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# AC800 Series
# Intelligent Mechanical Programmable Controller
## User Guide

Industrial Automation | Intelligent Elevator | New Energy Vehicle | Industrial Robot | Rail Transit

Data code 19010617B07

# Preface

## Introduction

The AC800 high-performance intelligent mechanical controller is a high-performance multi-axis motion controller based on the Intel X86 processor hardware platform and complies with the PLCopen specification. It uses EtherCAT bus to achieve multi-axis servo control and is especially suitable for the control of high-speed production equipment and large-scale equipment in advanced manufacturing.

This guide introduces the installation and wiring of the product, including mechanical installation, electrical installation, and operation instructions.

## Standard

The following table lists the certifications, directives, and standards that the product may comply with. For details about the acquired certificates, see the certification marks on the product nameplate.

| Certification | Directive | | Standard |
|---|---|---|---|
| CE Certification | EMC Directive | 2014/30/EU | **24 VDC products:**<br>EN 61131-2<br>**220 VAC products:**<br>EN 61131-2<br>EN 61000-3-2<br>EN 61000-3-3 |
| | LVD Directive | 2014/35/EU | EN 61010-1<br>EN 61010-2-201 |
| | RoHS Directive | 2011/65/EU amended by (EU) 2015/863 | EN IEC 63000 |
| UL/cUL Certification | - | | UL 61010-1<br>UL 61010-2-201<br>CAN/CSA-C22.2 No. 61010-1<br>CSA C22.2 NO. 61010-2-201 |
| KCC Certification | - | | - |
| EAC certification | - | | - |
| UKCA Certification | Safety Regulations | Electrical Equipment (Safety) Regulations 2016 | EN 61010-1<br>EN 61010-2-201 |
| | EMC Regulations | Electromagnetic Compatibility Regulations 2016 | **24 VDC products:**<br>EN 61131-2<br>**220 VAC products:**<br>EN 61131-2<br>EN 61000-3-2<br>EN 61000-3-3 |
| | RoHS Regulations | Directive (RoHS) Regulations 2012 | EN IEC 63000 |

## More Documents

| Document Name | Document Coding | Description |
|---|---|---|
| Medium-sized PLC Programming Software User Guide | PS00003145 | Introduces the basic functions, quick start, network configuration, programming basics, and more of the PLC software. |
| Medium-Sized PLC Programming Guide (Motion Control) | 19010539 | Introduces the composition of PLC motion control system, motion control program mechanism, detailed explanation of MC instructions, simulation and debugging related operations. |
| Medium-Sized PLC Instruction Guide | 19011700 | Introduces the basic instructions. |
| AC800 Series Intelligent Mechanical Programmable Controller User Guide (This guide) | 19010617 | Introduces the installation and wiring of the product, including mechanical installation, electrical installation, and operation instructions. |

## Revision History

| Revision date | Version | Description |
|---|---|---|
| February 2025 | B07 | Made minor corrections. |
| April 2024 | B06 | Modified the voltage specifications in *"4.3.1 I/O Communication Interface Specifications" on page 28*. |
| January 2024 | B05 | • Modified CPU fault codes in *"8.2 Appendix 2 Controller Related Error Codes" on page 62*.<br>• Modified the EtherCAT fault codes in *"8.3 Appendix 3 EtherCAT Related Error Codes" on page 64*. |
| July 2023 | B04 | Made minor corrections. |
| June 2023 | B03 | Deleted information on multi-functional expansion card slot.<br>Made minor corrections. |
| December 2022 | B02 | Optimized description of the interfaces |
| November 2022 | B01 | Made minor corrections. |
| October 2020 | B00 | • Added optional accessory: CAN expansion card.<br>• Added information on AC801 and AC812 models.<br>• Update the display screen operation and added "Expansion Card Version Information", "Restoring Backup Program", "UPS Settings", and "Restoring Factory Settings" sections. |
| November 2018 | A00 | Initial release. |

## Access to the Guide

This guide is not delivered with the product. You can obtain the PDF version by the following methods:

- Do keyword search under Service and Support at *www.inovance.com*.

- Scan the QR code on the product with your smart phone.
- Scan the QR code below to install My Inovance app, where you can search for and download user guides.

## Warranty Disclaimer

Inovance provides warranty service within the warranty period (as specified in your order) for any fault or damage that is not caused by improper operation of the user. Maintenance will be charged after the warranty expires.

Within the warranty period, maintenance will be charged for the following damage:

- Damage caused by operations not following the instructions in the user guide
- Damage caused by fire, flood, or unusual voltage
- Damage caused by unintended use of the product
- Damage caused by use beyond the specified scope of application of the product
- Damage or secondary damage caused by force majeure (natural disaster, earthquake, and lightning strike)

The maintenance is charged according to the latest Price List of Inovance. If otherwise agreed upon, the terms and conditions in the agreement shall prevail.

For details, see the Product Warranty Card.

# First Use

Read through this user guide carefully before use for the first time. If you have any question concerning product functions or performance, contact Inovance for technical support.

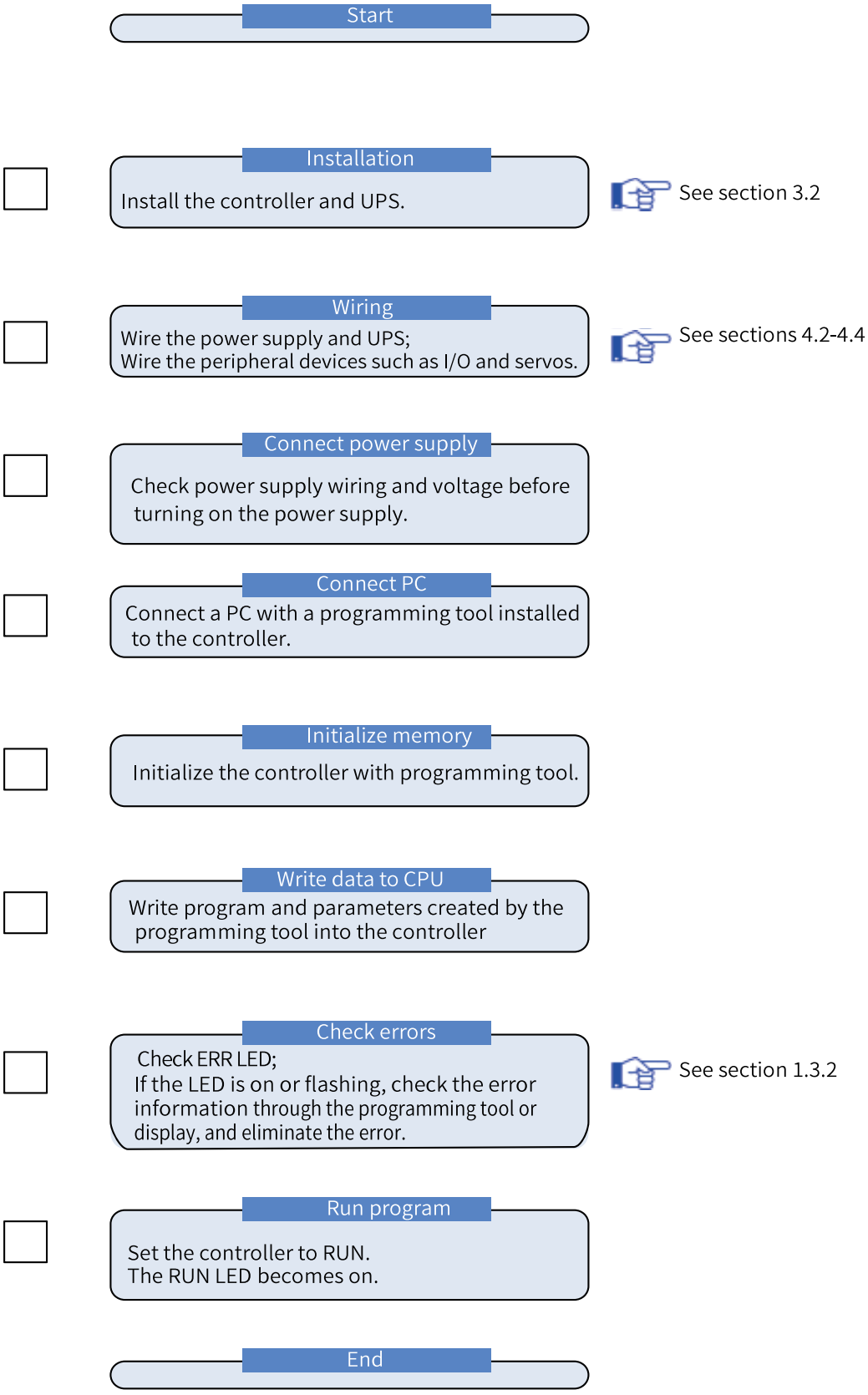
## Standard

Certification marks on the product nameplate indicate compliance with the corresponding certifications.

| Certification | Certification Mark | Directive | | Standard |
|---|---|---|---|---|
| CE Certification |  | EMC Directive | 2014/30/EU | EN 61800-3 |
| | | LVD Directive | 2014/35/EU | EN 61800-5-1 |
| | | RoHS Directive | 2011/65/EU | EN 50581 |
| TUV Certification |  | - | | EN 61800-5-1 |
| UL Certification |  | - | | UL61800-5-1<br>C22.2 No.14-13 |
| EAC Certification |  | - | | CU-TR |
| KCC Certification |  | - | | - |
| 3C Certification |  | - | | - |

- The integrator who integrates this drive into other products and attaches CE mark to the final assembly has the responsibility of ensuring compliance with CE standards and the European Norm.
- For more information on product certifications, contact Inovance agent.

## System Startup Process



# Table of Contents

# Fundamental Safety Instructions

## Safety Precautions

- This chapter provides essential safety instructions for proper use of the equipment. Before operating the equipment, read through the guide and comprehend all the safety instructions. Failure to comply with the safety instructions may result in death, severe personal injuries, or equipment damage.
- "CAUTION", "WARNING", and "DANGER" items in the guide only indicate some of the precautions that need to be followed; they just supplement the safety precautions.
- Use this equipment according to the designated environment requirements. Damage caused by improper use is not covered by warranty.
- Inovance shall take no responsibility for any personal injuries or property damage caused by improper use.

## Safety Levels and Definitions

Indicates that failure to comply with the notice will result in death or severe personal injuries.

Indicates that failure to comply with the notice may result in death or severe personal injuries.

Indicates that failure to comply with the notice may result in minor or moderate personal injuries or equipment damage.

## General Safety Instructions

- Drawings in the guide are sometimes shown without covers or protective guards. Remember to install the covers or protective guards as specified first, and then perform operations in accordance with the instructions.
- The drawings in the guide are shown for illustration only and may be different from the product you purchased.

| Unpacking |
| --- |
|  <br>• Do not install the equipment if you find damages, rust, or signs of use on the equipment or accessories upon unpacking.<br>• Do not install the equipment if you find water seepage or missing or damaged components upon unpacking.<br>• Do not install the equipment if you find the packing list does not conform to the equipment you received. |


- Check whether the packing is intact and whether there is damage, water seepage, dampness, and deformation before unpacking.
- Unpack the package by following the unpacking sequence. Do not strike the package violently.
- Check whether there is damage, rust, or injuries on the surface of the equipment and equipment accessories before unpacking.
- Check whether the package contents are consistent with the packing list before unpacking.

**Storage and Transportation**


- Large-scale or heavy equipment must be transported by qualified professionals using specialized hoisting equipment. Failure to comply may result in personal injuries or equipment damage.
- Before hoisting the equipment, ensure the equipment components such as the front cover and terminal blocks are secured firmly with screws. Loosely-connected components may fall off and result in personal injuries or equipment damage.
- Never stand or stay below the equipment when the equipment is being hoisted by the hoisting equipment.
- When hoisting the equipment with a steel rope, ensure the equipment is hoisted at a constant speed without suffering from vibration or shock. Do not turn the equipment over or let the equipment stay hanging in the air. Failure to comply may result in personal injuries or equipment damage.


- Handle the equipment with care during transportation and mind your steps to prevent personal injuries or equipment damage.
- When carrying the equipment with bare hands, hold the equipment casing firmly with care to prevent parts from falling. Failure to comply may result in personal injuries.
- Store and transport the equipment based on the storage and transportation requirements. Failure to comply will result in equipment damage.
- Avoid storing or transporting the equipment in environments with water splash, rain, direct sunlight, strong electric field, strong magnetic field, and strong vibration.
- Avoid storing the equipment for more than three months. Long-term storage requires stricter protection and necessary inspections.
- Pack the equipment strictly before transportation. Use a sealed box for long-distance transportation.
- Never transport the equipment with other equipment or materials that may harm or have negative impacts on this equipment.

**Installation**


- The equipment must be operated only by professionals with electrical knowledge. Non-professionals are not allowed.

WARNING

- Read through the guide and safety instructions before installation.
- Do not install this equipment in places with strong electric or magnetic fields.
- Before installation, check that the mechanical strength of the installation site can bear the weight of the equipment. Failure to comply will result in mechanical hazards.
- Do not wear loose clothes or accessories during installation. Failure to comply may result in an electric shock.
- When installing the equipment in a closed environment (such as a cabinet or casing), use a cooling device (such as a fan or air conditioner) to cool the environment down to the required temperature. Failure to comply may result in equipment over-temperature or a fire.
- Do not retrofit the equipment.
- Do not fiddle with the bolts used to fix equipment components or the bolts marked in red.
- When the equipment is installed in a cabinet or final assembly, a fireproof enclosure providing both electrical and mechanical protections must be provided. The IP rating must meet IEC standards and local laws and regulations.
- Before installing devices with strong electromagnetic interference, such as a transformer, install a shielding device for the equipment to prevent malfunction.
- Install the equipment onto an incombustible object such as a metal. Keep the equipment away from combustible objects. Failure to comply will result in a fire.

CAUTION

- Cover the top of the equipment with a piece of cloth or paper during installation. This is to prevent unwanted objects such as metal chippings, oil, and water from falling into the equipment and causing faults. After installation, remove the cloth or paper on the top of the equipment to prevent over-temperature caused by poor ventilation due to blocked ventilation holes.
- Resonance may occur when the equipment operating at a constant speed executes variable speed operations. In this case, install the vibration-proof rubber under the motor frame or use the vibration suppression function to reduce resonance.

**Wiring**

DANGER

- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
- Before wiring, cut off all the power supplies of the equipment, and wait for at least the time designated on the equipment warning label before further operations because residual voltage still exists after power-off. After waiting for the designated time, measure the DC voltage in the main circuit to ensure the DC voltage is within the safe voltage range. Failure to comply will result in an electric shock.
- Do not perform wiring, remove the equipment cover, or touch the circuit board with power ON. Failure to comply will result in an electric shock.
- Check that the equipment is grounded properly. Failure to comply will result in an electric shock.


- Do not connect the input power supply to the output end of the equipment. Failure to comply will result in equipment damage or even a fire.
- When connecting a drive to the motor, check that the phase sequences of the drive and motor terminals are consistent to prevent reverse motor rotation.
- Cables used for wiring must meet cross sectional area and shielding requirements. The shield of the cable must be reliably grounded at one end.
- Fix the terminal screws with the tightening torque specified in the user guide. Improper tightening torque may overheat or damage the connecting part, resulting in a fire.
- After wiring is done, check that all cables are connected properly and no screws, washers or exposed cables are left inside the equipment. Failure to comply may result in an electric shock or equipment damage.


- During wiring, follow the proper electrostatic discharge (ESD) procedure, and wear an antistatic wrist strap. Failure to comply will damage the equipment or the internal circuits of the equipment.
- Use shielded twisted pairs for the control circuit. Connect the shield to the grounding terminal of the equipment for grounding purpose. Failure to comply will result in equipment malfunction.

**Power-on**


- Before power-on, check that the equipment is installed properly with reliable wiring and the motor can be restarted.
- Check that the power supply meets equipment requirements before power-on to prevent equipment damage or a fire.
- After power-on, do not open the cabinet door or protective cover of the equipment, touch any terminal, or disassemble any unit or component of the equipment. Failure to comply will result in an electric shock.


- Perform a trial run after wiring and parameter setting to ensure the equipment operates safely. Failure to comply may result in personal injuries or equipment damage.
- Before power-on, check that the rated voltage of the equipment is consistent with that of the power supply. Failure to comply may result in a fire.
- Before power-on, check that no one is near the equipment, motor, or machine. Failure to comply may result in death or personal injuries.

**Operation**


- The equipment must be operated only by professionals. Failure to comply will result in death or personal injuries.
- Do not touch any connecting terminals or disassemble any unit or component of the equipment during operation. Failure to comply will result in an electric shock.


- Do not touch the equipment casing, fan, or resistor with bare hands to feel the temperature. Failure to comply may result in personal injuries.
- Prevent metal or other objects from falling into the equipment during operation. Failure to comply may result in a fire or equipment damage.

**Maintenance**

| |
|---|
|  <br>• Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.<br>• Do not maintain the equipment with power ON. Failure to comply will result in an electric shock.<br>• Before maintenance, cut off all the power supplies of the equipment and wait for at least the time designated on the equipment warning label.<br>• In case of a permanent magnet motor, do not touch the motor terminals immediately after power-off because the motor terminals will generate induced voltage during rotation even after the equipment power supply is off. Failure to comply will result in an electric shock. |
|  <br>• Perform routine and periodic inspection and maintenance on the equipment according to maintenance requirements and keep a maintenance record. |
| **Repair** |
|  <br>• Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.<br>• Do not repair the equipment with power ON. Failure to comply will result in an electric shock.<br>• Before inspection and repair, cut off all the power supplies of the equipment and wait for at least the time designated on the equipment warning label. |
|  <br>• Require repair services according to the product warranty agreement.<br>• When the fuse is blown or the circuit breaker or earth leakage current breaker (ELCB) trips, wait for at least the time designated on the equipment warning label before power-on or further operations. Failure to comply may result in death, personal injury or equipment damage.<br>• When the equipment is faulty or damaged, the troubleshooting and repair work must be performed by professionals that follow the repair instructions, with repair records kept properly.<br>• Replace quick-wear parts of the equipment according to the replacement instructions.<br>• Do not use damaged equipment. Failure to comply may result in death, personal injuries, or severe equipment damage.<br>• After the equipment is replaced, check the wiring and set parameters again. |
| **Disposal** |
|  <br>• Dispose of retired equipment in accordance with local regulations and standards. Failure to comply may result in property damage, personal injuries, or even death.<br>• Recycle retired equipment by observing industry waste disposal standards to avoid environmental pollution. |

## Safety label

For safe equipment operation and maintenance, comply with the safety labels on the equipment. Do not damage or remove the safety labels. See the following table for descriptions of the safety labels.

| Safety Label | Description |
| --- | --- |
|  | • Read through the safety instructions before operating the equipment. Failure to comply may result in death, personal injuries, or equipment damage.<br>• Do not touch the terminals or remove the cover with power ON or within 10 min after power-off. Failure to comply will result in an electric shock. |

# 1 Product Information

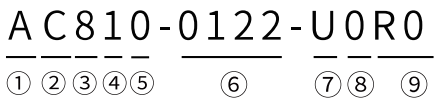
## 1.1 Overview

The AC800 series intelligent mechanical programmable controller adopts a book-style form factor with an all-metal body, offering abundant network interfaces capable of meeting various project expansion requirements, and delivers robust motion control performance. The controller supports multiple interfaces, including up to two Gigabit Ethernet ports, two EtherCAT interfaces, two USB2.0 interfaces, two USB3.0 interfaces, one RS485 interface, and one RS232 interface.

This product series features a wide operating temperature range (-5°C to +55°C) and excellent EMC performance. The controller is equipped with an Intel Celeron or Core i CPU with excellent computing capabilities, a 4 GB or above DDR4 memory and a large SSD, which make it a perfect match for high-load computing applications.

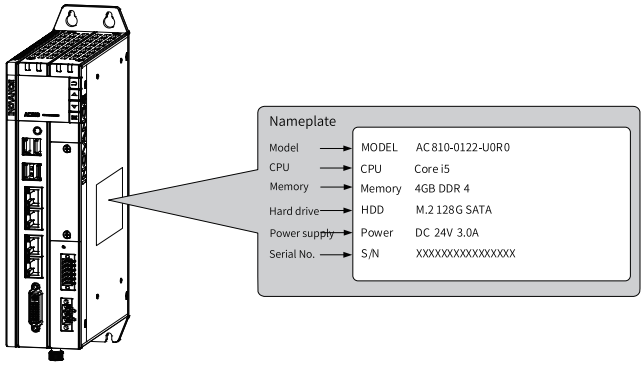
## 1.2 Nameplate and Model Number

Description of model number



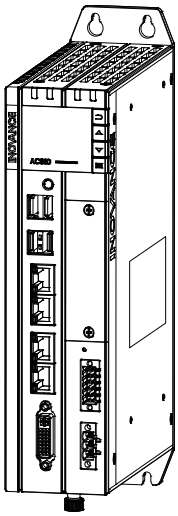

| | | |
|---|---|---|
| ① **Product name**<br>A: Controller | ④ **Sub-series number (2nd digit)**<br>1: Core i series processor | ⑦ **Software configuration**<br>W: Windows system<br>L: Linux system<br>U: Ubuntu system<br>V: Vxworks system |
| ② **Product structure type**<br>C: Booksize | ⑤ **Model**<br>0: AC810 | ⑧ **Software configuration**<br>0: system version |
| ③ **Series number (1st digit)**<br>8: 800 series | ⑥ **Hardware Configuration**<br>First two digits: CPU configuration (00 to 99), 00: i3, 01: i5; 02: Celeron; 03: i7<br>3rd digit: Standard memory: $2^n \times 1$ GB (1 GB to16 GB Max. 512 GB) (where n corresponds to the 3rd digit)<br>4th digit: Standard SSD: $2^n \times 32$ GB (32 GB to 256 GB Max. 16 TB) (where n corresponds to the 4th digit) | ⑨ **Software configuration**<br>R0: Software specification + version |

Description of nameplate




# 1.3 Components and Functions

## 1.3.1 Appearance



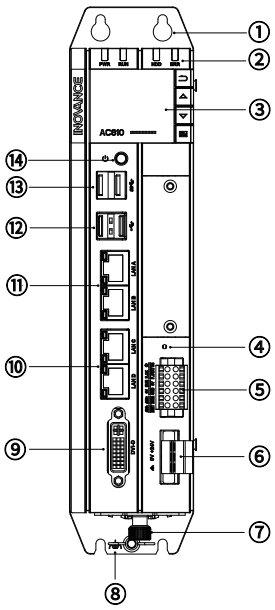
The AC800 series includes the following controllers and accessories:

| Product Type | Product description | Model | Product Code |
|---|---|---|---|
| Booksize controller | Intel Core i7; 4 GB memory; 128 GB hard drive; 2x USB2.0 interfaces; 2x USB3.0 interfaces; 4x network ports; DVI-D; with display; internal Mini-PCIE expansion slot | AC812-0322-U0R0 | 01440143 |
| Booksize controller | Intel Core i5; 4 GB memory; 128 GB hard drive; 2x USB2.0 interfaces; 2x USB3.0 interfaces; 4x network ports; DVI-D; with display; internal Mini-PCIE expansion slot | AC810-0122-U0R0 | 01440038 |

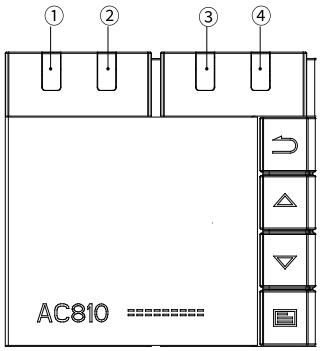
| Product Type | Product description | Model | Product Code |
|---|---|---|---|
| Booksize controller | Celeron; 4 GB memory; 128 GB hard drive; 2x USB2.0 interfaces; 2x USB3.0 interfaces; 4x network ports; DVI-D; with display; internal Mini-PCIE expansion slot | AC802-0222-U0R0 | 01440101 |
| Booksize controller | Celeron; 4 GB memory; 64 GB hard drive; 2x USB2.0 interfaces; 2x USB3.0 interfaces; 4x network ports; DVI-D; with display; internal Mini-PCIE expansion slot | AC801-0221-U0R0 | 01440103 |

The external interfaces of the controller are shown in the following figure:

Table 1–1 Controller interfaces

| - | No. | Interface name | Description |
|---|---|---|---|
|  | ① | Rear earhook | Standard |
| | ② | Status indicator | For the specific definition of the indicators, see *"1.3.2 LED Status Indicators" on page 15* |
| | ③ | Display and Buttons | For specific functions and operations, see section 5. |
| | ④ | Reset button | Pinhole reset button |
| | ⑤ | I/O communication interface | 3x DIs/2x DOs, RS485/ RS232, for details on the pins, see section *"4.3.3 RS485 Bus Wiring Instructions" on page 31* |
| | ⑥ | Power supply interface | 24 V power supply input |
| | ⑦ | Fan slot locker (only available in AC810 and AC812 series) | Remove this to replace the fan and RTC battery |
| | ⑧ | Grounding terminal | Controller grounding |
| | ⑨ | DVI-D interface | Standard DVI-D Display interface |
| | ⑩/⑪ | LAN port | 4x LAN ports: 2x Ethernet and 2x EtherCAT (1x EtherCAT in AC801 series) |
| | ⑫/⑬ | USB interface | 2x USB 2.0 ports and 2x USB 3.0 ports |
| | ⑭ | Power button | Controller startup control |

## 1.3.2 LED Status Indicators




The indicators are described as follows:

| No. | LED | Name | Function | Status | Description |
|---|---|---|---|---|---|
| 1 | PWR | Power indicator | Controller power status | Green | OFF: Abnormal<br>ON: Normal |
| 2 | RUN | RUN indicator | Running status | Green | OFF: User program is not running.<br>Blinking: The device is being identified.<br>ON: User program is running. |
| 3 | HDD | Hard drive indicator | Hard drive status | Green | OFF: HDD not detected.<br>Blinking: HDD is working normally. |
| 4 | ERR | Error indicator | Operation error | Red | OFF: Normal<br>Blinking: Low battery<br>ON:<br>1. Overtemperature<br>2. User program error<br>3. System failure |

## 1.3.3 Power Button

The power button is located under the front panel of the controller. See the following for the details:

| No. | Operation | Result |
|---|---|---|
| 1 | Power-on | The controller is turned on. |
| 2 | Pressing the button after power-on | No operation |
| 3 | Long pressing the button after power-on | The controller is shut down. |
| 4 | Pressing the button upon power on after the controller is shut down. | The controller is turned on. |

### 1.3.4 Display and Buttons

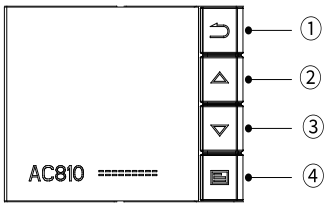



Figure 1-1 Display

The controller display is used to display basic information and perform simple commissioning. The display parameter specifications are as follows:

| Item | Description |
|---|---|
| Outline dimensions | 31.46 x 36.68 |
| Visible area | 16.3 x 28.78 |
| Display type | FSTN negative display |
| Resolution | 128 x 64 |

Functions of the buttons are described in the following table:

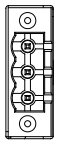
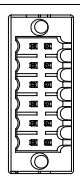
| Item | Description |
|---|---|
| Button 1 | Back |
| Button 2 | Page up |
| Button 3 | Page down |
| Button 4 | Enter |

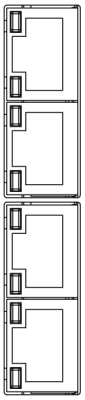
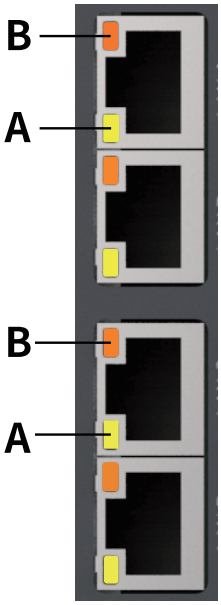
The display shows the information on the following. For detailed operation instructions, see *" Programming and Debugging" on page 55*.

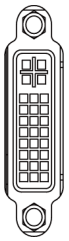
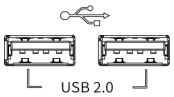
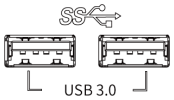
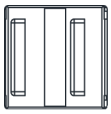
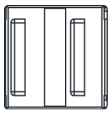
1. system operation
2. controller status
3. fault and commissioning
4. basic controller information: basic hardware information, software version, and IP address
5. upgrade and download progress

### 1.3.5 Interfaces

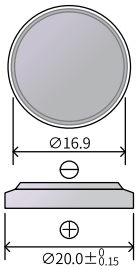
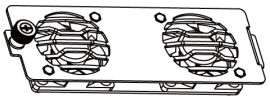
The following table summarizes all the interfaces of the controller:

| No. | Interface name | Function | Interface type | Terminal |
|---|---|---|---|---|
| 1 | Input power supply | 24 VDC (-20% to +20%) | 3-pin pluggable 5.08 Eurostyle terminal, spring crimping, with fixing screws, black |  |
| 2 | I/O communication terminal | 3DI, 2DO<br>RS485 interface<br>RS232 interface | 2 * 6-pin pluggable 3.5 mm Eurostyle terminals, spring crimping, with fixing screws, black |  |

<table>
<tr><th>No.</th><th>Interface name</th><th>Function</th><th>Interface type</th><th>Terminal</th></tr>
<tr><td>3</td><td>Ethernet port</td><td colspan="2">4 LAN ports: LAN A, LAN B, LAN C and LAN D (top to bottom).</td><td rowspan="2">  </td></tr>
<tr><td>4</td><td>EtherCAT port</td><td colspan="2">The Ethernet interface utilizes an Intel Gigabit Ethernet controller, fully compliant with 802.1Qav, IEEE1588/802.1AS, 802.3az and Intel® AMT functional requirements (Intel AMT supports Core i processors with specific SKU). Four standard RJ-45 Ethernet interfaces. The LED indicators are described as follows:
<table>
<tr><th>Indicator</th><th>Function</th><th>Color</th><th>Status</th><th>Meaning</th></tr>
<tr><td rowspan="6"> 
</td><td rowspan="3">A: Link/Act</td><td rowspan="3">Yellow</td><td></td><td>OFF:<br>Not connected</td></tr>
<tr><td></td><td>Flashing:<br>Sending/receiving data</td></tr>
<tr><td></td><td>ON:<br>Connected</td></tr>
<tr><td rowspan="3">B: Speed</td><td rowspan="3">Green/orange</td><td></td><td>OFF:<br>1. Connection at 10 Mbps<br>2. No connection</td></tr>
<tr><td></td><td>ON:<br>Connection at 100 Mbps</td></tr>
<tr><td></td><td>ON:<br>Connection at 1,000 Mbps</td></tr>
</table>
Description:
<table>
<tr><th>Port</th><th>Description</th><th>Function</th></tr>
<tr><td>LAN A</td><td>Ethernet 1</td><td>1. System program commissioning<br>2. User program download and commissioning<br>3. Modbus TCP protocol<br>4. Socket (TCP, UDP)</td></tr>
<tr><td>LAN B</td><td>Ethernet 2</td><td>1. Modbus TCP protocol<br>2. Socket (TCP, UDP)</td></tr>
<tr><td>LAN C</td><td>EtherCAT1</td><td>1. EtherCAT protocol<br>2. Auto scanning<br>3. Independent axis/IO</td></tr>
<tr><td>LAN D</td><td>EtherCAT2</td><td>1. EtherCAT protocol<br>2. Auto scanning<br>3. Independent axis/IO</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>No.</th><th>Interface name</th><th>Function</th><th>Interface type</th><th>Terminal</th></tr>
<tr><td>5</td><td>DVI socket</td><td>Standard DVI-D communication</td><td>Standard DVI-I socket, white plastic, with shielded housing</td><td>  </td></tr>
<tr><td>6</td><td>USB2.0</td><td colspan="2" rowspan="2">The controller provides 4 USB interfaces, all of which support plug-and-play and hot plugging, and can connect up to 127 external devices. Two USB 2.0 and two USB 3.0. The interfaces conform to the USB EHCI, Rev. 2.0 standard. Pin definition is as below:
<table>
<tr><th colspan="4">USB2.0 Pin Definition</th></tr>
<tr><td rowspan="5">  </td><td>Pin</td><td>Signal name</td><td>Function</td></tr>
<tr><td>1</td><td>VCC</td><td>Power supply</td></tr>
<tr><td>2</td><td>DATA-</td><td rowspan="2">USB2.0 differential data signal</td></tr>
<tr><td>3</td><td>DATA+</td></tr>
<tr><td>4</td><td>GND</td><td>Power supply GND</td></tr>
<tr><th colspan="4">USB3.0 Pin Definition</th></tr>
<tr><td rowspan="10">  </td><td>Pin</td><td>Signal name</td><td>Function</td></tr>
<tr><td>1</td><td>VCC</td><td>Power supply</td></tr>
<tr><td>2</td><td>DATA-</td><td rowspan="2">USB2.0 differential data signal</td></tr>
<tr><td>3</td><td>DATA+</td></tr>
<tr><td>4</td><td>GND</td><td>Power supply GND</td></tr>
<tr><td>5</td><td>SSRX-</td><td rowspan="2">High speed reception differential data signal</td></tr>
<tr><td>6</td><td>SSRX+</td></tr>
<tr><td>7</td><td>GND</td><td>Signal ground</td></tr>
<tr><td>8</td><td>SSTX-</td><td rowspan="2">High speed transmission differential data signal</td></tr>
<tr><td>9</td><td>SSTX+</td></tr>
</table></td><td>  </td></tr>
<tr><td>7</td><td>USB3.0</td><td>  </td></tr>
</table>

## 1.3.6 Spare Parts and Options

| No. | Name | Diagram | Description | Ordering code |
|---|---|---|---|---|
| 1 | RTC button battery CR2032 |  | 3 V, 230 mAh | 09050002 |
| 2 | fan components |  | 70,000 Hours at 40°C, 65% RH | 98050167 |
| 3 | UPS | - | An external UPS power supply is required for retentive at power failure. | 72030025 |

# 2 Specifications

## 2.1 General Specifications

The AC800 series includes several controllers, whose basic specifications are shown in the following table:

| Item | AC801-0221-U0R0 | AC802-0222-U0R0 | AC810-0122-U0R0 | AC812-0322-U0R0 |
|---|---|---|---|---|
| Power supply | 24 VDC (-20% to +20%) | 24 VDC (-20% to +20%) | 24 VDC (-20% to +20%) | 24 VDC (-20% to +20%) |
| CPU Model | Celeron | Celeron | Core i5 | Core i7 |
| Memory | 4 GB | 4 GB | 4 GB | 4 GB |
| Memory type | DDR4 SO-DIMM | DDR4 SO-DIMM | DDR4 SO-DIMM | DDR4 SO-DIMM |
| Hard disk capacity | 64 GB | 128 GB | 128 GB | 128 GB |
| Hard drive type | M.2(M key) SSD | M.2(M key) SSD | M.2(M key) SSD | M.2(M key) SSD |
| SPI FLASH | 64Mbit | 64Mbit | 64Mbit | 64Mbit |
| Programming mode | IEC 61131-3 programming language (LD, ST, SFC, CFC) | IEC 61131-3 programming language (LD, ST, SFC, CFC) | IEC 61131-3 programming language (LD, ST, SFC, CFC) | IEC 61131-3 programming language (LD, ST, SFC, CFC) |
| Program execution mode | Compiling execution | Compiling execution | Compiling execution | Compiling execution |
| User program storage space | 128 MB | 128 MB | 128 MB | 128 MB |
| User data storage space | 128 MB | 128 MB | 128 MB | 128 MB |
| EtherCAT communica-tion | 1 (each supports up to 128 slaves) | 2 (each supports up to 128 slaves) | 2 (each supports up to 128 slaves) | 2 (each supports up to 128 slaves) |
| Modbus TCP communica-tion | 2 (each supports up to 63 slaves) | 2 (each supports up to 63 slaves) | 2 (each supports up to 63 slaves) | 2 (each supports up to 63 slaves) |
| Modbus (serial port) communica-tion | 2 (each supports up to 31 slaves) | 2 (each supports up to 31 slaves) | 2 (each supports up to 31 slaves) | 2 (each supports up to 31 slaves) |
| Retentive space upon power failure | 5 MB, requires external UPS | 5 MB, requires external UPS | 5 MB, requires external UPS | 5 MB, requires external UPS |
| Dimensions (W x H x D) | 60 mm x 225 mm x 164 mm | 60 mm x 225 mm x 164 mm | 60 mm x 225 mm x 164 mm | 60 mm x 225 mm x 164 mm |
| Weight | Approx. 2.5 kg | Approx. 2.5 kg | Approx. 2.5 kg | Approx. 2.5 kg |
| Cooling method | Natural cooling | Natural cooling | Fan cooling | Fan cooling |
| Battery life | 5 years at 25°C, non-energized | | | |
| EMC specifications | EN61131-2 Zone B/EN61000-6-2/EN61000-6-4 | | | |

## 2.2 Environmental Specifications

The environmental specifications of the controller are shown in the following table:

| Item | Type | | Operating specification | Transportation | Storage |
|---|---|---|---|---|---|
| Environmental parameters (IEC60721-3) | Class | | IE33 | IE22 | IE12 |
| | Temperature | | -5°C to +55°C | -40°C to +70°C | -25°C to +70°C |
| | Humidity | | 10% RH to 95% RH, without condensation | | |
| | Vibration | Frequency | 5 Hz to 200 Hz | 2M2 | 1M2 |
| | | Displace-ment | 3.5 mm (direct installation) (< 8.4 Hz) | | |
| | | Acceleration | 1 g (direct installation) (> 8.4 Hz) | | |
| | | Direction | 3-axial directions | | |
| | Shock (collision) | | 15 g, 11 ms, half sine wave, 3-axial directions | | |
| | Altitude/Air pressure | | 0 m to 2,000 m | 0 m to 3,000 m (⩽ 70 kPa) | |

# 3 Installation and Fixing

## 3.1 Installation Requirements

### 3.1.1 Installation Environment

When installing the controller on the guide rail, take the operability, maintainability, and robustness into account. Do not install the module in a location which is subject to

- An ambient temperature exceeding the range of -5°C to +55°C
- An ambient humidity exceeding the range of 5% to 95% RH
- Drastic temperature changes and condensation
- Corrosive and flammable gas
- Conductive powders (such as dust and iron powder), oil mist, salt, and organic solvents
- Direct sunlight
- Strong electric and magnetic fields
- Vibration or shocks

### 3.1.2 Installation Space

To facilitate ventilation and module replacement, keep enough space between the module and its surroundings.

Installation diagram:

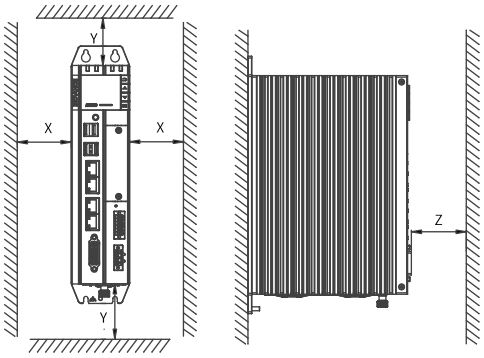



Figure 3-1 Installation space for booksize controller

The clearances are shown in the following table:

| Direction | Minimum requirement on cabinet dimensions (mm) |
|---|---|
| X | 50 |
| Y | 100 |
| Z | 50 |

### 3.1.3 Installation Precautions

- Before installation, ensure that the controller is powered off.
- To avoid damage to the controller, do not drop or shock the controller's housing, terminal block, or connector.
- Do not disassemble the controller; otherwise the controller may be damaged.
- To avoid damage to the terminal and controller, do not overtighten the fasteners.
- The left panel of the controller is an aluminum plate for heat dissipation. Exercise caution to avoid burns.

## 3.2 Installation Instructions

### 3.2.1 Installation Dimensions

The installation dimensions of the controller are shown in the following figure:

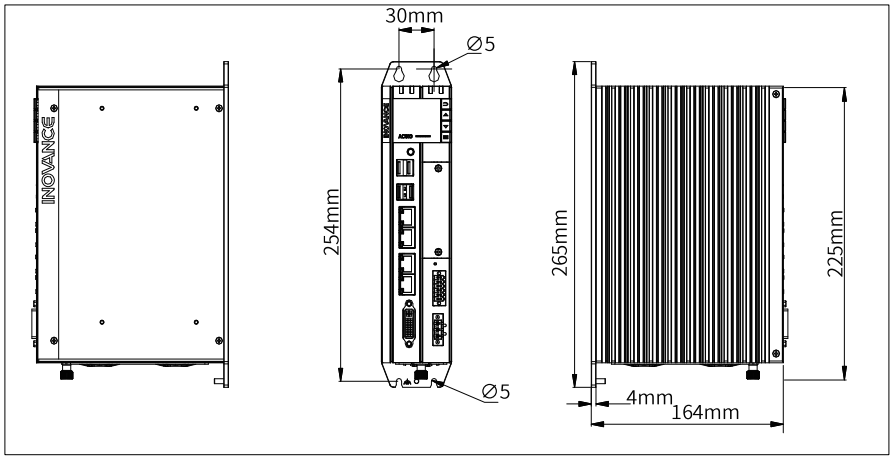
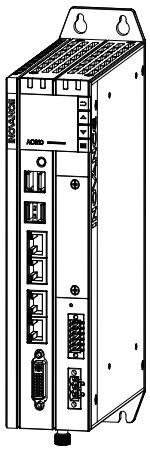



Figure 3-2 Installation dimensions (rear earhook)

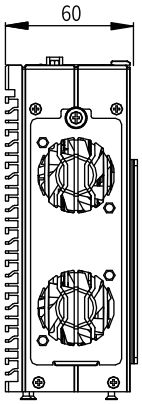
### 3.2.2 Installation Method

1) Rear earhook



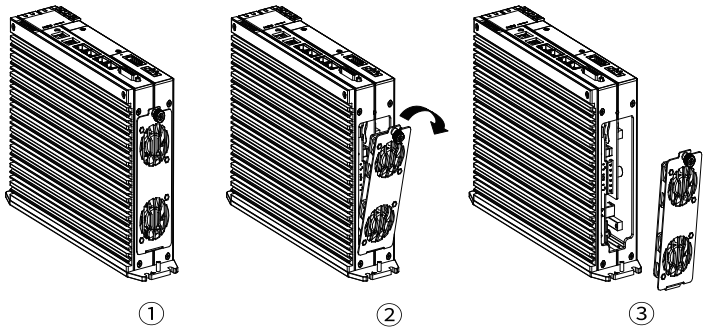
## 3.3 Installation and Removal of the Fan

Fan (mm)




### Removal

The bottom fan is removed as follows:




1. Unscrew the screws on the fan with your hand.
2. Pull out the fan assembly in the direction shown in the figure. Be careful not to damage the bottom wedge.
3. Remove the fan assembly.

### Installation

Install the fall in reverse order.

## 3.4 Installation and Removal of the Battery

### Prerequisite

The battery can only be installed or removed after the fan is removed. Remove the fan as instructed in section *"3.3 Installation and Removal of the Fan" on page 23* first.

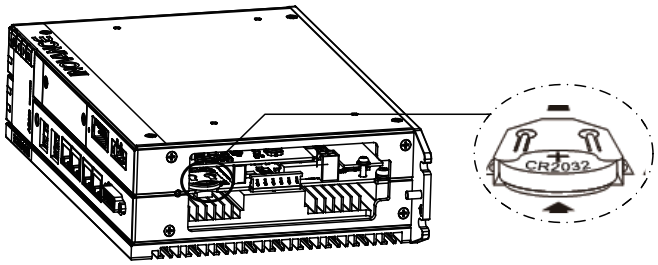
### Note

- When removing the battery,be careful not to touch the surrounding parts to avoid damage. Live working is not allowed.

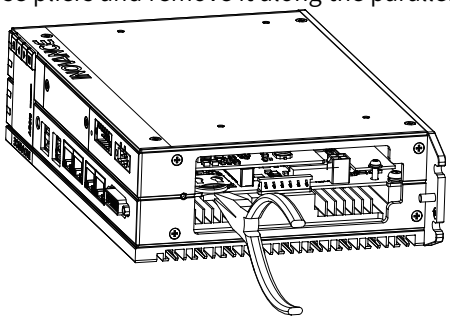
- When installing the battery, see the label at the bottom of the battery to identify the battery's positive and negative poles.
- After replacing the battery, you need to manually start the controller.
- After replacing the battery, power on the controller and check if the controller reports a battery error. If such an error is reported, check whether the battery is installed correctly.
- If the controller is powered on without reporting any error, recalibrate the system clock.
- Do not replace the battery in environments with potential explosion hazards such as gas, vapor, dust, or fibers.
- Dispose of the removed battery properly to avoid environmental pollution and physical injury.

## Operating procedure

1. Loosen the screws on the bottom of the controller and open the fan cover. You can see the battery as shown below.




2. Clamp the battery with flat-nose pliers and remove it along the parallel direction of the battery slot.



3. Use your fingers to push the new battery into the battery slot.

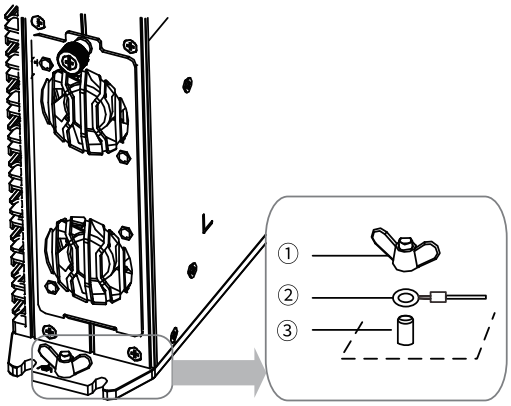
# 4 Wiring

## 4.1 Routing Recommendations

### 4.1.1 Grounding Requirements

A grounding point (⏚) is set on the power terminal of the controller and the rear earhook each. Choose one of the grounding points as needed. Use a grounding wire that is as thick and short (less than 30 cm) as possible to ground the controller. The grounding point on the back earhook is recommended.

Use a wing nut for grounding, with a tightening torque of 0.55 N.m to 0.8 N.m, as shown below:




1-Wing nut; 2-Grounding cable; 3-Grounding screw

Figure 4-1 Grounding the controller

### Grounding of shielded cables

Communication cables must be shielded cables. Ground the shielded cable as close to the controller as possible so that the cable is not interfered with by electromagnetic induction. The exposed shielded cable must touch the grounding point as much as possible to ensure good contact.

Do not solder a PVC wire to the shielded cable for grounding because this will increase the high frequency impedance and attenuate the shielding effect. Attention should be paid to avoid this whenever possible. The shielded cables of the communication signal cable must be grounded at both ends.

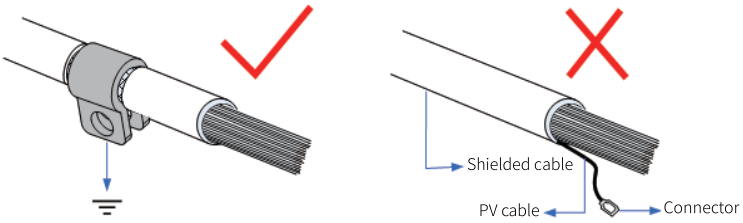



Figure 4-2 Grounding the shielded cable

### 4.1.2 Routing Requirements

Low-voltage cables (< 1 KV) are generally divided into four types. Only cables of the same type can be bundled together. Cables of different types must be separated without cross-connection or overlap. If cross-connection cannot be avoided, make them cross-connected at 90 degrees.

| No. | Category | Application |
|---|---|---|
| 1 | I | Ethernet port and EtherCAT port |
| 2 | II | Low-speed digital communication signals (RS232 and RS485) and DI/DO signals |
| 3 | III | Low-voltage AC power distribution cables or DC power supply cables (such as 24 VDC power supply cables with switched-mode power supply) |
| 4 | IV | Input and output cables, welding machine cables, and power converter power cables |

Keep a proper distance between different types of cables. For cables shorter than 30 m, the minimum distance allowed is shown in the figure below.

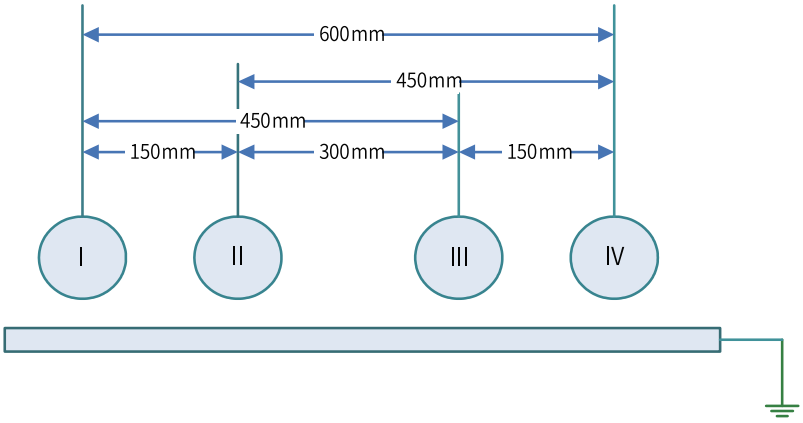



Figure 4-3 Required distances between different types of cables

***Note***

- If two cables run parallel for an extended length, increase the distances accordingly.
- You can also install spliced shielding plates between different types of cables. To reduce cross interference, route all cables as closely as possible to the grounded structural components of the cabinet, such as the cabinet's mounting plate or rack components.

### 4.1.3 Installing the Filter

If the controller is subject to a strong interference source (such as an AC drive), it is recommended that you add a noise filter to suppress the interference.

Install the filter as close as possible to the power supply of the controller. Fix the filter to the conductive backplane through screws. Protect the area around the screws with paint and ensure reliable grounding. The outgoing and incoming cables of the filter should be routed separately to avoid noise coupling on the cables.

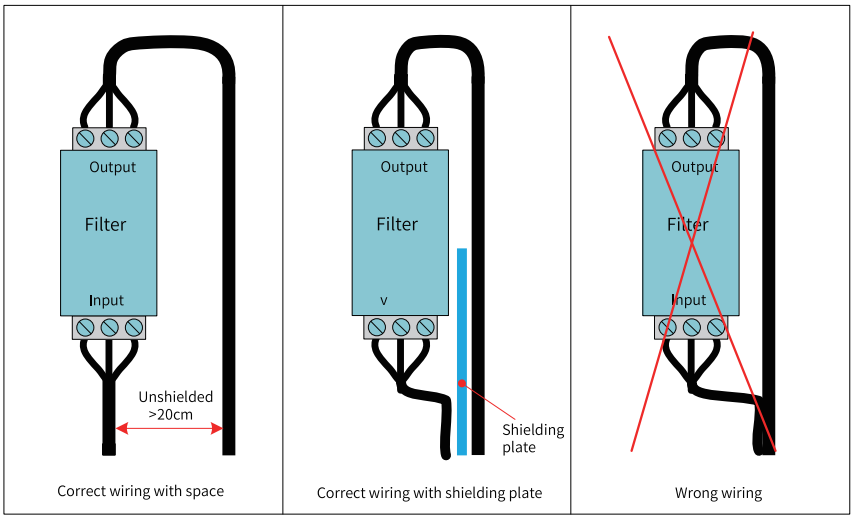



Figure 4-4 Installing the filter

## 4.2 Wiring of Power Input Terminals

The power input terminal is a 3-pin screw-fixed pluggable terminal with a pitch of 5.08 mm. To facilitate wiring, replacement and maintenance, use a spring clamp crimping terminal. The following illustration shows how the power supply cable connector is inserted into the power input terminal:

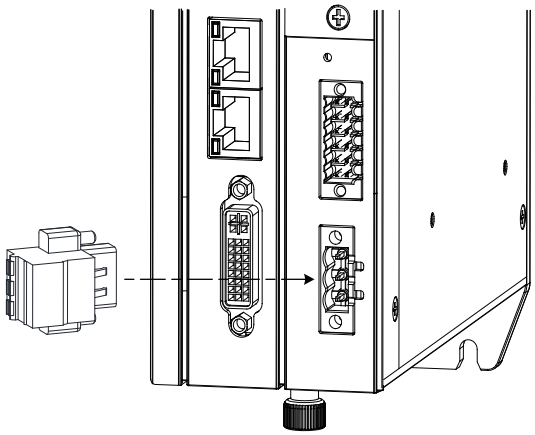
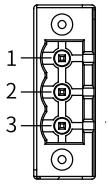


Figure 4-5 Wiring of power input terminals

1. **Definition of the power terminals**

| Terminal | No. | Name | Type | Function |
|---|---|---|---|---|
|   | 1 | +24 V | Input | DC input positive |
| | 2 | 0 V | Input | DC input negative |
| | 3 | ⏚ | Grounding | Enclosure protective GND |

2. **Specifications of input power supply**

| No. | Item | Specification |
|---|---|---|
| 1 | Input voltage | 24 VDC (-20% to +20%) |
| 2 | Input current | 3 A |
| 3 | Fool-proof design for connection | Supported |
| 4 | Short-circuit protection | Supported |

The power input must be equipped with a fuse.

3. **Power supply cable preparation**

   The power supply input cable uses a pin terminal. For preparation instructions, see section *"4.7.2 Cable Preparation Requirements" on page 39*.

# 4.3 Wiring of I/O Communication Port

## 4.3.1 I/O Communication Interface Specifications

### 1 Introduction

The I/O communication interface adopts a 12-pin (dual-row 6-pin) terminal with a 3.5mm pitch, which includes UPS auxiliary signals, RS-232 signals, RS-485 signals, power-on signals, PLC program run/stop control signals, and power status signals. The wiring terminal adopts screw-fixed pluggable terminals, utilizing spring-type and crimping connection methods for convenient on-site installation and wiring, replacement and maintenance.

The following configure shows the connection of the IO/communication terminal plug to the IO/communication interface.

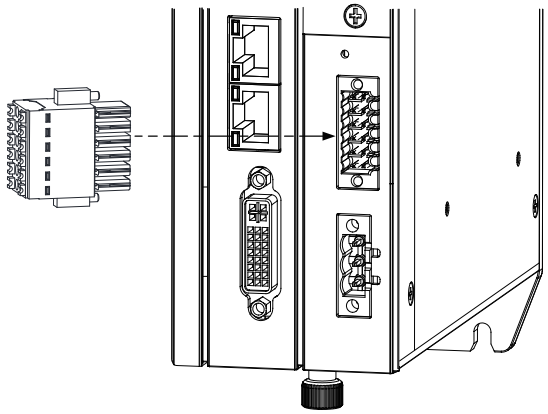
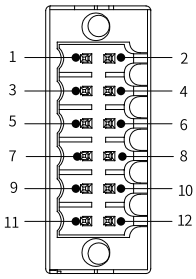


Figure 4-6 User terminal wiring diagram

## 2 Definition of I/O communication interface

| Description | Function | Signal | No. | I/O communication interface | No. | Signal | Function | Description |
|---|---|---|---|---|---|---|---|---|
| Starts the PLC through a 500 ms high level width pulse | On signal (works with UPS or remote start) | ⏻ | 1 |  | 2 | P_STATUS | Power-on indicator signal | Active after the controller is powered on |
| Enables power failure retention during ON-OFF switchover | Power failure detection signal | P_OK | 3 | | 4 | P_STATUS | Operation status signal | Active after the controller is powered on |
| OFF during RUN; ON during STOP | RUN/STOP | RUN | 5 | | 6 | 0 V | DO reference GND | – |
| – | Input common terminal | 0 V | 7 | | 8 | GND | Communication reference ground | – |
| COM1 | RS485+ | 485+ | 9 | | 10 | 232R | RS232 reception | COM0 |
| | RS485- | 485- | 11 | | 12 | 232T | RS232 transmission | |



### *Note*

The status control signals in the above table are dedicated I/Os and cannot be used otherwise.

## 3 Specifications of status control signals

The specifications of the status control signals are described in the following table:

| Item | Input Signal (pin 1/3/5) | | Output Signal (pin 2/4) |
|---|---|---|---|
| I/O type | DC digital input | | Transistor, high-level output |
| I/O mode | Source | | Source |
| Input/Output voltage class | 24 VDC (-20% to +20%) | OFF voltage: ⩽ 5 V | 24 VDC (-20% to +20%) |
| | | ON voltage: ⩾ 15 V | |
| ON response time | Less than 10 ms (hardware response time) | | Less than 0.5 ms (hardware response time) |
| OFF response time | Less than 10 ms (hardware response time) | | Less than 0.5 ms (hardware response time) |
| Isolation mode | Optocoupler isolation | | Optocoupler isolation |
| Short circuit-proof output | N/A | | Supported |

## 4 RS-485 communication specifications

RS485 communication supports the Modbus RTU protocol and free protocol, with relevant specifications as described in the following table.

| No. | Item | Specification |
|---|---|---|
| 1 | Station number | 1 to 247 |
| 2 | Communication rate (bps) | 4.8K, 9.6K, 19.2K, 38.4K, 57.6K, 115.2K |
| 3 | Data length | 8 bits |
| 4 | Parity check bit | None/Odd/Even |
| 5 | Stop bit | 1.2 |
| 6 | Max. number of stations | 32 |

## 5 RS-232 communication specifications

The RS232 bus supports the following communication specifications as described in the following table.

| No. | Item | Specification |
|---|---|---|
| 1 | Number of slaves | 1 |
| 2 | Communication rate (bps)* | 300, 600, 1.2K, 2.4K, 4.8K, 9.6K, 19.2K, 38.4K, 57.6K, 115.2K |

***Note***

When you use an RS232 to RS485 converter, it is recommended that you use an external power supply to power the converter. If the external power supply is unavailable, the baud rate should not exceed 9.6 kbps.

### 4.3.2 Wiring of UPS and Status I/Os

To enable power failure retention, a GA10–UPS12 UPS is required. The recommended wiring method for UPS and other I/O control signals is shown in the figure below:

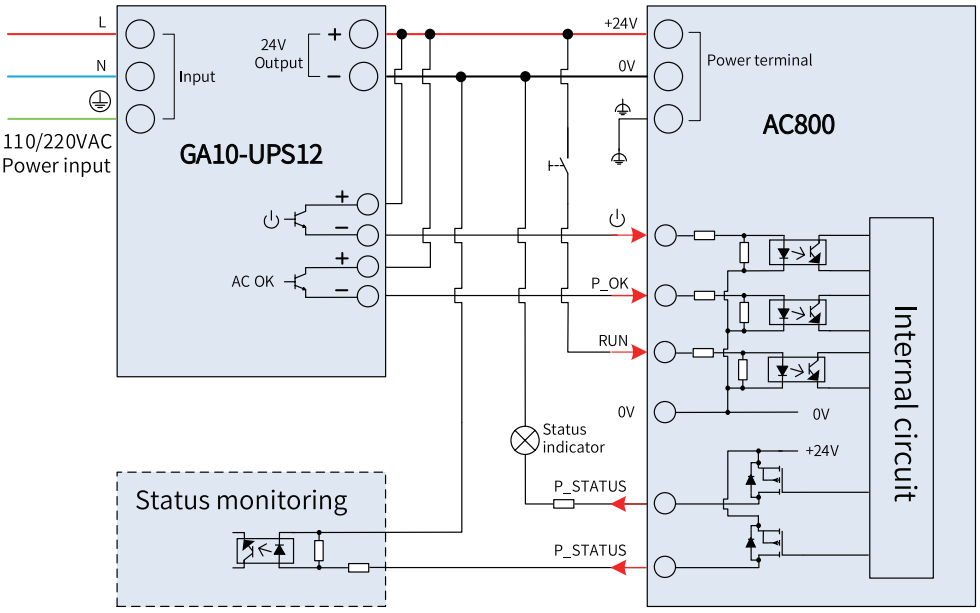



Figure 4-7 UPS connection

### *Note*

The power failure detection signal P_OK, common input terminal and remote start signal terminals must be connected according to the preceding figure. For other state signal terminals, connect them as required.

Wiring of P_OK power failure detection signal: See the above figure. When a power failure occurs, the signal turns from ON to OFF, and the PLC saves data and shuts down.

Wiring of power-on signal: If a power failure occurs, take measures according to the following situations:

- If the power is recovered before the UPS runs out of power, press the power button on the PLC to turn it on. If the PLC is installed inside the cabinet and its power button is inconvenient to operate, it is recommended to connect the 24V power supply to the signal via a non-latching button, enabling PLC startup through operating this non-latching button.
- If the power is recovered after the UPS runs out of power, the UPS charging signal will be sent to the PLC, at which point the PLC will automatically start up.

## 4.3.3 RS485 Bus Wiring Instructions

The RS485 bus connection topology is shown in the figure below. It is recommended to use shielded twisted-pair cables for RS485 bus connection and twisted pairs for RS485+ and RS485- connection. Install a termination resistor with the resistance of 120 Ω at both ends of the bus to prevent signal reflection. Connect the reference grounds of RS485 signals for all nodes together. A maximum of 32 nodes is supported and the distance between the node and the RS485 bus must be less than 3 m.

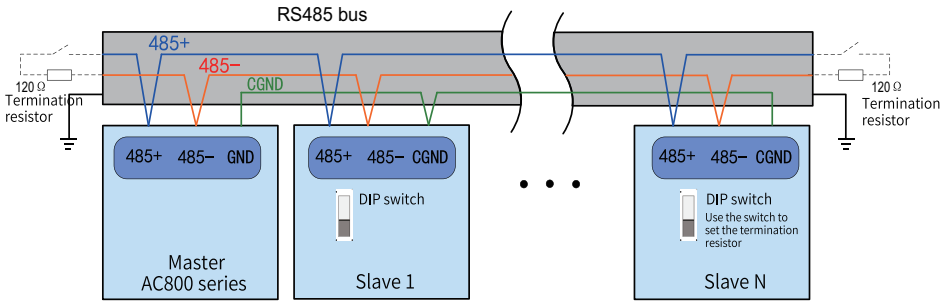



Figure 4-8 RS485 communication connection

### Multi-node connection

In case of a large number of nodes, connect the RS485 bus using the daisy chain mode. If branches need to be connected, keep the cable length between the bus and the node as short as possible, preferably not exceeding 3 m. Star connections are prohibited. Common bus structures are shown in the following figures.

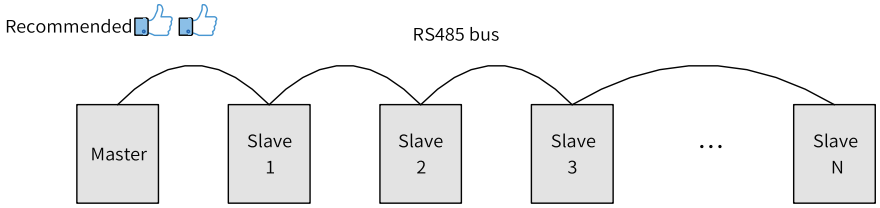



Figure 4-9 Daisy chain connection mode

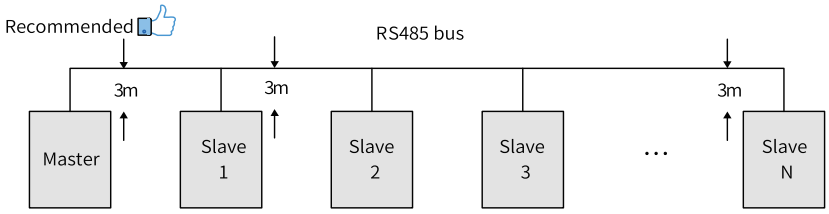



Figure 4-10 Branch connection structure

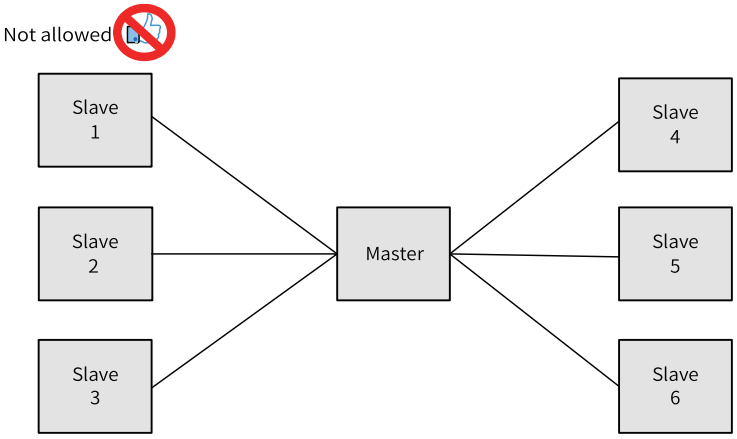
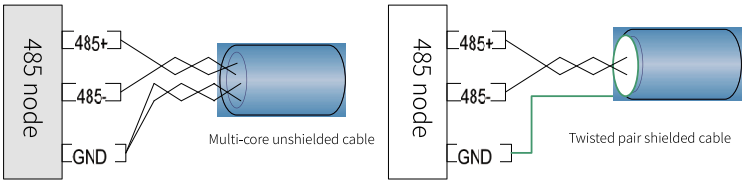



Figure 4-11 Star connection structure (wrong)

## Terminal wiring

The controller provides three terminals (485+, 485- and GND) for RS485 communication. Ensure that the RS485 bus contains three cables, and the terminals are connected correctly. If you are using shielded cables, the shielding layer must be connected to the GND terminal, rather than any other location (including housings and equipment ground terminals).

Due to cable attenuation, use AWG26 or thicker cables for connection longer than 3 m. Twisted pair cables are always recommended for connecting RS485+ and RS485- terminals.




a. Multicore unshielded cable b. Shielded twisted pair

Figure 4-12 Terminal wiring diagram

- Recommended cable 1: Use multi-conductor twisted pair cables, with one twisted pair connected to 485+ and 485-, and others twisted together to connect GND.
- Recommended cable 2: Use shielded twisted pair cables, with the twisted pair connected to 485+ and 485-, and the shield layer connected to GND.

### *Note*

Particular attention must be paid to scenarios where shielded cables are used as connection wiring—the shielding layer should only be connected to GND and must not be connected to the site ground.

### 4.3.4 RS232 Bus Wiring Instructions

When you use an RS232 to RS485 converter, it is recommended that you use an external power supply to power the converter. If the external power supply is unavailable, the baud rate should not exceed 9.6 kbps.

## 4.4 Wiring of Network Ports

### 4.4.1 Network Port Specifications

The AC800 series controller provides four gigabit Ethernet ports, which are described as follows:

| No. | Port | Function |
|---|---|---|
| 1 | LAN A | Programming port (used for downloading and monitoring), Modbus TCP, EtherNet/IP, OPC UA communication port |
| 2 | LAN B | Modbus TCP, EtherNet/IP, OPC UA communication port |
| 3 | LAN C | The EtherCAT master network port supports a communication rate of only 100M when used as an EtherCAT network port. |
| 4 | LAN D | |

***Note***

The IP addresses of LAN A and LAN B ports must not be within the same subnet.

#### Gigabit Ethernet specifications

- Supports 2x standard Ethernet interfaces.
- Supported protocols: Modbus TCP, EtherNet/IP, OPC UA.

The Modbus TCP communication specifications are as follows in the table.

| Item | Specification |
|---|---|
| Station number | 1 to 247 |
| Communication rate | 10M/100M/1000M adaptive |
| Data length | 8 bits |
| Parity check bit | None/Odd/Even |
| Stop bit | 1, 2 |
| Max. number of stations | 64 |
| Special functions | Diagnostic function |

The OPC UA communication specifications are as follows in the table.

| Item | Specification |
|---|---|
| Security policy | - |
| User authentication | Anonymous |
| Server port | 4840 |
| Session timeout (s) | 5 to 600,000 |
| Sampling interval (ms) | 100, 300, 500, 1,000, 2,500, 5,000 |
| Publish interval (ms) | 200 to 20,000,000 |

| Item | Specification |
|---|---|
| Maximum number of sessions | 50 |
| Maximum number of subscriptions per server | 200 |
| Maximum number of monitored nodes per server | 20,000 |
| Maximum number of subscriptions per session | 50 |
| Maximum number of monitored nodes per subscription | 10,000 |
| Maximum number of nodes for single-frame read/write | 1,000 |

### EtherCAT communication specifications

The LAN C and LAN D interfaces support EtherCAT communication, with specific specifications as described in the following table:

| Item | Specification |
|---|---|
| Communication Protocol | EtherCAT protocol |
| Supported services | FoE, CoE (PDO, SDO) |
| Min. synchronization period of the 12-axis cam | 500 μs (typical) |
| Max. sync jitter | ±40 μs |
| Max. axes | 256 |
| Synchronization mode | The servo comes with a distributed clock for synchronized inputs and outputs. |
| Physical layer | 100BASE-TX |
| Baud rate | 100 Mbps (100Base-TX) |
| Duplex mode | Full duplex |
| Topology | Ring |
| Transmission medium | Network cable, see cable specifications in the following section |
| Transmission distance | Less than 100 m between two nodes |
| Number of slaves | 256 |
| EtherCAT frame length | 44 bytes to 1,498 bytes |
| Process Data | Max. 1,486 bytes per Ethernet frame |
| Synchronous jitter of two slaves | < 1 μs |
| Refresh time | About 30 μs for 1,000 digital inputs and outputs<br>About 100 us for 32 servo axes |
| DLR function | Supported by AC801, not supported by AC802/AC810/AC812 |
| Automatic scanning function | Supported |

## 4.4.2 Ethernet Wiring Instructions

### Networking

With the Ethernet port, the controller can be connected point-to-point with devices such as a computer and HMI through an Ethernet cable.

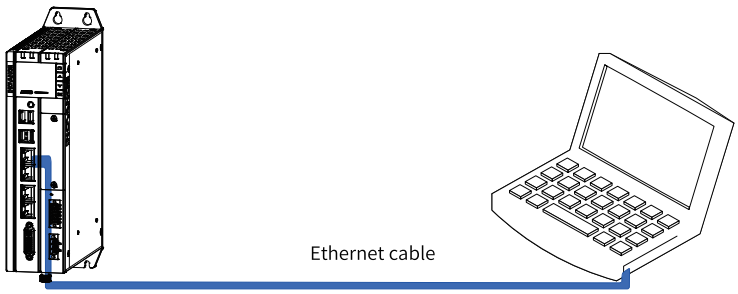



Figure 4-13 Connecting controller to PC

The controller can also be connected to a hub or switch, which is further connected with other network devices, through an Ethernet cable to achieve multi-point connection.

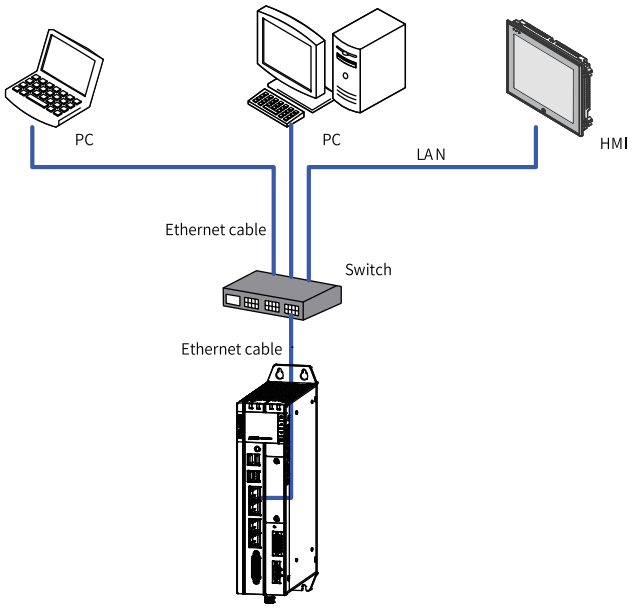



Figure 4-14 Connecting controller to other devices through switch

### 4.4.3 EtherCAT Wiring Instructions

With the EtherCAT port, the controller can be connected to various servo drives, slave modules or expansion modules that support EtherCAT communication.

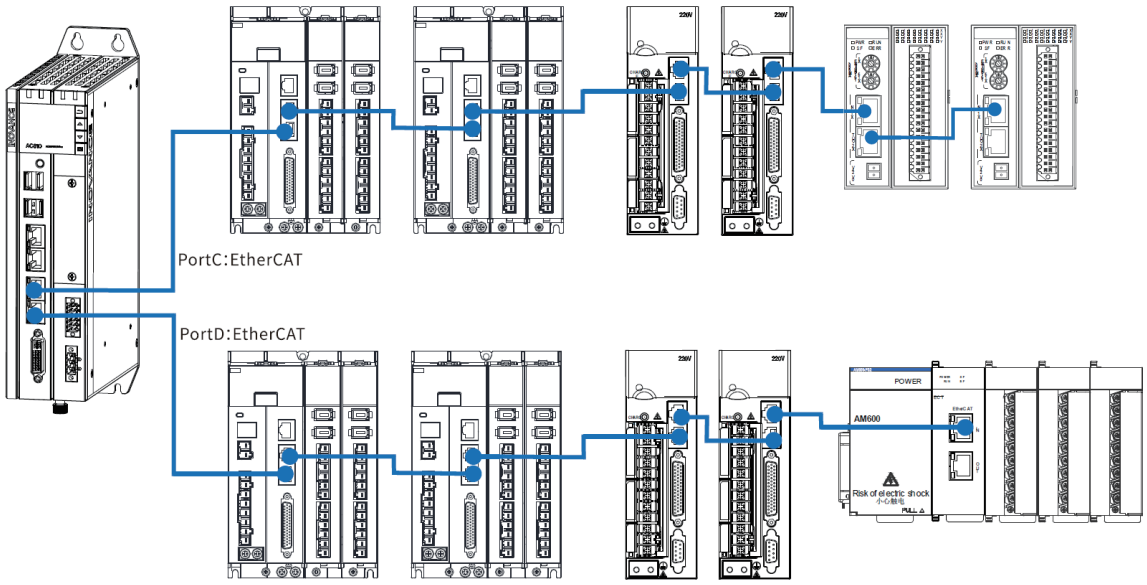



Figure 4-15 Connecting controller to other devices through EtherCAT port

### 4.4.4 Wiring Requirements of Communication Cables

#### Connection of RJ45 cable

Connection: Insert the cable into the RJ45 port of the communication module until you hear a click sound.

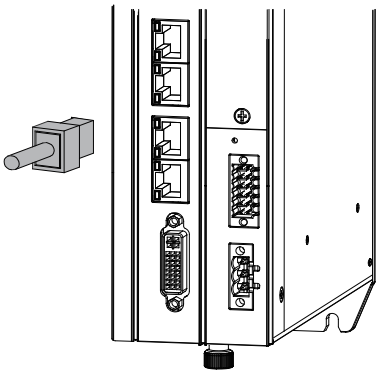


Figure 4-16 Connection of RJ45 cable

Removal: Press the tail of the registered jacket to pull out the connector.

#### Requirements on Ethernet cable

Use Cat 5e STP and injection cable with iron housing.

Figure 4-17 Requirements on Ethernet cable

| Unshielded cable | Shielded cable |
| --- | --- |
|  |  |

### Cable Preparation

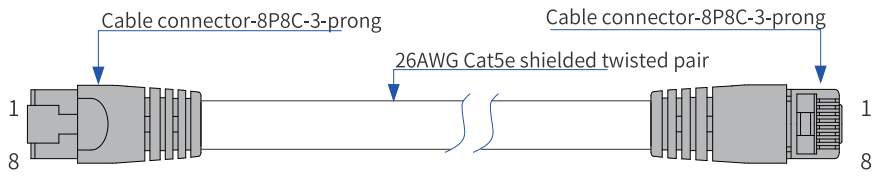



Figure 4-18 Requirement on the EtherCAT cable

### Signal pin assignment

| Pin | Signal (Ethernet 1,000 Mbps) | Signal Direction | Signal Description |
|---|---|---|---|
| 1 | TD+ | Output | Data transmission+ |
| 2 | TD- | Output | Data transmission- |
| 3 | RD+ | Input | Data reception + |
| 4 | –(DC+*) | –(bidirectional) | Unused (data C+) |
| 5 | –(DC-) | –(bidirectional) | Unused (data C+) |
| 6 | RD- | Input | Data reception - |
| 7 | –(DD+) | –(bidirectional) | Unused (data D+) |
| 8 | –(DD-) | –(bidirectional) | Unused (data D+) |

*Note: The definition of pins 4, 5, 7, and 8 under 1,000 Mbps differs from that under 100 Mbps. Pay attention to the information in parentheses.

- **Length requirements:**
  When an EtherCAT bus is used, the length of the cable between the devices must not exceed 100 meters. Exceeding this length will attenuate the signal and affect communication.
- **Technical requirements:**

  1. 100% continuity test without short circuit, open circuit, misalignment, or poor contact.
  2. The cable length is within the allowable tolerance range.

STP is used as EtherCAT bus for network data transmission. Cables with the following specifications are recommended:

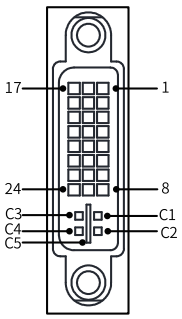
| Item | Specification |
|---|---|
| Cable type | Flexible crossover cable, S-FTP, Cat 5e |
| Standards compliance: | EIA/TIA568A, EN50173, ISO/IEC11801<br>EIA/TI Abulletin TSB, EIA/TIA SB40-A&TSB36 |
| Cross sectional area | AWG26 |
| Conductor type | Twisted pair |
| Number of pairs | 4 |

## 4.5 Display Interface

The controller provides a standard DVI-D display interface with the following specifications (no cable is provided):

| Item | Specification |
|---|---|
| Signal type | DVI-D (digital signal) |
| Interface type | 24+1 |
| Number of channels | Single-channel |
| Max. resolution | 1920 x 1200 @60 Hz |

The DVI-D interface is detailed in the following table:

| Illustration | Pin | Signal | Pin | Signal |
|---|---|---|---|---|
|  | 1 | TMDS data 2- | 13 | TMDS data 3+ |
| | 2 | TMDS data 2+ | 14 | +5 V DC power supply |
| | 3 | TMDS data 2/4 mask | 15 | GND (+5 V circuit) |
| | 4 | TMDS data 4- | 16 | Hot swapping detection |
| | 5 | TMDS data 4+ | 17 | TMDS data 0- |
| | 6 | DDC clock | 18 | TMDS data 0+ |
| | 7 | DDC data | 19 | TMDS data 0/5 mask |
| | 8 | Analog vertical synchronization | 20 | TMDS data 5- |
| | 9 | TMDS data 1- | 21 | TMDS data 5+ |
| | 10 | TMDS data 1+ | 22 | TMDS clock mask |
| | 11 | TMDS data 1/3 mask | 23 | TMDS clock+ |
| | 12 | TMDS data 3- | 24 | TMDS clock- |
| | C1 | Analog vertical synchronization | C4 | Analog horizontal synchronization |
| | C2 | Analog green | C5 | AGND (RGB circuit) |
| | C3 | Analog blue | - | - |

### *Note*

It is recommended to use a standard DVI-D cable. If your display does not provide a DVI-D interface, you can use a DVI to VGA converter.

## 4.6 USB Interface

The controller provides four USB ports: two USB2.0 ports (③ and ④ in the figure below), and two USB3.0 ports (① and ② in the figure below).

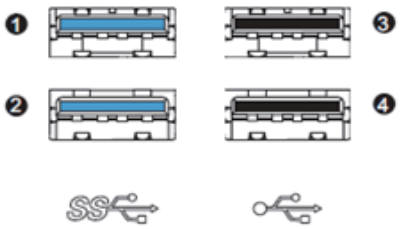



Figure 4-19 USB interface

The specifications of the USB ports are as follows:

| Item | USB2.0 | USB3.0 |
|---|---|---|
| Max. communication rate | 480Mbps | 5.0Gbps |
| Max. output current at 5 V | 500 mA | 900 mA |
| Max. communication distance | 5 m | 3 m |
| Isolation | Not supported | Not supported |

***Note***

- For industrial applications, select industry-level USB devices to ensure reliability.
- To prevent interference, avoid long distance connection and run the cable according to the routing specifications.
- If interference cannot be removed, install a magnetic ring at both ends of the communication cable to filter the interference.

# 4.7 Cable Selection and Preparation

## 4.7.1 Cable Selection

| Applicable Signal | Material Name | Applicable Cable Diameter | |
|---|---|---|---|
| | | $MM^2$ | AWG |
| Power signal cable | Pin type lug | 0.8-2.5 | 20-10 |
| User signal cable | Pin type lug | 0.2-1.5 | 24-16 |
| Grounding cable | Tubular lug | ⩾ 2 | ⩽ 14 |
| Ethernet cable | – | – | – |

## 4.7.2 Cable Preparation Requirements

### 1 Cable with pin type lug

Prepare a cable with a pin tye lug:

1. Strip back the wire outer coating by 6 mm.
2. Pass the cable through the tube of proper wire size.
3. Insert the exposed conductor into the hole of the cable lug, and then crimp it with recommended crimping tool.
4. Use a heat-shrinkable tube (Φ3) of 20 mm long to wrap the copper tube of a cable lug and then perform thermal shrinkage.
5. Insert the cable lug into the terminal block.

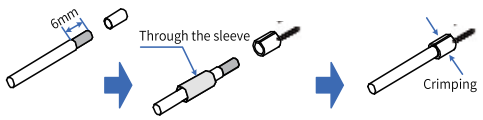



Figure 4-20 Preparing cable with pin type lug

## 2 Cable with tubular lug

Preparing a cable with a tubular lug:

1. Remove the insulation of the cable so that a length of 6 mm of the conductor is exposed. Then pass the cable through a cable marking tube.
2. Insert the exposed conductor into the hole of the cable lug, and then crimp it with recommended crimping tool.
3. Pass the cable lug through the terminal block and tighten it with a screwdriver. The maximum tightening torque is 0.45 N · m.

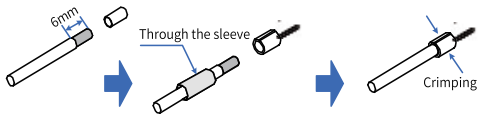
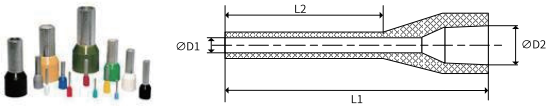



Figure 4-21 Preparing cable with tubular lug

For the 2*6-pin dual-row connector used for I/O and communication, the requirements are as follows:




| Category | Terminal Size | Length of Metal Part L2 | Strip Length |
|---|---|---|---|
| Tubular end with sheath (max. conductor OD: 2.6 mm) | 1.00 $mm^2$ [H1.0/18D] | 12 mm | 15 mm |
| | 0.75 $mm^2$ [H0.75/18D] | 12 mm | 14 mm |
| | 0.50 $mm^2$ [H0.5/16D] | 10 mm | 12 mm |
| | 0.34 $mm^2$ [H0.34/12D] | 8 mm | 10 mm |
| | 0.25 $mm^2$ [H0.25/12D] | 8 mm | 10 mm |
| Naked end | 1.50 $mm^2$ [H1.5/10D] | 10 mm | 10 mm |
| Tubular end with sheath (crimped with two conductors) | 2 x 0.20 $mm^2$ [H0.5/16D] | 10 mm | 12 mm |
| | 2 x 0.34 $mm^2$ [H0.5/16D] | 12 mm | 15 mm |

# 5 Operation Instructions

## 5.1 Power-On

### 5.1.1 Safety Precautions

| Safety Precautions |
| --- |
|  <br>• Do not touch the terminal when the power is on. Failure to comply may result in electric shock.<br>• Do not disassemble this product. Especially when the power is on or shortly after the power is turned off. Because high voltage can be generated by the voltage boost inside the power supply, which may cause electric shock. In addition, internal sharp parts and high temperatures may cause injuries. |
|  <br>It takes about 15 to 25 or 70 to 80 seconds from power-on to entering the operating mode. During this period, the output remains OFF or a value corresponding to module/slave settings, and external communication is unavailable. To avoid malfunction of external devices, you should construct a fail-safe circuit with "Output during Operation" of the power supply unit. |

### 5.1.2 PLC Startup

The PLC becomes operable after the following time since power-on. Before the PLC enters the operating status, the RUN LED indicator is off.

PLC startup time after power-on:

- If the programming port (enp1s0) is set to a static IP address, it takes about 15 to 25 seconds for the PLC to enter operating mode.
- If the programming port (enp1s0) is set to a DHCP-assigned address, but no DHCP server or network connection is available, it takes about 70 to 80 seconds for the PLC to enter operating mode.

***Note***

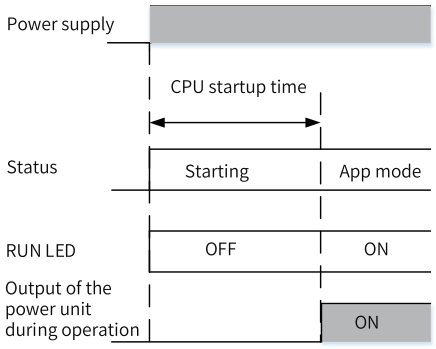
1. Some EtherCAT slaves allow you to set the maximum waiting time (1s to 200s), but the PLC only becomes operable when the EtherCAT master starts operation, regardless of the waiting time.
2. The EtherCAT master function module treats a slave that has not been activated within the maximum waiting time as an error.

### 5.1.3 Operations when PLC becomes Operable

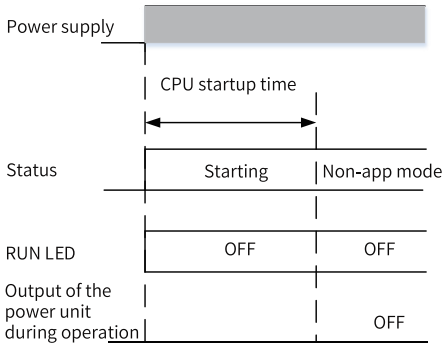
If there is an app when the PLC becomes operable, the PLC enters operating status immediately. You can also change the default setting to make the PLC to enter stop status instead. If the operation mode

of the user program (App) is "NO-APP" when the power is on, the PLC immediately enters No-APP state.

· App mode




· Non-app mode




# 5.2 Power-Off

## 5.2.1 Safety Precautions

| Safety Precautions |
| --- |
| Warning<br>• The AC800 series controller will continue to operate normally for a certain period of time when an instantaneous power failure occurs, so it may receive error signals from external devices affected by the instantaneous power failure.<br>• Take fail-safe measures externally and monitor the power supply voltage on the external device side as necessary, and also take safety measures in the user program. |

As shown in the following table, the power-off detection time may vary depending on the power supply type.

### Power-off voltage

| UPS code | Power supply input | Power-off voltage |
| --- | --- | --- |
| 72030025 | 24 VDC | Below 22.5 V |

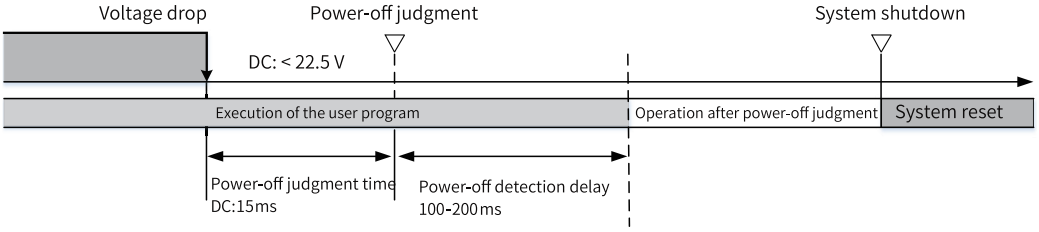
### Power supply type

| Power supply type | Power-off detection time |
| --- | --- |
| Non-UPS | Power off immediately |
| UPS | 15 ms |

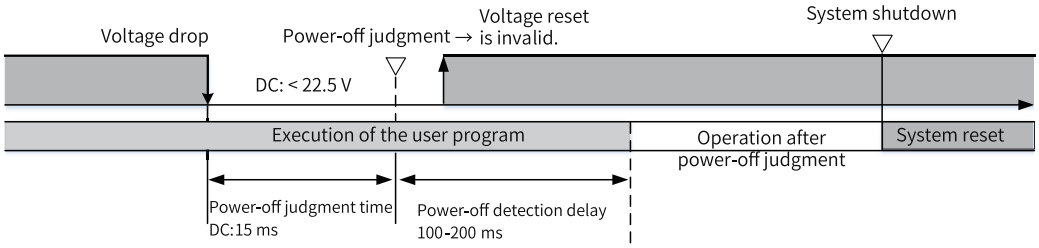
## 5.2.2 Operations at Power-Off

When the power is off due to exceeding the following power-off detection time, the user program will be terminated. The PLC will be stopped when the process after power-off detection are performed (described below).

| Power supply type | Instantaneous power-off time at power-off |
|---|---|
| Non-UPS | Power off immediately |
| UPS | Above 15 ms |




After the power-off detection time, even if the voltage is reset, the PLC still stops running, as shown in the following figure:



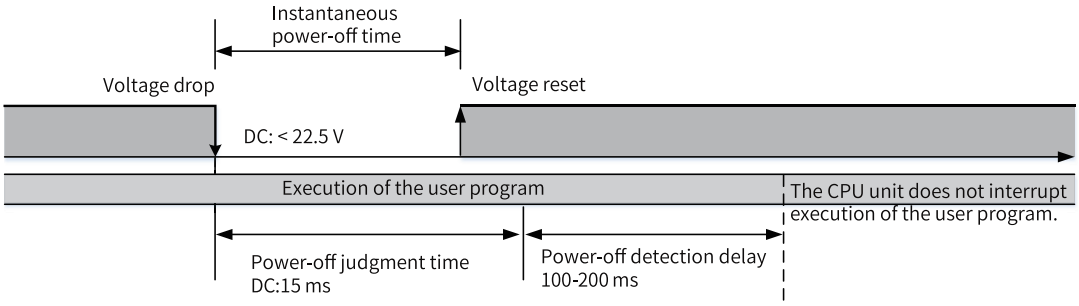

The times in the above figure are described as follows:

| Item | Description |
|---|---|
| Power-off detection time | The period from the time when the power supply voltage drops to the time when the UPS power supply detects that the power supply is off. Before it is determined that the power supply is off, the PLC continues to operate. |
| Power-off detection delay | The period from the time when the UPS detects that the power supply is off to the time when the PLC starts to process after power-off detection. |

## 5.2.3 Operations at Instantaneous Power-off

When an instantaneous power-off occurs within the following time, the user program will continue to execute.

| Power supply type | Time before Power-off |
|---|---|
| Non-UPS | Power off immediately |
| UPS | Below 15 ms |



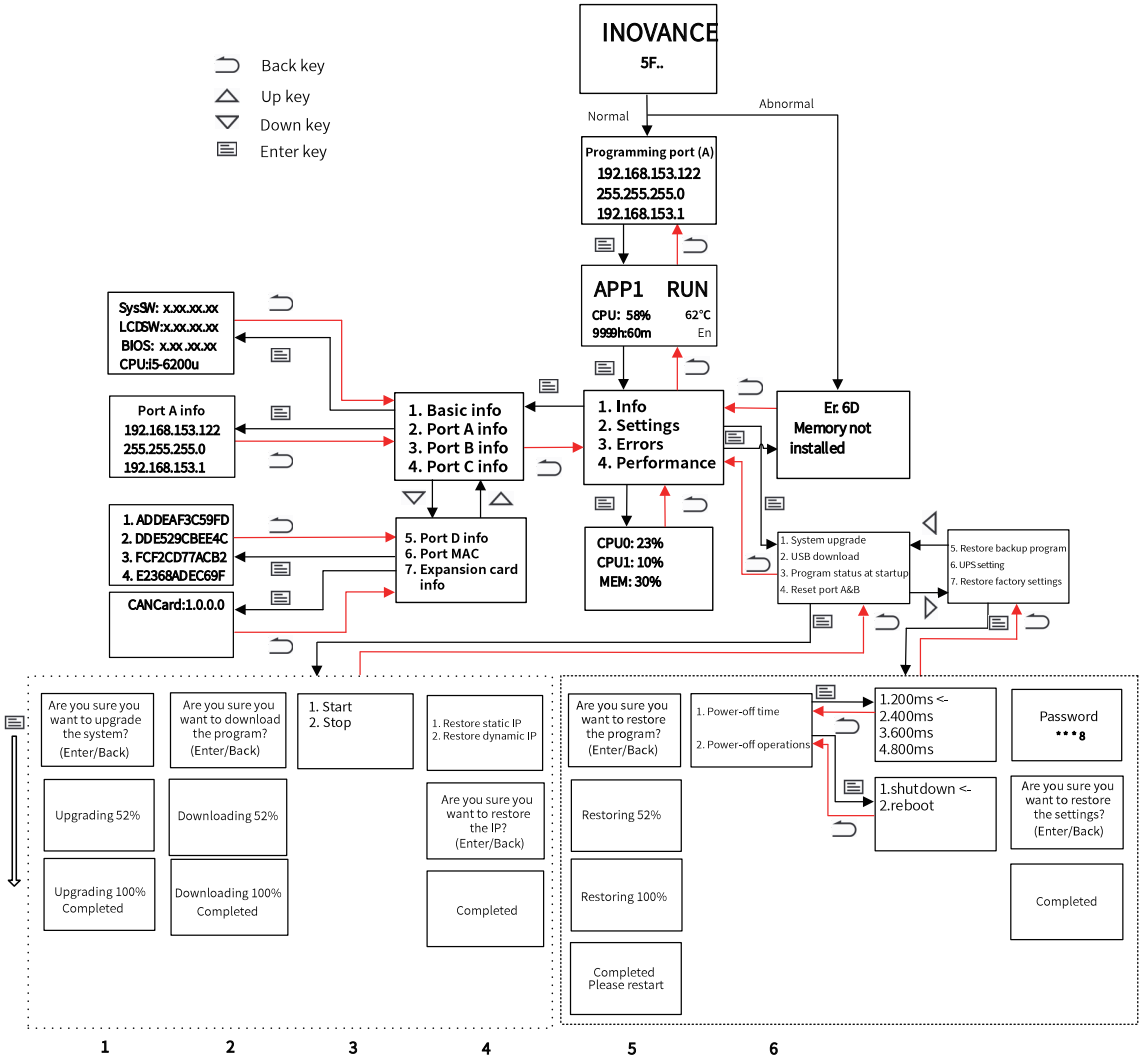

## 5.2.4 Processing after Power-off Detection

If the UPS determines that the power supply is off, it notifies the PLC through I/O to perform the following processes before the PLC stops.

| Item | | Contents |
|---|---|---|
| Processing | Transferring user program<br>(Including online editing) | The transfer is terminated. The controller will be in a no-app state at the next power-on, waiting for the user application program to be downloaded. |
| | Executing user program | The instruction execution is terminated, and the data is saved in the hard drive via power failure retention. |

# 5.3 Display

## 5.3.1 Menus




After the PLC is turned on, the BIOS starts and the main page, which includes the Inovance logo and self-test codes, displays.

- If no error occurs, you will see the programming interface page.
- If any error occurs, the error code and detailed error information will display (see section *"8.1 Appendix 1 Process Codes and Error Codes During BIOS Startup" on page 60* for details).

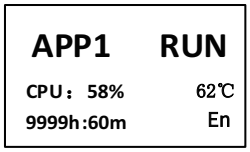
**Programming interface page:** Displays network information for the programming port (Port A, Ethernet). Use this information to establish a connection to Port A for PLC configuration, program downloads, and other operations. Press "Enter" or wait 30 seconds, to return to the main page.

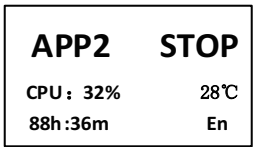
### *Note*

To prevent endless loop caused by improper programming, you can force the application program not to run at next PLC startup by pressing the combination key "Back" + "Enter", +, in the programming interface page. (see section *"8.2 Appendix 2 Controller Related Error Codes" on page 62* for details).

### 5.3.2 Main Page

The main page is the most frequently used page when the PLC is running. It is used to display the current status parameters of the PLC, including the application running status (such as "APP1 RUN"), the total CPU occupancy rate, temperature, the operation duration and the current system language.

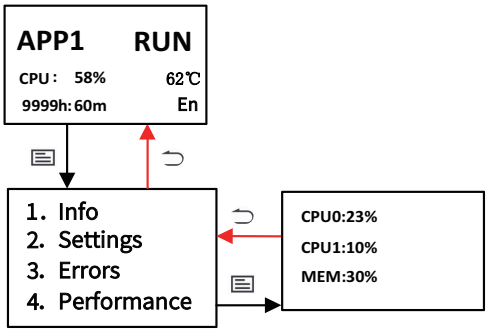



You can check the running status of multiple applications by pressing the "Up" and "Down" keys.

- Long press the Enter key for 3 seconds to switch the system language
- Press Enter to enter the "Main Menu" interface

Note: Through "Main Menu"-"Performance", you can also view the individual occupancy rate of each CPU core and memory occupancy (see section "4 Performance" in *"5.3.3 Main Menu" on page 46* for details).




### 5.3.3 Main Menu

#### 1 Info

The "Info" menu provides basic information such as PLC related version numbers and the CPU model, as well as information about each network port:

1. Basic Information

| Category | Description | Display |
|---|---|---|
| SysSW | Board software version | SysSW: 1.10.40.0<br>LCDSW: 1.0.20.0<br>BIOS: 5.12.0.3<br>CPU: i5- 6200u |
| LCDSW | Display software version | |
| BIOS | BIOS version | |
| CPU | CPU Model | |

2. Network port information

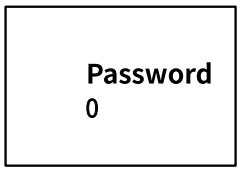
| Network port screenprint | Description | Network port information | Physical address[Note] | Remark |
|---|---|---|---|---|
| LAN A | Ethernet | Port A Info<br>192.168.153.122<br>255.255.255.0<br>192.168.153.1 | 1. ADDEAF3C59FD<br>2. DDE529CBEE4C<br>3. FCF2CD77ACB2<br>4. E2368ADEC69F | Factory recovery is supported. See "2 Settings (5)" in section *"5.3.3 Main Menu" on page 46* for details. |
| LAN B | | | | – |
| LAN C | EtherCAT | | | – |
| LAN D | | | | |

Note: The physical address of each network port can be viewed through "Network Port MAC".

## 2 Settings

1. Password

The Settings menu contains high permission level operations on the PLC. If no password is set through the InoProShop tool (see Help Document in InoProShop for details) or if the password is set as "0000" (regarded as no password), you can directly access the Settings menu to perform corresponding operations. If you have set a valid 4-digit password through the InoProShop tool, you will be prompted to enter the password when entering the submenu of Settings.





**Password page**

- After you enter the password page, the first digit of the password, which is 0, flashes. Press the Up/ Down keys to cycle through digits from 0 to 9.
- When you get the desired digit, press "Enter" to input the digit.
- Every time one digit is input, the focus will move to the next input field. Enter the digits in sequence to input the whole password.
- You cannot backspace any input digit because no such function is provided. You have to press the Back key to return to the previous menu, and then press the Enter key to re-enter the password page.

**Entering the password**

- The digit that you are currently inputing will be displayed in plain text. After pressing Enter, the digits will be ciphered.
- After you input the last digit and press Enter, if the password is wrong, all digits will be cleared you have to re-enter the password.
- If the password is correct, press Enter to enter the next menu.

### *Note*

Within 5 minutes after entering the correct password, you will enter the menu that requires permission without prompting for the password again. After 5 minutes or when the password is changed, you will be prompted to enter the password again when you re-enter the menu that requires permission.

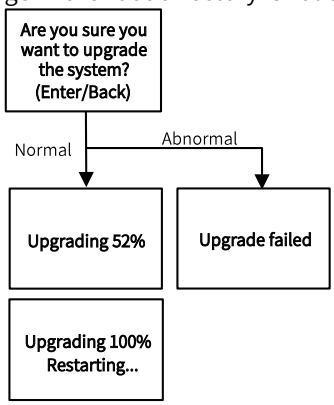
2. System upgrade

You can use the System Upgrade menu to upgrade the PLC system. After the upgrade is successful, you can view the current version information through Information-Basic Information menu.

Insert the USB drive containing the system upgrade package into any USB interface of the PLC, and select the System Upgrade menu to upgrade the system as instructed. When the upgrade progress reaches 100%, the PLC restarts. If any error occurs during upgrade, an "upgrade failed" message displays.

**Requirements for upgrade**

- a. A USB drive containing the system upgrade package provided by the manufacturer.
- b. The upgrade package is in the root directory of the USB drive (if there are multiple upgrade packages, only the upgrade package in the root directory is valid).




## *Note*

1. The system will be upgrade in an exclusive mode, that is, all key operations are temporarily disabled until the upgrade is successful or fails.
2. USB upgrade and InoProShop tool upgrade cannot be performed at the same time. If you start the system upgrade through the USB drive first, and then perform the upgrade again with the InoProShop tool, the tool will prompt "Firmware is being updated". If you start the system upgrade through the InoProShop tool first, and then perform the upgrade again through the USB drive, the display will prompt "Software tool is upgrading the system, please try again later."

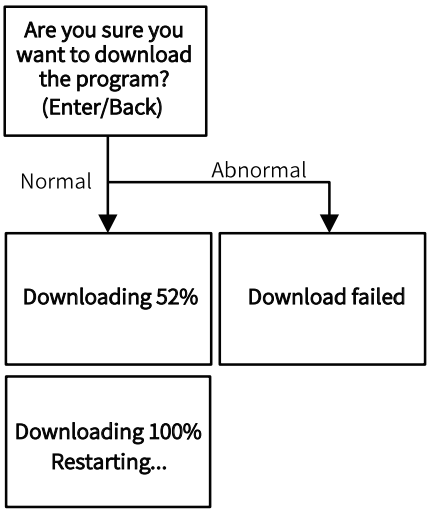
3. Download USB program

You can use the Download USB Program menu to download the application package in the USB drive and replace the application in PLC.

Insert the USB drive containing the application package into any USB interface of the PLC, and enter the "Download USB program" menu to download the program as instructed. When the download progress reaches 100%, a "download successful" message displays. If any error occurs during upgrade, a "download failed" message displays.

**Requirements for download**

- a. The USB drive contains the application package named Application.userprg, which is packaged and generated by InoProShop.
- b. The application package is in the root directory of the USB drive (if there are multiple packages, only the package in the root directory is valid).



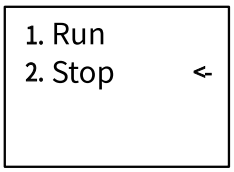

## *Note*

1. The program download is performed in an exclusive mode, that is, all key operations are temporarily disabled until the download is successful or fails.
2. USB download and InoProShop tool download cannot be performed at the same time. If you download the program through a USB drive first, and then perform the download again with the InoProShop tool, the tool will prompt "USB drive is updating firmware or downloading application program". If you download the program through InoProShop first, and then perform the download again through the USB drive, the display will prompt "Software tool is downloading program, please try again later".

4. Program status at startup

   You can use the Program Status at Startup menu to set the status of the application program at the next PLC startup (the factory default is "1. Run program at startup").

   Select this menu to enter the setting page. "<-" indicates the default startup status of the application program set in the PLC. Use the Up and Down keys to select the status, and press the Enter key to confirm the selection. After the setting is completed, "<-" will move to the selected item. If there are multiple applications in the PLC, this operation will take effect for all of them.




**Error handling**

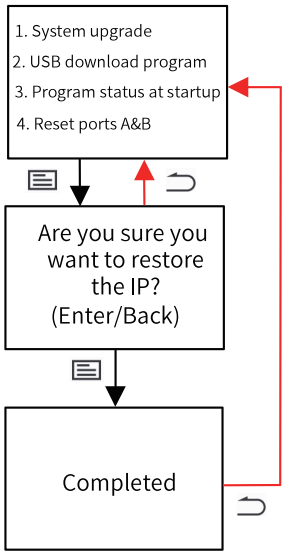
If any error occurs, the screen will show the error code in most cases. See section 5.3.3.3 Errors for details. If the screen does not show the error code and does not repond to any key operation, the PC may be freezing due to, for example, an infinite loop in the application. You can terminate and delete the application.

Operating procedure:

a. 1. Press Back+Enter for 5s at the startup screen to set "Program status at startup" to "Stop".
b. 2. Reset the equipment through InoProShop (see Medium Size PLC Programming Software User Guide) and download the correct application.

5. Reset network ports A and B

You can use Reset Network Ports A and B to restore the network ports A and B to the default IP or dynamic IP (as shown in the figure below). After the restoration is done, by setting the PC to the same network segment as the PLC, you can connect to and operate the PLC through a cable (For example, you can connect to port A by setting the PC to 192.168.1.X, and to port B by setting PC to 192.168.2.X).

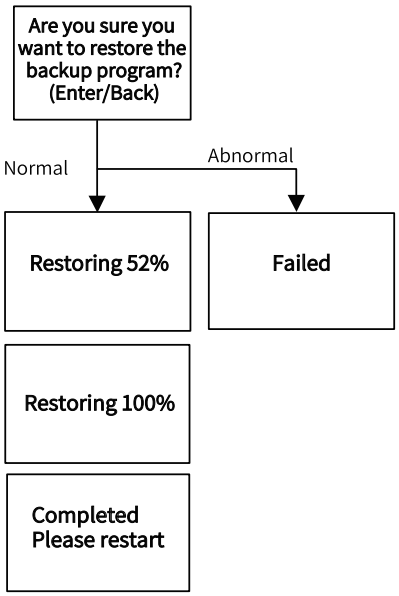



The network port information is shown in following table:

| Network port screenprint | LAN A | LAN B |
|---|---|---|
| Ex-factory information | **Port A Info**<br>192.168.1.88<br>255.255.255.0<br>192.168.11 | **Port B Info**<br>192.168.2.88<br>255.255.255.0<br>0. 0. 0. 0 |

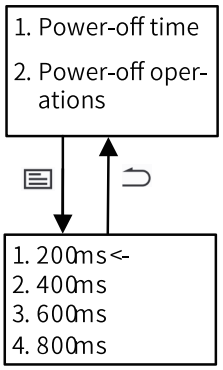
6. Restore backup program

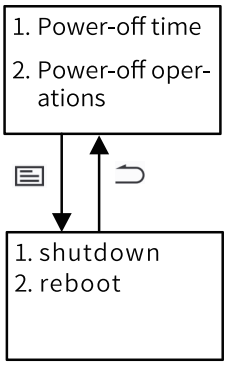
You can use Restore Backup Program to restore the APP to the latest backup program, no matter if it is online-modified or downloaded. The latest one is determined according to the modification time. The detailed procedure is as follows. After the restoration is done, restart the controller so that the latest back program can be applied to the APP.




7. UPS setting

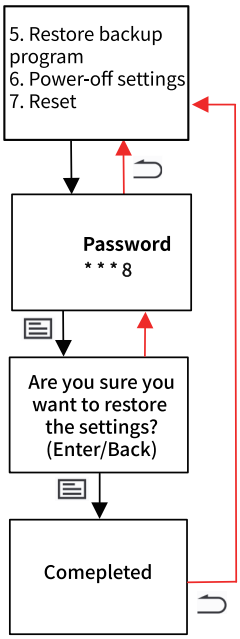
You can use the UPS Settings menu to set the UPS power-off time and power-off operation. You can set the power-off time to 200 ms, 400 ms, 600 ms, or 800 ms, and set the power-off operation to restart or shutdown.




8. Restore default settings

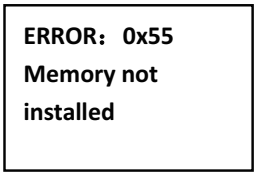
You can use the Restore Default Settings menu to restore the PLC to default settings, clear user password and application programs.




## 3 Errors

**Startup error**

After the PLC starts, it performs the BIOS self-test and displays the Inovance logo and self-test codes. If an error is detected during the self-test, you will be led to the error page, which shows the error code and detailed information (for details, see Appendix I).


If an error occurs during startup, see Appendix I or contact the manufacturer for support.

**BIOS error**

The display stays on the startup interface and displays the Inovance logo, which is caused by two errors that may occur during BIOS startup:

- After the self-test codes are sent, the system fails to be loaded. The display stays on the startup interface, showing the Inovance logo and self-test codes. After two minutes, the "Er.A1 Failed to switch BIOS to OS" message displays. You can return to the startup interface by pressing the Back key.
- No self-test code is sent when the BIOS starts. The display stays on the startup interface, showing the Inovance logo and self-test codes. After one minute, the "Er.A2 No BIOS data was received" message displays to warn the user that the BIOS self-test codes have not been sent. You can return to the startup interface by pressing the Back key.

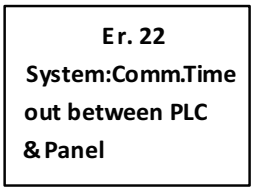
**Program and system error**

- Error window

When the display stays on the programming interface page or the main page, if an error occurs in the program or system, the screen will show the error code and detailed information. You can return to the previous interface through the Back key. If there are multiple errors, you can use the Up and Down keys to view the full information of an error, and use the Enter key to display the next error.

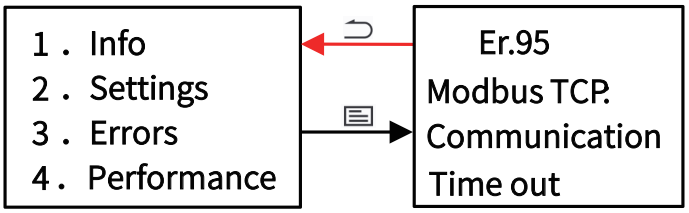
### *Note*

Special error Er.22 indicates that the communication between the display and the PLC is disconnected. It is due to system crash or communication timeout between the screen and board daemon process caused by an endless loop in an application program. In this case, the display cannot obtain and display PLC information, and cannot be operated by keys. The user can restart the computer and use the key combination Back+Enter on the programming interface page to forcibly modify the APP's next startup status to "stop". When the error is removed, the error information will be cleared.




Errors menu

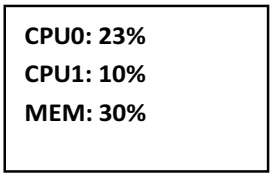
You can view the detailed information of current errors of the PLC through the Errors menu. If there are multiple errors, you can use the "Up" and "Down" keys to view the full information of an error, and use the Enter key to switch to the next error (for details, see *"8.1 Appendix 1 Process Codes and Error Codes During BIOS Startup" on page 60*).




If the PLC is free from any error, it will display "NO ERROR!!".


## 4 Performance

You can use the Performance menu to view the status parameters related to PLC performance, including the CPU core occupancy rate and memory occupancy rate.



### 5.3.4 Page Switchover

When you switch pages on the display panel:

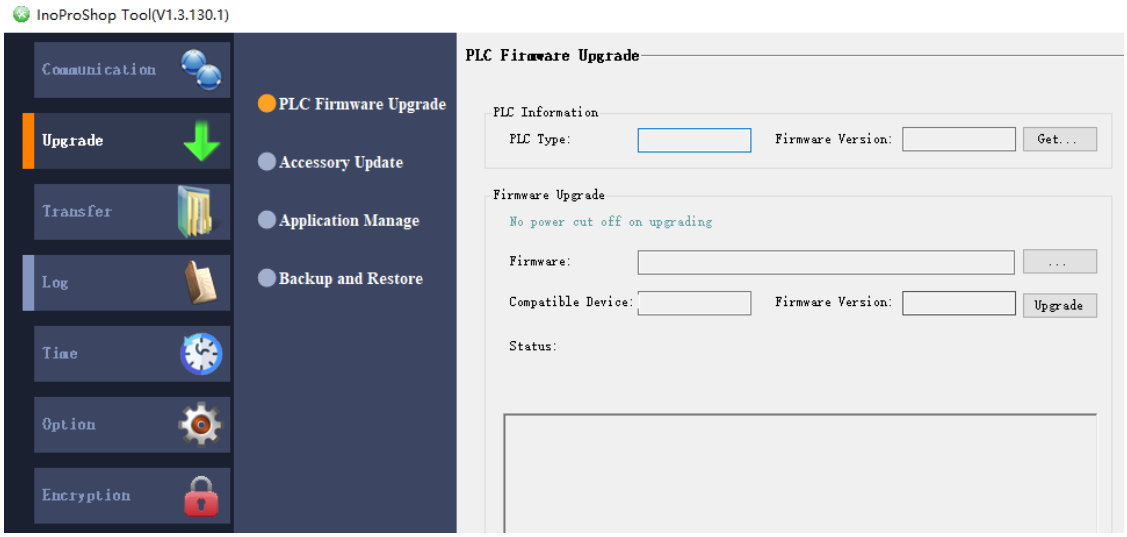
1. The screen will automatically turn off if there is no key operation for 15 minutes (the screen will not turn off when there is an error window). When the screen is off, press any key to wake up the screen.
2. The programming interface page displays for 30 seconds before switching to the active page.
3. Apart from the programming interface page and error page, if you stay on a page for 2 minutes without pressing any key, the screen will switch to the active page.
4. When you insert a USB drive and it is correctly recognized by the system, the display will directly switch to the Settings menu, which is convenient for further operations. However, this does not apply to an interactive page (a page related to upgrade, download, password input, and network port recovery).

## 5.4 System Upgrade

The PLC system can be upgraded in the following two ways.

1. InoProShop

   You can connect to the PLC with the InoProShop tool and select the PLC firmware upgrade package and accessory firmware upgrade package provided by the manufacturer to upgrade the PLC (see InoProShop User Guide for details).




2. USB drive

   You can upgrade the PLC by inserting a USB flash drive on the PLC and carry out the upgrade procedure on the display (see (3) Download USB program in 2 Settings in section 5.3.2).

# 6 Programming and Debugging

For the programming and debugging process, see *Medium-Sized PLC Programming Software User Guide*, *Medium-Sized PLC Programming Guide (Motion Control)*, and *Medium-Sized PLC Programming Instructions*.

# 7 Maintenance

## 7.1 Periodical Maintenance and Inspection

### Regular Checklist

| No. | Item | Description | Criteria | Process |
|---|---|---|---|---|
| 1 | Power supply | Measure the power terminal block and check that the voltage change is within the allowed range. | 24 VDC (-20% to +20%) | Use a multimeter to measure the terminals, and control the supply voltage within the allowable range. |
| 2 | Ambient environment | Check that the ambient temperature is suitable (when the controller is in a cabinet, the temperature in the cabinet is the ambient temperature). | -5°C to 55°C | Use a thermometer to measure the ambient temperature and control the ambient temperature within the range of 0°C to +55°C. |
| | | Check that the ambient humidity is suitable (when used inside the cabinet, the cabinet humidity is considered the ambient humidity). | 10% RH to 90% RH, without condensation | Use a hygrometer to measure the ambient humidity control the ambient humidity within 10% to 90% RH. If the temperature changes drastically, check for condensation. |
| | | Direct sunlight | Not allowed | Provide a shelter. |
| | | Dust, dirt, salt, and iron filings | Not allowed | Remove them and provide a shelter. |
| | | Droplets of water, oil, and chemicals | Not allowed | Remove them and provide a shelter. |
| | | Corrosive gas or flammable gas | Not allowed | Use an odor or gas sensor for detection. |
| | | Vibration or shock to the controller | The vibration and shock resistance should meet relevant requirements. | Install cushioning materials for vibration and shock resistance. |
| | | Interference sources | Not allowed | Keep the controller away from any interference sources or take shielding measures. |
| 3 | Installation and wiring | Check that cable connectors are fully inserted and locked. | Looseness is not allowed. | Fully insert the connector and lock it with screws. |
| | | Check that external wiring screws are securely fastened. | Looseness is not allowed. | Use a Phillips screwdriver to tighten the screws. |
| | | Check that external wiring terminals are properly distanced. | Ensure a proper distance between terminals. | Check the distance visually and correct any improper distance. |
| | | Check for broken external cables. | Broken external cables are not allowed. | Check cables visually and replace broken cables (if any). |

| No. | Item | Description | Criteria | Process |
|---|---|---|---|---|
| 4 | Real-time clock battery (button battery) | Check that the shelf life or service life does not expire. | No "battery voltage low" alarm is displayed on the controller. | The shelf life of the battery at 25°C is 5 years, and its service life is generally 0.75 to 5 years, depending on the model and ambient temperature. If this predefined period is exceeded, replace the battery no matter if it can still work normally or not. For the replacement method, see section *"3.4 Installation and Removal of the Battery" on page 23*. |
| 5 | Cooling fan | Check that the shelf life or service life does not expire. | No "Fan is abnormal" alarm on the controller. | The design life of the fan at 40°C is 70,000 hours, and its service life varies with the ambient temperature. If the predefined period is exceeded, replace the fan no matter if it can still work normally or not. For the replacement method, see section *"3.3 Installation and Removal of the Fan" on page 23*. |

### Tools needed

- Phillips screwdriver
- Multimeter or digital meter
- Industrial alcohol and cotton cloth
- Pliers

### Measuring instruments required for different occasions

- Oscilloscope
- Thermometer, humidity meter

## 7.2 Maintenance of the Battery

### Purpose of the battery

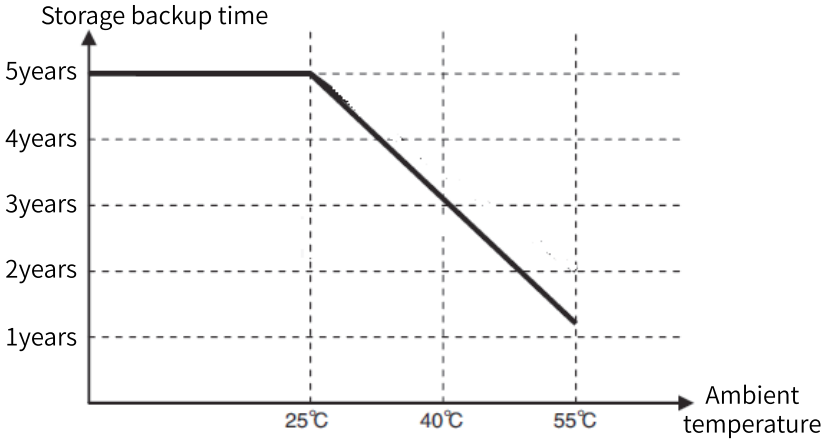
A battery is required for the RTC timing of the clock in the controller and for keeping the CMOS data when the power is off. If the battery is not installed or the battery is depleted, the clock will stop timing, and the BIOS CMOS data will be lost when the power is off.

### Battery life and replacement interval

The actual life of the battery is related to the application scenario of the controller. The curve below shows the longest life and is for reference only.

When the controller prompts that the battery is abnormal, replace the battery in time to ensure that the clock function of the controller is normal.

When a time deviation is found, check the battery voltage and replace the battery in time.



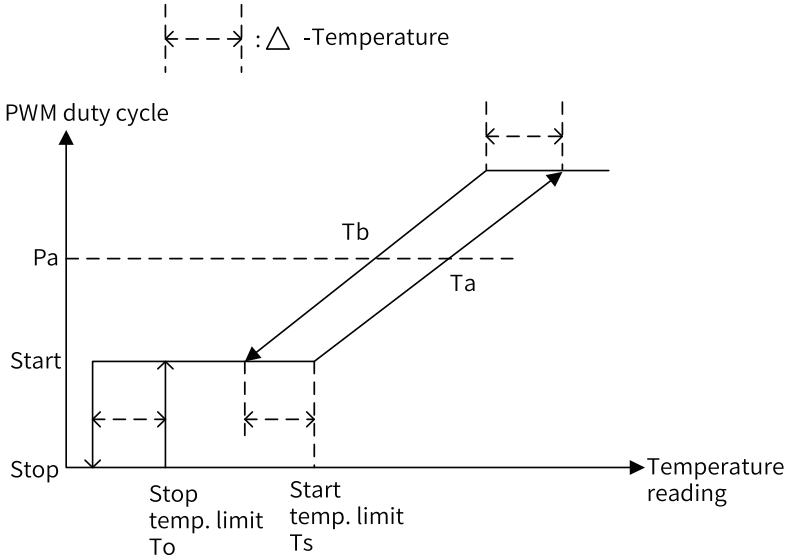

* The storage backup time in the figure is for reference.

## 7.3 Maintenance of the Fan

### Purpose of the fan

If the temperature in the controller reaches or exceeds the set temperature, the fan will automatically start to cool down the controller. When the temperature of the controller drops below the fan stop threshold, the fan will stop.

| Name | Stop temperature To | Start temperature limit Ts | Upper temperature limit Tf |
|---|---|---|---|
| Temperature threshold | 40°C | 45°C | 75°C |



## Fan life and replacement interval

| Code | Model | Fan service life |
|---|---|---|
| 98050167 | AC810-FAN1 | 70,000 hours |

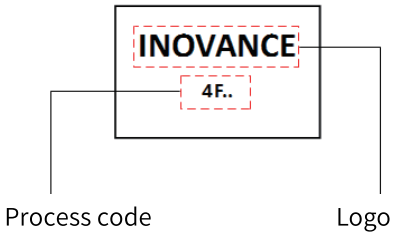
When the controller prompts that the fan is abnormal, replace the fan in time to ensure heat dissipation of the controller.

# 8 Appendix

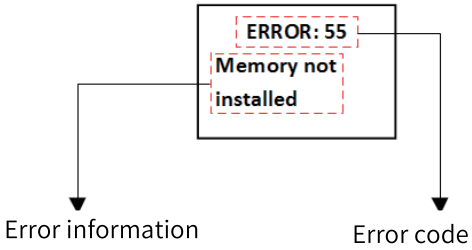
## 8.1 Appendix 1 Process Codes and Error Codes During BIOS Startup

Note: BIOS process coding and error coding are independent of other error coding of the controller.

1. The following figure illustrates display of a BIOS process code:




2. The following figure illustrates display of a BIOS error code:




| BIOS Code | Error Message |
|---|---|
| Process Code | |
| 0x15 | Pre-memory North Bridge initialization is started |
| 0x19 | Pre-memory South Bridge initialization is started |
| 0x32 | CPU post-memory initialization is started |
| 0x3B | Post-Memory South Bridge initialization is started |
| 0x4F | DXE IPL is started |
| 0x60 | DXE Core is started |
| 0x61 | NVRAM initialization |
| 0x62 | Installation of the South Bridge Runtime Services |
| 0x69 | North Bridge DXE initialization is started |
| 0x70 | South Bridge DXE initialization is started |
| 0x72 | South Bridge devices initialization |
| 0x78 | ACPI module initialization |
| 0x79 | CSM initialization |
| 0x90 | Boot Device Selection (BDS) phase is started |
| 0x91 | Driver connecting is started |
| 0x92 | PCI Bus initialization is started |
| 0x93 | PCI Bus Hot Plug Controller Initialization |
| 0x94 | PCI Bus Enumeration |
| 0x95 | PCI Bus Request Resources |
| 0x96 | PCI Bus Assign Resources |

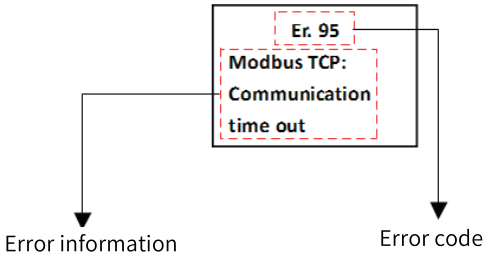
| BIOS Code | Error Message |
|---|---|
| 0x97 | Console Output devices connect |
| 0x98 | Console input devices connect |
| 0x99 | Super IO Initialization |
| 0x9A | USB initialization is started |
| 0x9C | USB Detect |
| 0x9D | USB Enable |
| 0xA0 | IDE initialization is started |
| 0xA2 | IDE Detect |
| 0xAD | Ready To Boot event |
| 0xAE | Legacy Boot event |
| 0xB2 | Legacy Option ROM Initialization |
| 0xB4 | USB hot plug |
| Error code (When a BIOS error occurs, restart the device; If the error persists, contact the manufacturer.) | |
| 0x0E | Microcode not found |
| 0x0F | Microcode not loaded |
| 0x50 | Memory initialization error. Invalid memory type or incompatible memory speed |
| 0x51 | Memory initialization error. SPD reading has failed |
| 0x52 | Memory initialization error. Invalid memory size or memory modules do not match |
| 0x53 | Memory initialization error. No usable memory detected |
| | Note: If the buzzer sounds 6 times during startup, it means that the memory is installed improperly or is not installed. Contact the manufacturer for a solution. |
| 0x54 | Unspecified memory initialization error |
| 0x55 | Memory not installed |
| 0x56 | Invalid CPU type or Speed |
| 0x57 | CPU mismatch |
| 0x58 | CPU self test failed or possible CPU cache error |
| 0x59 | CPU micro-code is not found or micro-code update is failed |
| 0x5A | Internal CPU error |
| 0x5B | reset PPI is not available |
| 0x5C | PEI phase BMC self-test failure |
| 0xAB | Setup Input Wait |
| 0xD0 | CPU initialization error |
| 0xD1 | North Bridge initialization error |
| 0xD2 | South Bridge initialization error |
| 0xD3 | Some of the Architectural Protocols are not available |
| 0xD4 | PCI resource allocation error. Out of Resources |
| 0xD5 | No Space for Legacy Option ROM |
| 0xD6 | No Console Output Devices are found |
| 0xD7 | No Console Input Devices are found |
| 0xD8 | Invalid password |
| 0xD9 | Error loading Boot Option (LoadImage returned error) |
| 0xDA | Boot Option is failed (StartImage returned error) |
| 0xDB | Flash update is failed |
| 0xDC | Reset protocol is not available |
| 0xDD | DXE phase BMC self-test failure |
| 0xE8 | S3 Resume Failed |
| 0xE9 | S3 Resume PPI not Found |

| BIOS Code | Error Message |
|---|---|
| 0xEA | S3 Resume Boot Script Error |
| 0xEB | S3 OS Wake Error |
| 0xF8 | Recovery PPI is not available |
| 0xF9 | Recovery capsule is not found |
| 0xFA | Invalid recovery capsule |
| 0xA1 | Failed to switch BIOS to OS |
| 0XA2 | No BIOS data was received |

## 8.2 Appendix 2 Controller Related Error Codes

Note: The error code IDs for controller-related functions are independent and do not conflict with other error code IDs.

The error code display examples for controller-related functions are shown in the figure below.




| Error Code | Error Message | Solution |
|---|---|---|
| Serial communication port 0 (Modbus/RTU) | | |
| 0x70 | Modbus RTU0:Slave address setting error | Set a legal slave address. |
| 0x71 | Modbus RTU0:Frame length error | Modify the data frame. |
| 0x72 | Modbus RTU0:Illegal data address | Modify it to a legal data address. |
| 0x73 | Modbus RTU0:CRC check failed | 1 Check that the termination resistor is connected correctly.<br>2 Optimize wiring, such as eliminating potential interference sources. |
| 0x74 | Modbus RTU0:Illegal function | Check the slave commands. |
| 0x75 | Modbus RTU0:Communication time out | 1 Check that the slave is working properly.<br>2 Check that the connection is normal.<br>3 Check that the termination resistor is connected correctly.<br>4 Optimize wiring, such as eliminating potential interference sources. |
| 0x76 | Modbus RTU0:Illegal data value | Check the range of data written by slave. |
| 0x77 | Modbus RTU0:Buffer overflow | Reduce communication load. |
| 0x78 | Modbus RTU0:Server device failure | Check the slave communication device. |
| 0x79 | Modbus RTU0:Serial port setting error | Check that the communication configuration is correct. |
| Serial communication port 1 (Modbus/RTU) | | |
| 0x80 | Modbus RTU1:Slave address setting error | Set a legal slave address. |
| 0x81 | Modbus RTU1:Frame length error | Modify the data frame. |

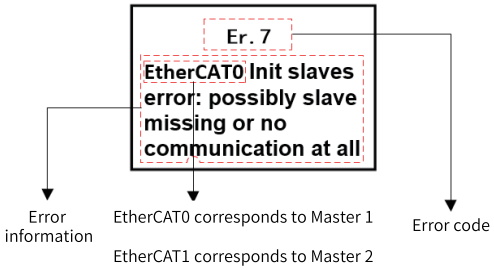
| Error Code | Error Message | Solution |
|---|---|---|
| 0x82 | Modbus RTU1:Illegal data address | Modify it to a legal data address. |
| 0x83 | Modbus RTU1:CRC check failed | 1 Check that the termination resistor is connected correctly.<br>2 Optimize wiring, such as eliminating potential interference sources. |
| 0x84 | Modbus RTU1:Illegal function | Check the slave commands. |
| 0x85 | Modbus RTU1:Communication time out | 1 Check that the slave is working properly.<br>2 Check that the connection is normal.<br>3 Check that the termination resistor is connected correctly.<br>4 Optimize wiring, such as eliminating potential interference sources. |
| 0x86 | Modbus RTU1:Illegal data value | Check the range of data written by slave. |
| 0x87 | Modbus RTU1:Buffer overflow | Reduce communication load. |
| 0x88 | Modbus RTU1:Server device failure | Check the slave communication device. |
| 0x89 | Modbus RTU1:Serial port setting error | Check that the communication configuration is correct. |
| Ethernet (Modbus TCP) | | |
| 0x90 | Modbus TCP:Slave address setting error | Set a legal slave address. |
| 0x91 | Modbus TCP:Frame length error | Modify the data frame. |
| 0x92 | Modbus TCP:Illegal data address | Modify it to a legal data address. |
| 0x93 | Modbus TCP:CRC check failed | 1 Check that the termination resistor is connected correctly.<br>2 Optimize wiring, such as eliminating potential interference sources. |
| 0x94 | Modbus TCP:Illegal function | Check the slave commands. |
| 0x95 | Modbus TCP:Communication time out | 1 Check that the slave is working properly.<br>2 Check that the connection is normal.<br>3 Check that the termination resistor is connected correctly.<br>4 Optimize wiring, such as eliminating potential interference sources. |
| 0x96 | Modbus TCP:Illegal data value | Check the range of data written by slave. |
| 0x97 | Modbus TCP:Buffer overflow | Reduce communication load. |
| 0x98 | Modbus TCP:Server device failure | Check the slave communication device. |
| 0x9A | Modbus TCP:Destination XX is unreachable | 1 Check that the slave is working properly.<br>2 Check that the connection is normal.<br>3 Check that the master hardware is working properly.<br>4 Optimize wiring, such as eliminating potential interference sources. |
| 0x9B | Modbus TCP:Protocol identifier error | Check the protocol identifier. |
| CPU error | | |
| 0x21 | Runtime crashed | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0x22 | LCD: Communication time out between CPU | |
| 0x24 | Battery voltage is too low or battery is in reverse | Replace the battery or check for incorrect installation. |
| 0x25 | Fan is broken or not installed | Check for fan malfunction. |

| Error Code | Error Message | Solution |
|---|---|---|
| 0x26 | Daemon: Communication time out between runtime | 1 Correct the application program, restart the PLC, and download and execute the program again.<br>2 Obtain application run logs through the diagnostic window.<br>3 Collect log information and analyze it through InoProShopTools. |
| 0x27 | Application exception | Check and update the application. |
| 0x28 | Bootproject load fail | Program startup abnormal, check and update the application. |
| 0x2E | ProcessorLoad exception | Check the application task configuration. |
| 0x2F | Network open failed | 1 Power on again.<br>2 Contact the agent or Inovance. |
| Authentication error | | |
| 0x23 | Authentication failed, please contact the supplier! | 1 Power on again.<br>2 Contact the agent or Inovance. |
| Memory error | | |
| 0x31 | Memory init fail | Return the device for repair. |
| Register error | | |
| 0x29 | FPGA PCIE offline and online again | 1 Record exceptions and provide feedback to our developers.<br>2 On site analysis of EMC issues. |

## 8.3 Appendix 3 EtherCAT Related Error Codes

Note: The error code IDs for EtherCAT are independent and do not conflict with other error code IDs. The specific error descriptions (in English) will be displayed on the screen.

The error code display examples for EtherCAT-related functions are shown in the figure below.



| Error Code | Error Message | Solution |
|---|---|---|
| EtherCAT | | |
| 0x01 | Error: communication lost! check the cables! | 1 Check that the network cable between the master and slave is connected properly.<br>2 Check that the connection to OUT port of the slave is correct.<br>3 Check that the network cable is connected properly.<br>4 Check that the network cable connector is wrapped in metal.<br>5 Check that the network cable meets the specification requirements for Cat5e cables.<br>6 Check that the device is properly grounded.<br>7 On the master, set xRestart to TRUE to restart the bus.<br>8 Power off and restart the PLC and slave. |
| 0x02 | Warning: number of slaves has changed or is different to the configuration! | Check if the slave is powered down and if the network cable is disconnected. |
| 0x03 | Distributed clock is always same value! Change in and out connector of slave | Check if the reference clock slave is disconnected. |
| 0x04 | Network adapter could not be found | 1 Check network port configuration.<br>2 Restart the PLC.<br>3 Replace the PLC. |
| 0x05 | Second Network adapter could not be found | 1 Check network port configuration.<br>2 Restart the PLC.<br>3 Replace the PLC. |
| 0x06 | Second Network adapter uses the MAC-ID as first network adapter | 1 Restart the PLC.<br>2 Replace the PLC. |
| 0x07 | Init slaves error: possibly slave missing or no communication at all | 1 Check if the network cable connection between the master and slave is down.<br>2 Check if the network cable connection between slave stations is disconnected, poorly connected, or experiencing hardware failure.<br>3 Check if the slaves are interconnected at OUT ports.<br>4 Use EtherCAT scanning function to locate the faulty slave.<br>5 Power off and restart all slaves. |
| 0x08 | VendorID does not match -> All stopped | 1 Use EtherCAT scanning function to compare configuration with scanning results.<br>2 Power off and restart the slave which the master failed to access. |
| 0x09 | ProductID does not match -> All stopped | 1 Use EtherCAT scanning function to compare configuration with scanning results.<br>2 Power off and restart the slave which the master failed to access. |
| 0x0A | Read of product or vendor ID not successful, more slaves in config as real? | Use EtherCAT scanning function to compare configuration with scanning results. |
| 0x0B | SDO write error in startup procedure | See the slave device user guide to find the error cause and the solution in "Return Error Code" section. |

| Error Code | Error Message | Solution |
|---|---|---|
| 0x0C | SDO timeout in startup procedure | 1 Check the network connection status of the slave.<br>2 Check user programs,reduce the scheduling times of SDO, EOE and SOE function blocks to reduce the communication load. |
| 0x0D | Emergency from device received | See the slave device user guide to find the error cause in "Emergency Event Error Code", "Error Register", and "Manufacturer Custom Error Code" sections. |
| 0x0E | IDN write error in startup procedure | 1 See the slave device user guide to find the error cause in "Return Error Code" section.<br>2 Reconnect the slave to the network. |
| 0x0F | IDN timeout in startup procedure | 1 Check the network connection status of the slave.<br>2 Check user programs to reduce the number and frequency of SDO, EOE, and SOE function blocks. |
| 0x10 | Watchdog expired for opmode | 1 In the overview interface of EtherCAT master, troubleshoot slaves whose receive error counter value is not equal to 0 and the network cable connection status.<br>2 Check that the device is properly grounded.<br>3 Restart EtherCAT master.<br>4 Replace the slave device. |
| 0x20 | Slave alias address duplicate error! | In the EtherCAT scanning interface, reconfigure the alias address of the conflicting slaves. After successful writing, power off and restart the slaves to take effect. |
| 0x21/0x12D | In/out connection error between slaves | 1 Connect the OUT port of the slave to the OUT port of another slave.<br>2 Connect the OUT port of the slave to the master. |
| 0x22 | Access slave EEPROM timeout | Power off and restart the slave. |
| 0x30 | Continuous frame drop error! | 1 Check that the network cable is connected.<br>2 Replace the network cable.<br>3 Replace the slave.<br>4 Add a magnetic ring or replace with a higher-grade network cable. |
| 0x31 | Link lost error! | 1 Check that the network cable connector is connected properly.<br>2 Check that the network cable is connected.<br>3 Replace the network cable. |
| 0x32 | Occasion frame drop error! | 1 Replace the network cable.<br>2 Replace the current slave or the previous slave.<br>3 Add a magnetic ring or replace with a higher-grade network cable. |
| 0x65 | Unspecified error | 1 Power on again.<br>2 Contact the agent or Inovance. |

| Error Code | Error Message | Solution |
|---|---|---|
| 0x66 | No memory | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0x6A | Firmware and EEPROM does not match | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0x6B | Firmware update not successful | Check the master state machine switchover request process; cross-level requests to change the slave state machine are prohibited. |
| 0x75 | Invalid requested state change | Check the master state machine switchover request process; cross-level requests to change the slave state machine are prohibited. |
| 0x76 | Unknown requested state | Check the master state machine switchover request process; cross-level requests to change the slave state machine are prohibited. |
| 0x77 | Bootstrap not supported | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0x78 | No valid firmware | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0x79 | Invalid mailbox configuration | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0x7A | Invalid mailbox configuration | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0x7B | Invalid sync manager configuration | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0x7C | No valid inputs available | Reconfigure slave input PDO data. |
| 0x7D | No valid outputs | Reconfigure slave output PDO data. |
| 0x7E | Synchronization error | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0x7F | Sync manager watchdog | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0x80 | Invalid Sync Manager Types | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0x81 | Invalid Output Configuration | The slave does not support the configuration quantity of output PDO object dictionary. Adjust the output PDO. |
| 0x82 | Invalid Input Configuration | The slave does not support the configuration quantity of output PDO object dictionary. Adjust the input PDO. |
| 0x83 | Invalid Watchdog Configuration | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0x84 | Slave needs cold star | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0x85 | Slave needs INIT | 1 Power on again.<br>2 Contact the agent or Inovance. |

| Error Code | Error Message | Solution |
|---|---|---|
| 0x86 | Slave needs PREOP | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0x87 | Slave needs SAFEOP | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0x88 | Invalid input mapping | 1 Check if input PDO object dictionary entries do not match the slave firmware program.<br>2 Check if Vendor ID verification is disabled in slave configuration.<br>3 Check if Product ID is inconsistent between slave configuration and actual hardware. |
| 0x89 | Invalid output mapping | 1 Check if output PDO object dictionary entries do not match the slave firmware program.<br>2 Check if Vendor ID verification is disabled in slave configuration.<br>3 Check if Product ID is inconsistent between slave configuration and actual hardware. |
| 0x8A | Inconsistent settings | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0x8B | Free-Run not supported | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0x8C | Synchronization not supported | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0x8D | Free-Run needs 3 buffer mode | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0x8E | Backgroundwatchdog | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0x8F | No valid inputs and outputs | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0x90 | Fatal Sync error | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0x91 | No Sync error | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0x92 | Cycle Time too small | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0x94 | Invalid DC SYNCH Configuration | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0x95 | Invalid DC Latch Configuration | 1 Power on again.<br>2 Contact the agent or Inovance. |

| Error Code | Error Message | Solution |
|---|---|---|
| 0x96 | PLL Error | 1 The slave reconnects after network disconnection, and the error is automatically reset.<br>2 The bus cycle is unreasonable, recommended parameters: 125μs–8000μs; the master synchronization offset is unreasonable, adjustment range: -50% to +50%. |
| 0x97 | Invalid DC IO Error | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0x98 | Invalid DC Timeout Error | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0x99 | DC invalid Sync Cycle Time | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0x9A | DC Sync0 Cycle Time | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0x9B | DC Sync1 Cycle Time | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0xA5 | MBX AOE | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0xA6 | MBX EOE | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0xA7 | MBX_COE | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0xA8 | MBX_FOE | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0xA9 | MBX SOE | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0xB3 | MBX_VOE | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0xB4 | EEPROM no access | Change the EEPROM access address or data length. |
| 0xB5 | EEPROM error | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0xB6 | External hardware not ready | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0xC4 | Slave restarted locally | 1 Power on again.<br>2 Contact the agent or Inovance. |
| 0xD4 | Detected Module and Configured does not match | Use EtherCAT scanning function to compare the project configuration with scanning results. |

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