

CK3E-series

Programmable Multi-Axis Controller

Hardware
User's Manual

CK3E-1□10

Programmable Multi-Axis Controller



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Introduction

Thank you for purchasing the CK3E-series Programmable Multi-Axis Controller (hereinafter, it may be abbreviated as “Motion 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 product 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 (electrical engineers or the equivalent).

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

Applicable Products

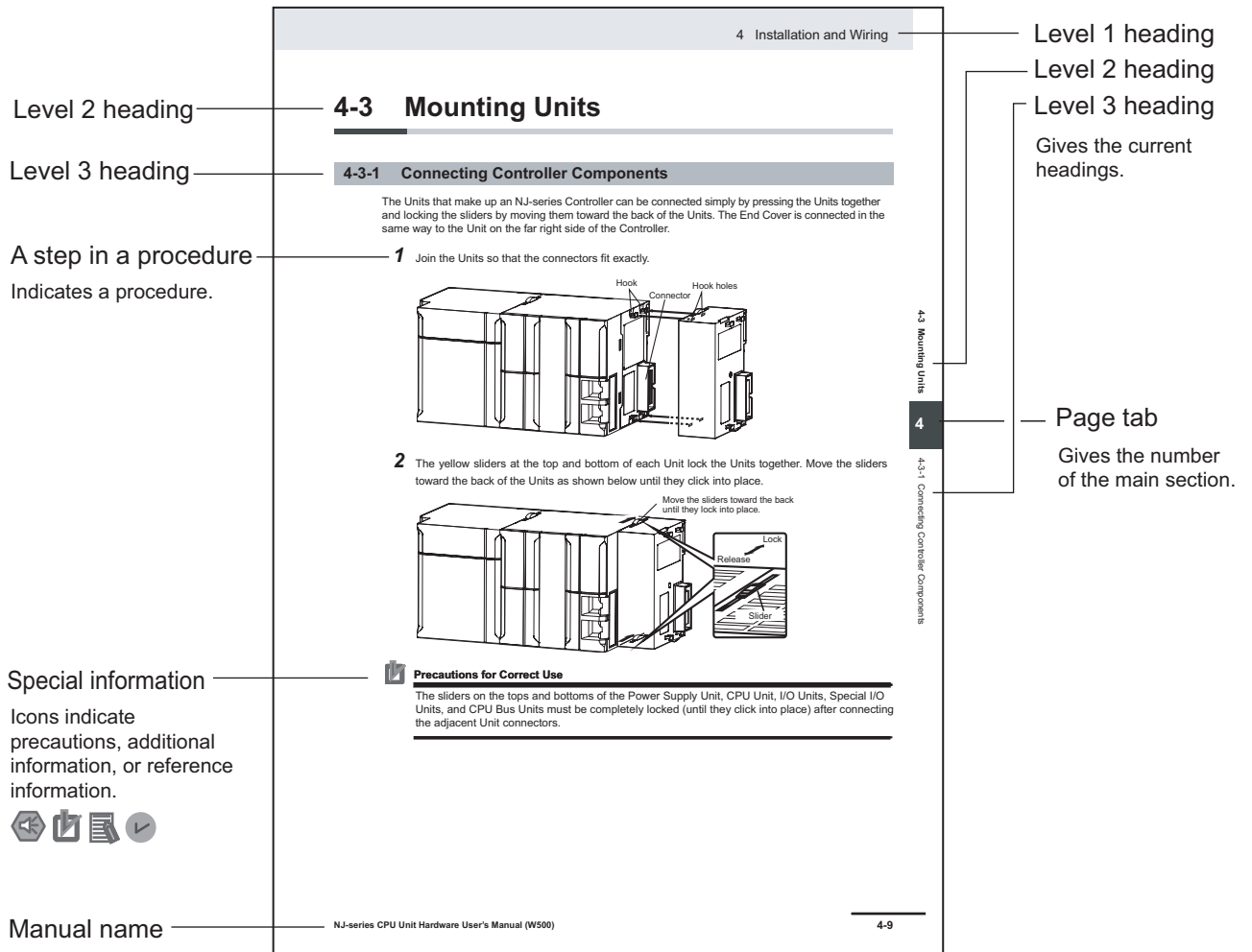
This manual covers the following products.

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

Manual Structure

Page Structure

The following page structure is used in this manual.



Note This illustration is provided only as a sample. 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 and make operation easier.

Sections in this Manual

1	Features and System Configuration	1
2	Specifications	2
3	Part Names and Functions	3
4	Mounting and Wiring	4
5	Troubleshooting	5
6	Inspection and Maintenance	6
A	Appendices	A
I	Index	I

CONTENTS

Introduction	1
Intended Audience	1
Applicable Products	1
Manual Structure.....	2
Page Structure	2
Special Information	3
Sections in this Manual	5
Terms and Conditions Agreement.....	9
Warranty, Limitations of Liability	9
Application Considerations	10
Disclaimers	10
Statement of Security Responsibilities for Assumed Use Cases and Against Threats	11
Safety Precautions.....	12
Definition of Precautionary Information.....	12
Symbols	12
WARNING.....	13
Cautions.....	15
Precautions for Safe Use	17
Precautions for Correct Use	22
Regulations and Standards	24
Conformance to EU Directives	24
Software Licenses and Copyrights	25
Related Manuals.....	26
Terminology.....	27
Revision History.....	28

Section 1 Features and System Configuration

1-1 Features	1-2
1-2 Introduction to the System Configurations.....	1-3
1-3 Support Software	1-5
1-4 Operating Procedure	1-6

Section 2 Specifications

2-1 Programmable Multi-Axis Controller	2-2
2-1-1 Model	2-2
2-1-2 General Specifications	2-2
2-1-3 Features and Performance Specifications	2-3
2-2 Specifications of Peripherals.....	2-5

2-2-1	USB Memory Device	2-5
2-2-2	Power Supply	2-5

Section 3 Part Names and Functions

3-1	Part Names and Functions.....	3-2
3-2	Operation Indicators.....	3-3
3-3	ID Information Indication Label	3-5

Section 4 Mounting and Wiring

4-1	Processing at Power ON and Power OFF.....	4-2
4-1-1	Power ON Operation.....	4-2
4-1-2	Power OFF Operation	4-2
4-2	Fail-safe Circuits	4-4
4-3	Motion Controller Installation	4-5
4-3-1	Mounting Direction in Cabinets or Control Panels	4-6
4-3-2	Installation in Cabinets or Control Panels	4-6
4-4	Power Supply Wiring	4-8
4-4-1	Power Supply Connector Specifications	4-8
4-4-2	Wiring the Power Supply Connector	4-8
4-5	Laying the EtherCAT Network	4-11
4-5-1	Supported Network Topologies	4-11
4-5-2	Installation Precautions	4-12
4-5-3	Installing EtherCAT Communications Cables.....	4-13
4-6	Laying the Ethernet Network	4-17
4-6-1	Installation Precautions	4-17
4-6-2	Installing Ethernet Networks	4-17
4-7	USB Memory Device Connection	4-22
4-8	Grounding.....	4-23
4-8-1	Considerations for Earthing Methods.....	4-23
4-8-2	Grounding	4-23

Section 5 Error Processing

5-1	Types 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	5-3
5-3	Troubleshooting for Errors	5-5
5-3-1	Fatal Errors in the Motion Controller	5-5
5-3-2	Non-fatal Errors in the Motion Controller.....	5-5
5-3-3	Initialization of the Motion Controller	5-7
5-4	Sys.Status Register	5-8
5-4-1	Sys.Status Register List	5-8
5-4-2	Details of Flags	5-9
5-5	EtherNet/IP Connection Status Codes and Troubleshooting	5-14

Section 6 Maintenance and inspection

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

Appendices

A-1	Dimensions	A-2
A-2	Restrictions on Using the NX-series EtherCAT Coupler Unit	A-4
A-3	Supported CIP Objects	A-5
A-3-1	Identity Object (Class ID: 01 Hex).....	A-5
A-3-2	Assembly Object (Class ID: 04 Hex).....	A-6
A-3-3	TCP/IP Interface Object (Class ID: F5 Hex).....	A-7
A-3-4	Ethernet Link Object (Class ID: F6 Hex).....	A-8

Index

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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 disassembly 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 for 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 something that you must do.

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

Do not attempt to take any Unit apart.

In particular, high-voltage parts are present in the Power Supply Unit 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 or 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.



The UPS used enables normal operation to continue for a certain period of time if a momentary power interruption occurs. This means that the CK3M-series Controller may receive incorrect signals from external devices that are also affected by the power interruption. Accordingly, take suitable actions, such as establishing external fail-safe measures and interlock conditions, to monitor the power supply voltage of the external device as required.



Unintended outputs may occur if an error occurs in internal data of the Controller. As a countermeasure for these problems, external safety measures must be provided to ensure safe operation of the system.



The Controller will turn OFF all outputs of output units in the following cases and the slaves will operate according to the settings in the slaves.

- If a power supply error occurs
- If the connected power supply is faulty
- If a CPU Unit error (watchdog timer error) or CPU Unit reset occurs
- If a major fault level Controller error occurs
- While the Controller is on standby 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.

To ensure safe use of the Controller, correctly make the limit settings for the position, speed, acceleration, jerk, current, and following error, as well as the encoder loss detection.



For devices that move in a vertical direction, use a motor brake to prevent them from falling down when the servo control is stopped.



Downloading

Always confirm safety at the destination before you transfer a user program, configuration data, or setup data from the Power PMAC IDE.

The devices or machines may perform unexpected operation 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, servo algorithm, data, and parameter settings for proper execution before you use them for actual operation.



Security Measures

Anti-virus protection

Install the latest commercial-quality antivirus software on the computer connected to the control system and maintain to keep the software up-to-date.



Security measures to prevent unauthorized access

Take the following measures to prevent unauthorized access to our products.

- Install physical controls so that only authorized personnel can access control systems and equipment.
- Reduce connections to control systems and equipment via networks to prevent access from untrusted devices.
- Install firewalls to shut down unused communications ports and limit communications hosts and isolate control systems and equipment from the IT network.
- Use a virtual private network (VPN) for remote access to control systems and equipment.
- Adopt multifactor authentication to devices with remote access to control systems and equipment.
- Set strong passwords and change them frequently.
- Scan virus to ensure safety of USB drives or other external storages before connecting them to control systems and equipment.



Data input and output protection

Validate backups and ranges to cope with unintentional modification of input/output data to control systems and equipment.

- Checking the scope of data
- Checking validity of backups and preparing data for restore in case of falsification and abnormalities
- Safety design, such as emergency shutdown and fail-soft operation in case of data tampering and abnormalities

**Data recovery**

Backup data and keep the data up-to-date periodically to prepare for data loss.



When using an intranet environment through a global address, connecting to a SCADA or an unauthorized terminal such as an HMI or to an unauthorized server may result in network security issues such as spoofing and tampering. You must take sufficient measures such as restricting access to the terminal, using a terminal equipped with a secure function, and locking the installation area by yourself.



When constructing an intranet, communication failure may occur due to cable disconnection or the influence of unauthorized network equipment. Take adequate measures, such as restricting physical access to network devices, by means such as locking the installation area.



When using a device equipped with the SD Memory Card function, there is a security risk that a third party may acquire, alter, or replace the files and data in the removable media by removing the removable media or unmounting the removable media. Please take sufficient measures, such as restricting physical access to the Controller or taking appropriate management measures for removable media, by means of locking the installation area, entrance management, etc., by yourself.

**Cautions**
Caution
Design

To control the motor safely and correctly, the servo algorithm design and gain setting work must be performed by engineers who understand control theories and the specifications of this product.



Create a program to verify the network is in cable redundancy before you enable it.

If such a program is not created, the cable may no longer be redundant due to disconnection on the ring topology without any notice.

Use the status variable `ECAT[i].RedundantLineBreak` to verify the network is in cable redundancy.

**Test Run**

When you perform a test run, take fail-safe measures and run the motor at a sufficiently low speed to ensure safety.



Downloading

Before you download a project written in C language, execute the re-initialization command (\$\$\$***) .



If you download a validated program to a different product, check the operation of the program again on the product because it may have different settings.



Precautions for Safe Use

Transporting

- Do not drop any Unit or subject it to abnormal vibration or shock. Doing so may result in Unit malfunction or burning.

Mounting

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

Installation

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

Wiring

- Follow the instructions in this manual to correctly perform terminal block and 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, connect it such that the FG terminal has the same electrical potential as the FG on the product.
A difference in electrical potential between the computer and the Controller may cause a failure or malfunction.
- Do not pull on the cables or bend the cables beyond their natural limit.
- Do not place heavy objects on top of the cables or other wiring lines. Doing so may break the cables.
- 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.
- Do not allow wire clippings, shavings, or other foreign material to enter the Controller. Otherwise, Controller burning, failure, or malfunctions may occur.
Cover the Controller or take other suitable countermeasures, in particular when carrying out wiring work.

Power Supply Design

- In the system, only use a 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. 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 user's manual for surge current specifications.

Actual Operation

- Build a program such that the Sys.Status flag is constantly monitored and safe operations are taken if any errors occur.

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.
 - a) Connecting cables or wiring the system
 - b) Connecting or disconnecting the connectors
- Do not disconnect the cable or turn OFF the power supply to the product when downloading data or programs from the Support Software. You may be unable to download the correct data, which could result in malfunctions.
- Do not turn OFF the power supply to the Controller while the built-in flash memory is being written. Data may become corrupted, and the Controller may not operate correctly.

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 operation mode setting when power is turned ON)
- 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 Setting** parameter is set to **Stop**, process data communications will stop for all the 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 will behave according to the slave specifications. For details, refer to the manual for the 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 in the network 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.
- There is a time lag between the moment when this Controller sends a command value to the EtherCAT type Servo Drive and the moment when it receives the feedback value. Perform servo control taking this time lag into consideration.
- When the cable connected to the third-party slave on the ring topology is disconnected or the power supply is disconnected, the frame being communicated may be lost. If the frame is lost, the input or output data of the slave will not be transmitted, and unintended operation may occur.
Before connecting a third-party slave on the ring topology, check the followings.
 - a) Connect and disconnect the communication cable connected to the OUT port of the third-party slave several times, and check the status change of *ECAT[i].RedundantLineBreak* and *ECAT[i].RedundantLineFixed* will only occur.
 - b) Connect and disconnect the communication cable connected to the IN port of the third-party slave several times, and check the status change of *ECAT[i].RedundantLineBreak* and *ECAT[i].RedundantLineFixed* will only occur.

- c) Turn the power OFF and ON of the third-party slave, and check that other slaves are not in any errors.

EtherNet/IP Communications

- Unexpected operation may result if inappropriate data link tables are set. Even if appropriate data link tables have been set, confirm that the controlled system will not be adversely affected before you transfer the data link tables. The data links start automatically after the data link tables are transferred.
- If EtherNet/IP tag data links (cyclic communications) are used with a repeating hub, the communications load on the network will increase. This will increase collisions and may prevent stable communications. Do not use repeating hubs on networks where tag data links are used. Use an Ethernet switch instead.
- Make sure to use the communications distance, number of nodes connected, and method of connection for EtherNet/IP within specifications. Do not connect EtherNet/IP communications to EtherCAT or other networks. An overload may cause the network to fail or malfunction.

Motion Control

- The motor is stopped if communications are interrupted between the 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.
- When you create a servo algorithm, take fail-safe measures in the user program which includes the servo algorithm.

Unit Replacement

- Make sure that the required data, including the user program, configurations, settings, and variables, is transferred to the Controller that was replaced and to externally connected devices before restarting operation.

Upgrading the Power PMAC IDE

- After you upgrade a project file created with an older version of the Power PMAC IDE for use with a newer version of Power PMAC IDE, perform a test run before use to check that the project file was upgraded correctly.

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.
- Dispose of the product according to local ordinances as they apply.

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 burning, in operation stopping, or in malfunction.
 - 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 the 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
- Before touching a Unit, be sure to first touch a grounded metallic object in order to discharge any static build-up.
- Install the Controller away from sources of heat and ensure proper ventilation. Not doing so may result in malfunction, in operation stopping, or in burning.
- Use the CK3W-EXS02 for the Expansion Slave Unit farthest from the CPU Rack.
When the CK5W-EXS01 is used, the signal becomes unstable, which may cause a malfunction.

Wiring

- Use the rated power supply voltage for the products.

Task Settings

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

During 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.
- Wiring slaves incorrectly in the ring topology to connect IN ports or OUT ports may cause message and process data communication to stop. Make sure that the wiring of all slaves is correct.
- If synchronous slaves exist in the network configuration when a slave outside the ring topology is disconnected or disconnected, the cable redundant is temporarily disabled due to the DC synchronization correction process.

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): EN61326 EMI (Electromagnetic Interference): EN61326 (Radiated emission: 10-m regulations).

● Conformance to EU Directives

The CK3E-series 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 Units must be installed within a control panel.
- You must use double or reinforced insulation power supply for the DC power supplies that are connected as the Unit power supplies for the CK3E-series.

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

- CK3E-series that comply with EU Directives also conform to the Common Emission Standard (EN61326). 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 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 the clamp core to the Ethernet communications cable. Refer to *Recommended Clamp Core and Attachment Procedure* on page 4-20 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. Use these manuals for reference. Contact your OMRON representative for information on how to procure these manuals.

Manual name	Cat. No.	Application	Description
CK3E-series Programmable Multi-Axis Controller Hardware User's Manual	I610	Learning the basic specifications of the CK3E-series Programmable Multi-Axis Controller, including introductory information, design, installation, and maintenance. Mainly hardware information is provided.	An introduction to the entire CK3E-series system is provided along with the following information. <ul style="list-style-type: none"> • Features and system configuration • Introduction • Part names and functions • General specifications • Installation and wiring • Maintenance and inspection
Power PMAC User's Manual	O014	Learning the features and usage examples of the Motion Controller.	The following information is provided on the Motion Controller. <ul style="list-style-type: none"> • Basic functions • Setup examples • Programming examples
Power PMAC Software Reference Manual	O015	Learning how to program the Motion Controller.	The following information is provided on the Motion 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-NC-16 Quick Start Manual	O017	Briefly understanding the basic usage of Power PMAC-NC16.	Describes the Quick setup procedure to run Power PMAC-NC16 on a desktop PC by showing some examples.
Power PMAC-NC16 .ini Configuration Manual	O018	Configuring an application for CNC devices by using Power PMAC-NC16.	Describes how to set up <i>PowerPmacNC.ini</i> , 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 to use 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 that can be used for Power PMAC-NC16, and relevant instructions.

Terminology

Term	Description
PMAC	The acronym for Programmable Multi-Axis Controller.
Motion control	Motion control can achieve intended operation by providing a target value to the axis to be controlled, or by controlling state transitions.
Axis	A functional unit within the Motion Control Function Module. An axis is assigned to the drive mechanism in an external Servo Drive, etc.
NC	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).
G-code	A type of language used to create NC programs.
CPU	Central Processing Unit. Hardware that executes instructions from computer programs.
Modbus/TCP	A protocol used for the Modbus communications on TCP/IP.
EtherCAT	The acronym for Ethernet for Control Automation Technology. EtherCAT is the real-time Ethernet protocol standards.
ENI file	ENI is the acronym for EtherCAT Network Information. The ENI file contains the network configuration information related to EtherCAT slaves.
ESI file	ESI is the acronym for EtherCAT Slave Information. The ESI file contains information unique to the EtherCAT slaves in XML format.
CIP	An abbreviation for Common Industrial Protocol. An industrial standard protocol used for networks such as EtherNet/IP and DeviceNet.
EDS	An abbreviation for Electronic Data Sheet. A text file that contains the EtherNet/IP slave setting information.
Originator	A node that makes a request for opening a connection when a tag data link connection is opened in an EtherNet/IP network.
Target	A node that receives a request for opening a connection when a tag data link connection is opened in an EtherNet/IP network.
RPI	An abbreviation for Requested Packet Interval. Represents a data refresh period set for each connection between originators and targets on an EtherNet/IP network.

Revision History

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

Cat. No.	I610-E1-05
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↑
Revision code

Revision code	Date	Revised content
01	August 2016	Original production
02	December 2018	Added to "Terms and Conditions Agreement".
03	August 2020	<ul style="list-style-type: none"> • Made changes accompanying the addition of EtherNet/IP functions. • Corrected mistakes.
04	July 2022	<ul style="list-style-type: none"> • Made changes accompanying the upgrade of PMAC firmware revision. • Corrected mistakes.
05	August 2022	Revisions for adding safety precautions regarding security.

1

Features and System Configuration

This section describes the features and system configuration of the CK3E-series Programmable Multi-Axis Controller.

1-1	Features	1-2
1-2	Introduction to the System Configurations	1-3
1-3	Support Software	1-5
1-4	Operating Procedure	1-6

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 Motion Controller uses the *Programmable Multi Axis Controller*, developed by Delta Tau Data Systems, Inc. (hereinafter referred to as “Delta Tau”), 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 whose motion control period is 250 μ s or more.

Constructing Systems with Greater Flexibility

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

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

Compactness

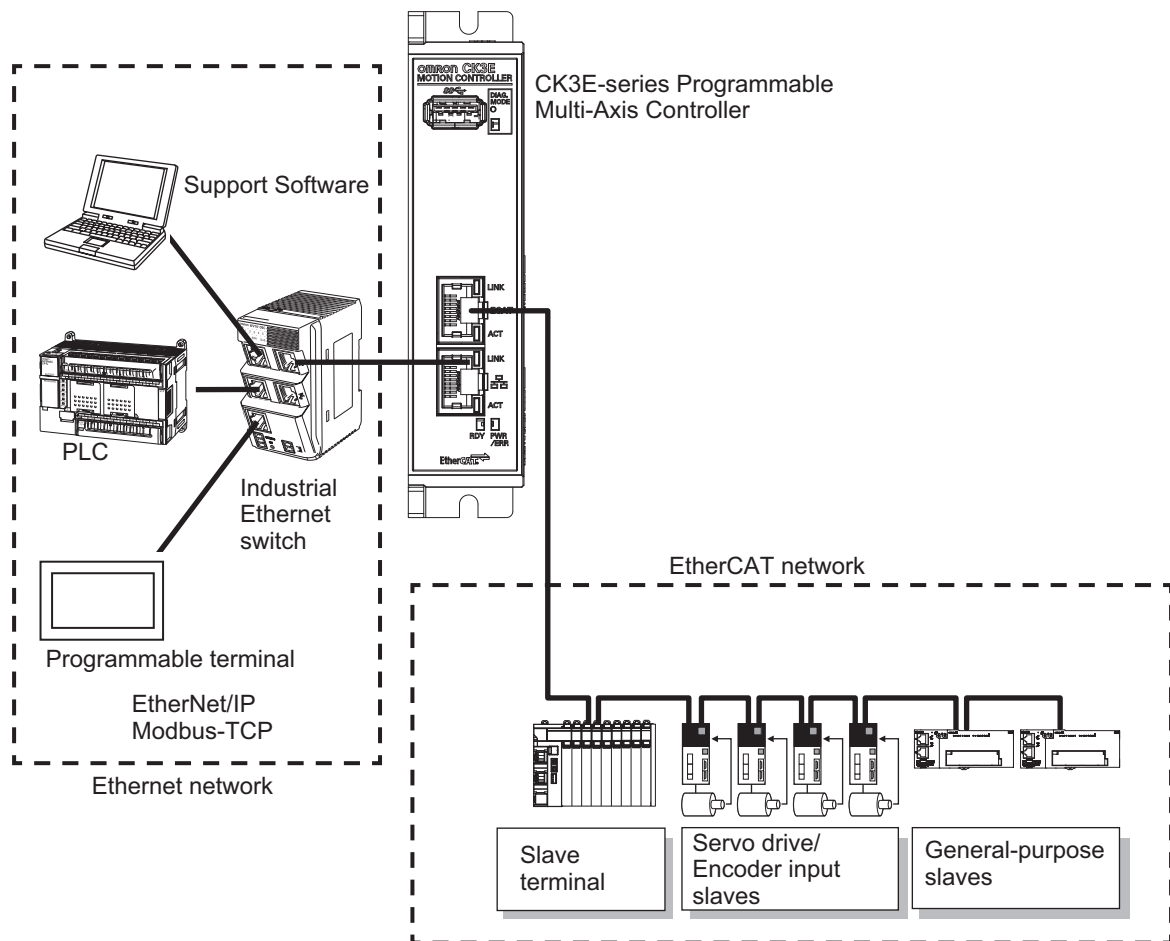
The Controller is compact and has less wiring due to the use of the EtherCAT network, which helps to downsize devices.

1-2 Introduction to the System Configurations

The Motion Controller supports the following system configurations.

The basic configurations include the EtherCAT network configuration, Ethernet network configuration, and Support Software.

Basic Configuration



● EtherCAT Network Configuration

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

The Programmable Multi-Axis 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, there are restrictions on the models and unit versions of EtherCAT Coupler Units that can be connected.

Refer to *A-2 Restrictions on Using the NX-series EtherCAT Coupler Unit* on page A-4 for details.

● Ethernet Network Configuration

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

The Ethernet communications port can also be used for Modbus-TCP communications.

EtherNet/IP communications support targets only, so originators are required for the communications. If the originator in use is an NJ/NX-series CPU Unit, refer to the *NJ/NX-series CPU Unit Built-in EtherNet/IP Port User's Manual (Cat. No. W506)* for details.

CPU Unit connection settings are required for EtherNet/IP communications. Refer to the *Power PMAC IDE User Manual (Cat. No. O016)* for details.

● Support Software

Connect a computer with the Support Software installed to the Motion 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 Motion Controller.

Configuration software		Application	How to Procure
Power PMAC IDE* ¹		This computer software is used to configure the Motion Controller, create user programs, and debug the programs.	This is free software. * ²
Power PMAC-NC16	Power PMAC-NC16 SDK	This computer software is used to control machine tools and CNC machines with the Motion Controller. Use this software to customize HMI screens. The product contains extension source codes for customization.	This is non-free software. * ²
	Power PMAC-NC16 Runtime	This computer software is used to control machine tools and CNC machines with the Motion Controller. Use this software when you do not customize HMI screens.	This is non-free software. * ²

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

*2. Contact your OMRON representative for information on how to procure.

1-4 Operating Procedure

This section describes the procedure to construct a motion control system by using the Motion Controller.

No.	Step		Description	Reference
1	Preparation for work	Check for specification compatibility	Check whether the system is compatible with specifications of the Motion Controller. <ul style="list-style-type: none"> • General specifications • Mounting direction 	2-1-2 <i>General Specifications</i> on page 2-2
		Selection of peripheral devices	Select peripheral devices to be used with the Motion 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 Motion Controller	Mounting	Mount the Motion Controller.	4-1 <i>Processing at Power ON and Power OFF</i> on page 4-2
		Wiring	Connect the unit power supply of the Motion Controller.	4-4 <i>Power Supply Wiring</i> on page 4-8
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. <ul style="list-style-type: none"> • 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 communications cable.	4-5 <i>Laying the EtherCAT Network</i> on page 4-11 4-8 <i>Grounding</i> on page 4-23	
5	Turning the Power ON	Turn on the power to the devices configuring the system.		
6	Construction of the EtherCAT network	Installation of ESI files	Install the ESI files of EtherCAT slaves to be connected to EC-Engineer.	Refer to the <i>Acontis EC-Engineer manual</i> for details. For information on the ESI file, refer to the manual for the EtherCAT slave.
		EtherCAT slave settings	Configure the EtherCAT communications settings by using EC-Engineer. Then, create an ENI file used to download the configured settings to the Motion Controller.	Refer to the <i>Acontis EC-Engineer manual</i> for details.
		Activation of the EtherCAT network	Use Power PMAC IDE to download the ENI file to the Motion Controller. Make sure that the ENI file has been correctly downloaded, and then activate the EtherCAT network.	Refer to the <i>Power PMAC IDE User Manual (Cat. No. O016)</i> for details.

No.	Step	Description	Reference
7	Construction of the EtherNet/IP network*1	Settings of the originator device	Configure the originator device settings. For details, refer to the manual for the originator device. Refer to the <i>NJ/NX-series CPU Unit Built-in EtherNet/IP Port User's Manual (Cat. No. W506)</i> when the NJ/NX Series is used.
		Settings of the connection	Configure the connection settings. Refer to the <i>Power PMAC IDE User Manual (Cat. No. O016)</i> for details.
8	Preparation for setting the Motion Controller	Creation of a new project	Connect the computer with the Support Software installed to the Motion Controller, and then start Power PMAC IDE and create a new project. Refer to the <i>Power PMAC IDE User Manual (Cat. No. O016)</i> for details.
		Initialization of the Controller	Use Power PMAC IDE to initialize the Motion Controller. Refer to the <i>Power PMAC IDE User Manual (Cat. No. O016)</i> for details.
9	Settings of the Motion Controller operation	Motor settings	Use Power PMAC IDE to set the motor operations for the Motion Controller. Refer to the <i>Power PMAC IDE User Manual (Cat. No. O016)</i> for details.
		Programming	Create user programs on Power PMAC IDE. Refer to the <i>Power PMAC User's Manual (Cat. No. O014)</i> and the <i>Power PMAC Software Reference Manual (Cat. No. O015)</i> for details.
10	Transferring project data and checking the operation	Transfer the created project data and check that operations work as expected. Refer to the <i>Power PMAC IDE User Manual (Cat. No. O016)</i> for details.	

*1. Perform settings only when EtherNet/IP is used.

2

Specifications

This section describes the specifications of the CK3E-series 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	2-2
2-1-3	Features and Performance Specifications	2-3
2-2	Specifications of Peripherals	2-5
2-2-1	USB Memory Device	2-5
2-2-2	Power Supply	2-5

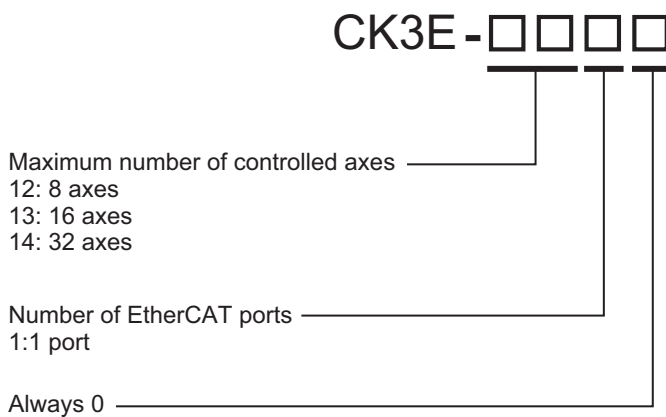
2-1 Programmable Multi-Axis Controller

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

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: 1GB	EtherCAT port: 1	16 axes
CK3E-1410			32 axes

2-1-2 General Specifications

Item	Specifications		
	CK3E-1210	CK3E-1310	CK3E-1410
Enclosure	Mounted in a panel		
Grounding method	Ground to less than 100 Ω.		
Dimensions (height × depth × width)	130.4(H) × 28.6(D) × 170.9(W) mm		
Weight	540 g max.		
Unit power supply rated voltage	24 VDC (20.4 to 26.4 VDC)		
Unit power current consumption	660 mA or less		

Item		Specifications		
		CK3E-1210	CK3E-1310	CK3E-1410
Operating environment	Ambient operating temperature	0 to 45 °C		
	Ambient operating humidity	10% to 95% RH (with no condensation or icing)		
	Atmosphere	Must be free of corrosive gases.		
	Ambient storage temperature	-25 to 70 °C (with no condensation or 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 ² 100 min each in X, Y, and Z directions (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		cULus, EU: EN61326, RCM, KC, EAC		

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

2-1-3 Features and Performance Specifications

Item			Specifications		
			CK3E-1210	CK3E-1310	CK3E-1410
Memory			Main memory: 1 GB Flash memory: 1GB		
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 x 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	250µs 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 (IEEE802.3)		
	Topology		Line, daisy chain, branching, and ring*1		
	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			

Item		Specifications			
		CK3E-1210	CK3E-1310	CK3E-1410	
Ethernet communications specifications	Baud rate		1Gbps/100Mbps		
	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) ^{*2}		
	Maximum transmission distance between Ethernet switch and node		100m		
	Maximum number of cascade connections		There are no restrictions if an Ethernet switch is used.		
	EtherNet/IP tag data link (cyclic communications) ^{*3}	Number of connections	32		
		Requested Packet Interval (RPI)	1 to 1,000 ms (0.5ms units)		
		Allowed communications bandwidth per Unit	3,200 pps ^{*4}		
		IO connection size	Input: 504 bytes max. Output: 504 bytes max.		
EtherNet/IP CIP message service ^{*3}	UCMM (un-connected message)	Number of servers that can perform communications simultaneously: 32			
EtherNet/IP conformance test		CT17 compliant			
USB port	Physical layer		USB 3.0 compliant, type A connector. Output voltage: 5 V, 0.9 A max.		
	Transmission distance		3 m max.		

*1. A ring topology is available with PMAC firmware revision version 2.7.0 or later.

*2. Always use shielded cables for EtherNet/IP communications.

*3. EtherNet/IP is available only for targets and not available for originators.

EtherNet/IP is available only for PMAC firmware revision version 2.6.0 or later whose date of production is September 25th, 2020 or later (Lot number 25920 and later).

Use Power PMAC IDE Ver.4.4.1 or a later version.

*4. Represents Packet Per Second and indicates the number of sent or received packets that can be processed in a second.

2-2 Specifications of Peripherals

2-2-1 USB Memory Device

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

- Uploading data
- Downloading data
- Saving relevant data
- Initializing Motion Controller

The following shows details of the recommended USB memory devices.

OMRON is not responsible for the operation of any other USB memory devices.

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

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>).

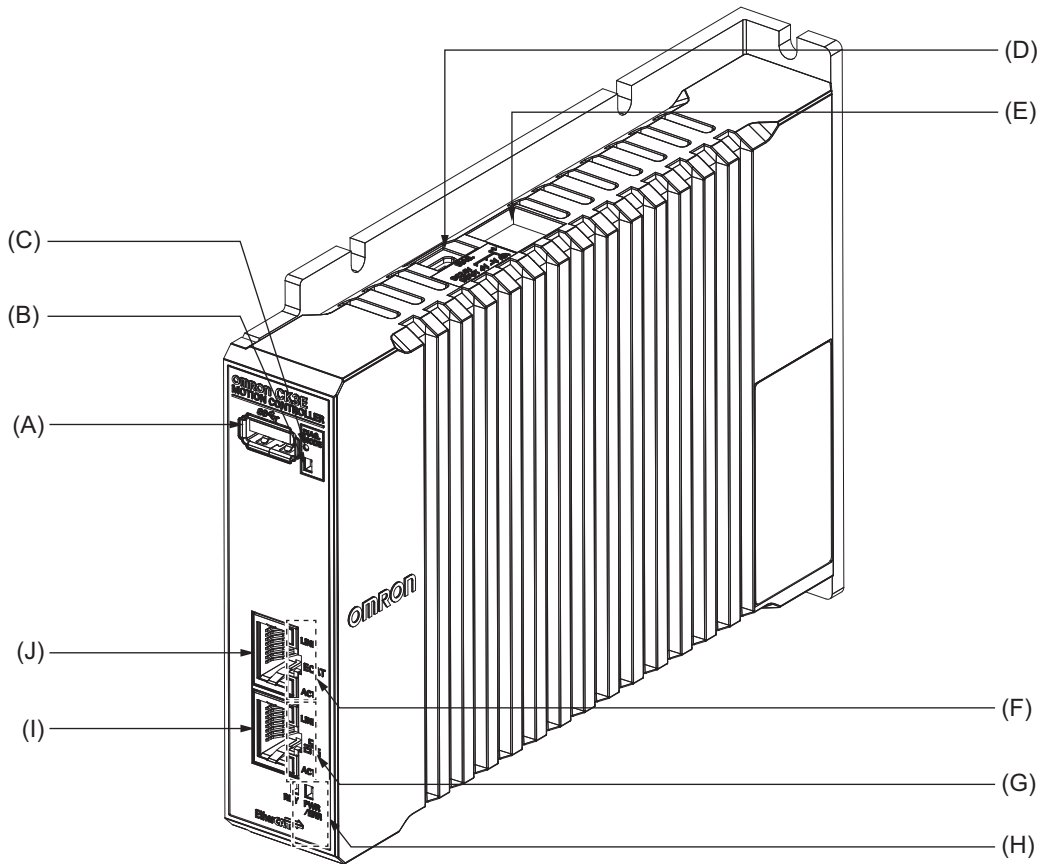
3

Part Names and Functions

This section describes the names and functions of the CK3E-series Programmable Multi-Axis Controller.

3-1	Part Names and Functions	3-2
3-2	Operation Indicators	3-3
3-3	ID Information Indication Label.....	3-5

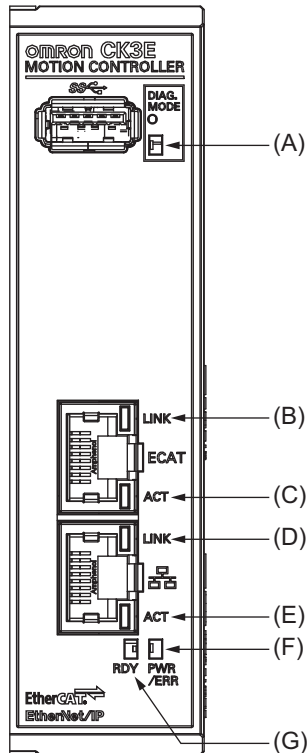
3-1 Part Names and Functions



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	Shows the operation status of EtherCAT.
(G)	Ethernet communications port operation indicators	Shows the operation status of Ethernet.
(H)	Unit operation indicators.	Shows 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.



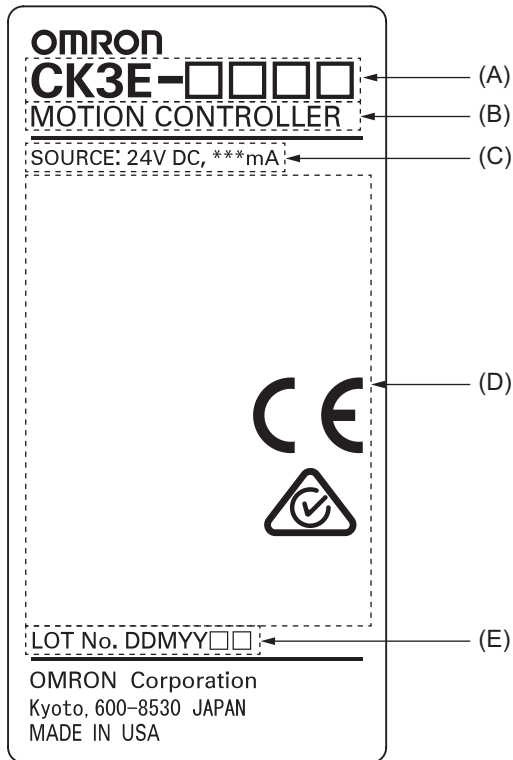
The operating statuses corresponding to the colors and statuses of the indicators are shown below.

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 error or another hardware error
			Not lit	Power is not supplied to the Unit.

Letter	Indicator	Color	Status	Description
(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.



Letter	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 CK3E-series Programmable Multi-Axis Controller is specified in the form of DDMYY□□. The “DD” represents the day, “M” is the month, and “YY” is the year the product is manufactured. □□ is the 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 CK3E-series Programmable Multi-Axis Controller, wiring the power supply used for the Motion Controller, and wiring the Motion Controller.

4

4-1	Processing at Power ON and Power OFF	4-2
4-1-1	Power ON Operation	4-2
4-1-2	Power OFF Operation	4-2
4-2	Fail-safe Circuits	4-4
4-3	Motion Controller Installation	4-5
4-3-1	Mounting Direction in Cabinets or Control Panels.....	4-6
4-3-2	Installation in Cabinets or Control Panels	4-6
4-4	Power Supply Wiring	4-8
4-4-1	Power Supply Connector Specifications	4-8
4-4-2	Wiring the Power Supply Connector	4-8
4-5	Laying the EtherCAT Network.....	4-11
4-5-1	Supported Network Topologies	4-11
4-5-2	Installation Precautions	4-12
4-5-3	Installing EtherCAT Communications Cables.....	4-13
4-6	Laying the Ethernet Network	4-17
4-6-1	Installation Precautions	4-17
4-6-2	Installing Ethernet Networks.....	4-17
4-7	USB Memory Device Connection	4-22
4-8	Grounding.....	4-23
4-8-1	Considerations for Earthing Methods.....	4-23
4-8-2	Grounding.....	4-23

4-1 Processing at Power ON and Power OFF

4-1-1 Power ON Operation

Once the power supply to the Power Supply Unit starts, the Motion Controller enters the program operation ready status after the following time elapses.

In addition, when the Unit is in the operation-ready status, the RDY LED lights up.

● Motion Controller Startup Time at Power ON

It takes approximately 60 to 80 seconds for the Motion Controller to start up.

Since the startup time is affected by the slave/unit configuration, confirm it on an actual device.

4-1-2 Power OFF Operation

This section describes how to perform the power OFF operation if a user program attempts to write data to the USB memory, or if the user program is to be downloaded to the built-in flash memory.

Writing to the USB Memory

If the power is interrupted while a user program is writing data to the USB memory, the data may be corrupted.

Confirm that no data is being written before you turn OFF the power supply.

Downloading to the Built-In Flash Memory

When you download a user program from the Power PMAC IDE, the data is once stored in the CPU cache before it is saved into the Motion Controller.

This means that, if you turn OFF the power supply immediately after starting the save operation, the CPU Unit cannot complete the transfer of the data from the cache to the built-in flash memory, which may result in a save operation failure or corruption of the saved data.

If the data is corrupted, issue a re-initialization command (\$\$\$***) from the Power PMAC IDE, and download the program again.

If the CPU Unit fails to connect to the Power PMAC IDE, refer to 5-3-3 *Initialization of the Motion Controller* on page 5-7 and implement initialization.

● Procedure to Download to the Built-in Flash Memory

Use the following procedure to download the user program to the built-in flash memory.

The procedure can be used for any firmware revision of the PMAC firmware.

- 1** Download the user program from the Power PMAC IDE.
- 2** At the Power PMAC IDE terminal, execute the **save** command.

3 Establish an SSH connection, and execute the **sync** command from the terminal that you connected to.

4 Wait for at least 5 seconds and turn OFF the power supply.

● **Procedure to Download to the Built-in Flash Memory (Version 2.5 or Later)**

For PMAC firmware revision version 2.5 or later, you can also use the following procedure to store the user program into the built-in flash memory.

1 Download the user program from the Power PMAC IDE.

2 At the Power PMAC IDE terminal, enter **Sys.SyncSave=1**.

3 At the Power PMAC IDE terminal, execute the **save** command.
Wait until the save completed notification is displayed on the Power PMAC IDE.

4 At the Power PMAC IDE terminal, enter **Sys.SyncSave=0**.

5 Wait for at least 5 seconds and turn OFF the power supply.

4-2 Fail-safe Circuits

WARNING

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.
- 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 if an error occurs in the internal memory of the product. As a countermeasure for these 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.
 - a) If a power supply error occurs
 - b) If the power supply connection becomes faulty
 - c) If a CPU Unit error (watchdog timer error) or CPU Unit reset occurs
 - d) If a major fault level Controller error occurs
 - e) While the Controller is on standby until RUN mode is entered after the power is turned ON
 - f) If a system initialization error occurs

As a countermeasure for these problems, external safety measures must be provided to ensure safe operation of the system.

- To ensure safe use of the Controller, correctly make the limit settings for the position, speed, acceleration, jerk, current, and following error, as well as the encoder loss detection.
- For devices that move in a vertical direction, use a motor brake to prevent them from falling down when the servo control is stopped.



4-3 Motion Controller Installation

This section describes how to install the CK3E-series Programmable Multi-Axis Controller in the cabinet.

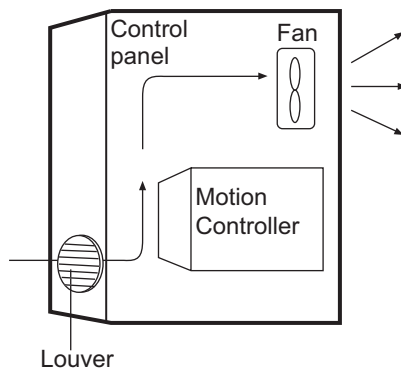
Installation in Cabinets or Control Panels

Please consider ambient temperature, operability, maintainability, and environmental resistance against noise when installing the Motion Controller in the cabinet or the control panel.

Consideration for Ambient Temperature

The operating ambient temperature of the Motion Controller must be within the range from 0 to 45 °C. When necessary, take the following measures to maintain the proper temperature.

- Provide enough space for good air flow.
- Do not install the Controller 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.

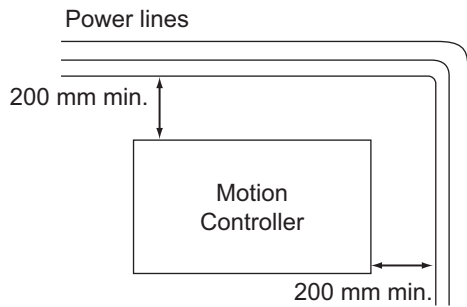


Accessibility for Operation and Maintenance

- To ensure safe access for operation and maintenance, separate the Controller as much as possible from high-voltage equipment and power machinery.
- It will be easy to operate the Controller if it is mounted at a height of 1.0 to 1.6 m 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.



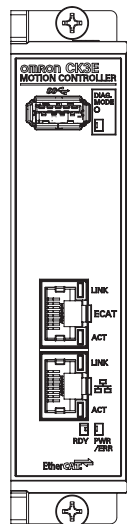
- Ground the mounting plate between the Controller and the mounting surface.

4-3-1 Mounting Direction in Cabinets or Control Panels

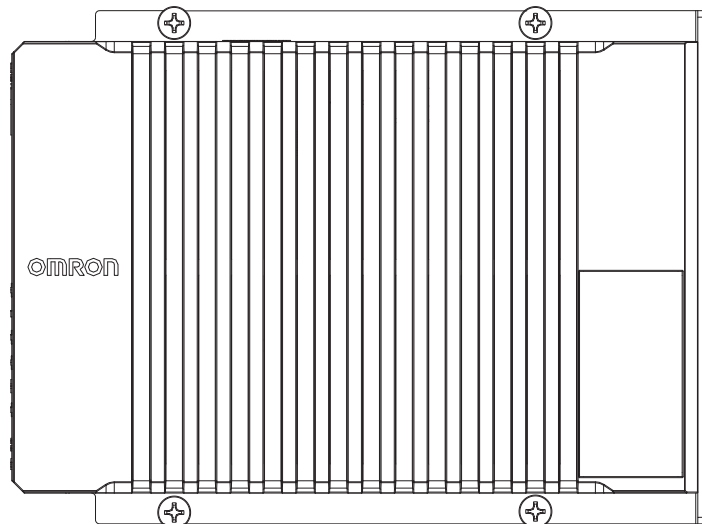
The Motion Controller can be installed facing the front or sideways.

The Controller must be mounted in an upright position to provide appropriate cooling.

Front mounting



Sideways mounting

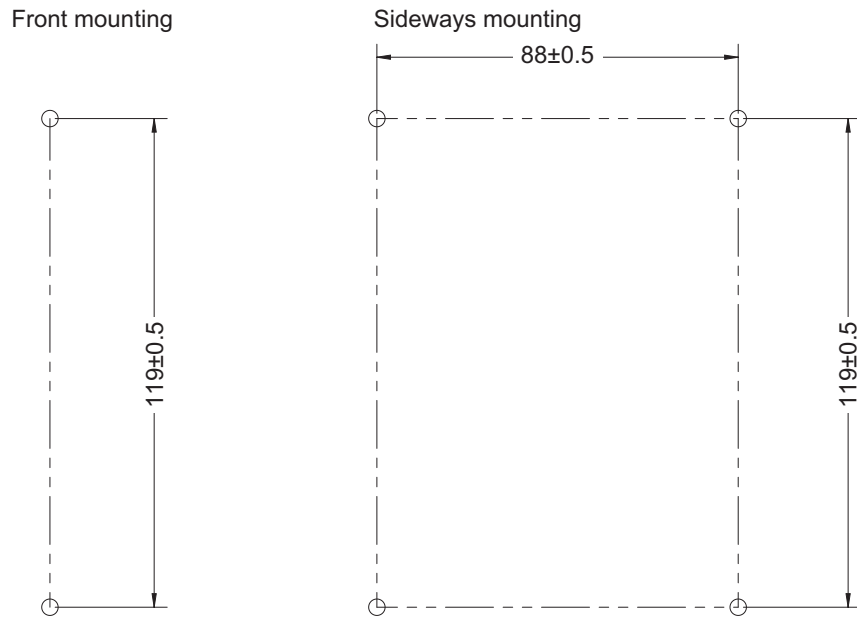


4-3-2 Installation in Cabinets or Control Panels

The following shows the mounting method of the Motion Controller.

It is recommended that M4 screws be used for mounting.

- 1 Create holes for the screws used to mount the Motion Controller. The screw positions are as follows.



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

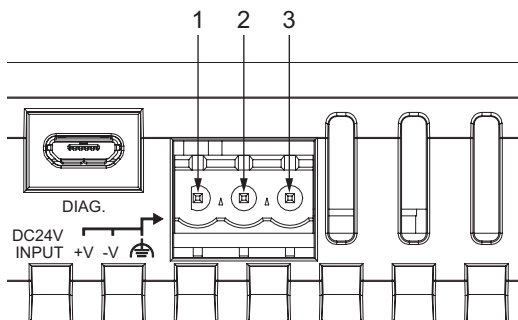
4-4 Power Supply Wiring

4-4-1 Power Supply Connector Specifications

The power supply connectors used for the Motion Controller are as follows.
One power supply connector is included in the Motion Controller.

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 Motion Controller.



Pin	Description
1	24 VDC
2	0VDC
3	Function grounding terminal

4-4-2 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 2.5mm ²	7mm
Twisted wire	0.2 to 2.5mm ²	7mm
Twisted wire with bar terminal, without plastic sleeve	0.25 to 2.5mm ²	7mm
Twisted wire with bar terminal, with plastic sleeve	0.25 to 2.5mm ²	7mm

Grounding

The type of grounding terminal on Motion 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 when 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 the devices 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 Motion Controller as possible and keep the ground line as short as possible.

Tools Used

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

The recommended screw driver is as follows.

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

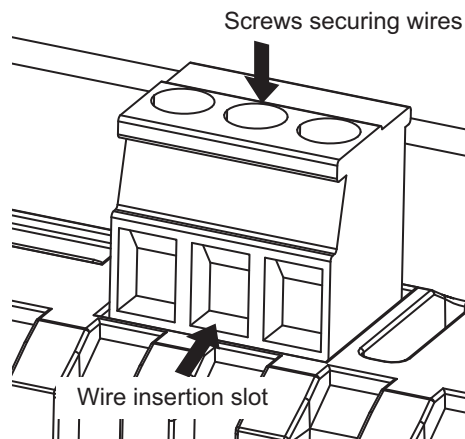
Procedure for Wiring the Power Supply Connector

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

- 1 Remove the sheath from the power cable.
The strip length when ferrules are not used is 7 mm.
Observe the application instructions for your ferrules when attaching ferrules.



- 2 Loosen the wire fixing screw at the top of the power supply connector to release the wire insertion slot.



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

4-5 Laying the EtherCAT Network

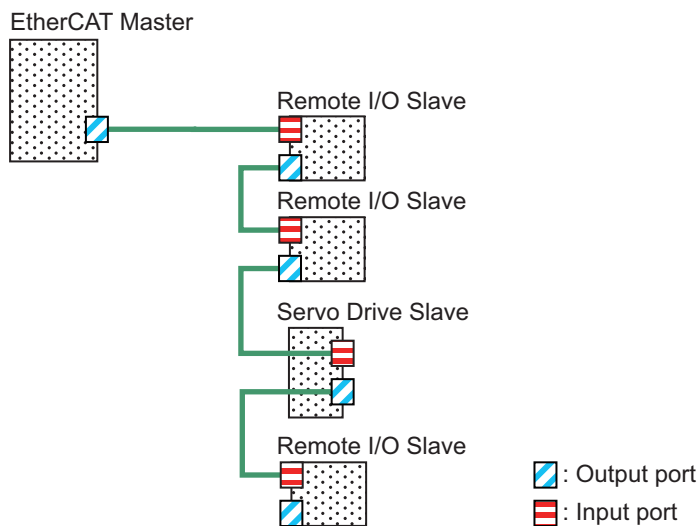
This section describes how to install EtherCAT networks.

4-5-1 Supported Network Topologies

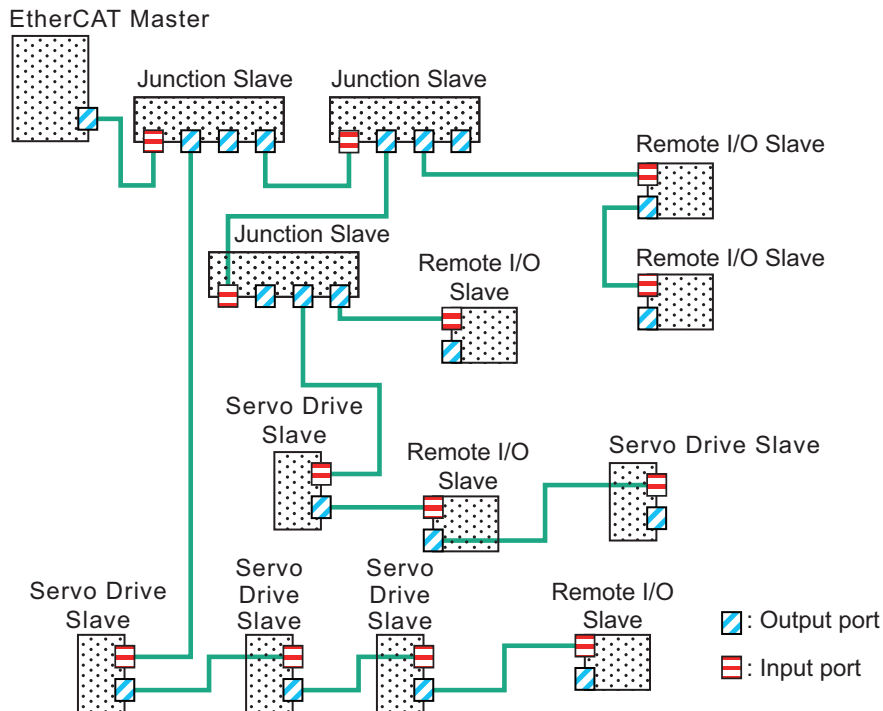
The EtherCAT port of the Motion Controller enables daisy chain connection without branching and branching using Junction Slaves. In addition, the ring wiring using Junction Slaves is available for CPU Units with PMAC firmware revision version 2.7.0 or later.

Examples of topology without branching, with branching (Junction Slaves), and ring wiring are shown below.

No Branching



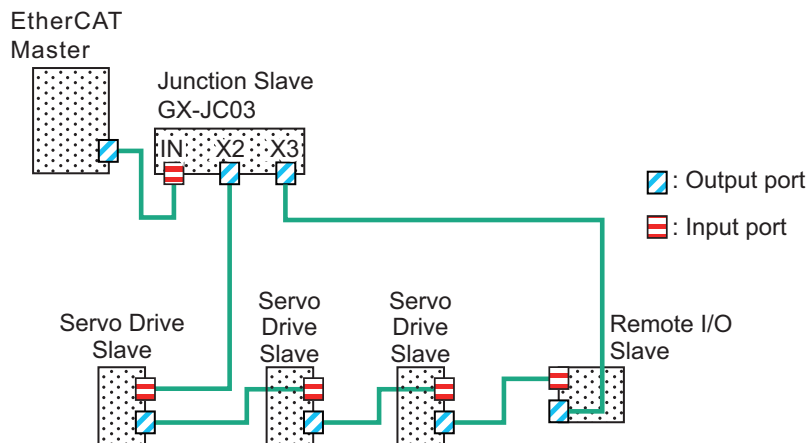
Branching



Ring Wiring

A configuration example of the ring wiring is shown below.

Refer to the *Power PMAC User's Manual (Cat. No. O014)* for the setting and usage of ring wiring.



4-5-2 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 X 5252" 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 EtherCAT 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 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.

4-5-3 Installing EtherCAT Communications Cables


Ethernet communications cables and connectors are used to connect the EtherCAT port of the Motion 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.

The following products are recommended.

Cable with Connectors




● Sizes and Conductor Pairs: AWG 26 × 4 Pairs

Product name	Manufacturer	Cable length (m) *1	Model	Contact information
Cable with Connectors on Both Ends (RJ45/RJ45) Standard RJ45 connector type 	OMRON Corporation	0.3	XS6W-6LSZH8SS30CM-Y *2	OMRON Customer Service Center
		0.5	XS6W-6LSZH8SS50CM-Y *2	
		1	XS6W-6LSZH8SS100CM-Y *2	
		10	XS6W-6LSZH8SS1000CM-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 communications 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 connector 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 Plugs on Both Ends (M12/M12) Shield Strengthening Connector cable M12/Smartclick connector type 	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 Plugs on Both Ends (M12/RJ45) Shield Strengthening Connector cable M12/Smartclick connector type Rugged RJ45 connector 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

Product 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.
	JMACS Japan Co., Ltd.	IETP-SB *1	JMACS Japan Co., Ltd.
RJ45 Connectors	Panduit Corporation	MPS588 *1	Panduit Corporation US Headquarters Osaka Branch Office

*1. We recommend that you use combinations of the above cables and connectors.

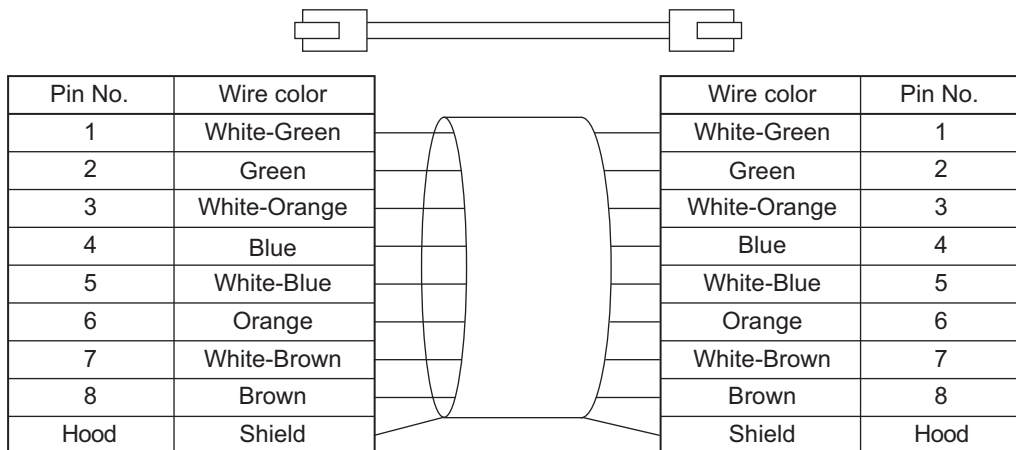
● **Sizes and conductor pairs: AWG 22 × 2 Pairs**

Product	Manufacturer	Model	Contact information
Cables	Kuramo Electric Co., Ltd.	KETH-PSB-OMR *1	Kuramo Electric 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, as shown below.



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

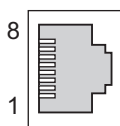
Note 2. There are two connection methods for Ethernet: T568A and T568B. The T568A connection method is shown above, but the T568B connection method can also be used.

● **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**

The pin assignments are as follows.



Pin No.	Signal name	Abbreviation	Signal direction
1	Transmission data +	TD+	Output
2	Transmission data -	TD-	Output
3	Reception data +	RD+	Input

Pin No.	Signal name	Abbreviation	Signal direction
4	Not used.	---	---
5	Not used.	---	---
6	Reception data -	RD -	Input
7	Not used.	---	---
8	Not used.	---	---
Hood	Frame ground	FG	---

4-6 Laying the Ethernet Network

4-6-1 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 X 5252" 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 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.

4-6-2 Installing Ethernet Networks

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

Ethernet Switches

Manufacturer	Model	Description
OMRON	W4S1-03B	Packet priority control (QoS): EtherNet/IP control data priority
	W4S1-05B	Failure detection: Broadcast storm, LSI error detection, 100Base-TX/
	W4S1-05C	10Base-T, Auto negotiation Number of ports: three for the W4S1-03B, or five each for the W4S1-05B and W4S1-05C Failure detection output (W4S1-05C only)

Manufacturer	Model	Description
Cisco Systems, Inc.		Consult the manufacturer. http://www.cisco.com/
Contec USA, Inc.		Consult the manufacturer. http://www.contec.com/
Phoenix Contact USA		Consult the manufacturer. https://www.phoenixcontact.com


Twisted-pair Cables and Connectors

Applicable EtherNet/IP communications cables and connectors vary depending on the used baud rate. For 100Base-TX and 10Base-T, use an STP (shielded twisted-pair) cable of category 5 or higher. You can use either straight or cross cable.

For 1000Base-T, use an STP (shielded twisted-pair) cable (double shielding with aluminum tape and braiding) of category 5e or higher. You can use either straight or cross cable.

Cabling materials used for EtherNet/IP communication cables are shown in the table below.

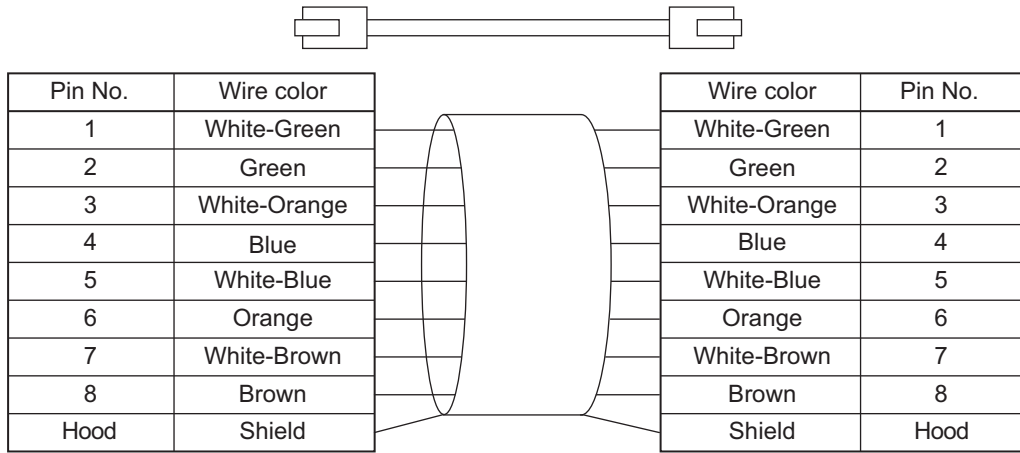
"100Base-TX" in the "Product" column of the table below indicates that either 100Base-TX or 10Base-T can be used.

Product		Manufacturer	Model
For 1000Base-T and 100Base-TX	Size and conductor pairs: AWG 24 × 4 pairs *1	Cable	Hitachi Metals, Ltd. NETSTAR-C5E SAB 0.5 × 4P CP
			Kuramo Electric Co. KETH-SB
			JMACS Japan Co., Ltd. IETP-SB
	RJ45 Connectors	Panduit Corporation MPS588	
For 100Base-TX	Size and conductor pairs: AWG22 × 2P*1	Cable	Kuramo Electric Co., Ltd. KETH-PSB-OMR
			JMACS Japan Co., Ltd. PNET/B
		RJ45 Assembly Connectors 	OMRON XS6G-T421-1

*1. We recommend that you use cables and connectors in above combinations.

Attaching the Connectors to the Cable and Pin Assignments

Use straight wiring to attach the connectors to the communications cable, as shown below.



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

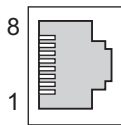
Note 2. There are two connection methods for Ethernet: T568A and T568B. The T568A connection method is shown above, but the T568B connection method can also be used.

● **Connector Specifications**

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

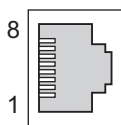
● **Pin Assignments**

Physical layer standards: 100BASE-TX



Pin No.	Signal name	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.	---	---

Physical layer standards: 1000BASE-T



Pin No.	Signal name	Abbreviation	Signal direction
1	Communication data DA+	BI_DA+	Input/output
2	Communication data DA-	BI_DA-	Input/output
3	Communication data DB+	BI_DB+	Input/output

Pin No.	Signal name	Abbreviation	Signal direction
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.

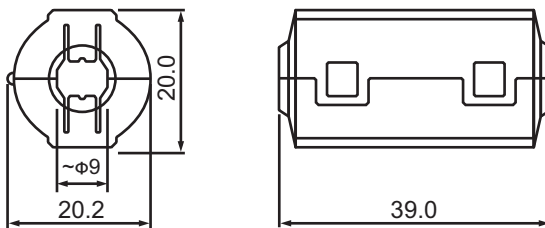
In that case, attach a clamp core to the Ethernet communications cable.

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

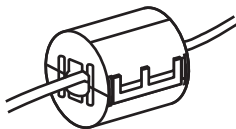
Manufacturer	Product name	Model
NEC TOKIN	Clamp core	ESD-SR-160

● Dimensions of the Recommended Product

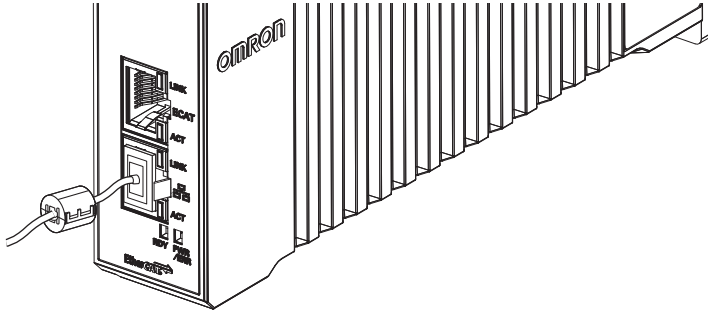


● Recommended Attachment Procedure

To attach the clamp core to the cable, make one loop with the Ethernet communications cable as shown in the figure below.



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



4-7 USB Memory Device Connection

Connect a USB memory device to the USB host port (Type A) on the Motion 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.

4-8 Grounding

This section describes the earthing methods and precautions.

4-8-1 Considerations for Earthing Methods

Local potential fluctuations due to lightning or noise from 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 for each usage condition are given in the following table.

Specifications of communications cables for EtherCAT and Ethernet	Earthing methods			
	Equipotential bonding system	Star earthing		Daisy Chain
		Connecting devices and noise sources to separate earth electrodes	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	Recommended	Recommended	Not recommended	Not recommended



Additional Information

- In countries or regions where earthing methods are 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 about the environmental resistance of the Ethernet switches to be used, the grounding between Ethernet switches, and the specifications of cables.

4-8-2 Grounding

This section describes the earthing methods and precautions.

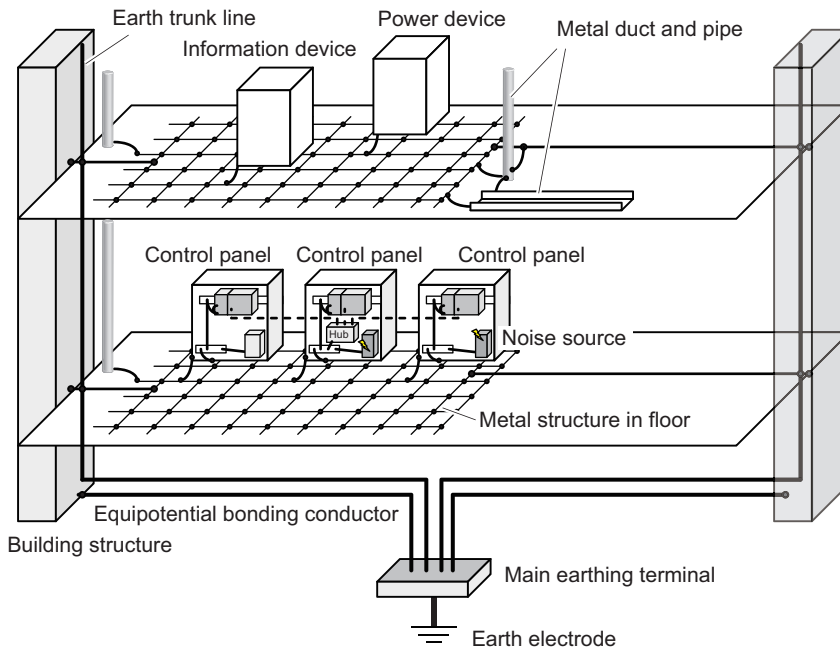
Equipotential Bonding System

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.



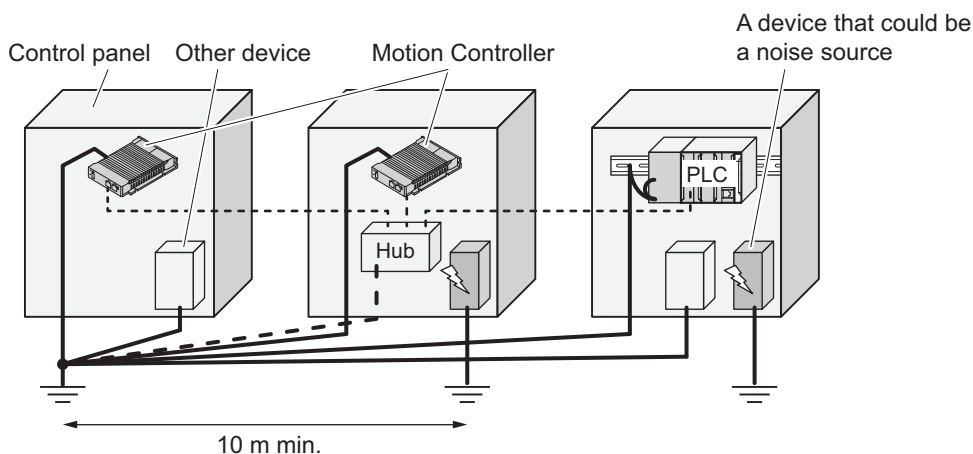
Star Earthing

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

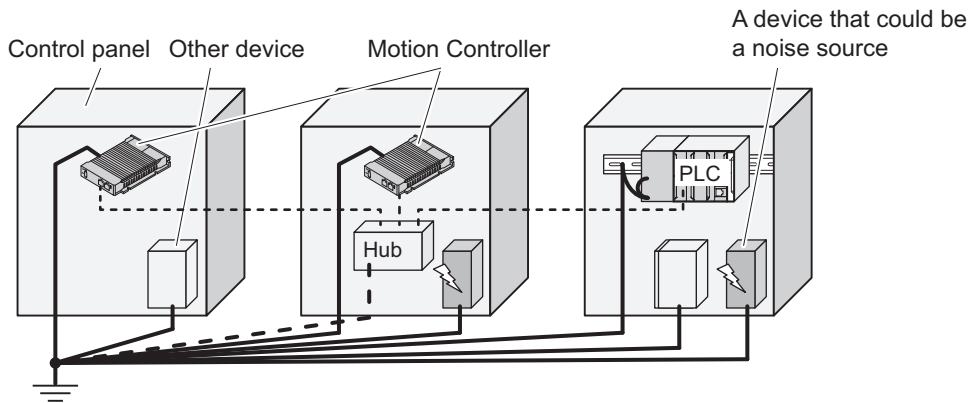
- a. Installation method by connecting devices and noise sources to separate earth electrodes

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 ground to 100 Ω 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.



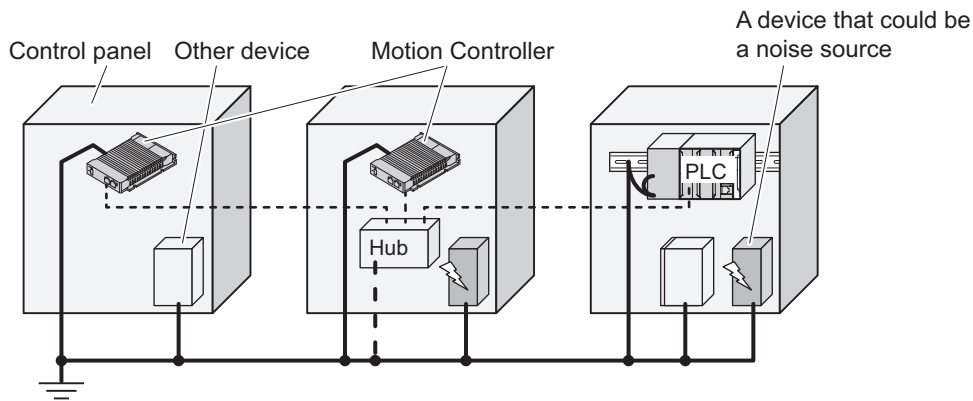
- b. Installation by connecting devices and noise sources to a common earth electrode
 This is an earthing method to connect the device that is connected with a communications cable, other devices, and a device that could be a noise source, to a common earth electrode.
 This earthing method is not recommended, because the device that is a potential 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 CK3E-series Programmable Multi-Axis Controller and taking corrective actions for the errors.

5-1	Types 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	5-3
5-3	Troubleshooting for Errors.....	5-5
5-3-1	Fatal Errors in the Motion Controller	5-5
5-3-2	Non-fatal Errors in the Motion Controller	5-5
5-3-3	Initialization of the Motion Controller	5-7
5-4	Sys.Status Register	5-8
5-4-1	Sys.Status Register List	5-8
5-4-2	Details of Flags.....	5-9
5-5	EtherNet/IP Connection Status Codes and Troubleshooting.....	5-14

5-1 Types of Errors

The errors in the Motion Controller are classified into the following two major categories.

- Fatal errors in the Motion Controller
Errors that occurred as the result of the Motion Controller operation stopping.
- Non-fatal errors in the Motion Controller
Errors that can be detected and managed by the Motion Controller itself that is still operating.

5-2 Using the Indicators to Check Errors

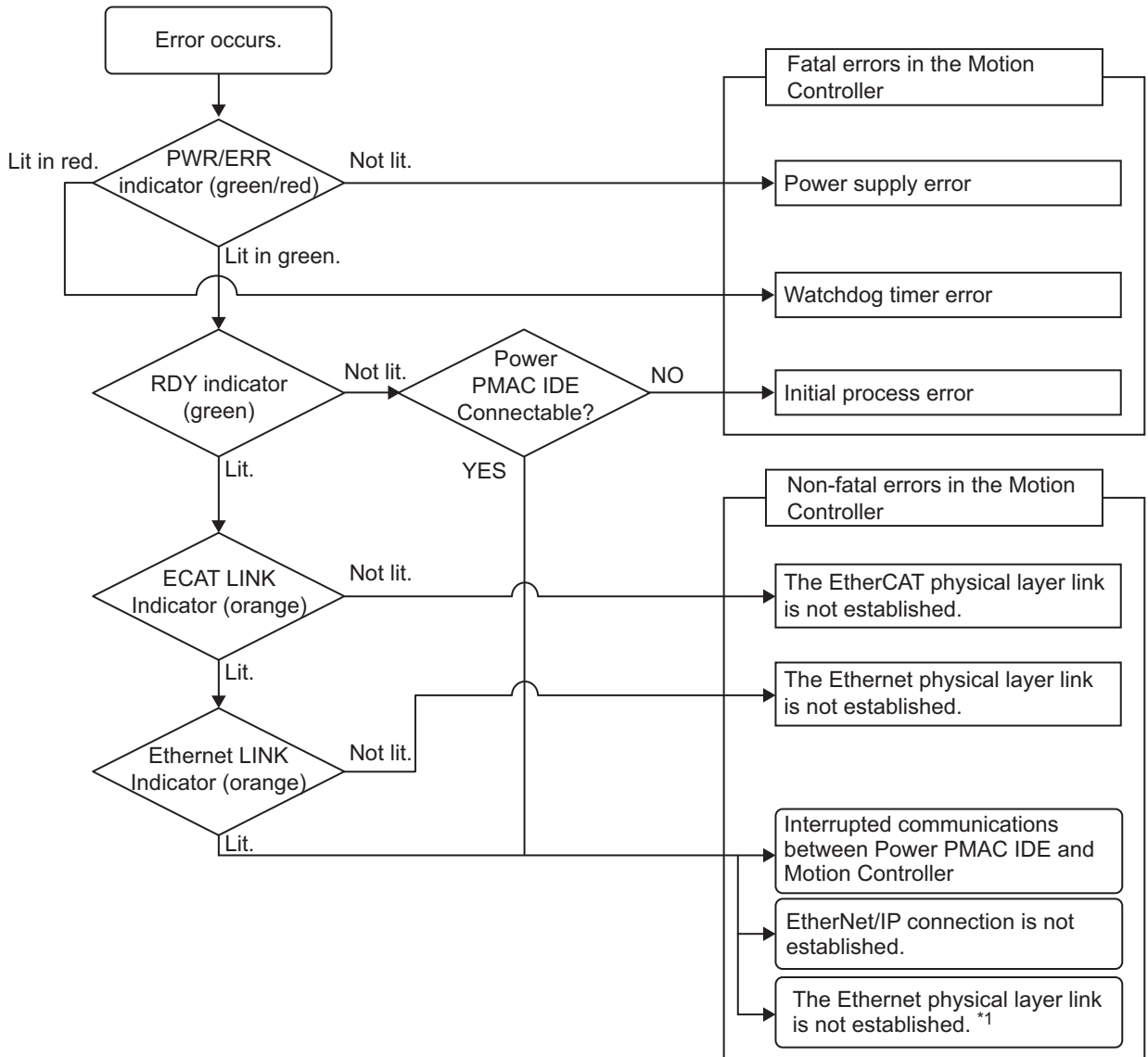
5-2-1 Indicator Types

The following shows the indicators on the Motion Controller and their functions.

Indicator name	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 Motion Controller, use the following flowchart to check the indicators and determine whether "the error is "fatal" for the Motion Controller" or "the error is "non-fatal" for the Motion Controller".



*1. For the details of errors that cannot be determined solely by checking the indicators, check the Sys.status register.
 Refer to 5-4-1 Sys.Status Register List on page 5-8 for the Sys.status flag.

5-3 Troubleshooting for Errors

5-3-1 Fatal Errors in the Motion Controller

For fatal errors in the Motion Controller, take the following corrective actions depending on the nature of the error.

Description	Cause	Corrective action
Power supply error	The unit's input power is not supplied.	Check the following items and adequately supply 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 allowable range. <ul style="list-style-type: none"> • Is the power supply voltage within the specified range? • Is the capacity of the power supply sufficient? • Is the power supply failing?
	The power supply unit of the Motion 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.
	Illegal user program	Refer to 5-3-3 <i>Initialization of the Motion Controller</i> on page 5-7, and execute re-initialization.
	Software watchdog trip caused by the insufficient task processing time or failed task interruption.	For details, please refer to the following manuals. <ul style="list-style-type: none"> • Power PMAC User's Manual (Cat. No. O014) • Power PMAC Software Reference Manual (Cat. No. O015)
	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 Motion Controller failed.	Replace the Motion 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 Motion Controller failed.	Replace the Motion Controller.

5-3-2 Non-fatal Errors in the Motion Controller

For fatal errors in the Motion Controller, take the following corrective actions depending on the nature of the error.

Description	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 is not being used, replace the cable.

Description	Cause	Corrective action
	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.
	Intrusion of noise	Check noise entry paths, and implement noise-related countermeasures as required.
	Power is not supplied to the first slave connected to the Motion Controller.	Supply power to the slave.
	A slave within the EtherCAT network configuration failed.	Replace the slave.
	The Motion Controller failed.	Replace the Motion 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 is not being 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.
	Intrusion of noise	Check noise entry paths, and implement noise-related countermeasures as required.
	Power is not supplied to the Ethernet switch connected to the Motion Controller.	Supply power to the Ethernet switch.
	A device within the Ethernet network configuration failed.	Replace the device.
	The Motion Controller failed.	Replace the Motion Controller.
Interrupted communications between Power PMAC IDE and Motion Controller	Communications are interrupted due to disconnection and reconnection of the Ethernet cable used for Ethernet communications between Power PMAC IDE and the Motion Controller while communication was being established.	If communications between Power PMAC IDE and the Motion Controller are interrupted while Ethernet communications between Power PMAC IDE and the Motion Controller are established, communications between Power PMAC IDE and the Motion Controller cannot be reestablished simply by rectifying the problem that interrupted the communications. To reestablish the communications, you need to click Communication Setup in Power PMAC IDE and restart communications.
	The power to the Ethernet switch between Power PMAC IDE and the Motion Controller is turned OFF and then ON while communications are being established, which caused communications to be interrupted.	
	Communications are interrupted because power to the Motion Controller is turned OFF and then ON while communications are being established.	
	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 the Motion Controller. To reestablish the communications, you need to restart Power PMAC IDE or reestablish the communications by using Power PMAC IDE.

Description	Cause	Corrective action
EtherNet/IP connection not established.	If the originator in use is an NJ/NX-series CPU Unit, you can use Network Configurator to identify the cause and corrective action. Refer to the <i>NJ/NX-series CPU Unit Built-in EtherNet/IP Port User's Manual (Cat. No. W506)</i> , 16-2 Checking Status with the Network Configurator for details. Refer to <i>5-5 EtherNet/IP Connection Status Codes and Troubleshooting</i> on page 5-14 for error codes detected by the CK3E.	

5-3-3 Initialization of the Motion Controller

If the Motion Controller fails to connect to the Power PMAC IDE, you can use a USB memory to initialize the CPU Unit to the factory default state.

Use the following procedure to carry out this process.

- 1** USB memory preparation
Prepare a blank USB memory formatted in FAT32. The recommended USB memory is listed in *2-2-1 USB Memory Device* on page 2-5.
- 2** Folder creation
Use a computer to create an empty folder named *PowerPmacFactoryReset* on the USB memory root.
- 3** With the power OFF, mount the above USB memory to the Motion Controller.
- 4** When the power to the Motion Controller is turned ON, the Motion Controller will be initialized to the factory default.
- 5** Connect the Power PMAC IDE, and issue a save command.
- 6** Turn the power OFF, and remove the USB memory.

5-4 Sys.Status Register

5-4-1 Sys.Status Register List

If an error cannot be identified with indicators, confirm the error status in the Sys.Status register.

If an error occurs during operation, check the Sys.Status register with the user program and take suitable action to avoid dangerous operation.

The Sys.Status register is not saved in the built-in flash memory, so it is deleted if the power goes OFF.

Sys.status can be checked on the Power PMAC IDE; select **Status–Global Status** on it.

The Sys.Status register is 32-bit data consisting of the following bits.

Bit	Name	Description
16-31	-	
15	CK3WHWChange	The registers are disabled in the CK3E-series.
14	CK3WConfigErr(bit2)	The values are always 0.
13	CK3WConfigErr(bit1)	
12	CK3WConfigErr(bit0)	
11	FlashSizeErr	The user program size exceeds the built-in flash memory capacity.
10	BufSizeErr	The buffer size exceeds the built-in RAM capacity.
9	AbortAll	In stop status after <i>Abort all</i> input
8	NoClocks	Cannot detect a phase clock or a servo clock.
7	Default	Factory default
6	FileConfigErr	System file setting error
5	HWChangeErr	The registers are disabled in the CK3E-series. The values are always 0.
4	ConfigLoadErr	Error in saved settings
3	ProjectLoadErr	User Project File Read Error
2	PwrOnFault	Read error when power is turned ON or during reset (bit 3 to 6 logical OR)
1	WDTFault (bit 1)	Real-time interruption software watchdog timer error
0	WDTFault (bit 0)	Background software watchdog timer error

5-4-2 Details of Flags

● FlashSizeErr

Register name	Sys.FlashSizeErr		
Description	The user program size exceeds the built-in flash memory capacity.		
Range	0 to 1		
Details	0: No error 1: The user program size exceeds the built-in flash memory capacity.		
Detection timing	When save command is issued		
Recovery	Re-issue save command.		
Effects	Save command is invalidated.		
Cause and correction	Cause (Assumed cause)	Correction	Prevention
	The user program size is too large.	Reduce the size of the user program. Or, delete the backup file.	None
Precautions/Remarks	None		

● BufSizeErr

Register name	Sys.BufSizeErr		
Description	The buffer size set in the user program exceeds the built-in RAM capacity.		
Range	0 to 1		
Details	0: No error 1: Buffer size exceeds the built-in RAM capacity.		
Detection timing	When power is turned ON or the Controller is reset.		
Recovery	Cycle the power supply, or issue reset command (\$\$\$)		
Effects	The buffer size is changed to the default value.		
Cause and correction	Cause (Assumed cause)	Correction	Prevention
	The buffer size set in the user program is too large.	Reduce the buffer size.	None
Precautions/Remarks	None		

● AbortAll

Register name	Sys.AbortAll		
Description	Stop by <i>Abort all</i> input		
Range	0 to 1		
Details	0: No stop by <i>Abort all</i> input 1: Stopped by <i>Abort all</i> input, or stopped in the past by <i>Abort all</i> input.		
Detection timing	With <i>Abort all</i> input		
Recovery	Cycle the power supply, or issue reset command (\$\$\$)		
Effects	Operation continues		
Cause and correction	Cause (Assumed cause)	Correction	Prevention
	<i>Abort all</i> was input.	None	None
Precautions/Remarks	None		

● NoClocks

Register name	Sys.NoClocks		
Description	Cannot detect a phase clock or a servo clock.		
Range	0 to 1		
Details	0: No error 1: Cannot detect a phase clock or a servo clock.		
Detection timing	When power is turned ON or the Controller is reset.		
Recovery	Cycle the power supply, or issue reset command (\$\$\$)		
Effects	Cannot enable the motor.		
Cause and correction	Cause (Assumed cause)	Correction	Prevention
	The clock-related register is overwritten by the user program.	If the error no longer occurs after the re-initialization command (\$\$\$**) is executed, review the user program.	None
	The Motion Controller failed.	If the error still persists even after the above corrective actions have been taken, replace the Motion Controller.	None
Precautions/Remarks	None		

● Default

Register name	Sys.Default		
Description	Initialized to the factory default setting.		
Range	0 to 1		
Details	0: No error 1: Cases below <ul style="list-style-type: none"> In the factory default state, or initialized to the factory default state by a re-initialization command (\$\$\$**). Configuration changed after save command was issued. 		
Detection timing	When power is turned ON or the Controller is reset.		
Recovery	Cycle the power supply, or issue reset command (\$\$\$)		
Effects	Operation continues		
Cause and correction	Cause (Assumed cause)	Correction	Prevention
	Re-initialization command (\$\$\$**) was issued.	None	None
	<i>ConfigLoadErr</i> occurred.	Check the corrective action for each error.	None
Precautions/Remarks	None		

● FileConfigErr

Register name	Sys.FileConfigErr		
Description	System file setting error		
Range	0 to 1		
Details	0: No error 1: System file setting error		
Detection timing	When power is turned ON or the Controller is reset.		
Recovery	Cycle the power supply, or issue reset command (\$\$\$)		
Effects	Operate with default settings.		
Cause and correction	Cause (Assumed cause)	Correction	Prevention
	System file settings are incorrect.	If the re-initialization command (\$\$\$**) is executed, and the error no longer occurs, review the user program.	None
	The Motion Controller failed.	If the error still persists even after the above corrective actions have been taken, replace the Motion Controller.	None
Precautions/Remarks	None		

● ConfigLoadErr

Register name	Sys.ConfigLoadErr		
Description	Read error in saved settings		
Range	0 to 1		
Details	0: No error 1: System file setting error		
Detection timing	When power is turned ON or the Controller is reset.		
Recovery	Cycle the power supply, or issue reset command (\$\$\$)		
Effects	Operate with default settings.		
Cause and correction	Cause (Assumed cause)	Correction	Prevention
	Settings are incorrect.	If the re-initialization command (\$\$\$**) is executed, and the error no longer occurs, review the settings.	None
	The Motion Controller failed.	If the error still persists even after the above corrective actions have been taken, replace the Motion Controller.	None
Precautions/Remarks	None		

● ProjectLoadErr

Register name	Sys.ProjectLoadErr		
Description	User Project File Read Error		
Range	0 to 1		
Details	0: No error 1: User Project File Read Error		
Detection timing	When power is turned ON or the Controller is reset.		
Recovery	Cycle the power supply, issue reset command (\$\$\$), or download the project		
Effects	Operate with default settings.		
Cause and correction	Cause (Assumed cause)	Correction	Prevention
	The project file is corrupted.	After executing the re-initialization command (\$\$ \$***), download the project file again.	If the unit power supply is turned OFF while saving the project file, the project file may be corrupted. Do not turn OFF the power supply while saving.
	An illegal project file was downloaded.	Identify the cause from the output window, and make corrections to the project file. After the corrections, execute the re-initialization command (\$\$\$***), and download the project file again.	None
	The Motion Controller failed.	If the error still persists even after the above corrective actions have been taken, replace the Motion Controller.	None
Precautions/Remarks	None		

● PwrOnFault

To know whether the error has occurred when the power is turned ON or at reset with one bit, the value in PwrOnFault becomes 1 when any of Sys.FileConfigErr, Sys.HWChangeErr, Sys.ConfigLoadErr, or Sys.ProjectLoadErr is "1".

● WDTFault

Register name	Sys.WDTFault		
Description	<i>Software Watchdog Timer ErrorStatus</i>		
Range	0 to 3		
Details	<p>Sys.WDTFault shows the software watchdog timer operation status with 2-bit data.</p> <p>Bit0: Background software watchdog timer error 0: No background watchdog timer error has occurred. 1: Background watchdog timer error has occurred.</p> <p>Bit1: Real-time interruption software watchdog timer error 0: No real-time interruption watchdog timer error has occurred. 1: Real-time interruption watchdog timer error has occurred.</p> <p>Refer to the <i>Power PMAC User's Manual (Cat. No. O014)</i> for details of the software watchdog timer.</p>		
Detection timing	During operation		
Recovery	Cycle the power supply, issue reset command (\$\$\$) or re-initialization command (\$\$\$***)		
Effects	User program: Stops Hardware: Enters reset state		
Cause and correction	Cause (Assumed cause)	Correction	Prevention
	Background software watchdog timer error occurred. <ul style="list-style-type: none"> Real-time interruption process took too long, and the background process could not be implemented at the interval set in the Sys.WDTRreset register. 	<ul style="list-style-type: none"> Review the user program. Review the Sys.WDTRreset register value. 	None
	Real-time interruption software watchdog timer error generated. <ul style="list-style-type: none"> Real-time interruption process could not be implemented at the interval set in the Sys.BgWDTRreset register. 	<ul style="list-style-type: none"> Review the user program. Review the Sys.BgWDTRreset register value. 	None
Precautions/Remarks	None		

5-5 EtherNet/IP Connection Status Codes and Troubleshooting

This section describes how to identify the cause of an error by the connection status of the tag data link and how to troubleshoot the error when the originator is an NJ/NX-series CPU Unit. The connection status can be monitored by the device monitor function of the Network Configurator. Refer to the *NJ/NX-series CPU Unit Built-in EtherNet/IP Port User's Manual (Cat. No. W506)* for details of how to start Network Configurator and the device monitor function.

Connection status		Error cause	Corrective action example
General Status (hex)	Additional Status (hex)		
00	0000	Normal status code The connection has been opened and the tag data link is communicating normally.	-
01	0106	Duplicate consumers Attempted to open multiple connections for single-consumer data.	If you change the scanner while a tag data link is established, restart the PMAC.
01	0112	Error code returned from target The RPI value is invalid.	If a single connection is connected to multiple originators, check if the RPI values are not different.
01	0114	Error code returned from target The Vendor ID and Product Code did not match when the connection was opened.	Check if the originator did not specify a target device model that was different from the model of the target device actually connected.
01	0115	Error code returned from target The Device Type did not match when opening connection.	Check if the originator did not specify a target device model that was different from the model of the target device actually connected.
01	0116	Error code returned from target The Major/Minor Revisions did not match when opening connection.	Check if the revision in the EDS file in use matches the revision of the device.
01	0117	Error code returned from target The tag set specified in the connection's target variables does not exist.	Check that the tag settings are correct with the EtherNet/IP setting tool.
01	011A	Error code returned from target The number of connections is more than 32.	Does not occur. *1
01	0127	Error code returned from target The connection size is different between the originator and target.	Check if the connection size of the target matches the connection size of the originator.
01	0128		
01	012F	Error code returned from target The application path is different between the originator and target.	Check that the setting values for the target variable and originator variable are correct with the EtherNet/IP setting tool.

Connection status		Error cause		Corrective action example
General Status (hex)	Additional Status (hex)			
01	0203	Error code generated by originator	The connection timed out.	Timeout of tag data link communication from the target occurred. Check the power supply to and cable wiring of the devices on the path including the target and switch. If the cause is a decrease in performance due to heavy load, review the performance design by increasing the timeout value, RPI, or etc.
01	0204	Error code generated by originator	The connection open process timed out.	The target did not respond. Check the power supply to and cable wiring of the devices on the path including the target and switch.
01	0302	Error code generated by originator or returned from target	The overall communication of EtherNet/IP configuration exceeds the tag data link allowable communication bandwidth (pps).	Review the EtherNet/IP settings so that pps does not exceed the limit.

*1. If the number of connections is more than 32, *Tag Data Link Timeout* will occur repeatedly. If the controller log contains repetitive *Tag Data Link Timeout* records, check if the number of connections is appropriate.



Maintenance and inspection

This section describes the procedures for the cleaning, inspection, and maintenance of the CK3E-series 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

This section describes daily maintenance and the cleaning and inspection methods.

In order to use the functions of the Motion Controller in the best condition, please perform daily or regular inspections.

6-1-1 Cleaning

Perform the following cleaning procedures periodically to ensure the Motion Controller is maintained in the best operating condition. Always turn OFF the power supply to the Motion Controller before performing the cleaning procedures.

- Wipe off the dust or dirt on the front, top, or bottom of the Unit with a dry, soft cloth when doing daily cleaning.
- If dust or dirt remains even after wiping with 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 rubber, vinyl, or tape that was left on for a long time. Remove the smudges when cleaning.



Precautions for Correct Use

Never use volatile solvents, such as paint thinner, benzene, or chemical wipes.

6-1-2 Periodic Inspections

Since Motion Controller elements can deteriorate under improper environmental conditions, periodic inspections are 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 may be necessary depending on the ambient environment.

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

Inspection item	Inspection details	Criteria	Correction
External power supply	Check for voltage fluctuations at the power supply terminals.	The voltage must be within the allowable voltage fluctuation range.	Use a voltage tester to check the power supply at the terminals. Take necessary steps to bring voltage of the supplied power to within the allowable voltage fluctuation range.
Ambient environment	Check the ambient temperature. *1	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. *2	Relative humidity must be 10% to 95% with no condensation.	Use a hygrometer to check the humidity and ensure that the ambient operating humidity remains between 10% and 90%. Make sure that condensation does not occur due to rapid changes in temperature.
	Check that the Controller is not in direct sunlight.	Not in direct sunlight	Protect the Controller if necessary.

Inspection item	Inspection details	Criteria	Correction
	Check for accumulation of dirt, dust, salt, metal powder, etc.	No accumulation	Clean and protect the Controller if necessary.
	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.
Installation and wiring	Check that cable connectors are fully inserted and locked.	No looseness	Fully insert and lock the connectors.
	Check for damaged external wiring cables.	No visible damage	Check visually and replace cables if necessary.

*1. If using a control panel, the temperature inside the control panel is the ambient temperature.

*2. If using a control panel, the humidity inside the control panel is the ambient humidity.

Tools Required for Inspections

● Required Tools

- Flat-blade screwdriver
- Phillips screwdriver
- Voltage tester or digital multimeter
- Industrial alcohol and pure cotton cloth
- Antistatic gas duster

● Tools Required Occasionally

- Oscilloscope
- Thermometer and hygrometer

6-2 Maintenance Procedures

This section describes the procedures to back up the data in the Motion Controller and to replace the Unit.

6-2-1 Unit Replacement Precautions

If you find any faulty Units during inspection, replace the Unit according to the following points.

- Do not replace a Unit until the power is turned OFF.
- After replacement, 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, enclose this description with the Unit, and request repairs.

6-2-2 Backup

Back up the Motion Controller data so that the data can be restored when a failure or other problems occur.

Use the Power PMAC IDE to create a backup file. The Power PMAC IDE is also used to restore the backup file to the Motion Controller.

For details of the backup and restoration procedures, refer to the *Power PMAC IDE User Manual (Cat. No. O016)*.

6-2-3 Unit Replacement

Procedure for Replacing the Motion Controller

The following describes the basic procedure for replacing the Motion Controller.

No.	Step	Description	Reference
1	Turn OFF power to the devices	Turn OFF power to the Motion Controller. Take measures to ensure that there are no effects on the peripheral devices, and then turn OFF power to the Motion Controller.	---
2	Disconnect cables	Remove the cable connected to the Motion Controller.	---
3	Replace the Motion Controller	Replace the Motion Controller with a new Controller, connect the cables, and turn ON power to the Motion Controller and EtherCAT devices.	---
4	Connect with IDE	Connect the Motion Controller and the Power PMAC IDE online through Ethernet.	---
5	Initialize the Motion Controller	In the Terminal window, input the re-initialization command (\$\$\$***), and initialize the Motion Controller.	---
6	Read the EtherCAT ENI file	In Power PMAC IDE, click Delta Tau—Tools—System Setup—Master[0] Deactivated in order. Click the Browse button, and read the backed-up ENI file into Power PMAC IDE.	Only when using EtherCAT
7	Write to the EtherCAT ENI file	Click the Download ENI file button, and write the ENI file to the Motion Controller.	Only when using EtherCAT

No.	Step	Description	Reference
8	Read the project file	Read out the backed-up project file in Power PMAC IDE.	The EtherNet/IP settings are contained in the project file.
9	Write to the project file	Right-click the project name, click Build and Download All Programs , and write the project file to the Motion Controller.	---
10	Execute save	In the Terminal window, input the save command, and save the program in the built-in flash memory.	---
11	Execute reset	In the Terminal window, input the reset command \$\$\$, and reset the Motion Controller.	---

Procedure to Replace an EtherCAT Slave

If you use EtherCAT, use the following procedure to replace an EtherCAT slave.

No.	Step	Description	Reference
1	Turn OFF power to the devices	Take measures to ensure that there are no effects on the peripheral devices, and then turn OFF power to the Motion Controller and all EtherCAT slaves.	-
2	Replace the EtherCAT Slave	For the EtherCAT slave replacement method, refer to the relevant manuals for each slave. Replace with a new Unit, turn ON power to the EtherCAT slave, and then turn ON power to the Motion Controller.	Refer to the manual for each EtherCAT slave for details.



Appendices

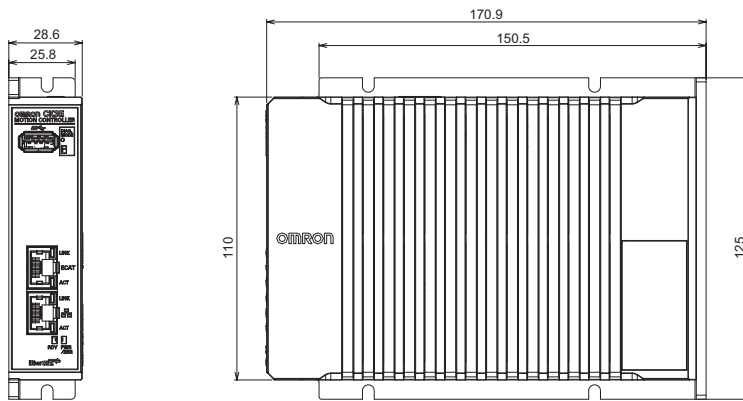
The appendices provide the Unit dimensions and restrictions on using the OMRON EtherCAT Coupler Unit.

A-1	Dimensions	A-2
A-2	Restrictions on Using the NX-series EtherCAT Coupler Unit	A-4
A-3	Supported CIP Objects	A-5
A-3-1	Identity Object (Class ID: 01 Hex)	A-5
A-3-2	Assembly Object (Class ID: 04 Hex)	A-6
A-3-3	TCP/IP Interface Object (Class ID: F5 Hex)	A-7
A-3-4	Ethernet Link Object (Class ID: F6 Hex)	A-8

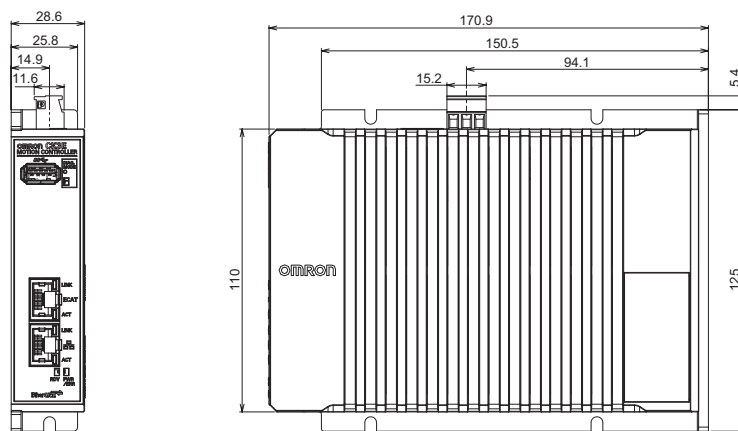
A-1 Dimensions

Dimensions are shown below. The unit of dimension is millimeters.

Main Body Only

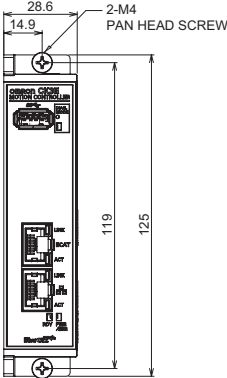


With Power Connector

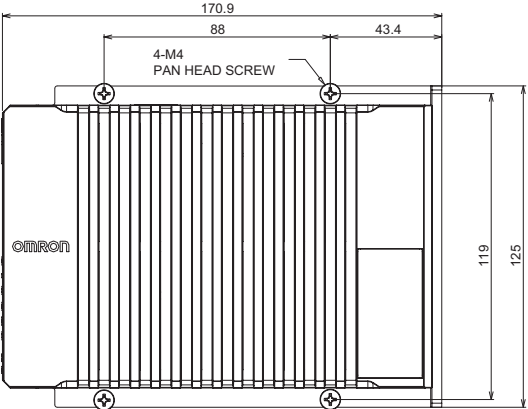


Mounting Dimensions

Front mounting



Sideways mounting



A-2 Restrictions on Using the NX-series EtherCAT Coupler Unit

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

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

A-3 Supported CIP Objects

The types of CIP objects supported in EtherNet/IP are as shown below.

Object name	Function	Reference
Identity object	Retrieves the product information of the CK3E.	A-3-1 Identity Object (Class ID: 01 Hex) on page A-5
Assembly object	Joins the I/O data of the CK3E.	A-3-2 Assembly Object (Class ID: 04 Hex) on page A-6
TCP/IP interface object	Configures the TCP/IP interface.	A-3-3 TCP/IP Interface Object (Class ID: F5 Hex) on page A-7
Ethernet link object	Retrieves various information on the Ethernet link.	A-3-4 Ethernet Link Object (Class ID: F6 Hex) on page A-8

A-3-1 Identity Object (Class ID: 01 Hex)

The Identity object is intended to retrieve the product information of the CK3E.

Service Code

Service code (hex)	Parameter name	Description	Supported services	
			Classes	Instances
01	Get_Attribute_All	Reads the values of all attributes.	Supported	Supported
05	Reset	0: Restart	Not supported	Supported
0E	Get_Attribute_Single	Reads the value of the specified attribute.	Supported	Supported

Class ID and Instance ID

The class ID and instance ID are as shown below.

ID type	Value (hex)
Class ID	01
Instance ID	01

Attribute ID

The attribute IDs for instances are as shown below.

Attribute ID (hex)	Parameter name	Description	Attribute	Data type	Value (hex)
01	Vendor ID	Vendor ID	Read	UINT	002F (always)
02	Device Type	Device type	Read	UINT	000E (always)
03	Product Code	Product code	Read	UINT	*1
04	Revision	CIP revision	Read	Struct	---
	Major Revision	Major revision	Read	USINT	01
	Minor Revision	Minor revision	Read	USINT	02
05	Status	Status	Read	WORD	*2

Attribute ID (hex)	Parameter name	Description	Attribute	Data type	Value (hex)
06	Serial Number	Serial number	Read	UDINT	Set value
07	Product Name	Product name	Read	SHORT_STRING	Set value

*1. Product code

Model	Product code (hex)
CK3E-1210	0BE5
CK3E-1310	0BE6
CK3E-1410	0BE7

*2. Status

Status	Value (hex)
The I/O connection is not established	0000
The I/O connection is established in RunMode	0060
The I/O connection is established in IdleMode	0070

A-3-2 Assembly Object (Class ID: 04 Hex)

The Assembly object is intended to join the I/O data of the CK3E.

Service Code

Service code (hex)	Parameter name	Description	Supported services	
			Classes	Instances
0E	Get_Attribute_Single	Reads the value of the specified attribute.	Supported	Supported
10	Set_Attribute_Single	Writes the value of the specified attribute.	Not supported	Supported

Class ID and Instance ID

The class ID and instance ID are as shown below.

ID type	Value (hex)
Class ID	04
Instance ID	ED: Listen Only Heartbeat Assembly EE: Input Only Heartbeat Assembly 300, 304, 308 to 37C (in 4 increments): Output Assembly 301, 305, 309 to 37D (in 4 increments): Input Assembly

Attribute ID

The attribute IDs for instances are as shown below.

● **Attribute ID for Output Assembly**

Attribute ID (hex)	Parameter name	Description	Attribute	Data type	Value (hex)
03	Data	Output data	Read and write	ARRAY of BYTE	0 to 504 byte data
04	Size	Output data size	Read	UINT	0 to 1F8

● **Attribute ID for Input Assembly**

Attribute ID (hex)	Parameter name	Description	Attribute	Data type	Value (hex)
03	Data	Input data	Read and write	ARRAY of BYTE	0 to 504 byte data
04	Size	Input data size	Read	UINT	0 to 1F8

A-3-3 TCP/IP Interface Object (Class ID: F5 Hex)

The TCP/IP Interface object is intended to configure the TCP/IP interface.

Service Code

Service code (hex)	Parameter name	Description	Supported services	
			Classes	Instances
01	Get_Attribute_All	Reads the values of all attributes.	Supported	Supported
0E	Get_Attribute_Single	Reads the value of the specified attribute.	Supported	Supported
10	Set_Attribute_Single	Writes the value of the specified attribute.	Not supported	Supported

Class ID and Instance ID

The class ID and instance ID are as shown below.

ID type	Value (hex)
Class ID	F5
Instance ID	01

Attribute ID

The attribute IDs for instances are as shown below.

Attribute ID (hex)	Parameter name	Description	Attribute	Data type	Value (hex)
01	Status	IP address setting status of the interface	Read	DWORD	00000001 (always)
02	Configuration Capability	Controller configurations and setup that can be set to the interface.	Read	DWORD	00000000 (always)
03	Configuration Control	Sets the method to used to set the IP address when the interface starts.	Read	DWORD	00000000 (always)

Attribute ID (hex)	Parameter name	Description	Attribute	Data type	Value (hex)
04	Physical Link Object	Path to the physical link object	Read	Struct	---
	Path Size	Path size	Read	UINT	0002 (always)
	Path	Fixed path	Read	Padded EPATH	20F62401 (always)
05	Interface Configuration	Interface configuration	Read	Struct	---
	IP Address	IP address	Read	UDINT	Set value
	Network Mask	Subnet mask	Read	UDINT	Set value
	Gateway Address	Default gateway	Read	UDINT	Set value
	Name Server	Primary name server	Read	UDINT	Set value
	Name Server 2	Secondary name server	Read	UDINT	Set value
	Domain Name	Domain name	Read	STRING	Set value
06	Host Name	Host name	Read	STRING	Set value
08	TTL Value	TTL value	Read	UINT	01 (always)
09	Mcast Config	Multicast configuration	Read	Struct	---
	Alloc Control	Multicast address allocation method	Read	USINT	00 (always)
	Reserved	Reserved	Read	USINT	00 (always)
	Num Mcast	Number of multicast addresses	Read	UINT	01 (always)
	Mcast Start Addr	Start multicast addresses	Read	UDINT	Set value
0D	Encapsulation Inactivity Timeout	Encapsulation inactivity timeout time	Read and write	UINT	Set value (120 seconds by default)

A-3-4 Ethernet Link Object (Class ID: F6 Hex)

The Ethernet link object is intended to retrieve various information on the Ethernet link.

Service Code

Service code (hex)	Parameter name	Description	Supported services	
			Classes	Instances
01	Get_Attribute_All	Reads the values of all attributes.	Supported	Supported
0E	Get_Attribute_Single	Reads the value of the specified attribute.	Supported	Supported
4C	Get_and_Clear	Specifies attribute 4, 5, 12, or 13 and resets the attribute to 0.	Not supported	Supported

Class ID and Instance ID

The class ID and instance ID are as shown below.

ID Type	Value (hex)
Class ID	F6

ID Type	Value (hex)
Instance ID	01

Attribute ID

The attribute IDs for instances are as shown below.

Attribute ID (hex)	Parameter name	Description	Attribute	Data type	Value (hex)
01	Interface Speed	Gives the baud rate for the interface.	Read	UDINT	Current value
02	Interface Flags	Gives the status of the interface.	Read	DWORD	*1
03	Physical Address	Gives the MAC address of the interface.	Read	ARRAY OF USINT	Current value of the MAC address
04	Interface Counters	Path to the physical link object	Read	Struct	---
	In Octets	The number of octets received through the interface.	Read	UDINT	Current value
	In Unicast Packets	The number of unicast packets received through the interface.	Read	UDINT	Current value
	In NonUnicast Packets	The number of packets besides unicast packets received through the interface.	Read	UDINT	Current value
	In Discards	The number of packets discarded after received by the interface	Read	UDINT	Current value
	In Errors	The number of incoming packets that had errors.	Read	UDINT	Current value
	In Unknown Protos	The number of incoming packets that were of an unknown protocol.	Read	UDINT	0 (always)
	Out Octets	The number of octets sent through the interface.	Read	UDINT	Current value
	Out Unicast Packets	The number of unicast packets sent through the interface.	Read	UDINT	Current value
	Out NonUnicast Packets	The number of packets besides unicast packets sent through the interface.	Read	UDINT	Current value
	Out Discards	The number of discarded sent packets.	Read	UDINT	Current value
Out Errors	The number of sent packets that had errors.	Read	UDINT	Current value	
05	Media Counters	Media counters for communications ports	Read	Struct	---
	Alignment Errors	Number of frames received that were not octets in length.	Read	UDINT	Current value
	FCS Errors	Number of frames received that did not pass the FCS check.	Read	UDINT	Current value
	Single Collisions	Number of frames sent successfully with only one collision.	Read	UDINT	Current value
	Multiple Collisions	Number of frames sent successfully with two or more collisions.	Read	UDINT	Current value

Attribute ID (hex)	Parameter name	Description	Attribute	Data type	Value (hex)
	SQE Test Errors	Number of times a SQE test error message was generated.	Read	UDINT	0 (always)
	Deferred Transmissions	The number of frames for which the first attempt to send was delayed because the media was busy.	Read	UDINT	Current value
	Late Collisions	The number of collisions detected in packets that were sent after 512 bit times.	Read	UDINT	Current value
	Excessive Collisions	The number of frames that failed to be sent because of excessive collisions.	Read	UDINT	Current value
	MAC Transmit Errors	The number of frames that failed to be sent due to an internal MAC sublayer transmission error.	Read	UDINT	Current value
	Carrier Sense Errors	The number of times the carrier sense condition was lost.	Read	UDINT	Current value
	Frame Too Longs	The number of frames received that exceeded the maximum allowed frame size.	Read	UDINT	Current value
	MAC Receive Errors	The number of frames that could not be received through the interface due to an internal MAC sublayer reception error.	Read	UDINT	Current value
07	Interface Type	Interface type	Read	USINT	02 (always)
0B	Interface Control	List of settings supported by the interface	Read	Struct	---
	Capability Bits	Settings supported by the interface	Read	DWORD	*2
	Speed/Duplex Array Count	The number of interface speed/duplex lists	Read	USINT	00 (always)
0C	HC Interface Counters	Counters related to packet transmission and reception on high capacity interfaces	Read	Struct	---
	HCInOctets	The number of octets received through the interface. This counter is the 64-bit edition of In Octets.	Read	ULINT	Current value
	HCInUnicastPkts	The number of unicast packets received through the interface. This counter is the 64-bit edition of In Unicast Packets.	Read	ULINT	Current value
	HCInMulticastPkts	The number of multicast packets received through the interface.	Read	ULINT	Current value
	HCInBroadcastPkts	The number of broadcast packets received through the interface.	Read	ULINT	Current value
	HCOutOctets	The number of octets sent through the interface. This counter is the 64-bit edition of Out Octets.	Read	ULINT	Current value
	HCOutUnicastPkts	The number of unicast packets sent through the interface. This counter is the 64-bit edition of Out Unicast Packets.	Read	ULINT	Current value
	HCOutMulticastPkts	The number of multicast packets sent through the interface.	Read	ULINT	Current value
	HCOutBroadcastPkts	The number of broadcast packets sent through the interface.	Read	ULINT	Current value

Attribute ID (hex)	Parameter name	Description	Attribute	Data type	Value (hex)
0D	HC Media Counters	High capacity media counters for communications ports	Read	Struct	---
	HCStatsAlignmentErrors	The number of frames received that were not octets in length. This counter is the 64-bit edition of Alignment Errors.	Read	ULINT	Current value
	HCStatsFCSErrors	The number of frames received that did not pass the FCS check. This counter is the 64-bit edition of FCS Errors.	Read	ULINT	Current value
	HCStatsInternalMacTransmitErrors	The number of frames that failed to be sent due to a MAC sublayer transmission error. This counter is the 64-bit edition of MAC Transmit Errors.	Read	ULINT	Current value
	HCStatsFrameTooLongs	The number of frames received that exceeded the maximum allowed frame size. This counter is the 64-bit edition of Frame Too Long.	Read	ULINT	Current value
	HCStatsInternalMacReceiveErrors	The number of frames that could not be received through the interface due to a MAC sublayer reception error. This counter is the 64-bit edition of MAC Receive Errors.	Read	ULINT	Current value
	HCStatsSymbolErrors	The number of frames that could not be received through the interface due to an internal MAC sublayer symbol error.	Read	ULINT	Current value

*1. Details on Interface Flags

Bit	Name	Description
0	Link Status	FALSE: The link is down. TRUE: The link is up.
1	Half/Full Duplex	FALSE: Half duplex TRUE: Full duplex
2-4	Negotiation Status	00 hex: Auto-negotiation is in progress. 01 hex: Auto-negotiation and speed detection failed. 02 hex: Auto-negotiation failed, but speed detection succeeded. 03 hex: Speed and duplex mode negotiation succeeded. 04 hex: Auto-negotiation was not attempted.

*2. Details on Capability Bits

Bit	Name	Description
0	Manual Setting Requirement Reset	Always FALSE
1	Auto-negotiate	Always TRUE
2	Auto-MDIX	Always TRUE
3	Manual Speed/Duplex	Always FALSE



Index



Index

B	
Basic Configuration.....	1-3
C	
Cleaning.....	6-2
Compatible Wires.....	4-8
D	
Daisy Chain.....	4-23, 4-25
DIAG.MODE.....	3-3
E	
Earthing Methods.....	4-23
ECAT ACT.....	3-3
ECAT LINK.....	3-3
Equipotential bonding system.....	4-23
EtherCAT communications connector.....	3-2
EtherCAT communications port operation indicators.....	3-2
Ethernet ACT.....	3-3
Ethernet communications connector.....	3-2
Ethernet communications port operation indicators.....	3-2
Ethernet LINK.....	3-3
F	
Function grounding terminal.....	4-8
G	
Grounding.....	4-8, 4-23
grounding to 100 Ω or less.....	4-9
I	
Initial process error.....	5-5
Initialization of the motion controller.....	5-7
Installation in cabinets or control panels.....	4-5
M	
Maximum number of controlled axes.....	2-2
Modbus-TCP communications.....	1-4
N	
network topology.....	4-11
O	
Operating Procedure.....	1-6
P	
Power PMAC IDE.....	1-5
Power PMAC-NC16 Runtime.....	1-5
Power PMAC-NC16 SDK.....	1-5
Power supply connector.....	3-2
Power supply error.....	5-5
Procedure for wiring power supply connector.....	4-9
PWR/ERR.....	3-3
R	
RDY.....	3-4
Recommended clamp core.....	4-20
Recommended Power Supply.....	2-5
recommended screwdriver.....	4-9
Recommended USB memory.....	2-5
Recommended USB memory.....	2-5
S	
Star earthing.....	4-23, 4-24
Support Software.....	1-5
T	
twisted-pair cable.....	4-13
U	
Unit operation indicators.....	3-2
USB 3.0 connector.....	3-2
W	
Watchdog timer error.....	5-5

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