



CK3E-series

Programmable Multi-Axis Controller

Hardware User's Manual

CK3E-1□10

Programmable Multi-Axis Controller





I610-E1-01

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Introduction

Thank you for purchasing a CK3E-series Programmable Multi-Axis Controller.

This manual contains information that is necessary to use the CK3E-series Programmable Multi-Axis Controller. Please read this manual and make sure you understand the functionality and performance of the CK3E-series Programmable Multi-Axis Controller before you attempt to use it in a control system.

Keep this manual in a safe place where it will be available for reference during operation.

Intended Audience

This manual is intended for the following personnel, who must also have knowledge of electrical systems (ie: be of the rank of electrical engineer or equivalent).

- Personnel in charge of introducing FA devices.
- Personnel in charge of designing FA systems.
- Personnel in charge of installing and maintaining FA devices.
- Personnel in charge of managing FA facilities.

Applicable Products

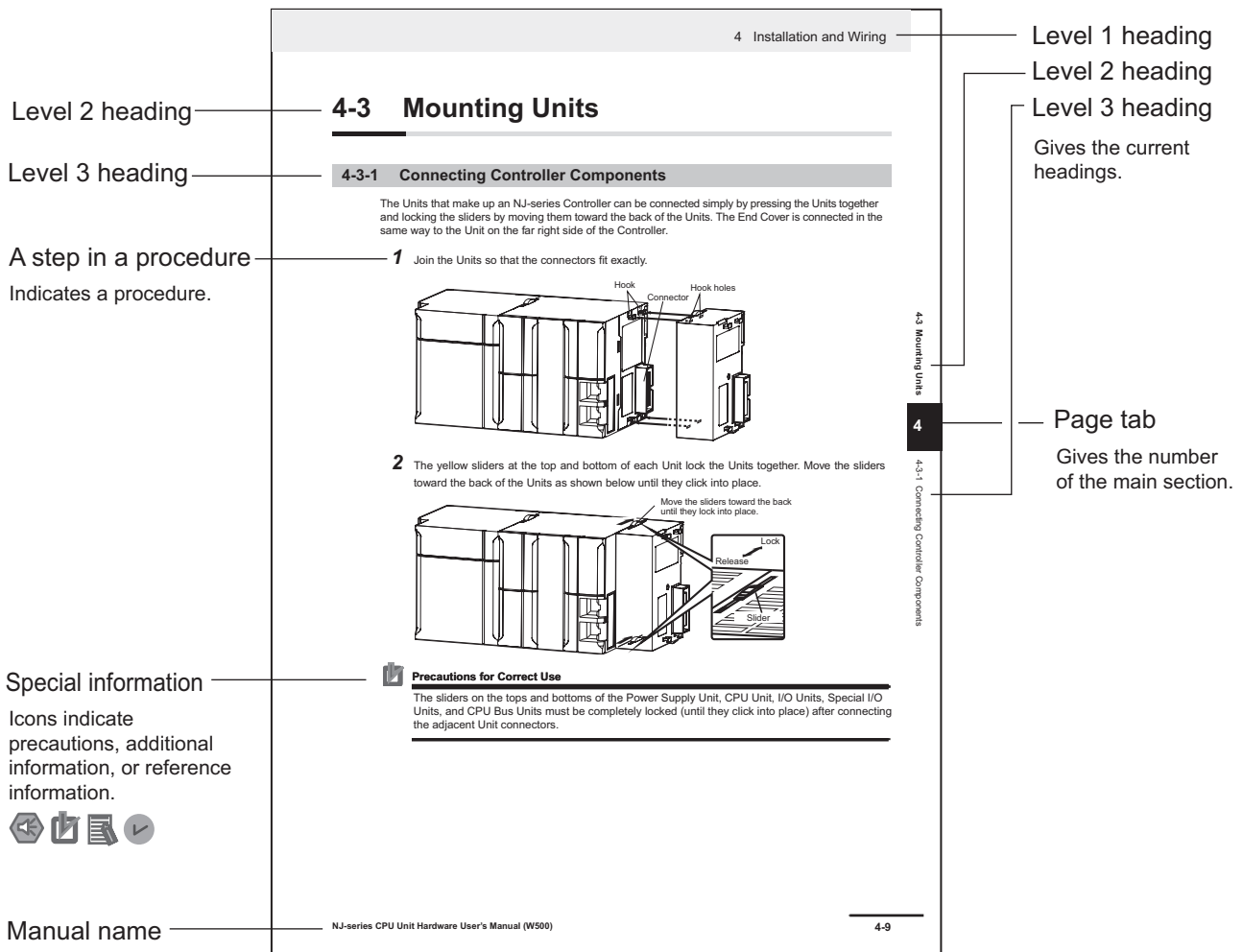
This manual covers the following products.

- CK3E-series Programmable Multi-Axis Controller
Model CK3E-□□□□

Manual Structure

Page Structure and Icons

The following page structure and icons are used in this manual.



Note This illustration is provided as a sample only. It may not literally appear in this manual.

Special Information

Special information in this manual is classified as follows:



Precautions for Safe Use

Precautions on what to do and what not to do to ensure safe usage of the product.



Precautions for Correct Use

Precautions on what to do and what not to do to ensure correct operation and performance.



Additional Information

Additional information to read as required.

This information is provided to increase understanding or make operation easier.

Note References are provided to more detailed or related information.

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Safety Precautions

Definition of Precautionary Information

The following notation is used in this manual to provide precautions required to ensure safe usage of the CK3E-series Programmable Multi-Axis Controller.

The safety precautions that are provided are extremely important to help ensure safety. Always read and heed the information provided in all safety precautions.

The following notation is used.

 WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury. Additionally, there may be severe property damage.
 Caution	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury, or property damage.

Symbols



The circle and slash symbol indicates operations that you must not do.
The specific operation is shown in the circle and explained in text.
This example indicates that disassembling is prohibited.



The triangle symbol indicates precautions (including warnings).
The specific operation is shown in the triangle and explained in text.
This example indicates a precaution against electric shock.



The triangle symbol indicates precautions (including warnings).
The specific operation is shown in the triangle and explained in text.
This example indicates a general precaution.



The filled circle symbol indicates operations that you must do.
The specific operation is shown in the circle and explained in text.
This example shows a general precaution for an action you must carry out.

WARNING**WARNING****During Power Supply**

Do not attempt to take any Unit apart.

In particular, high-voltage parts are present in the product while power is supplied or immediately after power is turned OFF. Touching any of these parts may result in electric shock.

There are sharp parts inside the Unit that may cause injury.

**Fail-safe Measures**

Provide safety measures in external circuits to ensure safety in the system if an abnormality occurs due to malfunction of the system due to other external factors affecting operation.

Not doing so may result in serious accidents due to incorrect operation.



Emergency stop circuits, interlock circuits, limit circuits, and similar safety measures must be provided in external control circuits.



You must take fail-safe measures to ensure safety in the event of incorrect, missing, or abnormal signals caused by broken signal lines, momentary power interruptions, or other causes. Not doing so may result in serious accidents due to incorrect operation.



The use of an Uninterruptible Power Supply (UPS) allows normal operation to continue even if a momentary power interruption occurs, possibly resulting in the reception of an erroneous signal from an external device affected by the momentary power failure. Take external fail-safe measures. Where necessary, monitor the power supply voltage on the system for external devices and use it as an interlock condition.



Unintended behavior may occur when an error occurs in internal memory of the product. As a countermeasure for such problems, external safety measures must be provided to ensure safe operation of the system.



The Controller will turn OFF all outputs from Output Units in the following cases. The slaves will operate according to the settings in the slaves.

- If a power supply error occurs
- If the power supply connection becomes faulty
- When a CPU error (watchdog timer error) or CPU reset occurs
- If a Controller error in the major fault level occurs
- While the Controller is in startup status until RUN mode is entered after the power is turned ON.
- If a system initialization error occurs



External safety measures must be provided to ensure safe operation of the system in such cases.

Transferring

Always confirm the safety status at the destination before you transfer a user program, configuration data, or setup data from POWER PMAC IDE. The devices or machines may perform unexpected operations regardless of the operating mode of the Controller.



After you transfer the user program, the Controller is restarted and communications with the EtherCAT slaves are cut off. During that period, the slave outputs behave according to the slave specifications.



The time that communications are cut off depends on the EtherCAT network configuration. Before you transfer the user program, confirm that the system will not be adversely affected.

Test Run

Before you start a Test Run, make sure that the operation parameters are set correctly.



Actual Operation

Check the user program, data, and parameter settings for proper execution before you use them for actual operation.



Precautions for Safe Use

Transporting

- Do not drop the Controller or expose it to abnormal vibration or shock. Doing so may result in the Controller malfunctioning or burning.

Mounting

- Be sure that the connectors and other items with locking devices are correctly locked into place.

Installation

- Always connect to a ground of 100 Ω or less when installing the Controller.

Wiring

- Follow the instructions in this manual to correctly perform connector wiring and insertion. Double-check all wiring and connector insertion before turning ON the power supply.
- If the external power supply to a slave has polarity, connect it with the correct polarity. If the polarity is reversed, current may flow in the reverse direction and damage the connected devices regardless of the operation of the Controller.
- Before you connect a computer to the Controller, disconnect the power supply plug of the computer from the AC outlet. Also, if the computer has an FG terminal, make the connections so that the FG terminal has the same electrical potential as the FG on the product. A difference in electrical potential between the computer and Controller may cause a failure or malfunction.
- Do not pull on the cables or bend the cables beyond their natural limit.
- Do not place any objects on top of the cables or other wiring lines. Doing so may cause the cables to break.
- Always use power supply wires with sufficient wire diameters to prevent voltage drop and burning. Make sure that the current capacity of the wire is sufficient. Otherwise, excessive heat may be generated. When cross-wiring terminals, the total current for all the terminals will flow in the wire. When wiring cross-overs, make sure that the current capacity of each of the wires is not exceeded.

Power Supply Design

- In the system, only use the power supply within the rated supply capacity range specified in this manual.

Turning ON the Power Supply

- It takes approximately several tens of seconds to enter RUN mode after the power supply is turned ON. During that time, outputs will be OFF or the values will be as according to settings in the Unit or slaves. Also, external communications will not be able to be performed. The outputs during this period will behave according to the slave and Unit specifications. Implement fail-safe circuits so that external devices do not operate incorrectly.
- Surge current occurs when the power supply is turned ON. When selecting fuses or breakers for external circuits, consider the above precaution and allow sufficient margin in shut-off performance. Refer to this manual for surge current specifications.

Turning OFF the Power Supply

- Do not turn off the power supply or remove the USB memory device while the Controller is accessing the USB memory device. Data may become corrupted, and the Controller will not operate correctly if it uses corrupted data.
- Always turn OFF the power supply before you attempt any of the following.
 - Connecting cables or wiring the system
 - Connecting or disconnecting the connectors
- If the product experiences a sudden loss of power or disconnecting the cable while saving a setting or transfer of data is underway, the changes may not be stored and unexpected behavior may occur.

Operation

Confirm that no adverse effects will occur in the system before you attempt any of the following.

- Changing the operating mode of the Controller (including changing the setting of the Startup Mode)
- Changing the user program or settings
- Changing set values or present values

EtherCAT Communications

- Make sure that the communications distance, number of nodes connected, and method of connection for EtherCAT are within specifications.
Do not connect EtherCAT communications to EtherNet/IP, a standard in-house LAN, or other networks. An overload may cause the network to fail or malfunction.
- If the Fail-soft Operation parameter is set to stop operations, process data communications will stop for all slaves when an EtherCAT communications error is detected in a slave. For this reason, if Servo Drives are connected, the Servos for all axes will be turned OFF. At that time, the Servo Drive will operate according to the Servo Drive specifications. Make sure that the Fail-soft Operation parameter setting results in safe operation when a device error occurs.
- If noise occurs or an EtherCAT slave is disconnected from the network, any current communications frames may be lost. If frames are lost, slave I/O data is not communicated, and unintended operation may occur. The slave outputs behave according to the slave specifications. For details, refer to relevant manuals for each slave.
- When an EtherCAT slave is disconnected or disabled, communications will stop and control of the outputs will be lost not only for the disconnected slave, but for all slaves connected after it. Confirm that the system will not be adversely affected before you disconnect or disable a slave.
- You cannot use standard Ethernet hubs or repeater hubs with EtherCAT communications. If you use one of these, a major fault level error or other error may occur.
- EtherCAT communications are not always established immediately after the power supply is turned ON. Use the system-defined variables and the EtherCAT Coupler Unit device variables in the user program to confirm that I/O data communications are established before attempting control operations.
- If you need to disconnect the cable from an EtherCAT slave during operation, first reset the EtherCAT and EtherCAT slaves that are connected after it to the Init state, then disconnect the EtherCAT slave.
- For EtherCAT and EtherNet, use the connection methods and cables that are specified in this manual. Otherwise, communications may be faulty.
- Make sure that all of the slaves to be restored are participating in the network before you reset the EtherCAT Master Function Module. If any slave is not participating when any of these errors is reset, the EtherCAT Master Function Module may access a slave with a different node address than the specified node address, or the error may not be reset correctly.

Motion Control

- The motor is stopped if communications are interrupted between POWER PMAC IDE and the Controller during a Test Run. Connect the communications cable securely and confirm that the system will not be adversely affected before you perform a Test Run.
- EtherCAT communications are not always established immediately after the power supply is turned ON. Use the system-defined variables in the user program to confirm that communications are established before attempting control operations.

Unit Replacement

- After replacing the Controller, make sure that the required data, including the user program, configurations, settings, and values of variables, has been transferred to the Controller that was replaced, as well as to externally connected devices before restarting operation.

Maintenance

- Do not attempt to disassemble, repair, or modify the Controller. Doing so may result in a malfunction or fire.
- Do not use corrosive chemicals to clean the Controller. Doing so may result in a failure or malfunction of the Controller.

Precautions for Correct Use

Storage and Installation

- Follow the instructions in this manual to correctly perform installation.
- Do not operate or store the Controller in the following locations. Doing so may result in a malfunction or halt operations.
 - a) Locations subject to direct sunlight
 - b) Locations subject to temperatures or humidity outside the range specified in the specifications
 - c) Locations subject to condensation as a result of severe changes in temperature
 - d) Locations subject to corrosive or flammable gases
 - e) Locations subject to dust (especially iron dust) or salts
 - f) Locations subject to exposure to water, oil, or chemicals
 - g) Locations subject to shock or vibration
- Take appropriate and sufficient countermeasures when installing the Controller in the following locations.
 - a) Locations subject to strong, high-frequency noise
 - b) Locations subject to static electricity or other forms of noise
 - c) Locations subject to strong electromagnetic fields
 - d) Locations subject to possible exposure to radioactivity.
 - e) Locations close to power lines
- Install the Controller away from sources of heat and ensure appropriate ventilation. Not doing so may result in a malfunction, operations halting, or burning.
- Always touch a grounded piece of metal to discharge static electricity from your body before starting an installation or maintenance procedure.

Wiring

- Do not allow wire clippings, shavings, or other foreign material to enter the Controller. Otherwise, the Controller may experience a failure, malfunction, or ignite. Cover the Controller or take other suitable countermeasures, in particular when carrying out wiring work.
- Always ensure the rated supply voltage is connected to the Controller.

Task Settings

- If a Task Period Exceeded error occurs, shorten the programs to fit in the task or increase the setting of the task period.

Operation

- Do not disconnect the communications cable while the system is running. Doing so may result in a failure or malfunction of the system.

Motion Control

- Do not download motion control settings during a Test Run.

EtherCAT Communications

- Set the Servo Drives to stop operation if an error occurs in EtherCAT communications between the Controller and a Servo Drive.
- Always use the specified EtherCAT slave cables. If you use any other cable, the EtherCAT master or the EtherCAT slaves may detect an error and one of the following may occur.
 - a) Continuous refreshing of process data communications will not be possible.
 - b) Continuous refreshing of process data communications will not end during the set cycle.

USB Device

- Always use USB memory devices that comply with the USB standards.

Regulations and Standards

Conformance to EU Directives

Applicable Directives

- EMC Directives

Concepts

● EMC Directives

OMRON devices that comply with EU Directives also conform to the related EMC standards so that they can be more easily built into other devices or the overall machine. The actual products have been checked for conformity to EMC standards.*1

Whether the products conform to the standards in the system used by the customer, however, must be checked by the customer. EMC-related performance of the OMRON devices that comply with EU Directives will vary depending on the configuration, wiring, and other conditions of the equipment or control panel on which the OMRON devices are installed. The customer must, therefore, perform the final check to confirm that devices and the overall machine conform to EMC standards.

*1. Applicable EMC (Electromagnetic Compatibility) standards are as follows:

EMS (Electromagnetic Susceptibility): EN 61326

EMI (Electromagnetic Interference): EN 61326 (Radiated emission: 10-m regulations).

● Conformance to EU Directives

The CK3E-series Controllers comply with EU Directives. To ensure that the machine or device in which the CK3E-series Controllers are used complies with EU Directives, the following precautions must be observed.

- The CK3E-series Controllers must be installed within a control panel.
- You must use SELV power supply for the DC power supplies that are connected as the Unit power supplies and I/O power supplies for the CK3E-series Controllers.

We recommend that you use the OMRON S8JX-series Power Supplies. EMC standard compliance was confirmed for the recommended Power Supplies.

- CK3E-series Controllers that comply with EU Directives also conform to the Common Emission Standard (EN 61326). Radiated emission characteristics (10-m regulations) may vary depending on the configuration of the control panel used, other devices connected to the control panel, wiring, and other conditions.

You must therefore confirm that the overall machine or equipment in which the CK3E-series Controllers are used complies with EU Directives.

- This is a Class A product (for industrial environments). In a residential environment, it may cause radio interference. If radio interference occurs, the user may be required to take appropriate measures.
- Attach a clamp core to the Ethernet communications cable. Refer to *Recommended Clamp Core and Attachment Procedure* on page 4-15 for details of the procedure to attach the clamp core.

Software Licenses and Copyrights

This product incorporates certain third party software. The license and copyright information associated with this software is available at http://www.fa.omron.co.jp/nj_info_e/.

Related Manuals

The following manuals are related. Contact your OMRON representative for information on how to procure these manuals. Use these manuals for reference.

Manual name	Cat.No.	Application	Description
Power PMAC User's Manual	O014	Learning the features and usage examples of the CK3E-series Programmable Multi-Axis Controller.	The following information is provided on a CK3E-series Programmable Multi-Axis Controller. <ul style="list-style-type: none"> • Basic features of the motion controller Power Programmable Multi-Axis Controller possessed by the Programmable Multi-Axis Controller. • Setup examples • Programming examples
Power PMAC Software Reference Manual	O015	Learning how to program a CK3E-series Programmable Multi-Axis Controller.	The following information is provided on a CK3E-series Programmable Multi-Axis Controller. <ul style="list-style-type: none"> • Details of commands • Details of data structure
Power PMAC IDE User Manual	O016	Learning how to operate Power PMAC IDE, the integrated development environment of the Controller.	Describes the operating procedures of Power PMAC IDE, and examples of how to start the system.
Power PMAC-NC16 Quick Start Manual	O017	Understanding the basic usage of Power PMAC-NC16 quickly.	Describes a Quick setup procedure to run Power PMAC-NC16 on a desktop PC by using an example.
Power PMAC-NC16 .ini Configuration Manual	O018	Constructing an application for CNC devices by using Power PMAC-NC16.	Describes how to set up "PowerPmacNC.ini", the setup data file to be loaded when Power PMAC-NC16 starts.
Power PMAC-NC16 Software User Manual	O019	Learning about usage and features of Power PMAC-NC16, Support Software required when using the Controller for CNC devices.	The following information is provided on Power PMAC-NC16. <ul style="list-style-type: none"> • How to use the software • Features included in the software • Features that can be customized
Power PMAC-NC16 Mill G-Code Manual	O020	Creating programs for CNC devices by using Power PMAC-NC16.	Describes the basic G-code set and the instructions that can be used for Power PMAC-NC16.
Acontis EC-Engineer manual	---	Configuring an EtherCAT network by using a CK3E-series Programmable Multi-Axis Controller as the EtherCAT master.	Operating procedure of Support Software used for EtherCAT network configuration is described.

Terms and Acronyms

Term or acronym	Description
CNC	The acronym for Computerized Numerical Control. A method to numerically control machining processes in production by using computers. CNC has been further automatized over conventional numerical control machine tools (NC machine tools).
CPU	Central Processing Unit. Core hardware mounted in computers that executes instructions from computer programs.
ESI file	ESI is the acronym for EtherCAT Slave Information. The ESI file contains information unique to the EtherCAT slaves in XML format.
ENI file	ENI is the acronym for EtherCAT Network Information. The ENI file contains the network configuration information related to EtherCAT slaves.
Ethernet	A network communications protocol used in TCP/IP networks.
EtherCAT	The acronym for Ethernet for Control Automation Technology. EtherCAT is the real-time Ethernet protocol standards.
EtherCAT master	The EtherCAT master node that manages the EtherCAT network, monitors the status of slaves, and exchanges I/O data with slaves. It has one output port.
G-code	A type of language used to create NC programs.
Modbus/TCP	A protocol used for the Modbus communication on TCP/IP.
PLC	Programmable Logic Controller
PMAC	The acronym for Programmable Multi-Axis Controller
USB	Universal Serial Bus
Servo Drive/Encoder input slave	Any of the EtherCAT slaves that is assigned to an axis.
Vision sensor	A sensor that calculates the area, center of gravity, length, position, and other feature quantities of objects by processing images captured using a camera, and outputs the data and judgment results.
Axis	A functional unit within the Motion Control Function Module. An axis is assigned to the drive mechanism in an external Servo Drive or the sensing mechanism in an external Encoder Input Slave Unit.
Node address	The node address is used to identify Units connected to EtherCAT.
General-purpose slave	Any of the EtherCAT slaves that cannot be assigned to an axis.
Programmable terminal	A human-machine interface used to facilitate the operation and control of machines.
Motion control	Motion control can achieve intended operation by providing a target value to the axis to be controlled, or by controlling state transitions.

Revision History

A manual revision code appears as a suffix to the catalog number on the front and back covers of the manual.

Man.No.	I610-E1-01
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↑
Revision code

Revision code	Date	Revised content
01	August 2016	Original production

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Features and System Configuration

This section describes the features and system configuration of the Programmable Multi-Axis Controller.

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1-1 Features

The CK3E-series is the Programmable Multi-Axis Controller that supports the EtherCAT master functions.

The CK3E-series Programmable Multi-Axis Controller has the following features.

Fast Multi-Axis Control

The Controller uses Programmable Multi-Axis Controller, developed by Delta Tau Data Systems, Inc., a manufacturer specializing in motion controllers.

It allows for multi-axis control of up to 32 axes per unit (when CK3E-1410 is used), and the fast control which motion control period is 250 μ s or more.

Constructing Systems with Greater Flexibility

Programs can be written in G-code, C language, or Programmable Multi-Axis Controller specific language for the Controller. Such function design flexibility allows you to create functions that are optimized for your equipment.

Various EtherCAT-compatible products such as vision sensors and I/O as well as motion controls can be connected, allowing you to construct original systems to suit the equipment.

Compactness

The Controller is compact and has less wiring due to the use of the EtherCAT network, which helps to downsize devices.



Additional Information

What is EtherCAT?

EtherCAT is an Ethernet (IEEE802.3) compliant, open, and super-fast industrial network system. Each node achieves a short communications cycle time by transmitting Ethernet frames at high speed. A mechanism that allows sharing of clock information enables high-precision synchronized control with low communications jitter.

1-2 Introduction to the System Configurations

The following shows the configurations of motion control systems using a Programmable Multi-Axis Controller. The basic configurations include the EtherCAT network configuration, Ethernet network configuration, and Support Software.

EtherCAT Network Configuration

By using the EtherCAT master communications port on the Programmable Multi-Axis Controller, EtherCAT slaves such as servo drives, frequency inverters, machine vision systems, digital and analog I/O, and other general-purpose slaves can be connected.

The Controller also supports EtherCAT Slave Terminals. The EtherCAT Slave Terminal helps you to save space and construct flexible systems using a broad range of types of NX Units.

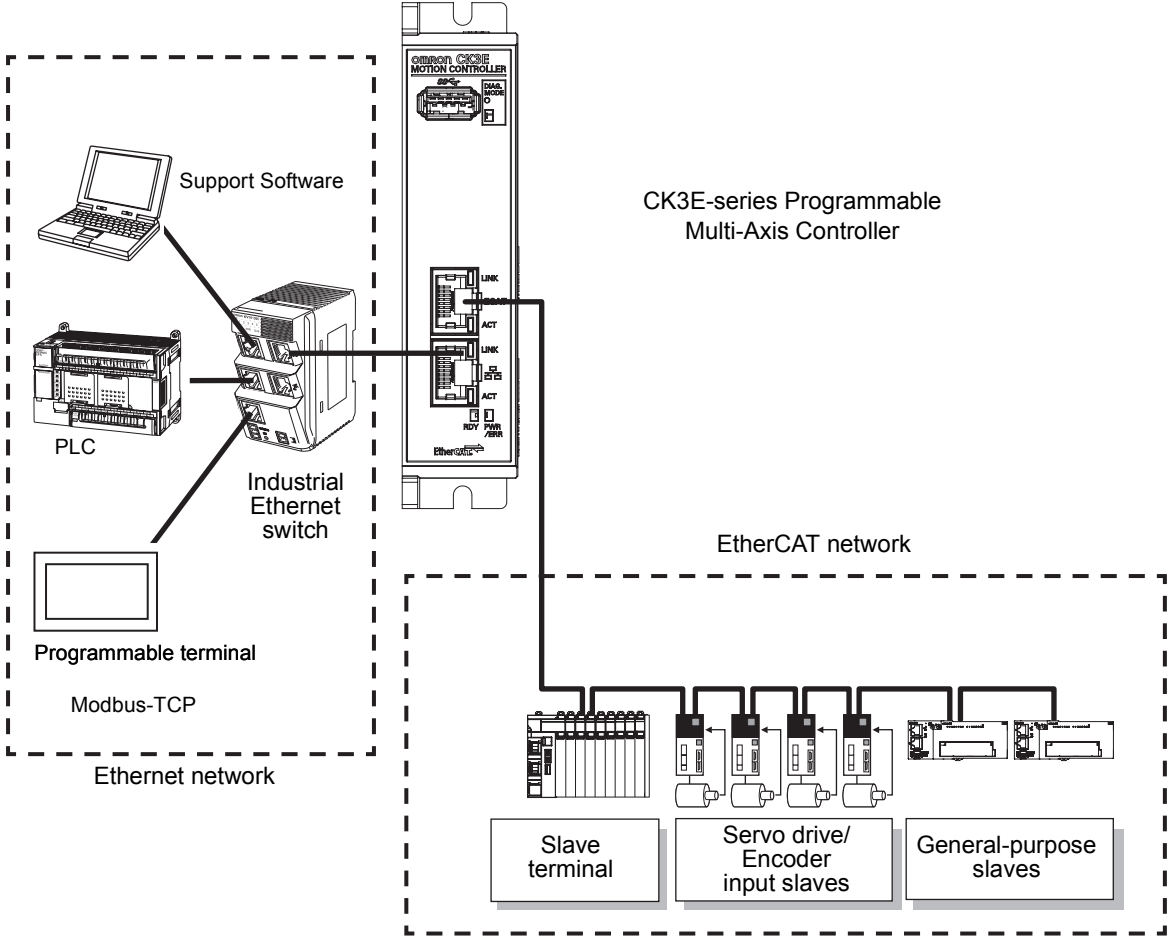
However, when OMRON NX-series EtherCAT Coupler Units are used for the EtherCAT Slave Terminal, only limited models and unit versions of EtherCAT Coupler Units can be connected. Refer to *A-2 Restrictions on Using the OMRON NX-Series EtherCAT Coupler Unit* on page A-3.

Ethernet Network Configuration

The Ethernet communications port on the Programmable Multi-Axis Controller supports the MODBUS-TCP protocol. It can be connected to devices such as a PLC or a programmable terminal that supports the MODBUS-TCP protocol.

Support Software

Connect a personal computer with the Support Software installed to the Programmable Multi-Axis Controller via the Ethernet network. Refer to *1-3 Support Software* on page 1-5 for details of the Support Software.



1-3 Support Software

The following table shows the Support Software used to configure, monitor, program, and debug the Programmable Multi-Axis Controller.

Software Name		Application	How to Procure
Power PMAC IDE* ¹		This computer software is used to configure the Controller, create user programs, and debug the programs.	This is free software. Contact your OMRON representative for information on how to procure.
Power PMAC-NC16	Power PMAC-NC16 SDK	This computer software is used to control working machines and other CNC machines with the Controller. Use this software when you want to customize the HMI screen. The product contains extension source codes used for customization.	This is non-free software. Contact your OMRON representative for information on how to procure.
	Power PMAC-NC16 Runtime	This computer software is used to control working machines and other CNC machines with the Controller. Use this software when you do not customize the HMI screen.	This is non-free software. Contact your OMRON representative for information on how to procure.
EC-Engineer		This computer software is used to configure and monitor the EtherCAT network by using the Controller as the EtherCAT master.	This is free software. Contact your OMRON representative for information on how to procure.

*1. Use Power PMAC IDE Ver.2.2 or a later version.

1-4 Application Procedure

This section describes the procedure to construct a motion control system by using the Multi-Axis Controller.

No.	Step		Description	Reference
1	Preparation before carrying out work	Check for specification compatibility	Check whether the system is compatible with specifications of the Programmable Multi-Axis Controller. • General specifications • Mounting direction	2-1-2 <i>General Specifications</i> on page 2-3
		Selection of peripheral devices	Select peripheral devices to be used for the Programmable Multi-Axis Controller.	2-2 <i>Specifications of Peripherals</i> on page 2-5
		Preparation of Support Software	Procure and install the Support Software required for the system.	1-3 <i>Support Software</i> on page 1-5
2	Mounting and wiring of the Programmable Multi-Axis Controller	Mounting	Mount the Programmable Multi-Axis Controller.	4-1 <i>Mounting the Programmable Multi-Axis Controller</i> on page 4-2
		Wiring	Connect the unit power supply of the Programmable Multi-Axis Controller.	4-2 <i>Power Supply Wiring</i> on page 4-4
3	Settings and wiring of the EtherCAT slave hardware.	Node address settings	Use the hardware switches on all of the EtherCAT slaves in the network to set the node addresses.	Refer to the manual for the EtherCAT slave.
		Mounting	Mount EtherCAT slaves.	Refer to the manual for the EtherCAT slave.
		Wiring	Wire EtherCAT slaves. • Wiring of the unit power supply • I/O wiring	Refer to the manual for the EtherCAT slave.
4	Wiring of the EtherCAT communication and grounding of the system		Ground and wire the EtherCAT communication cable.	4-3 <i>Laying the EtherCAT Network</i> on page 4-7 4-6 <i>Grounding</i> on page 4-17
5	Preparation for setting the Programmable Multi-Axis Controller	Creation of a new project	Connect the computer with the Support Software installed to the Programmable Multi-Axis Controller. Then start Power PMAC IDE and create a new project.	Refer to "Power PMAC IDE User Manual" for details.
		Initialization of the Controller	Initialize the Programmable Multi-Axis Controller by using Power PMAC IDE.	Refer to "Power PMAC IDE User Manual" for details.
6	Turning the Power ON		Turn on the power to the devices configuring the system.	---

No.	Step		Description	Reference
7	Construction of the EtherCAT network	Installation of ESI files	Install the ESI files of EtherCAT slaves to be connected to EC-Engineer.	Refer to "Acontis EC-Engineer manual" for details. For information on the ESI file, refer to the manual for the EtherCAT slave.
		EtherCAT slave settings	Configure the EtherCAT communication settings by using EC-Engineer. Then, create an ENI file used to download the configured settings to the Programmable Multi-Axis Controller.	Refer to "Acontis EC-Engineer manual" for details.
		Activation of the EtherCAT network	Download the ENI file to the Programmable Multi-Axis Controller by using Power PMAC IDE. Make sure that the ENI file has been correctly downloaded, and then activate the EtherCAT network.	Refer to "Power PMAC IDE User Manual" for details.
8	Settings of the Programmable Multi-Axis Controller operation	Programming	Create user programs on Power PMAC IDE.	Refer to "Power PMAC User's Manual" and "Power PMAC Software Reference Manual" for details.
		Motor settings	Set the motor operations for the Programmable Multi-Axis Controller by using Power PMAC IDE.	Refer to "Power PMAC IDE User Manual" for details.
9	Transferring project data and checking the operation		Transfer the created project data and check that operations work as expected.	Refer to "Power PMAC IDE User Manual" for details.

Specifications

This section describes the specifications of the Programmable Multi-Axis Controller and configuration devices.

2-1	Programmable Multi-Axis Controller	2-2
2-1-1	Model	2-2
2-1-2	General Specifications	2-3
2-1-3	Features and Performance Specifications	2-4
2-2	Specifications of Peripherals	2-5
2-2-1	USB Memory Device	2-5
2-2-2	Power Supply	2-5

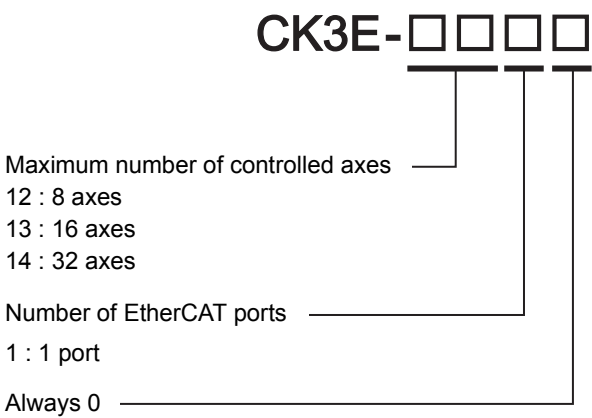
2-1 Programmable Multi-Axis Controller

The following provides the models and major specifications of the Programmable Multi-Axis Controller and configuration devices.

2-1-1 Model

Model Naming

CK3E-series Programmable Multi-Axis Controller model names are assigned according to the following rule.



Model List

Model	Specifications		
	Memory	Port	Maximum number of controlled axes
CK3E-1210	Main memory: 1 GB	Ethernet port: 1	8 axes
CK3E-1310	Flash memory: 1 GB	EtherCAT port: 1	16 axes
CK3E-1410			32 axes

2-1-2 General Specifications

Item		Specifications		
		Model CK3E-1210	Model CK3E-1310	Model CK3E-1410
Enclosure		Mounted in a panel		
Grounding methods		Ground of 100 Ω or less		
Dimensions (height \times depth \times width)		130.4 \times 28.6 \times 170.9 mm (H \times D \times W)		
Weight		540 g or less		
Unit power supply rated voltage		24 VDC (20.4 to 26.4 VDC)		
Unit power current consumption		660 mA or less		
Operating environment	Ambient operating temperature	0 to 45°C		
	Ambient operating humidity	10 to 95% RH (without condensation and icing)		
	Atmosphere	Must be free of corrosive gases.		
	Ambient storage temperature	-25 to +70°C (without condensation and icing)		
	Vibration resistance	Conforms to IEC 60068-2-6. 5 to 8.4 Hz with 3.5-mm amplitude, 8.4 to 150 Hz, acceleration of 9.8 m/s ² each in X, Y, and Z directions 100 min (10 sweeps of 10 min each = 100 min total)		
	Shock resistance	Conforms to IEC 60068-2-27, 147 m/s ² , 3 times each in X, Y, and Z directions		
Applicable standards *1		EU: EN 61326, RCM		

*1. For the latest applicable standards for each model, visit the OMRON website (www.fa.omron.co.jp or www.ia.omron.com), or contact your OMRON representative.

2-1-3 Features and Performance Specifications

Item		Specifications		
		Model CK3E-1210	Model CK3E-1310	Model CK3E-1410
Memory		Main memory: 1 GB Flash memory: 1 GB		
External terminals		[Communications connector] For EtherCAT communications • RJ45 × 1 (Shield supported) For Ethernet communications • RJ45 × 1 (Shield supported)		
		[Power supply input terminal] For unit power supply × 1		
		[USB port] For external memory connection, USB 3.0 host × 1 Type A		
Motion control	Maximum number of controlled axes	8 axes	16 axes	32 axes
	Motion control period	250 μs or more		
	Control method	Issuing control commands using EtherCAT communications		
EtherCAT communications specifications	Communications protocol	EtherCAT protocol		
	Baud rate	100 Mbps		
	Physical layer	100BASE-TX (IEEE 802.3)		
	Topology	Line, daisy chain, and branching		
	Transmission media	Twisted-pair cable of category 5 or higher (double-shielded cable with aluminum tape and braiding)		
	Transmission distance	Distance between nodes: 100 m or less		
	Maximum number of slaves	32		
	Range of node addresses that can be set	1 to 32		
Ethernet communications specifications	Physical layer	1000BASE-T/100BASE-TX		
	Frame length	1,514 bytes max.		
	Media access method	CSMA/CD		
	Modulation	Baseband		
	Topology	Star		
	Transmission media	Twisted-pair cable of category 5, 5e, or higher (shielded cable)		
	Maximum transmission distance between Ethernet switch and node	100 m		
	Maximum number of cascade connections	There are no restrictions if an Ethernet switch is used.		
USB port	Physical layer	USB 3.0 compliant, type A connector. Output voltage: 5 V, 0.9 A max.		
	Transmission distance	3 m max.		

2-2 Specifications of Peripherals

2-2-1 USB Memory Device

The following shows details of the recommended USB memory device.

OMRON is not responsible for the operation, performance, or write life of any other USB memory devices.

Recommended USB memory	Description
Model FZ-MEM2G	OMRON USB memory device (2 GB)
Model FZ-MEM8G	OMRON USB memory device (8 GB)

You can use the USB memory device for the following applications.

- Uploading data
- Downloading data
- Saving relevant data

2-2-2 Power Supply

The following shows details of the recommended power supply.

Recommended power supply: Model S8JX series (OMRON)

For specifications and manuals of Model S8JX, visit the OMRON website (<http://www.fa.omron.co.jp/products/family/1989/lineup.html>).

3

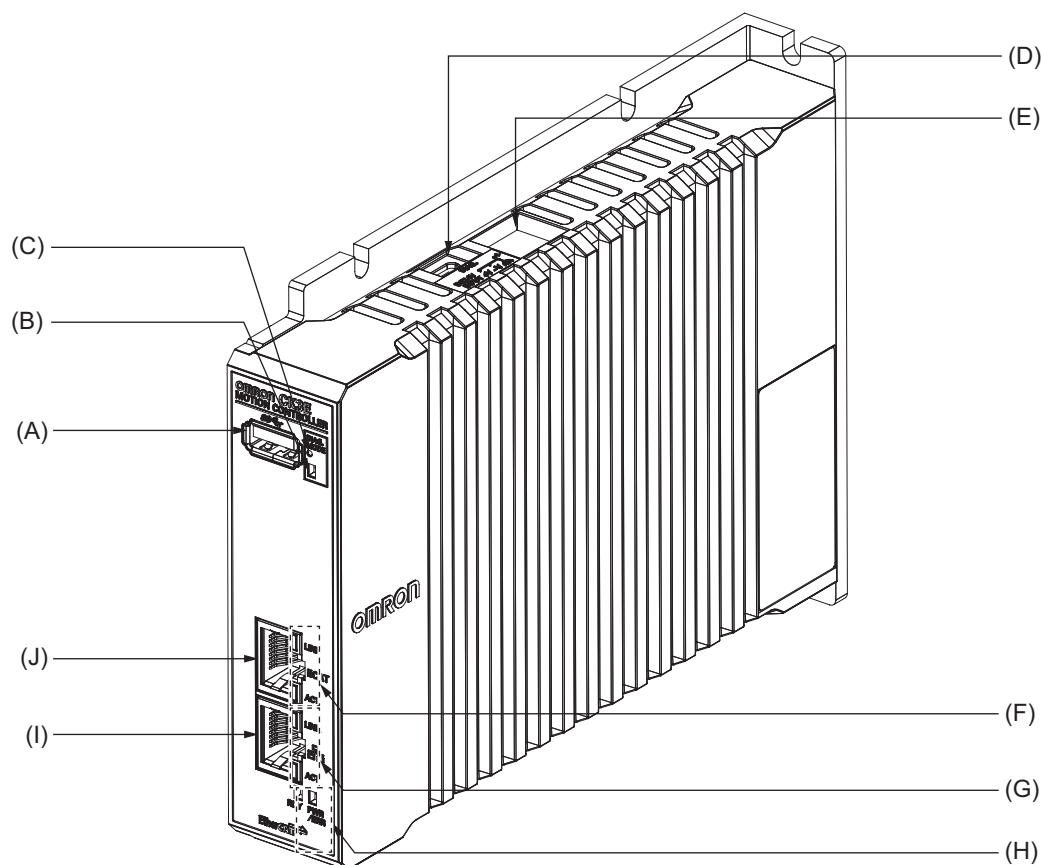
Part Names and Functions

3

This section describes the names and functions of the Programmable Multi-Axis Controller.

3-1	Part Names	3-2
3-2	Operation Indicators	3-3
3-3	ID Information Indication Label	3-4

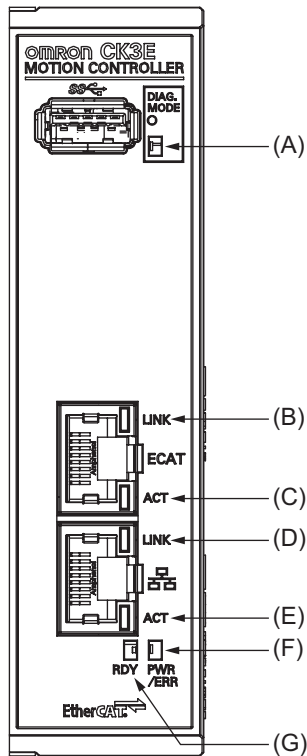
3-1 Part Names



Letter	Name	Function
(A)	USB 3.0 connector	The connector of USB 3.0 interface, used to connect a USB memory device.
(B)	Maintenance mode LED	Not used. Used for maintenance.
(C)	Maintenance mode enter button	Not used. Used to enter Maintenance mode. The user does not use it.
(D)	USB 2.0 connector	Not used. Used for maintenance. The user does not use it.
(E)	Power supply connector	Connects to the Unit power supply.
(F)	EtherCAT communications port operation indicators	Show the operation status of EtherCAT.
(G)	Ethernet communications port operation indicators	Show the operation status of Ethernet.
(H)	Unit operation indicators	Show the operation status of the Unit using multiple indicators.
(I)	Ethernet communications connector	Connects to an Ethernet network communications cable.
(J)	EtherCAT communications connector	Connects to an EtherCAT network communications cable.

3-2 Operation Indicators

The Programmable Multi-Axis Controller is equipped with indicators to show the current operations status of the Unit.

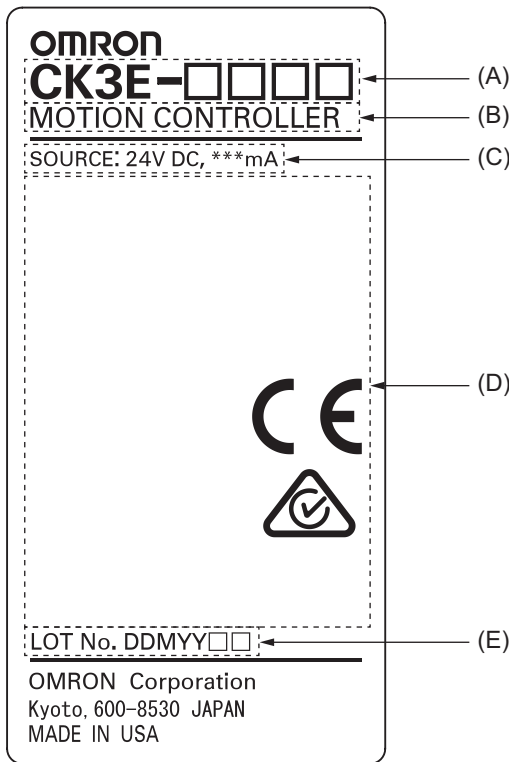


The operating statuses corresponding to colors and status of the indicators are shown below.

Letter	Indicator	Color	Status	Description
(A)	DIAG.MODE	Green	Lit	Not used.
(B)	ECAT LINK	Orange	Lit	The EtherCAT link is established.
			Not lit	The EtherCAT link is not established.
(C)	ECAT ACT	Yellow	Lit	The EtherCAT link is established.
			Flashing	Data communications are in progress after the EtherCAT link is established. Flashes every time data is sent or received.
			Not lit	The EtherCAT link is not established.
(D)	Ethernet LINK	Green/ Orange	Lit in green	The Ethernet link is established at 1 Gbps.
			Lit in orange	The Ethernet link is established at 100 Mbps.
			Not lit	The Ethernet link is not established.
(E)	Ethernet ACT	Yellow	Lit	The Ethernet link is established.
			Flashing	Data communications are in progress after the Ethernet link is established. Flashes every time data is sent or received.
			Not lit	The Ethernet link is not established.
(F)	PWR/ERR	Green/Red	Lit in green	Power is supplied to the Unit.
			Lit in red	Watchdog or another hardware error
			Not lit	Power is not supplied to the Unit.
(G)	RDY	Green	Lit	Power is supplied to the Unit, and the Unit is in operation-ready status.
			Not lit	Power is not supplied to the Unit, or initial processing is in progress.

3-3 ID Information Indication Label

The ID information indication label provides information relevant to the Programmable Multi-Axis Controller.



Item	Name	Description
(A)	Model	Refer to 2-1-1 Model on page 2-2.
(B)	Product name	Motion Controller
(C)	Power supply rating	Details of power supply rating
(D)	Standard logos	Logos used to represent applicable standards
(E)	Lot number	Information on the date of manufacturing. The lot number of the C3KE-series Programmable Multi-Axis Controller is specified in the form of DDMYY□□, where “DD” is the day, “M” is the month, and “YY” is the year the product is manufactured. “□□” is a character used by OMRON. For “M”, digits “1” to “9” respectively represent January to September, “X” represents October, “Y” November, and “Z” December.

4

Mounting and Wiring

This section describes the procedures for mounting the Programmable Multi-Axis Controller, wiring the power supply used for the Programmable Multi-Axis Controller, and wiring the Programmable Multi-Axis Controller.

4

4-1	Mounting the Programmable Multi-Axis Controller	4-2
4-1-1	Mounting the Programmable Multi-Axis Controller	4-2
4-1-2	Mounting Direction in Control Panels	4-3
4-1-3	Mounting Method in Control Panels	4-3
4-2	Power Supply Wiring	4-4
4-2-1	Power Supply Connector Specifications	4-4
4-2-2	Wiring the Power Supply Connector	4-4
4-3	Laying the EtherCAT Network	4-7
4-3-1	Supported Network Topologies	4-7
4-3-2	Installation Precautions	4-8
4-3-3	Installing EtherCAT Communications Cables	4-9
4-4	Laying the Ethernet Network	4-12
4-4-1	Installation Precautions	4-12
4-4-2	Installing Ethernet Networks	4-13
4-5	USB Memory Device Connection	4-16
4-6	Grounding	4-17
4-6-1	Considerations for Earthing Methods	4-17
4-6-2	Earthing Methods	4-18

4-1 Mounting the Programmable Multi-Axis Controller

4-1-1 Mounting the Programmable Multi-Axis Controller

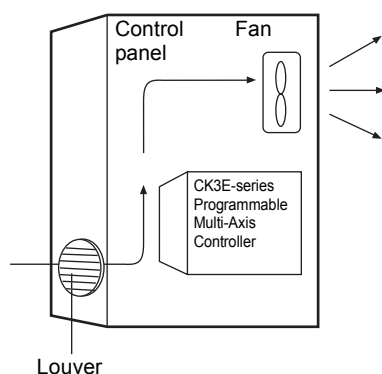
● Installation in Cabinets or Control Panels

When installing the Programmable Multi-Axis Controller in a cabinet or control panel, consider the ambient temperature, accessibility for operation and maintenance, noise immunity, as well as the mounting direction.

● Temperature Control

The allowable ambient operating temperature range of the Programmable Multi-Axis Controller is 0 to 45°C. When necessary, take the following steps to maintain the appropriate temperature.

- Provide sufficient space for adequate air flow.
- Do not install the Controller directly above equipment that generates a large amount of heat such as heaters, transformers, or high-capacity resistors.
- If the ambient temperature exceeds 45°C, install a cooling fan or air conditioner.

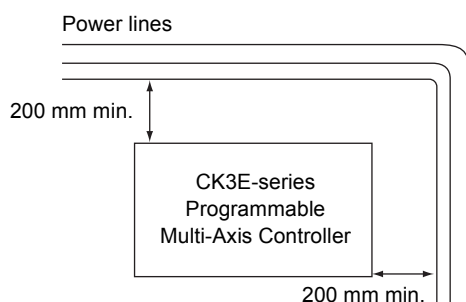


● Accessibility for Operation and Maintenance

- To ensure safe access for operation and maintenance, move the Controller as far away as possible from high-voltage equipment and electrical machinery.
- It will be easy to operate the Controller if it is mounted at a height of 1,000 to 1,600 mm above the floor.

● Improving Noise Resistance

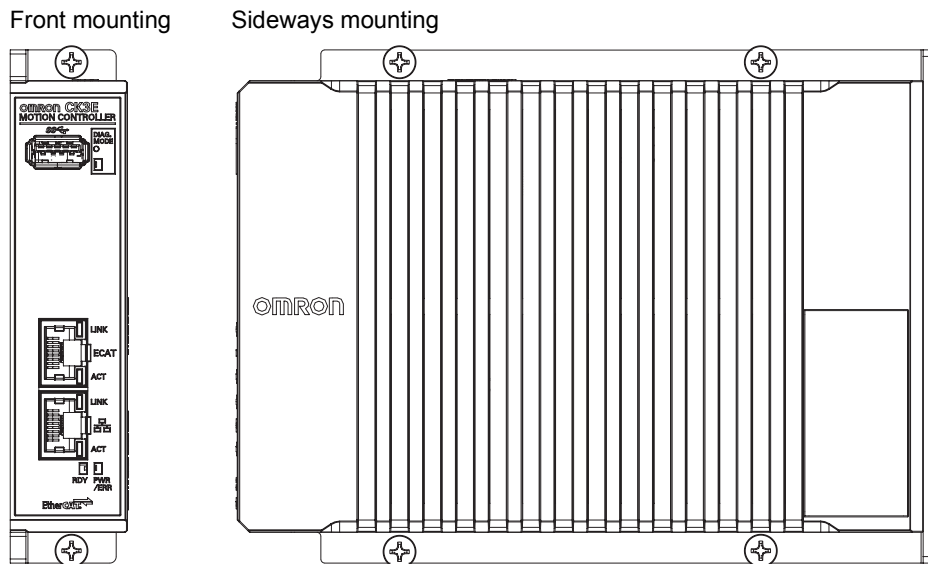
- Do not mount the Controller in a control panel containing high-voltage equipment.
- Install the Controller at least 200 mm away from power lines.



- Ground the mounting plate between the Controller and the mounting surface.

4-1-2 Mounting Direction in Control Panels

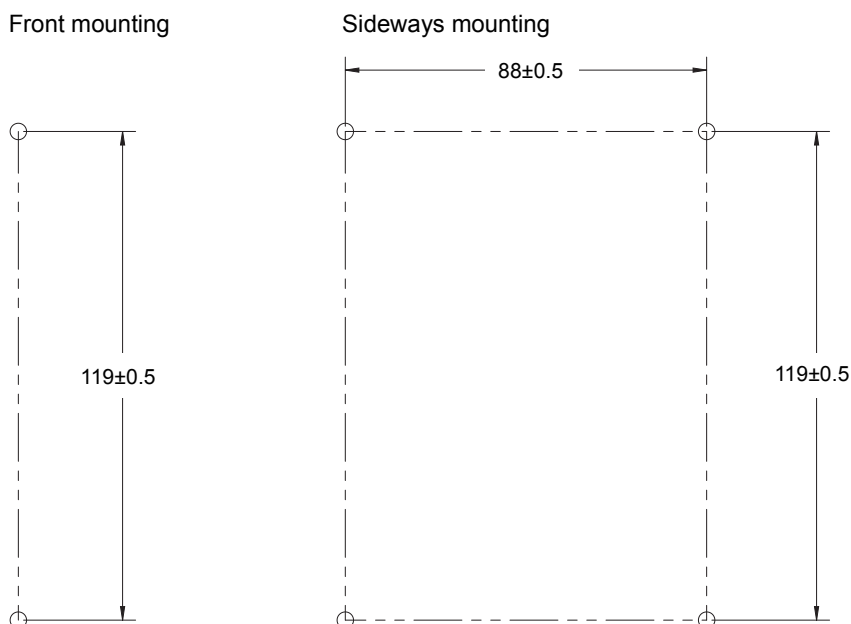
The Programmable Multi-Axis Controller can be installed facing the front or sideways. The Controller must be mounted in an upright position to provide appropriate cooling.



4-1-3 Mounting Method in Control Panels

The following shows the mounting method of the Programmable Multi-Axis Controller. It is recommended that M4 screws be used for mounting.

- 1** Create holes for the screws used to mount the Programmable Multi-Axis Controller. The screw positions are as follows.



- 2** Insert the screws into the designated positions to mount the Programmable Multi-Axis Controller.
- 3** Tighten the screws with 1.2 N-m torque to secure.

4-2 Power Supply Wiring

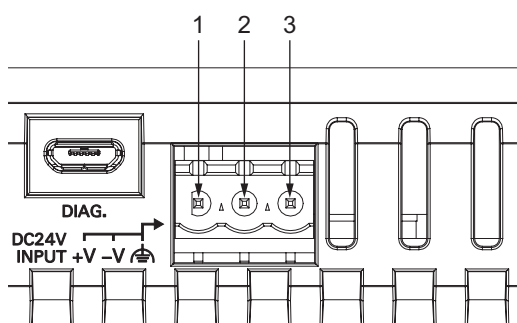
4-2-1 Power Supply Connector Specifications

The following power supply connector is used for the Programmable Multi-Axis Controller.

One power supply connector is included in the Programmable Multi-Axis Controller package.

Model	Manufacturer
MVSTBW 2.5/3-ST-5,08 (1792760)	Phoenix Contact

The following shows the pin assignment of the power supply connector used for the Programmable Multi-Axis Controller.



Pin	Description
1	24 VDC
2	0 VDC
3	Functional ground terminal

4-2-2 Wiring the Power Supply Connector

Compatible Wires

Wires that can be connected to terminal holes of the power supply connector are bar terminals attached to twisted wires, twisted wires, and solid wires.

Select a power supply conductor by considering voltage drops and heat due to the cable length within your installation environment. The following table provides information about the conductors that are compatible with this connector.

Wire type	Conductor cross-sectional area	Conductor length (stripping length)
Solid wire	0.2 to 2.5 mm ²	7 mm
Twisted wire	0.2 to 2.5 mm ²	7 mm
Twisted wire with bar terminal, without plastic sleeve	0.25 to 2.5 mm ²	7 mm
Twisted wire with bar terminal, with plastic sleeve	0.25 to 2.5 mm ²	7 mm

Grounding

The type of ground terminal on the Programmable Multi-Axis Controller is a functional ground terminal. A functional ground terminal takes protective measures for device and system functions, including prevention of noises from external sources, and prevention of noises from devices or equipment that may have harmful effects on other devices or equipment.

- Ground to 100 Ω or less, and as possible use a separate ground from those of other devices.
- If using an independent ground is not possible, then use a common ground. Connect to the ground pole of the other device.
- Never use a common ground particularly with a motor, inverter, or other type of high-power equipment. Use an independent ground so that they do not affect each other.
- To reduce the risk of receiving an electric shock, do not connect devices to ground poles to which multiple devices are connected.
- Use a ground pole as close to the Programmable Multi-Axis Controller as possible and keep the ground line as short as possible.

Tools Used

Use a flat-head screwdriver to connect and remove wires.

The recommended screwdriver is as follows.

Model	Manufacturer
SZF 0-0,4X2,5	Phoenix Contact

Procedure for Wiring the Power Supply Connector

The following shows the procedure for wiring the power supply connector.

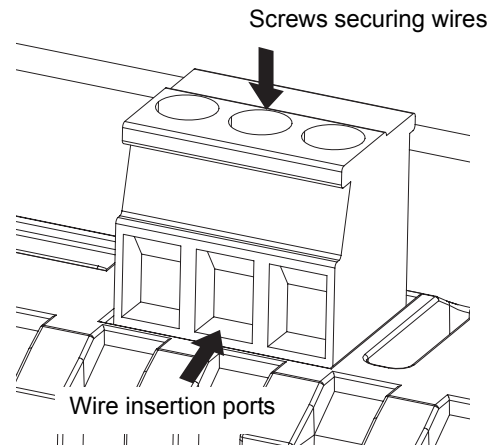
- 1** Peel off the sheath from the power supply cable.

The stripping length is 7 mm if a bar terminal is not used.

If a bar terminal is used, the stripping length must be determined according to the specification of the bar terminal.



- 2** Loosen the screws securing wires on the top of the power supply connector to release the wire insertion ports.



- 3** Insert the wires and tighten the screws.
Tighten the screws with 0.5 to 0.6 N-m torque.
Do not apply force to the cable after connecting the wires.

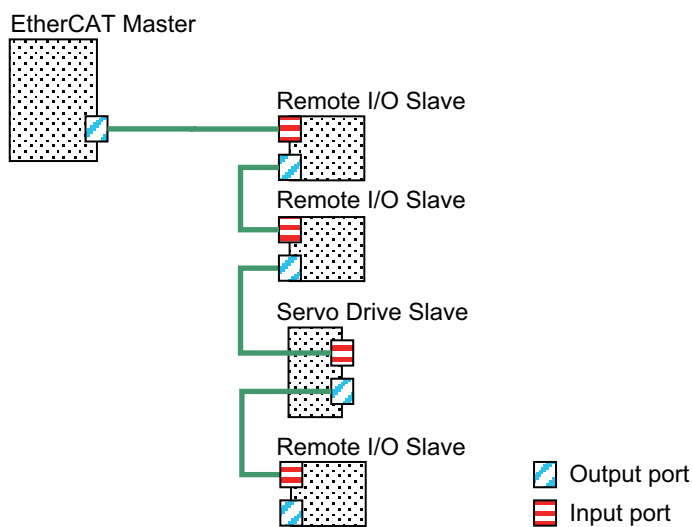
4-3 Laying the EtherCAT Network

This section describes how to install EtherCAT networks.

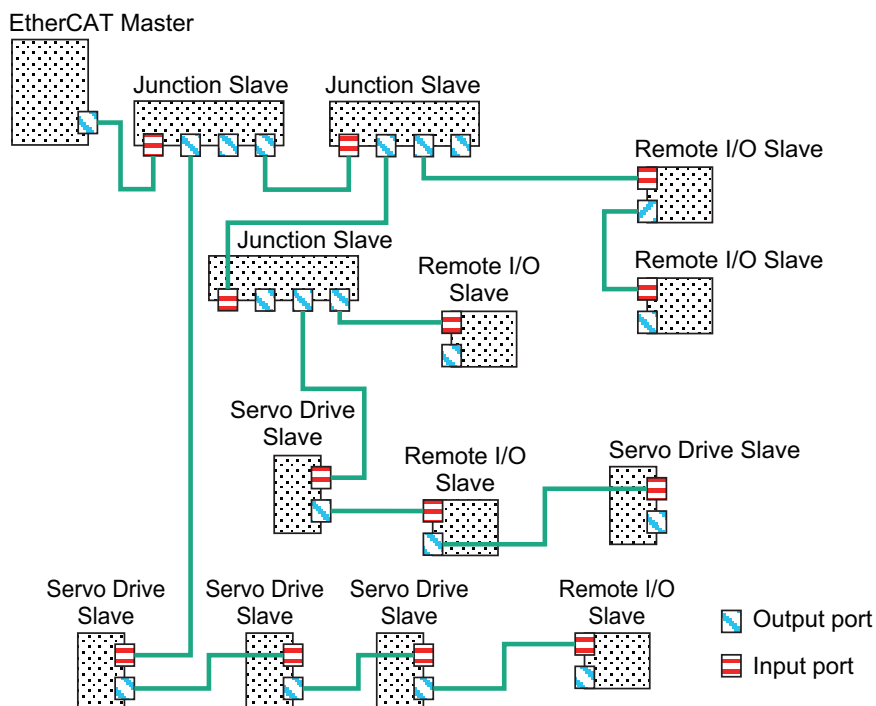
4-3-1 Supported Network Topologies

The Programmable Multi-Axis Controller can be connected using daisy chain connections with no branching, or with branching connections using Junction Slaves. Examples of topology without branching and with branching (Junction Slaves) are shown below.

● No Branching



● Branching



4-3-2 Installation Precautions

Basic precautions for the installation of EtherCAT networks are provided below.

Precautions when Installing a Network

- When you install an EtherCAT network, take sufficient safety precautions and follow the standards and specifications. (Refer to JIS X5252 or to electrical facility technical references.) An expert well versed in safety measures and the standards and specifications should be asked to perform the installation.
- Do not install EtherCAT network equipment near sources of noise. If the network must be installed in an area with noise, take steps to address the noise, such as placing equipment in metal cases.

Precautions when Installing Communications Cables

- Check the following items on the communications cables that are used in the network.
 - a) Are there any breaks?
 - b) Are there any shorts?
 - c) Are there any connector problems?
- When you connect the cable to the communications connectors on devices, firmly insert the communications cable connector until it locks in place.
- Do not lay the communications cables together with high-voltage lines.
- Do not lay the communications cable near devices that generate noise.
- Do not lay the communications cables in locations subject to high temperatures or high humidity.
- Do not lay the communications cables in locations subject to excessive dirt and dust or to oil mist or other contaminants.
- There are limitations on the bending radius of communications cables. Check the specifications of the communications cable for the bending radius.

4-3-3 Installing EtherCAT Communications Cables

Ethernet communications cables and connectors are used to connect the EtherCAT port of Programmable Multi-Axis Controller with EtherCAT slaves.

Use a straight, shielded twisted-pair cable (double shielding with aluminum tape and braiding) of Ethernet category 5 (100BASE-TX) or higher. Following products are recommended.

Cable with Connectors

● Sizes and Conductor Pairs: AWG 27 × 4 Pairs

Product name	Manufacturer	Cable length [m] ^{*1}	Model	Contact information
Cable with Connectors on Both Ends (RJ45/RJ45) Standard RJ45 plugs type	OMRON Corporation	0.3	XS6W-6LSZH8SS30 CM-Y ^{*2}	OMRON Customer Service Center
		0.5	XS6W-6LSZH8SS50 CM-Y ^{*2}	
		1	XS6W-6LSZH8SS100 CM-Y ^{*2}	
		10	XS6W-6LSZH8SS100 0CM-Y ^{*2}	

*1. For the latest list of the Cables, refer to the *Industrial Ethernet Connectors Catalog* (Cat. No. G019).

*2. The Cables are single-shielded, but the communication and noise characteristics are ensured to satisfy the standard values.

● Sizes and Conductor Pairs: AWG 22 × 2 Pairs

Product name	Manufacturer	Cable length [m] ^{*1}	Model	Contact information
Cable with Connectors on Both Ends (RJ45/RJ45) Rugged RJ45 plugs type	OMRON Corporation	0.3	XS5W-T421-AMD-K	OMRON Customer Service Center
		0.5	XS5W-T421-BMD-K	
		1	XS5W-T421-CMD-K	
		2	XS5W-T421-DMD-K	
		5	XS5W-T421-GMD-K	
		10	XS5W-T421-JMD-K	
Cable with Connectors on Both Ends (M12/M12) Shield Strengthening Connector cable M12/Smartclick Connectors	OMRON Corporation	0.5	XS5W-T421-BM2-SS	
		1	XS5W-T421-CM2-SS	
		2	XS5W-T421-DM2-SS	
		3	XS5W-T421-EM2-SS	
		5	XS5W-T421-GM2-SS	
		10	XS5W-T421-JM2-SS	
Cable with Connectors on Both Ends (M12 /RJ45) Shield Strengthening Connector cable M12/Smartclick Connectors Rugged RJ45 plugs type	OMRON Corporation	0.5	XS5W-T421-BMC-SS	
		1	XS5W-T421-CMC-SS	
		2	XS5W-T421-DMC-SS	
		3	XS5W-T421-EMC-SS	
		5	XS5W-T421-GMC-SS	
		10	XS5W-T421-JMC-SS	

*1. For the latest list of the Cables, refer to the *Industrial Ethernet Connectors Catalog* (Cat. No. G019).

Cables and Connectors

● Sizes and Conductor Pairs: AWG 24 × 4 Pairs

Part name	Manufacturer	Model	Contact information
Cables	Hitachi Metals, Ltd.	NETSTAR-C5E SAB 0.5 × 4P ^{*1}	Planning Department, Kanetsu Co., Ltd.
	Kuramo Electric Co., Ltd.	KETH-SB ^{*1}	Kuramo Electric Co., Ltd.
	SWCC Showa Cable Systems Co., Ltd.	FAE-5004 ^{*1}	SWCC Showa Cable Systems Co., Ltd.
	JMACS Japan Co., Ltd.	IETP-SB ^{*1}	JMACS Japan Co., Ltd.
RJ45 Connectors	Panduit Corporation	MPS588 ^{*1}	Panduit Corporation US Headquarters

*1. We recommend that you use combinations of the above Cables and Connectors.

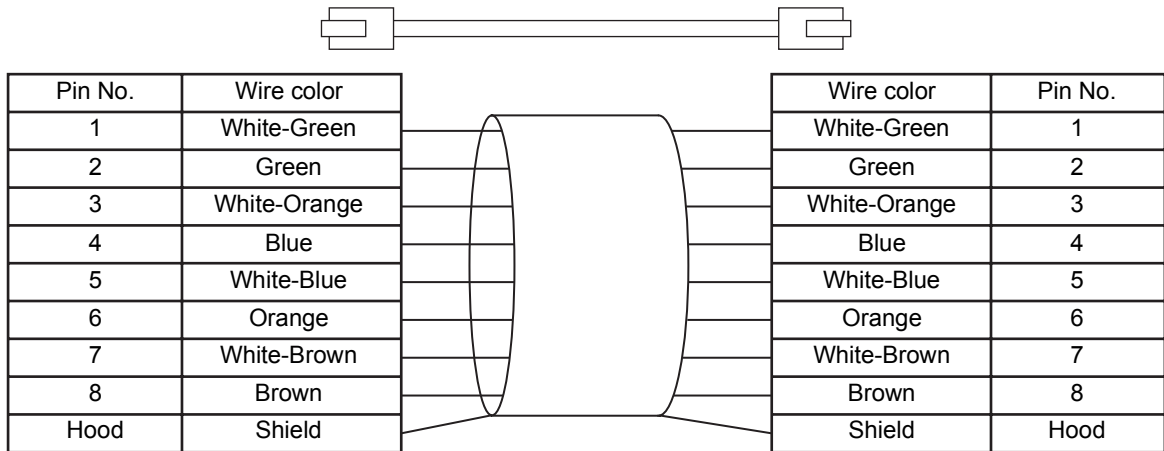
● Sizes and Conductor Pairs: AWG 22 × 2 Pairs

Part name	Manufacturer	Model	Contact information
Cables	Kuramo Electric Co., Ltd.	KETH-PSB-OMR ^{*1}	Kuramo Electric Co., Ltd.
	SWCC Showa Cable Systems Co., Ltd.	FAE-5002 ^{*1}	SWCC Showa Cable Systems Co., Ltd.
	JMACS Japan Co., Ltd.	PNET/B ^{*1}	JMACS Japan Co., Ltd.
RJ45 Assembly Connectors	OMRON Corporation	XS6G-T421-1 ^{*1}	OMRON Customer Service Center

*1. We recommend that you use combinations of the above Cables and Connectors.

Attaching the Connectors to the Cable and Pin Assignments

Use straight wiring to attach the connectors to the communications cable.

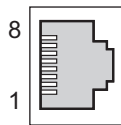


- *1. Connect the cable shield to the connector hood at both ends of the cable.
- *2. There are two connection methods for Ethernet: T568A and T568B. The T568A connection method is shown above, but the T568B connection method can also be used.

Connector Specifications

Item	Specification
Electrical characteristics	Conforms to IEEE 802.3 standards.
Connector structure	RJ45 8-pin modular connector (Conforms to ISO 8877.)

Pin Assignments



Pin No.	Signal name	Abbreviation	Signal direction
1	Transmission data +	TD+	Output
2	Transmission data –	TD–	Output
3	Reception data +	RD+	Input
4	Not used.	---	---
5	Not used.	---	---
6	Reception data –	RD–	Input
7	Not used.	---	---
8	Not used.	---	---
Hood	Frame ground	FG	---

4-4 Laying the Ethernet Network

4-4-1 Installation Precautions

Basic precautions for the installation of Ethernet networks are provided below.

Precautions when Installing a Network

- When you install an Ethernet network, take sufficient safety precautions and follow the standards and specifications. (Refer to JIS X5252 or to electrical facility technical references.)
An expert who is well trained in safety measures, standards and specifications should be asked to perform the installation.
- Do not install Ethernet network equipment near sources of noise.
If the network must be installed in an area subject to noise, take steps to address the noise, such as placing equipment in metal cases.

Precautions when Installing Communications Cables

- Check the following items on the communications cables that are used in the network.
 - a) Are there any breaks?
 - b) Are there any shorts?
 - c) Are there any connector problems?
- When you connect the cable to the communications connectors on devices, firmly insert the communications cable connector until it locks into place.
- Do not lay the communications cables together with high-voltage lines.
- Do not lay the communications cable near devices that generate noise.
- Do not lay the communications cables in locations subject to high temperatures or high humidity.
- Do not lay the communications cables in locations subject to excessive dirt and dust or to oil mist or other contaminants.
- There are limitations on the bending radius of communications cables. Check the specifications of the communications cable for the bending radius.

4-4-2 Installing Ethernet Networks

The following products are recommended as devices to be used to configure an Ethernet network.

Ethernet Switches

Manufacturer	Model	Function
OMRON Corporation	Model W4S1-03B	Priority control (QoS): Control data of EtherNet/IP is prioritized.
	Model W4S1-05B	Failure detection: Broadcast storm, LSI error detection, 10/100BASE-TX, Auto negotiation
	Model W4S1-05C	Number of ports (Model W4S1-03B:3, Model W4S1-05B:5, Model W4S1-05C:5)
Cisco Systems Inc.	Contact the manufacturer.	
CONTEC Co., Ltd.	Contact the manufacturer.	
Phoenix Contact	Contact the manufacturer.	

Twisted-pair Cables, Connectors

● Sizes and Conductor Pairs: AWG 24 × 4 Pairs (for 1000BASE-T/100BASE-TX)

Part name	Manufacturer	Model	Contact
Cables	Hitachi Metals, Ltd.	NETSTAR-C5ESAB 0.5 × 4P ^{*1}	Planning Department, Kanetsu Co., Ltd.
	Kuramo Electric Co., Ltd.	KETH-SB ^{*1}	Kuramo Electric Co., Ltd.
	SWCC Showa Cable Systems Co., Ltd.	FAE-5004 ^{*1}	SWCC Showa Cable Systems Co., Ltd.
RJ45 Connectors	Panduit Corporation	MPS588 ^{*1}	Panduit Corporation Osaka office, Japan branch

*1. We recommend that you use combinations of the above-mentioned Cables and Connectors.

● Sizes and Conductor Pairs: AWG 22 × 2 Pairs (for 100BASE-TX)

Part name	Manufacturer	Model	Contact
Cables	Kuramo Electric Co., Ltd.	KETH-PSB-OMR ^{*1}	Kuramo Electric Co., Ltd.
	SWCC Showa Cable Systems Co., Ltd.	FAE-5002 ^{*1}	SWCC Showa Cable Systems Co., Ltd.
	JMACS Japan Co., Ltd.	PNET/B ^{*1}	JMACS Japan Co., Ltd.
RJ45 Assembly Connectors	OMRON Corporation	Model XS6G-T421-1 ^{*1}	OMRON Customer Service Center

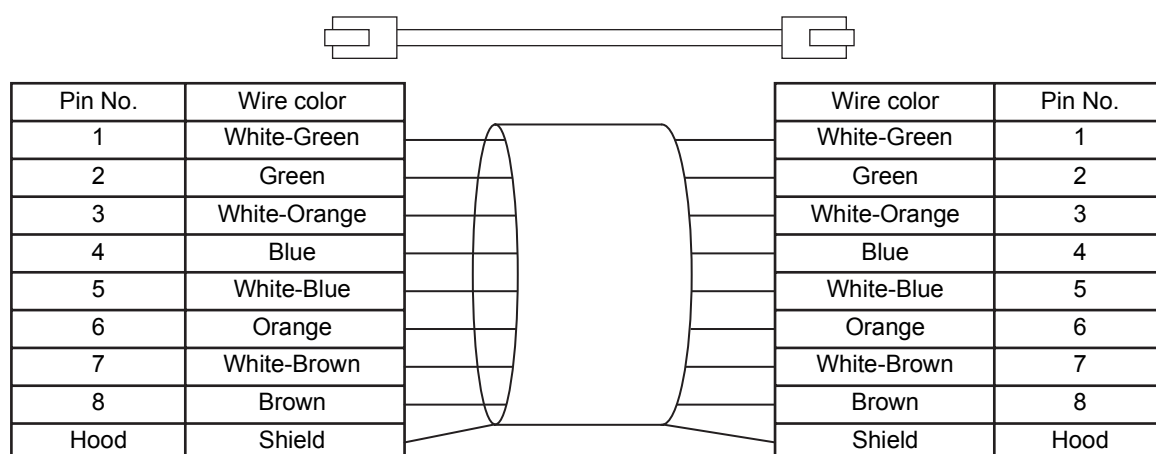
*1. We recommend that you use combinations of the above-mentioned Cables and Connectors.

● Size and conductor pairs: 0.5 mm × 4 Pairs (for 100BASE-TX)

Part name	Manufacturer	Model	Contact
Cables	Fujikura Ltd.	F-LINK-E 0.5 mm × 4 Pairs	Planning Department, Kanetsu Co., Ltd.
RJ45 Connectors	Panduit Corporation	MPS588	Panduit Corporation Osaka office, Japan branch

Attaching the Connectors to the Cable and Pin Assignments

Use straight wiring to attach the connectors to the communications cable.



*1. Connect the cable shield to the connector hood at both ends of the cable.

*2. There are two connection methods for Ethernet: T568A and T568B. The T568A connection method is shown above, but the T568B connection method can also be used.

● Connector Specifications

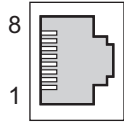
Item	Specification
Electrical characteristics	Conforms to IEEE 802.3 standards.
Connector structure	RJ45 8-pin modular connector (Conforms to ISO 8877.)

● Pin Assignments

Physical layer standards: 100BASE-TX

Pin No.	Signal name	Abbrevia- tion	Signal direc- tion
1	Transmission data +	TD+	Output
2	Transmission data -	TD-	Output
3	Reception data +	RD+	Input
4	Not used.	---	---
5	Not used.	---	---
6	Reception data -	RD-	Input
7	Not used.	---	---
8	Not used.	---	---

Physical layer standards: 1000BASE-T



Pin No.	Signal name	Abbrevia- tion	Signal direc- tion
1	Communication data DA+	BI_DA+	Input/output
2	Communication data DA-	BI_DA-	Input/output
3	Communication data DB+	BI_DB+	Input/output
4	Communication data DC+	BI_DC+	Input/output
5	Communication data DC-	BI_DC-	Input/output
6	Communication data DB-	BI_DB-	Input/output
7	Communication data DD+	BI_DD+	Input/output
8	Communication data DD-	BI_DD-	Input/output

Recommended Clamp Core and Attachment Procedure

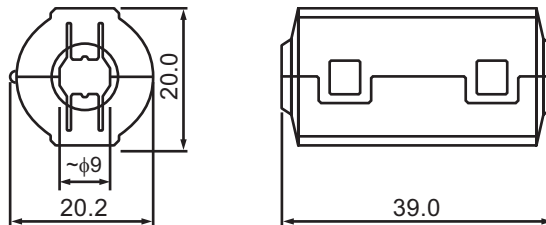
An Ethernet communications error may occur even when the recommended cable and RJ45 connector are used. In that case, attach a clamp core to the Ethernet communications cable.

The following shows the recommended clamp core and the procedure to attach it. The EU Directive (EN 61326) ensures the compliance of the recommended clamp core in the state where it is attached using the recommended procedure.

● Recommended Clamp Core Model

Manufacturer	Product name	Model
NEC TOKIN	Clamp core	ESD-SR-160

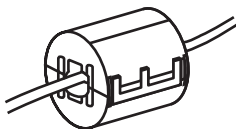
● Dimensions of the Recommended Product



● Recommended Attachment Procedure

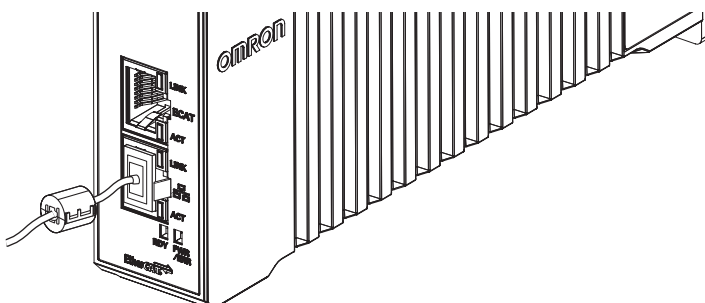
(a) Attaching the clamp core to the cable

Make one loop with the Ethernet communications cable as shown in the figure below.



(b) Attachment position

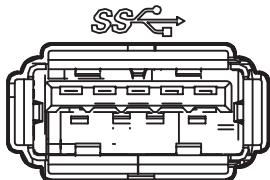
Secure the clamp core to the Ethernet communications cable close to the Ethernet communications connector as shown in the figure below.



4-5 USB Memory Device Connection

Connect a USB memory device to the USB host port (Type A) on the Programmable Multi-Axis Controller to upload and download data as well as to save relevant data.

Refer to 2-2-1 *USB Memory Device* on page 2-5 for information on the recommended USB memory devices.



4-6 Grounding

This section describes the earthing methods and precautions.

4-6-1 Considerations for Earthing Methods

Local potential fluctuations due to lightning or noise occurred by power devices will cause potential fluctuations between ground terminals of devices. This potential fluctuation may result in device malfunction or damage. To prevent this, it is necessary to suppress the occurrence of a difference in electrical potential between ground terminals of devices. You need to consider the earthing methods to achieve this objective.

The recommended earthing methods are given in the following table.

Specification of communications cables for EtherCAT and EtherNet	Earthing methods			
	Equipoten- tial bonding system	Star earthing		Daisy chain
		Connecting devices and noise sources to separate earth elec- trodes	Connecting devices and noise sources to a common earth electrode	
The cable shield connected to the connector hood at both ends of the communications cable	Recom- mended	Recommended	Not recom- mended	Not recom- mended



Additional Information

- In a country or region where the earthing method is regulated, you must comply with the regulations. Refer to the applicable local and national ordinances of the place where you install the system, or other international laws and regulations.
- When using Ethernet switches, ask the Ethernet switch manufacturer for information on the environmental resistance of the Ethernet switch to use, the grounding between Ethernet switches, or the specifications of cables.

4-6-2 Earthing Methods

Each of these earthing methods is given below.

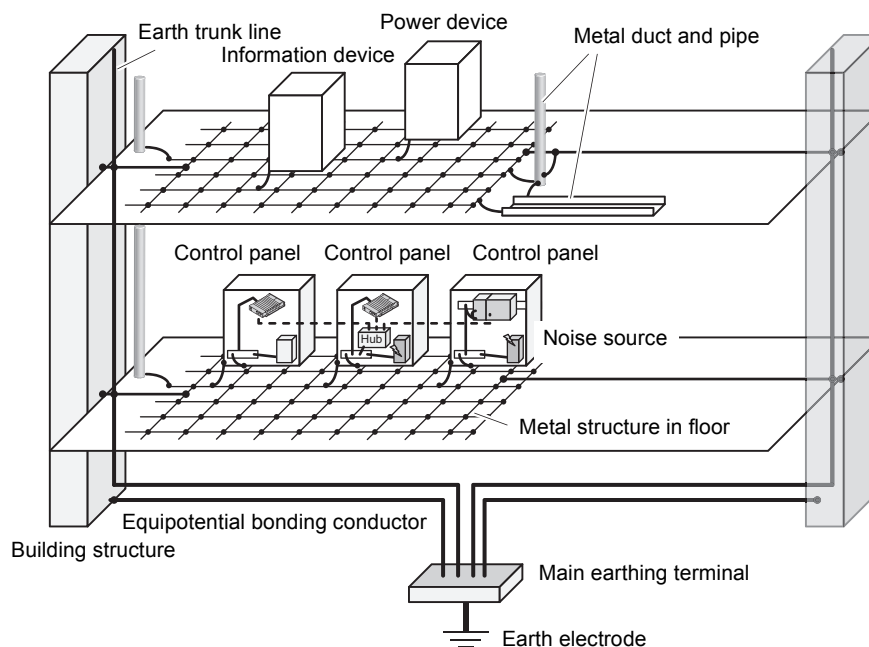
Equipotential Bonding System

Equipotential bonding is an earthing method in which steel frames and building structures, metal ducts and pipes, and metal structures in floors are connected together and make connections to the earth trunk line to achieve a uniform potential everywhere across the entire building. We recommend this earthing method.

The following figure shows an example of an equipotential bonding system.

Connect the main earthing terminal and building structures together with equipotential bonding conductors and embed the mesh ground line in each floor.

Connect the ground line of each control panel to the equipotential bonding system.



Star Earthing

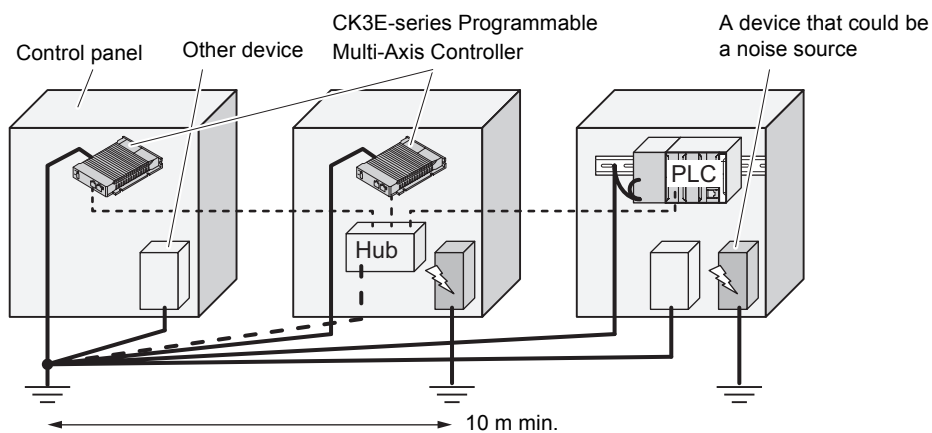
If the earthing method used for the building is not equipotential bonding or the earthing system is unknown, choose (a) from among the earthing methods given below.

(a) Connecting devices and noise sources to separate earth electrodes

This is an earthing method to separately ground an earth electrode of the device that is connected with a communications cable or other devices and an earth electrode of a high-power device that could be a noise source, such as a motor or inverter.

Each earth electrode must be grounded to $100\ \Omega$ or less.

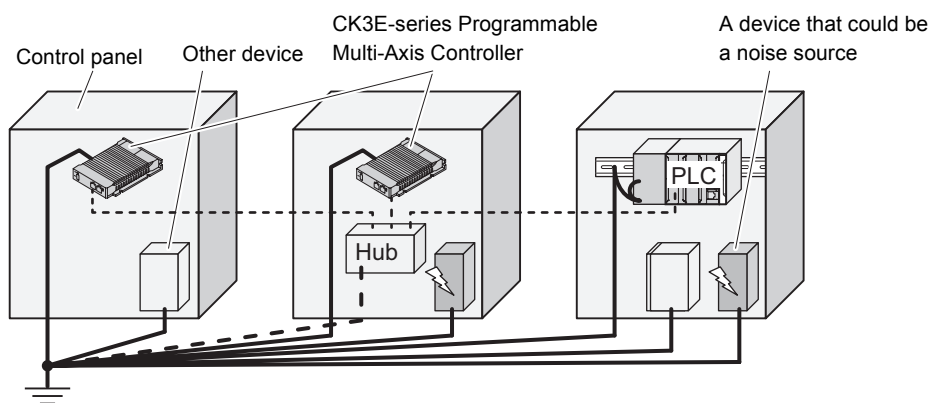
Connect the ground lines of the device that is connected with a communications cable and other devices as a bundle to a single earth electrode. Be sure that the earth electrode is separated by a minimum of 10 m from any other earth electrode of a device that could be a noise source.



(b) Connecting devices and noise sources to a common earth electrode

This is an earthing method to connect the device that is connected with a communications cable, other devices, and a device that could be a noise source, to a common earth electrode.

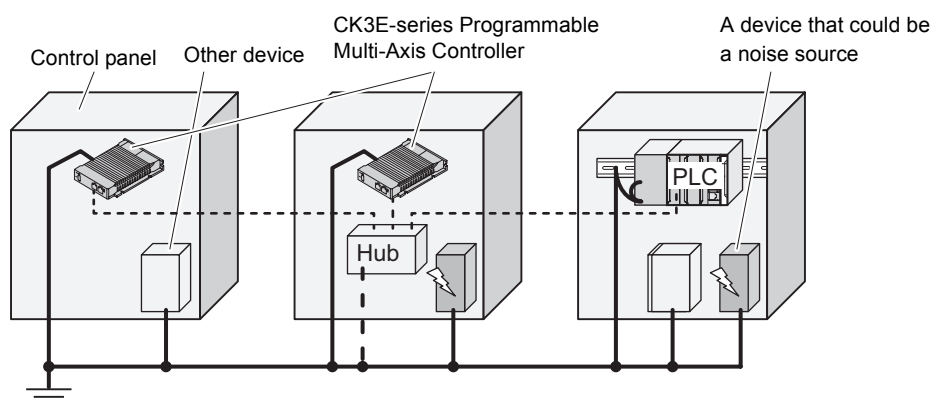
This earthing method is not recommended because the device that could be a noise source may interfere electromagnetically with other devices.



Daisy Chain

This is an earthing method to connect the device that is connected with a communications cable, other devices, and a device that could be a noise source using a daisy-chain topology to a common earth electrode.

This earthing method is not recommended because the device that could be a noise source may interfere electromagnetically with other devices.



5

Error Processing

This section describes the procedures for checking errors that may occur during operation of the Programmable Multi-Axis Controller and taking corrective actions for the errors.

5-1	Classification of Errors	5-2
5-2	Using the Indicators to Check Errors	5-3
5-2-1	Indicator Types	5-3
5-2-2	Procedure for Determining Errors	5-4
5-3	Corrective Actions for Errors	5-5
5-3-1	Fatal Errors in the Programmable Multi-Axis Controller	5-5
5-3-2	Non-fatal Errors in the Programmable Multi-Axis Controller	5-6

5-1 Classification of Errors

The errors in the Programmable Multi-Axis Controller are classified into the following two major categories.

- **Fatal errors in the Programmable Multi-Axis Controller**

Errors that occurred as the result of the Programmable Multi-Axis Controller being disabled.

- **Non-fatal errors in the Programmable Multi-Axis Controller**

Errors that can be detected and managed by the Programmable Multi-Axis Controller itself that is still operating.

5-2 Using the Indicators to Check Errors

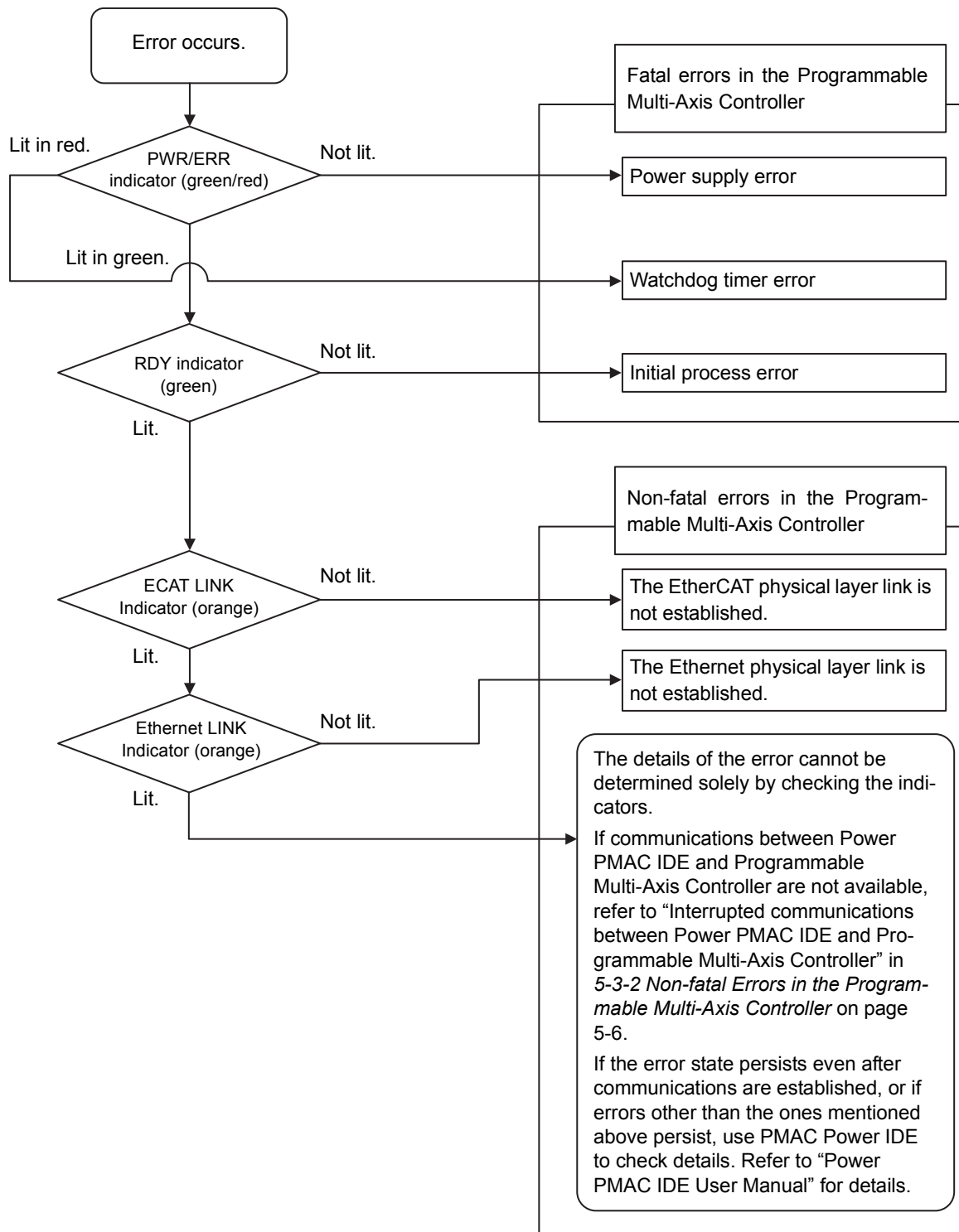
5-2-1 Indicator Types

The following shows the indicators on the Programmable Multi-Axis Controller and their functions.

Indicator	Function
ECAT LINK	Shows the link status of EtherCAT communications.
ECAT ACT	Shows the data communications status of EtherCAT communications.
Ethernet LINK	Shows the link status of Ethernet communications.
Ethernet ACT	Shows the data communications status of Ethernet communications.
PWR/ERR	Shows the power supply status to the Unit and the error status.
RDY	Shows whether the Unit is in operation-ready status.

5-2-2 Procedure for Determining Errors

When an error occurs in the Programmable Multi-Axis Controller, use the following flowchart to check the indicators and determine whether the error is “fatal” or “non-fatal”.



5-3 Corrective Actions for Errors

5-3-1 Fatal Errors in the Programmable Multi-Axis Controller

For fatal errors in the Programmable Multi-Axis Controller, take the following corrective actions depending on the nature of the error.

Details	Cause	Corrective action
Power supply error	The unit's input power is not supplied.	Check the following items and adequately supply adequate power to the unit. <ul style="list-style-type: none"> • Is the power turned on? • Is the power cable wired correctly? • Is the power cable free of damage?
	The unit's input power voltage is outside the permissible range.	Check the following items and adjust the voltage so that it falls within the permissible range. <ul style="list-style-type: none"> • Is the power voltage within the specification range? • Is the power capacity sufficient? • Is the power supply failing?
	The power supply unit of the Programmable Multi-Axis Controller failed.	If the error still persists even after the above corrective actions have been taken, replace the Programmable Multi-Axis Controller.
Watchdog timer error	Intrusion of noise	Check the FG, power supply lines, communications lines, and other noise entry paths, and implement noise-related countermeasures as required.
	Software watchdog trip caused by the insufficient task processing time or failed task interruption.	For details, refer to the following manuals. <ul style="list-style-type: none"> • Power PMAC User's Manual • Power PMAC Software Reference Manual
	A momentary power interruption occurred in the Programmable Multi-Axis Controller during operation caused by a momentary power interruption of the unit's power supply.	Take appropriate measures to ensure that the specified power with the rated voltage and frequency is supplied in places where the power supply is unstable.
	The Programmable Multi-Axis Controller failed.	Replace the Programmable Multi-Axis Controller.
Initial process error	Intrusion of noise	Check the FG, power supply lines, communications lines, and other noise entry paths, and implement noise-related countermeasures as required.
	The Programmable Multi-Axis Controller failed.	Replace the Programmable Multi-Axis Controller.

5-3-2 Non-fatal Errors in the Programmable Multi-Axis Controller

For non-fatal errors in the Programmable Multi-Axis Controller, take the following corrective actions depending on the nature of the error.

Details	Cause	Corrective action
The EtherCAT physical layer link is not established.	The Ethernet cable used for EtherCAT communications is broken or the specified cable is not being used.	If the Ethernet cable is broken or if the specified cable was not used, replace the cable.
	A connector on the Ethernet cable used for EtherCAT communications is disconnected, the contact is faulty, or parts are faulty.	Reconnect the connector and check to ensure it is mated correctly.
	Noise	Check noise entry paths, and implement noise-related countermeasures as required.
	A slave within the EtherCAT network configuration failed.	Replace the slave.
	The Programmable Multi-Axis Controller failed.	Replace the Programmable Multi-Axis Controller.
The Ethernet physical layer link is not established.	The Ethernet cable used for Ethernet communications is broken or the specified cable is not being used.	If the Ethernet cable is broken or if the specified cable was not used, replace the cable.
	A connector on the Ethernet cable used for Ethernet communications is disconnected, the contact is faulty, or parts are faulty.	Reconnect the connector and check to ensure it is mated correctly.
	Noise	Check noise entry paths, and implement noise-related countermeasures as required.
	A device within the Ethernet network configuration failed.	Replace the device.
	The Programmable Multi-Axis Controller failed.	Replace the Programmable Multi-Axis Controller.
Interrupted communications between Power PMAC IDE and Programmable Multi-Axis Controller	The Ethernet cable used for Ethernet communications between Power PMAC IDE and Programmable Multi-Axis Controller is disconnected and then reconnected while communications are being established, which caused communications to be interrupted.	If communications are interrupted between Power PMAC IDE and Programmable Multi-Axis Controller while Ethernet communications are established between them, the communications cannot be reestablished simply by rectifying the problem that interrupted the communications. To reestablish the communication, you need to restart Power PMAC IDE or reestablish the communications by using Power PMAC IDE. Refer to "Power PMAC IDE User Manual" for details.
	The power to the Ethernet switch between Power PMAC IDE and Programmable Multi-Axis Controller is turned OFF and then ON while communications are being established, which caused communications to be interrupted.	
	The power to Programmable Multi-Axis Controller is turned OFF and then ON while communications are being established, which caused communications to be interrupted.	
	Communications are temporarily interrupted by noise.	Check noise entry paths, and implement noise-related countermeasures as required. Then reestablish communications between Power PMAC IDE and Programmable Multi-Axis Controller. To reestablish the communication, you need to restart Power PMAC IDE or reestablish the communications by using Power PMAC IDE. Refer to "Power PMAC IDE User Manual" for details.

6

Inspection and Maintenance

This section describes the procedures for the cleaning, inspection, and maintenance of the Programmable Multi-Axis Controller.

6-1	Cleaning and Maintenance	6-2
6-1-1	Cleaning	6-2
6-1-2	Periodic Inspections	6-2
6-2	Maintenance Procedures	6-4
6-2-1	Unit Replacement Precautions	6-4
6-2-2	Backup	6-4
6-2-3	Unit Replacement	6-4

6-1 Cleaning and Maintenance

6-1-1 Cleaning

Perform the following cleaning procedures periodically to ensure the Programmable Multi-Axis Controller is maintained in optimum operating condition.

- During daily cleaning, wipe off dust and dirt using a soft, dry cloth.
- If any dust or dirt remains even after wiping using a soft, dry cloth, wipe over with a cloth that has been wet with a sufficiently diluted detergent (2%) and wrung dry.
- Smudges may remain on the Unit from gum, vinyl, or tape that was left on for a long time. Remove the smudges when cleaning.

6-1-2 Periodic Inspections

The Programmable Multi-Axis Controller can deteriorate under adverse environmental conditions. Periodic inspections are thus required to ensure that the required conditions are being maintained.

Inspection is recommended at least once every six months to a year, but more frequent inspections will be necessary in adverse environments.

Take immediate steps to correct the situation if any of the conditions in the following table are not met.

Periodic Inspection Items

No.	Item	Inspection details	Criteria	Correction
1	External power supply	Check for voltage fluctuations at the power supply terminals.	The voltage must be within the allowable voltage fluctuation range.	Take necessary steps to bring the voltage of the supplied power to within the allowable voltage fluctuation range.
2	Ambient environment	Check the ambient temperature. (Inside the control panel if the Controller is in a control panel.)	0 to 45°C	Use a thermometer to check the temperature and ensure that the ambient temperature remains within the allowed range of 0 to 45°C.
		Check the ambient humidity. (Inside the control panel if the Controller is in a control panel.)	Relative humidity must be 10% to 95% with no condensation.	Use a hygrometer to check the humidity and ensure that the ambient relative humidity remains between 10% and 95%. Make sure that no condensation forms due to rapid changes in temperature.
		Check that the Controller is not in direct sunlight.	Not in direct sunlight	Protect the Controller if necessary.
		Check for accumulation of dirt, dust, salt, metal powder, etc.	No accumulation	Clean and protect the Controller if necessary.

No.	Item	Inspection details	Criteria	Correction
2	Ambient environment	Check for water, oil, or chemical sprays hitting the Controller.	No spray	Clean and protect the Controller if necessary.
		Check for corrosive or flammable gases in the area of the Controller.	No corrosive or flammable gases	Check by smell or use a sensor.
		Check the level of vibration or shock.	Vibration resistance and shock resistance must be within specifications.	Install cushioning or shock absorbing equipment if necessary.
		Check for noise sources near the Controller.	No significant noise sources	Either separate the Controller and noise source or protect the Controller.
3	Mounting and wiring status	Check that cable connectors are fully inserted and locked.	No looseness	Fully inserted and lock the connectors.
		Check for damaged external wiring cables.	No visible damage	Check visually and replace cables if necessary.

Tools Required for Inspections

● Required Tools

- Flat-head screwdriver
- Phillips screwdriver
- Voltage tester or digital voltmeter
- Industrial alcohol and clean cotton cloth
- Antistatic gas duster

● Tools Required Occasionally

- Oscilloscope
- Thermometer and hygrometer

6-2 Maintenance Procedures

This section describes the procedures for backing up the Programmable Multi-Axis Controller data and replacing a Unit.

6-2-1 Unit Replacement Precautions

Note the following when replacing any faulty Unit.

- Do not replace a Unit until the power is turned OFF.
- Check the new Unit to ensure that there are no errors.
- If you return a faulty Unit for repair, describe the problem in as much detail as possible and enclose this description with the Unit.

6-2-2 Backup

Back up the Programmable Multi-Axis Controller data so that the data can be restored when a failure or other problems occur.

Use Power PMAC IDE to create a backup file. Power PMAC IDE is also used to restore the backup file to the Programmable Multi-Axis Controller.

For details of the backup and restoration procedures, refer to “Power PMAC IDE User Manual”.

6-2-3 Unit Replacement

Procedure for Replacing the Programmable Multi-Axis Controller

The following describes the basic procedure for replacing the Programmable Multi-Axis Controller.

No.	Step	Description	Reference
1	Creation of a backup file	Create a backup file for the Programmable Multi-Axis Controller by using Power PMAC IDE. The backup file can be saved on the computer hard disk where Power PMAC IDE is installed or on a USB memory device connected to the computer.	Refer to “Power PMAC IDE User Manual” for details.
2	Deactivation of the currently connected network	Deactivate the EtherCAT network. If the Programmable Multi-Axis Controller has been connected to the Ethernet network, take appropriate measures so that disconnection of the Controller from the network does not affect your operations.	Refer to “Power PMAC IDE User Manual” for details.
3	Removal	Turn OFF the power to the Programmable Multi-Axis Controller, and disconnect cables.	---
4	Mounting	Replace the Programmable Multi-Axis Controller with a new one, connect the cables, and turn the power ON.	---
5	Connection with Power PMAC IDE	Establish communications between Power PMAC IDE and the new Programmable Multi-Axis Controller.	Refer to “Power PMAC IDE User Manual” for details.

No.	Step	Description	Reference
6	Restoration and verification	Restore the backup file to the Programmable Multi-Axis Controller by using Power PMAC IDE. Then, verify the file restored to the Programmable Multi-Axis Controller with the backup file to ensure that the backup file has been adequately restored.	Refer to "Power PMAC IDE User Manual" for details.
7	Activation of the EtherCAT network	Activate the EtherCAT network by using Power PMAC IDE and change the state of the connected EtherCAT slaves to an operational state.	Refer to "Power PMAC IDE User Manual" for details.
8	Checking operation	By using Power PMAC IDE and the actual machine, check the motor settings and that the program has been adequately restored.	Refer to "Power PMAC IDE User Manual" for details.

Procedure to Replace an EtherCAT Slave

To replace an EtherCAT slave connected to the Programmable Multi-Axis Controller, you can only disconnect the target slave and slaves connected after it from the EtherCAT network. This enables you to replace slaves without interrupting the total communication system when performing maintenance or replacement work in the case a slave malfunctions.

The following describes the basic procedure to replace a slave connected to the Programmable Multi-Axis Controller.

No.	Step	Description	Reference
1	State transition instruction	By using Power PMAC IDE, instruct the slave to be replaced and slaves connected after it to change to the init state. The init state is a state where communications cannot be carried out. Then, ensure that the state transition of the slaves has been completed successfully.	Refer to "Power PMAC Software Reference Manual".
2	Disconnection of the Unit to be replaced	Turn OFF the unit power supply of the slave to be replaced or remove the EtherCAT communications cable to disconnect the slave from the EtherCAT network.	---
3	Mounting of a Unit	Connect a new slave to the EtherCAT network, and turn ON the unit power supply of the slave. In doing so, reconfigure the settings, if required, by referring to the manual for the slave.	Refer to the manual for the EtherCAT slave.
4	Mounting and wiring of the Programmable Multi-Axis Controller	By using Power PMAC IDE, instruct the slave in the init state to change to the communications status (pre-operational state, safe-operational state, or operational state) and allow it to connect to the EtherCAT network. Refer to "Power PMAC Software Reference Manual" for detailed instructions.	Refer to "Power PMAC Software Reference Manual".
5	Confirmation of connection	Make sure that the state transition of the slaves has been completed successfully.	Refer to "Acontis EC-Engineer manual" and "Power PMAC Software Reference Manual".



Appendices

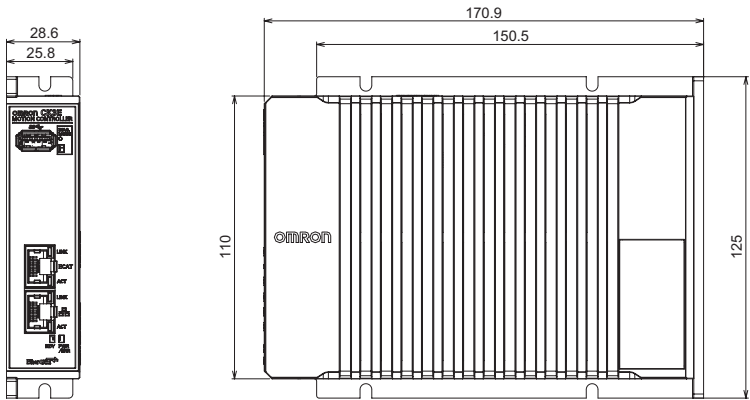
The following provides the dimension diagram, and restrictions on using the OMRON EtherCAT Coupler Unit.

A-1	Dimension Diagram	A-2
A-2	Restrictions on Using the OMRON NX-Series EtherCAT Coupler Unit	A-3

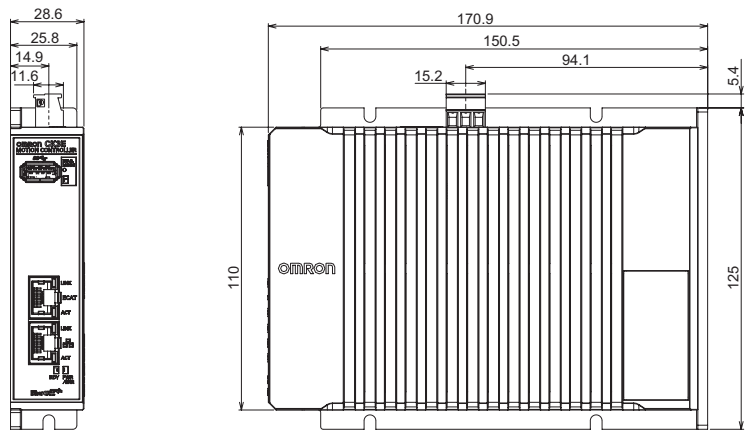
A-1 Dimension Diagram

The following shows the dimension diagrams of the Programmable Multi-Axis Controller. The unit of dimension is millimeter.

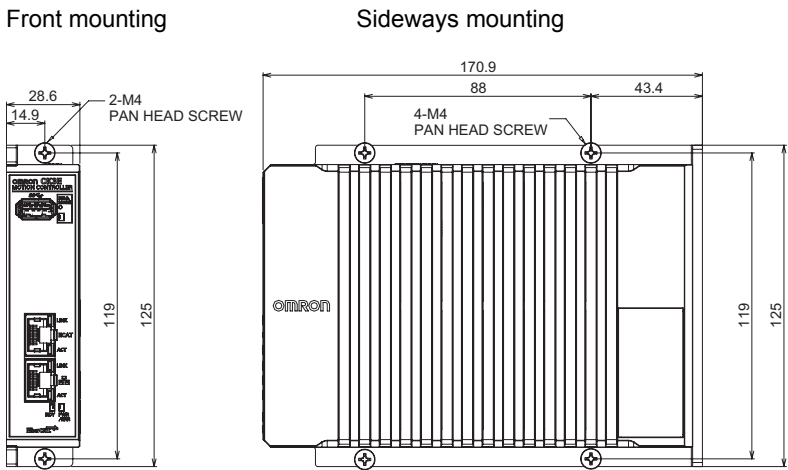
● Main Body Only



● With Power Connector



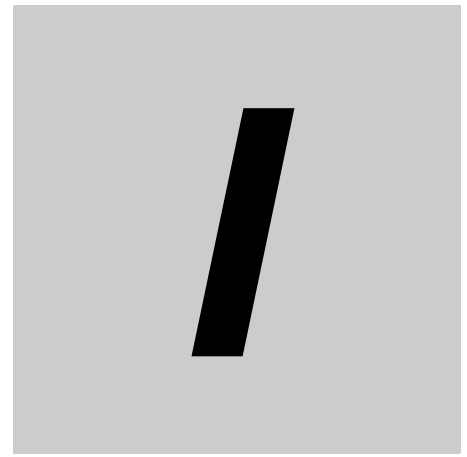
● Mounting Dimensions



A-2 Restrictions on Using the OMRON NX-Series EtherCAT Coupler Unit

When OMRON NX-series EtherCAT Coupler Units are used as slaves of the Programmable Multi-Axis Controller as the EtherCAT master, the following models and unit versions of EtherCAT Coupler Units can be connected.

Model	Unit version	Connectable/Unconnectable
Model NX-ECC203	Ver. 1.4 or later	Connectable
	Ver. 1.3 or earlier	Unconnectable
Model NX-ECC202	All versions	
Model NX-ECC201	All versions	



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