]

Sets the gateways and destinations.

(1) Press [F5 Gateway] in the Communications Setting Menu, and the Set Gateway window will appear as shown below.

![Set Gateway window](image)

(2) Select the item to be set, and then press [F5 Change.]. The numeric keypad will appear as shown below.

![Numeric keypad](image)

(3) Enter the desired value with the numerical buttons in the above window, and then press the OK button. The new entry will be entered into the Set Gateway window.

(4) Check the new entry, then press the OK button to make the new entry take effect. If you press the Cancel button instead of the OK button, the new entry will be cancelled. To close the Set Gateway window, press the OK or Cancel button.
Chapter 5  Commands Assigned to Function Keys of the Teach Pendant

Setting high speed program file transmission
[Ver. 1.4 or later]

Access: [F6 Set]—[F5 Set Com.]—[F7 HiSpeed!]

Sets the action of sending projects from the instruction system of the PC.

(1) Press [F7 HiSpeed!] in [Set Com.] menu. This opens [Program File Transfering settings] window.

(2) Select either 'Normal speed mode' or 'High speed mode' and press [OK].

When 'High speed mode' is selected

When 'High speed mode' is selected, the received data is not saved. Therefore the data is lost once power is switched off. To avoid this, make sure you save the received data by pressing [F9 SaveFile] in the [Set (Main)] window.
**Displaying the Maintenance menu**

**Access:** [F6 Set]—[F6 Maint.]

Displays the Maintenance menu.

1. Press [F6 Maint.] in the Settings (Main) window, and the Maintenance menu will appear as shown below.

![Maintenance menu](image)

2. Select the desired setting function. The corresponding window will display as described on pages 5-149 through 5-155.
**Displaying the robot controller ON-time and the robot running time**

Access: [F6 Set]—[F6 Maint.]—[F1 Total h]

Displays the robot controller ON-time and the robot running time.

(1) Press [F1 Total h] in the Maintenance menu, and the Total hours window will appear as shown below.

![Total hours window](image)

The Total hours window has the following items:

- **[Total operation]** Shows the grand total of the robot controller ON-time counted after the controller leaves the factory.
- **[Total running]** Shows the grand total of the robot running time counted after the robot leaves the factory.
- **[Cumu. operation]** Shows the total of the robot controller ON-time counted after you reset the user counter to zero.
- **[Cumu. running]** Shows the total of the robot running time counted after you reset the user counter to zero.
- **[Operation]** Shows the ON-time of the robot controller counted after it is turned ON this time.
- **[Running]** Shows the running time of the robot counted after the robot controller is turned ON this time.

<table>
<thead>
<tr>
<th>Function keys available</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>[F4 Cumu. o]</strong></td>
</tr>
<tr>
<td>Calls up the system message dialog box where you may reset the user counter of the robot controller ON-time.</td>
</tr>
<tr>
<td><strong>[F5 Cumu. r]</strong></td>
</tr>
<tr>
<td>Calls up the system message dialog box where you may reset the user counter of the robot running time.</td>
</tr>
</tbody>
</table>
(2) To reset the user counter of the robot controller ON-time to zero, press [F4 Cumu. o] in the Total hours window. The following window will appear. If you want to reset the counter to zero, press the OK button.

(3) To reset the user counter of the robot running time to zero, press [F5 Cumu. r] in the Total hours window. The following window will appear. If you want to reset the counter to zero, press the OK button.
Displaying the version information of each module
Access: [F6 Set]—[F6 Maint.]—[F2 Version]

Displays the version information of each module in the robot controller.


(2) Press the OK button or Cancel key to close the Version window.
Setting the calendar clock built in the robot controller
Access: [F6 Set]—[F6 Maint.]—[F3 Date.]

Sets the calendar clock built in the robot controller.

(1) Press [F3 Date.] in the Maintenance menu, and the Date & Time window will appear as shown below.

(2) Select the item to be set, and then press [F5 Change.]. The numeric keypad will appear as shown below.

(3) Enter the desired value with the numerical buttons in the above window, and then press the OK button to take the new entry into the Date & Time window.

(4) Check the new entry, then press the OK button to make the new entry take effect. If you press the Cancel button instead of the OK button, the system message “The parameters have been changed. Are you sure you want to revert to previous settings?” will appear. Press the OK button to cancel the new entry; press the Cancel button to return to the Date & Time screen.
Setting the next battery replacement date

Access: [F6 Set]—[F6 Maint.]—[F4 Battery]

Sets the next replacement date of the memory backup battery of the robot controller.

When the replacement day comes, the message "It's time to replace the backup battery of the robot controller." will appear in the menu bar of the teach pendant.

(1) Press [F4 Battery] in the Maintenance menu, and the Next Battery Replacement Date window will appear as shown below.

The current setting (June/5/2002 in this example) is displayed in the top of the window.

The date entry areas display the default replacement date (June 5, 2002) that is two years later the current date (June/5/2000) at which you open this window, assuming that the battery service life is two years.

(2) If you open this window just to check the current setting, be sure to press the Cancel button.

If the displayed default replacement date is the date you want to set, press the OK button.

To set new replacement date, select the item to be modified, and then press [F5 Change.]. The numeric keypad will appear as shown below.
(3) Enter the desired date with the numerical buttons in the above window, and then press the OK button.

**NOTE:** To set months, use the numerical buttons. For January, February, ...December, enter 1, 2, ...12, respectively.

The new entry will be entered into the Next Battery Replacement Date window.

**CAUTION:** Make sure that the new replacement date you set is within two years from when you have actually replaced the battery with a new one.

(4) Check the new entry, then press the OK button to make the new entry take effect.

If you press the Cancel button instead of the OK button, the new entry will be cancelled. To close the Next Battery Replacement Date window, press the OK or Cancel button.
**Displaying the odometer and trip meter for each axis**

**Access:** [F6 Set] — [F6 Maint.] — [F5 Odometer]

Displays the odometer and trip meter which count traversed distance of each axis. If the trip meter count reaches the distance requiring oil change, perform the necessary maintenance.

1. Press [F5 Odometer] in the Maintenance menu, and the following window will appear.

   ![Image of Odometer window]

   The Odometer window has the following items:

   - [Odometer]: Shows the total distance of each axis traversed after the robot leaves the factory.
   - [Trip meter]: Shows the distance of each axis traversed after you reset the trip meter to zero.
   - [Interval]: Shows the oil change intervals specified for each axis.

2. To reset the trip meter to zero, press [F6 Reset]. The following window will appear. If you want to reset the trip meter to zero, press the OK button.
Displaying the Option Menu

Access: [F6 Set]—[F7 Options.]

Displays the option menu.

1. Press [F5 Options.] in the Settings (Main) window, and the Option Menu window will appear as shown below.

2. Select the desired setting function. The corresponding window will display as described on pages 5-157 and 5-160.
**Setting the protection mode**

**Access:**  
[F6 Set]—[F7 Options.]—[F3 Protect.]

Sets the protection mode which protects programs and/or parameters from getting modified from the teach pendant.

(1) Press [F3 Protect.] in the Option Menu, and the Protection Mode Setting window will appear as shown below.

(2) Select the desired protection mode and press the OK button. The selected mode goes into effect.
Selecting language

Access: [F6 Set]—[F7 Options.]—[F6 Language]

Switches the pendant screen language version to the language you select.

(1) Press [F6 Language] in the Option Menu, and the Select Language window will appear as shown below.

(2) Select the desired language and then press the OK button.
(3) To make the new entry take effect, close all opened windows to call up the top screen. Then the top screen is expressed in the selected language (Japanese in this example).

Enabling extension functions

Access: [F6 Set]—[F7 Options.]—[F8 Extnsion]—[F5 Input ID]

Enables extension functions.
Once enabled, the setting will be retained even if the controller power is turned off and on.
Extension functions include the tip compliance control function described in the PROGRAMMER’S MANUAL, Chapter 3, Subsection 3.5.3.
Setting the robot type for the controller
Access: [F6 Set]—[F7 Options.]—[F11 ROBTYPE]

Sets the robot type for the controller.
This command is intended for YASKAWA service personnel only. Do not use this command.

Updating the controller system
Access: [F6 Set]—[F7 Options.]—[F12 Update.]

Updates the controller system version.
This command is intended for YASKAWA service personnel only. Do not use this command.
Saving system parameters

Access: [F6 Set]—[F8 Save!]

Saves the system parameters stored in the robot controller so that turning the robot controller off will not lose those parameter values.

1. Press [F8 Save!] in the Settings (Main) window, and the following system message dialog box will appear.

![System Message Dialog Box]

2. Press the OK button to save the system parameters and display the following system message dialog box.

![System Message Dialog Box]

3. Press the OK button to close the system message dialog box.
**Saving a program**

**Access:** [F6 Set]—[F9  SaveFile]

Saves the programs stored in the robot controller. This way the programs can be maintained even when power to the robot controller is switched off.

1. Press [F9 SaveFile] in [Set (Main0) window. The following system message dialog box will appear.

2. Press [OK] to save the program.

3. Once the program is saved the following system message will appear

4. Press [OK]
5.8 Switching between Internal and External Auto Modes

Access: [F10 Int/Ext]

Switches between the internal and external Auto modes.

When this command is to be executed, the robot controller should be placed either in internal Auto mode or external Auto mode.

(1) Press [F10 Int/Ext] on the top screen, and the following window will appear.

(2) Press the OK button to switch.
5.9 Preparing the Robot Controller to Unplug the Teach Pendant

Access: [F11 Unplug]

Prepares the robot controller so that you may unplug the teach pendant. Before unplugging the teach pendant from the robot controller or operating panel, be sure to use this command.

Before carrying out this command, ensure that:
1) The robot controller should be placed in Auto mode and
2) An emergency stop signal should be inputted.

(1) Press [F11 Unplug] on the top screen, and the following window will appear.

(2) Press the OK button to proceed.
   The following window will appear.

(3) Unplug the teach pendant from the robot controller or operating panel.
Chapter 6

Using the Mini-Pendant

This chapter describes how to control the robot using the mini-pendant.

**NOTE 1:** Avoid letting the mini-pendant undergo any strong shocks, impacts, or vibrations.

**NOTE 2:** Touch the mini-pendant with your fingers only, never with the tip of a pen or any pointed object. Otherwise, the LCD may be broken.
Chapter 6  Using the Mini-Pendant

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6.1 Commands Menu

Using the keys, buttons, and switches on the mini-pendant allows you to call up a variety of screens on the LCD. This section guides you through the menu tree and then gives you detailed operations.

6.1.1 Keypad and Top Screen

When the power is first applied to the robot controller, the mini-pendant displays the top screen shown below. In the top line of the screen is a status bar which always displays the current operation mode, program status, connected robot model, motion mode, speed, and other information. For details about the top screen, refer to Chapter 1, Subsection 1.4.
6.1.2 Menu Tree

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6-2
Chapter 6 Operation using Mini-Pendant

--- [COM Setting] ---

**Setting Communications Port**

- **Permit**
  - Calling Permission Screen and Choosing Port
  
  **[Permission]**
  - ★★★★★ 232C RS-232C port
  - ★★★★  COM3 COM port
  - ★★★★ COM4 COM port
  - ★★★★ Ether Ethernet port
  
  • Permit: ★★★★★
    - ★★★★★: Selected port name
  
  • Read/Write

- **RS-232C**
  - Changing Serial Port Speed and Choosing Serial Port
  
  **[Set RS-232C]**
  - ★★★★★ 232C RS-232C port
  - ★★★★ COM3 COM port
  - ★★★★ COM4 COM port
  - ★★★★ Ether Ethernet port
  
  • RS-232C rate
    - 9600bps
    - 38400bps
    - 57600bps
    - 115200bps

- **IP Address**
  - Setting IP Address

---

6-3
6.2 Operation Using the Mini-Pendant

6.2.1 Turning the Motor ON/OFF

Key: [MOTOR]

Operation
Pressing [MOTOR] toggles the joint-drive motors on and off.
Pressing this key when the LED is off will turn the motors on and switches the LED on.
Pressing it when the LED is on will turn the motors off and switches it off.

6.2.2 Machine Lock and Release

Key: [LOCK] [SHIFT] + [MOTOR]

Operation
Pressing [LOCK] toggles between the machine lock and release.
6.2.3 Choosing the Robot Model

Key: [1: R-SEL]

Operation

1. Press [1: R-SEL] to call up the Robot screen as shown below, which lists all robot models you can choose.

![Robot screen](image)

2. When the power is first applied to the robot controller, the mini-pendant shows robot models preset by default. Use up and down cursor keys to choose the robot model you want to run and then press [OK].

To discard the new setting, press [CANCEL].
6.2.4 Switching the Motion Modes

Key: [2: M-MOD]

Operation

(1) Press [2:M-MOD] to call up the "MoveMode" screen as shown below, which lists the motion modes you can choose for your robot.

![MoveMode Screen](image1)

(2) From the Joint, X-Y, and Tool modes, choose one in which you want to run your robot in Manual mode, by using up and down cursor keys. Then press [OK].

To discard the new setting, press [Cancel].

![MoveMode Screen](image2)
6.2.5 Changing Work Coordinates

Keys: [WORK] [SHIFT] + [2: M-MOD]

Operation

(1) Press [WORK] to call up the "WorkNo" screen as shown below, which shows the current work coordinates number.

![WorkNo Screen]

(2) When the power is first applied to the robot controller, the WORK0 (Base coordinate) is set by default. Enter a number indicating the desired work coordinates. Then press [OK].

To discard the new setting, press [CANCEL].

![WorkNo Screen with New Number]
6.2.6 Changing the Robot Speed

Key: [3: SPEED]

Operation

(1) Press [3:SPEED] to call up the "Speed" screen shown below where you can change the robot speed.

![Speed Screen]

(2) Use the right and left cursor keys to choose the desired speed (from 1 to 100), then press [OK].

Each time you press the right or left cursor key, the speed will increase or decrease in units of 5, respectively.

To discard the new setting, press [CANCEL].

![Speed Screen with Speed 100]
6.2.7 Changing Tool Coordinates

Keys: [TOOL] [SHIFT] + [3: SPEED]

Operation

(1) Press [TOOL] to call up the "ToolNo" screen as shown below, which shows the current tool coordinates number.

![ToolNo Screen](image1)

(2) When the power is first applied to the robot controller, the TOOL0 (Flange) is set by default. Enter a number indicating the desired tool coordinates. Then press [OK].

To discard the new setting, press [CANCEL].

![ToolNo Screen](image2)
6.2.8 Switching between Internal and External Auto Modes

Key: [INT/EXT]

Operation

1. With the top screen displayed, press [INT/EXT] in Internal Auto mode to switch to External Auto mode.

Switch to E

2. With the top screen displayed, press [INT/EXT] in External Auto mode to switch to Internal Auto mode.

Switch to A.
6.2.9 Handling Programs

Key: [PROGRAM]

Operation

(1) Press [PROGRAM] to call up the program list as shown below, which lists programs currently loaded in your robot controller.

![Program List]

(2) Press [OK] to call up the "Functions" screen that lists program handles.

![Functions Screen]

(3) Choose the "Display" handle with the up and down cursor and then press [OK]. The property of the selected program appears as shown below, including the program number, title, and the number of steps.

![Program Property]

(4) To display other program information, scroll the screen vertically with the up and down cursor keys.
(1) Checking the program in details

On the program list window called up by the [PROGRAM], you may check the program details—execution status, program size, execution time, and execution priority by scrolling the screen horizontally with the right and left cursor keys.

(1.1) Displaying the program execution status

You can check the execution status of programs currently loaded.

(1.2) Checking the program size

You can check the size of loaded programs in number of steps.

(1.3) Checking the program execution time

You can check the execution time (in seconds) of loaded programs.
(1.4) Checking the program execution priority
You can check the execution priority level of each program currently loaded.

(2) Starting a program

(1) On the program list window called up by the [PROGRAM], you may choose a program to run with the up and down cursor keys.

(2) Press [RUN] to show the program running mode menu.

(3) Choose a program running mode with the up and down cursor keys, then press [OK]. The selected program will run.

**NOTE:** Make sure that CAL has been completed and the motor power is on before starting any programs.
(4) If you want to stop the current robot motion immediately, press [STEP STOP], [CYCLE STOP] or [HALT] to halt the currently running program.

(3) Step Start

(1) On the program list window called up by the [PROGRAM], you may choose a program to run with the up and down cursor keys.

(2) Press [STEP START] to call up the program control screen, for instance “PRO1” as shown below.

(3) Press [OK] to step-start the selected program.

NOTE: Make sure that CAL has been completed and the motor power is on before starting any programs.
(4) If you want to stop the current robot motion immediately, press [STEP STOP], [CYCLE STOP] or [HALT] to halt the currently running program.

(4) Teach Check

(4.1) Cycle Start

(1) Turn the mode selector switch to the TEACH position to switch to Teach Check mode.

Switch to T. →

(2) Press [PROGRAM] to call up the program list window as shown below. Choose a program to run with the up and down cursor keys.

(3) Press [RUN] to call up the following screen.
(4) While holding down the deadman switch, press [OK] to start the program. Keep holding them down until the program will finish.

**NOTE:** Make sure that CAL has been completed and the motor power is on before starting any programs.

(5) If you release either one of the deadman switch and [OK], then the robot running by programs will immediately stop.

If you want to stop the current robot motion immediately, press [STEP STOP], [CYCLE STOP] or [HALT].
(4.2) Step Start and Step Back

(1) Turn the mode selector switch to the TEACH position to switch to Teach Check mode.

![Teach Check Mode](image)

(2) Press [PROGRAM] to call up the program list window as shown below. Choose a program to run with the up and down cursor keys.

![Program List](image)

(3) Press [STEP START] to call up the following screen.

![Step Start Screen](image)

(4) While holding down the deadman switch, press [OK] to start the program. Keep holding them down until the program will finish.

**NOTE:** Make sure that CAL has been completed and the motor power is on before starting any programs.
(5) If you release either one of the deadman switch and [OK], then the robot running by programs will immediately stop.

If you want to stop the current robot motion immediately, press [STEP STOP], [CYCLE STOP] or [HALT].

(6) Press [STEP BACK] to call up the program control screen.

(7) While holding down the deadman switch, press [OK] to start the program. Keep holding them down until the program will finish.

**NOTE:** Make sure that CAL has been completed and the motor power is on before starting any programs.

(8) If you release either one of the deadman switch and [OK], the robot running by programs will immediately stop.

If you want to stop the current robot motion immediately, press [STEP STOP], [CYCLE STOP] or [HALT].
6.2.10 Resetting Programs

Key: [PRO RESET] [SHIFT] + [PROGRAM]

Operation

(1) Press [PRO RESET] to call up the "Reset" screen as shown below. Choose one of the items listed on the screen by using the up and down cursor keys.

![Reset Screen](image)

(2) Press [OK] to reset the selected type of programs. To discard the new setting, press [CANCEL]. The display will return to the top screen.

![OK Screen](image)
6.2.11 Modifying the Current Robot Arm Position

Key: [ARM] [SHIFT] + [RUN]

Operation

(1) Press [ARM] to call up the current robot position window.

```
+-----+-------+------+
| J1  | 0.00  |
| J2  | 0.00  |
| J3  | 0.00  |
| J4  | 0.00  |
| J5  | 0.00  |
| J6  | 0.00  |
```

(2) When the robot controller is turned on, the coordinates is displayed in Joint type by default as shown above.

Press [OK] to call up the Display Style window where you can select the desired coordinates display type.

```
+-----+-------+------+
| X   | 15.00 |
| Y   | 0.00  |
| Z   | 1265.00 |
| RX  | 0.00  |
| RY  | 0.00  |
| RZ  | 0.00  |
```

(3) Choose the coordinates display type by using the up and down cursor keys, then press [OK].

To discard the new setting, press [CANCEL].
6.2.12 Changing the Variable Value

Key: [VARIABLE] [SHIFT] + [STEP BACK]

Operation

(1) Press [VARIABLE] to call up the screen which lists variables used in your robot controller.

```
A  V  M  X  Y  W  O  T  0  1  0  0  N
I [ 0/100]
I [ 1/100]
I [ 2/100]
```

(2) When the robot controller is turned on, the integer variables are displayed by default. You can cycle through variable types to be displayed by using the right and left cursor keys.

(The screen will cycle through "I → F → D → V → P → J → T → I")

```
P [ 0/100]
X : 0.0000000
Y : 0.0000000
Z : 0.0000000
RX : 0.0000000
```

(3) With the desired variables displayed, press [OK] to call up the "Function" screen to handle the selected variable.

To discard the new setting, press [CANCEL].

```
F u n c t i o n
• J u m p T o
• C h a n g e
• C o p y

[C a n c e l / O K]
```

Choose one of the handles with the up and down cursor keys, then press [OK]. To discard the new setting, press [CANCEL].
(3.1) **Jump To**

If you choose "Jump To" with the up and down cursor keys and press [OK], then the following Jump To screen appears. Enter the variable number you want to jump to, into the highlighted line and press [OK].

![Jump To screen](image)

(3.2) **Change**

If you choose "Change" with the up and down cursor keys and press [OK], then the following variable setting window appears. Enter the desired value to be assigned to the variable and press [OK].

To discard the new setting and return to the previous screen, press [CANCEL].

![Change screen](image)

(3.3) **Change**

If you choose "Copy" with the up and down cursor keys and press [OK], then the Copy To window appears. Enter an arbitrary variable number which the value of the variable will be copied to, then press [OK].

To discard the new setting and return to the previous screen, press [CANCEL].

![Copy screen](image)
6.2.13 Reconfiguring I/O Signals

Key: [I/O] [SHIFT] + [STEP START]

Operation

(1) Press [I/O] to call up the I/O signal truth table as shown below.

<table>
<thead>
<tr>
<th>A</th>
<th>VM</th>
<th>X</th>
<th>Y</th>
<th>W</th>
<th>O</th>
<th>T</th>
<th>0</th>
<th>1</th>
<th>0</th>
<th>0</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(2) To change the truth status assigned to I/O lines, choose the line with the up, down, left, and right cursor keys.

<table>
<thead>
<tr>
<th>A</th>
<th>VM</th>
<th>X</th>
<th>Y</th>
<th>W</th>
<th>O</th>
<th>T</th>
<th>0</th>
<th>1</th>
<th>0</th>
<th>0</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(3) Press [OK] call up the "Function" screen that handles I/O signals. Press [CANCEL] to return to the previous screen.

<table>
<thead>
<tr>
<th>A</th>
<th>VM</th>
<th>X</th>
<th>Y</th>
<th>W</th>
<th>O</th>
<th>T</th>
<th>0</th>
<th>1</th>
<th>0</th>
<th>0</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Jump To 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• ON/OFF 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[Cancel/OK] 7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
(4) Choose one of handles with the up and down cursor keys, then press [OK].

(4.1) ON/OFF

If you choose "ON/OFF" with the up and down cursor keys and press [OK], then the following screen appears where you may reverse the truth assignment of the line.

To discard the new setting and return to the previous screen, press [CANCEL].

(4.2) Jump To

If you choose "Jump To" with the up and down cursor keys, the Jump To screen appears. Enter a line number you want to jump to, into the highlighted line and then press [OK].

To discard the new setting and return to the previous screen, press [CANCEL].
6.2.14 Executing CAL

Key: [CAL]  (Effective in Manual mode)

Operation

(1) Press [CAL] to call up the CAL confirmation window as shown below.

(2) Check that the motor power is on, then press [OK] to execute CAL.
   To abort it and return to the previous screen, press [CANCEL].
6.2.15 Releasing and Locking Brakes

Key: [BRAKE] (Effective in Manual mode)

Operation

(1) Press [BRAKE] to call up the "Brake" window as shown below.

![Brake Control Window]

(2) Choose the All Axes or Each Axis to handle by using the up and down cursor keys, then press [OK]. The display will proceed to the brake control screen.

(2.1) All Axes

If you choose "All Axes" with the up and down cursor keys and press [OK], then the following All Axes screen appears where you can control the brakes.

To return to the previous screen, press [CANCEL].

![All Axes Control Window]

Choose "Release" or "Lock" with the up and down cursor, then press [OK].

To discard the new setting and return to the previous screen, press [OK].

During these operations, confirmation dialogs given on the next page will appear, confirming your operation. Press [OK] to proceed; press [CANCEL] to abort.
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Release brake confirmation dialog

ロックブラスト確認ダイアログ

Lock brake confirmation dialog

ロックブラスト確認ダイアログ

(2.2) Each Axis

If you choose "Each Axis" with the up and down cursor keys and press [OK], then the following Each Axis screen appears where you can control the brake for each joint. The letters, R and L, stand for current Release and Lock status of each joint brake, respectively.

To return to the previous screen, press [CANCEL].

Choose an arbitrary joint with the up and down cursor keys. (You may vertically scroll the screen with those keys.) Pressing OK will toggle between "Release" and "Lock" for each robot joint.

To discard the new setting, press [CANCEL].

During these operations, confirmation dialogs given on the next page will appear, confirming your operation. Press [OK] to proceed; press [CANCEL] to abort.

(2.2) 各軸

各軸を選択するには、上向きまたは下向きのカーソルキーを使用します。そして[OK]を押すと、各軸に対してブレーキのリリースまたはロックを設定することができます。RとLは、各軸のブレーキのリリースまたはロックの現在の状態を表しています。

前の画面に戻るには、[CANCEL]を押します。

選択した任意の軸に対して、[OK]を押すと、そのブレーキのリリースまたはロックが設定されます。[CANCEL]を押すと、新しい設定を破棄することができます。

これらの操作時に、次のページに表示される確認ダイアログが表示され、操作を確認します。[OK]を押すと操作が続けられます。[CANCEL]を押すと操作が中断されます。
Release brake confirmation dialog

Lock brake confirmation dialog
6.2.16 Logging Data

Key: [LOG]  [SHIFT] + [BRAKE]

Operation
Press [LOG] to call up the Log screen as shown below where you can handle the error and control logging.

(1) Checking error log
Choose "ErrorLog" with the up and down cursor keys, then press [OK] to call up the error log as shown below. You can check errors in your robot controller. You may vertically scroll the screen with the up and down cursor keys.

(2) Handling control log
Choose "CtrlLog" with the up and down cursor keys, then press [OK] to call up the save log confirmation dialog as shown below. Press [OK] to save control log. To discard the new setting, press [CANCEL].
6.2.17 Setting Communications Port

Key: [COM] (Effective in Manual mode)

Operation

(1) Press [COM] to call up the "COM Setting" screen shown below which lists communications setting for the robot controller.

(2) Choose "Permit" with the up and down cursor keys and then press [OK]. The Permission screen appears as shown below.

To return to the previous screen, press [CANCEL].

(3) Choose any port whose communications permission should be changed, from the 232C, COM3, COM4 and Ether ports, by using the up and down cursor keys. (You may vertically scroll the screen with those keys.)

Then press [OK] to proceed to the "Permit-COM" setting as shown below.

To return to the previous screen, press [CANCEL].

Choose any of "Disable", "read only" and "read/write," and then press [OK] to establish the new setting.

To cancel the new setting, press [CANCEL].
Chapter 6  Operation using Mini-Pendant

6.2.18 Changing Serial Port Speed

Key: [COM]  (Effective in Manual mode)

Operation

(1) Press [COM] to call up the "COM Setting" screen shown below which lists communications setting for the robot controller.

```
  COM Setting
  • Permit
  • RS-232C
  • IP address

[Cancel/OK]
```

(2) Choose "RS-232C" with the up and down cursor keys, then press [OK]. The communications ports window appears as shown below which lists the communications ports available in your robot controller. (You may vertically scroll the screen with those keys.)

To discard the new setting and return to the previous screen, press [CANCEL].

```
  Set RS-232C
  • COM2-232C
  • COM3
  • COM4

[Cancel/OK]
```

(3) Choose any port whose communications speed should be changed, from the COM2-232C, COM3 and COM4 ports, by using the up and down cursor keys. (You may vertically scroll the screen with those keys)

Then press [OK] to proceed to the "COM2-rate" setting shown below.

To discard the new setting and return to the previous screen, press [CANCEL].

```
  COM2-rate
  • 9600 bps
  • 19200 bps
  • 38400 bps

[Cancel/OK]
```

Choose any of "9600bps", "19200bps", "38400bps", "57600bps" and "115200bps," then press [OK] to establish it.

To discard the new setting, press [CANCEL].
6.2.19 Setting IP Address

Key: [COM] (Effective in Manual mode)

Operation

(1) Press [COM] to call up the "COM Setting" screen shown below which lists communications setting for the robot controller.

```
COM Setting
• Permit
• RS-232C
• IP address
        [Cancel/OK]
```

(2) Choose "IPaddress" with the up and down cursor keys, then press [OK]. The IP address setting window appears as shown below where you can set the IP address of your robot controller.

To return to the previous screen, press [CANCEL].

```
IP address
10.  8.  109.  86

Subnet mask
255. 255. 255. 0
```

(3) Choose an input field with the up, down, right, and left cursor keys, then enter a new address plus a dot (as a field delimiter).

To discard the new setting, press [CANCEL]. Generally, the "Subnet mask" fields will require no change.

```
IP address
  8.  8. 109.  86

Subnet mask
255. 255. 255. 0
```

When [8] is entered:
(4) After filling up the field, press [OK]. The following confirmation message dialog will appear.

Press [OK] to establish the new entry.

To discard the new setting, press [CANCEL].
6.2.20 Loading New Project

Key: [LOG] [SHIFT] + [COM]

Operation

(1) Press [LOAD] to load a new project into your robot controller. The load confirmation message will appear as shown below.

![Load confirmation message]

(2) Press [OK] to proceed. During loading, the message shown below is displayed.

**NOTE:** Loading a new project may take few minutes. To abort it, press [CANCEL].

![Loading progress message]
6.2.21 Using Auxiliary Functions

Key: [AUX]

Operation

(1) Press [AUX] to call up the "Aux. Function" menu shown below.

![Aux Function Menu]

(2) Choose a function you want to run with the up and down cursor keys. (You may vertically scroll the screen with those keys.) Then press [OK] to proceed.

(2.1) Version

If you choose "Version" in the "Aux Function" menu with the up and down cursor keys and press [OK], then the following Version menu appears where you can choose an object to view its version.

![Version Menu]

Choose "ROM" and press [OK], and the version of the system software currently loaded in your controller will appear.

Choose "Servo" and press [OK], and the version of the servo control subsystem will appear.
(2.2) **Save File**
If you choose "Save File" in the "Aux Function" menu with the up and down cursor keys and press [OK], then the following confirmation message will appear. Press [OK] to save the program files that are currently active. To abort saving, press [CANCEL].

![Save File Menu](image)

(2.3) **Clear Data**
If you choose "Clr Data" in the "Aux Function" menu with the up and down cursor keys and press [OK], then the following Clr Data menu appears.

![Clr Data Menu](image)

**Deleting program files**
Choose "Program" in the "Clr Data" menu with the up and down cursor keys, then press [OK]. The following confirmation message will appear. To abort deletion, press [CANCEL].

![Program Delete Menu](image)

Press [OK] to delete all program files currently loaded in your controller. To abort deletion, press [CANCEL].
Deleting variables

Choose "Variable" in the "Clr Data" menu with the up and down cursor keys, then press [OK]. The following confirmation message will appear.

To abort deletion, press [CANCEL].

Press [OK] to delete all variables currently loaded in your controller.

To abort deletion, press [CANCEL].

(2.4) Maintenance

If you choose "Maintenance" in the "Aux Function" menu with the up and down cursor keys and press [OK], the following Contrast menu will appear.

Choose your favorite contrast level with the up and down cursor keys. (You may vertically scroll the screen with those keys.) Then press [OK] to apply it.

NOTE: Making the new level go into effect may take a few minutes.

To discard the new setting, press [CANCEL].
The purpose of this manual is to provide accurate information in the handling and operating of the robot. Please feel free to send your comments regarding any errors or omissions you may have found, or any suggestions you may have for generally improving the manual.

In no event will YASKAWA be liable for any direct or indirect damages resulting from the application of the information in this manual.
Upon receipt of the product and prior to initial operation, read these instructions thoroughly, and retain for future reference.

MOTOMAN INSTRUCTIONS

MOTOMAN-□□□ INSTRUCTIONS
JRC BEGINNER’S GUIDE
JRC SETTING-UP MANUAL
JRC INSTALLATION & MAINTENANCE GUIDE
JRC WINCAPS II GUIDE
JRC PROGRAMMER’S MANUAL
JRC ERROR CODE TABLES
Preface

Thank you for purchasing this high-speed, high-accuracy handling robot.
Before operating your robot, read this manual carefully to safely get the maximum benefit from your robot in your assembling operations.

Important
To ensure operator safety, be sure to read the precautions and instructions in "SAFETY PRECAUTIONS," pages 1 through 8.
How the documentation set is organized

The documentation set consists of the following six books. If you are unfamiliar with this robot series, please read all six books and understand them fully before operating your robot.

BEGINNER’S GUIDE

Introduces you to the robot. Taking an equipment setup example, this book guides you through running your robot with the teach pendant, making a program in WINCAPSII, and running your robot automatically.

INSTALLATION & MAINTENANCE GUIDE - this book -

Provides an explanation of the robot outline, instructions for installing the robot components, and maintenance & inspection procedures.

SETTING-UP MANUAL

Describes how to set-up or teach your robot with the teach pendant or operating panel.

WINCAPSII GUIDE (that comes with WINCAPSII)

Provides instructions on how to use the teaching system installed on the PC, connected to the robot and its controller, for developing and managing programs.

PROGRAMMER'S MANUAL

Describes the PAC programming language, steps to develop programs in PAC, and command specifications.

ERROR CODE TABLES

List error codes that will appear on the teach pendant, operating panel, or PC screen if an error occurs in the robot series or WINCAPSII. These tables provide detailed description and recovery ways.
How this book is organized

This book is just one part of the documentation set. This book consists of SAFETY PRECAUTIONS, chapters one through six, and appendix.

SAFETY PRECAUTIONS
Defines safety terms and related symbols and provides precautions that should be observed. Be sure to read this section before operating your robot.

Chapter 1 General Information about Robot
This chapter describes the components and specifications of the robot. Read this chapter before installing and operating the robot to familiarize yourself with the robot.

Chapter 2 Installing Robot Components
This chapter describes the procedures and precautions for transporting the robot during installation, and for designing end-effectors.

Chapter 3 Optional Devices
This chapter describes the configurations and functions of the optional devices. Consult this chapter according to the optional device to be used.

The optional devices include an operating panel, a teach pendant, the PC teaching system “WINCAPS II,” a floppy disk drive, µVision board, Ethernet board, and DeviceNet board.

Chapter 4 Customizing Your Robot
This chapter describes how to customize your robot.

Chapter 5 Robot Controller Interface
This chapter describes the connections between the robot controller and other devices and precautions for connecting them.

Chapter 6 Maintenance and Inspections
This chapter describes the regular maintenance and inspections necessary for maintaining the performance and functions of the robot.

Appendix
SAFETY PRECAUTIONS

Be sure to observe all of the following safety precautions.

Strict observance of these warning and caution indications are a MUST for preventing accidents, which could result in bodily injury and substantial property damage. Make sure you fully understand all definitions of these terms and related symbols given below, before you proceed to the text itself.

<table>
<thead>
<tr>
<th>WARNING</th>
<th>Alerts you to those conditions, which could result in serious bodily injury or death if the instructions are not followed correctly.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAUTION</td>
<td>Alerts you to those conditions, which could result in minor bodily injury or substantial property damage if the instructions are not followed correctly.</td>
</tr>
</tbody>
</table>

Terminology and Definitions

**Maximum space**: Refers to the volume of space encompassing the maximum designed movements of all robot parts including the end-effector, workpiece and attachments. (Quoted from the RIA* Committee Draft.)

**Restricted space**: Refers to the portion of the maximum space to which a robot is restricted by limiting devices (i.e., mechanical stops). The maximum distance that the robot, end-effector, and workpiece can travel after the limiting device is actuated defines the boundaries of the restricted space of the robot. (Quoted from the RIA Committee Draft.)

**Motion space**: Refers to the portion of the restricted space to which a robot is restricted by software motion limits. The maximum distance that the robot, end-effector, and workpiece can travel after the software motion limits are set defines the boundaries of the motion space of the robot.

**Operating space**: Refers to the portion of the restricted space that is actually used by the robot while performing its task program. (Quoted from the RIA Committee Draft.)

**Task program**: Refers to a set of instructions for motion and auxiliary functions that define the specific intended task of the robot system. (Quoted from the RIA Committee Draft.)

(*RIA: Robotic Industries Association)
1. Introduction

This section provides safety precautions to be observed during installation, teaching, inspection, adjustment, and maintenance of the robot.

2. Installation Precautions

2.1 Insuring the proper installation environment

The robot and the robot controller have not been designed to withstand explosions, dust-proof, nor are they splash-proof. Therefore, they should not be installed in any environment where:

1. there are flammable gases or liquids,
2. there are any shavings from metal processing or other conductive material flying about,
3. there are any acidic, alkaline or other corrosive gases,
4. there is cutting or grinding oil mist,
5. it may likely be submerged in fluid,
6. there is sulfuric cutting or grinding oil mist, or
7. there are any large-sized inverters, high output/high frequency transmitters, large contactors, welders, or other sources of electrical noise.

When using the robot controller in an environment exposed to mist, put it in an optional protective box.

2.2 Service space

The robot and peripheral equipment should be installed so that sufficient service space is maintained for safe teaching, maintenance, and inspection.

2.3 Control devices outside the robot's restricted space

The robot controller, teach pendant, and operating panel should be installed outside the robot's restricted space and in a place where you can observe all of the robot's movements when operating the robot controller, teach pendant, or operating panel.

2.4 Positioning of gauges

Pressure gauges, oil pressure gauges and other gauges should be installed in an easy-to-check location.

2.5 Protection of electrical wiring and hydraulic/pneumatic piping

If there is any possibility of the electrical wiring or hydraulic/pneumatic piping being damaged, protect them with a cover or similar item.
SAFETY PRECAUTIONS

2.6 Positioning of emergency stop switches

Emergency stop switches should be provided in a position where they can be reached easily should it be necessary to stop the robot immediately.

1. The emergency stop switches should be red.
2. Emergency stop switches should be designed so that they will not be released after pressed, automatically or mistakenly by any other person.
3. Emergency stop switches should be separate from the power switch.

2.7 Positioning of operating status indicators

Operating status indicators should be positioned in such a way where workers can easily see whether the robot is on temporary halt or on an emergency or abnormal stop.

2.8 Setting-up the safety fence or enclosure

A safety fence or enclosure should be set up so that no one can easily enter the robot's restricted space. If it is impossible, utilize other protectors as described in Section 2.9.

1. The fence or enclosure should be constructed so that it cannot be easily moved or removed.
2. The fence or enclosure should be constructed so that it cannot be easily damaged or deformed through external force.
3. Establish the exit/entrance to the fence or enclosure. Construct the fence or enclosure so that no one can easily get past it by climbing over the fence or enclosure.
4. The fence or enclosure should be constructed to ensure that it is not possible for hands or any other parts of the body to get through it.
5. Take any one of the following protections for the entrance/exit of the fence or enclosure:
   1) Place a door, rope or chain across the entrance/exit of the fence or enclosure, and fit it with an interlock that ensures the emergency stop device operates automatically if it is opened or removed.
   2) Post a warning notice at the entrance/exit of the fence or enclosure stating "In operation--Entry forbidden" or "Work in progress--Do not operate" and ensure that workers follow these instructions at all times.

When making a test run, before setting up the fence or enclosure, place an overseer in a position outside the robot's restricted space and one in which he/she can see all of the robot's movements. The overseer should prevent workers from entering the robot's restricted space and be devoted solely to that task.
2.9 Positioning of rope or chain

If it is not possible to set up the safety fence or enclosure described in Section 2.8, hang a rope or chain around the perimeter of the robot’s restricted space to ensure that no one can enter the restricted space.

1. Ensure the support posts cannot be moved easily.
2. Ensure that the rope or chain’s color or material can easily be discerned from the surrounds.
3. Post a warning notice in a position where it is easy to see stating “In operation--Entry forbidden” or “Work in progress --Do not operate” and ensure that workers follow these instructions at all times.
4. Set the exit/entrance, and follow the instructions given in Section 2.8, (3) through (5).

2.10 Setting the robot’s motion space

The area required for the robot to work is called the robot’s operating space.

If the robot’s motion space is greater than the operating space, it is recommended that you set a smaller motion space to prevent the robot from interfering or disrupting other equipment.

Refer to the "INSTALLATION & MAINTENANCE GUIDE" Chapter 4.

2.11 No robot modification allowed

Never modify the robot unit, robot controller, teach pendant or other devices.

2.12 Cleaning of tools

If your robot uses welding guns, paint spray nozzles, or other end-effectors requiring cleaning, it is recommended that the cleaning process be carried out automatically.

2.13 Lighting

Sufficient illumination should be assured for safe robot operation.

2.14 Protection from objects thrown by the end-effector

If there is any risk of workers being injured in the event that the object being held by the end-effector is dropped or thrown by the end-effector, consider the size, weight, temperature and chemical nature of the object and take appropriate safeguards to ensure safety.
3. Precautions while robot is running

**Warning**

Touching the robot while it is in operation can lead to serious injury. Please ensure the following conditions are maintained and that the cautions listed from Section 3.1 onwards are followed when any work is being performed.

1) Do not enter the robot's restricted space when the robot is in operation or when the motor power is on.

2) As a precaution against malfunction, ensure that an emergency stop device is activated to cut the power to the robot motor upon entry into the robot's restricted space.

3) When it is necessary to enter the robot's restricted space to perform teaching or maintenance work while the robot is running, ensure that the steps described in Section 3.3 "Ensuring safety of workers performing jobs within the robot's restricted space" are taken.

3.1 Creation of working regulations and assuring worker adherence

When entering the robot's restricted space to perform teaching or maintenance inspections, set "working regulations" for the following items and ensure workers adhere to them.

1) Operating procedures required to run the robot.

2) Robot speed when performing teaching.

3) Signaling methods to be used when more than one worker is to perform work.

4) Steps that must be taken by the worker in the event of a malfunction, according to the contents of the malfunction.

5) The necessary steps for checking release and safety of the malfunction status, in order to restart the robot after robot movement has been stopped due to activation of the emergency stop device.

6) Apart from the above, any steps below necessary to prevent danger from unexpected robot movement or malfunction of the robot.

1) Display of the control panel (See Section 3.2 on the following page)

2) Assuring the safety of workers performing jobs within the robot's restricted space (See Section 3.3 on the following page)

3) Maintaining worker position and stance

Position and stance that enables the worker to confirm normal robot operation and to take immediate refuge if a malfunction occurs.
4) Implementation of measures for noise prevention
5) Signaling methods for workers of related equipment
6) Types of malfunctions and how to distinguish them

Please ensure "working regulations" are appropriate to the robot type, the place of installation and to the content of the work.

Be sure to consult the opinions of related workers, engineers at the equipment manufacturer and that of a labor safety consultant when creating these "working regulations".

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3.2 Display of operation panel</strong></td>
<td>To prevent anyone other than the worker from accessing the start switch or the changeover switch by accident during operation, display something to indicate it is in operation on the operating panel or teach pendant. Take any other steps as appropriate, such as locking the cover.</td>
</tr>
</tbody>
</table>
| **3.3 Ensuring safety of workers performing jobs within the robot's restricted space** | When performing jobs within the robot’s restricted space, take any of the following steps to ensure that robot operation can be stopped immediately upon a malfunction. (1) Ensure an overseer is placed in a position outside the robot’s restricted space and one in which he/she can see all robot movements, and that he/she is devoted solely to that task.  
   ① An emergency stop device should be activated immediately upon a malfunction.  
   ② Do not permit anyone other than the worker engaged for that job to enter the robot’s restricted space.  
   (2) Ensure a worker within the robot's restricted space carries the portable emergency stop switch so he/she can press it (the robot stop button on the teach pendant) immediately if it should be necessary to do so. |
| **3.4 Inspections before commencing work such as teaching** | Before starting work such as teaching, inspect the following items, carry out any repairs immediately upon detection of a malfunction and perform any other necessary measures. (1) Check for any damage to the sheath or cover of the external wiring or to the external devices.  
   (2) Check that the robot is functioning normally or not (any unusual noise or vibration during operation).  
   (3) Check the functioning of the emergency stop device.  
   (4) Check there is no leakage of air or oil from any pipes.  
   (5) Check there are no obstructive objects in or near the robot’s restricted space. |
| **3.5 Release of residual air pressure** | Before disassembling or replacing pneumatic parts, first release any residual air pressure in the drive cylinder. |
3.6 Precautions for test runs
Whenever possible, have the worker stay outside of the robot's restricted space when performing test runs.

3.7 Precautions for automatic operation
(1) At start-up
Before the robot is to be started up, first check the following items as well as setting the signals to be used and perform signaling practice with all related workers.

1) Check that there is no one inside the robot's restricted space.

2) Check that the teach pendant and tools are in their designated places.

3) Check that no lamps indicating a malfunction on the robot or related equipment are lit.

(2) Check that the display lamp indicating automatic operation is lit during automatic operation.

(3) Steps to be taken when a malfunction occurs
Should a malfunction occur with the robot or related equipment and it is necessary to enter the robot's restricted space to perform emergency maintenance, stop the robot's operation by activating the emergency stop device. Take any necessary steps such as placing a display on the starter switch to indicate work is in progress to prevent anyone from accessing the robot.

3.8 Precautions in repairs
(1) Do not perform repairs outside of the designated range.

(2) Under no circumstances should the interlock mechanism be removed.

(3) When opening the robot controller's cover for battery replacement or any other reasons, always turn the robot controller power off and disconnect the power cable.

(4) Use only spare tools authorized by YASKAWA.

4. Daily and periodical inspections
(1) Be sure to perform daily and periodical inspections. Before starting jobs, always check that there is no problem with the robot and related equipment. If any problems are found, take any necessary measures to correct them.

(2) When carrying out periodical inspections or any repairs, maintain records and keep them for at least 3 years.
5. Management of floppy disks

(1) After finishing teaching or making any changes, always save the programs and data onto floppy disks. Making back-ups will help you recover if data stored in the robot controller is lost due to the expired life of the back-up battery.

(2) Write the names of each of the floppy disks used for storing task programs to prevent incorrect disks from loading into the robot controller.

(3) Store the floppy disks where they will not be exposed to dust, humidity and magnetic field, which could corrupt the disks or data stored on them.
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Chapter 1

General Information about Robot

This chapter touches on general information about the specifications and configuration of the robot.
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1.1  Items Contained in the Package

1.1.1  Standard Items

The items listed in Table 1-1 are contained in the product package.

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>Qty.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>Robot controller</td>
<td>1</td>
</tr>
<tr>
<td>(2)</td>
<td>Manuals</td>
<td>1 each</td>
</tr>
<tr>
<td></td>
<td>1) BEGINNER'S GUIDE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2) INSTALLATION &amp; MAINTENANCE GUIDE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3) SETTING-UP MANUAL</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4) PROGRAMMER'S MANUAL</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5) ERROR CODE TABLES</td>
<td></td>
</tr>
<tr>
<td>(3)</td>
<td>Spare fuse for robot controller</td>
<td>3</td>
</tr>
<tr>
<td>(4)</td>
<td>Pendantless connector (Dummy connector)</td>
<td>1</td>
</tr>
<tr>
<td>(5)</td>
<td>Spare output IC for robot controller</td>
<td>1</td>
</tr>
<tr>
<td>(6)</td>
<td>Connector for primary power supply</td>
<td>1</td>
</tr>
</tbody>
</table>
1.2 Robot Configuration

1.2.1 Robot System

Figure 1-1 shows the entire configuration of the robot system.

Note 1: Items (1) to (5) are the standard components listed in Table 1-1.
Note 2: The pendantless connector is attached to the robot controller connector when no teach pendant is connected.
Note 3: The components illustrated above are typical models or parts.

Figure 1-1 Robot Components
1.2.2 Names of the Robot Controller Components

Figure 1-2 and Table 1-2 show the names of the robot controller components.

![Diagram of Robot Controller Components]

**Figure 1-2 Names of Robot Controller Components**
<table>
<thead>
<tr>
<th>Connector No.</th>
<th>Marking</th>
<th>Name</th>
<th>Connector No.</th>
<th>Marking</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>CN1</td>
<td>RS232C</td>
<td>Serial interface connector</td>
<td>CN8</td>
<td>INPUT</td>
<td>Connector for user input or system input</td>
</tr>
<tr>
<td>CN2</td>
<td>CRT</td>
<td>CRT connector</td>
<td>CN9</td>
<td>HAND I/O</td>
<td>Connector for end-effector I/O</td>
</tr>
<tr>
<td>CN3</td>
<td>KEYBD</td>
<td>Keyboard connector</td>
<td>CN10</td>
<td>OUTPUT/ E.STOP</td>
<td>Connector for user output, system output and emergency stop</td>
</tr>
<tr>
<td>CN4</td>
<td>MOUSE</td>
<td>Connector for PS/2 mouse</td>
<td>CN11</td>
<td>INPUT AC</td>
<td>Power connector</td>
</tr>
<tr>
<td>CN5</td>
<td>PENDANT</td>
<td>Connector for teach pendant</td>
<td>CN12</td>
<td>MOTOR</td>
<td>Motor connector</td>
</tr>
<tr>
<td>CN6</td>
<td>PRINTER</td>
<td>Printer connector</td>
<td>CN13</td>
<td>ENCODER</td>
<td>Encoder connector</td>
</tr>
<tr>
<td>CN7</td>
<td>I/O POWER</td>
<td>Power connector for I/O</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

⚠️ Caution: The robot controller connectors are of a screw-lock type or ring-lock type. Lock the connectors securely. If even one of the connectors is not locked, weak contact may result thereby causing an error. Be sure to turn the robot controller OFF before connecting/disconnecting the power connector or motor connector. Otherwise, the internal circuits of the robot controller may be damaged.
### 1.3 Robot Controller Specifications

#### Specifications

Table 1-3 lists the robot controller specifications.

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applicable robot</td>
<td>Small-sized, vertical articulated type</td>
</tr>
<tr>
<td>Model</td>
<td>ERCJ-UPJ3-□□□-■, ERCJ-SV3X-□□□-■</td>
</tr>
<tr>
<td></td>
<td>■:N=North America  E=Europe</td>
</tr>
<tr>
<td>Control system</td>
<td>PTP, CP 3-dimensional linear, 3-dimensional circular</td>
</tr>
<tr>
<td>No. of controllable axes</td>
<td>Up to eight axes simultaneously</td>
</tr>
<tr>
<td>Drive system</td>
<td>All axes: all digital AC servo</td>
</tr>
<tr>
<td>Memory capacity</td>
<td>1.25 MB (equivalent to 5000 steps, 13,000 points)</td>
</tr>
<tr>
<td>Language used</td>
<td>SLIM Based Robot Language (PAC)</td>
</tr>
<tr>
<td>Teaching system</td>
<td>1) Remote teaching  2) Numerical input (MDI)</td>
</tr>
<tr>
<td>Input signal</td>
<td>20 user open points (PLC 12, hand input 8) + 36 fixed system points</td>
</tr>
<tr>
<td>Output signal</td>
<td>32 user open points (PLC 24, hand output 8) + 33 fixed system points</td>
</tr>
<tr>
<td>External communication</td>
<td>RS-232C:1 line  Ethernet:1 line (option)</td>
</tr>
<tr>
<td>Timer function</td>
<td>0.02 to 10 sec.(in units of 1/60 sec.)</td>
</tr>
<tr>
<td>Self-diagnosis function</td>
<td>Overrun, servo error, memory error, input error, etc.</td>
</tr>
<tr>
<td>Error display</td>
<td>Error codes will be displayed on the external I/O or the operating panel (option). Error messages will be displayed in English on the teach pendant (option).</td>
</tr>
</tbody>
</table>
| Power source                      | 3-phase, 200 VAC-15% to 230 VAC+10%, 50/60 Hz, 0.8 kVA  
                          | Single-phase, 200 VAC-10% to 230 VAC+10%, 50/60 Hz, 0.8 kVA |
| Environmental conditions          | Temperature: 0 to 40°C  
                          | Humidity: 90% RH or less (no condensation allowed) |
| Degree of protection              | IP20                                              |
| Weight                            | Approx. 17 kg (excluding attached cables)         |
**CAUTION**

- DO NOT touch fins. Hot surface may cause severe burns.
- DO NOT insert fingers or foreign objects into opening, or personal injury may occur.
- DO NOT touch inside of controller before turning off power switch, disconnecting cable from controller and waiting 3 minutes or more, or you can receive electric shock.
- DO NOT attach or detach connectors while power switch is on. Improper operation may cause electric shock or controller failure.

**CAUTION IN INSTALLATION**

- This controller does not meet dust-proof, splash-proof or explosion-proof specifications.
- Read operation manual before installation.
- Do not place anything on the controller.
Chapter 1 General Information about Robot

[2] Outer Dimensions

Figure 1-3 shows the outer dimensions of the robot controller.

Figure 1-3 Outer Dimensions of Robot Controller
[ 3 ] Controller Setting Table

The controller setting table given on the next page is attached on the controller. It shows the parameters that are set before delivery of the robot, as well as the next replacement dates of the memory backup battery and encoder backup battery.

- Parameters (① in Figure)
  Shows only parameters changed from typical values. Blanks indicate that the typical values are set.
  For further information about parameters, see Chapter 4 "Robot Specification Changes."

- Main software Ver. (② in Figure)
  Shows the version of the main software for the controller.

- Sub software Ver. (③ in Figure)
  Shows the version of the control software.

- Battery replacement date (④ in Figure)
  Shows the next battery replacement date.

- SER No. (⑤ in Figure)
  Shows the serial number of the robot.

- TYPE (⑥ in Figure)
  Shows the model of the robot system. Its coding system is described below:
### Figure 1-4 Controller Setting Table

<table>
<thead>
<tr>
<th>パラメータ/PARAMETER</th>
<th>値/VALUE</th>
<th>名称/BOARD</th>
<th>型式/TYP</th>
<th>備考/REMARK</th>
</tr>
</thead>
<tbody>
<tr>
<td>正方向ソフトリミット/PLIM</td>
<td>1</td>
<td>メインボード/MAIN BOARD</td>
<td>RP227</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>I/Oボード/I/O BOARD</td>
<td>RP228, 229</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>電源ボード/POWER SUPPLY BOARD</td>
<td>RP214A, B</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>ハーネスボード/HARNESS BOARD</td>
<td>RP231</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>負方向ソフトリミット/NLIM</td>
<td>1</td>
<td>NFボード/NF BOARD</td>
<td>RP235A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>コンパクトABSボード/C-ABS BOARD</td>
<td>RP240A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>ブレーキリレーボード/BRAKE RELAY BOARD</td>
<td>RP242</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>回生抵抗ボード/RESISTER BOARD</td>
<td>RP243</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RANG</td>
<td>1</td>
<td>IPMボード(L)/IPM BOARD (L)</td>
<td>RP232</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>IPMボード(M)/IPM BOARD (M)</td>
<td>RP232</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>IPMボード(S)/IPM BOARD (S)</td>
<td>RP232</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6</td>
<td></td>
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<td></td>
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<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/0モード/I/O MODE</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td>2</td>
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<td>3</td>
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<td>6</td>
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<td>7</td>
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</tr>
<tr>
<td></td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>メインソフト Ver./MAIN SOFTWARE Ver.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>サブソフト Ver./SUB SOFTWARE Ver.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>電池交換日/DATE OF RENEWING BAT.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SERIAL No.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TYPE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1.4 Warranty

YASKAWA MOTOMAN manufactures robots under strict quality control. In case of failure, we warranty the robot under the following conditions:

Warranty Period
The warranty shall be effective for one year from the date of purchase.

Warranty Coverage
YASKAWA MOTOMAN shall repair the robot free of charge when a failure occurs and is attributable to the design, manufacture or material of the robot within the warranty period in spite of proper use.

Items Not Covered
Failures, which arise from one of the following, shall not be covered by the warranty even if the robot is under warranty:

(1) Failures caused by improper repair, modification, transfer or handling by you or a third party;

(2) Failures caused by the use of a part or oil/fat other than those specified by YASKAWA MOTOMAN;

(3) Failures caused by a fire, salt damage, earthquake, storm/flood or other acts of God;

(4) Failures caused by the use of the robot in an environment other than the environment specified by YASKAWA MOTOMAN, such as dust and water ingress;

(5) Failures caused by a worn-out consumable, such as a fan filter;

(6) Failures caused by improper performance or non-performance of maintenance or inspections stated in this owner's manual; and

(7) Damages other than the robot repair costs.
Chapter 2

Installing Robot Controller

This chapter describes the installation of the robot controller.

For safe operation of the robot, read "SAFETY PRECAUTIONS, 2. Installation Precautions."
2.1 Preparing a Proper Environment for Installation

Before installing the robot unit and robot controller, confirm that the operating environment is in conformity with each item of "SAFETY PRECAUTIONS, 2. Installation Precautions," and that the surrounding environment of the location where the robot is to be used meets the specifications as described below. Also, take proper measures to protect the components from vibration.

In an inappropriate environment, the robot will not operate to its full capacity or performance, components may not last long, and unexpected failure may result.

2.1.1 Installation Environments

The robot is not explosion-proof, dust-proof or splash-proof, so it should not be installed in any environment where:

1) there are flammable gases or liquids,
2) there are any shavings from metal processing or other conductive material flying about,
3) there are any acidic, alkaline or other corrosive gases,
4) there is cutting or grinding oil mist,
5) there is sulfuric cutting or grinding oil mist, or
6) there are any large-sized inverters, high output/high frequency transmitters, large contactors, welders, or other sources of electrical noise.
2.1.2 Ambient Temperature and Humidity

Keep the ambient temperature between 0°C and 40°C during operation.
Keep the ambient humidity at 90% or below to prevent dew condensation.

2.1.3 Vibration

Do not install the robot in an environment where it will be exposed to excessive vibration or impact.

2.1.4 Connecting the Robot Unit and Robot Controller

Caution: Confirm that the robot unit and the robot controller have the same order number.
For the position of the order number, see “1.2 Checking the Order Number” in the MOTOMAN Instructions.
Special care must be taken when more than one manipulator is to be installed.

If the numbers do not match, manipulators may not perform as expected and cause injury or damage.
2.2 Installing the Robot Controller

Before installing the robot controller to the target position, you need to secure the robot controller to the controller mounting panel as described in Subsection 2.2.1.

The robot controller supported by the mounting panel may be either stand-alone or wall-mounted.

For installing the robot unit, refer to MOTOMAN Instructions.

![Caution: When using the robot controller in any environment where there is mist, put the controller in an optional robot controller protective box. The robot controller is not dust-proof, splash-proof, or explosion-proof.]

2.2.1 Securing the Robot Controller to the Controller Mounting Panel

(1) Figure 2-10 shows the bottom view of the robot controller. Marked with "O," the M4-nut welded holes may be used for securing the robot controller to the mounting panel.

(2) Prepare a mounting panel large enough to mount the robot controller. Secure the robot controller to the mounting panel at six nut-welded holes marked with "O" in Figure 2-1, using six M4 screws.

![Caution (1) The controller mounting screws must not be more than the thickness of the mounting panel plus 5 mm in length. If they exceed 5 mm, the nut welded holes may be damaged. (2) Fix the robot controller at all of the six nut-welded holes.]
Figure 2-1  Location of Mounting Screw Holes
(on the bottom of the robot controller)
2.2.2 Installing the Robot Controller

The robot controller may be installed stand-alone or on the wall.

[ 1 ] Stand-alone

Install the robot controller as shown in Figure 2-2.

Caution: Do not place anything within 200 mm from the air inlet and air outlet of the robot controller.

![Figure 2-2 Stand-alone Installation](image-url)

Install the robot controller as shown in Figure 2-3.

⚠️ Caution: Do not place anything within 200 mm from the air inlet and air outlet on the robot controller.

Figure 2-3 Wall-mounted Installation
This chapter describes the configurations and functions of these optional devices—operating panel, teach pendant, PC teaching system "WINCAPSII," floppy disk drive, µVision board, Ethernet board, and DeviceNet board.
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3.1 Operating Panel

The operating panel is a operation console that allows you to recover the robot from a stop due to problems caused by peripheral units, etc, and it is a simple teach pendant for teaching. Therefore, the panel has minimum necessary teaching/operating functions.

To the operating panel you may connect a teach pendant which is designed for teaching and other fine operations.

The ROBOT STOP button and the STOP key on the operating panel and the teach pendant are available anytime. For other functions, you may select the operating panel or teach pendant. To switch between the operating panel and teach pendant, use the mode selector switch on the operating panel.

3.1.1 Operating Panel Functions

Operating
The operating panel provides these functions--motor power ON/OFF, CAL execution, program selection, speed change, automatic operation start/stop and manual operation. For further information, see the SETTING-UP MANUAL.

Display
The operating panel has an LCD capable of displaying 2 lines of 16 characters. It displays the current robot position, ongoing program number, error code when an error occurs, and related information in alphanumerical characters.

Connecting the Teach Pendant
A teach pendant can be connected to the TP terminal at the bottom of the operating panel. The robot can be operated from the teach pendant by setting the mode selector switch on the operating panel to TP.

When the mode selector switch is set to MANUAL or AUTO, the robot is operated from the operating panel.
3.1.2 Names of Operating Panel Components

Figure 3-1 shows the names of the operating panel components.
3.1.3 Operating Panel Specifications

Table 3-1 lists the operating panel specifications.

<table>
<thead>
<tr>
<th>Item</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>ERCJ-OP-1</td>
</tr>
<tr>
<td>Display</td>
<td>Liquid crystal display with backlight, 16 characters × 2 lines</td>
</tr>
<tr>
<td>Power source</td>
<td>24 VDC (supplied from robot controller)</td>
</tr>
<tr>
<td>Operation</td>
<td>23 flat key switches, Emergency STOP button, mode selector switch, deadman switch</td>
</tr>
</tbody>
</table>
| Installation conditions| Temperature: 0 to 40°C  
                      | Humidity: 90% RH or less (Dew condensation shall not be allowed.)              |
| Dimensions (H x W x D)| 140 × 100 × 40 mm (See Note 1)                                               |
| Weight                | Approx. 0.7 kg                                                                |
| Cable length          | 4 m or 8 m                                                                   |
| Others                | Equipped with a socket for connecting the teach pendant (See Note 2)          |

(Note 1) Projections caused by switches are not included in these measurements.
(Note 2) When no teach pendant is connected, a pendantless connector should be connected to the TP socket.

⚠️ Caution: The operating panel is a fixed type operation console. Be sure to secure it to the equipment.
3.1.4 Mounting and Connecting the Operating Panel

Connecting the operating panel
As shown in Figure 3-2, the operating panel can be connected to the robot controller. A teach pendant can also be connected to the operating panel.

Connection type 1: Operating panel only

Connection type 2: Operating panel connected with the teach pendant

Figure 3-2 Connecting the Operating Panel and Robot Controller

NOTE: Be sure to secure the operating panel to a safe place such as equipment.
NOTE: When using the operating panel without the teach pendant connected, always insert the pendantless connector into the TP socket on the operating panel.
3.2 Teach Pendant

The teach pendant is an entry/operation device for creating programs and teaching. The teach pendant can perform all operations except automatic external operation.

3.2.1 Teach Pendant Functions

For instructions on how to operate the teach pendant, refer to the SETTING-UP MANUAL.

Programming and teaching

This function allows you:
- to enter commands and store the robot arm position. You may specify a program and enter program steps one by one,
- to modify, delete, or copy those commands and robot arm positions, and
- to check edited programs in running them in Teach check mode.

Operating the robot

This function turns power to the motor ON/OFF, starts and stops automatic operation, and performs manual operation.

Displaying

This function displays the contents of programs, the progress of running programs, ongoing step number, current robot position or error messages.
3.2.2 Names of Teach Pendant Components

Figure 3-3 shows the names of the teach pendant components.

Figure 3-3 Names of Teach Pendant Components
3.2.3 Teach Pendant Specifications

[ 1 ] Specifications

Table 3-2 lists the teach pendant specifications.

<table>
<thead>
<tr>
<th>Item</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>ERCJ-TP-1</td>
</tr>
<tr>
<td>Display</td>
<td>Liquid crystal display with backlight, 640 × 480 pixels</td>
</tr>
<tr>
<td>Power source</td>
<td>24 VDC (supplied from robot controller)</td>
</tr>
<tr>
<td>Operation</td>
<td>Emergency Stop button, deadman switch, jog dial, motor power ON/OFF key, AUTO/MANUAL selector switch, function keys, arm traverse keys, LOCK key R-SEL key, M-MOD key, SPEED key cursor keys, STOP key, OK key, Cancel key</td>
</tr>
</tbody>
</table>
| Installation conditions | Temperature: 0 to 40°C  
Humidity: 90% RH or less  
(Dew condensation shall not be allowed.) |
| Outside dimensions | 260 × 186 × 60 mm (excluding projections)          |
| Weight          | 1 kg                                                |
| Cable length    | 4 m, 8 m, 12 m                                      |
[ 2 ] Outer Dimensions

Figure 3-4 shows the outer dimensions of the teach pendant.

Figure 3-4  Outer Dimensions of the Teach Pendant
[ 3 ] Pendantless State

What is Pendantless State?
The state without having connected the operating panel and the teach pendant
to the robot controller is called a pendantless state.

Setting the Pendantless State
As described below, there are four ways to set the pendantless state:
(1) Turning ON the power to the robot controller without the operating panel and
the teach pendant.
(2) Disconnecting the connected teach pendant.
(3) Disconnecting the connected operating panel.
(4) Disconnecting the connected operating panel and teach pendant.

Caution: Refer to the operation procedures described in "[ 4 ]
Connecting and Disconnecting Operating Panel and Teach
Pendant" on the next page when connecting or disconnecting
the operating panel and the teach pendant with the power to the
robot controller ON.

Pendantless State Precautions
Since no teach pendant is connected in the Pendantless state, the robot cannot
enter the manual operation mode or the teach check mode.
The robot is therefore in the Auto mode whenever the Enable Auto input is free.
The external mode cannot be switched, and the program cannot start to run.
When operating the robot in the Pendantless state perform the following steps:
(1) Set the robot not to start to operate when the Enable Auto input is free.
(2) Enable Auto input free state and automatic mode output. Refer to "5.3.2.2
Auto Mode (Output) and 5.5.2.2 Auto Mode (Output)".
Set the equipment to make an emergency stop in an AND state.
Add (1) and (2) above with the external sequence circuit.
Connecting and Disconnecting Operating Panel and Teach Pendant

The operating panel and the teach pendant can be connected or disconnected with the power to the robot controller ON. Connect or disconnect them according to the procedure described below.

Table 3-3 shows the state of change resulting from connecting or disconnecting the operating panel and/or the teach pendant.

Each letter in the table represents the appropriate connecting and disconnecting procedure (×: no procedure applicable).

Table 3-3  Table Showing Change of State by Connection and Disconnection

<table>
<thead>
<tr>
<th>Before change</th>
<th>Pendantless mode</th>
<th>OP connected</th>
<th>TP connected</th>
<th>OP and TP connected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pendantless mode</td>
<td>×</td>
<td>(A)</td>
<td>(B)</td>
<td>(A)</td>
</tr>
<tr>
<td>OP connected</td>
<td>(D)</td>
<td>×</td>
<td>×</td>
<td>(C)</td>
</tr>
<tr>
<td>TP connected</td>
<td>(D)</td>
<td>×</td>
<td>×</td>
<td>×</td>
</tr>
<tr>
<td>OP and TP connected</td>
<td>(D)</td>
<td>(D)</td>
<td>×</td>
<td>×</td>
</tr>
</tbody>
</table>

Caution: The operating panel and the teach pendant cannot be connected or disconnected while a program is being executed.
### Table 3-4 Connection and Disconnection Procedures

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Steps</th>
</tr>
</thead>
</table>
| (A)       | Step 1 Select the AUTO mode, and activate an emergency stop.  
           | Step 2 Disconnect the connector from CN5 on the robot controller.  
           | Step 3 Connect the connector used for pendantless operation to CN5 of the robot controller.  
           | Step 4 Error 2187 occurs. Clear it from the external device. |
| (B)       | Step 1 Select the AUTO mode, and activate an emergency stop.  
           | Step 2 Perform disconnection. See the SETTING-UP MANUAL, Section 5.9, "Preparing the Robot Controller to Unplug the Teach Pendant."  
           | Step 3 Disconnect the connector from CN5 on the robot controller within 15 seconds.  
           | Step 4 Connect the connector for Pendantless operation to CN5 on the robot controller. |
| (C)       | Step 1 Set the mode selector switch on the operating panel to TP.  
           | Step 2 Set the mode selector switch on the teach pendant to AUTO, and activate an emergency stop.  
           | Step 3 Perform disconnection. See the SETTING-UP MANUAL, Section 5.9, "Preparing the Robot Controller to Unplug the Teach Pendant."  
           | Step 4 Disconnect the teach pendant from the operating panel within 15 seconds.  
           | Step 5 Connect the connector used for Pendantless operation to the operating panel.  
           | Step 6 Set the mode selector switch on the operating panel to MANUAL. |
| (D)       | Step 1 Disconnect the connector used for pendantless operation from CN5 on the robot controller.  
           | Step 2 Connect the operating panel or teach pendant to CN5 on the robot controller. |
3.3 PC Teaching System Software, "WINCAPSII"

The PC teaching system facilitates the creation and editing of robot programs. Use this system to improve creation and/or robot management programs. For further information about how to use this teaching system, refer to the WINCAPSII GUIDE.

3.3.1 Functions in WINCAPSII

WINCAPSII has the following functions:

**Entering and editing robot programs**
Robot programs can be entered or edited.
New programs can be created by making use of the programs supplied as a library or with existing programs.

**Reading/writing data**
Programs, variables, coordinate values, CALSET data, log data, and other such data can be read from the robot controller to and displayed on the personal computer or written from the personal computer to the robot controller.

*Caution:* To use this function, the robot controller and the personal computer must be connected to each other with a communication cable.

**Save**
Programs, CALSET data, log data, etc. can be stored onto the hard disk or a floppy disk. Data stored on the hard disk or a floppy disk can be read, reedited or written to the robot controller.

**Print**
If a printer is connected to a personal computer the program's CALSET data, log data, and related data can be printed.

**Simulation**
Robot movements can be checked by simulating the movements of the robot in animation, on the personal computer display.
A simulation can be performed with the robot body connected to the robot controller.
When the robot is in automatic operation or manual operation mode, using the teach pendant, the simulated image movements correspond to the actual movement of the robot.
3.3.2 Operating Environment Required

The PC teaching system software requires the operating environments listed in Table 3-5.

<table>
<thead>
<tr>
<th>Table 3-5 Operating Environments for the PC Teaching System Software</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Personal computer</strong></td>
</tr>
<tr>
<td><strong>Operating system</strong></td>
</tr>
<tr>
<td><strong>Memory capacity</strong></td>
</tr>
<tr>
<td><strong>Hard disk</strong></td>
</tr>
<tr>
<td><strong>Monitor resolution</strong></td>
</tr>
</tbody>
</table>

**Note:** The teaching system cannot run properly on an older version of Windows 95.

The version of Windows 95 can be checked with [Control Panel - System – Information]. If A, B or C is not displayed (no symbol) at the end of the version information (4.00, 95B), update Windows 95 with the Windows 95 Service Pack 1, available from Microsoft’s web site.
3.3.3 Communication Cable

To enable the personal computer and the robot controller to communicate with each other, they must be connected with a communication cable. Use the appropriate RS-232C for cross cable wiring, as shown in Figures 3-5 and 3-6.

![Figure 3-5 RS-232C Communication Cable Wiring Diagram (IBM PC compatible)](image)

![Figure 3-6 RS-232C Communication Cable Wiring Diagram (PC-98)](image)
3.4 Floppy Disk Drive

The floppy disk drive is an optional storage device that stores or reads data, such as robot programs, to/from a floppy disk and is incorporated in the robot controller.

3.4.1 Floppy Disk Drive Functions

The floppy disk drive has the following functions:

Format
This function initializes a floppy disk so that it can store data. You need to initialize a new floppy disk before using it. Floppy disks will be initialized in MS-DOS format.

Save
This function stores programs, CALSET data, etc. from the robot controller onto a floppy disk.

Load
This function reads programs, CALSET data, etc. from a floppy disk to the robot controller.

⚠️ Caution NEVER load the CALSET data prepared for other robots. If loaded, the robot will malfunction. It is DANGEROUS.

3.4.2 Floppy Disk Drive Specifications

Table 3-6 lists the specifications of the built-in floppy disk drive.

**Table 3-6 Built-in Floppy Disk Drive Specifications**

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power source</td>
<td>5 VDC (supplied from the robot controller)</td>
</tr>
<tr>
<td>Environmental conditions</td>
<td>Temperature : 5 to 40°C</td>
</tr>
<tr>
<td></td>
<td>Humidity : 20% to 80% (without dew condensation)</td>
</tr>
<tr>
<td>Weight</td>
<td>155 g (body alone)</td>
</tr>
<tr>
<td>Applicable floppy disk</td>
<td>Type 2HD, 3.5-inch floppy disk</td>
</tr>
<tr>
<td></td>
<td>Storage capacity 1.44 MB</td>
</tr>
</tbody>
</table>
3.4.3 Location of the Floppy Disk Drive and its Component Names

Figure 3-7 Location of the Floppy Disk Drive and its Component Names

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floppy disk insertion slot</td>
<td>Insert a floppy disk through this slot. (see Figure 3-8).</td>
</tr>
<tr>
<td>Eject button</td>
<td>Push this button to eject the floppy disk.</td>
</tr>
<tr>
<td>Indicator</td>
<td>This lamp remains ON while the floppy disk is accessed.</td>
</tr>
</tbody>
</table>

Figure 3-8 Inserting a Floppy Disk

Caution: Do not eject the floppy disk when the indicator is lit. Doing so will damage or destroy data stored on the floppy disk.
3.4.4 Mounting the Floppy Disk Drive

Mount the floppy disk drive in the robot controller, according to the following procedure:

› **STEP 1**

Remove the eight screws from the controller top cover.

› **STEP 2**

Lift and remove the top cover from the robot controller.
STEP 3
Remove the four screws from the upper plate and take off the upper plate.

STEP 4
Push the two pins of the blind plate outwards and remove the blind plate.
STEP 5

Mount the floppy disk drive in the appropriate position of the robot controller. The floppy disk drive is secured to a disk drive mounting plate.

STEP 6

Tighten the two screws used to fasten the front panel of the floppy disk drive.
STEP 7

Tighten the four screws on the floppy disk drive mounting plate.

STEP 8

Connector J6 FDD 26P on the printed circuit board has a cable lock. If the connector is locked, lift and unlock it. The lock is made of resin. Do not apply excessive force to it or the lock may be damaged. Handle it with extreme care.

Insert the flat cable of the floppy disk drives completely into connector J6 FDD 26P on the circuit board. If the flat cable is inserted completely, the blue line marked on the connecting section will become aligned with the top edge of the connector.
STEP 9

Securely push in the connector lock.

STEP 10

Put the top cover and secure it with eight screws.

The mounting of the floppy disk drive is completed.
3.5 μVision Board

3.5.1 μVision Board Specifications

Insetting a μVision board in the robot controller makes a variety of image processing functions available. Similar to other commands, image processing commands are already incorporated and no special operations or programming are required.

<table>
<thead>
<tr>
<th>Item</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Image storage memory</td>
<td>Horizontal (H) $512 \times$ Vertical (V) $480$ pixels, $8$ bits $\times$ $4$ screens</td>
</tr>
<tr>
<td>Image storage memory (processed image)</td>
<td>Horizontal (H) $512 \times$ Vertical (V) $480$ pixels, $8$ bits $\times$ $4$ screens</td>
</tr>
<tr>
<td>Overlay memory</td>
<td>Horizontal (H) $624 \times$ Vertical (V) $480$ pixels, $2$ bits $\times$ $2$ screens</td>
</tr>
<tr>
<td>Search model registration memory</td>
<td>$1$ MB ($H255 \times V255 \times 8$ models), up to $100$ models registrable</td>
</tr>
<tr>
<td>Image input, number of channels</td>
<td>EIA/CCIR monochrome, $256$ gradations, $2$ channels</td>
</tr>
<tr>
<td>Image output</td>
<td>EIA/CCIR monochrome, $256$ gradations, $1$ channel</td>
</tr>
<tr>
<td>Image processing</td>
<td>Binary feature extract (area, center of gravity, main axis angle, luminance integration), histogram, edge detection, image-to-image operation, filtering, labeling, light/dark image search, code recognition (QR code)</td>
</tr>
<tr>
<td>Processing range specification (window)</td>
<td>Up to $512$ windows registrable (shape: straight line, rectangle, circle, ellipse, sector)</td>
</tr>
<tr>
<td>Self-diagnosis function</td>
<td>Memory check, incorrect input, incorrect processing range, improper camera connection, etc.</td>
</tr>
<tr>
<td>Error display</td>
<td>Errors will be displayed on the teach pendant (option).</td>
</tr>
<tr>
<td>Power source</td>
<td>$5$ VDC, $12$ V (supplied from controller ISA)</td>
</tr>
</tbody>
</table>
| Environmental conditions (during operation)| Temperature: $0$ to $40^\circ$C  
Humidity: $90$ %RH or less  
(Dew condensation shall not be allowed.) |
| Outside dimensions (H x W x D)            | $21.4 \times 114 \times 185$ mm (excluding projections of connectors)          |

Note (1) The number of registrable models depends on the model image and/or size.  
(2) Since power is supplied from the inside of the robot controller, no external power source is required.
Note (1) The switches and the short pins on the board are already preset at the factory. Do not change the settings. A failure may result.

Note (2) Do not connect anything to the unused connectors on the board. A failure may result.

Note (3) The serial port and the I/O port on the board are unusable. Do not connect anything to them. A failure may result.
[1] Location of the µVision Board and Names of Connectors

Insert a µVision board into extension slot 3 (Figure 3-10).

Inserting the board in a wrong slot may damage the internal circuits of the robot controller. For installation procedure, refer to Subsection 3.8, "Mounting Extension Boards."

![Figure 3-10 Location of µVision Board and Names of Connectors](image)

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camera input connector 1</td>
<td>Used for connection with camera 1 (12-pin, round connector)</td>
</tr>
<tr>
<td>Camera input connector 2</td>
<td>Used for connection with camera 2 (12-pin, round connector)</td>
</tr>
<tr>
<td>Monitor output connector</td>
<td>Used for connection with the monitor (BNC).</td>
</tr>
<tr>
<td>Serial port</td>
<td>RS-232C port (not used)</td>
</tr>
<tr>
<td>I/O port</td>
<td>TTL level input/output: 1 point each (not used)</td>
</tr>
</tbody>
</table>

Table 3-8 Camera Input Connector Pin Layout (Manufacturer: Hirose Electric HR10A-10R-12S or equivalent)

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Signal name</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GND</td>
<td>Camera power GND</td>
</tr>
<tr>
<td>2</td>
<td>+12V</td>
<td>Camera power 12V</td>
</tr>
<tr>
<td>3</td>
<td>GND</td>
<td>Camera power GND</td>
</tr>
<tr>
<td>4</td>
<td>VIDEO</td>
<td>Video signal</td>
</tr>
<tr>
<td>5</td>
<td>HDGND</td>
<td>HD synchronous signal GND</td>
</tr>
<tr>
<td>6</td>
<td>HD</td>
<td>Horizontal synchronous signal</td>
</tr>
<tr>
<td>7</td>
<td>VD</td>
<td>Vertical synchronous signal</td>
</tr>
<tr>
<td>8</td>
<td>NC</td>
<td>Not connected</td>
</tr>
<tr>
<td>9</td>
<td>NC</td>
<td>Not connected</td>
</tr>
<tr>
<td>10</td>
<td>NC</td>
<td>Not connected</td>
</tr>
<tr>
<td>11</td>
<td>TRIG</td>
<td>Trigger signal (not used)</td>
</tr>
<tr>
<td>12</td>
<td>VDGND</td>
<td>VD synchronous signal GND</td>
</tr>
</tbody>
</table>
Chapter 3  Optional Devices

[2]  Block Diagram and Internal Configuration of µVision Board

Figure 3-11  Block Diagram of µVision Board

Figure 3-11 illustrates the processing flow of the µ Vision board as reference. The actual circuit configuration is different from this diagram.

<table>
<thead>
<tr>
<th>Camera selector</th>
<th>Selects camera image.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A/D</td>
<td>Converts analog signals into digital signals (8-bit).</td>
</tr>
<tr>
<td>Monitor selector</td>
<td>Selects whether to display the camera or the static image on the monitor.</td>
</tr>
<tr>
<td>LT</td>
<td>Converts 8-bit data values using the appropriate table.</td>
</tr>
<tr>
<td>Overlay circuit</td>
<td>Overlays a drawn image, stored in the dedicated drawn image memory, on the camera or the static image (see Figure 3-12, the overlay conceptual diagram).</td>
</tr>
<tr>
<td>D/A</td>
<td>Converts digital data into analog signals.</td>
</tr>
<tr>
<td>Image storage memory</td>
<td>Reads and stores camera images. Images are displayed on the monitor as static images. Up to four screens can be stored on this board.</td>
</tr>
<tr>
<td>Dedicated drawn image memory</td>
<td>The memory used to store drawn images of characters and figures. Images can be displayed on the monitor using the overlay circuit. Up to two screens can be stored on this board.</td>
</tr>
<tr>
<td>Image processing circuit</td>
<td>The circuit to process images.</td>
</tr>
<tr>
<td>CPU</td>
<td>Manages the entire system.</td>
</tr>
</tbody>
</table>
Figure 3-12 Overlay Concept
3.5.2 Peripheral Devices

[1] General Information about the Camera

![Camera cable (option)](image)

Connected to connector for camera input of μVision board

CS-8320B camera (back)

![Camera Dimensions and its Parts Names](image)

Figure 3-13 Camera Dimensions and its Parts Names

Table 3-9 Camera Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer</td>
<td>Tokyo Electronic Industry Co., Ltd.</td>
</tr>
<tr>
<td>Manufacturer’s model</td>
<td>CS8320B</td>
</tr>
<tr>
<td>Image pickup interline transfer system</td>
<td>CCD pixels: 768 (H) × 493 (V)</td>
</tr>
<tr>
<td>Lens mount</td>
<td>C mount</td>
</tr>
<tr>
<td>Image output NTSC signal</td>
<td>1.0 Vp-p/75 Ω</td>
</tr>
<tr>
<td>Power source/Ambient temperature</td>
<td>Supplied from power adapter, 0 to +40°C</td>
</tr>
<tr>
<td>Weight</td>
<td>120 g</td>
</tr>
<tr>
<td>Vibration-proof</td>
<td>98 m/s, 10G (10 to 50 Hz, 30 minutes in each of X, Y and Z directions)</td>
</tr>
</tbody>
</table>

Cables (Option)

<table>
<thead>
<tr>
<th>Cable length</th>
<th>Camera cable model</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 m</td>
<td>CPC3440-03</td>
</tr>
<tr>
<td>5 m</td>
<td>CPC3440-05</td>
</tr>
<tr>
<td>15 m</td>
<td>CPC3440-15</td>
</tr>
</tbody>
</table>
Caution (1) When mounting the camera to the equipment, tighten the screws securely to the specified torque. See Figure 3-14.

(2) Do not apply a strong impact or vibration to the camera. A failure may result.

(3) Do not touch the inside of the camera. An electric shock or accident may result.

(4) For setting camera data, refer to the instruction manual that comes with the camera.
Chapter 3  Optional Devices


![Figure 3-14 Monitor Dimensions and its Parts Names](image)

**Table 3-10  Monitor Specifications**

<table>
<thead>
<tr>
<th>Item</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer</td>
<td>Chuo Musen Co., Ltd.</td>
</tr>
<tr>
<td>Manufacturer’s model</td>
<td>TMP-232-03</td>
</tr>
<tr>
<td>Cathode-ray tube</td>
<td>9-inch, monochrome</td>
</tr>
<tr>
<td>Image input NTSC signal</td>
<td>0.7 Vp-p (straight polarity)</td>
</tr>
<tr>
<td>Power supply</td>
<td>100 VAC, 50/60 Hz</td>
</tr>
<tr>
<td>Power consumption</td>
<td>Approx. 30 W</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>0 to 40°C</td>
</tr>
<tr>
<td>Humidity</td>
<td>90% or less (without dew condensation)</td>
</tr>
</tbody>
</table>

**Cables (Option)**

<table>
<thead>
<tr>
<th>Cable length</th>
<th>BNC coaxial cable type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 m</td>
<td>3CV-PP (1)</td>
</tr>
<tr>
<td>3 m</td>
<td>3CV-PP (3)</td>
</tr>
<tr>
<td>5 m</td>
<td>3CV-PP (5)</td>
</tr>
</tbody>
</table>

**Caution**

(1): NEVER disassemble the monitor.
(2): Be sure to set a ferrite core clamp (ZCAT1518) to the BNC cable at the monitor output connector of the μVision board.
3.6 Ethernet Board

If the robot controller has an Ethernet board integrated, it can communicate with the PC teaching system using the TCP/IP protocol.

This board is helpful for communication between a single PC teaching system and more than one robot controller. It also provides faster communication than an RS-232C cable, contributing to improved response of the PC teaching system.

3.6.1 Ethernet Board Position and Connector Names

Insert the Ethernet board in extension slot 1 (upper slot) or extension slot 2 (middle slot). See Figure 3-15.

Inserting the board into a wrong slot may damage the internal circuits of the robot controller. For installation procedure of the Ethernet board, refer to Subsection 3.8, "Mounting Extension Boards."

Table 3-11 Ethernet Board Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>10Base2, 10BaseT (IEEE 802.3)</td>
</tr>
<tr>
<td>Baud rate</td>
<td>10 Mbits/sec.</td>
</tr>
</tbody>
</table>

Figure 3-15 Location of Ethernet Board and its Parts Names
<table>
<thead>
<tr>
<th>Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Link LED</td>
<td>Lights when a signal is detected at the UTP port.</td>
</tr>
<tr>
<td>CRS LED</td>
<td>Lights when a carrier signal is detected or remains ON when neither the UTP connector nor the BNC connector is connected.</td>
</tr>
<tr>
<td>RJ-45 UTP connector</td>
<td>Used for 10BaseT connection.</td>
</tr>
<tr>
<td>BNC connector</td>
<td>Used for 10Base2 connection.</td>
</tr>
</tbody>
</table>
|                  | **Caution**  
|                  | (1) When not using 10Base2, attach a BNC connector cap (that comes with the Ethernet board) to the BNC connector.  
|                  | (2) When using 10Base2, use insulation tape to cover all exposed metallic parts of connectors and the T-branch connector. |
3.7 DeviceNet Board

3.7.1 Overview

The robot controller is a slave unit for serial communications which is compliant with the open network DeviceNet. It may easily exchange I/O data with a variety of DeviceNet-compliant control devices of many manufacturers.

[ 1 ] Features

(1) **DeviceNet-compliant board**
The DeviceNet is an internationally open network developed by Allen-Bradley and is designed to allow control devices (e.g., sensors and actuators) to communicate with each other.

(2) **Can be networked with control devices of various manufacturers**
The robot controller equipped with DeviceNet board can be networked with DeviceNet-compliant control devices of various domestic and foreign manufacturers since the communications specifications are open.

(3) **Easy wiring and maintenance**
The 5-core special cable and detachable connector of the DeviceNet board make it easy to install wiring between nodes (communications units) and disassembly/restructure the network. This will sharply reduce cost in wiring and maintenance, as well as making replacement of units easy at the time of failure.

(4) **Sufficient number of I/Os**
The controller is capable of handling a large quantity of I/O data as listed below. Further, increase or decrease of the number of user-input I/Os is possible in the 8 steps.

<table>
<thead>
<tr>
<th></th>
<th>Number of I/Os</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Transmission</strong></td>
<td></td>
</tr>
<tr>
<td>Standard Mode, specific</td>
<td>24 to 224</td>
</tr>
<tr>
<td>Special Mode, specific</td>
<td>24 to 224</td>
</tr>
<tr>
<td><strong>Reception</strong></td>
<td></td>
</tr>
<tr>
<td>Standard Mode, specific</td>
<td>24 to 216</td>
</tr>
<tr>
<td>Special Mode, specific</td>
<td>40 to 232</td>
</tr>
</tbody>
</table>


The figure below illustrates a typical network.

---

3-32
3.7.2 **Product Specifications**

The figure below shows the location of the LEDs, DIP switches, and DeviceNet connector on the DeviceNet board.
(1) **Status indicator LEDs**

The status indicators MS and NS ("A" in the figure given on the previous page) can light or flash in green or red. Each of the ON, flashing, and OFF states of those indicators shows the module or network status as listed below.

The flashing interval is once per second (0.5 second of ON and 0.5 second of OFF).

<table>
<thead>
<tr>
<th>LED name</th>
<th>Color</th>
<th>State</th>
<th>Definition</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MS (Module Status)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green</td>
<td></td>
<td>Normal state</td>
<td>• The unit works normally.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Setup not completed</td>
<td>• Reading the DIS switch settings.</td>
<td></td>
</tr>
<tr>
<td>Red</td>
<td></td>
<td>Fatal error</td>
<td>• Hardware failure.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Recoverable error</td>
<td>• Wrong DIP switch settings, etc.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>No power supplied</td>
<td>• No power is supplied to the DeviceNet module.</td>
<td>• Resetting data.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Waiting for initialization.</td>
<td></td>
</tr>
<tr>
<td><strong>NS (Network Status)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green</td>
<td></td>
<td>Communications link established</td>
<td>The network is working normally. (The line is connected.)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Communications link not established</td>
<td>The network is working normally, but the line is not connected yet.</td>
<td></td>
</tr>
<tr>
<td>Red</td>
<td></td>
<td>Fatal communications error</td>
<td>The unit detects any error disabling communication on the network.</td>
<td>• Node address double-assigned.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Recoverable communications error</td>
<td>Communications error in some slaves.</td>
<td>• &quot;Bus off&quot; detected.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Network power supply failure</td>
<td>• Not connected to the master unit.</td>
<td>• Communications line broken.</td>
</tr>
</tbody>
</table>

: ON : Flashing : OFF
Chapter 3  Optional Devices

(2) DIP switch

Use the DIP switch for setting the node address and bit rate as shown below.

```
<table>
<thead>
<tr>
<th>DIP switch</th>
<th>Node address</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (32)</td>
<td>0</td>
</tr>
<tr>
<td>2 (16)</td>
<td>0</td>
</tr>
<tr>
<td>3 (8)</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>5 (2)</td>
<td>0</td>
</tr>
<tr>
<td>6 (1)</td>
<td>0</td>
</tr>
</tbody>
</table>
```

**DIP Switch Setting**

**NOTE:** Always turn off the controller power (including the network power) before setting the DIP switch.

**Setting the node address**

Set the node address of the robot controller using selectors 1 through 6 of the DIP switch, referring to the table below. You may freely set any of 0 through 63 to a node address unless the address is double-assigned on the same network including the master and slaves. Double assignment will cause an address double-assignment error, disabling the network.

**Node Address Setting by the DIP Switch**

<table>
<thead>
<tr>
<th>DIP switch</th>
<th>Node address</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (32)</td>
<td>0</td>
</tr>
<tr>
<td>2 (16)</td>
<td>0</td>
</tr>
<tr>
<td>3 (8)</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>5 (2)</td>
<td>0</td>
</tr>
<tr>
<td>6 (1)</td>
<td>0</td>
</tr>
</tbody>
</table>

**Note 1:** Selector OFF and ON are expressed by 0 and 1, respectively. (Before shipment from the factory, all switches are set to 0 by default.)
Setting the bit rate

To match the bit rate of the robot controller with that of the network, use selectors 7 and 8 of the DIP switch, referring to the table below:

### Bit Rate Setting By DIP Switch

<table>
<thead>
<tr>
<th>Selector 7</th>
<th>Selector 8</th>
<th>Bit rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>125 kbps</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>250 kbps</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>500 kbps</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>500 kbps</td>
</tr>
</tbody>
</table>

**Note 1:** Selector OFF and ON are expressed by 0 and 1, respectively. (Before shipment from the factory, both of these selectors are set to 0 (=500 kbps) by default.

**Note 2:** On the same network, set the same bit rate to all nodes (master and slaves). Otherwise, slaves whose bit rate is different from that of the master cannot communicate only, but also they may cause a communications error between correctly set nodes.

### (3) DeviceNet Connector

The new robot controller uses an open type screw connector whose pin arrangement is shown below.

**NOTE:** When the controller power (including the network power) is on, do not disconnect/connect the communication connector or touch its pins. Doing so will result in a failure.

![DeviceNet Connector Diagram]

1: V  (Black)  
2: CAN _ L  (Blue)  
3: Drain  (Shield)  
4: CAN _H  (White)  
5: V+  (Red)

It is recommended that either of the following crimp terminals be used for the communication cable.

<table>
<thead>
<tr>
<th>No.</th>
<th>Crimp terminal</th>
<th>Tools required</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>AI series (Phoenix Contact)</td>
<td>ZA3 (Phoenix Contact)</td>
</tr>
</tbody>
</table>
| (2) | TC series (Nichifu)  
For thin cables: TME TC-0.5  
For thick cables: TME TC-2-11 (for power supply)  
TME TC-1.25-11 (for communication) | NH-32 |
The following tables list the controller environmental and communication specifications.

### (1) Environmental requirements

<table>
<thead>
<tr>
<th>Item</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power requirements</td>
<td>5 VDC (supplied via the controller ISA bus)</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>0 to 40°C</td>
</tr>
<tr>
<td>Operating relative humidity</td>
<td>90% RH or less (without condensation)</td>
</tr>
</tbody>
</table>

### (2) DeviceNet communications specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communications protocol</td>
<td>DeviceNet-compliant</td>
</tr>
<tr>
<td>Connection supported</td>
<td>Master/slave connection : Polling I/O function</td>
</tr>
<tr>
<td></td>
<td>Compliant with DeviceNet communications rules</td>
</tr>
<tr>
<td>Connection type (Note 1)</td>
<td>Multi-drop type with possible combination of T-branch (to trunk and branch lines)</td>
</tr>
<tr>
<td>Bit rate</td>
<td>500, 250, 125 kbps (selection by switch)</td>
</tr>
<tr>
<td>Communications media</td>
<td>Special cable with 5 wires (2 for signals, 2 for power supply and 1 as a shield wire)</td>
</tr>
<tr>
<td>Communications cable length</td>
<td>Max. network length: 100 m or less (Note 2)</td>
</tr>
<tr>
<td></td>
<td>Branch length: 6 m or less</td>
</tr>
<tr>
<td></td>
<td>Total branch length: 39 m or less</td>
</tr>
<tr>
<td></td>
<td>Max. network length: 250 m or less (Note 2)</td>
</tr>
<tr>
<td></td>
<td>Branch length: 6 m or less</td>
</tr>
<tr>
<td></td>
<td>Total branch length: 78 m or less</td>
</tr>
<tr>
<td></td>
<td>Max. network length: 500 m or less (Note 2)</td>
</tr>
<tr>
<td></td>
<td>Branch length: 6 m or less</td>
</tr>
<tr>
<td></td>
<td>Total branch length: 156 m or less</td>
</tr>
<tr>
<td>Communication power supply</td>
<td>External supply of 24 VDC ±10%</td>
</tr>
<tr>
<td>Max. number of connectable nodes</td>
<td>64 nodes (including configurator (converter) if connected)</td>
</tr>
<tr>
<td>Number of I/Os</td>
<td>Standard assignment</td>
</tr>
<tr>
<td></td>
<td>40 points for system input</td>
</tr>
<tr>
<td></td>
<td>32 points for system output</td>
</tr>
<tr>
<td></td>
<td>24 points to 216 for user input</td>
</tr>
<tr>
<td></td>
<td>24 to 224 points for user output</td>
</tr>
<tr>
<td></td>
<td>No. of I/Os can be set in unit of 8 points.</td>
</tr>
<tr>
<td></td>
<td>Special assignment</td>
</tr>
<tr>
<td></td>
<td>24 points for system input</td>
</tr>
<tr>
<td></td>
<td>32 points for system output</td>
</tr>
<tr>
<td></td>
<td>40 to 232 points for user input</td>
</tr>
<tr>
<td></td>
<td>24 to 224 points for user output</td>
</tr>
<tr>
<td></td>
<td>No. of I/Os can be set in unit of 8 points.</td>
</tr>
<tr>
<td>Error check</td>
<td>CRC</td>
</tr>
</tbody>
</table>

**Note 1:** Terminator resistors are needed at both ends of the trunk line.

**Note 2:** These values may apply when a special thick cable is used as a trunk line. If a special fine cable is used, the max. network length is 100 m or less.
### 3.7.3 Assignment of Serial I/O Data

#### [1] Standard Assignment Mode

In the standard assignment mode, serial input/output data are assigned as shown in the table below:

The controller with a DeviceNet board transfers the system input/output data only through the DeviceNet, disabling the parallel port. The controller, however, can handle the user input/output data using both parallel ports and DeviceNet. The following signals are transferred only through the parallel ports; robot stop, enable auto, and CPU normal.

#### (1) Input Data

<table>
<thead>
<tr>
<th>No.</th>
<th>Content</th>
<th>No.</th>
<th>Content</th>
<th>No.</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>512</td>
<td>Step stop (all tasks)</td>
<td>520</td>
<td>Bit 0 in data area 1</td>
<td>528</td>
<td>Bit 0 in data area 2</td>
</tr>
<tr>
<td>513</td>
<td>–</td>
<td>521</td>
<td>Bit 1 in data area 1</td>
<td>529</td>
<td>Bit 1 in data area 2</td>
</tr>
<tr>
<td>514</td>
<td>Halt (all tasks)</td>
<td>522</td>
<td>Bit 2 in data area 1</td>
<td>530</td>
<td>Bit 2 in data area 2</td>
</tr>
<tr>
<td>515</td>
<td>Strobe signal</td>
<td>523</td>
<td>Bit 3 in data area 1</td>
<td>531</td>
<td>Bit 3 in data area 2</td>
</tr>
<tr>
<td>516</td>
<td>Skip interrupt</td>
<td>524</td>
<td>Bit 4 in data area 1</td>
<td>532</td>
<td>Bit 4 in data area 2</td>
</tr>
<tr>
<td>517</td>
<td>–</td>
<td>525</td>
<td>Bit 5 in data area 1</td>
<td>533</td>
<td>Bit 5 in data area 2</td>
</tr>
<tr>
<td>518</td>
<td>–</td>
<td>526</td>
<td>Bit 6 in data area 1</td>
<td>534</td>
<td>Bit 6 in data area 2</td>
</tr>
<tr>
<td>519</td>
<td>Command data odd parity</td>
<td>527</td>
<td>Bit 7 in data area 1</td>
<td>535</td>
<td>Bit 7 in data area 2</td>
</tr>
</tbody>
</table>

**Note 1:** The numerals at No. are the I/O port numbers of the controller.

**Note 2:** The input data is handled in bytes (8 points). Default is 64 points. Up to 256 points can be used.

#### (2) Output Data

<table>
<thead>
<tr>
<th>No.</th>
<th>Content</th>
<th>No.</th>
<th>Content</th>
<th>No.</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>768</td>
<td>Robot running</td>
<td>776</td>
<td>Robot warning</td>
<td>784</td>
<td>Bit 0 in status area</td>
</tr>
<tr>
<td>769</td>
<td>–</td>
<td>777</td>
<td>Continuous start permitted</td>
<td>785</td>
<td>Bit 1 in status area</td>
</tr>
<tr>
<td>770</td>
<td>Robot alarm</td>
<td>778</td>
<td>Reserved</td>
<td>786</td>
<td>Bit 2 in status area</td>
</tr>
<tr>
<td>771</td>
<td>Servo ON</td>
<td>779</td>
<td>Reserved</td>
<td>787</td>
<td>Bit 3 in status area</td>
</tr>
<tr>
<td>772</td>
<td>Robot initialization finished</td>
<td>780</td>
<td>Reserved</td>
<td>788</td>
<td>Bit 4 in status area</td>
</tr>
<tr>
<td>773</td>
<td>Auto mode</td>
<td>781</td>
<td>Reserved</td>
<td>789</td>
<td>Bit 5 in status area</td>
</tr>
<tr>
<td>774</td>
<td>External mode</td>
<td>782</td>
<td>Command process finished</td>
<td>790</td>
<td>Bit 6 in status area</td>
</tr>
<tr>
<td>775</td>
<td>Battery warning</td>
<td>783</td>
<td>Status area odd parity</td>
<td>791</td>
<td>Bit 7 in status area</td>
</tr>
</tbody>
</table>

**Note 1:** The numerals at No. are the I/O port numbers of the controller.

**Note 2:** The input data is handled in bytes (8 points). Default is 56 points. Up to 256 points can be used.
[2] Special Assignment Mode

In the special assignment mode, the serial input/output data are assigned as shown in the table below:

The controller with a DeviceNet board transfers the system input/output data only through the DeviceNet, disabling the parallel ports. The controller, however, can handle the user input/output data using both parallel ports and DeviceNet. The following signals are transferred only through the parallel ports: robot stop, enable auto, and CPU normal.

(1) Input Data

<table>
<thead>
<tr>
<th>No.</th>
<th>Content</th>
<th>No.</th>
<th>Content</th>
<th>No.</th>
<th>Content</th>
<th>No.</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>512</td>
<td>Step stop (all tasks)</td>
<td>520</td>
<td>Program selection bit</td>
<td>528</td>
<td>Motor power ON</td>
<td>536</td>
<td>INPUT 536</td>
</tr>
<tr>
<td>513</td>
<td>Continue start</td>
<td>521</td>
<td>Bit 1 for program selection</td>
<td>529</td>
<td>CAL execution</td>
<td>537</td>
<td>INPUT 537</td>
</tr>
<tr>
<td>514</td>
<td>Halt (all tasks)</td>
<td>522</td>
<td>Bit 2 for program selection</td>
<td>530</td>
<td>–</td>
<td>538</td>
<td>INPUT 538</td>
</tr>
<tr>
<td>515</td>
<td>Operation ready start</td>
<td>523</td>
<td>Bit 3 for program selection</td>
<td>531</td>
<td>SP100</td>
<td>539</td>
<td>INPUT 539</td>
</tr>
<tr>
<td>516</td>
<td>Skip interrupt</td>
<td>524</td>
<td>Bit 4 for program selection</td>
<td>532</td>
<td>Switching to external mode</td>
<td>540</td>
<td>INPUT 540</td>
</tr>
<tr>
<td>517</td>
<td>Program start</td>
<td>525</td>
<td>Bit 5 for program selection</td>
<td>533</td>
<td>Program reset</td>
<td>541</td>
<td>INPUT 541</td>
</tr>
<tr>
<td>518</td>
<td>–</td>
<td>526</td>
<td>Bit 6 for program selection</td>
<td>534</td>
<td>Robot alarm</td>
<td>542</td>
<td>INPUT 542</td>
</tr>
<tr>
<td>519</td>
<td>–</td>
<td>527</td>
<td>Program selection parity</td>
<td>535</td>
<td>–</td>
<td>543</td>
<td>INPUT 543</td>
</tr>
</tbody>
</table>

Note 1: The numerals at No. are the I/O port numbers of the controller.
Note 2: The input data is handled in bytes (8 points). Default value is 64 points. Up to 256 points can be used.

(2) Output Data

<table>
<thead>
<tr>
<th>No.</th>
<th>Content</th>
<th>No.</th>
<th>Content</th>
<th>No.</th>
<th>Content</th>
<th>No.</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>768</td>
<td>–</td>
<td>776</td>
<td>Robot power ON finished</td>
<td>784</td>
<td>Error code, unit, 2^0</td>
<td>792</td>
<td>Error code, hundreds, 2^0</td>
</tr>
<tr>
<td>769</td>
<td>Robot running</td>
<td>777</td>
<td>Serve ON</td>
<td>785</td>
<td>Error code, unit, 2^1</td>
<td>793</td>
<td>Error code, hundreds, 2^1</td>
</tr>
<tr>
<td>770</td>
<td>Robot alarm</td>
<td>778</td>
<td>CAL finished</td>
<td>786</td>
<td>Error code, unit, 2^2</td>
<td>794</td>
<td>Error code, hundreds, 2^2</td>
</tr>
<tr>
<td>771</td>
<td>Auto mode</td>
<td>779</td>
<td>Teaching</td>
<td>787</td>
<td>Error code, unit, 2^3</td>
<td>795</td>
<td>Error code, hundreds, 2^3</td>
</tr>
<tr>
<td>772</td>
<td>External mode</td>
<td>780</td>
<td>Single cycle end</td>
<td>788</td>
<td>Error code, tens, 2^1</td>
<td>796</td>
<td>–</td>
</tr>
<tr>
<td>773</td>
<td>Program start reset</td>
<td>781</td>
<td>Battery warning</td>
<td>789</td>
<td>Error code, tens, 2^2</td>
<td>797</td>
<td>–</td>
</tr>
<tr>
<td>774</td>
<td>–</td>
<td>782</td>
<td>Robot warning</td>
<td>790</td>
<td>Error code, tens, 2^3</td>
<td>798</td>
<td>–</td>
</tr>
<tr>
<td>775</td>
<td>–</td>
<td>783</td>
<td>Continue start permitted</td>
<td>791</td>
<td>Error code, tens, 2^4</td>
<td>799</td>
<td>–</td>
</tr>
</tbody>
</table>

Note 1: The numerals at No. are the I/O port numbers of the controller.
Note 2: The input data is handled in bytes (8 points). Default value is 64 points. Up to 256 points can be used.
3.7.4 Parameter Entry Procedure

[1] Entering the Number of Input/Output Slots

This controller allows you to increase or decrease the number of input/output slots in bytes. The number of input slots can be set in the range from 8 (default) to 32 (max.), and the number of output slots in the range from 7 (default) to 32 (max.). The setting procedure is given below:

\[\text{STEP 1}\]

Press [F4 I/O] on the following screen.

\[\text{STEP 2}\]

Press [F6 Aux.] on the following screen.
STEP 3

Press [F1 Set H/W] on the following screen.

STEP 4

Select the box for changing the number of DeviceNet input/output slots and then press [F5 Change].

STEP 5

Enter a required number of slots on the following screen and press OK. The quick reference table given in the next subsection [2] will be helpful for you to determine the number of input/output slots.
STEP 6
Check that the number has been correctly changed (from 8 to 10 in this example) and press OK.

STEP 7
Turn the controller power OFF and then turn it back ON according to the message on the following screen.

NOTE: The internal data that you have changed will not go into effect until you turn the controller power off and on.
Quick Reference Table for the Number of Input/Output Slots

The table below lists the correspondence between the number of input/output slots and the number of user input/output points.

<table>
<thead>
<tr>
<th>Number of DeviceNet input slots</th>
<th>Max user input points in standard assignment</th>
<th>Max user input points in special assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>24</td>
<td>40</td>
</tr>
<tr>
<td>9</td>
<td>32</td>
<td>48</td>
</tr>
<tr>
<td>10</td>
<td>40</td>
<td>56</td>
</tr>
<tr>
<td>11</td>
<td>48</td>
<td>64</td>
</tr>
<tr>
<td>12</td>
<td>56</td>
<td>72</td>
</tr>
<tr>
<td>13</td>
<td>64</td>
<td>80</td>
</tr>
<tr>
<td>14</td>
<td>72</td>
<td>88</td>
</tr>
<tr>
<td>15</td>
<td>80</td>
<td>96</td>
</tr>
<tr>
<td>16</td>
<td>88</td>
<td>104</td>
</tr>
<tr>
<td>17</td>
<td>96</td>
<td>112</td>
</tr>
<tr>
<td>18</td>
<td>104</td>
<td>120</td>
</tr>
<tr>
<td>19</td>
<td>112</td>
<td>128</td>
</tr>
<tr>
<td>20</td>
<td>120</td>
<td>136</td>
</tr>
<tr>
<td>21</td>
<td>128</td>
<td>144</td>
</tr>
<tr>
<td>22</td>
<td>136</td>
<td>152</td>
</tr>
<tr>
<td>23</td>
<td>144</td>
<td>160</td>
</tr>
<tr>
<td>24</td>
<td>152</td>
<td>168</td>
</tr>
<tr>
<td>25</td>
<td>160</td>
<td>176</td>
</tr>
<tr>
<td>26</td>
<td>168</td>
<td>184</td>
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<tr>
<td>27</td>
<td>176</td>
<td>192</td>
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<tr>
<td>28</td>
<td>184</td>
<td>200</td>
</tr>
<tr>
<td>29</td>
<td>192</td>
<td>208</td>
</tr>
<tr>
<td>30</td>
<td>200</td>
<td>216</td>
</tr>
<tr>
<td>31</td>
<td>208</td>
<td>224</td>
</tr>
<tr>
<td>32</td>
<td>216</td>
<td>232</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of DeviceNet output slots</th>
<th>Max user output points in standard assignment</th>
<th>Max user output points in special assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>8</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>9</td>
<td>40</td>
<td>40</td>
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<tr>
<td>10</td>
<td>48</td>
<td>48</td>
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<tr>
<td>11</td>
<td>56</td>
<td>56</td>
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<tr>
<td>12</td>
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<tr>
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<td>136</td>
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<td>31</td>
<td>216</td>
<td>216</td>
</tr>
<tr>
<td>32</td>
<td>224</td>
<td>224</td>
</tr>
</tbody>
</table>
### 3.7.5 Error Code Table

Here, only the error codes relative to DeviceNet communication errors are described in the table below. For other error codes, refer to the ERROR CODE TABLES, "2 Controller Error Code Table."

#### DeviceNet Error Code Table

<table>
<thead>
<tr>
<th>Error code</th>
<th>What has happened:</th>
<th>What to do:</th>
<th>LEDs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1201</td>
<td>Preparing for communications (link not established)</td>
<td>Establish the link from the master device.</td>
<td>Ms: G</td>
</tr>
<tr>
<td></td>
<td>• The DeviceNet module is working normally, but has not established link with the master device.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1202</td>
<td>Preparing for communications (link not established)</td>
<td>Establish the I/O link from the master device.</td>
<td>Ms: G</td>
</tr>
<tr>
<td></td>
<td>• The DeviceNet module is working normally and has established explicit link with the master device, but not established an I/O link.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1203</td>
<td>Preparing for communications (communications idling)</td>
<td>Check the contents of I/O data that the master device sends.</td>
<td>Ms: G</td>
</tr>
<tr>
<td></td>
<td>• The DeviceNet module is working normally, but cannot receive data except empty data from the master device.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1204</td>
<td>Preparing for communications (I/O timeout)</td>
<td>Check that the DeviceNet cable is not broken or its connector is firmly plugged in. Check the DeviceNet cable length and that a terminator resistor is attached to each end of the trunk line.</td>
<td>Ms: G</td>
</tr>
<tr>
<td></td>
<td>• The DeviceNet module is working normally, but cannot receive data from the master device within the specified time.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1205</td>
<td>Initial setting error in the communications processor</td>
<td>Turn the controller power off and then on, and do the same operation again.</td>
<td>Ms: –</td>
</tr>
<tr>
<td></td>
<td>• Failed to establish the initial link with the DeviceNet communication processor.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1210</td>
<td>A DeviceNet internal communications error has occurred.</td>
<td>Turn the controller power off and then on, and do the same operation again.</td>
<td>Ms: –</td>
</tr>
<tr>
<td>1213</td>
<td>The network is broken or &quot;bus off.&quot;</td>
<td>Check whether the DeviceNet cable is connected with the robot controller. If this error occurs after you change the DIP switch setting, check whether the bit rate setting made with the DIP switch matches the network’s bit rate.</td>
<td>Ms: G</td>
</tr>
<tr>
<td></td>
<td>• The DeviceNet cable is broken or not connected.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1215</td>
<td>Preparing for communications (Initial setting error)</td>
<td>Check whether the bit rate setting made with the DIP switch matches the network's bit rate.</td>
<td>Ms: G</td>
</tr>
<tr>
<td></td>
<td>• No initial settings have been received from the robot.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1216</td>
<td>Data length setting error</td>
<td>Turn the controller power off and then on. Then, set correct DeviceNet INSLOT and OUTSLOT values.</td>
<td>Ms: R</td>
</tr>
<tr>
<td></td>
<td>• DeviceNet INSLOT or OUTSLOT is not 32 or less.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1217</td>
<td>Node address double-assign error</td>
<td>Assign an exclusive node address to each node (including the robot controller) on the same DeviceNet.</td>
<td>Ms: G</td>
</tr>
<tr>
<td></td>
<td>• The same node address is double assigned to the robot controller and any other online node.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**LEDs:**

- ON
- Flashing
- OFF
- Indefinite
## Chapter 3  Optional Devices

<table>
<thead>
<tr>
<th>Error code</th>
<th>What has happened:</th>
<th>What to do:</th>
<th>LEDs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1230</td>
<td>Retry error in the DPRAM built in the robot controller</td>
<td>Turn the controller power off and then on, and do the same operation again.</td>
<td>–&lt;br&gt;–</td>
</tr>
<tr>
<td>1232</td>
<td>Reset command received&lt;br&gt;• The robot controller has received a reset command from the master device.</td>
<td>Turn the controller power off and then on, and do the same operation again.</td>
<td>🟢&lt;br&gt;🟢</td>
</tr>
<tr>
<td>1234</td>
<td>DeviceNet internal RAM error</td>
<td>Turn the controller power off and then on, and do the same operation again.</td>
<td>🔴</td>
</tr>
<tr>
<td>1235</td>
<td>Reserved for System</td>
<td>–</td>
<td>✢&lt;br&gt;✷</td>
</tr>
<tr>
<td>1236</td>
<td>DeviceNet internal DPRAM error</td>
<td>Turn the controller power off and then on, and do the same operation again.</td>
<td>🟢&lt;br&gt;🔴</td>
</tr>
<tr>
<td>1237</td>
<td>DeviceNet EEPROM error</td>
<td>Turn the controller power off and then on, and do the same operation again.</td>
<td>🔴&lt;br&gt;🔴</td>
</tr>
<tr>
<td>1238</td>
<td>Retry error in the DeviceNet DPRAM</td>
<td>Turn the controller power off and then on, and do the same operation again.</td>
<td>🔴&lt;br&gt;🔴</td>
</tr>
</tbody>
</table>

- : ON<br> : Flashing<br>- : OFF<br>- : Indefinite
RC5 EDS File ($ DeviceNet Manager Generated Electronic Data Sheet)

[File]
DescText = "RC5 EDS File";
CreateDate = 11-14-1997;
CreateTime = 15:00:00;
ModDate = 06-26-1999;
ModTime = 10:57:07;
Revision = 1.1;

[Device]
VendCode = 171; $ Vendor Code
ProdType = 12; $ Product Type
ProdCode = 1; $ Product Code
MajRev = 1; $ Major Rev
MinRev = 1; $ Minor Rev
VendName =
ProdTypeStr = "Communication Adapter";
ProdName = "RC5";
Catalog = "";

[IO_Info]
Default = 0X0001; $ Poll Only
PollInfo = 0X0001, $ Poll Only
1, $ Default Input = Input1
1; $ Default Output = Output1

$Input Connections
Input1 =
7, $ From 7 to 32 Bytes, Variability
0, $ All bits are significant
0x0001, $ Poll Only Connection
"Data", $ Name
6, $ Path Length
"20 07 24 02 30 04", $ Register Object Instance 2 Attribute 4
"Robot Output Data"; $ Help

$Output Connections
Output1 =
8, $ From 8 to 32 Bytes, Variability
0, $ All bits are significant
0x0001, $ Poll Only Connection
"Data", $ Name
6, $ Path Length
"20 07 24 01 30 04", $ Register Object Instance 1 Attribute 4
"Robot Input Data"; $ Help
3.8 Mounting Extension Boards

This section describes how to mount the µVision board, Ethernet board, and DeviceNet board. When mounting only one of these boards, skip the steps for mounting other boards.

In the illustrations below, the typical controller model is drawn.

STEP 1

Remove the eight screws from the controller top cover.

STEP 2

Lift and remove the top cover from the robot controller.
STEP 3
Remove the two screws fastening the side plate from the front panel of the robot controller as shown below.

STEP 4
Remove the side plate.
Step 5
Remove the panel fastening screw and then the panel hole blind plate. To mount the μVision board, remove the lower blind plate. To mount the Ethernet board or DeviceNet board, remove the upper or the middle blind plate.

Step 6
To mount the μVision board to the robot controller (RC5-VM6A), remove the screws from the extension board retaining strut and take off the strut. If you do not mount the μVision board, skip to STEP 8.
STEP 7

Insert the µVision board in the lower slot connector.

STEP 8

Insert the Ethernet board or the DeviceNet board into the upper or the middle slot connector.
STEP 9

Using the removed panel hole blind plate, push up the panel of each extension board. Secure the extension board with the panel fastening screw.

STEP 10

Secure the board support plate to the extension board strut.
STEP 11
Set the assembled extension board strut back into place and tighten the screws.
Tightening torque: 0.69 Nm ±20%

STEP 12
Adjust the position of each board support plate with the screw so that each extension board will be supported firmly.
When installing more than one extension board, be sure to tighten screws starting from one on lower board.
Tightening torque: 0.15 Nm ±20% for the lower slot
0.10 Nm ±20% for the middle slot
0.15 Nm ±20% for the higher slot
STEP 13
Install the side plate and tighten the two screws.

STEP 14
Put the top cover and secure it with the eight screws.

The mounting of the extension boards is now finished.
3.9 Controller Protective Box

A controller protective box is available as an optional heat exchanger box to protect the robot controller from an undesirable environment (dust, oil mist) in plant.

3.9.1 Components in Package

Check that the following components are contained in the package of the controller protective box.

3.9.2 Names of the Components
3.9.3 Setting up the Controller Protective Box

Placing the controller protective box
Place the controller protective box on a flat, level plane.

Preparing a power supply
Make a single-phase 200 VAC power supply ready for use.
Connect the power supply to the fan motor drive terminal.
Recommended cable: 1.25 mm² x 3-core (outside diameter: 11 to 13 mm)

Note (1) Make the controller protective box share the same circuit breaker of the power supply (200 VAC) with the robot controller.
Note (2) Ground the controller protective box to prevent an electric shock.

Setting the robot controller into the protective box
(1) Remove the top cover from the controller protective box.
(2) For the controller protective box, remove the wing bolt and take off the partition plate (A).
(3) Put the robot controller into the protective box so that its rubber feet will be fitted into the controller fixtures of the protective box.
(4) For the controller protective box, secure the partition plate (A) with the wing bolt.
(5) Route the necessary cables through the ducts and connect them. As shown below, tie up each duct with an attached binding band.

Note: Tying up duct(s) not in use

Note: Tie up the opening of each duct not in use with an attached binding band to prevent entry of dust, water, etc. into the controller protective box.
3.9.4 Precautions

(1) The controller protective box is a dust-proof, splash-proof structure equivalent to JIS IP53.

The controller protective box is not explosion-proof and must not be installed in the following environments and locations to ensure safety:

- in an environment full of combustible gas, flammable liquid, etc;
- in an environment full of acid or alkali corrosive gas;
- in a location close to electric noise sources, such as large inverters, high-output high-frequency generators, large conductors and welders;
- in a location where the controller protective box will not be used outside the ambient temperature range from 0°C to 40°C;
- in a location where the controller protective box will be exposed to rain or dew;
- in an environment where the controller protective box will be exposed directly to water, oil or chips;
- in an environment where fine chips will be produced from cutting, etc;
- in an environment using oil other than YASKAWA’s recommended oil. YASKAWA’s recommended oil: YUSHIRON OIL No. 4

(2) Seal the mounting face and screws of the controller protective box when using it in an environment full of oil mist. Otherwise oil mist may remain on the fin, resulting in a collection of oil. Regularly clean the controller protective box.

(3) If oil mist, etc. collects in the controller protective box, remove the drain hole screw and drain off the oil.

(4) The controller protective box is not equipped with a power switch. Turn ON or OFF the controller using an external means.

(5) The controller protective box must be installed horizontally. Vertical installation will cause accidents.
Chapter 4
Specifying Your Robot

This chapter specifies how to customize your robot.
Chapter 4  Specifying Your Robot

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4.1 Modifying Software Motion Limits to Define New Motion Space

4.1.1 What Is a Software Motion Limit?

A limit to the operation range of the robot defined by the software is called a software motion limit. Software motion limits become valid after CAL of the robot has been completed and the robot has entered the range set by the limits. A mechanical operation limit is called a mechanical end and set by a mechanical stop. To prevent the robot from striking against a mechanical stop, each software motion limit is set slightly in front of the mechanical end as shown in Figure 4-1. Although there is no mechanical stop for the sixth axis, a software motion limit is set.

If the robot reaches a software motion limit during manual or automatic operation, an error message will be displayed (error code starting from 6070; the first digit represents the axis number) and the robot will come to a stop. The power to the motor is also turned OFF in such a case during automatic operation.

All axes are assigned a software motion limit in both the positive and negative direction of the operation range. The software motion limit in the positive direction is called the positive-direction software motion limit and that in the negative direction is called the negative-direction software motion limit.
4.1.2 Changing Software Motion Limits

If the robot interferes with any other device, change the software motion limits to make the motion space smaller as shown in Figures 4-2.

![Figure 4-2 Changing Software Motion Limits](image-url)
4.1.3 Precautions When Changing the Software Motion Limits

(1) Confirm the operating space of the robot in the actual working environment. Set the software motion limits using the correct unit of measurement. If the operating space is too small, the robot may seem to become inoperable.

4.1.4 Procedure for Changing the Software Motion Limits

Described below is the procedure for changing the software motion limits.

- **STEP 1**
  Turn the power switch of the robot controller to ON.

- **STEP 2**
  Set the mode selector switch of the teach pendant to MANUAL.

- **STEP 3**
  Press [F2 Arm] on the top screen of the teach pendant.

The Current Robot Position window appears as shown in Step 4.
STEP 4

Press the SHIFT key and then press [F12 Maint.].

The Maintenance Functions (Arm) window will appear.

STEP 5

Press [F1 M Space] on the Maintenance Functions (Arm) window. The Motion Space window will appear as shown below.
STEP 6

Select the item to be modified, then press [F5 Change].
The numeric keypad will appear as shown below.

Enter a desired value using the numeric keys, then press OK.
The new value will be set on the line of the item selected in the Motion Space window.
If two or more items must be changed, repeat Steps 4 and 5.

STEP 7

Press OK in the Motion Space (Software motion limit) window.

STEP 8

Turn OFF the power to the robot controller.
4.1.5 Changing the Software Motion Limit Temporarily

The robot can be operated by releasing limit check temporarily even if the robot stops by the software limit.
Following check function are released.
① Software Motion Limit Check for Each Axis
② Robot Arm Interference Check
③ Motion Space Check

NOTE 1:
When the software motion limits are released, the motion and the current position can not be set to the variable.

NOTE 2:
The software motion limit release is canceled by the following operation.
① Cancel of the software limit release is operated.
② Automatic mode or teaching mode is selected.
③ Controller's power supply is turned off.

Described below is the procedure for releasing the software motion limits.

› STEP 1  
Turn the power switch of the robot controller to ON.

› STEP 2  
Set the mode selector switch of the teach pendant to MANUAL.

› STEP 3  
Press [F2 Arm] on the top screen of the teach pendant.

› STEP 4  
Press [F6 Aux.].
STEP 5

① When the limit release button is pressed in the normal state (limit not released), the following message is displayed.

![System Message]

Press OK to release the limit.

② When the limit release button is pressed in the limit released state, the following message is displayed.

![System Message]

Press the OK key to release the limit.
4.2 CALSET

4.2.1 What Is CALSET?
Calibrating the relationship between position-related information recognized by the robot controller and the actual position of the robot body is called CALSET. CALSET must be performed when the motor is replaced or when the backup battery for the encoder goes dead and the position-related data retained in the encoder is lost as a result.
After CALSET is completed, the calibrated data of the robot body will be recorded in the robot controller. This data is called calsetting data, and it is different on each robot.

4.2.2 CALSET Procedure
Move the robot arm into contact with the CALSET position by the axis operation in manual mode.
There are two types of CALSET as follow.

- Single axis CALSET by specifying independent axis
- All axes CALSET by specifying all axes.

If you already know the absolute data in the CALSET position, input that data. The robot arm position for CALSET is called CALSET position.
In CALSET which performs before the robot is shipped, the position shown in Figure 4-3, 4-4 is set at the CALSET position.

The angle of the U-axis against the horizon is 0 degrees
The angle of the central line of the B-axis against the central line of the U-axis is 0 degrees.
The angle of the L-axis perpendicular to the ground.

The angle of the U-axis against the horizon is 0 degrees
The angle of the central line of the B-axis against the central line of the U-axis is 0 degrees.
The angle of the L-axis perpendicular to the ground.

Figure 4-3
Figure 4-4
4.2.3 Procedure for Performing CALSET

4.2.3.1 CALSET of a Single Axis

CALSET only a specified axis is called single axis CALSET. Perform single axis CALSET when the motor of an axis is replaced and the axis must therefore be CALSET, or when some axes cannot be moved to the CALSET positions at any given time because of interference between the equipment installed near the robot and the robot. The procedure for CALSET a single axis is described below:

**NOTE:** Steps 1 and 2 are required for CALSET of the 6th axis. To CALSET any other axis, skip to Step 3.

- **STEP 1**
  Move the desired axis to the CALSET position in manual mode and turn off the power to the motor.

- **STEP 2**
  Press [F2 Arm] on the teach pendant.

- **STEP 3**
  Press [F12 Maint.]
**STEP 4**

Press [F6 CALSET].

**STEP 5**

Press the axis number to be CALSET to turn ON CALSET (green display). Turn OFF CALSET (black display) for the other axes that are not required to be CALSET.

**STEP 6**

Press OK. The system message appears asking whether you want to carry out CALSET with a caution that the robot reference position will change.

**STEP 7**

Press OK. The system message appears informing that CALSET is completed.
4.2.3.2 CALSET of all Axes

The CALSET of all axes is called all-axis CALSET.
The procedure is the same as that for CALSET of a single axis.

4.2.3.3 Input the Absolute Data

Value of motor encoder at robot reference position is called absolute data.
Even if the robot controller is replaced, CALSET can be performed by inputting this absolute data of the old one.
Described below is the procedure for input the absolute data.

**STEP 1**

Press [F2 Arm] on the teach pendant.

**STEP 2**

Press [F12 Maint.].
STEP 3
Press [F6 CALSET].

STEP 4
Press [F1 ABS.DATA].

STEP 5
The example of changing the absolute data of the J1 axis from 606 to 706 is shown in the following. Press [F5 Change].
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STEP 6
Input “706”.

STEP 7
Press OK.

STEP 8
Press OK.
STEP 9

Press Cancel.
The altering of the absolute data has been completed.
4.3 Setting Control Set of Motion Optimization

The optimum speed or acceleration depends on the payload and center of gravity of the end-effector or workpiece that is to be set at the end of the robot arm. Set the payload and center of gravity position of the end-effector or workpiece and the control set of motion optimization according to the end load on or position of the robot.

For further information, see the PROGRAMMER’S MANUAL, Section 4.7 “Setting the Master Control Parameters in User Preferences.” For the setting procedure, refer to the SETTING-UP MANUAL, Section 2.9, "Setting the Master Control Parameters of the Payload, Center of Gravity, and Control Set of Motion Optimization."

The mass of payload is the total weight of the end-effector and workpiece, expressed in grams.

The payload center of gravity is represented by the TOOL0 coordinate system (see Figure 4-5) in the unit of mm.

The origin of the TOOL0 coordinate system is the center of the sixth axis flange. Its Y-component is in the direction from the flange center to the \( \phi \) 6H7 pin hole (orientation vector direction). The Z-component is in the vertical direction to the flange face across the flange center (approach vector direction). The X-component is in the X-axis direction of the right hand coordinate system (normal vector direction) with the orientation vector as the Y-axis and the approach vector as the Z-axis. (See Figure 4-6.)

![Figure 4-5 Payload Center of Gravity](Image)
Figure 4-6 Right Hand Coordinate System

- Y-axis positive direction (orientation vector)
- Z-axis positive direction (approach vector)
- X-axis positive direction (normal vector)
4.4 Setting Robot Installation Conditions

The optimum operating conditions will differ depending on whether the robot is floor-mounted or overhead-mounted.

The operating conditions set prior to delivery from the plant are for floor installation. If the installation conditions change, the settings must be changed accordingly.

For the setting procedure, refer to the SETTING-UP MANUAL, Section 2.10, "Setting the Robot Installation Condition" and the PROGRAMMER'S MANUAL, Subsection 4.7.2 "Setting Robot Installation Conditions."
4.5 Recovery Procedure After Encoder Reference Position Error

**Warning:** Move the robot in low speed which can be stopped at once with paying attention to the robot movement. Do not approach the robot when the robot operates.

4.5.1 Purpose of the Encoder Reference Position Error

If the encoder value detected at power on does not match the data stored in the encoder the last time the power was turned off, an error occurs when the controller power is turned on.

However, this error does not occur when the encoder line of all axis is not connected ("J# encoder initialization error" occurs, #: axis no.) at controller power ON.

There are two possible causes of this error:

- Error in the encoder system
- The robot was moved after the power was turned OFF.

If there is an error with the encoder system, the manipulator may stall when the program operation is started.

Therefore, if the encoder reference position error has occurred, the automatic operation and the teaching check operation are set not to function until the position check operation is done.
① Position Check
If the encoder reference position error occurs, move to the encoder reference position using the axis keys and check the position. Automatic operation, teach check operation, and other operations will not function.

② Pulse Difference Check
The pulse number at the encoder reference position is compared with that at the current position.
If the difference is within the allowable range, the program operation is enabled. If not, the encoder reference position error occurs again.
- The allowable range is the number of pulses per rotation of the motor.
- The initial value of the encoder reference position is the RANG value (CALSET position). This can be changed. For details, refer to "4.5.3 Setting the Encoder Reference Position".

③ Alarm Occurrence
If the encoder reference position error occurs again, there may be an error in the encoder system.
Check the system.
After adjusting the erroneous axis, perform CALSET operation for the erroneous axis, then check the position again.
All axes CALSET enables the program operation without having to check the Position.
4.5.2 Operation Limitation When Encoder Reference Position Error

The each function concerning an encoder reference position cannot be executed as shown in the following table based on the detection result of an encoder reference position error at the controller power ON.

<table>
<thead>
<tr>
<th>State</th>
<th>Position Check</th>
<th>Information</th>
<th>Move</th>
<th>Reference Change</th>
<th>Reset Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undetection</td>
<td>Disable</td>
<td>Enable</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
</tr>
<tr>
<td>On Error</td>
<td>Enable</td>
<td>Enable</td>
<td>Disable</td>
<td>Enable</td>
<td>Enable</td>
</tr>
<tr>
<td>Normal</td>
<td>Unnecessary</td>
<td>Enable</td>
<td>Enable</td>
<td>Enable</td>
<td>Enable</td>
</tr>
</tbody>
</table>

Undetection: When the encoder line of all axis is not connected at controller power ON
On Error: When there is an axis which exceeds tolerance in the detection result at controller power ON
Normal: When all axis are in tolerance in the detection result at controller power ON

Note: Even if an encoder reference position error is occurring, the error can be canceled by performing "Reference Change" and "Reference Reset". Do not perform before confirming that the encoder is normal.
4.5.3 Setting the Encoder Reference Position

The position set as a checkpoint of the encoder value is an encoder reference position besides an absolute data which the robot has in the peculiarity.

There are two kinds of setting an encoder reference position: Reference Change, Reference Reset.

Reference Change (Set the current position as the encoder reference position)

- **STEP 1**
  Move the robot to the position where the encoder reference position is set.

- **STEP 2**
  Press [F2 Arm] on the top screen of the teach pendant.

- **STEP 3**
  Press [F6 Maint.] with SHIFT key simultaneously.
STEP 4

Press [F8 ENC Ref]

STEP 5

Press [F5 chg. Ref]

The system message is displayed.
To continue this operation, press [OK].
To cancel this operation, press [Cancel].
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Reference Reset (Set the RANG value (CALSET position) as the encoder reference position)

- **STEP 1**
  Perform the same operation as from STEP2 to STEP4 of the Reference Change.

- **STEP 2**
  Press [F5 Ref rst]

The system message is displayed.
To continue this operation, press [OK].
To cancel this operation, press [Cancel].
4.5.4 Recovery Procedure After Encoder Reference Position Error

When the encoder reference position error occurs, perform the following operations:
・Reset the encoder reference position error
・Turn the motor power ON.

Then, perform the position check operation as follow.
If the encoder system is abnormal, give appropriate treatment like the exchange etc.

▶ STEP 1
Perform the same operation as from STEP2 to STEP4 of the Reference Change.

▶ STEP 2
Press [F1 POS chk]
The system message is displayed.
To continue this operation, press [OK].
To cancel this operation, press [Cancel].

If the encoder reference position error can not be canceled, the abnormal axis is displayed in the error message.
Move the robot again to the encoder reference position and perform the position check operation.
If the encoder reference position error cannot be canceled because the encoder line of all axes is not connected at controller power ON, "Detection Error" is displayed in the error message. Check the encoder system.

Follow the steps below when you perform the position check operation with the operating panel.

<table>
<thead>
<tr>
<th>STEP 1</th>
<th>Move the robot to the encoder reference position. The encoder reference position equals to the robot home position at the factory shipment.</th>
</tr>
</thead>
<tbody>
<tr>
<td>STEP 2</td>
<td>Turn the motor power OFF.</td>
</tr>
<tr>
<td>STEP 3</td>
<td>Press the [shift] key and then press the [cal] key. “FO:ENC.REF” is displayed in the LCD.</td>
</tr>
<tr>
<td>STEP 4</td>
<td>Press the [OK] key. The position is confirmed and the result is displayed. When the encoder reference position error is released, “No Problem” is displayed in the LCD. If it is not released, × O × O × O × O × O is displayed in the LCD. (×:Error, O:Normal, 1st axis, 2nd axis, from the left)</td>
</tr>
</tbody>
</table>
4.5.5 Moving the Robot to the Encoder Reference Position

- **STEP 1**
  Turn the motor power ON.

- **STEP 2**
  Perform the same operation as from STEP2 to STEP4 of the Reference Change.

- **STEP 3**
  Press [F4 Move]

  Choose the PTP motion mode or the CP motion mode. After completing choosing the motion mode, keep pressing the OK key of the teach pendant while squeezing the deadman switch until the operation is completed.

4.5.6 Displaying the Current Status

- **STEP 1**
  Perform the same operation as from STEP2 to STEP4 of the Reference Change.

- **STEP 2**
  The content same as the result of the position check is displayed.
This chapter describes the necessary requirements to connect the PLC and other external devices to the controller.
### Chapter 5  Robot Controller Interface

#### 5.1 General Information about the Interface

5.1.1 Standard Mode and Special Mode

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- 5.3.2.2 Auto Mode (Output)
- 5.3.2.3 External Mode (Output)
- 5.3.2.4 Servo ON (Output)
- 5.3.2.5 Robot in Operation (Output)
- 5.3.2.6 Normal CPU (Output)
- 5.3.2.7 Robot Error (Output)
- 5.3.2.8 Robot Warning (Output)
- 5.3.2.9 Dead Battery Warning (Output)
- 5.3.2.10 Continue Start Permitted (Output)

5.3.3 Types and Functions of System Input Signals (Standard Mode)

5.3.4 Usage of System Input Signals (Standard Mode)

- 5.3.4.1 Enable Auto (Input)
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- 5.3.4.3 Step Stop (All Tasks) (Input)
- 5.3.4.4 Instantaneous Stop (All Tasks) (Input)
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5.1 General Information about the Interface

5.1.1 Standard Mode and Special Mode

The Robot Controller can be operated in two different modes – standard mode and special mode. The default setting is standard mode. Determine and select either mode before operating the Robot Controller.

In the standard mode, all of the advantages can be expected from the new model Robot Controller by simultaneously running plural programs with multitasking.

In the special mode, there are some restrictions on the use of new functions, such as multitasking.

5.1.1.1 Switching Modes

Switch from one mode to the other using the teach pendant or the personal computer teaching system.

*Caution:* The selected mode will not become valid until the power to the Robot Controller is turned OFF and turned ON again, after the change.
Switching from the Teach Pendant

Follow the procedure below when switching from one mode to the other from the teach pendant:

**STEP 1**


The I/O Monitor window appears.

**STEP 2**

Press [F6 Aux.].

The Auxiliary Functions (I/O) window appears.
STEP 3

Press [F1 Set H/W].
The I/O Hardware Settings window appears.

STEP 4

Using the jog dial or cursor keys, select the Allocation mode field.

STEP 5

Press [F5 Change].
The Change Parameter window appears.
STEP 6
Enter the number of the desired mode by pressing the corresponding number key, then press OK.
The modes and their numbers are shown in the table below.

<table>
<thead>
<tr>
<th>Allocation mode</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special mode</td>
<td>0</td>
</tr>
<tr>
<td>Standard mode</td>
<td>1</td>
</tr>
</tbody>
</table>

STEP 7
Press OK.
The above system message appears, requesting you to restart the controller.

STEP 8
Press OK.
The screen returns to the Auxiliary Functions (I/O) window.

STEP 9
Turn the controller power OFF.

STEP 10
Turn the controller power ON again.
The I/O allocation mode is changed.
5-5

[2] Switching from the Personal Computer

Follow the procedure below when changing from one mode to the other from the personal computer.

STEP 1  
Start WINCAPS II on the personal computer. Log in with Programmer. Start WINCAPS II according to the procedure given in WINCAPS II GUIDE, Chapter 3, Section 3.1.
For details on the user level of Programmer, refer to the WINCAPS II GUIDE, Chapter 1, Section 1.3.

STEP 2  
Click on the DIO Manager button in the System Manager.

Start the DIO Manager and the DIO Manager window opens.
STEP 3

Select the SETTING command from the Tools menu of DIO Manager.

![SETTING window](image)

The SETTING window appears.

STEP 4

Click on the Hardware tab in the Options window.

![Hardware settings](image)

The hardware settings are displayed.
STEP 5

Double-click on the Allocation mode value setting field.

The Allocation mode value setting field is ready for entering.

STEP 6

Enter the number of the desired mode.
The modes and their numbers are shown in the table below.

### Modes and Their Corresponding Numbers

<table>
<thead>
<tr>
<th>Allocation mode</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special mode</td>
<td>0</td>
</tr>
<tr>
<td>Standard mode</td>
<td>1</td>
</tr>
</tbody>
</table>
STEP 7
Click on OK in the setting window.
The setting window closes.

STEP 8
Click on the Connect button to connect the personal computer to the Robot Controller.

The Connect button appears in a pressed state.

STEP 9
Click on the Transfer button.
The Transfer Environment Table window appears.
Chapter 5  Robot Controller Interface

STEP 10
Check off the check box by clicking on the Hard setting field.

STEP 11
Click on the Transfer button.

A message window appears confirming that you are sure to update the data.
STEP 12

Click on the Yes button.

The Transmitting hard setting table window appears displaying a bar graph that indicates the transfer progress.

STEP 13

After the Transmitting hard setting table window disappears from the screen, set the power switch of the Robot Controller to OFF.

STEP 14

Set the power switch of the Robot Controller to ON.
The I/O allocation mode is changed.
5.1.2 Robot Controller Appearance and Connector Names

Figure 5-1 shows the appearance of the Robot Controller and Table 5-1 shows the connector names.

Table 5-1 Connector Names

<table>
<thead>
<tr>
<th>No.</th>
<th>Mark</th>
<th>Name</th>
<th>No.</th>
<th>Mark</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>CN1</td>
<td>RS232C</td>
<td>Serial Communication Connector</td>
<td>CN7</td>
<td>I/O POWER</td>
<td>I/O Power Connector</td>
</tr>
<tr>
<td>CN2</td>
<td>CRT</td>
<td>CRT Connector</td>
<td>CN8</td>
<td>INPUT</td>
<td>User-input/System-input Connector</td>
</tr>
<tr>
<td>CN3</td>
<td>KEYBD</td>
<td>Keyboard Connector</td>
<td>CN9</td>
<td>HAND I/O</td>
<td>End-effector I/O Connector</td>
</tr>
<tr>
<td>CN4</td>
<td>MOUSE</td>
<td>PS/2 Mouse Connector</td>
<td>CN10</td>
<td>OUTPUT/E.STOP</td>
<td>User-output/System-output Emergency Stop Connector</td>
</tr>
<tr>
<td>CN5</td>
<td>PENDANT</td>
<td>Teach Pendant Connector</td>
<td>CN11</td>
<td>INPUT AC</td>
<td>Power Connector</td>
</tr>
<tr>
<td>CN6</td>
<td>PRINTER</td>
<td>Printer Connector</td>
<td>CN12</td>
<td>MOTOR</td>
<td>Motor Connector</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CN13</td>
<td>ENCODER</td>
<td>Encoder Connector</td>
</tr>
</tbody>
</table>

Caution: The Robot Controller connectors have a screw or ring locking mechanism. Lock them securely. If not securely locked, an incomplete contact may occur, resulting in an error. Engaging or disengaging the power connector or motor connector with the power switch of the Robot Controller ON may damage the internal circuit of the connector. Turn OFF the power switch before engaging or disengaging any of the connectors.
5.1.3 Example of Control System Configuration

Figure 5-2 shows an example of the control system configuration.

Figure 5-2 System Configuration Example
5.1.4 Types and General Information about I/O Signals

This section describes the I/O signals for the Robot Controller. The I/O signals are grouped into user I/O signals and system I/O signals. Note that the connector pin meanings are different between standard mode and compatible mode. Some of the signal lines used for user I/O in special mode are used for system input in standard mode. Additionally, part of the signal lines used for system I/O in special mode is used for command execution I/O signals in standard mode.

5.1.4.1 Standard Mode

In standard mode, 30 input points for command execution are used to direct program start and other instructions as I/O commands. Table 5-2 shows the types of I/O signals used in standard mode.

Table 5-2 Types of System I/O Signals Used in Standard Mode

<table>
<thead>
<tr>
<th>Type</th>
<th>No. of points</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>System input</td>
<td>5</td>
<td>Robot stop, Enable Auto, interrupt skip, instantaneous stop (all tasks), step stop (all tasks)</td>
</tr>
<tr>
<td>System output</td>
<td>12</td>
<td>Normal CPU, robot initialization complete, robot in operation, robot error, robot warning, automatic operation mode, servo ON, dead battery warning, external mode, continue start permitted, emergency stop, SS mode</td>
</tr>
<tr>
<td>Input for command execution</td>
<td>30</td>
<td>Command (4 bits) data area 1 (8 bits), data area 2 (16 bits), odd parity bit, strobe signal</td>
</tr>
<tr>
<td>Output for command execution</td>
<td>18</td>
<td>Command processing complete, status area (16 bits), odd parity bit</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type</th>
<th>No. of points</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>User input</td>
<td>12</td>
<td>Inputs to read the external I/O status with an IN command or IO [ ] variable. Used for analysis condition identification, condition satisfaction wait, data input from the external device, etc.</td>
</tr>
<tr>
<td>User output</td>
<td>24</td>
<td>Outputs to issue a signal to the external device during program execution with a SET command, RESET command, etc.</td>
</tr>
<tr>
<td>Hand input</td>
<td>8</td>
<td>Inputs to read the external I/O status with an IN command or IO [ ] variable. Used to confirm the end-effector check status, etc.</td>
</tr>
<tr>
<td>Hand output</td>
<td>8</td>
<td>Outputs to issue a signal to the external device with a SET command, RESET command, etc. Used to control the opening and closing of the end-effector.</td>
</tr>
</tbody>
</table>
5.1.4.2 Special Mode

Table 5-3 shows the types of I/O signals used in special mode.

Table 5-3 Types of I/O Signals Used in Special Mode

<table>
<thead>
<tr>
<th>Type</th>
<th>No. of points</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed by system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>System input</td>
<td>22</td>
<td>Inputs to turn ON the power to the robot from the external device (PLC), or select and start a program instead of operations by the operating panel or teach pendant.</td>
</tr>
<tr>
<td>System output</td>
<td>27</td>
<td>Outputs to inform the external device (PLC) of the robot status, such as the robot in operation or the occurrence of an error.</td>
</tr>
<tr>
<td>Controlled by user program</td>
<td></td>
<td></td>
</tr>
<tr>
<td>User input</td>
<td>25</td>
<td>Inputs to read the external I/O status with an IN command or IO [ ] variable. Used for analysis condition identification, condition satisfaction wait, data input from the external device, etc.</td>
</tr>
<tr>
<td>User output</td>
<td>24</td>
<td>Outputs to issue a signal to the external device during program execution with a SET command, RESET command, etc.</td>
</tr>
<tr>
<td>Hand input</td>
<td>8</td>
<td>Inputs to read the external I/O status with an IN command or IO [ ] variable. Used to confirm the end-effector check status, etc.</td>
</tr>
<tr>
<td>Hand output</td>
<td>8</td>
<td>Outputs to issue a signal to the external device (valve) with a SET command, RESET command, etc. Used to control the opening and closing of the end-effector.</td>
</tr>
</tbody>
</table>
5.2 Using User I/O Signals

To use user I/O signals you need to first declare, in the program, the use of user I/O as I/O type variables with a DEFIO command. Next, access the user I/O by writing it to the I/O type variables or reading it.

5.2.1 I/O Type Variable Declaration

I/O type variables are classified into I/O type global variables that are available without any declaration, and I/O type local variables that are not available without a declaration.

5.2.1.1 I/O Type Global Variables

I/O type global variables are used to refer to or change user I/O signals bit by bit. Since they are global variables, they can be used without any declaration. I/O type global variables are expressed in either of the following two ways:

- IO[nn] (nn: terminal number) Example: IO[104]
- IOnn (nn: terminal number) Example: IO104

5.2.1.2 I/O Type Local Variables

I/O type local variables are used to collectively refer to or change 1-bit, 8-bit, 16-bit or 32-bit user I/O signals starting from a specified terminal number. I/O type local variables require a declaration, which will be made with a DEFIO command, before they are used. For further information about declarations with a DEFIO command, refer to the PROGRAMMER'S MANUAL, Chapter 9, Section 9.7 "DEFIO (Statement) [Conforms to SLIM]."

5.2.2 User Input Commands

There are two types of user input commands, IN and WAIT. The IN command substitutes the input result for a variable. The WAIT command waits until the input result meets specified conditions.

5.2.2.1 IN Command

The IN command inputs a signal from the user input specified by an I/O type variable and substitutes it for an arithmetic variable. For further information about the IN command, refer to the PROGRAMMER'S MANUAL, Chapter 13, Section 13.1 "IN."

5.2.2.2 WAIT Command

The WAIT command suspends the execution of the program until specified conditions are met. If an I/O type variable is used for the conditional statement, this command suspends the execution of the program until the status of the signal from a specified user input is checked and meets the specified conditions. For further information about the WAIT command, refer to the PROGRAMMER'S MANUAL, Chapter 12, Section 12.5 "WAIT."
5.2.3 User Output Commands

There are three types of user output commands, SET, RESET and OUT. The SET and RESET commands turn ON and OFF all user outputs specified by I/O type variables. The OUT command outputs data to a specified user output.

5.2.3.1 SET Command

The SET command turns ON all user outputs specified by I/O type variables. For further information about the SET command, refer to the PROGRAMMER'S MANUAL, Chapter 13, Section 13.1 "SET."

5.2.3.2 RESET Command

The RESET command turns OFF all user outputs specified by I/O type variables. For further information about the RESET command, refer to the PROGRAMMER'S MANUAL, Chapter 13, Section 13.1 "RESET."

5.2.3.3 OUT Command

The OUT command outputs data to the user output specified by an I/O type variable. For further information about the OUT command, refer to the PROGRAMMER'S MANUAL, Chapter 13, Section 13.1 "OUT."
5.3 System I/O Signals Standard Mode

5.3.1 Types and Functions of System Output Signals (Standard Mode)

Table 5-4 shows the system output signals used in standard mode.

<table>
<thead>
<tr>
<th>Application</th>
<th>Signal name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start-up</td>
<td>Robot initialization complete</td>
<td>Outputs when preparations for operation are ready to start.</td>
</tr>
<tr>
<td></td>
<td>Auto mode</td>
<td>Outputs when the robot is in Auto mode.</td>
</tr>
<tr>
<td></td>
<td>External mode</td>
<td>Outputs when the robot is in external mode.</td>
</tr>
<tr>
<td></td>
<td>Servo ON</td>
<td>Outputs when the power to the motor is turned ON.</td>
</tr>
<tr>
<td></td>
<td>Continue start permitted</td>
<td>Outputs when Continue Start is enabled.</td>
</tr>
<tr>
<td>Program execution</td>
<td>Robot in operation</td>
<td>Outputs when the robot is in operation (the program is being executed).</td>
</tr>
<tr>
<td>Error/Warning</td>
<td>Normal CPU</td>
<td>Outputs when the CPU (hardware) of the Robot Controller is normal.</td>
</tr>
<tr>
<td></td>
<td>Robot error</td>
<td>Outputs when a serious error, such as a servo error and a program error, occurs.</td>
</tr>
<tr>
<td></td>
<td>Robot warning</td>
<td>Outputs when a slight error occurs.</td>
</tr>
<tr>
<td></td>
<td>Dead battery warning</td>
<td>Outputs when the voltage of the encoder back-up battery or memory back-up battery dangerously low.</td>
</tr>
<tr>
<td></td>
<td>SS mode</td>
<td>Outputs when the robot is in SS mode. Refer to the SETTING-UP MANUAL, Chapter 3, Subsection 3.4.6 &quot;SS (Safe Start) Function.&quot;</td>
</tr>
</tbody>
</table>
5.3.2 Usage of System Output Signals (Standard Mode)

The usage of each system output signal in standard mode is described below:

5.3.2.1 Robot Initialization Complete (Output)

(1) Function
The signal outputs to the external device that a MODE SWITCHING COMMAND is ready to execute from the device.

(2) Terminal number
No.5 of connector CN10.

(3) Usage
The "mode switching command" will be executed as soon as this signal and the auto mode signal are turned ON, after the power is turned ON.

(4) ON conditions
① The signal will be turned ON when the system program for the Robot Controller normally starts, after the power, is turned ON and the mode switching command is ready to execute.
② The signal will be turned ON when a robot error is cleared by the CANCEL key of the operating panel or teach pendant or by a ROBOT ERROR CLEAR COMMAND, after the power is turned OFF.

(5) OFF condition
The signal will be turned OFF when a robot error or robot warning signal is turned ON.

![Diagram of ROBOT FORMAT output](image-url)

- The system properly started to operate after the power was turned ON.
- A robot error is cleared with the OK or CANCEL key of the operating panel or teach pendant.
- A robot error is cleared with a ROBOT ERROR CLEAR COMMAND from an external device.
- Robot error or robot warning

Figure 5-3 Robot Format Output
5.3.2.2 Auto Mode (Output)

(1) Function
The signal outputs to the external device that the robot is in auto mode.

(2) Terminal number
No.6 of connector CN10.

(3) Usage
Starting the program from the external device requires an EXTERNAL MODE SWITCHING BY MODE SWITCHING COMMAND input and a PROGRAM START BY PROGRAM OPERATION COMMAND input. The signal is used to monitor the auto mode output signal and determine whether to execute the command.

(4) ON condition
The signal will be output when the robot enters auto mode by setting the mode selector switch of the operating panel or teach pendant to AUTO.

(5) OFF conditions
The signal will be turned OFF under the following conditions.
① The mode selector switch of the operating panel is set to MANUAL or the teach pendant is set to MANUAL or TEACH CHECK.
② The Enable Auto OFF is input.
(Note: The signal will not be turned OFF in the pendantless state described in Chapter 3, Subsection 3.2.3, “[3] Pendantless State.”)

Caution: The signal will not be turned OFF with INSTANTANEOUS STOP, STEP STOP or CYCLE STOP commands.

Figure 5-4 Auto mode Output
5.3.2.3 External Mode (Output)

(1) **Function**
The signal outputs to the external device that the robot is in external mode.

(2) **Terminal number**
No.7 of connector CN10.

(3) **Usage**
Starting the program from the external device requires an EXTERNAL MODE SWITCHING BY MODE SWITCHING COMMAND input and a PROGRAM START BY PROGRAM OPERATION COMMAND input. The signal is used to confirm that the robot is in external mode.

(4) **ON conditions**

- The signal will be turned ON under the following conditions.
  - The external mode is selected on the teach pendant.
  - The EXTERNAL/INTERNAL is input on the operating panel in AUTO MODE and in the INTERNAL CONTROL ON state.
  - The EXTERNAL MODE SWITCHING BY MODE SWITCHING COMMAND is input from the external device.

(5) **OFF conditions**
The signal will be turned ON under the following conditions.

- When internal mode is selected on the teach pendant.
- When the mode selector switch of the teaching pendant is set to MANUAL or TEACH CHECK in external mode.
- When EXTERNAL/INTERNAL is input on the operating panel in AUTO MODE and in the INTERNAL CONTROL OFF state.
- When ROBOT STOP is input.
- When ROBOT ERROR is output.

Caution: The signal will not be turned OFF with INSTANTANEOUS STOP, STEP STOP or CYCLE STOP.

- When an Enable Auto input is turned OFF.

![Diagram of External Mode Output](image-url)

**Figure 5-5 External Mode Output**
5.3.2.4 Servo ON (Output)

(1) Function
The signal outputs to the external device that the power to the motor of the robot is turned ON.

(2) Terminal number
No.4 of connector CN10.

(3) Usage
Starting the program requires the power to the motor to be turned ON. This signal is used to light the motor power ON indicator lamp on an external operating panel.

(4) ON conditions
The signal will be turned ON when the power to the motor is turned ON.
① When the MOTOR key of the operating panel or teach pendant is activated; or
② When the motor runs with a MOTOR ON AND CAL EXECUTION BY MODE SWITCHING COMMAND input from the external device.

(5) OFF conditions
The signal will be turned OFF when the power to the motor is turned OFF.
① When the MOTOR key of the operating panel or teach pendant is deactivated and the ROBOT STOP button is operated; or
② When ROBOT STOP is input from the external device; or
③ When a ROBOT ERROR is output. If errors $0 \times 6071$ to $607B$, $0 \times 6671$ to $667B$, $0 \times 607F$ occur, the servo will be turned OFF in automatic or external mode but will not be turned OFF in the manual or the teach check mode.

---

**Figure 5-6 Servo ON Output**
5.3.2.5 Robot in Operation (Output)

(1) Function
This signal outputs to the external device that the robot is in operation.

(2) Terminal number
No.2 of connector CN10.

(3) Usage
The signal is used to light the robot operating indicator lamp of an external operating panel.
Since the signal is turned OFF with STOP ALL PROGRAMS, outputs to the external device that all programs are stopped.

(4) ON conditions
The signal will be turned ON during execution of the program and also while in the WAIT STATE with a condition branch or timer command.

(5) OFF conditions
The signal will be turned OFF with STOP ALL PROGRAMS.

Caution: STOP ALL PROGRAMS means the operation of the ROBOT STOP or STOP button of the operating panel or teach pendant and INSTANTANEOUS STOP (ALL TASKS), STEP STOP (ALL TASKS) and ROBOT STOP inputs.
5.3.2.6 Normal CPU (Output)

(1) Function
The signal outputs to the external device that the Robot Controller CPU (hardware) is normal.

(2) Terminal number
No. 1 of connector CN10.

(3) Usage
- The signal is used to light the Robot Controller external operating panel error indicator lamp.
- The signal is used when a normal CPU SIGNAL is turned OFF because of an error and the PLC corrects it.

(4) ON conditions
The signal will be turned ON by the hardware when the Robot Controller CPU operates normally with the power turned ON.

(5) OFF conditions
The signal will be turned OFF by the hardware when the CPU does not operate normally.

Caution: The OFF state of this signal indicates that the Robot Controller internal arithmetic circuit may be damaged. Therefore, ROBOT ERROR, ERROR NUMBER, and other outputs may not be correct.

---

Figure 5-7 Normal CPU Output
5.3.2.7 Robot Error (Output)

(1) Function
The signal outputs to the external device that a problem, such as a servo error or a program error, occurs with the robot.

(2) Terminal number
No.3 of connector CN10.

(3) Usage
① The signal is used to light the robot external operating panel error indicator lamp of an.
② The signal is used to help the PLC clear an error in response to a ROBOT ERROR signal.

(4) ON conditions
As shown in Figure 5-8, the signal will be turned ON under the following conditions.
① When an error, such as a servo error, a program error or program undefined, occurs at the start of the program and during execution of the program.
② When an error occurs during execution of the program in internal operation by the operating panel or the teach pendant or in external operation by the PLC.

Caution: The signal will not be output when an error, such as a program input error occurs in manual operation, except when a servo error occurs in manual operation. For further information, see the “ERROR CODE TABLES.”

(5) OFF conditions
As shown in Figure 5-8, the signal will be turned OFF under the following conditions.
① When a ROBOT ERROR CLEAR COMMAND is input and the existing error is cleared.
② When the existing error is cleared by operating the OK or Cancel key on the operating panel or the teach pendant.

![Figure 5-8 Robot Error Output](image-url)
5.3.2.8 Robot Warning (Output)

(1) Function
The signal outputs to the external device that a minor error occurs with an I/O command or during servo processing.

Caution: The signal will not be output if a minor error, such as a program selection error caused by the operation of the teach pendant or operating panel.

(2) Terminal number
No. 9 of connector CN10.

(3) Usage
- The signal is used to light the robot warning indicator lamp of the external operating panel.
- The signal is used to help the PLC clear an error in response to a ROBOT WARNING signal.

(4) ON condition
As shown in Figure 5-9, the signal will be turned ON if a minor error occurs during I/O processing, execution of the program or servo processing, irrespective of the operation mode.

(5) OFF conditions
As shown in Figure 5-9, the robot-warning signal will be turned OFF under the following conditions.
- When a ROBOT ERROR CLEAR COMMAND is input from the external device and the existing error is cleared.
- When operating the OK or Cancel key on the operating panel or the teach pendant clears the existing error.

- When a slight error occurs during I/O processing, execution of the program or servo processing.
- When a ROBOT ERROR CLEAR COMMAND is input from an external device and the existing error is cleared.
- When the existing error is cleared by operating the OK or Cancel key of the operating panel or teach pendant.

Figure 5-9 Robot Warning Output
5.3.2.9 Dead Battery Warning (Output)

(1) Function
The signal will be output when the voltage of the encoder back-up battery or memory back-up battery becomes lower than acceptable.

(2) Terminal number
No.8 of connector CN10.

(3) Usage
The signal is used to check the timing battery replacement. For example, the battery voltage becomes lower than acceptable.

(4) ON condition
The signal will be turned ON when the voltage of the encoder back-up battery or memory back-up battery becomes lower than acceptable.

Caution: The operating panel shows any of ERROR64A1 to 64A6 when the encoder back-up battery voltage is low. Meanwhile, the teach pendant shows ERROR6103 when the memory back-up battery voltage is low. (Refer to Chapter 6, Section 6.4, “Biennial Inspections.”)

(5) OFF condition
The signal will be turned OFF when the power is turned ON after the dead battery was replaced.

Figure 5-10 Dead Battery Warning Output
5.3.2.10 Continue Start Permitted (Output)

(1) Function
The controller will output this signal when the continue start is permitted.

(2) Terminal number
No. 10 of connector CN10.

(3) Usage
Use this signal when you want to know whether the continue start is permitted.

(4) ON condition
This signal comes on when the continue start is permitted. For details, refer to the SETTING-UP MANUAL.

(5) OFF condition
This signal goes off by carrying out the "Task Status Change Operation."

5.3.3 Types and Functions of System Input Signals (Standard Mode)

Table 5-5 shows the system input signals to be used in standard mode:

Table 5-5  Types and Functions of System Input Signals to be Used in Standard Mode

<table>
<thead>
<tr>
<th>Application</th>
<th>Signal Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start-up</td>
<td>Enable Auto</td>
<td>Enables switching to automatic operation.</td>
</tr>
<tr>
<td>Stop</td>
<td>Robot stop</td>
<td>Stops the robot with canceling signals.</td>
</tr>
<tr>
<td></td>
<td>Instantaneous stop (all tasks)</td>
<td>Immediately stops all programs being executed with canceling signals.</td>
</tr>
<tr>
<td></td>
<td>Step stop (all tasks)</td>
<td>Step-stops all programs being executed with canceling signals.</td>
</tr>
<tr>
<td>Program interrupt</td>
<td>Interrupt skip</td>
<td>Interrupts the execution of the current step and starts executing the next step.</td>
</tr>
</tbody>
</table>
5.3.4 Usage of System Input Signals (Standard Mode)

The usage of each system input signal in standard mode is described below.

5.3.4.1 Enable Auto (Input)

(1) Function

① The signal enables switching of the robot mode to auto mode (shorted state).
② The signal enables switching of the robot mode to manual mode or teach check mode (open state).

(2) Terminal number

No.4 of connector CN8.

(3) Usage

The signal is used for the AUTO/TEACHING selector switch of an external operating panel and can be combined with a safety fence switch.

(4) Input conditions and operation

① As shown in Table 5-6, the selectable operation mode depends on whether this input is shorted or open.
② If the input becomes open during automatic operation, the mode will be switched to manual mode and ERROR21FC will be displayed.
③ If manual operation or a teach check is conducted with this input shorted, ERROR21F2 will be displayed.
④ If the mode selector switch of the teach pendant or operating panel is set to AUTO with this input open, ERROR21F3 will be displayed. Since this state is shown as × in Table 5-5, this error will remain displayed until the robot exits this state.
⑤ Although ERROR21FD or ERROR21FC will be displayed when the state is changed from ◯ to ∆ or ×, they will not be displayed when the state is changed from ∆ or × to ◯.
⑥ When the input is turned OFF (open) in external mode, the external mode output will also be turned OFF.

Table 5-6 Relationship Between Enable Auto Input and Selectable Mode

<table>
<thead>
<tr>
<th>Operation mode</th>
<th>Application</th>
<th>Enable Auto</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual mode</td>
<td>Manual operation with the operating panel or the teach pendant.</td>
<td>∆</td>
</tr>
<tr>
<td></td>
<td></td>
<td>◯</td>
</tr>
<tr>
<td>Teach check mode</td>
<td>Program check with the teach pendant.</td>
<td>∆</td>
</tr>
<tr>
<td></td>
<td></td>
<td>◯</td>
</tr>
<tr>
<td>Internal auto mode</td>
<td>Automatic operation with the operating panel or teach pendant.</td>
<td>◯</td>
</tr>
<tr>
<td></td>
<td></td>
<td>×</td>
</tr>
<tr>
<td>External auto mode</td>
<td>Automatic operation with the external device.</td>
<td>◯</td>
</tr>
<tr>
<td></td>
<td></td>
<td>×</td>
</tr>
</tbody>
</table>

Note: ◯ = Mode selectable
× = Mode not selectable
∆ = Mode selectable but manual operation program not executable

Caution: In the pendantless state described in Chapter 2, Subsect. 3.2.3, auto mode is valid even if the Enable Auto input is open. (The external mode cannot be switched and the program cannot begin execution.)

Perform the following when operating the robot in the pendantless state:
① Set the robot so that it will not start to operate when the Enable Auto input is open.
② Enable Auto input open state and auto mode output (See "5.3.2.2 Auto mode" and "5.5.2.2 "Auto Mode").
③ Set the equipment to make an emergency stop in an AND state.
④ Add ① and ② with the external sequence circuit.
5.3.4.2 Robot Stop (Input)

(1) Function

① The signal stops the robot from the external device by opening the robot stop input.
② The signal readies the power to the robot motor to be turned ON by shorting the robot stop input.

(2) Terminal number

No.2 of connector CN8.

(3) Input conditions and operation

① The robot stops with this input OFF (open).
② The power to the robot motor is made ready to be turned ON with this input ON (shorted).
③ Irrespective of whether internal mode, operation by the teach pendant, or external mode, remote operation by the external device, is selected, the power to the robot motor cannot be turned ON with this input OFF (open) and neither manual nor automatic operation can be performed until this input is turned ON (shorted). (ERROR2008 will be displayed.)
④ By turning OFF (open) this input the following conditions may result.
   1) The power to the motor will be turned OFF irrespective of whether manual, automatic, internal or external mode is selected.
   2) During execution of the program, robot in operation output ON, the power to the motor will be turned OFF and the mode will be switched to internal mode after the robot decelerates to a stop;
   3) When the program is not executed in manual and auto modes in manual and auto modes, everything will be the same except the power to the motor will be turned OFF. The power to the motor can be turned ON and the suspended operation can, therefore, be resumed by shorting the ROBOT STOP input. (However, the program will be executed from the beginning.)
⑤ Opening the ROBOT STOP input and pressing the ROBOT STOP button of the operating panel or the teach pendant function is the same.

(4) Timing of the input

This input will be processed prior to all commands and input signals.
5.3.4.3 Step Stop (All Tasks) (Input)

(1) Function
Input this signal to step-stop the program being executed from the external device. All tasks will be step-stopped.

(2) Terminal
No.5 of connector CN8.

(3) Input conditions and operation
① If the state of this signal is changed from ON (shorted) to OFF (open), the robot will stop all tasks as soon as the ongoing step is completed, and the robot in operation output will be turned OFF. However, auto mode or external mode will remain valid, and the suspended program will be resumed by inputting a program operation command (start). See Figure 5-11.
② For resuming the program after a step stop, see Chapter 5, "5.5.4.4 Program Start (Input)".

![Figure 5-11 Step Stop Signal](image-url)
5.3.4.4 Instantaneous Stop (All Tasks) (Input)

(1) Function
Input this signal to instantaneously stop the running programs from an external device. All tasks will stop.

(2) Terminal number
No.7 of connector CN8.

(3) Input conditions and operation
① If the state of this signal is turned from ON (shorted) to OFF (open), the robot will immediately stop in the middle of the ongoing step, and the robot in operation output will be turned OFF. However, auto mode or external mode will remain valid, and the suspended programs will be resumed by inputting Program start signal.
② For resuming the program after an instantaneous stop, see Chapter 5, "5.4.3.2 Program Operation Command (0001)".
③ The minimum required pulse width is 50 milliseconds (msec.) or more.

Figure 5-12 Minimum Instantaneous Stop Pulse Width
5.3.4.5 Interrupt Skip (Input)

(1) Function

If this signal is turned ON (shorted) during execution of the robot operation command, within the range between INTERRUPT ON and INTERRUPT OFF in the program, the correct step operation will immediately stop and the next step will start.

Caution: For further information about the INTERRUPT ON and OFF commands, see the PROGRAMMER'S MANUAL, Chapter 12, "12.3 INTERRUPT ON/OFF (Statement)."

For further information about the robot operation command, see the PROGRAMMER'S MANUAL, Chapter 12, "Robot Control Statements."

(2) Terminal number

No.9 of connector CN8.

(3) Usage

See the PROGRAMMER'S MANUAL, Chapter 12, "12.3 INTERRUPT ON/OFF."

(4) Input conditions and operation

If this signal is turned ON (shorted), the robot will immediately stop the current operation and start executing the next step.

![Figure 5-13 Input Conditions and Operation of Interrupt Skip](image-url)
Caution: When turning ON (shorting) the interrupt skip signal, at a minimum either the program reset signal or the program start signal must be turned OFF (open). If the interrupt skip signal is turned ON, the robot interprets the program start signal as immediately turned OFF (open). Consequently, the program selected with the program No. selection signal will be executed from the beginning. (See Figure 5-14 below.)
5.4 Command Execution I/O Signals

Dedicated to Standard Mode

In standard mode the I/O commands can be executed using command execution I/O signals. I/O commands execute the following.

- Operate (start and stop) a program for each task.
- Refer to or change variables from the external device.
- Refer to or change inputs and outputs from the external device.

5.4.1 General Information about Commands

Table 5-7 shows the I/O commands functions.

Table 5-7 I/O Command Functions

<table>
<thead>
<tr>
<th>Command</th>
<th>Description of function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program operation</td>
<td>- Starts the program cycle (specified program).</td>
</tr>
<tr>
<td></td>
<td>- Step-stops the program (specified program/all programs).</td>
</tr>
<tr>
<td></td>
<td>- Immediately stops the program (specified program/all programs).</td>
</tr>
<tr>
<td></td>
<td>- Resets the program (specified program/all programs).</td>
</tr>
<tr>
<td>Speed setting</td>
<td>- Sets the external speed.</td>
</tr>
<tr>
<td></td>
<td>- Sets the external acceleration.</td>
</tr>
<tr>
<td></td>
<td>- Sets the external deceleration.</td>
</tr>
<tr>
<td>Error number read</td>
<td>- Outputs the error number to the system I/O area.</td>
</tr>
<tr>
<td>Type I variable write</td>
<td>- Reads a value from the system I/O area and substitutes it for a Type I variable.</td>
</tr>
<tr>
<td>Type I variable read</td>
<td>- Outputs a Type I variable to the system I/O area.</td>
</tr>
<tr>
<td>Mode switching</td>
<td>- Switches the robot operation mode.</td>
</tr>
<tr>
<td>Robot error clear</td>
<td>- Clears a robot error from the external device.</td>
</tr>
<tr>
<td>Internal I/O write</td>
<td>- Sets the state of internal inputs and outputs.</td>
</tr>
<tr>
<td>Internal I/O read</td>
<td>- Outputs the state of internal inputs and outputs to the system I/O area.</td>
</tr>
</tbody>
</table>
5.4.2 Processing I/O Commands

5.4.2.1 General Information about Processing

I/O commands to be executed are processed as shown in Figure 5-15.

![Diagram of I/O Command Processing]

- Command Area (input)
- Data Area (input)
- Command and Data Area Odd Parity (input)

- Strobe Signal (input)

- Status Area (output)
- Status Parity (output)

- Command processing complete (output)

- Robot Error (output)

Note ① 1 ms or more

Figure 5-15 Outline of I/O Command Processing

Note ④ 100 ms. or less

Note ② 100 ms. or less
① Set a command area, a data area (if necessary) and command and data area odd parity for the command execution I/O signal from the external device to the Robot Controller.

② After the setting is completed, turn ON the strobe signal.

Caution: ① The data to be set in ① must be defined more at least 1 msec. before the strobe signal is turned ON.
② Perform command input with a strobe signal after the system output signal ROBOT INITIALIZATION COMPLETE is output.

③ The controller reads the command area, the data area and the command and data area odd parity as the strobe signal is input.

④ The controller starts processing based on the command it read.

⑤ If the command is one that outputs a status, the controller sets the status area and status parity.

⑥ After command processing has been completed and a status area has been set, the controller turns ON the command processing complete signal.
If an error occurs in the while processing, a robot error signal will be output together with the command processing complete signal.

⑦ The PLC waits until the command processing complete signal is input, and receives the status of the status area, if necessary. In this case, confirmation that no error exists with the robot.

⑧ After the PLC has read the status, it turns OFF the command and data areas and the strobe signal.

⑨ As soon as the strobe signal is turned OFF, the controller turns OFF the status area and the command processing complete signal.
The robot error signal, which is output due to a command processing error, remains ON until a robot error clear command is executed.

Caution: ③ The maximum time taken until the status area and the command processing complete signal are turned OFF, after the strobe signal is turned OFF in ③, is 100 msec.
⑥ If the strobe signal is turned OFF before the command processing complete signal is turned ON in ⑥, the command processing complete signal and the status area will be output and then turned OFF within 100 msec.
5.4.2.2 Using Each Signal Line

[ 1 ] Command and Data Areas

This section describes the usage of the command area (4 bits, input), data area 1 (8 bits, input), data area 2 (16 bits, input) and command and data area odd parity (input).

(1) Function

Specifies the commands to be executed by the Robot Controller.
Sets the command area at all times, and data areas 1 and 2, if necessary.

(2) Terminal numbers

Command area: No.35 to No.38 of connector CN8.
Data area 1: No.11 to No.18 of connector CN8.
Data area 2: No.19 to No.34 of connector CN8.
Command and data area odd parity: No.10 of connector CN8.

(3) Input conditions and operation

① Set the command area whenever I/O commands are to be executed.
   Set data for data areas 1 and 2 if commands require them.
② "Shorted" represents the bit value = 1.
   "Open" represents the bit value = 0.
   "Parity bit" is odd parity.
③ Input the command area, data areas 1 and 2, and command and data area odd parity before the strobe signal (1 msec. or more). Retain the status until the command processing complete signal is output.
④ Input 1 or 0 as the parity bit so that the total of 1s existing in the command area, data areas 1 and 2 and the command and data area odd parity will be odd.
   The data areas count even commands, which do not require any data area, in a check sum calculation.
⑤ Checksum can be set valid or invalid using a parameter. When checksum is invalid, no checksum check will be performed.
[2] Strobe Signal (Input)

(1) Function
This signal informs the Robot Controller that the command area, data areas 1 and 2, and the command and data area odd parity bit have been set. Additionally it directs the start of command processing.

Caution: Perform command input with a strobe signal after the system output signal ROBOT INITIALIZATION COMPLETE is output.

(2) Terminal number
No.8 of connector CN8.

(3) Input conditions and operation
① By turning ON this input in automatic or external mode, the Robot Controller reads the command area, data areas 1 and 2, and the command and data area odd parity bit starts processing.
② Retain the status until a command processing complete signal is output and the necessary status data is read. If the strobe signal is turned OFF before a command processing complete signal is output, the status area will not be output.
③ By turning OFF this input after the status is read, the command processing complete output, the status area and the status parity will be turned OFF.
[3] Command Processing Complete (Output)

(1) Function
The signal outputs to the external device that I/O command processing is completed.

(2) Terminal number
No.15 of connector CN10.

(3) Usage
The signal is used to confirm that I/O command processing is complete, or as a timing signal for obtaining the result of I/O command processing.

(4) ON conditions
① The signal will be turned ON upon completion of processing the I/O command given and determination of outputting the status area.
② If an error occurs as a result of executing an I/O command, the result will not be output to the status area, but the robot error signal and the command processing complete signal will be turned simultaneously ON.

(5) OFF conditions
① The signal will be turned OFF when the strobe signal is turned OFF.
② If the strobe signal is turned OFF, before command processing is completed, the command processing complete signal will be output and then turned OFF within 100 msec.
Chapter 5  Robot Controller Interface

[4] Status Area

This section describes the usage of the status area (16 bits, output) and of status area odd parity (output).

(1) Function
The signal outputs the result of I/O command processing to the external device.

(2) Terminal numbers
No.17 to No.32 of connector CN10.

(3) Usage
The signal is used to execute an I/O command and obtain the result of the PLC.

(4) ON conditions
① When processing of the I/O given is completed, the status corresponding to the command will be set.
② "ON" represents the bit value = 1.
   "OFF" represents the bit value = 0.
   "Parity bit" is odd parity.
③ Input 1 or 0 as the parity bit so that the total of 1s existing in the command area and status area parity will be odd.
The status area counts even commands, which do not require any data area, in a parity calculation.
④ Parity can be set valid or invalid with a parameter. When parity is invalid, no parity check will be performed.

(5) OFF conditions
① The signal will be turned OFF when the strobe signal is turned OFF.
② If the strobe signal is turned OFF, before command processing is completed, the status signal will be output and then turned OFF within 100 msec.
### 5.4.3 I/O Commands Details

#### 5.4.3.1 List of I/O Commands

Table 5-8 shows a list of I/O commands.

<table>
<thead>
<tr>
<th>Command area</th>
<th>Data area 1</th>
<th>Data area 2</th>
<th>Status area</th>
</tr>
</thead>
<tbody>
<tr>
<td>0001</td>
<td>00000001 Program reset start</td>
<td>Program number</td>
<td>—</td>
</tr>
<tr>
<td>Program operation</td>
<td>00000010 Program start</td>
<td>Program number</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>00000100 Continue start</td>
<td>Program number</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>00010000 Step stop</td>
<td>Program number</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>00100000 Instantaneous stop</td>
<td>Program number</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>01000000 Reset</td>
<td>Program number</td>
<td>—</td>
</tr>
<tr>
<td>0010</td>
<td>00000001 Speed setting</td>
<td>Set speed value</td>
<td>—</td>
</tr>
<tr>
<td>External speed and acceleration setting</td>
<td>00000010 Acceleration setting</td>
<td>Set acceleration value</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>00000100 Deceleration setting</td>
<td>Set deceleration value</td>
<td>—</td>
</tr>
<tr>
<td>0100</td>
<td>Error read</td>
<td>Error number</td>
<td>—</td>
</tr>
<tr>
<td>0101</td>
<td>Type I variable number</td>
<td>Set variable value (lower 16 bits)</td>
<td>—</td>
</tr>
<tr>
<td>Type I variable write</td>
<td>0110</td>
<td>Type I variable number</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>0111 Mode switching</td>
<td>00000001 Motor ON, CAL execution</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>00000010 External speed 100</td>
<td>00000000 External mode switching</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>10000000 Execution of all above (Motor ON→SP100→External)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>1000</td>
<td>Robot error clear</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>1001</td>
<td>Set I/O value</td>
<td>First internal I/O port address</td>
<td>—</td>
</tr>
<tr>
<td>I/O write</td>
<td>1010 I/O read</td>
<td>First internal I/O port address</td>
<td>I/O</td>
</tr>
</tbody>
</table>

**NOTE:** In execution of Continue Start command, program numbers will be ignored.
5.4.3.2 Program Operation Command (0001)

(1) Function
This command controls the operating state of the program specified in data area 2 based on the setting of data area 1.

(2) Format
Command area (4 bits, input)
0001

Data area 1 (8 bits, input)
00000001: Program reset start
00000010: Program start
00000100: Continue start
00010000: Step stop
00100000: Instantaneous stop
01000000: Reset
An error (ERROR2032) will occur if data is other than the above is set.

Data area 2 (16 bits, input)
Program number: Program number to start
When the number given in data area 2 is nn, the operating state of PR0nn will be controlled as given in data area 1. If the program number is negative in the case of a step stop, instantaneous stop or reset command, all programs will stop or be reset. If the program number is negative with a program reset start or program start command, ERROR73E4 will result.

Status area (16 bits, output)
Nothing will be output.

(3) Description
① Program reset start
This command is executable only in external mode. If executed in other mode an error will occur.
This command initializes and starts the program of the program number specified in data area 2. PRO0 to PRO32767 can be started.
If the program number specified in data area 2 is negative, an error (ERROR73E4) will occur.
Either of the following operations takes place according to the operating status of the program:
· If the specified program is terminated (stopped), step-stopped or immediately stopped, it will start from the beginning.
· If the specified program is running, an error (ERROR21F5) will be displayed, and the program will stop.
① Program start
This command is executable only in external mode. An error (ERROR2032) will occur in other modes.
This command starts the program of the program number specified in data area 2. PRO0 to PRO32767 can be started.
If the program number specified in data area 2 is negative, an error (ERROR73e4) will occur.
One of the following operations takes place according to the operating status of the program.
  · If the specified program is terminated (stopped), it will start from the beginning.
  · If the specified program is step-stopped, it will resume from the step following the suspended step.
  · If the specified program is immediately stopped, it will resume from the step following the suspended step. When the program is instantaneously stopped in while in execution of an operation command, it will resume from the operation still undone.
  · If the specified program is running, an error (ERROR21F5) will be displayed, and the program will stop.

② Continue start
This command is executable only in external mode when the Continue Start Permitted signal is on. The data area will be ignored.

③ Step stop
This command step-stops the program of the program number specified in data area 2. PRO0 to PRO32767 can be step-stopped.
If the program number specified in data area 2 is negative, all programs being executed will step-stop.
Either of the following operations takes place according to the operating status of the program.
  · If the specified program is terminated (stopped), step-stopped or immediately stopped, nothing will happen.
  · If the specified program is running, it will step-stop. If started after a step stop, the stopped program will resume from the step following the suspended step.

④ Instantaneous top
This command immediately stops the program of the program number specified in data area 2. PRO0 to PRO32767 can be stopped immediately.
If the program number specified in data area 2 is negative, all programs being executed will step-stop.
Either of the following operations takes place according to the operating status of the program:
  · If the specified program is terminated (stopped), step-stopped or immediately stopped, nothing will happen.
  · If the specified program is running, it will immediately stop. If started after an instantaneous stop, the stopped program will resume from the suspended step. If the program is immediately stopped in the middle of execution of an operation command, it will resume, starting from the last uncompleted operation.
© Reset

This command immediately stops and also initializes the program of the program number specified in data area 2. PR00 to PR032767 can be stopped.

This command cannot be used together with the program start command.

To start a step-stopped or cycle-stopped program from the beginning, use the program reset start command.

If the program number specified in data area 2 is negative, all programs being executed will be reset.

One of the following operations takes place according to the operating status of the program.

- When the specified program is terminated (stopped), nothing will happen.
- When the specified program is step-stopped or immediately stopped, it will be initialized. The initialized program will resume from the beginning.
- When the specified program is running, it will immediately stop and also be initialized. If started after an instantaneous stop, the stopped program will resume from the beginning.
5.4.3.3 External Speed and Acceleration Setting (0010)

(1) Function
This command sets the external speed, acceleration and deceleration values selected in data area 1 to the values specified in data area 2. This command is executable only in external mode. An error will occur in other modes.

(2) Format
Command area (4 bits, input)
0010

Data area 1 (8 bits, input)
00000001: Speed setting
00000010: Acceleration setting
00000100: Deceleration setting
An error (ERROR2032) will occur if data other than the above is set.

Data area 2 (16 bits, input)
Set values: Speed, acceleration and deceleration to be set
Enter any of the external speed, acceleration and deceleration values specified in data area 1.
The values must be between 1 and 100. If they are out of this range, an error (ERROR2003) will occur.

Status area (16 bits, output)
Nothing will be output.

(3) Description

1. Speed setting
The external speed is set to the value specified in data area 2. The value must be between 1 and 100. An error (ERROR2003) will occur if the value is out of this range.
The external acceleration and deceleration will be set simultaneously as shown below by setting the external speed:
External acceleration and external deceleration = External speed^2/100
(minimum value: 1)

2. Acceleration setting
The external acceleration is set to the value specified in data area 2. The value must be between 1 and 100. An error (ERROR2003) will occur if the value is out of this range.

3. Deceleration setting
The external deceleration is set to the value specified in data area 2. The value must be between 1 and 100. An error (ERROR2003) will occur if the value is out of this range.
5.4.3.4 Error Read (0100)

(1) Function
This command outputs the existing error number to the status area. This command is output to the status area only when the strobe signal remains ON.

Caution: This command will not be output if a minor error occurs, such as a program selection error, caused by the operation of the teach pendant or the operating panel.

(2) Format
Command area (4 bits, input)
0100
Data area 1 (8 bits, input)
Nothing will be input.
Data area 2 (16 bits, input)
Nothing will be input.
Status area (16 bits, output)
The existing error code will be output.

(3) Hexadecimal codes
Refer to Fig. 5-16.

<table>
<thead>
<tr>
<th>Hexadecimal</th>
<th>Hexadecimal</th>
<th>Hexadecimal</th>
<th>Hexadecimal</th>
</tr>
</thead>
<tbody>
<tr>
<td>××××</td>
<td>→ 0</td>
<td>×O×O</td>
<td>→ 5</td>
</tr>
<tr>
<td>×××O</td>
<td>→ 1</td>
<td>×O×O</td>
<td>→ 6</td>
</tr>
<tr>
<td>×xO×</td>
<td>→ 2</td>
<td>×O×O×</td>
<td>→ 7</td>
</tr>
<tr>
<td>××OO</td>
<td>→ 3</td>
<td>×OO×</td>
<td>→ 8</td>
</tr>
<tr>
<td>×O×X</td>
<td>→ 4</td>
<td>O××O</td>
<td>→ 8</td>
</tr>
<tr>
<td>×××</td>
<td>××</td>
<td>×××</td>
<td>××</td>
</tr>
</tbody>
</table>

Figure 5-16 Hexadecimal Codes

Figure 5-17 shows an example of error number output when ERROR6174 (overload error with the fourth axis) occurs.

(4) Description
If a command is executed when a robot error or the robot warning signal is output, the error number, which caused the robot error or robot warning signal to be output, will be output to the status area.
If no error exists after an error has been cleared, 0 will be output to the status area. Also, when there is an error that does not output any robot error or robot warning signal, 0 will be output.
5.4.3.5 Type I Variable Write (0101)

(1) **Function**

This command substitutes the value specified in data area 2 for the Type I (integer type) global variable of the number specified in data area 1.

(2) **Format**

Command area (4 bits, input)

0101

Data area 1 (8 bits, input)

The number of the Type I variable for which a value will be substituted. Any number between I [0] and I [255] can be specified. When the input data in data area 1 is nn, the value specified in data area 2 will be substituted for the Type I variable I [nn].

Data area 2 (16 bits, input)

The value to be substituted for the Type I variable specified in data area 1. Any value between -32768 and 32767 can be set.

Status area (16 bits, output)

Nothing will be output.

(3) **Description**

The value specified in data area 2 is substituted for the Type I variable specified in data area 1. Although the type I variable has a storage area of 32 bits, the 16-bit data in data area 2 will be substituted for the lower 16 bits. Zero will be substituted for the upper 16 bits of the Type I variable.
5.4.3.6 Type I Variable Read (0110)

(1) Function
This command outputs to the status area the value of the Type I (integer type) global variable of the number specified in data area 1.

(2) Format
Command area (4 bits, input)
0110

Data area 1 (8 bits, input)
The number of the Type I variable for which a value will be substituted. Any number between I [0] and I [255] can be specified. When the input data in data area 1 is nn, the value specified in data area 2 will be substituted for the Type I variable I [nn].

Data area 2 (16 bits, input)
Nothing will be input.

Status area (16 bits, output)
The lower 16 bit value of the Type I variable specified in data area 1 will be output.

(3) Description
The value of the Type I variable specified in data area 1 is output to the status area.
Although the Type I variable has a storage area of 32 bits, the lower 16 bits will be output to the status area.
Therefore, any value between -32768 and 32767 can be output properly. However, if the value is out of this range, only the lower 16 bits of the data will be output.
5.4.3.7  Mode Switching (0111)

(1) Function
This command switches the robot mode from the external device to prepare the robot for operation. This command is executable only in auto mode. An error will occur in other modes. Before executing this command, select auto mode on the operating panel or the teach pendant.

(2) Format
Command area (4 bits, input)
0111

Data area 1 (8 bits, input)
Bit 0 (00000001): Motor ON
Bit 1 (00000010): External speed 100
Bit 7 (10000000): External mode switching
These bits can be set together to execute commands. When two or more bits are set, commands will be executed one after another.

For example, when bits 0, 1 and 7 are set, motor ON, external speed 100 and external mode will be executed in this order.
If bits other than the above are set, an error will result.

Data area 2 (16 bits, input)
Nothing will be input.

Status area (16 bits, output)
Nothing will be output.

(3) Description
This command is used for equipment using the robot to switch the operation mode of the robot to external mode from the external device.

The processing operations to be executed are specified by the bits set in data area 1 and will be executed from bit 0 to bit 7.

① Motor ON (bit 0)
When this bit is set, the power to the Robot Controller motor will be turned ON.

② External speed 100 (bit 1)
When this bit is set, the external speed, external acceleration and external deceleration of the Robot Controller will be set to 100.

③ External mode switching (bit 7)
When this bit is set, the mode of the Robot Controller will be switched from automatic to external.
5.4.3.8 Robot Error Clear (1000)

(1) Function
This command clears a robot error that has occurred.

(2) Format
Command area (4 bits, input)
1000

Data area 1 (8 bits, input)
Nothing will be input.

Data area 2 (16 bits, input)
Nothing will be input.

Status area (16 bits, output)
Nothing will be output.

(3) Description
If a robot error occurs, this command clears it. When there is no error, no processing will take place.
When an error is displayed, the same processing as when the OK or Cancel key of the operating panel or the teach pendant is operated will be performed.
5.4.3.9  I/O Write (1001)

(1) Function
This command substitutes the status specified in data area 1 for the 8-bit internal I/O area starting from the number specified in data area 2.

(2) Format
Command area (4 bits, input)
1001

Data area 1 (8 bits, input)
The status to be set will be specified in the internal I/O area starting from the number specified in data area 2.

Data area 2 (16 bits, input)
This is first number of the internal I/O (8-bit) area for which the status will be substituted. The number can be set between 128 and 504. If the number is out of this range, an error (ERROR2034) will occur.

Status area (16 bits, output)
Nothing will be output.

(3) Description
This command substitutes the status specified in data area 1 for the 8-bit internal I/O area starting from the number specified in data area 2.
5.4.3.10 I/O Read (1010)

(1) Function
This command outputs to the lower 8 bits of the status area the status of the 8-bit internal I/O area starting from the number specified in data area 2.

(2) Format
Command area (4 bits, input)
1010

Data area 1 (8 bits, input)
Nothing will be input.

Data area 2 (16 bits, input)
This is the first number of the internal I/O (8-bit) area whose status will be output. The number can be set between 128 and 504. If the number is out of this range, an error (ERROR2034) will occur.

Status area (16 bits, output)
The status of the 8-bit internal I/O area starting from the number specified in data area 2 will be output to the lower 8 bits of this area.

(3) Description
This command outputs to the lower 8 bits of the status area the status of the 8-bit internal I/O area starting from the number specified in data area 2. Zero will be output to the upper 8 bits.
5.4.4 Example of Using System I/O Signals in Standard Mode

This section illustrates an example of starting and stopping the robot using system I/O signals.

(1) Equipment example

Equipment, which makes the robot perform operations by operating an external equipment operating panel connected to the Robot Controller through a PLC as shown in Figure 5-18 and equipped with a display, lamps and switches listed in Table 5-9.

![Figure 5-18 Example of Equipment Using a Robot](image-url)
Table 5-9  Example of Equipment Operating Panel Functions

<table>
<thead>
<tr>
<th>Classification</th>
<th>Part</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display</td>
<td>Display</td>
<td>Displays messages, such as ROBOT PREPARATION OK.</td>
</tr>
<tr>
<td>Lamp</td>
<td>① Automatic operation indicator lamp</td>
<td>・Lights during automatic operation. ・Turned OFF when the robot is not in automatic operation.</td>
</tr>
<tr>
<td></td>
<td>② Robot external mode indicator lamp</td>
<td>・Lights when the robot is in external mode. ・Turned OFF when the robot is not in external mode.</td>
</tr>
<tr>
<td></td>
<td>③ Operation OK indicator lamp</td>
<td>・Lights when the Enable Auto signal is ON. ・Turned OFF when the Enable Auto signal is OFF.</td>
</tr>
<tr>
<td>Switch</td>
<td>① Robot preparation button</td>
<td>Starts the preparation of the robot.</td>
</tr>
<tr>
<td></td>
<td>② Automatic start button</td>
<td>Starts the operation of the equipment.</td>
</tr>
<tr>
<td></td>
<td>③ Cycle stop button</td>
<td>Stops the equipment after a cycle of operations is completed.</td>
</tr>
<tr>
<td></td>
<td>④ Operation/Adjustment selector switch</td>
<td>Automatic operation of the robot possible when OPERATION is selected. Manual operation or teach check of the robot possible when ADJUSTMENT is selected.</td>
</tr>
</tbody>
</table>

Caution: Actual equipment requires emergency stop, interlock and other functions; however, described here are the necessary functions.

(2) Outline of procedure
Described below is the outline of the procedure when using the equipment taken as an example shown in Figure 5-18.
Follow steps ① to ④.
① Operation preparation start
After setting the MOTOR ON, CAL EXECUTION, EXTERNAL SPEED 100 and EXTERNAL MODE SWITCHING bits, execute the mode switching command to bring the robot into external automatic operation mode. This operation will be completed when the EXTERNAL MODE output signal is turned ON.
② Automatic operation
Start the program by which the robot starts from the operation origin, performs operations, and returns to the operation origin.
③ Operation end
Terminate the day's operations with a cycle stop, and turn OFF the power.

(3) Start and stop procedure, and system I/O signals
Figures 5-19 and 5-20 show the relationship between the system I/O signals and *
① The operations by the operator.
② The display on the equipment operating panel, processing by the PLC.
③ The operation of the robot when starting and stopping the robot.
**Step 1: Operation preparation start**

- **Operation by operator and display on equipment operating panel**
  - Equipment power ON
  - Setting operation/adjustment selector switch to operation
  - Operation OK indicator lamp ON
  - Setting Mode selector switch of the operating panel or the teach pendant to AUTO
  - Robot preparation button ON

- **PLC processing**
  - Enable Auto ON

- **Robot operation**
  - (Internal processing)

**Figure 5-19 Start and Stop Procedure and System I/O Signals-1**

**Operation start area check**

- Robot external mode indicator lamp ON

**Robot operation**

- Motor power ON
- Executing CAL
- Setting SP 100
- Switching mode to external mode
- External mode ON

**Operation position 1 ON**

(Continued on following page)
(Continued from preceding page)

<table>
<thead>
<tr>
<th>Step</th>
<th>Operation by operator and display on equipment operating panel</th>
<th>PLC processing</th>
<th>Robot operation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Equipment’s Automatic</td>
<td>Program No. Select ON</td>
<td>Program start</td>
</tr>
<tr>
<td></td>
<td>Equipment’s Cycle Stop button ON</td>
<td>Program start ON</td>
<td>Program start ON</td>
</tr>
<tr>
<td></td>
<td>Automatic Operation indicator lamp ON</td>
<td>Program start ON</td>
<td>Program start ON</td>
</tr>
<tr>
<td></td>
<td>Automatic Operation indicator lamp ON</td>
<td>Program start ON</td>
<td>Program start ON</td>
</tr>
<tr>
<td></td>
<td>Execute Program Operation Command</td>
<td>Program start ON</td>
<td>Program start ON</td>
</tr>
<tr>
<td></td>
<td>Program No. select ON</td>
<td>Program start ON</td>
<td>Program start ON</td>
</tr>
<tr>
<td></td>
<td>Program start ON</td>
<td>Program start ON</td>
<td>Program start ON</td>
</tr>
<tr>
<td></td>
<td>Robot running OFF</td>
<td>Robot running OFF</td>
<td>Robot running OFF</td>
</tr>
<tr>
<td></td>
<td>Equipment power OFF</td>
<td>Equipment power OFF</td>
<td>Equipment power OFF</td>
</tr>
</tbody>
</table>

Note ①: In data area 1, the bit to each of "motor ON, CAL execution," "external speed 100" and "External Mode switching" will be turned ON. Refer to Chapter 5 "5.4.3.7 Mode Switching (0111)".

②: The figure indicates a system I/O signal, and ← represents the flow of the signal.

Figure 5-20 Start and Stop Procedure and System I/O Signals-2
### 5.5 System I/O Signals Special Mode

#### 5.5.1 Types and Functions of System Output Signals (Special Mode)

Table 5-10 shows the system output signals used in the special mode.

<table>
<thead>
<tr>
<th>Application</th>
<th>Signal name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start-up</td>
<td>Robot power ON</td>
<td>Outputs when preparations for operation are ready to start.</td>
</tr>
<tr>
<td></td>
<td>complete</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Auto mode</td>
<td>Outputs when the robot is in auto mode.</td>
</tr>
<tr>
<td></td>
<td>Servo ON</td>
<td>Outputs when the power to the motor is turned ON.</td>
</tr>
<tr>
<td></td>
<td>CAL complete</td>
<td>Outputs when calibration is completed.</td>
</tr>
<tr>
<td></td>
<td>External mode</td>
<td>Outputs when the robot is in external mode.</td>
</tr>
<tr>
<td>Program pre-execution check</td>
<td>Teaching</td>
<td>Outputs when the robot is in manual or teach check mode.</td>
</tr>
<tr>
<td>Program execution</td>
<td>Program start reset</td>
<td>Outputs when execution of the program starts in response to the program start signal received.</td>
</tr>
<tr>
<td></td>
<td>Robot running</td>
<td>Outputs when the robot is in operation (the program is being executed).</td>
</tr>
<tr>
<td></td>
<td>Continue start permitted</td>
<td>Outputs when the continue start is permitted.</td>
</tr>
<tr>
<td>Program end</td>
<td>Single cycle end</td>
<td>Outputs when the program completes a cycle.</td>
</tr>
<tr>
<td>Error/warning</td>
<td>Normal CPU</td>
<td>Outputs when the CPU (hardware) of the Robot Controller is normal.</td>
</tr>
<tr>
<td></td>
<td>Robot error</td>
<td>Outputs when an error, such as a servo error and a program error, occurs in the robot.</td>
</tr>
<tr>
<td></td>
<td>Robot warning</td>
<td>Outputs when a slight error occurs.</td>
</tr>
<tr>
<td></td>
<td>Dead battery warning</td>
<td>Outputs when the voltage of the encoder back-up battery or memory back-up battery lowers.</td>
</tr>
<tr>
<td></td>
<td>Error No.</td>
<td>An error number will be output in BCD code if an error occurs.</td>
</tr>
<tr>
<td></td>
<td>SS mode</td>
<td>Outputs when the robot is in Safe Start (SS) mode.</td>
</tr>
</tbody>
</table>
5.5.2 Usage of System Output Signals in the Special Mode

The usage of each system output signal in the special mode is described below.

5.5.2.1 Robot Power ON Complete

(1) Function
The signal outputs to the external device that OPERATION PREPARATION START is possible.

(2) Terminal number
No.9 of connector CN10.

(3) Usage
OPERATION PREPARATION START will be executed after this signal and the auto mode signal are turned ON after the power was turned ON.

(4) ON conditions

① The signal will be turned ON when the Robot Controller system program properly starts. Preparations for operation can be started after the power was turned ON.

② The signal will be turned ON when the robot error is cleared by the OK or Cancel key of the operating panel or the teach pendant or by ROBOT ERROR CLEAR and OPERATION PREPARATION START signals, after the power was turned OFF.

(5) OFF conditions
The signal will be turned OFF when a robot error or robot warning signal is turned ON.

![Diagram](image_url)

Figure 5-21 Robot Power ON Complete Output
5.5.2.2 Auto Mode (Output)

(1) Function
The signal outputs to the external device that the robot is in the auto mode.

(2) Terminal number
No.4 of connector CN10.

(3) Usage
Starting the program from the external device requires an SWITCH EXT MODE input, a PROGRAM NO. SELECT input and a PROGRAM START input. The signal is used to confirm that the robot is in the auto mode.

(4) ON conditions
The signal will be output when the robot enters the auto mode under the following conditions.
① The mode selector switch of the operating panel or the teach pendant is set to AUTO.

(5) OFF conditions
The signal will be turned OFF under the following conditions.
① When the mode selector switch of the operating panel is set to MANUAL or the teach pendant is set to MANUAL or TEACH CHECK.
② When Enable Auto OFF is input.
(Caution: The signal will not be turned OFF in the pendantless state described in Chapter 3, Subsection 3.2.3, "[3] Pendantless State."

Caution: The signal will not be turned OFF with INSTANTANEOUS STOP, STEP STOP or CYCLE STOP.

![Figure 5-22 Auto Mode Output](image-url)
5.5.2.3 Servo ON (Output)

(1) Function
The signal outputs to the external device that the power to the robot motor is turned ON.

(2) Terminal number
No.10 of connector CN10.

(3) Usage
Executing CAL from the external device or starting the program requires the power to the motor to be turned ON. This signal is used to confirm that the power to the motor is turned ON and to light the motor power ON indicator lamp on an external operating panel.

(4) ON conditions
The signal will be turned ON when the power to the motor is turned ON under the following conditions.
① The MOTOR switch on the operating panel or the teach pendant is activated.
② MOTOR POWER ON + OPERATION PREPARATION START signals are input from the external device.

(5) OFF conditions
The signal will be turned OFF when the power to the motor is turned OFF under the following conditions.
① The MOTOR switch of the operating panel or the teach pendant is deactivated and the ROBOT STOP button is operated.
② ROBOT STOP is input from the external device.
③ ROBOT ERROR is output. If any of errors 0×6071 to 607B, 0×6671 to 667B, 0×607F occurs, the servo ON signal will be turned OFF in External Auto mode but will not be turned OFF in manual or teach check mode.

Figure 5-23 Servo ON Output

- When the MOTOR button of the operating panel or the teach pendant is turned ON.
- When MOTOR POWER ON and OPERATION PREPARATION START signals are input from the external device.
- When the MOTOR button of the operating panel or the teach pendant is turned OFF and the ROBOT STOP button is operated.
- When a ROBOT STOP signal is input from an external device.
- When a ROBOT ERROR occurs.
5.5.2.4 CAL Complete (Output)

(1) Function
The signal outputs to the external device that CAL is completed.

(2) Terminal number
No.11 of connector CN10.

(3) Usage
This signal is used to determine whether to execute CAL. Once CAL is completed, it does not need to be executed again.

(4) ON conditions
The signal will be turned ON upon proper completion of CAL under the following conditions.
1. When CAL is performed by the operating panel or teach pendant.
2. When CAL EXECUTION and OPERATION PREPARATION START signals are input from the external device.

(5) OFF conditions
The signal will be turned OFF when CAL is not properly completed as shown in Figure 5-24. It will remain OFF until CAL is performed again and properly completed.

![Figure 5-24 CAL Complete Output](image-url)
5.5.2.5 External Mode (Output)

(1) Function
The signal outputs to the external device that the robot is in the external mode.

(2) Terminal number
No.5 of connector CN10.

(3) Usage
Starting the program from the external device requires an SWITCH EXT MODE input, PROGRAM NO. SELECT input and a PROGRAM START input. The signal is used to confirm to the external device that the robot is in external mode.

(4) ON conditions
The signal will be turned ON under the following conditions.
1. When INTERNAL/EXTERNAL is input on the teach pendant and the external mode is selected.
2. When EXTERNAL/INTERNAL is input on the operating panel in AUTO MODE and in the INTERNAL CONTROL ON state.
3. When SWITCH EXT MODE and OPERATION PREPARATION START signals are input from the external device.

(5) OFF conditions
The signal will be turned OFF under the following conditions.
1. When the mode selector switch of the teach pendant is set to MANUAL or TEACH CHECK in external mode.
2. When EXTERNAL/INTERNAL is input on the teach pendant and external mode is selected.
3. When EXTERNAL/INTERNAL is input on the operating panel in AUTO MODE and in the INTERNAL CONTROL OFF state.
4. When ROBOT STOP is input.
5. When ROBOT ERROR is output.

Caution: The signal will not be turned OFF with STEP STOP.

© When an Enable Auto input is turned OFF.

Figure 5-25  External Mode Output
5.5.2.6 Teaching (Output)

(1) Function
The signal outputs to the external device that the robot is in the manual mode or teaches check mode.

(2) Terminal number
No.12 of connector CN10.

(3) Usage
This signal is used to inform an external operating panel that the robot is teaching when they are installed separately from each other.

(4) ON conditions
The signal will be turned ON when the mode selector switch of the operating panel or the teach pendant is set to MANUAL or TEACH CHECK, as shown in Figure 5-26.

(5) OFF conditions
The signal will be turned OFF when the mode selector switch of the operating panel or teach pendant is set to AUTO and the Enable Auto input is turned ON.

---

Figure 5-26 Teaching Output
5.5.2.7 Program Start Reset (Output)

(1) Function
This signal is output to the external device when the robot receives a start signal from the external device and starts to operate.

(2) Terminal number
No.6 of connector CN10.

(3) Usage
① The signal is used to prompt the external device to receive information that the robot program has started to run, and to process subsequent sequence programs.
② The signal is used as a condition to turn OFF the PROGRAM START signal sent from the external device to the robot.

(4) ON conditions
The signal will be turned ON immediately after the robot program starts to run, as shown in Figure 5-27.

(5) OFF conditions
The signal will be turned OFF automatically when the PROGRAM START signal sent to the robot is turned OFF.

![Figure 5-27 Program Start Reset Output ON Condition](image-url)
5.5.2.8  Robot Running (Output)

(1) Function
The signal outputs to the external device that the robot is in operation (executing more than one task).

(2) Terminal number
No.2 of connector CN10.

(3) Usage
The signal is used to light the robot operating indicator lamp of the external operating panel.
Since the signal is turned OFF with STOP ALL PROGRAMS, it outputs to the external device that all programs are stopped.

(4) ON conditions
The signal will be turned ON while executing the program and also in the Wait State with a condition branch or timer command.

(5) OFF conditions
The program will be turned OFF with STOP ALL PROGRAMS.

Caution: STOP ALL PROGRAMS means the operation of the ROBOT STOP or STOP button of the operating panel or the teach pendant and INSTANTANEOUS TOP (ALL TASKS), STEP STOP (ALL TASKS) and ROBOT STOP inputs.
5.5.2.9 Single-Cycle End (Output)

(1) Function
The signal outputs to the external device that a single-cycle of the program is completed.

Caution !!!: The single-cycle end signal will be output upon reading END of the program. However, it will be output earlier than the end of the actual robot operation because the Robot Controller pre-reads the program.

: The single-cycle end signal will be output on the premise that only one program is executed at a time. If two or more programs are executed simultaneously (multi-tasks), the single-cycle end signal will be turned ON immediately after any of the programs reads an END command.

(2) Terminal number
No.13 of connector CN10.

(3) Usage
The signal is used to operate another equipment in synchronization with a single-cycle end of the program.

(4) ON conditions
The signal will be turned ON when the program is read to the end.

(5) OFF conditions
The signal will be turned OFF immediately after the program starts to run.

![Figure 5-28 Single-Cycle End Output](image-url)
5.5.2.10 Normal CPU (Output)

(1) Function
The signal outputs to the external device that the CPU (hardware) of the Robot Controller is normal.

(2) Terminal number
No.1 of connector CN10.

(3) Usage
① The signal is used to light the Robot Controller error indicator lamp of an external operating panel.
② The signal is used when the NORMAL CPU signal is turned OFF because of an error and the PLC corrects it.

(4) ON conditions
The signal will be turned ON by the hardware when the CPU of the Robot Controller operates normally with the power turned ON.

(5) OFF conditions
The signal will be turned OFF by the hardware when the CPU does not operate normally.

Caution: The OFF state of this signal indicates that the internal arithmetic circuit of the Robot Controller may be damaged and ROBOT ERROR, ERROR NUMBER and other outputs may not be correct.

Figure 5-29 Normal CPU Output
5.5.2.11 Robot Error (Output)

(1) Function
The signal outputs to the external device that a problem, such as a servo error and a program error, occurs with the robot.

(2) Terminal number
No.3 of connector CN10.

(3) Usage
- The signal is used to light the robot error indicator lamp of an external operating panel.
- The signal is used to help the PLC clear an error in response to a ROBOT ERROR signal.

(4) ON conditions
As shown in Figure 5-30, the signal will be turned ON under the following conditions.
- When an error, such as a servo error, a program error and undefined program, occurs at the start of the program and during execution of the program.
- When an error occurs during execution of the program in internal operation by the operating panel or the teach pendant or in external operation by the PLC.
- When an error, such as undefined program, occurs at the start of the program only in external operation.

Caution: The signal will not be output when an error, such as a program input error occurs in manual operation, except when a servo error occurs in manual operation. For further information, see "ERROR CODE TABLES."

(5) OFF conditions
As shown in Figure 5-30, the signal will be turned OFF under the following conditions.
- When a ROBOT ERROR CLEAR COMMAND is input from the external device and the existing error is cleared.
- When the existing error is cleared by operating the Cancel key of the operating panel or the teach pendant.

- Program number, parity error, or an undefined program number at external start.
- The robot errors during automatic operation (both internal operation and external operation).
- When ROBOT ERROR CLEAR and OPERATION PREPARATION START signals are input.
- When the Cancel key of the operating panel or the teach pendant is operated.
5.5.2.12 Robot Warning (Output)

(1) Function
The signal outputs to the external device that a minor error has occurred with an I/O command or during servo processing.

Caution: The signal will not be output in case of a minor error, such as a program selection error, caused by the operation of the teach pendant or operating panel.

(2) Terminal number
No.15 of connector CN10.

(3) Usage
① The signal is used to light the robot warning indicator lamp of an external operating panel.
② The signal is used to help the PLC clear an error in response to a ROBOT WARNING signal.

(4) ON conditions
As shown in Figure 5-31, the signal will be turned ON when a minor error occurs during I/O processing, execution of the program or servo processing, irrespective of the operation mode.

(5) OFF conditions
As shown in Figure 5-31, the robot-warning signal will be turned OFF under the following conditions.
① When ROBOT ERROR CLEAR and OPERATION PREPARATION START signals are input from the external device and the existing error is cleared.
② When the existing error is cleared by operating the OK or Cancel key of the operating panel or the teach pendant.

Figure 5-31  Robot Warning Output
5.5.2.13 Dead Battery Warning (Output)

(1) Function
The signal will be output when the voltage of the encoder back-up battery or memory back-up battery becomes dangerously low.

(2) Terminal number
No.14 of connector CN10.

(3) Usage
The signal is used to check the timing of battery replacement (lowering of the battery voltage).

(4) ON conditions
The signal will be turned ON when the voltage of the encoder back-up battery or memory back-up battery becomes dangerously low.

Caution: Any error of ERROR64A1 to 64A6 indicating the dead encoder back-up battery or ERROR6103 informing the dead memory back-up battery will be displayed on the operating panel and the teach pendant respectively. (For details, refer to Chapter 6, Section 6.4, "Biennial Inspections.")

(5) OFF conditions
The signal will be turned OFF when the power is turned ON after the dead battery was replaced.

![Figure 5-32 Dead Battery Warning Output](image-url)
5.5.2.14 Error No. (Output)

(1) Function
When an error occurs, the signal outputs the error number in a 3-digit (12-bit) hexadecimal code.

(2) Terminal numbers
No.17 to No.28 of connector CN10.

(3) Usage
The signal is used to display an error number on the external device.

(4) Output conditions
The signal will be output when an error occurs.

(5) Clear conditions
The signal will be cleared when ROBOT ERROR CLEAR and OPERATION PREPARATION START signals are input or by operating the Cancel key of the operating panel or the teach pendant. When this signal is cleared, all states will become OFF (0).

(6) Hexadecimal codes
See Figure 5-33.

<table>
<thead>
<tr>
<th>Code</th>
<th>Hexadecimal Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>xxxx</td>
<td>0</td>
</tr>
<tr>
<td>xxxx</td>
<td>1</td>
</tr>
<tr>
<td>xxxx</td>
<td>2</td>
</tr>
<tr>
<td>xxxx</td>
<td>3</td>
</tr>
<tr>
<td>xxxx</td>
<td>4</td>
</tr>
<tr>
<td>xOxO</td>
<td>5</td>
</tr>
<tr>
<td>xOxO</td>
<td>6</td>
</tr>
<tr>
<td>xOxO</td>
<td>7</td>
</tr>
<tr>
<td>xOxO</td>
<td>8</td>
</tr>
<tr>
<td>xOxO</td>
<td>9</td>
</tr>
<tr>
<td>OOOX</td>
<td>A</td>
</tr>
<tr>
<td>OOOX</td>
<td>B</td>
</tr>
<tr>
<td>OOOX</td>
<td>C</td>
</tr>
<tr>
<td>OOOX</td>
<td>D</td>
</tr>
<tr>
<td>OOOX</td>
<td>E ⋯ ON</td>
</tr>
<tr>
<td>OOOO</td>
<td>F ⋯ OFF</td>
</tr>
</tbody>
</table>

Figure 5-33 Hexadecimal Codes

Figure 5-34 shows an example of error number output, when ERROR174 (overload error with the fourth axis) occurs.

<table>
<thead>
<tr>
<th>Terminal No. (connector CN10)</th>
<th>Hundreds of error No.</th>
<th>Tens of error No.</th>
<th>Units of error No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>28 27 26 25</td>
<td>24 23 22 21</td>
<td>20 19 18 17</td>
</tr>
<tr>
<td></td>
<td>x x x O</td>
<td>x O O O</td>
<td>x O O X</td>
</tr>
<tr>
<td>ERROR</td>
<td>1 7 4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 5-34 Example of Error Number Output
5.5.2.15 Continue Start Permitted (Output)

(1) Function
The controller will output this signal when the continue start is permitted.

(2) Terminal number
No.16 of connector CN10.

(3) Usage
Use this signal when you want to know whether the continue start is permitted.

(4) ON condition
This signal comes on when the continue start is permitted. For details, refer to the SETTING-UP MANUAL.

(5) OFF condition
This signal goes off by carrying out the "Task Status Change Operation."
### 5.5.3 Types and Functions of System Input Signals (Special Mode)

Table 5-11 shows the system input signals to be used in special mode.

<table>
<thead>
<tr>
<th>Application</th>
<th>Signal name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start-up</td>
<td>Enable Auto</td>
<td>Enables switching to Auto mode.</td>
</tr>
<tr>
<td></td>
<td>Motor power ON + operation preparation start</td>
<td>Turns ON the power to the motor.</td>
</tr>
<tr>
<td></td>
<td>CAL execution + operation preparation start</td>
<td>Executes calibration.</td>
</tr>
<tr>
<td></td>
<td>SP100 + operation preparation start</td>
<td>Sets the speed to 100%.</td>
</tr>
<tr>
<td></td>
<td>Switch Ext Mode + operation preparation start</td>
<td>Switches the mode to external mode.</td>
</tr>
<tr>
<td></td>
<td>Program reset + operation preparation start</td>
<td>Initializes all programs on halt. Starting a program after initialization will execute the program from the beginning.</td>
</tr>
<tr>
<td></td>
<td>Program No. select + program start</td>
<td>Executes a specified program.</td>
</tr>
<tr>
<td>Program execution</td>
<td>Program reset + program No. select + program start</td>
<td>Cancels the current program and starts executing a specified program from the beginning.</td>
</tr>
<tr>
<td></td>
<td>Continue start + program start</td>
<td>Executes a continue start.</td>
</tr>
<tr>
<td>Stop</td>
<td>Robot stop</td>
<td>Stops the robot by opening signals.</td>
</tr>
<tr>
<td></td>
<td>Robot stop</td>
<td>Stops the robot by canceling signals.</td>
</tr>
<tr>
<td></td>
<td>Step stop</td>
<td>Step-stops all programs by opening signals.</td>
</tr>
<tr>
<td></td>
<td>Instantaneous stop</td>
<td>Immediately stops all programs by opening signals.</td>
</tr>
<tr>
<td>Error clear</td>
<td>Robot error clear + operation preparation start</td>
<td>Clears an error.</td>
</tr>
<tr>
<td>Program interrupt</td>
<td>Interrupt skip</td>
<td>Interrupts the execution of the current step and starts the next step.</td>
</tr>
</tbody>
</table>

Caution: Two or more signal names shown in the signal name field indicate that they should be used in combination.
5.5.4 Usage of System Input Signals in Special Mode

The usage of each system input signal in Special mode is described below:

5.5.4.1 Enable Auto (Input)

1. **Function**
   - The signal enables switching of the robot mode to the Auto mode (shorted state).
   - The signal enables switching of the robot mode to the manual mode or the teach check mode (open state).

2. **Terminal number**
   - No.4 of connector CN8.

3. **Usage**
   - The signal is used for the AUTO/TEACHING selector switch of the external operating panel and can be combined with the safety fence switch.

4. **Input conditions and operation**
   - As shown in Table 5-12, the selectable operation mode depends on whether this input is shorted or open.
   - If the input becomes open during automatic operation, the mode will be switched to manual mode and ERROR21FC will be displayed.
   - If manual operation or a teach check is conducted with this input shorted, ERROR21F2 will be displayed.
   - If the mode selector switch of the teach pendant or the operating panel is set to AUTO with this input open, ERROR21F3 will be displayed.
   - Although ERROR21FD or ERROR21FC will be displayed when the state is changed from ○ to Δ or × shown in Table 5-12, they will not be displayed when the state is changed from Δ or × to ○.
   - When the input is turned OFF (open) in external mode, the external mode output will also be turned OFF.

<table>
<thead>
<tr>
<th>Operation Mode</th>
<th>Application</th>
<th>Enable Auto</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual mode</td>
<td>Manual operation with the operating panel or teach pendant</td>
<td>Δ  ○</td>
</tr>
<tr>
<td>Teach check mode</td>
<td>Program check with the teach pendant</td>
<td>Δ  ○</td>
</tr>
<tr>
<td>Internal Auto mode</td>
<td>Automatic operation with the operating panel or teach pendant</td>
<td>○  ×</td>
</tr>
<tr>
<td>External Auto mode</td>
<td>Automatic operation with the external device</td>
<td>○  ×</td>
</tr>
</tbody>
</table>

**Note:** ○ = Mode selectable, × = Mode not selectable, Δ = Mode selectable but manual operation and program not executable

Caution: In the pendantless state described in Chapter 3, subsection 3.2.3 [3], auto mode is valid even if the Enable Auto input is open (external mode cannot be switched and the program cannot start to run).

Perform the following when operating the robot in the pendantless state:

1. Set the robot not to start to operate when the Enable Auto input is open.
2. Enable Auto input open state and auto mode output (See 5.3.2.2 and 5.5.2.2 "Auto Mode ".)
3. Set the equipment to make an emergency stop in an AND state.
4. Add ⊙ and ⊙ with the external sequence circuit.
5.5.4.2 Operation Preparation Start (Input)

(1) Function

- By turning ON (short) this signal, input signals ① to ⑤ described in (3), input conditions and operation will be detected and the robot will automatically start to operate. Input these signals with the system output ROBOT POWER ON COMPLETE turned ON.
- By turning ON (short) ROBOT ERROR CLEAR, an error that has occurred will be cleared.

(2) Terminal number

No.8 of connector CN8.

(3) Input conditions and operation

Before inputting an operation preparation start signal, turn ON (short) inputs ① to ⑤ below:

① Motor power ON (input)
- Terminal number: No.19 of connector CN8
- By turning ON (short) the operation preparation start signal with this signal turned ON (shorted), the power to the motor will be turned ON. However, this signal can be used only in the Auto mode.

② CAL execution (input)
- Terminal number: No.20 of connector CN8
- By turning ON (short) the operation preparation start signal with this signal turned ON (shorted), calibration takes place. However, this signal cannot be used when the power to the motor is turned OFF (① not executed).

③ SP100 (input)
- Terminal number: No.22 of connector CN8
- By turning ON (short) the operation preparation start signal with this signal turned ON (shorted), SP100% will be set.

④ Switch Ext Mode (input)
- Terminal number: No.23 of connector CN8
- By turning ON (short) the operation preparation start signal with this signal turned ON (shorted), the mode will be set to the external mode. However, this signal cannot be used when the power to the motor is turned OFF and CAL is not completed.

⑤ Program reset (input)
- Terminal number: No.24 of connector CN8
- By turning ON (short) the operation preparation start signal with this signal turned ON (shorted), all programs will be initialized.

Caution: By turning ON (short) the operation preparation start signal with all inputs ① to ⑤ turned ON (shorted), ① to ⑤ will be executed one by one. Input ② cannot be executed until input ① is completed. Inputs ① to ⑤ will also become valid when part of them are executed by the operating panel or teach pendant.
For the input timing of the operation preparation start signal and ① to ⑥, see Figure 5-35.

Caution: The operation preparation start signal and each input signal, except the Enable Auto signal, will be turned OFF (falling) upon turning ON of the external mode output is turned ON. Although the robot is made to execute all items at start-up, execute only necessary items at the time of recovery from suspension during operation to reduce recovery time. The required time to execute all items may be about 5 seconds depending on CAL time. The time is about 1.3 seconds without CAL. (Once CAL is completed, it does not need to be executed again as long as the power to the Robot Controller is turned ON.) Determine whether to execute CAL according to the CAL complete output.

<table>
<thead>
<tr>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automatic operation enable</td>
<td>ON (shorted) &lt;br&gt; OFF (open)</td>
</tr>
<tr>
<td>Operation preparation start</td>
<td>ON (shorted) &lt;br&gt; OFF (open)</td>
</tr>
<tr>
<td>① Motor power ON</td>
<td>ON (shorted) &lt;br&gt; OFF (open)</td>
</tr>
<tr>
<td>② CAL execution</td>
<td>ON (shorted) &lt;br&gt; OFF (open)</td>
</tr>
<tr>
<td>③ SP100</td>
<td>ON (shorted) &lt;br&gt; OFF (open)</td>
</tr>
<tr>
<td>④ External mode switching</td>
<td>ON (shorted) &lt;br&gt; OFF (open)</td>
</tr>
<tr>
<td>Automatic mode output</td>
<td>ON (shorted) &lt;br&gt; OFF (open)</td>
</tr>
<tr>
<td>Servo ON</td>
<td>ON (shorted) &lt;br&gt; OFF (open)</td>
</tr>
<tr>
<td>CAL complete</td>
<td>ON (shorted) &lt;br&gt; OFF (open)</td>
</tr>
<tr>
<td>External mode output</td>
<td>ON (shorted) &lt;br&gt; OFF (open)</td>
</tr>
</tbody>
</table>

Caution: Indicates the input or output of the signal, and indicates robot operation.

Figure 5-35 Example of Operation Preparation Start Signal Timing Chart
5.5.4.3 Program No. Select (Input)

(1) Function
The program number to be executed can be specified from the external device by inputting this signal.

(2) Terminal numbers
No.11 to No.18 of connector CN8.

(3) Input conditions and operation

① This signal is executable only in the external mode. In other modes, an error (ERROR21E2, 21E4, 21E6) will be displayed, and the terminal motor power will be turned OFF.

② As shown in Table 5-13, the program No. select signal is made up of eight bits of 2⁰ to 2⁶ and the parity bit.

③ Input a decimal program number by converting it into binary 2⁰ to 2⁶ and parity bit.

④ "Short" represents the bit value = 1, "open" represents the bit value = 0, and the parity bit is odd parity.

⑤ As shown in Figure 5-36, input the program No. select signal before the program start signal (1 msec. or more), and hold the state until the robot starts to operate. If this condition is not met, ERROR2031 or ERROR2033 will be displayed, the power to the motor will be turned OFF, and the mode will be switched to the Auto mode.

<table>
<thead>
<tr>
<th>Robot status</th>
<th>Wait for start or preceding cycle</th>
<th>Single-cycle operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program start (input)</td>
<td>ON (shorted)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>OFF (open)</td>
<td></td>
</tr>
<tr>
<td>Program No. select signal</td>
<td>ON (shorted)</td>
<td></td>
</tr>
<tr>
<td>2⁰ to 2⁶</td>
<td>OFF (open)</td>
<td></td>
</tr>
<tr>
<td>Parity</td>
<td></td>
<td>1 ms. or more required</td>
</tr>
</tbody>
</table>

Figure 5-36 Program No. Select Signal

⑥ Input 1 or 0 as the parity bit so that the total of 1’s existing in the eight bits of 2⁰ to 2⁶ and the parity bit will be odd.
Example: When the program number is 15, the bit status of 2⁰ to 2⁶ is (001111), and the total number of 1s is four, an even number. Set 1 as the parity bit to make the total number of 1s five, an odd number.

Caution ⑤: The bit value =1 represents short, and the bit value =0 represents open.
⑦: The program numbers executable from the external device are limited to Pro0 to Pro127.
Table 5-13 Example of Program No. Select Signals

<table>
<thead>
<tr>
<th>Input signal</th>
<th>Program No. (decimal)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>$2^0 = 1$</td>
<td>1</td>
</tr>
<tr>
<td>$2^1 = 2$</td>
<td>0</td>
</tr>
<tr>
<td>$2^2 = 4$</td>
<td>0</td>
</tr>
<tr>
<td>$2^3 = 8$</td>
<td>0</td>
</tr>
<tr>
<td>$2^4 = 16$</td>
<td>0</td>
</tr>
<tr>
<td>$2^5 = 32$</td>
<td>0</td>
</tr>
<tr>
<td>$2^6 = 64$</td>
<td>0</td>
</tr>
<tr>
<td>Parity</td>
<td>0</td>
</tr>
</tbody>
</table>

Figure 5-37 shows an example of a program No. select signal sequence circuit considering parity.

![Figure 5-37 Example of Program No. Select Signal Sequence Circuit](image-url)
5.5.4.4 Program Start (Input)

(1) Function
This signal starts the program specified with the program No. select signal from the external device.

(2) Terminal number
No.10 of connector CN8.

(3) Input conditions and operation
By switching the status of this signal from ON (open) to ON (shorted) in external mode, operations ①, ② and ③ described below will take place.
(The status of the signal must be switched from OFF to ON.)
① If the program start signal is input (switched from OFF to ON) when the robot has not yet completed the program or is at rest after it has completed a cycle of the program, the program No. select signal will be read, the program will execute a cycle, and the robot will come to a stop.

Caution: The program start signal requires program start preparation time (50 msec. or more) before input from OFF (open) to ON (shorted).
The program start signal must remain OFF (open) during the program start preparation time. If it is turned ON (shorted) during that time, the next cycle will not start to run.
To start a new cycle, the status of the external start signal must be switched from OFF to ON before each cycle.
2. When the status of the program start signal is switched from OFF to ON with the program step-stopped, the program will resume from the step following the suspended step and stop at the cycle end.

**Figure 5-39 Program Start Operation-2**

<table>
<thead>
<tr>
<th>Robot status</th>
<th>Program start signal (input)</th>
<th>Step-stop signal (input)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ON (shorted)</td>
<td>ON (shorted)</td>
</tr>
<tr>
<td></td>
<td>OFF (open)</td>
<td>OFF (open)</td>
</tr>
</tbody>
</table>

**Caution:** To cancel the execution of the remaining steps of a step-stopped program and start it from the beginning, input a program reset signal, a program No. select signal and a program start signal at the same time. For further information, refer to Chapter 5 "5.5.4.5 Program Reset (Input)".
When the status of the program start signal is switched from OFF to ON with the program immediately stopped, the program will resume from the suspended step and stop at the cycle end.

Caution: To cancel the execution of the remaining steps of an instantaneously stopped program and start it from the beginning, input a program reset signal, a program No. select signal and a program start signal at the same time. For further information, refer to Chapter 5 "5.5.4.5 Program Reset (Input)".
(4) Example of program start signal (rise) ON and (fall) OFF timing

Example of program start signal rise (ON) timing

Figure 5-41 shows how to make the program start signal rise with robot system outputs (external mode output and single-cycle end output).

<table>
<thead>
<tr>
<th>Robot status</th>
<th>Wait for start</th>
<th>Single-cycle operation</th>
<th>Next cycle operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>External mode (output)</td>
<td>ON</td>
<td>OFF</td>
<td></td>
</tr>
<tr>
<td>1-cycle end (output)</td>
<td>ON</td>
<td>OFF</td>
<td></td>
</tr>
<tr>
<td>Program start signal (input)</td>
<td>ON (shorted)</td>
<td>OFF (open)</td>
<td></td>
</tr>
</tbody>
</table>

200 ms. or more required

Caution: The program start signal for the first cycle rises as soon as the external mode becomes valid and the conditions of the peripheral devices are met. The program start signal for subsequent cycles rises after output of a single-cycle end signal.
Example of program start signal fall (OFF) timing

a) Figure 5-42 shows how to make the program start signal fall with a robot system output (program start reset output). When the robot program starts to run, a program start reset signal is output. The external device receives it and makes the program start signal fall (OFF).

<table>
<thead>
<tr>
<th>Robot status</th>
<th>Wait for start or preceding cycle</th>
<th>Single-cycle operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program start reset (output)</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>Program start signal (input)</td>
<td>ON (shorted)</td>
<td>OFF (open)</td>
</tr>
</tbody>
</table>

Figure 5-42 Example of Program Start Signal Fall Timing-1

b) Figure 5-43 shows how to make the program start signal fall with the simplified method (1 shot method using a timer).

<table>
<thead>
<tr>
<th>Robot status</th>
<th>Wait for start</th>
<th>Single-cycle operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program start signal (input)</td>
<td>ON (shorted)</td>
<td>OFF (open)</td>
</tr>
</tbody>
</table>

50 ms. or more required

Figure 5-43 Example of Program Start Signal Fall Timing-2

Caution: Although the 1 shot method is easy, the timer setting for falling to raise the program start signal in the middle of the preceding cycle is difficult. Use this method only to raise the program start signal after the robot stops at the end of each cycle.

The status of the robot running, program start reset and single cycle end output signals changes in sequence after the program start signal is input (T₁→T₂→T₃ in Figure 5-44). The change of the status of these signals takes place within 100 msec. after the program start signal rises (ON). See Figure 5-44.
T₁, T₂, T₃: within 100 ms.

Figure 5-44  Program Start Signal Rise Output Signal Timing
5.5.4.5  Program Reset (Input)

(1) Function
By turning ON (short) this signal, any program can be forcibly executed from the beginning in a step-stopped state and a suspended state.

Caution: Generally, a step-stopped or suspended program resumes from where it stopped.

(2) Terminal number
No.24 of connector CN8.

(3) Input conditions and operation

When issued with the Program Start

1. Figure 5-45 shows the input conditions and an operation timing chart.
2. Use the program reset signal together with a program No. select signal, and input it before the program start signal (1 msec. or more).
3. Turn OFF the program reset signal after the robot starts to operate (after a program start reset signal is output).
4. A program No. select signal is required to execute the same program number as the suspended one from the beginning.

<table>
<thead>
<tr>
<th>Robot status</th>
<th>Executing cycle</th>
<th>Stop</th>
<th>Executing cycle from beginning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step-stop (input)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ON (shorted)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OFF (open)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Program start (input)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ON (shorted)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OFF (open)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Program No. select signal (input)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ON (shorted)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OFF (open)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Program reset (input)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ON (shorted)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OFF (open)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 5-45  Input Conditions and Operation of Program Reset Signal
When issued with the Operation Preparation Start

1. Figure 5-46 shows the input conditions and an operation timing chart.
2. Input Program Reset before Operation Preparation Start (1 msec. or more).
3. After turned ON, this signal may take a maximum of one second for initializing all programs. During the period, do not input signals to the robot.

![Figure 5-46 Input Conditions and Operation of Program Reset Signal](image-url)

---

**Figure 5-46 Input Conditions and Operation of Program Reset Signal**
5.5.4.6 Robot Stop (Input)

(1) Function

① The signal stops the robot with the external device by opening the robot stop input
② The signal readies the power to the robot motor to be turned ON by shorting the robot stop input.

(2) Terminal number

No.2 of connector CN8.

(3) Input conditions and operation

① The robot stops with this signal OFF (open).
② The power to the robot motor is ready to be turned ON with this signal ON (shorted).
③ Irrespective of whether internal mode (operation with the teach pendant) or external mode (remote operation by the external device) is selected, the power to the robot motor cannot be turned ON with this signal OFF (open). Neither manual nor automatic operation can be performed until this signal is turned ON (shorted). (ERROR2008 will be displayed.)
④ By turning OFF (open) this signal under the following conditions.
   1) The power to the motor will be turned OFF, irrespective of whether Manual, Internal Auto, or External Auto mode is selected.
   2) During execution of the program (robot running output ON), the power to the motor will be turned OFF and the mode will be switched to internal mode after the robot decelerates to a stop.
   3) When the program is at a stop in the Manual and the Auto mode the power to the motor will be turned OFF. The suspended operation can be resumed by turning ON the power to the motor and shorting the ROBOT STOP signal.
⑤ Opening the ROBOT STOP signal and pressing the ROBOT STOP button of the operating panel or the teach pendant function the same.

(4) Input timing

This signal will be processed prior to all commands and input signals.
5.5.4.7 Step Stop (All Tasks) (Input)

(1) Function
Input this signal to step-stop the program being executed from the external device. All tasks will be step-stopped.

(2) Terminal number
No.5 of connector CN8.

(3) Input conditions and operation

1. If the status of this signal is changed from ON (shorted) to OFF (open), the robot will stop all tasks immediately after the ongoing step is completed, and the robot running output will be turned OFF. However, External Auto mode will remain valid, and the suspended program will be resumed by inputting a program start signal. See Figure 5-47.
2. Turning OFF (open) this signal when inputting a program start signal makes the robot stop step by step.
3. Internal operation with the teach pendant is valid only when the status of this signal is changed from ON (shorted) to OFF (open).
4. For resuming the program after a step stop, refer to Chapter 5 "5.5.4.4 Program Start (Input)".

---

![Figure 5-47 Step Stop Signal](image-url)

---

Robot status | Single-cycle operation
---|---
Operating halfway | Step-stop | Performing remaining operation

Program start signal (input) | ON (shorted) | OFF (open)
Step-stop signal (input) | ON (shorted) | OFF (open)
Robot in operation (output) | ON | OFF
5.5.4.8 Instantaneous Stop (All Tasks) (Input)

(1) Function
Input this signal to instantaneously stop the program being executed from the external device. All tasks will instantaneously stop.

(2) Terminal number
No.7 of connector CN8.

(3) Input conditions and operation
① If the status of this signal is changed from ON (shorted) to OFF (open), the robot will instantaneously stop in the middle of the ongoing step, and the robot running output will be turned OFF. However, Auto mode or external mode will remain valid, and the suspended program will be resumed by inputting a program start signal.
② Internal operation by the teach pendant is valid only when the status of this signal is changed from ON (shorted) to OFF (open).
③ For resuming the program after an instantaneous stop, refer to Chapter 5 "5.5.4.4 Program Start (Input)".
④ The minimum required pulse width is 50 msec. or more.

![Figure 5-48 Minimum Instantaneous Stop Pulse Width](image-url)
5.5.4.9 Robot Error Clear (Input)

(1) Function
The robot can recover from a stopped state, resulting from a robot error by turning ON (shorted) the operation preparation start signal with this signal ON (shorted).

(2) Terminal number
No.25 of connector CN8.

Caution: The number of the terminal of connector CN8 for the operation preparation start signal is No. 8.

(3) Usage
The signal is used to clear an error that brought the robot to a stop.

(4) Input conditions and operation
① When a robot error occurs, clear the error display on the teach pendant and the external output ERROR NUMBER to ready the robot to operate.
② When the robot error clear signal is turned ON (shorted), other input signals (MOTOR POWER ON, CAL EXECUTION, SP100 and SWITCH EXT MODE), which are to be used in combination with the operation preparation start signal, will be ignored.
To turn ON the power to the motor after a robot error is cleared, turn OFF (open) the robot error clear signal after turning OFF the robot error signal (output) as shown in Figure 5-49.
③ Input the robot error clear signal before (1 msec. or more) the operation preparation start signal.

![Figure 5-49 Input Conditions and Operation of Robot Error Clear Signal](image-url)
5.5.4.10 Interrupt Skip (Input)

(1) Function
If this signal is turned ON (shorted) during execution of the robot operation command within the range between INTERRUPT ON and INTERRUPT OFF in the program, the operation of the ongoing step will stop and the next step will start.

Caution: For further information about the INTERRUPT ON and OFF commands, refer to Chapter 12 "12.3 INTERRUPT ON/OFF (Statement)" in PROGRAMMER'S MANUAL. For further information about the robot operation command, refer to Chapter 12 "Robot Control Statements" in PROGRAMMER'S MANUAL.

(2) Terminal number
No.9 of connector CN8.

(3) Usage
Refer to Chapter 12 "12.3 INTERRUPT ON/OFF" in PROGRAMMER'S MANUAL.

(4) Input conditions and operation
If this signal is turned ON (shorted), the robot will immediately stop the ongoing operation and start executing the next step.

![Figure 5-50 Input Conditions and Operation of Interrupt Skip](image)

Figure 5-50 Input Conditions and Operation of Interrupt Skip
5.5.4.11 Continue Start (Input)

(1) Function

Turning the program start signal ON when this continue start signal is ON will resume the current program being on halt.

(2) Terminal number

No. 6 of connector CN8.

(3) Input conditions and operation

This signal is executable only in external mode. If this signal is on, program numbers will be ignored at execution of Program start and the current program being on halt will be resumed. If Continue Start Permitted signal is not ON, the controller will issue ERROR27A8.
5.5.5 Example of Using System I/O Signals in Special Mode

This section describes an example of starting and stopping the robot using system I/O signals.

(1) Equipment example

In this example there is equipment which makes the robot perform operations by operating an external equipment operating panel connected to the Robot Controller through a PLC as shown in Figure 5-52 and equipped with a display, lamps and switches listed in Table 5-14.

Figure 5-52 Example of Equipment Using a Robot
Table 5-14 Example of Equipment Operating Panel Functions

<table>
<thead>
<tr>
<th>Classification</th>
<th>Part</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display</td>
<td>Display</td>
<td>Displays messages, such as ROBOT PREPARATION OK.</td>
</tr>
</tbody>
</table>
| Lamp           | ① Automatic operation indicator lamp | · Lights during automatic operation.  
· Not illuminated when the robot is not in automatic operation. |
| Lamp           | ② Robot external mode indicator lamp | · Lights when the robot is in external mode.  
· Turned OFF when the robot is not in external mode. |
| Lamp           | ③ Operation OK indicator lamp | · Lights when the Enable Auto signal is ON.  
· Turned OFF when the Enable Auto signal is OFF. |
| Switch         | ① Robot operation button | Starts the robot preparation. |
| Switch         | ② Automatic start button | Starts the operation of the equipment. |
| Switch         | ③ Cycle stop button | Stops the equipment after a cycle of operations is completed. |
| Switch         | ④ Operation/Adjustment selector switch | Automatic operation of the robot possible when OPERATION is selected.  
Manual operation or teach check of the robot possible when ADJUSTMENT is selected. |

Caution: Actual equipment requires emergency stop, interlock and other functions. However, described here are only necessary functions and others are omitted.

(2) Outline of procedure
Described below is the outline of the procedure when using the equipment, as shown in Figure 5-52.
Follow steps ① to ④.
① Operation preparation start
Setting the MOTOR POWER ON, CAL EXECUTION, SP100 and SWITCH EXT MODE bits, brings the robot into the External Auto mode. This operation will be completed when the EXTERNAL MODE output signal is turned ON.
② Automatic operation
Start the program by which the robot starts from the operation origin, performs operations, and returns to the operation origin.
③ Operation end
Terminate the day’s operations with a cycle stop, and turn OFF the power.

(3) Start and stop procedure and system I/O signals
Figures 5-53 and 5-54 show the relationship between the system I/O signals and the operations by the operator display on the equipment operating panel, processing by the PLC and the operation of the robot when starting and stopping the robot.
<table>
<thead>
<tr>
<th>Step</th>
<th>Operation by operator and display on equipment operating panel</th>
<th>PLC processing</th>
<th>Robot operation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Equipment power ON</td>
<td>Enable Auto ON</td>
<td>(Internal processing)</td>
</tr>
<tr>
<td></td>
<td>Setting operation/adjustment selector switch to operation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Operation OK indicator lamp ON</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Robot preparation button ON</td>
<td>System input for start-up ON</td>
<td>Motor power ON</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Operation Preparation Start ON</td>
<td>Executing CAL</td>
</tr>
<tr>
<td></td>
<td>Robot external mode indicator lamp ON</td>
<td>(Internal processing)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Motor power ON</td>
</tr>
<tr>
<td></td>
<td>Moving robot arm close to operation origin, when external mode indicator lamp is ON and operation position 1 indicator lamp is OFF.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Robot operation origin indicator lamp ON</td>
<td>(Internal processing)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Robot preparation OK display</td>
<td>(Internal processing)</td>
<td>Operation position 1 ON</td>
</tr>
</tbody>
</table>

(Note 0)

Figure 5-53 Start and Stop Procedure and System I/O Signals-1

(Continued on following page)
### Step Operation by operator and display on equipment operating panel

<table>
<thead>
<tr>
<th>Step</th>
<th>Operation by operator and display on equipment operating panel</th>
<th>PLC processing</th>
<th>Robot operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automatic operation</td>
<td>Equipment's Automatic Start</td>
<td>Program No. Select ON</td>
<td>Program start ON in the figure indicates a system I/O signal, and ← represents the flow of the signal.</td>
</tr>
<tr>
<td>Automatic Operation indicator lamp ON</td>
<td>Program start ON</td>
<td>Regular Operation Program is selected.</td>
<td></td>
</tr>
<tr>
<td>Operation end</td>
<td>Equipment's Cycle Stop button ON</td>
<td>Cycle Stop ON</td>
<td>Executing single-cycle</td>
</tr>
<tr>
<td>Operation end</td>
<td>Automatic operation indicator lamp OFF</td>
<td>(Internal processing)</td>
<td>Single-cycle End ON</td>
</tr>
<tr>
<td>Operation end</td>
<td>Equipment power OFF</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note**: The system inputs for startup here are four types of system inputs – "motor power ON," "CAL execution," "SP100" and "External Mode switching." Refer to Chapter 5 "5.5.4.2 Operation Preparation Start (Input)".

**Φ**: The figure indicates a system I/O signal, and ← represents the flow of the signal.

**Figure 5-54 Start and Stop Procedure and System I/O Signals-2**
5.6 I/O Circuits and Connectors (PNP type)

This section explains the I/O circuit of PNP type (sink input and source output). For the circuit of NPN type (source input and sink output), refer to Appendix 1.

5.6.1 I/O Signal Connector Pin Layout

This section describes the Robot Controller connector pin layouts for I/O signals. The definitions of the signals and pins of the output connector CN10 and input connector CN8 are different between the standard mode and the compatible mode.

As for the other connectors, the definitions of the pins are common to the standard mode and the compatible mode.

5.6.1.1 Connector Pin Layout Common to Both Modes

(1) HAND I/O CN9: Connector for end-effector I/O (common to both modes)

Table 5-15 CN9 Pin Layout (Common to both modes)

<table>
<thead>
<tr>
<th>Terminal No.</th>
<th>Name</th>
<th>Port number</th>
<th>Wire color</th>
<th>Terminal No.</th>
<th>Name</th>
<th>Port number</th>
<th>Wire color</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Standard</td>
<td></td>
<td></td>
<td></td>
<td>High strength</td>
</tr>
<tr>
<td>1</td>
<td>Hand output</td>
<td>64</td>
<td>Black</td>
<td>11</td>
<td>Hand Input</td>
<td>50</td>
<td>Pink</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Blue</td>
<td></td>
<td></td>
<td></td>
<td>White</td>
</tr>
<tr>
<td>2</td>
<td>Hand output</td>
<td>65</td>
<td>Brown</td>
<td>12</td>
<td>Hand Input</td>
<td>51</td>
<td>Pink</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Yellow</td>
<td></td>
<td></td>
<td></td>
<td>White</td>
</tr>
<tr>
<td>3</td>
<td>Hand output</td>
<td>66</td>
<td>Black</td>
<td>13</td>
<td>Hand Input</td>
<td>52</td>
<td>White</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Green</td>
<td></td>
<td></td>
<td></td>
<td>White</td>
</tr>
<tr>
<td>4</td>
<td>Hand output</td>
<td>67</td>
<td>Brown</td>
<td>14</td>
<td>Hand Input</td>
<td>53</td>
<td>White</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Red</td>
<td></td>
<td></td>
<td></td>
<td>White</td>
</tr>
<tr>
<td>5</td>
<td>Hand output</td>
<td>68</td>
<td>Red</td>
<td>15</td>
<td>Hand Input</td>
<td>54</td>
<td>White</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Violet</td>
<td></td>
<td></td>
<td></td>
<td>White</td>
</tr>
<tr>
<td>6</td>
<td>Hand output</td>
<td>69</td>
<td>Orange</td>
<td>16</td>
<td>Hand Input (interrupt input)</td>
<td>55</td>
<td>White</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Blue</td>
<td></td>
<td></td>
<td></td>
<td>High strength</td>
</tr>
<tr>
<td>7</td>
<td>Hand output</td>
<td>70</td>
<td>Yellow</td>
<td>17</td>
<td>Power E0V for Hand</td>
<td>—</td>
<td>White</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Yellow</td>
<td></td>
<td></td>
<td></td>
<td>High strength</td>
</tr>
<tr>
<td>8</td>
<td>Hand output</td>
<td>71</td>
<td>Green</td>
<td>18</td>
<td>Power E24V for Hand</td>
<td>—</td>
<td>White</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Green</td>
<td></td>
<td></td>
<td></td>
<td>High strength</td>
</tr>
<tr>
<td>9</td>
<td>Hand input</td>
<td>48</td>
<td>Blue</td>
<td>19</td>
<td>Not connected</td>
<td>—</td>
<td>White</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Red</td>
<td></td>
<td></td>
<td></td>
<td>High strength</td>
</tr>
<tr>
<td>10</td>
<td>Hand input</td>
<td>49</td>
<td>Violet</td>
<td>20</td>
<td>Not connected</td>
<td>—</td>
<td>White</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Violet</td>
<td></td>
<td></td>
<td></td>
<td>High strength</td>
</tr>
</tbody>
</table>
Table 5-16 CN7 Pin Layout (Common to both modes)

<table>
<thead>
<tr>
<th>Terminal No.</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Internal power source output +24V</td>
</tr>
<tr>
<td>2</td>
<td>Internal power source output +24V</td>
</tr>
<tr>
<td>3</td>
<td>Internal power source output 0V</td>
</tr>
<tr>
<td>4</td>
<td>Internal power source output 0V</td>
</tr>
<tr>
<td>5</td>
<td>FG</td>
</tr>
<tr>
<td>6</td>
<td>Power input E0V</td>
</tr>
<tr>
<td>7</td>
<td>Power input E0V</td>
</tr>
<tr>
<td>8</td>
<td>Power input E24V</td>
</tr>
<tr>
<td>9</td>
<td>Power input E24V</td>
</tr>
</tbody>
</table>

Caution: When using the internal power source, keep the total current capacity below 1.3 A. To use the internal power source of the Robot Controller, connect the wiring so that the internal power source will be separate from the external power source. Improper wiring may damage the internal circuit.
5.6.1.2 Connector Pin Layout for Standard Mode

(1) OUTPUT/E.STOP CN10: User-/System-output emergency Stop connector (standard mode)

Table 5-17 CN10 Pin Layout (Standard mode)

<table>
<thead>
<tr>
<th>Terminal number</th>
<th>Name</th>
<th>Port number</th>
<th>Wire color</th>
<th>Terminal number</th>
<th>Name</th>
<th>Port number</th>
<th>Wire color</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Normal CPU</td>
<td>72</td>
<td>Black</td>
<td>35</td>
<td>User output</td>
<td>106</td>
<td>Pink</td>
</tr>
<tr>
<td>2</td>
<td>Robot in operation</td>
<td>73</td>
<td>Brown</td>
<td>36</td>
<td>User output</td>
<td>107</td>
<td>Pink</td>
</tr>
<tr>
<td>3</td>
<td>Robot Error</td>
<td>74</td>
<td>Red</td>
<td>37</td>
<td>User output</td>
<td>108</td>
<td>Pink</td>
</tr>
<tr>
<td>4</td>
<td>Servo ON</td>
<td>75</td>
<td>Orange</td>
<td>38</td>
<td>User output</td>
<td>109</td>
<td>Pink</td>
</tr>
<tr>
<td>5</td>
<td>Robot initialization complete</td>
<td>76</td>
<td>Yellow</td>
<td>39</td>
<td>User output</td>
<td>110</td>
<td>Pink</td>
</tr>
<tr>
<td>6</td>
<td>Auto mode</td>
<td>77</td>
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### Table 5-18 CN8 Pin Layout (Standard mode)

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<th>Port number</th>
<th>Wire color</th>
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Terminal number 1 and 2 can’t be used.
### Connector Pin Layout for Special Mode

#### (1) OUTPUT/E.STOP CN10: User-/System-output emergency Stop connector (special mode)

#### Table 5-19 CN10 Pin Layout (Special mode)

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<th>Terminal number</th>
<th>Name</th>
<th>Port number</th>
<th>Wire color</th>
<th>Terminal number</th>
<th>Name</th>
<th>Port number</th>
<th>Wire color</th>
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### Table 5-20 CN8 Pin Layout (Special mode)

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<th>Name</th>
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<td>-</td>
<td>Black</td>
<td>26</td>
<td>User input</td>
<td>21</td>
<td>Pink</td>
</tr>
<tr>
<td>2</td>
<td>Not use</td>
<td>-</td>
<td>Brown</td>
<td>27</td>
<td>User input</td>
<td>22</td>
<td>Pink</td>
</tr>
<tr>
<td>3</td>
<td>Power for Enable Auto (internal +24V)</td>
<td>-</td>
<td>Red</td>
<td>28</td>
<td>User input</td>
<td>23</td>
<td>Pink</td>
</tr>
<tr>
<td>4</td>
<td>Enable Auto</td>
<td>-</td>
<td>Black</td>
<td>29</td>
<td>User input</td>
<td>24</td>
<td>White</td>
</tr>
<tr>
<td>5</td>
<td>Step-stop (all tasks)</td>
<td>0</td>
<td>Brown</td>
<td>30</td>
<td>User input</td>
<td>25</td>
<td>White</td>
</tr>
<tr>
<td>6</td>
<td>Continue start</td>
<td>1</td>
<td>Red</td>
<td>31</td>
<td>User input</td>
<td>26</td>
<td>White</td>
</tr>
<tr>
<td>7</td>
<td>Instantaneous stop (all tasks)</td>
<td>2</td>
<td>Orange</td>
<td>32</td>
<td>User input</td>
<td>27</td>
<td>White</td>
</tr>
<tr>
<td>8</td>
<td>Operation preparation start</td>
<td>3</td>
<td>Yellow</td>
<td>33</td>
<td>User input</td>
<td>28</td>
<td>White</td>
</tr>
<tr>
<td>9</td>
<td>Interrupt skip</td>
<td>4</td>
<td>Green</td>
<td>34</td>
<td>User input</td>
<td>29</td>
<td>White</td>
</tr>
<tr>
<td>10</td>
<td>Program start</td>
<td>5</td>
<td>Blue</td>
<td>35</td>
<td>User input</td>
<td>30</td>
<td>White</td>
</tr>
<tr>
<td>11</td>
<td>Program No. select bit 0</td>
<td>6</td>
<td>Violet</td>
<td>36</td>
<td>User input</td>
<td>31</td>
<td>White</td>
</tr>
<tr>
<td>12</td>
<td>Program No. select bit 1</td>
<td>7</td>
<td>Black</td>
<td>37</td>
<td>User input</td>
<td>32</td>
<td>Gray</td>
</tr>
<tr>
<td>13</td>
<td>Program No. select bit 2</td>
<td>8</td>
<td>Brown</td>
<td>38</td>
<td>User input</td>
<td>33</td>
<td>Gray</td>
</tr>
<tr>
<td>14</td>
<td>Program No. select bit 3</td>
<td>9</td>
<td>Red</td>
<td>39</td>
<td>User input</td>
<td>34</td>
<td>Gray</td>
</tr>
<tr>
<td>15</td>
<td>Program No. select bit 4</td>
<td>10</td>
<td>Orange</td>
<td>40</td>
<td>User input</td>
<td>35</td>
<td>Gray</td>
</tr>
<tr>
<td>16</td>
<td>Program No. select bit 5</td>
<td>11</td>
<td>Yellow</td>
<td>41</td>
<td>User input</td>
<td>36</td>
<td>Gray</td>
</tr>
<tr>
<td>17</td>
<td>Program No. select bit 6</td>
<td>12</td>
<td>Green</td>
<td>42</td>
<td>User input</td>
<td>37</td>
<td>Gray</td>
</tr>
<tr>
<td>18</td>
<td>Program No. select odd parity bit</td>
<td>13</td>
<td>Blue</td>
<td>43</td>
<td>User input</td>
<td>38</td>
<td>Gray</td>
</tr>
<tr>
<td>19</td>
<td>Motor power ON</td>
<td>14</td>
<td>Violet</td>
<td>44</td>
<td>User input</td>
<td>39</td>
<td>Gray</td>
</tr>
<tr>
<td>20</td>
<td>CAL execution</td>
<td>15</td>
<td>White</td>
<td>45</td>
<td>User input</td>
<td>40</td>
<td>Gray</td>
</tr>
<tr>
<td>21</td>
<td>Reserved</td>
<td>16</td>
<td>Pink</td>
<td>46</td>
<td>User input</td>
<td>41</td>
<td>Gray</td>
</tr>
<tr>
<td>22</td>
<td>SP100</td>
<td>17</td>
<td>Black</td>
<td>47</td>
<td>User input</td>
<td>42</td>
<td>Violet</td>
</tr>
<tr>
<td>23</td>
<td>Switch Ext Mode</td>
<td>18</td>
<td>Brown</td>
<td>48</td>
<td>User input</td>
<td>43</td>
<td>Violet</td>
</tr>
<tr>
<td>24</td>
<td>Program reset</td>
<td>19</td>
<td>Red</td>
<td>49</td>
<td>User input</td>
<td>44</td>
<td>Violet</td>
</tr>
<tr>
<td>25</td>
<td>Robot error clear</td>
<td>20</td>
<td>Orange</td>
<td>50</td>
<td>User input</td>
<td>45</td>
<td>Violet</td>
</tr>
</tbody>
</table>

Terminal number 1 and 2 can't be used.
5.6.2 Robot Controller I/O Circuits

5.6.2.1 User-Input, System-Input and Hand-Input Circuits

Figures 5-55 and 5-56 show examples of the user-input, system-input and hand-input circuit configurations and connections of the robot controller. The maximum allowable current capacity of the robot controller's internal power source is 1.3 A. Use the internal power source within this allowable range.

Caution

☑: Either an external power supply type or built-in power type Output card is available for the PLC. However, an external power supply type requires an additional power source (24V) to be installed. The power capacity is 15W or more.

☑: When controlling two or more robots with a single PLC using the internal power source of the Robot Controller, set a PLC Output card for each robot.

☑: Other than a PLC, a proximity switch, or a relay contact may be connected directly to the input terminal of the Robot Controller. In such a case, use the power input to pins 6 to 9 of the I/O power connector. A two-wire photoelectric switch or proximity switch can be connected if its leakage current is 1 mA or less.

Chapter 5 Robot Controller Interface

Figure 5-55 User-Input, System-Input and Hand-Input Circuits
(When the internal power source is used)

Figure 5-56 User-Input, System-Input and Hand-Input Circuits
(When an external power source is used)
5.6.2.2 Robot Stop Input and Enable Auto Input Circuits

The robot stop signal and the Enable Auto signal are important for safety. The input circuit for these signals must have contacts as shown in Figure 5-57. Use the INPUT CN8 (pins 1 and 3) of the robot controller for the power source, irrespective of whether the power source to be used for other I/O signals is the internal power source or an external power source.

![Robot Stop Input and Enable Auto Input Circuit](image)

Figure 5-57 Robot Stop Input and Enable Auto Input Circuit
5.6.2.3 User-Output, System-Output, and Hand-Output Circuits

Figures 5-58 and 5-59 show an example of the configuration and connection of the Robot Controller’s user-input output, system-output and hand-output circuit. Since the initial resistance of a lamp is small, the output circuit may be damaged by rush current that flows when the lamp lights.

When directly turning a lamp ON or OFF, use a lamp whose rating is 0.5W or less.

To reduce rush current, connect a resistor R that allows dark current 1/3 or less of the rated current to flow when the lamp goes OFF.

Figure 5-60 shows an example of connecting a lamp.

1. The User-Output, System-Output and Hand-Output Circuit are open collector output circuits.

2. The maximum allowable intake current is 70mA. Keep the current consumption of a device to be connected to the Robot Controller, such as a PLC and a relay coil, below the allowable current.

3. Select an induction load, such as a relay coil, which has a built-in diode (for absorbing inverse electromotive force).
   To use an induction load without a built-in diode, add a diode equivalent to the 1S1888 (Toshiba) in close vicinity to the coil.

   Caution: When externally attaching a diode, connect it with correct polarity. Incorrect polarity may damage the Output circuit.

4. Connecting a lamp requires a circuit through which dark current flows.

   Caution: Since the initial resistance of a lamp is small, the output circuit may be damaged by rush current that flows when the lamp lights. Refer to Figure 5-60.

5. When using the internal power source, prepare a PLC input circuit unit that does not contain a power source.

   Caution: Keep the total current capacity of the internal power source below 1.3A.


7. 24V internal power source of the robot controller must not be grounded.

   Caution: If the output terminal +24V of internal power source is grounded, there may be a case where the controller is damaged.
Figure 5-58  User-Output, System-Output and Hand-Output Circuit
(When the internal power source is used)

Figure 5-59  User-Output, System-Output and Hand-Output Circuit
(When an external power source is used)
Lamp

Transistor array

Controller

Supplied from the I/O power connector when the internal power source is used

Figure 5-60 Example of Circuit with Lamp
5.6.2.4 Emergency Stop Output Circuit

Figures 5-61 and 5-62 show the examples of configuration and connection of emergency stop circuit for the robot controller.

The red mushroom-shaped switch provided on the robot controller front panel, on the teach pendant, or on the operating panel can be used as a switch for stopping the equipment in case of emergency.

Figure 5-61   Emergency Stop Output Circuit (Activated by Internal Power Source)

Figure 5-62   Emergency Stop Output Circuit (Activated by External Power Source)
5.6.2.5 I/O Power Connector

For the power source to communicate signals between the robot controller and the external device, the internal power source of the robot controller or an external power source is used.

Figure 5-63 shows an example of connecting I/O power connectors when the internal power source is used, and Figure 5-64 shows an example of connecting I/O power connectors when an external power source is used.

![Diagram of I/O Power Connectors]

**Caution:** To use the internal power source of the robot controller, connect the wiring so that the internal power source will be separate from the external power source. Improper wiring may damage the internal circuit. +24V internal power source of the robot controller must not be grounded.
Figure 5-64  Example of Connecting I/O Power Connectors (When an external power source is used)

Caution: Use a cable of 0.5 mm\(^2\) or more in size for the wiring between the external power source and the I/O power input connectors of the robot controller.
5.6.3 Precautions When Wiring the Robot Controller I/O Connectors

After the wiring of the I/O connectors of the Robot Controller is completed, check the following before turning ON the power:

(1) Using a tester, check across the "+24V terminal" and "0V terminal" of each connector and across the "E24V terminal" and the "E0V terminal" to see that there is no continuity. See Figure 5-65.

⚠️ Caution: If the connector wiring between the Robot Controller’s "+24V terminal" and "0V terminal" and between the "E24V terminal" and the "E0V terminal" is shorted, damage to the power circuit of the Robot Controller will result.

(2) Using a tester, check across "each signal Output terminal" and "+24V terminal" or "E24V terminal" of each connector to see that there is no continuity. See Figure 5-65.

⚠️ Caution: If the wiring between "each signal Output terminal" and "+24V terminal" or "E24V terminal" of each connector is shorted, damage to the Output circuit and power circuit of the Robot Controller will result.

⚠️ Caution: Wind adhesive vinyl tape around all ends of the unconnected wiring of each connector to prevent them from contacting other wiring and parts, which results in shorting.
### Table 5-21 Connector Terminals Requiring Checking

**Connector for hand I/O**

![Diagram of Connector for hand I/O](image)

<table>
<thead>
<tr>
<th>Terminal Number</th>
<th>Name</th>
<th>Meaning</th>
<th>Check point</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 8</td>
<td>Hand output terminal</td>
<td>24V at output</td>
<td>(2)</td>
</tr>
<tr>
<td>17</td>
<td>Power terminal for hand (E0V)</td>
<td>Power (GND) output</td>
<td>(1)</td>
</tr>
<tr>
<td>18</td>
<td>Power terminal for hand (E24V)</td>
<td>24V power output</td>
<td>(1)</td>
</tr>
</tbody>
</table>

**Connector for user/system output and emergency stop**

![Diagram of Connector for user/system output and emergency stop](image)

<table>
<thead>
<tr>
<th>Terminal number</th>
<th>Name</th>
<th>Meaning</th>
<th>Check point</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 56</td>
<td>Signal output terminal</td>
<td>24V at output</td>
<td>(2)</td>
</tr>
</tbody>
</table>

**Connector for user/system input**

![Diagram of Connector for user/system input](image)

<table>
<thead>
<tr>
<th>Terminal Number</th>
<th>Name</th>
<th>Meaning</th>
<th>Check point</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 3</td>
<td>+24V internal power source terminal</td>
<td>+24V internal power source output</td>
<td>(1)</td>
</tr>
</tbody>
</table>

**Connector for I/O power source**

![Diagram of Connector for I/O power source](image)

<table>
<thead>
<tr>
<th>Terminal number</th>
<th>Name</th>
<th>Meaning</th>
<th>Check point</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 2</td>
<td>+24V internal power source terminal</td>
<td>+24V internal power source output</td>
<td>(1)</td>
</tr>
<tr>
<td>3, 4</td>
<td>0V internal power source terminal</td>
<td>0V internal power source output</td>
<td>(1)</td>
</tr>
<tr>
<td>6, 7</td>
<td>E0V (GND) input terminal</td>
<td>Power (GND) input</td>
<td>(1)</td>
</tr>
<tr>
<td>8, 9</td>
<td>E24V input terminal</td>
<td>24V power input</td>
<td>(1)</td>
</tr>
</tbody>
</table>
5.7 I/O Wiring

5.7.1 Multi-core Cables with Connectors

Use the recommended connectors and cables listed in Table 5-22.

Table 5-22 Standard of Recommended Connectors and Cables for I/O Cables

<table>
<thead>
<tr>
<th>Connector name</th>
<th>Connector model/manufacturer</th>
<th>Standard Cable</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUTPUT</td>
<td>PCR-E68FS connector PCS-E68LA cover Honda Communications Industry Co., Ltd.</td>
<td>UL2789 - With shield Equivalent to AWG28-68P</td>
<td>Caution: Set the shielding wire at the end of the prepared cable, as shown in Figure 5-63. Without this preparation, a noise malfunction may result.</td>
</tr>
<tr>
<td>HAND I/O</td>
<td>PCR-E20FS connector PCS-E20LA cover Honda Communications Industry Co., Ltd.</td>
<td>UL2789 - With shield Equivalent to AWG28-20P</td>
<td></td>
</tr>
<tr>
<td>INPUT</td>
<td>PCR-E50FS connector PCS-E50LA cover Honda Communications Industry Co., Ltd.</td>
<td>UL2789 - With shield Equivalent to AWG28-50P</td>
<td></td>
</tr>
<tr>
<td>I/O POWER</td>
<td>DE-9P connector DE-C4-J6 cover Japan Aviation Electronics Industry, Ltd.</td>
<td>UL2405 - With shield Equivalent to AWG20-2P</td>
<td></td>
</tr>
</tbody>
</table>

![Figure 5-63 Example of Preparing Shielding Wire](image-url)

The connector shell must be a conductive metal body.

Fasten to the connector

Vinyl tube

The crimping terminal is Fastened to the connector.
5.7.2 Wiring

Observe the following precautions when wiring the I/Os of the robot controller:

1. Connect the robot power cable to a power source separate from the welder power source.

2. Ground the grounding wire (green) of the robot power cable.

3. Ground the grounding terminal of the robot controller using a wire of 1.25 mm² or more in size.

4. For the robot power supply, use a grounding wire with grounding resistance of 100 Ω or less.

5. If the supply power source for the robot controller requires a leakage breaker, use a high frequency-proof leakage breaker for inverters.

6. Prepare wires of an appropriate capacity for the 200 VAC main line and other cables according to Tables 5-23.

### Table 5-23 Robot Controller Specifications

<table>
<thead>
<tr>
<th>Power voltage: 3-phase, 200 VAC -15% to 230 VAC + 10%, 50/60 Hz</th>
<th>Pin assignment on connector (CN11), 3-phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: 200 VAC, phase R</td>
<td>D: Ground</td>
</tr>
<tr>
<td>B: 200 VAC, phase S</td>
<td></td>
</tr>
<tr>
<td>C: 200 VAC, phase T</td>
<td></td>
</tr>
<tr>
<td>(View from pin face)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Power voltage: Single-phase, 200 VAC -10% to 230 VAC + 10%, 50/60 H (Available only for MOTOMAN-UPJ3)</th>
<th>Pin assignment on connector (CN11), single-phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: 200 VAC, phase R</td>
<td>D: Ground</td>
</tr>
<tr>
<td>B: 200 VAC, phase S</td>
<td></td>
</tr>
<tr>
<td>C: Not used.</td>
<td></td>
</tr>
<tr>
<td>(View from pin face)</td>
<td></td>
</tr>
</tbody>
</table>

Max. rush current when the power is turned ON: 50 A (for 1/50 or 1/60 second)

Caution: If ERROR6102 (power voltage drop) occurs when the robot is in operation, it may be attributable to an insufficient capacity of the primary side power source.

7. Do not bundle the teach pendant cables, I/O cables or motor cables together with high power lines such as 200 VAC lines and peripheral device cables, or route the motor cables near high power devices (motor, welder, parts feeder, etc.).

8. Do not route any additional cables or air tubes of end-effectors through the robot unit. Doing so will result in broken cables or tubes.
This chapter describes the regular maintenance and inspections necessary for maintaining the performance and functions of the robot.
Chapter 6  Maintenance and Inspection

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### 6.1 Maintenance & Inspection Intervals and Purposes

Table 6-1 lists the intervals and purposes of maintenance & inspection required for your robot.

> **Caution:** Before performing maintenance and inspection jobs, read the SAFETY PRECAUTIONS, "3 Precautions while robot is running" and "4 Daily and periodical inspections."

<table>
<thead>
<tr>
<th>No.</th>
<th>Intervals</th>
<th>Purposes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Daily</td>
<td>Perform inspection jobs specified in Section 6.2 every day before starting operations. To use your robot safely.</td>
</tr>
<tr>
<td>2</td>
<td>Quarterly</td>
<td>Perform inspection jobs specified in Section 6.3 every three months. To maintain the precision of the robot and to prevent failures caused by overheat of the robot controller.</td>
</tr>
<tr>
<td>3</td>
<td>Biennial</td>
<td>Replace backup batteries as specified in Section 6.5 every two years. To retain the robot-specific data (programs, parameters, etc.) stored in the internal memory of the robot controller and the position data stored in the electronic absolute encoder built in the robot unit.</td>
</tr>
</tbody>
</table>
# 6.2 Daily Inspections

## 6.2.1 Check Items

Before starting operations, check the items listed in Table 6-2 every day.

<table>
<thead>
<tr>
<th>No.</th>
<th>Check:</th>
<th>Controller Power</th>
<th>How to check:</th>
<th>Criterion</th>
<th>What to do: (Note 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Connectors (CN1 to CN12 on the robot controller) and their mating parts</td>
<td>OFF</td>
<td>Visually</td>
<td>No looseness, disengagement or dirt.</td>
<td>Engage the parts properly and clean them.</td>
</tr>
<tr>
<td>2</td>
<td>Cables (connected to CN1 to CN12 on the robot controller) and robot's external cables</td>
<td>OFF</td>
<td>Visually</td>
<td>Free of damage or gouges.</td>
<td>Repair or replace.</td>
</tr>
<tr>
<td>3</td>
<td>LCD on the teach pendant</td>
<td>ON</td>
<td>Visually</td>
<td>Properly displayed</td>
<td>Repair or replace.</td>
</tr>
<tr>
<td>4</td>
<td>Pilot lamps on the robot controller</td>
<td>ON</td>
<td>Visually</td>
<td>Should light.</td>
<td>Repair or replace.</td>
</tr>
<tr>
<td>5</td>
<td>Cooling fan in the robot controller</td>
<td>ON</td>
<td>Visually</td>
<td>Should work properly.</td>
<td>Repair or replace.</td>
</tr>
<tr>
<td>6</td>
<td>Calibration</td>
<td>ON</td>
<td>Visually</td>
<td>No error or unusual noise.</td>
<td>Repair or replace.</td>
</tr>
<tr>
<td>7</td>
<td>ROBOT STOP button on the operating panel or the teach pendant</td>
<td>ON</td>
<td>Press the ROBOT STOP button.</td>
<td>The robot should come to an emergency stop.</td>
<td>Repair or replace.</td>
</tr>
<tr>
<td>8</td>
<td>Safety door</td>
<td>ON</td>
<td>Operate the safety door switch and open the switch-wiring door.</td>
<td>The robot should come to an emergency stop.</td>
<td>Repair or replace.</td>
</tr>
</tbody>
</table>

**Note 1** Some repair and replacement operations, shown in "What to do:" column, may involve special work. Contact the YASKAWA Service Section.

**Note 2** The normal operation of the cooling fan is as shown in Figure 6-1.
Figure 6-1 Normal Operation of Cooling Fan
6.3 Quarterly Inspections

6.3.1 Check Items

Check the items listed in Table 6-3 every three months.

<table>
<thead>
<tr>
<th>No.</th>
<th>Check:</th>
<th>Controller Power</th>
<th>How to check:</th>
<th>Criterion</th>
<th>What to do:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cooling fan filters in the robot controller</td>
<td>OFF</td>
<td>Visually</td>
<td>No dust or dirt.</td>
<td>Clean the cooling fan filters. (Refer to Subsect. 6.3.2.)</td>
</tr>
</tbody>
</table>
6.3.2 Cleaning the Cooling Fan Filters in the Robot Controller

The robot controller has two cooling fan filters—innlet port filter and exhaust port filter.

If either of the filters is clogged, the robot controller becomes badly ventilated to overheat so that the internal electronic devices may fail due to heat.

If a power module error appears, it may be caused by clogged filters, so clean those filters.

### STEP 1

Turn the POWER switch of the Robot Controller OFF.

### STEP 2

Remove the screws with your fingers to release the inlet port filter.
STEP 3
Remove the support frame of the inlet port filter.

STEP 4
Remove the filter element from the support frame.
STEP 5
Remove the screws with your fingers to release the exhaust port filter.

STEP 6
Remove the support frame of the exhaust port filter.

STEP 7
Remove the filter element from the support frame.
STEP 8

Blow compressed air to the filter elements in the direction opposite to the regular air flow.

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

If the filters are excessively dirty, wash them with water or warm water (40°C or lower). A neutral detergent is most effective.

Notes
(1) Dry the washed filters completely before replacing them.
(2) If the filters are still dirty after air blowing or washing, replace them with new ones.

STEP 9

Reinstall the filters in the reverse order of removal.
6.4 Biennial Inspections

6.4.1 Battery Replacement and Check Items

Replace the two types of backup batteries listed in Table 6-4 during biennial inspections and maintenance.

<table>
<thead>
<tr>
<th>Battery type</th>
<th>Used to:</th>
<th>Located:</th>
<th>Refer to:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory backup battery</td>
<td>Back up programs, parameters, and CAL data.</td>
<td>In the robot controller</td>
<td>Subsect. 6.4.2</td>
</tr>
</tbody>
</table>

Programs, parameters, CAL data, etc. are stored in the internal memory of the robot controller.

The backup battery for each memory retains the above data while the power to the robot controller is turned OFF. However, these batteries have a limited lifetime and must, therefore, be replaced regularly.

**NOTE:** If two years elapse from replacement of either backup battery, the "Time to change controller backup battery" message will appear on the teach pendant.

⚠️ **Caution:** Without replacing the backup batteries, important robot-specific data stored in each memory will be lost.
6.4.2 Replacing the Memory Backup Battery

This section gives an example of replacing the memory backup battery using a floppy disk.

Caution: Before replacing the memory backup battery, save (write) the Robot Controller memory data onto a floppy disk. The built-in floppy disk drive is an option.

STEP 1

Save (write) the controller memory data onto a floppy disk.

For the procedure on saving the memory data, see the SETTING-UP MANUAL, Section 5.7 "Displaying the FDD Access Menu, [F6 Set]-[F3 FD.]-[F2 Write]."

STEP 2

Prepare a new memory backup battery.

STEP 3

Turn the controller power ON, wait at least one minute, and turn it to OFF again.
STEP 4
Remove the screw to release the backup battery support.

STEP 5
Pull out the backup battery support.
STEP 6
Disconnect the backup battery connector.

Caution: Complete the operations in Steps 6 and 7 within three minutes. If the battery is disconnected for over three minutes, the memory data will be lost.

STEP 7
Connect the new memory backup battery prepared in Step 2, to the robot controller.
**STEP 8**

Push the backup battery support into the robot controller.

**Caution:** Take care not to pinch the battery lead wires between covers or internal parts. Shorting may occur, resulting in an unexpected failure.

**STEP 9**

Secure the backup battery support with a screwdriver.
6.4.3 Setting the Next Battery Replacement Date

After replacing the memory backup battery, set the next battery replacement date from the teach pendant, according to the following procedure.

**NOTE:** This procedure cannot be performed with the operating panel.

**NOTE:** Check that the system clock of the robot controller shows the correct date beforehand. If it is incorrect, the next replacement date will also become incorrect.

1. **STEP 1**
   - On the top screen of the teach pendant, press [F6 Set].
   - The Settings (Main) window appears.

2. **STEP 2**
   - Press [F6 Maint.] in the Settings (Main) window.
   - The Maintenance menu appears.

3. **STEP 3**
   - Press [F4 Battery] in the Maintenance menu.
   - The Next Battery Replacement Date window appears.
   - In the top of the window, the current setting is displayed.
   - The date entry areas show the default replacement date that is two years later the current data at which you open this window, assuming that the battery service life is two years.

4. **STEP 4**
   - Press OK.
   - **NOTE:** If you do not want to change the replacement date, press Cancel.
   - The message "Are you sure you want to set the next battery replacement date?" appears.

5. **STEP 5**
   - Press OK.
   - The screen returns to the Settings (Main) window.
6.5 Supplies

Tables 6-5 lists the supplies to be replaced regularly and required tools, out of components used in robots.

6.5.1 Supplies

<table>
<thead>
<tr>
<th>No</th>
<th>Name</th>
<th>Part No.</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Filter (left)</td>
<td>410041-0760</td>
<td>Cooling fan filter (inlet port filter) in the robot controller</td>
</tr>
<tr>
<td>2</td>
<td>Filter (right)</td>
<td>410041-1220</td>
<td>Cooling fan filter (exhaust port filter) in the robot controller</td>
</tr>
<tr>
<td>3</td>
<td>Memory backup unit</td>
<td>410076-0090</td>
<td>Memory backup battery for controller (with metal plate)</td>
</tr>
<tr>
<td>4</td>
<td>Fuse (1.3A)</td>
<td>410054-0230</td>
<td>Fuse LM13 (1.3A) for controller I/O</td>
</tr>
<tr>
<td>5</td>
<td>Fuse (0.3A)</td>
<td>410054-0240</td>
<td>Fuse LM03 (0.3A) for controller I/O</td>
</tr>
<tr>
<td>6</td>
<td>IC for output (NPN)</td>
<td>410077-0010</td>
<td>IC (M54522P) for controller output</td>
</tr>
<tr>
<td>7</td>
<td>IC for output (PNP)</td>
<td>410077-0020</td>
<td>IC (M54564P) for controller output</td>
</tr>
</tbody>
</table>
6.6 Replacing Fuses

The robot controller is equipped with fuses to protect it from external wiring shorted.

If any fuse is blown, replace it according to the following procedure:

The fuse box containing fuses is mounted on the panel of the robot controller. See Figure 6-2.

Figure 6-2 Locations and Names of Fuses
Table 6-6 lists connectors corresponding to the fuses. If an output signal error occurs, check the corresponding fuse.

### Table 6-6 Output Connectors and Fuses

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</table>

Note: For the connector pin layout, refer to Chapter 5, Subsection 5.6.1 "I/O Signal Connector Pin Layout".
6.6.1 Replacing Fuses

Replace fuses according to the following procedure:

- **STEP 1**
  Turn the controller power OFF.

- **STEP 2**
  Remove the fuse cover mounting screw with a screwdriver.
STEP 3
Remove the fuse cover.

STEP 4
Pull out the fuse to be checked.
STEP 5

Using a circuit tester, check the removed fuse for continuity.

STEP 6

If no continuity is observed with the fuse in Step 5:
(1) Check the wiring of the corresponding output connector and remove the cause of the blown fuse.
(2) Insert a new fuse into place in the fuse box.

If continuity is observed with the fuse in Step 5, set the removed fuse back into place in the fuse box.
STEP 7
Set the fuse cover to the robot controller.

STEP 8
Replace the fuse cover mounting screw with a screwdriver.
Tightening torque: 0.6 ±0.2 Nm.
6.7 Replacing the Output ICs

If an output signal error persists even after replacement of the output fuse, the related output IC needs to be replaced.

Output ICs are located in the panel of the robot controller as shown below.

Table 6-7 lists output signals and related IC numbers and fuses.
### Table 6-7  Output ICs and Fuses

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<td></td>
<td>30</td>
<td>93</td>
<td>IC 5</td>
<td>F6 (1.3A)</td>
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<td>94</td>
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<td>38</td>
<td>101</td>
<td>IC 7</td>
<td>F7 (1.3A)</td>
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<td>125</td>
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<td>126</td>
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<td></td>
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<tr>
<td></td>
<td>58</td>
<td>127</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6.7.1 Replacing an Output IC

Replace an output IC according to the procedure given below:

- **STEP 1**
  Turn the controller power OFF.

- **STEP 2**
  Remove the two screws to release the output IC cover with a screwdriver.
STEP 3
Remove the output IC cover.

STEP 4
Check the ICs marked with "IC1" to "IC8" on the PC board, and remove the defective output IC with an IC pull-out jig and replace the IC.

Caution
1. If any output IC is damaged, remove the cause of damage, and replace it with a new output IC.
2. Do not directly touch the elements and their terminals on each PC board.
STEP 5
Install the output IC cover to the robot controller.

STEP 6
Secure the output IC cover with two mounting screws.
Tightening torque: 0.6 ±0.2 Nm.
6.8 Checking the Odometer and Trip Meter

You may check the odometer and trip meter which count traversed distance of each axis in the Odometer window of the teach pendant. With the trip meter, you may learn when oil change should be made.

The access to the Odometer window is [F6 Set]—[F6 Maint.]—[F5 Odometer].

The Odometer window shows the following items:

- [Odometer] Shows the total distance of each axis traversed after the robot leaves the factory. You cannot reset the odometer.
- [Trip meter] Shows the distance of each axis traversed after you reset the trip meter to zero.
- [Interval] Shows the oil change intervals specified for each axis, as a guide.

6.8.1 Displaying the Odometer, Trip Meter, and Oil Change Intervals

- **STEP 1**
  Turn the controller power ON.

- **STEP 2**
  On the teach pendant, set the mode switch to the MANUAL position.

- **STEP 3**
  On the top screen, press [F6 Set]. The Settings (Main) window appears as shown below.

  ![Settings (Main) window]

  Press [F6 Maint.].
STEP 4

The Maintenance menu appears as shown below.

Press [F5 Odometer].

STEP 5

The Odometer window appears as shown below.

In the above Odometer window, the J1 through J6 are expressed in rpm. If the Trip meter count exceeds the Interval value, the oil change prompt message will appear.
6.8.2 Resetting the Trip Meter to Zero

STEP 1

On the top screen, press [F6 Set].
The Settings (Main) window appears as shown below.

Press [F6 Maint.].

STEP 2

The Maintenance menu appears as shown below.

Press [F5 Odometer].
STEP 3
The Odometer window appears as shown below.

Press [F6 Reset].

STEP 4
The following message appears.

Press the OK button.
The trip meter has been reset to zero.
6.9 Checking the Controller ON-Time and the Robot Running Time and Resetting Their User Counters

You may check the robot controller ON-time and the robot running time in the Total hours window of the teach pendant.

The Total hours window shows the following items:

- [Total operation]: Shows the grand total of the robot controller ON-time counted after the controller leaves the factory.
- [Total running]: Shows the grand total of the robot running time counted after the robot leaves the factory.
- [Cumu. operation]: Shows the total of the robot controller ON-time counted after you reset the user counter to zero.
- [Cumu. running]: Shows the total of the robot running time counted after you reset the user counter to zero.
- [Operation]: Shows the ON-time of the robot controller counted after it is turned ON this time.
- [Running]: Shows the running time of the robot counted after the robot controller is turned ON this time.

6.9.1 Displaying the Controller ON-time and the Robot Running Time

» STEP 1  
Turn the robot controller power ON.

» STEP 2  
On the teach pendant, set the mode switch to the MANUAL position.

» STEP 3  
On the top screen, press [F6 Set].

The Settings (Main) window appears as shown below.

Press [F6 Maint.].
STEP 4

The Maintenance menu appears as shown below.

Press [F1 Total h].

STEP 5

The Total hours window appears as shown below.
6.9.2 Resetting the User Counters of the Controller ON-Time and the Robot Running Time

STEP 1

On the teach pendant, press [F6 Set]. The Settings (Main) window appears as shown below.

![Settings (Main) window](image)

Press [F6 Maint.].

STEP 2

The Maintenance menu appears as shown below.

![Maintenance menu](image)

Press [F1 Total h].
STEP 3

The Total hours window appears as shown below.

To reset the user counter of the controller ON-time to zero, press [F4 Cumu. o].

STEP 4

The following system message appears.

Press the OK button.
The user counter of the controller ON-time has been reset to zero.
Appendix
Appendix

Appendix 1  I/O Circuits and Connectors (NPN type) ......................................................... Appendix-1
  1.1 I/O Signal Connector Pin Layout .................................................................................. Appendix-1
      1.1.1 Connector Pin Layout Common to Both Modes ................................................ Appendix-1
      1.1.2 Connector Pin Layout for Standard Mode ............................................................ Appendix-3
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  1.2 Robot Controller I/O Circuits ....................................................................................... Appendix-6
      1.2.1 User-Input, System-Input and Hand-Input Circuits ............................................ Appendix-6
      1.2.2 Robot Stop Input and Enable Auto Input Circuits .............................................. Appendix-9
      1.2.3 User-Output, System-Output, and Hand-Output Circuits ................................... Appendix-10
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      1.2.5 I/O Power Connector .......................................................................................... Appendix-14
  1.3 Precautions When Wiring the Robot Controller I/O Connectors ................................ Appendix-16
Appendix 1 I/O Circuits and Connectors (NPN type)

This section explains the I/O circuit of NPN type (source input and sink output). For the circuit of PNP type (sink input and source output), refer to Chapter 5, Section 5.6, "I/O Circuits and Connectors (PNP type)."

1.1 I/O Signal Connector Pin Layout

This section describes the Robot Controller connector pin layouts for I/O signals. The definitions of the signals and pins of the output connector CN10 and input connector CN8 are different between the standard mode and the compatible mode.
As for the other connectors, the definitions of the pins are common to the standard mode and the compatible mode.

1.1.1 Connector Pin Layout Common to Both Modes

(1) HAND I/O CN9: Connector for end-effector I/O (common to both modes)

Table 1-1  CN9 Pin Layout (Common to both modes)

<table>
<thead>
<tr>
<th>Terminal No.</th>
<th>Name</th>
<th>Port number</th>
<th>Wire color</th>
<th>Terminal No.</th>
<th>Name</th>
<th>Port number</th>
<th>Wire color</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Standard</td>
<td></td>
<td></td>
<td></td>
<td>High strength</td>
</tr>
<tr>
<td>1</td>
<td>Hand output</td>
<td>64</td>
<td>Black</td>
<td>11</td>
<td>Hand Input</td>
<td>50</td>
<td>Pink</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Blue</td>
<td></td>
<td></td>
<td></td>
<td>White</td>
</tr>
<tr>
<td>2</td>
<td>Hand output</td>
<td>65</td>
<td>Brown</td>
<td>12</td>
<td>Hand Input</td>
<td>51</td>
<td>Pink</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Yellow</td>
<td></td>
<td></td>
<td></td>
<td>White</td>
</tr>
<tr>
<td>3</td>
<td>Hand output</td>
<td>66</td>
<td>Black</td>
<td>13</td>
<td>Hand Input</td>
<td>52</td>
<td>White</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td>White</td>
</tr>
<tr>
<td>4</td>
<td>Hand output</td>
<td>67</td>
<td>Brown</td>
<td>14</td>
<td>Hand Input</td>
<td>53</td>
<td>White</td>
</tr>
<tr>
<td></td>
<td></td>
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<td>5</td>
<td>Hand output</td>
<td>68</td>
<td>Red</td>
<td>15</td>
<td>Hand Input</td>
<td>54</td>
<td>White</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Violet</td>
<td></td>
<td></td>
<td></td>
<td>White</td>
</tr>
<tr>
<td>6</td>
<td>Hand output</td>
<td>69</td>
<td>Orange</td>
<td>16</td>
<td>Hand Input</td>
<td>55</td>
<td>White</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Blue</td>
<td></td>
<td></td>
<td></td>
<td>Brown</td>
</tr>
<tr>
<td>7</td>
<td>Hand output</td>
<td>70</td>
<td>Yellow</td>
<td>17</td>
<td>Power E24V for Hand</td>
<td>—</td>
<td>White</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Yellow</td>
<td></td>
<td></td>
<td></td>
<td>Brown</td>
</tr>
<tr>
<td>8</td>
<td>Hand output</td>
<td>71</td>
<td>Green</td>
<td>18</td>
<td>Power E0V for Hand</td>
<td>—</td>
<td>White</td>
</tr>
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<td></td>
<td></td>
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<td>9</td>
<td>Hand input</td>
<td>48</td>
<td>Blue</td>
<td>19</td>
<td>Not connected</td>
<td>—</td>
<td>White</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Red</td>
<td></td>
<td></td>
<td></td>
<td>Brown</td>
</tr>
<tr>
<td>10</td>
<td>Hand input</td>
<td>49</td>
<td>Violet</td>
<td>20</td>
<td>Not connected</td>
<td>—</td>
<td>White</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Violet</td>
<td></td>
<td></td>
<td></td>
<td>Brown</td>
</tr>
</tbody>
</table>
(2) I/O POWER CN7: Power connector for I/O (common to both modes)

Table 1-2 CN7 Pin Layout (Common to both modes)

![View from the cable side]

<table>
<thead>
<tr>
<th>Terminal No.</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Internal power source output +24V</td>
</tr>
<tr>
<td>2</td>
<td>Internal power source output +24V</td>
</tr>
<tr>
<td>3</td>
<td>Internal power source output 0V</td>
</tr>
<tr>
<td>4</td>
<td>Internal power source output 0V</td>
</tr>
<tr>
<td>5</td>
<td>FG</td>
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<tr>
<td>6</td>
<td>Power input E24V</td>
</tr>
<tr>
<td>7</td>
<td>Power input E24V</td>
</tr>
<tr>
<td>8</td>
<td>Power input E0V</td>
</tr>
<tr>
<td>9</td>
<td>Power input E0V</td>
</tr>
</tbody>
</table>

⚠️ Caution: When using the internal power source, keep the total current capacity below 1.3 A. To use the internal power source of the robot controller, connect the wiring so that the internal power source will be separated from the external power source. Improper wiring may damage the internal circuit.
### 1.1.2 Connector Pin Layout for Standard Mode

(1) OUTPUT/E.STOP CN10: User-/System-output emergency stop connector (standard mode)

#### Table 1-3 CN10 Pin Layout (Standard mode)

![View from the cable side diagram]

<table>
<thead>
<tr>
<th>Terminal number</th>
<th>Name</th>
<th>Port number</th>
<th>Wire color</th>
<th>Terminal number</th>
<th>Name</th>
<th>Port number</th>
<th>Wire color</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Normal CPU</td>
<td>72</td>
<td>Black</td>
<td>35</td>
<td>User output</td>
<td>106</td>
<td>Pink</td>
</tr>
<tr>
<td>2</td>
<td>Robot in operation</td>
<td>73</td>
<td>Brown</td>
<td>36</td>
<td>User output</td>
<td>107</td>
<td>Pink</td>
</tr>
<tr>
<td>3</td>
<td>Robot Error</td>
<td>74</td>
<td>Red</td>
<td>37</td>
<td>User output</td>
<td>108</td>
<td>Pink</td>
</tr>
<tr>
<td>4</td>
<td>Servo ON</td>
<td>75</td>
<td>Orange</td>
<td>38</td>
<td>User output</td>
<td>109</td>
<td>Pink</td>
</tr>
<tr>
<td>5</td>
<td>Robot initialization complete</td>
<td>76</td>
<td>Yellow</td>
<td>39</td>
<td>User output</td>
<td>110</td>
<td>Pink</td>
</tr>
<tr>
<td>6</td>
<td>Automatic mode</td>
<td>77</td>
<td>Black</td>
<td>40</td>
<td>User output</td>
<td>111</td>
<td>White</td>
</tr>
<tr>
<td>7</td>
<td>External mode</td>
<td>78</td>
<td>Brown</td>
<td>41</td>
<td>User output</td>
<td>112</td>
<td>White</td>
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<td>Dead battery warning</td>
<td>79</td>
<td>Red</td>
<td>42</td>
<td>User output</td>
<td>113</td>
<td>White</td>
</tr>
<tr>
<td>9</td>
<td>Robot warning</td>
<td>80</td>
<td>Orange</td>
<td>43</td>
<td>User output</td>
<td>114</td>
<td>White</td>
</tr>
<tr>
<td>10</td>
<td>Continue start permitted</td>
<td>81</td>
<td>Yellow</td>
<td>44</td>
<td>User output</td>
<td>115</td>
<td>White</td>
</tr>
<tr>
<td>11</td>
<td>SS mode</td>
<td>82</td>
<td>Green</td>
<td>45</td>
<td>User output</td>
<td>116</td>
<td>White</td>
</tr>
<tr>
<td>12</td>
<td>Reserved</td>
<td>83</td>
<td>Blue</td>
<td>46</td>
<td>User output</td>
<td>117</td>
<td>White</td>
</tr>
<tr>
<td>13</td>
<td>Reserved</td>
<td>84</td>
<td>Violet</td>
<td>47</td>
<td>User output</td>
<td>118</td>
<td>White</td>
</tr>
<tr>
<td>14</td>
<td>Reserved</td>
<td>85</td>
<td>Gray</td>
<td>48</td>
<td>User output</td>
<td>119</td>
<td>White</td>
</tr>
<tr>
<td>15</td>
<td>Command processing complete</td>
<td>86</td>
<td>Pink</td>
<td>49</td>
<td>User output</td>
<td>120</td>
<td>White</td>
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<tr>
<td>16</td>
<td>Status area odd parity</td>
<td>87</td>
<td>Black</td>
<td>50</td>
<td>User output</td>
<td>121</td>
<td>Gray</td>
</tr>
<tr>
<td>17</td>
<td>Status area bit 0</td>
<td>88</td>
<td>Black</td>
<td>51</td>
<td>User output</td>
<td>122</td>
<td>Violet</td>
</tr>
<tr>
<td>18</td>
<td>Status area bit 1</td>
<td>89</td>
<td>Brown</td>
<td>52</td>
<td>User output</td>
<td>123</td>
<td>Violet</td>
</tr>
<tr>
<td>19</td>
<td>Status area bit 2</td>
<td>90</td>
<td>Red</td>
<td>53</td>
<td>User output</td>
<td>124</td>
<td>Violet</td>
</tr>
<tr>
<td>20</td>
<td>Status area bit 3</td>
<td>91</td>
<td>Orange</td>
<td>54</td>
<td>User output</td>
<td>125</td>
<td>Violet</td>
</tr>
<tr>
<td>21</td>
<td>Status area bit 4</td>
<td>92</td>
<td>Yellow</td>
<td>55</td>
<td>User output</td>
<td>126</td>
<td>Violet</td>
</tr>
<tr>
<td>22</td>
<td>Status area bit 5</td>
<td>93</td>
<td>Green</td>
<td>56</td>
<td>User output</td>
<td>127</td>
<td>Violet</td>
</tr>
<tr>
<td>23</td>
<td>Status area bit 6</td>
<td>94</td>
<td>Blue</td>
<td>57</td>
<td>Not used.</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>24</td>
<td>Status area bit 7</td>
<td>95</td>
<td>Gray</td>
<td>58</td>
<td>Not used.</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>25</td>
<td>Status area bit 8</td>
<td>96</td>
<td>Pink</td>
<td>59</td>
<td>Power of robot Stop1 (internal +24V)</td>
<td>—</td>
<td>Violet</td>
</tr>
<tr>
<td>26</td>
<td>Status area bit 9</td>
<td>97</td>
<td>Brown</td>
<td>60</td>
<td>Robot Stop1</td>
<td>—</td>
<td>Gray</td>
</tr>
<tr>
<td>27</td>
<td>Status area bit 10</td>
<td>98</td>
<td>Red</td>
<td>61</td>
<td>Power of robot Stop2 (internal +24V)</td>
<td>—</td>
<td>Gray</td>
</tr>
<tr>
<td>28</td>
<td>Status area bit 11</td>
<td>99</td>
<td>Orange</td>
<td>62</td>
<td>Robot Stop2</td>
<td>—</td>
<td>Gray</td>
</tr>
<tr>
<td>29</td>
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<td>100</td>
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<td>63</td>
<td>Emergency Stop1+</td>
<td>—</td>
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<td>30</td>
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<td>Green</td>
<td>64</td>
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<td>—</td>
<td>Gray</td>
</tr>
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<td>31</td>
<td>Status area bit 14</td>
<td>102</td>
<td>Blue</td>
<td>65</td>
<td>Emergency stop2 +</td>
<td>—</td>
<td>Gray</td>
</tr>
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<td>32</td>
<td>Status area bit 15</td>
<td>103</td>
<td>Pink</td>
<td>66</td>
<td>Emergency stop 2−</td>
<td>—</td>
<td>Gray</td>
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<tr>
<td>33</td>
<td>User output</td>
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<td>Black</td>
<td>67</td>
<td>Dead man SW+</td>
<td>—</td>
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<td>34</td>
<td>User output</td>
<td>105</td>
<td>Brown</td>
<td>68</td>
<td>Dead man SW−</td>
<td>—</td>
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</table>
## (2) INPUT CN8: User-/System-input connector (standard mode)

### Table 1-4  CN8 Pin Layout (Standard mode)

![View from the cable side](image)

<table>
<thead>
<tr>
<th>Terminal number</th>
<th>Name</th>
<th>Port number</th>
<th>Wire color</th>
<th>Terminal number</th>
<th>Name</th>
<th>Port number</th>
<th>Wire color</th>
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<td>Data area 2 bit 8</td>
<td>22</td>
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<td>3</td>
<td>Power for Enable Auto (internal +24V)</td>
<td>—</td>
<td>Red</td>
<td>28</td>
<td>Data area 2 bit 9</td>
<td>23</td>
<td>Pink</td>
</tr>
<tr>
<td>4</td>
<td>Enable Auto</td>
<td>—</td>
<td>Black</td>
<td>29</td>
<td>Data area 2 bit 10</td>
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<tr>
<td>5</td>
<td>Step-stop (all tasks)</td>
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<td>Brown</td>
<td>30</td>
<td>Data area 2 bit 11</td>
<td>25</td>
<td>White</td>
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<tr>
<td>6</td>
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<td>1</td>
<td>Red</td>
<td>31</td>
<td>Data area 2 bit 12</td>
<td>26</td>
<td>White</td>
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<tr>
<td>7</td>
<td>Instantaneous stop (all tasks)</td>
<td>2</td>
<td>Orange</td>
<td>32</td>
<td>Data area 2 bit 13</td>
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<td>Strobe signal</td>
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<td>Yellow</td>
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<td>Interrupt skip</td>
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<td>34</td>
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<td>Command and data odd parity</td>
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<td>Blue</td>
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<td>Command area 0 bit 0</td>
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<td>Data area 1 bit 0</td>
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<td>Violet</td>
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<td>Command area 0 bit 1</td>
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<td>Black</td>
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<td>Command area 0 bit 2</td>
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<td>Data area 1 bit 4</td>
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<td>Gray</td>
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<td>41</td>
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<td>17</td>
<td>Data area 1 bit 6</td>
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<td>19</td>
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<td>Gray</td>
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<td>20</td>
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<td>Pink</td>
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<td>User input</td>
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<td>Gray</td>
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<td>22</td>
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<td>Violet</td>
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<td>Data area 2 bit 6</td>
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<td>Orange</td>
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<td>User input</td>
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Terminal number 1 and 2 can’t be used.
1.1.3 Connector Pin Layout for Compatible Mode

(1) OUTPUT/E. Stop CN10: User-/System-output emergency stop connector (compatible mode)

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<tr>
<th>Terminal number</th>
<th>Name</th>
<th>Port number</th>
<th>Wire color</th>
<th>Terminal number</th>
<th>Name</th>
<th>Port number</th>
<th>Wire color</th>
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<td>Normal CPU</td>
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<td>User output</td>
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<td>Pink</td>
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<tr>
<td>2</td>
<td>Robot running</td>
<td>73</td>
<td>Brown</td>
<td>36</td>
<td>User output</td>
<td>107</td>
<td>Pink</td>
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<tr>
<td>3</td>
<td>Robot error</td>
<td>74</td>
<td>Red</td>
<td>37</td>
<td>User output</td>
<td>108</td>
<td>Pink</td>
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<td>4</td>
<td>Auto mode</td>
<td>75</td>
<td>Orange</td>
<td>38</td>
<td>User output</td>
<td>109</td>
<td>Pink</td>
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<td>External mode</td>
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<td>Program start reset</td>
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<td>Black</td>
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<td>User output</td>
<td>111</td>
<td>White</td>
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<td>78</td>
<td>Brown</td>
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<td>8</td>
<td>Unused</td>
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<td>Robot power ON complete</td>
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<td>44</td>
<td>User output</td>
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<td>CAL complete</td>
<td>82</td>
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<td>User output</td>
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<td>Continue start permit</td>
<td>87</td>
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<td>User output</td>
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<td>Error units bit 0</td>
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<td>Violet</td>
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<td>Violet</td>
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<td>Orange</td>
<td>54</td>
<td>User output</td>
<td>125</td>
<td>Violet</td>
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<td>21</td>
<td>Error tens bit 0</td>
<td>92</td>
<td>Yellow</td>
<td>55</td>
<td>User output</td>
<td>126</td>
<td>Violet</td>
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<td>Green</td>
<td>56</td>
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<td>Violet</td>
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<td>23</td>
<td>Error tens bit 2</td>
<td>94</td>
<td>Blue</td>
<td>57</td>
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<td>—</td>
<td>Violet</td>
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<td>24</td>
<td>Error tens bit 3</td>
<td>95</td>
<td>Gray</td>
<td>58</td>
<td>Not connected</td>
<td>—</td>
<td>Violet</td>
</tr>
<tr>
<td>25</td>
<td>Error hundreds bit 0</td>
<td>96</td>
<td>Pink</td>
<td>59</td>
<td>Power of robot Stop1(internal +24V)</td>
<td>—</td>
<td>Violet</td>
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<td>61</td>
<td>Power of robot Stop2(internal +24V)</td>
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<td>Orange</td>
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<td>65</td>
<td>Emergency stop2 +</td>
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<td>Gray</td>
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<td>Pink</td>
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<td>Emergency stop 2-</td>
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<td>67</td>
<td>Dead man SW+</td>
<td>—</td>
<td>Blue</td>
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<td>34</td>
<td>User output</td>
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<td>Brown</td>
<td>68</td>
<td>Dead man SW-</td>
<td>—</td>
<td>Blue</td>
</tr>
</tbody>
</table>
(2) INPUT CN8: User-/System-input connector (Compatible mode)

Table 1-6  CN8 Pin Layout (Compatible mode)

View from the cable side

<table>
<thead>
<tr>
<th>Terminal number</th>
<th>Name</th>
<th>Port number</th>
<th>Wire color</th>
<th>Terminal number</th>
<th>Name</th>
<th>Port number</th>
<th>Wire color</th>
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</thead>
<tbody>
<tr>
<td>1</td>
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<td>Black</td>
<td>26</td>
<td>User input</td>
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<td>Pink</td>
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<td>Not use</td>
<td>-</td>
<td>Brown</td>
<td>27</td>
<td>User input</td>
<td>22</td>
<td>Pink</td>
</tr>
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<td>Power for Enable Auto (internal +24V)</td>
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<td>Red</td>
<td>28</td>
<td>User input</td>
<td>23</td>
<td>Pink</td>
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<tr>
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<td>Enable Auto</td>
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<td>26</td>
<td>White</td>
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<td>Yellow</td>
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<td>User input</td>
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<td>White</td>
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<td>Program start</td>
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<td>Blue</td>
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<td>White</td>
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<td>31</td>
<td>White</td>
</tr>
<tr>
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<td>Program No. select bit 3</td>
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<td>Orange</td>
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<td>Program No. select bit 6</td>
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</tr>
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<td>User input</td>
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<td>Brown</td>
<td>48</td>
<td>User input</td>
<td>43</td>
<td>Violet</td>
</tr>
<tr>
<td>24</td>
<td>Program reset</td>
<td>19</td>
<td>Red</td>
<td>49</td>
<td>User input</td>
<td>44</td>
<td>Violet</td>
</tr>
<tr>
<td>25</td>
<td>Robot error clear</td>
<td>20</td>
<td>Orange</td>
<td>50</td>
<td>User input</td>
<td>45</td>
<td>Violet</td>
</tr>
</tbody>
</table>

Terminal Terminal number 1 and 2 can't be used.

1.2 Robot Controller I/O Circuits

1.2.1 User-Input, System-Input and Hand-Input Circuits

Figures 1-1 and 1-2 show examples of the user-input, system-input and hand-input circuit configurations and connections of the robot controller.

The maximum allowable current capacity of the robot controller's internal power...
source is 1.3 A.
Use the internal power source within this allowable range.

<table>
<thead>
<tr>
<th>Caution</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>①</td>
<td>Either an external power supply type or built-in power type Output card is available for the PLC. However, an external power supply type requires an additional power source (24V) to be installed. The power capacity is 15W or more.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>②</td>
<td>When controlling two or more robots with a single PLC using the internal power source of the Robot Controller, set a PLC Output card for each robot.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>③</td>
<td>Other than a PLC, a proximity switch, or a relay contact may be connected directly to the input terminal of the Robot Controller. In such a case, use the power input to pins 6 to 9 of the I/O power connector. A two-wire photoelectric switch or proximity switch can be connected if its leakage current is 1 mA or less.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>④</td>
<td>Use a multi-core shielding cable for the purpose of protecting the Robot Controller from noise. Ground it to the Robot Controller.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 1-1  User-Input, System-Input and Hand-Input Circuits
(When the internal power source is used)

Figure 1-2  User-Input, System-Input and Hand-Input Circuits
(When an external power source is used)
1.2.2 Robot Stop Input and Enable Auto Input Circuits

The robot stop signal and the Enable Auto signal are important for safety. The input circuit for these signals must have contacts as shown in Figure 1-3. Use the INPUT CN8 (pins 1 and 3) of the robot controller for the power source, irrespective of whether the power source to be used for other I/O signals is the internal power source or an external power source.

Figure 1-3 Robot Stop Input and Enable Auto Input Circuit
1.2.3 User-Output, System-Output, and Hand-Output Circuits

Figures 1-4 and 1-5 show an example of the configuration and connection of the Robot Controller's user-input output, system-output and hand-output circuit.

Since the initial resistance of a lamp is small, the output circuit may be damaged by rush current that flows when the lamp lights.

When directly turning ON and OFF a lamp, use a lamp whose rating is 0.5W or less.

To reduce rush current, select and connect a resistor R that allows dark current 1/3 or less of the rated current to flow when the lamp goes OFF.

Figure 1-6 shows an example of connecting a lamp.

(1) The User-Output, System-Output and Hand-Output Circuit are open collector output circuits.

(2) The maximum allowable intake current is 70mA. Keep the current consumption of a device to be connected to the Robot Controller, such as a PLC and a relay coil, below the allowable current.

(3) Select an induction load, such as a relay coil, which has a built-in diode (for absorbing inverse electromotive force).
   To use an induction load without a built-in diode, add a diode equivalent to the 1S1888 (Toshiba) in close vicinity to the coil.

⚠️ Caution: When externally attaching a diode, connect it with correct polarity. Incorrect polarity may damage the Output circuit.

(4) Connecting a lamp requires a circuit through which dark current flows.

⚠️ Caution: Since the initial resistance of a lamp is small, the output circuit may be damaged by rush current that flows when the lamp lights. Refer to Figure 1-6.

(5) When using the internal power source, prepare a PLC input circuit unit that does not contain a power source.

⚠️ Caution: Keep the total current capacity of the internal power source below 1.3A.

(6) Use a multi-core shielding cable for the purpose of protecting the devices from external noise. Ground it to the Robot Controller.

(7) +24V internal power source of the robot controller must not be grounded.

⚠️ Caution: If the output terminal +24V of internal power source is grounded, there may be a case where the controller is damaged.
Figure 1-4  User-Output, System-Output and Hand-Output Circuit (When the internal power source is used)

Figure 1-5  User-Output, System-Output and Hand-Output Circuit (When an external power source is used)
Figure 1-6  Example of Circuit with Lamp
1.2.4 Emergency Stop Output Circuit

Figures 1-7 and 1-8 show the examples of configuration and connection of emergency stop circuit for the robot controller.

The red mushroom-shaped switch provided on the robot controller front panel, on the teach pendant, or on the operating panel can be used as a switch for stopping the equipment in case of emergency.

**Figure 1-7**  Emergency Stop Output Circuit (Activated by Internal Power Source)

**Figure 1-8**  Emergency Stop Output Circuit (Activated by External Power Source)
1.2.5 I/O Power Connector

For the power source to communicate signals between the robot controller and the external device, the internal power source of the robot controller or an external power source is used.

Figure 1-9 shows an example of connecting I/O power connectors when the internal power source is used, and Figure 1-10 shows an example of connecting I/O power connectors when an external power source is used.

**Caution:** To use the internal power source of the robot controller, connect the wiring so that the internal power source will be separate from the external power source. Improper wiring may damage the internal circuit.

---

**Figure 1-9 Example of Connecting I/O Power Connectors (When the internal power source is used)**

---

**Table 1-4 Key to Locations and Wires**

<table>
<thead>
<tr>
<th>Location</th>
<th>Wire Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>0.5 mm² or more</td>
</tr>
<tr>
<td>F2</td>
<td>0.5 mm² or more</td>
</tr>
<tr>
<td>PLC</td>
<td>AWG20 or more</td>
</tr>
<tr>
<td>0V</td>
<td>AWG20 or more</td>
</tr>
<tr>
<td>+24V</td>
<td></td>
</tr>
<tr>
<td>Robot controller</td>
<td></td>
</tr>
</tbody>
</table>
Appendix

Figure 1-10 Example of Connecting I/O Power Connectors (When an external power source is used)

⚠️ Caution: Use a cable of 0.5 mm² or more in size for the wiring between the external power source and the I/O power input connectors of the robot controller.
1.3 Precautions When Wiring the Robot Controller I/O Connectors

After the wiring of the I/O connectors of the Robot Controller is completed, check the following before turning ON the power:

(1) Using a tester, check across the “+24V terminal” and “0V terminal” of each connector and across the “E24V terminal” and the “E0V terminal” to see that there is no continuity. See Figure 1-11.

⚠️ Caution: If the connector wiring between the Robot Controller’s “+24V terminal” and “0V terminal” and between the “E24V terminal” and the “E0V terminal” is shorted, damage to the power circuit of the Robot Controller will result.

(2) Using a tester, check across “each signal Output terminal” and “+24V terminal” or “E24V terminal” of each connector to see that there is no continuity. See Figure 1-11.

⚠️ Caution: If the wiring between “each signal Output terminal” and “+24V terminal” or “E24V terminal” of each connector is shorted, damage to the Output circuit and power circuit of the Robot Controller will result.

⚠️ Caution: Wind adhesive vinyl tape around all ends of the unconnected wiring of each connector to prevent them from contacting other wiring and parts, which results in shorting.

![Figure 1-11 Checking Example](image-url)
### Table 1-7 Connector Terminals Requiring Checking

#### Connector for hand I/O

**View from cable side engaging face**

<table>
<thead>
<tr>
<th>Terminal Number</th>
<th>Name</th>
<th>Meaning</th>
<th>Check point</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 8</td>
<td>Hand output terminal</td>
<td>0V (GND) at output</td>
<td>(2)</td>
</tr>
<tr>
<td>17</td>
<td>Power terminal for hand (E24V)</td>
<td>24V power output</td>
<td>(1)</td>
</tr>
<tr>
<td>18</td>
<td>Power terminal for hand (E0V)</td>
<td>Power (GND) output</td>
<td>(1)</td>
</tr>
</tbody>
</table>

#### Connector for user/system output and emergency Stop

**View from cable side engaging face**

<table>
<thead>
<tr>
<th>Terminal number</th>
<th>Name</th>
<th>Meaning</th>
<th>Check point</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 56</td>
<td>Signal output terminal</td>
<td>0V (GND) at output</td>
<td>(2)</td>
</tr>
</tbody>
</table>

#### Connector for user/system input

**View from cable side engaging face**

<table>
<thead>
<tr>
<th>Terminal Number</th>
<th>Name</th>
<th>Meaning</th>
<th>Check point</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 3</td>
<td>+24V internal power source terminal</td>
<td>+24V internal power source output</td>
<td>(1)</td>
</tr>
</tbody>
</table>

#### Connector for I/O power source

**View from cable side engaging face**

<table>
<thead>
<tr>
<th>Terminal number</th>
<th>Name</th>
<th>Meaning</th>
<th>Check point</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 2</td>
<td>+24V internal power source terminal</td>
<td>+24V internal power source output</td>
<td>(1)</td>
</tr>
<tr>
<td>3, 4</td>
<td>0V internal power source terminal</td>
<td>0V internal power source output</td>
<td>(1)</td>
</tr>
<tr>
<td>6, 7</td>
<td>E24V input terminal</td>
<td>24V power input</td>
<td>(1)</td>
</tr>
<tr>
<td>8, 9</td>
<td>E0V (GND) input terminal</td>
<td>Power (GND) input</td>
<td>(1)</td>
</tr>
</tbody>
</table>
The purpose of this manual is to provide accurate information in the handling and operating of the robot. Please feel free to send your comments regarding any errors or omissions you may have found, or any suggestions you may have for generally improving the manual.

In no event will YASKAWA be liable for any direct or indirect damages resulting from the application of the information in this manual.
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YASKAWA ELECTRIC CORPORATION

Specifications are subject to change without notice for on going product modifications and improvements.
Upon receipt of the product and prior to initial operation, read these instructions thoroughly, and retain for future reference.
Preface

Thank you for purchasing the YASKAWA MOTOMAN. This publication lists error codes to be displayed on the teach pendant, operating panel, or PC screen if an error occurs in the robot series or WINCAPSII given below. Those error codes are followed by detailed explanation and recovery action to be taken.

If an error occurs, use this list together with the related instruction manuals.

Robot series and PC teaching system covered by this error code tables

- Vision device, μVision-21 SERIES
- WINCAPSII

CONTENTS

1  Error Level Table ............................................................................................................. 1
2  Controller Error Code Table ........................................................................................ 3
3  WINCAPSII Error Code Table ...................................................................................... 78
1 Error Level Table

If an error occurs in the controller, the robot will stop in accordance with the following statuses.

<table>
<thead>
<tr>
<th>Error level</th>
<th>Error occurs in operation</th>
<th>Error output</th>
<th>Program stop</th>
<th>Motion mode</th>
<th>Motor power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>Teaching pendant (TP) or operation panel (OP)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Level 2</td>
<td>TP or OP</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>Robot warning</td>
<td>Halt</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Level 3</td>
<td>TP or OP</td>
<td>-</td>
<td>-</td>
<td>External → Internal</td>
<td>Shutoff (See Note ①.)</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>Robot failure</td>
<td>Halt</td>
<td>External → Internal</td>
<td>Shutoff</td>
</tr>
<tr>
<td>Level 4</td>
<td>TP or OP</td>
<td>Robot failure</td>
<td>Emergency stop</td>
<td>External → Internal</td>
<td>Shutoff</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>Robot failure</td>
<td>Emergency stop</td>
<td>External → Internal</td>
<td>Shutoff</td>
</tr>
<tr>
<td>Level 5</td>
<td>TP or OP</td>
<td>Robot failure</td>
<td>Emergency stop</td>
<td>External → Internal</td>
<td>Shutoff (restart disabled)</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>Robot failure</td>
<td>Emergency stop</td>
<td>External → Internal</td>
<td>Shutoff (restart disabled)</td>
</tr>
</tbody>
</table>

Note ①: The motor power cannot be shut down if a 6071-607B/6671-667B (software motion limit over, out of motion space or singular point) or 607F (figure mismatch) error occurs in the manual mode during robot motion.

Note ②: Even if happened by teach pendant or operating panel operation, ERROR 6000s and errors in programs will be treated in the same way as for errors caused by "Others" in the above table.
## 1 Error Level Table

The meaning of each item in the above table is as follows.

<table>
<thead>
<tr>
<th>Error occurs in operation on</th>
<th>Teaching pendant (TP) or operation panel (OP)</th>
<th>This stop method is used when the wrong operation is carried out on the pendant or operation panel (forbidden operation is carried out in the current mode).</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>· If a level 2 or 3 error occurs, an error message is displayed but the motion continues.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>· If an error higher than level 4 occurs, the robot will always stop even when it is operated using TP or OP.</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>This stop method is used when an error occurs in program execution, dedicated I/O input operation, or in the servo.</td>
</tr>
<tr>
<td>Error output</td>
<td>Robot warning</td>
<td>Robot failure is output to inform the external devices (such as PLC) of the occurrence of a level 2 error.</td>
</tr>
<tr>
<td></td>
<td>Robot failure</td>
<td>Robot failure is output to inform the external devices (such as PLC) of the occurrence of a level 3 error.</td>
</tr>
<tr>
<td>Program stop</td>
<td>Halt</td>
<td>The robot stops instantaneously. The robot traces the same motion path as the normal motion even during the deceleration motion for this stop.</td>
</tr>
<tr>
<td></td>
<td>Emergency stop</td>
<td>The robot stops in emergency. Deceleration is executed with the maximum deceleration for each axis. Therefore, the path during deceleration for this stop may be different from the normal motion (especially in the case of CP motion).</td>
</tr>
<tr>
<td>Motion mode</td>
<td>External → Internal</td>
<td>If an error occurs in the external automatic mode, the mode changes to the internal automatic mode.</td>
</tr>
<tr>
<td>Motor power</td>
<td>Shut down</td>
<td>If the motor power is ON when an error occurs, the motor power turns OFF.</td>
</tr>
<tr>
<td></td>
<td>Shut down - restart not available</td>
<td>If the motor power is ON when an error occurs, the motor power turns OFF. If an attempt is made to turn ON the motor power again without turning OFF the controller power after the error occurs, a 27A6 error (cannot execute due to a fatal error) may occur.</td>
</tr>
</tbody>
</table>

**Note:** For Level 2 and level 3 errors (except for errors caused by teach pendant or operating panel, errors 6000s, and errors in programs), the controller will neither issue Robot warning or Robot failure signal nor stop the robot.
# Controller Error Code Table

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>Lv</th>
<th>Description</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1201</td>
<td>Prepare for communication (unconnected)</td>
<td>4</td>
<td>DeviceNet module operation is normal. However, no connection with the master device has been established.</td>
<td>Establish connection from the master device.</td>
</tr>
<tr>
<td>1202</td>
<td>Prepare for communication (unconnected)</td>
<td>4</td>
<td>DeviceNet module operation is normal and connection with the master device is explicitly established, however, the I/O connection is not established.</td>
<td>Establish connection from the master device.</td>
</tr>
<tr>
<td>1203</td>
<td>Prepare for communication (idle status)</td>
<td>4</td>
<td>The DPRAM of the DeviceNet master module cannot be accessed from the robot.</td>
<td>Reconsider the contents of I/O data output from the master device.</td>
</tr>
<tr>
<td>1204</td>
<td>Prepare for communication (I/O timeout)</td>
<td>4</td>
<td>DeviceNet module operation is normal. However, no data can be received from the master device in regular time.</td>
<td>Check for disconnection of network cable, loosening of connector, proper cable length, and whether the termination resister position is correct.</td>
</tr>
<tr>
<td>1205</td>
<td>Initial setting error in com. process</td>
<td>4</td>
<td>Initial connection with DeviceNet communication part failed.</td>
<td>Turn OFF the power switch of the controller and restart operation.</td>
</tr>
<tr>
<td>1210</td>
<td>DeviceNet internal communication error</td>
<td>4</td>
<td>Communication data failed due to something such as noise.</td>
<td>↑</td>
</tr>
<tr>
<td>1213</td>
<td>Disconnected/bus-off state</td>
<td>4</td>
<td>Network cable is disconnected or bus is OFF (network not connected).</td>
<td>Verify that the cable connector is securely plugged in at the robot side. If this error occurs after you change the DIP switch settings, verify that the network communication speed matches DIP switch settings.</td>
</tr>
<tr>
<td>1215</td>
<td>Prep. to communicate (initial set error)</td>
<td>4</td>
<td>DeviceNet communication process part did not receive initial setting from the controller.</td>
<td>Verify that the network communication speed matches the DIP switch settings.</td>
</tr>
<tr>
<td>1216</td>
<td>Transfer data length abnormal</td>
<td>4</td>
<td>The number of input/output slots for DeviceNet exceeds the specified range.</td>
<td>Change the input slot number for DeviceNet to one of 8<del>32, and that of output slot to one of 7</del>32, turn the control power OFF and then ON again.</td>
</tr>
<tr>
<td>1217</td>
<td>Same node No. specified duplication</td>
<td>4</td>
<td>Controller node number is overlapped with another node in the online status.</td>
<td>Change the node number so that the node number of the controller does not overlap other nodes.</td>
</tr>
<tr>
<td>1220</td>
<td>I/O option board connection error</td>
<td>4</td>
<td>Two or more I/O optional boards are inserted at the same time.</td>
<td>Simultaneous access disabled: turn the power off and insert only one board.</td>
</tr>
<tr>
<td>1221</td>
<td>Busy time of Master exceeded setup value</td>
<td>4</td>
<td>DeviceNet master initialization did not end normally.</td>
<td>Turn OFF the power switch of the controller once and restart operation.</td>
</tr>
<tr>
<td>1222</td>
<td>Master failed in the scanlist formation</td>
<td>4</td>
<td>Scan list creation processing of the DeviceNet master failed.</td>
<td>Perform scan list creation processing again.</td>
</tr>
<tr>
<td>1223</td>
<td>Serial number is un-decision</td>
<td>4</td>
<td>No serial number is decided for the DeviceNet master.</td>
<td>Enter a serial number from the pendant.</td>
</tr>
<tr>
<td>1224</td>
<td>The setup of master board is unusual</td>
<td>4</td>
<td>Abnormal setting information is defined in the DeviceNet master.</td>
<td>Turn OFF the power switch of the controller once and restart operation.</td>
</tr>
</tbody>
</table>
## 2 Controller Error Code Table

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>Lv</th>
<th>Description</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1225</td>
<td>Serial number change failure</td>
<td>4</td>
<td>Serial number rewriting failed due to any factor in the DeviceNet master.</td>
<td>Perform serial number rewrite processing again.</td>
</tr>
<tr>
<td>1226</td>
<td>EPR change failure</td>
<td>4</td>
<td>EPR rewriting failed due to any factor.</td>
<td>Perform EPR rewrite processing again.</td>
</tr>
<tr>
<td>1227</td>
<td>ISD change failure</td>
<td>4</td>
<td>ISD rewriting failed due to any factor in the DeviceNet master.</td>
<td>Perform ISD rewrite processing again.</td>
</tr>
<tr>
<td>1228</td>
<td>Scanlist change failure</td>
<td>4</td>
<td>Scan list rewriting failed due to any factor in the DeviceNet master.</td>
<td>Perform scan list rewrite processing again.</td>
</tr>
<tr>
<td>1229</td>
<td>Master FlashROM failure (serial No)</td>
<td>4</td>
<td>A serial number could not be written normally in FlashROM of the DeviceNet master.</td>
<td>Turn OFF the power switch of the controller, confirm whether the board is securely inserted, and perform the same processing again.</td>
</tr>
<tr>
<td>122A</td>
<td>Master FlashROM failure (EPR)</td>
<td>4</td>
<td>EPR could not be written normally in FlashROM of the DeviceNet master.</td>
<td>↑</td>
</tr>
<tr>
<td>122B</td>
<td>Master FlashROM failure (ISD)</td>
<td>4</td>
<td>ISD could not be written normally in FlashROM of the DeviceNet master.</td>
<td>↑</td>
</tr>
<tr>
<td>122C</td>
<td>Master FlashROM failure (scanlist)</td>
<td>4</td>
<td>A scan list could not be written normally in FlashROM of the DeviceNet master.</td>
<td>↑</td>
</tr>
<tr>
<td>122D</td>
<td>DeviceNet Master board doesn't exist</td>
<td>2</td>
<td>An attempt was made to change DeviceNet master board data to a controller without DeviceNet master board.</td>
<td>Set the DeviceNet master board to the controller and perform the same operation.</td>
</tr>
<tr>
<td>1230</td>
<td>Robot access failure in DPRAM(slave)</td>
<td>4</td>
<td>The DPRAM of the DeviceNet slave module cannot be accessed from the robot.</td>
<td>Turn OFF the power switch of the controller and restart operation.</td>
</tr>
<tr>
<td>1232</td>
<td>Reset command receiving state</td>
<td>4</td>
<td>A reset command was received from the master device.</td>
<td>↑</td>
</tr>
<tr>
<td>1234</td>
<td>DeviceNet internal RAM failure</td>
<td>4</td>
<td>RAM failure was detected due to self-check of communication part.</td>
<td>↑</td>
</tr>
<tr>
<td>1236</td>
<td>DeviceNet internal DPRAM failure</td>
<td>4</td>
<td>DPRAM failure was detected due to self-check of communication part.</td>
<td>↑</td>
</tr>
<tr>
<td>1237</td>
<td>DeviceNet internal EEPROM failure</td>
<td>4</td>
<td>EEPROM failure was detected by self-check of communication unit.</td>
<td>↑</td>
</tr>
<tr>
<td>1238</td>
<td>Slave board access failure in DPRAM</td>
<td>4</td>
<td>DeviceNet slave communication part software cannot access DPRAM.</td>
<td>↑</td>
</tr>
<tr>
<td>1239</td>
<td>Out of set output range</td>
<td>2</td>
<td>Output address is out of the specified range, therefore, output is not available.</td>
<td>Check output address.</td>
</tr>
<tr>
<td>123A</td>
<td>Out of set input range</td>
<td>3</td>
<td>Input address is out of the specified range, therefore, input is not available.</td>
<td>Check input address.</td>
</tr>
<tr>
<td>1240</td>
<td>Slave I/O area overlaps</td>
<td>4</td>
<td>An invalid node address is specified for the slave.</td>
<td>Respecify a node address so that the slave I/O area is not overlapped.</td>
</tr>
</tbody>
</table>
### Controller Error Code Table

<table>
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<tr>
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<tbody>
<tr>
<td>1241</td>
<td>I/O area range overcoat</td>
<td>4</td>
<td>The slave I/O area exceeds the valid range.</td>
<td>Respecify a node address so that the I/O area does not exceed the valid range.</td>
</tr>
<tr>
<td>1242</td>
<td>Non-registrable slave detection</td>
<td>4</td>
<td>The I/O size of one slave exceeds 64 bytes.</td>
<td>Respecify the I/O size with 64 bytes or fewer.</td>
</tr>
<tr>
<td>1243</td>
<td>Registered slave doesn't exist</td>
<td>4</td>
<td>No slave is registered in the scan list.</td>
<td>Register slave information in the scan line by pendant operation.</td>
</tr>
<tr>
<td>1244</td>
<td>Inconsistent I/O slave size</td>
<td>4</td>
<td>The I/O size of the slave unmaches one registered in the scan list.</td>
<td>Rescan from pendant or return the I/O size of the slave to the registered one.</td>
</tr>
<tr>
<td>1245</td>
<td>No response from slave</td>
<td>4</td>
<td>No response was returned from the slave.</td>
<td>Normally operate the abnormal slave.</td>
</tr>
<tr>
<td>1246</td>
<td>Master MACID overlaps with slave</td>
<td>4</td>
<td>The master node address is duplicated with the slave one.</td>
<td>Change either node address.</td>
</tr>
<tr>
<td>1247</td>
<td>BusOff condition is detected</td>
<td>4</td>
<td>Network entered communication disabled state.</td>
<td>Turn OFF the power switch of the controller and restart operation.</td>
</tr>
<tr>
<td>1248</td>
<td>No network power supply</td>
<td>4</td>
<td>No DeviceNet network power is supplied.</td>
<td>Confirm the network power supply line.</td>
</tr>
<tr>
<td>1249</td>
<td>CAN transmission time out</td>
<td>4</td>
<td>Transmission to the CAN chip failed on the DeviceNet master.</td>
<td>Resolve the abnormality on network.</td>
</tr>
<tr>
<td>124A</td>
<td>DeviceNet master RAM failure</td>
<td>4</td>
<td>DeviceNet master communication part software detected a RAM hardware error.</td>
<td>Turn OFF the power of the controller and restart operation.</td>
</tr>
<tr>
<td>124B</td>
<td>DeviceNet master ROM failure</td>
<td>4</td>
<td>DeviceNet master communication part software detected a ROM hardware error.</td>
<td></td>
</tr>
<tr>
<td>124C</td>
<td>DeviceNet master DPRAM failure</td>
<td>4</td>
<td>DeviceNet master communication part software detected a DPRAM hardware error.</td>
<td></td>
</tr>
<tr>
<td>124D</td>
<td>Master board access failure in DPRAM</td>
<td>4</td>
<td>DeviceNet master communication part software failed access to DPRAM.</td>
<td></td>
</tr>
<tr>
<td>124E</td>
<td>Robot setup bit failure</td>
<td>4</td>
<td>The robot set an invalid bit in the DeviceNet master.</td>
<td></td>
</tr>
<tr>
<td>124F</td>
<td>Master communication start is unusual</td>
<td>4</td>
<td>An error occurred in network communication processing at initialization of the DeviceNet master.</td>
<td></td>
</tr>
<tr>
<td>126A</td>
<td>CIF board access error</td>
<td>4</td>
<td>Failure to access to CIF board.</td>
<td>Reboot the controller.</td>
</tr>
<tr>
<td>126B</td>
<td>CIF board DPRAM access error</td>
<td>4</td>
<td>Failed to access to DPRAM of CIF board.</td>
<td>Reboot the controller. If the problem still occurs, CIF board may be damaged.</td>
</tr>
</tbody>
</table>
## 2 Controller Error Code Table

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<thead>
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</thead>
<tbody>
<tr>
<td>126C</td>
<td>CIF board initialization error</td>
<td>4</td>
<td>An error occurred in initialization of CIF board.</td>
<td></td>
</tr>
<tr>
<td>126D</td>
<td>CIF board watchdog error</td>
<td>4</td>
<td>Watchdog error of CIF board has occurred.</td>
<td></td>
</tr>
<tr>
<td>126E</td>
<td>Failed CIF board resetting</td>
<td>4</td>
<td>Failed to reset the CIF board.</td>
<td></td>
</tr>
<tr>
<td>126F</td>
<td>Network is not established</td>
<td>4</td>
<td>A network for CIF board, such as PROFIBUS is not established.</td>
<td>1. Check if the connector of communication line is disconnected or not.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. Verify the setting of network (such as node address).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3. Check if the communication line is not cut off.</td>
</tr>
<tr>
<td>127A</td>
<td>CIF board internal buffer access error</td>
<td>4</td>
<td>Failed to access to an internal buffer of CIF board.</td>
<td></td>
</tr>
<tr>
<td>127B</td>
<td>CIF board message send time out</td>
<td>4</td>
<td>Timeout occurred as CIF board's sending messages.</td>
<td></td>
</tr>
<tr>
<td>127C</td>
<td>CIF board message received time out</td>
<td>4</td>
<td>Timeout occurred as CIF board's receiving messages.</td>
<td></td>
</tr>
<tr>
<td>127D</td>
<td>Communication watchdog is invalid</td>
<td>4</td>
<td>Invalid setting of watchdog for communication.</td>
<td>Confirmation of establishment of network cannot be done unless the setting of watchdog for communication is valid.</td>
</tr>
<tr>
<td>127E</td>
<td>Network configuration mismatch</td>
<td>4</td>
<td>The configuration data sent from master is different from the one sent from slave.</td>
<td>Verify the setting of network (such as module type)</td>
</tr>
<tr>
<td>127F</td>
<td>CIF board Initializing</td>
<td>4</td>
<td>Inappropriate operation in initialization of CIF board is done.</td>
<td>Repeat the same procedure after waiting for about 20 seconds.</td>
</tr>
<tr>
<td>15A0</td>
<td>Received data error</td>
<td>3</td>
<td>Received data includes an error.</td>
<td>1. Check the communication settings.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. Check the number of communication data.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3. Turn power OFF and then back ON.</td>
</tr>
<tr>
<td>15A1</td>
<td>Receiving timeout</td>
<td>3</td>
<td>Receiving timeout occurred.</td>
<td>1. Change the receiving timeout time.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. Check the communication cable.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3. Turn OFF the power and turn it ON.</td>
</tr>
</tbody>
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</table>
| 15A2    | Sending timeout                              | 3  | Sending timeout occurred.                            | 1. Change the receiving timeout time.  
                                                      |                                                             | 2. Check the communication cable.  
                                                      |                                                             | 3. Turn power OFF and then back ON.                  |
| 15A3    | Receiving buffer overflow                    | 3  | The number of receiving data exceeded available input number. | 1. Check the communication setting.  
                                                      |                                                             | 2. Check the number of communication data.          | 3. Turn power OFF and then back ON.                  |
| 15A4    | Received delimiter error                     | 3  | Received separate code (delimiter) is not correct.   | 1. Check the delimiter.  
                                                      |                                                             | 2. Check the number of communication data.          | 3. Turn power OFF and then back ON.                  |
| 15A5    | Serial port communication error              | 5  | Communication error occurred due to excess retry number. | 1. Change the number of communication retries.  
                                                      |                                                             | 2. Check the communication cable.  
                                                      |                                                             | 3. Turn the power OFF and then back ON.              |
| 15A6    | Ethernet communication error                 | 5  | Communication error occurred due to excess retry number. | 1. Change the number of communication retries.  
                                                      |                                                             | 2. Check the communication cable.  
                                                      |                                                             | 3. Turn the power OFF and then back ON.              |
| 15A8    | Packet failure                               | 1  | Communication packet failed.                         | 1. Check the communication setting.  
                                                      |                                                             | 2. Check the number of communication data.          | 3. Turn power OFF and then back ON.                  |
| 15A9    | Communication data error                     | 1  | Communication error occurred due to excess NAK retry number. | 1. Change the number of NAK communication retries.  
                                                      |                                                             | 2. Check the communication cable.  
                                                      |                                                             | 3. Turn power OFF and then back ON.                  |
| 15AA    | Same IP address specified twice              | 2  | IP address is overlapped.                            | Set IP address so that it does not overlap.                           |
| 2003    | Value out of range                           | 3  | A numeric value given as process parameter was out of range. | Designate a value in the designated range before executing the process again. |
| 2004    | CAL not executed                             | 3  | Attempt was made to execute a process executable after completion of CAL. | Execute CAL before executing the process again.                       |
| 2006    | Turn ON the motor power                      | 2  | Attempt was made to execute a process executable with the motor power ON. | Turn ON the motor power before executing the process again.            |
| 2008    | Robot stop is activated                      | 2  | Attempt was made to execute a process that is not available in the robot stop ON status. | Turn OFF the robot stop status before executing the process again.     |
| 200A    | Turn OFF the motor power                     | 2  | Attempt was made to execute a process that is not available in the motor power OFF status. | Turn OFF the motor power before executing the process again.            |
| 201E    | Machine lock ON                              | 2  | Attempt was made to change the mode in machine lock status on the operation panel. | Release the machine lock using the teaching pendant.                   |
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<tbody>
<tr>
<td>2031</td>
<td>Program not found</td>
<td>3</td>
<td>Object program for process execution was not found.</td>
<td>1. Check if the wrong program number is designated.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. Check if a program was loaded after it was transmitted or compiled.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3. Check if a transmit error occurs when the execution form file is sent from WINCAPS II to the controller.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4. Check if an error has occurred during compiling by the controller.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5. Create the execution form file again by using WINCAPS II or the controller. Disable the DATE INSPECTION option in WINCAPS II at this time.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6. Check if the status of the command area and the data area are settled when the strobe signal rises in the standard mode.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7. Check if the program select signal status is settled when the program start signal rises in the compatible mode.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8. Check if an error has occurred during compiling by the controller.</td>
</tr>
<tr>
<td>2032</td>
<td>Data area 1 remains undefined</td>
<td>2</td>
<td>The content of data area 1 is undefined by the program motion command in the standard I/O mode.</td>
<td>1. Execute again after correcting the status of data area 1.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. Check if the status of data area 1 is settled when the strobe signal rises.</td>
</tr>
<tr>
<td>2033</td>
<td>I/O parity error occurred</td>
<td>3</td>
<td>The parity bit status of system-I/O input only is not an odd parity.</td>
<td>1. Set the parity bit status so that the number of bits which are ON in the system input only I/O and the parity bits of the I/O parity calculation object are odd.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. Set the parity parameter of I/O hardware setting to invalid if no parity bit is detected.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3. Check if the status of the command area and data area are settled when the strobe signal rises in the standard mode.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4. Check if the program select signal status is settled when the program start signal rises in the compatible mode.</td>
</tr>
<tr>
<td>2034</td>
<td>Internal I/O out of range</td>
<td>2</td>
<td>Attempt was made to read or write in an area other than the internal I/O using the standard I/O read and write commands.</td>
<td>Correct so that I/O read and write objects are in the internal I/O range.</td>
</tr>
<tr>
<td>207B</td>
<td>Cannot move to this position</td>
<td>2</td>
<td>The point read is a singular point.</td>
<td>Set the reading point to a point other than a singular point.</td>
</tr>
<tr>
<td>2103</td>
<td>Time to change controller backup battery</td>
<td>1</td>
<td>It is time to replace the backup battery in the controller.</td>
<td>Replace the controller backup battery and set the date for the next inspection of the battery.</td>
</tr>
<tr>
<td>2187</td>
<td>Communication error with TP or OP</td>
<td>4</td>
<td>Communication failure between the teaching pendant or operation panel and the controller.</td>
<td>Properly connect the controller with the teaching pendant or operation panel. If the error persists, the cause may be that the teaching pendant wires are disconnected or failure of the teaching pendant or operation panel.</td>
</tr>
<tr>
<td>21BA</td>
<td>Interference check execution error</td>
<td>4</td>
<td>An error occurred when interference check was executed.</td>
<td>Check the interference check setting.</td>
</tr>
<tr>
<td>21BB</td>
<td>Loading</td>
<td>2</td>
<td>This operation is not available during loading.</td>
<td>Execute this operation after loading is finished.</td>
</tr>
<tr>
<td>21BC</td>
<td>Compiling</td>
<td>2</td>
<td>This operation is not available during compiling.</td>
<td>Execute this operation after compiling is finished.</td>
</tr>
</tbody>
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<tr>
<td>21BD</td>
<td>Program editing</td>
<td>2</td>
<td>This operation is not available during program editing.</td>
<td>Execute this operation after program editing is finished.</td>
</tr>
<tr>
<td>21BE</td>
<td>Parameter editing</td>
<td>2</td>
<td>This operation is not available during parameter editing.</td>
<td>Execute this operation after parameter editing is finished.</td>
</tr>
<tr>
<td>21BF</td>
<td>Not executable while robot is suspended</td>
<td>2</td>
<td>Variable cannot be moved during robot suspension.</td>
<td>Release the robot suspension status.</td>
</tr>
<tr>
<td>21C0</td>
<td>Subtraction error</td>
<td>5</td>
<td>Controller internal error.</td>
<td>Turn OFF the controller power switch and restart the operation.</td>
</tr>
<tr>
<td>21C1</td>
<td>Debug exception</td>
<td>5</td>
<td>Controller internal error.</td>
<td>↑</td>
</tr>
<tr>
<td>21C2</td>
<td>NMI interruption</td>
<td>5</td>
<td>Controller internal error.</td>
<td>↑</td>
</tr>
<tr>
<td>21C3</td>
<td>Break point</td>
<td>5</td>
<td>Controller internal error.</td>
<td>↑</td>
</tr>
<tr>
<td>21C4</td>
<td>INTO command overflow</td>
<td>5</td>
<td>Controller internal error.</td>
<td>↑</td>
</tr>
<tr>
<td>21C5</td>
<td>Boundary check fault</td>
<td>5</td>
<td>Controller internal error.</td>
<td>↑</td>
</tr>
<tr>
<td>21C6</td>
<td>Illegal operation code</td>
<td>5</td>
<td>Controller internal error.</td>
<td>↑</td>
</tr>
<tr>
<td>21C7</td>
<td>Device not usable</td>
<td>5</td>
<td>Controller internal error.</td>
<td>↑</td>
</tr>
<tr>
<td>21C8</td>
<td>Double fault</td>
<td>5</td>
<td>Controller internal error.</td>
<td>↑</td>
</tr>
<tr>
<td>21C9</td>
<td>Coprocessor segment over</td>
<td>5</td>
<td>Controller internal error.</td>
<td>↑</td>
</tr>
<tr>
<td>21CA</td>
<td>Illegal TSS</td>
<td>5</td>
<td>Controller internal error.</td>
<td>↑</td>
</tr>
<tr>
<td>21CB</td>
<td>Illegal segment</td>
<td>5</td>
<td>Controller internal error.</td>
<td>↑</td>
</tr>
<tr>
<td>21CC</td>
<td>Stack segment fault</td>
<td>5</td>
<td>Controller internal error.</td>
<td>↑</td>
</tr>
<tr>
<td>21CD</td>
<td>General protection exception</td>
<td>5</td>
<td>Controller internal error.</td>
<td>↑</td>
</tr>
<tr>
<td>Code</td>
<td>Message</td>
<td>Lv</td>
<td>Description</td>
<td>Remedy</td>
</tr>
<tr>
<td>--------</td>
<td>---------------------------------------</td>
<td>----</td>
<td>------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>21CE</td>
<td>Page exception</td>
<td>5</td>
<td>Controller internal error.</td>
<td>⬆️</td>
</tr>
<tr>
<td>21CF</td>
<td>(Intel reservation)</td>
<td>5</td>
<td>Controller internal error.</td>
<td>⬆️</td>
</tr>
<tr>
<td>21D0</td>
<td>Coprocessor error (overflow)</td>
<td>5</td>
<td>1. Digit overflow occurred in the program.</td>
<td>1. Reboot the controller and correct the digit overflow.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Controller internal error.</td>
<td>2. Turn OFF the controller power switch and restart the operation.</td>
</tr>
<tr>
<td>21D1</td>
<td>Adjustment check</td>
<td>5</td>
<td>Controller internal error.</td>
<td>Turn OFF the controller power switch and restart the operation.</td>
</tr>
<tr>
<td>21D2</td>
<td>Only signal handler was called</td>
<td>5</td>
<td>Controller internal error.</td>
<td>⬆️</td>
</tr>
<tr>
<td>21D3</td>
<td>Error occurred</td>
<td>1</td>
<td>Attempt was made to execute a process that is not allowed when another error</td>
<td>Clear the current error before executing the process again.</td>
</tr>
<tr>
<td></td>
<td>occurs.</td>
<td></td>
<td>occurs.</td>
<td></td>
</tr>
<tr>
<td>21D4</td>
<td>Cannot operate from TP</td>
<td>1</td>
<td>Attempt was made to execute a process not executable from the teaching</td>
<td>Execute from a usable device (I/O device or personal computer).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>pendant or operation panel.</td>
<td></td>
</tr>
<tr>
<td>21D5</td>
<td>Cannot operate from PC</td>
<td>1</td>
<td>Attempt was made to execute a process not executable from a personal</td>
<td>Execute from a device (I/O device, teaching pendant, or operation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>computer.</td>
<td>panel).</td>
</tr>
<tr>
<td>21D6</td>
<td>Cannot operate from external I/O</td>
<td>1</td>
<td>Attempt was made to execute a process not executable from the external I/O.</td>
<td>Execute from a usable device (personal computer, teaching pendant, or operation panel).</td>
</tr>
<tr>
<td>21D7</td>
<td>Select dummy I/O mode</td>
<td>1</td>
<td>Attempt was made to execute a process executable only in the dummy I/O mode.</td>
<td>Select the dummy I/O mode before executing the process again.</td>
</tr>
<tr>
<td>21D8</td>
<td>Release dummy I/O mode</td>
<td>1</td>
<td>Attempt was made to execute a process not executable in the dummy I/O mode.</td>
<td>Release the dummy I/O mode before executing the process again.</td>
</tr>
<tr>
<td>21D9</td>
<td>Hand cable disconnected</td>
<td>3</td>
<td>The hand cable between the robot controller and robot is disconnected.</td>
<td>Check for hand cable disconnection, contact failure of the connector and cable disconnection.</td>
</tr>
<tr>
<td>21DB</td>
<td>Failure to allocate memory</td>
<td>3</td>
<td>An attempt to allocate process memory was made to stop a batch of programs,</td>
<td>Turn OFF the controller power switch and restart the operation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>but the attempt failed.</td>
<td></td>
</tr>
<tr>
<td>21DC</td>
<td>Internal task stopped</td>
<td>5</td>
<td>The internal process task failed and the stop status activated,</td>
<td>⬆️</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>therefore, processing was aborted.</td>
<td></td>
</tr>
<tr>
<td>21DD</td>
<td>Undefined I/O device</td>
<td>2</td>
<td>Attempt was made to operate a device not defined as an I/O device.</td>
<td>⬆️</td>
</tr>
<tr>
<td>21DE</td>
<td>Release machine lock</td>
<td>2</td>
<td>Attempt was made to execute a process not executable in machine lock status.</td>
<td>Release machine lock before executing the process again.</td>
</tr>
<tr>
<td>21DF</td>
<td>Activate machine lock</td>
<td>2</td>
<td>Attempt was made to execute a process executable only in machine lock status.</td>
<td>Select machine lock before executing the process again.</td>
</tr>
</tbody>
</table>
## 2 Controller Error Code Table

<table>
<thead>
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<tbody>
<tr>
<td>21E0</td>
<td>Program is running</td>
<td>2</td>
<td>Attempt was made to execute a process not executable during program running.</td>
<td>Terminate all the programs before executing the process.</td>
</tr>
<tr>
<td>21E1</td>
<td>All programs stopped</td>
<td>2</td>
<td>Attempt was made to execute a process executable only during program running.</td>
<td>Run the program before executing the process again after.</td>
</tr>
<tr>
<td>21E2</td>
<td>Cannot execute in manual mode</td>
<td>2</td>
<td>Attempt was made to execute a process not executable in the manual mode.</td>
<td>Select a mode other than the manual mode before executing the process again.</td>
</tr>
<tr>
<td>21E3</td>
<td>Select manual mode</td>
<td>2</td>
<td>Attempt was made to execute a process executable only in the manual mode.</td>
<td>Select the manual mode before executing the process again.</td>
</tr>
<tr>
<td>21E4</td>
<td>Cannot execute in teach check mode</td>
<td>2</td>
<td>Attempt was made to execute a process not executable in the teach check mode.</td>
<td>Select a mode other than the teach check mode before executing the process again.</td>
</tr>
<tr>
<td>21E5</td>
<td>Select teach check mode</td>
<td>2</td>
<td>Attempt was made to execute a process executable only in the teach check mode.</td>
<td>Execute again after selecting the teach check mode.</td>
</tr>
<tr>
<td>21E6</td>
<td>Cannot execute in automatic mode</td>
<td>2</td>
<td>Attempt was made to execute a process not executable in the automatic mode.</td>
<td>Select a mode other than the automatic mode before executing the process again.</td>
</tr>
<tr>
<td>21E7</td>
<td>Select automatic mode</td>
<td>2</td>
<td>Attempt was made to execute a process executable only in the automatic mode.</td>
<td>Select the automatic mode before executing the process again.</td>
</tr>
<tr>
<td>21E8</td>
<td>Cannot execute in external mode</td>
<td>2</td>
<td>Attempt was made to execute a process not executable in the external mode.</td>
<td>Select a mode other than the external mode before executing the process again.</td>
</tr>
<tr>
<td>21E9</td>
<td>Select external mode</td>
<td>2</td>
<td>Attempt was made to execute a process executable only in the external mode.</td>
<td>Select the external mode before executing the process again.</td>
</tr>
<tr>
<td>21EA</td>
<td>CAL has been executed</td>
<td>2</td>
<td>Attempt was made to execute a process executable only before CAL processing.</td>
<td>Turn OFF the power switch and back ON and execute the process before executing CAL.</td>
</tr>
<tr>
<td>21EB</td>
<td>Release the deadman switch</td>
<td>2</td>
<td>Attempt was made to execute a process not executable with the deadman switch ON.</td>
<td>Release the deadman switch before executing the process again.</td>
</tr>
<tr>
<td>21EC</td>
<td>Press the deadman switch</td>
<td>2</td>
<td>Attempt was made to execute a process executable only with the deadman switch ON.</td>
<td>Press the deadman switch before executing the process again.</td>
</tr>
<tr>
<td>21ED</td>
<td>Robot stop OFF</td>
<td>2</td>
<td>Attempt was made to execute a process not executable with the robot stop status OFF.</td>
<td>Turn ON the robot stop status before executing the process again.</td>
</tr>
<tr>
<td>21EE</td>
<td>Halt ON</td>
<td>2</td>
<td>Attempt was made to execute a process not executable with the halt I/O input ON.</td>
<td>Turn OFF the halt I/O input before executing the process again.</td>
</tr>
<tr>
<td>21EF</td>
<td>Halt OFF</td>
<td>2</td>
<td>Attempt was made to execute a process not executable with the halt I/O input OFF.</td>
<td>Turn ON the halt I/O input before executing the process again.</td>
</tr>
<tr>
<td>21F0</td>
<td>Step stop ON</td>
<td>2</td>
<td>Attempt was made to execute a process not executable with the step stop I/O input ON.</td>
<td>Turn OFF the step stop I/O input before executing the process again.</td>
</tr>
</tbody>
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<tbody>
<tr>
<td>21F1</td>
<td>Step stop OFF</td>
<td>2</td>
<td>Attempt was made to execute a process executable with the step stop I/O input OFF.</td>
<td>Turn ON the step stop I/O input before executing the process again.</td>
</tr>
<tr>
<td>21F2</td>
<td>Enable Auto ON</td>
<td>2</td>
<td>Attempt was made to execute a process executable with the automatic enable I/O input ON.</td>
<td>Turn OFF the automatic enable I/O input before executing the process again.</td>
</tr>
<tr>
<td>21F3</td>
<td>Enable Auto OFF</td>
<td>2</td>
<td>Attempt was made to execute a process not executable with the automatic enable I/O input OFF.</td>
<td>Turn ON the automatic enable I/O input before executing the process again.</td>
</tr>
<tr>
<td>21F4</td>
<td>Undefined I/O command</td>
<td>2</td>
<td>The status of the command area was not defined using the standard mode I/O.</td>
<td>1. Check if the status was defined as an I/O command.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. When the strobe signal is input, Check if the I/O command area status is secured.</td>
</tr>
<tr>
<td>21F5</td>
<td>Same program is running</td>
<td>2</td>
<td>During program execution, Attempt was made to execute the same program again.</td>
<td>Reconsider the process so that the same program does not start during program execution.</td>
</tr>
<tr>
<td>21F6</td>
<td>Can't change speed while program running</td>
<td>2</td>
<td>During program execution, a speed change command was received from the external device. However, it failed.</td>
<td>Change after the motion is finished, because changing the speed from the external device is prohibited during program execution.</td>
</tr>
<tr>
<td>21F7</td>
<td>Cannot take arm semaphore</td>
<td>4</td>
<td>1. A task having no arm semaphore tried to execute robot motion-related commands.</td>
<td>1. Take the arm semaphore with the TAKEARM statement, and execute the robot motion related commands.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Attempt was made to take arm semaphore but another task already had the arm semaphore.</td>
<td>2. Change the programs so that multiple programs do not attempt to take the arm semaphore at the same time.</td>
</tr>
<tr>
<td>21F8</td>
<td>Cannot release arm semaphore</td>
<td>4</td>
<td>Attempt was made to release the arm semaphore although another task has already taken the arm semaphore.</td>
<td>Edit the program so that the task that took the arm semaphore with the TAKEARM statement also releases the arm semaphore.</td>
</tr>
<tr>
<td>21F9</td>
<td>Cannot take vision semaphore</td>
<td>4</td>
<td>1. A task having no vision semaphore tried to execute vision related commands.</td>
<td>1. Execute vision-related commands after taking semaphore using the TAKEVIS statement.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Attempt was made to take the vision semaphore although another task already took the vision semaphore.</td>
<td>2. Change so that multiple programs do not attempt to take the vision semaphore at the same time.</td>
</tr>
<tr>
<td>21FA</td>
<td>Cannot release vision semaphore</td>
<td>4</td>
<td>Attempt was made to release the vision semaphore although another task has already taken the vision semaphore.</td>
<td>Edit the program so that the task that took the vision semaphore with the TAKEVIS statement also releases the vision semaphore.</td>
</tr>
<tr>
<td>21FB</td>
<td>Reserved output area writing error</td>
<td>3</td>
<td>An attempt was made to access a write-inhibited system area.</td>
<td>Check the output address.</td>
</tr>
<tr>
<td>21FC</td>
<td>Enable Auto signal OFF</td>
<td>2</td>
<td>In the internal and external mode, the external automatic enable signal turned OFF.</td>
<td>Match the select SW and the external automatic enable signal status and then determine the mode.</td>
</tr>
<tr>
<td>21FD</td>
<td>Enable Auto signal ON</td>
<td>2</td>
<td>In the manual and teach check mode, the external automatic enable signal turned ON.</td>
<td>Match the select SW and the external automatic enable signal status and then determine the mode.</td>
</tr>
<tr>
<td>21FE</td>
<td>Power OFF during compiling</td>
<td>4</td>
<td>The controller power supply turned OFF during compiling.</td>
<td>Compile again or transfer an execution file from WINCAPSII.</td>
</tr>
<tr>
<td>222E</td>
<td>Communication to restart failed (master)</td>
<td>2</td>
<td>Communication of the DeviceNet master restarted after parameter change, but it failed.</td>
<td>Confirm whether the cable connected to the DeviceNet master board is loosened, and restart communication by rescanning.</td>
</tr>
</tbody>
</table>
### 2 Controller Error Code Table

<table>
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</table>
| 2257 | Reading failure due to CRC error | 5 | Reading failed due to abnormal check sum in CRC of the read data. | 1. Check to see that the FG (frame ground) terminals of the robot body and controller are grounded.  
2. Check to see that there is no noise-generating equipment (welder, etc.) near the robot body and controller.  
3. Operate the robot again after turning the controller power off once.  
4. If the same error occurs again, the data is destroyed. Manually input the setting data again. |
| 225B | DeviceNet master data is not found | 2 | The controller power was turned OFF during compilation. | Recompile or transfer an execution file from WINCAPS II. |
| 235A | Power off while receiving data | 2 | When high-speed transfer setting was valid, the power was turned OFF without saving data during transfer from WINCAPS II to the controller or after transfer ended. | When this error occurred, the execution-format file gets undefined, and deleted.  
After transfer ended, save the file or edit it with the teaching pendant for compilation. |
| 235B | Power OFF during files saving | 5 | The power was turned OFF during file saving. The program file may be destroyed. | Restart the system and then confirm the contents of the program file.  
Perform transfer, editing, and compilation as required. |
| 235C | Files saving | 2 | This operation is invalid because file saving is in progress. | Perform this operation after file saving ends. |
| 23E9 | Semaphore error | 4 | Access to I/O failed. | Turn OFF the controller power switch and restart the operation. |
| 2481 | Arm-end position out of allowable range | 3 | In Continue-start operation the distance between the auto-adjustment position and the present position is out of allowable range. | Increase parameters of arm allowable range of auto position adjustment. |
| 2490 | Forbidden area 0 invasion | 4 | Tool-end invaded forbidden area | Cancel area 0 during motor off and move out of area 0, then make area 0 effective.  
Release machine-lock when machine-lock occurs. |
| 2491 | Forbidden area 1 invasion | 4 | Tool-end invaded forbidden area | Cancel area 1 during motor off and move out of area 1, then make area 1 effective.  
Release machine-lock when machine-lock occurs. |
| 2492 | Forbidden area 2 invasion | 4 | Tool-end invaded forbidden area | Cancel area 2 during motor off and move out of area 2, then make area 2 effective.  
Release machine-lock when machine-lock occurs. |
| 2493 | Forbidden area 3 invasion | 4 | Tool-end invaded forbidden area | Cancel area 3 during motor off and move out of area 3, then make area 3 effective.  
Release machine-lock when machine-lock occurs. |
| 2494 | Forbidden area 4 invasion | 4 | Tool-end invaded forbidden area | Cancel area 4 during motor off and move out of area 4, then make area 4 effective.  
Release machine-lock when machine-lock occurs. |
| 2495 | Forbidden area 5 invasion | 4 | Tool-end invaded forbidden area | Cancel area 5 during motor off and move out of area 5, then make area 5 effective.  
Release machine-lock when machine-lock occurs. |
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</thead>
<tbody>
<tr>
<td>2496</td>
<td>Forbidden area 6 invasion</td>
<td>4</td>
<td>Tool-end invaded forbidden area</td>
<td>Cancel area 6 during motor off and move out of area 6, then make area 6 effective. Release machine-lock when machine-lock occurs.</td>
</tr>
<tr>
<td>2497</td>
<td>Forbidden area 7 invasion</td>
<td>4</td>
<td>Tool-end invaded forbidden area</td>
<td>Cancel area 7 during motor off and move out of area 7, then make area 7 effective. Release machine-lock when machine-lock occurs.</td>
</tr>
<tr>
<td>24A0</td>
<td>Time to change robot backup battery</td>
<td>1</td>
<td>It is time to replace the encoder backup battery (robot).</td>
<td>Replace the encoder backup battery (robot).</td>
</tr>
<tr>
<td>27A0</td>
<td>Initialized</td>
<td>5</td>
<td>The RAM drive was cleared due to a RAM drive initialization error.</td>
<td>Restart the controller and set each item again.</td>
</tr>
<tr>
<td>27A1</td>
<td>Deletion of program/variables completed</td>
<td>5</td>
<td>The ROM drive (programs and variables) was cleared by ROM drive initialization error.</td>
<td>Restart the controller and load programs and variables in the controller again.</td>
</tr>
<tr>
<td>27A2</td>
<td>Forbidden operation in FD processing</td>
<td>2</td>
<td>Forbidden operation was executed during FD (floppy disk) processing.</td>
<td>Execute the operation again after FD (floppy disk) process is finished.</td>
</tr>
<tr>
<td>27A3</td>
<td>Write-enable setting overlapped</td>
<td>2</td>
<td>Two or more ports are selected from COM2, COM3, COM4 and Ethernet as the read /write port in communication permission setting.</td>
<td>Select only one port from COM2, COM3, COM4, and Ethernet in communication permission setting.</td>
</tr>
<tr>
<td>27A4</td>
<td>Illegal character used in file name</td>
<td>2</td>
<td>File name has unusable characters.</td>
<td>Change the file name.</td>
</tr>
<tr>
<td>27A5</td>
<td>FD processing failed (internal error)</td>
<td>3</td>
<td>Internal error occurred during FD (floppy disk) processing.</td>
<td>To retry FD processing, turn OFF the controller power switch and restart the operation.</td>
</tr>
<tr>
<td>27A6</td>
<td>Not executable due to fatal error</td>
<td>2</td>
<td>Forbidden operation was executed when a serious error (level 5 or higher) occurred.</td>
<td>Turn OFF the controller power switch and restart the operation.</td>
</tr>
<tr>
<td>27A7</td>
<td>Initial communication error in TP/OP</td>
<td>4</td>
<td>Communication error occurred in TP (Teaching Pendant) or OP (Operation Panel) when the controller was started.</td>
<td>Turn OFF the power switch of the controller and restart the operation. If the error persists, replace the teaching pendant or operation panel.</td>
</tr>
<tr>
<td>27A8</td>
<td>Continue-start error</td>
<td>3</td>
<td>Continue-start was executed when it was not permitted.</td>
<td>Execute Continue-start only when Continue-start permission signal is ON.</td>
</tr>
<tr>
<td>27A9</td>
<td>Continue-start failed</td>
<td>4</td>
<td>Executed operation was not permitted during Continue-start.</td>
<td>Do not execute such operations during Continue-start.</td>
</tr>
<tr>
<td>27AA</td>
<td>Program reset signal ON</td>
<td>2</td>
<td>Program reset signal is ON.</td>
<td>Turn OFF reset signal and retry.</td>
</tr>
<tr>
<td>27AB</td>
<td>Failed in auto position adjustment</td>
<td>4</td>
<td>Failed in auto position adjustment at Continue-start.</td>
<td>Robot moved to the position unrecoverable by auto position adjustment.</td>
</tr>
<tr>
<td>27AC</td>
<td>System Update busy</td>
<td>2</td>
<td>Executed operation is not permitted during System Update.</td>
<td>Turn OFF the controller power switch after System Update and restart the operation.</td>
</tr>
<tr>
<td>27AD</td>
<td>System Update completed</td>
<td>5</td>
<td>System Update is completed.</td>
<td>Reboot the controller.</td>
</tr>
</tbody>
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<tr>
<td>27AE</td>
<td>System Update failed.</td>
<td>5</td>
<td>Failed in System Update.</td>
<td>Retry System Update. (The controller does not restart if power is shut down before System Update completion.)</td>
</tr>
<tr>
<td>27AF</td>
<td>System Update not permitted.</td>
<td>2</td>
<td>System Update was executed from WINCAPS II when not permitted by the controller.</td>
<td>Permit System Update from WINCAPS II with the controller.</td>
</tr>
<tr>
<td>27B0</td>
<td>Robot type undefined.</td>
<td>2</td>
<td>Robot type is undefined.</td>
<td>Robot type is not defined. Set the Robot type with Pendant or transfer the saved data. Robot type is set on the data transfer. Then reboot the controller.</td>
</tr>
<tr>
<td>27B1</td>
<td>Robot type inconsistent</td>
<td>2</td>
<td>Robot type is not consistent.</td>
<td>Robot type saved in FD and the Robot type of the controller is inconsistent. Set the Robot type with Pendant and then reboot the controller.</td>
</tr>
<tr>
<td>27B2</td>
<td>Flash area allocation error.</td>
<td>2</td>
<td>Could not allocate Flash area to save control logs.</td>
<td>Cannot allocate Flash area to save control logs. Collect control log data with WINCAPS II before power shut down.</td>
</tr>
<tr>
<td>27C0</td>
<td>Starting from the step upon power interruption by [Conti-start] upon power recovery</td>
<td>1</td>
<td>The program is normally restored to the state upon power interruption.</td>
<td>Operation restarts from the state upon power interruption by [Conti-start].</td>
</tr>
<tr>
<td>27C1</td>
<td>Power recovery abnormality, abnormal program count</td>
<td>3</td>
<td>More than 32 program steps were running upon power interruption.</td>
<td>Power recovery failed. Since the program is executed from the start, restart operation after fully checking no influence on the equipment.</td>
</tr>
<tr>
<td>27C2</td>
<td>Power recovery abnormality, data error (memory over)</td>
<td>3</td>
<td>Failure in backup of the program information upon power interruption.</td>
<td>✈️</td>
</tr>
<tr>
<td>27C3</td>
<td>Power recovery abnormality, data error (process information)</td>
<td>3</td>
<td>✈️</td>
<td>✈️</td>
</tr>
<tr>
<td>27C4</td>
<td>Power recovery abnormality, data error (status information)</td>
<td>3</td>
<td>✈️</td>
<td>✈️</td>
</tr>
<tr>
<td>27C5</td>
<td>Power recovery abnormality, data error (continue information)</td>
<td>3</td>
<td>✈️</td>
<td>✈️</td>
</tr>
<tr>
<td>27C6</td>
<td>Power recovery abnormality, data error (servo information)</td>
<td>3</td>
<td>✈️</td>
<td>✈️</td>
</tr>
<tr>
<td>27C7</td>
<td>Power recovery abnormality, program starting failure</td>
<td>3</td>
<td>Failed in restoration to the state upon power interruption.</td>
<td>✈️</td>
</tr>
<tr>
<td>27C8</td>
<td>Power recovery abnormality, visual instruction executed upon power interruption</td>
<td>3</td>
<td>Power interruption occurred during execution of a visual instruction.</td>
<td>✈️</td>
</tr>
<tr>
<td>27C9</td>
<td>power recovery abnormality, INPUT or LINEINPUT executed upon power interruption</td>
<td>3</td>
<td>Power interruption occurred during data receiving.</td>
<td>✈️</td>
</tr>
<tr>
<td>27CA</td>
<td>Power recovery abnormality, semaphore in use upon power interruption</td>
<td>3</td>
<td>Power interruption occurred during execution of a program using semaphore.</td>
<td>✈️</td>
</tr>
</tbody>
</table>
## 2 Controller Error Code Table

<table>
<thead>
<tr>
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<th>Remedy</th>
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<tbody>
<tr>
<td>27CB</td>
<td>Power recovery abnormality, robot stop instructed</td>
<td>2</td>
<td>Robot stop instruction is ON upon returning to the automatic mode after power recovery.</td>
<td>Reset the robot stop instruction. Power recovery processing starts after resetting.</td>
</tr>
<tr>
<td>27CC</td>
<td>Power recovery abnormality, failed in data saving upon power interruption</td>
<td>3</td>
<td>Failed in backup of the program information upon power interruption.</td>
<td>Power recovery failed. Since the program is executed from the start, restart operation after fully checking no influence on the equipment.</td>
</tr>
<tr>
<td>27CD</td>
<td>Power recovery completed, restored to the state upon power interruption</td>
<td>1</td>
<td>The program is restored normally to the state upon power interruption.</td>
<td>Operation starts by [Conti-start] from the state upon power interruption.</td>
</tr>
<tr>
<td>27CF</td>
<td>Power recovery abnormality, memory reading error</td>
<td>3</td>
<td>Failed in restoration of the program state upon power interruption.</td>
<td>Power recovery failed. Since the program is executed from the start, restart operation after fully checking no influence on the equipment.</td>
</tr>
</tbody>
</table>
| 2AF1 | Encoder reference position error | 3 | When encoder valve in a state of power-on is different from in a state of power-off, it will be output as encoder reference position error. The followings are the 2 cases when an error occurs.  
・ Encoder has some trouble.  
・ Although encoder is in its normal state, a robot is operated after the power turned off. | Perform the position check operation or the all axes CALSET operation referring the Installation & Maintenance manual. |
| 2AF2 | During a software limit check release | 2 | The variable movement operation was done or the current position was got into the variable while temporarily releasing the software limit. | Perform after canceling the software limit temporarily releasing. |
| 330B | Project directory not found | 5 | A failure occurred in saved memory area of the program. | After turning OFF the controller power, turn it ON again and send the data (WINCAPS II or FD) again. |
| 330C | Cannot create project file | 3 | Memory capacity required for compiling was not sufficient or a failure occurred in memory area for storing programs. | Delete files not required and reduce the number of programs. If the error persists carry out the same remedy as 330B. |
| 330D | Cannot open program file | 3 | A failure occurred in saved memory area of the program. | After turning OFF the controller power, turn it ON again and send data (WINCAPS II or FD) again. |
| 330E | Cannot open compile condition set file | 3 | A failure occurred in saved memory area of the program. | Delete unnecessary files and reduce the number of programs. If the error persists carry out the same remedy as 330B. |
| 330F | Cannot create compile log file | 3 | Memory capacity required for compiling was not sufficient or a failure occurred in memory area for storing programs. | Delete unnecessary files and reduce the number of programs. If the error persists carry out the same remedy as 330B. |
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<tbody>
<tr>
<td>331E</td>
<td>Cannot find PAC file to be compiled</td>
<td>2</td>
<td>Compiling was executed without PAC file of compiling object.</td>
<td>Create a PAC file or transmit the PAC file from WINCAPS II. Then change the setting SW to Use and execute compiling.</td>
</tr>
<tr>
<td>331F</td>
<td>More than 256 PAC files to be compiled</td>
<td>2</td>
<td>Attempt was made to compile more than 256 PAC files.</td>
<td>Reduce the number of compiling object PAC files to 256 or less.</td>
</tr>
<tr>
<td>3A00</td>
<td>*** Aborts compile: error No. exceeds 100 ***</td>
<td>3</td>
<td>Compiling is discontinued because the number of errors exceeded 100.</td>
<td>Recompile after correcting the error.</td>
</tr>
<tr>
<td>3A01</td>
<td>Cannot find related files.</td>
<td>3</td>
<td>Could not find files for the date-check.</td>
<td>Check if program source files and include-files are not deleted.</td>
</tr>
</tbody>
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## 2 Controller Error Code Table

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<tr>
<td>3A02</td>
<td>Unknown file</td>
<td>3</td>
<td>Unknown file name was designated.</td>
<td>Compile information file of PAC manager output may be destroyed. Check the file system error condition.</td>
</tr>
<tr>
<td>3A03</td>
<td>File cannot open.</td>
<td>3</td>
<td>Impossible to open the file because of several reasons.</td>
<td>Check if the file is present or is in accessible condition.</td>
</tr>
<tr>
<td>3B00</td>
<td>Not SELECT statement</td>
<td>3</td>
<td>The block command that corresponds to the END SELECT statement is not SELECT CASE.</td>
<td>Describe the corresponding SELECT CASE statement.</td>
</tr>
<tr>
<td>3B01</td>
<td>Not IF or ELSEIF</td>
<td>3</td>
<td>The block command corresponding to the END IF statement is not the IF statement or the ELSEIF statement.</td>
<td>Describe the corresponding IF statement or ELSEIF statement.</td>
</tr>
<tr>
<td>3B02</td>
<td>Repeat/conditional statement not closed</td>
<td>3</td>
<td>Block is not closed because the beginning and end of the repeat statement or the conditional statement do not correspond.</td>
<td>Check the correspondence of the repeat statement or the conditional statement.</td>
</tr>
<tr>
<td>3B03</td>
<td>Mismatch between IF and END IF</td>
<td>3</td>
<td>IF statement corresponding to END IF statement was not found.</td>
<td>Describe the corresponding IF statement or ELSEIF statement.</td>
</tr>
<tr>
<td>3B04</td>
<td>Mismatch between SELECT and ENDSELECT</td>
<td>3</td>
<td>SELECT CASE corresponding to END SELECT was not found.</td>
<td>Describe the corresponding SELECT CASE statement.</td>
</tr>
<tr>
<td>3B05</td>
<td>CASE statement not found</td>
<td>3</td>
<td>Although there is no CASE, CASE ELSE is described.</td>
<td>Be sure to describe at least one CASE statement if a CASE ELSE statement is used.</td>
</tr>
<tr>
<td>3B06</td>
<td>Previous statement not including SELECT</td>
<td>3</td>
<td>The statement before the first CASE is not a SELECT statement.</td>
<td>Before the first CASE statement, be sure to make the SELECT CASE statement.</td>
</tr>
<tr>
<td>3B07</td>
<td>Mismatch between SELECT and ENDSELECT</td>
<td>3</td>
<td>The SELECT CASE statement corresponding to the END SELECT was not found.</td>
<td>Describe the corresponding SELECT CASE statement.</td>
</tr>
<tr>
<td>3B08</td>
<td>Wrong loop variable</td>
<td>3</td>
<td>A variable other than a numeric value was designated as the loop variable (FOR statement).</td>
<td>Set the loop variable designated with the FOR statement to a numeric variable.</td>
</tr>
<tr>
<td>3B09</td>
<td>Mismatch between FOR and NEXT</td>
<td>3</td>
<td>The FOR statement corresponding to the NEXT statement was not found.</td>
<td>Describe the corresponding FOR statement.</td>
</tr>
<tr>
<td>3B0A</td>
<td>Wrong loop variable</td>
<td>3</td>
<td>A local variable other than a numeric value was designated as the loop variable (NEXT statement).</td>
<td>Set the loop variable designated with the NEXT statement to a numeric variable.</td>
</tr>
<tr>
<td>3B0B</td>
<td>Wrong loop variable</td>
<td>3</td>
<td>A global variable other than a numeric value was designated as the loop variable (NEXT statement).</td>
<td>Set the loop variable designated with the NEXT statement as a numeric variable.</td>
</tr>
<tr>
<td>3B0C</td>
<td>Mismatch between DO and LOOP</td>
<td>3</td>
<td>The DO statement corresponding to the LOOP statement was not found.</td>
<td>Describe the corresponding DO statement.</td>
</tr>
<tr>
<td>3B0D</td>
<td>Mismatch between REPEAT and UNTIL</td>
<td>3</td>
<td>The REPEAT statement corresponding to the UNTIL statement was not found.</td>
<td>Describe the corresponding REPEAT statement.</td>
</tr>
<tr>
<td>3B0E</td>
<td>Mismatch between WHILE and WEND</td>
<td>3</td>
<td>The WHILE statement corresponding to the WEND statement was not found.</td>
<td>Describe the corresponding WHILE statement.</td>
</tr>
<tr>
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<tr>
<td>-------</td>
<td>----------------------------------</td>
<td>----</td>
<td>-----------------------------------------------------------------------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>3B0F</td>
<td>Not positional data</td>
<td>3</td>
<td>Expected data was not pose type (types P, J and T).</td>
<td>Specify the pose type data.</td>
</tr>
<tr>
<td>3B10</td>
<td>EXIT DO is not between DO and</td>
<td>3</td>
<td>EXIT DO was described out of DO ~ LOOP.</td>
<td>Check the description position of the EXIT DO statement.</td>
</tr>
<tr>
<td></td>
<td>LOOP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3B11</td>
<td>EXIT FOR is not between FOR and</td>
<td>3</td>
<td>EXIT FOR was described out of FOR ~ NEXT.</td>
<td>Check the description position of the EXIT FOR statement.</td>
</tr>
<tr>
<td></td>
<td>NEXT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3B12</td>
<td>Type not usable for SELECT CASE</td>
<td>3</td>
<td>Type not usable for condition of SELECT CASE was found.</td>
<td>Check the designated type.</td>
</tr>
<tr>
<td>3B13</td>
<td>Type J data</td>
<td>3</td>
<td>Although the joint type was expected another data type was designated.</td>
<td>Describe joint type data.</td>
</tr>
<tr>
<td>3B16</td>
<td>Not type J data</td>
<td>3</td>
<td>Although the joint type was expected, another data type was designated.</td>
<td>Describe joint type data.</td>
</tr>
<tr>
<td>3B17</td>
<td>Not type V data</td>
<td>3</td>
<td>Although the vector type was expected, another data type was designated.</td>
<td>Describe Vector type data.</td>
</tr>
<tr>
<td>3B18</td>
<td>Not type P data</td>
<td>3</td>
<td>Although the position type was expected, another data type was designated.</td>
<td>Describe position type data.</td>
</tr>
<tr>
<td>3B19</td>
<td>Not type T data</td>
<td>3</td>
<td>Although the homogeneous transformation type was expected, another data type was designated.</td>
<td>Describe homogeneous transformation type data.</td>
</tr>
<tr>
<td>3B1A</td>
<td>Type V data</td>
<td>3</td>
<td>Although the vector type was expected, another data type was designated.</td>
<td>Describe vector type data.</td>
</tr>
<tr>
<td>3B1B</td>
<td>Not type I data</td>
<td>3</td>
<td>Although the integer type was expected, another data type was designated.</td>
<td>Describe integer type data.</td>
</tr>
<tr>
<td>3B1C</td>
<td>Not type F data</td>
<td>3</td>
<td>Although the single precision real type was expected, another data type was designated.</td>
<td>Describe data of single precision real type.</td>
</tr>
<tr>
<td>3B1E</td>
<td>Type T data</td>
<td>3</td>
<td>Although the homogeneous transformation type was expected, another data type was designated.</td>
<td>Describe homogeneous transformation type data.</td>
</tr>
<tr>
<td>3B21</td>
<td>Wrong name</td>
<td>3</td>
<td>Improper name designated as program name.</td>
<td>Correct the name.</td>
</tr>
<tr>
<td>3B22</td>
<td>Wrong interpolation method</td>
<td>3</td>
<td>Interpolation method was ignored or the designation was wrong.</td>
<td>Designate correct interpolation method.</td>
</tr>
<tr>
<td>3B23</td>
<td>Not type D data</td>
<td>3</td>
<td>Although the double precision real type was expected, another data type was designated.</td>
<td>Describe data of the double precision real type.</td>
</tr>
<tr>
<td>3B25</td>
<td>Not type S data</td>
<td>3</td>
<td>Although the character string type was expected, another data type was designated.</td>
<td>Describe data of the character string.</td>
</tr>
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<tr>
<td>3B38</td>
<td>Wrong operator</td>
<td>3</td>
<td>An unexpected operator appeared.</td>
<td>Check the operators.</td>
</tr>
<tr>
<td>3B39</td>
<td>Type not usable for condition statement</td>
<td>3</td>
<td>Data type not usable for comparison with a conditional statement was used.</td>
<td>Check the described data type.</td>
</tr>
<tr>
<td>3B3A</td>
<td>Wrong relational operator</td>
<td>3</td>
<td>An unexpected relational operator appeared.</td>
<td>Check the relational operator.</td>
</tr>
<tr>
<td>3B3B</td>
<td>Not an I/O variable</td>
<td>3</td>
<td>Undefined name used as an I/O variable.</td>
<td>Check the type of the variable.</td>
</tr>
<tr>
<td>3B3C</td>
<td>Wrong subscript No. in array variable</td>
<td>3</td>
<td>Array subscript number was different from the dimension number when it was defined.</td>
<td>Check the designated number of dimensions.</td>
</tr>
<tr>
<td>3B3D</td>
<td>Subscript value out of permissible range</td>
<td>3</td>
<td>Subscript of &lt;Error in execution&gt; array exceeded the defined range.</td>
<td>Check the value of the variable used as a subscript.</td>
</tr>
<tr>
<td>3B3E</td>
<td>Value out of permissible range</td>
<td>3</td>
<td>A value designated as an &lt;Error in execution&gt; argument exceeded the permissible range.</td>
<td>Check the value of the variable used as an argument.</td>
</tr>
<tr>
<td>3B42</td>
<td>Wrong sign</td>
<td>3</td>
<td>The sign is wrong.</td>
<td>Remove the sign.</td>
</tr>
<tr>
<td>3B43</td>
<td>Wrong number of type P variable elements</td>
<td>3</td>
<td>Position type variable was designated. However, the number of elements exceeded that of the position type variable.</td>
<td>Check the number of elements.</td>
</tr>
<tr>
<td>3B44</td>
<td>Wrong number of type J variable elements</td>
<td>3</td>
<td>Joint type variable was designated. However, the number of elements exceeded that of the joint type variable.</td>
<td>Check the number of elements.</td>
</tr>
<tr>
<td>3B47</td>
<td>Wrong reference</td>
<td>3</td>
<td>A variable not defined as an array was referred.</td>
<td>Check the definition of variables.</td>
</tr>
<tr>
<td>3B48</td>
<td>Wrong number of type V variable elements</td>
<td>3</td>
<td>Vector type variable was designated. However, the number of elements exceeded that of the vector type variable.</td>
<td>Check the number of elements.</td>
</tr>
<tr>
<td>3B49</td>
<td>Wrong number of type T variable elements</td>
<td>3</td>
<td>Homogeneous transformation type variable was designated. However, the number of elements exceeded that of the homogeneous transformation type variable.</td>
<td>Check the number of elements.</td>
</tr>
<tr>
<td>3B4E</td>
<td>Wrong command format</td>
<td>3</td>
<td>Described command and expression did not conform to the format.</td>
<td>Check the described contents.</td>
</tr>
<tr>
<td>3BF9</td>
<td>Too many arguments for macro function</td>
<td>3</td>
<td>The number of macro function arguments exceeded 32.</td>
<td>Check the number of arguments for macro declaration.</td>
</tr>
<tr>
<td>3BFA</td>
<td>Too many uses of #define</td>
<td>3</td>
<td>#define exceeded 2048 (the maximum number allowable for definition).</td>
<td>The #define cannot define more than this. Delete unnecessary definitions with #undef if required.</td>
</tr>
<tr>
<td>3BFB</td>
<td>Identifier not found</td>
<td>3</td>
<td>Macro name not defined.</td>
<td>Describe the macro name after #define.</td>
</tr>
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<tr>
<td>3BFC</td>
<td>Definition contents not found</td>
<td>3</td>
<td>Macro extension contents not defined.</td>
<td>Describe the contents after the macro name in macro name definition.</td>
</tr>
<tr>
<td>3BFD</td>
<td>Wrong macro function</td>
<td>3</td>
<td>Macro function definition was wrong.</td>
<td>Check the error and correct it.</td>
</tr>
<tr>
<td>3BFE</td>
<td>Use of kana or kanji</td>
<td>3</td>
<td>2-byte characters and half size katakana character were found in other than comment or character string.</td>
<td>Check if 2-byte code (kanji) and half size katakana are present.</td>
</tr>
<tr>
<td>3BFF</td>
<td>Error</td>
<td>3</td>
<td>Successive message was a character string defined with #error.</td>
<td>Delete if required.</td>
</tr>
<tr>
<td>3C00</td>
<td>Wrong usage of &lt;&gt; or &quot;&quot;</td>
<td>3</td>
<td>Double quotations or parenthesis at the head and the tail of the file name in the #include statement did not correctly correspond.</td>
<td>Check if the correspondence is correct.</td>
</tr>
<tr>
<td>3C01</td>
<td>Wrong argument No.</td>
<td>3</td>
<td>Macro argument was different from the defined number.</td>
<td>Check the number of defined arguments.</td>
</tr>
<tr>
<td>3C02</td>
<td>File cannot open</td>
<td>3</td>
<td>A file designated with the #include statement could not be opened.</td>
<td>Check if the designated file is present.</td>
</tr>
<tr>
<td>3C03</td>
<td>Unusable statement</td>
<td>3</td>
<td>This statement is currently a reserved word.</td>
<td>Delete the statement or set it to a comment.</td>
</tr>
<tr>
<td>3C04</td>
<td>Not positional data</td>
<td>3</td>
<td>Designated type was not the pose type.</td>
<td>Describe data of the pose type.</td>
</tr>
<tr>
<td>3C05</td>
<td>Used in wrong position</td>
<td>3</td>
<td>Although the description position was limited in the program, it was not correctly described.</td>
<td>Check the described position and correct it.</td>
</tr>
<tr>
<td>3C09</td>
<td>Type P data</td>
<td>3</td>
<td>Although the position type was expected, another data type was designated.</td>
<td>Describe data of the position type.</td>
</tr>
<tr>
<td>3C19</td>
<td>Pass start displacement at relay</td>
<td>3</td>
<td>Path start displacement cannot be described at a relay point of the arc interpolation.</td>
<td>Remove the path start displacement at the relay point.</td>
</tr>
<tr>
<td>3C1A</td>
<td>TIME or SPEED option</td>
<td>3</td>
<td>TIME and SPEED options were designated together.</td>
<td>Delete one of the two.</td>
</tr>
<tr>
<td>3C1C</td>
<td>Same option defined twice</td>
<td>3</td>
<td>Attempt was made to use multiple options with the same meaning.</td>
<td>Use only one.</td>
</tr>
<tr>
<td>3C1D</td>
<td>Cannot specify negative value</td>
<td>3</td>
<td>A negative value cannot be described for precision designation.</td>
<td>Describe the precision designation with a positive value.</td>
</tr>
<tr>
<td>3C1E</td>
<td>No precision specified</td>
<td>3</td>
<td>Precision designation followed by @ was not present or not correct.</td>
<td>Describe the precision designation.</td>
</tr>
<tr>
<td>3C1F</td>
<td>Improper positioning accuracy</td>
<td>3</td>
<td>Designation of positioning accuracy was wrong.</td>
<td>Check the error and correct it.</td>
</tr>
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<td>3C21</td>
<td>Wrong designation of rotation plane</td>
<td>3</td>
<td>Designation of a rotation plane was wrong.</td>
<td>Check the designation of the rotation plane and correct it.</td>
</tr>
<tr>
<td>3C24</td>
<td>Wrong option</td>
<td>3</td>
<td>Designated option has an error.</td>
<td>Check the option and correct it.</td>
</tr>
<tr>
<td>3C2A</td>
<td>Undefined name</td>
<td>3</td>
<td>Attempt was made to refer to an undefined name.</td>
<td>Check the name and define it.</td>
</tr>
<tr>
<td>3C2C</td>
<td>Program not found</td>
<td>3</td>
<td>Valid program line was not present.</td>
<td>Describe the program.</td>
</tr>
<tr>
<td>3C2D</td>
<td>Double definition</td>
<td>3</td>
<td>Attempt was made to define the same name.</td>
<td>Check the name and correct it so that it does not overlap.</td>
</tr>
<tr>
<td>3C2E</td>
<td>Wrong subscript</td>
<td>3</td>
<td>In the PROGRAM statement, a subscript was not described for a program array argument.</td>
<td>Describe the number of subscripts for when arrays are to be handled.</td>
</tr>
<tr>
<td>3C2F</td>
<td>Wrong subscript in No. of array variable</td>
<td>3</td>
<td>In the PROGRAM statement, the described argument of the program array exceeded the dimension number range.</td>
<td>Define the number of array dimension from 1 to 3.</td>
</tr>
<tr>
<td>3C34</td>
<td>Too many arguments in a program</td>
<td>3</td>
<td>The number of program arguments exceeded 32.</td>
<td>Check the number of arguments and correct so that it does not exceed the upper limit.</td>
</tr>
<tr>
<td>3C35</td>
<td>No type name after AS</td>
<td>3</td>
<td>Type name followed by AS was not present.</td>
<td>Describe the type name.</td>
</tr>
<tr>
<td>3C36</td>
<td>Improper program name</td>
<td>3</td>
<td>The name was not accepted as a program name.</td>
<td>Check the program name.</td>
</tr>
<tr>
<td>3C37</td>
<td>Improper file name</td>
<td>3</td>
<td>The file name was not accepted as a program name.</td>
<td>Change the file name or use the PROGRAM statement to define the program name.</td>
</tr>
<tr>
<td>3C38</td>
<td>Program name is too long</td>
<td>3</td>
<td>The number of program characters exceeded 64.</td>
<td>Define the program name so that it does not exceed 64 characters.</td>
</tr>
<tr>
<td>3C39</td>
<td>Program PROn includes argument</td>
<td>3</td>
<td>An argument was described in a program that did not have an argument.</td>
<td>Arguments cannot be added to a program PRO&lt;Numeral&gt;.</td>
</tr>
<tr>
<td>3C3A</td>
<td>Plural program names are defined</td>
<td>3</td>
<td>Attempt was made to define multiple program names.</td>
<td>Check the name and correct it so that it does not overlap.</td>
</tr>
<tr>
<td>3C3B</td>
<td>Double definition</td>
<td>3</td>
<td>Attempt was made to define the same name.</td>
<td>Check the name and correct it so that it does not overlap.</td>
</tr>
<tr>
<td>3C3D</td>
<td>Wrong argument</td>
<td>3</td>
<td>In CALL statement, an argument was described in a program that did not have an argument.</td>
<td>Arguments cannot be added to a program PRO&lt;Numeral&gt;.</td>
</tr>
<tr>
<td>3C48</td>
<td>Plural cycle options are defined</td>
<td>3</td>
<td>Multiple cycle options were designated in the RUN statement.</td>
<td>Check the option and correct it.</td>
</tr>
</tbody>
</table>
## 2 Controller Error Code Table

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
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<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>3C49</td>
<td>Plural priority options are defined</td>
<td>3</td>
<td>Multiple priority options were designated in the RUN statement.</td>
<td>Check the option and correct it.</td>
</tr>
<tr>
<td>3C4A</td>
<td>Wrong option</td>
<td>3</td>
<td>An option in the RUN statement has an error.</td>
<td>Check the option and correct it.</td>
</tr>
<tr>
<td>3C4B</td>
<td>Wrong argument</td>
<td>3</td>
<td>In the RUN statement, an argument was described in a program that did not have an argument.</td>
<td>Arguments cannot be added to a program \texttt{PRO&lt;Numeral&gt;}.</td>
</tr>
<tr>
<td>3C51</td>
<td>Unsupported command</td>
<td>3</td>
<td>The command is currently not supported.</td>
<td>Delete this or set it to a comment.</td>
</tr>
<tr>
<td>3C53</td>
<td>Wrong use of command or function</td>
<td>3</td>
<td>There is an error in description of DEFEND.</td>
<td>Check the usage of the DEFEND statement and correct it.</td>
</tr>
<tr>
<td>3C54</td>
<td>Label name not defined</td>
<td>3</td>
<td>Attempt was made to refer to an undefined label.</td>
<td>Check the label name and correct it.</td>
</tr>
<tr>
<td>3C55</td>
<td>No quotation mark at the string end</td>
<td>3</td>
<td>The defined character string did not end in double quotations.</td>
<td>Add the double quotation at the end of the character string.</td>
</tr>
<tr>
<td>3C56</td>
<td>Value exceeds permissible range</td>
<td>3</td>
<td>The value exceeds the range that the PAC can handle.</td>
<td>Check the available value range and correct the value.</td>
</tr>
<tr>
<td>3C5A</td>
<td>Type V data</td>
<td>3</td>
<td>Although the vector type was expected, another data type was designated.</td>
<td>Describe data of the vector type.</td>
</tr>
<tr>
<td>3C5B</td>
<td>Type T data</td>
<td>3</td>
<td>Although the homogeneous transformation type was expected, another data type was designated.</td>
<td>Describe data of the homogeneous transformation type.</td>
</tr>
<tr>
<td>3C5C</td>
<td>Function</td>
<td>3</td>
<td>Function was specified where such command is not allowed.</td>
<td>Functions cannot be used.</td>
</tr>
<tr>
<td>3C5F</td>
<td>Circuit No.</td>
<td>3</td>
<td>Circuit number was ignored.</td>
<td>Check the circuit number and describe it.</td>
</tr>
<tr>
<td>3C63</td>
<td>Unusable function</td>
<td>3</td>
<td>The function is currently not usable.</td>
<td>Delete this or set this to a comment.</td>
</tr>
<tr>
<td>3C64</td>
<td>Function w/o argument has parentheses</td>
<td>3</td>
<td>An argument was described for a function without arguments.</td>
<td>Check the function specification and delete the arguments.</td>
</tr>
<tr>
<td>3C65</td>
<td>Argument is omitted</td>
<td>3</td>
<td>The specified function does not include an argument that cannot be omitted.</td>
<td>Describe the function without omitting the arguments.</td>
</tr>
<tr>
<td>3C66</td>
<td>Argument is omitted</td>
<td>3</td>
<td>The specified function does not include an argument that cannot be omitted.</td>
<td>Describe the function without omitting the arguments.</td>
</tr>
<tr>
<td>3C68</td>
<td>Wrong number of arguments</td>
<td>3</td>
<td>The designated function did not meet the number of required arguments.</td>
<td>Check the number of arguments and correct it.</td>
</tr>
</tbody>
</table>
## 2 Controller Error Code Table

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<tbody>
<tr>
<td>3C69</td>
<td>Function without any argument</td>
<td>3</td>
<td>An argument was not described in the function with an argument.</td>
<td>Check the function specification and describe the argument.</td>
</tr>
<tr>
<td>3C6A</td>
<td>User function not defined</td>
<td>3</td>
<td>Designated user function was not defined.</td>
<td>Check the function definition.</td>
</tr>
<tr>
<td>3C6B</td>
<td>Option for automatic line numbering</td>
<td>3</td>
<td>Although the “automatic line number” option was valid, the line number was described.</td>
<td>Check the program specification and correct the program.</td>
</tr>
<tr>
<td>3C6D</td>
<td>Wrong label name</td>
<td>3</td>
<td>A name not available for use (such as reserved word) was referred to as a label.</td>
<td>Check the label name.</td>
</tr>
<tr>
<td>3C6E</td>
<td>Wrong subscript No. of array variables</td>
<td>3</td>
<td>A position where the position type or vector type should have been designated had a description of variables with numbers of another type.</td>
<td>Describe data of the position type or vector type.</td>
</tr>
<tr>
<td>3C6F</td>
<td>Wrong subscript No. of array variables</td>
<td>3</td>
<td>The value described as an array subscript was not an integer.</td>
<td>Describe the array subscript with an integer.</td>
</tr>
<tr>
<td>3C70</td>
<td>Wrong subscript No. of array variables</td>
<td>3</td>
<td>Designated array dimension number and the subscript number were different.</td>
<td>Describe the array dimension number from 1 to 3.</td>
</tr>
<tr>
<td>3C71</td>
<td>Subscript of array out of range</td>
<td>3</td>
<td>Shown out of the range available to describe as a subscript of the array, when the array variable subscript was designated with constants.</td>
<td>Check the upper limit value for the subscript and correct it.</td>
</tr>
<tr>
<td>3C7D</td>
<td>Wrong postposition found</td>
<td>3</td>
<td>Different type postposition was described.</td>
<td>Check if there is a contradiction in the type and correct it.</td>
</tr>
<tr>
<td>3CA2</td>
<td>Wrong label definition</td>
<td>3</td>
<td>A name not available for use (such as reserved words) was defined as a label.</td>
<td>Check if a reserved word is not used.</td>
</tr>
<tr>
<td>3CA3</td>
<td>Too long character string</td>
<td>3</td>
<td>Character string is described exceeding 247 characters.</td>
<td>Correct the character string within 247 characters.</td>
</tr>
<tr>
<td>3CA4</td>
<td>More than 255 characters in a line</td>
<td>3</td>
<td>The number of characters exceeded 255, the number of characters available in a line of PAC language.</td>
<td>Correct so that the number of digits in a line is 255 or less.</td>
</tr>
<tr>
<td>3CA5</td>
<td>Table underflow</td>
<td>3</td>
<td>Attempt was made to read data of a number higher than registered from the corresponding process table.</td>
<td>Checks if the head and end of the block is a conditional branch pair such as an IF ~ THEN ~ ENDIF statement or a repeat command such as a FOR ~ NEXT statement.</td>
</tr>
<tr>
<td>3CA6</td>
<td>Table size over</td>
<td>3</td>
<td>Data registered in the corresponding process table exceeded the total number.</td>
<td>Change the table size by selecting “Compile” tab in “Set”.</td>
</tr>
<tr>
<td>3CA7</td>
<td>Error line No.</td>
<td>3</td>
<td>Multiple line numbers were present.</td>
<td>Check if the line numbers overlap.</td>
</tr>
<tr>
<td>3CA8</td>
<td>Line No. not defined</td>
<td>3</td>
<td>Designated line number was not defined.</td>
<td>Check if the designated line number is correct and if there is no line to designate then create it.</td>
</tr>
<tr>
<td>3CA9</td>
<td>Related file not found</td>
<td>3</td>
<td>Object file could not be found for date inspection.</td>
<td>Check if the program source file or include file is not deleted.</td>
</tr>
</tbody>
</table>
## Controller Error Code Table

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<tr>
<td>3CAA</td>
<td>loadModule</td>
<td>3</td>
<td>Reading of &lt;For HOST&gt; child process failed.</td>
<td>OS memory may be lacking. Check the OS status.</td>
</tr>
<tr>
<td>3CAB</td>
<td>symFindByName</td>
<td>3</td>
<td>The name for &lt;For HOST&gt; was not found.</td>
<td>There is a possibility that an execution file of the application was deleted or the status of the OS has changed.</td>
</tr>
<tr>
<td>3CAC</td>
<td>Unknown file</td>
<td>3</td>
<td>Unknown file name was designated.</td>
<td>The compile information file (output by PAC manager) may be broken. Check if the file system has an error.</td>
</tr>
<tr>
<td>3CAD</td>
<td>File cannot open</td>
<td>3</td>
<td>File cannot be opened.</td>
<td>Check if the file is present, or whether the status does not allow access to files.</td>
</tr>
<tr>
<td>3CAE</td>
<td>Wrong option</td>
<td>3</td>
<td>Wrong option when program was started.</td>
<td>The compile information file (output by PAC manager) may be broken. Check if the file system has an error.</td>
</tr>
<tr>
<td>3CB1</td>
<td>Undefined name</td>
<td>3</td>
<td>Designated name not yet defined.</td>
<td>Check the name and correct it.</td>
</tr>
<tr>
<td>3CB2</td>
<td>Type mismatch</td>
<td>3</td>
<td>Designated variable or constant type is wrong.</td>
<td>Check the designated data type and correct it.</td>
</tr>
<tr>
<td>3CB4</td>
<td>Too long name</td>
<td>3</td>
<td>An identifier or name was described using more than 64 characters.</td>
<td>Correct so that it is within 64 characters.</td>
</tr>
<tr>
<td>3CB5</td>
<td>Source file cannot open</td>
<td>3</td>
<td>Source input file could not be opened.</td>
<td>Check if the file is present, or whether the status does not allow access to files.</td>
</tr>
<tr>
<td>3CB6</td>
<td>Output object file cannot open</td>
<td>3</td>
<td>Object output file could not be opened.</td>
<td>Check if the disk capacity is full and whether file access is available.</td>
</tr>
<tr>
<td>3CB7</td>
<td>Variable and/or constant types not match</td>
<td>3</td>
<td>Specified variable or constant types are incorrect.</td>
<td>Check the specified data type and correct it.</td>
</tr>
<tr>
<td>3CB8</td>
<td>Improper use of command or function</td>
<td>3</td>
<td>The use of an instruction or a function is incorrect.</td>
<td>Check the format in the Program Instruction manual and correct it.</td>
</tr>
<tr>
<td>3CB9</td>
<td>Same program name is present</td>
<td>3</td>
<td>More than one program having the same name is defined.</td>
<td>Correct the program name so that the name is not used more than once.</td>
</tr>
<tr>
<td>3CBA</td>
<td>Double definition</td>
<td>3</td>
<td>More than one definition with the same name is defined.</td>
<td>Correct the definition name so that the name is not used more than once.</td>
</tr>
<tr>
<td>3CBB</td>
<td>Wrong command format</td>
<td>3</td>
<td>Syntax error.</td>
<td>Check the syntax and correct it.</td>
</tr>
<tr>
<td>3CBC</td>
<td>Program too large to be compiled</td>
<td>3</td>
<td>Compiling aborted because the buffer to output codes is full.</td>
<td>Reduce the size of one program by dividing the program into multiple programs.</td>
</tr>
<tr>
<td>3CBD</td>
<td>Too many nests</td>
<td>3</td>
<td>Nesting of included files exceeds 8 nests.</td>
<td>Correct the number of nests to 8 nests or less.</td>
</tr>
</tbody>
</table>
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<tr>
<td>3CBF</td>
<td>Improper function name</td>
<td>3</td>
<td>Improper name of a function is specified.</td>
<td>Correct the user function so that characters followed by FN are always alphabet letters.</td>
</tr>
<tr>
<td>3CC0</td>
<td>Invalid statement</td>
<td>2</td>
<td>The compiler setting caused the statement to become meaningless.</td>
<td>To make the statement valid, change the compiler setting with PROJECT SETTING.</td>
</tr>
<tr>
<td>3CC2</td>
<td>Error occurred during error processing</td>
<td>3</td>
<td>While processing errors &lt;Error in execution&gt; another error occurred.</td>
<td>Check the cause of the error and correct the program.</td>
</tr>
<tr>
<td>3CC3</td>
<td>Improper extension in #include statement</td>
<td>3</td>
<td>The extension of the specified include file is one that is not permitted.</td>
<td>Include files are limited to files with the extensions *.PAC or *.H, check the corresponding file extensions are correct.</td>
</tr>
<tr>
<td>3CC4</td>
<td>RESUME is in error processing routine</td>
<td>3</td>
<td>RESUME statement was executed with a normal process of &lt;Error in execution&gt;.</td>
<td>The RESUME statement is not present except for the error process or the control errors in processing due to branch commands other than the ON ERROR GOTO statement.</td>
</tr>
<tr>
<td>3D80</td>
<td>IC_DUMP is aborted</td>
<td>3</td>
<td>Processing aborted because an error occurred while creating the list file.</td>
<td>Check that there is sufficient free space on the disk and that the file is accessible.</td>
</tr>
<tr>
<td>3D81</td>
<td>Option error</td>
<td>3</td>
<td>Incorrect option at the start-up.</td>
<td>Compile information file of PAC manager output may be destroyed. Check the file system error condition.</td>
</tr>
<tr>
<td>3D82</td>
<td>Source file cannot open</td>
<td>3</td>
<td>Impossible to open the source input file because of several reasons.</td>
<td>Check if the file is present and available to access.</td>
</tr>
<tr>
<td>3D83</td>
<td>Output object file cannot open</td>
<td>3</td>
<td>Impossible to open the output object file because of several reasons.</td>
<td>Check if the disk capacity is not full and the file is available to access.</td>
</tr>
<tr>
<td>3E00</td>
<td>Option error</td>
<td>3</td>
<td>Incorrect option at the start-up.</td>
<td>Compile information file of PAC manager output may be destroyed. Check the file system error condition.</td>
</tr>
<tr>
<td>3F01</td>
<td>File cannot open</td>
<td>3</td>
<td>Impossible to open the file because the file is not found or an error occurred.</td>
<td>Check if the file is present and that the file is available to access.</td>
</tr>
<tr>
<td>3F02</td>
<td>File writing error</td>
<td>3</td>
<td>An error occurred in writing files.</td>
<td>Check that there is sufficient free space on the disk and that the file is accessible.</td>
</tr>
<tr>
<td>3F04</td>
<td>Memory cannot be allocated</td>
<td>3</td>
<td>Working memory for the linker was not allocated normally.</td>
<td>Increase the available memory by changing the OS setting.</td>
</tr>
<tr>
<td>3F05</td>
<td>Table overflow</td>
<td>3</td>
<td>The table size exceeded the one used in the link.</td>
<td>Change the size of the corresponding table in the tab menu by clicking SETTING and then MAKE.</td>
</tr>
<tr>
<td>3F06</td>
<td>Too many libraries</td>
<td>3</td>
<td>Too many link libraries in the program.</td>
<td>Reduce the number of link libraries.</td>
</tr>
<tr>
<td>3F07</td>
<td>Too many objects</td>
<td>3</td>
<td>Too many link objects in the program.</td>
<td>Reduce the number of link libraries.</td>
</tr>
<tr>
<td>3F08</td>
<td>Option error</td>
<td>3</td>
<td>Incorrect option at the start-up.</td>
<td>Compile information file of PAC manager output may be destroyed. Check the file system error condition.</td>
</tr>
<tr>
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</tr>
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<td>--------</td>
<td>----------------------------------</td>
<td>----</td>
<td>------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>3F09</td>
<td>Same program name is present</td>
<td>3</td>
<td>More than one program having the same name is defined.</td>
<td>Correct the program name avoiding duplication.</td>
</tr>
<tr>
<td>3F0A</td>
<td>Undefined name</td>
<td>3</td>
<td>Designated name is not defined.</td>
<td>Check the name and correct properly.</td>
</tr>
<tr>
<td>3F0B</td>
<td>Type mismatch</td>
<td>3</td>
<td>Designated variable or constant type is wrong.</td>
<td>Check the designated data type and correct properly.</td>
</tr>
<tr>
<td>42A1</td>
<td>Vision board not mounted</td>
<td>2</td>
<td>1. The vision board is not mounted.</td>
<td>1. Mount the vision board.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Cannot recognize vision board.</td>
<td>2. Delete the vision only instructions from the program.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3. If the vision board is mounted, initialize the vision board from the</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>teaching board.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4. Turn OFF the power switch ON the controller and restart the</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>operation.</td>
</tr>
<tr>
<td>42A2</td>
<td>Vision parameter 1 out of range</td>
<td>3</td>
<td>Parameter 1 of the vision command is out of range.</td>
<td>Correct the corresponding parameters.</td>
</tr>
<tr>
<td>42A3</td>
<td>Vision parameter 2 out of range</td>
<td>3</td>
<td>Parameter 2 of the vision command is out of range.</td>
<td>Correct the corresponding parameters.</td>
</tr>
<tr>
<td>42A4</td>
<td>Vision parameter 3 out of range</td>
<td>3</td>
<td>Parameter 3 of the vision command is out of range.</td>
<td>Correct the corresponding parameters.</td>
</tr>
<tr>
<td>42A5</td>
<td>Vision parameter 4 out of range</td>
<td>3</td>
<td>Parameter 4 of the vision command is out of range.</td>
<td>Correct the corresponding parameters.</td>
</tr>
<tr>
<td>42A6</td>
<td>Vision parameter 5 out of range</td>
<td>3</td>
<td>Parameter 5 of the vision command is out of range.</td>
<td>Correct the corresponding parameters.</td>
</tr>
<tr>
<td>42A7</td>
<td>Vision parameter 6 out of range</td>
<td>3</td>
<td>Parameter 6 of the vision command is out of range.</td>
<td>Correct the corresponding parameters.</td>
</tr>
<tr>
<td>42A8</td>
<td>Vision parameter 7 out of range</td>
<td>3</td>
<td>Parameter 7 of the vision command is out of range.</td>
<td>Correct the corresponding parameters.</td>
</tr>
<tr>
<td>42A9</td>
<td>Vision parameter 8 out of range</td>
<td>3</td>
<td>Parameter 8 of the vision command is out of range.</td>
<td>Correct the corresponding parameters.</td>
</tr>
<tr>
<td>42AA</td>
<td>Vision parameter 9 out of range</td>
<td>3</td>
<td>Parameter 9 of the vision command is out of range.</td>
<td>Correct the corresponding parameters.</td>
</tr>
<tr>
<td>42AB</td>
<td>Vision parameter 10 out of range</td>
<td>3</td>
<td>Parameter 10 of the vision command is out of range.</td>
<td>Correct the corresponding parameters.</td>
</tr>
<tr>
<td>42AC</td>
<td>Vision parameter 11 out of range</td>
<td>3</td>
<td>Parameter 11 of the vision command is out of range.</td>
<td>Correct the corresponding parameters.</td>
</tr>
<tr>
<td>42AD</td>
<td>Vision parameter 12 out of range</td>
<td>3</td>
<td>Parameter 12 of the vision command is out of range.</td>
<td>Correct the corresponding parameters.</td>
</tr>
<tr>
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</tr>
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<td>-------</td>
<td>----------------------------------------</td>
<td>----</td>
<td>-----------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>42AE</td>
<td>Vision parameter 13 out of range</td>
<td>3</td>
<td>Parameter 13 of the vision command is out of range.</td>
<td>Correct the corresponding parameters.</td>
</tr>
<tr>
<td>42AF</td>
<td>Vision parameter 14 out of range</td>
<td>3</td>
<td>Parameter 14 of the vision command is out of range.</td>
<td>Correct the corresponding parameters.</td>
</tr>
<tr>
<td>42B0</td>
<td>Transmission command failure</td>
<td>3</td>
<td>A failure occurred in the communication protocol with the vision board</td>
<td>1. Initialize the vision board from the teaching board. 2. Turn OFF the power switch ON the controller and restart the operation.</td>
</tr>
<tr>
<td>42B1</td>
<td>Reception command failure</td>
<td>3</td>
<td>A failure occurred in the communication protocol with the vision board</td>
<td>1. Initialize the vision board from the teaching board. 2. Turn OFF the power switch ON the controller and restart the operation.</td>
</tr>
<tr>
<td>42B2</td>
<td>Camera input error</td>
<td>3</td>
<td>1. The camera is not connected. 2. A failure was detected with the camera or</td>
<td>1. Connect the camera. 2. Initialize the vision board from the teaching board. 3. Reboot the camera and the controller power.</td>
</tr>
<tr>
<td>42B3</td>
<td>Vision undefined command</td>
<td>3</td>
<td>1. Undefined instruction for the vision board 2. Communication error occurred.</td>
<td>1. Initialize the vision board from the teaching board. 2. Turn OFF the power switch ON the controller and restart the operation.</td>
</tr>
<tr>
<td>42B4</td>
<td>No response from vision board</td>
<td>3</td>
<td>A vision board communication error.</td>
<td>1. Initialize the vision board from the teaching board. 2. Turn OFF the power switch ON the controller and restart the operation.</td>
</tr>
<tr>
<td>42B5</td>
<td>Vision board failure</td>
<td>3</td>
<td>A vision board communication error.</td>
<td>1. Initialize the vision board from the teaching board. 2. Turn OFF the power switch ON the controller and restart the operation.</td>
</tr>
<tr>
<td>42B6</td>
<td>Window shape error</td>
<td>3</td>
<td>The window setting is out of range.</td>
<td>Correct the corresponding window settings.</td>
</tr>
<tr>
<td>42B7</td>
<td>Vision board undefined</td>
<td>3</td>
<td>An error occurred on the vision board.</td>
<td>1. Initialize the vision board from the teaching board. 2. Turn OFF the power switch ON the controller and restart the operation.</td>
</tr>
<tr>
<td>42B8</td>
<td>Vision receiving timeout</td>
<td>3</td>
<td>Communication timeout occurred (receiving).</td>
<td>1. Initialize the vision board from the teaching board. 2. Turn OFF the power switch ON the controller and restart the operation.</td>
</tr>
<tr>
<td>42B9</td>
<td>Vision sending timeout</td>
<td>3</td>
<td>Communication timeout occurred (sending).</td>
<td>1. Initialize the vision board from the teaching board. 2. Turn OFF the power switch ON the controller and restart the operation.</td>
</tr>
<tr>
<td>42BA</td>
<td>Vision communication protocol error</td>
<td>3</td>
<td>1. An error occurred in communication. 2. This occurs when vision the</td>
<td>1. Initialize the vision board from the teaching board. 2. Turn OFF the power switch ON the controller and restart the operation.</td>
</tr>
<tr>
<td>42BB</td>
<td>Error in vision command execution</td>
<td>3</td>
<td>The vision commands are not executable with the set parameters.</td>
<td>Correct the corresponding vision command (parameter) settings.</td>
</tr>
<tr>
<td>52D0</td>
<td>Main memory failure</td>
<td>5</td>
<td>The controller detected a failure by R/W check on the CPU built-in memory</td>
<td>Replace the teaching pendant.</td>
</tr>
</tbody>
</table>

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## 2 Controller Error Code Table

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>Lv</th>
<th>Description</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>52D1</td>
<td>Buzzer failure</td>
<td>2</td>
<td>The controller detected a failure by R/W check on the buzzer I/O in the</td>
<td>Replace the teaching pendant or the cable.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>teaching pendant.</td>
<td></td>
</tr>
<tr>
<td>52D2</td>
<td>Backlight failure</td>
<td>3</td>
<td>The controller detected a failure by R/W check on the backlight I/O in the</td>
<td>If the backlight does not properly illuminate, replace the teaching</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>teaching pendant.</td>
<td>pendant.</td>
</tr>
<tr>
<td>52D3</td>
<td>Motor LED failure</td>
<td>2</td>
<td>The controller detected a failure by R/W check on the motor LED I/O in the</td>
<td>If the motor LED does not properly illuminate, replace the teaching</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>teaching pendant.</td>
<td>pendant.</td>
</tr>
<tr>
<td>52D4</td>
<td>Machine lock LED failure</td>
<td>2</td>
<td>The controller detected a failure by R/W check on the machine lock LED I/O</td>
<td>If the machine lock LED does not properly illuminate, replace the</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>in the teaching pendant.</td>
<td>teaching pendant.</td>
</tr>
<tr>
<td>52D5</td>
<td>GIVF failure</td>
<td>3</td>
<td>The controller checks if GIVF LOS in the teaching pendant is set at Low (0).</td>
<td>If the image is improperly displayed, replace the teaching pendant or</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(L: digital transmission signal being sent, H: digital transmission signal</td>
<td>the cable.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>stopped)</td>
<td></td>
</tr>
<tr>
<td>52D6</td>
<td>Touch panel failure 1</td>
<td>2</td>
<td>The controller outputs 00 to the scan signal line (bit 2-4 of port E) of the</td>
<td>Replace the teaching pendant.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>analog touch panel and checks the reading through the same port.</td>
<td></td>
</tr>
<tr>
<td>52D7</td>
<td>Touch panel failure 2</td>
<td>2</td>
<td>The controller outputs 01 to the scan signal line (bit 2-4 of port E) of the</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>analog touch panel and checks the reading through the same port.</td>
<td></td>
</tr>
<tr>
<td>52D8</td>
<td>Touch panel failure 3</td>
<td>2</td>
<td>The controller outputs 010 to the scan signal line (bit 2-4 of port E) of the</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>analog touch panel and checks the reading through the same port.</td>
<td></td>
</tr>
<tr>
<td>52D9</td>
<td>Touch panel failure 4</td>
<td>2</td>
<td>The controller outputs 100 to the scan signal line (bit 2-4 of port E) of the</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>analog touch panel and checks the reading through the same port.</td>
<td></td>
</tr>
<tr>
<td>52DA</td>
<td>Dedicated key failure 1</td>
<td>3</td>
<td>The controller outputs 0001 to the SW matrix scan signal line (bit 6-9 of port</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>E) and checks the reading through the same port. It does not check the return</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>line.</td>
<td></td>
</tr>
<tr>
<td>52DB</td>
<td>Dedicated key failure 2</td>
<td>3</td>
<td>The controller outputs 0010 to the SW matrix scan signal line (bit 6-9 of port</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>E) and checks the reading through the same port. It does not check the return</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>line.</td>
<td></td>
</tr>
<tr>
<td>52DC</td>
<td>Dedicated key failure 3</td>
<td>3</td>
<td>The controller outputs 0100 to the SW matrix scan signal line (bit 6-9 of port</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>E) and checks the reading through the same port. It does not check the return</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>line.</td>
<td></td>
</tr>
<tr>
<td>52DD</td>
<td>Dedicated key failure 4</td>
<td>3</td>
<td>The controller outputs 1000 to the SW matrix scan signal line (bit 6-9 of port</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>E) and checks the reading through the same port. It does not check the return</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>line.</td>
<td></td>
</tr>
<tr>
<td>52DE</td>
<td>Dedicated key failure 5</td>
<td>3</td>
<td>The controller outputs 0000 to the SW matrix scan signal line (bit 6-9 of port</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>E) and checks the reading through the port. It does not check the return line.</td>
<td></td>
</tr>
<tr>
<td>52DF</td>
<td>RTS failure</td>
<td>5</td>
<td>The controller detected a failure in the RTS signal line of the teaching</td>
<td>Replace the teaching pendant or the cable.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>pendant or the cable.</td>
<td></td>
</tr>
<tr>
<td>531C</td>
<td>Memory capacity isn't enough</td>
<td>5</td>
<td>Memory necessary for compilation is not enough.</td>
<td>1. Close all windows and recompile.</td>
</tr>
<tr>
<td></td>
<td>for compiling</td>
<td></td>
<td></td>
<td>2. If this error recurs, reduce the number of programs for compilation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Otherwise, compile with WINCAPS2 and send data to the controller.</td>
</tr>
</tbody>
</table>
## 2 Controller Error Code Table

<table>
<thead>
<tr>
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<th>Description</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>5790</td>
<td>Speed over in direct mode</td>
<td>4</td>
<td>Excessive speed in manual operation occurred during teaching in direct mode.</td>
<td>Carefully prevent excessive force application when operating the robot.</td>
</tr>
<tr>
<td>5791</td>
<td>Axis 1 speed over in direct mode</td>
<td>4</td>
<td>Excessive speed (axis 1) in manual operation occurred during teaching in direct mode.</td>
<td>↑</td>
</tr>
<tr>
<td>5792</td>
<td>Axis 2 speed over in direct mode</td>
<td>4</td>
<td>Excessive speed (axis 2) in manual operation occurred during teaching in direct mode.</td>
<td>↑</td>
</tr>
<tr>
<td>5793</td>
<td>Axis 3 speed over in direct mode</td>
<td>4</td>
<td>Excessive speed (axis 3) in manual operation occurred during teaching in direct mode.</td>
<td>↑</td>
</tr>
<tr>
<td>5794</td>
<td>Axis 4 speed over in direct mode</td>
<td>4</td>
<td>Excessive speed (axis 4) in manual operation occurred during teaching in direct mode.</td>
<td>↑</td>
</tr>
<tr>
<td>5795</td>
<td>Axis 5 speed over in direct mode</td>
<td>4</td>
<td>Excessive speed (axis 5) in manual operation occurred during teaching in direct mode.</td>
<td>↑</td>
</tr>
<tr>
<td>5796</td>
<td>Axis 6 speed over in direct mode</td>
<td>4</td>
<td>Excessive speed (axis 6) in manual operation occurred during teaching in direct mode.</td>
<td>↑</td>
</tr>
<tr>
<td>6001</td>
<td>Not executable</td>
<td>3</td>
<td>The specified operation is not executable.</td>
<td>1. Enter again in executable status.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. Enter a proper command.</td>
</tr>
<tr>
<td>6002</td>
<td>Wrong operation mode</td>
<td>2</td>
<td>The specified operation does not match the selected operation mode.</td>
<td>Select the mode suitable for the operation.</td>
</tr>
<tr>
<td>6003</td>
<td>Excess in effective value range</td>
<td>3</td>
<td>The specified value of various commands exceeds the permissible range.</td>
<td>Enter the correct value again.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Examples</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1. Set value of speed and acceleration is not 1 ~ 100.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. The using condition parameter is not within designation available range.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3. Number of robot figures exceeds 31.</td>
<td></td>
</tr>
<tr>
<td>6004</td>
<td>Calibration not executed</td>
<td>2</td>
<td>1. The program was executed before calibration.</td>
<td>Execute calibration and operate again.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Manual XY and TOOL motion were executed.</td>
<td></td>
</tr>
<tr>
<td>6005</td>
<td>Manual mode not selected</td>
<td>2</td>
<td>The manual XY mode, tool mode or the individual axis mode is not selected.</td>
<td>Select a mode to manually operate.</td>
</tr>
<tr>
<td>6006</td>
<td>Motor power is off</td>
<td>2</td>
<td>The motor power is not ON.</td>
<td>Turn ON the motor power.</td>
</tr>
<tr>
<td>6008</td>
<td>Robot stop is on</td>
<td>2</td>
<td>1. The motor power attempted to turn ON, although the robot stop input was not ON (short).</td>
<td>1. Set the robot stop signal of system input to ON (short).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. The motor power attempted to turn ON with the robot stop button pressed on the operating panel or on the teaching pendant.</td>
<td>2. Check if the robot stop button remains ON. If it is, release it.</td>
</tr>
<tr>
<td>6009</td>
<td>Turning off controller and restart</td>
<td>5</td>
<td>After an error, which required a restart, occurred the motor power attempted to turn ON without turning OFF the controller power.</td>
<td>Turn OFF the power switch ON the controller and restart the operation.</td>
</tr>
<tr>
<td>Code</td>
<td>Message</td>
<td>Lv</td>
<td>Description</td>
<td>Remedy</td>
</tr>
<tr>
<td>----------</td>
<td>----------------------------------------------</td>
<td>----</td>
<td>----------------------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>600A</td>
<td>Motor power is ON</td>
<td>3</td>
<td>An unavailable operation was executed while the motor power was ON.</td>
<td>Operate after turning off the motor power.</td>
</tr>
<tr>
<td>600B</td>
<td>Robot is running</td>
<td>3</td>
<td>The robot performed inoperable running.</td>
<td>After the robot stops, restart operation.</td>
</tr>
<tr>
<td>600C</td>
<td>Emergency stop ON</td>
<td>0</td>
<td>The robot stop input was turned OFF. The robot stop button was pressed.</td>
<td>Set the robot stop input to ON (short). Release the robot stop button.</td>
</tr>
<tr>
<td>600D</td>
<td>Deadman switch off</td>
<td>2</td>
<td>The deadman switch is turned OFF.</td>
<td>Operate with the deadman switch pressed.</td>
</tr>
<tr>
<td>600E</td>
<td>Robot type setting error</td>
<td>5</td>
<td>Robot type setting is incomplete or wrong.</td>
<td>Set the correct Robot type or transfer necessary parameters to the controller. Then turn OFF the power switch and restart the operation.</td>
</tr>
<tr>
<td>600F</td>
<td>Do CAL after initializing encoder data</td>
<td>2</td>
<td>The encoder preset data was initialized because data was not received by the encoder occurred.</td>
<td>Execute calibration and operate again.</td>
</tr>
<tr>
<td>6014</td>
<td>Calibration aborted</td>
<td>2</td>
<td>Calibration execution aborted.</td>
<td>If this error occurs in automatic booting with the operation preparation start, check that the step stop and the halt of the system input are not OFF. If OFF, set them to ON (short).</td>
</tr>
<tr>
<td>6017</td>
<td>Vector calculation error</td>
<td>3</td>
<td>Posture vectors (normal, orient, and approach) were not correctly set.</td>
<td>Properly set the specified vector and the type T variable.</td>
</tr>
<tr>
<td>6018</td>
<td>Arc interpolation calculation error</td>
<td>4</td>
<td>Arc interpolation through a specified passing position to a destination position is not available or a path shift due to deceleration stop occurred.</td>
<td>Set the passing or the destination position correctly. If this error occurs when restarting the robot after it is stopped with the motor OFF, curing motion, use the halt as the means to stop the robot.</td>
</tr>
<tr>
<td>6019</td>
<td>Path plane setting error</td>
<td>4</td>
<td>The path plane cannot be calculated with the MKPL and the ROTATE command.</td>
<td>A plane can not be formed with a vector specified as the argument. Correctly set it again.</td>
</tr>
<tr>
<td>601A</td>
<td>Tool change not allowed</td>
<td>3</td>
<td>The tool attempted to change in status but the tool change was not available.</td>
<td>Changing the tool is not allowed while the robot is in motion. After the motion stops, operate again.</td>
</tr>
<tr>
<td>601B</td>
<td>Parameter change not allowed</td>
<td>3</td>
<td>Attempted to change the parameter status but the parameter change was not allowed.</td>
<td>When the motor power is ON, you cannot change parameters. Turn OFF the motor power and operate again.</td>
</tr>
<tr>
<td>601C</td>
<td>Change the posture</td>
<td>1</td>
<td>The motion destination figure position does not meet the motion finish.</td>
<td>There are times when the figure at the motion destination position does not match with that of the motion finish. Execute teaching again, at the motion finish position. The occurrence of this error does not affect the motion.</td>
</tr>
<tr>
<td>601D</td>
<td>Motion restart command not executed</td>
<td>3</td>
<td>Controller internal error.</td>
<td>Set the robot stop input to ON and then to OFF before restarting the robot.</td>
</tr>
<tr>
<td>601E</td>
<td>Machine lock on</td>
<td>2</td>
<td>Operations not available such as 1. Motor on 2. Brake releasing 3. Calibration or CALSET was executed while the machine was locked.</td>
<td>Release the machine lock and operate again.</td>
</tr>
</tbody>
</table>
## Controller Error Code Table

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>601F</td>
<td>Decrease the path start displacement</td>
<td>1</td>
<td>The set path start displacement distance exceeds the permissible value.</td>
<td>Set the path start displacement distance again. The path start displacement distance should be less than half of the moving distance.</td>
</tr>
<tr>
<td>6038</td>
<td>Improper arm parameter</td>
<td>3</td>
<td>Arm parameter failure</td>
<td>Transmit the arm manager file corresponding to the robot and reboot the robot.</td>
</tr>
</tbody>
</table>
| 6039  | Power failure (servo watchdog error)         | 5  | Servo detected NMI. This errors occurs when you turn OFF the controller power, however, this is not a failure. | 1. Check if the FG (frame ground) terminals of the robot and the controller are grounded.  
2. Check if no equipment (such as welding machines) which generates noise is near the robot and the controller. |
| 603A  | Servo CPU error                              | 5  | Controller internal failure (Servo CPU stops.)                            | Turn OFF the power switch of the controller and restart the operation.                                                                           |
| 6071  | Current position J1 software motion limit over | 3  | Current position exceeded the software motion limit of the 1st axis in motion. The 1st axis exceeded the software motion limit during CP motion for deceleration stop. | 1. Re-specify the target position within the motion space.  
2. If this error occurs after you change the robot data (by CALSET), check if you followed correct procedures to change the data.  
3. Check if the robot does not pass the vicinity of the singular point in the CP motion, and correct the program so that it avoids the singular point.  
However, if you return the robot to the motion space, move the axes in manual mode. Axis movement may be impossible in XY or TOOL mode.  
4. If this error occurs with increase In CP motion speed, decrease the speed. |
| 6072  | Current position J2 software motion limit over | 3  | Current position exceeded the software motion limit of the 2nd axis in motion. The 2nd axis exceeded the software motion limit during CP motion for deceleration stop. | ↑                                                                                                                                            |
| 6073  | Current position J3 software motion limit over | 3  | Current position exceeded the software motion limit of the 3rd axis in motion. The 3rd axis exceeded the software motion limit during CP motion for deceleration stop. | ↑                                                                                                                                            |
| 6074  | Current position J4 software motion limit over | 3  | Current position exceeded the software motion limit of the 4th axis in motion. The 4th axis exceeded the software motion limit during CP motion for deceleration stop. | ↑                                                                                                                                            |
| 6075  | Current position J5 software motion limit over | 3  | Current position exceeded the software motion limit of the 5th axis in motion. The 5th axis exceeded the software motion limit during CP motion for deceleration stop. | ↑                                                                                                                                            |
| 6076  | Current position J6 software motion limit over | 3  | Current position exceeded the software motion limit of the 6th axis in motion. The 6th axis exceeded the software motion limit during CP motion for deceleration stop. | ↑                                                                                                                                            |
## 2 Controller Error Code Table

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<th>Remedy</th>
</tr>
</thead>
</table>
| 6079  | Current pos. out of operation range 1| 3  | Current position reached out of motion space.                              | 1. Re-specify the target position within the motion space.  
2. If this error occurs after you change the robot data (by CALSET), check if you followed correct procedures to change the data.  
3. Check if target position of PTP motion and P/T variables in P2J and T2J commands specify a position and a figure where robot movement is physically possible. |
| 607A  | Current pos. out of operation range 2| 3  | Current position reached out of operation range.                           |                                                                                                                  |
| 607B  | Current pos. is in singular point     | 3  | Current position is at a singular point, which disables execution of reverse coordinate transformation command. | Set the contents of the position variable to a non-singular point value.                                           |
| 607D  | Not movable near singular point      | 4  | The robot cannot move because it passes near a singular point in the CP motion. | Select PTP mode if no interference occurs during robot movement. Correct the program to avoid a singular point in the CP motion.  
3. If this error occurs with increase in CP motion speed, decrease the speed. |
| 607E  | Inoperable in this shape             | 2  | Cannot move to the specified position in this shape.                       | Change the shape and re-execute.                                                                                 |
| 607F  | Robot posture mismatch               | 3  | 1. Having specified a figure different from the current figure at the destination point in the CP motion, the specified motion is not possible.  
2. When you restart the motion from the halt during the path motion from the PTP motion to the CP, the figure at the halt does not meet the one at the destination position of the CP motion. | 1. The robot does not move if the wrist, elbow and arm figures do not match the current figures at the destination positions, excluding a few exceptions. If this error occurs, teach the robot so that the wrist, the elbow and the arm figures match with those of the current figures.  
2. This error may be possibly occurred when restarting the robot after it is stopped with the halt during path motion from the PTP motion to the CP motion.  
Do not designate the path motion if you need to restart the robot after the robot stops during path motion from the PTP motion to the CP motion. |
| 6081  | J1 command speed limit over          | 3  | The CP motion cannot execute with the specified speed because the speed command value of the 1st axis exceeds the limit value. | 1. Reduce the speed or set the motion of the PTP, if there is no problem, such as interference, on the motion path.  
2. Check the robot does not pass the singular point vicinity in the CP motion and correct the program so that it avoids the singular point.  
3. Set the control set of motion optimization to 2 or 3. |
| 6082  | J2 command speed limit over          | 3  | The CP motion cannot execute with the specified speed because the speed command value of the 2nd axis exceeds the limit value. |                                                                                                                  |
| 6083  | J3 command speed limit over          | 3  | The CP motion cannot execute with the specified speed because the speed command value of the 3rd axis exceeds the limit value. |                                                                                                                  |
| 6084  | J4 command speed limit over          | 3  | The CP motion cannot execute with the specified speed because the speed command value of the 4th axis exceeds the limit value. |                                                                                                                  |
| 6085  | J5 command speed limit over          | 3  | The CP motion cannot execute with the specified speed because the speed command value of the 5th axis exceeds the limit value. |                                                                                                                  |
# Controller Error Code Table

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<thead>
<tr>
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<th>Message</th>
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<th>Description</th>
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</tr>
</thead>
<tbody>
<tr>
<td>6086</td>
<td>J6 command speed limit over</td>
<td>3</td>
<td>The CP motion cannot execute with the specified speed because the speed command value of the 6th axis exceeds the limit value.</td>
<td></td>
</tr>
<tr>
<td>6089</td>
<td>J1 command speed limit over (servo)</td>
<td>4</td>
<td>The CP motion cannot execute with the specified speed because the speed command value of the 1st axis exceeds the limit value.</td>
<td>1. Check that the FG (frame ground) terminals of the robot and the controller are grounded.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. Check that the robot and the controller are away from noise source such as a welding machine.</td>
</tr>
<tr>
<td>608A</td>
<td>J2 command speed limit over (servo)</td>
<td>4</td>
<td>The CP motion cannot execute with the specified speed because the speed command value of the 2nd axis exceeds the limit value.</td>
<td></td>
</tr>
<tr>
<td>608B</td>
<td>J3 command speed limit over (servo)</td>
<td>4</td>
<td>The CP motion cannot execute with the specified speed because the speed command value of the 3rd axis exceeds the limit value.</td>
<td></td>
</tr>
<tr>
<td>608C</td>
<td>J4 command speed limit over (servo)</td>
<td>4</td>
<td>The CP motion cannot execute with the specified speed because the speed command value of the 4th axis exceeds the limit value.</td>
<td></td>
</tr>
<tr>
<td>608D</td>
<td>J5 command speed limit over (servo)</td>
<td>4</td>
<td>The CP motion cannot execute with the specified speed because the speed command value of the 5th axis exceeds the limit value.</td>
<td></td>
</tr>
<tr>
<td>608E</td>
<td>J6 command speed limit over (servo)</td>
<td>4</td>
<td>The CP motion cannot execute with the specified speed because the speed command value of the 6th axis exceeds the limit value.</td>
<td></td>
</tr>
<tr>
<td>6091</td>
<td>J1 power module failure</td>
<td>5</td>
<td>Power module failure on the 1st axis.</td>
<td>As the controller may be possibly damaged, execute the following remedy.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1. Check if the controller is properly installed, in accordance with the Instruction manual.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. Check the working ambient temperature.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3. Clean the fan filter.</td>
</tr>
<tr>
<td>6092</td>
<td>J2 power module failure</td>
<td>5</td>
<td>Power module failure on the 2nd axis</td>
<td></td>
</tr>
<tr>
<td>6093</td>
<td>J3 power module failure</td>
<td>5</td>
<td>Power module failure on the 3rd axis</td>
<td></td>
</tr>
<tr>
<td>6094</td>
<td>J4 power module failure</td>
<td>5</td>
<td>A power module failure occurred on 4th axis.</td>
<td></td>
</tr>
<tr>
<td>6095</td>
<td>J5 power module failure</td>
<td>5</td>
<td>A power module failure occurred on 5th axis.</td>
<td></td>
</tr>
<tr>
<td>6096</td>
<td>J6 power module failure</td>
<td>5</td>
<td>A power module failure occurred on 6th axis.</td>
<td></td>
</tr>
<tr>
<td>60B1</td>
<td>J1 current offset failure</td>
<td>5</td>
<td>Offset of the 1st axis detection current exceeds the reference value.</td>
<td>Inspect or repair the 1st axis power module.</td>
</tr>
<tr>
<td>60B2</td>
<td>J2 current offset failure</td>
<td>5</td>
<td>Offset of the 2nd axis detection current exceeds the reference value.</td>
<td>Inspect or repair the 2nd axis power module.</td>
</tr>
</tbody>
</table>
## 2 Controller Error Code Table

<table>
<thead>
<tr>
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<th>Message</th>
<th>Lv</th>
<th>Description</th>
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</tr>
</thead>
<tbody>
<tr>
<td>60B3</td>
<td>J3 current offset failure</td>
<td>5</td>
<td>Offset of the 3rd axis detection current exceeds the reference value.</td>
<td>Inspect or repair the 3rd axis power module.</td>
</tr>
<tr>
<td>60B4</td>
<td>J4 current offset failure</td>
<td>5</td>
<td>Offset of the 4th axis detection current exceeds the reference value.</td>
<td>Inspect or repair the 4th axis power module.</td>
</tr>
<tr>
<td>60B5</td>
<td>J5 current offset failure</td>
<td>5</td>
<td>Offset of the 5th axis detection current exceeds the reference value.</td>
<td>Inspect or repair the 5th axis power module.</td>
</tr>
<tr>
<td>60B6</td>
<td>J6 current offset failure</td>
<td>5</td>
<td>Offset of the 6th axis detection current exceeds the reference value.</td>
<td>Inspect or repair the 6th axis power module.</td>
</tr>
<tr>
<td>60BE</td>
<td>Multi operation buffer overflow</td>
<td>5</td>
<td>Controller internal error (software)</td>
<td>Turn OFF the power switch on the controller and restart the operation.</td>
</tr>
<tr>
<td>60BF</td>
<td>Multi operation buffer release failure</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60C0</td>
<td>Robot 1 motion control buffer failure</td>
<td>5</td>
<td>Controller internal error (software)</td>
<td></td>
</tr>
<tr>
<td>60C1</td>
<td>Robot 2 motion control buffer failure</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60C2</td>
<td>Path creation stack failure</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60C3</td>
<td>Path creation buffer failure</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60C4</td>
<td>Path creation file failure</td>
<td>5</td>
<td>Path creation parameter error.</td>
<td>Transmit the arm manager file corresponding to the robot and reboot.</td>
</tr>
<tr>
<td>60C5</td>
<td>Servo file failure</td>
<td>5</td>
<td>Servo parameter error.</td>
<td></td>
</tr>
<tr>
<td>60C6</td>
<td>Deceleration stop command failure</td>
<td>4</td>
<td>Controller internal error (Command value for deceleration stop cannot be created.)</td>
<td>Turn OFF the power switch on the controller and restart the operation.</td>
</tr>
<tr>
<td>60C7</td>
<td>Command transfer buffer write error</td>
<td>5</td>
<td>Controller internal error (Command value storage buffer is not present.)</td>
<td></td>
</tr>
<tr>
<td>60C8</td>
<td>Command transfer buffer read error</td>
<td>5</td>
<td>Controller internal error (Command value is not created.)</td>
<td></td>
</tr>
<tr>
<td>60C9</td>
<td>Path creation aborted</td>
<td>5</td>
<td>Controller internal error (Path creation process stopped.)</td>
<td></td>
</tr>
<tr>
<td>60CA</td>
<td>Halt processing aborted</td>
<td>5</td>
<td>Controller internal error (Halt process failed.)</td>
<td></td>
</tr>
<tr>
<td>Code</td>
<td>Message</td>
<td>Lv</td>
<td>Description</td>
<td>Remedy</td>
</tr>
<tr>
<td>-------</td>
<td>----------------------------------------------</td>
<td>----</td>
<td>-----------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>60CB</td>
<td>Deceleration stop aborted</td>
<td>5</td>
<td>Controller internal error (Deceleration stop process failed.)</td>
<td>↑</td>
</tr>
<tr>
<td>60CC</td>
<td>Halt time over</td>
<td>5</td>
<td>Controller internal error (Halt process unfinished.)</td>
<td>↑</td>
</tr>
<tr>
<td>60CD</td>
<td>Deceleration stop time over</td>
<td>5</td>
<td>Controller internal error (Deceleration stop process unfinished.)</td>
<td>↑</td>
</tr>
<tr>
<td>60CE</td>
<td>Internal cycle processing aborted</td>
<td>5</td>
<td>Controller internal error (Host internal cycle process stop failure)</td>
<td>↑</td>
</tr>
<tr>
<td>60CF</td>
<td>Motion command processing aborted</td>
<td>5</td>
<td>Controller internal error (Motion command process stop failure)</td>
<td>↑</td>
</tr>
<tr>
<td>60D0</td>
<td>Motion optimization function inexecutable</td>
<td>4</td>
<td>Command speed could not be changed when the control set of motion optimization was 2 or 3.</td>
<td>1. Reduce the speed or set the motion of the PTP, if there is no problem, such as interference, on the motion path. 2. Check the robot does not pass the singular point vicinity in the CP motion and correct the program so that it avoids the singular point.</td>
</tr>
<tr>
<td>60D1</td>
<td>Motion optimization parameter error</td>
<td>4</td>
<td>Acceleration cannot be calculated due to load condition parameter failure when the control set of motion optimization mode was 2 or 3.</td>
<td>Enter the proper load condition value according to the practical load.</td>
</tr>
<tr>
<td>60D2</td>
<td>Mass of payload out of setting range</td>
<td>3</td>
<td>End load setting value is outside the robot specifications.</td>
<td>Enter the proper end load setting value.</td>
</tr>
<tr>
<td>60DC</td>
<td>Executing pass restart process</td>
<td>1</td>
<td>Since stop processing was performed during path operation, save processing was performed at restart.</td>
<td>After save processing ended, return to normal operation.</td>
</tr>
<tr>
<td>60DD</td>
<td>Execute CAL</td>
<td>2</td>
<td>Fetch of the correct position data failed. CAL execution is necessary.</td>
<td>Turn ON the motor and execute CAL.</td>
</tr>
<tr>
<td>60DE</td>
<td>Rotary motion other than specified</td>
<td>4</td>
<td>While the arc interpolation command is executing, after a path motion, with the other motion command, you attempted to hold the robot and restart.</td>
<td>If the robot is held during execution of the arc interpolation command, after the path motion with the other motion command, and you restart the operation, the radius of the rotation and the motion position may change. Do not execute such operation.</td>
</tr>
<tr>
<td>60DF</td>
<td>Automatic slowdown in progress</td>
<td>1</td>
<td>The command speed was changed when the control set of motion optimization was 2 or 3.</td>
<td>To avoid changing the command speed, set the control set of motion optimization to 0 or 1, and reduce the speed so that the command speed failure will not occur.</td>
</tr>
<tr>
<td>60E0</td>
<td>Log data retrieving error</td>
<td>5</td>
<td>Controller internal error. (A control log obtaining failure.)</td>
<td>Turn OFF the power switch of the controller and restart the operation.</td>
</tr>
<tr>
<td>60E1</td>
<td>Log data recording error</td>
<td>5</td>
<td>Controller internal error. (A control log recording failure.)</td>
<td>↑</td>
</tr>
</tbody>
</table>
| 60E2  | Obtain log                                   | 2  | Attempt was made to refer to the load estimation value without obtaining control log. | Obtain the control log and operate again. }
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<tr>
<td>60E3</td>
<td>Control log area allocation error</td>
<td>4</td>
<td>Control log is not available because of insufficient data area for the control log function.</td>
<td>Reset to the default value if the control log recording mode was altered. If the error occurs with default settings, the memory capacity is insufficient and the memory capacity shall be increased to use the control log function.</td>
</tr>
<tr>
<td>60EF</td>
<td>Reset compliance mode</td>
<td>2</td>
<td>The motor was turned OFF during conference control and compliance control was ended forcibly.</td>
<td>When the motor was turned OFF during compliance control, continue start is disabled. Reset the program and restart operation.</td>
</tr>
<tr>
<td>60F0</td>
<td>Task creation error</td>
<td>5</td>
<td>Controller internal error occurred. (An OS error.)</td>
<td>Turn OFF the power switch on the controller and restart the operation.</td>
</tr>
<tr>
<td>60F1</td>
<td>Semaphore creation error</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60F2</td>
<td>Semaphore taking error</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60F3</td>
<td>Gravity compensation task halt</td>
<td>5</td>
<td>Controller internal error occurred (OS error).</td>
<td>Turn OFF the power switch on the controller and restart the operation.</td>
</tr>
<tr>
<td>60F4</td>
<td>Compliance processing delay</td>
<td>4</td>
<td>Compliance processing delayed.</td>
<td>This error may occur when the controller keyboard is operated or the communication frequency by the RS232C or Ethernet is high where the compliance is valid. Lower the communication frequency.</td>
</tr>
<tr>
<td>60F5</td>
<td>Compliance control is not executable</td>
<td>4</td>
<td>When the compliance is valid, the current is limited or gravity compensation is invalid.</td>
<td>Make the current limit invalid and the gravity compensation invalid, then restart operation.</td>
</tr>
<tr>
<td>60F6</td>
<td>Improper compliance parameter</td>
<td>5</td>
<td>The specified compliance parameter exceeded the allowable range.</td>
<td>Specify the compliance parameter in the allowable range.</td>
</tr>
<tr>
<td>60F7</td>
<td>Compliance state is unchangeable</td>
<td>4</td>
<td>Compliance function switching error.</td>
<td>Turn OFF the power switch of the controller once and restart operation.</td>
</tr>
<tr>
<td>60F8</td>
<td>Compliance deviation excess error</td>
<td>4</td>
<td>The compliance position deviation exceeded the allowable value.</td>
<td>Change the allowable value of the compliance position deviation.</td>
</tr>
<tr>
<td>60F9</td>
<td>Improper compliance set/reset operation</td>
<td>4</td>
<td>Program reset or step-back operation was performed during compliance set/reset operation. The program was reset due to an error.</td>
<td>When performing program reset or step-back operation at instantaneous stop during compliance invalid operation, turn OFF the motor once and make the compliance invalid.</td>
</tr>
<tr>
<td>60FA</td>
<td>Not Executable in compliance control</td>
<td>4</td>
<td>The gravity compensation was made invalid, the current limit was made valid, or the compliance parameter was changed during compliance processing.</td>
<td>Make the compliance invalid to invalidate the gravity compensation, validate the current limit, or change the compliance parameter.</td>
</tr>
<tr>
<td>60FB</td>
<td>Improper compliance reference</td>
<td>4</td>
<td>An improper compliance reference value was specified during compliance control.</td>
<td>Confirm whether the extreme power is applied due to the interference of the robot. Also check whether the robot is moved in the compliance control direction.</td>
</tr>
<tr>
<td>60FC</td>
<td>Speed limit over in compliance mode</td>
<td>3</td>
<td>The specified speed is limited within 50% during compliance control.</td>
<td>Specify the internal speed so that the specified speed is within 50%.</td>
</tr>
</tbody>
</table>
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<tr>
<td>60FD</td>
<td>PTP motion is not executable</td>
<td>3</td>
<td>PTP operation cannot be performed during compliance control. This error occurs when PTP operation is executed.</td>
<td>Change to CP operation</td>
</tr>
<tr>
<td>60FE</td>
<td>Servo CPU version unmatched</td>
<td>2</td>
<td>The servo CPU is too old; so, its functions are unusable.</td>
<td>Upgrade the version of the servo CPU.</td>
</tr>
<tr>
<td>60FF</td>
<td>Exception error occurred</td>
<td>5</td>
<td></td>
<td>Turn OFF the power switch of the controller once and restart operation.</td>
</tr>
<tr>
<td>6101</td>
<td>Watchdog error</td>
<td>5</td>
<td>The host detected a NMI.</td>
<td></td>
</tr>
<tr>
<td>6102</td>
<td>Power failure</td>
<td>5</td>
<td>1. +24V output is short-circuited.</td>
<td>1. Check if the +24V and 0V wires or +24 V and output terminals have short circuit at the controller I/O cable destination. 2. Check if the AC200V power supply voltage is outside the specified range of AC253 to AC170V. 3. Check if each AC200V power cable wire is firmly connected. Do not plug in or unplug with the controller power switch on. If you plug in or unplug the connector, be sure to turn OFF the power switch on the controller. 4. Check if the hand, including the work-piece, specification is outside the robot standard specifications. 5. If the error still occurs after you turn ON the power again, you need to inspect and repair the controller.</td>
</tr>
<tr>
<td>6103</td>
<td>Warning: Backup battery low voltage</td>
<td>1</td>
<td>The memory backup battery voltage is low.</td>
<td>Save each manager file with WINCAPSII and replace the backup battery.</td>
</tr>
<tr>
<td>6111</td>
<td>J1 excess error</td>
<td>4</td>
<td>An excess deviation error on the 1st axis. Servo deviation exceeded permissible value.</td>
<td>1. Check if any axis, including the hand and the work-piece, interferes with an obstacle (peripheral devices, pipes or wires). 2. If this error occurs because the corresponding axis bumps into the mechanical stopper, change the software motion limit or check if you have executed the wrong procedures for CALSET. 3. Check if the hand, including a work-piece, specification is outside the robot standard specifications. 4. Check if the cable between the robot and the controller is firmly plugged. 5. Check if the servo motor connector for each axis is firmly plugged. 6. Check if the AC200V voltage power has dropped.</td>
</tr>
<tr>
<td>6112</td>
<td>J2 excess error</td>
<td>4</td>
<td>An excess deviation error on the 2nd axis. The servo deviation exceeded the permissible value.</td>
<td></td>
</tr>
<tr>
<td>6113</td>
<td>J3 excess error</td>
<td>4</td>
<td>An excess deviation error on the 3rd axis. The servo deviation exceeded the permissible value.</td>
<td></td>
</tr>
<tr>
<td>6114</td>
<td>J4 excess error</td>
<td>4</td>
<td>An excess deviation error on the 4th axis. The servo deviation exceeded the permissible value.</td>
<td></td>
</tr>
</tbody>
</table>
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<tbody>
<tr>
<td>6115</td>
<td>J5 excess error</td>
<td>4</td>
<td>An excess deviation error on the 5th axis. The servo deviation exceeded the permissible value.</td>
<td>↑</td>
</tr>
<tr>
<td>6116</td>
<td>J6 excess error</td>
<td>4</td>
<td>An excess deviation error on the 6th axis. The servo deviation exceeded the permissible value.</td>
<td>↑</td>
</tr>
<tr>
<td>6121</td>
<td>J1 overcurrent</td>
<td>4</td>
<td>An overcurrent error on the 1st axis. The current to the motor exceeded the permissible value.</td>
<td>1. Check if any axis, including the hand and the work-piece, interferes with an obstacle (peripheral devices, pipes or wires). 2. If this error occurs because the corresponding axis bumps into the mechanical stopper, change the software motion limit or check if you have executed the wrong procedures for CALSET. 3. Check if the hand, including a work-piece, specification is outside the robot standard specifications. 4. Check if the cable between the robot and the controller is firmly plugged. 5. Check that the FG terminals on the robot and the controller are grounded.</td>
</tr>
<tr>
<td>6122</td>
<td>J2 overcurrent</td>
<td>4</td>
<td>An overcurrent error on the 2nd axis. The current to the motor exceeded the permissible value.</td>
<td>↑</td>
</tr>
<tr>
<td>6123</td>
<td>J3 overcurrent</td>
<td>4</td>
<td>An overcurrent error on the 3rd axis. The current to the motor exceeded the permissible value.</td>
<td>↑</td>
</tr>
<tr>
<td>6124</td>
<td>J4 overcurrent</td>
<td>4</td>
<td>An overcurrent error on the 4th axis. The current to the motor exceeded the permissible value.</td>
<td>↑</td>
</tr>
<tr>
<td>6125</td>
<td>J5 overcurrent</td>
<td>4</td>
<td>An overcurrent error on the 5th axis. The current to the motor exceeded the permissible value.</td>
<td>↑</td>
</tr>
<tr>
<td>6126</td>
<td>J6 overcurrent</td>
<td>4</td>
<td>An overcurrent error on the 6th axis. The current to the motor exceeded the permissible value.</td>
<td>↑</td>
</tr>
<tr>
<td>6129</td>
<td>J1 overcurrent (software)</td>
<td>4</td>
<td>An overcurrent error on the 1st axis. The current to the motor exceeded the permissible value set in the software.</td>
<td>1. Check if any axis, including the hand and the work-piece, interferes with an obstacle (peripheral devices, pipes or wires). 2. If this error occurs because the corresponding axis bumps into the mechanical stopper, change the software motion limit or check if you have executed the wrong procedures for CALSET. 3. Check if the hand, including a work-piece, specification is outside the robot standard specifications. 4. Check if the cable between the robot and the controller is firmly plugged. 5. Check that the FG terminals on the robot and the controller are grounded.</td>
</tr>
<tr>
<td>612A</td>
<td>J2 overcurrent (software)</td>
<td>4</td>
<td>An overcurrent error on the 2nd axis. The current to the motor exceeded the permissible value set in the software.</td>
<td>↑</td>
</tr>
</tbody>
</table>
## 2 Controller Error Code Table

<table>
<thead>
<tr>
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<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>612B</td>
<td>J3 overcurrent (software)</td>
<td>4</td>
<td>An overcurrent error on the 3rd axis. The current to the motor exceeded the permissible value set in the software.</td>
<td>↑</td>
</tr>
<tr>
<td>612C</td>
<td>J4 overcurrent (software)</td>
<td>4</td>
<td>An overcurrent error on the 4th axis. The current to the motor exceeded the permissible value set in the software.</td>
<td>↑</td>
</tr>
<tr>
<td>612D</td>
<td>J5 overcurrent (software)</td>
<td>4</td>
<td>An overcurrent error on the 5th axis. The current to the motor exceeded the permissible value set in the software.</td>
<td>↑</td>
</tr>
<tr>
<td>612E</td>
<td>J6 overcurrent (software)</td>
<td>4</td>
<td>An overcurrent error on the 6th axis. The current to the motor exceeded the permissible value set in the software.</td>
<td>↑</td>
</tr>
</tbody>
</table>
| 6131   | J1 encoder cable break                 | 4  | 1st axis cable is not connected or broken.                                  | Check if the cable between the robot and the controller is firmly plugged.  
                                             |                                         | Check if the cable of the axis is not broken.                          | Check that the FG terminals on the robot and the controller are grounded. |
| 6132   | J2 encoder cable break                 | 4  | 2nd axis cable is not connected or broken.                                 | ↑                                                                      |
| 6133   | J3 encoder cable break                 | 4  | 3rd axis cable is not connected or broken.                                 | ↑                                                                      |
| 6134   | J4 encoder cable break                 | 4  | 4th axis cable is not connected or broken.                                 | ↑                                                                      |
| 6135   | J5 encoder cable break                 | 4  | 5th axis cable is not connected or broken.                                 | ↑                                                                      |
| 6136   | J6 encoder cable break                 | 4  | 6th axis cable is not connected or broken.                                 | ↑                                                                      |
| 6140   | Motor brake fuse blown                 | 4  | A motor brake power supply fuse was blown.                                 | 1. Check the cable between the robot and the controller.              
<pre><code>                                         |                                         | 2. Inspect the motor.                                                   |                                                                         |
</code></pre>
<p>| 6141   | J1 power module failure                | 4  | A fuse on the 1st axis power module was blown.                             | Inspection or repair of the power module is required. Do not replace the fuse on the power module. If excess deviation, overcurrent, motor overload or controller overload occurred prior to this error, follow the remedy steps corresponding to each error. |
| 6142   | J2 power module failure                | 4  | A fuse on the 2nd axis power module was blown.                             | ↑                                                                      |
| 6143   | J3 power module failure                | 4  | A fuse on the 3rd axis power module was blown.                             | ↑                                                                      |
| 6144   | J4 power module failure                | 4  | A fuse on the 4th axis power module was blown.                             | ↑                                                                      |
| 6145   | J5 power module failure                | 4  | A fuse on the 5th axis power module was blown.                             | ↑                                                                      |</p>
<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>6146</td>
<td>J6 power module failure</td>
<td>4</td>
<td>A fuse on the 6th axis power module was blown.</td>
</tr>
<tr>
<td>6170</td>
<td>Regenerative resister overload</td>
<td>4</td>
<td>An overload occurred on the regenerative resister, inside the controller.</td>
</tr>
<tr>
<td>6171</td>
<td>J1 motor overload</td>
<td>4</td>
<td>An overload error occurred on the 1st axis motor.</td>
</tr>
<tr>
<td>6172</td>
<td>J2 motor overload</td>
<td>4</td>
<td>An overload error occurred on the 2nd axis motor.</td>
</tr>
<tr>
<td>6173</td>
<td>J3 motor overload</td>
<td>4</td>
<td>An overload error occurred on the 3rd axis motor.</td>
</tr>
<tr>
<td>6174</td>
<td>J4 motor overload</td>
<td>4</td>
<td>An overload error occurred on the 4th axis motor.</td>
</tr>
<tr>
<td>6175</td>
<td>J5 motor overload</td>
<td>4</td>
<td>An overload error occurred on the 5th axis motor.</td>
</tr>
<tr>
<td>6176</td>
<td>J6 motor overload</td>
<td>4</td>
<td>An overload error occurred on the 6th axis motor.</td>
</tr>
<tr>
<td>6180</td>
<td>Servo communication data error</td>
<td>5</td>
<td>Controller internal error (The servo receiving data is over than allowable range) has arisen.</td>
</tr>
<tr>
<td>6181</td>
<td>Servo calculation time over</td>
<td>5</td>
<td>Controller internal error (Servo process time over.)</td>
</tr>
<tr>
<td>6182</td>
<td>Servo communication interruption delay (host)</td>
<td>5</td>
<td>Controller internal error (Interruption from servo exceeded the preset time.)</td>
</tr>
<tr>
<td>6183</td>
<td>Servo data check sum error</td>
<td>5</td>
<td>A check sum failure occurred in communicating data between the host and the servo.</td>
</tr>
</tbody>
</table>

Remedy:
1. Check if the hand, including the work-piece, specification is beyond the robot standard specifications.
2. Check if the cable between the robot and the controller is firmly plugged.
3. Insert a timer between the motion commands, and reduce the speed and acceleration. Wait one minute before attempting to operate again.

1. Check that the robot and FG (Frame Ground) are grounded.
2. Check that the robot and the controller are away from noise source such as a welding machine.

↑
## 2 Controller Error Code Table

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</tr>
</thead>
<tbody>
<tr>
<td>6185</td>
<td>Host data check sum error</td>
<td>5</td>
<td>A check sum failure occurred in communicating data between the host and the servo.</td>
<td>▲</td>
</tr>
</tbody>
</table>
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</tr>
</thead>
<tbody>
<tr>
<td>6186</td>
<td>Servo answer command receive error (host)</td>
<td>5</td>
<td>Controller internal error (An unregistered command was received from servo.)</td>
<td>Turn OFF the power switch of the controller and restart the operation.</td>
</tr>
<tr>
<td>6189</td>
<td>Servo transmission command undefined</td>
<td>5</td>
<td>Controller internal error (An unregistered command was received from upper module.)</td>
<td>$\uparrow$</td>
</tr>
<tr>
<td>618A</td>
<td>Host send command receive error (servo)</td>
<td>5</td>
<td>Controller internal error (An unregistered command was received from host.)</td>
<td>$\uparrow$</td>
</tr>
<tr>
<td>618B</td>
<td>Servo command mode unknown</td>
<td>5</td>
<td>Controller internal error (The sub data quantity of command to send servo is not defined.)</td>
<td>$\uparrow$</td>
</tr>
<tr>
<td>618C</td>
<td>Servo command delete error</td>
<td>5</td>
<td>Controller internal error (The corresponding command to the one answered from servo is not present.)</td>
<td>$\uparrow$</td>
</tr>
<tr>
<td>618D</td>
<td>Servo transmit command buffer overflow</td>
<td>5</td>
<td>Controller internal error (The number of commands to send from servo is over.)</td>
<td>$\uparrow$</td>
</tr>
<tr>
<td>618E</td>
<td>Servo ans. command buffer overflow</td>
<td>5</td>
<td>Controller internal error (The number of commands waiting for answer from servo is over.)</td>
<td>$\uparrow$</td>
</tr>
<tr>
<td>618F</td>
<td>Servo answer command mismatch</td>
<td>5</td>
<td>Controller internal error (There is no command that corresponds to the command returned from the servo.)</td>
<td>$\uparrow$</td>
</tr>
<tr>
<td>61A1</td>
<td>J1 torque limit time over</td>
<td>4</td>
<td>The 1st axis torque command reached its limit and the time exceeded its limit while maintaining that status.</td>
<td>1. Check if any axis, including the hand and the work-piece, interferes with an obstacle (peripheral devices, pipes or wires). 2. If this error occurs because the corresponding axis bumps into the mechanical stopper, change the software motion limit or check if you have executed the wrong procedures for CALSET. 3. Check if the hand, including a work-piece, specification is outside the robot standard specifications. 4. Check if the cable between the robot and the controller is firmly plugged.</td>
</tr>
<tr>
<td>61A2</td>
<td>J2 torque limit time over</td>
<td>4</td>
<td>The 2nd axis torque command reached its limit and the time exceeded its limit while maintaining that status.</td>
<td>$\uparrow$</td>
</tr>
<tr>
<td>61A3</td>
<td>J3 torque limit time over</td>
<td>4</td>
<td>The 3rd axis torque command reached its limit and the time exceeded its limit while maintaining that status.</td>
<td>$\uparrow$</td>
</tr>
<tr>
<td>61A4</td>
<td>J4 torque limit time over</td>
<td>4</td>
<td>The 4th axis torque command reached its limit and the time exceeded its limit while maintaining that status.</td>
<td>$\uparrow$</td>
</tr>
<tr>
<td>61A5</td>
<td>J5 torque limit time over</td>
<td>4</td>
<td>The 5th axis torque command reached its limit and the time exceeded its limit while maintaining that status.</td>
<td>$\uparrow$</td>
</tr>
<tr>
<td>61A6</td>
<td>J6 torque limit time over</td>
<td>4</td>
<td>The 6th axis torque command reached its limit and the time exceeded its limit while maintaining that status.</td>
<td>$\uparrow$</td>
</tr>
</tbody>
</table>
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<table>
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<tbody>
<tr>
<td>61A9</td>
<td>J1 motor lock overload</td>
<td>4</td>
<td>An overload occurred because the 1st axis motor locked.</td>
<td>1. Check if any axis, including the hand and the work-piece, interferes with an obstacle (peripheral devices, pipes or wires). 2. If this error occurs because the corresponding axis bumps into the mechanical stopper, change the software motion limit or check if you have executed the wrong procedures for CALSET.</td>
</tr>
<tr>
<td>61AA</td>
<td>J2 motor lock overload</td>
<td>4</td>
<td>An overload occurred because the 2nd axis motor locked.</td>
<td>↑</td>
</tr>
<tr>
<td>61AB</td>
<td>J3 motor lock overload</td>
<td>4</td>
<td>An overload occurred because the 3rd axis motor locked.</td>
<td>↑</td>
</tr>
<tr>
<td>61AC</td>
<td>J4 motor lock overload</td>
<td>4</td>
<td>An overload occurred because the 4th axis motor locked.</td>
<td>↑</td>
</tr>
<tr>
<td>61AD</td>
<td>J5 motor lock overload</td>
<td>4</td>
<td>An overload occurred because the 5th axis motor locked.</td>
<td>↑</td>
</tr>
<tr>
<td>61AE</td>
<td>J6 motor lock overload</td>
<td>4</td>
<td>An overload occurred because the 6th axis motor locked.</td>
<td>↑</td>
</tr>
<tr>
<td>61B1</td>
<td>J1 power module overload</td>
<td>4</td>
<td>An overload error occurred in the 1st axis power module of the controller.</td>
<td>1. Check if any axis, including the hand and the work-piece, interferes with an obstacle (peripheral devices, pipes or wires). 2. If this error occurs because the corresponding axis bumps into the mechanical stopper, change the software limit or check if you have executed the wrong procedures for CALSET.</td>
</tr>
<tr>
<td>61B2</td>
<td>J2 power module overload</td>
<td>4</td>
<td>An overload error occurred in the 2nd axis power module of the controller.</td>
<td>↑</td>
</tr>
<tr>
<td>61B3</td>
<td>J3 power module overload</td>
<td>4</td>
<td>An overload error occurred in the 3rd axis power module of the controller.</td>
<td>↑</td>
</tr>
<tr>
<td>61B4</td>
<td>J4 power module overload</td>
<td>4</td>
<td>An overload error occurred in the 4th axis power module of the controller.</td>
<td>↑</td>
</tr>
<tr>
<td>61B5</td>
<td>J5 power module overload</td>
<td>4</td>
<td>An overload error occurred in the 5th axis power module of the controller.</td>
<td>↑</td>
</tr>
<tr>
<td>61B6</td>
<td>J6 power module overload</td>
<td>4</td>
<td>An overload error occurred in the 6th axis power module of the controller.</td>
<td>↑</td>
</tr>
<tr>
<td>61FF</td>
<td>Overcurrent error (mode undetected)</td>
<td>4</td>
<td>An overcurrent error was accidentally detected.</td>
<td>1. Check that the FG (frame ground) terminals of the robot and the controller are grounded. 2. Check that the robot and the controller are away from noise sources such as a welding machine.</td>
</tr>
<tr>
<td>6308</td>
<td>Brake releasing</td>
<td>2</td>
<td>The motor power was attempted to turn ON during motor brake releasing.</td>
<td>Lock the motor brake and turn ON the motor power.</td>
</tr>
</tbody>
</table>
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<tbody>
<tr>
<td>6401</td>
<td>J1 encoder acceleration error</td>
<td>5</td>
<td>1st axis encoder exceeded the acceleration limit value.</td>
<td>Check if the cable between the robot and the controller is firmly plugged. Check that the FG terminals on the robot and the controller are grounded. Check if the cable of the axis is not broken.</td>
</tr>
<tr>
<td>6402</td>
<td>J2 encoder acceleration error</td>
<td>5</td>
<td>2nd axis encoder exceeded the acceleration limit value.</td>
<td>↑</td>
</tr>
<tr>
<td>6403</td>
<td>J3 encoder acceleration error</td>
<td>5</td>
<td>3rd axis encoder exceeded the acceleration limit value.</td>
<td>↑</td>
</tr>
<tr>
<td>6404</td>
<td>J4 encoder acceleration error</td>
<td>5</td>
<td>4th axis encoder exceeded the acceleration limit value.</td>
<td>↑</td>
</tr>
<tr>
<td>6405</td>
<td>J5 encoder acceleration error</td>
<td>5</td>
<td>5th axis encoder exceeded the acceleration limit value.</td>
<td>↑</td>
</tr>
<tr>
<td>6406</td>
<td>J6 encoder acceleration error</td>
<td>5</td>
<td>6th axis encoder exceeded the acceleration limit value.</td>
<td>↑</td>
</tr>
<tr>
<td>6411</td>
<td>J1 encoder system down</td>
<td>5</td>
<td>System down occurred on 1st axis encoder.</td>
<td>1. Check that the encoder backup battery connector is firmly plugged. 2. If the connector for the battery has been disconnected for more than 3 minutes, this error occurs. To recover, reset the encoder and execute CALSET.</td>
</tr>
<tr>
<td>6412</td>
<td>J2 encoder acceleration error</td>
<td>5</td>
<td>System down occurred on 2nd axis encoder.</td>
<td>↑</td>
</tr>
<tr>
<td>6413</td>
<td>J3 encoder acceleration error</td>
<td>5</td>
<td>System down occurred on 3rd axis encoder.</td>
<td>↑</td>
</tr>
<tr>
<td>6414</td>
<td>J4 encoder acceleration error</td>
<td>5</td>
<td>System down occurred on 4th axis encoder.</td>
<td>↑</td>
</tr>
<tr>
<td>6415</td>
<td>J5 encoder acceleration error</td>
<td>5</td>
<td>System down occurred on 5th axis encoder.</td>
<td>↑</td>
</tr>
<tr>
<td>6416</td>
<td>J6 encoder acceleration error</td>
<td>5</td>
<td>System down occurred on 6th axis encoder.</td>
<td>↑</td>
</tr>
</tbody>
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</table>
| 6421   | J1 encoder data not received   | 4  | Communication error occurred on the 1st axis encoder.                        | 1. Check that the encoder backup battery connector is firmly plugged.  
2. Check that the robot and the controller are away from noise sources such as a welding machine.  
3. Check if the cable between the robot and the controller is firmly plugged.  
4. If this error occurs after you change the motor, check if the encoder ID number of the motor is correctly set.  
Using the error log, check if encoder-data-no-reception error occurs on the other axes. If this error occurs on six axes starting from the specific axis, check if the first axis encoder connector for normal connection. If this error occurs on all axes, follow the above step 3. |
| 6422   | J2 encoder data not received   | 4  | A communication error occurred on the 2nd axis encoder.                      |                                                                                                                                        |
| 6423   | J3 encoder data not received   | 4  | A communication error occurred on the 3rd axis encoder.                      |                                                                                                                                        |
| 6424   | J4 encoder data not received   | 4  | A communication error occurred on the 4th axis encoder.                      |                                                                                                                                        |
| 6425   | J5 encoder data not received   | 4  | A communication error occurred on the 5th axis encoder.                      |                                                                                                                                        |
| 6426   | J6 encoder data not received   | 4  | A communication error occurred on the 6th axis encoder.                      |                                                                                                                                        |
| 6431   | J1 encoder counter overflow    | 5  | The 1st axis multiple rotation data encoder overflowed.                      | Reset the 1st axis encoder and execute CALSET.                                                                                         |
| 6432   | J2 encoder counter overflow    | 5  | The 2nd axis multiple rotation data encoder overflowed.                      | Reset the 2nd axis encoder and execute CALSET.                                                                                         |
| 6433   | J3 encoder counter overflow    | 5  | The 3rd axis multiple rotation data encoder overflowed.                      | Reset the 3rd axis encoder and execute CALSET.                                                                                         |
| 6434   | J4 encoder counter overflow    | 5  | The 4th axis multiple rotation data encoder overflowed.                      | Reset the 4th axis encoder and execute CALSET.                                                                                         |
| 6435   | J5 encoder counter overflow    | 5  | The 5th axis multiple rotation data encoder overflowed.                      | Reset the 5th axis encoder and execute CALSET.                                                                                         |
| 6436   | J6 encoder counter overflow    | 5  | The 6th axis multiple rotation data encoder overflowed.                      | Reset the 6th axis encoder and execute CALSET.                                                                                         |
| 6441   | J1 encoder counter error       | 5  | Counter error occurred on 1st axis encoder.                                 | 1. Check that the FG (frame ground) terminals of the robot and the controller are grounded.  
2. Check that the robot and the controller are away from noise sources such as a welding machine.  
3. Check that the cable between the robot and the controller is firmly plugged. |
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<tr>
<td>6442</td>
<td>J2 encoder counter error</td>
<td>5</td>
<td>Counter error on the 2nd axis encoder</td>
<td>↑</td>
</tr>
<tr>
<td>6443</td>
<td>J3 encoder counter error</td>
<td>5</td>
<td>Counter error on the 3rd axis encoder</td>
<td>↑</td>
</tr>
<tr>
<td>6444</td>
<td>J4 encoder counter error</td>
<td>5</td>
<td>Counter error on the 4th axis encoder</td>
<td>↑</td>
</tr>
<tr>
<td>6445</td>
<td>J5 encoder counter error</td>
<td>5</td>
<td>Counter error on the 5th axis encoder</td>
<td>↑</td>
</tr>
<tr>
<td>6446</td>
<td>J6 encoder counter error</td>
<td>5</td>
<td>Counter error on the 6th axis encoder</td>
<td>↑</td>
</tr>
<tr>
<td>6451</td>
<td>J1 encoder G/A count error</td>
<td>5</td>
<td>Controller internal error (G/A count error)</td>
<td>Check that the FG (Frame Ground) terminals on the robot and the controller are grounded.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Check that the robot and the controller are away from noise source such as a welding machine.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Check if the cable between the robot and the controller is firmly plugged.</td>
</tr>
<tr>
<td>6452</td>
<td>J2 encoder G/A count error</td>
<td>5</td>
<td></td>
<td>↑</td>
</tr>
<tr>
<td>6453</td>
<td>J3 encoder G/A count error</td>
<td>5</td>
<td></td>
<td>↑</td>
</tr>
<tr>
<td>6454</td>
<td>J4 encoder G/A count error</td>
<td>5</td>
<td></td>
<td>↑</td>
</tr>
<tr>
<td>6455</td>
<td>J5 encoder G/A count error</td>
<td>5</td>
<td></td>
<td>↑</td>
</tr>
<tr>
<td>6456</td>
<td>J6 encoder G/A count error</td>
<td>5</td>
<td></td>
<td>↑</td>
</tr>
<tr>
<td>6461</td>
<td>J1 encoder Rx phase signal missing</td>
<td>4</td>
<td>1st axis cable is not connected or broken.</td>
<td>Check if the cable between the robot and the controller is firmly plugged.</td>
</tr>
<tr>
<td></td>
<td>error</td>
<td></td>
<td></td>
<td>Check that the FG terminals on the robot and the controller are grounded.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Check if the cable of the axis is not broken.</td>
</tr>
<tr>
<td>6462</td>
<td>J2 encoder Rx phase signal missing</td>
<td>4</td>
<td>2nd axis cable is not connected or broken.</td>
<td>↑</td>
</tr>
<tr>
<td></td>
<td>error</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6463</td>
<td>J3 encoder Rx phase signal missing</td>
<td>4</td>
<td>3rd axis cable is not connected or broken.</td>
<td>↑</td>
</tr>
<tr>
<td></td>
<td>error</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6464</td>
<td>J4 encoder Rx phase signal missing</td>
<td>4</td>
<td>4th axis cable is not connected or broken.</td>
<td>↑</td>
</tr>
</tbody>
</table>
## 2 Controller Error Code Table

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<tbody>
<tr>
<td>6465</td>
<td>J5 encoder Rx phase signal missing error</td>
<td>4</td>
<td>5th axis cable is not connected or broken.</td>
<td>↑</td>
</tr>
<tr>
<td>6466</td>
<td>J6 encoder Rx phase signal missing error</td>
<td>4</td>
<td>6th axis cable is not connected or broken.</td>
<td>↑</td>
</tr>
<tr>
<td>6470</td>
<td>CALSET execution failed</td>
<td>3</td>
<td>CALSET execution error on all axes</td>
<td>Check if the motor can be turned ON. If possible, execute again. If not, reboot the system.</td>
</tr>
<tr>
<td>6471</td>
<td>J1 CALSET execution failed</td>
<td>2</td>
<td>CALSET execution error on the 1st axis</td>
<td>Move the corresponding axis a little bit with hand before executing CALSET and return the axis again to the CALSET position.</td>
</tr>
<tr>
<td>6472</td>
<td>J2 CALSET execution failed</td>
<td>2</td>
<td>CALSET execution error on the 2nd axis</td>
<td>↑</td>
</tr>
<tr>
<td>6473</td>
<td>J3 CALSET execution failed</td>
<td>2</td>
<td>CALSET execution error on the 3rd axis</td>
<td>↑</td>
</tr>
<tr>
<td>6474</td>
<td>J4 CALSET execution failed</td>
<td>2</td>
<td>CALSET execution error on the 4th axis</td>
<td>↑</td>
</tr>
<tr>
<td>6475</td>
<td>J5 CALSET execution failed</td>
<td>2</td>
<td>CALSET execution error on the 5th axis</td>
<td>↑</td>
</tr>
<tr>
<td>6476</td>
<td>J6 CALSET execution failed</td>
<td>2</td>
<td>CALSET execution error on the 6th axis</td>
<td>↑</td>
</tr>
<tr>
<td>6486</td>
<td>Position error at restart (ARRIVE command)</td>
<td>2</td>
<td>At restart the deviation from the stop position exceeded the permissible value.</td>
<td>Cannot continue the operation. Restart from the top of the program.</td>
</tr>
<tr>
<td>6488</td>
<td>Stop command in positioning accuracy check</td>
<td>1</td>
<td>Halt was executed while the controller was checking the positioning accuracy (@E) by accuracy check command.</td>
<td>Check of static accuracy was interrupted by the halt, and so the accuracy check has not been finished. Check the static accuracy when restarting the robot.</td>
</tr>
<tr>
<td>6489</td>
<td>Execution condition failed. (ARRIVE command)</td>
<td>2</td>
<td>Cannot continue the operation because the condition designated by ARRIVE command was not fulfilled.</td>
<td>Cannot continue the operation. Restart from the top of the program.</td>
</tr>
<tr>
<td>648A</td>
<td>Objective axis setting error (ARRIVE command)</td>
<td>2</td>
<td>ARRIVE command was executed to the inoperable axis.</td>
<td>↑</td>
</tr>
<tr>
<td>648B</td>
<td>Impossible to calculate arc parameters</td>
<td>2</td>
<td>Cannot calculate parameters needed for arc operation.</td>
<td>↑</td>
</tr>
<tr>
<td>648C</td>
<td>Operation command not executed (ARRIVE command)</td>
<td>2</td>
<td>Operation command was not executed.</td>
<td>↑</td>
</tr>
<tr>
<td>64A1</td>
<td>J1 encoder battery low voltage</td>
<td>2</td>
<td>The 1st axis encoder back-up battery voltage dropped.</td>
<td>Replace the encoder back-up battery.</td>
</tr>
<tr>
<td>64A2</td>
<td>J2 encoder battery low voltage</td>
<td>2</td>
<td>The 2nd axis encoder back-up battery voltage dropped.</td>
<td>↑</td>
</tr>
</tbody>
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<tr>
<td>64A3</td>
<td>J3 encoder battery low voltage</td>
<td>2</td>
<td>The 3rd axis encoder back-up battery voltage dropped.</td>
<td>↑</td>
</tr>
<tr>
<td>64A4</td>
<td>J4 encoder battery low voltage</td>
<td>2</td>
<td>The 4th axis encoder back-up battery voltage dropped.</td>
<td>↑</td>
</tr>
<tr>
<td>64A5</td>
<td>J5 encoder battery low voltage</td>
<td>2</td>
<td>The 5th axis encoder back-up battery voltage dropped.</td>
<td>↑</td>
</tr>
<tr>
<td>64A6</td>
<td>J6 encoder battery low voltage</td>
<td>2</td>
<td>The 6th axis encoder back-up battery voltage dropped.</td>
<td>↑</td>
</tr>
</tbody>
</table>
| 64B1 | J1 encoder CRC check error     | 4  | A CRC check failure occurred on 1st axis encoder data.                     | 1. Check that the FG (frame ground) terminals of the robot and the controller are grounded.  
2. Check that the robot and the controller are away from noise sources such as a welding machine.  
3. Check that the cable between the robot and the controller is firmly plugged. |
| 64B2 | J2 encoder CRC check error     | 4  | CRC check failure occurred on the 2nd axis encoder data.                   | ↑                                                                      |
| 64B3 | J3 encoder CRC check error     | 4  | CRC check failure occurred on the 3rd axis encoder data.                   | ↑                                                                      |
| 64B4 | J4 encoder CRC check error     | 4  | CRC check failure occurred on the 4th axis encoder data.                   | ↑                                                                      |
| 64B5 | J5 encoder CRC check error     | 4  | CRC check failure occurred on the 5th axis encoder data.                   | ↑                                                                      |
| 64B6 | J6 encoder CRC check error     | 4  | CRC check failure occurred on the 6th axis encoder data.                   | ↑                                                                      |
| 64C1 | J1 encoder framing error       | 4  | Frame configuration error in the 1st axis encoder data.                    | 1. Check that the FG (frame ground) terminals of the robot and the controller are grounded.  
2. Check that the robot and the controller are away from noise sources such as a welding machine.  
3. Check that the cable between the robot and the controller is firmly plugged. |
| 64C2 | J2 encoder framing error       | 4  | Frame configuration error in the 2nd axis encoder data.                    | ↑                                                                      |
| 64C3 | J3 encoder framing error       | 4  | Frame configuration error in the 3rd axis encoder data.                    | ↑                                                                      |
| 64C4 | J4 encoder framing error       | 4  | Frame configuration error in the 4th axis encoder data.                    | ↑                                                                      |
| 64C5 | J5 encoder framing error       | 4  | Frame configuration error in the 5th axis encoder data.                    | ↑                                                                      |
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<td>64C6</td>
<td>J6 encoder framing error</td>
<td>4</td>
<td>Frame configuration error in the 6th axis encoder data.</td>
<td>↑</td>
</tr>
<tr>
<td>64D1</td>
<td>J1 encoder data (software) abnormal</td>
<td>4</td>
<td>Encoder data error (data skip) on the 1st axis.</td>
<td>1. Check that the FG (frame ground) terminals of the robot and the controller are grounded. 2. Check that the robot and the controller are away from noise source such as a welding machine. 3. Check that the cable between the robot and the controller is firmly plugged.</td>
</tr>
<tr>
<td>64D2</td>
<td>J2 encoder data (software) abnormal</td>
<td>4</td>
<td>Encoder data error (data skip) on 2nd axis</td>
<td>↑</td>
</tr>
<tr>
<td>64D3</td>
<td>J3 encoder data (software) abnormal</td>
<td>4</td>
<td>Encoder data error (data skip) on 3rd axis</td>
<td>↑</td>
</tr>
<tr>
<td>64D4</td>
<td>J4 encoder data (software) abnormal</td>
<td>4</td>
<td>Encoder data error (data skip) on 4th axis</td>
<td>↑</td>
</tr>
<tr>
<td>64D5</td>
<td>J5 encoder data (software) abnormal</td>
<td>4</td>
<td>Encoder data error (data skip) on 5th axis.</td>
<td>↑</td>
</tr>
<tr>
<td>64D6</td>
<td>J6 encoder data (software) abnormal</td>
<td>4</td>
<td>Encoder data error (data skip) on 6th axis.</td>
<td>↑</td>
</tr>
<tr>
<td>64E1</td>
<td>J1 encoder Rx phase not received (CABS)</td>
<td>4</td>
<td>1st axis encoder communication error occurred.</td>
<td>Check that the FG (Frame Ground) terminals on the robot and the controller are grounded. Check that the robot and the controller are away from noise source such as a welding machine. Check if the cable between the robot and the controller is firmly plugged. If the error occurred after motor change, check that the encoder ID number of the changed motor is correctly set. Check the error log if communication error on the other axes occurred. If error occurred on the specific axis through the 6th axis, then check the specific axis encoder connector is securely plugged. If error occurred on all axes, perform remedy 3.</td>
</tr>
<tr>
<td>64E2</td>
<td>J2 encoder Rx phase not received (CABS)</td>
<td>4</td>
<td>2nd axis encoder communication error occurred.</td>
<td>↑</td>
</tr>
<tr>
<td>64E3</td>
<td>J3 encoder Rx phase not received (CABS)</td>
<td>4</td>
<td>3rd axis encoder communication error occurred.</td>
<td>↑</td>
</tr>
<tr>
<td>64E4</td>
<td>J4 encoder Rx phase not received (CABS)</td>
<td>4</td>
<td>4th axis encoder communication error occurred.</td>
<td>↑</td>
</tr>
<tr>
<td>64E5</td>
<td>J5 encoder Rx phase not received (CABS)</td>
<td>4</td>
<td>5th axis encoder communication error occurred.</td>
<td>↑</td>
</tr>
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<tbody>
<tr>
<td>64E6</td>
<td>J6 encoder Rx phase not received (CABS)</td>
<td>4</td>
<td>6th axis encoder communication error occurred.</td>
<td>↑</td>
</tr>
<tr>
<td>64F1</td>
<td>J1 encoder CRC error (CABS)</td>
<td>4</td>
<td>CRC error on 1st axis encoder data occurred.</td>
<td>Check that the FG (Frame Ground) terminals on the robot and the controller are grounded. Check that the robot and the controller are away from noise source such as a welding machine. Check if the cable between the robot and the controller is firmly plugged.</td>
</tr>
<tr>
<td>64F2</td>
<td>J2 encoder CRC error (CABS)</td>
<td>4</td>
<td>CRC error on 2nd axis encoder data occurred.</td>
<td>↑</td>
</tr>
<tr>
<td>64F3</td>
<td>J3 encoder CRC error (CABS)</td>
<td>4</td>
<td>CRC error on 3rd axis encoder data occurred.</td>
<td>↑</td>
</tr>
<tr>
<td>64F4</td>
<td>J4 encoder CRC error (CABS)</td>
<td>4</td>
<td>CRC error on 4th axis encoder data occurred.</td>
<td>↑</td>
</tr>
<tr>
<td>64F5</td>
<td>J5 encoder CRC error (CABS)</td>
<td>4</td>
<td>CRC error on 5th axis encoder data occurred.</td>
<td>↑</td>
</tr>
<tr>
<td>64F6</td>
<td>J6 encoder CRC error (CABS)</td>
<td>4</td>
<td>CRC error on 6th axis encoder data occurred.</td>
<td>↑</td>
</tr>
<tr>
<td>64FF</td>
<td>Encoder error (mode undetected)</td>
<td>4</td>
<td>Though the encoder GA detected an encoder error; however, the encoder does not detect any error.</td>
<td>1. Check that the FG (frame ground) terminals of the robot and the controller are grounded. 2. Check that the robot and the controller are away from noise source such as a welding machine. 3. Check that the cable between the robot and the controller is firmly plugged.</td>
</tr>
<tr>
<td>6600</td>
<td>Host-servo communicate IC error (servo)</td>
<td>5</td>
<td>Controller internal error (A communication IC failure was detected in the servo initialization. A communication error occurred in servo communication.)</td>
<td>↑</td>
</tr>
<tr>
<td>6601</td>
<td>Host-servo com. IC error (1:host-1)</td>
<td>5</td>
<td>Controller internal error (A send error was detected just before the host data was sent or when the periodical check was done.)</td>
<td>1. Check that the FG (frame ground) terminals of the robot and the controller are grounded. 2. Check that the robot and the controller are away from noise source such as a welding machine. 3. Check that the cable between the robot and the controller is firmly plugged.</td>
</tr>
<tr>
<td>6602</td>
<td>Host-servo com. IC error (2:host-2)</td>
<td>5</td>
<td>Controller internal error (A receiving error was detected just before host data was sent or when periodical check was done.)</td>
<td>↑</td>
</tr>
<tr>
<td>6603</td>
<td>Host com. interrupt delay (servo)</td>
<td>4</td>
<td>Controller internal error (Interruption from host stops exceeds the fixed time.)</td>
<td>↑</td>
</tr>
<tr>
<td>6604</td>
<td>Servo command answer timeout</td>
<td>4</td>
<td>Controller internal error (The command finish answer from servo was not returned.)</td>
<td>↑</td>
</tr>
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<tr>
<td>6605</td>
<td>Host-servo com. IC error (host receiving)</td>
<td>5</td>
<td>Controller internal error (A communication failure was detected just after the host data was received.)</td>
<td></td>
</tr>
<tr>
<td>6631</td>
<td>J1 speed limit over</td>
<td>4</td>
<td>Motion exceeded the 1st axis speed limit.</td>
<td>1. Check if any axis, including the hand and the work-piece, interferes with an obstacle (peripheral devices, pipes or wires).&lt;br&gt;2. Check if the hand, including a work-piece, specification is outside the robot standard specifications.&lt;br&gt;3. Check that the FG terminals on the robot and the controller are grounded.&lt;br&gt;4. Check that the robot and the controller are away from noise source such as a welding machine.&lt;br&gt;5. Check if the robot and the controller are firmly connected with the cables.</td>
</tr>
<tr>
<td>6632</td>
<td>J2 speed limit over</td>
<td>4</td>
<td>Motion exceeded the 2nd axis speed limit.</td>
<td></td>
</tr>
<tr>
<td>6633</td>
<td>J3 speed limit over</td>
<td>4</td>
<td>Motion exceeded the 3rd axis speed limit.</td>
<td></td>
</tr>
<tr>
<td>6634</td>
<td>J4 speed limit over</td>
<td>4</td>
<td>Motion exceeded the 4th axis speed limit.</td>
<td></td>
</tr>
<tr>
<td>6635</td>
<td>J5 speed limit over</td>
<td>4</td>
<td>Motion exceeded the 5th axis speed limit.</td>
<td></td>
</tr>
<tr>
<td>6636</td>
<td>J6 speed limit over</td>
<td>4</td>
<td>Motion exceeded the 6th axis speed limit.</td>
<td></td>
</tr>
<tr>
<td>6641</td>
<td>J1 acceleration limit over</td>
<td>4</td>
<td>Motion exceeded the 1st axis acceleration limit.</td>
<td>1. Check if any axis, including the hand and the work-piece, interferes with an obstacle (peripheral devices, pipes or wires).&lt;br&gt;2. Check if the hand, including a work-piece, specification is outside the robot standard specifications.&lt;br&gt;3. Check that the FG terminals on the robot and the controller are grounded.&lt;br&gt;4. Check that the robot and the controller are away from noise source such as a welding machine.&lt;br&gt;5. Check if the robot and the controller are firmly connected with the cables.</td>
</tr>
<tr>
<td>6642</td>
<td>J2 acceleration limit over</td>
<td>4</td>
<td>Motion exceeded the 2nd axis acceleration limit.</td>
<td></td>
</tr>
<tr>
<td>6643</td>
<td>J3 acceleration limit over</td>
<td>4</td>
<td>Motion exceeded the 3rd axis acceleration limit.</td>
<td></td>
</tr>
<tr>
<td>6644</td>
<td>J4 acceleration limit over</td>
<td>4</td>
<td>Motion exceeded the 4th axis acceleration limit.</td>
<td></td>
</tr>
<tr>
<td>6645</td>
<td>J5 acceleration limit over</td>
<td>4</td>
<td>Motion exceeded the 5th axis acceleration limit.</td>
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<tr>
<td>6646</td>
<td>J6 acceleration limit over</td>
<td>4</td>
<td>Motion exceeded the 6th axis acceleration limit.</td>
<td></td>
</tr>
<tr>
<td>6651</td>
<td>Check command time over</td>
<td>3</td>
<td>The current position does not reach stop accuracy within the specified time when stop accuracy (@E) is specified.</td>
<td>1. Check if any axis, including the hand and the work-piece, interferes with an obstacle (peripheral devices, pipes or wires).&lt;br&gt;2. Check if the hand, including a work-piece, specification is outside the robot standard specifications.&lt;br&gt;3. Check if the parameters of the permissible pulse width and the motion finish timeout, in the using condition parameters, are too small for their initial values.&lt;br&gt;4. Execute ResetPulseWidth ( ) and ResetTimeOut ( ) with the program and check the motion.</td>
</tr>
<tr>
<td>665A</td>
<td>Cannot set current limit</td>
<td>3</td>
<td>Attempted to execute current limit setting while the gravity compensation is ineffective.</td>
<td>Execute current limit setting after enabling the gravity compensation.</td>
</tr>
<tr>
<td>665B</td>
<td>Cannot disable the gravity compensation</td>
<td>3</td>
<td>Attempted to disable the gravity compensation while the current limit is effective.</td>
<td>Disable gravity compensation after releasing current limit.</td>
</tr>
<tr>
<td>6671</td>
<td>Destination position out of J1 software motion limit</td>
<td>3</td>
<td>1. The motion destination position of the 1st axis is out of the software motion limit.&lt;br&gt;2. The robot cannot physically perform linear movements in the CP motion for the coordinate entered.</td>
<td>1. Change the motion destination position to within the motion space.&lt;br&gt;2. If this error occurs after you change the robot specifications (CALSET), check that you have not executed wrong procedures to change the specification.&lt;br&gt;3. Check that the robot does not pass the singular point vicinity in the CP motion and correct the program so that it avoids the singular point. However, if you return the robot to within the motion space, use the manual mode for each axis. It is not possible to move an axis with either the XY mode or the TOOL mode.</td>
</tr>
<tr>
<td>6672</td>
<td>Destination position out of J2 software motion limit</td>
<td>3</td>
<td>1. The motion destination position of the 2nd axis is out of the software motion limit.&lt;br&gt;2. The robot cannot physically perform linear movements in the CP motion for the coordinate entered.</td>
<td></td>
</tr>
<tr>
<td>6673</td>
<td>Destination position out of J3 software motion limit</td>
<td>3</td>
<td>1. The motion destination position of the 3rd axis is out of the software motion limit.&lt;br&gt;2. The robot cannot physically perform linear movements in the CP motion for the coordinate entered.</td>
<td></td>
</tr>
<tr>
<td>6674</td>
<td>Destination position out of J4 software motion limit</td>
<td>3</td>
<td>1. The motion destination position of the 4th axis is out of the software motion limit.&lt;br&gt;2. The robot cannot physically perform linear movements in the CP motion for the coordinate entered.</td>
<td></td>
</tr>
<tr>
<td>6675</td>
<td>Destination position out of J5 software motion limit</td>
<td>3</td>
<td>1. The motion destination position of the 5th axis is out of the software motion limit.&lt;br&gt;2. The robot cannot physically perform linear movements in the CP motion for the coordinate entered.</td>
<td></td>
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<td>6676</td>
<td>Destination position out of J6 software motion limit</td>
<td>3</td>
<td>1. The motion destination position of the 6th axis is out of the software motion limit. 2. The robot cannot physically perform linear movements in the CP motion for the coordinate entered.</td>
<td>↑</td>
</tr>
<tr>
<td>6679</td>
<td>Destination position out of motion space 1</td>
<td>3</td>
<td>The motion destination position is out of the motion space.</td>
<td>1. Re-specify the target position within the motion space. 2. If this error occurs after you change the robot data (by CALSET), check that you followed correct procedures to change the data. 3. Specify a position and a figure where robot movements are physically possible as the target position of the PTP motion and P/T variables of P2J and T2J commands.</td>
</tr>
<tr>
<td>667A</td>
<td>Destination position out of motion space 2</td>
<td>3</td>
<td>The motion destination position is out of the motion space.</td>
<td>↑</td>
</tr>
<tr>
<td>667B</td>
<td>Destination position in singular point</td>
<td>3</td>
<td>A singular point has been specified as the contents of the variable. Therefore, reverse coordinate transformation command cannot execute.</td>
<td>Set the contents of the position variable to a non-singular point value.</td>
</tr>
<tr>
<td>66D1</td>
<td>J1 software limit over (Compliance)</td>
<td>3</td>
<td>The 1 axis software limit was exceeded during compliance control.</td>
<td>Correct the operation position so that the robot is operable in the software limit.</td>
</tr>
<tr>
<td>66D2</td>
<td>J2 software limit over (Compliance)</td>
<td>3</td>
<td>The 2 axis software limit was exceeded during compliance control.</td>
<td>↑</td>
</tr>
<tr>
<td>66D3</td>
<td>J3 software limit over (Compliance)</td>
<td>3</td>
<td>The 3 axis software limit was exceeded during compliance control.</td>
<td>↑</td>
</tr>
<tr>
<td>66D4</td>
<td>J4 software limit over (Compliance)</td>
<td>3</td>
<td>The 4 axis software limit was exceeded during compliance control.</td>
<td>↑</td>
</tr>
<tr>
<td>66D5</td>
<td>J5 software limit over (Compliance)</td>
<td>3</td>
<td>The 5 axis software limit was exceeded during compliance control.</td>
<td>↑</td>
</tr>
<tr>
<td>66D6</td>
<td>J6 software limit over (Compliance)</td>
<td>3</td>
<td>The 6 axis software limit was exceeded during compliance control.</td>
<td>↑</td>
</tr>
<tr>
<td>6710</td>
<td>Servo communication initialization error</td>
<td>5</td>
<td>Controller internal error. (The host and the servo communication process initialization failed.)</td>
<td>1. Check that the FG (frame ground) terminals of the robot and the controller are grounded. 2. Check that the robot and the controller are away from noise sources such as a welding machine. 3. Check that the cable between the robot and the controller is firmly plugged.</td>
</tr>
<tr>
<td>671A</td>
<td>Command value calculation delay</td>
<td>4</td>
<td>Time-over error occurred in calculation of command value.</td>
<td>This error may occur if communication is frequently executed with the RS232C and the Ethernet or if you operate the controller keyboard during the robot motion. Operate again after the robot stops.</td>
</tr>
</tbody>
</table>
## 2 Controller Error Code Table

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>671B</td>
<td>Servo command processing delay</td>
<td>4</td>
<td>Controller internal error. (A command interruption delay from the servo.)</td>
<td>1. Check that the FG (frame ground) terminals of the robot and the controller are grounded. &lt;br&gt;2. Check that the robot and the controller are away from noise sources such as a welding machine. &lt;br&gt;3. Check that the cable between the robot and the controller is firmly plugged.</td>
</tr>
<tr>
<td>6721</td>
<td>J1 acceleration limit exceeded</td>
<td>4</td>
<td>Operation was executed exceeding the 1st axis acceleration limit.</td>
<td>Check if any axis, including the hand and the work-piece, interferes with an obstacle (peripheral devices, pipes or wires). &lt;br&gt;Check if the hand specification, including work-piece, exceeds the robot standards. &lt;br&gt;Check that the FG (Frame Ground) terminals on the robot and the controller are grounded. &lt;br&gt;Check that the robot and the controller are away from noise source such as a welding machine. &lt;br&gt;Check if the cable between the robot and the controller is firmly plugged.</td>
</tr>
<tr>
<td>6722</td>
<td>J2 acceleration limit exceeded</td>
<td>4</td>
<td>Operation was executed exceeding the 2nd axis acceleration limit.</td>
<td>↑</td>
</tr>
<tr>
<td>6723</td>
<td>J3 acceleration limit exceeded</td>
<td>4</td>
<td>Operation was executed exceeding the 3rd axis acceleration limit.</td>
<td>↑</td>
</tr>
<tr>
<td>6724</td>
<td>J4 acceleration limit exceeded</td>
<td>4</td>
<td>Operation was executed exceeding the 4th axis acceleration limit.</td>
<td>↑</td>
</tr>
<tr>
<td>6725</td>
<td>J5 acceleration limit exceeded</td>
<td>4</td>
<td>Operation was executed exceeding the 5th axis acceleration limit.</td>
<td>↑</td>
</tr>
<tr>
<td>6726</td>
<td>J6 acceleration limit exceeded</td>
<td>4</td>
<td>Operation was executed exceeding the 6th axis acceleration limit.</td>
<td>↑</td>
</tr>
<tr>
<td>6731</td>
<td>J1 acceleration limit exceeded</td>
<td>4</td>
<td>Operation was executed exceeding the 1st axis acceleration limit.</td>
<td>Check if any axis, including the hand and the work-piece, interferes with an obstacle (peripheral devices, pipes or wires). &lt;br&gt;Check if the hand specification, including work-piece, exceeds the robot standards. &lt;br&gt;Check that the FG (Frame Ground) terminals on the robot and the controller are grounded. &lt;br&gt;Check that the robot and the controller are away from noise source such as a welding machine. &lt;br&gt;Check if the cable between the robot and the controller is firmly plugged.</td>
</tr>
<tr>
<td>6732</td>
<td>J2 acceleration limit exceeded</td>
<td>4</td>
<td>Operation was executed exceeding the 2nd axis acceleration limit.</td>
<td>↑</td>
</tr>
<tr>
<td>6733</td>
<td>J3 acceleration limit exceeded</td>
<td>4</td>
<td>Operation was executed exceeding the 3rd axis acceleration limit.</td>
<td>↑</td>
</tr>
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<tr>
<td>6734</td>
<td>J4 acceleration limit exceeded</td>
<td>4</td>
<td>Operation was executed exceeding the 4th axis acceleration limit.</td>
<td>↑</td>
</tr>
<tr>
<td>6735</td>
<td>J5 acceleration limit exceeded</td>
<td>4</td>
<td>Operation was executed exceeding the 5th axis acceleration limit.</td>
<td>↑</td>
</tr>
<tr>
<td>6736</td>
<td>J6 acceleration limit exceeded</td>
<td>4</td>
<td>Operation was executed exceeding the 6th axis acceleration limit.</td>
<td>↑</td>
</tr>
<tr>
<td>6741</td>
<td>J1 acceleration limit exceeded</td>
<td>4</td>
<td>Operation was executed exceeding the 1st axis acceleration limit.</td>
<td>Check if any axis, including the hand and the work-piece, interferes with an obstacle (peripheral devices, pipes or wires). Check if the hand specification, including work-piece, exceeds the robot standards. Check that the FG (Frame Ground) terminals on the robot and the controller are grounded. Check that the robot and the controller are away from noise sources such as a welding machine. Check if the cable between the robot and the controller is firmly plugged.</td>
</tr>
<tr>
<td>6742</td>
<td>J2 acceleration limit exceeded</td>
<td>4</td>
<td>Operation was executed exceeding the 2nd axis acceleration limit.</td>
<td>↑</td>
</tr>
<tr>
<td>6743</td>
<td>J3 acceleration limit exceeded</td>
<td>4</td>
<td>Operation was executed exceeding the 3rd axis acceleration limit.</td>
<td>↑</td>
</tr>
<tr>
<td>6744</td>
<td>J4 acceleration limit exceeded</td>
<td>4</td>
<td>Operation was executed exceeding the 4th axis acceleration limit.</td>
<td>↑</td>
</tr>
<tr>
<td>6745</td>
<td>J5 acceleration limit exceeded</td>
<td>4</td>
<td>Operation was executed exceeding the 5th axis acceleration limit.</td>
<td>↑</td>
</tr>
<tr>
<td>6746</td>
<td>J6 acceleration limit exceeded</td>
<td>4</td>
<td>Operation was executed exceeding the 6th axis acceleration limit.</td>
<td>↑</td>
</tr>
<tr>
<td>6750</td>
<td>CALSET not executed</td>
<td>2</td>
<td>CALSET has not been executed on all axes.</td>
<td>1. If you did not execute CALSET after resetting the encoder, then execute CALSET. 2. If you did not transmit the arm parameters after clearing the memory, transmit the parameters.</td>
</tr>
<tr>
<td>6751</td>
<td>Execute J1 CALSET</td>
<td>2</td>
<td>CALSET has not been executed on the 1st axis.</td>
<td>↑</td>
</tr>
<tr>
<td>6752</td>
<td>Execute J2 CALSET</td>
<td>2</td>
<td>CALSET has not been executed on the 2nd axis.</td>
<td>↑</td>
</tr>
<tr>
<td>6753</td>
<td>Execute J3 CALSET</td>
<td>2</td>
<td>CALSET has not been executed on the 3rd axis.</td>
<td>↑</td>
</tr>
<tr>
<td>6754</td>
<td>Execute J4 CALSET</td>
<td>2</td>
<td>CALSET has not been executed on the 4th axis.</td>
<td>↑</td>
</tr>
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<tbody>
<tr>
<td>6755</td>
<td>Execute J5 CALSET</td>
<td>2</td>
<td>CALSET has not been executed on the 5th axis.</td>
<td>↑</td>
</tr>
<tr>
<td>6756</td>
<td>Execute J6 CALSET</td>
<td>2</td>
<td>CALSET has not been executed on the 6th axis.</td>
<td>↑</td>
</tr>
<tr>
<td>6761</td>
<td>J1 command accel limit over (servo)</td>
<td>4</td>
<td>The CP motion is not available with the specified speed because the acceleration command value exceeds the limit on the 1st axis.</td>
<td>1. Reduce the speed and the acceleration. If there are no problems, such as interference in the motion path, set the PTP motion. 2. Check that the robot does not pass the singular point vicinity in the CP motion, and correct the program so that it avoids the singular point. 3. If an error occurs when the control set of motion optimization is set to 2 or 3, decrease the speed and deceleration.</td>
</tr>
<tr>
<td>6762</td>
<td>J2 command accel limit over (servo)</td>
<td>4</td>
<td>The CP motion is not available with the specified speed because the acceleration command value exceeds the limit on the 2nd axis.</td>
<td>↑</td>
</tr>
<tr>
<td>6763</td>
<td>J3 command accel limit over (servo)</td>
<td>4</td>
<td>The CP motion is not available with the specified speed because the acceleration command value exceeds the limit on the 3rd axis.</td>
<td>↑</td>
</tr>
<tr>
<td>6764</td>
<td>J4 command accel limit over (servo)</td>
<td>4</td>
<td>The CP motion is not available with the specified speed because the acceleration command value exceeds the limit on the 4th axis.</td>
<td>↑</td>
</tr>
<tr>
<td>6765</td>
<td>J5 command accel limit over (servo)</td>
<td>4</td>
<td>The CP motion is not available with the specified speed because the acceleration command value exceeds the limit on the 5th axis.</td>
<td>↑</td>
</tr>
<tr>
<td>6766</td>
<td>J6 command accel limit over (servo)</td>
<td>4</td>
<td>The CP motion is not available with the specified speed because the acceleration command value exceeds the limit on the 6th axis.</td>
<td>↑</td>
</tr>
<tr>
<td>6769</td>
<td>J1 command accel limit over (host)</td>
<td>4</td>
<td>The CP motion is not available with the specified speed because acceleration command value exceeds the limit on the 1st axis.</td>
<td>1. Reduce the speed and the acceleration. If there are no problems, such as interference in the motion path, set the PTP motion. 2. Check that the robot does not pass the singular point vicinity in the CP motion, and correct the program so that it avoids the singular point. 3. If an error occurs when the control set of motion optimization is set to 2 or 3, decrease the speed and deceleration.</td>
</tr>
<tr>
<td>676A</td>
<td>J2 command accel limit over (host)</td>
<td>4</td>
<td>The CP motion is not available with the specified speed because acceleration command value exceeds the limit on the 2nd axis.</td>
<td>↑</td>
</tr>
<tr>
<td>676B</td>
<td>J3 command accel limit over (host)</td>
<td>4</td>
<td>The CP motion is not available with the specified speed because acceleration command value exceeds the limit on the 3rd axis.</td>
<td>↑</td>
</tr>
<tr>
<td>676C</td>
<td>J4 command accel limit over (host)</td>
<td>4</td>
<td>The CP motion is not available with the specified speed because acceleration command value exceeds the limit on the 4th axis.</td>
<td>↑</td>
</tr>
<tr>
<td>676D</td>
<td>J5 command accel limit over (host)</td>
<td>4</td>
<td>The CP motion is not available with the specified speed because acceleration command value exceeds the limit on the 5th axis.</td>
<td>↑</td>
</tr>
<tr>
<td>676E</td>
<td>J6 command accel limit over (host)</td>
<td>4</td>
<td>The CP motion is not available with the specified speed because acceleration command value exceeds the limit on the 6th axis.</td>
<td>↑</td>
</tr>
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<tr>
<td>6771</td>
<td>J1 encoder speed over</td>
<td>5</td>
<td>When the controller power was OFF, an encoder speed error occurred on the 1st axis.</td>
<td>When the controller power is OFF, if excess force is applied on the robot, this error occurs. Reset the encoder and execute CALSET.</td>
</tr>
<tr>
<td>6772</td>
<td>J2 encoder speed over</td>
<td>5</td>
<td>When the controller power was OFF, an encoder speed error occurred on the 2nd axis.</td>
<td>↑</td>
</tr>
<tr>
<td>6773</td>
<td>J3 encoder speed over</td>
<td>5</td>
<td>When the controller power was OFF, an encoder speed error occurred on the 3rd axis.</td>
<td>↑</td>
</tr>
<tr>
<td>6774</td>
<td>J4 encoder speed over</td>
<td>5</td>
<td>When the controller power was OFF, an encoder speed error occurred on the 4th axis.</td>
<td>↑</td>
</tr>
<tr>
<td>6775</td>
<td>J5 encoder speed over</td>
<td>5</td>
<td>When the controller power was OFF, an encoder speed error occurred on the 5th axis.</td>
<td>↑</td>
</tr>
<tr>
<td>6776</td>
<td>J6 encoder speed over</td>
<td>5</td>
<td>When the controller power was OFF, an encoder speed error occurred on the 6th axis.</td>
<td>↑</td>
</tr>
<tr>
<td>6781</td>
<td>J1 speed over at brake releasing</td>
<td>2</td>
<td>When the brake is OFF, an encoder speed error occurred on the 1st axis.</td>
<td>When you move the robot by releasing the brake, do not apply excess force on the robot.</td>
</tr>
<tr>
<td>6782</td>
<td>J2 speed over at brake releasing</td>
<td>2</td>
<td>When the brake is OFF, an encoder speed error occurred on the 2nd axis.</td>
<td>↑</td>
</tr>
<tr>
<td>6783</td>
<td>J3 speed over at brake releasing</td>
<td>2</td>
<td>When the brake is OFF, an encoder speed error occurred on the 3rd axis.</td>
<td>↑</td>
</tr>
<tr>
<td>6784</td>
<td>J4 speed over at brake releasing</td>
<td>2</td>
<td>When the brake is OFF, an encoder speed error occurred on the 4th axis.</td>
<td>↑</td>
</tr>
<tr>
<td>6785</td>
<td>J5 speed over at brake releasing</td>
<td>2</td>
<td>When the brake is OFF, an encoder speed error occurred on the 5th axis.</td>
<td>↑</td>
</tr>
<tr>
<td>6786</td>
<td>J6 speed over at brake releasing</td>
<td>2</td>
<td>When the brake is OFF, an encoder speed error occurred on the 6th axis.</td>
<td>↑</td>
</tr>
<tr>
<td>67B3</td>
<td>Failure in operation command data storage</td>
<td>3</td>
<td>The power was turned off before storage of the operation command.</td>
<td>Restarting in succession to the state before power off is impossible. Since all programs and I-O units are initialized, operate the robot after moving the robot to a safe position to prevent it from coming into contact with any adjacent equipment.</td>
</tr>
<tr>
<td>67B4</td>
<td>Abnormal backup data of ARRIVE command</td>
<td>3</td>
<td>The power was turned off before storage of the ARRIVE command data.</td>
<td>↑</td>
</tr>
<tr>
<td>67B5</td>
<td>Power recovery impossible for operation command during manual operation or teach check</td>
<td>3</td>
<td>No operation command executed in the automatic mode.</td>
<td>↑</td>
</tr>
<tr>
<td>67B6</td>
<td>Power recovery impossible during Machine lock status.</td>
<td>3</td>
<td>The power switch turned off in machine lock status.</td>
<td>↑</td>
</tr>
<tr>
<td>67FE</td>
<td>Error in initialization process</td>
<td>5</td>
<td>Controller internal error. (The host initialization process failed.)</td>
<td>Turn OFF the power switch of the controller and restart the operation.</td>
</tr>
</tbody>
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<tr>
<td>67FF</td>
<td>Abnormal configuration</td>
<td>5</td>
<td>Controller internal error (software failure).</td>
<td></td>
</tr>
<tr>
<td>6A91</td>
<td>J1 encoder communication error(bit)</td>
<td>4</td>
<td>1st axis data received from encoder is abnormal.</td>
<td>1. Check that the robot and FG(Frame Ground) are grounded. 2. Check that the robot and the controller are away from noise source such as a welding machine.</td>
</tr>
<tr>
<td>6A92</td>
<td>J2 encoder communication error(bit)</td>
<td>4</td>
<td>2nd axis data received from encoder is abnormal.</td>
<td></td>
</tr>
<tr>
<td>6A93</td>
<td>J3 encoder communication error(bit)</td>
<td>4</td>
<td>3rd axis data received from encoder is abnormal.</td>
<td></td>
</tr>
<tr>
<td>6A94</td>
<td>J4 encoder communication error(bit)</td>
<td>4</td>
<td>4th axis data received from encoder is abnormal.</td>
<td></td>
</tr>
<tr>
<td>6A95</td>
<td>J5 encoder communication error(bit)</td>
<td>4</td>
<td>5th axis data received from encoder is abnormal.</td>
<td></td>
</tr>
<tr>
<td>6A96</td>
<td>J6 encoder communication error(bit)</td>
<td>4</td>
<td>6th axis data received from encoder is abnormal.</td>
<td></td>
</tr>
<tr>
<td>6A97</td>
<td>J7 encoder communication error(bit)</td>
<td>4</td>
<td>7th axis data received from encoder is abnormal.</td>
<td></td>
</tr>
<tr>
<td>6A98</td>
<td>J8 encoder communication error(bit)</td>
<td>4</td>
<td>8th axis data received from encoder is abnormal.</td>
<td></td>
</tr>
<tr>
<td>6AA1</td>
<td>J1 encoder backup error</td>
<td>5</td>
<td>1st axis backup power was down and the internal data was lost.</td>
<td>1. Check that the encoder backup battery connector is firmly plugged. 2. If the connector for the battery has been disconnected, this error occurs. To recover, reset the 1st axis encoder and execute CALSET operation.</td>
</tr>
<tr>
<td>6AA2</td>
<td>J2 encoder backup error</td>
<td>5</td>
<td>2nd axis backup power was down and the internal data was lost.</td>
<td>1. Check that the encoder backup battery connector is firmly plugged. 2. If the connector for the battery has been disconnected, this error occurs. To recover, reset the 2nd axis encoder and execute CALSET operation.</td>
</tr>
<tr>
<td>6AA3</td>
<td>J3 encoder backup error</td>
<td>5</td>
<td>3rd axis backup power was down and the internal data was lost.</td>
<td>1. Check that the encoder backup battery connector is firmly plugged. 2. If the connector for the battery has been disconnected, this error occurs. To recover, reset the 3rd axis encoder and execute CALSET operation.</td>
</tr>
<tr>
<td>6AA4</td>
<td>J4 encoder backup error</td>
<td>5</td>
<td>4th axis backup power was down and the internal data was lost.</td>
<td>1. Check that the encoder backup battery connector is firmly plugged. 2. If the connector for the battery has been disconnected, this error occurs. To recover, reset the 4th axis encoder and execute CALSET operation.</td>
</tr>
<tr>
<td>6AA5</td>
<td>J5 encoder backup error</td>
<td>5</td>
<td>5th axis backup power was down and the internal data was lost.</td>
<td>1. Check that the encoder backup battery connector is firmly plugged. 2. If the connector for the battery has been disconnected, this error occurs. To recover, reset the 5th axis encoder and execute CALSET operation.</td>
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<tr>
<td>6AA6</td>
<td>J6 encoder backup error</td>
<td>5</td>
<td>6th axis backup power was down and the internal data was lost.</td>
<td>1. Check that the encoder backup battery connector is firmly plugged. 2. If the connector for the battery has been disconnected, this error occurs. To recover, reset the 6th axis encoder and execute CALSET operation.</td>
</tr>
<tr>
<td>6AA7</td>
<td>J7 encoder backup error</td>
<td>5</td>
<td>7th axis backup power was down and the internal data was lost.</td>
<td>1. Check that the encoder backup battery connector is firmly plugged. 2. If the connector for the battery has been disconnected, this error occurs. To recover, reset the 7th axis encoder and execute CALSET operation.</td>
</tr>
<tr>
<td>6AA8</td>
<td>J8 encoder backup error</td>
<td>5</td>
<td>8th axis backup power was down and the internal data was lost.</td>
<td>1. Check that the encoder backup battery connector is firmly plugged. 2. If the connector for the battery has been disconnected, this error occurs. To recover, reset the 8th axis encoder and execute CALSET operation.</td>
</tr>
<tr>
<td>6AA9</td>
<td>J1 encoder initialize error</td>
<td>4</td>
<td>Failure occurred on the 1st axis encoder initialization check.</td>
<td>1. Check that the robot and FG (Frame Ground) are grounded. 2. Check that the robot and the controller are away from noise source such as a welding machine.</td>
</tr>
<tr>
<td>6AAA</td>
<td>J2 encoder initialize error</td>
<td>4</td>
<td>Failure occurred on the 2nd axis encoder initialization check.</td>
<td></td>
</tr>
<tr>
<td>6AAB</td>
<td>J3 encoder initialize error</td>
<td>4</td>
<td>Failure occurred on the 3rd axis encoder initialization check.</td>
<td></td>
</tr>
<tr>
<td>6AAC</td>
<td>J4 encoder initialize error</td>
<td>4</td>
<td>Failure occurred on the 4th axis encoder initialization check.</td>
<td></td>
</tr>
<tr>
<td>6AAD</td>
<td>J5 encoder initialize error</td>
<td>4</td>
<td>Failure occurred on the 5th axis encoder initialization check.</td>
<td></td>
</tr>
<tr>
<td>6AAE</td>
<td>J6 encoder initialize error</td>
<td>4</td>
<td>Failure occurred on the 6th axis encoder initialization check.</td>
<td></td>
</tr>
<tr>
<td>6AAF</td>
<td>J7 encoder initialize error</td>
<td>4</td>
<td>Failure occurred on the 7th axis encoder initialization check.</td>
<td></td>
</tr>
<tr>
<td>6AB0</td>
<td>J8 encoder initialize error</td>
<td>4</td>
<td>Failure occurred on the 8th axis encoder initialization check.</td>
<td></td>
</tr>
<tr>
<td>6AB1</td>
<td>J1 encoder absolute data error</td>
<td>5</td>
<td>1st axis position data may be wrong.</td>
<td></td>
</tr>
<tr>
<td>6AB2</td>
<td>J2 encoder absolute data error</td>
<td>5</td>
<td>2nd axis position data may be wrong.</td>
<td></td>
</tr>
<tr>
<td>6AB3</td>
<td>J3 encoder absolute data error</td>
<td>5</td>
<td>3rd axis position data may be wrong.</td>
<td></td>
</tr>
<tr>
<td>6AB4</td>
<td>J4 encoder absolute data error</td>
<td>5</td>
<td>4th axis position data may be wrong.</td>
<td></td>
</tr>
</tbody>
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<table>
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<tr>
<th>Code</th>
<th>Message</th>
<th>Lv</th>
<th>Description</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>6AB5</td>
<td>J5 encoder absolute data error</td>
<td>5</td>
<td>5th axis position data may be wrong.</td>
<td>↑</td>
</tr>
<tr>
<td>6AB6</td>
<td>J6 encoder absolute data error</td>
<td>5</td>
<td>6th axis position data may be wrong.</td>
<td>↑</td>
</tr>
<tr>
<td>6AB7</td>
<td>J7 encoder absolute data error</td>
<td>5</td>
<td>7th axis position data may be wrong.</td>
<td>↑</td>
</tr>
<tr>
<td>6AB8</td>
<td>J8 encoder absolute data error</td>
<td>5</td>
<td>8th axis position data may be wrong.</td>
<td>↑</td>
</tr>
<tr>
<td>6AB9</td>
<td>J1 encoder error</td>
<td>5</td>
<td>Failure occurred on the 1st axis encoder.</td>
<td>1. Check that the robot and FG (Frame Ground) are grounded. 2. Check that the robot and the controller are away from noise sources such as a welding machine. 3. Reset the 1st axis encoder and perform CALSET operation before restarting.</td>
</tr>
<tr>
<td>6ABA</td>
<td>J2 encoder error</td>
<td>5</td>
<td>Failure occurred on the 2nd axis encoder.</td>
<td>1. Check that the robot and FG (Frame Ground) are grounded. 2. Check that the robot and the controller are away from noise sources such as a welding machine. 3. Reset the 2nd axis encoder and perform CALSET operation before restarting.</td>
</tr>
<tr>
<td>6ABB</td>
<td>J3 encoder error</td>
<td>5</td>
<td>Failure occurred on the 3rd axis encoder.</td>
<td>1. Check that the robot and FG (Frame Ground) are grounded. 2. Check that the robot and the controller are away from noise sources such as a welding machine. 3. Reset the 3rd axis encoder and perform CALSET operation before restarting.</td>
</tr>
<tr>
<td>6ABC</td>
<td>J4 encoder error</td>
<td>5</td>
<td>Failure occurred on the 4th axis encoder.</td>
<td>1. Check that the robot and FG (Frame Ground) are grounded. 2. Check that the robot and the controller are away from noise sources such as a welding machine. 3. Reset the 4th axis encoder and perform CALSET operation before restarting.</td>
</tr>
<tr>
<td>6ABD</td>
<td>J5 encoder error</td>
<td>5</td>
<td>Failure occurred on the 5th axis encoder.</td>
<td>1. Check that the robot and FG (Frame Ground) are grounded. 2. Check that the robot and the controller are away from noise sources such as a welding machine. 3. Reset the 5th axis encoder and perform CALSET operation before restarting.</td>
</tr>
<tr>
<td>6ABE</td>
<td>J6 encoder error</td>
<td>5</td>
<td>Failure occurred on the 6th axis encoder.</td>
<td>1. Check that the robot and FG (Frame Ground) are grounded. 2. Check that the robot and the controller are away from noise sources such as a welding machine. 3. Reset the 6th axis encoder and perform CALSET operation before restarting.</td>
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<tr>
<td>6ABF</td>
<td>J7 encoder error</td>
<td>5</td>
<td>Failure occurred on the 7th axis encoder.</td>
<td>1. Check that the robot and FG (Frame Ground) are grounded.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. Check that the robot and the controller are away from noise source</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>such as a welding machine.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3. Reset the 7th axis encoder and perform CALSET operation before</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>restarting.</td>
</tr>
<tr>
<td>6AC0</td>
<td>J8 encoder error</td>
<td>5</td>
<td>Failure occurred on the 8th axis encoder.</td>
<td>1. Check that the robot and FG (Frame Ground) are grounded.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. Check that the robot and the controller are away from noise source</td>
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<td>3. Reset the 8th axis encoder and perform CALSET operation before</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>restarting.</td>
</tr>
<tr>
<td>6AC1</td>
<td>J1 encoder over speed error</td>
<td>5</td>
<td>1st axis rotation speed at turning the power ON is too high.</td>
<td>Turn the power ON again when the robot rests.</td>
</tr>
<tr>
<td>6AC2</td>
<td>J2 encoder over speed error</td>
<td>5</td>
<td>2nd axis rotation speed at turning the power ON is too high.</td>
<td>↑</td>
</tr>
<tr>
<td>6AC3</td>
<td>J3 encoder over speed error</td>
<td>5</td>
<td>3rd axis rotation speed at turning the power ON is too high.</td>
<td>↑</td>
</tr>
<tr>
<td>6AC4</td>
<td>J4 encoder over speed error</td>
<td>5</td>
<td>4th axis rotation speed at turning the power ON is too high.</td>
<td>↑</td>
</tr>
<tr>
<td>6AC5</td>
<td>J5 encoder over speed error</td>
<td>5</td>
<td>5th axis rotation speed at turning the power ON is too high.</td>
<td>↑</td>
</tr>
<tr>
<td>6AC6</td>
<td>J6 encoder over speed error</td>
<td>5</td>
<td>6th axis rotation speed at turning the power ON is too high.</td>
<td>↑</td>
</tr>
<tr>
<td>6AC7</td>
<td>J7 encoder over speed error</td>
<td>5</td>
<td>7th axis rotation speed at turning the power ON is too high.</td>
<td>↑</td>
</tr>
<tr>
<td>6AC8</td>
<td>J8 encoder over speed error</td>
<td>5</td>
<td>8th axis rotation speed at turning the power ON is too high.</td>
<td>↑</td>
</tr>
<tr>
<td>6AC9</td>
<td>J1 encoder communication error</td>
<td>4</td>
<td>1st axis encoder data was not updated normally.</td>
<td>1. Check that the robot and FG (Frame Ground) are grounded.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. Check that the robot and the controller are away from noise source</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>such as a welding machine.</td>
</tr>
<tr>
<td>6ACA</td>
<td>J2 encoder communication error</td>
<td>4</td>
<td>2nd axis encoder data was not updated normally.</td>
<td>↑</td>
</tr>
<tr>
<td>6ACB</td>
<td>J3 encoder communication error</td>
<td>4</td>
<td>3rd axis encoder data was not updated normally.</td>
<td>↑</td>
</tr>
<tr>
<td>6ACC</td>
<td>J4 encoder communication error</td>
<td>4</td>
<td>4th axis encoder data was not updated normally.</td>
<td>↑</td>
</tr>
<tr>
<td>6ACD</td>
<td>J5 encoder communication error</td>
<td>4</td>
<td>5th axis encoder data was not updated normally.</td>
<td>↑</td>
</tr>
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<tr>
<td>6ACE</td>
<td>J6 encoder communication error</td>
<td>4</td>
<td>6th axis encoder data was not updated normally.</td>
<td></td>
</tr>
<tr>
<td>6ACF</td>
<td>J7 encoder communication error</td>
<td>4</td>
<td>7th axis encoder data was not updated normally.</td>
<td></td>
</tr>
<tr>
<td>6AD0</td>
<td>J8 encoder communication error</td>
<td>4</td>
<td>8th axis encoder data was not updated normally</td>
<td></td>
</tr>
</tbody>
</table>
| 6AD1 | J1 encoder data not received   | 4  | 1st axis encoder data was not received. | 1. Check that the robot and FG (Frame Ground) are grounded.  
2. Check that the robot and the controller are away from noise source such as a welding machine.  
3. Check if the cable between the robot and the controller is firmly plugged. |
| 6AD2 | J2 encoder data not received   | 4  | 2nd axis encoder data was not received. |                                                                                             |
| 6AD3 | J3 encoder data not received   | 4  | 3rd axis encoder data was not received. |                                                                                             |
| 6AD4 | J4 encoder data not received   | 4  | 4th axis encoder data was not received. |                                                                                             |
| 6AD5 | J5 encoder data not received   | 4  | 5th axis encoder data was not received. |                                                                                             |
| 6AD6 | J6 encoder data not received   | 4  | 6th axis encoder data was not received. |                                                                                             |
| 6AD7 | J7 encoder data not received   | 4  | 7th axis encoder data was not received. |                                                                                             |
| 6AD8 | J8 encoder data not received   | 4  | 8th axis encoder data was not received. |                                                                                             |
| 6AD9 | J1 encoder over heat error     | 4  | 1st axis encoder internal temperature is too high. | As the controller may be possibly damaged, execute the following remedy.  
1. Check if the controller is properly installed, in accordance with the instruction manual.  
2. Check the working ambient temperature. |
| 6ADA | J2 encoder over heat error     | 4  | 2nd axis encoder internal temperature is too high. |                                                                                             |
| 6ADB | J3 encoder over heat error     | 4  | 3rd axis encoder internal temperature is too high. |                                                                                             |
| 6ADC | J4 encoder over heat error     | 4  | 4th axis encoder internal temperature is too high. |                                                                                             |
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<tr>
<td>6ADD</td>
<td>J5 encoder over heat error</td>
<td>4</td>
<td>5th axis encoder internal temperature is too high.</td>
<td></td>
</tr>
<tr>
<td>6ADE</td>
<td>J6 encoder over heat error</td>
<td>4</td>
<td>6th axis encoder internal temperature is too high.</td>
<td></td>
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<tr>
<td>6ADF</td>
<td>J7 encoder over heat error</td>
<td>4</td>
<td>7th axis encoder internal temperature is too high.</td>
<td></td>
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<tr>
<td>6AE0</td>
<td>J8 encoder over heat error</td>
<td>4</td>
<td>8th axis encoder internal temperature is too high.</td>
<td></td>
</tr>
<tr>
<td>6AE1</td>
<td>J1 encoder battery low voltage</td>
<td>2</td>
<td>1st axis encoder battery voltage is low.</td>
<td>Replace the 1st axis encoder backup battery.</td>
</tr>
<tr>
<td>6AE2</td>
<td>J2 encoder battery low voltage</td>
<td>2</td>
<td>2nd axis encoder battery voltage is low.</td>
<td>Replace the 2nd axis encoder backup battery.</td>
</tr>
<tr>
<td>6AE3</td>
<td>J3 encoder battery low voltage</td>
<td>2</td>
<td>3rd axis encoder battery voltage is low.</td>
<td>Replace the 3rd axis encoder backup battery.</td>
</tr>
<tr>
<td>6AE4</td>
<td>J4 encoder battery low voltage</td>
<td>2</td>
<td>4th axis encoder battery voltage is low.</td>
<td>Replace the 4th axis encoder backup battery.</td>
</tr>
<tr>
<td>6AE5</td>
<td>J5 encoder battery low voltage</td>
<td>2</td>
<td>5th axis encoder battery voltage is low.</td>
<td>Replace the 5th axis encoder backup battery.</td>
</tr>
<tr>
<td>6AE6</td>
<td>J6 encoder battery low voltage</td>
<td>2</td>
<td>6th axis encoder battery voltage is low.</td>
<td>Replace the 6th axis encoder backup battery.</td>
</tr>
<tr>
<td>6AE7</td>
<td>J7 encoder battery low voltage</td>
<td>2</td>
<td>7th axis encoder battery voltage is low.</td>
<td>Replace the 7th axis encoder backup battery.</td>
</tr>
<tr>
<td>6AE8</td>
<td>J8 encoder battery low voltage</td>
<td>2</td>
<td>8th axis encoder battery voltage is low.</td>
<td>Replace the 8th axis encoder backup battery.</td>
</tr>
<tr>
<td>6AE9</td>
<td>J1 encoder overflow warning</td>
<td>4</td>
<td>1st axis multiple rotation data will be overflowed if the axis is kept</td>
<td>If it is necessary to rotate the axis to the overflow direction, reset the 1st axis encoder and execute CALSET.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>rotating in the current rotation direction.</td>
<td></td>
</tr>
<tr>
<td>6AEA</td>
<td>J2 encoder overflow warning</td>
<td>4</td>
<td>2nd axis multiple rotation data will be overflowed if the axis is kept</td>
<td>If it is necessary to rotate the axis to the overflow direction, reset the 2nd axis encoder and execute CALSET.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>rotating in the current rotation direction.</td>
<td></td>
</tr>
<tr>
<td>6AEB</td>
<td>J3 encoder overflow warning</td>
<td>4</td>
<td>3rd axis multiple rotation data will be overflowed if the axis is kept</td>
<td>If it is necessary to rotate the axis to the overflow direction, reset the 3rd axis encoder and execute CALSET.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>rotating in the current rotation direction.</td>
<td></td>
</tr>
<tr>
<td>6AEC</td>
<td>J4 encoder overflow warning</td>
<td>4</td>
<td>4th axis multiple rotation data will be overflowed if the axis is kept</td>
<td>If it is necessary to rotate the axis to the overflow direction, reset the 4th axis encoder and execute CALSET.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>rotating in the current rotation direction.</td>
<td></td>
</tr>
<tr>
<td>6AED</td>
<td>J5 encoder overflow warning</td>
<td>4</td>
<td>5th axis multiple rotation data will be overflowed if the axis is kept</td>
<td>If it is necessary to rotate the axis to the overflow direction, reset the 5th axis encoder and execute CALSET.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>rotating in the current rotation direction.</td>
<td></td>
</tr>
<tr>
<td>Code</td>
<td>Message</td>
<td>Lv</td>
<td>Description</td>
<td>Remedy</td>
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<td>-------</td>
<td>----------------------------------------</td>
<td>----</td>
<td>-----------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>6AEE</td>
<td>J6 encoder overflow warning</td>
<td>4</td>
<td>6th axis multiple rotation data will be overflowed if the axis is kept</td>
<td>If it is necessary to rotate the axis to the overflow direction, reset the 6th axis encoder and execute CALSET.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>rotating in the current rotation direction.</td>
<td></td>
</tr>
<tr>
<td>6AEF</td>
<td>J7 encoder overflow warning</td>
<td>4</td>
<td>7th axis multiple rotation data will be overflowed if the axis is kept</td>
<td>If it is necessary to rotate the axis to the overflow direction, reset the 7th axis encoder and execute CALSET.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>rotating in the current rotation direction.</td>
<td></td>
</tr>
<tr>
<td>6AF0</td>
<td>J8 encoder overflow warning</td>
<td>4</td>
<td>8th axis multiple rotation data will be overflowed if the axis is kept</td>
<td>If it is necessary to rotate the axis to the overflow direction, reset the 8th axis encoder and execute CALSET.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>rotating in the current rotation direction.</td>
<td></td>
</tr>
<tr>
<td>6AF3</td>
<td>Interference area detected by J1,2,3</td>
<td>3</td>
<td>The interference area specified for each robot was detected.</td>
<td>Move the robot in the direction kept away from the interference area.</td>
</tr>
<tr>
<td>7047</td>
<td>Subroutine return stack overflow</td>
<td>4</td>
<td>Number of calling subroutines exceeded their set value.</td>
<td>1. Check that the program, which had the error, does not call itself as a subroutine.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. Check that the program calls the other program as a subroutine and that the subroutine calls the main program (calling) again as a subroutine.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3. Change the program configuration so that the subroutine is not called exceeding the set times of calling.</td>
</tr>
<tr>
<td>7048</td>
<td>Undefined process command</td>
<td>4</td>
<td>An undefined processing command in the current software attempted to</td>
<td>1. Check that the controller software version agrees with that of WINCAPSII.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>execute.</td>
<td>2. Re-create the execution form file using WINCAPSII or the controller. At this time, disable the DATE INSPECTION option in WINCAPSII.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3. Check that no error occurs when the program is transferred from WINCAPSII to the controller and when the program is loading.</td>
</tr>
<tr>
<td>71E0</td>
<td>Program busy</td>
<td>2</td>
<td>Attempted to perform an operation not executable while the program is</td>
<td>Restart the operation confirming that the program is not in execution.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>in execution.</td>
<td></td>
</tr>
<tr>
<td>736A</td>
<td>Stop operation error</td>
<td>4</td>
<td>Operation did not stop within a specified time after HALT and Robot stop.</td>
<td>Clear error and restart the operation.</td>
</tr>
<tr>
<td>736B</td>
<td>Cannot execute Auto-loading.</td>
<td>2</td>
<td>The automatic road is performed when the program list or the variable type</td>
<td>Reload with Teaching pendant.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>select window are displayed.</td>
<td></td>
</tr>
<tr>
<td>736C</td>
<td>Started program is in Teach-Check</td>
<td>2</td>
<td>A program in Teach-Check condition was attempted to start by RUN command</td>
<td>If the operation is confirmed to be safe, start the program. If not, restart the program after ‘HALT’ of the Teach-Check program.</td>
</tr>
<tr>
<td></td>
<td>condition.</td>
<td></td>
<td>from other program.</td>
<td></td>
</tr>
<tr>
<td>736D</td>
<td>TC time detected. All program halted.</td>
<td>1</td>
<td>This condition occurs when TC time (non-operation time) exceeds the set</td>
<td>Cannot start next operation by the unknown causes. Solve the causes.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>time in SS function stop mode setting.</td>
<td></td>
</tr>
<tr>
<td>736E</td>
<td>Executed program version does not</td>
<td>4</td>
<td>Cannot load the program because the program version does not coincide with</td>
<td>Recompile the program with the controller or make the WINCAPSII version coincide with the controller version.</td>
</tr>
<tr>
<td></td>
<td>coincide with the controller version.</td>
<td></td>
<td>the controller version.</td>
<td></td>
</tr>
<tr>
<td>737A</td>
<td>Cannot store operation history</td>
<td>1</td>
<td>Failed in recording robot operation command data used in step-back</td>
<td>Execute step start or cycle start in case of executing the step-back of the program. The limitation of step back in this condition is up to the first robot operation command when step start or cycle start was executed after the error occurrence.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>function.</td>
<td></td>
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<tr>
<td>737B</td>
<td>Failed in initializing operation history</td>
<td>1</td>
<td>Failed in initializing the robot operation command data used in step back function.</td>
<td>In case of using step back function, switch off the controller power switch and restart the operation.</td>
</tr>
<tr>
<td>737C</td>
<td>Restart operation execution error</td>
<td>3</td>
<td>Failed in the execution of step back function. Or failed in step start or cycle start to the starting point of the step back operation</td>
<td>In case of using step back function, execute the robot operation command by step start or cycle start.</td>
</tr>
<tr>
<td>737D</td>
<td>Cannot step back further</td>
<td>1</td>
<td>Cannot step back further.</td>
<td>Execute the robot operation command by step start or cycle start.</td>
</tr>
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<tbody>
<tr>
<td>737E</td>
<td>No operation history</td>
<td>1</td>
<td>No operation command data to be used in step back function was found.</td>
<td>Execute the robot operation command by step start or cycle start.</td>
</tr>
<tr>
<td>737F</td>
<td>Restart operation busy</td>
<td>1</td>
<td>In execution of step back operation, or in execution of step start / cycle start to the starting point of the step back operation.</td>
<td>Execute step start or cycle start again.</td>
</tr>
<tr>
<td>738A</td>
<td>Cannot change nonexistent parameter program</td>
<td>2</td>
<td>A variable specified with the program does not exist. (The table number or element number is out of range.)</td>
<td>Read the program again and change or correct the program so that the table number and element number is within the range.</td>
</tr>
<tr>
<td>738B</td>
<td>Cannot change this parameter by program</td>
<td>3</td>
<td>A variable specified with a program cannot be changed from the program.</td>
<td>Read the program again and delete this command or correct the variable so that it is available to use.</td>
</tr>
<tr>
<td>738C</td>
<td>No RETURN position</td>
<td>3</td>
<td>RETURN command was used by the program not executed with GOSUB.</td>
<td>Review the program and correct the RETURN position or GOSUB.</td>
</tr>
<tr>
<td>738D</td>
<td>Return stack of the program destroyed</td>
<td>4</td>
<td>The content of the Return stack is destroyed.</td>
<td>Switch off the controller power switch and restart the operation. Recompile the program. Notify us if the condition is not improved by the recompile.</td>
</tr>
<tr>
<td>738E</td>
<td>CRC error of BP's data</td>
<td>5</td>
<td>A break-point data error was detected.</td>
<td>Release all break points, turn OFF the power switch of the controller, and respecify break points for operation.</td>
</tr>
<tr>
<td>739B</td>
<td>Failure to allocate task control area</td>
<td>4</td>
<td>Memory area for multitasking program manager was not normally allocated.</td>
<td>Turn OFF the power switch of the controller and restart the operation.</td>
</tr>
<tr>
<td>739C</td>
<td>Failure to initialize prog. exe. process</td>
<td>4</td>
<td>An error occurred when the multitasking program process section was initialized.</td>
<td>↑</td>
</tr>
<tr>
<td>739D</td>
<td>Failure to initialize step exe. process</td>
<td>4</td>
<td>An error occurred when the step execution process section was initialized.</td>
<td>↑</td>
</tr>
</tbody>
</table>
| 739E | Failure to load execution file              | 4  | The controller could not load the execution form file.                    | 1. Check that the execution form file and the mutual reference file were transmitted from WINCAPSII to the controller, before you execute loading.  
2. Check that another error occurs in execution of loading with the error log function. If the error occurred, remove the cause of the error and reload them.  
3. Check that no error occurs when a program is transferred from WINCAPSII to the controller.  
4. Check that no error occurs when the compiling is executed in the controller.  
5. Use WINCAPSII or the controller and create the execution form file again. When you do this, set the DATE INSPECTION option to invalid in WINCAPSII. |
| 739F | Failure to create internal task             | 4  | Creation of a task, used in the internal process, failed.                 | Turn OFF the power switch of the controller and restart the operation. |
## 2 Controller Error Code Table

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<thead>
<tr>
<th>Code</th>
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<th>Remedy</th>
</tr>
</thead>
</table>
| 73A1  | Failure to delete semaphore                 | 4  | Semaphore was not deleted normally.                                         | 1. Check if the semaphore ID given with the GIVESEM statement is the same as that taken with the CREATESEM statement.  
2. Turn OFF the power switch of the controller and restart the operation.                                                                                           |
| 73A2  | Failure to create semaphore                 | 4  | Creation of a task used in the internal process failed.                     | Turn OFF the power switch of the controller and restart the operation.                                                                                                                                    |
| 73A3  | Failure to terminate cycle process          | 4  | The termination process for the CYCLE option executing section of the RUN   | ↑                                                                                                                                                                                                                                                                  |
|       | statement could not execute.                |    | statement could not execute.                                                |                                                                                                                                                                                                                                                                  |
| 73A4  | Failure to initialize cycle process         | 4  | Initialization for the CYCLE option executing section of the RUN statement   | ↑                                                                                                                                                                                                                                                                  |
|       | could not execute.                          |    | could not execute.                                                          |                                                                                                                                                                                                                                                                  |
| 73A5  | Failure to start cycle process              | 4  | The start process for the CYCLE option executing section of the RUN statement| ↑                                                                                                                                                                                                                                                                  |
|       | could not execute.                          |    | could not execute.                                                          |                                                                                                                                                                                                                                                                  |
| 73A6  | Forbidden process tried during loading      | 4  | A process command not available to execute attempted to execute in program   | 1. Check that no transmit error occurs when an execution form file is transmitted from WINCAPSII to the controller.  
2. Check that no error occurs when compiling is executed in the controller.  
3. Use WINCAPSII or the controller and create the execution form file again. When you do this, set the DATE INSPECTION option to invalid in WINCAPSII. |
|       |                                              |    | load processing.                                                            |                                                                                                                                                                                                                                                                  |
| 73A7  | Cannot take cycle process semaphore         | 4  | Internal process semaphore for execution of CYCLE option of RUN statement     | Turn OFF the power switch of the controller and restart the operation.                                                                                                                                |
|       | was not taken normally.                     |    | was not taken normally.                                                      |                                                                                                                                                                                                                                                                  |
| 73A8  | Failure to write Interpreter queue          | 4  | Transfer of an execution contents command to the program executing section   | ↑                                                                                                                                                                                                                                                                  |
|       | failed.                                     |    | failed.                                                                     |                                                                                                                                                                                                                                                                  |
| 73A9  | Failure to release cycle process semaphore  | 4  | Internal process semaphore for execution of CYCLE option of RUN statement     | ↑                                                                                                                                                                                                                                                                  |
|       | was not released normally.                  |    | was not released normally.                                                   |                                                                                                                                                                                                                                                                  |
| 73AA  | Cannot allocate interpreter memory          | 4  | Memory area for execution form file interpreter was not allocated normally.  | ↑                                                                                                                                                                                                                                                                  |
| 73AB  | Undefined variable format (1) appeared      | 4  | Attempted to interpret variable data; however, different data from the      | 1. Check that the controller software version corresponds to that of WINCAPSII.  
2. Check that no transmit error occurs when an execution form file is transmitted from WINCAPSII to the controller.  
3. Check that no error occurs when compiling is executed in the controller.  
4. Use WINCAPSII or the controller and create the execution form file again. When you do this, set the DATE INSPECTION option to invalid in WINCAPSII. |
|       |                                              |    | variable data appeared in the execution form file.                         |                                                                                                                                                                                                                                                                  |
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<tbody>
<tr>
<td>73AC</td>
<td>Undefined variable format (2) appeared</td>
<td>4</td>
<td>Attempted to interpret the variable data; however, different data from the variable data appeared in the execution form file.</td>
<td>1. Check that the controller software version corresponds to that of WINCAPSII. 2. Check that no transmit error occurs when an execution form file is transmitted from WINCAPSII to the controller. 3. Check that no error occurs when compiling is executed in the controller. 4. Use WINCAPSII or the controller and create the execution form file again. When you do this, set the DATE INSPECTION option to invalid in WINCAPSII.</td>
</tr>
<tr>
<td>73AD</td>
<td>Non-integer type variable appeared</td>
<td>4</td>
<td>Integer data attempted to interpret; however, different data from the integer data appeared in the execution form file.</td>
<td>1. Check that the controller software version corresponds to that of WINCAPSII. 2. Check that no transmit error occurs when an execution form file is transmitted from WINCAPSII to the controller. 3. Check that no error occurs when compiling is executed in the controller. 4. Use WINCAPSII or the controller and create the execution form file again. When you do this, set the DATE INSPECTION option to invalid in WINCAPSII.</td>
</tr>
<tr>
<td>73AE</td>
<td>Program internal No. not defined</td>
<td>4</td>
<td>Attempted to be read a program number in program load processing; however, the number did not appear.</td>
<td>1. Check that the controller software version corresponds to that of WINCAPSII. 2. Check that no transmit error occurs when an execution form file is transmitted from WINCAPSII to the controller. 3. Check that no error occurs when compiling is executed in the controller. 4. Use WINCAPSII or the controller and create the execution form file again. When you do this, set the DATE INSPECTION option to invalid in WINCAPSII.</td>
</tr>
<tr>
<td>73AF</td>
<td>Program define start command not found</td>
<td>4</td>
<td>Attempted to read the program definition; however, the command declaring the program start did not appear.</td>
<td>1. Check that no transmit error occurs when an execution form file is transmitted from WINCAPSII to the controller. 2. Check that no error occurs when compiling is executed in the controller. 3. Use WINCAPSII or the controller and create the execution form file again. When you do this, set the DATE INSPECTION option to invalid in WINCAPSII.</td>
</tr>
<tr>
<td>73B0</td>
<td>Program define No. out of setting range</td>
<td>4</td>
<td>A program internal definition number was read; however, the value was out of permissible range.</td>
<td>1. Check that the controller software version corresponds to that of WINCAPSII. 2. Check that no transmit error occurs when an execution form file is transmitted from WINCAPSII to the controller. 3. Check that no error occurs when compiling is executed in the controller. 4. Use WINCAPSII or the controller and create the execution form file again. When you do this, set the DATE INSPECTION option to invalid in WINCAPSII.</td>
</tr>
</tbody>
</table>
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</thead>
<tbody>
<tr>
<td>73B1</td>
<td>Cannot allocate program define memory area</td>
<td>4</td>
<td>Working memory for copying program contents in the program loading process was not allocated normally.</td>
</tr>
</tbody>
</table>
|        |                                              |    | 1. Check that the controller software version corresponds to that of WINCAPSII.  
|        |                                              |    | 2. Check that no transmit error occurs when an execution form file is transmitted from WINCAPSII to the controller.  
|        |                                              |    | 3. Check that no error occurs when compiling is executed in the controller.  
|        |                                              |    | 4. Use WINCAPSII or the controller and create the execution form file again. When you do this, set the DATE INSPECTION option to invalid in WINCAPSII.  
|        |                                              |    | 5. The program size total number exceeds the system permissible value. Reduce the number of programs, which construct the project, recompile and load them.                                                                                                                                 |
| 73B2   | Program size differs from definition         | 4  | Program size declaration appeared at the head of the program definition and the practical program size did not match that definition.                                                                                                                                                                                                 |
|        |                                              |    | 1. Check that the controller software version corresponds to that of WINCAPSII.  
|        |                                              |    | 2. Check that no transmit error occurs when an execution form file is transmitted from WINCAPSII to the controller.  
|        |                                              |    | 3. Check that no error occurs when compiling is executed in the controller.  
|        |                                              |    | 4. Use WINCAPSII or the controller and create the execution form file again. When you do this, set the DATE INSPECTION option to invalid in WINCAPSII.                                                                                                                                 |
| 73B3   | Local variable not initialized              | 4  | 1. A local variable was declared. The variable contents attempted to read without assigning a value at least once.  
|        |                                              |    | 2. A attempted calling a subroutine; however, the corresponding program could not be found.  
|        |                                              |    | 3. HOME is not set before execution of the GOHOME command.  
|        |                                              |    | Case 1.:  
|        |                                              |    | - Read the program again and correct the program so that the value is assigned before the value of the local variable is read, after the program is loaded.  
|        |                                              |    | Case 2.:  
|        |                                              |    | - Check that no transmit error occurs when an execution form file is transmitted from WINCAPSII to the controller.  
|        |                                              |    | - Check that no error occurs when compiling is executed in the controller.  
|        |                                              |    | - Use WINCAPSII or the controller and create the execution form file again. When you do this, set the DATE INSPECTION option to invalid in WINCAPSII.  
|        |                                              |    | Case 3.:  
|        |                                              |    | Set the home position with the HOME command.                                                                                                                                                                                                                                   |
| 73B4   | Failure to allocate variable reading area    | 4  | Process area to read variable data from could not be allocated.                                                                                                                                                                                                                                                                              |
|        |                                              |    | Turn OFF the power switch on the controller and restart the operation.                                                                                                                                                                                                                                                                     |
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</thead>
</table>
| 73B5   | Undefined variable format (1) appeared                | 4  | Attempted to interpret variable data; however, data different from the variable data appeared in the execution form file. | 1. Check that the controller software version corresponds to that of WINCAPSII.  
2. Check that no transmit error occurs when an execution form file is transmitted from WINCAPSII to the controller.  
3. Check that no error occurs when compiling is executed in the controller.  
4. Use WINCAPSII or the controller and create the execution form file again. When you do this, set the DATE INSPECTION option to invalid in WINCAPSII. |
| 73B6   | Undefined variable format (2) appeared                | 4  | Attempted to interpret variable data; however, data different from the variable data appeared in the execution form file. | 1. Check that the controller software version corresponds to that of WINCAPSII.  
2. Check that no transmit error occurs when an execution form file is transmitted from WINCAPSII to the controller.  
3. Check that no error occurs when compiling is executed in the controller.  
4. Use WINCAPSII or the controller and create the execution form file again. When you do this, set the DATE INSPECTION option to invalid in WINCAPSII. |
| 73B8   | Failure to write load data                            | 4  | Attempted to transmit data to the process section, in order to load the program; however, transfer writing failed.        | Turn OFF the power switch on the controller and restart the operation.                                                                 |
| 73B9   | Failure to read load data                             | 4  | The process section attempted to read data, in order to load a program. However, the reading failed. An attempted to transmit data to the process section and to load the program, by transfer writing failed. | ↑                                                                                                                                      |
| 73BA   | Program restart failed                                | 4  | The RUN command could not restart the program, which was in a hold status, due to the halt.                            | Set the program to the stop status and execute again, from the top.                                                                    |
| 73BB   | Failure to specify start program                       | 4  | Program start was attempted by the pendant I/O or PAC RUN command. But the controller failed to specify the program number at the program interpreter. | Turn OFF the power switch on the controller and restart the operation.                                                               |
| 73BC   | Program suspension failed                             | 4  | Attempt was made to suspend the program. But, it was terminated because of failure.                                  | ↑                                                                                                                                 |
| 73BD   | Program restart failed                                | 4  | The controller failed to restart the program in hold status.                                                        | Set the program to stop status and run the program again from the top.                                                               |
| 73C0   | Failure to read break point reading area              | 4  | The controller failed to secure the reading area to read the break point setting lines.                             | Turn OFF the power switch on the controller and restart the operation.                                                               |
| 73C1   | Cannot set no more break points                      | 4  | The number of break points attempted to set for the program exceeds the upper limit.                                | Release unnecessary break points and set again.                                                                                       |
| 73C2   | No break point is set in a line                      | 4  | Attempt was made to delete the break point at a line where no break point was set.                                  | Check if a break point is set on the line where the break point attempted to delete.                                                  |
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</tr>
</thead>
<tbody>
<tr>
<td>73C3</td>
<td>Program stop designation undefined</td>
<td>4</td>
<td>Attempt was made to set an undefined status process, to designate status for the break point, program execution trace, step start and step stop.</td>
<td>Turn OFF the power switch on the controller and restart the operation.</td>
</tr>
<tr>
<td>73C4</td>
<td>Step stop specify semaphore not prepared</td>
<td>4</td>
<td>Step stop was attempted. But the required internal semaphore was not prepared.</td>
<td>↑</td>
</tr>
<tr>
<td>73C6</td>
<td>Failure to create break point semaphore</td>
<td>4</td>
<td>Internal semaphore for the break point process was not created normally.</td>
<td>↑</td>
</tr>
<tr>
<td>73C7</td>
<td>Failure to take break point semaphore</td>
<td>4</td>
<td>Internal semaphore for the break point process was not taken normally.</td>
<td>↑</td>
</tr>
<tr>
<td>73C8</td>
<td>Failure to delete break point semaphore</td>
<td>4</td>
<td>Internal semaphore for the break point process was not deleted normally.</td>
<td>↑</td>
</tr>
<tr>
<td>73C9</td>
<td>Failure to obtain task status</td>
<td>4</td>
<td>The program operation status was not obtained normally.</td>
<td>1. Check that the controller software version corresponds to that of WINCAPS II. 2. Check that no transmit error occurs when an execution form file is transmitted from WINCAPS II to the controller. 3. Check that no error occurs when compiling is executed in the controller. 4. Use WINCAPS II or the controller and create the execution form file again. When you do this, set the DATE INSPECTION option to invalid in WINCAPS II.</td>
</tr>
<tr>
<td>73CA</td>
<td>Failure to obtain task information</td>
<td>4</td>
<td>Attempted to obtain the program information; however, the information recorded section could not be found.</td>
<td>Turn OFF the power switch on the controller and restart the operation.</td>
</tr>
<tr>
<td>73CB</td>
<td>Failure to search task information</td>
<td>4</td>
<td>The program information recorded section was searched; however, it could not be found.</td>
<td>1. The number of PAC programs, which construct the project, exceeds the set upper limit. Reduce the number of the PAC programs. Then, recompile and load them. 2. Check that no transmit error occurs when an execution form file is transmitted from WINCAPS II to the controller. 3. Check that no error occurs when compiling is executed in the controller. 4. Use WINCAPS II or the controller and create the execution form file again. When you do this, set the DATE INSPECTION option to invalid in WINCAPS II.</td>
</tr>
<tr>
<td>Code</td>
<td>Message</td>
<td>Lv</td>
<td>Description</td>
<td>Remedy</td>
</tr>
<tr>
<td>------</td>
<td>---------</td>
<td>----</td>
<td>-------------</td>
<td>--------</td>
</tr>
<tr>
<td>73CC</td>
<td>Failure to allocate task info record area</td>
<td>4</td>
<td>When the program was being loaded, the program information attempted to record; however, it could not record because the record area was full.</td>
<td>1. The number of PAC programs, which construct the project, exceeds the set upper limit. Reduce the number of the PAC programs. Then, recompile and load them. 2. Check that no transmit error occurs when an execution form file is transmitted from WINCAPSII to the controller. 3. Check that no error occurs when compiling is executed in the controller. 4. Use WINCAPSII or the controller and create the execution form file again. When you do this, set the DATE INSPECTION option to invalid in WINCAPSII.</td>
</tr>
<tr>
<td>73CD</td>
<td>Wrong data type of command argument</td>
<td>4</td>
<td>When the program was executed, a command argument of a type, which does not correspond to the command attempted to execute, appeared.</td>
<td>1. Check that the controller software version corresponds to that of WINCAPSII. 2. Check that no transmit error occurs when an execution form file is transmitted from WINCAPSII to the controller. 3. Check that no error occurs when compiling is executed in the controller. 4. Use WINCAPSII or the controller and create the execution form file again. When you do this, set the DATE INSPECTION option to invalid in WINCAPSII.</td>
</tr>
<tr>
<td>73CE</td>
<td>Failure to get version char. string area</td>
<td>4</td>
<td>The program tried to get the software specification version but failed to allocate the record memory area.</td>
<td>Turn OFF the power switch on the controller and restart the operation.</td>
</tr>
<tr>
<td>73CF</td>
<td>Failure to read type P variables</td>
<td>4</td>
<td>Type P variables were not normally read from the temporary storage.</td>
<td>1. Check that the controller software version corresponds to that of WINCAPSII. 2. Check that no transmit error occurs when an execution form file is transmitted from WINCAPSII to the controller. 3. Check that no error occurs when compiling is executed in the controller. 4. Use WINCAPSII or the controller and create the execution form file again. When you do this, set the DATE INSPECTION option to invalid in WINCAPSII.</td>
</tr>
<tr>
<td>73D0</td>
<td>Failure to read type T variables</td>
<td>4</td>
<td>Type T variables were not normally read from the temporary storage.</td>
<td>1. Check that the controller software version corresponds to that of WINCAPSII. 2. Check that no transmit error occurs when an execution form file is transmitted from WINCAPSII to the controller. 3. Check that no error occurs when compiling is executed in the controller. 4. Use WINCAPSII or the controller and create the execution form file again. When you do this, set the DATE INSPECTION option to invalid in WINCAPSII.</td>
</tr>
<tr>
<td>73D2</td>
<td>Interpreter failure</td>
<td>4</td>
<td>Data in the controller was somehow corrupted.</td>
<td>Turn OFF the power switch on the controller and restart the operation.</td>
</tr>
<tr>
<td>Code</td>
<td>Message</td>
<td>Lv</td>
<td>Description</td>
<td>Remedy</td>
</tr>
<tr>
<td>------</td>
<td>--------------------------</td>
<td>----</td>
<td>----------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| 73D3 | Code undefined           | 4  | The controller attempted to execute an unexpected command. The following possible reasons are considered.  
1. If teaching was done with a personal computer, perhaps WINCAPS II and the controller version do not match.  
2. The controller attempted to execute unsupported commands.  
3. Data in the controller was somehow corrupted. | Case 1: Replace the version with the right one.  
Case 2: Do not manually execute unsupported commands.  
Case 3: Turn OFF the power switch on the controller and restart the operation. |
| 73D4 | Lack of memory           | 4  | A newly declared variable area could not be secured.                       | Delete the declaration of unused variables and increase the memory space. If the teaching pendant displays the program contents, close the window for operation. |
| 73D5 | Register failure         | 4  | Data in the controller was corrupted.                                       | Turn OFF the power switch of the controller and restart the operation.                   |
| 73D6 | Unsupported command      | 4  | The controller attempted to execute unexpected command. The following possible reasons are considered.  
1. (If teaching was done with a personal computer.) WINCAPS II and controller version do not match.  
2. The controller attempted to execute unsupported commands.  
3. Data in the controller was somehow corrupted. | In case of 1: Replace the version with the right one.  
In case of 2: Do not manually execute unsupported commands.  
In case of 3: Turn OFF the power switch of the controller and restart the operation. |
| 73D7 | Data size error          | 4  | Data in the controller was somehow corrupted.                               | Turn OFF the power switch on the controller and restart the operation.                   |
| 73D8 | User code area not registered | 3  | The variables have not been initialized.                                    | Read the program again and initialize the variables.                                    |
| 73D9 | No user code             | 3  | Data in the controller was somehow corrupted.                               | Turn OFF the power switch on the controller and restart the operation.                   |
| 73DA | Type mismatch            | 4  | Data in the controller was somehow corrupted.                               |                                                                                          |
| 73DB | Data tag error           | 4  | 1. Data type is different.  
2. Data in the controller was somehow corrupted. | 1. Read the program again and check that there is an assignment to different type data and correct it.  
2. Turn OFF the power switch on the controller and restart the operation. |
| 73DC | Improper data length     | 4  | 1. The maximum number of characters exceeds the character string type.  
2. Data in the controller was somehow corrupted. | 1. Read the program again and check that there is an assignment to different type data and correct it.  
2. Turn OFF the power switch on the controller and restart the operation. |
| 73DD | Zero division error      | 4  | The expression operation of which the denominator becomes 0 was attempted.  | Read the program again and initialize the variables. Delete or change the operation to divide by 0. |
| 73DE | External reference       | 4  | The value of the approximation comparison parameter exceeds the permissible range. | Reconsider the value of the approximation comparison parameter.                           |
| 73DF | User code range error    | 4  | Data in the controller was somehow corrupted.                               | Turn OFF the power switch on the controller and restart the operation.                   |
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<tbody>
<tr>
<td>73E0</td>
<td>User code range over</td>
<td>4</td>
<td>Time data attempted to operate with the character string functions.</td>
<td></td>
</tr>
<tr>
<td>73E1</td>
<td>User code not registered</td>
<td>4</td>
<td>The newly declared variable area could not be secured.</td>
<td></td>
</tr>
<tr>
<td>73E2</td>
<td>Time data error</td>
<td>3</td>
<td>Time data attempted to operate with the character string functions.</td>
<td></td>
</tr>
<tr>
<td>73E3</td>
<td>Lack of memory</td>
<td>4</td>
<td>The newly declared variable area could not be secured.</td>
<td></td>
</tr>
<tr>
<td>73E4</td>
<td>Out of I/O range</td>
<td>3</td>
<td>An I/O number, which is outside the available range, was specified.</td>
<td></td>
</tr>
<tr>
<td>73E5</td>
<td>Undefined input/output device</td>
<td>4</td>
<td>Device not available was selected.</td>
<td></td>
</tr>
<tr>
<td>73E6</td>
<td>Stack overflow</td>
<td>4</td>
<td>The data area, which can be used by the program, is overfilled.</td>
<td></td>
</tr>
<tr>
<td>73E7</td>
<td>Stack underflow</td>
<td>4</td>
<td>Data area that can be used by the program is insufficient.</td>
<td></td>
</tr>
<tr>
<td>73E8</td>
<td>Pose data error</td>
<td>4</td>
<td>The data in the controller was somehow corrupted.</td>
<td></td>
</tr>
<tr>
<td>73E9</td>
<td>Semaphore error</td>
<td>4</td>
<td>The data in the controller was somehow corrupted.</td>
<td></td>
</tr>
<tr>
<td>73EA</td>
<td>Syntax error</td>
<td>4</td>
<td>1. The data type is different. 2. Character string not initialized was used.</td>
<td>1. Read the program again to check if there is an assignment with different type data and correct it.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3. The data in the controller was somehow corrupted.</td>
<td>2. Initialize (assign the data) the character string.</td>
</tr>
<tr>
<td>73EB</td>
<td>Undefined joint type</td>
<td>4</td>
<td>Attempt was made to move unusable joint.</td>
<td>Read the program again and delete the command for moving the unusable joint.</td>
</tr>
<tr>
<td>73EC</td>
<td>Unsupported command</td>
<td>4</td>
<td>The controller tried to execute unexpected commands. The possible causes are as follows:</td>
<td>Case 1: Do not manually execute unsupported commands.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1. Execution of an unsupported command.</td>
<td>Case 2: Turn OFF the power switch on the controller and reboot the operation.</td>
</tr>
<tr>
<td>73ED</td>
<td>Unsupported command</td>
<td>4</td>
<td>Controller data was destroyed due to some reason.</td>
<td></td>
</tr>
<tr>
<td>73EE</td>
<td>Cannot run (max. number of tasks)</td>
<td>4</td>
<td>The number of tasks, which exceeded the set number of user tasks, attempted to run.</td>
<td>Correct the number of user tasks, reboot the controller and try the operation again.</td>
</tr>
</tbody>
</table>
## 2 Controller Error Code Table

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>Lv</th>
<th>Description</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>73EF</td>
<td>Variable/element No. out of set range</td>
<td>3</td>
<td>Subscripts of array variables or element number types T, J and P exceeded the permissible range.</td>
<td>Read the program again and change it so that the array subscript or the element number types T, J and P become permissible values or extend the array area.</td>
</tr>
<tr>
<td>73F0</td>
<td>Index error</td>
<td>4</td>
<td>Array variable subscripts were not out of range.</td>
<td>Read the program again and change the values so that the array subscript becomes the permissible value.</td>
</tr>
<tr>
<td>73F1</td>
<td>No project</td>
<td>4</td>
<td>Although the execution available project was not present, loading was attempted.</td>
<td>Create a project.</td>
</tr>
<tr>
<td>73F2</td>
<td>Domain error</td>
<td>4</td>
<td>The robot program arguments are out of range.</td>
<td>Read the program again and change the value so that the argument becomes the permissible value.</td>
</tr>
<tr>
<td>73F3</td>
<td>Value out of range</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>73F4</td>
<td>All memory initial (variable area error)</td>
<td>5</td>
<td>A failure was found in the variable storage area in program loading.</td>
<td>This is information that the system found an error and the correction process was finished. However, because all the variables are initialized, execute the process to return the values of the variables back to their original values.</td>
</tr>
<tr>
<td>73F5</td>
<td>Local variable initialized</td>
<td>2</td>
<td>A value of the local variable was initialized.</td>
<td>This is information that due to program transmission and compiling all the local variables are initialized.</td>
</tr>
<tr>
<td>73F6</td>
<td>Cannot fetch position w/o CAL execution</td>
<td>3</td>
<td>Obtaining a position is not available because CAL is not executed.</td>
<td>Return to the arm menu and execute CAL.</td>
</tr>
<tr>
<td>73F7</td>
<td>Specified tool No. not usable</td>
<td>3</td>
<td>The specified TOOL number cannot be used.</td>
<td>Change the TOOL number in the program to the permissible value.</td>
</tr>
<tr>
<td>73F8</td>
<td>Failure to create semaphore</td>
<td>4</td>
<td>Semaphore was not created normally.</td>
<td>The maximum number of semaphores was exceeded. Reduce the number of created semaphores.</td>
</tr>
<tr>
<td>73F9</td>
<td>Failure to delete semaphore</td>
<td>4</td>
<td>Semaphore was not deleted normally.</td>
<td>The semaphore to be deleted is not found. Review the usage of DELETESEM function.</td>
</tr>
<tr>
<td>73FA</td>
<td>Failure to take semaphore</td>
<td>4</td>
<td>Semaphore was not taken normally.</td>
<td>The semaphore is used by another task. Review the usage of TAKESEM function.</td>
</tr>
<tr>
<td>73FB</td>
<td>Semaphore taking timeout</td>
<td>3</td>
<td>Timeout error occurred in taking semaphore.</td>
<td>The semaphore is used by another task. Review the usage of TAKESEM function.</td>
</tr>
<tr>
<td>73FC</td>
<td>Failure to release semaphore</td>
<td>3</td>
<td>Semaphore was not released normally.</td>
<td>The semaphore to be released is not found. Review the usage of GIVESEM function.</td>
</tr>
<tr>
<td>73FD</td>
<td>Failure to release the tasks waiting semaphore</td>
<td>3</td>
<td>Semaphore-waiting tasks were not released normally.</td>
<td>Semaphore to be released is not found. Review the usage of FLUSHSEM function.</td>
</tr>
<tr>
<td>73FE</td>
<td>Cannot start program with arguments</td>
<td>2</td>
<td>A program with arguments cannot run from the teaching pendant, the operating panel or an external device.</td>
<td>If you are calling a program with arguments, use another program.</td>
</tr>
</tbody>
</table>
### Controller Error Code Table

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>Lv</th>
<th>Description</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>73FF</td>
<td>Cannot start program during the HALT process execution.</td>
<td>2</td>
<td>Program start was executed during the HALT process execution. (This error occurs when Deadman switch is released and then started.)</td>
<td>Restart the operation after pause.</td>
</tr>
</tbody>
</table>
### 3 WINCAPSII Error Code Table

<table>
<thead>
<tr>
<th>No.</th>
<th>Message</th>
<th>Description</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>PacManager no response</td>
<td>No response from PAC Manager</td>
<td>Restart System Manager if no response is received after a short time.</td>
</tr>
<tr>
<td>1001</td>
<td>VarManager no response</td>
<td>No response from Variable Manager</td>
<td>Restart System Manager if no response is received after a short time.</td>
</tr>
<tr>
<td>1002</td>
<td>DioManager no response</td>
<td>No response from DIO Manager</td>
<td>Restart System Manager if no response is received after a short time.</td>
</tr>
<tr>
<td>1003</td>
<td>ArmManager no response</td>
<td>No response from Arm Manager</td>
<td>Restart System Manager if no response is received after a short time.</td>
</tr>
<tr>
<td>1004</td>
<td>VisionManager no response</td>
<td>No response from Vision Manager</td>
<td>Restart System Manager if no response is received after a short time.</td>
</tr>
<tr>
<td>1005</td>
<td>LogManager no response</td>
<td>No response from Log Manager</td>
<td>Restart System Manager if no response is received after a short time.</td>
</tr>
<tr>
<td>1006</td>
<td>RoboTalk no response</td>
<td>No response from Communication Manager</td>
<td>Restart System Manager if no response is received after a short time.</td>
</tr>
<tr>
<td>1007</td>
<td>File writing error. Check detail setting</td>
<td>Cannot write a file when creating a new project.</td>
<td>Press INITIALIZE key of DETAIL SETTING. Also check whether respective default file names of managers are correct.</td>
</tr>
<tr>
<td>1008</td>
<td>File reading error</td>
<td>Cannot read file. Either the file does not exist or the contents are invalid.</td>
<td>Restart System Manager. If the file does not exist, specify a file to read.</td>
</tr>
<tr>
<td>1009</td>
<td>Data batch transmission failure</td>
<td>Data batch transmission failed. An error was generated during transmission because of something such as a wrong connection or time-out</td>
<td>Re-check the communication status and connection. If necessary, extend the time-out length.</td>
</tr>
<tr>
<td>100A</td>
<td>TAPI initialization error</td>
<td>Initialization failed when transmitting data over the telephone line.</td>
<td>Check connection of the modem and other communication devices. Initialize the state and operate again.</td>
</tr>
<tr>
<td>100C</td>
<td>Illegal password. Make re-entry.</td>
<td>Invalid password has been input.</td>
<td>Input correct password again.</td>
</tr>
<tr>
<td>100D</td>
<td>Illegal project name. Make re-entry.</td>
<td>The project name already exists or it is invalid.</td>
<td>Input the project name correctly.</td>
</tr>
<tr>
<td>100E</td>
<td>Illegal folder name.</td>
<td>Folder name is invalid.</td>
<td>Input the folder name correctly.</td>
</tr>
<tr>
<td>1010</td>
<td>New password not matching. Input again.</td>
<td>Invalid password entered when registering a new password.</td>
<td>Input a correct password.</td>
</tr>
<tr>
<td>No.</td>
<td>Message</td>
<td>Description</td>
<td>Action</td>
</tr>
<tr>
<td>------</td>
<td>---------------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>1011</td>
<td>Failed to end because either the command was canceled or a modal form is on display.</td>
<td>Attempt to end System Manager failed because another manager canceled the end command or because a dialog remains open.</td>
<td>Close all open dialogs, save the project and proceed to end the manager.</td>
</tr>
<tr>
<td>1012</td>
<td>FD tool no start</td>
<td>Failed to start FD tool.</td>
<td>Uninstall WINCAPSII, then install again.</td>
</tr>
<tr>
<td>1015</td>
<td>Operation invalid because of connection state. Reset the connection and execute again.</td>
<td>Operation rejected because one of the managers is connected.</td>
<td>Reset connection of all managers.</td>
</tr>
<tr>
<td>1016</td>
<td>Illegal robot dependent data. Project new creation function not usable.</td>
<td>Dependent data of selected robot type does not exist.</td>
<td>Uninstall WINCAPSII and then reinstall.</td>
</tr>
<tr>
<td>1017</td>
<td>Robot program wizard failed to function normally.</td>
<td>Program wizard is not functioning normally. Normal installation cannot be carried out.</td>
<td>Uninstall WINCAPSII and then reinstall.</td>
</tr>
<tr>
<td>1018</td>
<td>Association of VBS script file failed to function normally.</td>
<td>Microsoft Windows scripting host is not installed.</td>
<td>Install Microsoft Windows scripting host.</td>
</tr>
<tr>
<td>1019</td>
<td>System project data cannot be opened because it is newer than the application version.</td>
<td>Attempt was made to open data file created using a newer version than the current WINCAPSII.</td>
<td>New data cannot be directly opened. Either read data via the controller or deliver data using the FD tool.</td>
</tr>
<tr>
<td>101C</td>
<td>Response cannot be made because the system is busy.</td>
<td>Could not respond because selected manager is currently busy processing.</td>
<td>Wait until the processing is finished and proceed with the operation.</td>
</tr>
<tr>
<td>101D</td>
<td>Operation is disabled because other manager is operating. Stop the operation of other manager.</td>
<td>Operation was disabled because another manager is in operation.</td>
<td>Stop the operation of the other manager.</td>
</tr>
<tr>
<td>101E</td>
<td>Configuration is transmitted. Restart the controller or normal operation may not be possible.</td>
<td>The controller must be restarted to have the controller reflect the data contents that have been transmitted.</td>
<td>Restart the controller.</td>
</tr>
<tr>
<td>101F</td>
<td>Communication manager is already started. Shut it down once and then restart it.</td>
<td>Since the communication manager is already started, it is advised to restart the communication manager.</td>
<td>Not necessary</td>
</tr>
<tr>
<td>1021</td>
<td>Disc not inserted or not formatted. Insert disc.</td>
<td>Disc is not inserted or not formatted.</td>
<td>Insert formatted disc to the drive.</td>
</tr>
<tr>
<td>1022</td>
<td>Write error. Check the write-protect of the disc.</td>
<td>Disc is write-protected or broken.</td>
<td>Make the disc ready for writing.</td>
</tr>
<tr>
<td>102A</td>
<td>Failed in uploading ROM data. Retry uploading without controller power off.</td>
<td>Failed in uploading the ROM data because of communication error, etc.</td>
<td>Check communication condition and connection without controller power off. Set longer time out value if necessary.</td>
</tr>
<tr>
<td>102B</td>
<td>Failed in downloading ROM data.</td>
<td>Failed in downloading the ROM data because of communication error, etc.</td>
<td>1. Check communication condition and connection. Set longer time out value if necessary.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Check if disc capacity for writing is sufficient. (More than 4 MB is needed.)</td>
</tr>
</tbody>
</table>
### WincapsII Error Code Table

<table>
<thead>
<tr>
<th>No.</th>
<th>Message</th>
<th>Description</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>102D</td>
<td>Failed in the export of ROM data.</td>
<td>Failed in the export of ROM data.</td>
<td>Check if disk capacity for writing is sufficient. (More than 4 MB is needed.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1. Disc capacity is insufficient.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Source data is destroyed.</td>
<td></td>
</tr>
<tr>
<td>102E</td>
<td>Failed in the import of ROM data.</td>
<td>Failed in the import of ROM data.</td>
<td>Check if disk capacity for writing is sufficient. (More than 4 MB is needed.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1. Disc capacity is insufficient.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Source data is destroyed.</td>
<td></td>
</tr>
<tr>
<td>102F</td>
<td>Connected controller does not have the ability to cope with this function.</td>
<td>Connected controller does not have the ability to cope with this function.</td>
<td>Revise the controller for new version.</td>
</tr>
<tr>
<td>1030</td>
<td>SystemManager no response</td>
<td>No response from System Manager.</td>
<td>Restart System Manager in case of no response after a pause.</td>
</tr>
<tr>
<td>1031</td>
<td>Initialization error</td>
<td>Failed in the initialization at start up.</td>
<td>1. Designate the project and reopen.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. The content of the previously opened project is incorrect or no file is present.</td>
<td></td>
</tr>
<tr>
<td>1032</td>
<td>Connection error</td>
<td>Cannot connect to the controller.</td>
<td>Check connection.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Check communication condition from the communication manager and connect again.</td>
</tr>
<tr>
<td>1033</td>
<td>Auto-respose setting error</td>
<td>Auto-response setting through telephone line failed.</td>
<td>Check the condition of modem and telephone line. Initialize modem.</td>
</tr>
<tr>
<td>1034</td>
<td>On-hook processing error</td>
<td>Cannot disconnect the telephone line.</td>
<td>Disconnect manually from modem.</td>
</tr>
<tr>
<td>1035</td>
<td>Auto-receiving setting error</td>
<td>Failed in setting Auto-receiving to modem.</td>
<td>Check the condition of modem and telephone line. Initialize modem.</td>
</tr>
<tr>
<td>1036</td>
<td>Auto-receiving release error</td>
<td>Failed in releasing Auto-receiving setting of modem.</td>
<td>Check the condition of modem and telephone line. Initialize modem.</td>
</tr>
<tr>
<td>103B</td>
<td>Cannot open the designated port.</td>
<td>The designated port is already used or not present.</td>
<td>1. Terminate the application using the designated port.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Designate correct port.</td>
</tr>
<tr>
<td>103C</td>
<td>Cannot transfer a file with more than 40 bytes file name.</td>
<td>Cannot transfer a file with more than 40 bytes file name.</td>
<td>Rename the file name within 40 bytes.</td>
</tr>
<tr>
<td>103D</td>
<td>We do not support the connection with upper version controller.</td>
<td>Cannot connect to the controller having newer version than WincapsII (PC side software).</td>
<td>Install WincapsII of the newest version.</td>
</tr>
<tr>
<td>103E</td>
<td>Robot type mismatch</td>
<td>Connection is not allowed because the robot type of currently opened project and the controller robot type are different.</td>
<td>Make both robot types the same.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1. Make a new project with the same robot type of the controller.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Change controller robot type.</td>
</tr>
<tr>
<td>&lt;PAC Manager&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>SystemManager no response</td>
<td>No response was received from System Manager.</td>
<td>Restart System Manager if no response is received after a short time.</td>
</tr>
</tbody>
</table>
## 3 WINCAPSII Error Code Table

<table>
<thead>
<tr>
<th>No.</th>
<th>Message</th>
<th>Description</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>LogManager no response</td>
<td>No response was received from Log Manager.</td>
<td>Restart System Manager if no response is received after a short time</td>
</tr>
<tr>
<td>2003</td>
<td>Initialization error</td>
<td>Initialization has failed. Either the contents of the previously opened project are invalid or the file does not exist.</td>
<td>(1) Specify the project and reopen. &lt;br&gt; (2) Create a new project.</td>
</tr>
<tr>
<td>2004</td>
<td>File read error</td>
<td>File read error was generated. Either the file contents are invalid or the file does not exist.</td>
<td>(1) Restart System Manager. &lt;br&gt; (2) Specify a valid file.</td>
</tr>
<tr>
<td>2005</td>
<td>File write error</td>
<td>File write error was generated. File cannot be overwritten. Capacity for writing is insufficient.</td>
<td>(1) Expand write disk capacity. &lt;br&gt; (2) Restart System Manager.</td>
</tr>
<tr>
<td>2006</td>
<td>Project file read error</td>
<td>Project file read error was generated. Either the project contents are invalid or the project file does not exist.</td>
<td>Specify a valid project file.</td>
</tr>
<tr>
<td>2007</td>
<td>Project file write error</td>
<td>File write error was generated. File cannot be overwritten. Write disk capacity is insufficient.</td>
<td>(1) Expand write disk capacity. &lt;br&gt; (2) Restart System Manager.</td>
</tr>
<tr>
<td>2009</td>
<td>File transmission failure</td>
<td>File transmission has failed. Either there is a connection error or time-out occurred. The controller rejected transmission. Error generated during transmission.</td>
<td>(1) Check connection. &lt;br&gt; (2) Check for abnormality on the controller. &lt;br&gt; (3) If time-out error was generated, extend the time-out length.</td>
</tr>
<tr>
<td>200A</td>
<td>Association application start failure</td>
<td>Application could not be started. Either the application does not exist or there is an invalid application association.</td>
<td>Re-associate the application.</td>
</tr>
<tr>
<td>200B</td>
<td>Configuration transmission failure</td>
<td>Transmission failed. Either there is a connection error or an error was generated during transmission.</td>
<td>(1) Check the connection. &lt;br&gt; (2) Check for abnormality on the controller. &lt;br&gt; (3) If time-out error was generated, extend the time-out length.</td>
</tr>
<tr>
<td>200C</td>
<td>Release failure</td>
<td>Attempt was made to release all programs.</td>
<td>Release by allowing at least one program to remain.</td>
</tr>
<tr>
<td>200D</td>
<td>Syntax error</td>
<td>Syntax error found in the program contents. This disables the analysis of program name and argument.</td>
<td>Check the syntax especially around the format of the Program Text.</td>
</tr>
<tr>
<td>200E</td>
<td>Registration failure</td>
<td>Program could not be registered in program bank. Either there is a bank file error or the write disk capacity is insufficient.</td>
<td>Check the write disk capacity. If there is a program bank error, create a new bank for registration.</td>
</tr>
<tr>
<td>2012</td>
<td>PrintManager no response</td>
<td>No response was received from Print Manager.</td>
<td>Restart System Manager if no response is received after a short time</td>
</tr>
<tr>
<td>2013</td>
<td>Program information acquisition error</td>
<td>Failed to acquire the controller program information (status, line number for execution, cycle time). Failed to make correct communication.</td>
<td>(1) Check the connection. &lt;br&gt; (2) Check for any error on the controller. &lt;br&gt; (3) If time-out error was generated, extend the time-out length.</td>
</tr>
<tr>
<td>2014</td>
<td>Variable acquisition failure</td>
<td>Failed to acquire variable from Variable Manager. Either there is a connection error or the Variable Manager is not functioning normally.</td>
<td>(1) Check the connection. &lt;br&gt; (2) Check for any error on the controller. &lt;br&gt; (3) If time-out error was generated, extend the time-out length.</td>
</tr>
<tr>
<td>2015</td>
<td>File name redundant</td>
<td>Specified file name already exists. Redundant file name not allowed.</td>
<td>Specify a separate file name.</td>
</tr>
<tr>
<td>2016</td>
<td>Program error number (number of warning) = &lt;n&gt;&lt;m&gt;</td>
<td>Display of the program error number (number of warning)</td>
<td>If any error exists, correct it and then recompile.</td>
</tr>
</tbody>
</table>
### 3 WINCAPSII Error Code Table

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<thead>
<tr>
<th>No.</th>
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</thead>
<tbody>
<tr>
<td>2017</td>
<td>System busy no response</td>
<td>Unable to make a response because selected manager is currently busy processing.</td>
<td>Wait until the processing is completed and then proceed with operation.</td>
</tr>
<tr>
<td>2018</td>
<td>Execution file name is illegal. Input the file name again.</td>
<td>File name of executed file is invalid</td>
<td>Input the file name for execution again.</td>
</tr>
<tr>
<td>2019</td>
<td>No further program can be added</td>
<td>No further programs could be added because the maximum number of programs that can be registered to the project has been reached.</td>
<td>Rearrange processing and decrease the number of programs in the project.</td>
</tr>
<tr>
<td>201A</td>
<td>File name is illegal.</td>
<td>File name is invalid.</td>
<td>Specify a valid name.</td>
</tr>
<tr>
<td>2026</td>
<td>Modification not possible on your current access level.</td>
<td>Operation is not possible on the current access level.</td>
<td>Login again and raise the access level. If access is currently on the Programmer level, the item cannot be accessed.</td>
</tr>
<tr>
<td>2028</td>
<td>Program bank read error</td>
<td>Program bank read error was generated. Either the contents of program bank are invalid or the program bank file itself does not exist.</td>
<td>(1) Specify a valid program bank file. (2) If the program bank has an error, create a new file.</td>
</tr>
<tr>
<td>2029</td>
<td>Class name is redundant. Make entry again.</td>
<td>The specified class name already exists. Redundant class name is not allowed.</td>
<td>Specify a separate class name.</td>
</tr>
<tr>
<td>202A</td>
<td>Usable printer is not incorporated.</td>
<td>The printer in use is not registered.</td>
<td>Add a printer from the Windows control panel.</td>
</tr>
<tr>
<td>202B</td>
<td>File copy failure</td>
<td>File cannot be copied. Either there is a disk error or the write disk capacity is insufficient.</td>
<td>Check the write disk capacity.</td>
</tr>
<tr>
<td>202C</td>
<td>Input data error</td>
<td>Input data value is invalid. Overflow generated during conversion process.</td>
<td>Input a valid value.</td>
</tr>
<tr>
<td>2031</td>
<td>Program has too many arguments. Maximum number of program arguments is 32.</td>
<td>Too many program arguments</td>
<td>Keep the number of program arguments under the upper limit.</td>
</tr>
<tr>
<td>2032</td>
<td>Environment setting for the editor is inappropriate.</td>
<td>Inappropriate value exists in the environment setting for the program editor.</td>
<td>Check and correct the content of the program editor environment setting.</td>
</tr>
<tr>
<td>2033</td>
<td>Environment setting for the make is inappropriate.</td>
<td>Inappropriate value exists in the environment setting for the make.</td>
<td>Check and correct the contents of the make environment setting.</td>
</tr>
<tr>
<td>2034</td>
<td>Environment setting for the compiler is inappropriate.</td>
<td>Inappropriate value exists in the environment setting for the compiler.</td>
<td>Check and correct the contents of the compiler environment setting.</td>
</tr>
<tr>
<td>2035</td>
<td>Class name is illegal.</td>
<td>Class name is not valid.</td>
<td>Specify a valid class name.</td>
</tr>
<tr>
<td>2036</td>
<td>Illegal value</td>
<td>Specified value is erroneous.</td>
<td>Specify a valid value.</td>
</tr>
<tr>
<td>2037</td>
<td>Print Manager is already in use.</td>
<td>Print Manager is already in use. Only one manager can access the Print Manager at a time.</td>
<td>End the Print Manager and then try again.</td>
</tr>
<tr>
<td>2038</td>
<td>PAC status modification failure</td>
<td>Data cannot be transmitted to the controller during transmission.</td>
<td>(1) Check connection.  (2) Check for abnormality on the controller.</td>
</tr>
</tbody>
</table>
### 3 WINCAPSII Error Code Table

<table>
<thead>
<tr>
<th>No.</th>
<th>Message</th>
<th>Description</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>2039</td>
<td>Connection selection failure</td>
<td>Cannot make connection to the controller.</td>
<td>Check connection. Check the communication condition from Communication Manager and try the connection again.</td>
</tr>
<tr>
<td>203A</td>
<td>Setting failure</td>
<td>Invalid contents exist in the project setting.</td>
<td>Check the contents of the project setting and correct.</td>
</tr>
<tr>
<td>203B</td>
<td>Configuration is transmitted. Restart the controller or normal operation may not be possible.</td>
<td>The controller must be restarted to reflect the contents of data transmitted to the controller.</td>
<td>Restart the controller.</td>
</tr>
<tr>
<td>203D</td>
<td>Either file not existent or illegal. Specify a file to open in succession.</td>
<td>Error was generated when opening the file.</td>
<td>Specify a separate file. Restart System Manager.</td>
</tr>
<tr>
<td>203E</td>
<td>Limit the number of characters for a program name to 64 or under.</td>
<td>Characters for the program name exceed 64.</td>
<td>Limit the number of characters for a program name to 64 or under.</td>
</tr>
</tbody>
</table>

### <Variable Manager>

<table>
<thead>
<tr>
<th>No.</th>
<th>Message</th>
<th>Description</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>3000</td>
<td>SystemManager no response</td>
<td>No response was received from System Manager.</td>
<td>Restart System Manager if no response is received after a short time</td>
</tr>
<tr>
<td>3001</td>
<td>LogManager no response</td>
<td>No response was received from Log Manager.</td>
<td>Restart System Manager if no response is received after a short time</td>
</tr>
<tr>
<td>3002</td>
<td>Initialization error</td>
<td>Initialization failed. Either the contents of the previously opened project are invalid or the file does not exist.</td>
<td>(1) Specify the project and reopen. (2) Create a new project.</td>
</tr>
<tr>
<td>3003</td>
<td>File read error</td>
<td>File read error was generated. Either the file contents are invalid or the file does not exist.</td>
<td>(1) Restart System Manager. (2) Specify a valid file.</td>
</tr>
<tr>
<td>3004</td>
<td>File write error</td>
<td>File write error was generated. File cannot be overwritten. Capacity for writing is insufficient.</td>
<td>(1) Expand the write disk capacity. (2) Restart System Manager.</td>
</tr>
<tr>
<td>3005</td>
<td>Table transfer failure</td>
<td>Table transfer failed. Either the wrong connection was made or an error was generated during transfer.</td>
<td>(1) Check the connection. (2) Check for abnormality on the controller. (3) If time-out error was generated, extend the time-out length.</td>
</tr>
<tr>
<td>3006</td>
<td>Read error</td>
<td>Cannot read variable data.</td>
<td>(1) Check the connection. (2) Check for abnormality on the controller. (3) If time-out error was generated, extend the time-out length.</td>
</tr>
<tr>
<td>3007</td>
<td>Write error</td>
<td>Cannot write variable data.</td>
<td>(1) Check the connection. (2) Check for abnormality on the controller. (3) If time-out error was generated, extend the time-out length.</td>
</tr>
<tr>
<td>3008</td>
<td>PrintManager no response</td>
<td>No response was received from Print Manager.</td>
<td>Wait a short time for response. If no response is received, restart System Manager.</td>
</tr>
<tr>
<td>3009</td>
<td>Find What not found</td>
<td>Specified character string was not found.</td>
<td>--</td>
</tr>
</tbody>
</table>
### 3 WINCAPSII Error Code Table

<table>
<thead>
<tr>
<th>No.</th>
<th>Message</th>
<th>Description</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>300A</td>
<td>Response cannot be made because the system is busy.</td>
<td>Could not respond because selected manager was currently busy processing.</td>
<td>Wait until the processing is finished and proceed with the operation.</td>
</tr>
<tr>
<td>300B</td>
<td>Acquire Pose failure</td>
<td>The robot attitude data could not be acquired from the controller.</td>
<td>(1) Check the connection. (2) Check for abnormality on the controller. (3) If time-out error was generated, extend the time-out length.</td>
</tr>
<tr>
<td>300C</td>
<td>Communication Manager is in use or RS232C is not open.</td>
<td>Could not make RS232C pseudo output. RS232C pseudo output cannot be executed unless all the managers are disconnected.</td>
<td>(1) Turn all the managers OFF. (2) Check the connection. (3) Check for abnormality on the controller. (4) If time-out error was generated, extend the time-out length.</td>
</tr>
<tr>
<td>300D</td>
<td>Calculator start failure. Check if the calculator is installed.</td>
<td>The &quot;Calculator&quot; application of the standard Windows accessories could not be started.</td>
<td>Install a calculator.</td>
</tr>
<tr>
<td>300E</td>
<td>Usable printer is not incorporated.</td>
<td>Printer in use is not registered.</td>
<td>Add a printer from the Windows control panel.</td>
</tr>
<tr>
<td>300F</td>
<td>Input data error</td>
<td>Input data has invalid value. Overflow was generated during conversion process.</td>
<td>Input a valid value.</td>
</tr>
<tr>
<td>300G</td>
<td>Print Manager is already in use.</td>
<td>Print Manager is already in use. Only one manager can access the Print Manager at a time.</td>
<td>End the Print Manager and then try again.</td>
</tr>
<tr>
<td>300H</td>
<td>Connection selection failure</td>
<td>Cannot make connection to the controller.</td>
<td>Check the connection. Check the communication status from the Communication Manager and make connection again.</td>
</tr>
<tr>
<td>300I</td>
<td>Do you make a new file? If 'NO', designate the file to open next.</td>
<td>As the designated file could not be opened, whether to make a new file or to designate a file again is inquired.</td>
<td>1. Designate the file to open again. 2. Make a new file.</td>
</tr>
<tr>
<td>300J</td>
<td>Improper variable setting</td>
<td>There is some error in variable setting.</td>
<td>Check the setting and input correct value.</td>
</tr>
</tbody>
</table>

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### <DIO Manager>

<table>
<thead>
<tr>
<th>No.</th>
<th>Message</th>
<th>Description</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>4000</td>
<td>SystemManager no response</td>
<td>No response was received from System Manager.</td>
<td>Restart System Manager if no response is received after a short time.</td>
</tr>
<tr>
<td>4001</td>
<td>LogManager no response</td>
<td>No response was received from Log Manager.</td>
<td>Restart System Manager if no response is received after a short time.</td>
</tr>
<tr>
<td>4002</td>
<td>Initialization error</td>
<td>Initialization failed. Either the contents of the previously opened project are invalid or the file does not exist.</td>
<td>(1) Specify the project and reopen. (2) Create a new project.</td>
</tr>
<tr>
<td>4003</td>
<td>DLL initialization error</td>
<td>DLL loading failure.</td>
<td>Uninstall WINCAPSII, then reinstall.</td>
</tr>
<tr>
<td>4004</td>
<td>File write error</td>
<td>File write error was generated. File cannot be overwritten. Capacity for writing is insufficient.</td>
<td>(1) Expand the write disk capacity. (2) Restart System Manager.</td>
</tr>
</tbody>
</table>
### 3 WINCAPSII Error Code Table

<table>
<thead>
<tr>
<th>No.</th>
<th>Message</th>
<th>Description</th>
<th>Action</th>
</tr>
</thead>
</table>
| 4005 | File read error | File read error was generated. Either the file contents are invalid or the file does not exist. | (1) Restart System Manager.  
(2) Specify a valid file. |
| 4006 | Table transmission failure | Table transmission failed. Either wrong connection was made or an error was generated during transmission. | (1) Check the connection.  
(2) Check for abnormality on the controller.  
(3) If time-out error was generated, extend the time-out length. |
| 4007 | ON-OFF selection failure | I/O ON-OFF selection to the controller has failed. | (1) Check the connection.  
(2) Check for abnormality on the controller.  
(3) If time-out error was generated, extend the time-out length. |
| 4008 | State acquisition failure | I/O status cannot be acquired from the controller. | (1) Check the connection.  
(2) Check for abnormality on the controller.  
(3) If time-out error was generated, extend the time-out length. |
| 4009 | PrintManager no response | No response was received from Print Manager. | Restart System Manager if no response is received after a short time. |
| 400A | Find What not found. | Specified character string was not found. | – |
| 400B | Macro definition file creation failure | File write error was generated. File cannot be overwritten. Write capacity is insufficient. | (1) Expand write disk capacity.  
(2) Restart System Manager. |
| 400C | Response cannot be made because the system is busy. | Could not respond because selected manager is currently in use. | Wait until the processing is finished and proceed with the operation. |
| 400D | Modification not possible on your current access level. | Operation is not possible on the current access level. | Login again and raise the access level. If access is currently on the Programmer level, the item cannot be accessed. |
| 4014 | Usable printer is not incorporated. | Printer in use is not registered. | Add a printer from the Windows control panel. |
| 4015 | Input data error | Input data value is invalid. Overflow generated during conversion process. | Input a valid value. |
| 4016 | Print Manager is already in use. | Print Manager is already in use. Only one manager can access the Print Manager at a time. | End the Print Manager and then try again. |
| 4017 | Connection selection failure | Connection to the controller could not be made. | Check the connection. Check the communication status from the Communication Manager and make connection again. |
| 4018 | Configuration is transmitted. Restart the controller or normal operation may not be possible. | The controller must be restarted to have the controller reflect the data contents that have been transmitted. | Restart the controller. |
### 3 WINCAPSII Error Code Table

<table>
<thead>
<tr>
<th>No.</th>
<th>Message</th>
<th>Description</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>4019</td>
<td>Do you make a new file?</td>
<td>As the designated file could not be opened, whether to make a new file or to designate a file again is inquired. 1. File not found. 2. File is destroyed. 3. File not found. File is destroyed.</td>
<td>1. Designate the file to open again. 2. Make a new file.</td>
</tr>
<tr>
<td>5000</td>
<td>SystemManager no response</td>
<td>No response was received from System Manager.</td>
<td>Restart System Manager if no response is received after a short time.</td>
</tr>
<tr>
<td>5001</td>
<td>LogManager no response</td>
<td>No response was received from Log Manager.</td>
<td>Restart System Manager if no response is received after a short time.</td>
</tr>
<tr>
<td>5002</td>
<td>Initialization error</td>
<td>Initialization failed. Either the contents of the previously opened project are invalid or the file does not exist.</td>
<td>(1) Specify the project and reopen. (2) Create a new project.</td>
</tr>
<tr>
<td>5003</td>
<td>File write error</td>
<td>File write error was generated. File cannot be overwritten. Capacity for writing is insufficient.</td>
<td>(1) Expand write disk capacity. (2) Restart System Manager.</td>
</tr>
<tr>
<td>5004</td>
<td>File read error</td>
<td>File read error was generated. Either file contents are invalid or the file does not exist.</td>
<td>(1) Restart System Manager. (2) Specify a valid file.</td>
</tr>
<tr>
<td>5005</td>
<td>Table transmission failure</td>
<td>Table transmission failed. Either the wrong connection was made or an error was generated during transmission.</td>
<td>(1) Check the connection. (2) Check for abnormality on the controller. (3) If time-out error was generated, extend the time-out length.</td>
</tr>
<tr>
<td>500A</td>
<td>PrintManager no response</td>
<td>No response was received from Print Manager.</td>
<td>Restart System Manager if no response is received after a short time.</td>
</tr>
<tr>
<td>500B</td>
<td>Current pose acquisition failure</td>
<td>Robot attitude data could not be acquired from the controller.</td>
<td>(1) Check the connection. (2) Check for abnormality on the controller. (3) If time-out error was generated, extend the time-out length.</td>
</tr>
<tr>
<td>500C</td>
<td>Illegal object name</td>
<td>Object name is invalid. &quot;¥&quot; is included in the object name.</td>
<td>Specify a valid object name.</td>
</tr>
<tr>
<td>500D</td>
<td>Cannot add object name</td>
<td>No more object names could be added as the upper limit was reached.</td>
<td>Delete unnecessary objects.</td>
</tr>
<tr>
<td>500F</td>
<td>Out of Memory</td>
<td>Windows memory shortage</td>
<td>(1) Do not start a multiple number of managers simultaneously. (2) Expand the memory.</td>
</tr>
<tr>
<td>5012</td>
<td>Modification not possible on your current access level.</td>
<td>Operation was not possible on the current access level.</td>
<td>Login again and raise the access level. If the access is currently on the Programmer level, the item cannot be accessed.</td>
</tr>
<tr>
<td>5017</td>
<td>Usable printer is not incorporated.</td>
<td>Printer in use is not registered.</td>
<td>Add a printer from the Windows control panel.</td>
</tr>
</tbody>
</table>
3  WINCAPSII Error Code Table

<table>
<thead>
<tr>
<th>No.</th>
<th>Message</th>
<th>Description</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>5018</td>
<td>Input data error</td>
<td>Invalid input data value. Overflow was generated during conversion process.</td>
<td>Input a valid value.</td>
</tr>
<tr>
<td>5019</td>
<td>Reverse conversion not allowed.</td>
<td>Robot attitude type could not be converted.</td>
<td>Use a separate type.</td>
</tr>
<tr>
<td>501A</td>
<td>Print Manager is already in use.</td>
<td>Print Manager is already in use. Only one manager can access the Print Manager at a time.</td>
<td>End the Print Manager and then operate again.</td>
</tr>
<tr>
<td>501B</td>
<td>Connection selection failure</td>
<td>Could not make connection to the controller.</td>
<td>(1) Check the connection. (2) Check for abnormality on the controller. (3) If time-out error was generated, extend the time-out length.</td>
</tr>
<tr>
<td>501C</td>
<td>Cannot delete root node or a node</td>
<td>Specified object could not be deleted.</td>
<td>Delete all the child node objects, then delete the desired object.</td>
</tr>
<tr>
<td></td>
<td>with a child node.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>501D</td>
<td>Configuration is transmitted. Restart</td>
<td>The controller must be restarted to have the controller reflect the data contents that have been transmitted.</td>
<td>Restart the controller.</td>
</tr>
<tr>
<td></td>
<td>the controller or normal operation may not be possible.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 501E | Do you make a new file?              | As the designated file could not be opened, whether to make a new file or to designate a file again is inquired.  | 1. Designate the file to open again  
|      | if 'NO', designate the file to open next |                                                                                                                                           |                                                                                              |

<Vision Manager>

<table>
<thead>
<tr>
<th>No.</th>
<th>Message</th>
<th>Description</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>6000</td>
<td>SystemManager no response</td>
<td>No response was received from System Manager.</td>
<td>Restart System Manager if no response is received after a short time.</td>
</tr>
<tr>
<td>6001</td>
<td>PacManager no response</td>
<td>No response was received from PAC Manager.</td>
<td>Restart System Manager if no response is received after a short time.</td>
</tr>
<tr>
<td>6002</td>
<td>VarManager no response</td>
<td>No response was received from Variable Manager.</td>
<td>Restart System Manager if no response is received after a short time.</td>
</tr>
<tr>
<td>6003</td>
<td>LogManager no response</td>
<td>No response was received from Log Manager.</td>
<td>Restart System Manager if no response is received after a short time.</td>
</tr>
<tr>
<td>6004</td>
<td>ArmManager no response</td>
<td>No response was received from Arm Manager.</td>
<td>Restart System Manager if no response is received after a short time.</td>
</tr>
<tr>
<td>6005</td>
<td>Initialization error</td>
<td>Initialization failed. Either the contents of the previously opened project are invalid or the file does not exist.</td>
<td>(1) Specify the project and reopen. (2) Create a new project.</td>
</tr>
<tr>
<td>6006</td>
<td>DLL initialization error</td>
<td>DLL loading failure</td>
<td>Uninstall WINCAPSII, then reinstall.</td>
</tr>
<tr>
<td>No.</td>
<td>Message</td>
<td>Description</td>
<td>Action</td>
</tr>
<tr>
<td>-----</td>
<td>----------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>6007</td>
<td>File write error</td>
<td>File write error was generated. File cannot be overwritten. Capacity for writing is insufficient.</td>
<td>(1) Expand the write disk capacity. (2) Restart System Manager.</td>
</tr>
<tr>
<td>6008</td>
<td>File read error</td>
<td>File read error was generated. Either the file contents are invalid or the file does not exist.</td>
<td>(1) Restart System Manager. (2) Specify a valid file.</td>
</tr>
<tr>
<td>6009</td>
<td>Table transmission failure</td>
<td>Table transmission failed. Either the wrong connection was made or an error was generated during transmission.</td>
<td>(1) Check the connection. (2) Check for abnormality on the controller. (3) If time-out error was generated, extend the time-out length.</td>
</tr>
<tr>
<td>600A</td>
<td>Unused window does not exist.</td>
<td>Window numbers (0 ~ 511) for newly registered windows are not available.</td>
<td>Delete unnecessary windows.</td>
</tr>
<tr>
<td>600C</td>
<td>Edit window error</td>
<td>Window cannot be registered to the controller.</td>
<td>(1) Check the connection. (2) Correct the window setting.</td>
</tr>
<tr>
<td>600D</td>
<td>Unused model does not exist.</td>
<td>Search model numbers (0 ~ 99) for newly registered search models are not available.</td>
<td>Delete unnecessary search models.</td>
</tr>
<tr>
<td>600E</td>
<td>Model edit error</td>
<td>Search model could not be registered to the controller.</td>
<td>(1) Check the connection. (2) Correct the search model setting.</td>
</tr>
<tr>
<td>6011</td>
<td>Vision teaching error</td>
<td>Error was generated in communication with the vision board.</td>
<td>(1) Check the connection. (2) Initialize vision board from the pendant or turn the power OFF and ON again. (3) Restart WINCAPSII.</td>
</tr>
<tr>
<td>6012</td>
<td>Calibration error</td>
<td>Read and write from and to the vision file (*.VIS) failed. File cannot be overwritten. Write disk capacity is insufficient.</td>
<td>(1) Expand the write disk capacity. (2) Remove faults and try again.</td>
</tr>
<tr>
<td>6013</td>
<td>Variable acquisition failure</td>
<td>Failed to acquire variable from Variable Manager. Either there is a connection error or the Variable Manager is not functioning normally.</td>
<td>(1) Check the connection. (2) Check for any error on the controller. (3) If time-out error was generated, extend the time-out length.</td>
</tr>
<tr>
<td>6014</td>
<td>System busy no response</td>
<td>Unable to make response because selected manager was currently busy processing.</td>
<td>Wait until the processing is completed and proceed to operation.</td>
</tr>
<tr>
<td>6015</td>
<td>Macro definition file creation failure</td>
<td>Failed to write to macro definition file (vis_tab.h). File cannot be overwritten. Write disk capacity is insufficient.</td>
<td>(1) Expand the write disk capacity. (2) Remove faults and try again.</td>
</tr>
<tr>
<td>6016</td>
<td>Image data read error</td>
<td>Image data read error was generated. Either the file contents are invalid or the file does not exist.</td>
<td>(1) Restart System Manager. (2) Specify a valid file.</td>
</tr>
<tr>
<td>6017</td>
<td>Image data write error</td>
<td>Image data write error was generated. File cannot be overwritten. Write capacity is insufficient.</td>
<td>(1) Expand the write disk capacity. (2) Remove faults and try again.</td>
</tr>
<tr>
<td>6018</td>
<td>Modification not possible on your current access level.</td>
<td>Operation is not possible on the current access level.</td>
<td>Login again and raise the access level. If access is currently on the Programmer level, the item cannot be accessed.</td>
</tr>
<tr>
<td>6020</td>
<td>Error of unknown reason generated. Status =xxx</td>
<td>Error of unknown origin was generated during image measurement.</td>
<td>(1) Initialize the vision board from the pendant or turn the power OFF and ON again. (2) Restart WINCAPSII.</td>
</tr>
<tr>
<td>No.</td>
<td>Message</td>
<td>Description</td>
<td>Action</td>
</tr>
<tr>
<td>------</td>
<td>----------------------------------------------</td>
<td>--------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>6021</td>
<td>Register condition is erroneously specified.</td>
<td>Search model could not be registered to the controller.</td>
<td>Correct the search model setting.</td>
</tr>
<tr>
<td>6022</td>
<td>Registration range is erroneously specified.</td>
<td>Search model registration range is erroneously specified.</td>
<td>Correct the registration range setting (X-coordinates, Y-coordinates, width, height, standard X-coordinates, and standard Y-coordinates).</td>
</tr>
</tbody>
</table>
| 6023 | Space for registering search model is in shortage. | Vision board has no space (memory) for registering the search model. | (1) Delete unnecessary search models to acquire space.  
(2) Reduce the range of search model being registered. |
| 6024 | Model cannot be registered (no characteristics). | Image information in specified range has no characteristics that can be registered to the search model. | Change the range for registration and try again. |
| 6025 | Model cannot be registered (complex). | Image information in the specified range is too complex to register to search model. | Change the range for registration and try again. |
| 6026 | Search time may become long. | Image information in specified range could be registered to the search model, but the search measurement time took too long. | No problem is expected in this case, but to shorten the search measurement time, specify a slightly more complex image in the registration range. |
| 602B | Camera input failure | Failed to fetch camera image information on the processing screen. | Check the connection of camera specified by the camera number. |
| 602C | Window for measuring histogram is not selected. | Rectangular window for specifying the histogram measurement range is not specified. | (1) Select the window that specifies the process range of the binary-coded registration tool.  
(2) Register a rectangular window for specifying the histogram measurement range to the vision board.  
(3) Acquire the vision board window information from 9.3.2 Get Info, in Owner’s Manual (WINCAPSII). |
| 602D | Measuring window is not selected. | Window for specifying the measurement range is not specified. | (1) Select a window for specifying the process range of the image analysis tool.  
(2) Register the window for specifying the measurement range to the vision board.  
(3) Acquire the vision board window information from 9.3.2 Get Info, in Owner’s Manual (WINCAPSII). |
| 602E | Spindle cannot be measured with the fan window. | When the shape of the window is a fan type the spindle cannot be measured. | Set the measuring mode of area, center of gravity and the spindle measurement tool to "0-Area" or "1-Center of gravity." |
| 602F | Measuring condition is erroneously set. | Error was found in the measurement condition set for the image analysis tool. | Correct the measurement condition set for the image analysis tool. |
| 6030 | Object area for measurement does not exist. | Object (white or black) area for measurement does not exist in the specified window. | Set the object (white or black) to actual area for measurement. |
| 6031 | Window setting condition error | Window shape setting value is incorrect. Window extends beyond the screen or the respective set values are not correct. | Correct the window such that it fits in the screen. Check and correct incorrect values by referring to 21.3.1 WINDMAKE, in Owner’s Manual (Programming). |
| 6032 | Object label for measurement does not exist. | Attempted to measure the detailed data on the label with the label measurement tool despite the fact that the object label does not exist. | Press "EXECUTE" of the label measurement tool to measure the label data, then click the "Object Label Column (F)" in the "List of Measuring Results." |
| 6033 | Cannot read the code. | QR code could not be read. | (1) Fetch size of QR code may be too small to obtain measurement information. Increase the code fetch size in such a case.  
(2) Adjust the binary-code level so as to have QR correctly coded. |
### 3 WINCAPSII Error Code Table

<table>
<thead>
<tr>
<th>No.</th>
<th>Message</th>
<th>Description</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>6034</td>
<td>Search model for measuring is not selected.</td>
<td>Search model for measurement is not specified.</td>
<td>(1) Select &quot;Search Model&quot; for the model search measurement tool.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(2) Register the search model to the vision board.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(3) Acquire the vision board search model information from 9.3.2 Get Info, in Owner's manual (WINCAPSII).</td>
</tr>
<tr>
<td>6035</td>
<td>Search model is not registered.</td>
<td>Error was found with the search model specified by the model search measurement tool.</td>
<td>(1) Acquire the vision board search model information from 9.3.2 Get Info, in Owner's manual (WINCAPSII).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(2) Register the search model to the vision board.</td>
</tr>
<tr>
<td>6036</td>
<td>Search model error</td>
<td>Error was found with the search model specified by the model search measurement tool.</td>
<td>Delete the search model with the error and create a new search model.</td>
</tr>
<tr>
<td>6037</td>
<td>Measuring time-out or the object not detected</td>
<td>Measurement was made under the condition specified by the model search measurement tool, but the measurement time exceeded the specified search time or the object could not be detected.</td>
<td>(1) Correct the measurement condition.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(2) Modify the search time by referring to 9.4.1.2 General Setting, in Owner’s manual (WINCAPSII). (If the object cannot be detected, care should be taken since processing cannot be ended unless the set time set has elapsed.)</td>
</tr>
<tr>
<td>6038</td>
<td>Coordinate data inappropriate</td>
<td>Robot and vision coordinates input by the calibration tool are not appropriate.</td>
<td>Input coordinates for the robot and vision that match each of the three reference points. If they do not match the correct calibration data cannot be calculated.</td>
</tr>
<tr>
<td>603A</td>
<td>Controller information (Window/Search Model) acquisition failure</td>
<td>Error was generated in communication with the vision board and the controller information (Window/Search Model) was not acquired.</td>
<td>(1) Check the connection.</td>
</tr>
<tr>
<td>603B</td>
<td>Search model file does not exist locally (in the personal computer).</td>
<td>Search model file received earlier from the controller does not exist in the project folder.</td>
<td>Receive the search model from the controller according to &quot;9.2.5 Transfer, WINCAPSII Instruction Manual.&quot;</td>
</tr>
<tr>
<td>603C</td>
<td>Data on process screen 3 cannot be registered to the search model.</td>
<td>Image data on process screen 3 could not be registered to the search model.</td>
<td>Register image data on process screens 0 to 2 in the search model.</td>
</tr>
<tr>
<td>603D</td>
<td>Cannot measure process screen 3 data</td>
<td>Image data on process screen 3 could not be registered to the search model.</td>
<td>Model-search image data on process screens 0 to 2.</td>
</tr>
<tr>
<td>603E</td>
<td>Make the width and height of the window larger than the search model.</td>
<td>If the width and height of the window are smaller than the search model, the model search measurement is not possible.</td>
<td>Make the width and height of the window larger than the search model.</td>
</tr>
<tr>
<td>603F</td>
<td>Window information unmatched between the controller and personal computer.</td>
<td>Since the window information registered in the controller and acquired by the personal computer do not match, measurement was not possible.</td>
<td>Acquire the vision board window information by referring to 9.3.2 Get Info, in Owner’s manual (WINCAPSII).</td>
</tr>
<tr>
<td>6040</td>
<td>Usable printer is not incorporated.</td>
<td>Printer in use is not registered.</td>
<td>Add a printer from the Windows control panel.</td>
</tr>
<tr>
<td>6041</td>
<td>Input data error</td>
<td>Input data has invalid value. Overflow was generated during the conversion process.</td>
<td>Input a valid value.</td>
</tr>
<tr>
<td>6042</td>
<td>Robot information acquisition failure</td>
<td>Unable to acquire robot information from the robot controller.</td>
<td>(1) Check the connection.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(2) Turn the controller OFF and ON again.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(3) Restart WINCAPSII.</td>
</tr>
</tbody>
</table>
### 3 WINCAPSII Error Code Table

<table>
<thead>
<tr>
<th>No.</th>
<th>Message</th>
<th>Description</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>6044</td>
<td>PrintManager no response</td>
<td>No response was received from Print Manager.</td>
<td>Restart System Manager if no response is received after a short time.</td>
</tr>
<tr>
<td>6045</td>
<td>Print Manager is already in use.</td>
<td>Print Manager is already in use. Only one manager can access the Print Manager at a time.</td>
<td>End the Print Manager and then try again.</td>
</tr>
<tr>
<td>6046</td>
<td>Connection selection failure</td>
<td>Could not connect to the controller.</td>
<td>Check the connection. Check the communication status from the communication manager and make connection again.</td>
</tr>
<tr>
<td>6047</td>
<td>Do you make new file? If 'NO', designate the file to open next.</td>
<td>As the designated file could not be opened, whether to make a new file or to designate a file again is inquired.</td>
<td>1. Designate the file to open again. 2. Make new file.</td>
</tr>
<tr>
<td>604A</td>
<td>Display switching error</td>
<td>Error occurred in switching the visual monitor display. Camera is not connected properly.</td>
<td>Check the connection of camera designated on the display.</td>
</tr>
<tr>
<td>604B</td>
<td>Cannot measure</td>
<td>Error occurred in the probe measurement result. Cannot measure because of too many singular points on the object for processing.</td>
<td>Check the measurement condition and set up correct condition. Make less the singular points using filters, etc.</td>
</tr>
</tbody>
</table>

**<Log Manager>**

<table>
<thead>
<tr>
<th>No.</th>
<th>Message</th>
<th>Description</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>7000</td>
<td>Initialization error</td>
<td>Initialization failed. Either the contents of the previously opened project are invalid or the file does not exist.</td>
<td>(1) Specify the project and reopen. (2) Create a new project.</td>
</tr>
<tr>
<td>7001</td>
<td>SystemManager no response</td>
<td>No response was received from System Manager.</td>
<td>Restart System Manager if no response is received after a short time.</td>
</tr>
<tr>
<td>7002</td>
<td>PacManager no response</td>
<td>No response from PAC Manager</td>
<td>Restart System Manager if no response is received after a short time.</td>
</tr>
<tr>
<td>7003</td>
<td>VarManager no response</td>
<td>No response from Variable Manager</td>
<td>Restart System Manager if no response is received after a short time.</td>
</tr>
<tr>
<td>7004</td>
<td>DioManager no response</td>
<td>No response from DIO Manager</td>
<td>Restart System Manager if no response is received after a short time.</td>
</tr>
<tr>
<td>7005</td>
<td>ArmManager no response</td>
<td>No response from Arm Manager</td>
<td>Restart System Manager if no response is received after a short time.</td>
</tr>
<tr>
<td>7006</td>
<td>File write error</td>
<td>File write error was generated. File cannot be overwritten. Write disk capacity is insufficient.</td>
<td>(1) Expand write disk capacity. (2) Restart System Manager.</td>
</tr>
<tr>
<td>7007</td>
<td>File read error</td>
<td>File read error was generated. Either file contents are invalid or the file does not exist.</td>
<td>(1) Restart System Manager. (2) Specify a valid file.</td>
</tr>
</tbody>
</table>
## 3 WINCAPSII Error Code Table

<table>
<thead>
<tr>
<th>No.</th>
<th>Message</th>
<th>Description</th>
<th>Action</th>
</tr>
</thead>
</table>
| 7008| Table transmission error                         | Table transmission failed. Either the wrong connection was made or an error was generated during transmission. | (1) Check the connection.  
(2) Check for abnormality on the controller.  
(3) If time-out error was generated, extend the time-out length. |
| 7009| Status acquisition failure                       | Status information could not be acquired from the controller.                | (1) Check the connection.  
(2) Check for abnormality on the controller.  
(3) If time-out error was generated, extend the time-out length. |
| 700A| Find What not found.                              | Specified character string was not found.                                   | –                                                                                           |
| 700C| PrintManager no response                         | No response was received from Print Manager.                                | Restart System Manager if no response is received after a short time.                      |
| 700D| Action reproduction failure                       | Robot failed to reproduce action according to the control log data. No reproduction action is possible if Arm Manager is connected. | Set Arm Manager connection to OFF, turn the monitor ON and proceed with reproduction action. |
| 700E| Response cannot be made because the system is busy| Could not respond because selected manager is currently busy processing.    | Wait until the processing is finished and proceed with the operation.                      |
| 7013| Usable printer is not incorporated.               | Printer in use is not registered.                                           | Add a printer from the Windows control panel.                                             |
| 7014| Editor environment setting is inappropriate.      | Inappropriate value exists in the editor environment setting.               | Check the contents of the editor environment setting and correct.                          |
| 7015| Print Manager is already in use.                 | Print Manager is already in use. Only one manager can access the Print Manager at a time. | End the Print Manager and then try again.                                                 |
| 7016| Connection selection failure                      | Could not be connected to the controller.                                   | Check the connection. Check the communication status from Communication Manager and make connection again. |
| 7017| Do you make new file? If ‘NO’, designate the file to open next | As the designated file could not be opened, whether to make a new file or to designate a file again is inquired.  
1. File not found.  
2. File is destroyed. | 1. Designate the file to open again.  

<Robotalk Manager>

<table>
<thead>
<tr>
<th>No.</th>
<th>Message</th>
<th>Description</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>8000</td>
<td>SystemManager no response</td>
<td>No response was received from System Manager.</td>
<td>Restart System Manager if no response is received after a short time.</td>
</tr>
<tr>
<td>8001</td>
<td>LogManager no response</td>
<td>No response was received from Log Manager.</td>
<td>Restart System Manager if no response is received after a short time.</td>
</tr>
<tr>
<td>8002</td>
<td>VarManager no response</td>
<td>No response was received from Variable Manager.</td>
<td>Restart System Manager if no response is received after a short time.</td>
</tr>
</tbody>
</table>
## 3 WINCAPSII Error Code Table

<table>
<thead>
<tr>
<th>No.</th>
<th>Message</th>
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<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>8003</td>
<td>DioManager no response</td>
<td>No response was received from DIO Manager.</td>
<td>Restart System Manager if no response is received after a short time.</td>
</tr>
<tr>
<td>8004</td>
<td>ArmManager no response</td>
<td>No response was received from Arm Manager.</td>
<td>Restart System Manager if no response is received after a short time.</td>
</tr>
<tr>
<td>8005</td>
<td>Initialization error</td>
<td>Initialization failed. Either the contents of the previously opened project are invalid or the file does not exist.</td>
<td>(1) Specify the project and reopen. (2) Create a new project.</td>
</tr>
<tr>
<td>8006</td>
<td>Connection failure</td>
<td>Could not make connection to the controller.</td>
<td>Check the connection. Check the communication status from Communication Manager and make connection again.</td>
</tr>
<tr>
<td>8007</td>
<td>Automatic response setting failure</td>
<td>Automatic response setting could not be made for the telephone line connection.</td>
<td>Check the status of the modem and/or the telephone line. Initialize the modem.</td>
</tr>
<tr>
<td>8008</td>
<td>On - hook process failure</td>
<td>Telephone line could not be disconnected.</td>
<td>Disconnect the telephone line manually from the modem.</td>
</tr>
<tr>
<td>8009</td>
<td>Automatic terminating setting failure</td>
<td>Could not set the modem to automatic termination.</td>
<td>Check the status of the modem and/or the telephone line. Initialize the modem.</td>
</tr>
<tr>
<td>800A</td>
<td>Automatic terminating resetting failure</td>
<td>Could not reset the modem to automatic termination.</td>
<td>Check the status of the modem and/or the telephone line. Initialize the modem.</td>
</tr>
<tr>
<td>800F</td>
<td>Specified port cannot be opened.</td>
<td>Specified port is already in use or it does not exist.</td>
<td>(1) End the application using the specified port. (2) Specify a valid port.</td>
</tr>
<tr>
<td>8010</td>
<td>File name having characters of over 40 bytes cannot be transmitted.</td>
<td>File names having characters of over 40 bytes cannot be transmitted.</td>
<td>Limit the number of characters to under 40 bytes for a file name.</td>
</tr>
</tbody>
</table>

### Others - FD Tool

<table>
<thead>
<tr>
<th>No.</th>
<th>Message</th>
<th>Description</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>File read error</td>
<td>File read error was generated. Either the file contents are invalid or the file does not exist.</td>
<td>(1) Restart System Manager. (2) Specify a valid file.</td>
</tr>
<tr>
<td>1001</td>
<td>File write error</td>
<td>File cannot be written when creating a new project.</td>
<td>Press INITIALIZE of DETAIL SETTING. Also check that each manager has the correct default file name.</td>
</tr>
<tr>
<td>1002</td>
<td>Project name illegal. Input again.</td>
<td>Either the project already exists or the project name is invalid.</td>
<td>Input a valid project name.</td>
</tr>
<tr>
<td>1003</td>
<td>Folder name illegal</td>
<td>Folder name is invalid.</td>
<td>Input a valid folder name.</td>
</tr>
<tr>
<td>1004</td>
<td>Illegal robot dependent data. Project new creation function not usable.</td>
<td>Dependent data of selected robot type does not exist.</td>
<td>Uninstall WINCAPSII and reinstall the latest version of WINCAPSII.</td>
</tr>
<tr>
<td>1006</td>
<td>Either the disk is not inserted or formatted. Insert the disk.</td>
<td>Either the disk is not inserted in the drive or it is not formatted.</td>
<td>Insert a formatted disk in the drive.</td>
</tr>
<tr>
<td>1007</td>
<td>Insert a disk of #&lt;n&gt;. (Wrong disk is inserted.)</td>
<td>Inserted disk is not required.</td>
<td>Insert a valid disk in the drive.</td>
</tr>
</tbody>
</table>
## 3 WINCAPSII Error Code Table

<table>
<thead>
<tr>
<th>No.</th>
<th>Message</th>
<th>Description</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1009</td>
<td>CRC error is generated. The disk content is destructed.</td>
<td>The contents of the disk have been destroyed.</td>
<td>Write the data to another disk.</td>
</tr>
</tbody>
</table>
| 100A | Cannot write. Check the disk write protect. | Cannot write to the disk. Either it is write protected or the disk has been destroyed. | (1) Cancel the disk write protect.  
(2) Write data to a separate disk. |
| 100F | Read error is generated. | (1) The contents of the disk have been destroyed.  
(2) Data is from an unreadable version | Prepare a new disk and write the data again from the controller. |
| 1010 | Write error is generated. | The disk content is destructed. | Write the data to a separate disk. |
| 1011 | Too many program numbers. No more addition acceptable. | Number of programs that can be added to the project has reached the upper limit value (256). | Create a new project to which add programs. |
| 1013 | Cannot read the designated data (xxx) because of version mismatch. | Cannot read the designated data as the version (xxx) of the designated data does not coincide with the project version. | Make both versions coincide.  
1. Make new project and change compile-output code with program manager setting and make the execution program again. Then read the FD data into this project. |
| 1015 | Cannot read the designated data (xxx) because of robot type mismatch. | Cannot read the designated data as the robot type (xxx) of the designated data does not coincide with the project robot type. | Make both robot types coincide.  
1. Make new project with the same robot type and read the FD data into the project. |
| 1016 | Cannot process the designated data (xxx). | Cannot process the designated data. Cannot read the data as it is upper version data. | 1. Install the newest WINCAPSII.  
2. Read data via the controller. |
| 1017 | Cannot process the designated data (Ver 1.0,1.1). To change output version, select version with the program manager [Tool(T) ] menu : - [ Set(O) ] – [ Compiler ] – [ Output Code ]. Then perform [Make Execution Program (E)]. | Cannot process version 1.0x and 1.1x. | Change output version of the data.  
Select version with the program manager [Tool(T) ] menu :  
Then perform [Make Execution Program (E)]. |
| 1018 | Cannot find xxx. | Cannot find file xxx. | Check the location of the file and make the execution program. |
The purpose of this manual is to provide accurate information in the handling and operating of the robot. Please feel free to send your comments regarding any errors or omissions you may have found, or any suggestions you may have for generally improving the manual.

In no event will YASKAWA be liable for any direct or indirect damages resulting from the application of the information in this manual.
JRC
ERROR CODE TABLES

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