OMRON

CK3M-series

Programmable Multi-Axis Controller Hardware

User's Manual

CK3M-CPU1□1
CK3W-PD048
CK3W-AX1313□/-AX1414□/-AX1515□/-AX2323□
CK3W-MD71□0
CK3W-AD□100
CK3W-EXM01/-EXS02

Programmable Multi-Axis Controller

O036-E1-03

NOTE

Trademarks

Copyrights

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

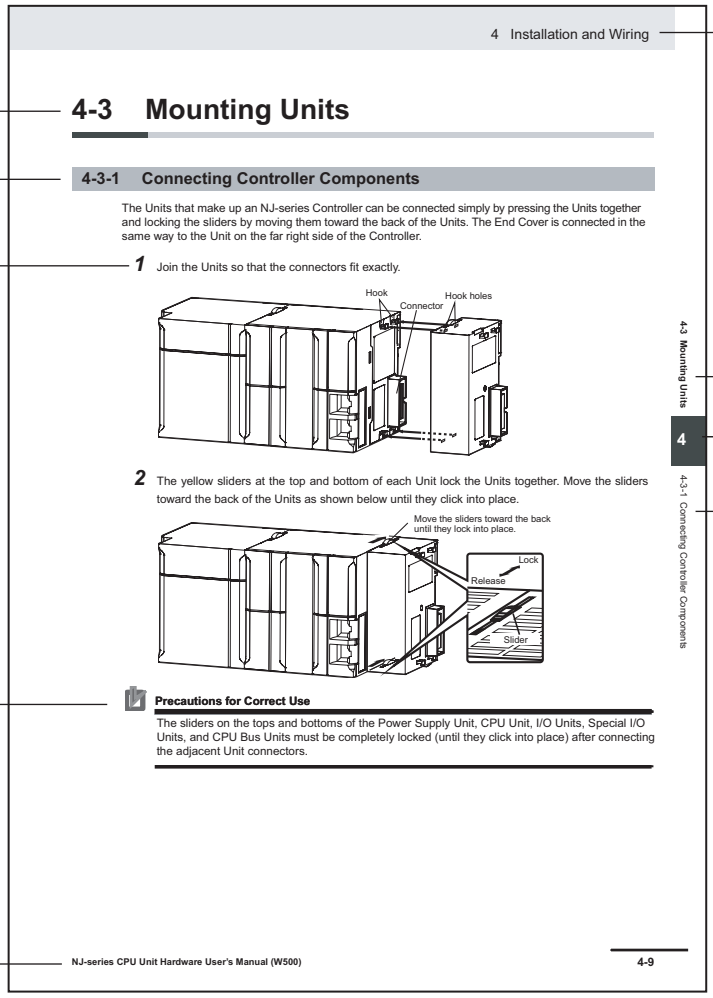
This manual covers the following products.

- CK3M-series Programmable Multi-Axis Controller
  CK3M-CPU1□1
  CK3W-PD048
  CK3W-AX1313□/-AX1414□/-AX1515□/-AX2323□
  CK3W-MD71□0
  CK3W-AD□100
  CK3W-EXM01/-EXS02

Manual Structure

Page Structure

The following page structure is used in this manual.



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

Special Information

Special information in this manual is classified as follows:

Precautions for Safe Use

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

Precautions for Correct Use

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

Additional Information

Additional information to read as required.
This information is provided to increase understanding and make operation easier.

Sections in this Manual

CONTENTS

Section 3 Configuration Units

Section 4 Installation

Section 5 Wiring

Section 6 Troubleshooting

Section 7 Inspection and Maintenance

Appendices

Index

Terms and Conditions Agreement

Warranty, Limitations of Liability

Warranties

- **Exclusive Warranty**

  Omron's exclusive warranty is that the Products will be free from defects in materials and workmanship for a period of twelve months from the date of sale by Omron (or such other period expressed in writing by Omron). Omron disclaims all other warranties, express or implied.

- **Limitations**

  OMRON MAKES NO WARRANTY OR REPRESENTATION, EXPRESS OR IMPLIED, ABOUT NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OF THE PRODUCTS. BUYER ACKNOWLEDGES THAT IT ALONE HAS DETERMINED THAT THE PRODUCTS WILL SUITABLY MEET THE REQUIREMENTS OF THEIR INTENDED USE.

  Omron further disclaims all warranties and responsibility of any type for claims or expenses based on infringement by the Products or otherwise of any intellectual property right.

- **Buyer Remedy**

  Omron's sole obligation hereunder shall be, at Omron's election, to (i) replace (in the form originally shipped with Buyer responsible for labor charges for removal or replacement thereof) the non-complying Product, (ii) repair the non-complying Product, or (iii) repay or credit Buyer an amount equal to the purchase price of the non-complying Product; provided that in no event shall Omron be responsible for warranty, repair, indemnity or any other claims or expenses regarding the Products unless Omron's analysis confirms that the Products were properly handled, stored, installed and maintained and not subject to contamination, abuse, misuse or inappropriate modification. Return of any Products by Buyer must be approved in writing by Omron before shipment. Omron Companies shall not be liable for the suitability or unsuitability or the results from the use of Products in combination with any electrical or electronic components, circuits, system assemblies or any other materials or substances or environments. Any advice, recommendations or information given orally or in writing, are not to be construed as an amendment or addition to the above warranty.

  See http://www.omron.com/global/ or contact your Omron representative for published information.

Limitation on Liability; Etc

OMRON COMPANIES SHALL NOT BE LIABLE FOR SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, LOSS OF PROFITS OR PRODUCTION OR COMMERCIAL LOSS IN ANY

WAY CONNECTED WITH THE PRODUCTS, WHETHER SUCH CLAIM IS BASED IN CONTRACT, WARRANTY, NEGLIGENCE OR STRICT LIABILITY.

Further, in no event shall liability of Omron Companies exceed the individual price of the Product on which liability is asserted.

Application Considerations

Suitability of Use

Omron Companies shall not be responsible for conformity with any standards, codes or regulations which apply to the combination of the Product in the Buyer's application or use of the Product. At Buyer's request, Omron will provide applicable third party certification documents identifying ratings and limitations of use which apply to the Product. This information by itself is not sufficient for a complete determination of the suitability of the Product in combination with the end product, machine, system, or other application or use. Buyer shall be solely responsible for determining appropriateness of the particular Product with respect to Buyer's application, product or system. Buyer shall take application responsibility in all cases.

NEVER USE THE PRODUCT FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY OR IN LARGE QUANTITIES WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE OMRON PRODUCT(S) IS PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.

Programmable Products

Omron Companies shall not be responsible for the user's programming of a programmable Product, or any consequence thereof.

Disclaimers

Performance Data

Data presented in Omron Company websites, catalogs and other materials is provided as a guide for the user in determining suitability and does not constitute a warranty. It may represent the result of Omron's test conditions, and the user must correlate it to actual application requirements. Actual performance is subject to the Omron's Warranty and Limitations of Liability.

Change in Specifications

Product specifications and accessories may be changed at any time based on improvements and other reasons. It is our practice to change part numbers when published ratings or features are changed, or when significant construction changes are made. However, some specifications of the Product may

be changed without any notice. When in doubt, special part numbers may be assigned to fix or establish key specifications for your application. Please consult with your Omron's representative at any time to confirm actual specifications of purchased Product.

Errors and Omissions

Information presented by Omron Companies has been checked and is believed to be accurate; however, no responsibility is assumed for clerical, typographical or proofreading errors or omissions.

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.

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

Symbols

	The circle and slash symbol indicates operations that you must not do. The specific operation is shown in the circle and explained in text. This example indicates that disassembly is prohibited.
	The triangle symbol indicates precautions (including warnings). The specific operation is shown in the triangle and explained in text. This example indicates a precaution for electric shock.
	The triangle symbol indicates precautions (including warnings). The specific operation is shown in the triangle and explained in text. This example indicates a general precaution.
	The filled circle symbol indicates operations that you must do. The specific operation is shown in the circle and explained in text. This example shows a general precaution for something that you must do.

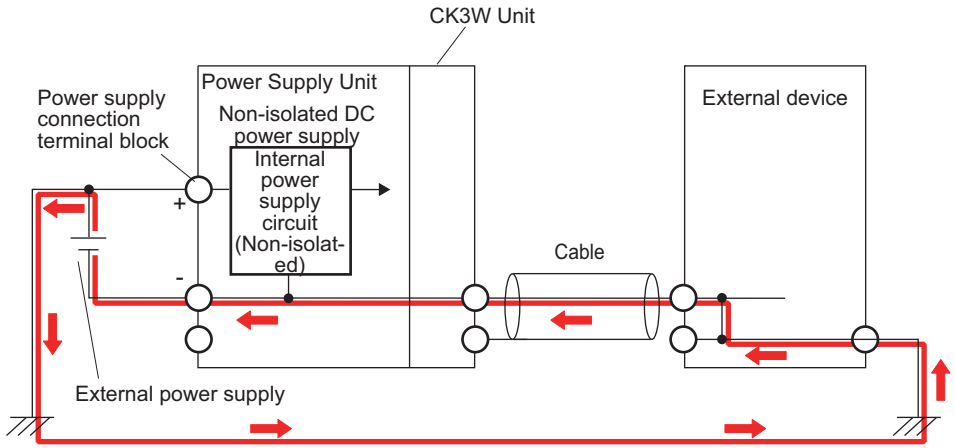
WARNING

⚠ WARNING

Wiring

Connect this Controller correctly to the servo amplifier, encoder, and limit sensors according to the instructions in this manual. Not doing so may cause the motor to run away, resulting in serious accidents.

For the Power Supply Unit or any other power supply connected to peripheral devices, connect the 0-V side to ground, or do not ground them at all.
Depending on how devices connected to the non-insulated circuit are grounded, the power supply may be short-circuited.
Never ground the 24-V side of the power supply, as shown in the following figure.



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

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

- If a power supply error occurs
- If the connected power supply is faulty
- If a CPU Unit error (watchdog timer error) or CPU Unit reset occurs
- If a major fault level Controller error occurs
- While the Controller is on standby until RUN mode is entered after the power is turned ON
- If a system initialization error occurs

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

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.

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

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

Downloading

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

After you transfer the user program, the Controller is restarted and communications with the EtherCAT slaves are cut off. During that period, the slave outputs behave according to the slave specifications.
The time that communications are cut off depends on the EtherCAT network configuration.
Before you transfer the user program, confirm that the system will not be adversely affected.

Test Run

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

Actual Operation

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

Cautions

⚠ Caution

Design

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

Test Run

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

Downloading

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

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

Precautions for Safe Use

Transporting

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

Mounting

- Be sure that the 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 CK3W Units connected to the CPU Unit must be within the specified range.

Installation

- Always connect to a ground of 100 Ω 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 functions of the CK3W Units, observe the following points when wiring to avoid the effects of the noise.
  a) Use twisted-pair shielded wire for the encoder connection lines, amplifier connection lines, and analog input lines.
  b) Wire the encoder connection lines, amplifier connection lines, and analog input 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.
- Do not apply voltages to the Input Units in excess of the rated input voltage.
- Do not apply voltages or connect loads to the Output Units in excess of the maximum switching capacity.

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 Setting** parameter is set to **Stop**, process data communications will stop for all the slaves when an EtherCAT communications error is detected in a slave. This means that if a Servo Drive is connected, the Servo turns OFF for all the axes. At that time, the Servo Drive will operate according to the Servo Drive specifications. Make sure that the fail-soft operation setting results in safe operation when a device error occurs.
- If noise occurs or an EtherCAT slave is disconnected from the network, any current communications frames may be lost. If frames are lost, slave I/O data is not communicated, and unintended operation may occur. The slave outputs will behave according to the slave specifications. For details, refer to the manual for the slave.
- When an EtherCAT slave is disconnected or disabled, communications will stop and control of the outputs will be lost not only for the disconnected slave, but for all slaves connected after it. Confirm that the system will not be adversely affected before you disconnect or disable a slave.
- You cannot use standard Ethernet hubs or repeater hubs with EtherCAT communications. If you use one of these, a major fault level error or other error may occur.

- EtherCAT communications are not always established immediately after the power supply is turned ON. Use the system-defined variables and the EtherCAT Coupler Unit device variables in the user program to confirm that I/O data communications are established before attempting control operations.
- If you need to disconnect the cable from an EtherCAT slave during operation, first reset the EtherCAT and EtherCAT slaves that are connected after it to the Init state, then disconnect the EtherCAT slave.
- For EtherCAT and EtherNet, use the connection methods and cables that are specified in this manual. Otherwise, communications may be faulty.
- Make sure that all of the slaves to be restored are participating in the network before you reset the EtherCAT Master Function Module. If any slave is not participating in the network when any of these errors is reset, the EtherCAT Master Function Module may access a slave with a different node address than the specified node address, or the error may not be reset correctly.
- There is a time lag between the moment when this Controller sends a command value to the EtherCAT type Servo Drive and the moment when it receives the feedback value. Perform servo control taking this time lag into consideration.

Motion Control

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

Unit Replacement

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

Upgrading the Power PMAC IDE

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

Maintenance

- Do not attempt to disassemble, repair, or modify the Controller. Doing so may result in a malfunction or fire.

- Do not use corrosive chemicals to clean the Controller. Doing so may result in a failure or malfunction of the Controller.
- Dispose of the product according to local ordinances as they apply.

Precautions for Correct Use

Storage and Installation

- Follow the instructions in this manual to correctly perform installation.
- Do not operate or store the Controller in the following locations. Doing so may result in burning, in operation stopping, or in malfunction.
  a) Locations subject to direct sunlight
  b) Locations subject to temperatures or humidity outside the range specified in the specifications
  c) Locations subject to condensation as the result of severe changes in temperature
  d) Locations subject to corrosive or flammable gases
  e) Locations subject to dust (especially iron dust) or salts
  f) Locations subject to exposure to water, oil, or chemicals
  g) Locations subject to shock or vibration
- Take appropriate and sufficient countermeasures when installing the Controller in the following locations.
  a) Locations subject to strong, high-frequency noise
  b) Locations subject to static electricity or other forms of noise
  c) Locations subject to strong electromagnetic fields
  d) Locations subject to possible exposure to radioactivity
  e) Locations close to power lines
- Before touching a Unit, be sure to first touch a grounded metallic object in order to discharge any static build-up.
- Install the Controller away from sources of heat and ensure proper ventilation. Not doing so may result in malfunction, in operation stopping, or in burning.

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.

Condition for Compliance with EU Directives

The immunity test condition for the CK3M-series Analog Input Units is as shown below.

Unit type	Overall accuracy
Analog Input Unit	+6%/-6%

To connect an Analog Input Unit, use 2-core twisted-pair shielded wire. Note that compliance was confirmed with the shielded wire grounded at both ends.

Conformance to UL and CSA Standards

The CK3M-series Units comply with UL and CSA standards.
For how to make your machine or device compliant with these standards, refer to the *INSTRUCTION SHEET* included with the product.
The *INSTRUCTION SHEET* provides usage conditions to make it compliant with the standards.

Conformance to KC Certification

When you use this product in South Korea, observe the following precautions.

사 용 자 안 내 문
이 기기는 업무용 환경에서 사용할 목적으로 적합성평가를 받은 기기로서 가정용 환경에서 사용하는 경우 전파간섭의 우려가 있습니다.

This product meets the electromagnetic compatibility requirements for business use. There is a risk of radio interference when this product is used in home.

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.

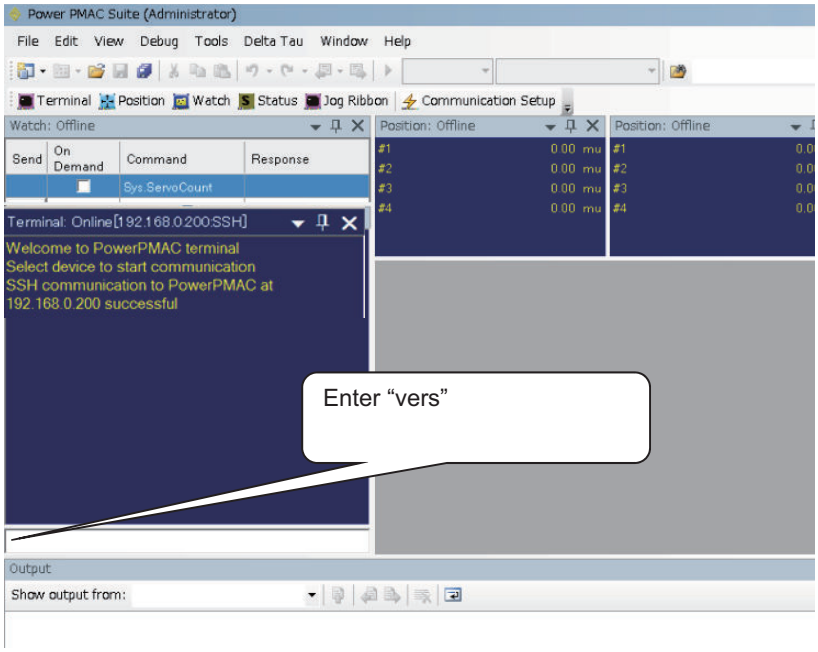
Checking Versions

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

Checking with Power PMAC IDE

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 Programmable 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 Manual	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 *PowerPmacNC.ini*, the setup data file to be loaded when Power PMAC-NC16 starts.
Power PMAC-NC16 Software User Manual	O019	Learning about usage and features of Power PMAC-NC16, Support Software required 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*, the CPU Unit accesses the CK3W Unit with Gate3[i] data structure.
DirectPWM	A Servo Drive interface unique to Delta Tau Data Systems, Inc.
FilteredPWM	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.
Sinusoidal encoder	A type of encoder that outputs SIN/COS waveforms at 1 Vpp.
Encoder loss detection 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 code	Date	Revised content
01	July 2018	Original production
02	July 2019	• Made changes accompanying the addition of CK3W-AX1313□/-AX2323□/-MD71□0/-AD□100/-EXM01/-EXS02 Units. • Corrected mistakes.
03	July 2019	Corrected mistakes.

1

Introduction to Motion Controllers

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

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. (hereinafter referred to as “Delta Tau”), a manufacturer specializing in motion controllers. This enables control of a maximum of 16 axes of an analog input type or DirectPWM type Servo Drive (when using four CK3W-AX□□□□□ Units and an Expansion Rack) 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 Unit configuration, EtherCAT network configuration, Ethernet network configuration, and Support Software.

Basic Configuration

- CK3W Unit Configuration
  Up to four CK3W Units (or up to two CK3W-AX Units) can be connected to the CPU Unit.

Unit type	Model
Axis Interface Unit	CK3W-AX1313□/-AX1414□/-AX1515□/-AX2323□
Digital I/O Unit	CK3W-MD71□0
Analog Input Unit	CK3W-AD□100

In addition to the CPU Rack, an Expansion Rack can be used to install additional CK3W Units.

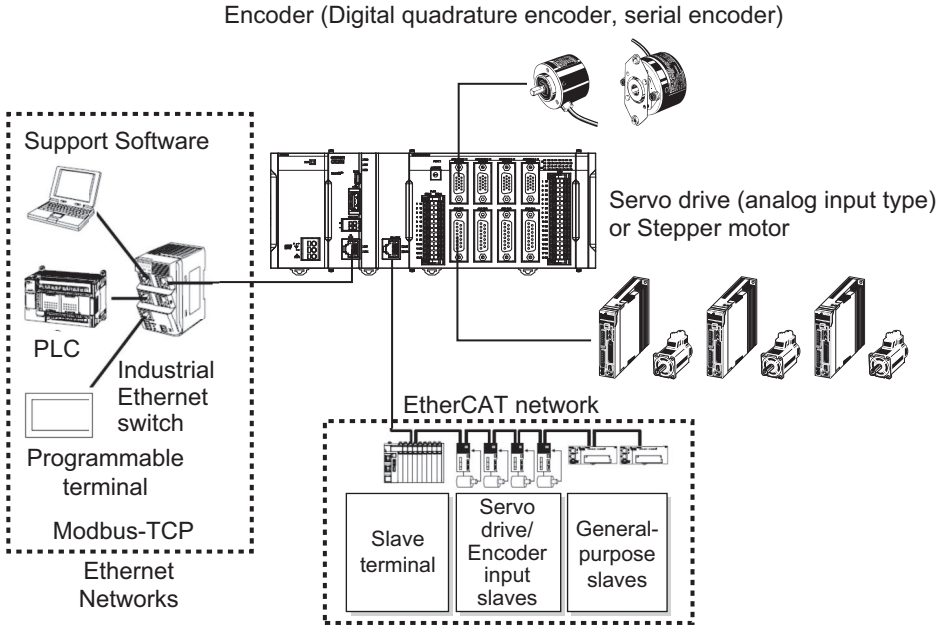
You can add up to four CK3W Units (or up to two CK3W-AX Units) with the Expansion Rack.

By connecting an analog input type or DirectPWM type Servo Drive to a CK3W-AX Unit, high-speed axis control is enabled.
One CK3W-AX Unit controls up to four axes.
With the Expansion Rack, one CK3M-series CPU Unit can connect up to four CK3W-AX Units and control a maximum of 16 axes in total.
A digital quadrature encoder, serial encoder, or sinusoidal encoder may be connected to the CK3W-AX Units as encoder input for feedback. The CK3W-AX Units have general digital I/O with 16-point input and 16-point output.

- 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-8 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.



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

*1. Refer to *A-5 Version Information* on page A-10 for the supported Power PMAC IDE versions.

*2. 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.	Step		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 4-5
		Address switch setting	Set the address switches for the CK3W Units.	*3-3-4 Address Switch Setting* on page 3-16
		Wiring	Perform Motion Controller wiring.	*Section 5 Wiring* on page 5-1
3	Settings and wiring of the EtherCAT slave hardware *1	Node address settings	Use the hardware switches on all of the EtherCAT slaves in the network to set the node addresses.	Refer to the manual for the EtherCAT slave.
		Mounting	Mount EtherCAT slaves.	Refer to the manual for the EtherCAT slave.
		Wiring	Wire EtherCAT slaves. • Wiring of the unit power supply • I/O wiring	Refer to the manual for the EtherCAT slave.
4	EtherCAT communications wiring *1		Perform wiring for the EtherCAT communications cables.	*5-2-1 Laying the EtherCAT Network* on page 5-7
5	Turn ON the power supply to EtherCAT slaves.		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. O016)* 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. O016)* 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. O016)* for details.

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. O016)* for details.
		Initialization of the Controller	Use Power PMAC IDE to initialize the Motion Controller.	Refer to *Power PMAC IDE User Manual (Cat. No. O016)* for details.
8	Settings of the Motion Controller operation	Motor settings	Use Power PMAC IDE to set the motor operations for the Motion Controller.	Refer to *Power PMAC IDE User Manual (Cat. No. O016)* for details.
		Programming	Create user programs on Power PMAC IDE.	Refer to *Power PMAC User's Manual (Cat. No. O014)* and *Power PMAC Software Reference Manual (Cat. No. O015)* 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. O016)* for details.

*1. Perform settings for the CK3M-CPU111/CPU121 only.

2

System Configuration

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

2-1 Basic 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) CK3W 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 CK3W Units.
In addition to the CPU Rack, an Expansion Rack can be used to install additional CK3W Units.
Motion control is enabled by connecting a DirectPWM type Servo Drive, 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

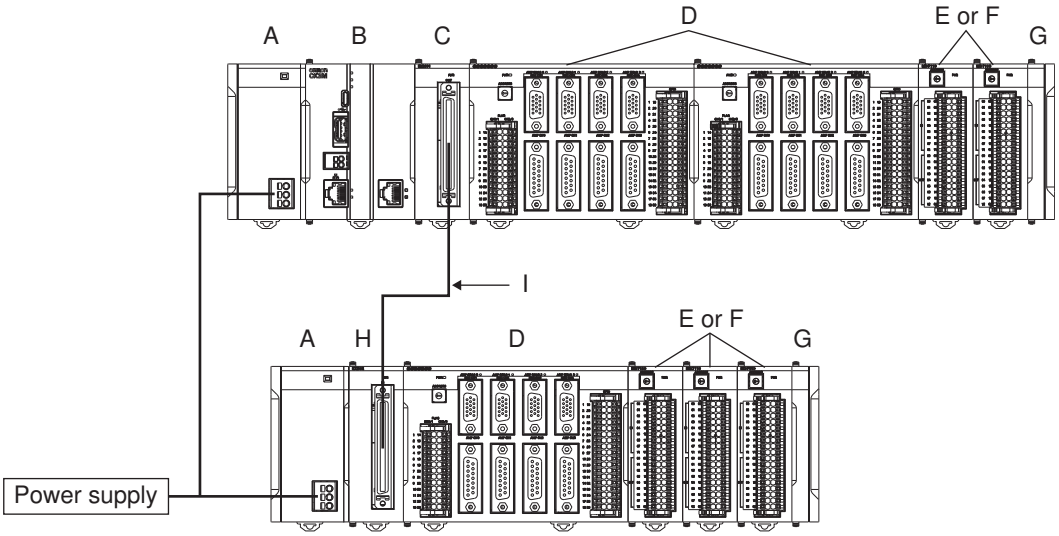
The following shows the configuration of CK3W Units.

CPU Rack

The CK3W Unit configuration in the CPU Rack consists of a Power Supply Unit, CPU Unit, CK3W-AX Unit, CK3W-MD Unit, CK3W-AD Unit, and End Cover.
Up to four CK3W Units (or up to two CK3W-AX Units) can be connected to the CPU Unit.

Expansion Rack

One Expansion Rack can be connected per CPU Unit.
To connect an Expansion Rack, use the Expansion Master Unit (CK3W-EXM01) and Expansion Slave Unit (CK3W-EXS02).
Up to four CK3W Units (or up to two CK3W-AX Units) can be installed to the Expansion Rack.
Connect the Expansion Master Unit (CK3W-EXM01) adjacent to the right side of the CPU Unit. Connect the Expansion Slave Unit (CK3W-EXS02) adjacent to the right side of the Power Supply Unit.
Unless the Expansion Master Unit (CK3W-EXM01) is connected adjacent to the right side of the CPU Unit, the Sys.Status register CK3WConfigErr becomes "5".

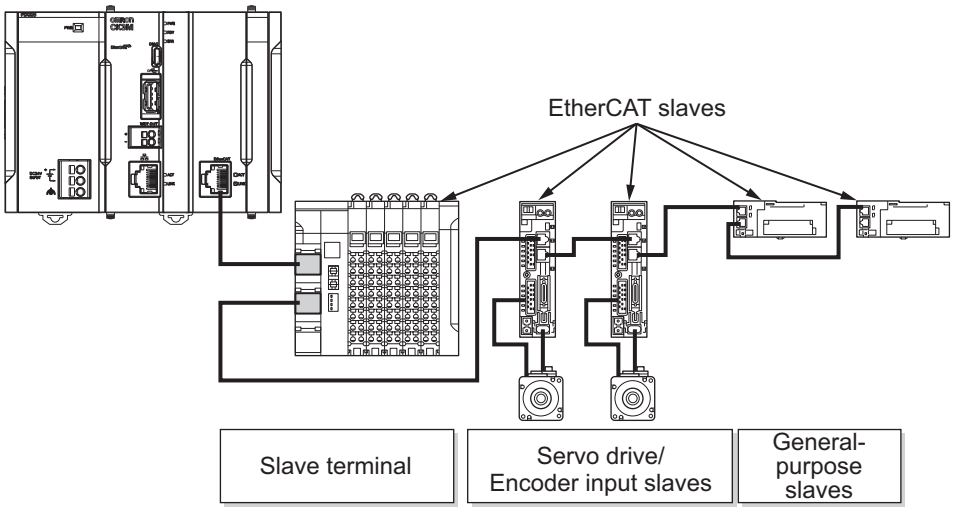


Letter	Configuration	Remarks
A	Power Supply Unit	Input the 24 V power source. Always wire the CPU Rack and Expansion Rack to the same power supply.
B	CK3M-series CPU Unit	This is the Unit at the center of the motion control, which executes the motion program.
C	CK3W-EXM01	Expansion Master Unit. Connect this Unit adjacent to the right side of the CPU Unit in the Expansion Rack.
D	CK3W-AX Unit	Axis Interface Unit. For axis control, connect this to a Servo Drive and encoder.
E	CK3W-MD Unit	Digital I/O Unit. You can add 16 digital inputs and 16 digital outputs.
F	CK3W-AD Unit	Analog Input Unit. You can add 4 or 8 voltage inputs.
G	End Cover	Must be connected to the right end of the CPU Rack and Expansion Rack. The CPU Unit and the Expansion Slave Unit are each provided with one End Cover.
H	CK3W-EXS02	Expansion Slave Unit. Use this in the Expansion Rack. Connect this Unit adjacent to the right side of the Power Supply Unit.
I	Expansion cable	Use this cable to connect the Expansion Master Unit and the Expansion Slave Unit. The cable length is 30 cm. Be sure to use the CK3W-CAX003A (30 cm) cable.

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.



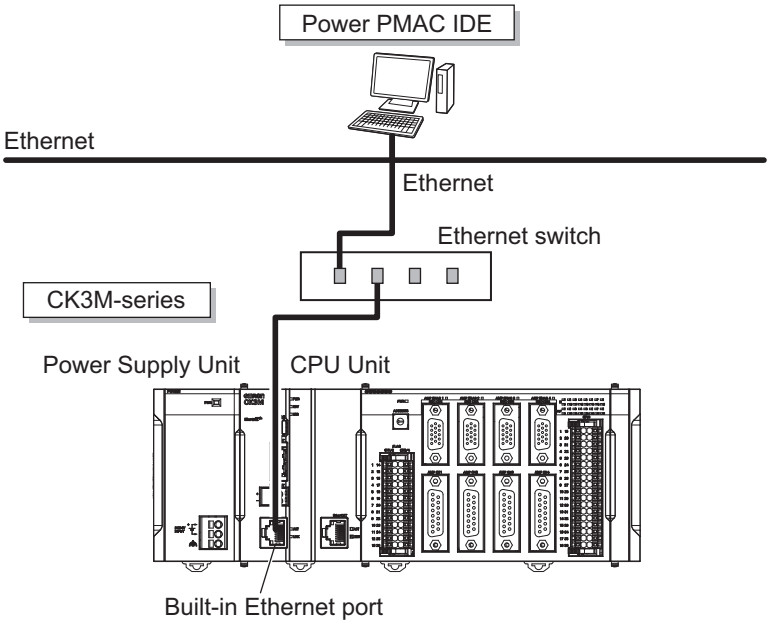
EtherCAT is synchronized with the servo cycle of the CK3M-series CPU Unit. This enables acquisition of the I/O data of slave terminals that are synchronized with the servo cycle.

Precautions for Correct Use

Before you connect a slave from another manufacturer, refer to the relevant manual and be sure to check its operation.
EtherCAT setup software that is provided by other manufacturers cannot be connected to CK3M-series CPU Units.

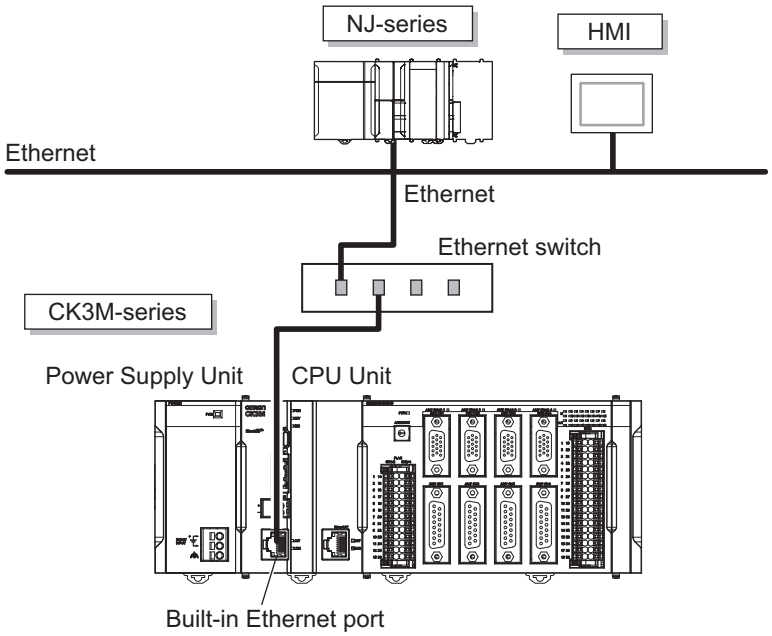
2-2 Connecting to the Power PMAC IDE

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.



3

Configuration Units

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

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 Built-In Flash Memory: 1 GB	None	---
	CK3M-CPU111	RAM: 1 GB Built-In Flash Memory: 1 GB	EtherCAT: 1 port (DC sync)	4 axes
	CK3M-CPU121	RAM: 1 GB Built-In Flash Memory: 1 GB	EtherCAT: 1 port (DC sync)	8 axes

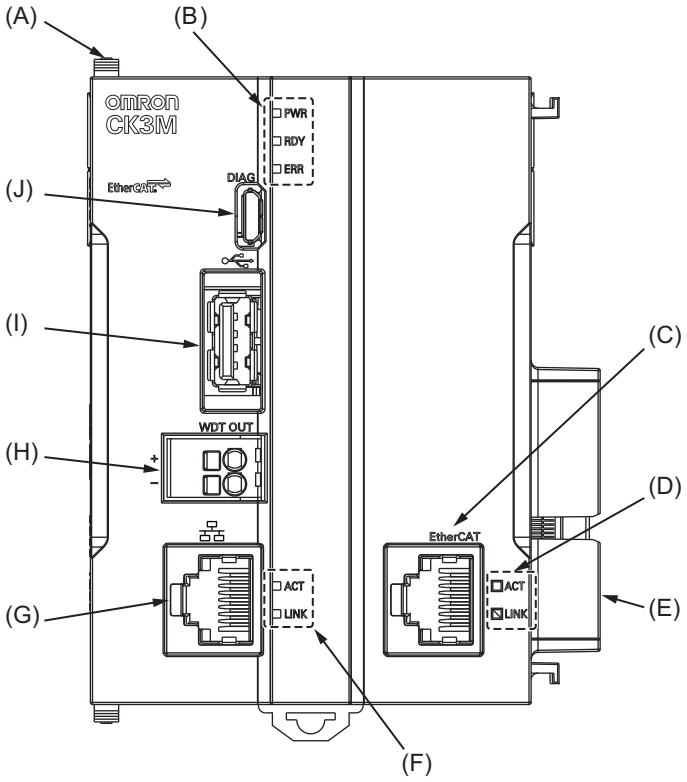
Performance Specifications

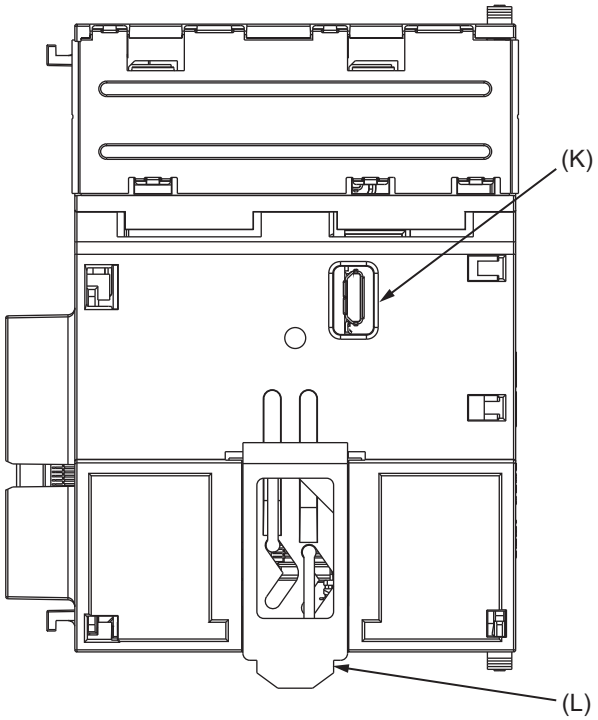
The performance specifications are shown below.

Item			CK3M-CPU101	CK3M-CPU111	CK3M-CPU121
Memory			Main memory: 1 GB Built-In Flash Memory: 1 GB		
Number of connectable CK3W Units (when using Expansion Rack)			8 Units max. Or 4 CK3W-AX Units max.		
External connection terminals			No EtherCAT	For EtherCAT communications RJ45 × 1 (Shield supported)	
			For Ethernet communications RJ45 × 1 (Shield supported)		
			USB port For external memory connection, USB 2.0 host × 1 Type A		
Motion control	**CK3W-AX Unit**	**Maximum number of controlled axes**	16 axes (when using four CK3W-AX Units)		
		Control method	Speed and torque control using analog output Stepper motor control using pulse output Commutation control using DirectPWM output		
	EtherCAT	**Maximum number of controlled axes**	None	4 axes	8 axes
		Control method		Issuing control commands using EtherCAT	

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

3-1-2 Part Names and Functions





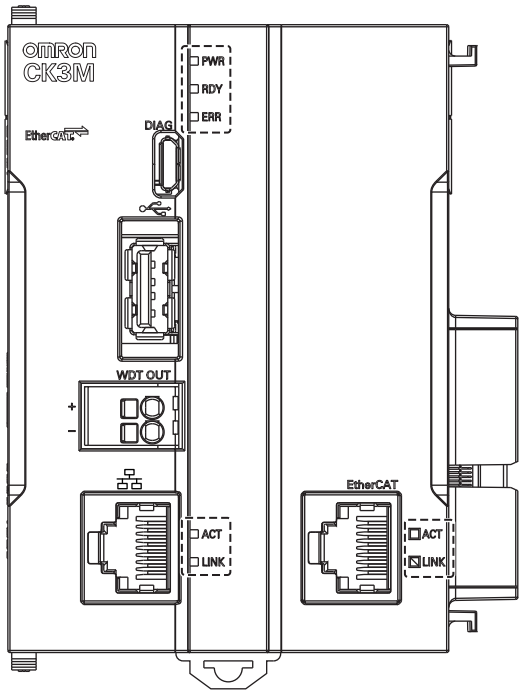
Letter	Name	Function
A	Slider	Holds the Units together.
B	CPU Unit operation indicators	Shows the operation status of the CPU Unit using multiple indicators.
C	EtherCAT communications connector	Connects to an EtherCAT network communications cable.

Letter	Name	Function
D	EtherCAT communications port operation indicators	Shows the operation status of EtherCAT.
E	Unit connector	Connector that connects to the Unit.
F	Ethernet communications port operation indicators	Shows the operation status of Ethernet.
G	Ethernet communications connector	Connects to an Ethernet network communications cable.
H	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.

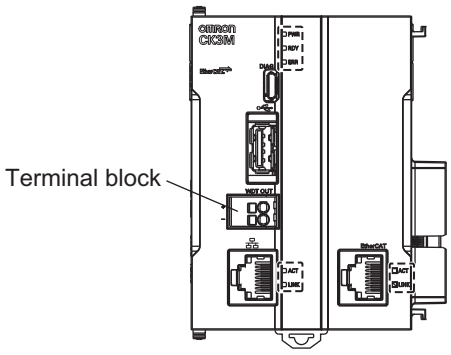
Indicator name	Color	Status	Description
PWR	Green	Lit.	Power is supplied to the Unit.
		Not lit.	Power is not supplied to the Unit.

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-

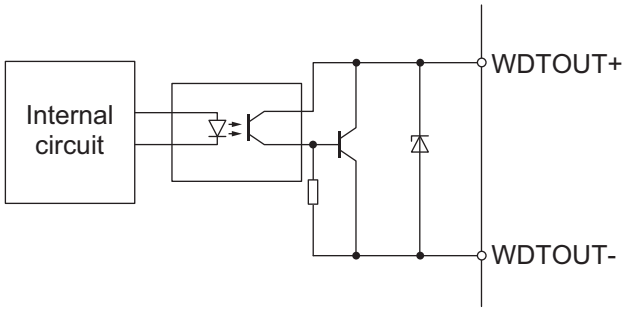
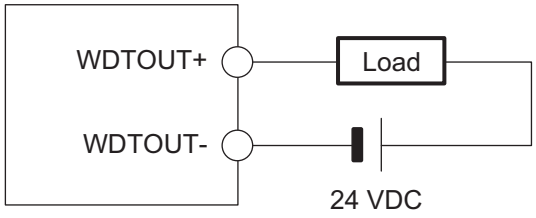
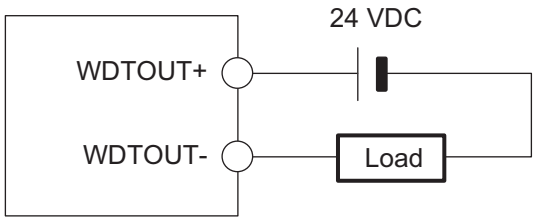
Output Status

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

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	
Terminal connection diagram	NPN type  PNP type 

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

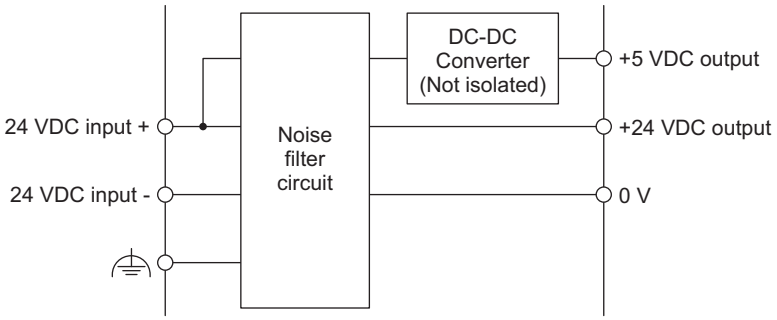
Models and Outline of Specifications

The models and outline of specifications are given below.

Unit type	Model	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	
Weight	130 g max.
Dimensions (height × depth × width)	90(H)/80(D)/45(W)

*1. 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

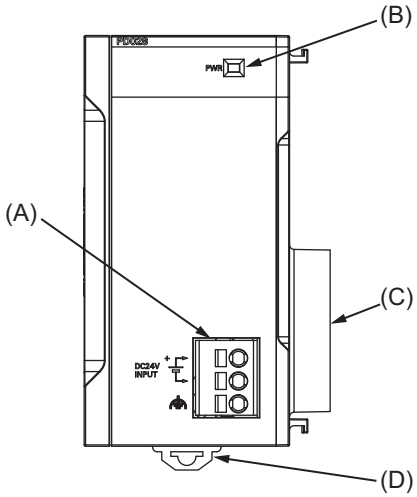
Use a SELV power supply that meets the following conditions.

- 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
A	Power supply connection terminal block	Connects the power supply.
B	Power supply status indicator	Lights when 5 V is output from the Power Supply Unit.
C	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 digital input/ output type
Axis Interface Unit	CK3W-AX1313N	DirectPWM output	Digital quadrature encoder/Serial encoder	NPN type
	CK3W-AX1414N	DA output (FilteredPWM)		
	CK3W-AX1515N	DA output (TrueDAC)		
	CK3W-AX2323N	DirectPWM output	Sinusoidal encoder/ Serial encoder	
	CK3W-AX1313P	DirectPWM output	Digital quadrature encoder/Serial encoder	PNP type
	CK3W-AX1414P	DA output (FilteredPWM)		
	CK3W-AX1515P	DA output (TrueDAC)		
	CK3W-AX2323P	DirectPWM output	Sinusoidal encoder/ Serial encoder	

Axis Interface Unit Specifications

The main specifications for axis interface are given below.

- **CK3W-AX1414□/-AX1515□**

Item		Specification (CK3W-)			
		AX1414N	AX1414P	AX1515N	AX1515P
Address setting range		0 to F			
Number of channels		4 channels/Unit			
Encoder power supply output		5 VDC 500 mA/channel or less However, the total output current of each Unit is 1 A or less.			
Digital quadrature encoder input	Input form	Line receiver input			
	Maximum response frequency	Phases A, B, and C: 10 MHz			
Serial encoder 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			

Item		Specification (CK3W-)			
		AX1414N	AX1414P	AX1515N	AX1515P
Analog output	Method	FilteredPWM type		TrueDAC type	
	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 output	Output form	Line driver output			
	Output method	Pulse output + directional output, or phase difference output			
	Maximum output frequency	10 MHz			
Amp enable output		1 point/channel			
Fault input		1 point/channel			
Flags	Digital input	4 points/channel (HOME, PLIM, NLIM, USER)			
	Digital output	1 point/channel (EQU)			
General digital I/O	Number of points	16 inputs, 16 outputs			
	Internal common	NPN	PNP	NPN	PNP
Power consumption		5 VDC: 4.5 W max. 24 VDC: 10.8 W max.		5 VDC: 4.5 W max. 24 VDC: 12.5 W max.	
Dimensions (height × depth × width)		90(H)/80(D)/130(W)			
Weight		520 g max.			

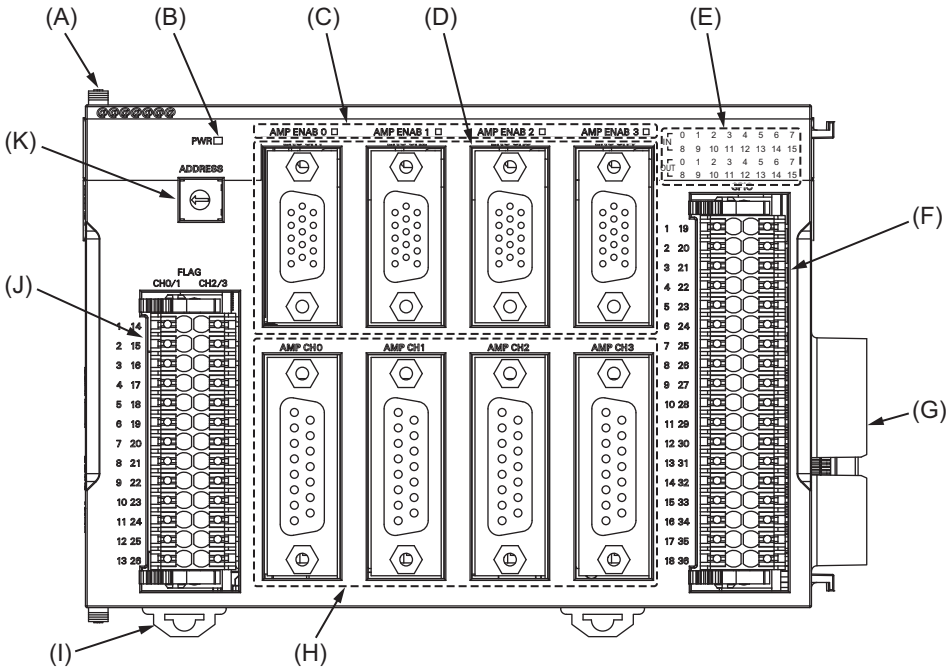
● CK3W-AX1313□/-AX2323□

Item		Specification (CK3W-)			
		AX1313N	AX1313P	AX2323N	AX2323P
Address setting range		0 to F			
Number of channels		4 channels/Unit			
Encoder power supply output		5 VDC 500 mA/channel or less However, the total output current of each Unit is 1 A or less.			
Digital quadrature encoder input	Input form	Line receiver input		---	
	Maximum response frequency	Phases A, B, and C: 10 MHz			
Serial encoder input	Supported protocol	Contact your OMRON representative for information on the support protocols.			
Sinusoidal encoder input	Input signal	---		1-Vpp SIN/COS signal	
	Maximum input frequency			2 MHz	
Digital Hall sensor		4 points/channel (U, V, W, T)			
DirectPWM output		Amplifier interface unique to Delta Tau			
Amp enable output		1 point/channel (built into DirectPWM)			
Fault input		1 point/channel (built into DirectPWM)			
Flags	Digital input	4 points/channel (HOME, PLIM, NLIM, USER)			
	Digital output	1 point/channel (EQU)			

Item		Specification (CK3W-)			
		AX1313N	AX1313P	AX2323N	AX2323P
General digital I/O	Number of points	16 inputs, 16 outputs			
	Internal common	NPN	PNP	NPN	PNP
Power consumption		5 VDC: 3.4 W max. 24 VDC: 12.5 W max.		5 VDC: 3.0 W max. 24 VDC: 13.1 W max.	
Dimensions (height × depth × width)		90(H)/80(D)/130(W)			
Weight		480 g max.			490 g max.

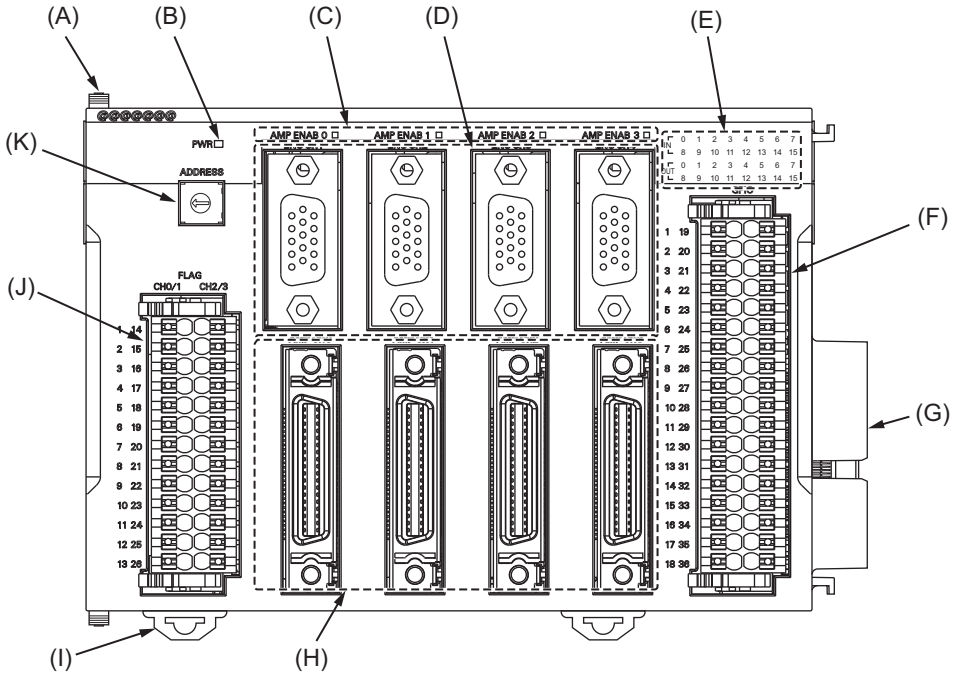
3-3-2 Part Names and Functions

CK3W-AX1414□/-AX1515□



Letter	Name	Function
A	Slider	Holds the Units together.
B	Power supply status indicator	Shows the power supply status.
C	Amp enable status indicator	Shows the Amp enable status.
D	Encoder connector	Connects the encoder.
E	General digital input/output status indicator	Shows the general digital input/output status.
F	General digital I/O connection terminal block	Connects the general digital input/output.
G	Unit connector	Connector that connects to the Unit.
H	Amplifier connector	Connects the amplifier.
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.

CK3W-AX1313□/-AX2323□



Letter	Name	Function
A	Slider	Holds the Units together.
B	Power supply status indicator	Shows the power supply status.
C	Amp enable status indicator	Shows the Amp enable status.
D	Encoder connector	Connects the encoder.
E	General digital input/output status indicator	Shows the general digital input/output status.
F	General digital I/O connection terminal block	Connects the general digital input/output.
G	Unit connector	Connector that connects to the Unit.
H	Amplifier connector	Connects the amplifier.
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	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

This Unit is equipped with a PMAC3 style DSPGate3 IC.
Refer to the *Power PMAC User's Manual (Cat. No. O014)* 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
B	11
C	12
D	13
E	14
F	15

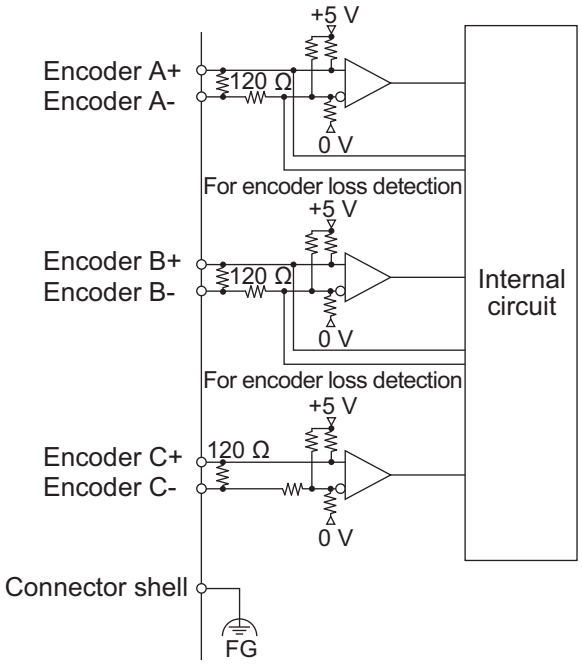
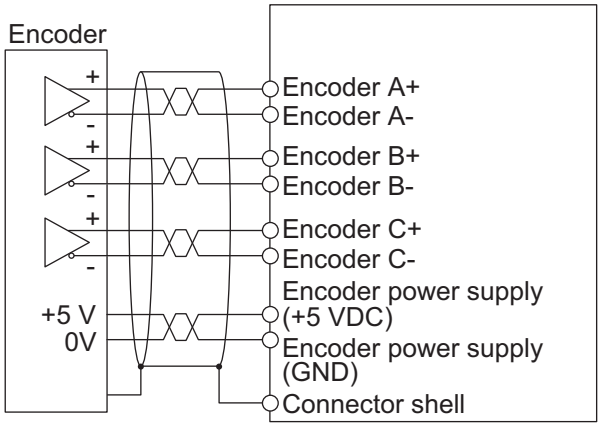
For example, if the address switch setting is *0*, the Gate3 Index becomes *0*.
In this case, this Unit is accessed with a Gate3[0] data structure.
Make sure that the address switch settings of Units do not overlap.
If they overlap, the Sys.Status register CK3WConfigErr becomes *7*.
Refer to *6-4 Sys.Status Register* on page 6-9 for Sys.Status.

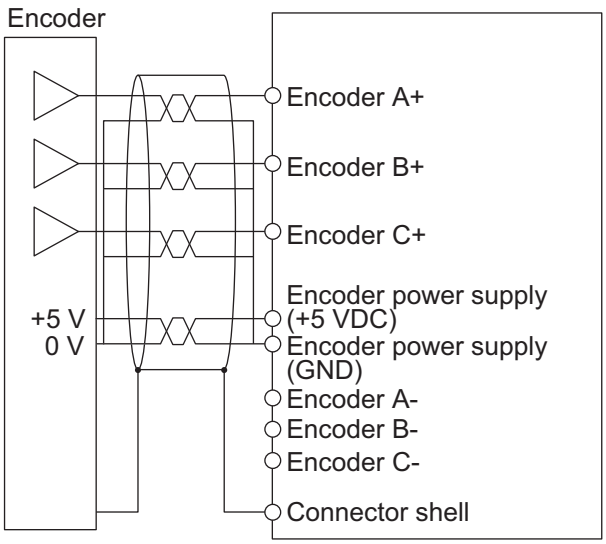
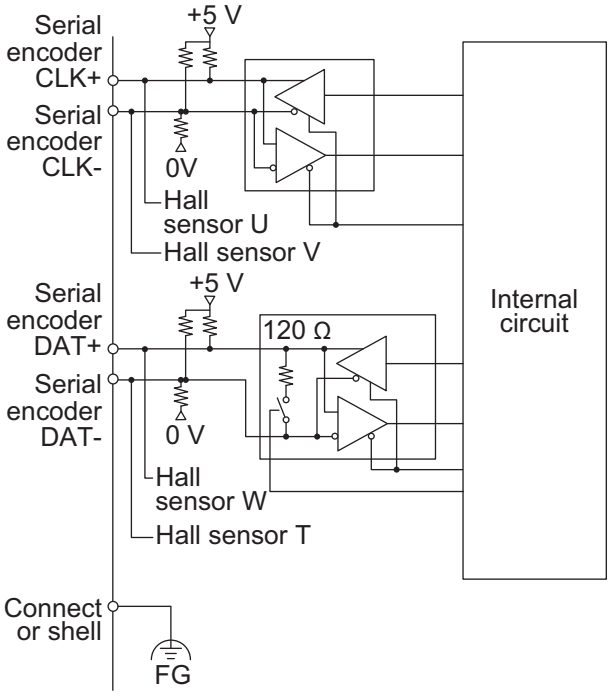
One CK3W Unit in the system supplies servo clock and phase clock signals to all the other Units.
The supply-source CK3W Unit must be installed to the CPU Rack.
Connect the Unit with the smallest address value to the CPU Rack because, by default, it is the supply source of clock signals.
You may specify the Unit with a desired address as the clock supply source by setting the register.
If the Unit that serves as the clock supply source is connected to the Expansion Rack, an error occurs because the CPU Unit cannot recognize clock signals.
If this error occurs, the Sys.Status register Sys.NoClocks becomes *1*.

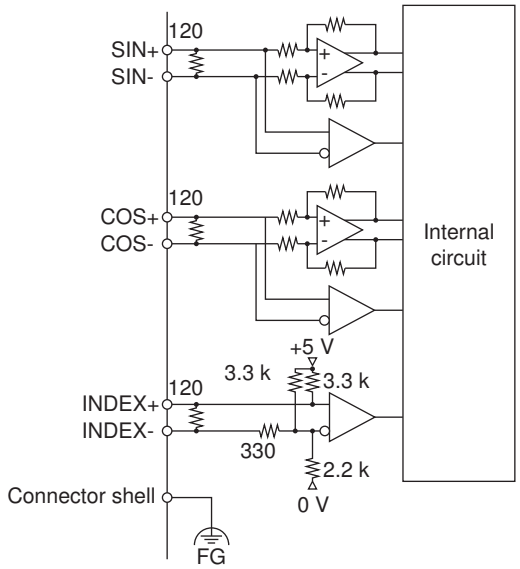
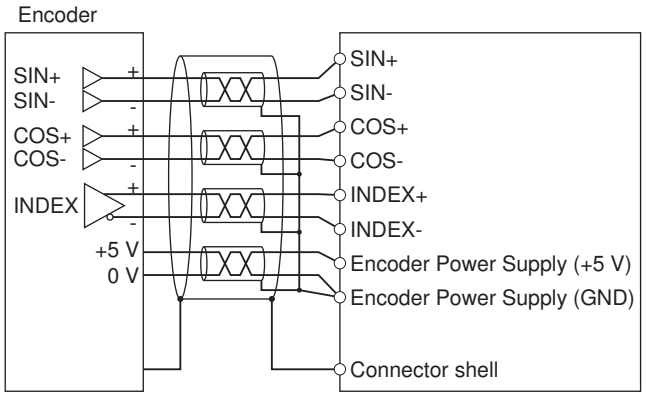
3-3-5 Encoder Connector Specifications

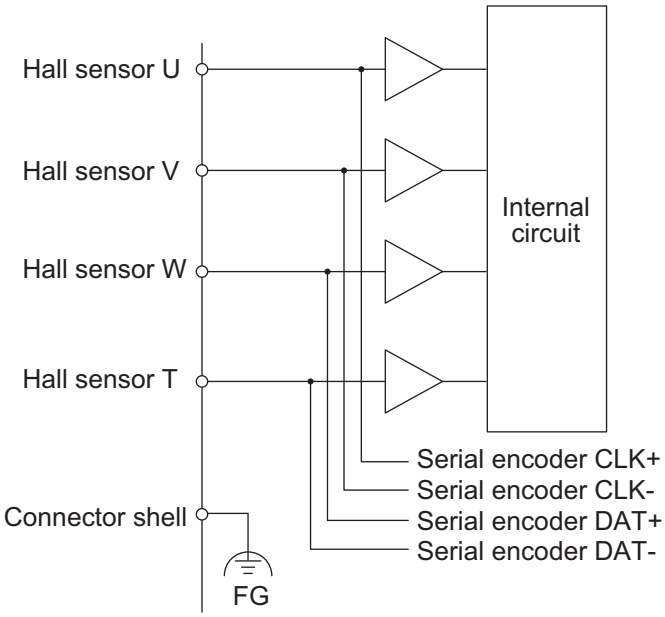
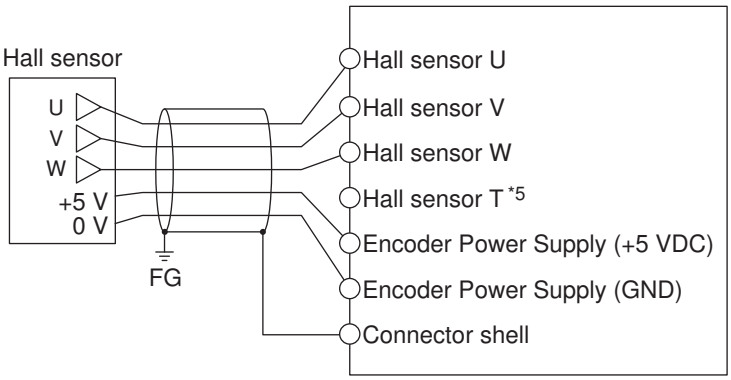
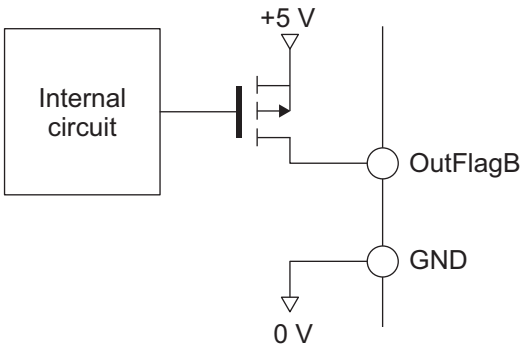
The electrical specifications for the encoder connector are as follows.

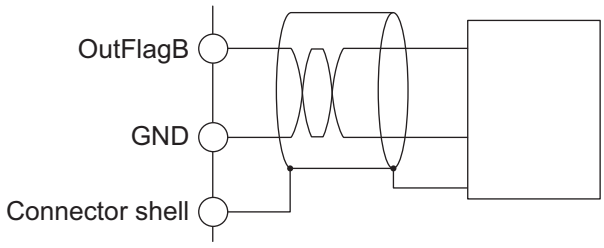
For the connector arrangement of the encoder connector, refer to *5-3-1 Encoder Connector Wiring* on page 5-18.

Isolation method		Not isolated (between internal circuit and encoder circuit)
Encoder power supply output	**Rated output voltage**	5 VDC
	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 is 1 A or less.
Digital quadrature encoder input *1	**Input form**	Line receiver input (differential or single-ended input)
	Counting unit	Pulse
	Input voltage	Differential input: EIA standard RS-422A line driver levels Single-ended input *2: ON voltage 3.0 V or more, OFF voltage 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, B, and C: 10 MHz
	Encoder loss detection	Differential input: Detectable With single-ended input: Detection disabled
	Circuit configuration	
	Terminal connection diagram	With differential input 

		With single-ended input  With single-ended input, use twisted-pair wire to improve noise resistance, and pair the respective signals of encoder A+, B+, C+ with GND.
Serial encoder input	**Supported protocol**	Contact your OMRON representative for information on the support protocols.
	Clock output	EIA standard RS-422A line driver levels
	Data I/O	EIA standard RS-485 line driver/receiver level
	Circuit configuration	

Sinusoidal encoder input *3	**Input form**	Line receiver input + AD conversion
	Number of inputs	2 points/channel (SIN signal, COS signal)
	Maximum rated input voltage	0 to Encoder Power Supply (+5 V) Encoder Power Supply as GND reference
	Allowable differential input voltage range	0.6 to 1.35 Vpp
	Allowable input voltage range	0 to 4.0 V Encoder Power Supply as GND reference
	Maximum input frequency	2 MHz
	AD converter resolution	16 bits
	Maximum cable length	20 m
	Circuit configuration	
	Terminal connection diagram	To reduce the effects of the noise, we recommend that you use a double-shielded cable and connect the inner shields to the Encoder Power Supply (GND) pin and the outer shield to the connector shell. 
Digital Hall sensor *4	**ON Voltage**	3.0 VDC min.
	OFF Voltage	0.9 VDC max.
	Maximum input rating	-0.3 to 6.0 VDC

	Circuit configuration	
	Terminal connection diagram	
OutFlagB output specifications *6	**Output signal**	1 point/channel
	Rated output voltage	5 VDC
	Maximum load current when ON	5 mA
	Residual voltage when ON	0.4 V max.
	Isolation method	Not isolated from internal circuit
	Circuit configuration	

	Connection diagram	
		 For the GND, use an encoder power source (GND).

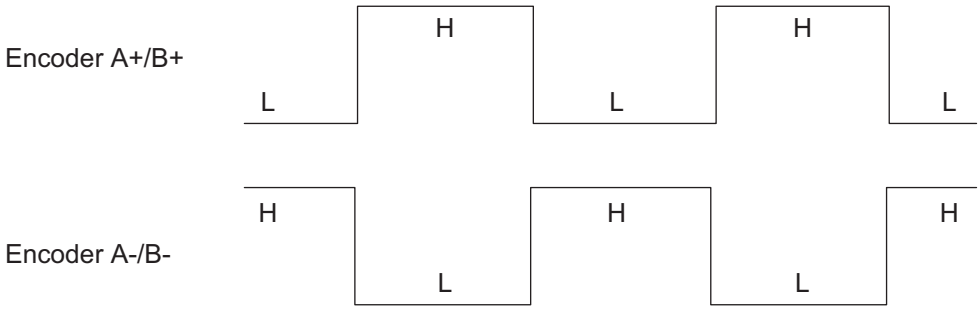
*1. This function is available with the CK3W-AX1313□/-AX1414□/-AX1515□ Units.
*2. With single-ended input, only a voltage output type encoder can be connected. Open collector type encoders cannot be connected.
*3. This function is available with the CK3W-AX2323□ Units.
*4. A Hall sensor is a sensor that 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.
*5. HALL T is not normally used, however, it can be used as a general 5V digital input.
*6. This output function is available with the CK3W-AX1414□/1515□ Units.

3-3-6 Encoder Loss Detection

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
H	L	Normal
L	H	Normal
H	H	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.

Encoder Loss Detection in Sinusoidal Encoder

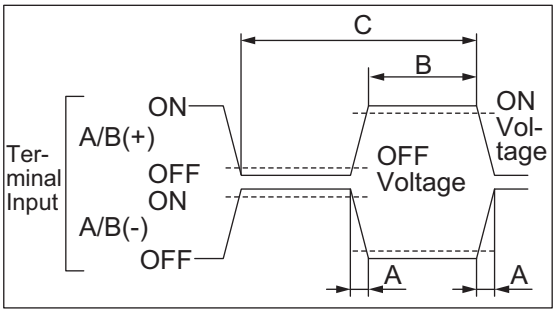
Normally, the sum of SIN squared and COS squared is always a constant value.
The sinusoidal encoder detects encoder loss by checking the sum of SIN squared and COS squared.
If loss is detected, the value of Gate3[i].Chan[j].SosError becomes 1.

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

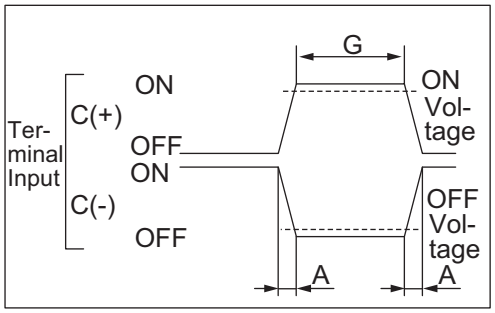
There are two types of input methods, differential input and single-ended input, for the digital quadrature encoder.
The respective pulse input timing specifications are given below.

With Differential Input

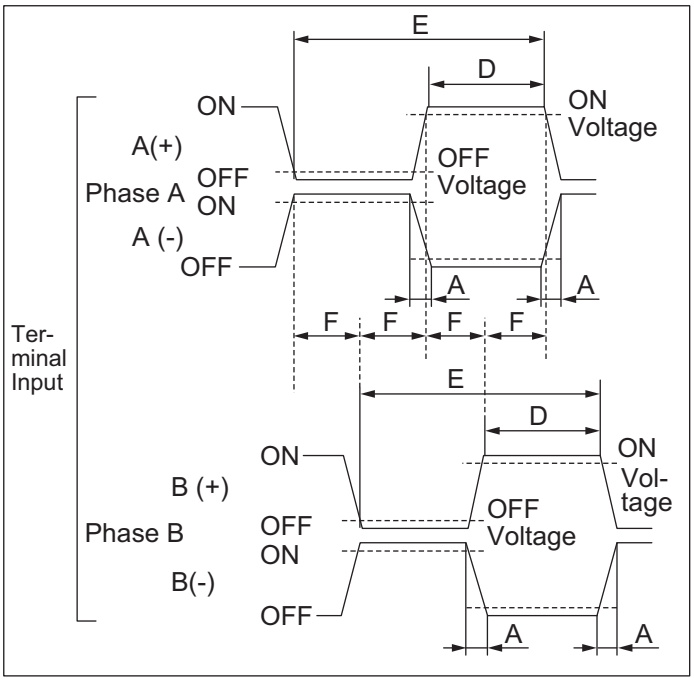
Encoder input (Phases A & B)
Input pulse duty = 50%



Encoder input (Phase C)



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

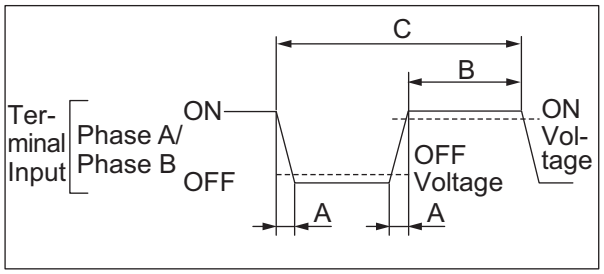


Timing conditions (with 10 MHz input)						
A	**B**	**C**	**D**	**E**	**F**	**G**
< 2.5 ns	> 50 ns	> 100 ns	> 50 ns	> 100 ns	> 25 ns	> 50 ns

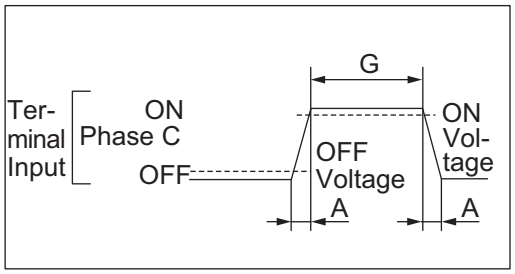
(With *Gate3[i].EncClockDiv = 0 : 100MHz* setting)

Single-Ended Input

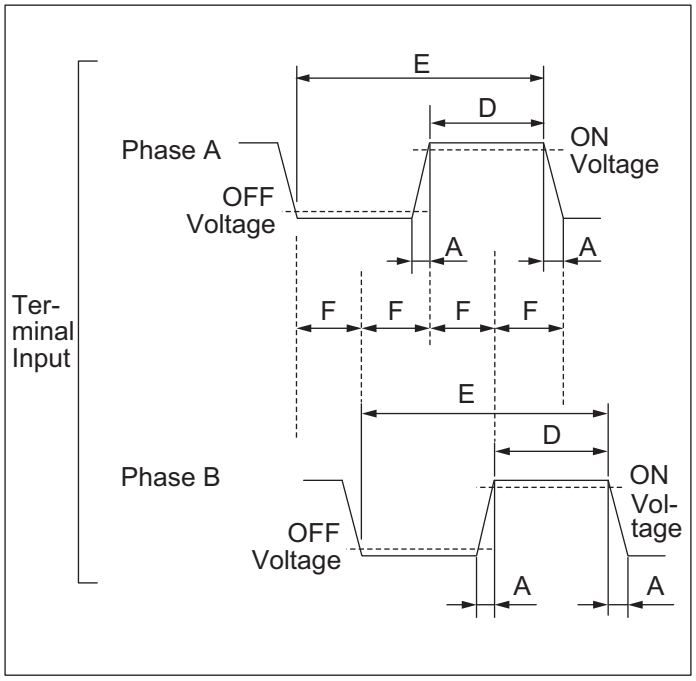
Encoder input (Phases A & B)
Input pulse duty = 50%



Encoder input (Phase C)



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



Timing conditions (with 10 MHz input)						
A	**B**	**C**	**D**	**E**	**F**	**G**
< 2.5 ns	> 50 ns	> 100 ns	> 50 ns	> 100 ns	> 25 ns	> 50 ns

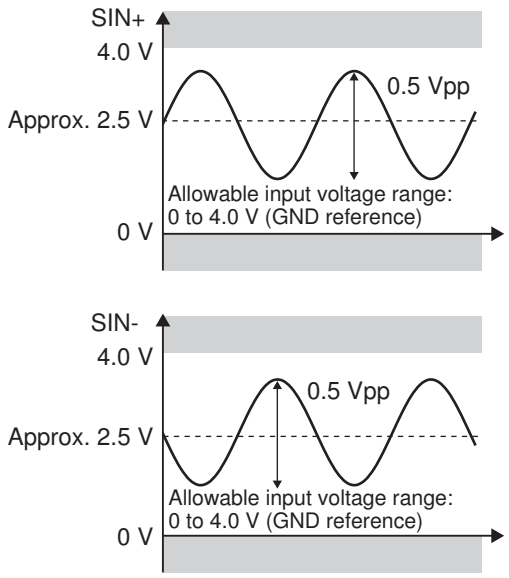
(With *Gate3[i].EncClockDiv = 0: 100MHz* setting)

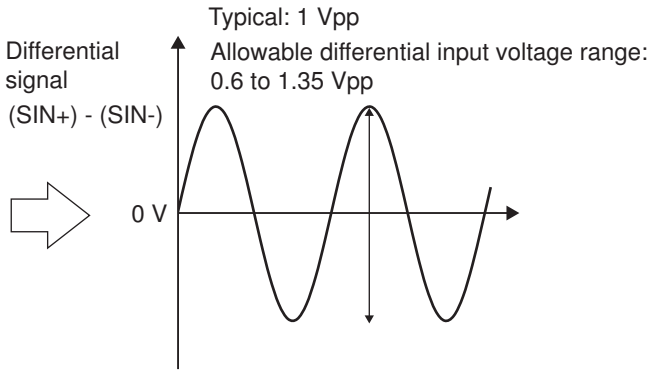
3-3-8 Input Specifications for Sinusoidal Encoder

This section describes the input specifications for the sinusoidal encoder.

Input Waveform

For the sinusoidal encoder, input a sinusoidal differential signal with an amplitude of 1 Vpp between SIN+ and SIN-.
With GND as the reference voltage, the SIN+ waveform has an amplitude of 0.5 Vpp with the center line at approximately 2.5 V, whereas the waveform is inverted for SIN-.



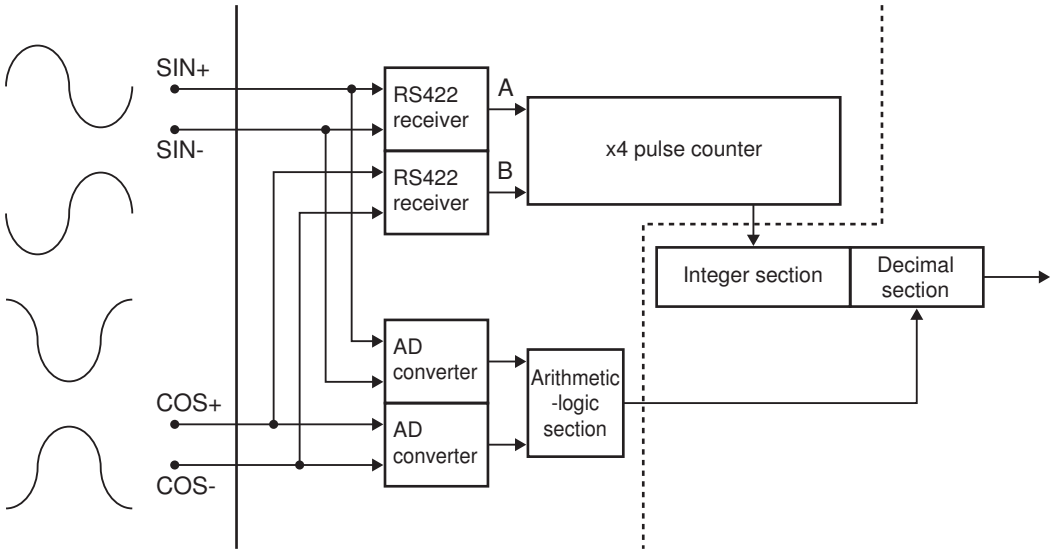


Between COS+ and COS-, input a waveform with a phase shift of +90° or -90° from the sinusoidal wave.

Make sure that the SIN and COS differential signals are within the range of 0.6 to 1.35 V. Also, make sure that the SIN+, SIN-, COS+, and COS- signals are within the range of 0 to 4.0 V relative to the GND reference.
The encoder may not convert the input signal correctly if it is out of the specified range.

Data Processing

SIN and COS signals are input to both the RS-422 receivers and the AD converters. The RS-422 receivers count the number of pulses with the x4 pulse counter and capture data at the timing of the servo clock.
The AD converters obtain analog data at the timing of the servo clock and perform an arctangent operation to determine the sinusoidal phase for the obtained analog data.
By combining these two types of data, it is possible to generate high-accuracy position data.



To read values from the sinusoidal encoder correctly, the following register settings are required.
These register settings are the default.

Gate3[i].EncClockDiv = 3
Gate3[i].AdcEncClockDiv = 3
Gate3[i].AdcEncCtrl = $3FFFC000
Gate3[i].AdcEncDelay = 0
Gate3[i].AdcEncHeaderBits = 0
Gate3[i].AdcEncStrobe = $3FFFC0
Gate3[i].AdcEncUtoS = 0

3-3-9 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

This function can be used with the CK3W-AX1414□/1515□ Unit.

● 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

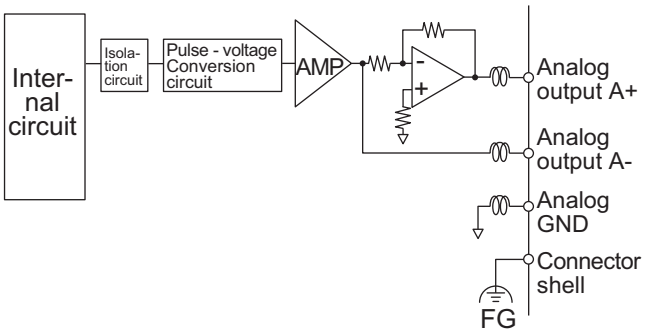
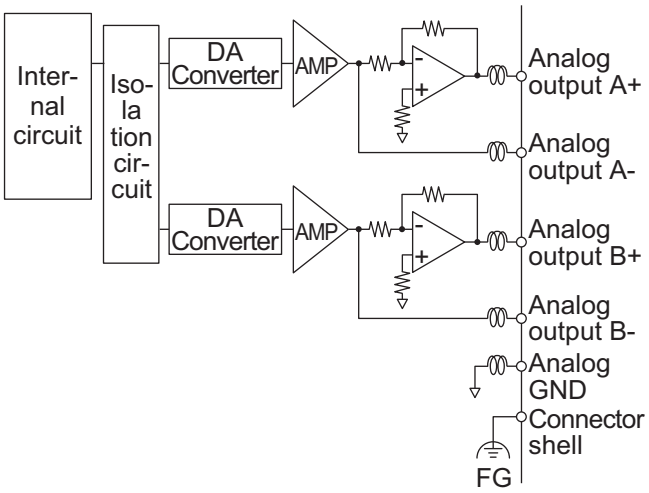
You can enable or disable the terminating resistance of the serial encoder DAT+/- terminal as shown in the table below by setting the *Gate3[i].Chan[j].OutFlagD* register and the *Gate3[i].Chan[j].SerialEncEna* register, which is for switching between enabling and disabling the serial encoder.

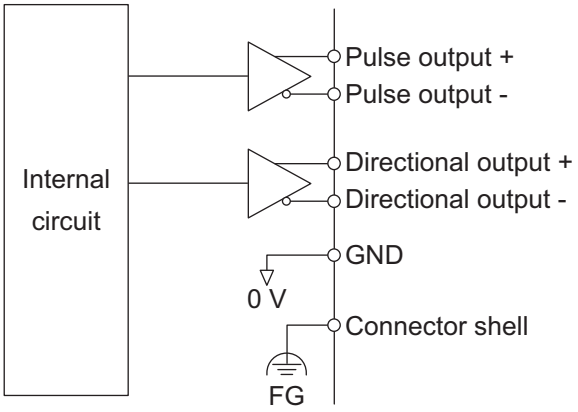
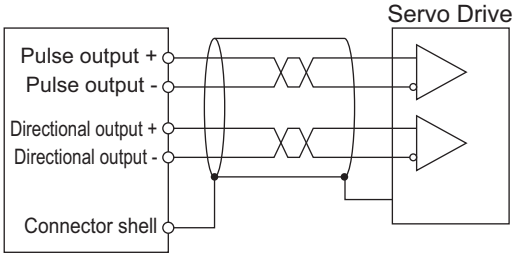
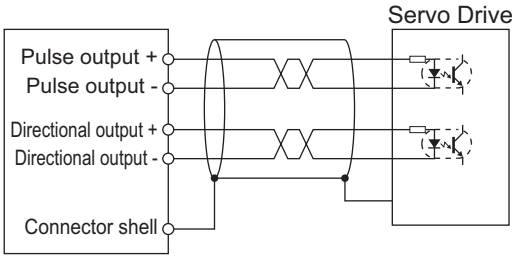
Gate3[i].Chan[j].OutFlagD	Gate3[i].Chan[j].SerialEncEna	Terminating resistance
0 (Default)	0 (Default)	Disabled
	1	Enabled
1	0	Disabled
	1	Disabled

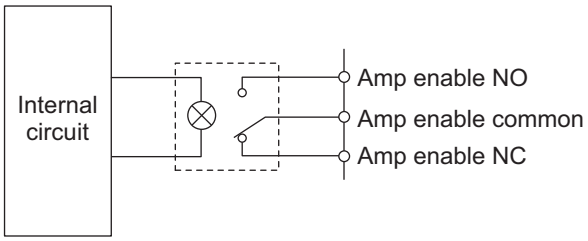
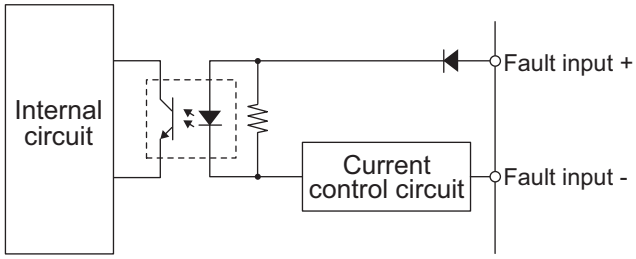
3-3-10 Amplifier Connector Specifications

This section describes the connector arrangement and electrical specifications for the amplifier connector.
For the connector arrangement of the amplifier connector, refer to *5-3-2 Amplifier Connector Wiring* on page 5-24.

Analog output (FilteredPWM type)	**Number of outputs**	1 point/channel
	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 *3-3-11 DA Output Method* on page 3-30.
	Isolation method	Isolation by Digital Isolator (between analog output and internal circuit)

	Circuit configuration	
Analog output (TrueDAC type)	**Number of outputs**	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)
	Circuit configuration	
DirectPWM output	**Communications method**	Controller-Servo Drive interface unique to Delta Tau
	Connectable amplifier	Contact your OMRON representative.
	Output form	Line driver output
	Input form	Line driver input
	Isolation method	Not isolated from internal circuit
	Cables	For connection with an amplifier, be sure to use the following cables. • CK3W-CAAD009A (0.9 m) • CK3W-CAAD018A (1.8 m) • CK3W-CAAD036A (3.6 m)
Pulse output*2	**Output signal**	Output: 2 points/channel
	Pulse output method	Pulse output + directional output, or phase difference output
	Pulse output form	Line driver output

	Output voltage	EIA standard RS-422A line driver levels
	Maximum output frequency	10 MHz
	Cable length	10 m max.
	Isolation method	Not isolated from internal circuit
	Circuit configuration	
	Terminal connection diagram	Connection with a Servo Drive with line receiver input  Connection with a Servo Drive with 5-VDC photocoupler input *3 
Amp enable output*2	**Number of outputs**	1 point/channel
	Output method	Relay output (N.O. + N.C.)
	Maximum switching capacity	24 VDC/0.5 A
	Minimum switching capacity	5 VDC, 1 mA
	Relay service life	100,000 operations
	ON/OFF response time	10 ms max./10 ms max.
	Isolation method	Isolation by Relay (between amp enable output and internal circuit)

	Circuit configuration	
Fault input*2	**Number of inputs**	1 point/channel
	Rated input voltage	5 to 24 VDC
	Maximum input voltage	26.4 VDC
	Input current	7 mA typical (24 VDC)
	ON voltage/ON current	3 VDC min./1 mA min.
	OFF current	0.1 mA max.
	ON/OFF response time	20 μs min./400 μs max.
	Isolation method	Isolation by Photocoupler (between fault input and internal circuit)
	Circuit configuration	

*1. 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-.

*2. Available with the CK3W-AX1414□/1515□ Units.

*3. For connection with a Servo Drive with 5-VDC photocoupler input, only CK3W-AX1414□/-AX1515□ Units whose date of production is July 1, 2019 or later (Lot number 01719K and later) are available.
Refer to *A-6 How to Read the Lot Number* on page A-11 for the lot number.

3-3-11 DA Output Method

The following two methods are available for DA output.

- FilteredPWM
- TrueDAC

This section describes each of the methods.

FilteredPWM

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

Set value	Voltage between analog output + and analog output -	Voltage between analog output + and analog GND
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_{PWM} : PWM frequency
PwmFreqMult : Value set at Gate3[i].Chan[j].PwmFreqMult (Setting range: 0 to 7)
$f_{IntPhase}$: Internal 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.
$300000 \div f_{PWM}$ (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.

3-3-12 DirectPWM Output Method

DirectPWM is a Servo Drive interface unique to Delta Tau, and only DirectPWM-compatible Servo Drives can be connected to this interface.
Contact your OMRON representative for information on DirectPWM-compatible Servo Drives.

DirectPWM allows the Motion Controller to directly send motor current commands to Servo Drives and monitor the actual motor current.
Because the Motion Controller directly sends motor current commands and monitors the motor current, high-speed precision motion control is enabled.

To use the DirectPWM output, the following settings are required.
These register settings are the default.
Gate3[i].AdcAmpClockDiv = 5

Gate3[i].AdcAmpStrobe = $FFFFFC
Gate3[i].AdcAmpDelay = 0
Gate3[i].AdcAmpHeaderBits = 2

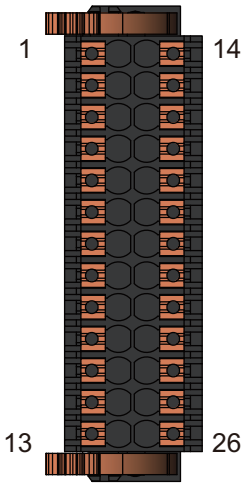
Additionally, set the phase clock frequency and the PWM frequency for each channel to 40 KHz or less.

3-3-13 Flag Connection Terminal Block Specifications

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

Terminal Arrangement

● **NPN Type**

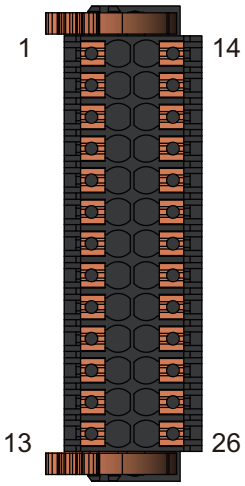


No.	Signal		No.	Signal (4ch type)
1	EQU0		14	EQU2
2	EQU1		15	EQU3
3	COM_EQU		16	COM_EQU
4	HOME0		17	HOME2
5	PLIM0		18	PLIM2
6	NLIM0		19	NLIM2
7	USER0		20	USER2
8	V_FLAG0		21	V_FLAG2
9	HOME1		22	HOME3
10	PLIM1		23	PLIM3
11	NLIM1		24	NLIM3
12	USER1		25	USER3
13	V_FLAG1		26	V_FLAG3

Signal	Signal name	
EQUn	Position comparison output	Output
COM_EQU	Position comparison output (Common)	Common

Signal	Signal name	
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

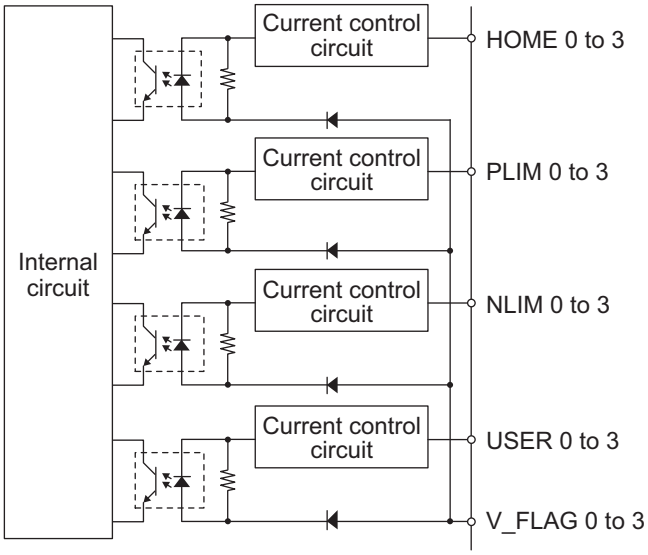
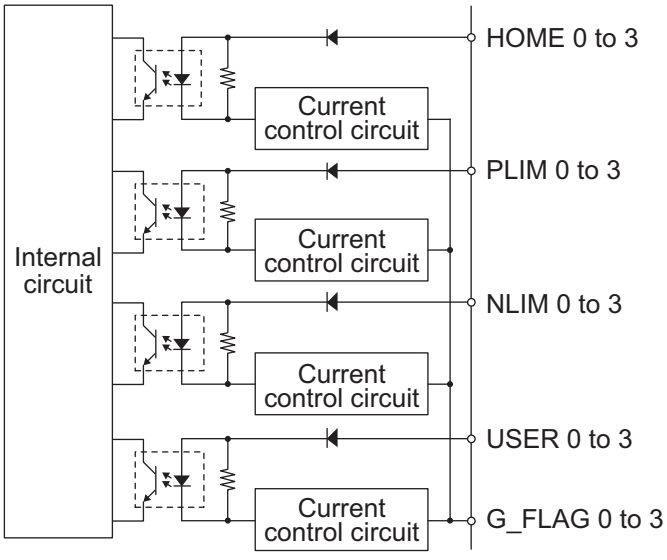


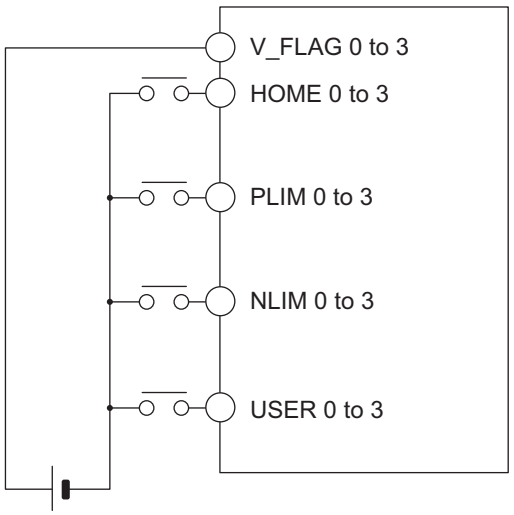
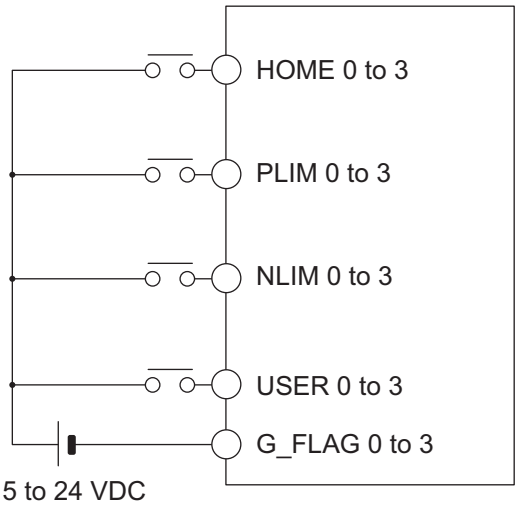
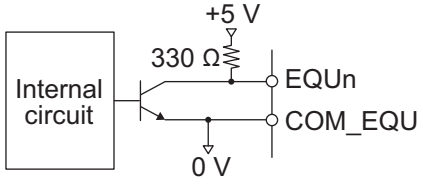
No.	Signal		No.	Signal (4ch type)
1	EQU0		14	EQU2
2	EQU1		15	EQU3
3	COM_EQU		16	COM_EQU
4	HOME0		17	HOME2
5	PLIM0		18	PLIM2
6	NLIM0		19	NLIM2
7	USER0		20	USER2
8	G_FLAG0		21	G_FLAG2
9	HOME1		22	HOME3
10	PLIM1		23	PLIM3
11	NLIM1		24	NLIM3
12	USER1		25	USER3
13	G_FLAG1		26	G_FLAG3

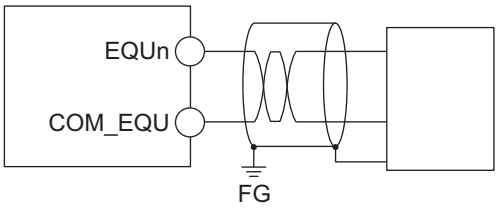
Signal	Signal name	
EQUn	Position comparison output	Output
COM_EQU	Position comparison output (Common)	Common
HOMEn	Zero Position Detection Flag	Input
PLIMn	Positive Limit Flag	Input
NLIMn	Negative Limit Flag	Input
USERn	General-purpose Flag	Input
G_FLAGn	Flag (Common)	Common

Electrical Specifications of Flag Connection Terminal Block

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

Digital Input Specifications	**Input signal**	HOME, PLIM, NLIM, USER/Channel
	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)
	ON voltage/ON current	3 VDC min. / 1 mA min.
	OFF voltage/OFF current *1	1.0 VDC max. / 0.1 mA max.
	ON/OFF response time	HOME, PLIM, NLIM: 20 µs max./400 µs max. USER: 20 µs max./20 µs max.
	Isolation method	Isolation by Photocoupler (between input and internal circuit)
	Circuit configuration	NPN type  PNP type 

	Connection diagram	NPN type  5 to 24 VDC
		PNP type  5 to 24 VDC
Digital Output Specifications	**Output signal**	EQU/Channel
	Rated output voltage	5 VDC
	Maximum load current when ON	35 mA
	Residual voltage when ON	0.4 V max.
	Isolation method	Internal circuits and not isolated
	Circuit configuration	

	Connection diagram *2	

*1. Since the OFF current is small, connection to the two-wire sensor may not be successful. Refer to *Precautions When Connecting a Two-wire DC Sensor* on page 5-29 for information on using the two-wire sensor.

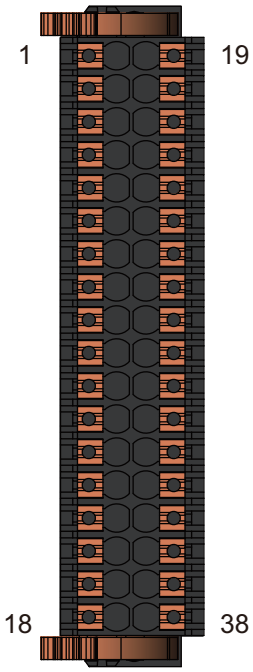
*2. For high-speed output, we recommend the use of shielded wiring.

3-3-14 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.

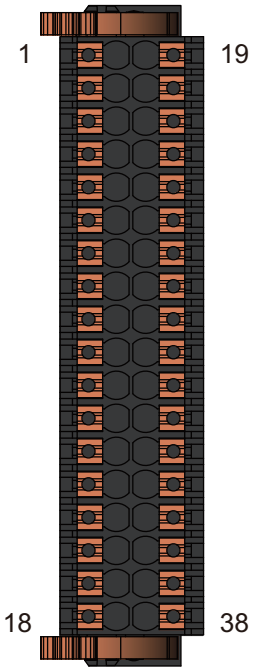
Terminal Arrangement

● **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

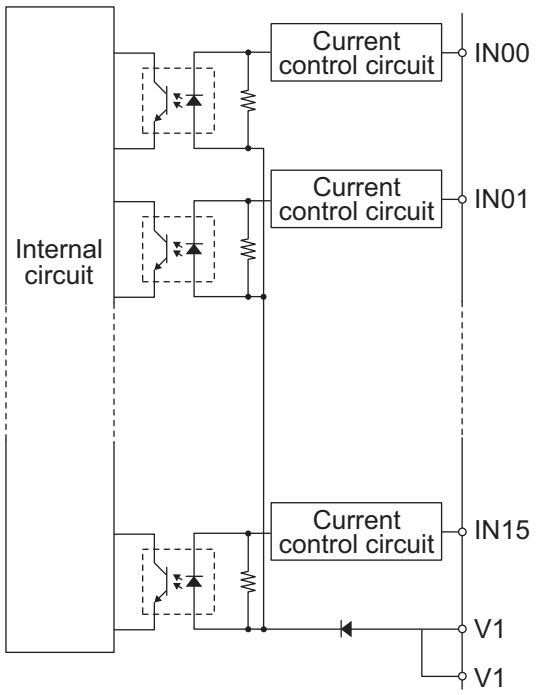
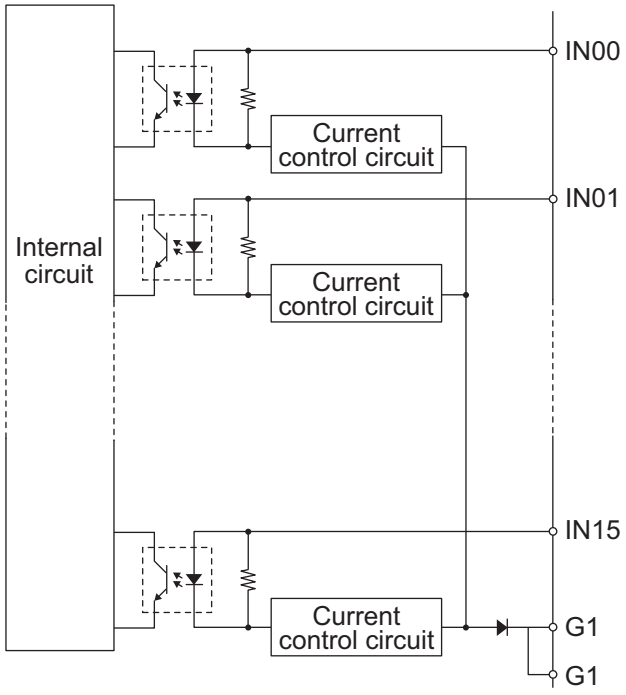
● PNP Type

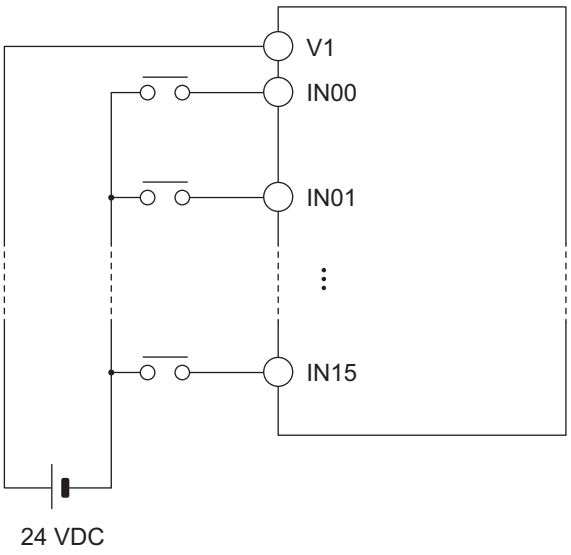
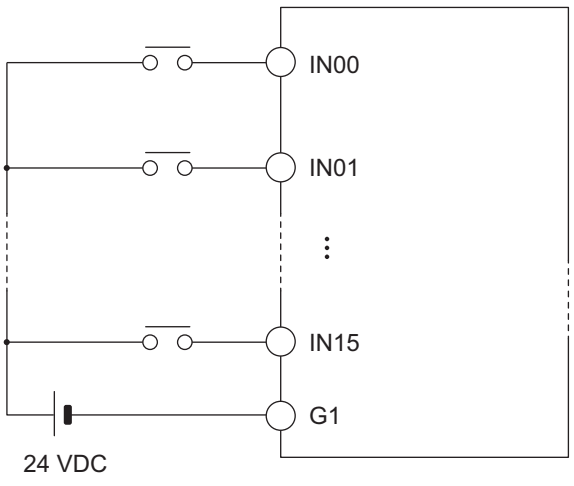


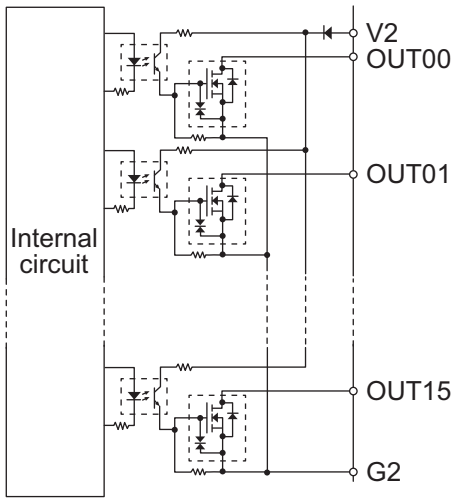
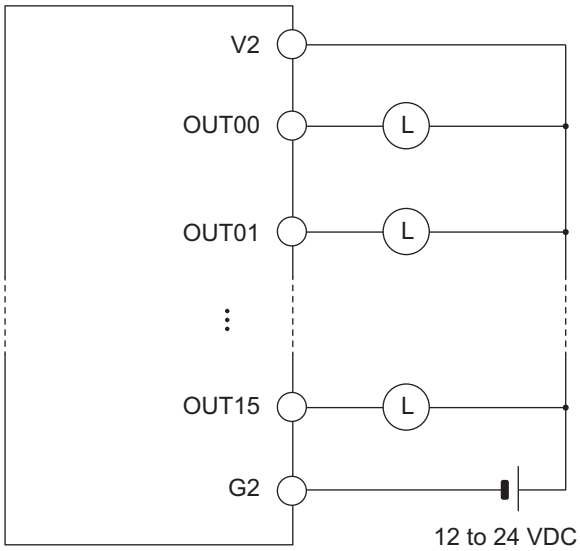
No.	Signal		No.	Signal
1	IN00		19	IN08
2	IN01		20	IN09
3	IN02		21	IN10
4	IN03		22	IN11
5	IN04		23	IN12
6	IN05		24	IN13
7	IN06		25	IN14
8	IN07		26	IN15
9	G1		27	G1
10	OUT00		28	OUT08
11	OUT01		29	OUT09
12	OUT02		30	OUT10
13	OUT03		31	OUT11
14	OUT04		32	OUT12
15	OUT05		33	OUT13
16	OUT06		34	OUT14
17	OUT07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

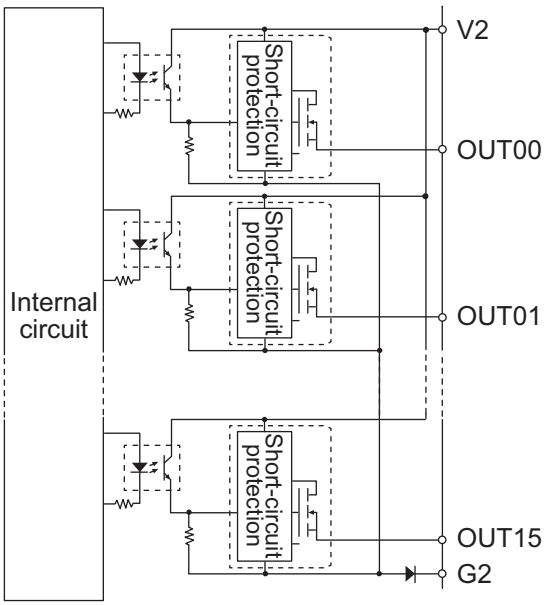
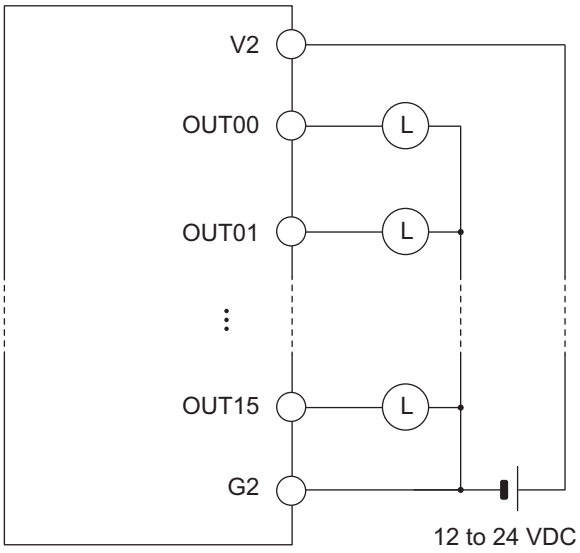
Electrical Specifications of General Digital I/O Connection Terminal Block

General digital input (NPN/PNP)	**Number of inputs**	16 points
	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 min.
	OFF voltage/OFF current	5 VDC max./1 mA max.
	ON/OFF response time	20 μs max./400 μs max.
	Isolation method	Isolation by Photocoupler (between input and internal circuit)

	Circuit configuration	NPN type  PNP type 

	Connection diagram	NPN type 
		PNP type 
General digital output (NPN)	**Internal common**	NPN
	Rated voltage	12 to 24 VDC
	Current consumption	40 mA max.
	Operating load voltage range	10.2 to 26.4 VDC
	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

	Circuit configuration	
	Connection diagram	NPN type 
General digital output (PNP)	**Internal common**	PNP
	Rated voltage	12 to 24 VDC
	Current consumption	80 mA max.
	Operating load voltage range	10.2 to 26.4 VDC
	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.
	Current 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	Provided

	Circuit configuration	
	Connection diagram	PNP type 

3-4 Digital I/O Unit

This section describes the Digital I/O Unit.

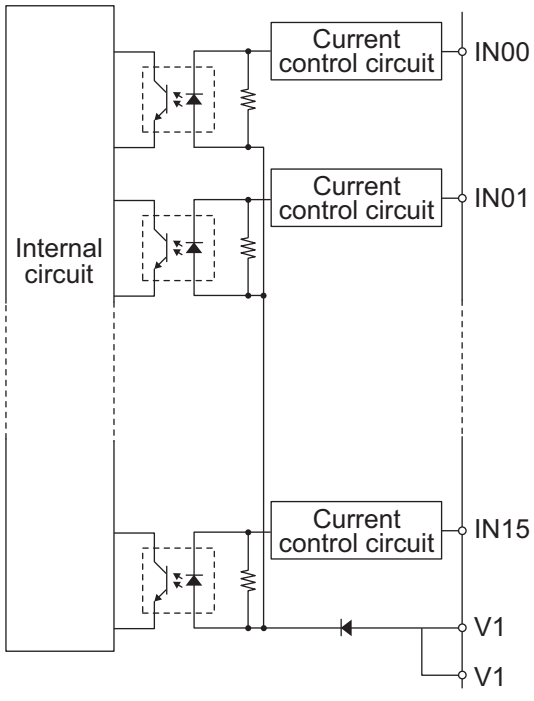
3-4-1 Models and Specifications

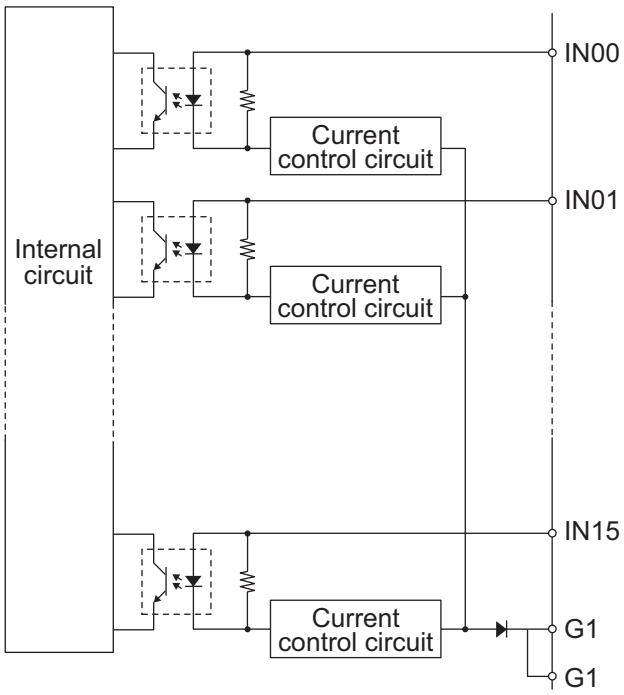
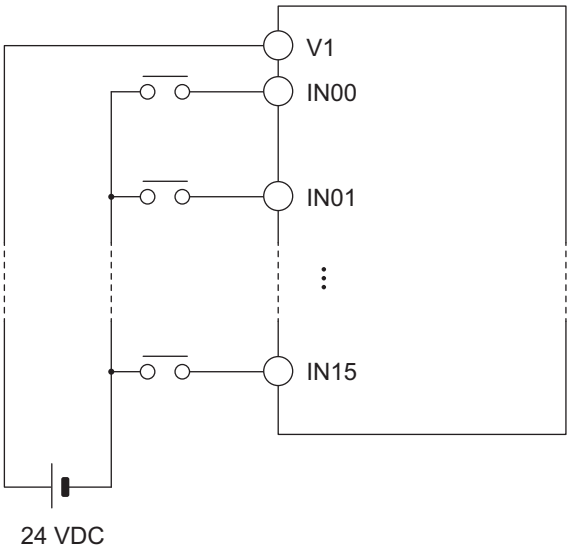
Models and Outline of Specifications

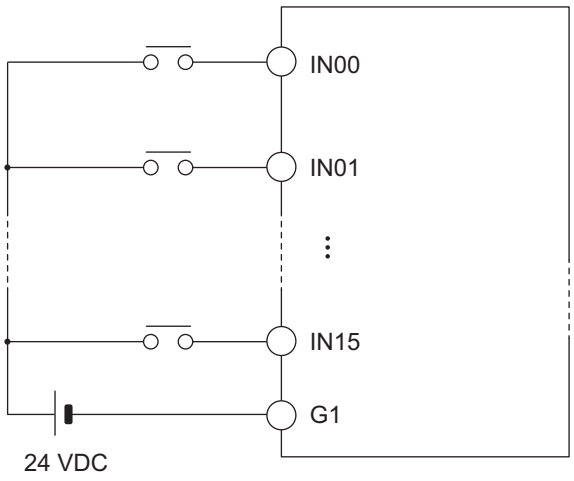
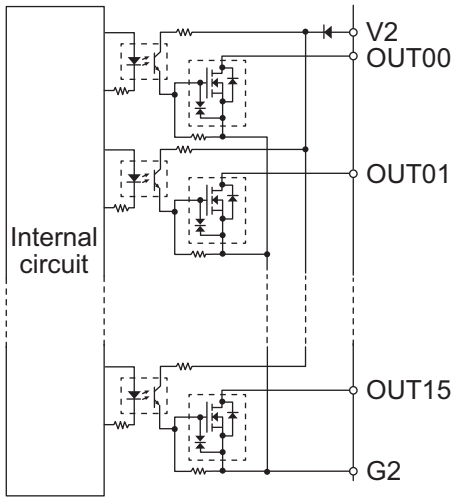
The models and outline of specifications are given below.

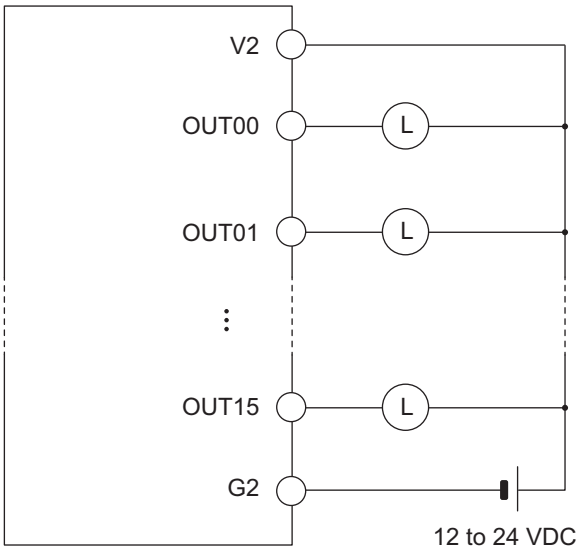
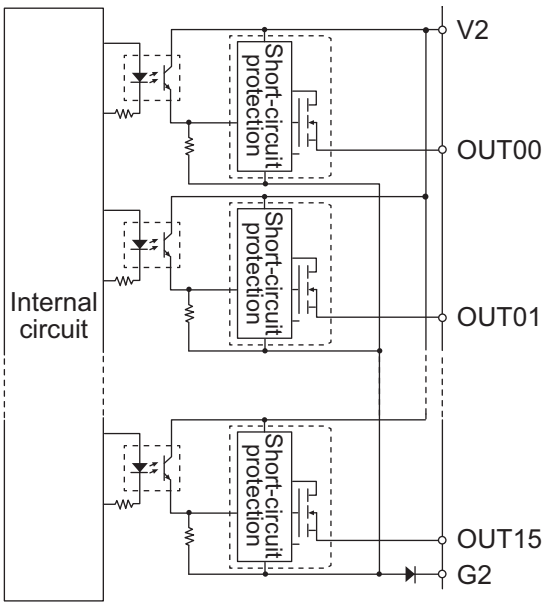
Unit type	Model	Number of inputs	Number of outputs	I/O type
Digital I/O Unit	CK3W-MD7110	16 points	16 points	NPN
	CK3W-MD7120	16 points	16 points	PNP

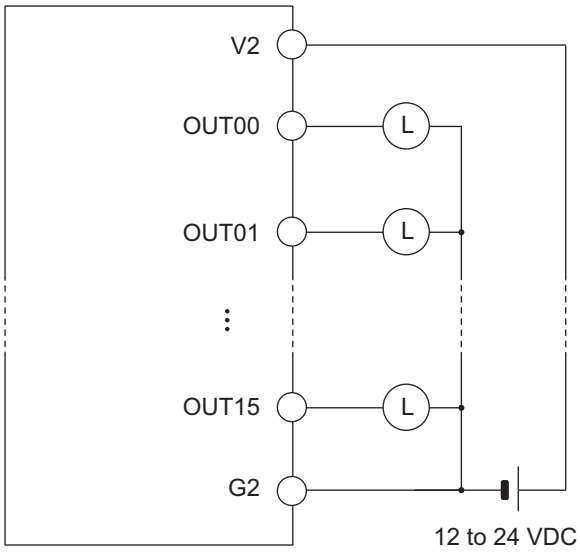
Specifications

Digital input (NPN/PNP)	**Number of inputs**	16 points
	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 min.
	OFF voltage/OFF current	5 VDC max./1 mA max.
	ON/OFF response time	20 μs max./400 μs max.
	Isolation method	Isolation by Photocoupler (between input and internal circuit)
	Circuit configuration	NPN type 

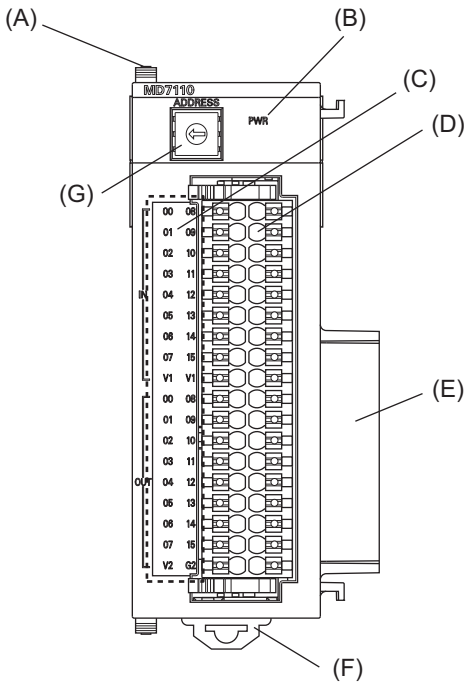
		PNP type 
	Connection diagram	NPN type 

		PNP type 
Digital output (NPN)	**Internal common**	NPN
	Rated voltage	12 to 24 VDC
	Current consumption	40 mA max.
	Operating load voltage range	10.2 to 26.4 VDC
	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
	Circuit configuration	

	Connection diagram	
Digital output (PNP)	**Internal common**	PNP
	Rated voltage	12 to 24 VDC
	Current consumption	80 mA max.
	Operating load voltage range	10.2 to 26.4 VDC
	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	Provided
	Circuit configuration	

	Connection diagram	
Power consumption		5 V: 1.0 W max.
Dimensions (height × depth × width)		90(H)/80(D)/31.6(W)
Weight		150 g max.

3-4-2 Part Names and Functions



Letter	Name	Function
A	Slider	Holds the Units together.
B	Power supply status indicator	Shows the power supply status.
C	Digital input/output status indicator	Shows the digital input/output status.
D	Terminal block	Connects the digital input/output.
E	Unit connector	Connector that connects to the Unit.
F	DIN Track mounting hook	Used to mount the Unit to a DIN Track.
G	Address switch	Sets the Gate3 Index.

3-4-3 Operation Indicators

The LED indicators show the unit operating status of the Digital I/O Unit.
The operating statuses corresponding to the colors and statuses of the indicators are shown below.

Indicator name	Color	Status	Description
PWR	Green	ON	Power is supplied.
		OFF	Power is not being supplied.
IN 0 to 15	Yellow	ON	The input contact is ON.
		OFF	The input contact is OFF.
OUT 0 to 15	Yellow	ON	The output contact is ON.
		OFF	The output contact is OFF.

3-4-4 Address Switch Setting

This Unit is equipped with a PMAC3 style DSPGate3 IC.
Refer to the *Power PMAC User's Manual (Cat. No. O014)* 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
B	11
C	12
D	13
E	14
F	15

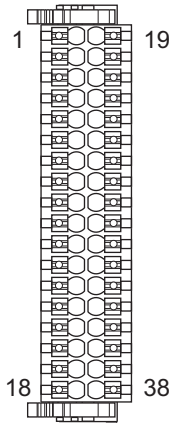
For example, if the address switch setting is *0*, the Gate3 Index becomes *0*.
In this case, this Unit is accessed with a Gate3[0] data structure.
Make sure that the address switch settings of Units do not overlap.
If they overlap, the Sys.Status register CK3WConfigErr becomes *7*.
Refer to *6-4 Sys.Status Register* on page 6-9 for Sys.Status.

One CK3W Unit in the system supplies servo clock and phase clock signals to all the other Units.
The supply-source CK3W Unit must be installed to the CPU Rack.
Connect the Unit with the smallest address value to the CPU Rack because, by default, it is the supply source of clock signals.
You may specify the Unit with a desired address as the clock supply source by setting the register.
If the Unit that serves as the clock supply source is connected to the Expansion Rack, an error occurs because the CPU Unit cannot recognize clock signals.
If this error occurs, the Sys.Status register Sys.NoClocks becomes *1*.

3-4-5 Terminal Arrangement

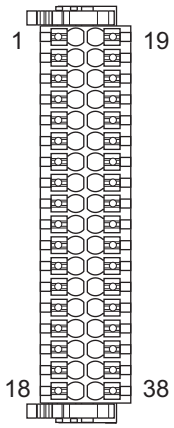
This section describes the terminal arrangement of the digital I/O connection terminal block.

CK3W-MD7110



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

CK3W-MD7120



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

3-4-6 I/O Data

The CPU Unit can access I/O data via the *Gate3[i].GpioData[0]* register.

Input data is stored in each bit of the register as shown below.

Input	Register
IN0	Gate3[i].GpioData[0].0
IN1	Gate3[i].GpioData[0].1
IN2	Gate3[i].GpioData[0].2
IN3	Gate3[i].GpioData[0].3
IN4	Gate3[i].GpioData[0].4
IN5	Gate3[i].GpioData[0].5
IN6	Gate3[i].GpioData[0].6

Input	Register
IN7	Gate3[i].GpioData[0].7
IN8	Gate3[i].GpioData[0].8
IN9	Gate3[i].GpioData[0].9
IN10	Gate3[i].GpioData[0].10
IN11	Gate3[i].GpioData[0].11
IN12	Gate3[i].GpioData[0].12
IN13	Gate3[i].GpioData[0].13
IN14	Gate3[i].GpioData[0].14
IN15	Gate3[i].GpioData[0].15

Output data is stored in each bit of the register as shown below.

Output	Register
OUT0	Gate3[i].GpioData[0].16
OUT1	Gate3[i].GpioData[0].17
OUT2	Gate3[i].GpioData[0].18
OUT3	Gate3[i].GpioData[0].19
OUT4	Gate3[i].GpioData[0].20
OUT5	Gate3[i].GpioData[0].21
OUT6	Gate3[i].GpioData[0].22
OUT7	Gate3[i].GpioData[0].23
OUT8	Gate3[i].GpioData[0].24
OUT9	Gate3[i].GpioData[0].25
OUT10	Gate3[i].GpioData[0].26
OUT11	Gate3[i].GpioData[0].27
OUT12	Gate3[i].GpioData[0].28
OUT13	Gate3[i].GpioData[0].29
OUT14	Gate3[i].GpioData[0].30
OUT15	Gate3[i].GpioData[0].31

To capture the I/O data correctly, the following register settings are required.
These register settings are the default.

Gate3[i].GpioDir[0] = $FFFF0000
Gate3[i].GpioPol[0] = $00000000
Gate3[i].GpioCtrl[0] = $00000000

3-5 Analog Input Unit

This section describes the Analog Input Unit.

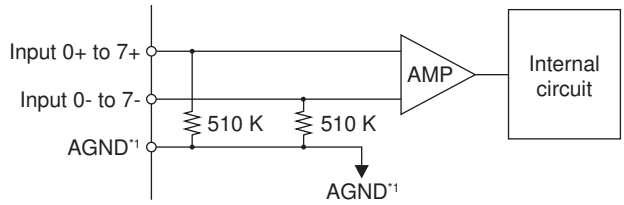
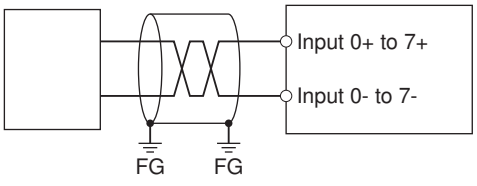
3-5-1 Models and Specifications

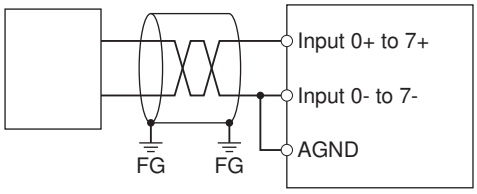
Models and Outline of Specifications

The models and outline of specifications are given below.

Unit type	Model	Number of inputs	Input range
Analog Input Unit	CK3W-AD2100	4 points	-10 to 10 V
	CK3W-AD3100	8 points	-10 to 10 V

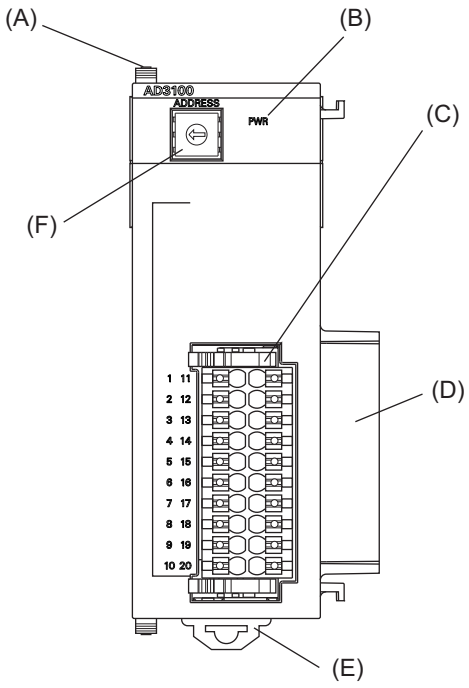
Specifications

Analog input	**Input method**	Differential or single-ended input *1
	Input range	-10 to 10 V
	Absolute maximum rating	±12 V (GND reference)
	Input impedance	1 MΩ min.
	Resolution	1/65116 (full scale)
	Accuracy (25°C)	±1.0%FS
	Effect of temperature	±0.018%FS/°C
	Isolation method	Between input and internal circuit: Power supply = Transformer, Signal = Digital isolator (Not isolated between inputs)
	Circuit configuration	 AGND: Analog circuit GND
	Terminal connection diagram	For differential input 

		For single-ended input  • If any of Input 0- to Input 7- is single ended input, apply a short-circuit between the input and AGND. • Use a shielded cable and ground at both ends of the cable.
Power consumption		CK3W-AD3100: 5 V 0.9 W max., 24 V 2.0 W max. CK3W-AD2100: 5 V 0.9 W max., 24 V 1.4 W max.
Dimensions (height × depth × width)		90(H)/80(D)/31.6(W)
Weight		CK3W-AD3100: 140 g max. CK3W-AD2100: 120 g max.

*1. Differential input and single-ended input can be mixed in a Unit.

3-5-2 Part Names and Functions



Letter	Name	Function
A	Slider	Holds the Units together.
B	Power supply status indicator	Shows the power supply status.
C	Terminal block	Connects the analog input.
D	Unit connector	Connector that connects to the Unit.
E	DIN Track mounting hook	Used to mount the Unit to a DIN Track.
F	Address switch	Sets the Gate3 Index.

3-5-3 Operation Indicators

The LED indicator shows the unit operating status of the Analog Input Unit.
The operating statuses corresponding to the colors and statuses of the indicators are shown below.

Indicator name	Color	Status	Description
PWR	Green	ON	Power is supplied.
		OFF	Power is not being supplied.

3-5-4 Address Switch Setting

This Unit is equipped with a PMAC3 style DSPGate3 IC.
Refer to the *Power PMAC User's Manual (Cat. No. O014)* 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
B	11
C	12
D	13
E	14
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.
Make sure that the address switch settings of Units 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.

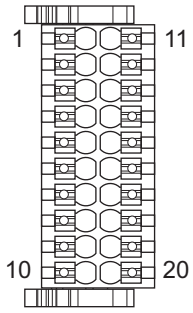
One CK3W Unit in the system supplies servo clock and phase clock signals to all the other Units.
The supply-source CK3W Unit must be installed to the CPU Rack.

Connect the Unit with the smallest address value to the CPU Rack because, by default, it is the supply source of clock signals.
You may specify the Unit with a desired address as the clock supply source by setting the register.
If the Unit that serves as the clock supply source is connected to the Expansion Rack, an error occurs because the CPU Unit cannot recognize clock signals.
If this error occurs, the Sys.Status register Sys.NoClocks becomes *1*.

3-5-5 Terminal Arrangement

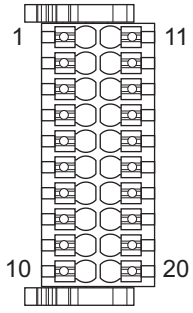
This section describes the terminal arrangement of the analog input connection terminal block.

CK3W-AD2100



No.	Signal		No.	Signal
1	AIN0+		11	AIN0-
2	AIN1+		12	AIN1-
3	AIN2+		13	AIN2-
4	AIN3+		14	AIN3-
5	AGND		15	AGND
6	NC		16	NC
7	NC		17	NC
8	NC		18	NC
9	NC		19	NC
10	AGND		20	AGND

CK3W-AD3100

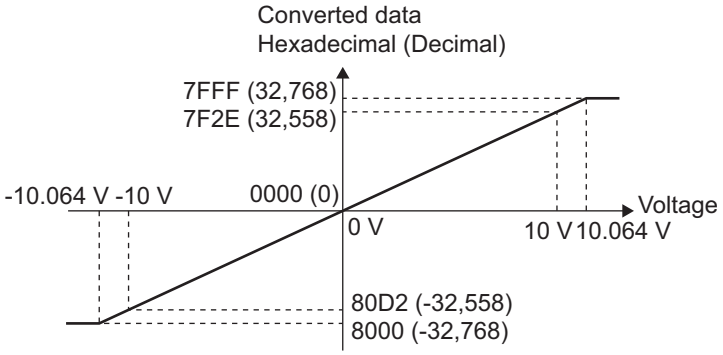


No.	Signal		No.	Signal
1	AIN0+		11	AIN0-
2	AIN1+		12	AIN1-
3	AIN2+		13	AIN2-
4	AIN3+		14	AIN3-
5	AGND		15	AGND
6	AIN4+		16	AIN4-
7	AIN5+		17	AIN5-
8	AIN6+		18	AIN6-
9	AIN7+		19	AIN7-
10	AGND		20	AGND

3-5-6 Analog Input Data

This section describes the correspondence between input analog signals and analog input data.

The graph shows that a voltage between -10 to 10 V is converted to data between 80D2 and 7F2E hex (-32,558 to 32,558).
When a negative voltage is input, it is expressed as the two's complement (hexadecimal).



Analog input data is stored in the upper 16 bits of the following register.

To use a register value, divide it by 2^{16} by using the program.

Input	Register	Bit position
AIN0	Gate3[i].Chan[0].ADCAmp[0]	[31:16]
AIN1	Gate3[i].Chan[0].ADCAmp[1]	[31:16]
AIN2	Gate3[i].Chan[0].ADCAmp[2]	[31:16]
AIN3	Gate3[i].Chan[0].ADCAmp[3]	[31:16]
AIN4	Gate3[i].Chan[1].ADCAmp[0]	[31:16]
AIN5	Gate3[i].Chan[1].ADCAmp[1]	[31:16]
AIN6	Gate3[i].Chan[1].ADCAmp[2]	[31:16]
AIN7	Gate3[i].Chan[1].ADCAmp[3]	[31:16]

The following table shows the conversion timing of analog input.

Input	Conversion timing
AIN0, AIN1, AIN4, AIN5	At the rising edge of the phase clock
AIN2, AIN3, AIN6, AIN7	At the falling edge of the phase clock

Note that the conversion timing of AIN0, AIN1, AIN4, AIN5 and that of AIN2, AIN3, AIN6, AIN7 are not the same.

To capture analog input data correctly, the following register settings are required.
These register settings are the default.

Gate3[i].AdcAmpClockDiv = 5 or 4 (5 by default)
Gate3[i].AdcAmpCtrl = $FFFFFC01
Gate3[i].AdcAmpDelay = 0
Gate3[i].AdcAmpHeaderBits = 1
Gate3[i].AdcAmpStrobe = $FFFFFC
Gate3[i].AdcAmpUtoS = 0
Gate3[i].GpioCtrl = $00000000
Gate3[i].GpioDir[0] = $0000FFFF
Gate3[i].GpioPol[0] = $00000000

3-5-7 Input Filter

The Analog Input Unit incorporates a hardware filter.
You can select the filter cut-off frequency from among 24.5 kHz, 12.2 kHz, 4.3 kHz, and 3.2 kHz and switch the frequency among them by setting the *Gate3[i].GpioData[0]* register as shown below.

Input	Input filter cut-off frequency (kHz)	Setting
AIN0	3.2 (Default)	Gate3[i].GpioData[0].0=0, Gate3[i].GpioData[0].1=0
	4.3	Gate3[i].GpioData[0].0=1, Gate3[i].GpioData[0].1=0
	12.2	Gate3[i].GpioData[0].0=0, Gate3[i].GpioData[0].1=1
	24.5	Gate3[i].GpioData[0].0=1, Gate3[i].GpioData[0].1=1
AIN1	3.2 (Default)	Gate3[i].GpioData[0].2=0, Gate3[i].GpioData[0].3=0
	4.3	Gate3[i].GpioData[0].2=1, Gate3[i].GpioData[0].3=0
	12.2	Gate3[i].GpioData[0].2=0, Gate3[i].GpioData[0].3=1
	24.5	Gate3[i].GpioData[0].2=1, Gate3[i].GpioData[0].3=1
AIN2	3.2 (Default)	Gate3[i].GpioData[0].4=0, Gate3[i].GpioData[0].5=0
	4.3	Gate3[i].GpioData[0].4=1, Gate3[i].GpioData[0].5=0
	12.2	Gate3[i].GpioData[0].4=0, Gate3[i].GpioData[0].5=1
	24.5	Gate3[i].GpioData[0].4=1, Gate3[i].GpioData[0].5=1
AIN3	3.2 (Default)	Gate3[i].GpioData[0].6=0, Gate3[i].GpioData[0].7=0
	4.3	Gate3[i].GpioData[0].6=1, Gate3[i].GpioData[0].7=0
	12.2	Gate3[i].GpioData[0].6=0, Gate3[i].GpioData[0].7=1
	24.5	Gate3[i].GpioData[0].6=1, Gate3[i].GpioData[0].7=1
AIN4	3.2 (Default)	Gate3[i].GpioData[0].8=0, Gate3[i].GpioData[0].9=0
	4.3	Gate3[i].GpioData[0].8=1, Gate3[i].GpioData[0].9=0
	12.2	Gate3[i].GpioData[0].8=0, Gate3[i].GpioData[0].9=1
	24.5	Gate3[i].GpioData[0].8=1, Gate3[i].GpioData[0].9=1
AIN5	3.2 (Default)	Gate3[i].GpioData[0].10=0, Gate3[i].GpioData[0].11=0
	4.3	Gate3[i].GpioData[0].10=1, Gate3[i].GpioData[0].11=0
	12.2	Gate3[i].GpioData[0].10=0, Gate3[i].GpioData[0].11=1
	24.5	Gate3[i].GpioData[0].10=1, Gate3[i].GpioData[0].11=1

Input	Input filter cut-off frequency (kHz)	Setting
AIN6	3.2 (Default)	Gate3[i].GpioData[0].12=0, Gate3[i].GpioData[0].13=0
	4.3	Gate3[i].GpioData[0].12=1, Gate3[i].GpioData[0].13=0
	12.2	Gate3[i].GpioData[0].12=0, Gate3[i].GpioData[0].13=1
	24.5	Gate3[i].GpioData[0].12=1, Gate3[i].GpioData[0].13=1
AIN7	3.2 (Default)	Gate3[i].GpioData[0].14=0, Gate3[i].GpioData[0].15=0
	4.3	Gate3[i].GpioData[0].14=1, Gate3[i].GpioData[0].15=0
	12.2	Gate3[i].GpioData[0].14=0, Gate3[i].GpioData[0].15=1
	24.5	Gate3[i].GpioData[0].14=1, Gate3[i].GpioData[0].15=1

3-6 Expansion Master Unit and Expansion Slave Unit

This section describes the Expansion Master Unit and the Expansion Slave Unit.

3-6-1 Models and Specifications

Models and Outline of Specifications

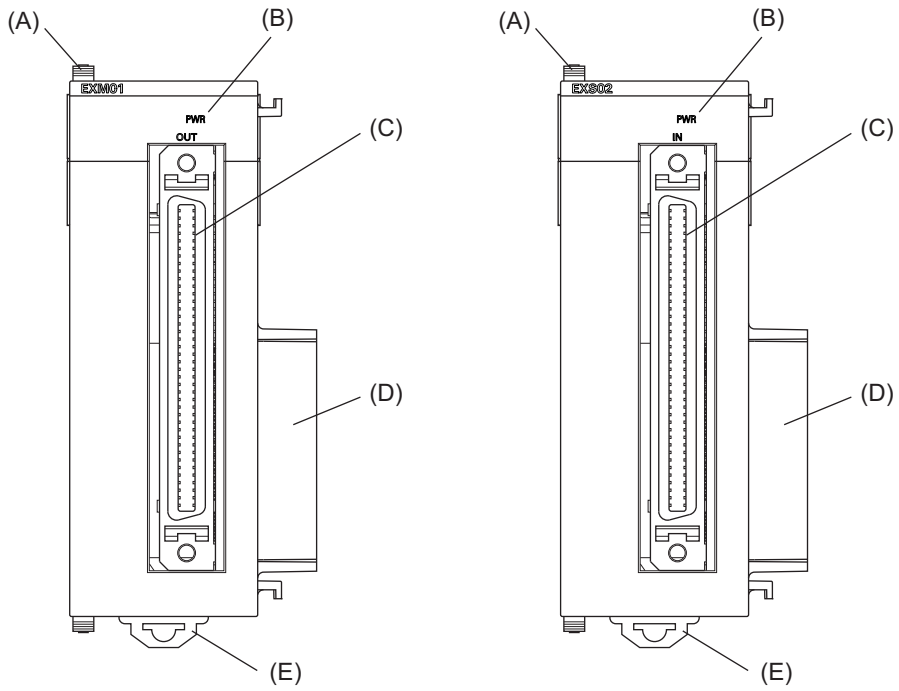
The models and outline of specifications are given below.

Unit type	Model
Expansion Master Unit	CK3W-EXM01
Expansion Slave Unit	CK3W-EXS02

Specifications

Expansion cable	For connection between the Expansion Master Unit and the Expansion Slave Unit, be sure to use the following cable. CK3W-CAX003A (0.3 m)
Power consumption	CK3W-EXM01: 5 V 0.4 W max. CK3W-EXS02: 5 V 0.2 W max.
Dimensions (height × depth × width)	90(H)/80(D)/31.6(W)
Weight	CK3W-EXM01: 100 g max. CK3W-EXS02: 130 g max. (including End Cover)

3-6-2 Part Names and Functions



Letter	Name	Function
A	Slider	Holds the Units together.
B	Power supply status indicator	Shows the power supply status.
C	Connector	Connect the Expansion Master Unit and the Expansion Slave Unit.
D	Unit connector	Connector that connects to the Unit.
E	DIN Track mounting hook	Used to mount the Unit to a DIN Track.

3-6-3 Operation Indicators

Each LED indicator shows the unit operating status of the Expansion Master Unit or Expansion Slave Unit.

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

Indicator name	Color	Status	Description
PWR	Green	ON	Power is supplied.
		OFF	Power is not being supplied.

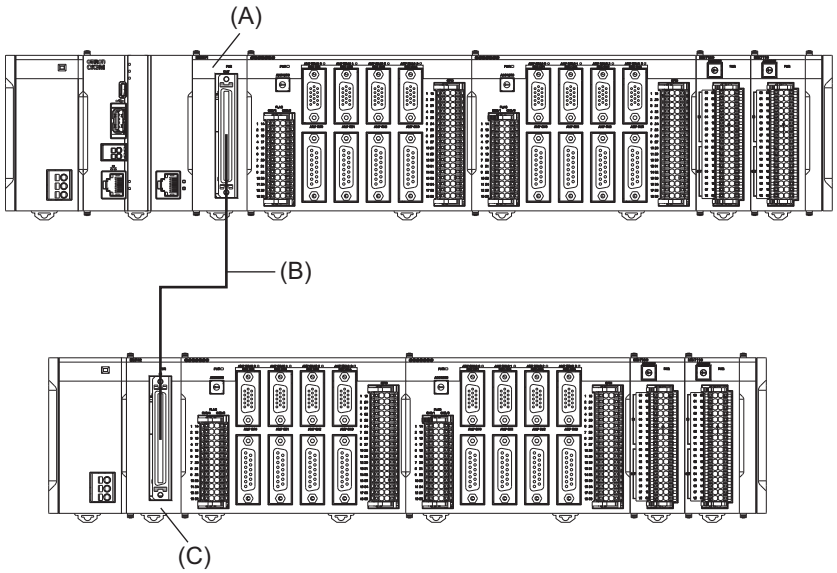
3-6-4 System Configuration

You can use the Expansion Master Unit and the Expansion Slave Unit to connect an Expansion Rack to the CPU Unit.

One Expansion Rack can be connected per CPU Unit.

Up to four CK3W Units (or up to two CK3W-AX Units) can be installed to the Expansion Rack.

Connect the Expansion Master Unit adjacent to the right side of the CPU Unit. Connect the Expansion Slave Unit adjacent to the right side of the Power Supply Unit.



Letter	Name	Model
A	Expansion Master Unit	CK3W-EXM01
B	Expansion cable	CK3W-CAX003A
C	Expansion Slave Unit	CK3W-EXS02

4

Installation

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

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

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

Writing to the USB Memory

If the power is interrupted while a user program is writing data to the USB memory, the data may be corrupted.
Confirm that no data is being written before you turn OFF the power supply.

Downloading to the Built-In Flash Memory

When you download a user program from the Power PMAC IDE, the data is once stored in the CPU cache before it is saved into the CPU Unit.
This means that, if you turn OFF the power supply immediately after starting the save operation, the CPU Unit cannot complete the transfer of the data from the cache to the built-in flash memory, which may result in a save operation failure or corruption of the saved data.

If the data is corrupted, issue a re-initialization command ($$$***) from the Power PMAC IDE, and download the program again.
If the CPU Unit fails to connect to the Power PMAC IDE, refer to *6-3-3 Initialization of CPU Unit Using USB Memory* on page 6-8 and implement initialization.

● Procedure to Download to the Built-in Flash Memory

Use the following procedure to download the user program to the built-in flash memory.
The procedure can be used for any firmware revision of the PMAC firmware.

1 Download the user program from the Power PMAC IDE.

2 At the Power PMAC IDE terminal, execute the **save** command.

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

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

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

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

1 Download the user program from the Power PMAC IDE.

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

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

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

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

4-2 Fail-safe Circuits

⚠ WARNING

Provide safety measures in external circuits to ensure safety in the system if an abnormality occurs due to malfunction of the system due to other external factors affecting operation. Not doing so may result in serious accidents due to incorrect operation.

- Emergency stop circuits, interlock circuits, limit circuits, and similar safety measures must be provided in external control circuits.
- You must take fail-safe measures to ensure safety in the event of incorrect, missing, or abnormal signals caused by broken signal lines, momentary power interruptions, or other causes.
- The use of an Uninterruptible Power Supply (UPS) allows normal operation to continue even if a momentary power interruption occurs, possibly resulting in the reception of an erroneous signal from an external device affected by the momentary power failure. Take external fail-safe measures. Where necessary, monitor the power supply voltage on the system for external devices and use it as an interlock condition.
- Unintended behavior may occur if an error occurs in the internal memory of the product. As a countermeasure for these problems, external safety measures must be provided to ensure safe operation of the system.
- The Controller will turn OFF all outputs from Output Units in the following cases. The slaves will operate according to the settings in the slaves.
  a) If a power supply error occurs
  b) If the power supply connection becomes faulty
  c) If a CPU error (watchdog timer error) or CPU reset occurs
  d) If a major fault level Controller error occurs
  e) While the Controller is on standby until RUN mode is entered after the power is turned ON
  f) If a system initialization error occurs

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

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

4-3 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

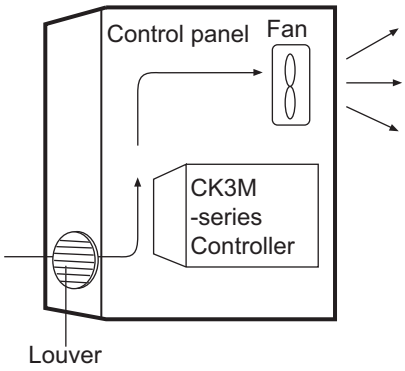
4-3-1 Installation in a Control Panel

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.

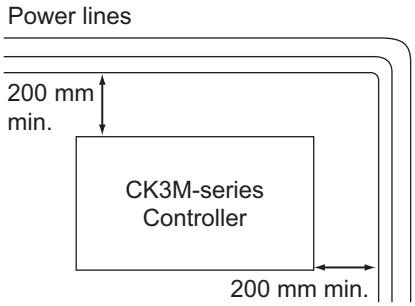


● Accessibility for Operation and Maintenance

- 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

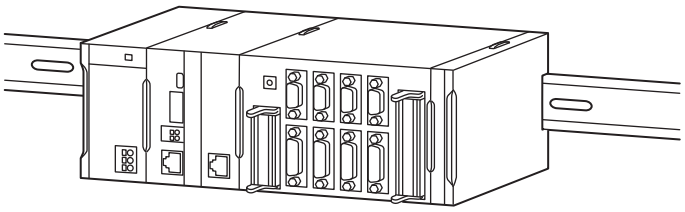
- Do not mount the Controller in a control panel containing high-voltage equipment.
- Install the Controller at least 200 mm away from power lines.



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

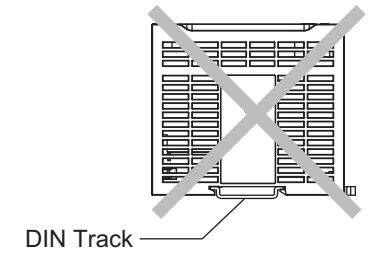
● Controller Orientation

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

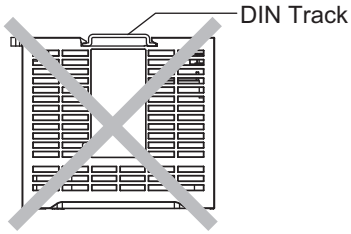


- Do not install a Rack in any of the following positions.

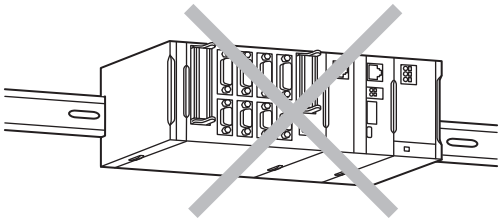
Mounting with the DIN Track on the Bottom



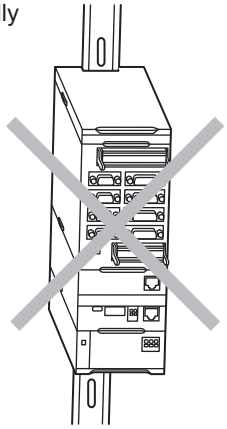
Mounting with the DIN Track on the Top



Mounting with the Rack Upside Down



Mounting with the DIN Track Installed Vertically

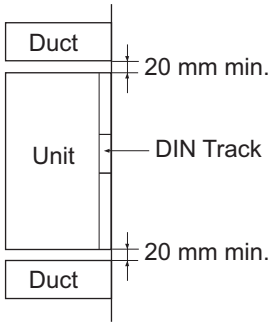


Additional Information

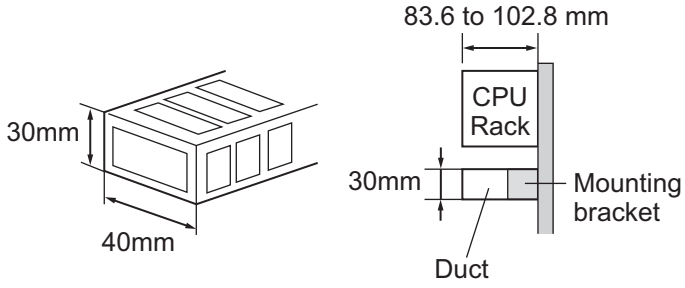
A Controller must be mounted on a DIN Track. It cannot be mounted with screws.

● 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.

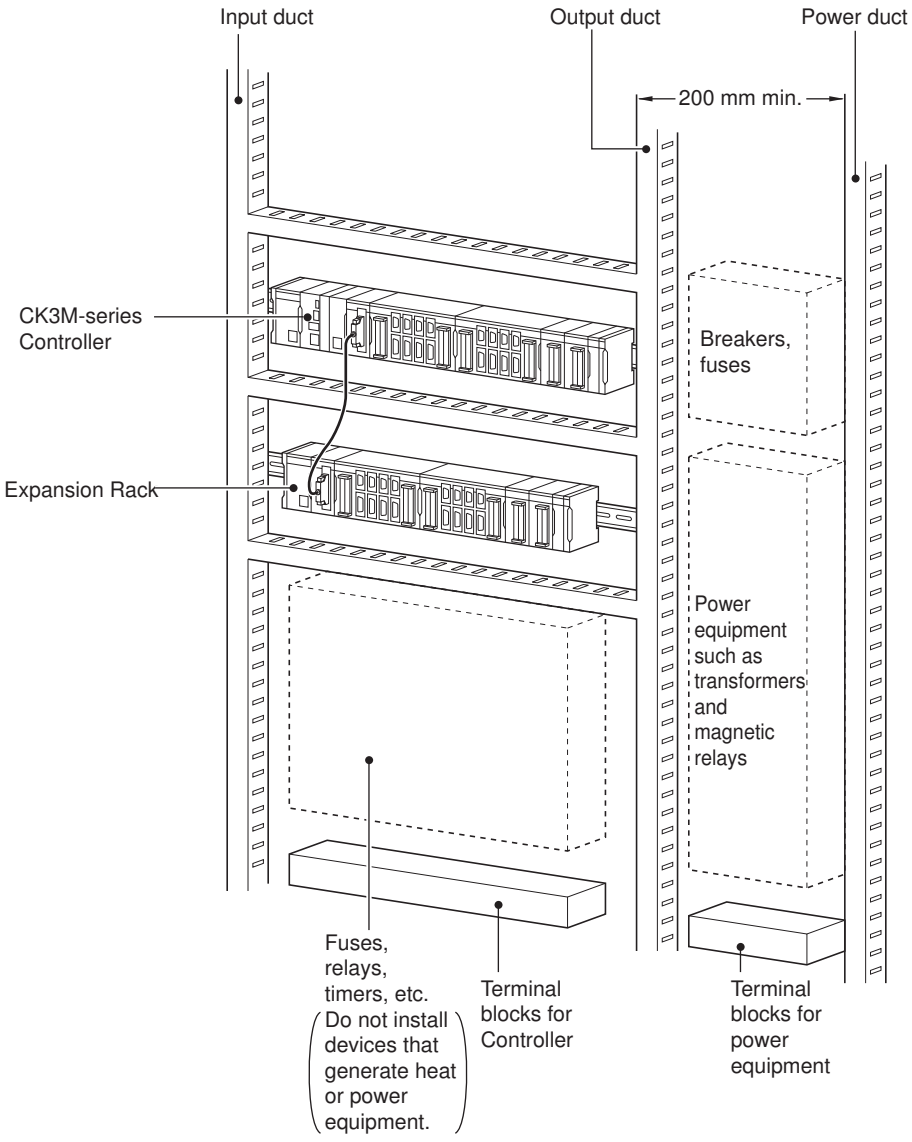


● Wiring Duct Example



● Routing Wiring Ducts

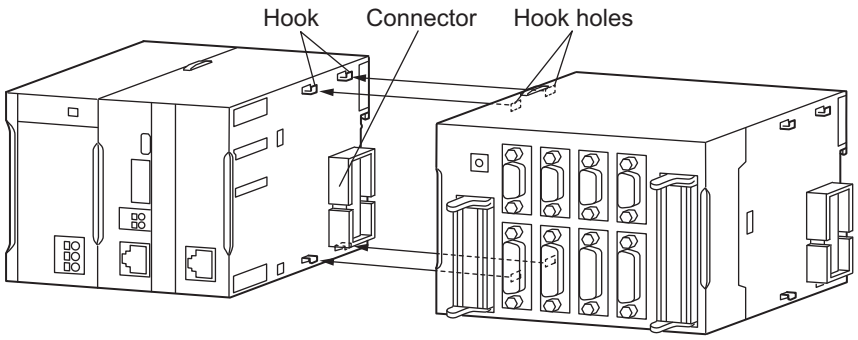
Install the wiring ducts at least 20 mm away from the tops of the Rack and any other objects (e.g., ceiling, wiring ducts, structural supports, devices, etc.) to provide enough space for air circulation and replacement of Units.



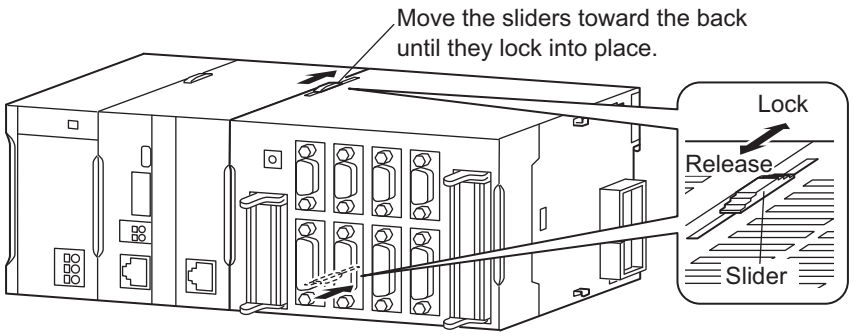
4-3-2 Connecting Adjacent Units

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.



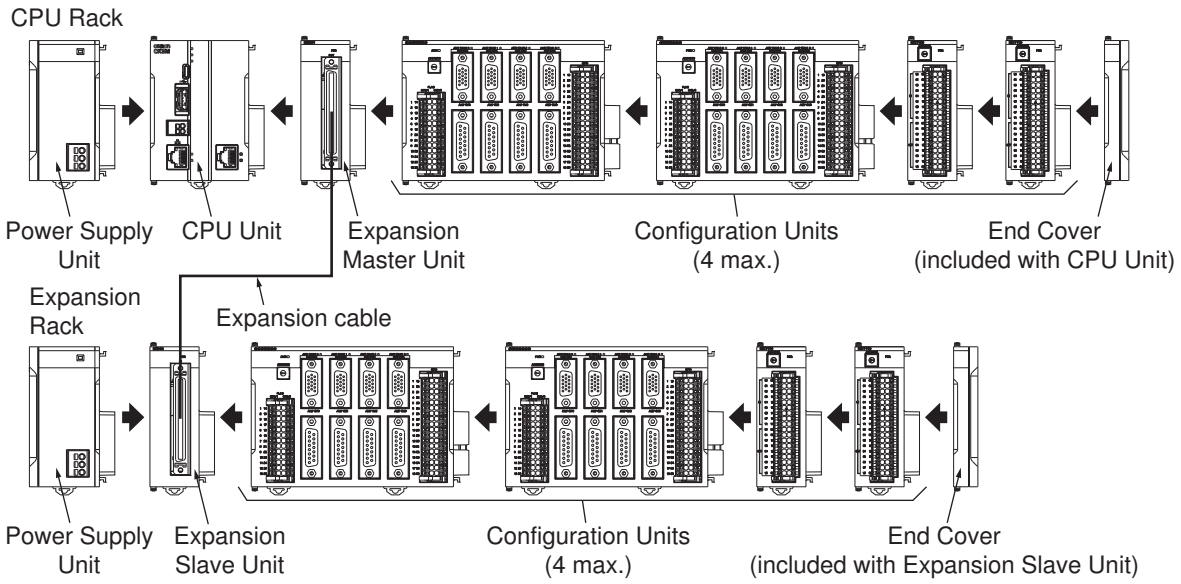
2 The yellow sliders at the top and bottom of each Unit lock the Units together. Move the sliders toward the back of the Units as shown below until they click into place.



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.



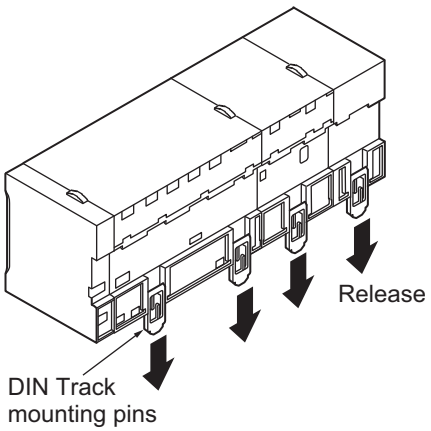
Precautions for Correct Use

- 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.
- You can connect up to four CK3W Units (or up to two CK3W-AX Units) to each of the CPU Rack and Expansion Rack. If you connect more than that number, the *Sys.CK3WConfigErr Flag* goes ON.
  Operation will continue even with the *Sys.CK3WConfigErr Flag* ON.

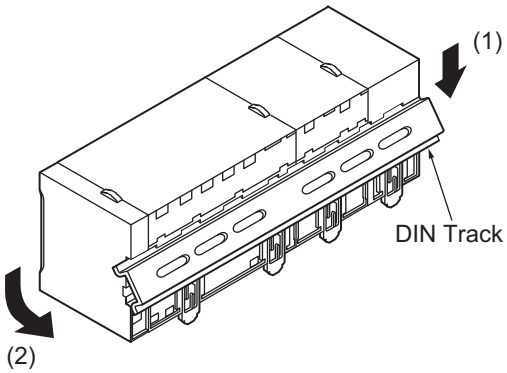
4-3-3 Mounting to DIN Track

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

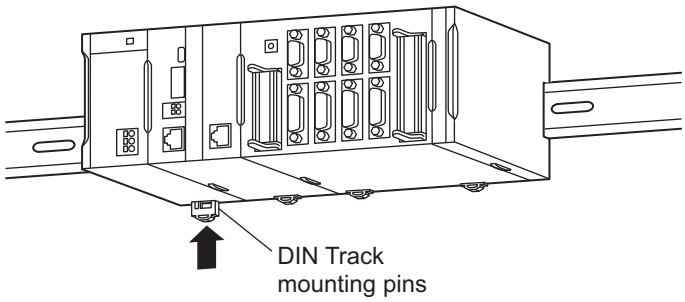
1 Release the DIN Track mounting pins on the backs of the Units.



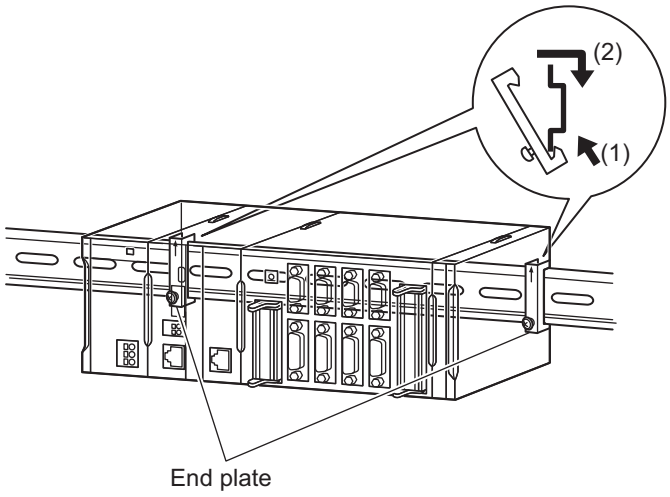
2 To mount, hook on the DIN Track from above (1), and insert into the back (2).



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.

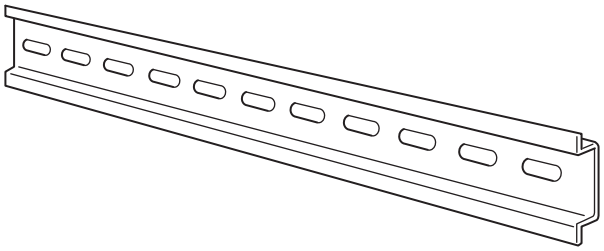
Precautions for Safe Use

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

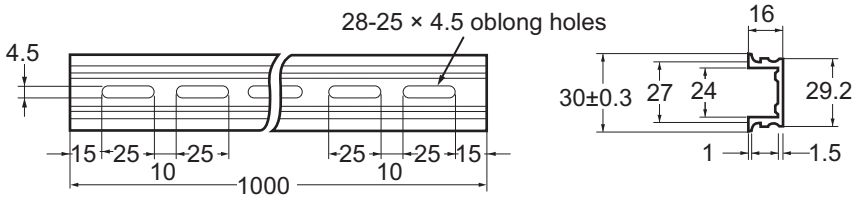
Mount the CK3M-series Controller on the DIN Track.
Secure each DIN Track inside a control panel with at least three screws.

DIN Tracks

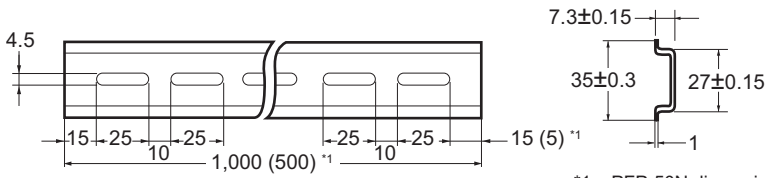


Secure the DIN Track to the control panel using M4 screws separated by 210 mm (3 holes) or less and using at least 3 screws. The tightening torque is 1.2 N·m.

● **PFP-100N2**



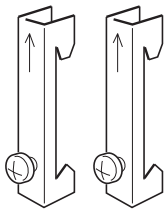
● **PFP-100N/50N**



*1. PFP-50N dimensions are given in parentheses.

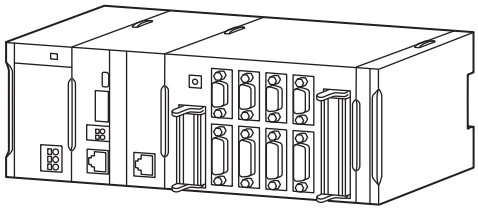
DIN Track End Plates

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

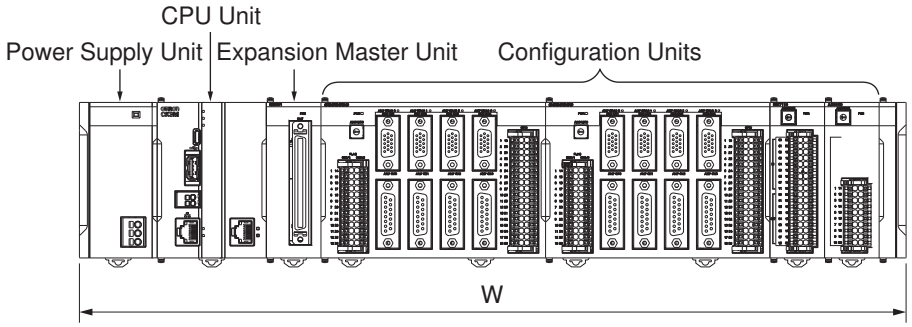
● Axis Interface Unit

Model	Unit width (mm)
CK3W-AX1313N	130
CK3W-AX1414N	
CK3W-AX1515N	
CK3W-AX2323N	
CK3W-AX1313P	
CK3W-AX1414P	
CK3W-AX1515P	
CK3W-AX2323P	

● Digital I/O Unit, Analog Input Unit, Expansion Master Unit, and Expansion Slave Unit

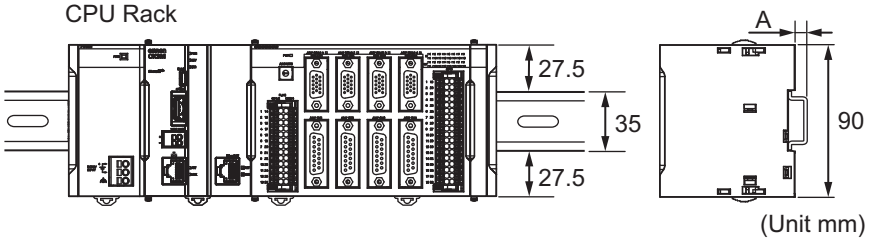
Model	Unit width (mm)
CK3W-MD7110	31.6
CK3W-MD7120	
CK3W-AD2100	
CK3W-AD3100	
CK3W-EXM01	
CK3W-EXS02	

● Design Example for Width W



Name	Model	Unit width (mm)	Qty	Subtotal unit width (mm)
Power Supply Unit	CK3W-PD048	45	1	45
CPU Unit	CK3M-CPU101	63.2	1	63.2
Expansion Master Unit	CK3W-EXM01	31.6	1	31.6
Axis Interface Unit	CK3W-AX1414N	130	2	260
Digital I/O Unit	CK3W-MD7110	31.6	1	31.6
Analog Input Unit	CK3W-AD2100	31.6	1	31.6
End Cover	CK3W-TER11	15.6	1	15.6
Total W = 45 + 63.2 + 31.6 + 130 × 2 + 31.6 + 31.6 + 15.6				478.6

Installation Dimensions

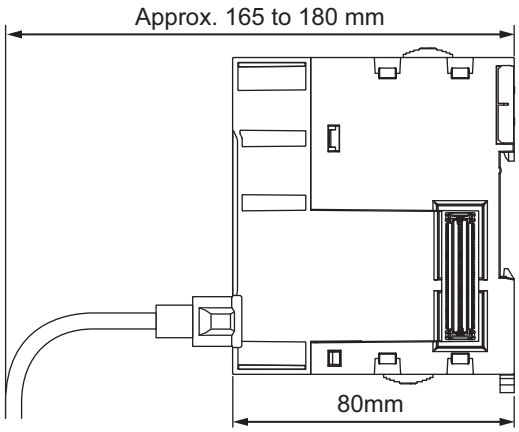


DIN Track	A (mm)
PFP-100N2	16
PFP-100N	7.3
PFP-50N	7.3

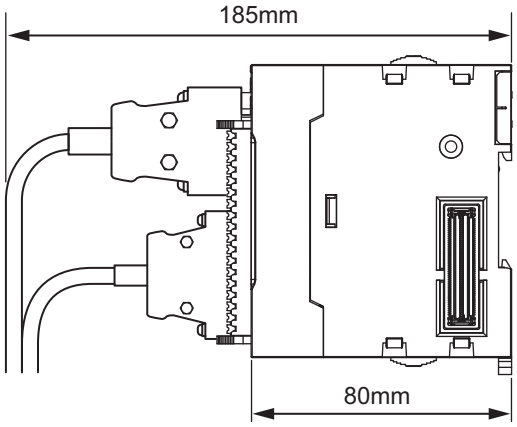
Installation Height

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.

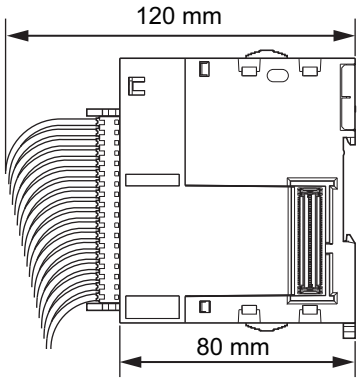
● For CK3M-series CPU Unit



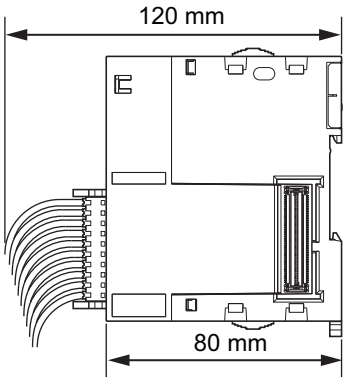
● For CK3W-AX Unit



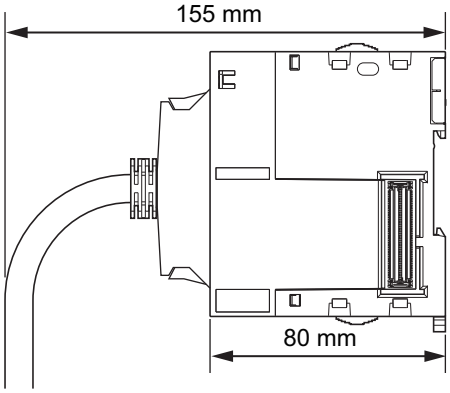
● For CK3W-MD Unit



● **For CK3W-AD Unit**



● **For CK3W-EXM01 and CK3W-EXS02**



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

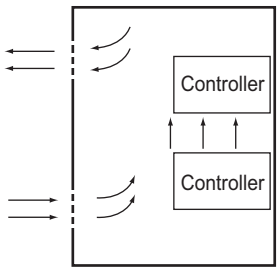
Panels have been reduced in size due to space-saving and miniaturization in devices and systems, and the temperature inside the panel may be at least 10 to 15°C higher than outside the panel. Implement the following measures against overheating at the installation site and in the panel, and allow a sufficient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

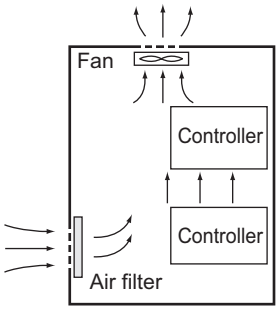
● Natural Cooling

- 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.



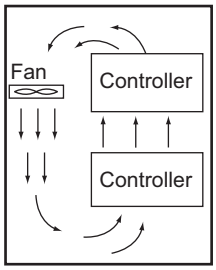
Natural Cooling

● Forced Ventilation (by Fan at Top of Panel)



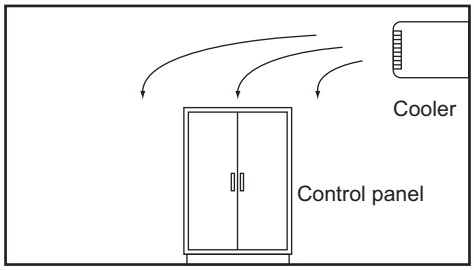
Forced Ventilation Method

● Forced Air Circulation (by Fan in Closed Panel)



Forced Air Circulation

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



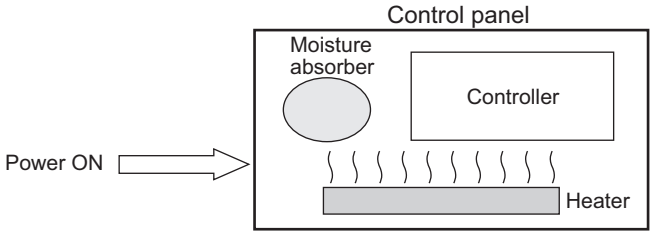
Room Cooling

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.

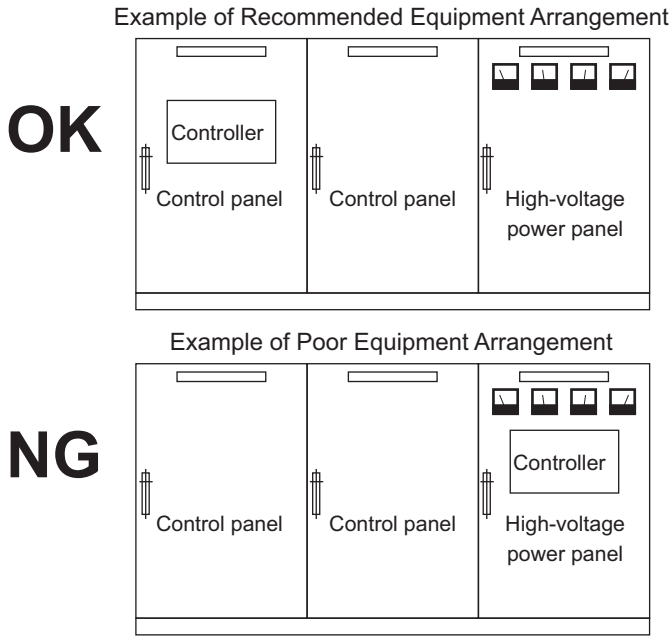
- In locations exposed to dust, dirt, salt, metal powder, soot, or organic solvents, use a panel with an airtight structure. Be careful of temperature increases inside the panel.
- In locations exposed to corrosive gas, purge the air inside the panel to clear the gas and then pressurize the inside of 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

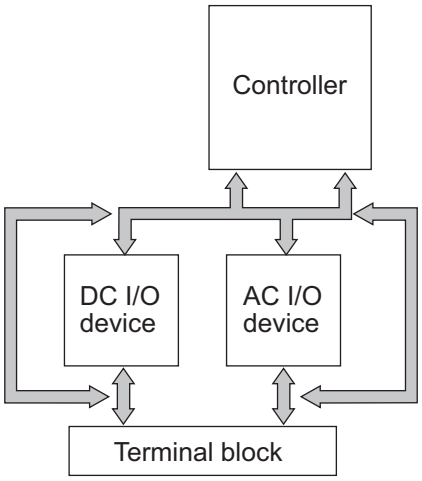
Install separately the Controller from high-voltage (600 V or higher) and power devices to ensure safe operation and maintenance. Install the Controller as far away as possible in case of unavoidable circumstances.



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.



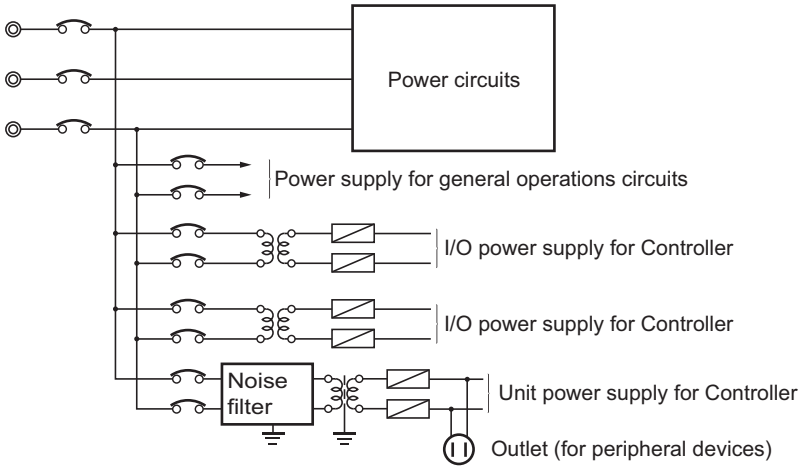
Example of Arrangement in Panel

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.

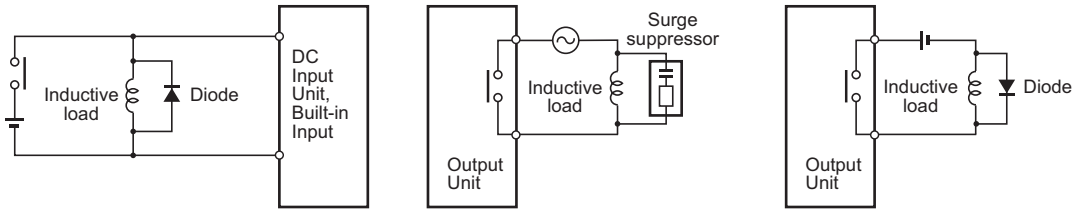


Power Supply System Diagram

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.



Connect a diode in a DC circuit.

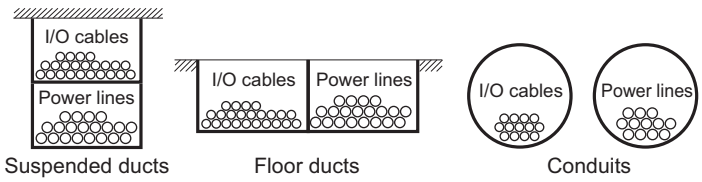
Connect a surge suppressor in an AC circuit.

Connect a diode 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.



Suspended ducts

Floor ducts

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

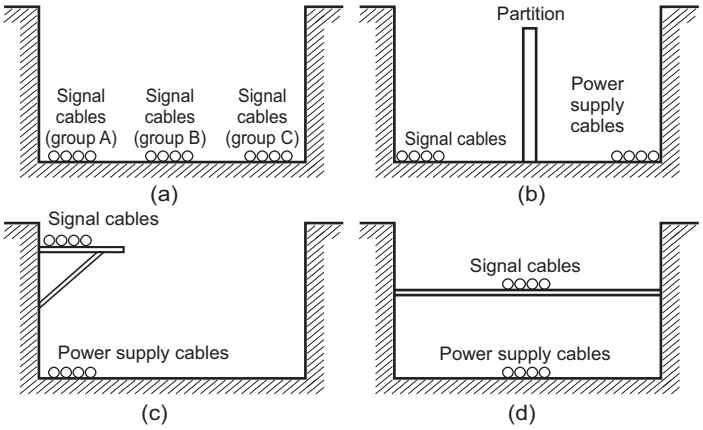
Each of the following combinations includes different signal types, properties, or levels. They will cause the signal-to-noise ratio to drop due to factors such as electrical induction. As a general rule when wiring, either use separate cables or separate wiring routes for these items. Future maintenance 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

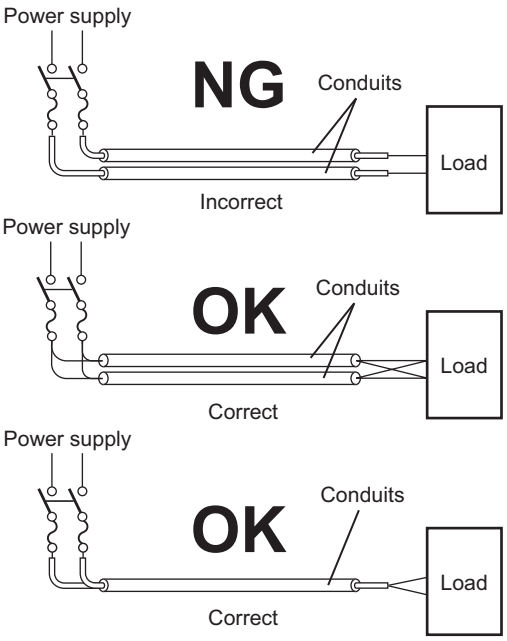
Observe the following points when wiring power supply and signal cables.

- 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.



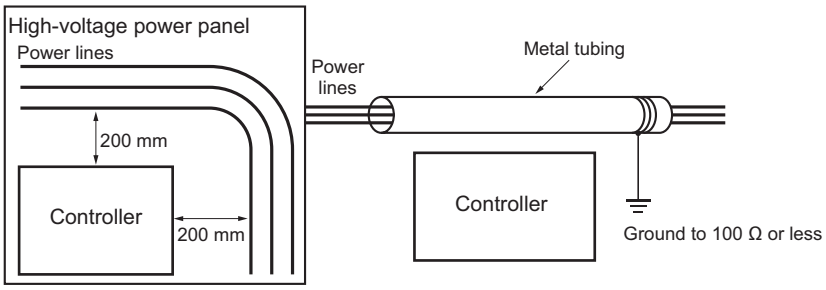
Partitioning Methods for Signal and Power Supply Cables

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



Parallel Wiring (Single Phase)

- 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 4-19.)
- 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 Ω 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.

Specifications of communications cables for EtherCAT and Ethernet	Earthing methods			
	Equipotential bonding system	Star earthing		Daisy Chain
		Connecting devices and noise sources to separate earth electrodes	Connecting devices and noise sources to a common earth electrode	
The cable shield connected to the connector hood at both ends of the communications cable	Recommended	Recommended	Not recommended	Not recommended

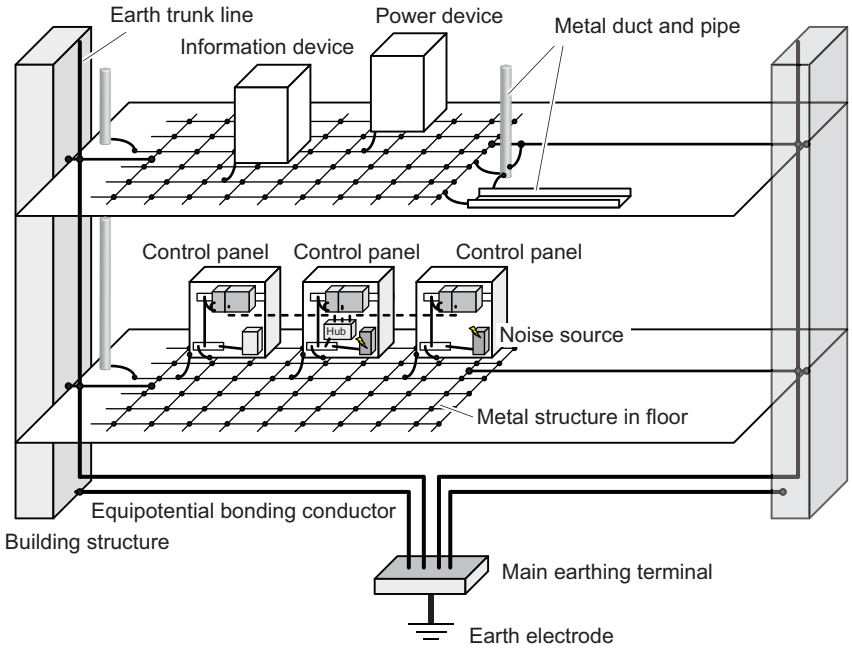
Additional Information

- In countries or regions where earthing methods are regulated, you must comply with the regulations. Refer to the applicable local and national ordinances of the place where you install the system, or other international laws and regulations.
- When using Ethernet switches, ask the Ethernet switch manufacturer for information about the environmental resistance of the Ethernet switches to be used, the grounding between Ethernet switches, and the specifications of cables.

● Equipotential Bonding System

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

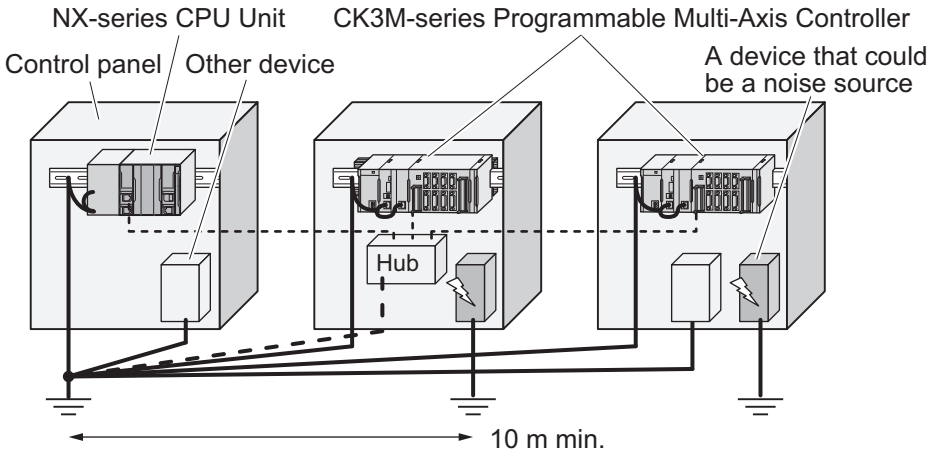
The following figure shows an example of an equipotential bonding system.
Connect the main earthing terminal and building structures together with equipotential bonding conductors and embed the mesh ground line in each floor.
Connect the ground line of each control panel to the equipotential bonding system.



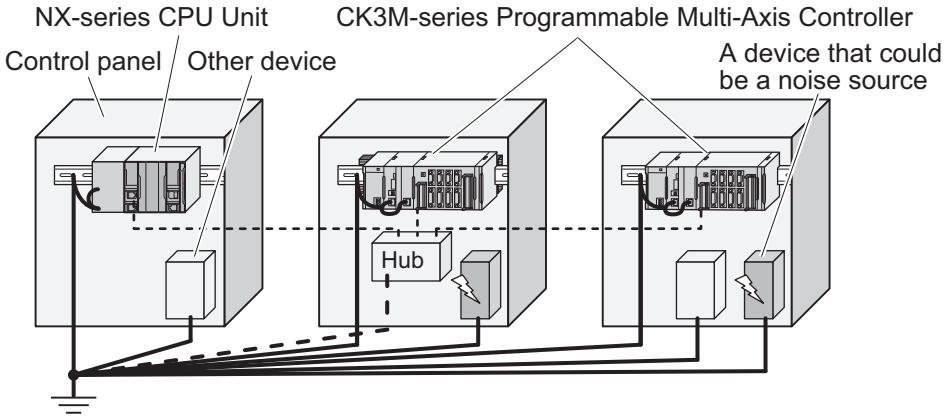
● Star Earthing

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

a. Installation method by connecting devices and noise sources to separate earth electrodes
This is an earthing method to separately ground an earth electrode of the device that is connected with a communications cable or other devices and an earth electrode of a high-power device that could be a noise source, such as a motor or inverter. Each earth electrode must be ground to 100 Ω or less.
Connect the ground lines of the device that is connected with a communications cable and other devices as a bundle to a single earth electrode. Be sure that the earth electrode is separated by a minimum of 10 m from any other earth electrode of a device that could be a noise source.

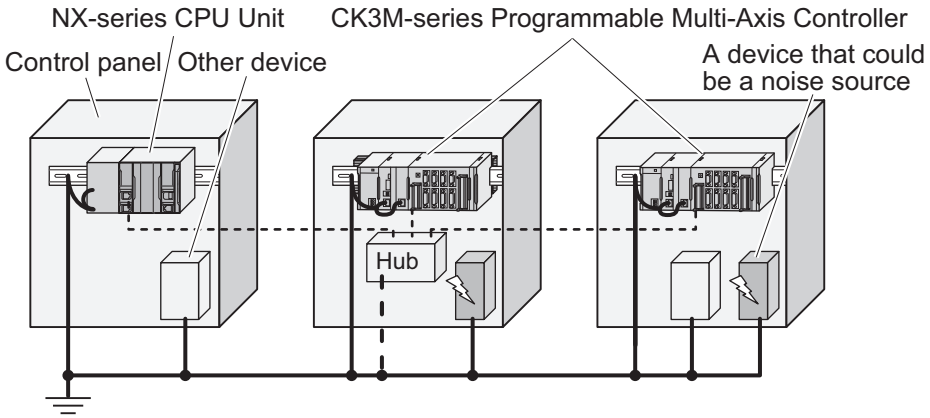


b. Installation by connecting devices and noise sources to a common earth electrode
This is an earthing method to connect the device that is connected with a communications cable, other devices, and a device that could be a noise source, to a common earth electrode.
This earthing method is not recommended,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



● Daisy Chain

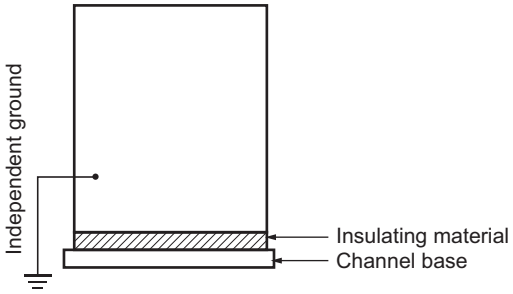
This is an earthing method to connect the device that is connected with a communications cable, other devices, and a device that could be a noise source using a daisy-chain topology to a common earth electrode.
This earthing method is not recommended because the device that could be a noise source may interfere electromagnetically with other devices.



Precautions for Grounding

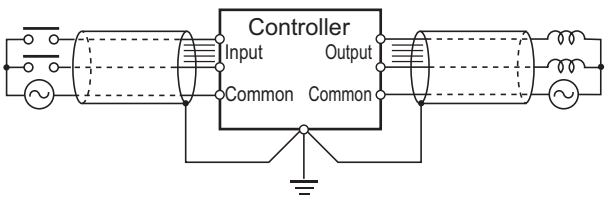
● General Precautions

- To prevent electrical shock, do not connect devices to ground poles (or steel frames) with non-equalized 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.

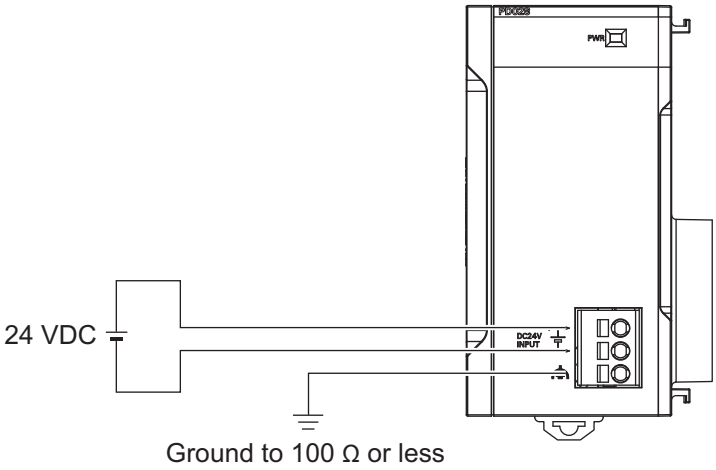
5

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

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

Precautions for Correct Use

Always wire the CPU Rack and Expansion Rack to the same power supply.

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 (mm^2 (AWG))	Crimping Tool (applicable wire size given in parentheses)
Phoenix Contact	AI0,25-8	0.25 (#24)	Phoenix Contact CRIMPFOX 6 (0.25 to 6 mm^2, AWG24 to 10)
	AI0,5-8	0.5 (#20)	
	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 PZ6 Roto (0.14 to 6 mm^2, AWG26 to 10)
	H0.34/12	0.34 (#22)	
	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^2	8 mm
Twisted wire	0.2 to 2.5 mm^2	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 Ω or less, and when possible use a separate ground from those of other devices.
- If using an independent ground is not possible, then use a common ground. Connect to the ground pole of the other device.
- Never use a common ground particularly with a motor, inverter, or other type of high-power equipment. Use an independent ground so that the devices do not affect each other.
- To reduce the risk of receiving an electric shock, do not connect devices to ground poles to which multiple devices are connected.
- Use a ground pole as close to the Power Supply Unit as possible and keep the ground line as short as possible.

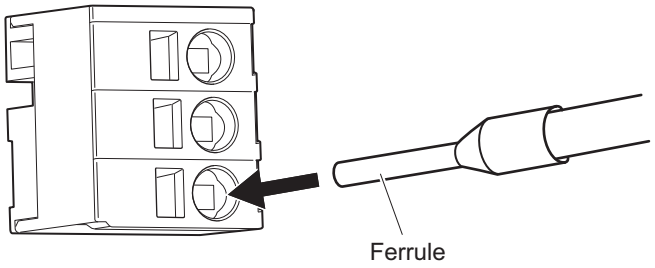
5-1-5 Required Tools

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.

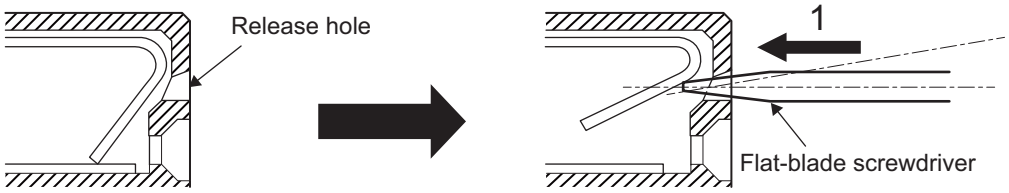


After you make a connection, make sure that the ferrule is securely connected to the terminal block.

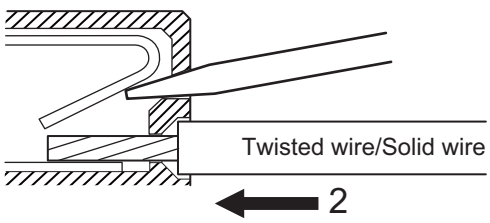
5-1-7 Connecting Twisted Wires/Solid Wires

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

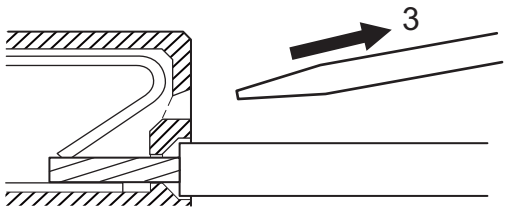
1 Press a flat-blade screwdriver straight into the release hole.
If you press in the screwdriver correctly, you will feel the spring in the release hole, and the screw driver will begin to incline.



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.

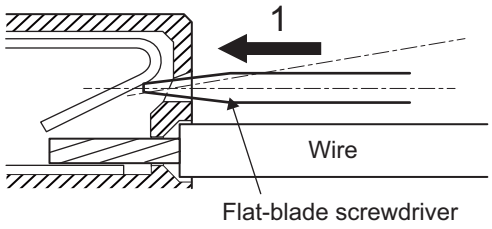
Precautions for Safe Use

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

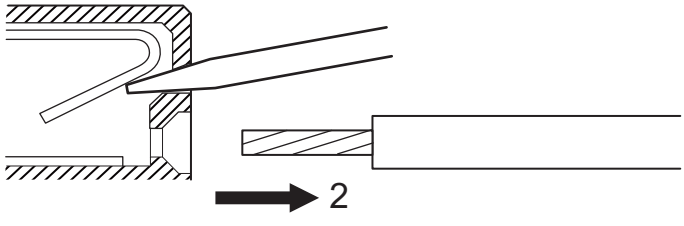
5-1-8 Removing Wires

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.

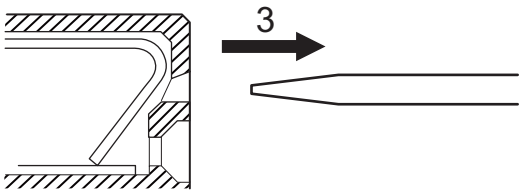
1 Press a flat-blade screwdriver straight into the release hole.
If you press in the screwdriver correctly, you will feel the spring in the release hole, and the screw driver will begin to incline.



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 CPU Unit Wiring

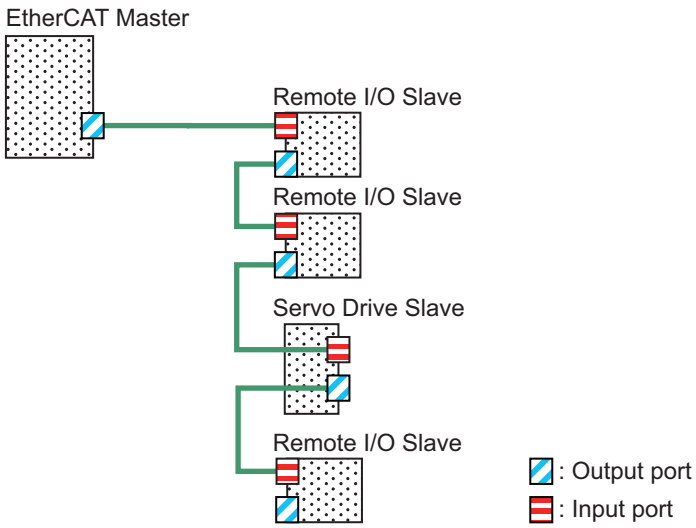
5-2-1 Laying the EtherCAT Network

This section describes how to install EtherCAT networks.

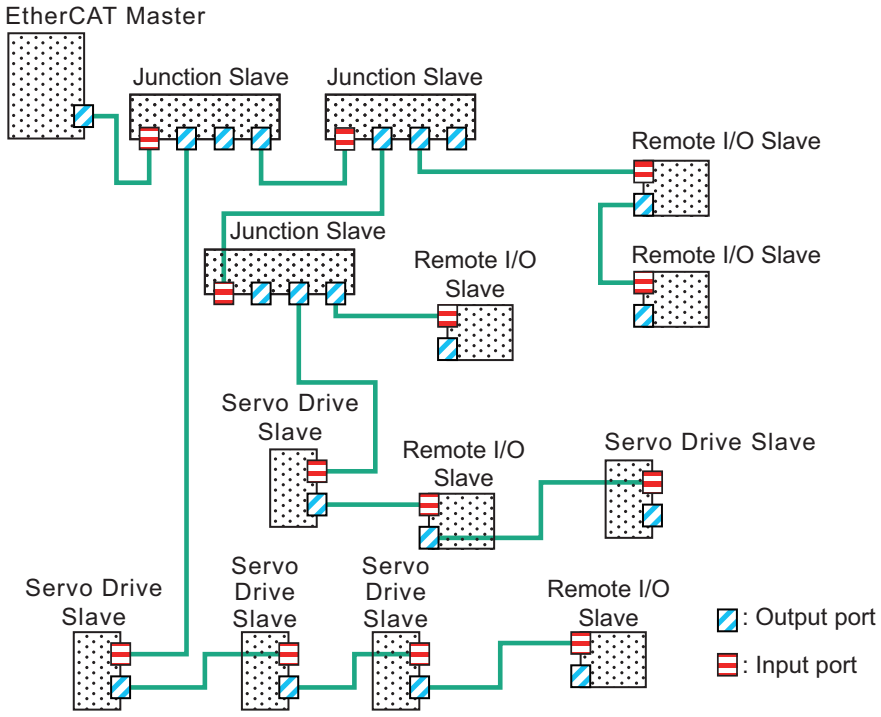
Supported Network Topologies

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



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.

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

The table below lists 4-pair cables with 27 AWG conductors.

Product name	Manufacturer	Cable length (m) *1	Model	Contact information
Cable with Connectors on Both Ends (RJ45/RJ45) Standard RJ45 connector type 	OMRON Corporation	0.3	XS6W-6LSZH8SS30CM-Y *2	OMRON Customer Service Center TEL: 0120-919-066
		0.5	XS6W-6LSZH8SS50CM-Y *2	
		1	XS6W-6LSZH8SS100CM-Y *2	
		10	XS6W-6LSZH8SS1000CM-Y *2	

*1. For the latest list of the Cables, refer to the *Industrial Ethernet Connectors Catalog (Cat. No. G019)*.
*2. The Cables are single-shielded, but the communications and noise characteristics are ensured to satisfy the standard values.

The table below lists 2-pair cables with 22 AWG conductors.

Product name	Manufacturer	Cable length (m) *1	Model	Contact information
Cable with Connectors on Both Ends (RJ45/RJ45) Rugged RJ45 connector type 	OMRON Corporation	0.3	XS5W-T421-AMD-K	OMRON Customer Service Center TEL: 0120-919-066
		0.5	XS5W-T421-BMD-K	
		1	XS5W-T421-CMD-K	
		2	XS5W-T421-DMD-K	
		5	XS5W-T421-GMD-K	
		10	XS5W-T421-JMD-K	
Cable with Plugs on Both Ends (M12/M12) Double-shielded cable M12/Smartclick connector type 	OMRON Corporation	0.5	XS5W-T421-BM2-SS	
		1	XS5W-T421-CM2-SS	
		2	XS5W-T421-DM2-SS	
		3	XS5W-T421-EM2-SS	
		5	XS5W-T421-GM2-SS	
		10	XS5W-T421-JM2-SS	
Cable with Plugs on Both Ends (M12/RJ45) Double-shielded cable M12/Smartclick connector type Rugged RJ45 connector type 	OMRON Corporation	0.5	XS5W-T421-BMC-SS	
		1	XS5W-T421-CMC-SS	
		2	XS5W-T421-DMC-SS	
		3	XS5W-T421-EMC-SS	
		5	XS5W-T421-GMC-SS	
		10	XS5W-T421-JMC-SS	

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

● Cables and Connectors

The table below lists 4-pair cables with 24 AWG conductors and connectors.

Product name	Manufacturer	Model	Contact information
Cables	Hitachi Metals, Ltd.	NETSTAR-C5E SAB 0.5 × 4P *1	Planning Department, Kanetsu Co., Ltd. TEL: 075-662-0996
	Kuramo Electric Co., Ltd.	KETH-SB *1	Kuramo Electric Co., Ltd. TEL: 03-5644-7601 TEL: 06-6231-8151
	SWCC Showa Cable Systems Co., Ltd.	FAE-5004 *1	SWCC Showa Cable Systems Co., Ltd. TEL: 03-3597-7117
	JMACS Japan Co., Ltd.	IETP-SB *1	JMACS Japan Co., Ltd. TEL: 03-3239-5204 TEL: 06-4796-0080

Product name	Manufacturer	Model	Contact information
RJ45 Connectors	Panduit Corporation	MPS588*1	Panduit Corporation US Headquarters Osaka Branch Office

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

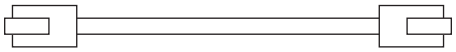
The table below lists 2-pair cables with 22 AWG conductors and connectors.

Product name	Manufacturer	Model	Contact information
Cables	Kuramo Electric Co., Ltd.	KETH-PSB-OMR *1	Kuramo Electric Co., Ltd. TEL: 03-5644-7601 TEL: 06-6231-8151
	SWCC Showa Cable Systems Co., Ltd.	FAE-5002 *1	SWCC Showa Cable Systems Co., Ltd. TEL: 03-3597-7117
	JMACS Japan Co., Ltd.	PNET/B *1	JMACS Japan Co., Ltd. TEL: 03-3239-5204 TEL: 06-4796-0080
RJ45 Assembly Connectors 	OMRON Corporation	XS6G-T421-1 *1	OMRON Customer Service Center TEL: 0120-919-066

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

● Attaching the Connectors to the Cable and Pin Assignments

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



Pin No.	Wire color
1	White-Green
2	Green
3	White-Orange
4	Blue
5	White-Blue
6	Orange
7	White-Brown
8	Brown
Hood	Shield

Wire color	Pin No.
White-Green	1
Green	2
White-Orange	3
Blue	4
White-Blue	5
Orange	6
White-Brown	7
Brown	8
Shield	Hood

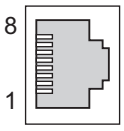
Note 1. Connect the cable shield to the connector hood at both ends of the cable.

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.

The connector specifications are as follows.

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

The pin assignments are as follows.



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

5-2-2 Laying the Ethernet Network

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.

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 EtherNet/IP is prioritized. Failure detection: Broadcast storm, LSI error detection, 10/100BASE-TX, Auto-Negotiation	3
	W4S1-05B		5
	W4S1-05C		
Cisco Systems Inc.	Contact the manufacturer.		
CONTEC Co., Ltd.	Contact the manufacturer.		
Phoenix Contact	Contact the manufacturer.		

● Twisted-pair Cables and Connectors

The table below lists 4-pair cables with 24 AWG conductors and connectors 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. TEL: 075-662-0996
	Kuramo Electric Co., Ltd.	KETH-SB *1	Kuramo Electric Co., Ltd. TEL: 03-5644-7601 TEL: 06-6231-8151
	SWCC Showa Cable Systems Co., Ltd.	FAE-5004 *1	SWCC Showa Cable Systems Co., Ltd. TEL: 03-5404-6966
RJ45 Connectors	Panduit Corporation	MPS588 *1	Panduit Corporation US Headquarters Osaka Branch Office

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

The table below lists 2-pair cables with 22 AWG conductors and connectors for 100BASE-TX.

Product name	Manufacturer	Model	Contact information
Cables	Kuramo Electric Co., Ltd.	KETH-PSB-OMR *1	Kuramo Electric Co., Ltd. TEL: 03-5644-7601 TEL: 06-6231-8151
	SWCC Showa Cable Systems Co., Ltd.	FAE-5002 *1	SWCC Showa Cable Systems Co., Ltd. TEL: 03-5404-6966
	JMACS Japan Co., Ltd.	PNET/B *1	JMACS Japan Co., Ltd. TEL: 03-3239-5204 TEL: 06-4796-0080
RJ45 Assembly Connectors	OMRON Corporation	XS6G-T421-1 *1	OMRON Customer Service Center TEL: 0120-919-066

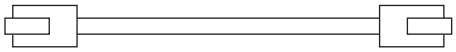
*1. We recommend that you use combinations of the above cables and connectors.

The table below lists 4-pair cables with 0.5-mm conductors and connectors for 100BASE-TX.

Product name	Manufacturer	Model	Contact information
Cables	Fujikura Ltd.	F-LINK-E 0.5 mm × 4 Pairs	Planning Department, Kanetsu Co., Ltd. TEL: 075-662-0996
RJ45 Connectors	Panduit Corporation	MPS588	Panduit Corporation US Headquarters Osaka Branch Office

● Attaching the Connectors to the Cable and Pin Assignments

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



Pin No.	Wire color	Wire color	Pin No.
1	White-Green	White-Green	1
2	Green	Green	2
3	White-Orange	White-Orange	3
4	Blue	Blue	4
5	White-Blue	White-Blue	5
6	Orange	Orange	6
7	White-Brown	White-Brown	7
8	Brown	Brown	8
Hood	Shield	Shield	Hood

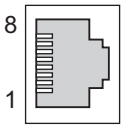
Note 1. Connect the cable shield to the connector hood at both ends of the cable.

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.

The connector specifications are as follows.

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

The pin assignments are as follows.



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

5-2-3 Watchdog Timer Output Wiring

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^2 (AWG))	Crimping Tool (applicable wire size given in parentheses)
Phoenix Contact	AI0,25-8	0.25 (#24)	Phoenix Contact CRIMPFOX 6 (0.25 to 6 mm^2, AWG24 to 10)
	AI0,5-8	0.5 (#20)	
	AI0,75-8	0.75 (#18)	
Weidmüller	H0.25/12	0.25 (#24)	Weidmüller PZ6 Roto (0.14 to 6 mm^2, AWG26 to 10)
	H0.34/12	0.34 (#22)	
	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^2	8 mm
Twisted wire		

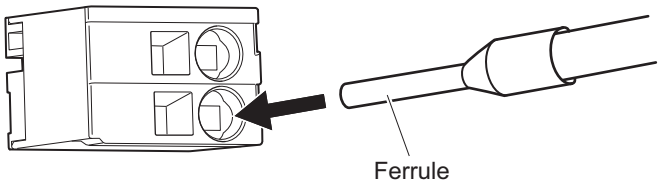
Required Tools

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 into the release hole.

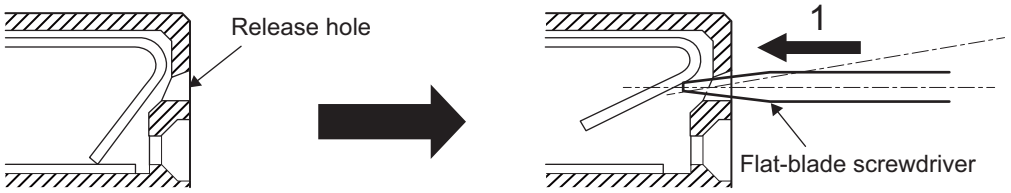


After you make a connection, make sure that the ferrule is securely connected to the terminal block.

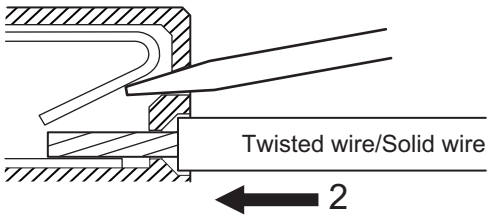
Connecting Twisted Wires/Solid Wires

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

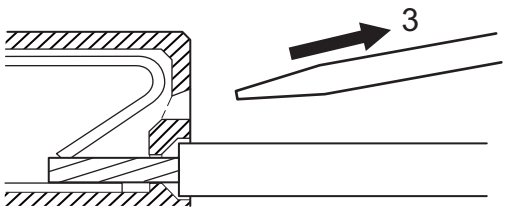
1 Press a flat-blade screwdriver straight into the release hole.
If you press in the screwdriver correctly, you will feel the spring in the release hole, and the screw driver will begin to incline.



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.

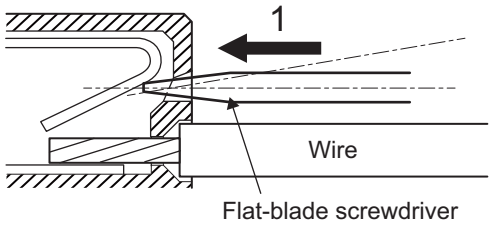
Precautions for Safe Use

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

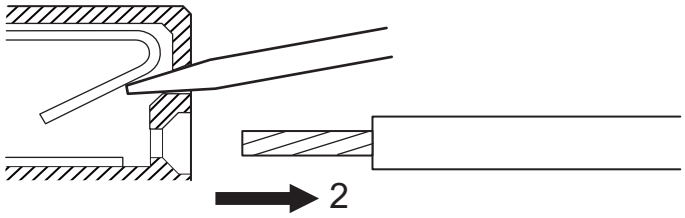
Removing Wires

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.

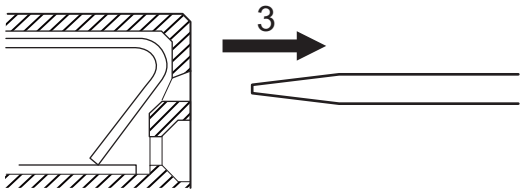
1 Press a flat-blade screwdriver straight into the release hole.
If you press in the screwdriver correctly, you will feel the spring in the release hole, and the screw driver will begin to incline.



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.

5-2-4 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 3-8 for information on the recommended USB memory devices.

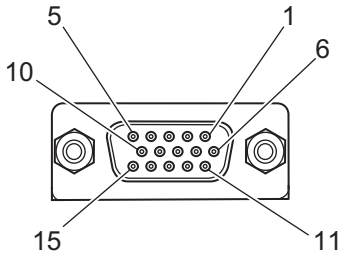
5-3 Axis Interface Unit Wiring

5-3-1 Encoder Connector Wiring

Connector Arrangement for Digital Quadrature Encoder

This section describes the connector arrangement for the CK3W-AX1313□/-AX1414□/-AX1515□ Units.

The Unit side connector is a high-density D-sub 15-pin female connector (MIL-C-24308 compliant, lock screw #4-40 UNC).



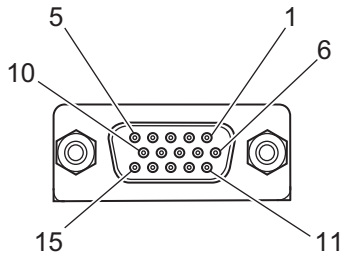
Pin No.	Symbol	Digital Quadrature Encoder + UVW signal		Serial Encoder		Digital Quadrature Encoder + Serial Encoder	
1	CHA	Encoder A+	Input	Not wired	-	Encoder A+	Input
2	CHB	Encoder B+	Input	Not wired	-	Encoder B+	Input
3	CHC	Encoder C+	Input	Not wired	-	Encoder C+	Input
4	CHU	Hall sensor U	Input	Serial 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 Power Supply (+5 VDC)	Output	Encoder Power Supply (+5 VDC)	Output
12	ENCPWR	Encoder Power Supply (+5 VDC)	Output	Encoder Power 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

Pin No.	Symbol	Digital Quadrature Encoder + UVW signal		Serial Encoder		Digital Quadrature Encoder + Serial Encoder	
14	GND	Encoder Power Supply (GND)	Common	Encoder Power Supply (GND)	Common	Encoder Power Supply (GND)	Common
15	OutFlagB*1	OutFlagB	Output	OutFlagB	Output	OutFlagB	Output
Shell	SHELL	Shield		Shield		Shield	

*1. The OutFlagB output function is not available with the CK3W-AX1313□ Units.

Connector Arrangement for Sinusoidal Encoder

This section describes the connector arrangement for the CK3W-AX2323□ Units.
The Unit side connector is a high-density D-sub 15-pin female connector (MIL-C-24308 compliant, lock screw #4-40 UNC).



Pin No.	Symbol	Sinusoidal encoder + UVW signal		Serial Encoder + UVW signal		Sinusoidal encoder + Serial Encoder	
1	SIN	SIN+	Input	Not wired	-	SIN+	Input
2	COS	COS+	Input	Not wired	-	COS+	Input
3	INDEX	INDEX+	Input	Not wired	-	INDEX+	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	SIN/	SIN-	Input	Not wired	-	SIN-	Input
7	COS/	COS-	Input	Not wired	-	COS-	Input
8	INDEX/	INDEX-	Input	Not wired	-	INDEX-	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 Power Supply (+5 VDC)	Output	Encoder Power Supply (+5 VDC)	Output
12	ENCPWR	Encoder Power Supply (+5 VDC)	Output	Encoder Power Supply (+5 VDC)	Output	Encoder Power Supply (+5 VDC)	Output
13	GND	Encoder Power Supply (GND)	Output	Encoder Power Supply (GND)	Output	Encoder Power Supply (GND)	Output
14	GND	Encoder Power Supply (GND)	Output	Encoder Power Supply (GND)	Output	Encoder Power Supply (GND)	Output

Pin No.	Symbol	Sinusoidal encoder + UVW signal		Serial Encoder + UVW signal		Sinusoidal encoder + Serial Encoder	
15	NC	Not wired	-	Not wired	-	Not wired	-
Shell	SHELL	Shield		Shield		Shield	

Precautions for Correct Use

Do not connect a digital quadrature encoder to a CK3W-AX2323□ Unit. If you connect a digital quadrature encoder, the Unit may be damaged.

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.

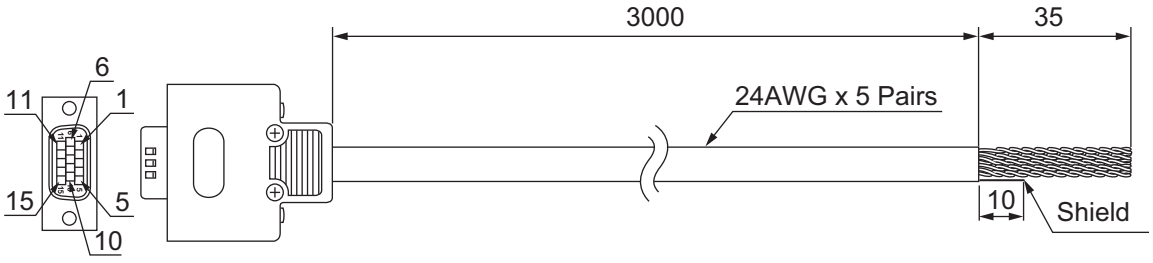
Type	Model	Length
For Digital Quadrature Encoder	CK3W-CAED03A	3 m
For Sinusoidal Encoder	CK3W-CAEA03A	3 m
For Serial Encoder	CK3W-CAES03A	3 m
For “Digital Quadrature Encoder + UVW Signal” or “Digital Quadrature Encoder + Serial Encoder”	CK3W-CAEW03A	3 m
For “Sinusoidal Encoder + UVW Signal” or “Sinusoidal Encoder + Serial Encoder”	CK3W-CAEAW03A	3 m

Additional Information

You may use a self-made cable.
When you create a self-made cable, use the following cable to block the effects of noise.

- Use a twisted-pair shielded cable for digital quadrature encoder, serial encoder, or UVW signal connection.
- Use a shielded twisted-pair cable with an overall shield and pair shields for sinusoidal encoder connection.

● For 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*1	Pink	Black	Encoder A+ Serial Encoder DAT+
	6, 10*2	Pink	Red	Encoder A- Serial Encoder DAT-

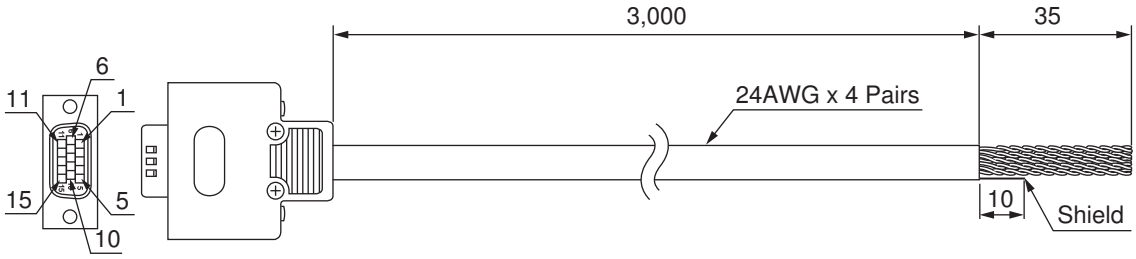
Type	Pin No.	Cable color	Mark	Signal
Pair 3	2	Green	Black	Encoder B+
	7	Green	Red	Encoder B-
Pair 4	3	Orange	Black	Encoder C+
	8	Orange	Red	Encoder C-
Pair 5	15	Gray	Black	OutFlagB
	14	Gray	Red	GND

*1. Inside the connector, Pin 1 and Pin 5 are short-circuited.

*2. Inside the connector, Pin 6 and Pin 10 are short-circuited.

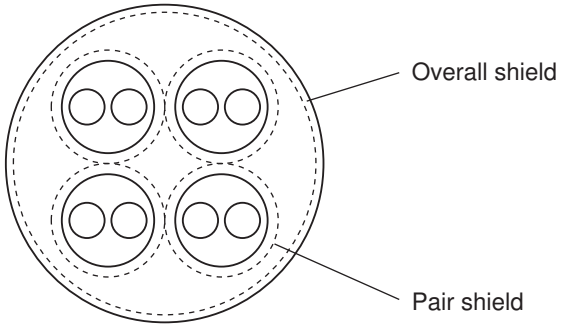
Note The cable shield is connected to the connector shell of the encoder connector.
When using this cable, set to *OutFlagD = 1*, and disable the serial encoder DAT terminating resistance.

● For Sinusoidal Encoder

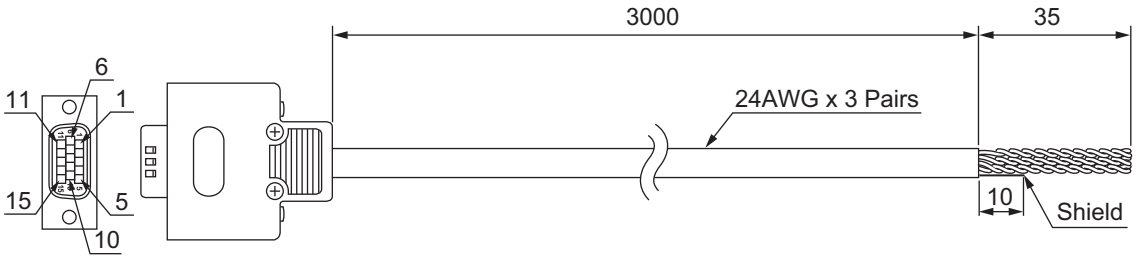


Type	Pin No.	Cable color	Signal
Pair 1	11	Black	Encoder Power Supply (+5 VDC)
	13	Blue	Encoder Power Supply (GND)
Pair 2	1	Black	SIN+
	6	Red	SIN-
Pair 3	2	Black	COS+
	7	White	COS-
Pair 4	3	Black	INDEX+
	8	Green	INDEX-

Note The cable shield consists of an overall shield and pair shields.
The overall shield is connected to the connector shell of the encoder connector.
The pair shields are connected to the Encoder Power Supply (GND) pin.



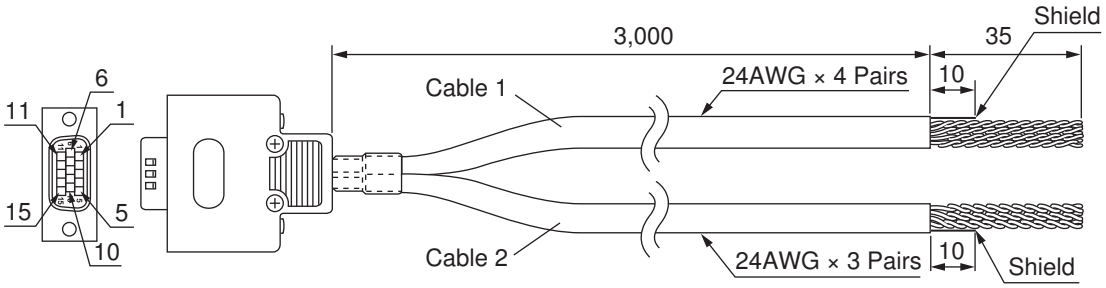
● For Serial Encoder



Type	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

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	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.

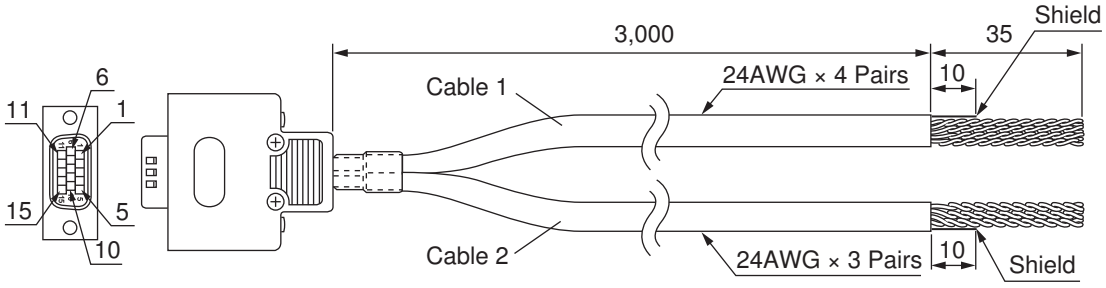
Cable 2

Type	Pin No.	Cable color	Mark	Signal	
				U, V, W	Serial Encoder
Pair 1	12	Blue	Black	Encoder Power Supply (+5 VDC)	
	14	Blue	Red	Encoder Power Supply (GND)	

Type	Pin No.	Cable color	Mark	Signal	
				U, V, W	Serial Encoder
Pair 2	4	Pink	Black	Hall sensor U	Serial Encoder CLK+
	9	Pink	Red	Hall sensor V	Serial Encoder CLK-
Pair 3	5	Green	Black	Hall sensor W	Serial Encoder DAT+
	10	Green	Red	Hall sensor T	Serial Encoder DAT-

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

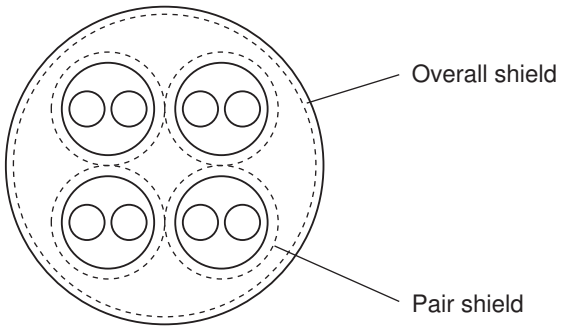
● For "Sinusoidal Encoder + UVW Signal" or "Sinusoidal Encoder + Serial Encoder"



Cable 1

Type	Pin No.	Cable color	Signal
Pair 1	11	Black	Encoder Power Supply (+5 VDC)
	13	Blue	Encoder Power Supply (GND)
Pair 2	1	Black	SIN+
	6	Red	SIN-
Pair 3	2	Black	COS+
	7	White	COS-
Pair 4	3	Black	INDEX+
	8	Green	INDEX-

Note The cable shield consists of an overall shield and pair shields.
The overall shield is connected to the connector shell of the encoder connector.
The pair shields are connected to the Encoder Power Supply (GND) pin.



Cable 2

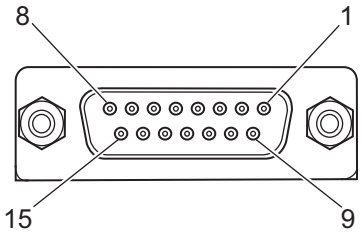
Type	Pin No.	Cable color	Signal	
			U, V, W	Serial Encoder
Pair 1	12	Blue	Encoder Power Supply (+5 VDC)	
	14	White	Encoder Power Supply (GND)	
Pair 2	4	Black	Hall sensor U	Serial Encoder CLK+
	9	Green	Hall sensor V	Serial Encoder CLK-
Pair 3	5	Yellow	Hall sensor W	Serial Encoder DAT+
	10	Brown	Hall sensor T	Serial Encoder DAT-

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

5-3-2 Amplifier Connector Wiring

Connector Arrangement of FilteredPWM/TrueDAC Type Amplifier Connector

This section describes the connector arrangement for the CK3W-AX1414□/-AX1515□ Units.
The Unit side connector is a D-sub 15-pin female connector (MIL-C-24308 compliant, lock screw #4-40 UNC).



Pin No.	Symbol	During analog output		During pulse output	
1	DACA+	Analog output A+	Output	Not wired	-
2	DACB+	Analog output B+ *1	Output	Not wired	-
3	AGND	Analog GND	Common	Not wired	-
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	-	GND	Common
15	AE_COM	Amp enable Common	Common	Amp enable Common	Common
Shell	SHELL	Shield		Shield	

*1. In the FilteredPWM type, there is no analog output B.

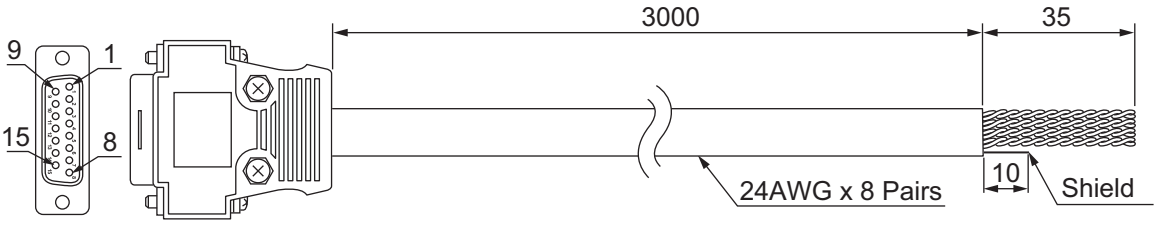
Dedicated Cable

● For FilteredPWM/TrueDAC type

This section describes the cable used for the CK3W-AX1414□/-AX1515□ Units.
The dedicated cable for wiring to the FilteredPWM/TrueDAC type 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.

Type	Model	Length
For FilteredPWM/TrueDAC type	CK3W-CAA03A	3 m



Type	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		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.

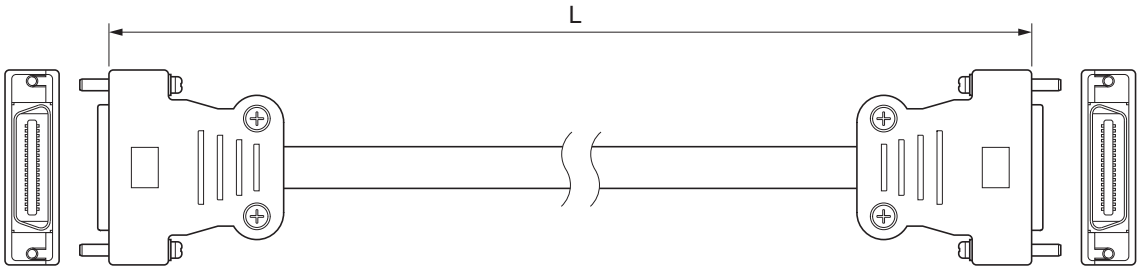
Additional Information

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.

● For DirectPWM type

This section describes cables used for the CK3W-AX1313□/-AX2323□ Units.
Be sure to use the following cables for the DirectPWM type amplifier connector.

Type	Model	Length (L)
For DirectPWM type	CK3W-CAAD009A	0.9 m
	CK3W-CAAD018A	1.8 m
	CK3W-CAAD036A	3.6 m



5-3-3 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.

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.

Manufacturer	Ferrule model	Applicable wire (mm^2 (AWG))	Crimping Tool (applicable wire size given in parentheses)
Phoenix Contact	AI0,5-10	0.5 (#20)	Phoenix Contact CRIMPFOX 6 (0.25 to 6 mm^2, AWG24 to 10)
	AI0,75-10	0.75 (#18)	
	AI1,0-10	1.0 (#18)	
	AI1,5-10	1.5 (#16)	
Weidmüller	H0.5/16	0.5 (#20)	Weidmüller PZ6 Roto (0.14 to 6 mm^2, AWG26 to 10)
	H0.75/16	0.75 (#18)	
	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^2	10 mm
Twisted wire		

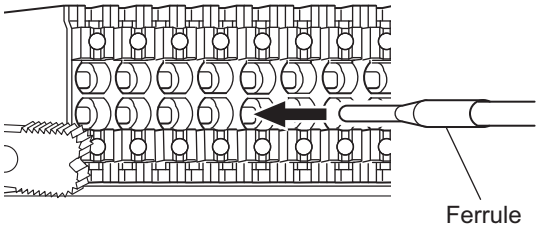
● Required Tools

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.

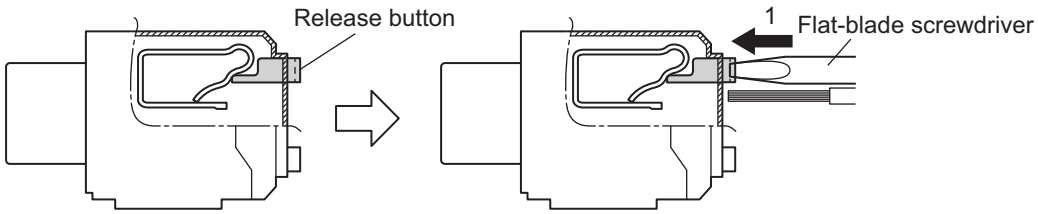


After you make a connection, make sure that the ferrule is securely connected to the terminal block.

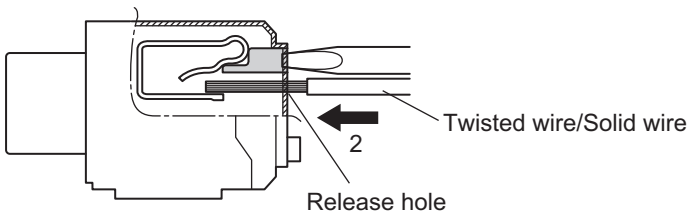
● Connecting Twisted Wires/Solid Wires

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

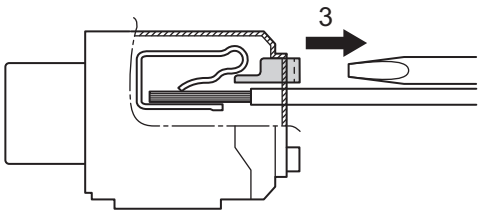
1 Press a flat-blade screwdriver straight against the release button from the terminal block front.



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

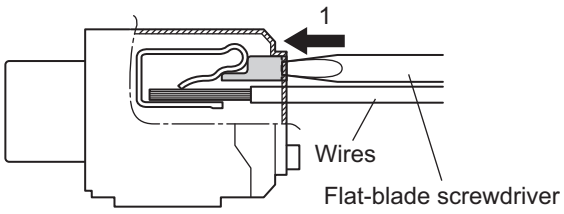
- Make sure that all wiring is correct.
- Do not bend the cable forcibly. Doing so may break the cables.

● Removing Wires

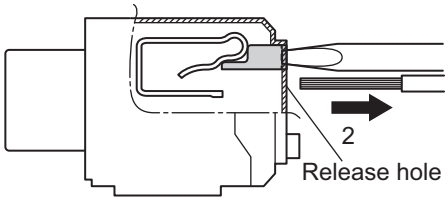
Use the following procedure to remove the wires from the terminal block.
The removal method is the same for ferrules, twisted wires, and solid wires.

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

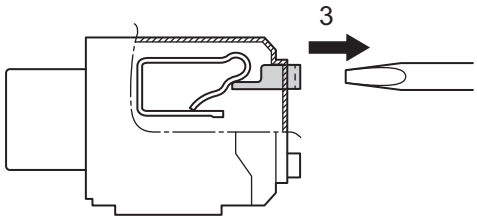
1 Press a flat-blade screwdriver straight against the release button from the terminal block front.



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.



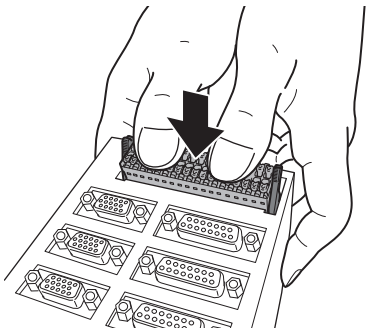
Precautions for Safe Use

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

● Installing a Terminal Block

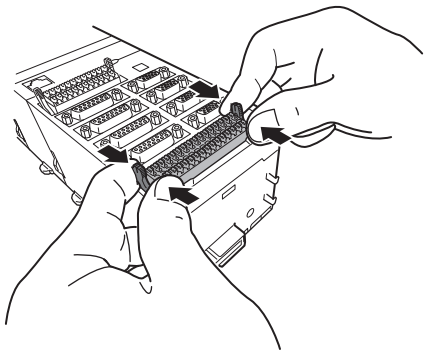
Insert the terminal block into the main body, and press hard to click the terminal block into place on the Unit.

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.



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

$V_{ON} \leq V_{CC} - V_R$

V_{ON}: ON voltage of general digital input and flag input

V_{CC}: Input voltage of general digital input and flag input

V_R: 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) ≤ I_{ON} ≤ 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:

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

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

V_{CC}: Input voltage of general digital input and flag input

V_R: Output residual voltage of sensor

I_{ON}: Input current of general digital input and flag input

I_{OUT}: 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:

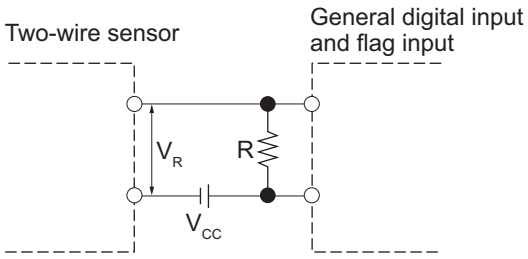
$I_{OFF} \geq I_{leak}$

When I_{leak} is greater than I_{OFF}, connect a bleeder resistor R.

Use the following equation to calculate the bleeder resistance constant.

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

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



V_{CC}: Power supply voltage
V_{ON}: ON voltage of general digital input and flag input
V_{OFF}: OFF voltage of general digital input and flag input
I_{ON}: ON current of general digital input and flag input
I_{OFF}: OFF current of general digital input and flag input
V_R: Output residual voltage of sensor
I_{OUT}: Sensor control output (load current)
I_{leak}: Sensor leakage current
R: Bleeder resistor

● 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.

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.

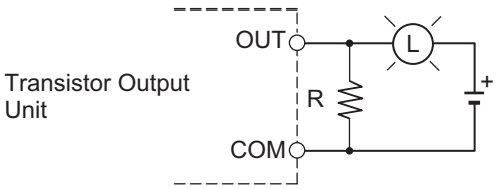
● Precautions for Inrush Current

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.

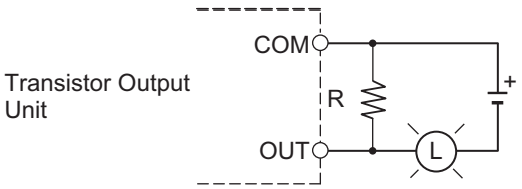
In countermeasure 1, the current consumption from the I/O power supply is increased although the voltage supplied to the load L is not decreased.
In countermeasure 2, the voltage supplied to the load L is decreased although the current consumption from the I/O power supply is not increased.
Select the appropriate countermeasures according to the operating conditions.

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

NPN type



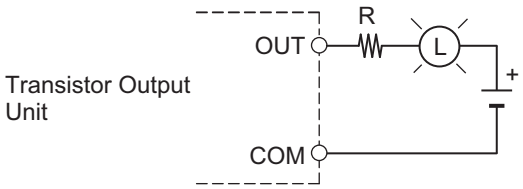
PNP type



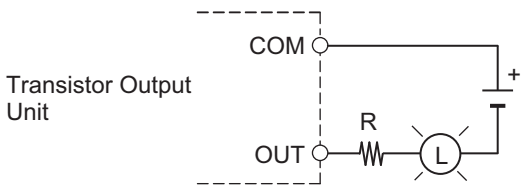
Countermeasure 2

Mount a limiting resistor.

NPN type



PNP type



5-4 Digital I/O Unit Wiring

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

5-4-1 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.

Manufacturer	Ferrule model	Applicable wire (mm^2 (AWG))	Crimping Tool (applicable wire size given in parentheses)
Phoenix Contact	AI0,5-10	0.5 (#20)	Phoenix Contact CRIMPFOX 6 (0.25 to 6 mm^2, AWG24 to 10)
	AI0,75-10	0.75 (#18)	
	AI1,0-10	1.0 (#18)	
	AI1,5-10	1.5 (#16)	
Weidmüller	H0.5/16	0.5 (#20)	Weidmüller PZ6 Roto (0.14 to 6 mm^2, AWG26 to 10)
	H0.75/16	0.75 (#18)	
	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^2	10 mm
Twisted wire		

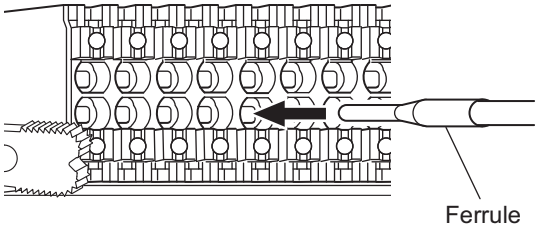
Required Tools

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.

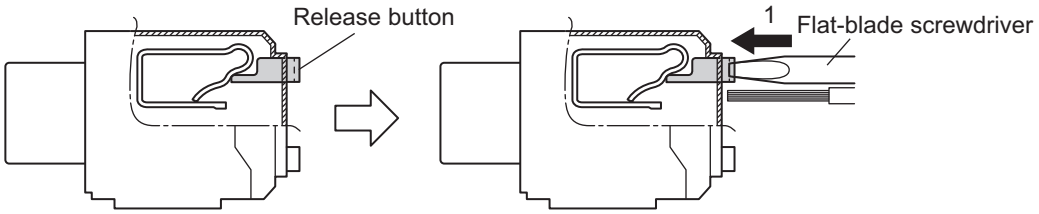


After you make a connection, make sure that the ferrule is securely connected to the terminal block.

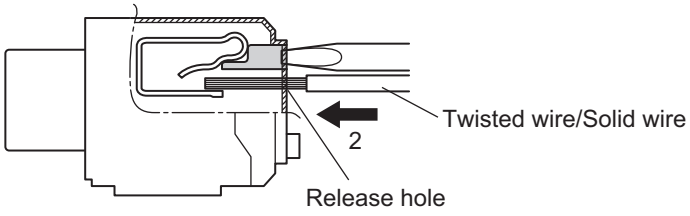
Connecting Twisted Wires/Solid Wires

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

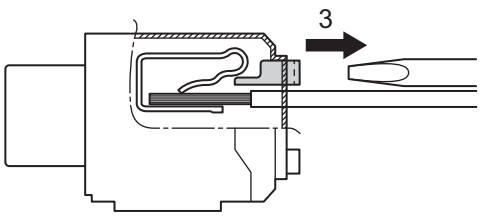
1 Press a flat-blade screwdriver straight against the release button from the terminal block front.



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

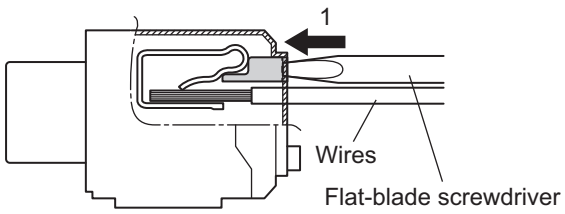
- Make sure that all wiring is correct.
- Do not bend the cable forcibly. Doing so may break the cables.

Removing Wires

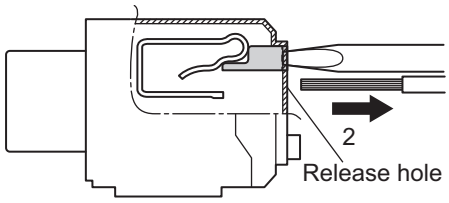
Use the following procedure to remove the wires from the terminal block.
The removal method is the same for ferrules, twisted wires, and solid wires.

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

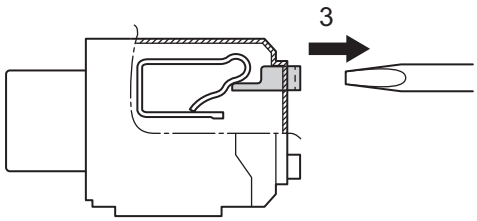
1 Press a flat-blade screwdriver straight against the release button from the terminal block front.



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.



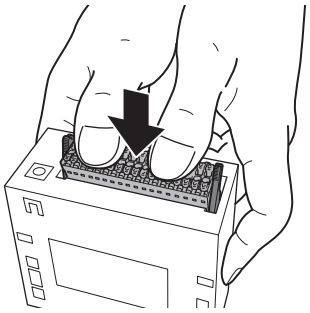
Precautions for Safe Use

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

Installing a Terminal Block

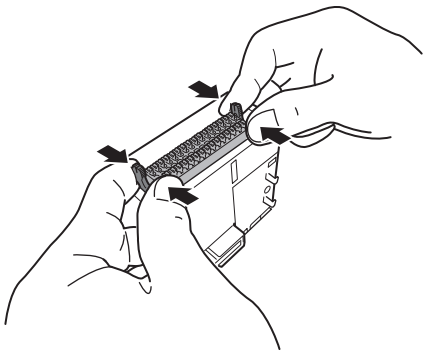
Insert the terminal block into the main body, and press hard to click the terminal block into place on the Unit.

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.



5-4-2 Precautions When Connecting a Two-wire DC Sensor

When a two-wire sensor is used with a digital input, check that the following conditions are met. Failure to meet these conditions may result in operating errors.

Relation between ON Voltage of the Digital Input and Sensor Residual Voltage

$V_{ON} \leq V_{CC} - V_R$

V_{ON}: ON voltage of digital input

V_{CC}: Input voltage of digital input

V_R: Output residual voltage of sensor

Relation between Input Current to the Digital Input and Sensor Control Output (Load Current)

I_{OUT} (min) ≤ I_{ON} ≤ I_{OUT} (max)

Precautions for Correct Use

The digital input is 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:

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

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

V_{CC}: Input voltage of digital input
V_R: Output residual voltage of sensor
I_{ON}: Input current of digital input
I_{OUT}: Sensor control output (load current)

Relation between OFF Current of the Digital Input and Sensor Leakage Current

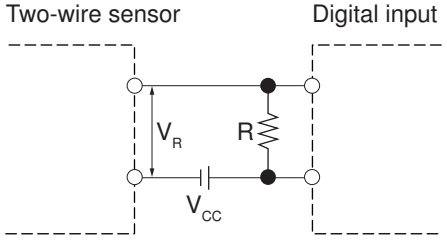
The digital input cannot detect sensor output OFF unless the following conditions are satisfied:

$I_{OFF} \geq I_{leak}$

When I_{leak} is greater than I_{OFF}, connect a bleeder resistor R.
Use the following equation to calculate the bleeder resistance constant.

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

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



V_{CC}: Power supply voltage V_R: Output residual voltage of sensor

V_{ON}: ON voltage of digital input
V_{OFF}: OFF voltage of digital input
I_{ON}: ON current of digital input
I_{OFF}: OFF current of digital input
I_{OUT}: Sensor control output (load current)
I_{leak}: Sensor leakage current
R: Bleeder resistor

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.

5-4-3 Precautions When Connecting to 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

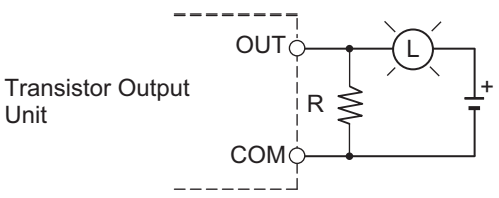
When you use general digital output, steps must be taken to avoid damage to the output transistor when connecting a load with a high inrush current such as an incandescent lamp.
Use either of the following methods to reduce the inrush current.

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.

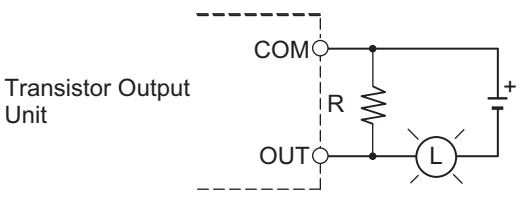
● Countermeasure 1

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

NPN type



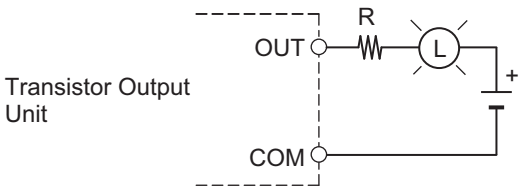
PNP type



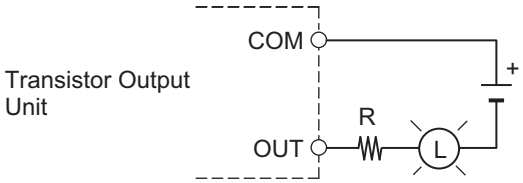
● Countermeasure 2

Mount a limiting resistor.

NPN type



PNP type



5-5 Analog Input Unit Wiring

This section describes the wiring for the analog input connection terminal block.

5-5-1 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.

Manufacturer	Ferrule model	Applicable wire (mm^2 (AWG))	Crimping Tool (applicable wire size given in parentheses)
Phoenix Contact	AI0,5-10	0.5 (#20)	Phoenix Contact CRIMPFOX 6 (0.25 to 6 mm^2, AWG24 to 10)
	AI0,75-10	0.75 (#18)	
	AI1,0-10	1.0 (#18)	
	AI1,5-10	1.5 (#16)	
Weidmüller	H0.5/16	0.5 (#20)	Weidmüller PZ6 Roto (0.14 to 6 mm^2, AWG26 to 10)
	H0.75/16	0.75 (#18)	
	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^2	10 mm
Twisted wire		

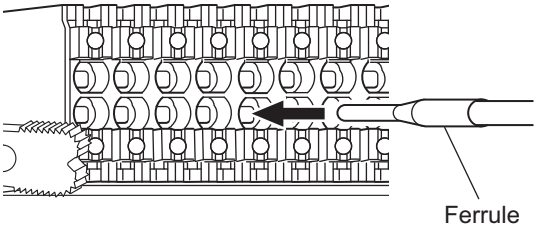
Required Tools

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.

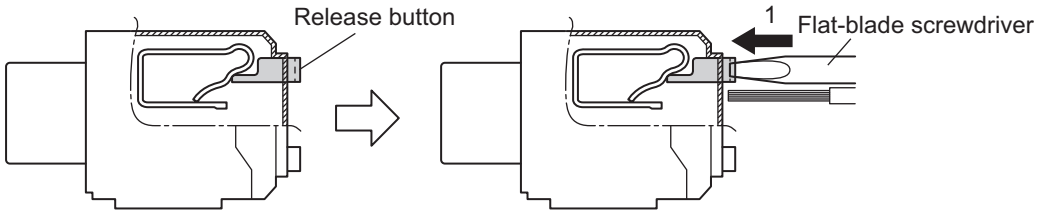


After you make a connection, make sure that the ferrule is securely connected to the terminal block.

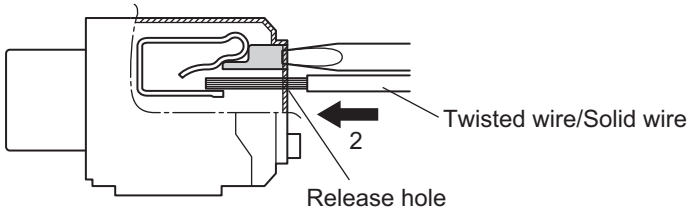
Connecting Twisted Wires/Solid Wires

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

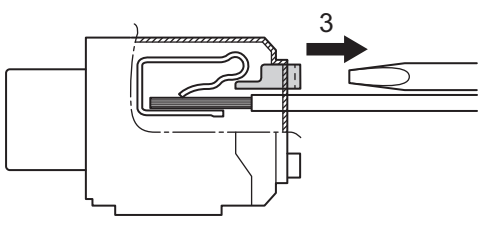
1 Press a flat-blade screwdriver straight against the release button from the terminal block front.



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

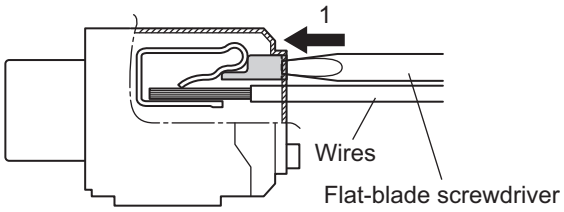
- Make sure that all wiring is correct.
- Do not bend the cable forcibly. Doing so may break the cables.

Removing Wires

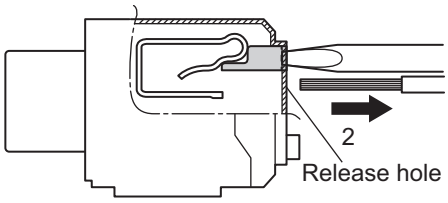
Use the following procedure to remove the wires from the terminal block.
The removal method is the same for ferrules, twisted wires, and solid wires.

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

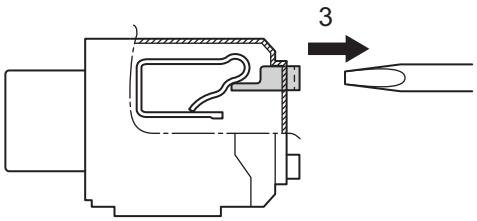
1 Press a flat-blade screwdriver straight against the release button from the terminal block front.



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.



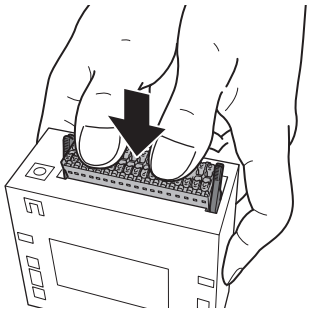
Precautions for Safe Use

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

Installing a Terminal Block

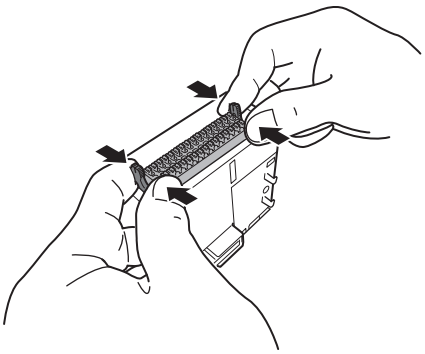
Insert the terminal block into the main body, and press hard to click the terminal block into place on the Unit.

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.



5-6 Expansion Master Unit and Expansion Slave Unit Wiring

For connection between the Expansion Master Unit and the Expansion Slave Unit, be sure to use the following expansion cable.

Type	Model	Length
Expansion cable	CK3W-CAX003A	0.3 m

6

Troubleshooting

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

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

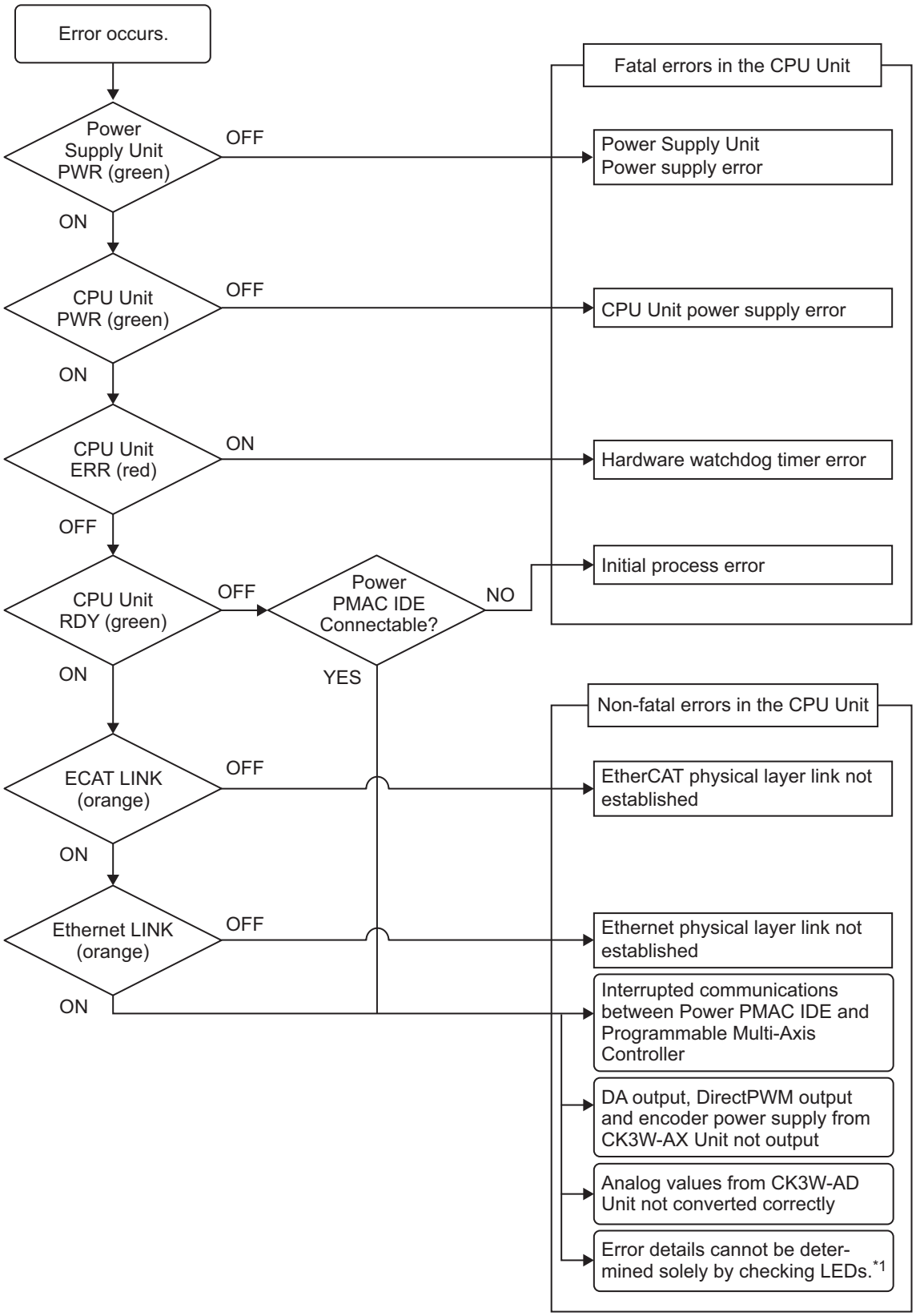
6-2-1 Indicator Types

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

Unit	Indicator name	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 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.



*1. 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	Remove the connected Units one by one, and if the error is eliminated, replace that Unit.
	The number of connected Units exceeds the maximum capacity	Check whether the connected Units exceed the maximum connectable 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 between 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 EtherCAT 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 EtherCAT 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	Cause	Corrective action
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 cable is not being used, replace the cable.
	Disconnected connector on the Ethernet cable used for Ethernet 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 Ethernet 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	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.
	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	
	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, DirectPWM output and encoder power supply from CK3W-AX Unit not output	Power Supply Unit other than CK3W-PD048 is being used.	Check the Power Supply Unit model.
	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.

Description	Cause	Corrective action
Position data for encoder connected to CK3W-AX Unit not converted correctly	The wiring is incorrect.	Check that the wiring is correct.
	The connected device is faulty.	Replace the connected device.
	The settings are incorrect.	Correct the settings.
	Input waveforms are not within the specified range.	Review the connected device and wiring so that input waveforms are within the specified range.
	The frequency of the input signal is not within the specified range.	Adjust the frequency to within the specified range.
	CK3W-AX Unit failure	Replace the CK3W-AX Unit.
Analog values from CK3W-AD Unit not converted correctly	The wiring is incorrect.	Check that the wiring is correct.
	Power Supply Unit other than CK3W-PD048 is being used.	Check the Power Supply Unit model.
	CK3W-AD Unit failure	Replace the CK3W-AD Unit.
	Internal 24 V power is not being input to the CK3W-AD Unit due to a failure of a 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 3-8.

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 configuration was changed during operation.		
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		
Detection timing	Continuous		
Recovery	Cycle the power supply, reset command ($$$)		
Effects	Operation continues		
Cause and correction	**Cause (Assumed cause)**	**Correction**	**Prevention**
	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 countermeasures.
	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		

● 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: Five or more CK3W Units are installed to the CPU Rack or Expansion Rack, except for the Expansion Master Unit and Expansion Slave Unit. 3: Reserve 4: Three or more Axis Interface Units are installed to the CPU Rack or Expansion Rack. 5: The Expansion Master Unit is not installed adjacent to the right side of the CPU Unit. 6: Reserve 7: Address switches overlap. When an error occurs, the Unit number counted from the CPU Unit at which the error was detected is written to the Sys.CK3WConfigCount register. However, the CK3W-EXS02 (Expansion Slave Unit) is excluded from the count. If Sys.CK3WConfigCount is “0”, it shows that an error was detected in the CPU Unit. If Sys.CK3WConfigCount is “1”, it shows that an error was detected in the Unit installed next to the CPU Unit.		
Detection timing	When power is turned ON or reset		
Recovery	Cycle the power supply, reset command ($$$)		
Effects	Operation continues		
Cause and correction	**Cause (Assumed cause)**	**Correction**	**Prevention**
	No End Cover	Attach an End Cover	None
	Three or more CK3W-AX Units are connected to the CPU Rack or Expansion Rack.	Reduce 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
	Five or more CK3W Units are installed to the CPU Rack or Expansion Rack, except for the Expansion Master Unit and Expansion Slave Unit.	Reduce the number of CK3W Units connected to four or less in each rack.	None
	The Expansion Master Unit is not installed adjacent to the right side of the CPU Unit.	Install the Expansion Master Unit adjacent to the right side of the CPU Unit.	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		
Description	The user program size exceeds the built-in flash memory capacity.		
Range	0 to 1		
Details	0: No error 1: The user program size exceeds the built-in flash memory capacity.		
Detection timing	When save command is issued		
Recovery	save command re-issue		
Effects	save command invalidated		
Cause and correction	**Cause (Assumed cause)**	**Correction**	**Prevention**
	The user program size is too large.	Reduce the size of the user program. Or, delete the backup file.	None
Precautions/ Remarks	None		

● BufSizeErr

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

● AbortAll

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

● NoClocks

Register name	Sys.NoClocks		
Description	Cannot detect a phase clock or a servo clock.		
Range	0 to 1		
Details	0: No error 1: Cannot detect a phase clock or a servo clock.		
Detection timing	When power is turned ON or reset		
Recovery	Cycle the power supply, reset command ($$$)		
Effects	Cannot enable the motor.		
Cause and correction	**Cause (Assumed cause)**	**Correction**	**Prevention**
	A Unit that supplies servo clock and phase clock signals is installed to the Expansion Rack.	Install the Unit that supplies clock signals to the CPU Rack.	None
	The clock-related register is overwritten by the user program.	If the error no longer occurs after the re-initialization command ($$$***) is executed, review the user program.	None
	The 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		

● Default

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

● FileConfigErr

Register name	Sys.FileConfigErr		
Description	System file setting error		
Range	0 to 1		
Details	0: No error 1: System file setting error		
Detection timing	When power is turned ON or reset		
Recovery	Cycle the power supply, reset command ($$$)		
Effects	Operate at default settings.		
Cause and correction	**Cause (Assumed cause)**	**Correction**	**Prevention**
	System file settings are incorrect.	If the re-initialization command ($$$***) is executed, and the error no longer occurs, review the user program.	None
	The 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		

● 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. 1: After the save, the hardware configuration was changed.		
Detection timing	When power is turned ON or reset		
Recovery	Cycle the power supply, reset command ($$$)		
Effects	Operate at default settings.		
Cause and correction	**Cause (Assumed cause)**	**Correction**	**Prevention**
	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		
Range	0 to 1		
Details	0: No error 1: System file setting error		
Detection timing	When power is turned ON or reset		
Recovery	Cycle the power supply, reset command ($$$)		
Effects	Operate at default settings.		
Cause and correction	**Cause (Assumed cause)**	**Correction**	**Prevention**
	Settings are incorrect.	If the re-initialization command ($$$***) is executed, and the error no longer occurs, review the settings.	None
	The 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		

● ProjectLoadErr

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

● 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 Error* 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. O014)* for details of the software watchdog timer.		
Detection timing	During operation		
Recovery	Cycle the power supply, reset command ($$$), re-initialization command ($$$***)		
Effects	User program: Stops Hardware: Reset status		
Cause and correction	**Cause (Assumed cause)**	**Correction**	**Prevention**
	Background software watchdog timer error occurred. • Real-time interruption process was too long, and the background process could not be implemented at the interval set in the Sys.WDTReset register.	• Review the user program. • Review the Sys.WDTReset register value.	None
	Real-time interruption software watchdog timer error generated • Real-time interruption process could not be implemented at the interval set in the Sys.BgWDTReset register.	• Review the user program. • Review the Sys.BgWDTReset register value.	None
Precautions/ Remarks	None		

7

Inspection and Maintenance

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

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.

Inspection item	Inspection details	Criteria	Correction
External power supply	Check for voltage fluctuations at the power supply terminals.	The voltage must be within the allowable voltage fluctuation range.	Use a voltage tester to check the power supply at the terminals. Take necessary steps to bring voltage of the supplied power to within the allowable voltage fluctuation range.

Inspection item	Inspection details	Criteria	Correction
Ambient environment	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 flammable gases in the area of the Controller.	No corrosive or flammable gases	Check by smell or use a sensor.
	Check the level of vibration or shock.	Vibration resistance and shock resistance must be within specifications.	Install cushioning or shock absorbing equipment if necessary.
	Check for noise sources near the Controller.	No significant noise sources	Either separate the Controller and noise source or protect the Controller.
Installation and wiring	Check that 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.
	Check for damaged external wiring cables.	No visible damage	Check visually and replace cables if necessary.

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

Tools Required for Inspections

● Required Tools

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

● Tools Required Occasionally

- Oscilloscope
- Thermometer and hygrometer

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

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

Procedure to Replace a CK3W Unit

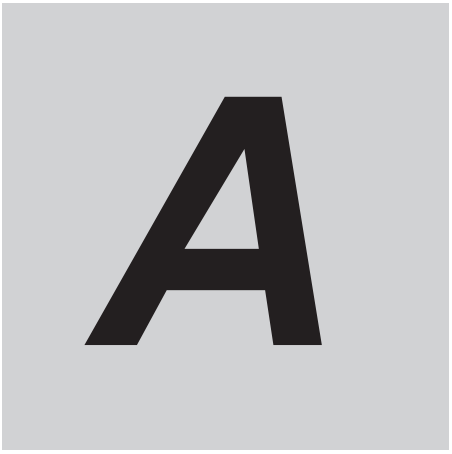
The following describes the replacement procedure for a CK3W Unit.

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 CK3W Unit.	-
3	Set the address switch	Set the address switch of the new Unit to the same setting as that of the previous Unit.	-
4	Replace the CK3W Unit	Replace with the 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 power to the devices	Take measures to ensure that there are no effects on the peripheral devices, and then turn OFF power to the Motion Controller and all EtherCAT slaves.	-
2	Replace the EtherCAT Slave	For the EtherCAT slave replacement method, refer to the relevant manuals for each slave. Replace with a new Unit, turn ON power to the EtherCAT slave, and then turn ON power to the Motion Controller.	Refer to the manual for each EtherCAT slave for details.



Appendices

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

A-1 General Specifications

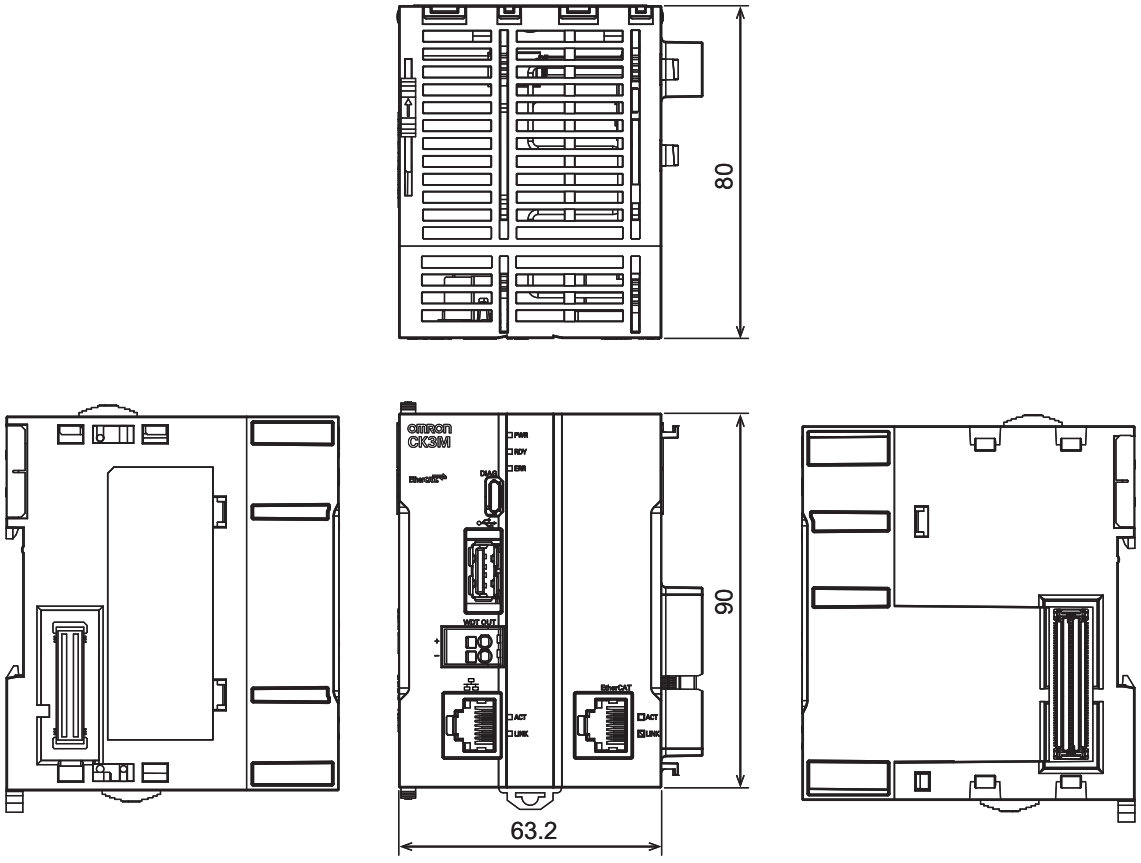
This section describes the Motion Controller specifications.

Item		Specification
Enclosure		Mounted in a panel
Grounding Method		Ground to less than 100 Ω.
Operating Environment	**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.
	Ambient Storage Temperature	-25 to 70°C (with no condensation or icing)
	Vibration Resistance	Conforms to IEC 60068-2-6. 5 to 8.4 Hz with 3.5-mm amplitude, 8.4 to 150 Hz, acceleration of 9.8 m/s^2 100 min each in X, Y, and Z directions (10 sweeps of 10 min each = 100 min total)
	Shock Resistance	Conforms to IEC 60068-2-27. 147 m/s^2, 3 times each in X, Y, and Z directions
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

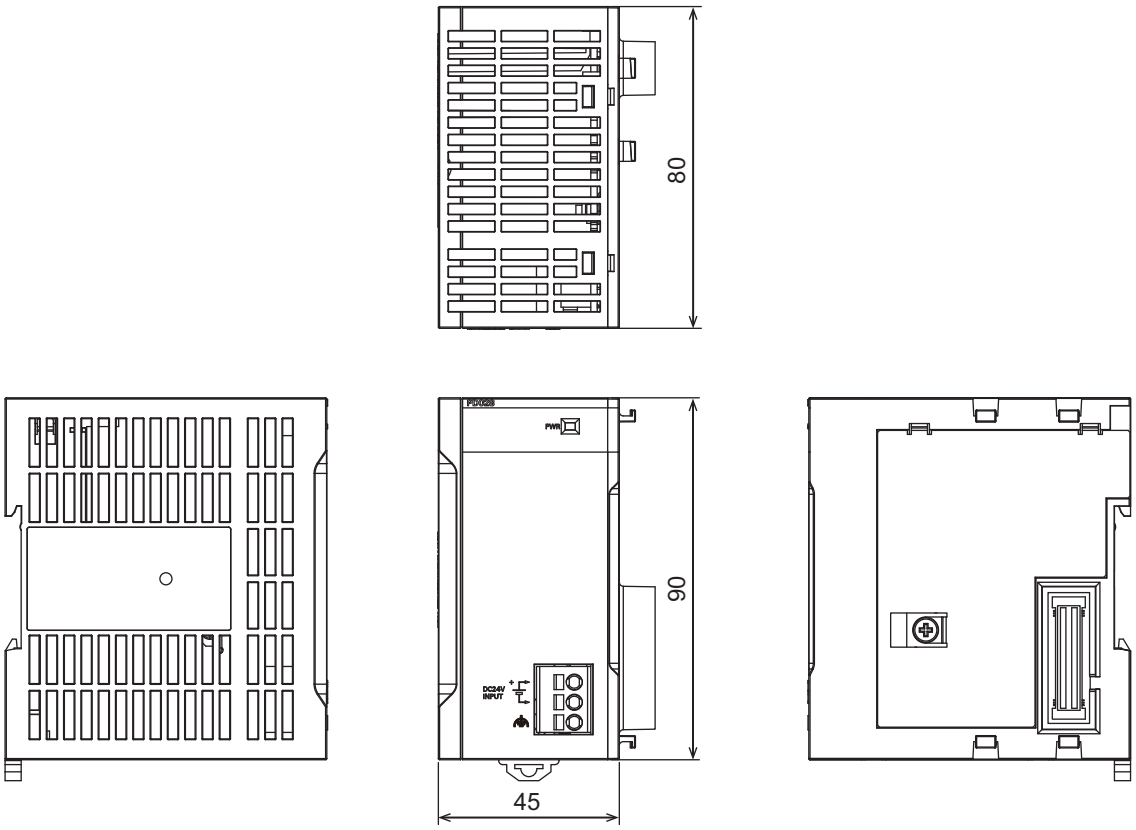
A-2 Dimensions

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

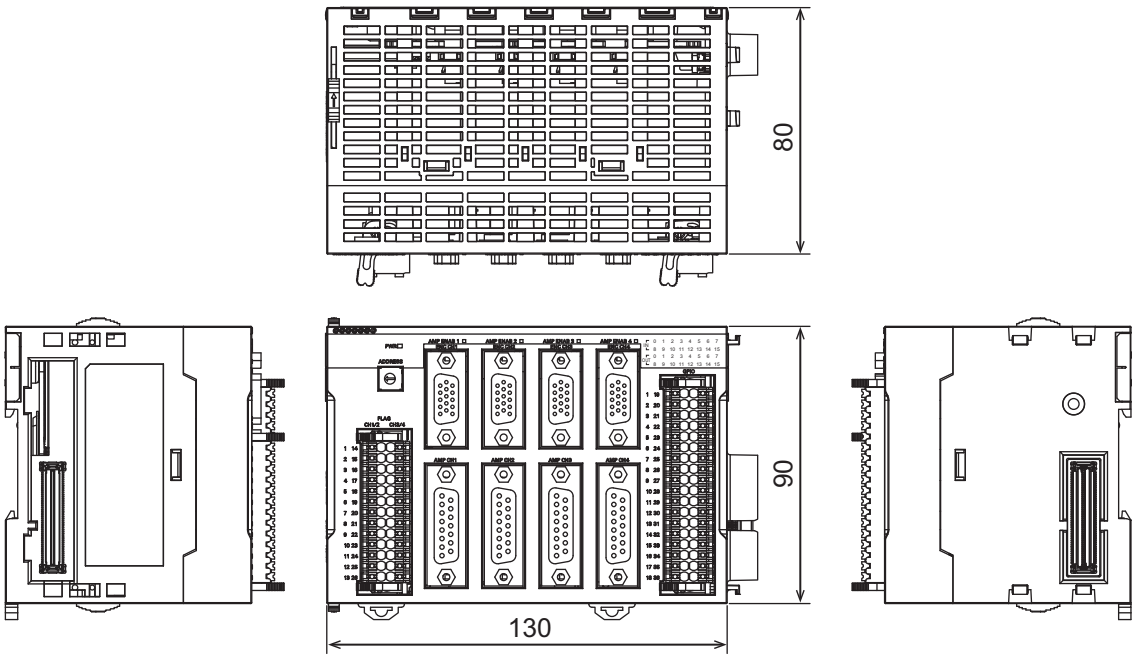
A-2-1 CPU Unit



A-2-2 Power Supply Unit

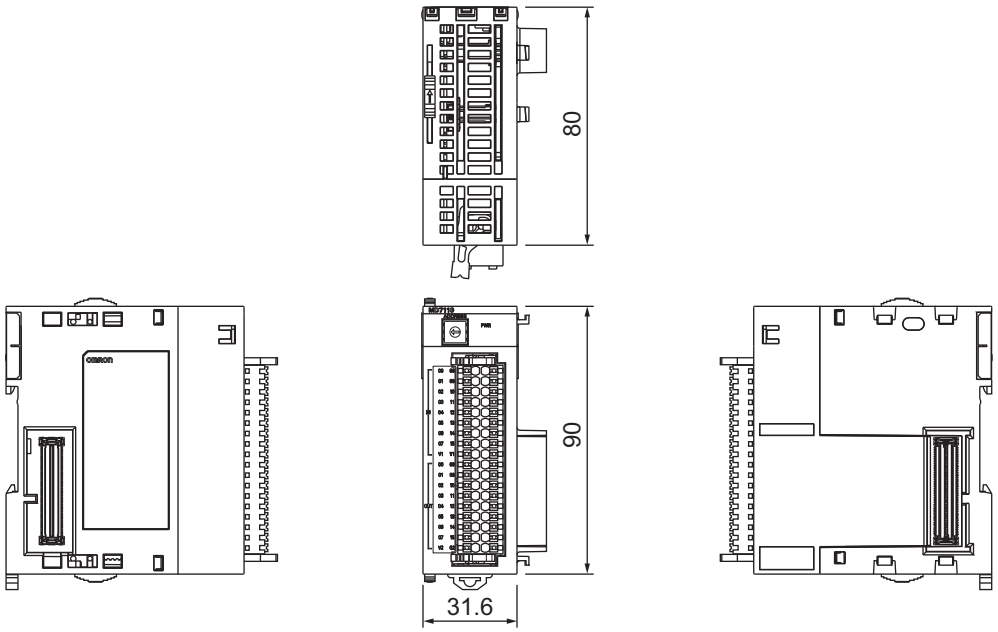


A-2-3 Axis Interface Unit

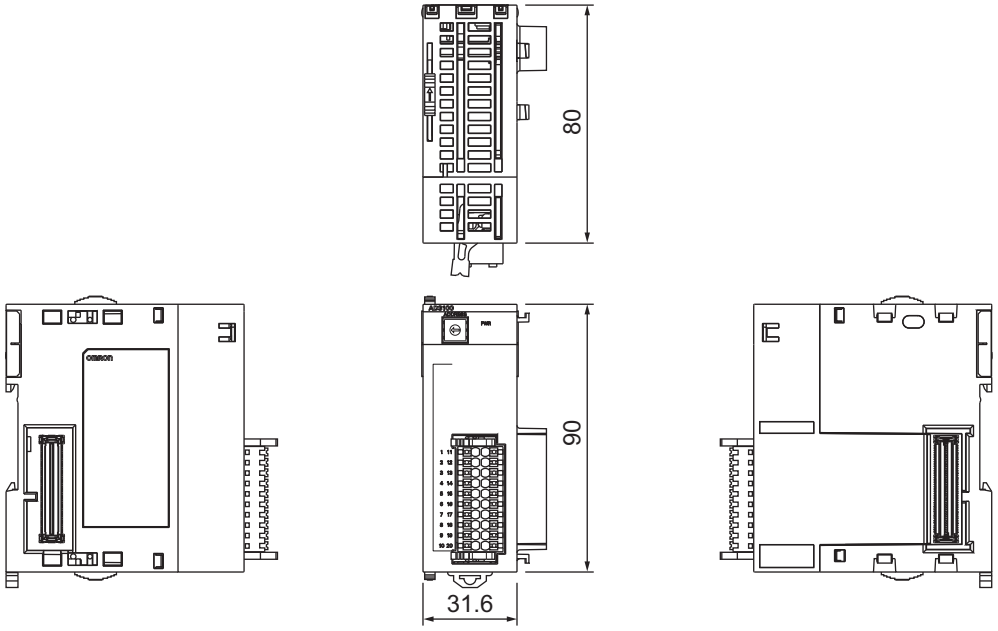


A-2-4 CK3W-MD and CK3W-AD Units

CK3W-MD Unit

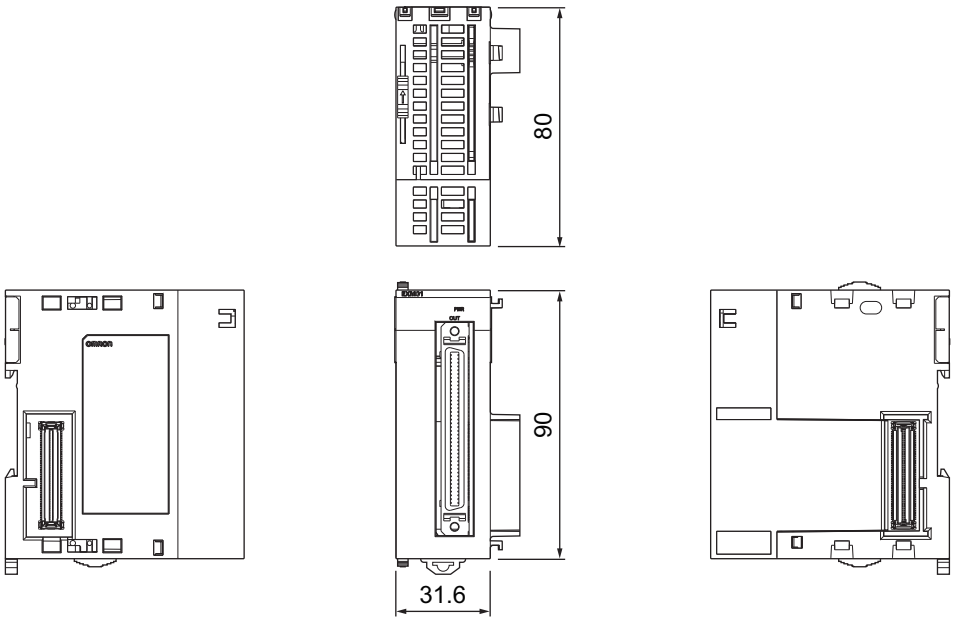


CK3W-AD Unit

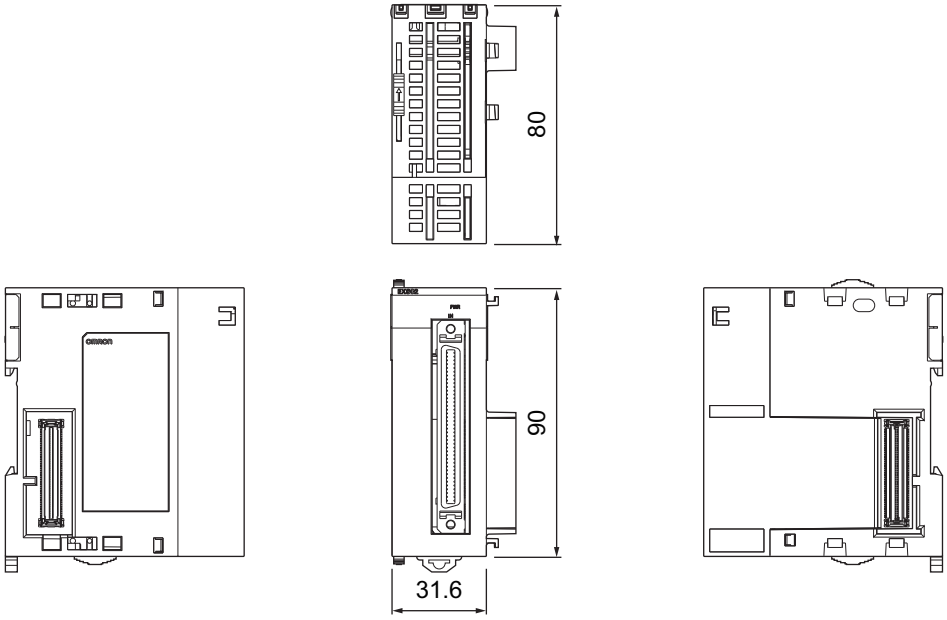


A-2-5 Expansion Master Unit and Expansion Slave Unit

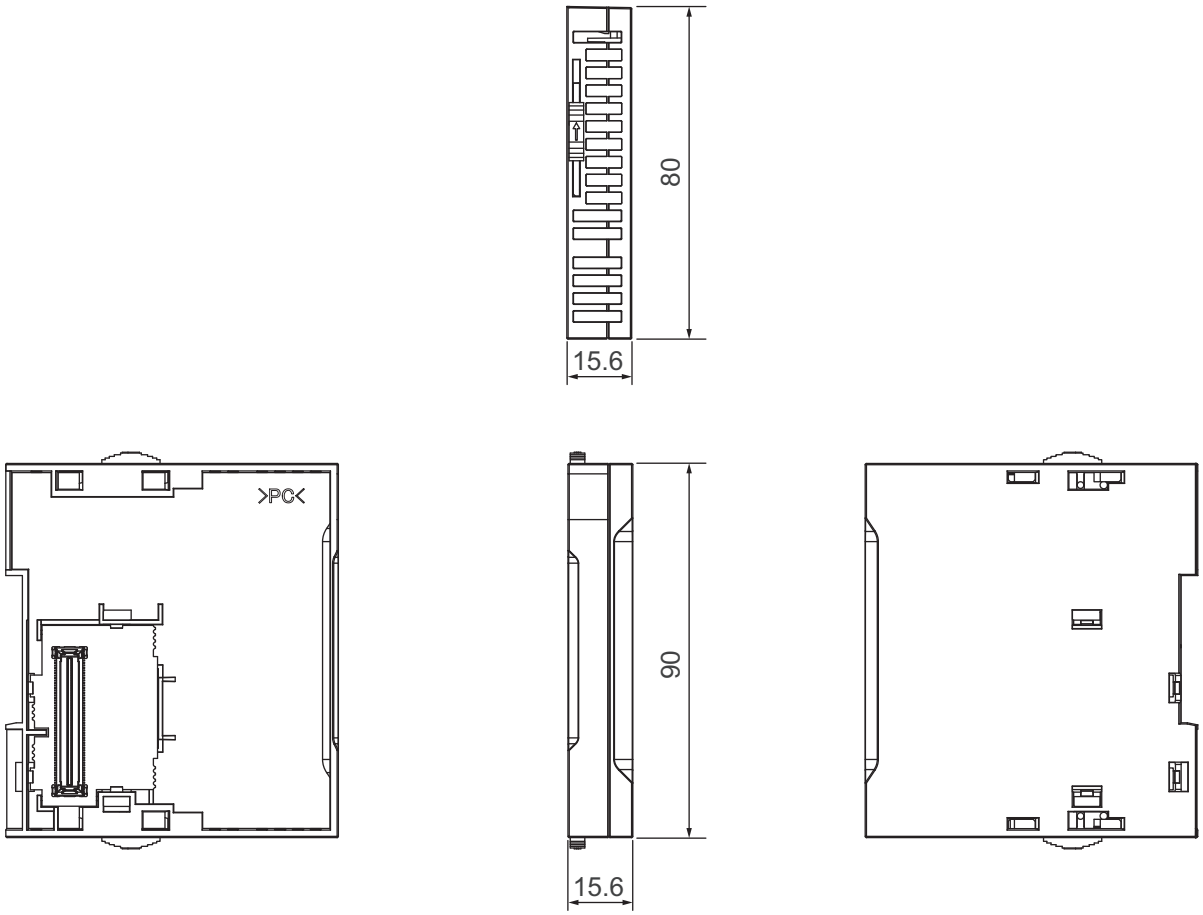
Expansion Master Unit



Expansion Slave Unit



A-2-6 End Cover



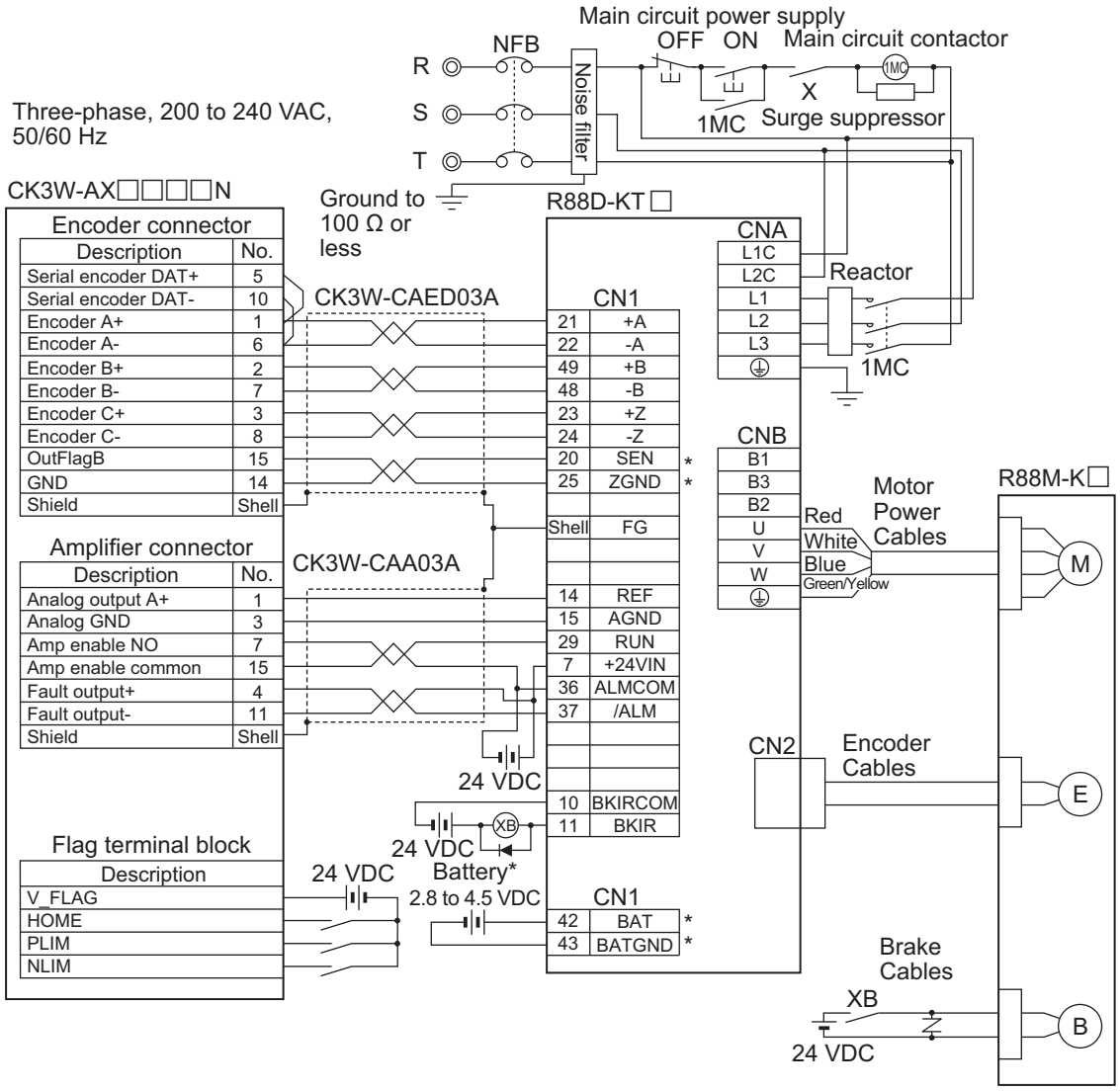
A-3 Restrictions on Using the NX-series EtherCAT Coupler Unit

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

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

A-4 OMRON Servo Drive Connection Example

This section shows an example of a connection between a CK3W-AX1414□ or CK3W-AX1515□ Unit and an 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.

A-5 Version Information

This section provides version information that you need to know when connecting a CK3W Unit to a CPU Unit and PowerPMAC IDE.
The table below specifies the correspondence between each CK3W Unit and the versions of CPU Unit and Power PMAC IDE.

Be sure to use the version combinations listed in the table below.

CK3W Unit	Supported version	
	CPU Unit's PMAC firmware revision	Power PMAC IDE version
CK3W-AX1414□/-AX1515□	All versions supported	Ver. 4.2 or later
CK3W-AX1313□/-AX2323□	Ver. 2.5.2 or later	Ver. 4.3 or later
CK3W-MD7110/-MD7120	Ver. 2.5.2 or later	Ver. 4.3 or later
CK3W-AD2100/-AD3100	Ver. 2.5.2 or later	Ver. 4.3 or later
CK3W-EXM01/-EXS02	Ver. 2.5.2 or later	Ver. 4.3 or later

A-6 How to Read the Lot Number

The table below shows how to read the lot number.

Assume that the lot number is DDMYY□.

Symbol	Description
DD	Day of production: 1 to 31
M	Month of production: 1 to 9, X (October), Y (November), Z (December)
YY	Year of production: Last two digits of the year
□	OMRON's control number

I

Index

Index

OMRON Corporation **Industrial Automation Company**
Kyoto, JAPAN

Contact: www.ia.omron.com

Regional Headquarters
OMRON EUROPE B.V.
Wegalaan 67-69, 2132 JD Hoofddorp
The Netherlands
Tel: (31)2356-81-300/Fax: (31)2356-81-388

OMRON ELECTRONICS LLC
2895 Greenspoint Parkway, Suite 200
Hoffman Estates, IL 60169 U.S.A.
Tel: (1) 847-843-7900/Fax: (1) 847-843-7787

OMRON ASIA PACIFIC PTE. LTD.
No. 438A Alexandra Road # 05-05/08 (Lobby 2),
Alexandra Technopark,
Singapore 119967
Tel: (65) 6835-3011/Fax: (65) 6835-2711

OMRON (CHINA) CO., LTD.
Room 2211, Bank of China Tower,
200 Yin Cheng Zhong Road,
PuDong New Area, Shanghai, 200120, China
Tel: (86) 21-5037-2222/Fax: (86) 21-5037-2200

Authorized Distributor:

Cat. No. O036-E1-03 0719