# OMRON

#### **CK3M-series**

# **Programmable Multi-Axis Controller Hardware**

## **User's Manual**

CK3M-CPU1□1 CK3W-PD048 CK3W-AX1414□/1515□

**Programmable Multi-Axis Controller** 



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# Introduction

Thank you for purchasing a CK3M-series Programmable Multi-Axis Controller (may be called Motion Controller hereinafter).

This manual contains information that is necessary to use the CK3M-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**

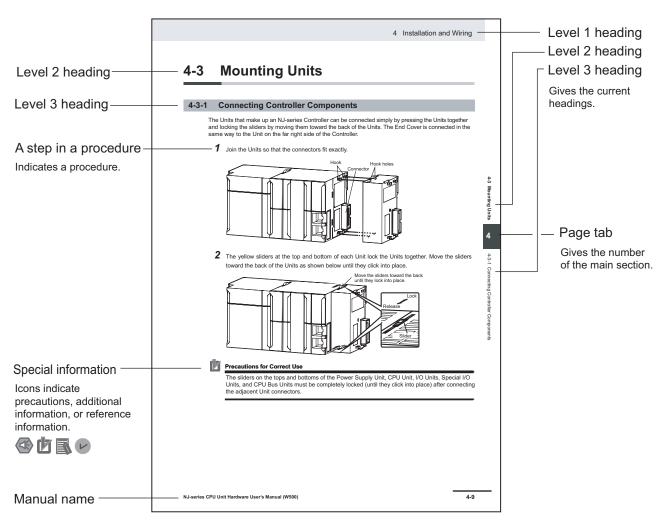
This manual covers the following products.

 CK3M-series Programmable Multi-Axis Controller CK3M-CPU1□1 CK3W-PD048
 CK3W-AX1414□/1515□

# **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**

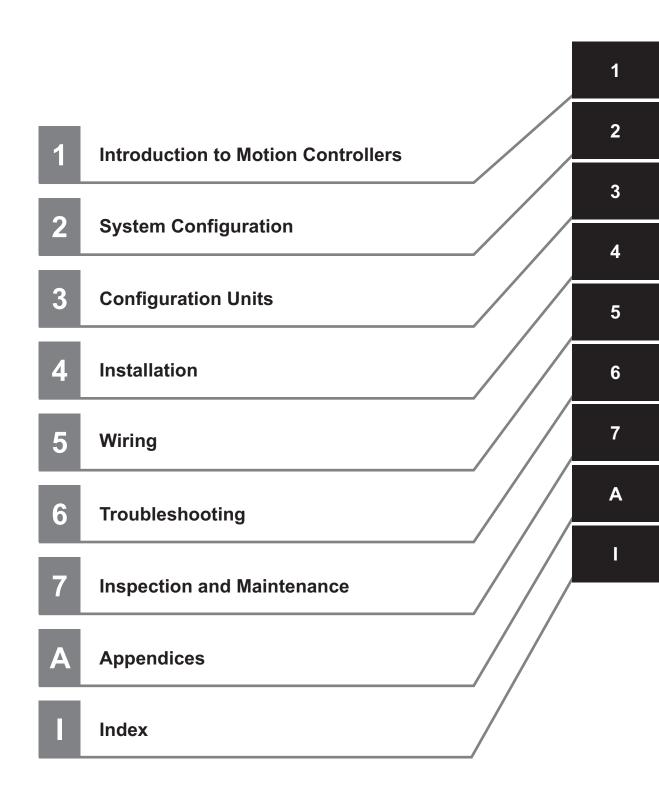
Additional information to read as required.

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

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Manual Structure

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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 CK3M-series Programmable Multi-Axis Controller.

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

The following notation is used.



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



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 products 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.

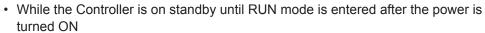


Unintended outputs may occur if an error occurs in internal data of the Controller. As a countermeasure for such problems, external safety measures must be provided to ensure safe operation of the system.



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 an error occurs in the power supply
- · 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





If a system initialization error occurs

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

The product outputs may remain ON or OFF due to deposition or burning of the output relays or destruction of the output transistors. As a countermeasure for such problems, external safety measures must be provided to ensure safe operation of the system.



#### **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, data, and parameter settings for proper execution before you use them for actual operation.



# **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 terminal blocks, connectors, and other items with locking devices are correctly locked into place before use.
- When connecting the Power Supply Unit, CPU Unit, and CK3W Unit, connect the units together, then slide the sliders on the top and bottom until they click into place, and lock securely.
- Always mount an end cover for use. Note that if an end cover is not mounted, the Unit may not function satisfactorily.
- The number of Axis Interface Units connected to the CPU Unit must be up to 2 units at maximum.

#### Installation

- Always connect to a ground of 100  $\Omega$  or less when installing the Units.
- For DIN Track installation, correctly follow the instructions in this manual.

#### 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 digital output or 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.
- To ensure safe use of the Axis Interface Unit function, observe the following points when wiring to avoid the effects of the noise.
  - a) Use twisted-pair shielded wire for the encoder connection lines and amplifier connection lines.
  - b) Wire the encoder connection lines and amplifier connection lines separately from the AC power lines, motor power lines, and other power lines, and do not insert into the same duct.
  - c) If there are noise effects from power supply lines when using the same power supply to power an electrical welder or an electric discharge machine, or there is a high-frequency source nearby, insert a noise filter into the power supply input section.

## **Power Supply Design**

- In the system, only use a power supply within the rated supply capacity range specified in this manual.
- Install external breakers and take other safety measures against short-circuiting and overcurrents in external wiring.

# **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.
- Configure the external circuits so that the power supply to the digital output turns ON only after the power supply to the Controller has turned ON.
  - If the power supply to the Controller is turned ON after the digital output power supply, the digital output may suddenly malfunction when the power supply is turned ON to the Controller.

## **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) Mounting or removing the Units
  - b) Assembling the Units
  - c) Setting rotary switches
  - d) Connecting cables or wiring the system
  - e) Connecting or disconnecting the terminal blocks or 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 when performing write processes to the built-in flash memory. Data may be corrupted, which could result in malfunctions.

#### 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 communication to EtherNet/IP, a standard in-house LAN, or other networks. An overload may cause the network to fail or malfunction.
- If the Fail-soft Operation parameter is set to stop operation, process data communications will stop for all slaves when an EtherCAT communications error is detected in a slave. 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 Ether-CAT 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.

#### **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.

#### **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.

#### **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.

## 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

## **USB Devices**

• 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 CK3M-series Units comply with EU Directives. To ensure that the machine or device in which the CK3M-series Units are used complies with EU Directives, the following precautions must be observed.

- The CK3M-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 CK3M-series Units.
  - We recommend that you use the OMRON S8VK-S series DC Power Supplies. EMC standard compliance was confirmed for the recommended Power Supplies.
- The CK3M-series Units 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 CK3M-series Units 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

#### **Conformance to KC Certification**

Observe the following precaution if you use NX-series Units in Korea.

A급 기기 (업무용 방송통신기자재) 이 기기는 업무용(A급) 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.

Class A Device (Broadcasting Communications Device for Office Use)

This device obtained EMC registration for office use (Class A), and it is intended to be used in places other than homes.

Sellers and/or users need to take note of this.

# **Versions**

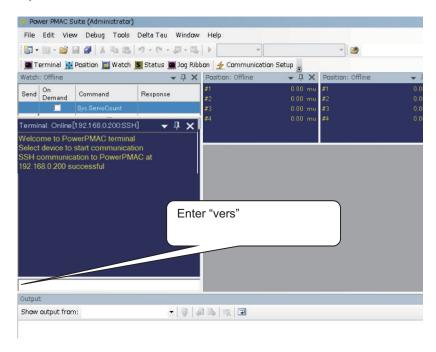
PMAC firmware revisions are used to manage the motion control firmware in CK3M-series CPU Units. The PMAC firmware revision is updated each time there is a change in motion control firmware. Even when two CPU Units have the same model number, they will have functional or performance differences if they have different PMAC firmware revisions.

#### **Checking Versions**

You can check the PMAC firmware revision in Power PMAC IDE.

### **Checking with PMAC Firmware Revision**

- 1 Connect the CK3M-series CPU Unit and Power PMAC IDE online.
- **2** Input *vers* to the terminal window.



The firmware revision is displayed on the command line.

# **Related Manuals**

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

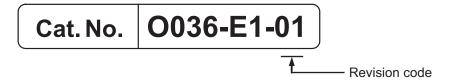
Manual name	Cat. No.	Application	Description
CK3M-series Programma- ble Multi-Axis Controller Hardware User's Manual	O036	Learning the basic specifications of the CK3M-series Programmable Multi-Axis Controller, including introductory information, design, installation, and maintenance.  Mainly hardware information is provided.	An introduction to the entire CK3M-series system is provided along with the following information.  • Features and system configuration  • Introduction  • Part names and functions  • General specifications  • Installation and wiring  • Maintenance and inspection
Power PMAC User's Man- ual	O014	Learning the features and usage examples of the CK3M-series Programmable Multi- Axis Controller.	The following information is provided on the CK3M-series Programmable Multi-Axis Controller.  • Basic functions  • Setup examples  • Programming examples
Power PMAC Software Reference Manual	O015	Learning how to program a CK3M-series Programmable Multi-Axis Controller.	The following information is provided on the CK3M-series Programmable Multi-Axis Controller.  • 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 Soft- ware 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.  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.
PMAC3 Style DSPGate3 IC	Motion control IC developed by the U.S. company Delta Tau Data Systems, Inc.
Gate3 index	IC index for PMAC3 Style DSPGate3 IC. Gate3 index is set with the DIP switch of the Unit. If index is <i>i</i> , the CPU Unit accesses the CK3W Unit with Gate3[i] data structure.
FilterdPWM	Method for creating analog output by smoothing the PWM pulse.
TrueDAC	Method for creating analog output using a DA converter.
Serial Encoder	An encoder that uses communications to perform data transfer.
Digital Quadrature Encoder	A type of encoder that outputs pulse signals.
Encoder Loss De- tection Function	Function that detects if encoder is not connected.
Hall sensor	A sensor that detects the rotor position of the motor by detecting the magnetic field.

# **Revision History**

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



Revision Date		Revised content
01	July 2018	Original production

**Revision History** 



# **Introduction to Motion Controllers**

This section describes the features, system configuration, and operating procedure of a CK3M-series Programmable Multi-Axis Controller.

1-1	Featu	res and System Configuration1	- 2
		Motion Controller Features	
	1-1-2	Introduction to the System Configurations	- 2
	1-1-3	Support Software	- 4
1-2	CK3N	I-series Operating Procedure1	- 5

# 1-1 Features and System Configuration

This section describes the features and basic system configuration of the CK3M-series Programmable Multi-Axis Controller and Support Software.

#### 1-1-1 Motion Controller Features

#### **Fast Multi-Axis Control**

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

This enables control of the maximum of 8 axes analog type servo drive (when using two CK3W-AX  $\square$   $\square$   $\square$   $\square$  units) at high speeds using the Axis Interface Unit.

# **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.

#### 1-1-2 Introduction to the System Configurations

The Motion Controller supports the following system configurations.

The basic configurations include the CK3W-AX Unit configuration, EtherCAT network configuration, Ethernet network configuration, and Support Software.

### **Basic Configuration**

Axis Interface Unit (CK3W-AX Unit) Configuration

By connecting analog input type servo drive to CK3W-AX Unit, high-speed axis control is enabled. One CK3W-AX Unit controls up to four axes. A CK3M-series CPU Unit can connect up to two CK3W-AX Units, and controls a maximum of 8 axes total.

The digital quadrature encoder and serial encoder may be connected as encoder input for feedback. In addition, 16-point input, 16-point output general digital I/O is built-in.

EtherCAT Network Configuration

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

The CPU Unit also supports connections with 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-3 Restrictions on Using the NX-series EtherCAT Coupler Unit on page A - 6 for details.

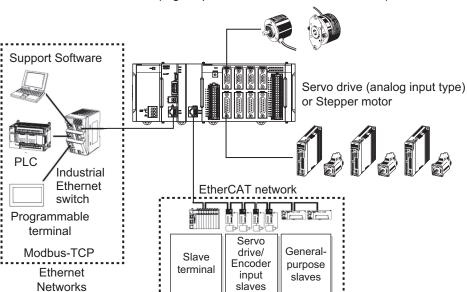
#### · Ethernet Network Configuration

The Ethernet communications port on the CPU Unit supports the Modbus-TCP protocol. It can be connected to devices such as PLCs and programmable terminals that support the Modbus-TCP protocol.

#### · Support Software

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

Refer to 1-1-3 Support Software on page 1 - 4 for details of the Support Software.



Encoder (Digital quadrature encoder, serial encoder)

# 1-1-3 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 working machines and other 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 working machines and other CNC machines with the Motion Controller. Use this software when you do not customize HMI screens.	This is non-free software. *2

<sup>\*1.</sup> Use Power PMAC IDE Ver.4.0 or a later version.

<sup>\*2.</sup> Contact your OMRON representative for information on how to procure.

# 1-2 CK3M-series Operating Procedure

This section describes the procedure to construct a motion control system by using the CK3M-series Programmable Multi-Axis Controller.

No.	S	tep	Description	Reference	
1	Preparation for work	Check for specification compatibility	Check compatibility with specifications of each Unit.  General specifications  Mounting direction	A-1 General Specifications on page A - 2	
		Selection of peripheral devices	Select peripheral devices to be used with the Motion Controller.		
		Preparation of Support Software	Procure and install the Support Software required for the system.	1-1-3 Support Software on page 1 - 4	
2	Mounting and wiring of the Motion Controller	Mounting	Mount the Motion Controller.  Connecting adjacent Units  Mounting to DIN Track	4-3 Mounting Units on page 4 - 4	
		Address switch setting	Set the address switch for the Axis Interface Units.	3-3-4 Address Switch Setting on page 3 - 13	
		Wiring	Perform Motion Controller wiring.	Section 5 Wiring on page 5 - 1	
3	Settings and wir- ing of the Ether- CAT slave hard-	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.	
	ware *1	Mounting	Mount EtherCAT slaves.	Refer to the manual for the EtherCAT slave.	
		Wiring	Wire EtherCAT slaves.  • Wiring of the unit power supply  • I/O wiring	Refer to the manual for the EtherCAT slave.	
4	EtherCAT commu	nications wiring *1	Perform wiring for the EtherCAT communications cables.	5-2 Laying the EtherCAT Net- work on page 5 - 6	
5	Turn ON the power CAT slaves.	er supply to Ether-	Turn on the power to the devices configuring the system.		
6	Construction of the EtherCAT network *1	Installation of ESI files	Install the ESI files of EtherCAT slaves to be connected.	Refer to Power PMAC IDE User Manual (Cat. No. 0016) for details. For information on the ESI file, refer to the manual for the EtherCAT slave.	
		EtherCAT slave settings	Configure the EtherCAT communications settings. Then, create an ENI file used to download the configured settings to the Motion Controller.	Refer to Power PMAC IDE User Manual (Cat. No. 0016) 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 Power PMAC IDE User Manual (Cat. No. 0016) for de- tails.	

No.	Step		Description	Reference
7	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 Power PMAC IDE User Manual (Cat. No. 0016) for details.
		Initialization of the Controller	Use Power PMAC IDE to initialize the Motion Controller.	Refer to Power PMAC IDE User Manual (Cat. No. 0016) for de- tails.
8	Settings of the Motion Control- ler operation	Motor settings	Use Power PMAC IDE to set the motor operations for the Motion Controller.	Refer to <i>Power PMAC IDE User Manual (Cat. No. 0016)</i> for details.
		Programming	Create user programs on Power PMAC IDE.	Refer to Power PMAC User's Manual (Cat. No. 0014) and Power PMAC Software Reference Manual (Cat. No. 0015) for details.
9	Transferring project data and checking the operation		Transfer the created project data and check that operations work as expected.	Refer to Power PMAC IDE User Manual (Cat. No. 0016) for de- tails.

<sup>\*1.</sup> Perform settings for the CK3M-CPU111/CPU121 only.

# **System Configuration**

This section describes the basic system configuration used for CK3M-series Motion Controllers.

2-1	Basic	2 - 2		
		CK3W Unit Configuration		
		EtherCAT Network Configuration		
2-2	Conn	necting to the Power PMAC IDE	2 - 4	
2-3	Ethernet Network Configuration2 -			

# 2-1 Basic System Configuration

A Motion Controller supports the following two types of configurations.

· Basic Configuration

The basic configurations include the CPU Unit and the Configuration Units that are controlled directly by the CPU Unit. There are two basic configurations.

- a) Axis Interface Unit (CK3W-AX Unit) configuration
- b) EtherCAT network configuration
- · Other Network Configuration

This is the configuration of the system that is connected to the CPU Unit's built-in EtherNet port.

### **Basic System Configurations**

#### CK3W Unit Configuration

The CPU Rack is configured with an Axis Interface Unit (CK3W-AX Unit).

Motion control is enabled by connecting an analog input type Servo Drive or a stepper motor to the Axis Interface Unit.

#### EtherCAT Network Configuration

With a CK3M-series CPU Unit, you can use an EtherCAT network.

Motion control is enabled by connecting an EtherCAT type Servo Drive to the CPU Unit.

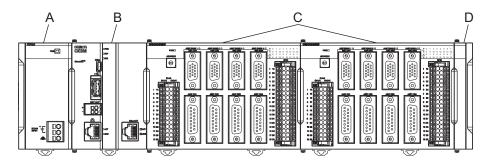
# 2-1-1 CK3W Unit Configuration

The following shows the configuration of CK3W Units.

#### **CPU Rack**

The Axis Interface Unit configuration in the CPU Rack consists of a Power Supply Unit, CPU Unit, CK3W-AX Unit, and End Cover.

Up to two CK3W-AX Units can be connected to the CPU Unit.



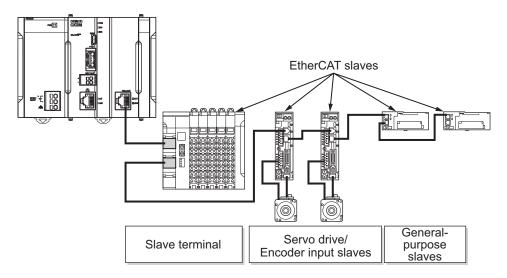
Letter	Configuration	Remarks
Α	Power Supply Unit	Input the 24 V power source.
В	CK3M-series CPU Unit	This is the Unit at the center of the motion control, which executes the motion
		program.

Letter	Configuration	Remarks
С	CK3W-AX Unit	Axis Interface Unit. For axis control, connect the Servo Drive and Encoder.
D	End Cover	Must be connected to the right end of the CPU Rack. One End Cover is provided with the CPU Unit.

#### 2-1-2 EtherCAT Network Configuration

The EtherCAT network configuration consists of a Power Supply Unit, CPU Unit, End Cover, and EtherCAT slaves.

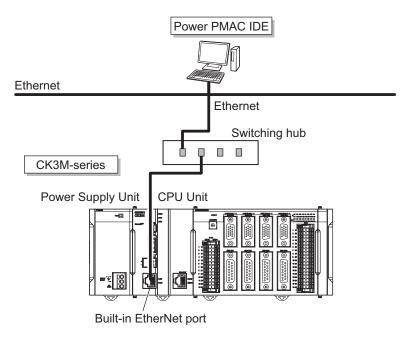
Use the built-in EtherCAT port on the CK3M-series CPU Unit to connect EtherCAT slaves.



EtherCAT is synchronized with the servo cycle of the CK3M-series CPU Unit. This enables acquisition of the I/O data of slave terminals that are synchronized with the servo cycle.

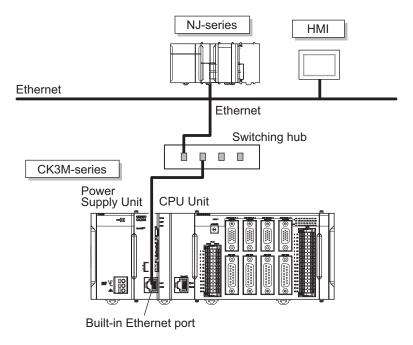
# 2-2 Connecting to the Power PMAC IDE

Connect the CK3M-series CPU Unit and the Power PMAC IDE through Ethernet.



# 2-3 Ethernet Network Configuration

The Ethernet communications port on the CK3M-series CPU Unit supports the Modbus-TCP protocol. It can be connected to devices such as PLCs and programmable terminals that support the Modbus-TCP protocol.



2 System Configuration
------------------------



# **Configuration Units**

This section describes configuration devices in the CK3M-series Motion Controller configuration.

3-1	CPU U		2 0
3-1	J. J J.		
	3-1-1	Models and Specifications	
	3-1-2	Part Names and Functions	3 - 4
	3-1-3	Operation Status Indicators	3 - 5
	3-1-4	Watchdog Output Terminal Block	3 - 6
	3-1-5	USB Memory Device	
3-2	Power	Supply Unit	3 - 9
	3-2-1	Models and Specifications	
	3-2-2	Part Names and Functions	
3-3	Axis In	terface Unit	3 - 11
	3-3-1	Models and Specifications	3 - 11
	3-3-2	Part Names and Functions	
	3-3-3	Operation Status Indicators	
	3-3-4	Address Switch Setting	
	3-3-5	Encoder Connector Specifications	3 - 14
	3-3-6	Encoder Loss Detection in Digital Quadrature Encoder	3 - 18
	3-3-7	Pulse Input Timing Specifications for Digital Quadrature Encoder	
	3-3-8	OutFlag Function	3 - 20
	3-3-9	Amplifier Connector Specifications	
	3-3-10	DA Output Method	
	3-3-11	Flag Connection Terminal Block Specifications	
	3-3-12	General Digital I/O Connection Terminal Block Specifications	

# 3-1 CPU Unit

This section describes the models and major specifications of the CK3M-series CPU Units.

# 3-1-1 Models and Specifications

# **Models and Outline of Specifications**

The models and outline of specifications are given below.

Unit type	Model	Memory capacity	EtherCAT port	Maximum number of controlled axes at EtherCAT port
CPU Unit	CK3M-CPU101	RAM: 1 GB	None	
		Built-In Flash Memory: 1 GB		
	CK3M-CPU111	RAM: 1 GB	EtherCAT: 1 port (DC	4 axes
		Built-In Flash Memory: 1 GB	sync)	
	CK3M-CPU121	RAM: 1 GB	EtherCAT: 1 port (DC	8 axes
		Built-In Flash Memory: 1 GB	sync)	

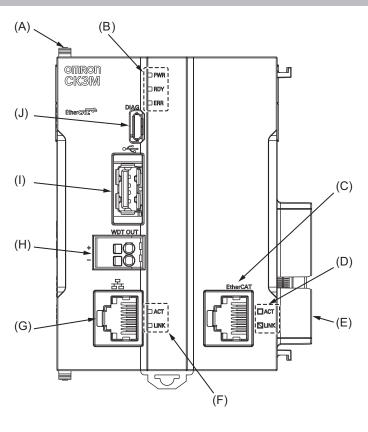
# **Performance Specifications**

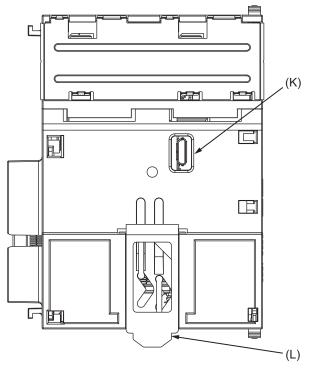
The performance specifications are shown below.

	Item		CK3M-CPU101	CK3M-CPU111	CK3M-CPU121
Memory			Main memory: 1 GB Built-In Flash Memory: 1 GB		
Number of connectable CK3W-AX Unit Units			2 Units max.		
			No EtherCAT	For EtherCAT cor RJ45 × 1 (Shield	
External connec	tion terminals		For Ethernet communications RJ45 × 1 (Shield supported)		
			USB port For external memory connection, USB 2.0 host × 1 Type A		
	Maximum number of control-led axes		8 axes (when usin	ng two CK3W-AX U	nits)
Mation control		Control method	Speed and torque control using analog output Stepper motor control using pulse output		-
Motion control	EtherCAT	Maximum num- ber of control- led axes	None	4 axes	8 axes
	Control method			Issuing control co EtherCAT	mmands using

	Item	CK3M-CPU101	CK3M-CPU111	CK3M-CPU121	
	Communications protocol	None	EtherCAT protoco	l	
	Baud rate		100 Mbps		
	Physical layer		100BASE-TX (IEE	EE 802.3)	
	Topology		Line, daisy chain,	and branching	
EtherCAT com- munications specifications	Transmission media		Twisted-pair cable higher (double-shi aluminum tape an	elded cable with	
.,	Transmission distance		Distance between less	nodes: 100 m or	
	Maximum number of slaves		32		
	Range of node addresses that can be set		1 to 32		
	Baud rate	100 Mbps			
	Physical layer	100BASE-TX (IEEE 802.3)			
	Frame length	1,514 bytes max.			
	Media access method	CSMA/CD			
	Modulation	Baseband			
Ethernet com-	Topology	Star			
munications specifications	Transmission media	Twisted-pair cable of category 5, 5e, or higher (shield ed cable)			
	Maximum transmission distance between Ethernet switch and node	100 m			
	Maximum number of cascade connections	There are no restrictions if an Ethernet switch is used.			
USB port	Physical layer	USB 2.0 compliant, type A connector. Output voltag 5 V, 0.5 A max.			
	Transmission distance	3 m max.			
Current consumption		CK3M-CPU101: 5 VDC 7.2 W max. CK3M-CPU111/CPU121: 5 VDC 7.8 W max. (including End Cover)		W max.	
Dimensions (hei	ght × depth × width)	90(H)/80(D)/63.2(	W)		
Weight (includin	g End Cover)	220 g max.	230 g max.		

# 3-1-2 Part Names and Functions





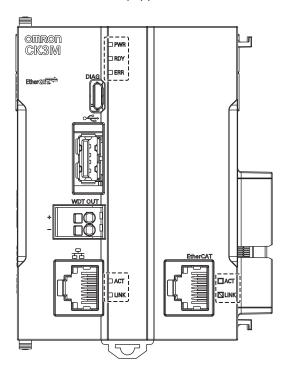
Letter	Name	Function
Α	Slider	Holds the Units together.
В	CPU Unit operation indicators	Shows the operation status of the CPU Unit using multiple indicators.
С	EtherCAT communications connector	Connects to an EtherCAT network communications cable.

Letter	Name	Function
D	EtherCAT communications port opera-	Shows the operation status of EtherCAT.
	tion indicators	
Е	Unit connector	Connector that connects to the Unit.
F	Ethernet communications port opera-	Shows the operation status of Ethernet.
	tion indicators	
G	Ethernet communications connector	Connects to an Ethernet network communications cable.
Н	Watchdog output terminal block	Normally in ON state, and switches to OFF when watchdog is
		activated.
I	USB 2.0 connector	USB 2.0 interface connector.
		Connects the USB memory.
J	USB connector for maintenance	Do not use.
K	USB connector for maintenance	Do not use.
L	DIN Track mounting hook	Used to mount the Unit to a DIN Track.

# 3-1-3 Operation Status Indicators

# **CPU Unit Operation Status Indicators**

The CPU Unit is equipped with indicators to show the current operations status.



#### CPU Unit Status Indicators

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

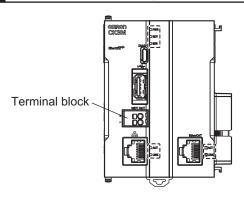
Indicator name	Color	Status	Description
PWR	Green	Lit.	Power is supplied to the Unit.
		Not lit.	Power is not supplied to the Unit.

Indicator name	Color	Status	Description
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.
ERR	Red	Lit.	Watchdog error or another hardware error
		Not lit.	The Unit is operating normally.
ECAT LINK	Orange	Lit.	The EtherCAT link is established.
		Not lit.	The EtherCAT link is not established.
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.
Ethernet LINK	Orange	Lit.	The Ethernet link is established.
		Not lit.	The Ethernet link is not established.
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.

# 3-1-4 Watchdog Output Terminal Block

The Watchdog Output Terminal Block is described below.

# **Terminal Arrangement**



Abbreviation	Signal name	
+	WDTOUT+	
-	WDTOUT-	

# **Output Status**

In normal operation, it is ON, and at other times it is OFF.

Status	Output
When unit power is OFF	OFF

Status	Output
During normal operation	ON
When hardware watchdog error occurs	OFF
When software watchdog error occurs	OFF

# Output Specifications

- Cutput Opecinications		
Item	Specification	
Rated voltage	24 VDC	
Operating load voltage range	20.4 to 26.4 VDC	
Maximum load current	0.1 A	
Leakage current	0.1 mA max.	
Residual voltage	1.5 V max.	
ON/OFF response time	10 ms max./10 ms max.	
Isolation method	Photocoupler isolation	
Circuit configuration	Internal circuit WDTOUT+	
Terminal connection diagram	NPN type  WDTOUT-  Load  WDTOUT-  24 VDC  PNP type  24 VDC  WDTOUT-  WDTOUT-  Load	

# 3-1-5 USB Memory Device

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

- · Saving relevant data
- Initializing the CPU Unit

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)

# 3-2 Power Supply Unit

This section describes the model and major specifications of the Power Supply Unit.

#### 3-2-1 Models and Specifications

### **Models and Outline of Specifications**

The models and outline of specifications are given below.

Unit type Model Specific		Specification
Power Supply Unit	CK3W-PD048	Rated output voltage: 5 VDC/24 VDC
		Maximum output power: 5 VDC 23 W, 24 VDC 66 W

# **Specifications**

The specifications are shown below.

Item	Specification
Power supply voltage	24 VDC
Allowable power supply voltage range	20.4 to 26.4 VDC
Power consumption	101.7 W max.
Rated output voltage	5 VDC/24 VDC
Maximum output power *1	5 VDC 23 W 24 VDC 66 W
Isolation method	Not isolated
Circuit configuration	24 VDC input - Noise filter circuit +24 VDC output 0 V
Weight	130 g max.
Dimensions (height × depth × width)	90(H)/80(D)/45(W)

<sup>\*1.</sup> Internal components in the Power Supply Unit may deteriorate or be damaged if the Power Supply Unit is used for an extended period of time exceeding the power supply output capacity or used when the outputs are shorted.

# **Recommended Power Supplies**

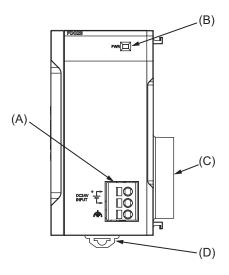
Use a SELV power supply that meets the following conditions.

· Has overcurrent protection.

· Has double or reinforced insulation between the input and output.

Recommended Power Supplies: S8VK-S series (manufactured by OMRON)

# 3-2-2 Part Names and Functions



Letter	Name	Function
Α	Power supply connection terminal	Connects the power supply.
	block	
В	Power supply status indicator	Lights when 5 V is output from the Power Supply Unit.
С	CPU Unit connector	Connector that connects to the CPU Unit.
D	DIN Track mounting hook	Used to mount the Unit to a DIN Track.

# 3-3 Axis Interface Unit

This section describes the models and major specifications of the Axis Interface Units.

#### 3-3-1 Models and Specifications

# **Models and Outline of Specifications**

The models and outline of specifications are given below.

Unit type	Model	Amplifier interface	Encoder interface	FLAG input, general digi- tal input/ output type
Axis Interface	CK3W-AX1414N	DA output (Filtered PWM)	Digital quadrature en-	NPN type
Unit	CK3W-AX1515N	DA output (True DAC)	coder/Serial encoder	
	CK3W-AX1414P	DA output (Filtered PWM)		PNP type
	CK3W-AX1515P	DA output (True DAC)		

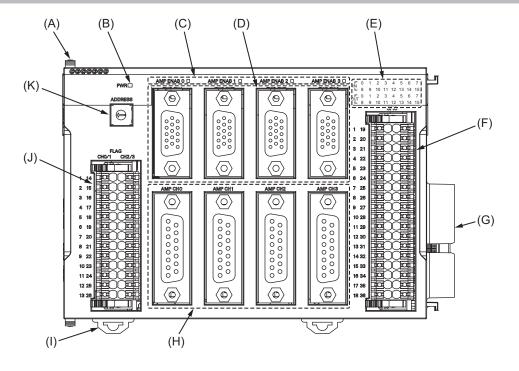
# **Axis Interface Unit Specifications**

The main specifications for axis interface are given below.

Item		Specification (CK3W-)			
IT	em	AX1414N	AX1414P	AX1515N	AX1515P
Address setting range 0 to F					
Number of c	hannels	4 channels/Unit			
Encoder pow put	ver supply out-	bly out- SVDC 500 mA/channel or less However, the total output current of each unit channel is 1 A or less		less	
Digital	Input form	Line receiver input			
quadrature encoder in- put	Maximum response frequency	Phases A and B: Single-phase 10 MHz (phase differential pulse input x4: 2.5 MHz) Phase C: 10 MHz			
Serial en- coder input	Supported protocol	Contact your OMRON representative for information on the support protocols.			
Digital Hall sensor		4 points/channel (U, V, W, T)			
OUTFlagB output		1 point/channel			
Analog out-	Method	FilterdPWM type		TrueDAC type	
put	Number of points	1 point/channel 2 points/channel			
Output range		Between DACA+/DACB+ and DACA-/DACB-: -20 to 20 V Between DACA+/DACB+ and AGND: -10 to 10 V			
Pulse out-	Output form	Line driver output			
Output Pulse output + directional output, or phase difference output method  Maximum output frequency  10 MHz		Pulse output + directional output, or phase difference output			

Item		Specification (CK3W-)				
	tem	AX1414N	AX1414P	AX1515N	AX1515P	
Amp enable	output	1 point/channel				
Fault input		1 point/channel				
Flags	Digital input	4 points/channel (Ho	OME, PLIM, NLIM, U	SER)		
	Digital out-	1 point/channel (EQ	U)			
	put					
General	Number of	16 inputs, 16 outputs				
digital I/O	points					
	Internal	NPN	PNP	NPN	PNP	
	common					
Current con	sumption	5 VDC: 4.5 W max. 5 VDC: 4.		5 VDC: 4.5 W max.	5 W max.	
		24 VDC: 10.8 W max. 24 VDC: 12.5 W max.				
Dimensions (height ×		90(H)/80(D)/130(W)				
depth × width)						
Weight		520 g max.				

### 3-3-2 Part Names and Functions



Letter	Name	Function
Α	Slider	Holds the Units together.
В	Power supply status indicator	Shows the power supply status.
С	Amp enable status indicator	Shows the Amp enable status.
D	Encoder connector	Connects the encoder.
Е	General digital input/output status indicator	Shows the general digital input/output status.
F	General digital input/output con- nection terminal block	Connects the general digital input/output.
G	Unit connector	Connector that connects to the Unit.
Н	Amplifier connector	Connects the amplifier.

Letter	Name	Function
I	DIN Track mounting hook	Used to mount the Unit to a DIN Track.
J	Flag connection terminal block	Connects the HOME/PLIM/NLIM/USER inputs and EQU output.
K	Address switch	Sets the Gate3 Index.

#### 3-3-3 Operation Status Indicators

The LED indicators show the unit operating status of the Axis Interface Unit.

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

Indicator name	Color	Status	Description
PWR	PWR Green Lit.		Power is supplied.
		Not lit.	Power is not being supplied.
AMP ENAB0 to 3	Yellow	Lit.	Command values output to Servo Drive.
		Not lit.	Command values not output to Servo Drive.
IN 0 to 15	Yellow	Lit.	The input contact is ON.
		Not lit.	The input contact is OFF.
OUT 0 to 15	Yellow	Lit.	The output contact is ON.
		Not lit.	The output contact is OFF.

## 3-3-4 Address Switch Setting

The Axis Interface Unit is equipped with a PMAC3 style DSPGate3 IC.

Refer to the Power PMAC User's Manual (Cat. No. 0014) for the PMAC3 style DSPGate3 IC.

The address switch settings are used to set the Gate3 Index.

The setting range is from 0 to F. (Factory setting: 0)



Address switch setting	Power PMAC "Gate3" Index
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
A	10
В	11
С	12
D	13
E	14

Address switch setting	Power PMAC "Gate3" Index
F	15

For example, if the address switch setting is 0, the Gate3 Index becomes 0.

In this case, this unit is accessed with a Gate3[0] data structure.

Set so that the unit address settings do not overlap.

If they overlap, the Sys.Status register CK3WConfigErr becomes 7.

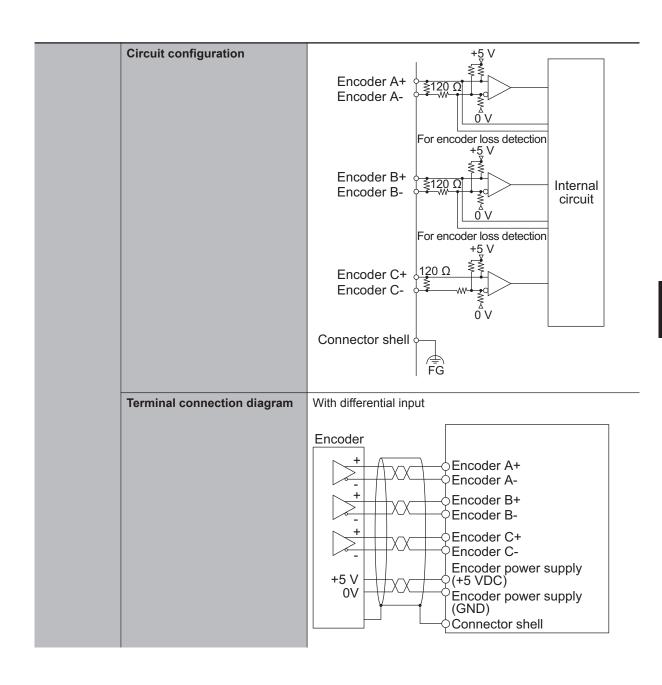
Refer to 6-4 Sys. Status Register on page 6 - 9 for Sys. Status.

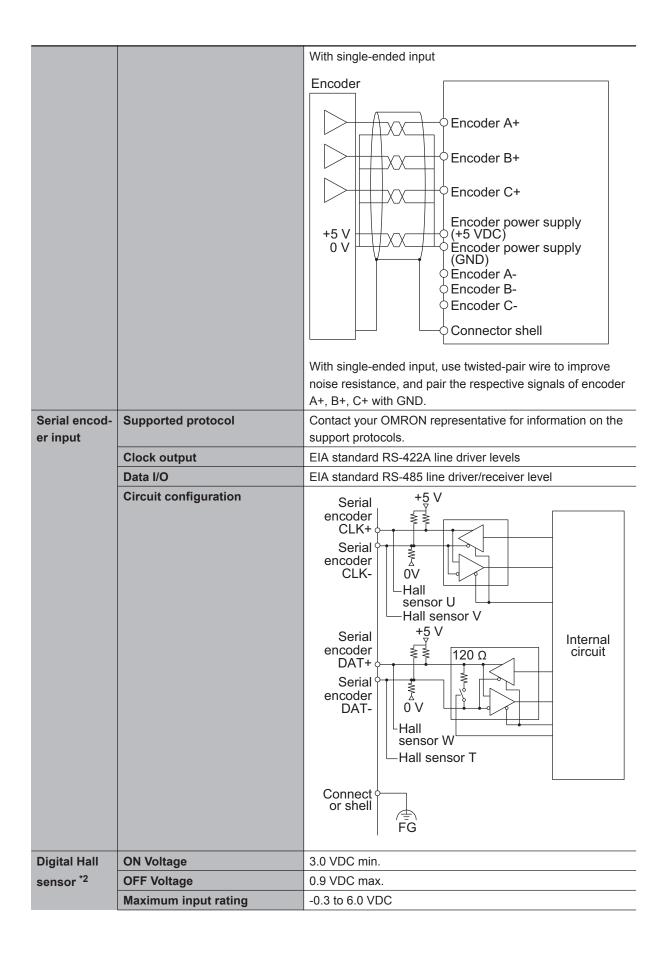
#### 3-3-5 Encoder Connector Specifications

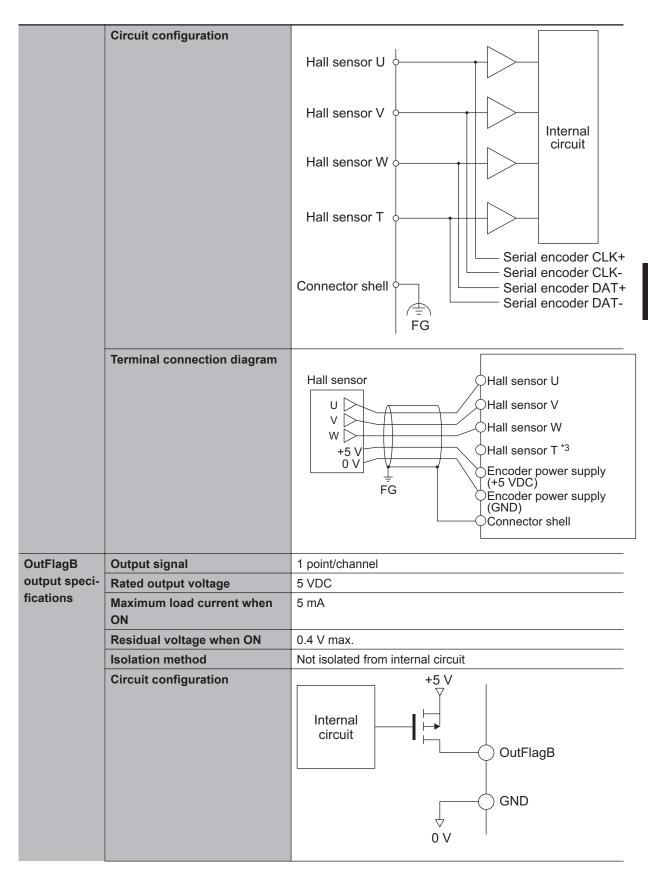
The electrical specifications for the encoder connector are as follows.

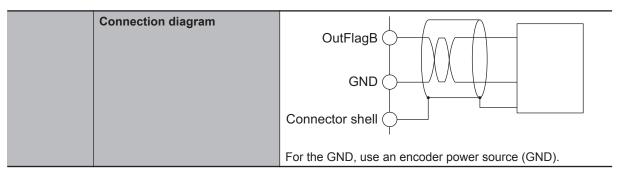
For the connector arrangement of the encoder connector, refer to 5-6-1 Connector Arrangement on page 5 - 19.

Isolation method		Not isolated (between internal circuit and encoder circuit)		
Encoder	Rated output voltage	5 VDC		
power sup- ply output Output voltage range		4.9 to 5.25 VDC (5 VDC +5%/-2%)		
	Maximum output current	500 mA/channel or less		
		However, the total output current of each unit channel is 1 A		
		or less		
Digital quad-	Input form	Line receiver input (differential or single-ended input)		
rature en-	Counting unit	Pulse		
coder input	Input voltage	Differential input: EIA standard RS-422A line driver levels		
		Single-ended input *1: ON voltage 3.0 V or more, OFF volt-		
		age 1.0 V or less		
	Maximum input voltage	Differential input: EIA standard RS-422A line driver levels		
		Single-ended input: -0.3 to 6.0 VDC		
	Maximum response frequency	Phases A and B: Single-phase 10 MHz (phase differential		
		pulse input x4: 2.5 MHz),		
		Phase C: 10 MHz		
	Encoder loss detection	Differential input: Detectable		
		With single-ended input: Detection disabled		







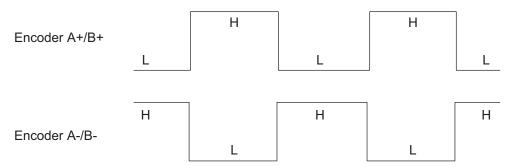


- \*1. With single-ended input, only a voltage output type encoder can be connected. Open collector type encoders cannot be connected.
- \*2. A Hall sensor is a sensor that detects the rotor position of the motor by detecting the magnetic field. This is normally used to check the position when the power is turned ON.
- \*3. HALL T is not normally used, however, it can be used as a general 5V digital input.

#### 3-3-6 Encoder Loss Detection in Digital Quadrature Encoder

Encoder loss detection is a function for detecting the encoder detachment. It can detect the encoder loss, and stop the motor.

In the differential input for the digital quadrature encoder, when a correct signal arrives in encoder A +/A-, encoder B+/B-, if the signal level is H in one side, the signal level of the other side is always L.



You can detect the encoder loss by setting a circuit so that both signals turn H or L when the encoder is not connected.

Encoder A+/B+	Encoder A-/B-	Encoder loss detection
Н	L	Normal
L	Н	Normal
Н	Н	Detects loss
L	L	Detects loss

If loss is detected, the value of Gate3[i].Chan[j].LossStatus becomes 1.

*Motor[x].EncLossCount* adds 1 to the count when encoder loss is detected, and subtracts 1 when encoder loss is not detected.

However, the minimum value of *Motor[x].EncLossCount* is 0, and it will never become a negative value

You can set the motor to stop if *Motor[x].EncLossCount* exceeds the value set in the *Motor[x].EncLossLimit*. However, in a pulse input state, mis-detection of encoder loss may occur. Therefore, when you use the function to stop the motor at encoder loss, take the possibility of mis-detection during pulse input into consideration, and set the *Motor[x].EncLossLimit* register to *40* or more.



#### **Precautions for Correct Use**

If the digital quadrature encoder is used with single-ended input, you cannot use encoder loss detection since the encoder loss may be detected even if the encoder is connected correctly.

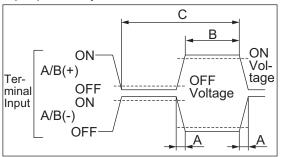
# 3-3-7 Pulse Input Timing Specifications for Digital Quadrature Encoder

There are two types of input methods, differential input and single-ended input, for the digital quadrature encoder.

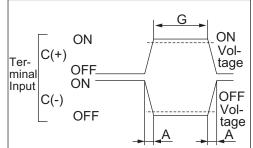
The respective pulse input timing specifications are given below.

## With Differential Input

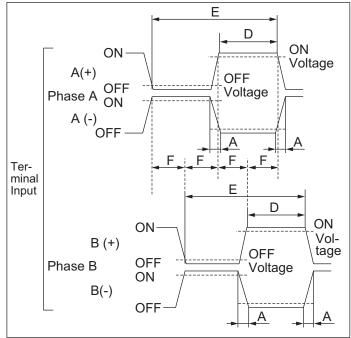
Encoder input (Phases A & B) Input pulse duty = 50%



Encoder input (Phase C)



Relationship between Phase A and Phase B for Phase Differential Pulse Inputs

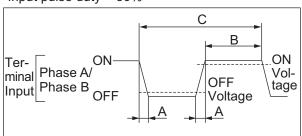


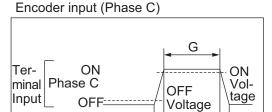
Timing conditions (with 10 MHz input)						
Α	В	С	D	E	F	G
< 2.5 ns	> 50 ns	> 100 ns	> 50 ns	> 100 ns	> 25 ns	> 50 ns

(With Gate3[i].EncClockDiv = 0 : 100MHz setting)

# Single-Ended Input

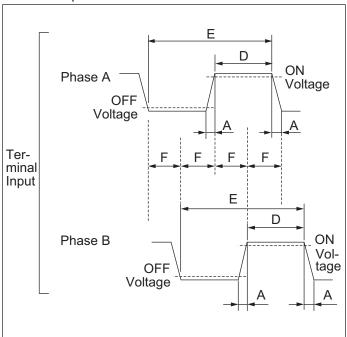
Encoder input (Phases A & B) Input pulse duty = 50%





Α

Relationship between Phase A and Phase B for Phase Differential Pulse Inputs



Timing conditions (with 10 MHz input)						
Α	В	С	D	E	F	G
< 2.5 ns	> 50 ns	> 100 ns	> 50 ns	> 100 ns	> 25 ns	> 50 ns

(With Gate3[i].EncClockDiv = 0: 100MHz setting)

## 3-3-8 OutFlag Function

The OutFlagB to D functions can be used to perform settings for the encoder.

The details for the functions are described below.

#### **OutFlagB Function**

#### Applications

Use this function as a signal to connect with the SEN signal that is necessary to acquire the absolute encoder value when connecting with the OMRON G5-series Servo Drives with General-purpose Pulse Train or Analog Inputs.

#### Details on the Function

You can switch the output transistor state of the 15-pin of the encoder connector by manipulating the *Gate3[i].Chan[j].OutFlagB* register.

Register value	Output transistor status
0 (Default)	OFF
1	ON

### **OutFlagC Function**

#### Applications

Use this function when a servo clock signal must be output externally for synchronization with other devices.

#### Details on the Function

You can switch the serial encoder CLK+/- signal to the servo clock signal by manipulating the Gate3[i].Chan[j].OutFlagC register.

Register value	Signal level		
0 (Default)	Serial encoder CLK+/- signal		
1	Servo clock +/- signal		

# **OutFlagD Function**

#### Applications

When connecting with the OMRON G5-series Servo Drives with General-purpose Pulse Train or Analog Inputs, the encoder A+/- terminal and the serial encoder DAT+/- terminal are short circuited and used to enable obtaining the absolute encoder value sent from the Servo Drive.

Use this function to disable the terminating resistance of the serial encoder DAT+/- terminal, because the terminating resistances of the short-circuited encoder A+/- terminal and the serial encoder DAT +/- terminal overlap.

#### Details on the Function

You can enable or disable the terminating resistance of the serial encoder DAT+/- terminal as shown in the table below by setting the *Gate3[i].Chan[j].OutFlagD* register and the *Gate3[i].Chan[j].SerialEncEna* register, which is for switching between enabling and disabling the serial encoder.

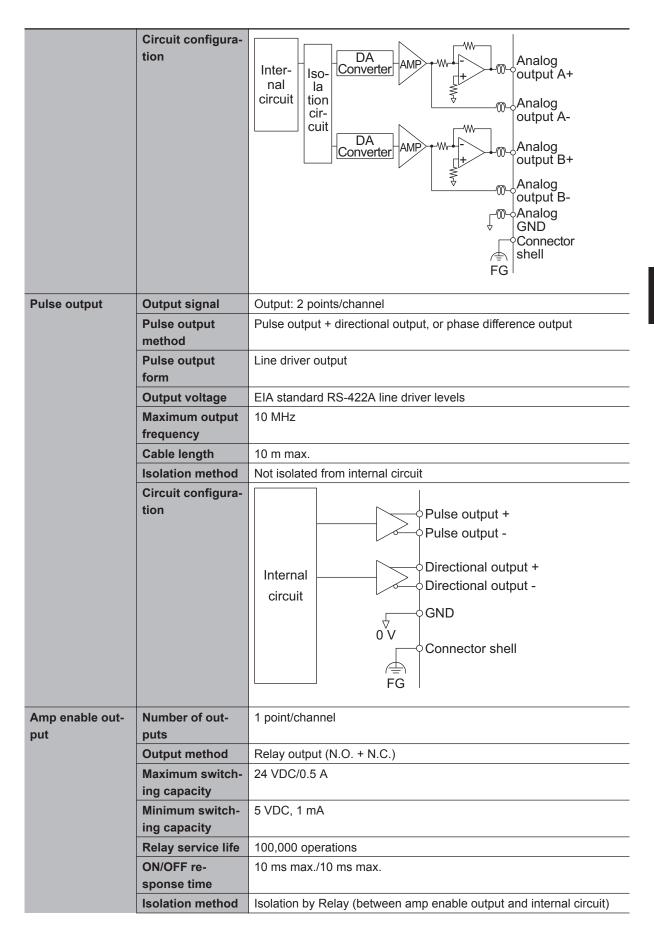
Gate3[i].Chan[j].OutFlagD	Gate3[i].Chan[j].SerialEncEna	Terminating resistance	
0 (Default)	0 (Default)	Disabled	
	1	Enabled	
1	0	Disabled	
	1	Disabled	

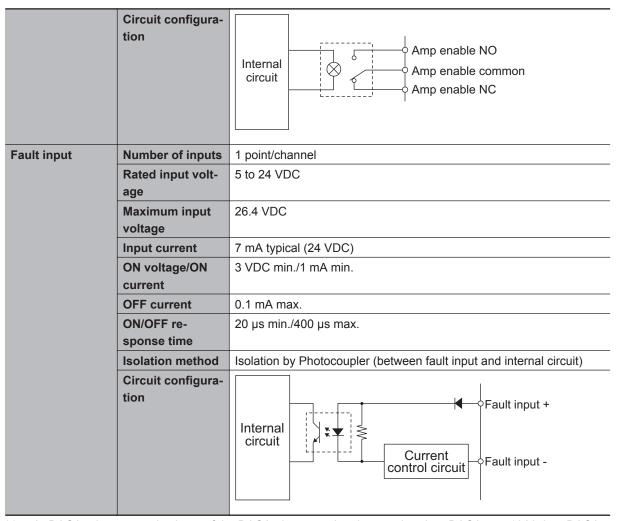
# 3-3-9 Amplifier Connector Specifications

This section describes the connector arrangement and electrical specifications for the amplifier connector.

For the connector arrangement of the amplifier connector, refer to 5-7-1 Connector Arrangement on page 5 - 23.

Analog output	Number of out-	1 point/channel			
(Filtered PWM	puts				
type)	Output method	Between DACA+ and DACA-: Differential output Between DACA+ and AGND: Single-ended output			
	Output range	Between DACA+ and DACA-: -20 to 20V *1 Between DACA+ and AGND: -10 to 10V			
	Allowable load resistance	5 kΩ min.			
	Resolution	Refer to 3-3-10 DA Output Method on page 3 - 25.			
	Isolation method	Isolation by Digital Isolator (between analog output and internal circuit)			
	Circuit configura- tion	Internal circuit  Internal cir			
Analog output (True DAC type)	Number of out-	2 points/channel			
(	Output method	Between DACA+/DACB+ and DACA-/DACB-: Differential output Between DACA+/DACB+ and AGND: Single-ended output			
	Output range	Between DACA+/DACB+ and DACA-/DACB-: -20 to 20 V *1 Between DACA+/DACB+ and AGND: -10 to 10V			
	Allowable load resistance	5 kΩ min.			
	Resolution	1/65535 (full scale)			
	Isolation method	Isolation by Digital Isolator (between analog output and internal circuit)			





<sup>\*1.</sup> In DACA-, the reversed voltage of the DACA+ is output. In other words, when DACA+ = +10 V, then DACA- = -10 V. In this case, between DACA+ and DACA-, a 20 V potential difference is generated. The same applies to DACB+/DACB-.

#### 3-3-10 DA Output Method

The following two methods are available for DA output.

- FilterdPWM
- TrueDAC

This section describes each of the methods.

#### **FilterdPWM**

This is a method for creating analog output by smoothing the PWM pulse.

The relationship between the set value and output voltage is shown below.

Set value	Voltage between analog output + and analog output -	Voltage between analog output + and analog GND	
-16384	-20 V	-10 V	
0	0 V	0 V	
16383	+20 V	+10 V	

PWM frequency is determined by the formula below.

$$f_{PWM} = \frac{PwmFreqMult+1}{2} f_{IntPhase}$$

f<sub>PWM</sub> :PWM frequency

PwmFreqMult :Value set at Gate3[i].Chan[j].PwmFreqMult (Setting range 0 to 7)

fIntPhase :Phase clock frequency (Set at Gate3[i].PhaseFreq)

In addition, while the setting is between -16384 and 16383, the actual effective resolution can be calculated as follows.

300000÷f<sub>PWM</sub> (kHz)

Since this is a method for smoothing out the PWM pulse, the higher the PWM frequency, the smaller the ripple, but the resolution also declines. To adequately reduce the ripple, set the PWM frequency to 30 kHz or more.

If the PWM frequency is set to 30 kHz, from the above formula, the full-scale effective resolution is a 10000 resolution.

#### **TrueDAC**

This is a method for creating analog output using a DA converter.

The relationship between the set value and output voltage is shown below.

Set value	Voltage between analog output + and analog output -	Voltage between analog output + and analog GND
-32768	-20 V	-10 V
0	0 V	0 V
32767	+20 V	+10 V

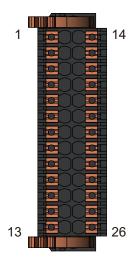
In TrueDAC, the setting range and effective resolution are the same.

# 3-3-11 Flag Connection Terminal Block Specifications

This section describes the terminal arrangement and electrical specifications of the flag connection terminal block.

# **Terminal Arrangement**

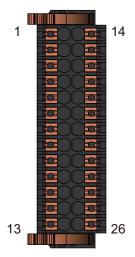
#### NPN Type



No.	Signal	No.	Signal (4ch type)
1	EQU0	14	EQU2
2	EQU1	15	EQU3
3	COM_EQU	16	COM_EQU
4	HOME0	17	HOME2
5	PLIM0	18	PLIM2
6	NLIM0	19	NLIM2
7	USER0	20	USER2
8	V_FLAG0	21	V_FLAG2
9	HOME1	22	HOME3
10	PLIM1	23	PLIM3
11	NLIM1	24	NLIM3
12	USER1	25	USER3
13	V_FLAG1	26	V_FLAG3

Signal	Signal name			
EQUn	Position comparison output Output			
COM_EQU	Position comparison output (Common)	Common		
HOMEn	Zero Position Detection Flag	Input		
PLIMn	Positive Limit Flag	Input		
NLIMn	Negative Limit Flag	Input		
USERn	General-purpose Flag	Input		
V_FLAGn	Flag (Common)	Common		

#### PNP Type



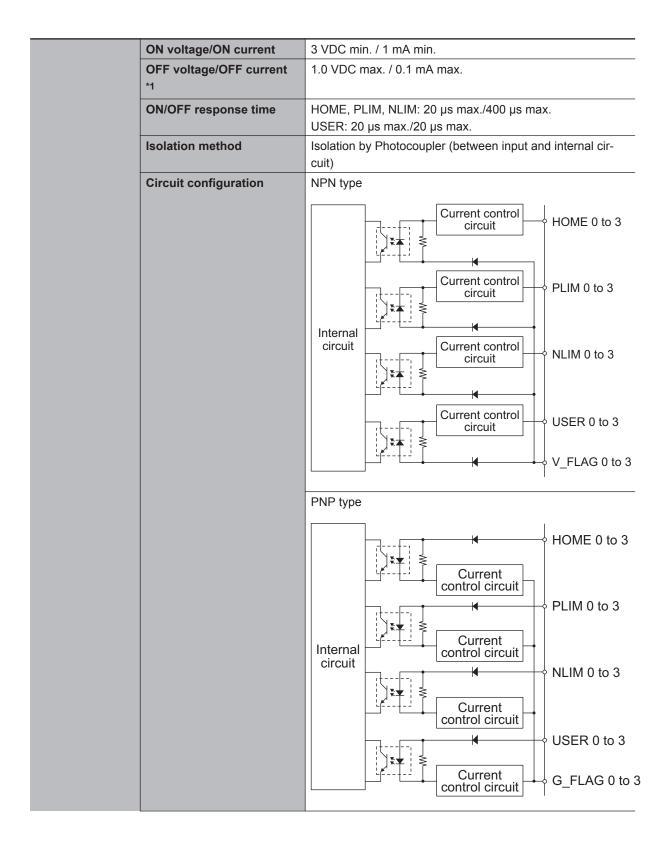
No.	Signal	No.	Signal (4ch type)
1	EQU0	14	EQU2
2	EQU1	15	EQU3
3	COM_EQU	16	COM_EQU
4	HOME0	17	HOME2
5	PLIM0	18	PLIM2
6	NLIM0	19	NLIM2
7	USER0	20	USER2
8	G_FLAG0	21	G_FLAG2
9	HOME1	22	HOME3
10	PLIM1	23	PLIM3
11	NLIM1	24	NLIM3
12	USER1	25	USER3
13	G_FLAG1	26	G_FLAG3

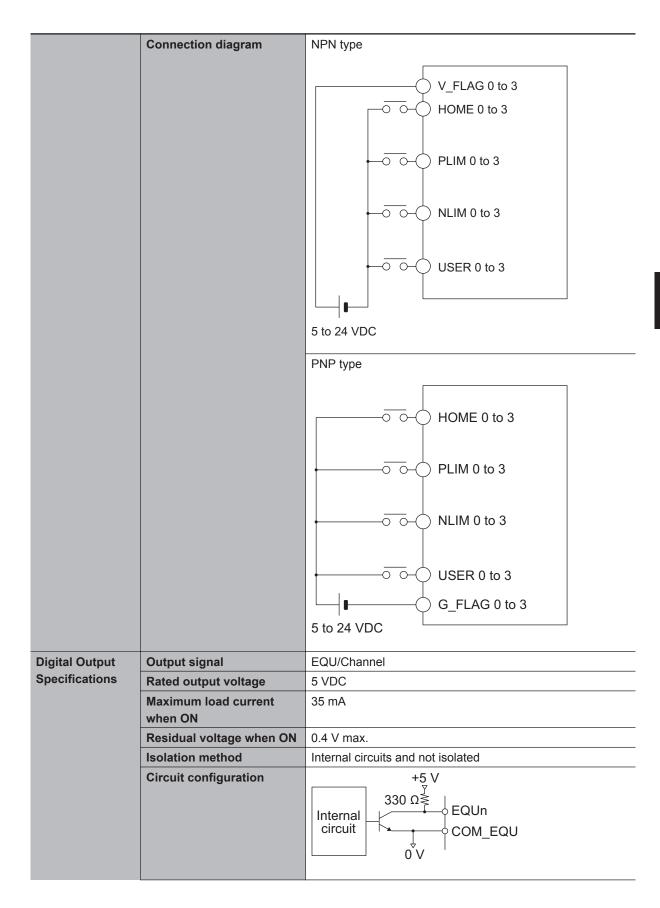
Signal	Signal name		
EQUn	Position comparison output Output		
COM_EQU	Position comparison output (Common)	Common	
HOMEn	Zero Position Detection Flag	Input	
PLIMn	Positive Limit Flag	Input	
NLIMn	Negative Limit Flag	Input	
USERn	General-purpose Flag	Input	
G_FLAGn	Flag (Common)	Common	

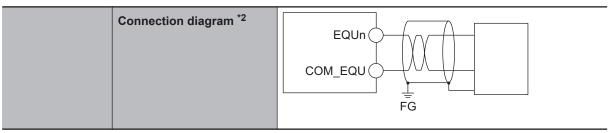
# **Electrical Specifications of Flag Connection Terminal Block**

This section describes the electrical specifications for the flag connection terminal block.

Digital Input	Input signal	HOME, PLIM, NLIM, USER/Channel
Specifications	Rated input voltage	5 to 24 VDC
	Maximum input voltage	26.4 VDC
	Input current	HOME, PLIM, NLIM: 7.0 mA typical (24 VDC)
		USER: 9.3 mA typical (24 VDC)







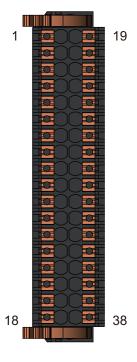
- 1. Since the OFF current is small, connection to the two-wire sensor may not be successful. Refer to 5-8-2 Precautions When Connecting a Two-wire DC Sensor on page 5 28 for information on using the two-wire sensor.
- \*2. For high-speed output, we recommend the use of shielded wiring.

#### 3-3-12 General Digital I/O Connection Terminal Block Specifications

This section describes the terminal arrangement and electrical specifications of the general digital I/O connection terminal block.

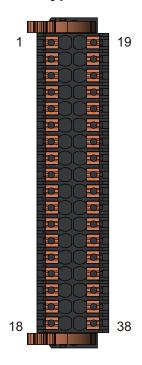
# **Terminal Arrangement**

#### NPN Type



No.	Signal	No.	Signal
1	IN00	19	IN08
2	IN01	20	IN09
3	IN02	21	IN10
4	IN03	22	IN11
5	IN04	23	IN12
6	IN05	24	IN13
7	IN06	25	IN14
8	IN07	26	IN15
9	V1	27	V1
10	OUT00	28	OUT08
11	OUT01	29	OUT09
12	OUT02	30	OUT10
13	OUT03	31	OUT11
14	OUT04	32	OUT12
15	OUT05	33	OUT13
16	OUT06	34	OUT14
17	OUT07	35	OUT15
18	V2	36	G2

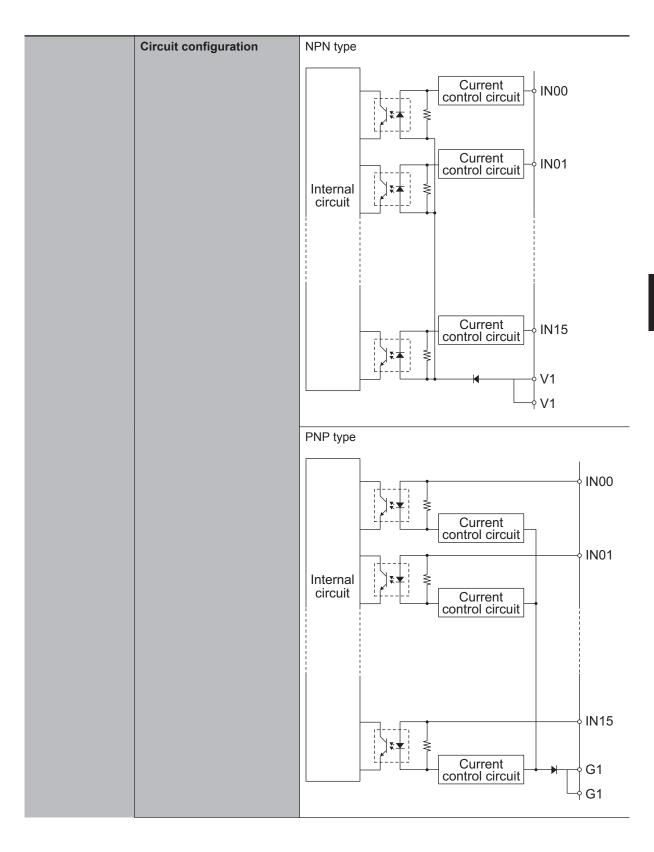
# PNP Type



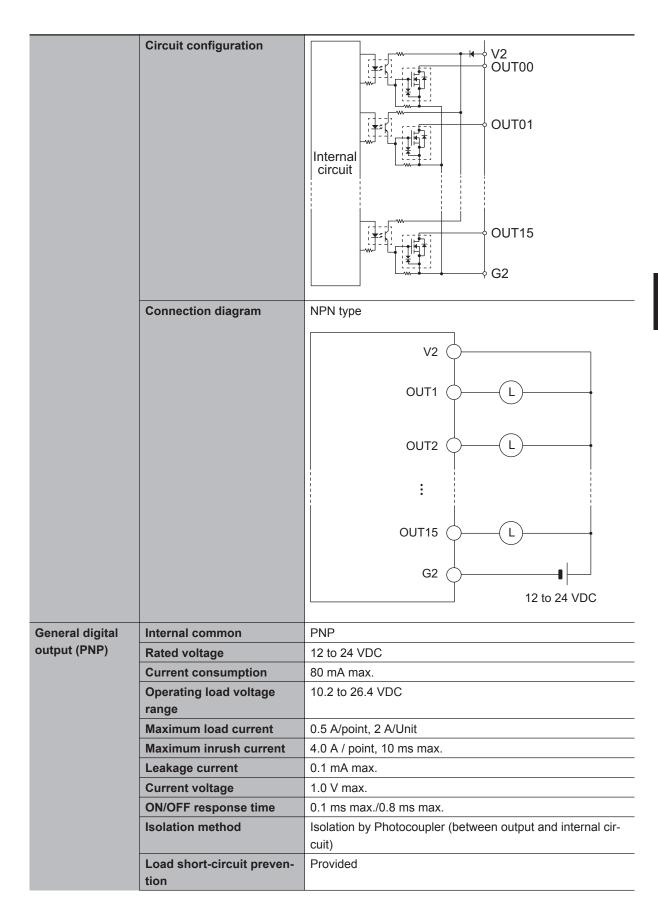
No.	Signal	No.	Signal
1	IN00	19	IN08
2	IN01	20	IN09
3	IN02	21	IN10
4	IN03	22	IN11
5	IN04	23	IN12
6	IN05	24	IN13
7	IN06	25	IN14
8	IN07	26	IN15
9	G1	27	G1
10	OUT00	28	OUT08
11	OUT01	29	OUT09
12	OUT02	30	OUT10
13	OUT03	31	OUT11
14	OUT04	32	OUT12
15	OUT05	33	OUT13
16	OUT06	34	OUT14
17	OUT07	35	OUT15
18	V2	36	G2

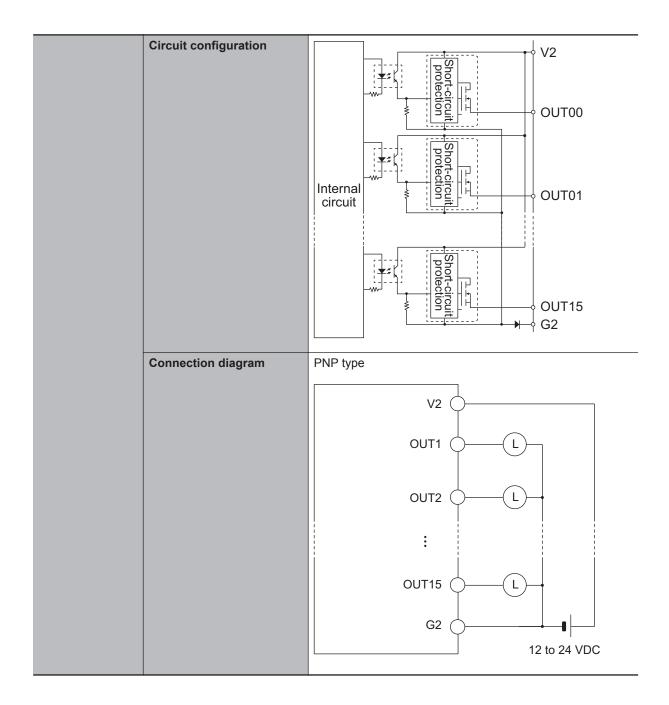
# Electrical Specifications of General Digital I/O Connection Terminal Block

General digital	Number of inputs	16 points
input (NPN/PNP)	Rated input voltage	24 VDC
	Maximum input voltage	26.4 VDC
Input current		3.9 mA typical (24 VDC)
	ON voltage/ON current	15 VDC min./3 mA max.
	OFF voltage/OFF current	5 VDC max./1 mA max.
	ON/OFF response time	20 µs min./400 µs max.
	Isolation method	Isolation by Photocoupler (between input and internal cir-
		cuit)



	Connection diagram	NPN type
		V1
General digital	Internal common	NPN
output (NPN)	Rated voltage	12 to 24 VDC
	Current consumption	40 mA max.
	Operating load voltage	10.2 to 26.4 VDC
	range	
	Maximum load current	0.5 A/point, 2 A/Unit
	Maximum inrush current	4.0 A / point, 10 ms max.
	Leakage current	0.1 mA max.
	Residual voltage	1.0 V max.
	ON/OFF response time	0.1 ms max./0.8 ms max.
	Isolation method	Isolation by Photocoupler (between output and internal circuit)
	Load short-circuit prevention	Not provided







# Installation

This section describes how to install the CK3M-series Programmable Multi-Axis Controller as well as details on installation locations.

4-1	Proce	essing at Power ON and Power OFF	4 - 2
	4-1-1	<u>-</u>	
	4-1-2		
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4-3	Moun	ting Units	4 - 4
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# 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 CPU Unit 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.

#### CPU Unit Startup Time at Power ON

It takes approximately 40 to 60 seconds for the CPU Unit 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

If the power is interrupted while a user program writes data in the USB memory or the built-in flash memory, the data may be destroyed.

Confirm that no write processes are underway before you turn off the power.

If data is destroyed, issue a re-initialization command (\$\$\$\*\*\*) from IDE, and perform a re-download of the program.

If the IDE connection cannot be performed, refer to 6-3-3 *Initialization of CPU Unit Using USB Memory* on page 6 - 8 and implement initialization.

# 4-2 Fail-safe Circuits

# riangle 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 error (watchdog timer error) or CPU reset occurs
  - d) If a major fault level Controller error occurs
  - e) While the CPU Unit 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.

 The outputs may remain ON or OFF due to welding or burning of the output relays or destruction of the output transistors. As a countermeasure for these problems, external safety measures must be provided to ensure safe operation of the system.

# 4-3 Mounting Units

This section describes how to mount Units to the CK3M-series Controller.



#### **Precautions for Safe Use**

Always turn OFF the power supply to the Controller before attempting any of the following.

- Mounting or removing CK3W-AX Units or Motion Controllers
- · Assembling the Units
- · Setting rotary switches
- · Connecting cables or wiring the system
- · Connecting or disconnecting the terminal blocks or connectors

The built-in power supply of the Controller may continue to supply power after the power supply is turned OFF. The POWER indicator remains lit as long as power is supplied. Make sure that the POWER indicator is not lit before you perform any of the above operations.



#### **Precautions for Correct Use**

- Follow the instructions in this manual to correctly perform installation.
- Do not operate or store the Units 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 during installation in the following locations.
  - a) Locations near devices that produce 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

#### 4-3-1 Installation in a Control Panel

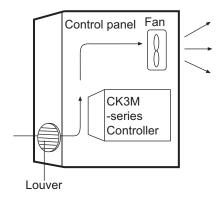
# **Installation in Cabinets or Control Panels**

When the CK3M-series Controller is being installed in a cabinet or control panel, be sure to provide proper ambient conditions as well as access for operation and maintenance.

#### Temperature Control

The ambient temperature within the CK3M-series Controller must be within the operating range of 0 to 55°C. When necessary, take the following steps 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 55°C, install a cooling fan or air conditioner.

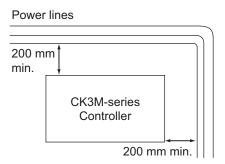


#### Accessibility for Operation and Maintenance

- 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

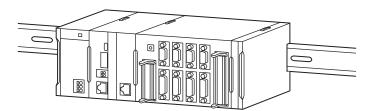
- Do not mount the Controller in a control panel containing high-voltage equipment.
- Install the Controller at least 200 mm away from power lines.



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

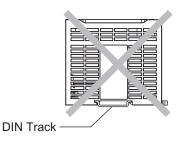
#### Controller Orientation

• Each Rack must be mounted in the following position to provide proper cooling. This position is called an upright position.



• Do not install a Rack in any of the following positions.

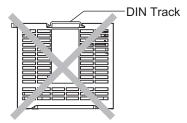
Mounting with the DIN Track on the Bottom



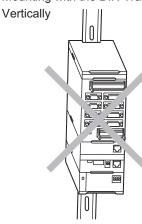
Mounting with the Rack Upside Down



Mounting with the DIN Track on the Top



Mounting with the DIN Track Installed





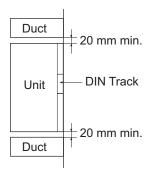
#### **Additional Information**

A Controller must be mounted on a DIN Track. It cannot be mounted with screws.

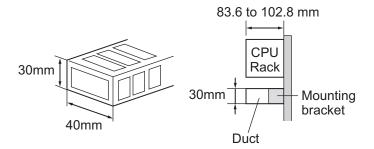
#### Wiring Ducts

Whenever possible, route I/O wiring through wiring ducts.

Install mounting bracket so that it is easy to fish wire through the duct. It is handy to have the duct at the same height as the CPU Rack.

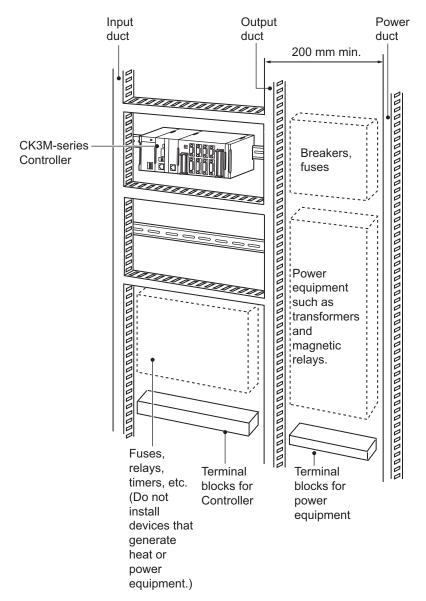


## Wiring Duct Example



#### Routing Wiring Ducts

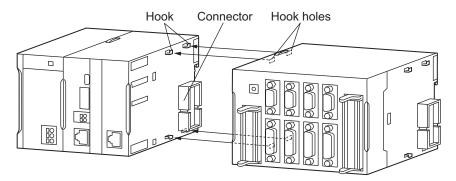
Install the wiring ducts at least 20 mm away from the tops of the Rack and any other objects (e.g., ceiling, wiring ducts, structural supports, devices, etc.) to provide enough space for air circulation and replacement of Units.



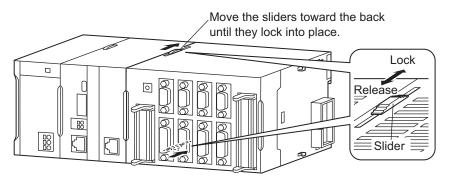
# 4-3-2 Connecting Adjacent Units

The Units that make up a CK3M-series Controller can be connected simply by pressing the Units together and locking the sliders by moving them toward the back of the Units. The End Cover is connected in the same way to the Unit on the far right side of the Controller.

**1** Join the Units so that the connectors fit exactly.



2 The yellow sliders at the top and bottom of each Unit lock the Units together. Move the sliders toward the back of the Units as shown below until they click into place.

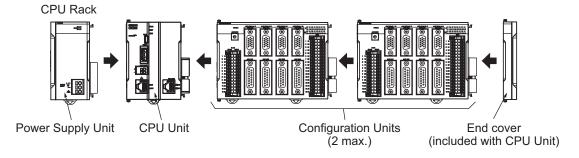




#### **Precautions for Safe Use**

The sliders on the top and bottom of the CK3W Unit must be completely locked (until they click into place) after connecting the adjacent Unit connectors.

**3** Attach the End Cover to the Unit on the far right side of the Rack.





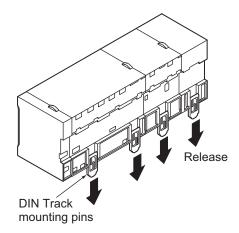
#### **Precautions for Correct Use**

- Always turn OFF the power supply before connecting Units to each other.
- During maintenance, always turn OFF the power supply to the entire system before replacing a Unit
- Up to two Axis Interface Units can be connected. If you connect more than that number, the Sys.CK3WConfigErr Flag goes ON.
  - Operation will continue even with the Sys.CK3WConfigErr Flag ON.

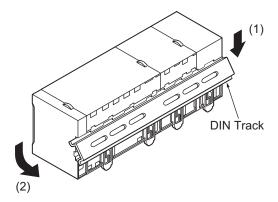
# 4-3-3 Mounting to DIN Track

Use the following procedure to install a CK3M-series Controller on DIN Track.

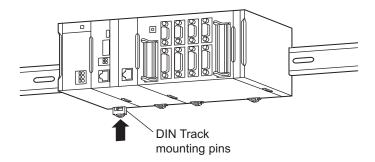
**1** Release the DIN Track mounting pins on the backs of the Units.



2 To mount, hook on the DIN Track from above (1), and insert into the back (2).



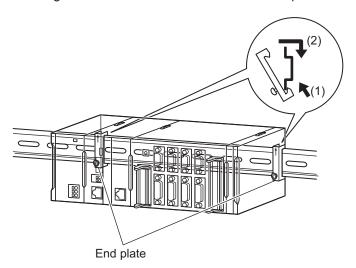
**3** Lock all the DIN Track mounting pins.



4 Install a DIN Track End Plate on each end of the Controller.

To mount an End Plate, hook from the underside (1), hook to the upper side, and then pull downward (2).

Then tighten the screw to lock the End Plate in place.





#### **Additional Information**

To remove Units, perform the steps above in reverse order.



#### **Precautions for Safe Use**

Always turn OFF the power supply to the Controller before attempting any of the following.

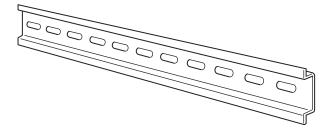
- Mounting or removing CK3W-AX Units or CPU Units.
- · Assembling the Units.
- · Setting rotary switches.
- Connecting cables or wiring the system.
- Connecting or disconnecting the connectors.

### 4-3-4 DIN Track and Accessories

Mount the CK3M-series Controller on the DIN Track.

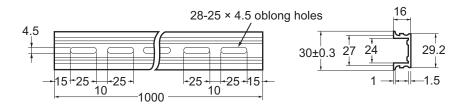
Secure each DIN Track inside a control panel with at least three screws.

# **DIN Tracks**

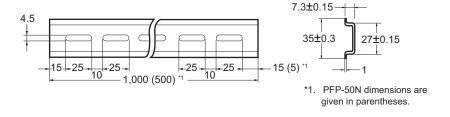


Secure the DIN Track to the control panel using M4 screws separated by 210 mm (3 holes) or less and using at least 3 screws. The tightening torque is  $1.2 \text{ N} \cdot \text{m}$ .

#### PFP-100N2

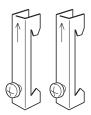


#### PFP-100N/50N



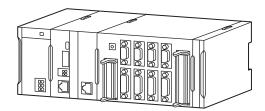
# **DIN Track End Plates**

PFP-M (2 required)



# 4-3-5 Assembled Appearance and Dimensions

The CK3M-series Units are connected to each other. An End Cover is connected to the right end.



# **Dimensions**

# Power Supply Unit

Model	Unit width (mm)		
CK3W-PD048	45		

#### CPU Unit

Model	Unit width (mm)
CK3M-CPU101	63.2
CK3M-CPU111	
CK3M-CPU121	

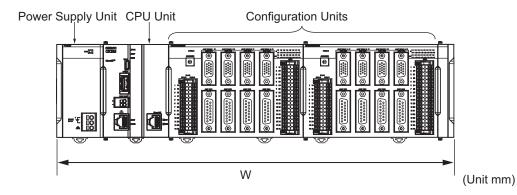
#### End Cover

Model	Unit width (mm)		
CK3W-TER11	15.6		

#### Axis Interface Unit

Model	Unit width (mm)
CK3W-AX1414N	130
CK3W-AX1515N	
CK3W-AX1414P	
CK3W-AX1515P	

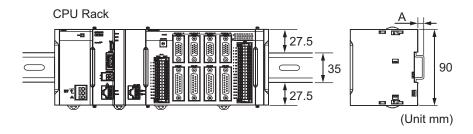
#### Design Example for Width W



NameModelUnit width (mm)QtySubtotal unit width (mm)Power Supply UnitCK3W-PD04845145

Name	Model	Unit width (mm)	Qty	Subtotal unit width (mm)
CPU Unit	CK3M-CPU101	63.2	1	63.2
Axis Interface Unit	CK3W-AX1414N	130	2	260
End Cover	CK3W-TER11	15.6	1	15.6
Total W = 45 + 63.2 + 130 × 2 + 15.6				383.8

# **Installation Dimensions**



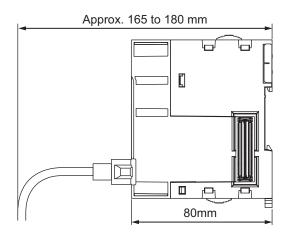
DIN Track	A (mm)
PFP-100N2	16
PFP-100N	7.3
PFP-50N	7.3

# **Installation Height**

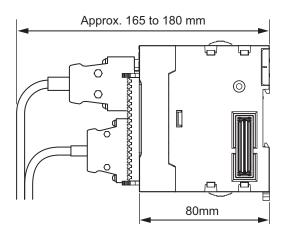
The installation height of a CK3M-series Controller is 80.0 mm.

When cables are connected (such as a connecting cable to Support Software, an encoder connection cable, or an amplifier connection cable, etc.), however, even greater height is required. Allow sufficient depth in the control panel containing the Controller.

#### For CK3M-series CPU Unit



# • For CK3W-AX Unit



# 4-4 Control Panel Installation

To ensure system reliability and safety, the system must be designed and configured according to the installation environment (temperature, humidity, vibration, shock, corrosive gases, overcurrent, noise, etc.).

## 4-4-1 Temperature

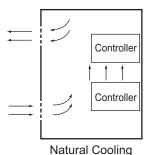
Panels have been reduced in size due to space-saving and miniaturization in devices and systems, and the temperature inside the panel may be at least 10 to 15°C higher than outside the panel. Implement the following measures against overheating at the installation site and in the panel, and allow a sufficient margin for the temperature before use.

# **High Temperatures**

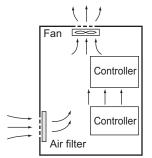
Use the following cooling methods as required, taking into account the ambient temperature and the amount of heating inside the panel.

### Natural Cooling

- Natural cooling relies on natural ventilation through slits in the panel, rather than using cooling devices such as fans or coolers. When using this method, observe the following points.
- Do not install the Controller at the top of the panel, where hot air tends to stagnate.
- To provide ventilation space above and below the Controller, leave sufficient distance from other devices, wiring ducts, etc.
- Do not mount the Units in the wrong direction (e.g., vertically or upside down). Doing so may cause abnormal heating in the Controller.
- Do not install the Controller directly above any heat-generating equipment, such as heaters, transformers, and devices with high resistance.
- Do not install the Controller in a location exposed to direct sunlight.

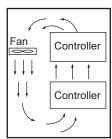


### Forced Ventilation (by Fan at Top of Panel)



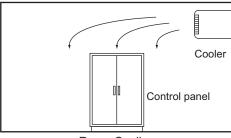
Forced Ventilation Method

#### Forced Air Circulation (by Fan in Closed Panel)



Forced Air Circulation

# Room Cooling (Cooling the Entire Room Where the Control Panel Is Located)



Room Cooling

# **Low Temperatures**

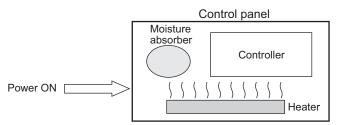
The Controller may not start normally if the temperature is below 0°C when the power is turned ON. Maintain an air temperature of at least approximately 5°C inside the panel, by implementing measures such as installing a low-capacity space heater in the panel.

Alternatively, leave the Controller power ON to keep the Controller warm.

# 4-4-2 Humidity

Rapid temperature changes can cause condensation to occur, resulting in malfunctioning due to short-circuiting.

When there is a possibility of this occurring, take measures against condensation, such as leaving the Controller power ON at night or installing a heater in the control panel to keep it warmer.



Examples of Measures against Condensation

#### 4-4-3 Vibration and Shock

The Controller is tested for conformity with the sine wave vibration test method (IEC 60068-2-6) and the shock test method (IEC 60068-2-27) of the Environmental Testing for Electrotechnical Products. It is designed so that malfunctioning will not occur within the specifications for vibration and shock. If, however, the Controller is to be used in a location in which it will be directly subjected to regular vibration or shock, then implement the following countermeasures:

- Separate the control panel from the source of the vibration or shock.
   Or secure the Controller and the panel with rubber padding to prevent vibration.
- · Make the building or the floor vibration-resistant.
- To prevent shock when other devices in the panel such as electromagnetic contactors operate, secure either the source of the shock or the Controller with rubber padding.

## 4-4-4 Atmosphere

Using the Controller in any of the following locations can cause defective contact with connectors and corrosion of components. Implement countermeasures such as purging the air as required.

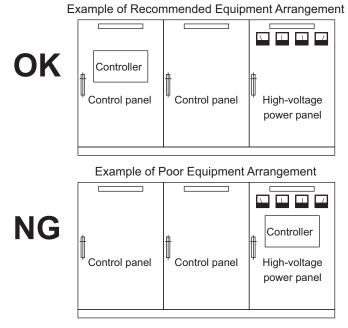
- In locations exposed to dust, dirt, salt, metal powder, soot, or organic solvents, use a panel with an airtight structure. Be careful of temperature increases inside the panel.
- In locations exposed to corrosive gas, purge the air inside the panel to clear the gas and then pressurize the inside of the panel to prevent gas from entering from outside.
- In locations where flammable gas is present, either use an explosion-protected construction or do not use the Controller.

## 4-4-5 Electrical Environment

When installing or wiring devices, make sure that there will be no danger to people and that noise will not interfere with electrical signals.

#### **Controller Installation Location**

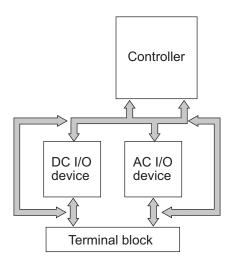
Install separately the Controller from high-voltage (600 V or higher) and power devices to ensure safe operation and maintenance. Install the Controller as far away as possible in case of unavoidable circumstances.



Examples of Equipment Arrangement in Panel with High-voltage Devices

# **Arrangement of Controller and Units**

The coils and contacts in electromagnetic contacts and relays in an external circuit are sources of noise. Do not install them close to the Controller. Locate them at least 100 mm away from the Controller.



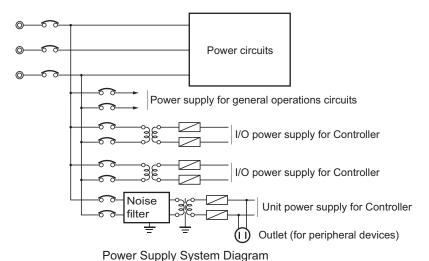
**Example of Arrangement in Panel** 

# Wire Layout for the Power Supply System

Observe the following points when wiring the power supply system.

• Separate the Controller power supply from the I/O device power supply and install a noise filter near the Controller power supply feed section.

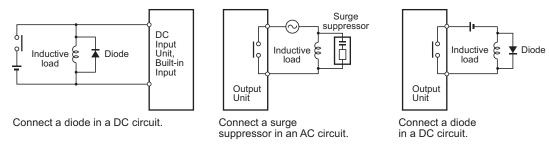
- Use an isolating transformer to significantly reduce noise between the Controller and the ground. Install the isolating transformer between the Controller power supply and the noise filter, and do not ground the secondary coil of the transformer.
- Keep the wiring between the transformer and the Controller as short as possible, twist the wires well, and keep the wiring separate from high-voltage and power lines.



# Wiring External I/O Signal Lines

Observe the following points when wiring external I/O signal lines.

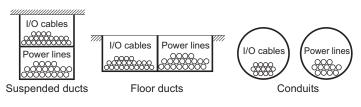
To absorb reverse electromotive force when an inductive load is connected to an output signal, connect a surge suppressor near the inductive load in an AC circuit, or connect a diode near the inductive load in a DC circuit.



Input Signal Noise Countermeasures

**Output Signal Noise Countermeasures** 

Never bundle output signal lines with high-voltage or power lines, and do not route them in close
proximity or parallel to such lines.
 If output signal lines must be routed in close proximity to such lines, place them in separate ducts or
conduits. Be sure to ground the ducts or conduits.



I/O Cable Arrangement

- If the signal lines and power lines cannot be routed in separate ducts, use shielded cable. Connect the shield to the ground terminal at the Controller, and leave it unconnected at the input device.
- Wire the lines so that common impedance does not occur.
   Such wiring will increase the number of wires, so use common return circuits.
   Use thick wires with sufficient allowance for the return circuits, and bundle them with lines of the same signal level.
- For long I/O lines, wire the input and output signal lines separately.
- Use twisted-pair wires for pilot lamps (and particularly lamps with filaments).
- Use countermeasures, such as CR surge absorbers and diodes, for input device and output load device noise sources, as required.

# **External Wiring**

Wiring, and noise countermeasures in particular, are based on experience, and it is necessary to closely manage wiring based on experience and information in the manuals.

#### Wiring Routes

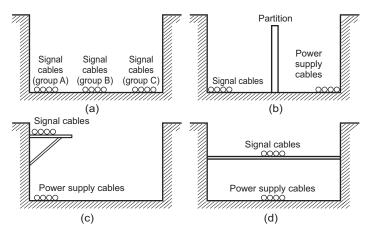
Each of the following combinations includes different signal types, properties, or levels. They will cause the signal-to-noise ratio to drop due to factors such as electrical induction. As a general rule when wiring, either use separate cables or separate wiring routes for these items. Future maintenance operations and changes to the system will also be made easier by carefully organizing the wiring from the start.

- · Power lines and signal lines
- · Input signals and output signals
- Analog signals and digital signals
- · High-level signals and low-level signals
- · Communications lines and power lines
- · DC signals and AC signals
- High-frequency devices (such as Inverters) and signal lines (communications)

#### Wiring

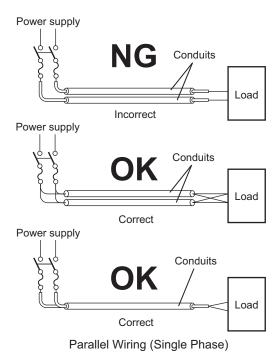
Observe the following points when wiring power supply and signal cables.

- When routing signal cables with differing characteristics through the same duct, always keep them separated.
- As much as possible, avoid routing multiple power supply lines through the same duct.
   If it cannot be avoided, then construct a partition between them in the duct and ground the partition.

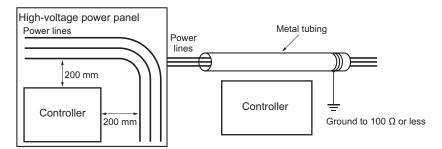


Partitioning Methods for Signal and Power Supply Cables

• To avoid overheating the conduits when using conduits for wiring, do not place wires for a single circuit in separate conduits.



- · Power cables and signal cables adversely affect each other. Do not wire them in parallel.
- Noise induction may occur if the Controller is installed in a panel that includes high-voltage devices. Wire and install them as far apart as possible. (Refer to *Controller Installation Location* on page 4 17.)
- Either install the Controller a minimum of 200 mm away from high-voltage lines or power lines, or place the high-voltage lines or power lines in metal tubing and completely ground the metal tubing to  $100 \Omega$  or less.



Example: Separating Controller from Power Lines

#### Other Precautions

Digital I/O Units have both plus and minus commons, so pay attention to the polarity when wiring.

### 4-4-6 Grounding

This section describes the earthing methods and precautions.

# **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.

	Earthing methods			
		Star ea		
Specifications of communications cables for EtherCAT and EtherNet/IP	Equipotential bonding system	Connecting devices and noise sources to separate earth electrodes	Connecting devices and noise sources to a common earth electrode	Daisy Chain
The cable shield connected to the connector hood at both ends of the com-	Recommended	Recommended	Not recom- mended	Not recom- mended
munications cable				



#### **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.

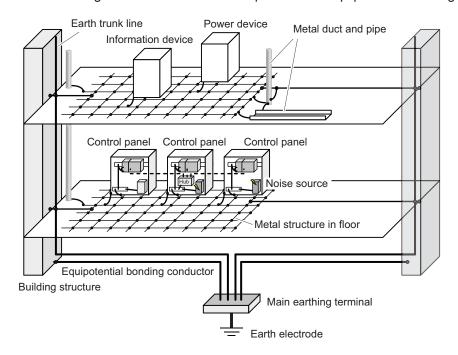
#### Equipotential Bonding System

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.

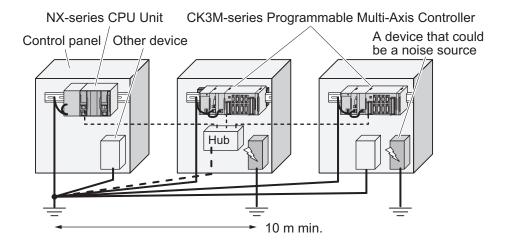


#### Star Earthing

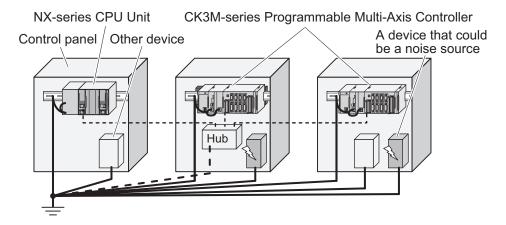
If the earthing method used for the building is not equipotential bonding or the earthing system is unknown, choose (a) from the earthing methods given below.

(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  $100~\Omega$  or less.

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



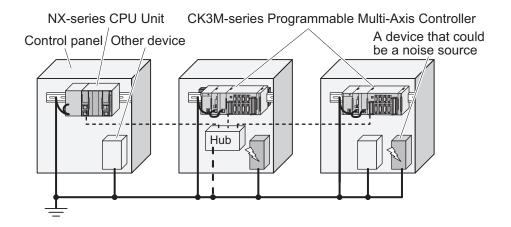
(b) Installation by connecting devices and noise sources to a common earth electrode This is an earthing method to connect the device that is connected with a communications cable, other devices, and a device that could be a noise source, to a common earth electrode. This earthing method is not recommended, 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.

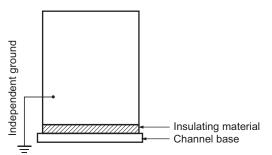
This earthing method is not recommended because the device that could be a noise source may interfere electromagnetically with other devices.



# **Precautions for Grounding**

#### General Precautions

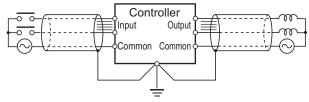
- To prevent electrical shock, do not connect devices to ground poles (or steel frames) with nonequalized potential to which multiple devices are connected.
- Use a ground pole as close to the Controller as possible and keep the ground line as short as possible.
- If the same ground is used for both the signal lines and the enclosure, isolate the channel base (a metal plate inside a grounded control panel) with an insulating material.



Example: Insulating and Grounding an Enclosure

- If high-frequency equipment is present, then ground not only the high-frequency equipment but also the panel itself in which the Controller is housed.
- As shown in the following diagram, when using shielded cable for I/O wiring, connect the shield near the Controller to the enclosure ground terminal.

Follow the instructions in the Communications Unit manual for preparing shielded communications cables.



Shielded Cable Ground

#### Controller Ground Terminals

The Controller has the following ground terminal.

Grounding type	Symbol	Connection
Functional Grounding		Ground this terminal when power supply noise causes malfunctioning.

When the functional ground terminal is correctly grounded, it is generally effective in suppressing power supply common noise. Occasionally, however, grounding this terminal will result in picking up more noise, so be careful when using it.

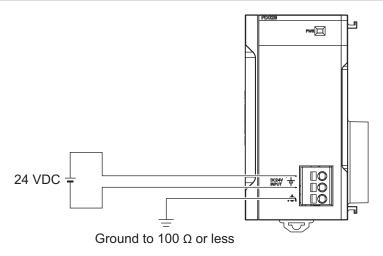
# Wiring

This section describes how to wire the CK3M-series Programmable Multi-Axis Controller.

5-1	Power	Supply Wiring	
	5-1-1	Power Supply Unit CK3W-PD048	
	5-1-2	Power Supply Used	
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# 5-1 Power Supply Wiring

# 5-1-1 Power Supply Unit CK3W-PD048



# 5-1-2 Power Supply Used

24 VDC power is supplied to the Unit power supply terminals (+, -). The power supply voltage range for the Unit power supplies is as follows.

Model	Power supply voltage range
CK3W-PD048	20.4 to 26.4 VDC

For the Unit power supply, use an SELV power supply with overcurrent protection.

An SELV power supply refers to a power supply with double or reinforced insulation between input and output, and with an output voltage of 30 V rms with a 42.4-V peak or an output voltage of 60 VDC max.

We recommend the following power supply.

Recommended Power Supply	Manufacturer	
S8VK-S series	OMRON	

# 5-1-3 Applicable Wires

The wires that you can connect to the terminal block are twisted wires, solid wires, and ferrules that are attached to the twisted wires. The following section describes the dimensions and processing methods for applicable wires.

# **Using Ferrules**

If you use ferrules, attach the twisted wires to them.

Observe the application instructions for your ferrules for the wire stripping length when attaching ferrules.

Always use plated one-pin ferrules. Do not use unplated ferrules or two-pin ferrules.

The applicable ferrules, wires, and crimping tools are listed in the following table.

Manufacturer	Ferrule model	Applicable wire (mm² (AWG))	Crimping Tool (applicable wire size given in parentheses)
Phoenix Con-	AI0,25-8	0.25 (#24)	Phoenix Contact
tact	AI0,5-8	0.5 (#20)	CRIMPFOX 6 (0.25 to 6 mm <sup>2</sup> , AWG24 to 10)
	AI0,75-8	0.75 (#18)	
	AI1,0-8	1.0 (#18)	
	AI1,5-8	1.5 (#16)	
Weidmüller	H0.25/12	0.25 (#24)	Weidmüller
	H0.34/12	0.34 (#22)	PZ6 Roto (0.14 to 6 mm <sup>2</sup> , AWG26 to 10)
	H0.5/14	0.5 (#20)	
	H0.75/14	0.75 (#18)	
	H1.0/14	1.0 (#18)	
	H1.5/14	1.5 (#16)	

# **Using Twisted or Solid Wires**

Wire type	Conductor cross-sectional area	Conductor length (stripping length)
Solid wire	0.2 to 4 mm <sup>2</sup>	8 mm
Twisted wire	0.2 to 2.5 mm <sup>2</sup>	8 mm

# 5-1-4 Grounding

The type of ground terminal on the Power Supply Unit 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  $\Omega$  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 Power Supply Unit as possible and keep the ground line as short as possible.

# 5-1-5 Required Tools

Use a flat-blade screwdriver to remove wires.

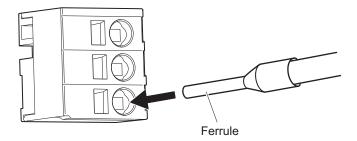
The recommended screwdriver is as follows.

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

# 5-1-6 Connecting Ferrules

Insert the ferrule straight into the terminal hole.

It is not necessary to press a flat-blade screwdriver into the release hole.



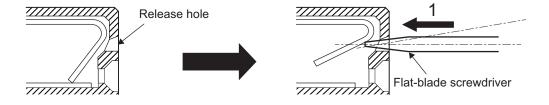
After you make a connection, make sure that the ferrule is securely connected to the terminal block.

# 5-1-7 Connecting Twisted Wires/Solid Wires

Use the following procedure to connect the twisted wires or solid wires to the terminal block.

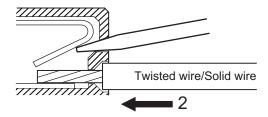
1 Press a flat-blade screwdriver straight into the release hole.

If you press in the screwdriver correctly, you will feel the spring in the release hole, and the screw driver will begin to incline.

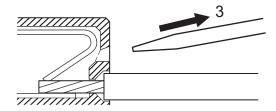


**2** Leave the flat-blade screwdriver pressed into the release hole and insert the twisted wire or the solid wire into the terminal hole.

Insert the twisted wire or the solid wire until the stripped portion is no longer visible to prevent shorting.



**3** Remove the flat-blade screwdriver from the release hole.



After you make a connection, make sure that the twisted wire or the solid wire is securely connected to the terminal block.



#### **Precautions for Safe Use**

- · Make sure that all wiring is correct.
- · Do not bend the cable forcibly. Doing so may break the cable.

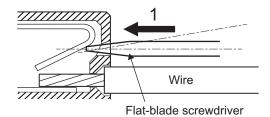
#### 5-1-8 Removing Wires

Use the following procedure to remove the wires from the terminal block.

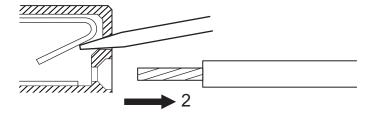
The removal method is the same for ferrules, twisted wires, and solid wires.

1 Press a flat-blade screwdriver straight into the release hole.

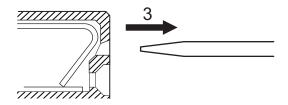
If you press in the screwdriver correctly, you will feel the spring in the release hole, and the screw driver will begin to incline.



**2** Leave the flat-blade screwdriver pressed into the release hole and pull out the wire.



**3** Remove the flat-blade screwdriver from the release hole.





#### **Precautions for Safe Use**

- · Make sure that all wiring is correct.
- · Do not bend the cable forcibly. Doing so may break the cable.

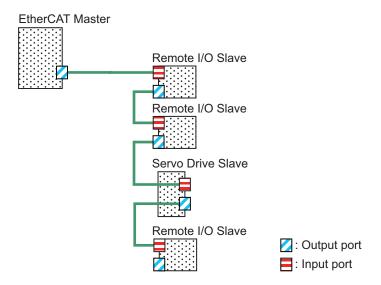
# 5-2 Laying the EtherCAT Network

This section describes how to install EtherCAT networks.

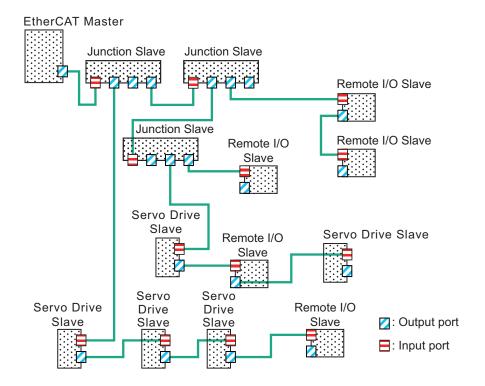
#### 5-2-1 Supported Network Topologies

The EtherCAT port on the CK3M-series Programmable Multi-Axis Controller can be connected using daisy chain connections with no branching, or with branching connections using Junction Slaves. Examples of topology without branching and with branching (Junction Slaves) are shown below.

#### No Branching



#### Branching



#### 5-2-2 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.

## 5-2-3 Installing EtherCAT Communications Cables

Ethernet communications cables and connectors are used to connect the EtherCAT port of the CPU Unit 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 27 × 4 Pairs

Product name	Manufac- turer	Cable length (m) *1	Model	Contact informa- tion
Cable with Connectors on	OMRON	0.3	XS6W-6LSZH8SS30CM-	OMRON Customer
Both Ends	Corpora-		Y *2	Service Center
(RJ45/RJ45)	tion	0.5	XS6W-6LSZH8SS50CM-	
Standard RJ45 connector type			Y *2	
туре		1	XS6W-6LSZH8SS100C	
			M-Y *2	
4		10	XS6W-6LSZH8SS1000C	
			M-Y *2	

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

<sup>\*2.</sup> 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	Manufac- turer	Cable length (m) *1	Model	Contact informa- tion
Cable with Connectors on	OMRON	0.3	XS5W-T421-AMD-K	OMRON Customer
Both Ends	Corpora-	0.5	XS5W-T421-BMD-K	Service Center
(RJ45/RJ45)	tion	1	XS5W-T421-CMD-K	
Rugged RJ45 connector type		2	XS5W-T421-DMD-K	
		5	XS5W-T421-GMD-K	
***		10	XS5W-T421-JMD-K	
Cable with Plugs on Both	OMRON	0.5	XS5W-T421-BM2-SS	
Ends	Corpora-	1	XS5W-T421-CM2-SS	
(M12/M12)	tion	2	XS5W-T421-DM2-SS	
Double-shielded cable		3	XS5W-T421-EM2-SS	
M12/Smartclick connector type		5	XS5W-T421-GM2-SS	
(ypc		10	XS5W-T421-JM2-SS	
Cable with Plugs on Both	OMRON	0.5	XS5W-T421-BMC-SS	
Ends	Corpora-	1	XS5W-T421-CMC-SS	
(M12/RJ45)	tion	2	XS5W-T421-DMC-SS	
Double-shielded cable		3	XS5W-T421-EMC-SS	
M12/Smartclick connector type		5	XS5W-T421-GMC-SS	
Rugged RJ45 connector type		10	XS5W-T421-JMC-SS	

<sup>\*1.</sup> 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	Planning Department,
		0.5 × 4P *1	Kanetsu Co., Ltd.
	Kuramo Electric Co., Ltd.	KETH-SB *1	Kuramo Electric Co., Ltd.
	SWCC Showa Cable	FAE-5004 *1	SWCC Showa Cable
	Systems Co., Ltd.		Systems Co., Ltd.
	JMACS Japan Co., Ltd.	IETP-SB *1	JMACS Japan Co., Ltd.
RJ45 Connectors	Panduit Corporation	MPS588*1	Panduit Corporation US
			Headquarters

<sup>\*1.</sup> We recommend that you use combinations of the above Cables and Connectors.

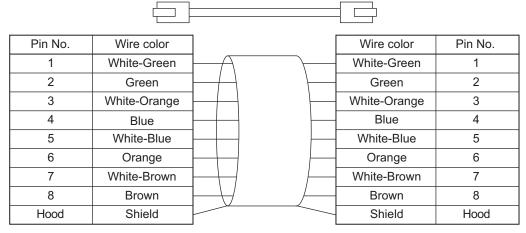
#### Sizes and Conductor Pairs: AWG 22 × 2 Pairs

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

<sup>\*1.</sup> 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



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	

## 5-3 Laying the Ethernet Network

#### 5-3-1 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.

## 5-3-2 Installing Ethernet Networks

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

#### **Ethernet Switches**

Manufacturer	Model	Function	Number of ports
OMRON Corporation	W4S1-03B	Priority control (QoS): Control data of Ether-	3
	W4S1-05B	Net/IP is prioritized.	5
	W4S1-05C	S1-05C Failure detection: Broadcast storm, LSI error	
		detection, 10/100BASE-TX, Auto-Negotiation	
Cisco Systems Inc.	Contact the manufacturer.		

Manufacturer	Model	Function	Number of ports
CONTEC Co., Ltd.	Contact the manufacturer.		
Phoenix Contact	Contact the manufacturer.		

## **Twisted-pair Cables, Connectors**

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

Product name	Manufacturer	Model	Contact information
Cables	Hitachi Metals, Ltd.	NETSTAR-C5ESAB 0.5 × 4P *1	Planning Department, Kanetsu Co., Ltd.
	Kuramo Electric Co., Ltd.	KETH-SB *1	Kuramo Electric Co., Ltd.
	SWCC Showa Cable Systems Co., Ltd.	FAE-5004 *1	SWCC Showa Cable Systems Co., Ltd.
RJ45 Connectors	Panduit Corporation	MPS588 *1	Panduit Corporation US Headquarters

<sup>\*1.</sup> We recommend that you use combinations of the above-mentioned Cables and Connectors.

#### • Sizes and Conductor Pairs: AWG22 × 2 Pairs (for 100BASE-TX)

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

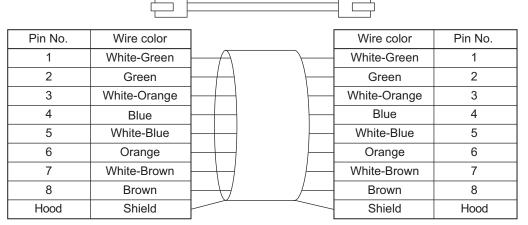
<sup>\*1.</sup> We recommend that you use combinations of the above-mentioned Cables and Connectors.

#### Sizes and Conductor Pairs: 0.5 mm × 4 Pairs (for 100BASE-TX)

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

## 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



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

# 5-4 Watchdog Timer Output Wiring

## 5-4-1 Applicable Wires

The wires that you can connect to the terminal block are twisted wires, solid wires, and ferrules that are attached to the twisted wires. The following section describes the dimensions and processing methods for applicable wires.

## **Using Ferrules**

If you use ferrules, attach the twisted wires to them.

Observe the application instructions for your ferrules for the wire stripping length when attaching ferrules.

Always use plated one-pin ferrules. Do not use unplated ferrules or two-pin ferrules.

The applicable ferrules, wires, and crimping tools are listed in the following table.

Manufacturer	Ferrule model	Applicable wire (mm <sup>2</sup> (AWG))	Crimping Tool (applicable wire size given in parentheses)
Phoenix Con-	AI0,25-8	0.25 (#24)	Phoenix Contact
tact	AI0,5-8	0.5 (#20)	CRIMPFOX 6 (0.25 to 6 mm <sup>2</sup> , AWG24 to 10)
	AI0,75-8	0.75 (#18)	
Weidmüller	H0.25/12	0.25 (#24)	Weidmüller
	H0.34/12	0.34 (#22)	PZ6 Roto (0.14 to 6 mm <sup>2</sup> , AWG26 to 10)
	H0.5/14	0.5 (#20)	
	H0.75/14	0.75 (#18)	

## **Using Twisted or Solid Wires**

Wire type	Conductor cross-sectional area	Conductor length (stripping length)
Solid wire	0.2 to 1.5 mm <sup>2</sup>	8 mm
Twisted wire		

## 5-4-2 Required Tools

Use a flat-blade screwdriver to remove wires.

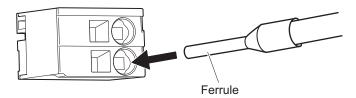
The recommended screwdriver is as follows.

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

## 5-4-3 Connecting Ferrules

Insert the ferrule straight into the terminal hole.

It is not necessary to press a flat-blade screwdriver into the release hole.



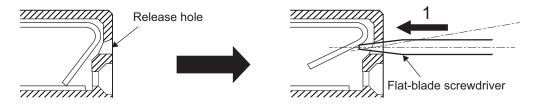
After you make a connection, make sure that the ferrule is securely connected to the terminal block.

## 5-4-4 Connecting Twisted Wires/Solid Wires

Use the following procedure to connect the twisted wires or solid wires to the terminal block.

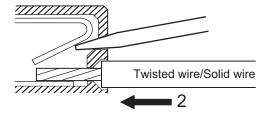
1 Press a flat-blade screwdriver straight into the release hole.

If you press in the screwdriver correctly, you will feel the spring in the release hole, and the screw driver will begin to incline.

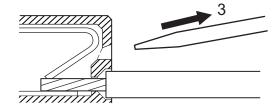


**2** Leave the flat-blade screwdriver pressed into the release hole and insert the twisted wire or the solid wire into the terminal hole.

Insert the twisted wire or the solid wire until the stripped portion is no longer visible to prevent shorting.



**3** Remove the flat-blade screwdriver from the release hole.



After you make a connection, make sure that the twisted wire or the solid wire is securely connected to the terminal block.



#### **Precautions for Safe Use**

- · Make sure that all wiring is correct.
- · Do not bend the cable forcibly. Doing so may break the cable.

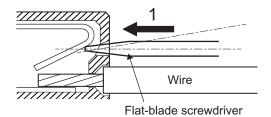
## 5-4-5 Removing Wires

Use the following procedure to remove the wires from the terminal block.

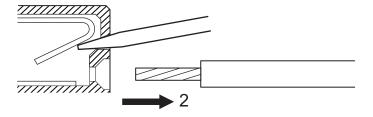
The removal method is the same for ferrules, twisted wires, and solid wires.

Press a flat-blade screwdriver straight into the release hole.

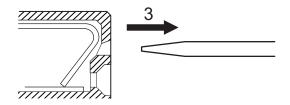
If you press in the screwdriver correctly, you will feel the spring in the release hole, and the screw driver will begin to incline.



**2** Leave the flat-blade screwdriver pressed into the release hole and pull out the wire.



**3** Remove the flat-blade screwdriver from the release hole.





#### **Precautions for Safe Use**

- Make sure that all wiring is correct.
- · Do not bend the cable forcibly. Doing so may break the cable.

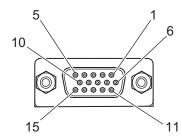
# 5-5 USB Memory Device Connection

Connect a USB memory device to the USB host port (Type A) on the CPU Unit to save relevant data. Refer to 3-1-5 USB Memory Device on page 3 - 7 for information on the recommended USB memory devices.

# 5-6 Encoder Connector Wiring

## 5-6-1 Connector Arrangement

The Unit side connector is a high-density D-sub 15-pin female (MIL-C-24308 compliant) connector.



Pin No.	Symbol	er	Digital Quadrature Encoder Serial Encoder + Serial Encoder + Serial Encoder		Serial Encoder		
1	CHA	Encoder A+	Input	Not wired	-	Encoder A+	Input
2	СНВ	Encoder B+	Input	Not wired	-	Encoder B+	Input
3	CHC	Encoder C+	Input	Not wired	-	Encoder C+	Input
4	CHU	Hall sensor U	Input	Serial Encoder CLK+	Output	Serial Encoder CLK+	Output
5	CHW	Hall sensor W	Input	Serial Encoder DAT+	Input / Output	Serial Encoder DAT+	Input / Output
6	CHA/	Encoder A-	Input	Not wired	-	Encoder A-	Input
7	CHB/	Encoder B-	Input	Not wired	-	Encoder B-	Input
8	CHC/	Encoder C-	Input	Not wired	-	Encoder C-	Input
9	CHV	Hall sensor V	Input	Serial Encoder CLK-	Output	Serial Encoder CLK+	Output
10	CHT	Hall sensor T	Input	Serial Encoder DAT-	Input / Output	Serial Encoder DAT+	Input / Output
11	ENCPWR	Encoder Power Supply (+5 VDC)	Output	Encoder Pow- er Supply (+5 VDC)	Output	Encoder Power Supply (+5 VDC)	Output
12	ENCPWR	Encoder Power Supply (+5 VDC)	Output	Encoder Pow- er Supply (+5 VDC)	Output	Encoder Power Supply (+5 VDC)	Output
13	GND	Encoder Power Supply (GND)	Common	Encoder Power Supply (GND)	Common	Encoder Power Supply (GND)	Common
14	GND	Encoder Power Supply (GND)	Common	Encoder Pow- er Supply (GND)	Common	Encoder Power Supply (GND)	Common
15	OutFlagB	OutFlagB	Output	OutFlagB	Output	OutFlagB	Output
Shell	SHELL	Shield		Shield		Shield	

#### 5-6-2 Dedicated Cable

The dedicated cables for wiring to the encoder connector are provided as an option.

The encoder connection side has discrete wires. Perform wiring to match the encoder specifications.

The cable models are as shown below.

Туре	Model	Length
Digital Quadrature Encoder	CK3W-CAED03A	3 m
For Serial Encoder	CK3W-CAES03A	3 m
For "Digital Quadrature Encoder + UVW Signal" or "Digital Quadrature Encoder +	CK3W-CAEW03A	3 m
Serial Encoder"		

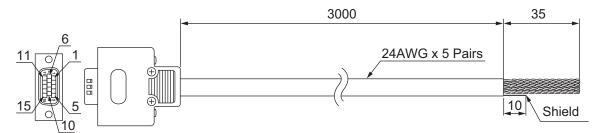


#### **Additional Information**

You may use a self-made cable.

When you create a self-made cable, use a shielded twisted-pair cable to block the effects of noise.

## **Digital Quadrature Encoder**



Type	Pin No.	Cable color	Mark	Signal
Pair 1	11	Blue	Black	Encoder Power Supply (+5 VDC)
	13	Blue	Red	Encoder Power Supply (GND)
Pair 2	1, 5 <sup>*1</sup>	Pink	Black	Encoder A+
				Serial Encoder DAT+
	6, 10 <sup>*2</sup>	Pink	Red	Encoder A-
	·			Serial Encoder DAT-
Pair 3	2	Green	Black	Encoder B+
	7	Green	Red	Encoder B-
Pair 4	3	Orange	Black	Encoder C+
	8	Orange	Red	Encoder C-
Pair 5	15	Gray	Black	OutFlagB
	14	Gray	Red	GND

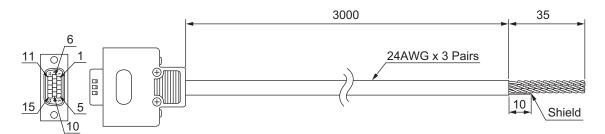
<sup>\*1.</sup> Inside the connector, Pin 1 and Pin 5 are short-circuited.

Note The cable shield is connected to the connector shell of the encoder connector.

When using this cable, set to OutFlagD = 1, and disable the serial encoder DAT terminating resistance.

<sup>\*2.</sup> Inside the connector, Pin 6 and Pin 10 are short-circuited.

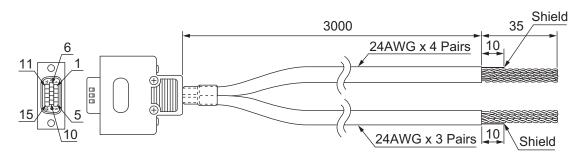
## For Serial Encoder



Туре	Pin No.	Cable color	Mark	Signal
Pair 1	12	Blue	Black	Encoder Power Supply (+5 VDC)
	14	Blue	Red	Encoder Power Supply (GND)
Pair 2	4	Pink	Black	Encoder CLK+
	9	Pink	Red	Encoder CLK-
Pair 3	5	Green	Black	Serial Encoder DAT+
	10	Green	Red	Serial Encoder DAT-

Note The cable shield is connected to the connector shell of the encoder connector.

# For "Digital Quadrature Encoder + UVW Signal" or "Digital Quadrature Encoder + Serial Encoder"



#### Cable 1

Туре	Pin No.	Cable color	Mark	Signal
Pair 1	11	Blue	Black	Encoder Power Supply (+5 VDC)
	13	Blue	Red	Encoder Power Supply (GND)
Pair 2	1	Pink	Black	Encoder A+
	6	Pink	Red	Encoder A-
Pair 3	2	Green	Black	Encoder B+
	7	Green	Red	Encoder B-
Pair 4	3	Orange	Black	Encoder C+
	8	Orange	Red	Encoder C-

Note The cable shield is connected to the connector shell of the encoder connector.

#### • Cable 2

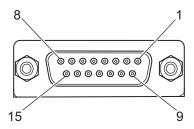
Turne	Din No	Cable color	Moule		Signal	
Type	Pin No.	Cable color	Mark	U, V, W	Serial Encoder	
Pair 1	12	Blue	Black	Encoder Power Supply (+5 VDC)		
	14	Blue	Red	Encoder Power Supply (GND)		
Pair 2	4	Pink	Black	Hall sensor U Serial Encoder C		
	9	Pink	Red	Hall sensor V Serial Encoder C		
Pair 3	5	Green	Black	Hall sensor W Serial Encoder DA		
	10	Green	Red	Hall sensor T	Serial Encoder DAT-	

Note The cable shield is connected to the connector shell of the encoder connector.

# 5-7 Amplifier Connector Wiring

## 5-7-1 Connector Arrangement

The Unit side connector is a D-sub 15-pin female (MIL-C-24308 compliant) connector.



Pin No.	Symbol	During analog of	utput	During pulse ou	tput
1	DACA+	Analog output A+	Output	Not wired	-
2	DACB+	Analog output B+ *1	Output	Not wired	-
3	AGND	Analog GND	Common	Analog GND	Common
4	FAULT+	Fault input +	Input	Fault input +	Input
5	PULSE+	Not wired	-	Pulse output +	Output
6	DIR+	Not wired	-	Directional output +	Output
7	AE_NO	Amp enable NO	Output	Amp enable NO	Output
8	AE_NC	Amp enable NC	Output	Amp enable NC	Output
9	DACA-	Analog output A-	Output	Not wired	-
10	DACB-	Analog output B- *1	Output	Not wired	-
11	FAULT-	Fault input -	Input	Fault input -	Input
12	PULSE-	Not wired	-	Pulse output -	Output
13	DIR-	Not wired	-	Directional output -	Output
14	GND	Not wired	-	Not wired	-
15	AE_COM	Amp enable Common	Common	Amp enable Common	Common
Shell	SHELL	Shield		Shield	

<sup>\*1.</sup> In the Filtered PWM type, there is no analog output B.

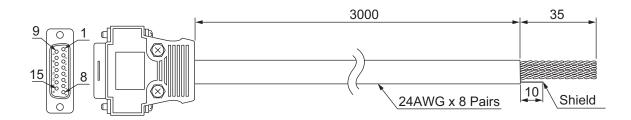
#### 5-7-2 Dedicated Cable

The dedicated cable for wiring to the amplifier connector is provided as an option.

The amplifier connection side has discrete wires. Wire in accordance with the Servo Drive specifications.

The cable model is as shown below.

Туре	Model	Length
For amplifier connection	CK3W-CAA03A	3 m



Туре	Pin No.	Cable color	Mark	Signal
Pair 1	1	Blue	Black 1 dot	Analog output A+
	9	Blue	Red 1 dot	Analog output A-
Pair 2	2	Pink	Black 1 dot	Analog output B+
	10	Pink	Red 1 dot	Analog output B-
Pair 3	3	Green	Black 1 dot	Analog GND
	3	Green	Red 1 dot	Analog GND
Pair 4	5	Orange	Black 1 dot	Pulse output +
	12	Orange	Red 1 dot	Pulse output -
Pair 5	6	Gray	Black 1 dot	Directional output +
	13	Gray	Red 1 dot	Directional output -
Pair 6	4	Blue	Black 2 dot	Fault input +
	11	Blue	Red 2 dot	Fault input -
Pair 7	7	Pink	Black 2 dot	Amp enable NO
	15	Pink	Red 2 dot	Amp enable common
Pair 8	8	Green	Black 2 dot	Amp enable NC
	15	Green	Red 2 dot	Amp enable common

Note The cable shield is connected to the connector shell of the amplifier connector.



#### **Additional Information**

You may use a self-made cable.

When you create a self-made cable, use a shielded twisted-pair cable to block the effects of noise.

# 5-8 Flag Terminal Block/General I/O Terminal Block Wiring

This section describes the wiring for the flag connection terminal block and the general digital I/O connection terminal block.

#### 5-8-1 Wiring the Terminals

## **Applicable Wires**

The wires that you can connect to the terminal block are twisted wires, solid wires, and ferrules that are attached to the twisted wires. The following section describes the dimensions and processing methods for applicable wires.

#### Using Ferrules

If you use ferrules, attach the twisted wires to them.

Observe the application instructions for your ferrules for the wire stripping length when attaching ferrules.

Always use plated one-pin ferrules. Do not use unplated ferrules or two-pin ferrules.

The applicable ferrules, wires, and crimping tools are listed in the following table.

Manufactur- er	Ferrule model	Applicable wire (mm² (AWG))	Crimping Tool (applicable wire size given in parentheses)
Phoenix Con-	AI0,5-10	0.5 (#20)	Phoenix Contact
tact	AI0,75-10	0.75 (#18)	CRIMPFOX 6 (0.25 to 6 mm <sup>2</sup> , AWG24 to 10)
	AI1,0-10	1.0 (#18)	
	AI1,5-10	1.5 (#16)	
Weidmüller	H0.5/16	0.5 (#20)	Weidmüller
	H0.75/16	0.75 (#18)	PZ6 Roto (0.14 to 6 mm <sup>2</sup> , AWG26 to 10)
	H1.0/16	1.0 (#18)	
	H1.5/16	1.5 (#16)	

#### Using Twisted or Solid Wires

Wire type	Conductor cross-sectional area	Conductor length (stripping length)
Solid wire	0.14 to 1.5 mm <sup>2</sup>	10 mm
Twisted wire		

## **Required Tools**

Use a flat-blade screwdriver to remove wires.

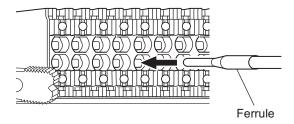
The recommended screwdriver is as follows.

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

## **Connecting Ferrules**

Insert the ferrule straight into the terminal hole.

It is not necessary to press a flat-blade screwdriver against the release button.

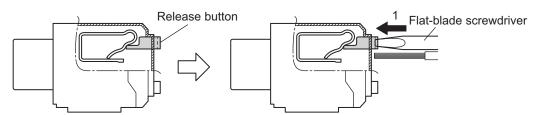


After you make a connection, make sure that the ferrule is securely connected to the terminal block.

## **Connecting Twisted Wires/Solid Wires**

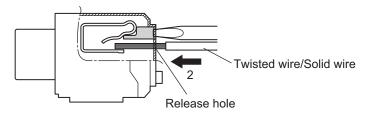
Use the following procedure to connect the twisted wires or solid wires to the terminal block.

1 Press a flat-blade screwdriver straight against the release button from the terminal block front.

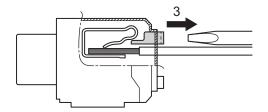


**2** Leave the flat-blade screwdriver pressed against the release button and insert the twisted wire or the solid wire into the terminal hole.

Insert the twisted wire or the solid wire until the stripped portion is no longer visible, to prevent shorting.



**3** Pull the flat-blade screwdriver away from the release button.



After you make a connection, make sure that the twisted wire or the solid wire is securely connected to the terminal block.



#### **Precautions for Safe Use**

- · Make sure that all wiring is correct.
- Do not bend the cable forcibly. Doing so may break the cables.

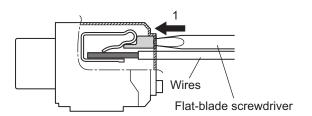
## **Removing Wires**

Use the following procedure to remove the wires from the terminal block.

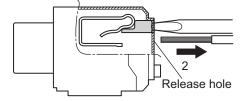
The removal method is the same for ferrules, twisted wires, and solid wires.

If wires are secured firmly to the terminal block, release them first.

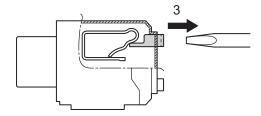
1 Press a flat-blade screwdriver straight against the release button from the terminal block front.



**2** Leave the flat-blade screwdriver pressed against the release button and pull out the wire from the terminal hole.



**3** Pull the flat-blade screwdriver away from the release button.





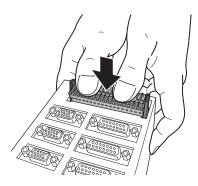
#### **Precautions for Safe Use**

- Make sure that all wiring is correct.
- Do not bend the cable forcibly. Doing so may break the cables.

## **Installing a Terminal Block**

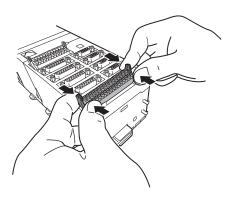
Insert the terminal block into the main body, and press hard to click the terminal block into place on the Unit.

After you mount the terminal block, make sure that it is fixed to the Unit.



## Removing a Terminal Block

Drop the lock levers on both sides of the terminal block at the same time to remove the terminal block.



## 5-8-2 Precautions When Connecting a Two-wire DC Sensor

When a two-wire sensor is used with a general digital input and a flag input, check that the following conditions are met.

Failure to meet these conditions may result in operating errors.

 Relation between ON voltage of the general digital input / flag input and sensor residual voltage

 $V_{ON} \le V_{CC} - V_{R}$ 

V<sub>ON</sub>: ON voltage of general digital input and flag input

V<sub>CC</sub>: Input voltage of general digital input and flag input

V<sub>R</sub>: Output residual voltage of sensor

#### Relation between input current to the general digital input / flag input and sensor control output (load current)

 $I_{OUT}$  (min)  $\leq I_{ON} \leq I_{OUT}$  (max)



#### **Precautions for Correct Use**

The general digital input and flag input are constant current type input.

For constant current type input, the input current does not increase linearly with the input voltage.

If you gradually raise the input voltage, once the input current reaches  $I_{ON}$ , the input current does not increase and remains roughly constant even when the input voltage is raised.

When  $I_{ON}$  is smaller than  $I_{OUT}$  (min), connect a bleeder resistor R. The bleeder resistor constant can be calculated as follows:

$$R \le (V_{CC} - V_R) / (I_{OUT} (min) - I_{ON})$$

Power W of bleeder resistor ≥ (V<sub>CC</sub> - V<sub>R</sub>)<sup>2</sup> / R × 4 [allowable margin]

V<sub>CC</sub>: Input voltage of general digital input and flag input

V<sub>R</sub>: Output residual voltage of sensor

ION: Input current of general digital input and flag input

I<sub>OUT</sub>: Sensor control output (load current)

#### Relation between OFF current of the general digital input / flag input and sensor leakage current

The general digital input and flag input cannot detect sensor output OFF unless the following conditions are satisfied:

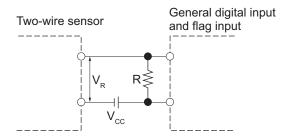
I<sub>OFF</sub> ≥ I<sub>leak</sub>

When I<sub>leak</sub> is greater than I<sub>OFF</sub>, connect a bleeder resistor R.

Use the following equation to calculate the bleeder resistance constant.

$$R \le (V_{OFF} / I_{OFF}) \times V_{OFF} / (I_{leak} \times (V_{OFF} / I_{OFF}) - V_{OFF})$$

Power W of bleeder resistor  $\geq (V_{CC} - V_R)^2 / R \times 4$  [allowable margin]



V<sub>CC</sub>: Power supply voltage V<sub>R</sub>: Output residual voltage of sensor

 $V_{OFF}$ : OFF voltage of general digital input and flag input  $I_{leak}$ : Sensor leakage current

I<sub>ON</sub>: ON current of general digital input and flag input R: Bleeder resistor

I<sub>OFF</sub>: OFF current of general digital input and flag input

#### Precautions for Sensor Inrush Current

An incorrect input may occur due to sensor inrush current if a sensor is turned ON after the Unit has started up to the point where inputs are possible.

Determine the time required for sensor operation to stabilize after the sensor is turned ON and take appropriate measures, such as inserting an ON delay into the application program after turning ON the sensor.

#### 5-8-3 Precautions When Connecting to General Digital Output

## **Output Short-circuit Protection**

If a load connected to the output terminals is short-circuited, output components and printed circuit boards may be damaged.

When you use a NPN type output that does not include the load short-circuit protection, incorporate a protective fuse in the output. Use a fuse with a capacity of protection, around twice the rated output.

## **Precautions for Inrush Current**

When you use general digital output, steps must be taken to avoid damage to the output transistor when connecting a load with a high inrush current such as an incandescent lamp.

Use either of the following methods to reduce the inrush current.

In countermeasure 1, the current consumption from the I/O power supply is increased although the voltage supplied to the load L is not decreased.

In countermeasure 2, the voltage supplied to the load L is decreased although the current consumption from the I/O power supply is not increased.

Select the appropriate countermeasures according to the operating conditions.

#### Countermeasure 1

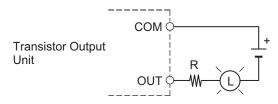
Draw about 1/3 of the rated current consumed by the load.

## Countermeasure 2

Mount a limiting resistor.

NPN type

PNP type





# **Troubleshooting**

This section describes the confirmation methods and corrections for errors that occur in the CK3M-series Programmable Multi-Axis Controller.

6-1	Types	s of Errors	6 - 2
6-2	Using	the Indicators to Check Errors	6 - 3
	6-2-1		
	6-2-2	Procedure for Identifying Errors	
6-3	Troub	oleshooting for Errors	6 - 5
	6-3-1	Fatal Errors in the CPU Unit	
	6-3-2	Non-fatal errors in the CPU Unit	6 - 6
	6-3-3	Initialization of CPU Unit Using USB Memory	6 - 8
6-4	Sys.S	Status Register	6 - 9
		Sys.Status Register List	
		Details of Flags	

# **6-1** Types of Errors

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

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

# 6-2 Using the Indicators to Check Errors

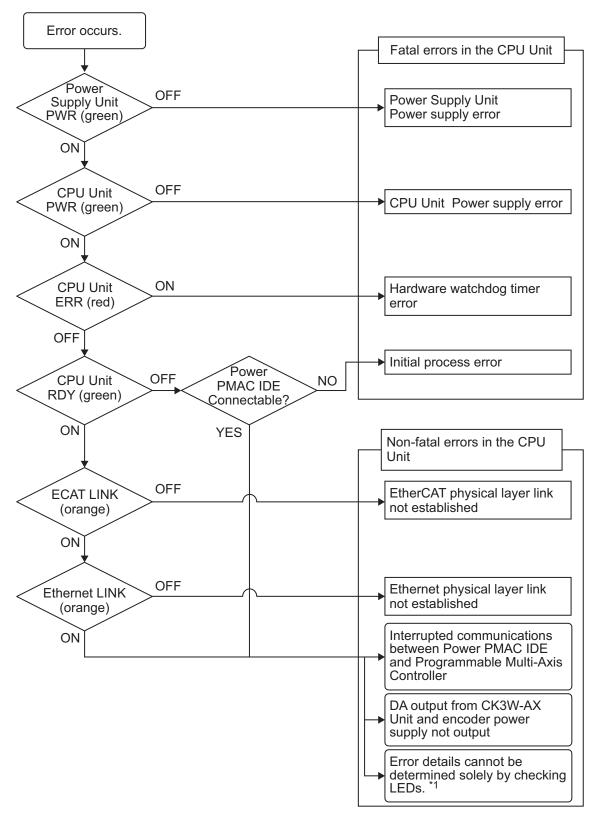
## 6-2-1 Indicator Types

The Motion Controller indicators used for error checks and their functions are as shown below.

Unit	Indicator	Description
Power Supply Unit	PWR	Shows that power is being supplied to the Unit.
CPU Unit	PWR	Shows the CPU Unit internal power status.
	RDY	Shows whether the CPU Unit is in operation-ready status.
	ERR	Shows the CPU Unit watchdog timer error status.
	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.
CK3W-AX Unit	PWR	Shows the Unit internal power status.

## 6-2-2 Procedure for Identifying Errors

When an error occurs in the Motion Controller, check the indicators with the following flowchart to first identify if either a "non-fatal error in the CPU Unit" or a "fatal error in the CPU Unit" has occurred.



<sup>\*1.</sup> For the details of errors that cannot be determined solely by checking the indicators, check the Sys.Status register.

Refer to 6-4-1 Sys. Status Register List on page 6 - 9 for the Sys. Status flag.

# **6-3** Troubleshooting for Errors

## 6-3-1 Fatal Errors in the CPU Unit

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

Description	Cause	Corrective action
Power Supply Unit power supply error	Power is not supplied to the Power Supply Unit	Check the following items and adequately supply power to the unit.  Is the power turned on?  Is the power cable wired correctly?  Is the power cable free of damage?
	Input voltage is out of allowable range	Check the following items and adjust the voltage so that it falls within the allowable range.  Is the power supply voltage within the specified range?  Is the capacity of the power supply sufficient?  Is the power supply failing?
	Output current of the power supplied to the encoder exceeds the maximum current capacity	Check the following items and adjust the voltage so that it does not exceed the maximum current capacity.  Does encoder current consumption exceed the maximum current capacity?  Is the encoder connector wiring connected correctly?  Has the encoder cable short-circuited?  Is the encoder failing?
	Power supply error of mounted unit  The number of con-	Remove the connected Units one by one, and if the error is eliminated, replace that Unit.  Check whether the connected Units exceed the maximum con-
	nected Units exceeds the maximum capacity	nectable number. The maximum connectable number is 2 CK3W-AX Units.
	Power Supply Unit failure	If the error persists even after you make the above corrections, replace the Power Supply Unit.
CPU Unit power supply error	Connection error be- tween the Power Supply Unit and the CPU Unit	Make sure that the Power Supply Unit and the CPU Unit are connected correctly.
	CPU Unit or Power Supply Unit failure	If the error persists even after you make the above corrections, replace the CPU Unit or the Power Supply Unit.

Description	Cause	Corrective action
Hardware watchdog timer error	Unit disconnection during operations	Make sure that the Units are connected correctly.
	Illegal user program	Refer to 6-3-3 Initialization of CPU Unit Using USB Memory on page 6 - 8, and execute re-initialization.
	Ingress of conductive object	If there is conductive material nearby, blow air through the CPU Unit.
	Noise	If the error did not result from the above causes, cycle the power to the Controller and see if that resets the error. If the error occurs frequently, check the FG and power supply lines to see if noise is entering on them. Implement noise countermeasures as required.
	CPU Unit failure	If the error persists even after you make the above corrections, replace the CPU Unit.
Initial process error	Ingress of conductive object	If there is conductive material nearby, blow air through the CPU Unit.
	Noise	If the error did not result from the above causes, cycle the power to the Controller and see if that resets the error. If the error occurs frequently, check noise entry paths such as the FG and the power supply lines and implement noise countermeasures as required.
	CPU Unit failure	If the error persists even after you make the above corrections, replace the CPU Unit.

## 6-3-2 Non-fatal errors in the CPU Unit

For non-fatal errors in the CPU Unit, take the following corrective actions depending on the nature of the error.

Description	Cause	Corrective action
EtherCAT physical layer link 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.
	Disconnected connector on the Ethernet cable used for Ether- CAT communications, contact failure, or part failure	Reconnect the connector and check to ensure it is mated correctly.
	Power is not supplied to the first slave connected to the CPU Unit.	Supply power to the slave.
	Failure of slave within Ether-CAT network configuration	Replace the slave.
	Noise	Check noise entry paths, and implement noise-related countermeasures as required.
	CPU Unit failure	Replace the CPU Unit.

Description	Coupe	Corrective action
Description	Cause	
Ethernet physical layer link 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 ca- ble is not being used, replace the cable.
	Disconnected connector on the Ethernet cable used for Ether- net communications, contact failure, or part failure	Reconnect the connector and check to ensure it is mated correctly.
	Power is not supplied to the Ethernet switch connected to the CPU Unit.	Supply power to the Ethernet switch.
	Failure of device within Ether- net network configuration	Replace the device.
	Noise	Check noise entry paths, and implement noise-related countermeasures as required.
	CPU Unit failure	Replace the CPU Unit.
Interrupted communications between Power PMAC IDE and CPU Unit	Communications interruption, due to disconnection and reconnection of the Ethernet cable used for Ethernet communication between Power PMAC IDE and the CPU Unit while communication was being established  Communications interruption due to power to Ethernet switch between Power PMAC IDE and CPU Unit being turned OFF — ON while communications were being established  Communications interruption due to power to CPU Unit being turned OFF — ON while communications were being established	If communications are interrupted between Power PMAC IDE and the CPU Unit with Ethernet communications established, communications 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.
	Temporary communications interruption due to noise	Check noise entry paths, and implement noise-related countermeasures as required. Then reestablish communications between Power PMAC IDE and the CPU Unit.  To reestablish the communications, you need to restart Power PMAC IDE or reestablish the communications by using Power PMAC IDE.
DA output from CK3W-AX Unit and encoder	Power Supply Unit other than CK3W-PD048 is being used.	Check the Power Supply Unit model.
power supply not output	CK3W-AX Unit failure	Replace the CK3W-AX Unit.
	Internal 24 V power is not being input to the CK3W-AX Unit due to a failure of the Unit to its left.	Replace the Unit to the left of this Unit.

## 6-3-3 Initialization of CPU Unit Using USB Memory

If the CPU Unit fails to connect to the Power PMAC IDE, you can use a USB memory to initialize the CPU Unit to the factory 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 3-1-5 USB Memory Device on page 3 7.
- **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 CPU Unit.
- 4 When the power to the CPU Unit is turned ON, the CPU Unit 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.

# 6-4 Sys. Status Register

### 6-4-1 Sys.Status Register List

If an error cannot be identified with indicators, the error status can be confirmed 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 using the Power PMAC IDE **Status** — **Global Status**.

The Sys.Status register is 32-bit data with the configuration shown below.

Bit	Name	Description
16-31	-	
15	CK3WHWChange	The CK3W hardware configuration was changed during operation.
14	CK3WConfigErr(bit2)	There is an error in the CK3W hardware configuration.
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 Abort all input
8	NoClocks	Cannot detect a phase clock or a servo clock.
7	Default	Factory default
6	FileConfigErr	System file setting error
5	HWChangeErr	After the save, the hardware configuration was changed.
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

# 6-4-2 Details of Flags

### CK3WHWChange

Register name	Sys.CK3WHWChange		
Description	The CK3W hardware configu	ration was changed during op-	eration.
Range	0 to 1		
Details	Checks if there were any changes in the configurations of the connected CK3W Unit and End Cover during operation.  0: No changes in hardware configurations during operation  1: Changes in hardware configurations during operation		
<b>Detection timing</b>	Continuous		
Recovery	Cycle the power supply, rese	t command (\$\$\$)	
Effects	Operation continues		
Cause and cor-	Cause (Assumed cause)	Correction	Prevention
rection	The CK3W Unit address switch was changed during operation.	Check if there were any changes in the address switch.	None
	The CK3W Unit or End Cover was disconnected during operation.	Make sure that the Units are installed correctly.	None
	Contamination with conductive object	If there is conductive material nearby, blow air through the Unit.	Do not perform any metal work in the vicinity of the control panel.  Make sure that the work environment is free of dirt and dust.  Then close the control panel.
	Noise     Data corruption in bus signals     Malfunction of bus interface circuit	If the error occurs even after making the above correction, check noise entry paths such as the FG and the power supply lines and implement noise countermeasures as required.	Implement noise counter- measures.
	The CPU Unit or the CK3W Unit has failed Internal bus contact failure	If this error persists even after you make the above two corrections, replace the CPU Unit or the CK3W Unit.	None
Precautions/ Remarks	None		
Remarks	None		

## • CK3WConfigErr

Register name	Sys.CK3WConfigErr		
Description	There is an error in the CK3W hardware configuration.		
Range	0 to 7		
Details	Checks that there are no errors in the configurations of the connected CK3W Unit and End Cover.  0: No hardware configuration error  1: No End Cover  2: Reserve  3: Reserve  4: 3 or more Axis Interface Units are installed.  5: Reserve  6: Reserve  7: Address switches overlap.  When an error occurs, the Unit number where the error was detected counting from the CPU Unit is written to the Sys.CK3WConfigCount register.		
	'	'0", it shows that an error was Count is "1", it shows that an e t.	
<b>Detection timing</b>	When power is turned ON or	reset	
Recovery	Cycle the power supply, rese	t command (\$\$\$)	
Effects	Operation continues		
Cause and cor-	Cause (Assumed cause)	Correction	Prevention
rection	No End Cover	Attach an End Cover	None
	Three or more CK3W-AX Units are connected to the CPU Unit.	Set the number of CK3W-AX Units connected to two or less.	None
	The CK3W Unit address switch value is used more than once.	Set a unique address to prevent duplication of the address switch value.	None
	Contamination with conductive object	If there is conductive material nearby, blow air through the Unit.	Do not perform any metal work in the vicinity of the control panel.  Make sure that the work environment is free of dirt and dust.  Then close the control panel.
	Noise  Data corruption in bus signals  Malfunction of bus interface circuit	If the error occurs even after making the above correction, check noise entry paths such as the FG and the power supply lines and implement noise countermeasures as required.	Implement noise countermeasures.
	The CPU Unit or the CK3W Unit has failed  The internal bus is disconnected.	If this error persists even after you make the above two corrections, replace the CPU Unit or the CK3W Unit.	None
Precautions/ Remarks	None		

#### FlashSizeErr

Register name	Sys.FlashSizeErr	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.			
Data ation timina	1 0	<i>_</i>	capacity.	
Detection timing	When save command is issu	ea		
Recovery	save command re-issue	save command re-issue		
Effects	save command invalidated			
Cause and cor-	Cause (Assumed cause)	Correction	Prevention	
rection	The user program size is	Reduce the size of the user	None	
	too large.	program.		
		Or, delete the backup file.		
Precautions/	None			
Remarks				

#### BufSizeErr

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

#### AbortAll

Register name	Sys.AbortAll		
Description	Stop based on Abort all input	t	
Range	0 to 1		
Details	0: No stop based on Abort al	/ input	
	1: Stopped based on Abort a	// input, or stopped in the past	based on "Abort all" input.
<b>Detection timing</b>	With Abort all input		
Recovery	Cycle the power supply, rese	t command (\$\$\$)	
Effects	Operation continues		
Cause and cor-	Cause (Assumed cause)	Correction	Prevention
rection	Abort all was input.	None	None
Precautions/	None		
Remarks			

#### 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 clo	0: No error 1: Cannot detect a phase clock or a servo clock.		
<b>Detection timing</b>	When power is turned ON or	reset		
Recovery	Cycle the power supply, reset command (\$\$\$)			
Effects	Cannot enable the motor.			
Cause and cor- Cause (Assumed cause) Correction		Correction	Prevention	
rection	The clock-related register is overwritten by the user program.	If the re-initialization command (\$\$\$****) is executed, and the error no longer occurs, review the user program.	None	
	The CPU Unit or the CK3W Unit has failed	If this error persists even after you make the above corrections, replace the CPU Unit or the CK3W Unit.	None	
Precautions/	None	•		
Remarks				

### Default

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

# • FileConfigErr

Register name	Sys.FileConfigErr		
Description	System file setting error		
Range	0 to 1		
Details	0: No error		
	1: System file setting error		
<b>Detection timing</b>	When power is turned ON or	reset	
Recovery	Cycle the power supply, rese	t command (\$\$\$)	
Effects	Operate at default settings.		
Cause and cor-	Cause (Assumed cause)	Correction	Prevention
rection	System file settings are incorrect.	If the re-initialization command (\$\$\$***) is executed, and the error no longer occurs, review the user program.	None
	The CPU Unit or the CK3W Unit has failed	If this error persists even after you make the above corrections, replace the CPU Unit or the CK3W Unit.	None
Precautions/	None		
Remarks			

## HWChangeErr

Register name	Sys.HWChangeErr		
Description	After the save, the hardware	configuration was changed.	
Range	0 to 1		
Details	0: No change in hardware configuration.		
		re configuration was changed.	
Detection timing	When power is turned ON or	reset	
Recovery	Cycle the power supply, rese	t command (\$\$\$)	
Effects	Operate at default settings.		
Cause and cor-	Cause (Assumed cause)	Correction	Prevention
rection	After the save, the Unit configuration or address switch was changed.	Check the Unit configuration or address switch. When changing the Unit configuration or address switch, change the settings to match the new configuration, and issue a save command. If the Unit configuration or address switch has not changed, implement the following measures.	None
	Contamination with conductive object	If there is conductive material nearby, blow air through the Unit.	Do not perform any metal work in the vicinity of the control panel. Make sure that the work environment is free of dirt and dust.  Then close the control panel.
	Noise  Data corruption in bus signals  Malfunction of bus interface circuit	If the error occurs even after making the above correction, check noise entry paths such as the FG and the power supply lines and implement noise countermeasures as required.	Implement noise countermeasures.
	The CPU Unit or the CK3W Unit has failed	If this error persists even after you make the above corrections, replace the CPU Unit or the CK3W Unit.	None
Precautions/ Remarks	None		

# ConfigLoadErr

Register name	Sys.ConfigLoadErr			
Description	Read error in saved settings	Read error in saved settings		
Range	0 to 1			
Details	0: No error			
	1: System file setting error			
<b>Detection timing</b>	When power is turned ON or	reset		
Recovery	Cycle the power supply, rese	t command (\$\$\$)		
Effects	Operate at default settings.			
Cause and cor-	Cause (Assumed cause) Correction Prevention			
rection	Settings are incorrect.	If the re-initialization com-	None	
		mand (\$\$\$***) is executed,		
		and the error no longer oc-		
		curs, review the settings.		
	The CPU Unit or the CK3W	If this error persists even	None	
	Unit has failed	after you make the above		
		corrections, replace the		
		CPU Unit or the CK3W		
		Unit.		
Precautions/	None			
Remarks				

#### ProjectLoadErr

Register name	Sys.ProjectLoadErr		
Description	User Project File Read Error		
Range	0 to 1		
Details	0: No error 1: User Project File Read Err	or	
Detection timing	When power is turned ON or	reset	
Recovery	Cycle the power supply, rese	t command (\$\$\$), downloadin	g
Effects	Operate at default settings.		
Cause and cor-	Cause (Assumed cause)	Correction	Prevention
rection	The project file is corrupted.  An illegal project file was	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.  None
	downloaded.	output window, and make corrections to the project file. After the corrections, execute the re-initialization command (\$\$\$***), and download the project file again.	
	CPU Unit failure	If this error persists even after you make the above corrections, replace the CPU Unit.	None
Precautions/	None		
Remarks			

#### PwrOnFault

To ensure that the errors when the power is turned on or during reset can be checked with 1 bit, the Sys.PwrOnFault register is set to "1" when any of Sys.FileConfigErr, Sys.HWChangeErr, Sys.ConfigLoadErr, or Sys.ProjectLoadErr is "1".

#### WDTFault

Register name	Sys.WDTFault		
Description	Software Watchdog Timer Er	ror Status	
Range	0 to 3		
Details	Sys.WDTFault shows the software watchdog timer operation status with 2-bit data.  Bit0: Background software watchdog timer error  0: No background watchdog timer  1: Background watchdog timer operates  Bit1: Real-time interruption software watchdog timer error  0: No real-time interruption watchdog timer  1: Real-time interruption watchdog timer operates  Refer to Power PMAC User's Manual (Cat. No. 0014) for details of the software watchdog timer.		
<b>Detection timing</b>	During operation		
Recovery	Cycle the power supply, rese	t command (\$\$\$), re-initializati	ion command (\$\$\$***)
Effects	User program: Stops Hardware: Reset status		
Cause and cor-	Cause (Assumed cause)	Correction	Prevention
rection	Background software watchdog timer error occur- red. • Real-time interruption process was too long, and the background process could not be im- plemented at the interval set in the Sys.WDTReset register.	Review the user program.     Review the Sys.WDTReset register value.	None
	Real-time interruption soft- ware watchdog timer error generated • Real-time interruption process could not be im- plemented at the interval set in the Sys.BgWDTReset regis- ter.	Review the user program.     Review the Sys.BgWDTReset register value.	None
Precautions/	None	1	1
Remarks			



# **Inspection and Maintenance**

This section describes the cleaning, inspection, and maintenance of the CK3M-series Programmable Multi-Axis Controller.

7-1	Cleani	ing and Maintenance	7 - 2
		Cleaning	
		Periodic Inspections	
7-2	Mainte	enance Procedures	7 - 4
	7-2-1	Unit Replacement Precautions	7 - 4
	7-2-2	Backup	7 - 4
	7-2-3	Unit Replacement	7 - 4

# 7-1 Cleaning and Maintenance

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

Daily or periodic inspections are required in order to maintain the CK3M-series Programmable Multi-Axis Controller's functions in peak operating condition.

#### 7-1-1 Cleaning

Perform the following cleaning procedures periodically to ensure the CK3M-series Programmable Multi-Axis Controller is maintained in the best operating condition. Always turn OFF the power supply to the 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.

#### 7-1-2 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.

Inspec- tion 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.	supply at the terminals. Take necessary steps to bring voltage of the supplied power to within the allowable voltage fluctuation
			range.

Inspec- tion item	Inspection details	Criteria	Correction
Ambient environ- ment	Check the ambient temperature. *1	0 to 55°C	Use a thermometer to check the temperature and ensure that the ambient temperature remains within the allowed range of 0 to 55°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.
	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 flam- mable 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 resist- ance 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.
Installa- tion and wiring	Check that the connectors for each Unit are fully inserted and locked.	No looseness	Press the connectors together completely and lock them with the sliders.
	Check that cable connectors are fully inserted and locked.	No looseness	Fully insert and lock the connectors.
*1 If using	Check for damaged external wiring cables.	No visible damage	Check visually and replace cables if necessary.

<sup>\*1.</sup> If using a control panel, the temperature inside the control panel is the ambient temperature.

## **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

<sup>\*2.</sup> If using a control panel, the humidity inside the control panel is the ambient humidity.

# 7-2 Maintenance Procedures

This section describes the procedures to back up the data in the CPU Unit and to replace the Unit. Use Power PMAC IDE Ver.4.0 or a higher version.

#### 7-2-1 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.

#### **7-2-2** Backup

Store the project file and the EtherCAT ENI file so that the data can be restored when a failure or other problems occur.

If you are not using EtherCAT, saving the ENI file is not necessary.

#### 7-2-3 Unit Replacement

## Procedure to Replace a CPU Unit

The following describes the basic replacement procedure for the CPU Unit.

No.	Step	Description	Reference
1	Turn OFF power	Turn OFF power to the Motion Controller.	-
	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.	
2	Disconnect ca-	Disconnect the cables connected to the CPU Unit.	-
	bles		
3	Replace the CPU	Replace the CPU Unit with a new Unit, connect the cables, and turn	-
	Unit	ON power to the Motion Controller and EtherCAT equipment.	
4	Connect with IDE	Connect the CPU Unit and the Power PMAC IDE online through Ether-	-
		net.	
5	Initialize	In the terminal window, input the re-initialization command (\$\$\$***),	-
		and initialize the CPU Unit.	
6	Read the Ether-	In Power PMAC IDE, click <b>Delta Tau</b> — <b>Tools</b> — <b>System Setup</b> —	Only when
	CAT ENI file	Master[0] Deactivated in order.	using Ether-
		Click the <b>Browse</b> button, and read the backed-up ENI file into Power PMAC IDE.	CAT
7	Write the Ether-	Click the <b>Download ENI file</b> button, and write the ENI file to the CPU	Only when
	CAT ENI file	Unit.	using Ether-
			CAT
8	Read the project	ne project Read out the backed-up project file in Power PMAC IDE.	
	file		
9	Write the project	Right-click the project name, click <b>Build and Download All</b> -	
	file	<b>Programs</b> , and write the project file to the CPU Unit.	

No.	Step	Description	Reference
10	Execute save	n the terminal window, input the save command, and save the pro-	
		gram in the built-in flash memory.	
11	Execute reset	In the terminal window, input the reset command \$\$\$, and reset the	-
		CPU Unit.	

## Procedure to Replace an Axis Interface Unit

The following describes the replacement procedure for the Axis Interface Unit.

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.	-
2	Disconnect cables	Disconnect the cables connected to the Axis Interface Unit	
3	Set the Address Switch	Change the address switch of the new unit to the same setting as previous unit.	
4	Replace the Axis Inter- face Unit	Replace with a new unit, connect the cables, and turn ON power to 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 pow-	Take measures to ensure that there are no effects on the peripher-	-
	er to the devi-	al devices, and then turn OFF power to the Motion Controller and	
	ces	all EtherCAT slaves.	
2	Replace the	For the EtherCAT slave replacement method, refer to the relevant	Refer to the man-
	EtherCAT Slave	manuals for each slave.	ual for each Ether-
		Replace with a new Unit, turn ON power to the EtherCAT slave,	CAT slave for de-
		and then turn ON power to the Motion Controller.	tails.

7 Inspection and Mair	itenance
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# **Appendices**

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

A-1	Gene	ral Specifications	A - 2
A-2	Dime	nsions	A - 3
		CPU Unit	
		Power Supply Unit	
		Axis Interface Unit	
	A-2-4	End Cover	A - 5
A-3	Restr	ictions on Using the NX-series EtherCAT Coupler Unit	A - 6
A-4	OMR	ON Servo Drive Connection Example	A - 7

# A-1 General Specifications

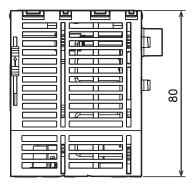
This section describes the Motion Controller specifications.

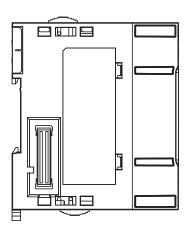
Item		Specification
Enclosure		Mounted in a panel
<b>Grounding Method</b>		Ground to less than 100 $\Omega$ .
	Ambient Operating Temperature	0 to 55°C
	Ambient Operating Humidity	10% to 95% (with no condensation or icing)
	Atmosphere	Must be free of corrosive gases.
Operating Environ-	Ambient Storage Temperature	-25 to 70°C (with no condensation or icing)
ment	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 <sup>2</sup> 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/s², 3 times each in X, Y, and Z directions
Insulation Resistance		20 MΩ min. between isolated circuits (at 100 VDC)
Dielectric Strength		510 VAC between isolated circuits for 1 minute with a leakage current of 5 mA max.
Applicable Standards		cULus, EU: EN 61326, RCM, KC, EAC

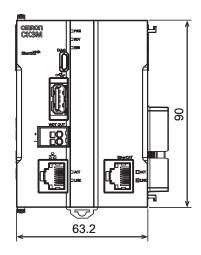
# **A-2** Dimensions

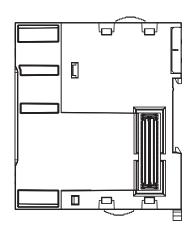
Dimensions are shown below. The unit of dimension is millimeters.

### A-2-1 CPU Unit

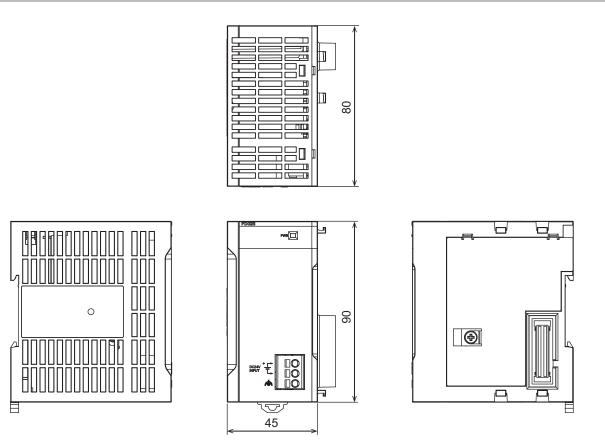




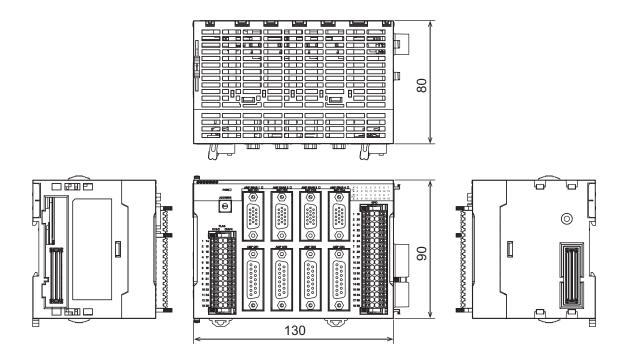




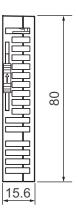
# A-2-2 Power Supply Unit

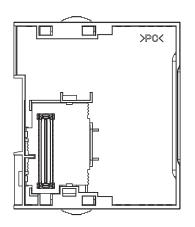


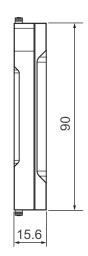
## A-2-3 Axis Interface Unit

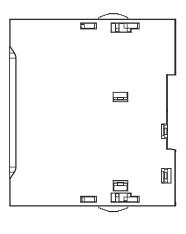


# A-2-4 End Cover









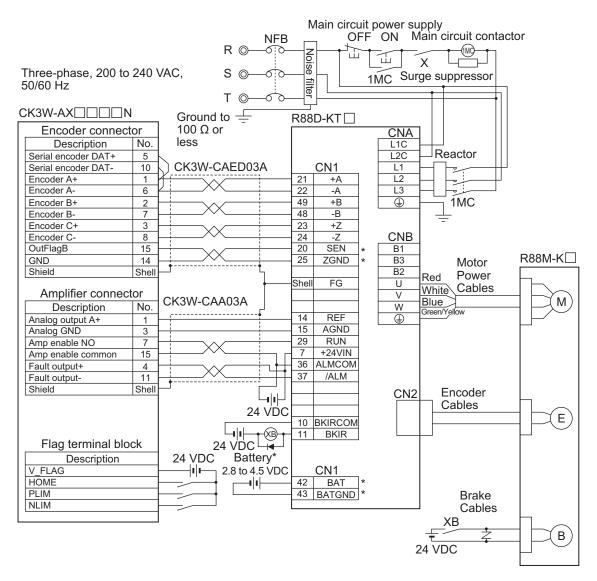
# A-3 Restrictions on Using the NX-series EtherCAT Coupler Unit

When OMRON NX-series EtherCAT Coupler Units are used as slaves with the CPU Unit as the Ether-CAT 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	

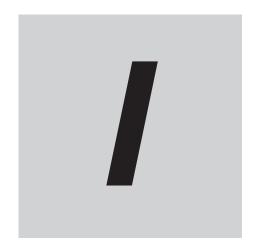
# A-4 OMRON Servo Drive Connection Example

This section shows an example of a connection with the OMRON G5-series Servo Drive R88D-KT□□□.



- Note 1. The terminal and wiring marked with \* are used when an absolute encoder is used. When an incremental encoder is used, the wiring marked with \* is not necessary.
- Note 2. Do not connect the signal wires that are not used.

**Appendices** 



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