Cat. No. W613-E1-01

SYSMAC CP Series

CP2E-E□□D□-□
CP2E-S□□D□-□
CP2E-N□□D□-□

CP2E CPU Unit Hardware

USER'S MANUAL

OMRON

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SYSMAC CP Series
CP2E-E□□D□-□
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CP2E CPU Unit Hardware

User's Manual

Produced September 2019

Introduction

Thank you for purchasing a SYSMAC CP-series CP2E Programmable Controller.

This manual contains information required to use the CP2E. Read this manual completely and be sure you understand the contents before attempting to use the CP2E.

Intended Audience

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

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

Applicable Products

● CP-series CP2E CPU Units

- Essential Model CP2E-E□□D□-□
  A model of CPU Unit that supports connections to Programmable Terminals and basic control applications using instructions such as basic, movement, arithmetic, and comparison instructions.
- Standard Model CP2E-S□□D□-□
  A model of CPU Unit that supports connections to inverters and servo drives.
- Network Model CP2E-N□□D□-□
  A model of CPU Unit that supports Ethernet connection and enhanced positioning functions such as 4-axis linear interpolation and pulse.

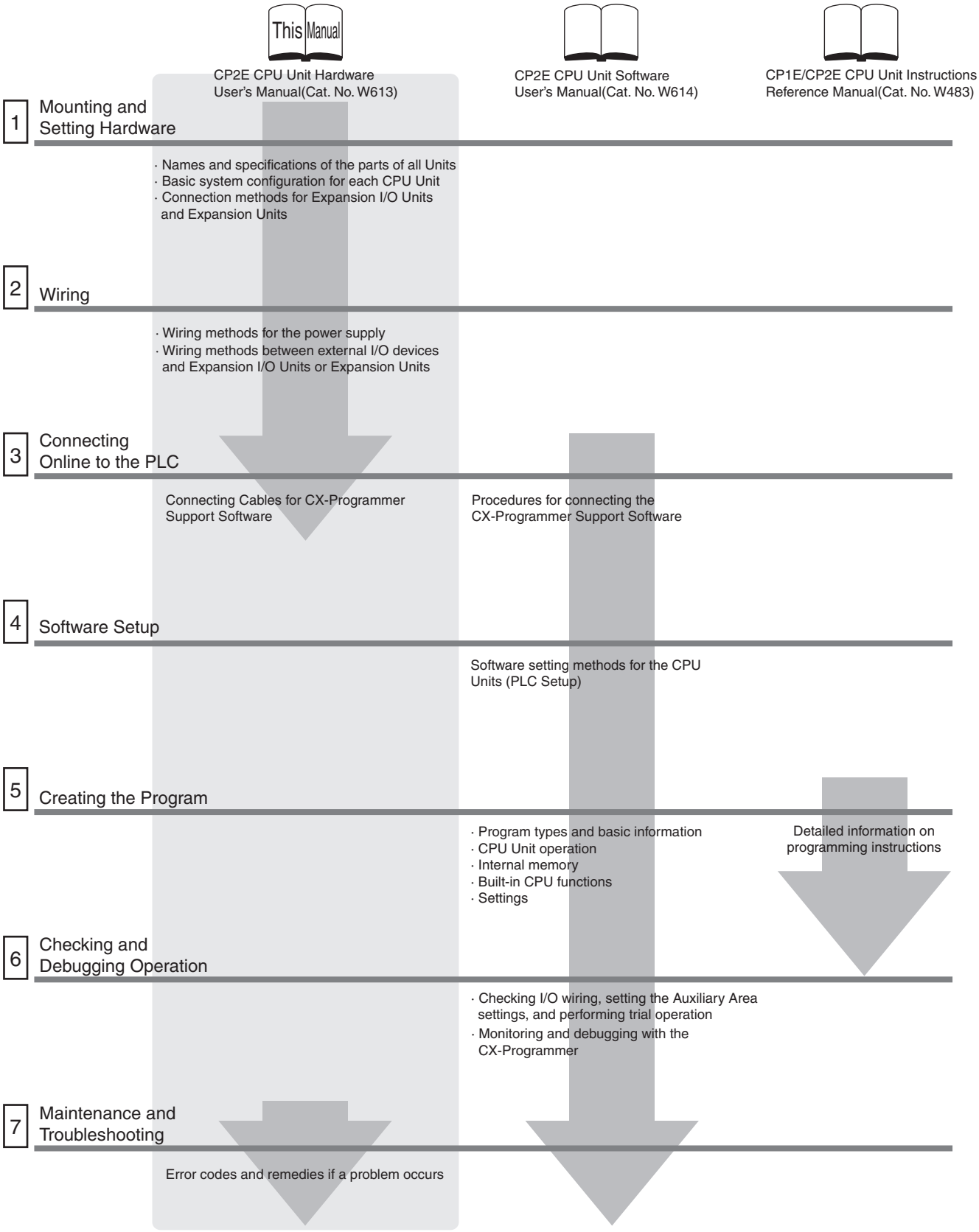
The CP Series is centered around the CP1H, CP1L, CP1E and CP2E CPU Units and is designed with the same basic architecture as the CS and CJ Series.

Always use CP-series Expansion Units and CP-series Expansion I/O Units when expanding I/O capacity.

CP2E CPU Unit Manuals

Information on the CP2E CPU Units is provided in the following manuals.

Refer to the appropriate manual for the information that is required.



Manual Configuration

The CP2E CPU manuals are organized in the sections listed in the following tables. Refer to the appropriate section in the manuals as required.

CP2E CPU Unit Hardware User's Manual (Cat. No. W613) (This Manual)

Section	Contents
Section 1 Overview and Specifications	This section gives an overview of the CP2E, describes its features, and provides its specifications.
Section 2 Basic System Configuration and Devices	This section describes the basic system configuration and unit models of the CP2E.
Section 3 Part Names and Functions	This section describes the part names and functions of the CPU Unit, Expansion I/O Units, and Expansion Units in a CP2E PLC .
Section 4 Programming Device	This section describes the features of the CX-Programmer used for programming and debugging PLCs, as well as how to connect the PLC with the Programming Device by USB, Ethernet and serial port.
Section 5 Installation and Wiring	This section describes how to install and wire CP2E Units.
Section 6 Troubleshooting	This section describes how to troubleshoot problems that may occur with a CP2E PLC, including the error indications provided by the CP2E Units.
Section 7 Maintenance and Inspection	This section describes periodic inspections, the service life of the Battery, and how to replace the Battery.
Section 8 Using Expansion Units and Expansion I/O Units	This section describes application methods for Expansion Units.
Appendices	The appendices provide information on dimensions, wiring diagrams, wiring serial communications, network installation for the CP2E, and comparison between CP1E and CP2E.

CP2E CPU Unit Software User's Manual (Cat. No. W614)

Section	Contents
Section 1 Overview	This section gives an overview of the CP2E, describes its application procedures.
Section 2 CPU Unit Memory	This section describes the types of internal memory in a CP2E CPU Unit and the data that is stored.
Section 3 CPU Unit Operation	This section describes the operation of a CP2E CPU Unit.
Section 4 Programming Concepts	This section provides basic information on designing ladder programs for a CP2E CPU Unit.
Section 5 I/O Memory	This section describes the types of I/O memory areas in a CP2E CPU Unit and the details.
Section 6 I/O Allocation	This section describes I/O allocation used to exchange data between the CP2E CPU Unit and other units.
Section 7 PLC Setup	This section describes the PLC Setup, which are used to perform basic settings for a CP2E CPU Unit.
Section 8 Overview and Allocation of Built-in Functions	This section lists the built-in functions and describes the overall application flow and the allocation of the functions.
Section 9 Quick-response Inputs	This section describes the quick-response inputs that can be used to read signals that are shorter than the cycle time.

Section	Contents
Section 10 Interrupts	This section describes the interrupts that can be used with CP2E PLCs, including input interrupts and scheduled interrupts.
Section 11 High-speed Counters	This section describes the high-speed counter inputs, high-speed counter interrupts, and the frequency measurement function.
Section 12 Pulse Outputs	This section describes positioning functions such as trapezoidal control, jogging, and origin searches.
Section 13 PWM Outputs	This section describes the variable-duty-factor pulse (PWM) outputs.
Section 14 Serial Communications	This section describes communications with Programmable Terminals (PTs) without using communications programming, no-protocol communications with general components, and connections with a Modbus-RTU Easy Master, Serial PLC Link, host computer and Modbus-RTU Slave.
Section 15 Built-in Ethernet	This section gives an outline of the built-in Ethernet function, explains its specification and how to make the settings required for operation.
Section 16 Other Functions	This section describes PID temperature control, clock functions, DM backup functions, security functions.
Section 17 Analog Option Board	This section describes an overview of the Analog Option Board, describes its installation and setting methods, memory allocations, start-up operation, refresh time, troubleshooting and how to use the Analog Option Board.
Section 18 Operating the Programming Device	This section describes basic functions of the CX-Programmer, such as using the CX-Programmer to write ladder programs to control the CP2E CPU Unit, to transfer the programs to the CP2E CPU Unit, and to debug the programs.
Appendices	The appendices provide lists of programming instructions, the Auxiliary Area, cycle time response performance, PLC performance at power interruption, memory map and Ethernet functions.

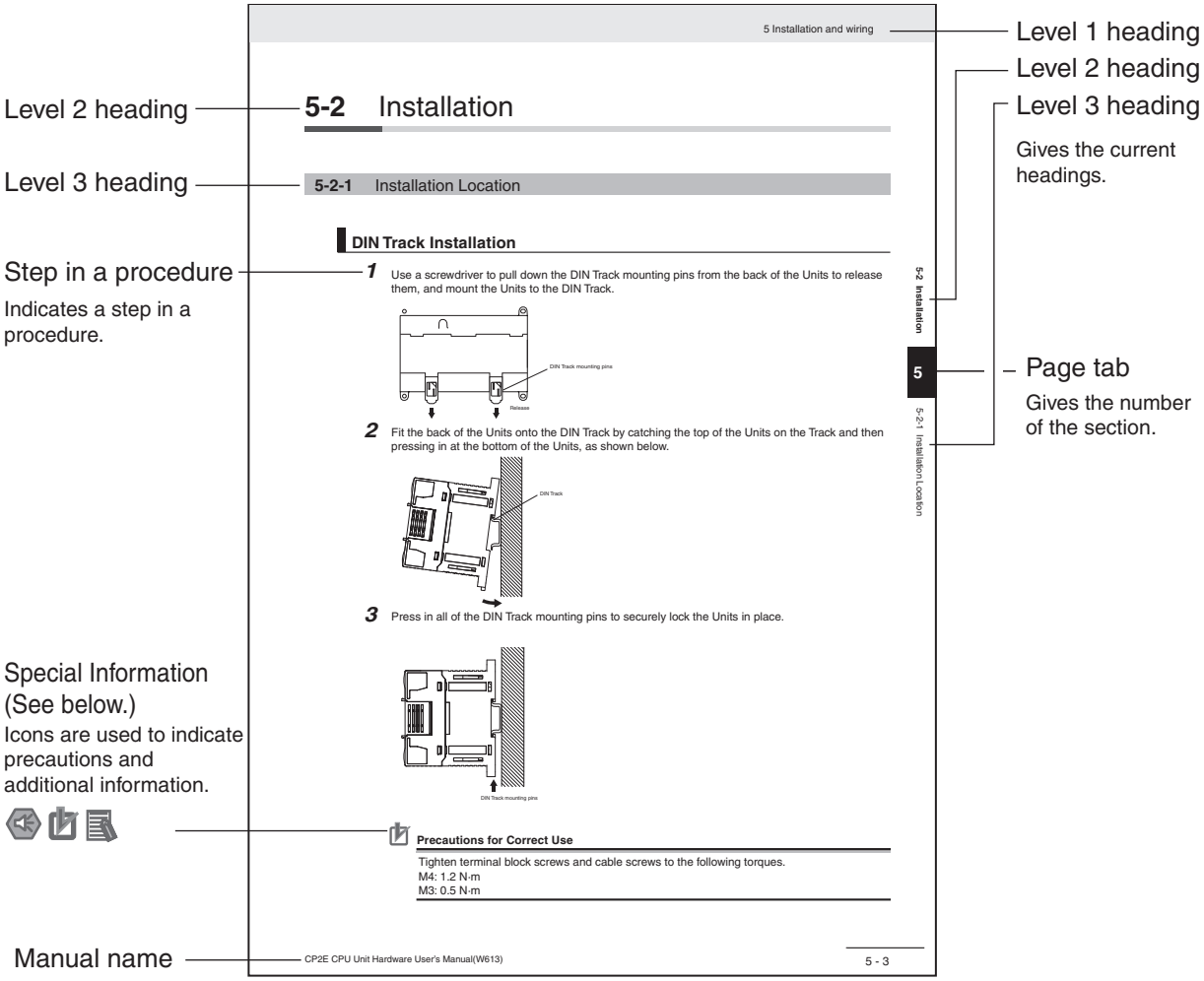
CP1E/CP2E CPU Unit Instructions Reference Manual (Cat. No. W483)

Section	Contents
Section 1 Summary of Instructions	This section provides a summary of instructions used with a CP1E/CP2E CPU Unit.
Section 2 Instruction	This section describes the functions, operands and sample programs of the instructions that are supported by a CP1E/CP2E CPU Unit.
Section 3 Instruction Execution Times and Number of Steps	This section provides the execution times for all instructions used with a CP1E/CP2E CPU Unit.
Section 4 Monitoring and Computing the Cycle Time	This section describes how to monitor and calculate the cycle time of a CP1E/CP2E CPU Unit that can be used in the programs.
Appendices	The appendices provide a list of instructions by Mnemonic and ASCII code table for the CP1E/CP2E CPU Unit.

Manual Structure

Page Structure and Icons

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



This illustration is provided only as a sample and 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 using the product safely.

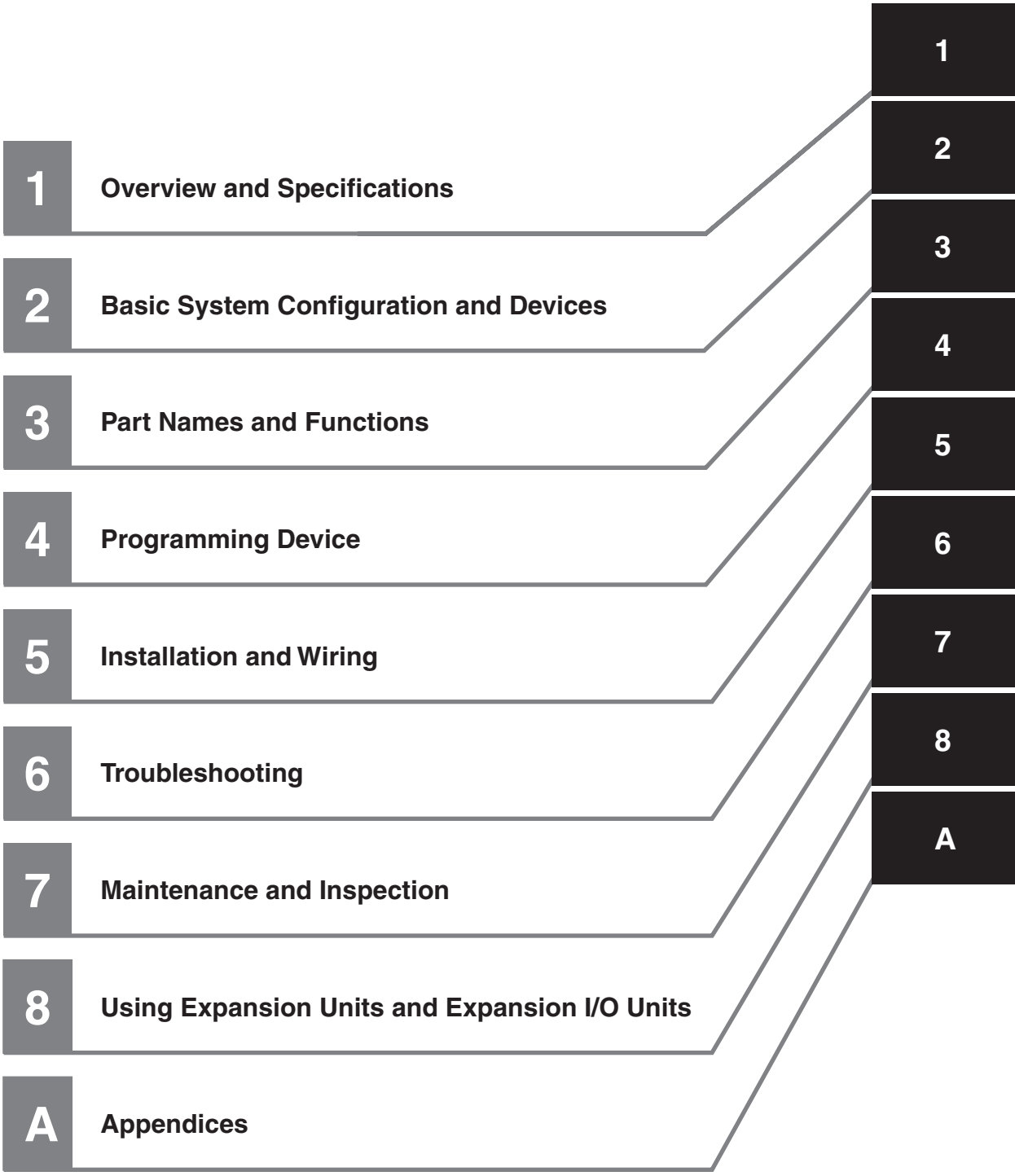
Precautions for Correct Use
Precautions on what to do and what not to do to ensure proper operation and performance.

Additional Information
Additional information to increase understanding or make operation easier.

Terminology and Notation

Term	Description
E-type CPU Unit	An essential model of CPU Unit that supports connections to Programmable Terminals and basic control applications using instructions such as basic, movement, arithmetic, and comparison instructions. Essential models of CPU Units are called “E□□-type CPU Units” or “E14/20 CPU Units” in this manual. The models of E□□-type CPU Units are shown below. CP2E-E□□D□-□
S-type CPU Unit	A standard model of CPU Unit that supports connections to inverters and servo drives. Standard models of CPU Units are called “S□□-type CPU Units” or “S30/40/60 CPU Units” in this manual. The models of S□□-type CPU Units are shown below. CP2E-S□□D□-□
N-type CPU Unit	A network model of CPU Unit that supports Ethernet connection and enhanced positioning functions such as 4-axis linear interpolation and pulse. Network models of CPU Units are called “N□□-type CPU Units” or “N30/40/60 CPU Units” in this manual. The models of N□□-type CPU Units are shown below. CP2E-N□□D□-□
CX-One **CX-Programmer**	A programming device that applies for programming and debugging PLCs. CP2E CPU Units are supported by CX-One version 4.51 or higher and CX-Programmer version 9.72 or higher.

Sections in this Manual



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Warranty, Limitations of Liability

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Safety Precautions

Definition of Precautionary Information

The following notation is used in this manual to provide precautions required to ensure safe usage of a CP-series PLC. The safety precautions that are provided are extremely important to safety. Always read and heed the information provided in all safety precautions.

WARNING	Indicates an imminently hazardous situation which, if not avoided, will 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.

Precautions for Safe Use
Indicates precautions on what to do and what not to do to ensure using the product safely.

Precautions for Correct Use
Indicates precautions on what to do and what not to do to ensure proper operation and performance.

Symbols

	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 circle and slash symbol indicates operations that you must not do. The specific operation is shown in the circle and explained in text.
	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.
	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 triangle symbol indicates precautions (including warnings). The specific operation is shown in the triangle and explained in text. This example indicates a precaution for hot surfaces.

⚠ WARNING

Do not attempt to take any Unit apart while the power is being supplied.

Doing so may result in electric shock.

Do not touch any of the terminals or terminal blocks while the power is being supplied.

Doing so may result in electric shock.

Provide safety measures in external circuits (i.e., not in the Programmable Controller), including the following items, to ensure safety in the system if an abnormality occurs due to malfunction of the PLC or another external factor affecting the PLC operation.

Not doing so may result in serious accidents.

- Emergency stop circuits, interlock circuits, limit circuits, and similar safety measures must be provided in external control circuits.
- The PLC will turn OFF all outputs when its self-diagnosis function detects any error or when a severe failure alarm (FALS) instruction is executed. Unexpected operation, however, may still occur for errors in the I/O control section, errors in I/O memory, and errors that cannot be detected by the self-diagnosis function. As a countermeasure for all these errors, external safety measures must be provided to ensure safety in the system.
- The PLC outputs may remain ON or OFF due to deposition or burning of the output relays or destruction of the output transistors. As a countermeasure for such problems, external safety measures must be provided to ensure safety in the system.
- When the 24-VDC output (service power supply to the PLC) is overloaded or short-circuited, the voltage may drop and result in the outputs being turned OFF. As a countermeasure for such problems, external safety measures must be provided to ensure safety in the system.

Fail-safe measures must be taken by the customer to ensure safety in the event of incorrect, missing, or abnormal signals caused by broken signal lines, momentary power interruptions, or other causes.

Serious accidents may result from abnormal operation if proper measures are not provided.

Do not apply the voltage/current outside the specified range to this unit.

It may cause a malfunction or fire.

⚠ Caution

Be sure to sufficiently confirm the safety at the destination when you transfer the program or I/O memory or perform procedures to change the I/O memory.

Devices connected to PLC outputs may incorrectly operate regardless of the operating mode of the CPU Unit.

Execute online edit only after confirming that no adverse effects will be caused by extending the cycle time.

Otherwise, the input signals may not be readable.

Tighten the screws on the terminal block of the AC power supply section to the torque specified in the user's manual.

The loose screws may result in burning or malfunction.

Do not touch the power supply section and I/O terminal blocks when power is being supplied or immediately after the power supply is turned OFF.

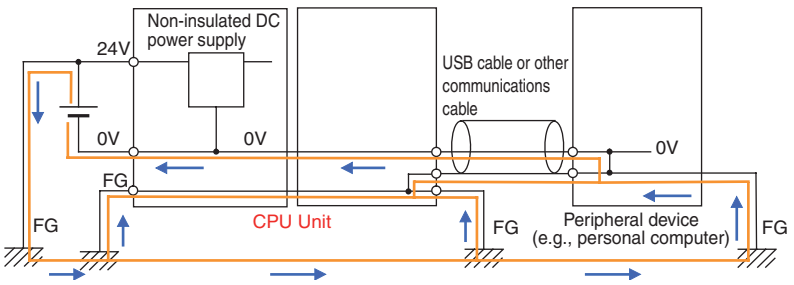
The power supply section and I/O terminal blocks will be hot and you may be burned.

Pay careful attention to the polarities (+/-) when wiring the DC power supply.

A wrong connection may cause malfunction of the system.

When connecting the PLC to a computer or other peripheral device, either ground the 0-V side of the external power supply or do not ground the external power supply at all.

Otherwise the external power supply may be shorted depending on the connection methods of the peripheral device. DO NOT ground the 24 V-side of the external power supply, as shown in the following diagram.



⚠ Caution

Sufficiently check safety if I/O bit status or present values are monitored in the Ladder Section Pane or present values are monitored in the Watch Pane.

If bits are set, reset, force-set, or force-reset by inadvertently pressing a shortcut key, devices connected to PLC outputs may operate incorrectly regardless of the operating mode.

Program so that the memory area of the start address is not exceeded when using a word address or symbol for the offset.

For example, write the program so that processing is executed only when the indirect specification does not cause the final address to exceed the memory area by using an input comparison instruction or other instruction.
If an indirect specification causes the address to exceed the area of the start address, the system will access data in other area, and unexpected operation may occur.

Set the temperature range according to the type of temperature sensor connected to the Unit.

Temperature data will not be converted correctly if the temperature range does not match the sensor.

Do not set the temperature range to any values other than those for which temperature ranges are given in the following table.

An incorrect setting may cause operating errors.

Precautions for Safe Use

Observe the following precautions when using a CP-series PLC.

● Power Supply

- Always use the power supply voltages specified in the user's manuals. An incorrect voltage may result in malfunction or burning.
- Take appropriate measures to ensure that the specified power with the rated voltage and frequency is supplied. Be particularly careful in places where the power supply is unstable. An incorrect power supply may result in malfunction.
- Double-check all wiring and switch settings before turning ON the power supply. Incorrect wiring may result in burning.
- Always turn OFF the power supply to the PLC before attempting any of the following. Not turning OFF the power supply may result in malfunction or electric shock.
  - Mounting or dismounting Expansion Units or Expansion I/O Units
  - Mounting or dismounting Option Boards
  - Setting DIP switches or rotary switches
  - Connecting cables or wiring the system
  - Connecting or disconnecting the connectors

● Installation

- Before touching a Unit, be sure to first touch a grounded metallic object in order to discharge any static build-up. Not doing so may result in malfunction or damage.
- Install the Unit properly as specified in the operation manual. Improper installation of the Unit may result in malfunction.
- Be sure that the terminal blocks, connectors, Option Boards, and other items with locking devices are properly mounted and locked into place. Improper locking may result in malfunction.

● Wiring

- Wire correctly according to specified procedures in this manual.
- Keep the wire cuttings out of the Unit when wiring.
- Always use the following size wire when connecting I/O terminals: AWG22 to AWG18 (0.32 to 0.82 mm^2).
- When unpacking the Unit, check carefully for any external scratches or other damages. Also, shake the Unit gently and check for any abnormal sound.
- Install external breakers and take other safety measures against short-circuiting in external wiring. Insufficient safety measures against short-circuiting may result in burning.
- Always connect to a ground of 100 Ω or less when installing the Units. Not connecting to a ground of 100 Ω or less may result in electric shock.
- Keep foreign substances, such as wiring chips, from entering into the Units. It may cause a fire, failure or malfunction. Take protective measures especially at the time of construction.
- Use crimp terminals for wiring. Do not connect bare stranded wires directly to terminals. Connection of bare stranded wires may result in burning.
- Do not apply voltages to the input terminals in excess of the rated input voltage. Excess voltages may result in burning.
- Do not apply voltages or connect loads to the output terminals in excess of the maximum switching capacity. Excess voltage or loads may result in burning.
- Disconnect the functional ground terminal when performing withstand voltage tests. Not disconnecting the functional ground terminal may result in burning.

- Be sure that all the PLC terminal screws and cable connector screws are tightened to the torque specified in the relevant manuals. The tightening torque for the terminals on the CP1W-CIF11/CIF12-V1 terminal block is 0.23 N·m Incorrect tightening torque may result in malfunction.
- The NV3W-M□20L Programmable Terminal can be connected to pin 6 (+5V) on the built-in RS-232C port on the CPU Unit or the RS-232C Option Board (CP1W-CIF01) mounted to the CPU Unit. Do not connect pin 6 to any other device.
- Use the cables that are specified in the manual for each device. External devices or the CPU Unit may be damaged if a commercially available RS-232C computer cable is used.
- Do not pull on the cables or bend the cables beyond their natural limit. Doing either of these may break the cables.
- Do not place objects on top of the cables or other wiring lines. Doing so may break the cables.

● Handling

- Set the Unit properly as specified in the operation manual. Improper setting of the Unit may result in malfunction.
- Check that the DIP switches and data memory (DM) are properly set before starting operation.
- To initialize the DM Area, back up the initial contents for the DM Area to the Flash Memory using one of the following methods.
  - Set the number of words of the DM Area to be backed up starting with D0 in the *Number of CH of DM for backup* Box in the *Startup Data Read* Area.
  - Include programming to back up specified words in the DM Area to the built-in Flash Memory by turning ON A751.15 (DM Backup Save Start Bit).
- Check the ladder program for proper execution before actually running it on the Unit. Not checking the program may result in an unexpected operation.
- Transfer a routing table to the CPU Unit only after confirming that no adverse effects will be caused by restarting CPU Bus Units, which is automatically done to make the new tables effective.
- The ladder program and parameter area data in the CP2E CPU Units are backed up in the built-in Flash Memory. The BKUP indicator will light on the front of the CPU Unit when the backup operation is in progress. Do not turn OFF the power supply to the CPU Unit when the BKUP indicator is lit. The data will not be backed up if power is turned OFF and a memory error will occur the next time the power supply is turned ON.
- With a CP2E CPU Unit, data memory can be backed up to the built-in Flash Memory. The BKUP indicator will light on the front of the CPU Unit when backup is in progress. Do not turn OFF the power supply to the CPU Unit when the BKUP indicator is lit. If the power is turned OFF during a backup, the data will not be backed up and will not be transferred to the DM Area in RAM the next time the power supply is turned ON.
- Do not turn OFF the power supply to the PLC for a long time after the battery is attached. Otherwise the battery life may be shortened.
- Install a battery (sold separately), if you are using clock data for the program. If the battery is not installed, the clock data will be initialized when the power is turned off, and the program may cause malfunction.
- When using a battery, set it to “Detect Low Battery” in PLC settings. If the setting is not changed, a program that uses clock data may cause malfunction, when the battery is exhausted.
- Before replacing the battery, supply power to the CPU Unit for at least 30 minutes and then complete battery replacement within 5 minutes. Clock data may be corrupted if this precaution is not observed.
- The equipment may operate unexpectedly if inappropriate parameters are set. Even if the appropriate parameters are set, confirm that equipment will not be adversely affected before transferring the parameters or routing tables to the CPU Unit.
- After replacing the CPU Unit, make sure that the required data for the DM Area, Holding Area, and other memory areas has been transferred to the new CPU Unit before restarting operation.
- Do not attempt to disassemble, repair, or modify any Units. Any attempt to do so may result in malfunction, fire, or electric shock.

- Do not drop the Unit or subject the Unit to unusual vibration and shock. Do so may result in failure or fire.
- Confirm that no adverse effect will occur in the system before attempting any of the following. Not doing so may result in an unexpected operation.
  - Changing the operating mode of the PLC (including the setting of the startup operating mode).
  - Force-setting/force-resetting any bit in memory.
  - Changing the present value of any word or any set value in memory.
- When replacing parts, be sure to confirm that the rating of a new part is correct. Not doing so may result in malfunction or burning.
- Do not touch the Expansion I/O Unit Connecting Cable while the power is being supplied in order to prevent malfunction due to static electricity.
- Do not turn OFF the power supply to the Unit while data is being transferred.
- When transporting or storing Units or Board, static electricity can destroy LSIs or ICs. Cover the PCBs with a conductive material and maintain the specified storage temperature.
- Do not touch circuit boards or the components mounted to them with your bare hands. There are sharp leads and other parts on the boards that may cause injury if handled improperly.
- Double-check the pin numbers when assembling and wiring the connectors.
- Never short-circuit the positive and negative terminals of a battery or charge, disassemble, heat, or incinerate the battery. Do not subject the battery to strong shocks or deform the battery by applying pressure. Doing any of these may result in leakage, rupture, heat generation, or ignition of the battery. Dispose of any battery that has been dropped on the floor or otherwise subjected to excessive shock. Batteries that have been subjected to shock may leak if they are used.
- Dispose of the product and batteries according to local ordinances as they apply.

- UL standards require that only an experienced engineer can replace the battery. Make sure that an experienced engineer is in charge of battery replacement. Follow the procedure for battery replacement given in this manual.
- The following precaution must be displayed on all products that contain a lithium primary battery (containing at least 6 ppb of perchlorate) and that will be exported to or transported through the State of California in the USA.
  Perchlorate Material - special handling may apply. See
  http://www.dtsc.ca.gov/hazardouswaste/perchlorate
  A CP2W-BAT02 lithium primary battery (containing at least 6 ppb of perchlorate) can be mounted in a CP2E-N/S□□D□-□ CPU Unit. Display the precaution given above on your product's packaging box or shipping box if the product contains a CP2W-BAT02 Battery and is exported to or through the State of California in the USA.
- This product is EMC compliant when assembled in a complete PLC system. Refer to the applicable manual for grounding, cable selection, and any other conditions for EMC compliance.
- This is a Class A product for use in industrial environments. In residential environments it may cause radio interference, in which case the user may be required to take adequate measures to reduce interference.

● External Circuits

- Always configure the external circuits to turn ON power to the PLC before turning ON power to the control system. If the PLC power supply is turned ON after the control power supply, temporary errors may result in control system signals because the output terminals on DC Output Units and other Units will momentarily turn ON when power is turned ON to the PLC.
- Fail-safe measures must be taken by the customer to ensure safety in the event that outputs from output terminals remain ON as a result of internal circuit failures, which can occur in relays, transistors, and other elements.

- If the I/O Hold Bit is turned ON, the outputs from the PLC will not be turned OFF and will maintain their previous status when the PLC is switched from RUN or MONITOR mode to PROGRAM mode. Make sure that the external loads will not produce dangerous conditions when this occurs. (When operation stops for a fatal error, including those produced with the FALS instruction, all outputs from PLC will be turned OFF and only the internal output status in the CPU Unit will be maintained.)

Operating Environment Precautions

● Perform installation following the instructions in this manual

Follow the instructions in this manual to correctly perform installation.

● Do not operate the control system in the following locations

- Locations subject to direct sunlight
- Locations subject to temperatures or humidity outside the range specified in the specifications
- Locations subject to condensation as the result of severe changes in temperature
- Locations subject to corrosive or flammable gases
- Locations subject to dust (especially iron dust) or salts
- Locations subject to exposure to water, oil, or chemicals
- Locations subject to shock or vibration
- Locations subject to direct rain fall
- Locations subject to direct strong UV

● Take countermeasures in the following locations

- Locations subject to static electricity or other forms of noise
- Locations subject to strong electromagnetic fields
- Locations subject to possible exposure to radioactivity
- Locations close to power supplies

Regulations and Standards

Conformance to EC Directives

Applicable Directives

- EMC Directives
- Low Voltage Directive

Concepts

● EMC Directives

OMRON devices are electrical components that are designed to be built into equipment and manufacturing systems. OMRON devices that comply with EMC Directives also conform to the related EMC standards*, so that they can be more easily built into other devices or the overall machine. 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 EC 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.

* The applicable EMC (Electromagnetic Compatibility) standard is EN61131-2.

● Low Voltage Directive

Always ensure that devices operating at voltages of 50 to 1,000 VAC and 75 to 1,500 VDC meet the required safety standards for the PLC (EN 61131-2).

● Conformance to EC Directives

The CP2E PLCs comply with EC Directives. To ensure that the machine or device in which the CP2E PLC is used complies with EC Directives, the PLC must be installed as follows:

- The CP-series PLC must be installed within a control panel.
- CP-series PLCs complying with EC Directives also conform to EN61131-2. 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 complies with EC Directives.
- A SYSMAC CP-series PLC is a class A product (for an industrial environment). In residential areas it may cause radio interference, in which case the user may be required to take adequate measures to reduce interference.

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Related Manuals

The following manuals are related to the CP2E. Use them together with this manual.

Manual name	Cat. No.	Model numbers	Application	Contents
SYSMAC CP Series CP2E CPU Unit Hardware User's Manual (this manual)	W613	CP2E-E□□D□-□ CP2E-S□□D□-□ CP2E-N□□D□-□	To learn the hardware specifications of the CP2E PLCs	Describes the following information for CP2E PLCs. • Overview and features • Basic system configuration • Part names and functions • Installation and settings • Troubleshooting
			Use this manual together with the CP2E CPU Unit Software User's Manual (Cat. No. W614) and Instructions Reference Manual (Cat. No. W483).	

SYSMAC CP Series CP2E CPU Unit Software User's Manual	W614	CP2E-E□□D□-□
		CP2E-S□□D□-□
		CP2E-N□□D□-□
			To learn the software specifications of the CP2E PLCs	Describes the following information for CP2E PLCs.
				• CPU Unit operation
				• Internal memory
				• Programming
				• Settings
				• CPU Unit built-in functions
				  • Interrupts
				  • High-speed counter inputs
				  • Pulse outputs
				  • Serial communications
				  • Ethernet
				  • Other functions

			Use this manual together with the CP2E CPU Unit Hardware User's Manual (Cat. No. W613) and Instructions Reference Manual (Cat. No. W483).	
SYSMAC CP Series CP1E/CP2E CPU Unit Instructions Reference Manual	W483	CP1E-E□□D□-□ CP1E-N□□D□-□ CP1E-NA□□D□-□ CP2E-E□□D□-□ CP2E-S□□D□-□ CP2E-N□□D□-□	To learn programming instructions in detail	Describes each programming instruction in detail. When programming, use this manual together with the CP2E CPU Unit Software User's Manual (Cat. No. W614).
CS/CJ/CP/NSJ Series Communications Commands Reference Manual	W342	CS1G/H-CPU□□H CS1G/H-CPU□□-V1 CS1D-CPU□□H CS1D-CPU□□S CS1W-SCU□□-V1 CS1W-SCB□□-V1 CJ1G/H-CPU□□H CJ1G-CPU□□P CJ1M-CPU□□ CJ1G-CPU□□ CJ1W-SCU□□-V1	To learn communications commands for CS/CJ/CP/NSJ-series Controllers in detail	Describes 1) C-mode commands and 2) FINS commands in detail. Read this manual for details on C-mode and FINS commands addressed to CPU Units.
			Note This manual describes commands addressed to CPU Units. It does not cover commands addressed to other Units or ports (e.g., serial communications ports on CPU Units, communications ports on Serial Communications Units/Boards, and other Communications Units).	
CX-One FA Integrated Tool Package Setup Manual	W463	CXONE-AL□□D-V4	To install the software provided in the CX-One	Describes the overview of the CX-One FA Integrated Tool Package, and how to install and uninstall the CX-One.
CX-Programmer Operation Manual	W446		To learn the operation procedures for the CX-Programmer, the Programming Device for Windows computers	Describes the operation procedures for the CX-Programmer.
CX-Programmer Operation Manual (Function Blocks/ Structured Text)	W447			
CX-Simulator Operation Manual	W366		To learn the operation procedures for the CX-Simulator, the Simulation Device for Windows computers	Describes the operation procedures for the CX-Simulator.
CX-Integrator Operation Manual	W464		To set up and monitor networks	Describes the operation procedures for the CX-Integrator.

1

Overview and Specifications

This section gives an overview of the CP2E, describes its features, and provides its specifications.

1-1 CP2E Overview 1-2
1-1-1 Overview of Features 1-2
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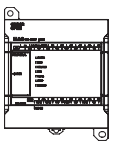
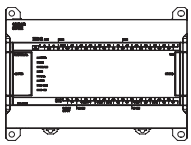
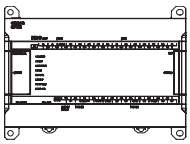
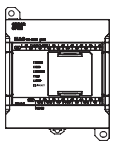
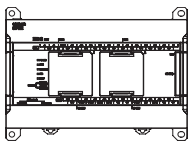
1-1 CP2E Overview

1-1-1 Overview of Features

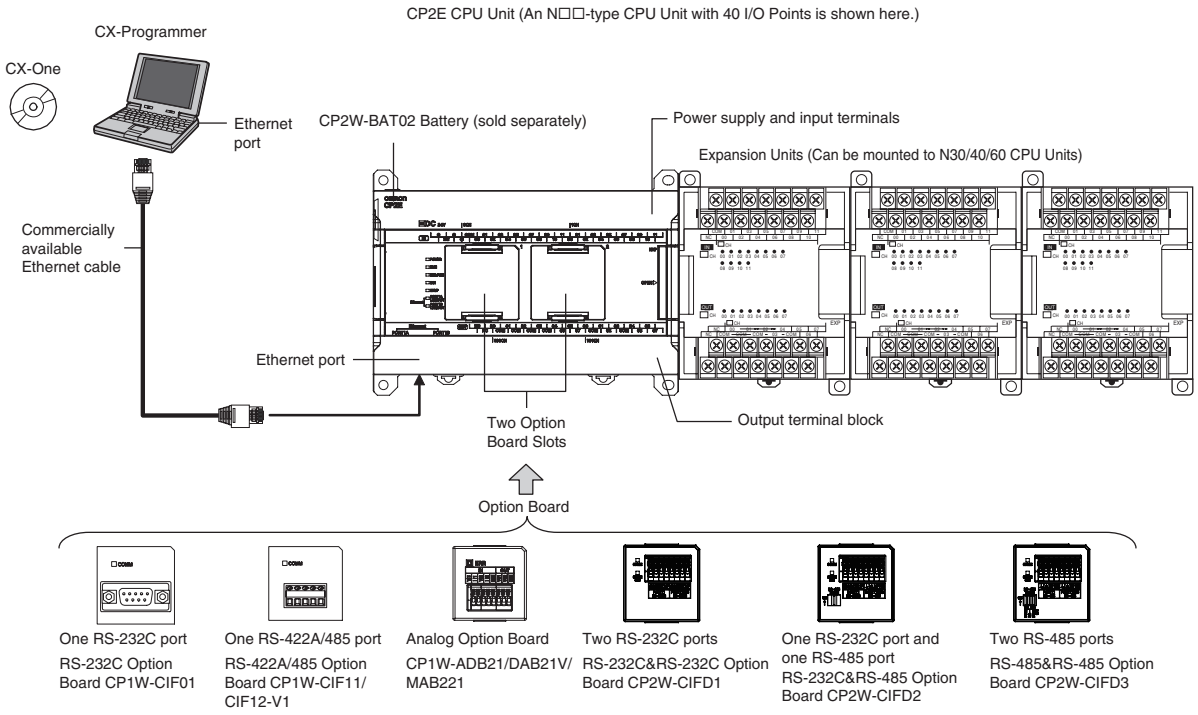
The SYSMAC CP2E Programmable Controller is a package-type PLC made by OMRON that is designed for easy application. The CP2E includes E□□-type CPU Units (essential models) that support connections to Programmable Terminals and basic control applications using basic, movement, arithmetic, and comparison instructions, S□□-type CPU Units (standard models) that support connections to Inverters and Servo Drives and N□□-type CPU Units (network models) that support Ethernet connection and enhanced positioning functions such as 4-axis linear interpolation and pulse.

	Essential Models		Standard Models	Network Models	
	E□□-type CPU Units		S□□-type CPU Units	N□□-type CPU Units	
	CPU Unit with 14, 20 I/O Points	CPU Unit with 30, 40 or 60 I/O Points	CPU Unit with 30, 40 or 60 I/O Points	CPU Unit with 14, 20 I/O Points	CPU Unit with 30, 40 or 60 I/O Points
Appearance					
I/O points	14/20	30/40/60	30/40/60	14/20	30/40/60
Program capacity	4K steps		8K steps	10K steps	
FB capacity	4K steps		8K steps	10K steps	
DM Area capacity	4K words Of these 1,500 words can be written to the built-in Flash Memory.		8K words Of these 7,000 words can be written to the built-in Flash Memory.	16K words Of these 15,000 words can be written to the built-in Flash Memory.	
Mounting Expansion I/O Units and Expansion Units	Not supported.	3 Units maximum	3 Units maximum	Not supported.	3 Units maximum
Model with transistor outputs	Not supported.		Available		
Pulse outputs (Models with transistor outputs only)	Not supported.		2 axes supported.	2 axes supported. (Linear interpolation supported)	4 axes supported. (Linear interpolation supported)
Built-in serial communications port	RS-232C port provided.		RS-232C/RS-485 port provided.	Not provided. Expand to up to two ports by a Option Board.	Not provided. Expand to up to three ports by Option Boards.
Option Board	Not supported.			1 slot	2 slots
Built-in Ethernet port	No provided.			1 port	2 ports (Switch function)
Connection port for Programming Device	USB port			Ethernet port	
Clock	Not supported.		Supported		
Using a Battery	Not supported.		Supported (CP2W-BAT02 sold separately)		
Battery-free operation	Always battery-free operation. Data in I/O Memory is retained even if no battery is attached.				

1-1-2 Features

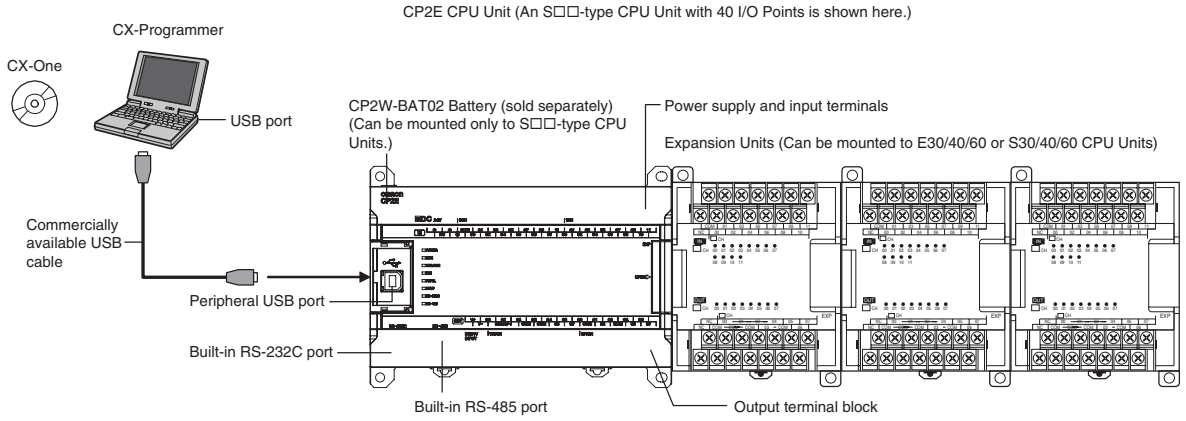
● System Configuration

Network Model



Note 1. Maximum one Analog Option Board can be mounted on an N□□-type CPU Unit.
2. CP2W-CIFD1/2/3 can only be mounted on option slot 1.
3. The following Option Boards cannot be used.
· CP1W-DAM01 LCD Option Board
· CP1W-CIF41 Ethernet Option Board

Essential/Standard Model



Programming, Setting, and Monitoring with the CX-Programmer

The CX-Programmer is used as the Programming Device for the CP2E.

Easy Connection with Computers Using Commercially Available USB/Ethernet Cables

The CX-Programmer is connected using a commercially available USB/Ethernet cable between the computer's USB/Ethernet port and the built-in USB/Ethernet port of the CP2E.

With E30/40/60, S30/40/60 or N30/40/60 CPU Units, Add I/O by Connecting Expansion I/O Units

A total of up to three of the following Expansion I/O Units can be connected to an E30/40/60, S30/40/60 or N30/40/60 CPU Unit. (The total of three Units must also include Expansion Units.)

24-input/16-output Unit, 32-output Unit, 12-input/8-output Unit, 16-output Unit, 8-input Unit, or 8-output Unit

With E30/40/60, S30/40/60 or N30/40/60 CPU Units, Add Analog I/O or Temperature Inputs by Connecting Expansion Units

With an E30/40/60, S30/40/60 or N30/40/60 CPU Unit, a total of up to three of the following Expansion Units can be connected. (The total of three Units must also include Expansion I/O Units.)

Analog I/O Unit, Analog Input Unit, Analog Output Unit, Temperature Sensor Units

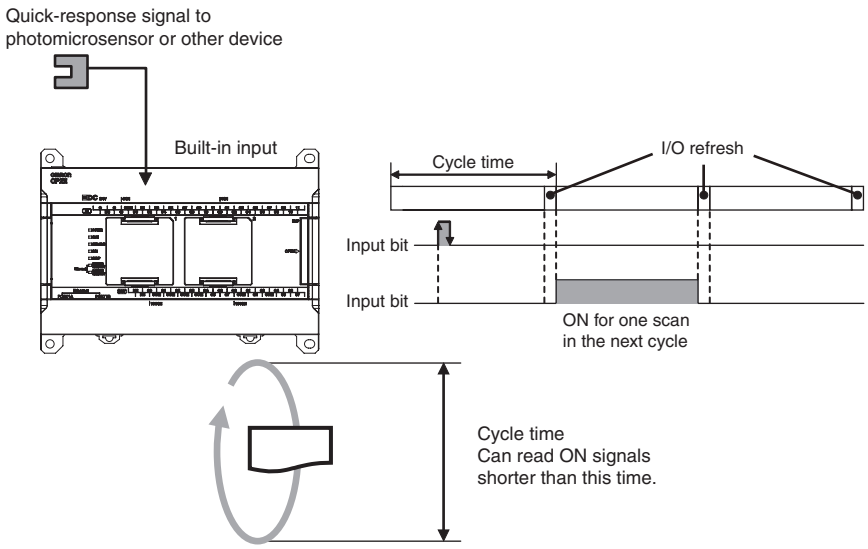
Batteryless Data Backup

Data Memory Area (D), Holding Area (H), Counter Area (C) and Auxiliary Area (A) will be retained even if power is turned OFF with no battery installed.

Quick-response Inputs

By setting a built-in input to quick-response input operation, inputs with signal widths as small as 50 μs can be read with certainty regardless of the cycle time.

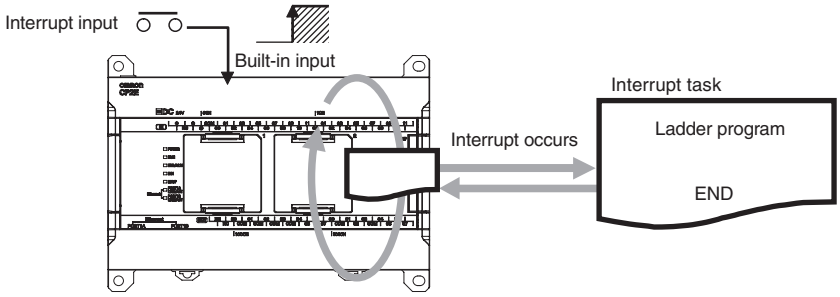
Up to eight quick-response inputs can be used.



Note The user setting in the PLC Setup determines if each input is a quick-response input, normal input, interrupt input, or high-speed counter input.

Input Interrupts

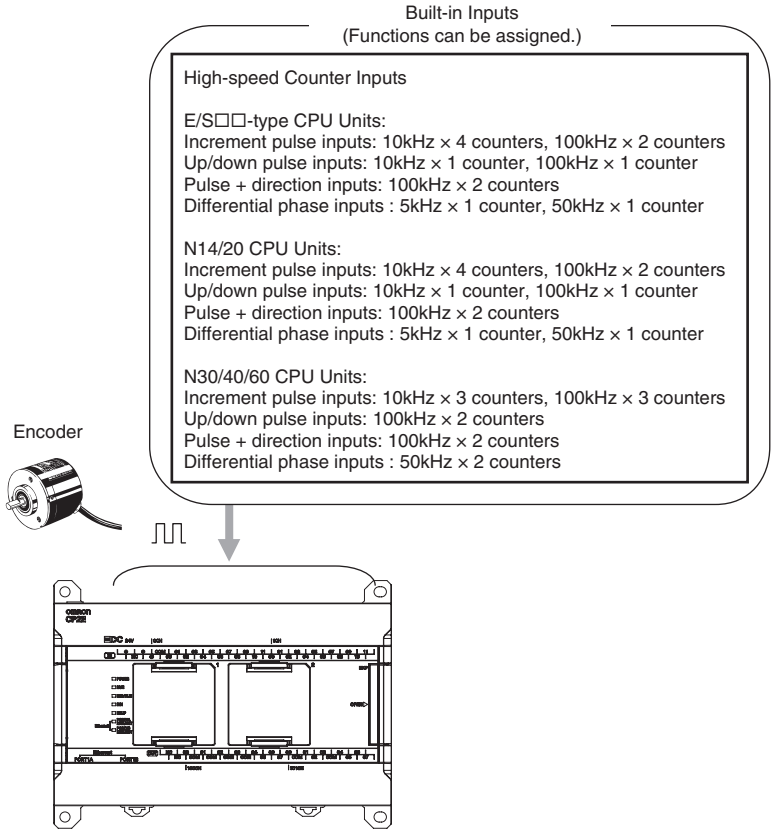
An interrupt task can be started when a built-in input turns ON or turns OFF .
Up to eight interrupt inputs can be used.



Note The user setting in the PLC Setup determines if each input is a quick-response input, normal input, interrupt input, or high-speed counter input.

Complete High-speed Counter Functionality

A high-speed counter input can be used by connecting a rotary encoder to a built-in input. A CP2E CPU Unit is equipped with more than one high-speed counter input, making it possible to control devices for multiple axes with a single PLC.



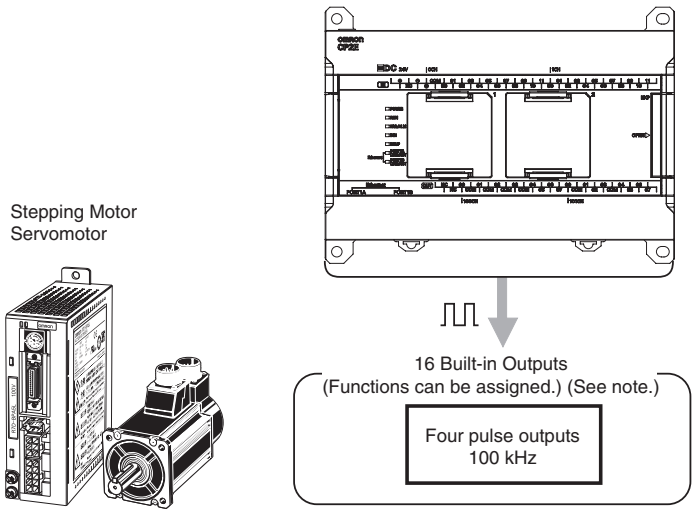
Note The user setting in the PLC Setup determines if each input is a quick-response input, normal input, interrupt input, or high-speed counter input.

- High-speed counters can be used for high-speed processing, using either target value comparison or range comparison with the counter's PV to create interrupts.
  An interrupt task can be started when the count reaches a specified value or falls within a specified range.
- High-speed counter input frequency (speed) can be measured.
  The input pulse frequency can be measured using the PRV instruction (counter 0 only).

Versatile Pulse Control for Transistor Output CPU Units

Fixed duty ratio pulse outputs can be output from the CPU Unit's built-in outputs and used to perform positioning or speed control with a servomotor or a stepping motor that accepts pulse inputs.

Up to four pulse outputs at 100 kHz are provided as standard features.



Note The instruction used to control each output determines whether it is used as a normal output, pulse output, or PWM output.

● Positioning is possible with Trapezoidal Acceleration and Deceleration

Trapezoidal acceleration and deceleration can be used for positioning using the PULSE OUTPUT (PLS2) instruction.

● Jogging can be Performed

Jogging can be performed by executing the SPED or ACC instruction.

● Origin Searches and Origin Returns can be Performed Using the ORIGIN SEARCH Instruction

An accurate origin search combining all I/O signals can be executed with a single instruction. It is also possible to move directly to an established origin using the ORIGIN SEARCH (ORG) instruction.

● Linear Interpolation Operation

Up to one linear interpolation can be used for an N14/20 CPU Unit, and up to two linear interpolations can be used for an N30/40/60 CPU Unit. Linear interpolation operation can be performed by executing the LINEAR INTERPOLATION (ITPL) instruction.

● Easy Interrupt Feeding

An interrupt input can be used as a trigger to switch from speed control to position control and output the specified number of pulses, then decelerate to a stop using the INTERRUPT FEEDING (IFEED) instruction.

PWM Outputs for Transistor Output CPU Units

Lighting and power control can be performed by outputting variable duty ratio pulse (PWM) output signals from the CPU Unit's built-in outputs.

Built-in RS-232C Port for E/S□□-type CPU Units

The E/S□□-type CPU Units have one built-in RS-232C port as a standard feature.

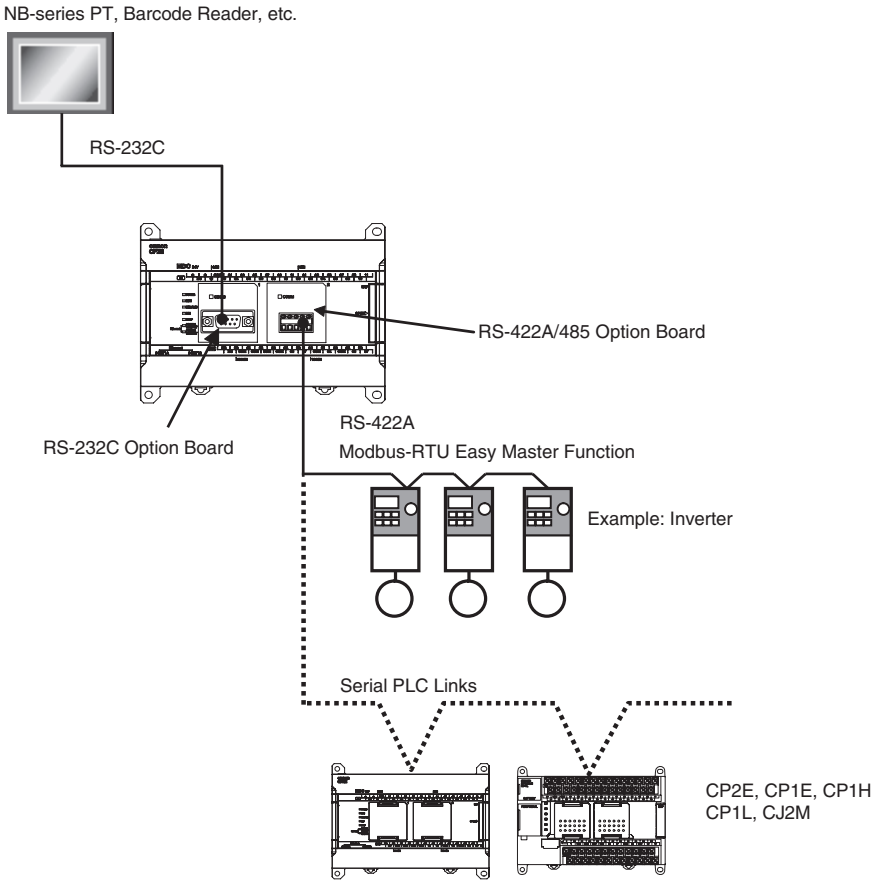
Built-in RS-485 Port for S□□-type CPU Units

The S□□-type CPU Units have one built-in RS-485 port as a standard feature.

Mounting Serial Option Boards to N□□-type CPU Units

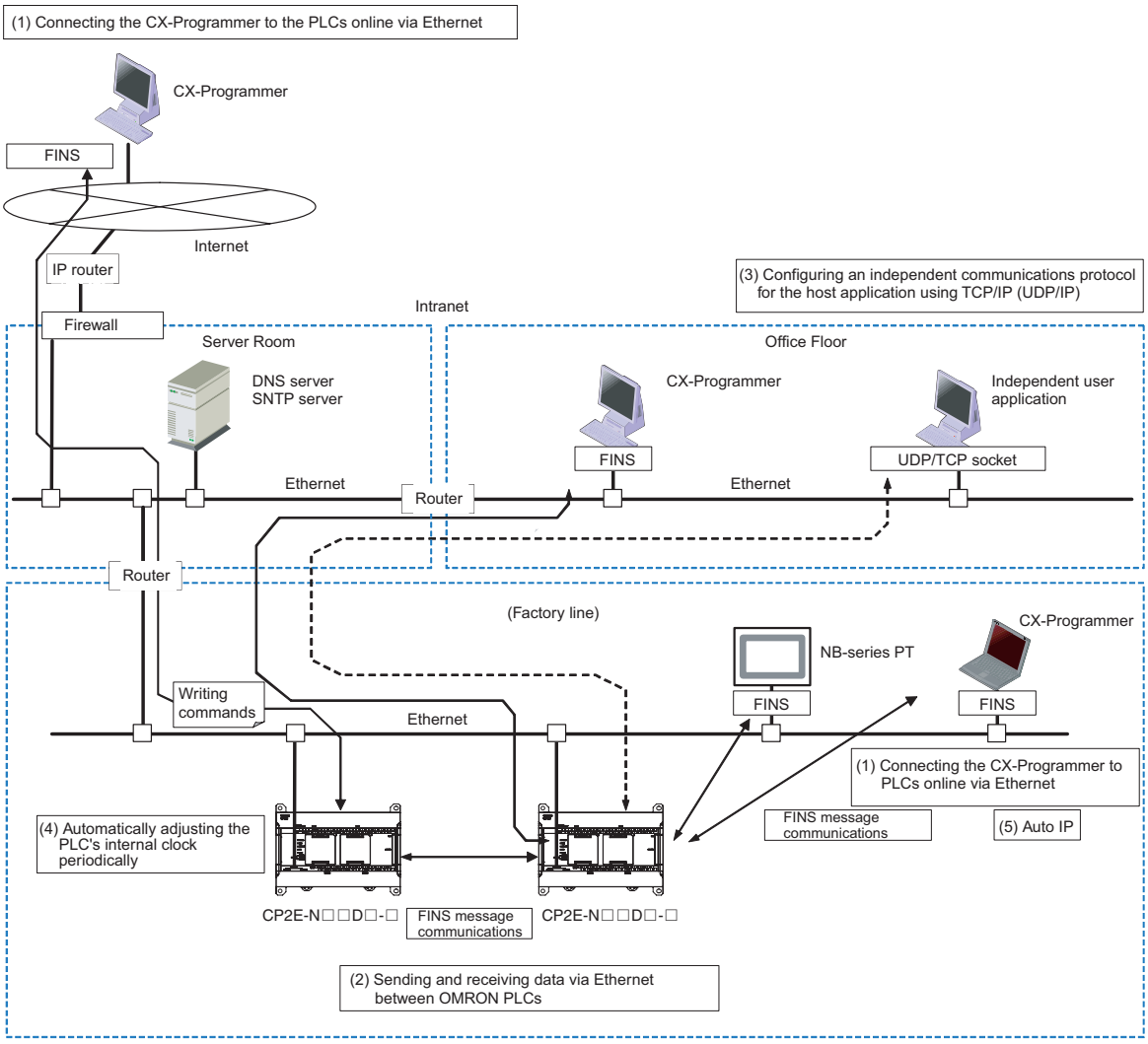
UP to two Serial Communications Option Boards can be added to an N□□-type CPU Unit. With the serial communications port, it is easy to connect to general components, such as barcode readers, and other components such as PTs, other CP-series PLCs, and Inverters.

Note Serial Option Boards cannot be mounted to the E/S□□-type CPU Unit.



Built-in Ethernet Port for Various Ethernet Application for N□□-type CPU Units

With the built-in Ethernet port, it is possible to connect the CX-Programmer to PLCs and exchange data between OMRON PLCs using Ethernet. It can also create an original communication procedure using TCP/IP or UDP/IP for the host application or communicate with PLCs from another manufacturer.



1-2 Basic Operating Procedure

In general, use the following procedure.

1. Setting Devices and Hardware

Connect the CPU Unit, Expansion I/O Units, and Expansion Units.
Set the DIP switches on the Option Board and Expansion Units as required.

Refer to *Section 3 Part Names and Functions* and *Section 5 Installation and Wiring* in the *CP2E CPU Unit Hardware User's Manual* (Cat. No. W613).

2. Wiring

Wire the power supply, I/O, and communications.

Refer to *Section 5 Installation and Wiring* in the *CP2E CPU Unit Hardware User's Manual* (Cat. No. W613).

3. Connecting Online to the PLC

Connect the personal computer online to the PLC.

Refer to *Section 4 Programming Device* in the *CP2E CPU Unit Hardware User's Manual* (Cat. No. W613).

4. I/O Allocations

Allocations for built-in I/O on the CPU Unit are predetermined and memory is allocated automatically to Expansion I/O Units and Expansion Units, so the user does not have to do anything.

Refer to Section 6 I/O Allocation in the *CP2E CPU Unit Software User's Manual* (Cat. No. W614).

5. Software Setup

Make the PLC settings using the CX-Programmer.

Refer to *Section 7 PLC Setup* in the *CP2E CPU Unit Software User's Manual* (Cat. No. W614).

6. Writing the Programs

Write the programs using the CX-Programmer.

Refer to *Section 4 Programming Concepts* in the *CP2E CPU Unit Software User's Manual* (Cat. No. W614).

7. Checking Operation

Check the I/O wiring and the Auxiliary Area settings, and perform trial operation.
The CX-Programmer can be used for monitoring and debugging.

Refer to *Section 8 Overview and Allocation of Built-in Functions* in the *CP2E CPU Unit Software User's Manual* (Cat. No. W614).

8. Basic Program Operation

Set the operating mode to RUN mode to start operation.

1-3 Specifications

1-3-1 General Specifications

The following table lists the general specifications of CP2E CPU Units.

Item		AC power supply	DC power supply
Model		CP2E-□□□D□-A	CP2E-□□□D□-D
Enclosure		Mounted in a panel	
Dimensions (H × D × W)		CPU Unit with 14 or 20 I/O points (CP2E-□14/20D□-□): 90mm*1 ×80mm*2 × 86mm CPU Unit with 30 I/O points (CP2E-□30D□-□): 90mm*1 × 80mm*2 × 130mm CPU Unit with 40 I/O points (CP2E-□40D□-□): 90mm*1 × 80mm*2 × 150mm CPU Unit with 60 I/O points (CP2E-□60D□-□): 90mm*1 × 80mm*2 × 195mm	
Weight		CPU Unit with 14 I/O points (CP2E-□14D□-□): 335g max. CPU Unit with 20 I/O points (CP2E-□20D□-□): 340g max. CPU Unit with 30 I/O points (CP2E-□30D□-□): 580g max. CPU Unit with 40 I/O points (CP2E-□40D□-□): 640g max. CPU Unit with 60 I/O points (CP2E-□60D□-□): 780g max.	
Electrical specifications	Supply voltage	100 to 240 VAC 50/60 Hz	24 VDC
	Operating voltage range	85 to 264 VAC	20.4 to 26.4 VDC
	Power consumption	15 VA/100 VAC max. 25 VA/240 VAC max. (CP2E-□14/20D□-A)	13W max. (CP2E-□14/20D□-D)
		50 VA/100 VAC max. 70 VA/240 VAC max. (CP2E-□30/40/60D□-A)	20W max. (CP2E-□30/40/60D□-D) *4
	Inrush current	120 VAC, 20 A for 8 ms max. for cold start at room temperature 240 VAC, 40 A for 8 ms max. for cold start at room temperature	24 VDC, 30A for 20 ms max. for cold start at room temperature
	External power supply *3	Not provided. (CP2E-□14/20D□-A) 24 VDC, 300 mA (CP2E-□30/40/60D□-A)	Not provided.
	Insulation resistance	20 MΩ min. (at 500 VDC) between the external AC terminals and GR terminals	No insulation between primary and secondary DC power supplies
	Dielectric strength	2,300 VAC 50/60Hz for 1 min between AC external and GR terminals Leakage current: 5 mA max.	No insulation between primary and secondary DC power supplies
	Power interrupt time	10 ms min.	2 ms min.
Application environment	Ambient operating temperature	-20 to 60°C	
	Ambient humidity	10% to 90%	
	Atmosphere	No corrosive gas.	
	Ambient storage temperature	-20 to 75°C (excluding battery)	
	Altitude	2,000 m max.	
	Pollution degree	2 or less: Conforms to IEC61010-2-201.	
	Noise resistance	2 kV on power supply line (Conforms to IEC61000-4-4.)	
	Overvoltage category	Category II: Conforms to IEC61010-2-201.	
	EMC immunity level	Zone B	
	Vibration resistance	Conforms to JIS 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 for 100 min in X, Y, and Z directions (10 sweeps of 10 min each = 100 min total)	
	Shock resistance	Conforms to JIS 60068-2-27. 147 m/s^2, 3 times in X, Y, and Z directions	
Terminal block		Fixed (not removable)	
Terminal screw size		M3	
Applicable standards		Conforms to EC Directives.	
Grounding method		Ground to 100Ω or less.	

*1 Total of 110 mm with mounting brackets.

*2 Excluding cables.

*3 Use the external power supply to power input devices. Do not use it to drive output devices.

*4 This is the rated value for the maximum system configuration. Use the following formula to calculate power consumption for CPU Units with DC power.
Formula: DC power consumption = (5V current consumption × 5 V/70% (internal power efficiency) + 24V current consumption) × 1.1(current fluctuation factor)
The above calculation results show that a DC power supply with a greater capacity is required.

*5 The Expansion I/O Units and Expansion Units work under the same conditions as the CPU Units unless otherwise specified.

1-3-2 Characteristics

The following table gives the characteristics of CP2E CPU Units.

Item			CP2E-E□□D□-□	CP2E-S□□D□-□	CP2E-N□□D□-□
Program capacity			4K steps	8K steps	10K steps
FB capacity			4K steps	8K steps	10K steps
Control method			Stored program method		
I/O control method			Cyclic scan with immediate refreshing		
Program language			Ladder diagram		
Function blocks			Maximum number of function block definitions: 64 Maximum number of instances: 128 Languages usable in function block definitions: Ladder diagrams, structured text (ST)		
Instructions			Approximately 220		
Processing speed	**Overhead processing time**		0.1ms	0.15ms	0.2ms
	Instruction execution times		LD 0.23μs MOV 1.76μs		
Number of CP1W-series Expansion I/O Units and Expansion Units connected			CP2E-□14/20D□-□: None CP2E-□30/40/60D□-□: 3units		
Maximum number of I/O points			CP2E-□14D□-□: 14 CP2E-□20D□-□: 20 CP2E-□30D□-□: 150 (30 built in, 40 × 3 expansion) CP2E-□40D□-□: 160 (40 built in, 40 × 3 expansion) CP2E-□60D□-□: 180 (60 built in, 40 × 3 expansion)		
Built-in input function	**High-speed counters**	**High-speed counter mode/maximum frequency**	Incremental Pulse Inputs 100 kHz: 2 counters 10 kHz: 4 counters Up/Down Inputs 100 kHz: 1 counter 10 kHz: 1 counter Pulse + Direction Inputs 100 kHz: 2 counters Differential Phase Inputs (4x) 50 kHz: 1 counter 5 kHz: 1 counter		N14/20D□-□ Incremental Pulse Inputs 100 kHz: 2 counters 10 kHz: 4 counters Up/Down Inputs 100 kHz: 1 counter 10 kHz: 1 counter Pulse + Direction Inputs 100 kHz: 2 counters Differential Phase Inputs 50 kHz: 1 counter 5 kHz: 1 counter N30/40/60D□-□ Incremental Pulse Inputs 100 kHz: 3 counters 10 kHz: 3 counters Up/Down Inputs 100 kHz: 2 counters, Pulse + Direction Inputs 100 kHz: 2 counters Differential Phase Inputs 50 kHz: 2 counters
		Counting mode	• Linear mode • Ring mode		
		Count value	32 bits		
		Counter reset modes	• Phase Z and software reset(excluding increment pulse input) • Software reset		
		Control method	• Target matching • Range comparison		
	Input interrupts		6 inputs		8 inputs (6 inputs only for 14 I/O points)
			Interrupt input pulse width: 50 μs min.		
	Quick-response inputs		6 inputs		8 inputs (6 inputs only for 14 I/O points)
			Input pulse width: 50 μs min.		
	Normal input	**Input constants**	Delays can be set in the PLC setup (0 to 32 ms, default: 8 ms). Set values: 0, 1, 2, 4, 8, 16, or 32 ms		
Built-in output function	**Pulse outputs (Models with transistor outputs only)**	**Pulse output**	Pulse output function not included	Pulse+Direction Mode	
		Frequency		1 Hz to 100kHz : 2 outputs	N14/20D□-□ 1 Hz to 100kHz: 2 outputs N30/40/60D□-□ 1 Hz to 100kHz: 4 outputs
		Output mode		• Continuous mode (for speed control) • Independent mode (for position control)	
		Number of output pulses		• Relative coordinates: 0000 0000 to 7FFF FFFF hex (0 to 2147483647) • Absolute coordinates: 8000 0000 to 7FFF FFFF hex (-2147483647 to 2147483647)	
		Acceleration/ deceleration curves		Trapezoidal acceleration and deceleration (Cannot perform S-curve acceleration and deceleration).	
		Changing SVs during instruction execution		Only target position can be changed.	
		Origin searches		Included	
		Linear interpolation		None	N14/20D□-□ 2 axes max. N30/40/60D□-□ 4 axes max.

Item			CP2E-E□□D□-□	CP2E-S□□D□-□	CP2E-N□□D□-□
Built-in output function	PWM outputs (Models with transistor outputs only)	Frequency	PWM output function not included	2.0 to 6,553.5 Hz (in increments of 0.1 Hz) with 1 output or 2 Hz to 32,000 Hz (in increments of 1 Hz) with 1 output	
		Duty factor		0.0% to 100.0% (in increments of 0.1%) Accuracy: +1%/-0% at 2 Hz to 10,000 Hz and +5%/-0% at 10,000 Hz to 32,000 kHz	
		Output mode		Continuous Mode	
Communications	Peripheral USB port		Conforming to USB 2.0 B-type conntor		None
		Transmission distance	5m max.		
	Built-in RS232C port		Interface: Conforming to EIA RS-232C		None
		Transmission distance	15m max.		
		Communications method	Half duplex		
		Synchronization	Start-stop		
		Baud rate	1.2, 2.4, 4.8, 9.6, 19.2, 38.4, 57.6, or 115.2 kbps		
		Supported protocol	• Host Link • 1:N NT Link • No-protocol mode • Serial PLC Links (master, slave) • Modbus-RTU Easy Master • Modbus-RTU Slave		
	Built-in RS485 port (not isolated)		None	Interface: Conforming to EIA RS-485	None
		Transmission distance		50m max.	
		Communications method		Half duplex	
		Synchronization		Start-stop	
		Baud rate		1.2, 2.4, 4.8, 9.6, 19.2, 38.4, 57.6, or 115.2 kbps	
		Supported protocol		• Host Link • 1:N NT Link • No-protocol mode • Serial PLC Links (master, slave) • Modbus-RTU Easy Master • Modbus-RTU Slave	
	Serial Option port	Number of Option Boards	None		N14/20D□-□ 1 Option Board N30/40/60D□-□ 2 Option Boards
		Number of serial communications			N14/20D□-□ 2 ports max. N30/40/60D□-□ 3 ports max.
		Communications method			Depends on Option Board
		Synchronization			Depends on Option Board
		Baud rate			1.2, 2.4, 4.8, 9.6, 19.2, 38.4, 57.6, or 115.2 kbps
		Mountable Option Boards			Serial Communication Option Board with one port • One RS-232C port: CP1W-CIF01 (Start-stop) • One RS-422A/485 port (not isolated): CP1W-CIF11 (Start-stop) • One RS-422A/485 port (isolated): CP1W-CIF12-V1 (Start-stop) Serial Communication Option Board with two ports*1 • Two RS-232C ports: CP2W-CIFD1 (Start-stop) • One RS-232C port and one RS-485 port (isolated): CP2W-CIFD2 (Start-stop) • Two RS-485 ports (isolated): CP2W-CIFD3 (Start-stop) Analog Option Board*2 CP1W-MAB221/ADB21/DAB21V *1 CP2W-CIFD□ can only be mounted on option slot 1. *2 Maximum one Analog Option Board can be mounted on an N□□-type CPU Unit.
		Compatible protocols			• Host Link* • 1:N NT Link* • No-protocol mode • Serial PLC Links (master, slave) • Modbus-RTU Easy Master • Modbus-RTU Slave * PORT1(EX) is not supported.

Item			CP2E-E□□D□-□	CP2E-S□□D□-□	CP2E-N□□D□-□
Communications	Ethernet	Physical layer	None		100/10BASE-TX (Auto-MDIX)
		Media access methiod			CSMA/CD
		Modulation			Baseband
		Baud rate			100BASE-TX: 100Mbit/s 10BASE-T: 10Mbit/s • Half/full auto-negotiation for each port • Link speed auto-sensing for each port
		Transmission media			100BASE-TX • Unshielded twisted-pair (UDP) cable Categories: 5, 5e • Shielded twisted-pair (STP) cable Categories: 100Ω at 5, 5e 10BASE-T • Unshielded twisted-pair (UDP) cable Categories: 3, 4, 5, 5e • Shielded twisted-pair (STP) cable Categories: 100Ω at 3, 4, 5, 5e
		Transmission distance			100 m (distance between switch and node)
		Protocol			TCP, UDP, ARP, ICMP (ping only), SNTP, DNS
		Applications			FINS, Socket, SNTP, DNS (Client)
		Switching hub function			Layer 2 switch * N14/20 is not supported.
Number of tasks			17 • 1 cyclic task • 16 interrupt tasks Scheduled interrupt task: Interrupt task 1 (fixed) Built-in input interrupt task: Interrupt task 2 to 9 (IN8 and IN9 can only be used in N20/30/40/60 CPU Units) High-speed counter interrupt task: Interrupt task 1 to 16		
Maximum subroutine number			128		
Maximum jump number			128		
Scheduled interrupt tasks			1 interrupt task		
Battery service life *With CP2W-BAT02 Battery (optional)			Battery cannot be mounted.	CP2W-BAT02 can be mounted. Maximum battery service life: 5 years Guaranteed Lifetime Ambient temperature is 60°C: 13,000 hours (approx. 1.5 years) Ambient temperature is 25°C: 43,000 hours (approx. 5 years)	
Clock			None	Supported. Accuracy (monthly deviation): -4.5 min to -0.5 min (ambient temperature: 60°C), -2.0 min to +2.0 min (ambient temperature: 25°C), -2.5 min to +1.5 min (ambient temperature: -20°C)	
Memory backup	Built-in Flash Memory		Ladder programs and parameters are automatically saved to built-in Flash Memory. A section of the Data Memory Area can be saved to the built-in Flash Memory.		
	Built-in non-volatile memory		Data Memory Area (D), Holding Area (H), Counter Area (C) and Auxiliary Area (A) are automatically saved to the built-in non-volatile memory.		
CIO Area	Input Bits		1,600 bits (100 words): CIO 0.00 to CIO 99.15 (CIO 00 to CIO 99)		
	Output Bits		1,600 bits (100 words): CIO 100.00 to CIO 199.15 (CIO 100 to CIO 199)		
	Serial PLC Link Words		1,440 bits (90 words): CIO 200.00 to CIO 289.15 (CIO 200 to CIO 289)		
Work Area (W)			2,048 bits (128 words): W0.00 to W127.15 (W0 to W127)		
Holding Area (H)			2,048 bits (128 words): H0.00 to H127.15 (H0 to 127) Words H512 to H1535: These words can be used only for function blocks.		
Auxiliary Area (A)			Read-only: 7,168 bits (448 words): A0.00 to A447.15 (A0 to A447) Read/write: 8,192 bits (512 words): A448.00 to A959.15 (A448 to A959)		
Temporary Area (TR)			16 bits: TR0 to TR15		
Timer Area (T)			256 timer numbers (T0 to T255 (separate from counters)) Words T256 to T511: These words can be used only for function blocks.		
Counter Area (C)			256 counter numbers (C0 to C255 (separate from timers)) Words C256 to C511: These words can be used only for function blocks.		
Data Memory Area (D)			4 K words: D0 to D4095 DM backup: 1,500 words (D0 to D1499)	8 K words: D0 to D8191 DM backup : 7,000 words (D0 to D6999)	16 K words: D0 to D16383 DM backup : 15,000 words (D0 to D14999)
Index Registers (IR)			16 registers: IR0 to IR15		
Data Registers (DR)			16 registers: DR0 to DR15		
Operating modes			PROGRAM Mode: Program execution is stopped. Preparations can be executed prior to program execution in this mode. MONITOR Mode: Programs are executed. Some operations, such as online editing, and changes to present values in I/O memory, are enabled in this mode. RUN Mode: Programs are executed. This is the normal operating mode.		

1-3-3 Functional Specifications

The following table gives the functional specifications of CP2E CPU Units.

Function					Description
Cycle time management	Minimum cycle time				Makes the cycle time consistent.
	Cycle time monitoring				Monitors the cycle time.
CPU Unit built-in functions	Inputs	High-speed counters inputs	High-speed pulse inputs		High-speed pulses from devices such as a rotary encoder are counted. The counted values are stored in the Auxiliary Area.Interrupt tasks can be executed when target is reached or by range comparison.
			Input pulse frequency measurement		The frequency of pulses input by the PRV instruction is measured.
		Interrupt inputs			Relevant interrupt tasks are executed during the cycle when the CPU Unit built-in inputs turn ON or turn OFF.
		Quick-response inputs			Inputs can be read without being affected by cycle time. Use the quick-response inputs to read signals shorter than the cycle time.
		Normal inputs	I/O refreshing	Cyclic refreshing	The CPU Unit's built-in I/O are cyclically refreshed.
				Immediate refreshing	I/O refreshing by immediate refreshing instructions.
			Input response times		Input constants can be set for built-in CPU inputs. The response time can be increased to reduce the effects of chattering and noise at input contacts. The response time can be decreased to enable detecting shorter input pulses.
	Outputs	Pulse outputs (Models with transistor outputs only)	Pulse control		A pulse signal is output and positioning or speed control is performed with a servo driver that accepts a pulse input. Continuous mode for speed control or independent mode for position control can be used. There are functions for changing to positioning during speed control and for changing the target value during positioning.
			Linear interpolation		Up to 2 linear interpolations can be executed by the ITPL instrnction.
			Origin positioning		Origin searches and origin returns.
		PWM outputs (Models with transistor outputs only)			Pulses for which the duty ratio (ratio between ON time and OFF time during one pulse cycle) can be set are output.
		Normal outputs	Load OFF function		All of the outputs on the CPU Unit's I/O are turned OFF when an error occurs in RUN or MONITOR mode.
Expansion I/O Units and Expansion Units	Functions supported by both Expansion I/O Unit and Expansion Unit	I/O refreshing	Cyclic refreshing		The Expansion I/O Units and Expansion Units are cyclically refreshed.
			Refreshing by IORF		I/O refreshing by IORF instruction.
		Load OFF function			All of the outputs on Expansion I/O Units and Expansion Units are turned OFF (0000 hex) when an error occurs in RUN or MONITOR mode.
	Expansion I/O Units	Input response times			The response time can be increased to reduce the effects of chattering and noise at input contacts. The response time can be decreased to enable detecting shorter input pulses.
	Expansion Units	Unit error detection			Errors in Expansion Units are detected. The CPU Unit is notified that the Expansion Unit stopped due to an error.
Memory management functions	Holding I/O memory when changing operating modes				The status of I/O memory can be held when the operating mode is changed. The forced-set/reset status can be held when the operating mode is changed .
	Automatic backup to the backup memory (built-in Flash Memory)				Automatic backup of ladder programs and parameter area to the backup memory (built-in Flash Memory).
	Batteryless I/O Memory backup				Data Memory Area (D), Holding Area (H), Counter Area (C) and Auxiliary Area (A) be retained when the power is interrupted.
Communications	Peripheral USB port	Peripheral bus (toolbus)			For communications with programming device (CX-Programmer).
	Ethernet port				For communications with programming device (CX-Programmer). Data can be transferred with devices such as PTs, computers or PLCs via Ethernet port.
	Serial port	Host Link (SYSWAY) communications			Host Link commands can be sent from a PT or a computer to read/write I/O memory, and perform other operations for PLC.
		No-protocol communications			I/O instructions for communications ports (TXD/RXD instructions) can be used for data transfer with peripheral devices such as bar code readers.
		NT Link communications			I/O memory in the PLC can be allocated and directly linked to various PT functions, including status control areas, status notification areas, touch switches, lamps, memory tables, and other objects.
		Serial PLC Links			Up to 10 words of data per Unit can be shared between up to nine CPU Units (one polling unit and eight polled units). * A PT cannot be connected.
		Modbus-RTU Easy Master function			Modbus-RTU commands are sent by the Modbus-RTU Master function. Modbus slaves, such as inverters, can be easily controlled with serial communications.
		Modbus-RTU Slave function			Communications with Modbus-RTU Master. Data can be transferred by commands from Modbus-RTU Master.
Interrupt	Scheduled interrupts				Tasks can be executed at a specified interval (1.0 ms min., Unit: 0.1 ms).
	Input interrupts				Interrupt tasks are processed when the built-in input turns ON or OFF.
	High-speed counter interrupts				This function counts input pulses with the CPU Unit's built-in high-speed counter and executes an interrupt task when the count reaches the preset value or falls within a preset range (target value or zone comparison).

Function			Description
Power supply management	**Memory protection**		Holding Area data, DM Area data, Counter Completion Flags, Counter Present Values and Auxiliary Area data are held even when power is turned OFF. Data is retained without battery even if the power supply is interrupted.
	Number of power interruptions counter		The number of times power has been interrupted is counted.
Debugging	**Online editing**		The program can be changed during operation in MONITOR mode or PROGRAM mode.
	Force-set/reset		Specified bits can be set or reset.
	Differentiate monitoring		ON/OFF changes in specified bits can be monitored.
	Storing the stop position at errors		The location and task number where execution stopped for a program error is recorded.
	Program check		The programs can be checked for items such as no END instruction and FALS/FAL errors at startup.
Self-diagnosis and restoration	**Error Log**		Details and the time of occurance of error codes predefined by the CPU Unit are stored.
	CPU error detection		CPU Unit WDT errors are detected.
	User-defined failure diagnosis		Errors can be generated for user-specified conditions:Non-fatal errors (FAL) and fatal errors (FALS).
	Load OFF function		The built-in outputs, Expansion I/O Unit outputs, and Expansion Unit outputs are turned OFF.
	Non-fatal error detection	**System FAL error detection (User-defined non-fatal error)**	This function generates a non-fatal (FAL) error when the user-defined conditions are met in program.
		Backup memory error detection	This function detects when data in the backup memory that stores the ladder program is corrupted.
		PLC Setup error detection	This function detects setting errors in the PLC Setup.
		Option Board errors	This function detects when the Option Board is malfunctioning or disconnected.
		Battery error detection (N/S□□-type CPU Units only)	This function detects when the battery voltage is low or the battery is disconnected. * This function is valid only when a battery is mounted and the *Do not detect battery error* Check Box is cleared in the PLC Setup.
		Built-in Ethernet error (N□□-type CPU Units only)	This function detects errors in Ethernet connection and setup.
		Ethernet setting table error (N□□-type CPU Units only)	This function detects logic errors that occur in routing tables or Ethernet address tables.
	Fatal Error Detection	**Memory error detection**	This function detects errors that occur in memory of the CPU Unit.
		I/O bus error detection	This function detects errors that occur during data transfer between the CPU Unit and another Unit.
		Detection of too many I/O points	This function detects when more than the maximum number of CP1W Expansion I/O Units and Expansion Units are connected to the PLC.
		Built-in Ethernet stop error (N□□-type CPU Units only)	This function detects that Ethernet stops working because of sum value of MAC address error or controller error.
		Program error detection	This function detects when there is an error in the program. See the following for details.
		Instruction processing error detection	This function detects an error when the given data value is invalid when executing an instruction, or execution of instruction between tasks was attempted.
		Indirect DM addressing BCD error	This function detects an error when an indirect DM/EM address in BCD mode is not BCD.
		Illegal area access error detection	This function detects an error when an attempt is made to access an illegal area with an instruction operand.
		No END error detection	This function detects an error when there is no END instruction at the end of the program.
		Task error detection	The execution condition for an interrupt task was met but there is no interrupt task with the specified number.
		Differentiation overflow error detection	This function detects an error when too many differentiated instructions are entered or deleted during online editing (131,072 times or more).
		Invalid instruction error detection	This function detects an error when an attempt is made to execute an instruction that is not defined in the system.
		User program area overflow error detection	This function detects an error when instruction data is stored after the last address in user program area.
		Cycle time exceeded error detection	This function monitors the cycle time (10 to 1,000 ms) and stops the operation when the set value is exceeded.
		System FALS error detection (user-defined fatal error)	This function generates a fatal (FALS) error when the user-defined conditions are met in program.
Maintenance	**Automatic online connection via network**		This function enables automatically connecting to the PLC online when the CX-Programmer is directly connected by a communication port (peripheral USB port or Ethernet port).
Security functions	**Read protection using password**		This function protects reading and displaying programs using passwords. Read protection: Set a password using the CX-Programmer. * Overwrite protection function not included.

2

Basic System Configuration and Devices

This section describes the basic system configuration and device models of the CP2E.

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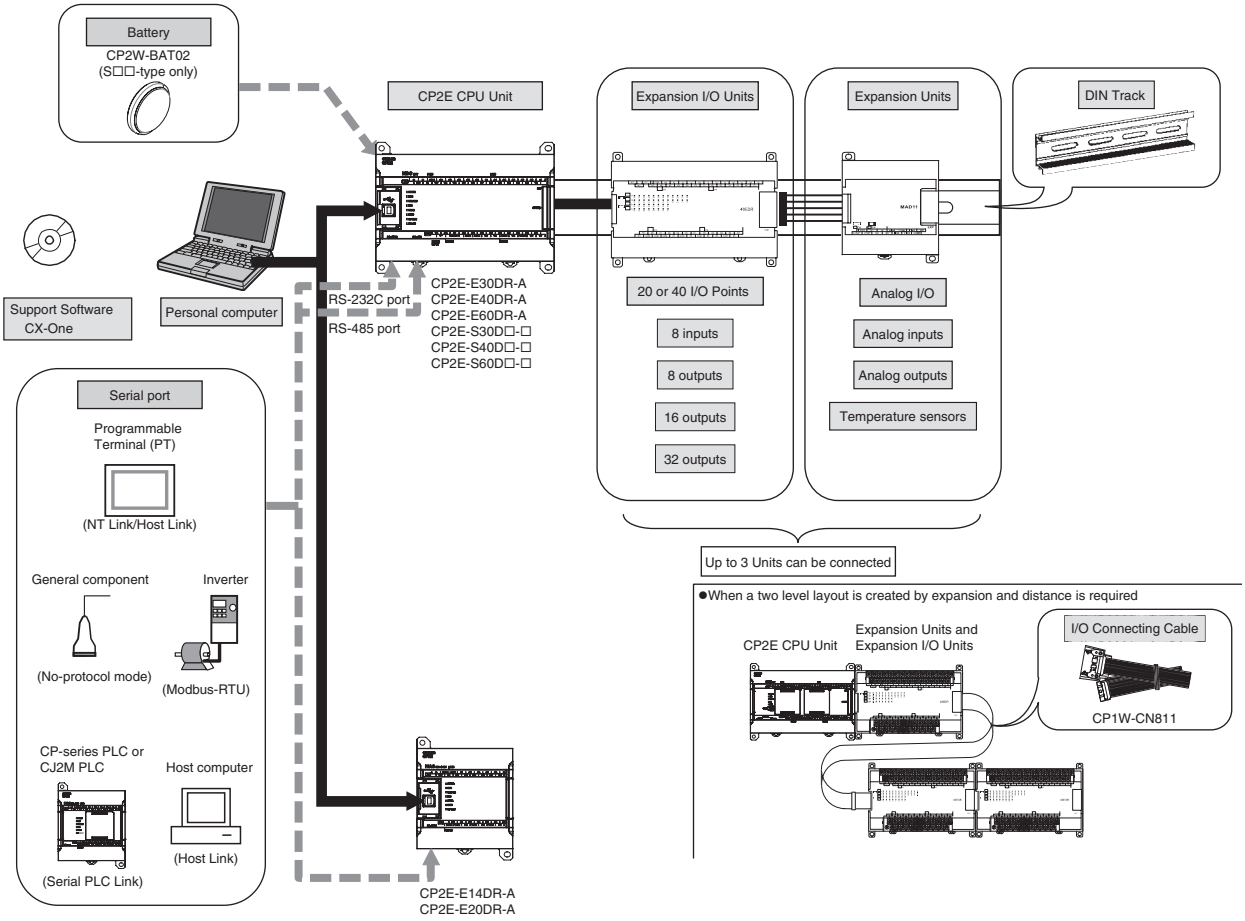
2-1 Basic System Configuration

This section describes the system configurations using CP2E CPU Units.

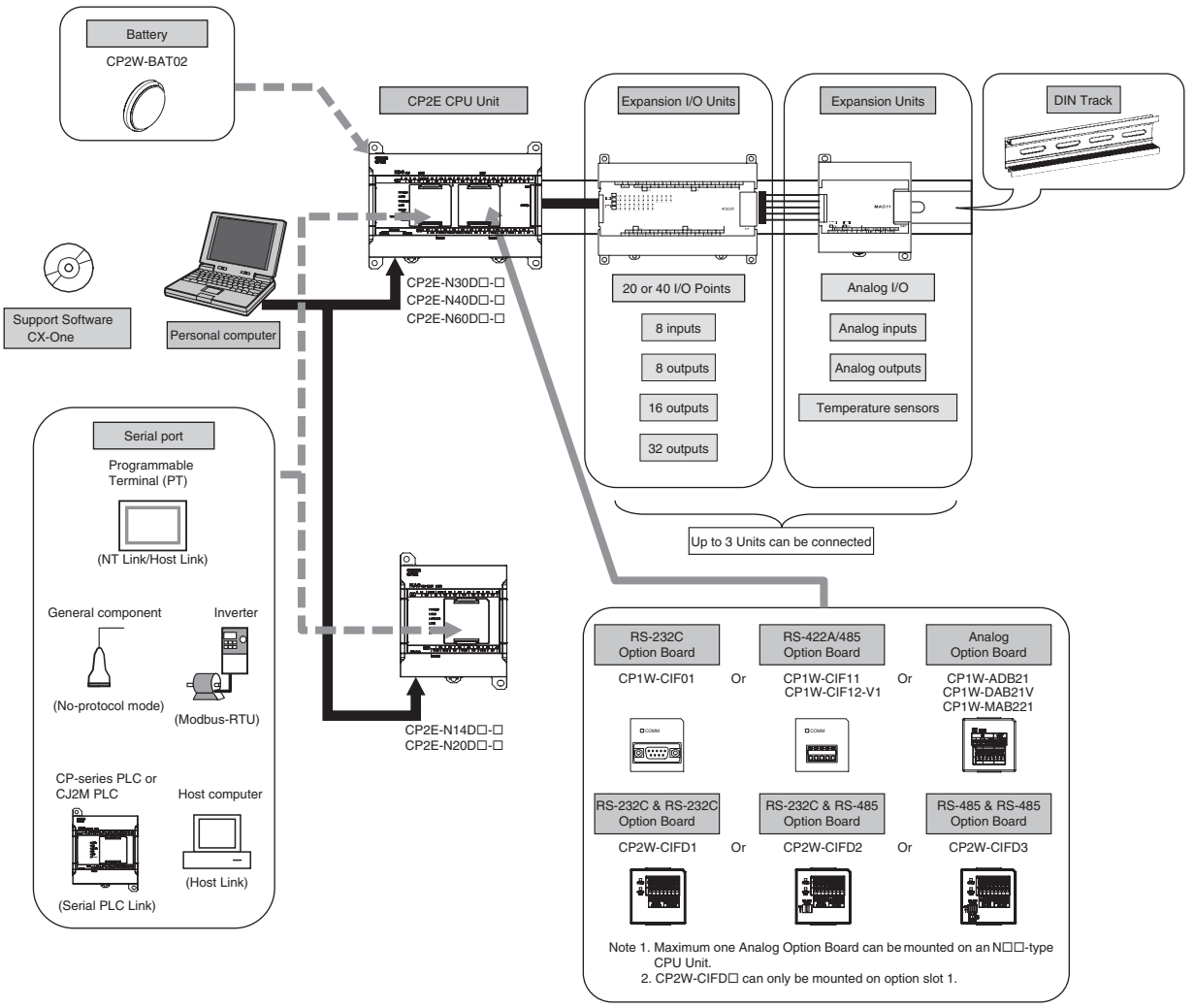
2-1-1 Basic System Configuration Using an E/S□□-type CPU Unit

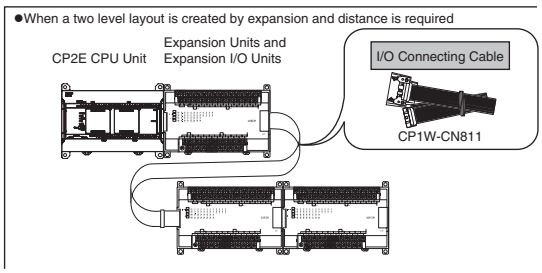
The system configuration when using a CP2E E/S□□-type CPU Unit is shown below.



2-1-2 Basic System Configuration Using an N□□-type CPU Unit

The system configuration when using a CP2E N□□-type CPU Unit is shown below.



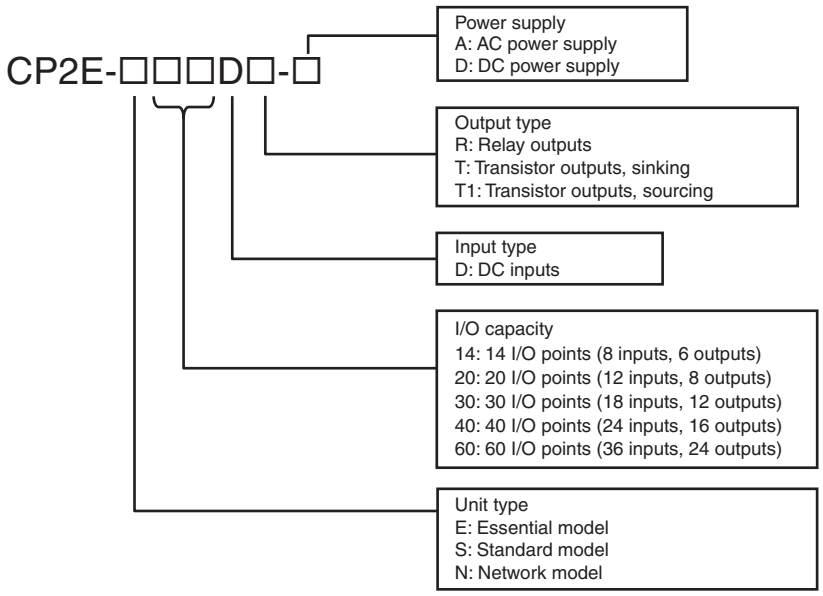


2-2 CPU Units

This section describes the models of CP2E CPU Units.

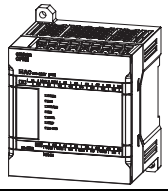
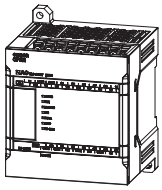
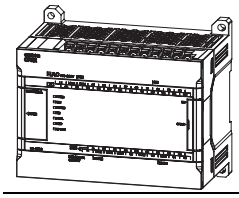
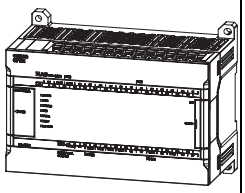
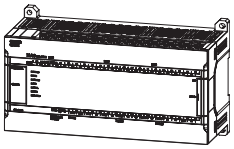
2-2-1 CPU Unit Models

The CP2E CPU Unit model numbers are configured as shown below.



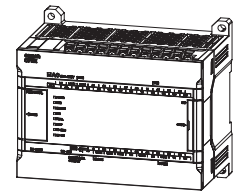
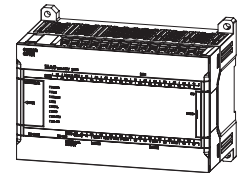
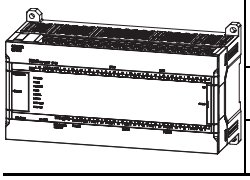
The following is a list of available CP2E CPU Unit models.

E□□-type CPU Units

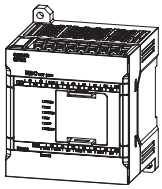
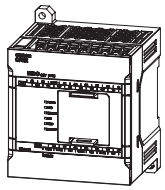
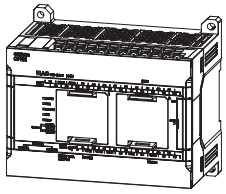
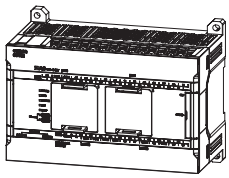
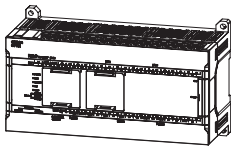
Name and appearance	Model number	Number of built-in I/O points			Power supply specifications	Output type	Program capacity	DM Area capacity	Current consumption		Weight
		Total	Number of inputs	Number of outputs					5 VDC	24 VDC	
CPU Unit with 14 I/O Points 	CP2E-E14DR-A	14	8	6	AC power supply 100 to 240 VAC	Relays	4K steps (FB capacity: 4K steps)	4K words	0.06A	0.04A	320g max.
CPU Unit with 20 I/O Points 	CP2E-E20DR-A	20	12	8					0.08A	0.06A	325g max.
CPU Unit with 30 I/O Points 	CP2E-E30DR-A	30	18	12					0.12A	0.07A	550g max.
CPU Unit with 40 I/O Points 	CP2E-E40DR-A	40	24	16					0.13A	0.09A	610g max.
CPU Unit with 60 I/O Points 	CP2E-E60DR-A	60	36	24					0.16A	0.13A	750g max.

Note A battery cannot be mounted to an E-type CPU Unit.

S□□-type CPU Units

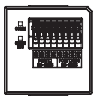
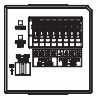
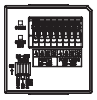
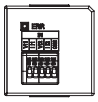
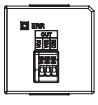
Name and appearance	Model number	Number of built-in I/O points			Power supply specifications	Output type	Program capacity	DM Area capacity	Current consumption		Weight
		Total	Number of inputs	Number of outputs					5 VDC	24 VDC	
CPU Unit with 30 I/O Points 	CP2E-S30DR-A	30	18	12	AC power supply 100 to 240 VAC	Relays	8K steps (FB capacity: 8K steps)	8K words	0.12A	0.07A	560g max.
	CP2E-S30DT-D				DC power supply 24VDC	Sinking transistor			0.28A	0.02A	430g max.
	CP2E-S30DT1-D					Sourcing transistor					
CPU Unit with 40 I/O Points 	CP2E-S40DR-A	40	24	16	AC power supply 100 to 240 VAC	Relays			0.13A	0.09A	610g max.
	CP2E-S40DT-D				DC power supply 24VDC	Sinking transistor			0.34A	0.02A	480g max.
	CP2E-S40DT1-D					Sourcing transistor					
CPU Unit with 60 I/O Points 	CP2E-S60DR-A	60	36	24	AC power supply 100 to 240 VAC	Relays			0.16A	0.13A	760g max.
	CP2E-S60DT-D				DC power supply 24VDC	Sinking transistor			0.48A	0.02A	590g max.
	CP2E-S60DT1-D					Sourcing transistor					

N□□-type CPU Units

Name and appearance	Model number	Number of built-in I/O points			Power supply specifications	Output type	Program capacity	DM Area capacity	Current consumption		Weight
		Total	Number of inputs	Number of outputs					5 VDC	24 VDC	
CPU Unit with 14 I/O Points 	CP2E-N14DR-A	14	8	6	AC power supply 100 to 240 VAC	Relays	10K steps (FB capacity: 10K steps)	16K words	0.15A	0.05A	335g max.
	CP2E-N14DT-A					Sinking transistor			0.21A	0.02A	320g max.
	CP2E-N14DR-D				DC power supply 24VDC	Relays			0.15A	0.05A	325g max.
	CP2E-N14DT-D					Sinking transistor			0.21A	0.02A	305g max.
	CP2E-N14DT1-D					Sourcing transistor			0.22A	0.02A	305g max.
CPU Unit with 20 I/O Points 	CP2E-N20DR-A	20	12	8	AC power supply 100 to 240 VAC	Relays			0.17A	0.06A	340g max.
	CP2E-N20DT-A					Sinking transistors			0.27A	0.02A	330g max.
	CP2E-N20DR-D				DC power supply 24VDC	Relays			0.17A	0.06A	320g max.
	CP2E-N20DT-D					Sinking transistors			0.27A	0.02A	310g max.
	CP2E-N20DT1-D					Sourcing transistors			0.26A	0.02A	310g max.
CPU Unit with 30 I/O Points 	CP2E-N30DR-A	30	18	12	AC power supply 100 to 240 VAC	Relays			0.41A	0.07A	580g max.
	CP2E-N30DT-A					Sinking transistors			0.52A	0.03A	550g max.
	CP2E-N30DR-D				DC power supply 24VDC	Relays			0.37A	0.07A	470g max.
	CP2E-N30DT-D					Sinking transistors			0.51A	0.03A	450g max.
	CP2E-N30DT1-D					Sourcing transistors			0.51A	0.03A	450g max.
CPU Unit with 40 I/O Points 	CP2E-N40DR-A	40	24	16	AC power supply 100 to 240 VAC	Relays			0.39A	0.09A	640g max.
	CP2E-N40DT-A					Sinking transistors			0.59A	0.03A	600g max.
	CP2E-N40DR-D				DC power supply 24VDC	Relays			0.39A	0.09A	540g max.
	CP2E-N40DT-D					Sinking transistors			0.59A	0.03A	500g max.
	CP2E-N40DT1-D					Sourcing transistors			0.59A	0.03A	500g max.
CPU Unit with 60 I/O Points 	CP2E-N60DR-A	60	36	24	AC power supply 100 to 240 VAC	Relays			0.44A	0.13A	780g max.
	CP2E-N60DT-A					Sinking transistor			0.71A	0.03A	720g max.
	CP2E-N60DR-D				DC power supply 24VDC	Relays			0.41A	0.13A	670g max.
	CP2E-N60DT-D					Sinking transistor			0.71A	0.03A	620g max.
	CP2E-N60DT1-D					Sourcing transistor			0.71A	0.03A	620g max.

2-2-2 Optional Products

Optional Products for CPU Units

Name and appearance	Model number	Applications	Current consumption		Weight
			5 VDC	24 VDC	
RS-232C Option Board	CP1W-CIF01	Mounted in the option slot of an N□□-type CPU Unit and can be used as an RS-232C port. Maximum transmission distance: 15 m	0.04A	–	20g
Non-isolated RS-422A/485 Option Board	CP1W-CIF11	Mounted in the option slot of an N□□-type CPU Unit and can be used as an RS-422A/485 port. Maximum transmission distance: 50 m	0.04A	–	15g
Isolated RS-422A/485 Option Board	CP1W-CIF12-V1	Mounted in the option slot of an N□□-type CPU Unit and can be used as an RS-422A/485 port. Maximum transmission distance: 500 m	0.04A	–	15g
RS-232C&RS-232C Option Board 	CP2W-CIFD1	Mounted in the option slot 1 of an N□□-type CPU Unit and can be used as two RS-232C ports. Maximum transmission distance: 15 m	0.04A	–	25g
RS-232C&RS-485 Option Board 	CP2W-CIFD2	Mounted in the option slot 1 of an N□□-type CPU Unit and can be used as one RS-232C port and one isolated RS-485 port. Maximum transmission distance: 15 m (RS-232C) 500 m (RS-485)	0.06A	–	25g
RS-485&RS-485 Option Board 	CP2W-CIFD3	Mounted in the option slot 1 of an N□□-type CPU Unit and can be used as two isolated RS-485 ports. Maximum transmission distance: 500 m	0.08A	–	25g
Analog Input Option Board 	CP1W-ADB21	Mounted in the option slot of an N□□-type CPU Unit and can be used as an analog input module. • 2 analog inputs 0 to 10 V (Resolution: 1/4000) 0 to 20 mA (Resolution: 1/2000)	0.02A	–	25g
Analog Output Option Board 	CP1W-DAB21V	Mounted in the option slot of an N□□-type CPU Unit and can be used as an analog output module. • 2 analog outputs 0 to 10 V (Resolution: 1/4000)	0.06A	–	25g
Analog Input/Output Option Board	CP1W-MAB221	Mounted in the option slot of an N□□-type CPU Unit and can be used as an analog input/output module. • 2 analog inputs 0 to 10 V (Resolution: 1/4000) 0 to 20 mA (Resolution: 1/2000) • 2 analog outputs 0 to 10 V (Resolution: 1/4000)	0.08A	–	25g

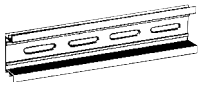
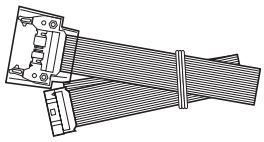
Name and appearance	Model number	Applications	Current consumption		Weight
			5 VDC	24 VDC	
Battery	CP2W-BAT02	Mounted in an N/S□□-type CPU Unit. Mount the Battery when using the clock function. A Battery cannot be mounted to an E□□-type CPU Unit.	–	–	–

Note 1 Maximum one Analog Option Board can be mounted on an N□□-type CPU Unit.

2 The CP1W-ME05M Memory Cassette, CP1W-DAM01 LCD Option Board, and CP1W-CIF41 Ethernet Option Board cannot be used with the CP2E CPU Unit.

3 Serial Option Boards cannot be used with the E/S□□-type CPU Unit.

Installation and Wiring Products

Name and appearance	Model number	Specifications and application
DIN Track 	PFP-50N	Track length: 50 cm, Height: 7.3 mm
	PFP-100N	Track length: 1 m, Height: 7.3 mm
	PFP-100N2	Track length: 1 m, Height: 16 mm
End Plate	PFP-M	Stopper to prevent Units from moving on the DIN Track.
I/O Connecting Cable 	CP1W-CN811	Length: 800 mm This cable is used if the connecting cable for the Expansion I/O Unit or Expansion Unit is not long enough or for a vertical configuration. Only one I/O Connecting Cable can be used in each PLC.

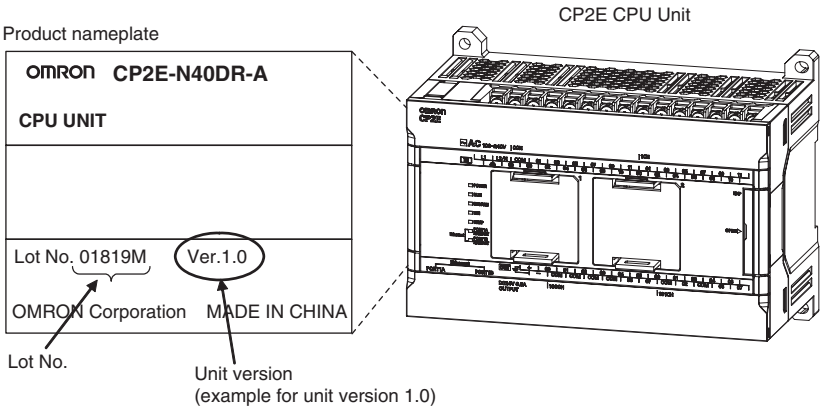
2-2-3 Unit Versions of CPU Units

Unit Versions

A “unit version” has been introduced to manage CPU Units in the CP Series according to differences in functionality accompanying Unit upgrades.

● Notation of Unit Versions on Products

The unit version is given to the right of the lot number on the nameplate of the products for which unit versions are being managed, as shown below.



● Confirming Unit Versions with Support Software

CX-Programmer can be used to confirm the unit version of the CP2E CPU Units.

Refer to *4-1 Applicable Programming Devices for CP2E* for details on the CX-Programmer.

The CX-Programmer can be used to confirm the unit version using one of the following methods.

- Using the PLC Information
- Using the Unit Manufacturing Information

● Unit Versions

Type	Model numbers	Unit version
CP2E CPU Units	CP2E-E□□D□-□ CP2E-S□□D□-□ CP2E-N□□D□-□	Unit version 1.□

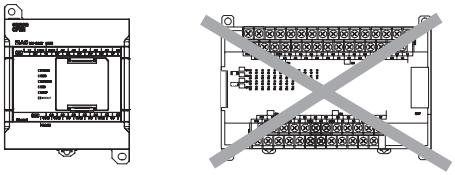
2-3 Expansion I/O Unit or Expansion Unit

This section describes the connection of Expansion I/O Units or Expansion Units to a CP2E CPU Unit.

2-3-1 Expandable CPU Units

- Expansion I/O Units and Expansion Units cannot be connected to E14/20 or N14/20 CPU Units.
- A total of up to three Expansion I/O Units and Expansion Units can be connected to an E30/40/60, S30/40/60 or N30/40/60 CPU Unit.

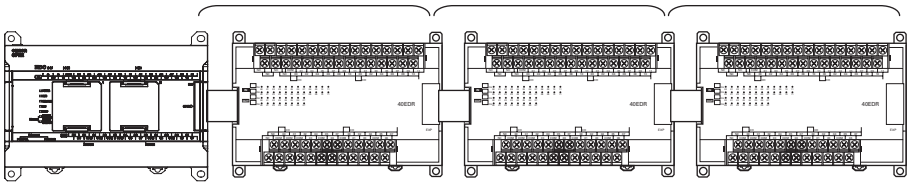
● CP2E E14/20 or N14/20 CPU Unit



CP-series Expansion Units and Expansion I/O Units cannot be connected.

● CP2E E30/40/60, S30/40/60 or N30/40/60 CPU Unit

A total of up to three CP-series Expansion I/O Units and Expansion Units can be connected.



2-3-2 Connection Methods

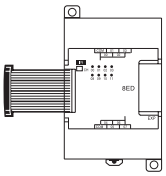
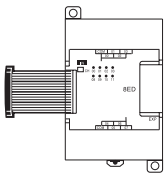
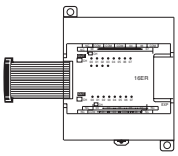
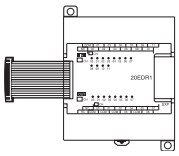
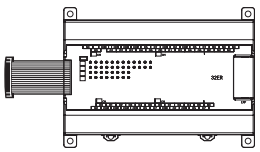
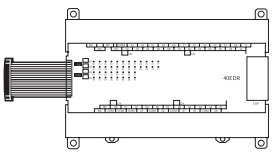
Connection cables for the Expansion I/O Units and Expansion Units are used to connect the Units.
The length can be extended by using a CP1W-CN811 I/O Connecting Cable (length: 800 mm).
Leave approximately 10mm of space between the CPU Unit and the Exapansion I/O Units or Expansion Units.

2-3-3 Maximum Number of I/O Points for an Expansion I/O Unit or Expansion Unit

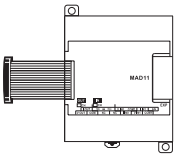
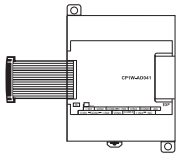
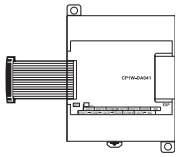
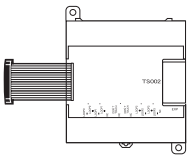
CPU Unit	Built-in I/O on CPU Unit			Total number of Expansion I/O Units and Expansion Units that can be connected	Number of inputs: 24 Number of outputs: 16 Total number of I/O points when three CP1W-40ED□ Expansion I/O Units are connected		
	Total	Number of inputs	Number of outputs		Total	Number of inputs	Number of outputs
CP2E-□14D□-□	14	8	6	Not possible.	14	8	6
CP2E-□20D□-□	20	12	8		20	12	8
CP2E-□30D□-□	30	18	12	3 Units maximum	150	90	60
CP2E-□40D□-□	40	24	16		160	96	64
CP2E-□60D□-□	60	36	24		180	108	72

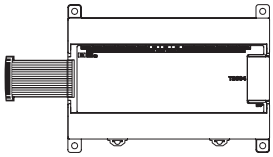
2-3-4 Expansion I/O Units and Expansion Units

Expansion I/O Units

Name and appearance	Model number	Specifications		Current consumption		Weight
		Outputs	Inputs	5V	24V	
8-point Input Unit 	CP1W-8ED	Not provided.	8 inputs, 24 VDC	0.018A	–	200g
8-point Output Unit 	CP1W-8ER	8 relay outputs	Not provided.	0.026A	0.044A	250g
	CP1W-8ET	8 transistor outputs, sinking		0.075A	–	250g
	CP1W-8ET1	8 transistor outputs, sourcing		0.075A	–	250g
16-point Output Unit 	CP1W-16ER	16 relay outputs	Not provided.	0.042A	0.090A	280g
	CP1W-16ET	16 transistor outputs, sinking		0.076A	–	225g
	CP1W-16ET1	16 transistor outputs, sourcing		0.076A	–	225g
20-point I/O Unit 	CP1W-20EDR1	8 relay outputs	12 inputs, 24 VDC	0.103A	0.044A	300g
	CP1W-20EDT	8 transistor outputs, sinking		0.130A	–	300g
	CP1W-20EDT1	8 transistor outputs, sourcing		0.130A	–	300g
32-point Output Unit 	CP1W-32ER	32 relay outputs	Not provided.	0.049A	0.131A	465g
	CP1W-32ET	32 transistor outputs, sinking		0.113A	–	325g
	CP1W-32ET1	32 transistor outputs, sourcing		0.113A	–	325g
40-point I/O Unit 	CP1W-40EDR	16 relay outputs	24 inputs, 24 VDC	0.080A	0.090A	380g
	CP1W-40EDT	16 transistor outputs, sinking		0.160A	–	320g
	CP1W-40EDT1	16 transistor outputs, sourcing		0.160A	–	320g

Expansion Units

Name and appearance	Model number	Specifications	Current consumption		Weight
			5V	24V	
Analog I/O Unit 	CP1W-MAD11	2 analog inputs 0 to 5 V, 1 to 5 V, 0 to 10 V, -10 to 10 V, 0 to 20 mA, and 4 to 20 mA 1 analog output 1 to 5 V, 0 to 10 V, -10 to 10 V, 0 to 20 mA, 4 to 20 mA Resolution: 1/6,000	0.083A	0.110A	250g
	CP1W-MAD42	4 analog inputs 0 to 5 V, 1 to 5 V, 0 to 10 V, -10 to 10 V, 0 to 20 mA, and 4 to 20 mA 2 analog outputs 1 to 5 V, 0 to 10 V, -10 to 10 V, 0 to 20 mA, 4 to 20 mA Resolution: 1/12,000	0.120A	0.120A	260g
	CP1W-MAD44	4 analog inputs 0 to 5 V, 1 to 5 V, 0 to 10 V, -10 to 10 V, 0 to 20 mA, and 4 to 20 mA 4 analog outputs 1 to 5 V, 0 to 10 V, -10 to 10 V, 0 to 20 mA, 4 to 20 mA Resolution: 1/12,000	0.120A	0.170A	260g
Analog Input Unit 	CP1W-AD041	4 analog inputs 0 to 5 V, 1 to 5 V, 0 to 10 V, -10 to 10 V, 0 to 20 mA, and 4 to 20 mA Resolution: 1/6,000	0.100A	0.090A	200g
	CP1W-AD042	4 analog inputs 0 to 5 V, 1 to 5 V, 0 to 10 V, -10 to 10 V, 0 to 20 mA, and 4 to 20 mA Resolution: 1/12,000	0.100A	0.050A	200g
Analog Output Unit 	CP1W-DA021	2 analog outputs 1 to 5 V, 0 to 10 V, -10 to 10 V, 0 to 20 mA, and 4 to 20 mA Resolution: 1/6,000	0.040A	0.095A	200g
	CP1W-DA041	4 analog outputs 1 to 5 V, 0 to 10 V, -10 to 10 V, 0 to 20 mA, and 4 to 20 mA Resolution: 1/6,000	0.080A	0.124A	200g
	CP1W-DA042	4 analog outputs 1 to 5 V, 0 to 10 V, -10 to 10 V, 0 to 20 mA, and 4 to 20 mA Resolution: 1/12,000	0.070A	0.160A	200g
Temperature Sensor Unit 	CP1W-TS001	Thermocouple inputs K or J, 2 inputs	0.040A	0.059A	250g
	CP1W-TS002	Thermocouple inputs K or J, 4 inputs	0.040A	0.059A	250g
	CP1W-TS003	Thermocouple inputs K or J, 4 inputs or 2 analog inputs 0 to 10 V, 1 to 5 V, 4 to 20 mA Resolution: 1/12,000	0.070A	0.030A	225g
	CP1W-TS101	Platinum resistance thermometer inputs Pt100 or JPt100, 2 inputs	0.054A	0.073A	250g
	CP1W-TS102	Platinum resistance thermometer inputs Pt100 or JPt100, 4 inputs	0.054A	0.073A	250g

Name and appearance	Model number	Specifications	Current consumption		Weight
			5V	24V	
Temperature Sensor Unit 	CP1W-TS004	Thermocouple inputs K or J, 12 inputs	0.080A	0.050A	380g

2-3-5 Restrictions on System Configuration

The following restrictions apply to the CP-series Expansion Units and CP-series Expansion I/O Units that can be connected to CP2E CPU Units.

Restriction on the Number of Connected Units

A total of up to three Expansion Units and Expansion I/O Units can be connected to an E30/40/60, S30/40/60 or N30/40/60 CPU Unit. Expansion Units and Expansion I/O Units cannot be connected to E14/20 or N14/20 CPU Units.

Refer to *2-4-1 External Power Supply Capacity When Expansion I/O Units or Expansion Units are Connected* for power consumption calculation method to ensure it is sufficient when Expansion Units, Expansion I/O Units and Option Board Units are connected.

Each N□□-type CPU Unit can connect one device to pin 6 (+5V power supply) of the CP1W-CIF01.

Restrictions on External Power Supply Capacity

The following restrictions apply when using the CPU Unit's external power supply.

● AC-power-supply E30/40/60, S30/40/60 or N30/40/60 CPU Unit

The power supply capacity is restricted for AC-power-supply E30/40/60, S30/40/60 or N30/40/60 CPU Units. It may not be possible to use the full 300 mA of the external power supply, though a CPU Unit can connect any CP-series Expansion I/O Unit or Expansion Unit.

The entire 300 mA from the external power supply can be used if Expansion Units and Expansion I/O Units are not connected.

Refer to *2-4-1 External Power Supply Capacity When Expansion I/O Units or Expansion Units are Connected* for details.

● AC-power-supply E14/20, N14/20 CPU Unit or DC-power-supply CPU Unit

There is no external power supply.

Restrictions by ambient temperature

According to the ambient temperature, there are restrictions on power supply voltage and output load current for the DC-power-supply CPU Units.

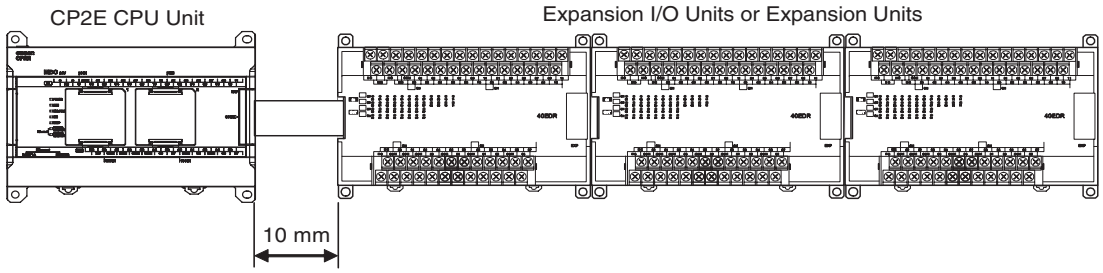
Refer to *Output Specifications for Relay Outputs* in *3-2-4 I/O Specifications* for details.

Restrictions on the Number of Simultaneously ON Points

Use CP1W-32ER/ET/ET1 32-point Output Units with the number of simultaneously ON less than 24 points (75%).

Mounting Restriction

When connecting CP-series Expansion Units or Expansion I/O Units to a CPU Unit with AC power, provide a space of approximately 10 mm between the CPU Unit and the first Expansion Unit or Expansion I/O Unit.



If sufficient space cannot be provided between the CPU Unit and the first Expansion Unit or Expansion I/O Unit, use the PLC in an ambient temperature of -20 to 50°C.

2-4 Unit Current Consumption and External Power Supply Capacity

This section describes the current consumption and external power supply capacity of units used by the CP2E.

2-4-1 External Power Supply Capacity When Expansion I/O Units or Expansion Units are Connected

When connecting Expansion Units and Expansion I/O Units to an E30/40/60, S30/40/60 or N30/40/60 CPU Unit, or when using the external power supply, ensure the power supply capacity is satisfied as the following calculation examples.

● Power Supply Capacity

CPU Unit	Current consumption		Power consumption
	5 VDC	24 VDC	
CP2E-□30D□-□	1.2 A max.	0.7 A max.	18.5 W max.
CP2E-□40D□-□			
CP2E-□60D□-□			

Calculation Example of the AC-Power-Supply CPU Units

	CPU Unit	Expansion (I/O) Units			Other devices using PLC internal power supply	Total	Limit
		1st unit	2nd unit	3rd unit			
	CP2E-N40DR-A	CP1W-DA041	CP1W-DA041	CP1W-DA041	NV3W-MR20L-V1 + CP1W-CIF01		
5V	0.39A	0.08A	0.08A	0.08A	0.24A	0.87A	≤1.2A
24V	0.09A	0.124A	0.124A	0.124A	–	0.462A	≤0.7A
Power consumption	5 V×0.87 A=4.35 W 24 V×0.462 A=11.088 W					15.438 W	≤18.5 W
Usable capacity of external power supply	18.5 W (Total of usable power consumption) – 15.438 W= 3.062 W 3.062 W/24 V=0.127 A					0.127A	≤0.3A

Calculation Example of the DC-Power-Supply CPU Units

	CPU Unit	Expansion (I/O) Units			Other devices using PLC internal power supply	Total	Limit
		1st unit	2nd unit	3rd unit			
	CP2E-N60DT-D	CP1W-40EDT	CP1W-TS003	CP1W-DA041	CP1W-CIF01		
5V	0.71A	0.16A	0.07A	0.12A	0.08A	1.14A	≤1.2A
24V	0.03A	–	0.03A	0.17A	–	0.23A	≤0.7A
Power consumption	5 V×1.14 A=5.7 W 24 V×0.23 A=5.52 W					11.22 W	≤18.5 W

Note DC-Power-Supply CPU Units have no external power supply.

2-4-2 Current Consumption

● CPU Units

E□□-type CPU Units

I/O capacity	Model number	Current consumption	
		5 VDC	24 VDC
14 I/O points	CP2E-E14DR-A	0.06A	0.04A
20 I/O points	CP2E-E20DR-A	0.08A	0.06A
30 I/O points	CP2E-E30DR-A	0.12A	0.07A
40 I/O points	CP2E-E40DR-A	0.13A	0.09A
60 I/O points	CP2E-E60DR-A	0.16A	0.13A

S□□-type CPU Units

I/O capacity	Model number	Current consumption	
		5 VDC	24 VDC
30 I/O points	CP2E-S30DR-A	0.12A	0.07A
	CP2E-S30DT-D	0.28A	0.02A
	CP2E-S30DT1-D		
40 I/O points	CP2E-S40DR-A	0.13A	0.09A
	CP2E-S40DT-D	0.34A	0.02A
	CP2E-S40DT1-D		
60 I/O points	CP2E-S60DR-A	0.16A	0.13A
	CP2E-S60DT-D	0.48A	0.02A
	CP2E-S60DT1-D		

N□□-type CPU Units

I/O capacity	Model number	Current consumption	
		5 VDC	24 VDC
14 I/O points	CP2E-N14DR-A	0.15A	0.05A
	CP2E-N14DT-A	0.21A	0.02A
	CP2E-N14DR-D	0.15A	0.05A
	CP2E-N14DT-D	0.21A	0.02A
	CP2E-N14DT1-D	0.22A	0.02A
20 I/O points	CP2E-N20DR-A	0.17A	0.06A
	CP2E-N20DT-A	0.27A	0.02A
	CP2E-N20DR-D	0.17A	0.06A
	CP2E-N20DT-D	0.27A	0.02A
	CP2E-N20DT1-D	0.26A	0.02A
30 I/O points	CP2E-N30DR-A	0.41A	0.07A
	CP2E-N30DT-A	0.52A	0.03A
	CP2E-N30DR-D	0.37A	0.07A
	CP2E-N30DT-D	0.51A	0.03A
	CP2E-N30DT1-D	0.51A	0.03A
40 I/O points	CP2E-N40DR-A	0.39A	0.09A
	CP2E-N40DT-A	0.59A	0.03A
	CP2E-N40DR-D	0.39A	0.09A
	CP2E-N40DT-D	0.59A	0.03A
	CP2E-N40DT1-D	0.59A	0.03A
60 I/O points	CP2E-N60DR-A	0.44A	0.13A
	CP2E-N60DT-A	0.71A	0.03A
	CP2E-N60DR-D	0.41A	0.13A
	CP2E-N60DT-D	0.71A	0.03A
	CP2E-N60DT1-D	0.71A	0.03A

Note The current consumptions given in the following table must be added to the current consumption of the CPU Unit if an Expansion Unit, Expansion I/O Unit or Option Board Unit is connected.

● Expansion I/O Units, Expansion Units and Option Board Units

Unit name			Model number	Current consumption	
				5 VDC	24 VDC
Expansion I/O Units		8 inputs	CP1W-8ED	0.018A	–
		8 outputs	CP1W-8ER	0.026A	0.044A
			CP1W-8ET	0.075A	–
			CP1W-8ET1		
		16 outputs	CP1W-16ER	0.042A	0.090A
			CP1W-16ET	0.076A	–
			CP1W-16ET1		
		20 I/O points 12 inputs 8 outputs	CP1W-20EDR1	0.103A	0.044A
			CP1W-20EDT	0.130A	–
			CP1W-20EDT1		
		32 outputs	CP1W-32ER	0.049A	0.131A
			CP1W-32ET	0.113A	–
			CP1W-32ET1		
		40 I/O points 24 inputs 16 outputs	CP1W-40EDR	0.080A	0.090A
			CP1W-40EDT	0.160A	–
			CP1W-40EDT1		
Expansion Units	Analog Input Unit	4 inputs	CP1W-AD041	0.100A	0.090A
			CP1W-AD042	0.100A	0.050A
	Analog Output Unit	2 outputs	CP1W-DA021	0.040A	0.095A
		4 outputs	CP1W-DA041	0.080A	0.124A
			CP1W-DA042	0.070A	0.160A
	Analog I/O Unit	Analog inputs: 2 Analog outputs: 1	CP1W-MAD11	0.083A	0.110A
		Analog inputs: 4 Analog outputs: 2	CP1W-MAD42	0.120A	0.120A
		Analog inputs: 4 Analog outputs: 4	CP1W-MAD44	0.120A	0.170A
	Temperature Sensor Units	K or J thermocouples	CP1W-TS001	0.040A	0.059A
			CP1W-TS002		
			CP1W-TS004	0.080A	0.050A
		K, J thermocouples or analog inputs	CP1W-TS003	0.070A	0.030A
		Pt or JPt platinum resistance thermometers	CP1W-TS101	0.054A	0.073A
			CP1W-TS102		
Option Board Units		One RS-232C port	CP1W-CIF01	0.04A	–
		One RS-422A/485 port	CP1W-CIF11	0.04A	–
			CP1W-CIF12-V1	0.04A	–
		Two RS-232C ports	CP2W-CIFD1	0.04A	–
		One RS-232C port and One RS-485 port	CP2W-CIFD2	0.06A	–
		Two RS-485 ports	CP2W-CIFD3	0.08A	–
		Analog input	CP1W-ADB21	0.02A	–
		Analog output	CP1W-DAB21V	0.06A	–
		Analog I/O	CP1W-MAB221	0.08A	–

● Other Devices Using PLC Internal Power Supply

Unit name		Model number	Current consumption	
			5 VDC	24 VDC
Programmable Terminal	Backlight Green/Orange/Red	NV3W-MG20L-V1	0.2A	–
	Backlight White/Pink/Red	NV3W-MR20L-V1	0.2A	–

3

Part Names and Functions

This section describes the part names, function specifications and terminal arrangements of the CP2E CPU Unit and other Units.

3-1 CPU Units 3-2
3-1-1 E14/20 or N14/20 CPU Units 3-2
3-1-2 E30/40/60, S30/40/60 or N30/40/60 CPU Units 3-6
3-1-3 Common I/O Specifications 3-12
3-1-4 Serial Communication Port 3-17
3-1-5 Analog Option Board for N□□-type CPU Units 3-24
3-2 Expansion I/O Units 3-28
3-2-1 Expansion Input Unit 3-28
3-2-2 Expansion Output Units 3-29
3-2-3 Expansion I/O Units 3-31
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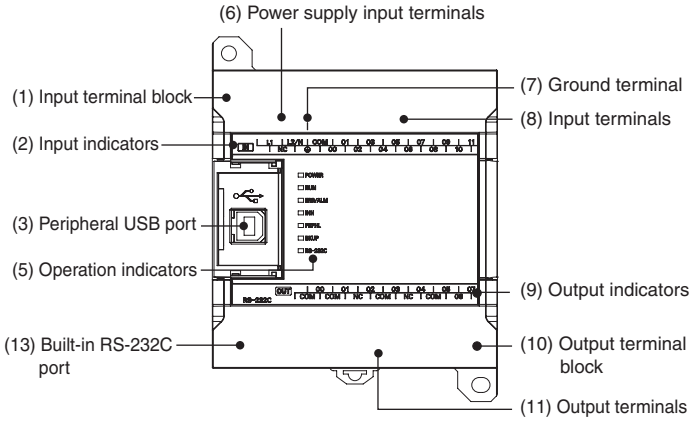
3-1 CPU Units

This section describes the names of the CPU Unit parts and provides the I/O specifications and terminal arrangements. Refer to *A-1 Dimensions* for the dimensions, *A-2 Wiring Diagrams* for the wiring diagrams.

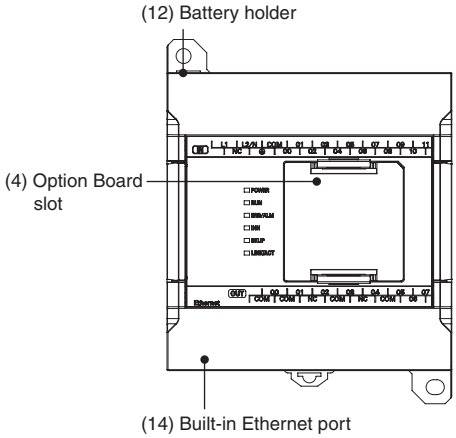
3-1-1 E14/20 or N14/20 CPU Units

Part Names and Functions

E-type CPU Unit
CP2E-E14/20DR-A



N-type CPU Unit
CP2E-N14/20D□-□



Number	Name	Function
(1)	Input terminal block (not removable)	This is the terminal block for inputs such as the power supply input and 24 VDC inputs.
(2)	Input indicators (yellow)	Input status is displayed. An indicator will be ON when the input is ON.
(3)	Peripheral USB port	Used to connect to a personal computer for programming and monitoring by the CX-Programmer for CP2E.
(4)	Option Board slot for N□□-type CPU Units	An Option Board can be connected to the slot. • CP1W-CIF01 RS-232C Option Board • CP1W-CIF11 RS-422A/485 Option Board (Maximum transmission distance: 50 m) • CP1W-CIF12-V1 RS-422A/485 Option Board (Maximum transmission distance: 500 m) • CP1W-MAB221/ADB21/DAB21V Analog Option Board • CP2W-CIFD1 Option Board with two RS-232C ports • CP2W-CIFD2 Option Board with one RS-232C port and one RS-485 port (isolated) • CP2W-CIFD3 Option Board with two RS-485 ports (isolated)
(5)	Operation indicators	The CPU Unit's operating status can be confirmed with this indicator. Refer to *CPU Unit Status Indicators* (Page 3-4).
(6)	Power supply input terminals	Power of 100 to 240 VAC or 24 VDC can be supplied.
(7)	Ground terminal	Protective ground (⏚): To prevent electric shock, ground to 100 Ω or less.
(8)	Input terminals	Input devices such as switches and sensors can be connected.
(9)	Output indicators (yellow)	Output status is displayed. An indicator will be ON when the output is ON.
(10)	Output terminal block (not removable)	This is the terminal block for outputs such as relay outputs and transistor outputs.
(11)	Output terminals	Loads such as lamps, contactors, and solenoid valves can be connected.
(12)	Battery holder for N□□-type CPU Units	A Battery can be installed by opening the cover. (The Battery is optional.)
(13)	Built-in RS-232C port for E□□-type CPU Units	By connecting a PT, the controlled system can be monitored and data can be collected.
(14)	Built-in Ethernet port for N□□-type CPU Units	Used to connect to a personal computer for programming and monitoring by the CX-Programmer for CP2E, or connect to other OMRON PLCs for data exchange.

CPU Unit Status Indicators

● : Not lit ◐ : Flashing ☼ : Lit

E□□-type

- POWER
- RUN
- ERR/ALM
- INH
- PRPHL
- BKUP
- RS-232C

N□□-type

- POWER
- RUN
- ERR/ALM
- INH
- BKUP
- LINK/ACT

Name	Color	Function	Description
POWER	Green	☼ Lit	When PLC power is ON.
		● Not lit	When PLC power is OFF.
RUN	Green	☼ Lit	When PLC is executing a program under RUN or MONITOR mode.
		● Not lit	Operation is stopped in PROGRAM mode or due to a fatal error.
ERR/ALM	Red	☼ Lit	A fatal error (including FALS execution) or a hardware error (WDT error) has occurred. PLC operation will stop and all outputs will be turned OFF.
		◐ Flashing	A non-fatal error has occurred (including FAL execution). PLC operation will continue.
		● Not lit	Operation is normal.
INH	Yellow	☼ Lit	All outputs has been turned OFF. Output OFF bit (A500.15) has been turned OFF.
		● Not lit	Operation is normal.
PRPHL (E□□-type only)	Yellow	◐ Flashing	Communications (either sending or receiving) are in progress through the peripheral USB port.
		● Not lit	Other than the above.
BKUP	Yellow	☼ Lit	A user program, parameters, or Data Memory is being written to the built-in Flash Memory.
		● Not lit	Other than the above.
RS-232C (E□□-type only)	Yellow	◐ Flashing	Communications (either sending or receiving) are in progress through the RS-232C port.
		● Not lit	Other than the above.
LINK/ACT (N□□-type only)	Yellow	☼ Lit	A valid link is detected.
		◐ Flashing	Communications (either sending or receiving) are in progress through the Ethernet port.
		● Not lit	Other than the above.

Precautions for Safe Use

Do not turn OFF the power supply to the PLC when the BKUP indicator is lit. It indicates that data is being written to the built-in Flash Memory.

If the power is turned OFF during backup, the data will not be backed up and transferred to the DM Area in RAM next time the power supply is turned ON.

Terminal Arrangements

● Input Arrangement

AC Power Supply

CP2E-□14D□-A

CIO 0

L1	L2/N	COM	01	03	05	07	NC	NC
NC	⏚	00	02	04	06	NC	NC	

L1,L2/N : Power supply terminal
⏚ : Protective ground terminal
COM : Common terminal
00 to 07 : Input terminal
NC : No connection

CP2E-□20D□-A

CIO 0

L1	L2/N	COM	01	03	05	07	09	11
NC	⏚	00	02	04	06	08	10	

L1,L2/N : Power supply terminal
⏚ : Protective ground terminal
COM : Common terminal
00 to 11 : Input terminal
NC : No connection

DC Power Supply

CP2E-N14D□-D

CIO 0

+	−	COM	01	03	05	07	NC	NC
NC	⏚	00	02	04	06	NC	NC	

+,− : Power supply terminal
⏚ : Protective ground terminal
COM : Common terminal
00 to 07 : Input terminal
NC : No connection

CP2E-N20D□-D

CIO 0

+	−	COM	01	03	05	07	09	11
NC	⏚	00	02	04	06	08	10	

+,− : Power supply terminal
⏚ : Protective ground terminal
COM : Common terminal
00 to 11 : Input terminal
NC : No connection

● Output Arrangement

AC Power Supply and DC Power Supply

CP2E-□14D□-□

00	01	02	03	04	05	NC
COM	COM	NC	COM	NC	COM	NC

CIO 100

COM : Common terminal
00 to 05 : Output terminal
NC : No connection

CP2E-□20D□-□

00	01	02	03	04	05	07
COM	COM	NC	COM	NC	COM	06

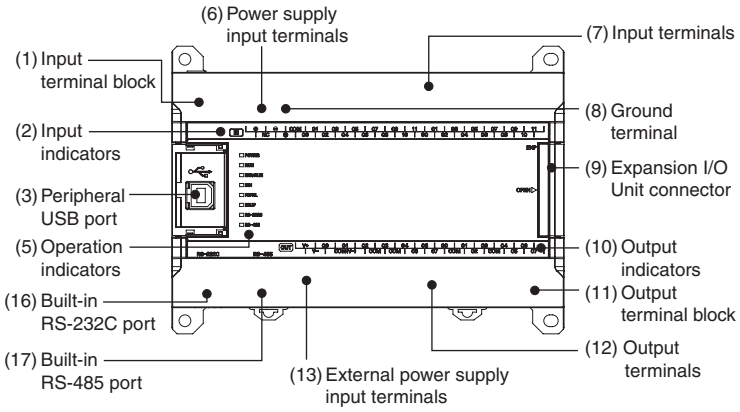
CIO 100

COM : Common terminal
00 to 07 : Output terminal
NC : No connection

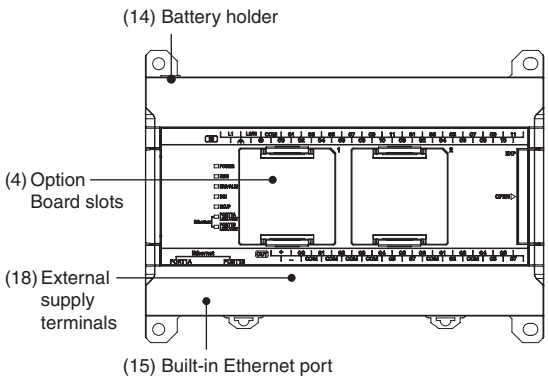
3-1-2 E30/40/60, S30/40/60 or N30/40/60 CPU Units

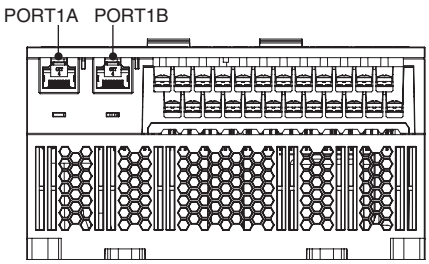
Part Names and Functions

E/S-type CPU Unit
CP2E-E30/40/60DR-A
CP2E-S30/40/60D□-□



N-type CPU Unit
CP2E-N30/40/60D□-□





(Bottom View)

Number	Name	Function
(1)	Input terminal block (not removable)	This is the terminal block for inputs such as the power supply input and 24 VDC inputs.
(2)	Input indicators (yellow)	Input status is displayed. An indicator will be ON when the input is ON.
(3)	Peripheral USB port	Used to connect to a personal computer for programming and monitoring by the CX-Programmer for CP2E.
(4)	Option Board slots for N□□-type CPU Units	Option Boards can be connected to the slots. • CP1W-CIF01 RS-232C Option Board • CP1W-CIF11 RS-422A/485 Option Board (Maximum transmission distance: 50 m) • CP1W-CIF12-V1 RS-422A/485 Option Board (Maximum transmission distance: 500 m) • CP1W-MAB221/ADB21/DAB21V Analog Option Board • CP2W-CIFD1 Option Board with two RS-232C ports • CP2W-CIFD2 Option Board with one RS-232C port and one RS-485 port (isolated) • CP2W-CIFD3 Option Board with two RS-485 ports (isolated)
(5)	Operation indicators	The CPU Unit's operating status can be confirmed with this indicator. Refer to *CPU Unit Status Indicators* (Page 3-8).
(6)	Power supply input terminals	Power of 100 to 240 VAC or 24 VDC can be supplied.
(7)	Input terminals	Input devices such as switches and sensors can be connected.
(8)	Ground terminal	Protective ground (⏚): To prevent electric shock, ground to 100 Ω or less. Functional ground (⏚): If noise is a significant source of errors or if electrical shock is a problem, connect to the protective ground terminal and ground both with a ground of 100Ω or less (AC power supply only).
(9)	Expansion I/O Unit connector	CP-series Expansion I/O Units or Expansion Units such as Analog I/O Units, and Temperature Sensors can be connected. Refer to *5-2-4 Connecting Expansion I/O Units and Expansion Units*.
(10)	Output indicators (yellow)	Output status is displayed. An indicator will be ON when the output is ON.
(11)	Output terminal block (not removable)	This is the terminal block for outputs such as relay outputs, transistor outputs, and the external power supply output.
(12)	Output terminals	Loads such as lamps, contactors, and solenoid valves can be connected.
(13)	External power supply input terminals for S□□-type CPU Units	Power of 20.4V to 26.4 VDC can be supplied to CIO 100.00 and CIO 100.01.
(14)	Battery holder for N/S□□-type CPU Units	A Battery can be installed by opening the cover. (Battery is optional.)
(15)	Built-in Ethernet port for N□□-type CPU Units	Used to connect to a personal computer for programming and monitoring by the CX-Programmer for CP2E, or connect to other OMRON PLCs for data exchange.
(16)	Built-in RS-232C port for E/S□□-type CPU Units	By connecting a PT, the controlled system can be monitored and data can be collected.
(17)	Built-in RS-485 port for S□□-type CPU Units	Communications are possible between an inverter and a PLC by using Modbus-RTU and Serial PLC Links.
(18)	External supply terminals	The external supply terminals output up to 300 mA max at 24 VDC. They can be used as a service power supply for input devices (AC power supply only).

CPU Unit Status Indicators

●: Not lit ◐ : Flashing ☼ : Lit

E/S□□-type

- POWER
- RUN
- ERR/ALM
- INH
- PRPHL
- BKUP
- RS-232C
- RS-485

N□□-type

- POWER
- RUN
- ERR/ALM
- INH
- BKUP
- PORT1A LINK/ACT
- PORT1B LINK/ACT

Name	Color	Function	Description
POWER	Green	☼ Lit	When PLC power is ON.
		● Not lit	When PLC power is OFF.
RUN	Green	☼ Lit	When PLC is executing a program under RUN or MONITOR mode.
		● Not lit	Operation is stopped in PROGRAM mode or due to a fatal error.
ERR/ALM	Red	☼ Lit	A fatal error (including FALS execution) or a hardware error (WDT error) has occurred. PLC operation will stop and all outputs will be turned OFF.
		◐ Flashing	A non-fatal error has occurred (including FAL execution).PLC operation will continue.
		● Not lit	Operation is normal.
INH	Yellow	☼ Lit	All outputs has been turned OFF. Output OFF bit (A500.15) has been turned OFF.
		● Not lit	Operation is normal.
PRPHL (E/S□□-type only)	Yellow	◐ Flashing	Communications (either sending or receiving) are in progress through the peripheral USB port.
		● Not lit	Other than the above.
BKUP	Yellow	☼ Lit	A user program, parameters, or Data Memory is being written to the bulit-in Flash Memory.
		● Not lit	Other than the above.
RS232C (E/S□□-type only)	Yellow	◐ Flashing	Communications (either sending or receiving) are in progress through the RS-232C port.
		● Not lit	Other than the above.
RS485 (S□□-type only)	Yellow	◐ Flashing	Communications (either sending or receiving) are in progress through the RS-485 port.
		● Not lit	Other than the above.
PORT1A LINK/ACT (N□□-type only)	Yellow	☼ Lit	A valid link is detected.
		◐ Flashing	Communications (either sending or receiving) are in progress through the Ethernet port (Left: PORT1A).
		● Not lit	Other than the above.
PORT1B LINK/ACT (N□□-type only)	Yellow	☼ Lit	A valid link is detected.
		◐ Flashing	Communications (either sending or receiving) are in progress through the Ethernet port (Right: PORT1B).
		● Not lit	Other than the above.

Precautions for Safe Use

Do not turn OFF the power supply to the PLC when the BKUP indicator is lit. It indicates that data is being written to the built-in Flash Memory.

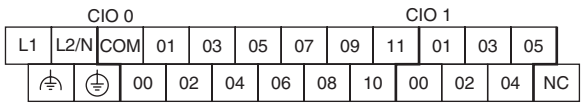
If the power is turned OFF during backup, the data will not be backed up and transferred to the DM Area in RAM next time the power supply is turned ON.

Terminal Arrangements

● Input Arrangement

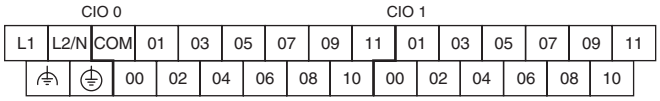
AC Power Supply

CP2E-□30D□-A

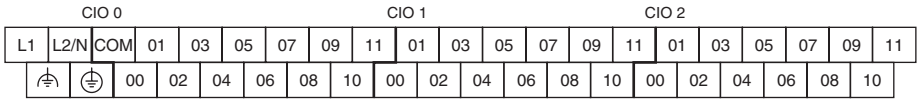


L1, L2/N : Power supply terminal
COM : Common terminal
00 to 11 : Input terminal
: Functional ground terminal
: Protective ground terminal
NC : No connection

CP2E-□40D□-A

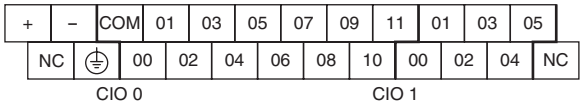


CP2E-□60D□-A



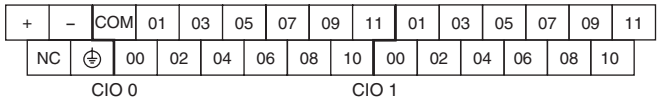
DC Power Supply

CP2E-□30D□-D

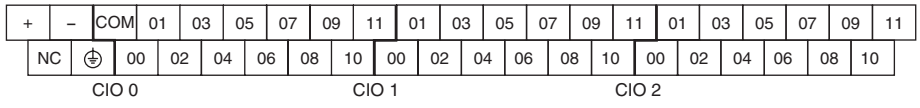


+, − : Power supply terminal
COM : Common terminal
00 to 11 : Input terminal
NC : No connection
: Protective ground terminal

CP2E-□40D□-D



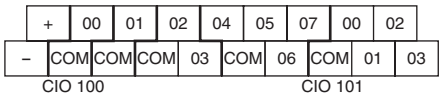
CP2E-□60D□-D



● Output Arrangement

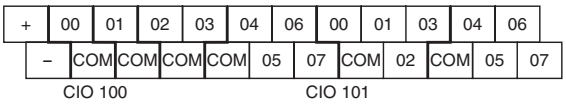
AC Power Supply

CP2E-□30D□-A

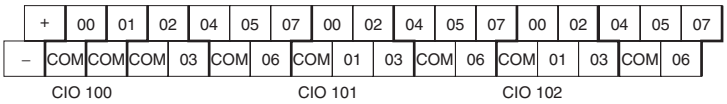


+,– : External supply terminal
COM : Common terminal
00 to 07 : Output terminal

CP2E-□40D□-A

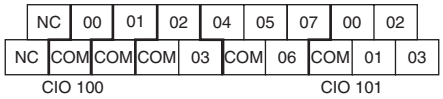


CP2E-□60D□-A



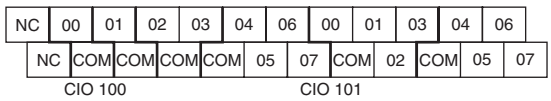
DC Power Supply

CP2E-N30D□-D

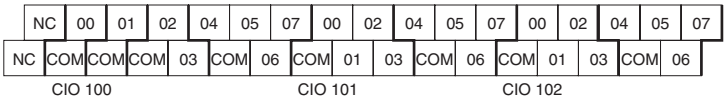


NC : No connection
COM : Common terminal
00 to 07 : Output terminal

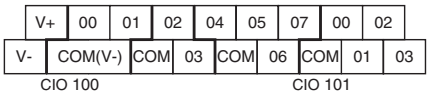
CP2E-N40D□-D



CP2E-N60D□-D



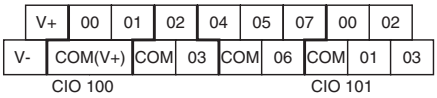
CP2E-S30DT-D



Note COM(V-) has been connected with V- in an inner circuit.

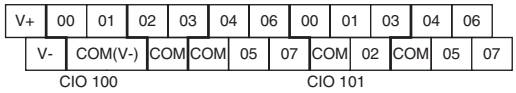
COM : Common terminal
00~07 : Output terminal
V+ : External power supply input terminal for CIO 100.00/01 (DC24V)
V− : External power supply input terminal for CIO 100.00/01 (0V)

CP2E-S30DT1-D



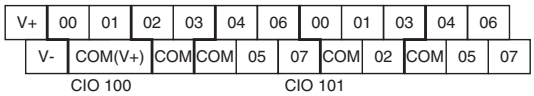
Note COM(V+) has been connected with V+ in an inner circuit.

CP2E-S40DT-D



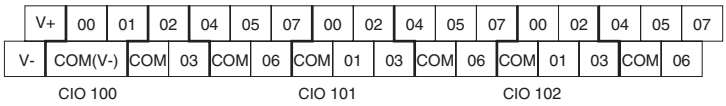
Note COM(V-) has been connected with V- in an inner circuit.

CP2E-S40DT1-D



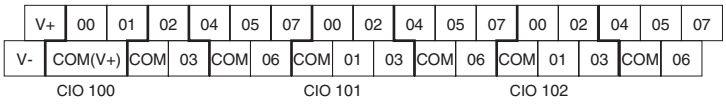
Note COM(V+) has been connected with V+ in an inner circuit.

CP2E-S60DT-D



Note COM(V-) has been connected with V- in an inner circuit.

CP2E-S60DT1-D

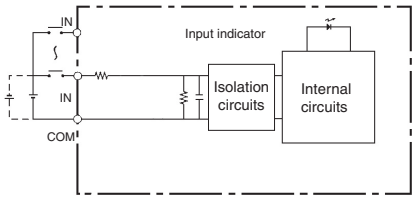


Note COM(V+) has been connected with V+ in an inner circuit.

3-1-3 Common I/O Specifications

The following table gives the specifications that apply to the built-in I/O on a CP2E CPU Unit.

Specifications

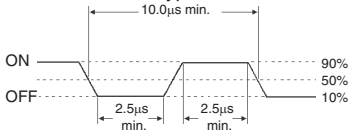
Item		Specification		
Input type		High-speed counter inputs or normal inputs	High-speed counter inputs, interrupt inputs, quick-response inputs or normal inputs	Normal inputs
Input bits	E/S□□-type and N14 CPU Units	CIO 0.00 and CIO 0.01	CIO 0.02 to CIO 0.07	CIO 0.08 to CIO 0.11, CIO 1.00 to CIO 1.11 and CIO 2.00 to CIO 2.11 *1
	N20 CPU Units	CIO 0.00 and CIO 0.01	CIO 0.02 to CIO 0.09	CIO 0.10 to CIO 0.11
	N30/40/60 CPU Units	CIO 0.00 to CIO 0.03	CIO 0.04 to CIO 0.09	CIO 0.10, CIO 0.11, CIO 1.00 to CIO 1.11 and CIO 2.00 to CIO 2.11 *1
Applicable inputs		2-wire and 3-wire sensors		
Input voltage		24 VDC, +10% / -15%		
Input impedance		3.3 kΩ	3.3 kΩ	4.8 kΩ
Input current		7.5 mA (typical)	7.5 mA (typical)	5 mA (typical)
ON voltage/current		17.0 VDC min. / 3 mA min.	17.0 VDC min. / 3 mA min.	14.4 VDC min. / 3 mA min.
OFF voltage/current		5.0 VDC max. / 1 mA max.	5.0 VDC max. / 1 mA max.	5.0 VDC max. / 1 mA max.
ON response time*2		2.5 μs min.	50 μs max.	1 ms max.
OFF response time*2		2.5 μs min.	50 μs max.	1 ms max.
Circuit configuration				

*1 The bits that can be used depend on the model of CPU Unit.

*2 The response time is the delay caused by hardware. The delay set in the PLC Setup (0 to 32 ms, default: 8 ms) for a normal input must be added to this value.

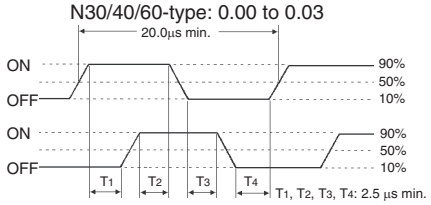
Interrupt input mode
Pulse plus direction input mode
Increment mode
Up/down input mode

E/S□□-type: 0.00/0.01
N14/20-type: 0.00/0.01
N30/40/60-type: 0.00 to 0.02

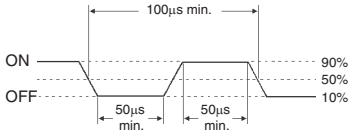


Differential phase mode

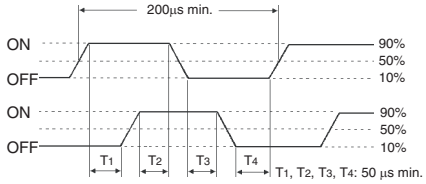
E/S□□-type: 0.00/0.01
N14/20-type: 0.00/0.01
N30/40/60-type: 0.00 to 0.03



E/S□□-type: 0.02 to 0.07
N14-type: 0.02 to 0.07
N20-type: 0.02 to 0.09
N30/40/60-type: 0.04 to 0.09

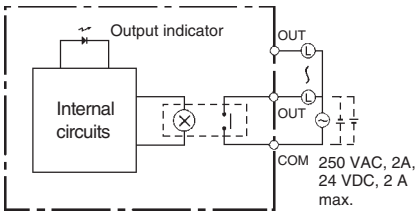


E/S□□-type: 0.02/0.03
N14/20-type: 0.02/0.03



Output Specifications for Relay Outputs

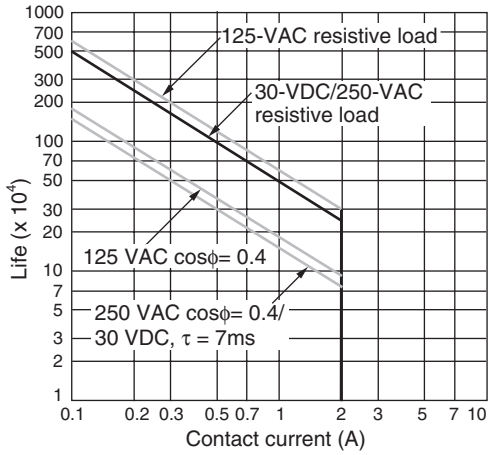
CP2E-□□□DR-□

Item			Specification
Maximum switching capacity			2 A 250 VAC (cosϕ= 1) 2 A 24 VDC (4 A/common)
Minimum switching capacity			10 mA 5 VDC
Service life of relay	Electrical	Resistive load	200,000 operations (24 VDC)
		Inductive load	70,000 operations (250 VAC, cosϕ = 0.4)
	Mechanical		20,000,000 operations
ON response time			15 ms max.
OFF response time			15 ms max.
Circuit configuration			

Estimating the Service Life of Relays

Under normal conditions, the service life of output contacts is as shown above. The service life of relays is as shown in the following diagram as a guideline.

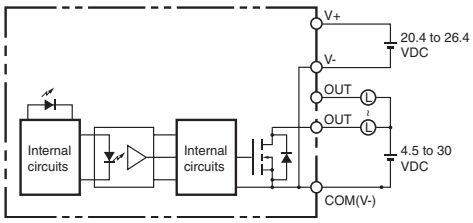
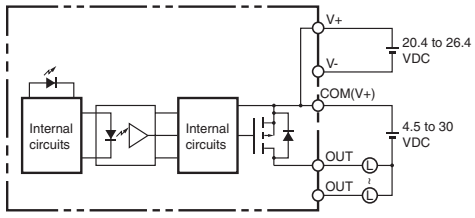
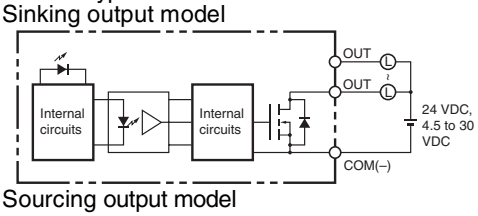
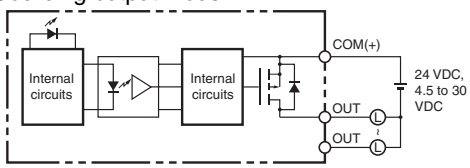
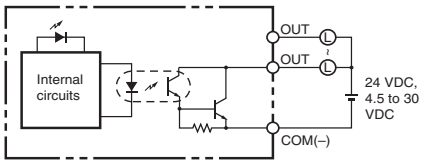
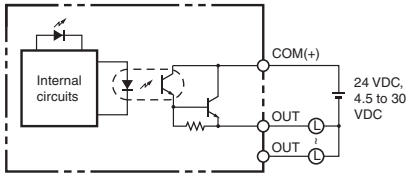
CP2E-□□□DR-□



Output Specifications for Transistor Outputs (Sinking or Sourcing)

CP2E- N14/20/30/40/60DT(1)-□, CP2E-S30/40/60DT(1)-□

● Normal Outputs

Item	Specification	
	S□□-type: CIO 100.00 and CIO 100.01 N□□-type: CIO 100.00, CIO 100.01, CIO 101.00 and CIO 101.01	**S□□-type: CIO 100.02 to CIO 102.07 *2 N□□-type: CIO 100.02 to CIO 100.07, CIO 101.02 to CIO 102.07 *2**
Maximum switching capacity	0.3 A/output, 0.9 A/common*1 4.5 to 30 VDC CP2E-N14D□-□: 1.5 A/Unit CP2E-S/N40D□-□: 3.6 A/Unit CP2E-N20D□-□: 1.8 A/Unit CP2E-S/N60D□-□: 5.4 A/Unit CP2E-S/N30D□-□: 2.7 A/Unit	
Minimum switching capacity	1 mA 4.5 to 30 VDC	
Leakage current	0.1mA max.	
Residual voltage	0.6 V max.	1.5V max.
ON response time	0.1 ms max.	0.1 ms max.
OFF response time	0.1 ms max.	1 ms max.
Fuse	Not provided.	
External power supply	20.4 to 26.4VDC 30mA max. (N□□-type is not needed)	Not needed
Circuit configuration	• S□□-type CPU Unit Sinking output model  Sourcing output model  • N□□-type CPU Unit Sinking output model  Sourcing output model 	Sinking output model  Sourcing output model 

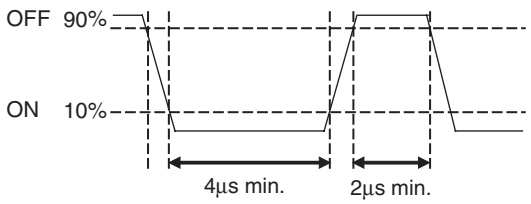
*1 Also do not exceed 0.9 A for the total of CIO 100.00 to CIO 100.03, which are different common.

*2 The bits that can be used depend on the model of CPU Unit.

Precautions for Correct Use

Do not connect a load to an output terminal or apply a voltage in excess of the maximum switching capacity.

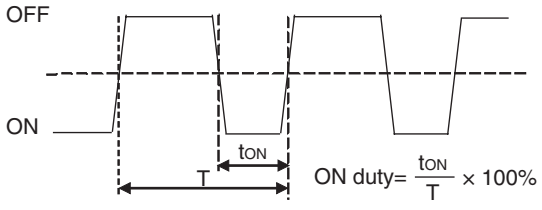
● Pulse Outputs

Item	Specification
	S□□-type: CIO 100.00 and CIO 100.01 N□□-type: CIO 100.00, CIO 100.01, CIO 101.00 and CIO 101.01
Maximum switching capacity	100 mA 4.5 to 26.4 VDC
Minimum switching capacity	7 mA 4.5 to 26.4 VDC
Maximum output frequency	100 kHz
Output waveform	 The OFF and ON refer to the output transistor. The output transistor is ON at level “L”.

Additional Information

- The load for the above values is assumed to be the resistive load, and does not take into account the impedance for the connecting cable to the load.
- Due to distortions in pulse waveforms resulting from connecting cable impedance, the pulse widths in actual operation may be smaller than the values shown above.

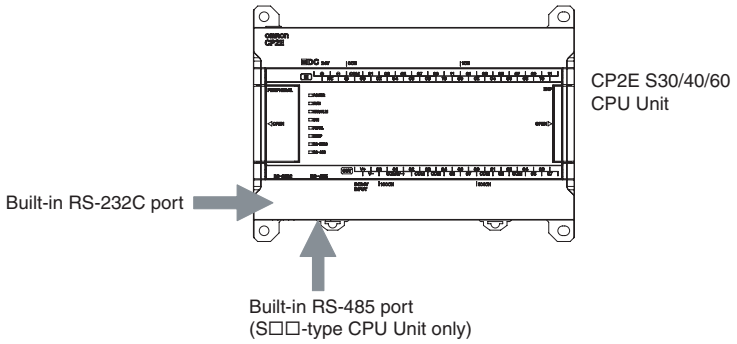
● PWM Output (CIO 100.01)

Item	Specification
Maximum switching capacity	30 mA 4.5 to 26.4 VDC
Maximum output frequency	32 kHz
PWM output accuracy	For ON duty +1%, -0%:10 kHz output For ON duty +5%, -0%: 0 to 32 kHz output
Output waveform	 The OFF and ON refer to the output transistor. The output transistor is ON at level “L”.

3-1-4 Serial Communication Port

The Serial Communication Port can be used for a CP2E CPU Unit.

E/S□□-type CPU Units



Built-in RS-232C Port for E/S□□-type CPU Units

Pin	Abbr.	Signal Name	Signal direction
1	SD(TXD)	Send data	Output
2	RD(RXD)	Receive data	Input
3	RS(RTS)	Request to send	Output
4	CS(CTS)	Clear to send	Input
5	SG(0V)	Signal ground	–
6	FG	Frame ground	–

Built-in RS-485 Port (2-wire) for S□□-type CPU Units

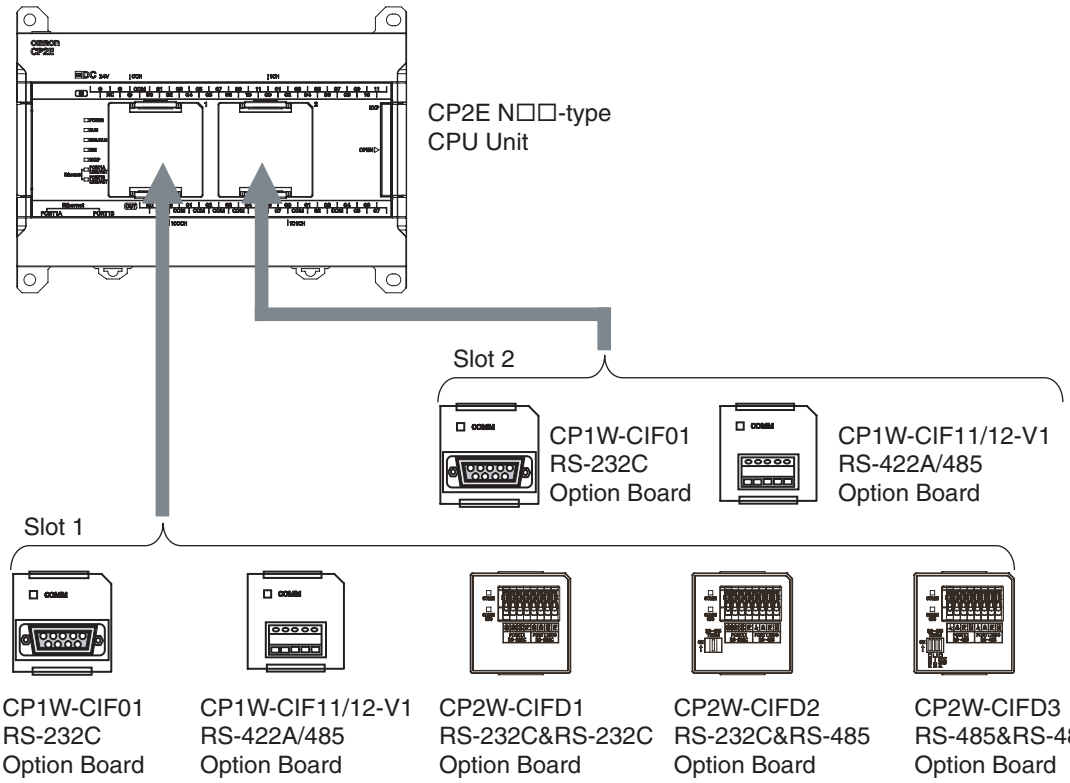
● RS-485 Terminal Block

Pin	Abbr.	Signal Name	Signal direction
1	A-	Send/Receive data -	–
2	B+	Send/Receive data +	–
3	FG	Frame ground	–

● DIP Switch for Terminating Resistance Settings

Setting			
ON⇧ 	ON	ON (both ends)	Terminating resistance selection Resistance value: 220Ω typical
	OFF	OFF	

N□□-type CPU Units



Note CP2W-CIFD□ can only be mounted on option slot 1.

Serial Communication Option Board

Model numbers	Port	Maximum transmission distance	Connection method
CP1W-CIF01	One RS-232C port	15m	Connector (D-sub, 9 pin female)
CP1W-CIF11	One RS-422A/485 port (not isolated)	50m	Terminal block (using ferrules)
CP1W-CIF12-V1	One RS-422A/485 port (isolated)	500m	Terminal block (using ferrules)
CP2W-CIFD1	Two RS-232C Ports	15m	Terminal block (using ferrules)
CP2W-CIFD2	One RS-232C port and one RS-485 port (isolated)	15m (RS-232C) 500m (RS-485)	Terminal block (using ferrules)
CP2W-CIFD3	Two RS-485 ports (isolated)	500m	Terminal block (using ferrules)

● How to Mount a Serial Option Board

When mounting an Option Board, first remove the slot cover.

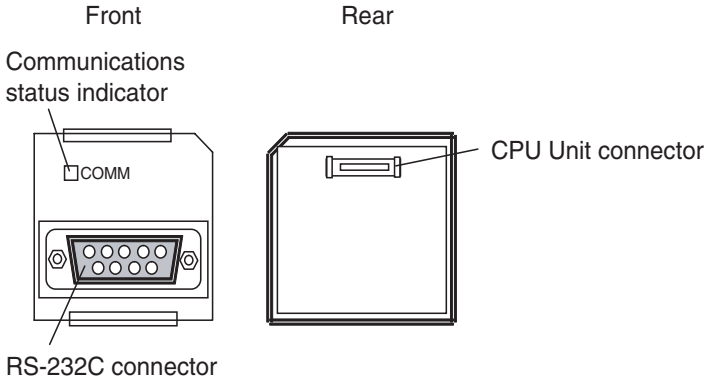
Press the up/down lock-levers on both sides of the Option Board slot cover at the same time to unlock the cover, and then pull the cover out.

Check the alignment to make the corner cut of the Option Board fit in the Option Board slot, and firmly press the Option Board in until it snaps into place.

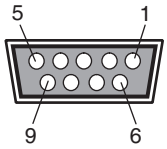
Precautions for Correct Use

Always turn OFF the power supply to the PLC before mounting or removing an Option Board.

CP1W-CIF01 RS-232C Option Board



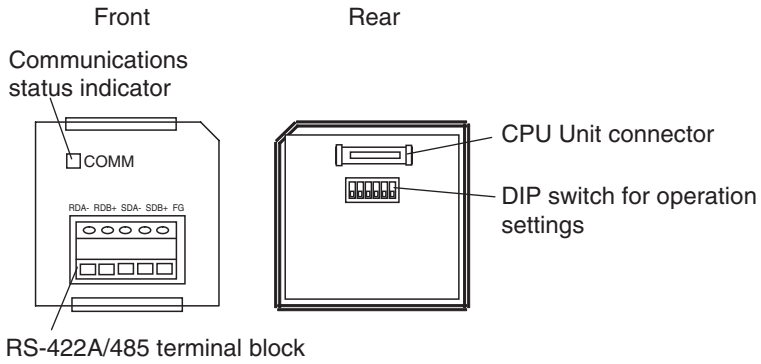
● RS-232C Connector



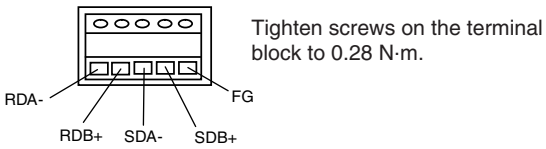
Pin	Abbr.	Signal	Signal direction
1	FG	Frame ground	–
2	SD(TXD)	Send data	Output
3	RD(RXD)	Receive data	Input
4	RS(RTS)	Request to send	Output
5	CS(CTS)	Clear to send	Input
6	5V	Power	–
7	DR(DSR)	Data set ready	Input
8	ER(DTR)	Data terminal ready	Output
9	SG(0V)	Signal ground	–
Connector hood	FG	Frame ground	–

Note The NV3W-M□20L-V1 Programmable Terminal can be connected to pin 6 (+5V) on the RS-232C Option Board (CP1W-CIF01) mounted to the CPU Unit. Do not connect pin 6 to any other device.

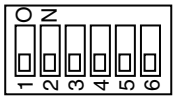
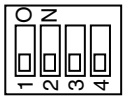
CP1W-CIF11 or CP1W-CIF12-V1 RS-422A/485 Option Board



● RS-422A/485 Terminal Block



● DIP Switch for Operation Settings

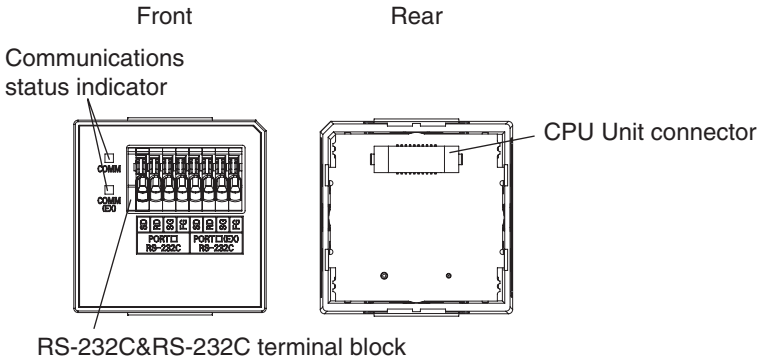
CP1W-CIF11		CP1W-CIF12-V1		Setting		
	Pin		Pin			
SW 	1	SW1 	1	ON	ON (both ends)	Terminating resistance selection Resistance value: 220Ω typical
				OFF	OFF	
	2		2	ON	2-wire connections	2-wire or 4-wire selection*1
				OFF	4-wire connections	
	3		3	ON	2-wire connections	2-wire or 4-wire selection*1
				OFF	4-wire connections	
	4		4	–	–	Not used.
	5	SW2	1	ON	RS control enabled	RS control selection for RD*2
				OFF	RS control disabled (Data always received.)	
	6		2	ON	RS control enabled	RS control selection for SD*3
				OFF	RS control disabled (Data always sent.)	

*1 Set both pins 2 and 3 to either ON (2-wire) or OFF (4-wire).

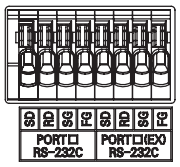
*2 To disable the echo-back function, set pin 5 to ON (RS control enabled).

*3 When connecting to a device on the N side in a 1: N connection with the 4-wire method, set pin 6 to ON (RS control enabled).
Also, when connecting by the 2-wire method, set pin 6 to ON (RS control enabled).

CP2W-CIFD1 RS-232C&RS-232C Option Board



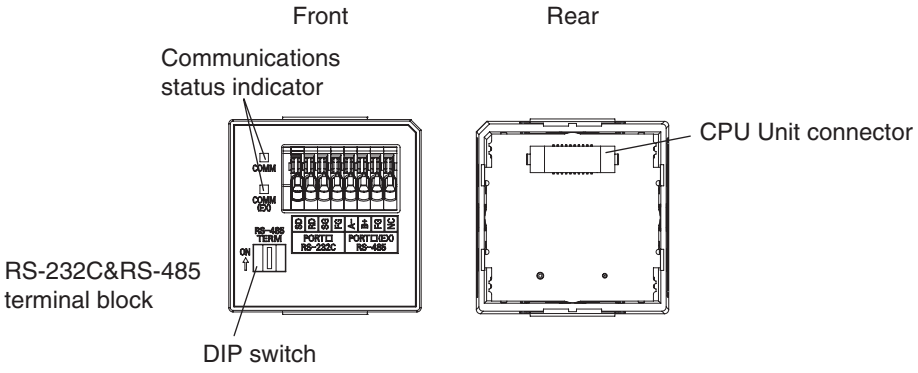
● RS-232C&RS-232C Terminal Block



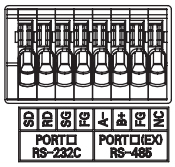
Port	Pin	Abbr.	Signal Name	Signal direction
PORT□	1	SD(TXD)	Send data	Output
	2	RD(RXD)	Receive data	Input
	3	SG(0V)	Signal ground	–
	4	FG	Frame ground	–
PORT□(EX)	5	SD(TXD)	Send data	Output
	6	RD(RXD)	Receive data	Input
	7	SG(0V)	Signal ground	–
	8	FG	Frame ground	–

Note CP2W-CIFD1 can only be mounted on option slot 1.
PORT□ is supported by serial port 1 and PORT□(EX) is supported by serial port 1(EX).

CP2W-CIFD2 RS-232C&RS-485 Option Board



● RS-232C&RS-485 Terminal Block



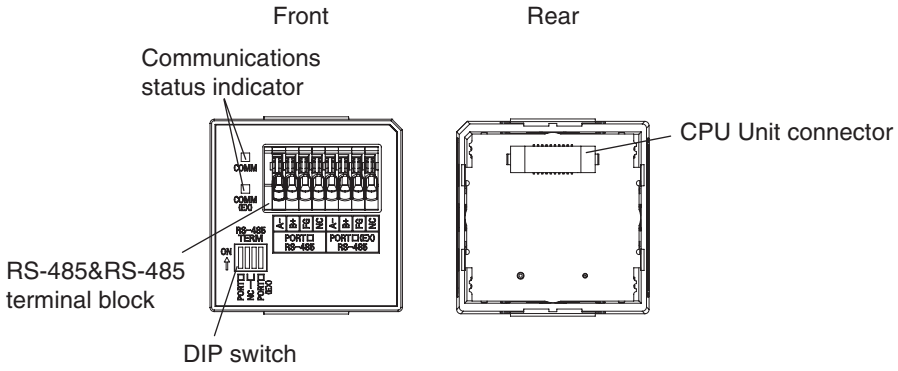
Port	Pin	Abbr.	Signal Name	Signal direction
PORT□	1	SD(TXD)	Send data	Output
	2	RD(RXD)	Receive data	Input
	3	SG(0V)	Signal ground	–
	4	FG	Frame ground	–
PORT□(EX)	5	A-	Send/Receive data -	–
	6	B+	Send/Receive data +	–
	7	FG	Frame ground	–
	8	NC	NC	–

Note CP2W-CIFD2 can only be mounted on option slot 1.
PORT□ is supported by serial port 1 and PORT□(EX) is supported by serial port 1(EX).

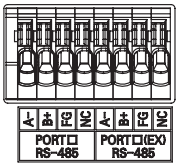
● DIP Switch for Terminating Resistance Settings

Setting			
	ON	ON (both ends)	Terminating resistance selection Resistance value: 220Ω typical
	OFF	OFF	

CP2W-CIFD3 RS-485&RS-485 Option Board



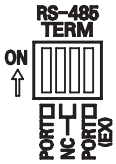
● RS-485&RS-485 Terminal Block



Port	Pin	Abbr.	Signal Name	Signal direction
PORT□	1	A-	Send/Receive data -	–
	2	B+	Send/Receive data +	–
	3	FG	Frame ground	–
	4	NC	NC	–
PORT□(EX)	5	A-	Send/Receive data -	–
	6	B+	Send/Receive data +	–
	7	FG	Frame ground	–
	8	NC	NC	–

Note CP2W-CIFD3 can only be mounted on option slot 1.
PORT□ is supported by serial port 1 and PORT□(EX) is supported by serial port 1(EX).

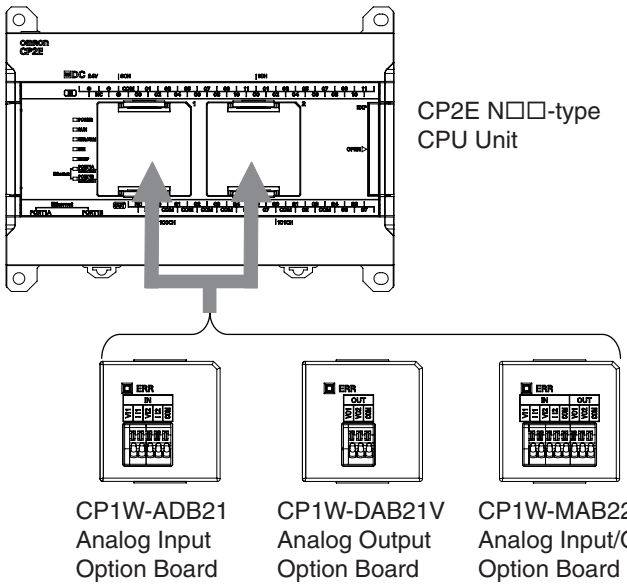
● DIP Switch for Terminating Resistance Settings

Pin		Setting		
	1	ON	ON (both ends)	Terminating resistance selection
		OFF	OFF	Resistance value: 220Ω typical
	2	–	–	Not used.
	3	–	–	Not used.
	4	ON	ON (both ends)	Terminating resistance selection
		OFF	OFF	Resistance value: 220Ω typical

3-1-5 Analog Option Board for N□□-type CPU Units

The Analog Option Board can be used for a CP2E N□□-type CPU Unit.

N□□-type CPU Units



Note Maximum one Analog Option Board can be mounted on an N□□-type CPU Unit.
If two Analog Option Boards are mounted, an option board error will occur and both Analog Option Boards do not work.

Analog Option Board

Analog option board units are non-isolated analog units which allow you to easily realize analog input/output function for CP2E N□□-type CPU Unit.

Analog Option Board		Voltage Input 0V~10V (Resolution: 1/4000)	Current Input 0mA~20mA (Resolution: 1/2000)	Voltage Output 0V~10V (Resolution: 1/4000)
Analog I/O Option Board	CP1W-MAB221	2CH		2CH
Analog Input Option Board	CP1W-ADB21	2CH		---
Analog Output Option Board	CP1W-DAB21V	---		2CH

● How to Mount an Analog Option Board

When mounting an Option Board, first remove the slot cover.

Press the up/down lock-levers on both sides of the Option Board slot cover at the same time to unlock the cover, and then pull the cover out.

Check the alignment to make the corner cut of the Option Board fit in the Option Board slot, and firmly press the Option Board in until it snaps into place.

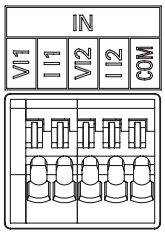
Precautions for Correct Use

Always turn OFF the power supply to the PLC before mounting or removing an Option Board.

Not doing so may result in an unexpected operation.

Analog Input Option Board

● Analog Input Terminal Arrangement



VI1	Voltage Input 1
II1	Current Input 1
VI2	Voltage Input 2
II2	Current Input 2
COM	Input Common

Note When using current inputs, voltage input terminals must be short-circuited with current input terminals.

● Main Specifications

Item		Specifications	
		Voltage Input	Current Input
Input signal range		0 V to 10 V	0 mA to 20 mA
Max. rated input		0 V to 15 V	0 mA to 30 mA
External input impedance		200 kΩ min.	Approx. 250 Ω
Resolution		1/4000 (full scale)	1/2000 (full scale)
Overall accuracy	25°C	±0.5% (full scale)	±0.6% (full scale)
	0 to 60°C	±1.0% (full scale)	±1.2% (full scale)
	-20 to 0°C	±1.3% (full scale)	±1.5% (full scale)
A/D conversion data		0000 to 0FA0 hex	0000 to 07D0 hex
Averaging function		Not supported	
Conversion time		Inner sample time 2ms/point Refresh time refers to *17-9 Analog Option Board Refresh Time* in the *CP2E CPU Unit Software User's Manual* (Cat. No. W614)	
Isolation method		None	
Current consumption		5 VDC: 20 mA max.	

Analog Output Option Board

● Analog Output Terminal Arrangement

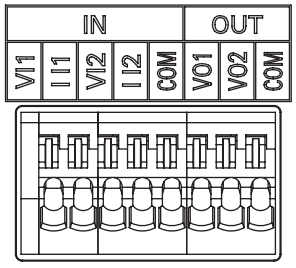
VO1	Voltage Output 1
VO2	Voltage Output 2
COM	Output Common

● Main Specifications

Item		Specifications	
		Voltage Output	Current Output
Output signal range		0 V to 10 V	---
External output allowable load resistance		2 kΩ min.	---
External output impedance		0.5 Ω max.	---
Resolution		1/4,000 (full scale)	---
Overall accuracy	25°C	±0.5% (full scale)	---
	0 to 60°C	±1.0% (full scale)	---
	-20 to 0°C	±1.3% (full scale)	---
D/A conversion data		0000 to 0FA0 hex	---
Conversion time		Inner conversion time 2ms/point Refresh time refers to *17-9 Analog Option Board Refresh Time* in the *CP2E CPU Unit Software User's Manual* (Cat. No. W614)	
Isolation method		None	
Current consumption		5 VDC: 60 mA max.	

Analog I/O Option Board

● Analog I/O Terminal Arrangement



VI1	Voltage Input 1
II1	Current Input 1
VI2	Voltage Input 2
II2	Current Input 2
COM	Analog I/O Common
VO1	Voltage Output 1
VO2	Voltage Output 2
COM	Analog I/O Common

Note When using current inputs, voltage input terminals must be short-circuited with current input terminals.

● Main Specifications

Item			Specifications	
			Voltage I/O	Current I/O
Analog Input Section	Input signal range		0 V to 10 V	0 mA to 20 mA
	Max. rated input		0 V to 15 V	0 mA to 30 mA
	External input impedance		200 kΩ min.	Approx. 250 Ω
	Resolution		1/4,000 (full scale)	1/2,000 (full scale)
	Overall accuracy	25°C	±0.5% (full scale)	±0.6% (full scale)
		0 to 60°C	±1.0% (full scale)	±1.2% (full scale)
		-20 to 0°C	±1.3% (full scale)	±1.5% (full scale)
	A/D conversion data		0000 to 0FA0 hex	0000 to 07D0 hex
	Averaging function		Not supported	
Analog Output Section	Output signal range		0 V to 10 V	---
	External output allowable load resistance		2 kΩ min.	---
	External output impedance		0.5 Ω max.	---
	Resolution		1/4,000 (full scale)	---
	Overall accuracy	25°C	±0.5% (full scale)	---
		0 to 60°C	±1.0% (full scale)	---
		-20 to 0°C	±1.3% (full scale)	---
	D/A conversion data		0000 to 0FA0 hex	---
Conversion time			Inner conversion time 6ms (4CH total) Refresh time refers to *17-9 Analog Option Board Refresh Time* in the *CP2E CPU Unit Software User's Manual* (Cat. No. W614)	
Isolation method			None	
Current consumption			5 VDC: 80 mA max.	

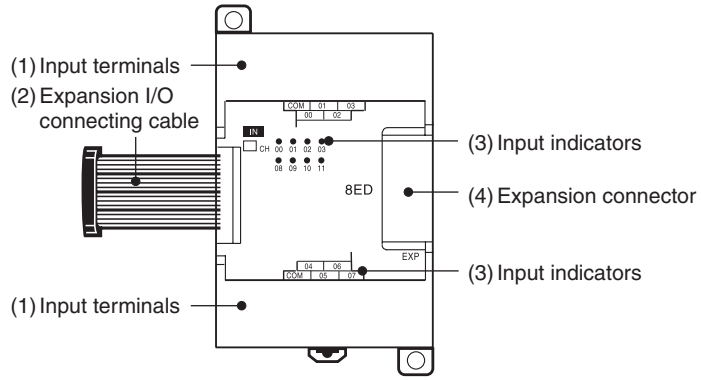
3-2 Expansion I/O Units

This section describes the names of the Expansion I/O Unit parts and provides the input specifications and terminal arrangement. Refer to *A-1 Dimensions* for the dimensions, *A-2 Wiring Diagrams* for the wiring diagrams.

3-2-1 Expansion Input Unit

Part Names and Functions

8-point Input Units (CP1W-8ED)

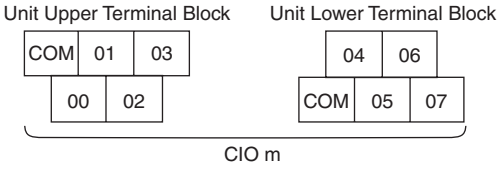


Number	Name	Function
(1)	Input terminals (not removable)	Used to connect input devices.
(2)	Expansion I/O connecting cable	This is a connection cable to connect the adjacent CPU Unit, Expansion I/O Unit, or Expansion Unit. For extended connections or vertical arrangements, use the CP1W-CN811 I/O Connecting Cable (length: 800 mm).
(3)	Input indicators	Input status is displayed. An indicator will be ON when the input is ON.
(4)	Expansion connector	CP-series Expansion I/O Units or Expansion Units can be connected. Refer to *5-2-4 Connecting Expansion I/O Units and Expansion Units*

Terminal Arrangements

The first word of input words allocated to the Expansion Input Unit is indicated by CIO m.

● Input Terminal Arrangement

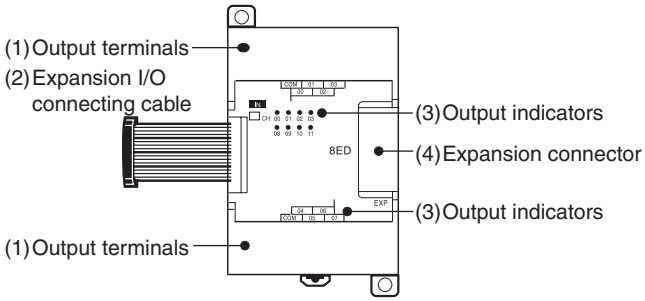


Note COM terminals are connected inside.

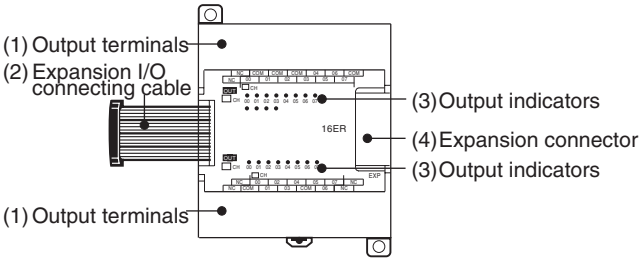
3-2-2 Expansion Output Units

Part Names and Functions

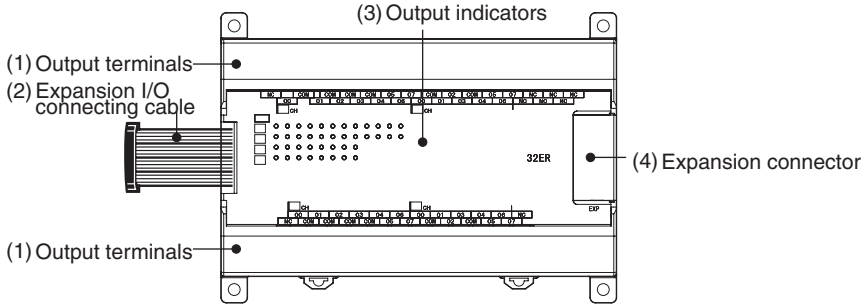
8-point Output Units
CP1W-8ER/8ET/8ET1



16-point Output Units
CP1W-16ER/ET/ET1



32-point Output Units
CP1W-32ER/ET/ET1

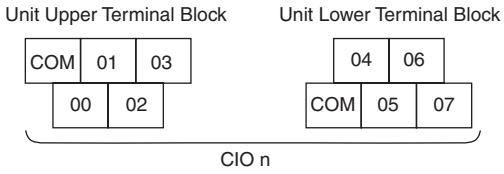


Number	Name	Function
(1)	Output terminals (not removable)	Used to connect output devices.
(2)	Expansion I/O connecting cable	This is a connection cable to connect the adjacent CPU Unit, Expansion I/O Unit, or Expansion Unit. For extended connections or vertical arrangements, use the CP1W-CN811 I/O Connecting Cable (length: 800 mm).
(3)	Output indicators	Output status is displayed. An indicator will be ON when output is ON.
(4)	Expansion connector	CP-series Expansion I/O Units or Expansion Units can be connected. Refer to *5-2-4 Connecting Expansion I/O Units and Expansion Units*.

Terminal Arrangements

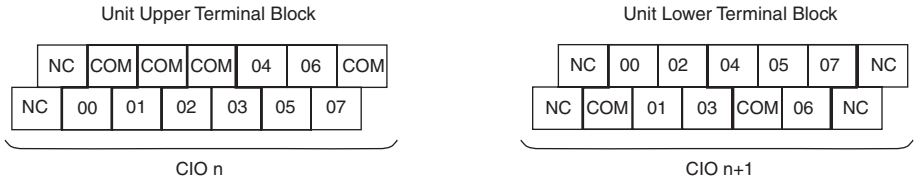
The first word of output words allocated to the Expansion Output Unit is indicated by CIO n.

● 8-point Output Units (CP1W-8E□)



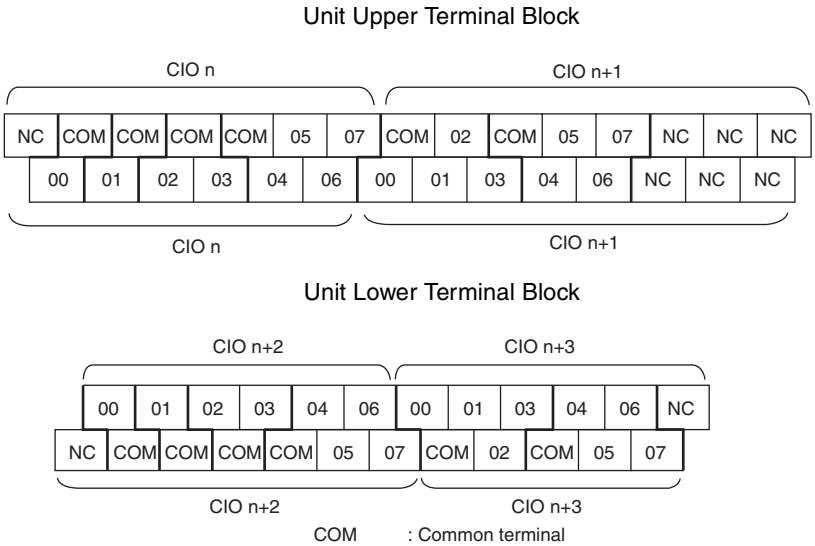
COM : Common terminal
00 to 07 : Output terminal

● 16-point Output Units (CP1W-16E□)



COM : Common terminal
00 to 07 : Output terminal
NC : No connection

● Units with 32 Output Points (CP1W-32E□)

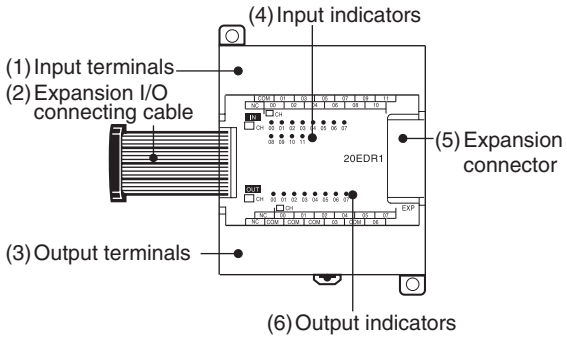


COM : Common terminal
00 to 07 : Output terminal
NC : No connection

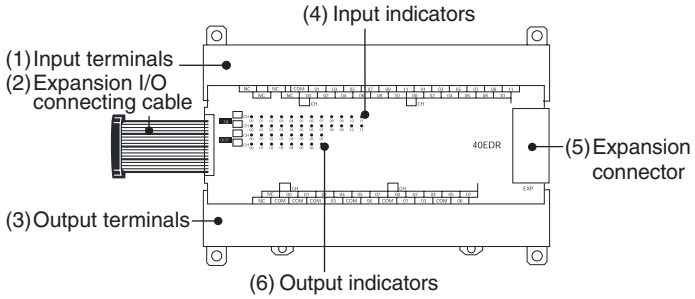
3-2-3 Expansion I/O Units

Part Names and Functions

Units with 20 I/O Points
CP1W-20EDR1/EDT/EDT1



Units with 40 I/O Points
CP1W-40 EDR/EDT/EDT1



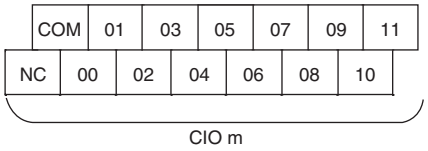
Number	Name	Function
(1)	Input terminals (not removable)	Used to connect input devices.
(2)	Expansion I/O connecting cable	This is a connection cable to connect the adjacent CPU Unit, Expansion I/O Unit, or Expansion Unit. For extended connections or vertical arrangements, use the CP1W-CN811 I/O Connecting Cable (length: 800 mm).
(3)	Output terminals (not removable)	Used to connect output devices.
(4)	Input indicators	Input status is displayed. An indicator will be ON when the input is ON.
(5)	Expansion connector	CP-series Expansion I/O Units or Expansion Units can be connected. Refer to *5-2-4 Connecting Expansion I/O Units and Expansion Units.*
(6)	Output indicators	Output status is displayed. An indicator will be ON when the output is ON.

Terminal Arrangements

The first word of input words allocated to the Expansion I/O Unit is indicated by CIO m and the first word of the output words by CIO n.

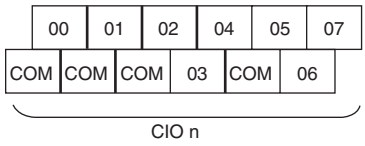
● 20-point I/O Units (CP1W-20ED□)

- Input (Unit Upper Terminal Block)



COM : Common terminal
00 to 11 : Input terminal
NC : No connection

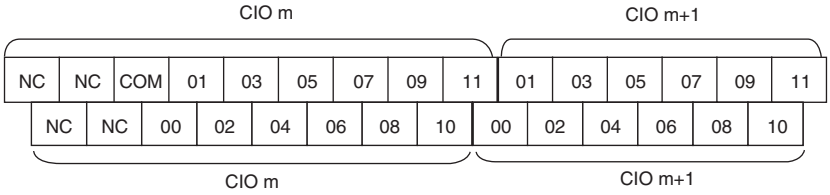
- Output (Unit Lower Terminal Block)



COM : Common terminal
00 to 07 : Output terminal

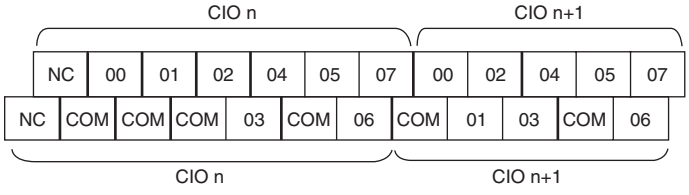
● 40-point I/O Units (CP1W-40ED□)

- Input (Unit Upper Terminal Block)



COM : Common terminal
00 to 11 : Input terminal
NC : No connection

- Output (Unit Lower Terminal Block)



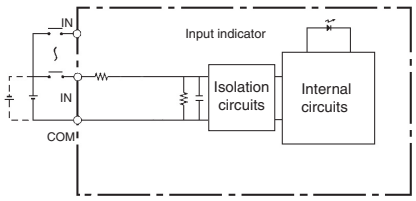
COM : Common terminal
00 to 07 : Output terminal
NC : No connection

3-2-4 I/O Specifications

This section describes the I/O specifications common to all Expansion I/O Units.

I/O Specifications

● Input Specifications (CP1W-8ED/20EDR1/20EDT/20EDT1/40EDR/40EDT/40EDT1)

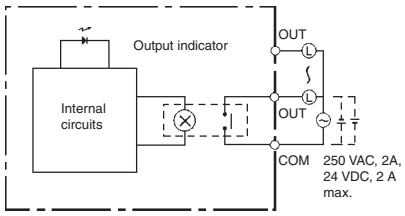
Item	Specification
Input voltage	24 VDC, +10% / -15%
Input impedance	4.7 kΩ
Input current	5 mA typical
ON voltage / current	14.4 VDC min. / 3mA min.
OFF voltage / current	5.0 VDC max. / 1mA max.
ON response time	1 ms max.*
OFF response time	1 ms max.*
Circuit configuration	

* The response time is the delay caused by hardware. The delay set in the PLC Setup (0 to 32 ms, default: 8 ms) must be added to this value. For the CP1W-40EDR/EDT/EDT1, a fixed value of 16 ms must be added.

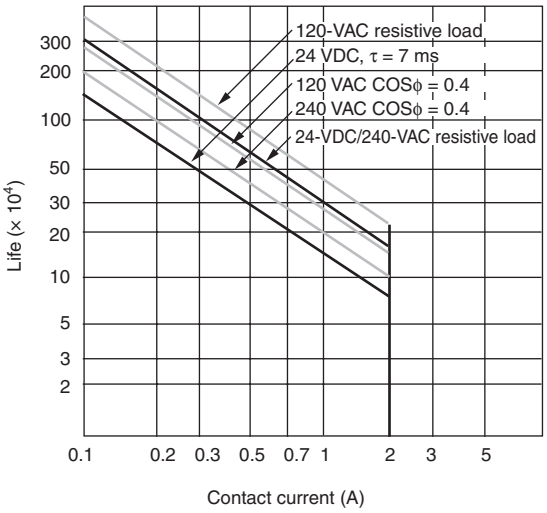
Precautions for Safe Use

Do not apply voltage in excess of the rated voltage to the input terminal.

● Output Specifications for Relay Outputs (CP1W-8ER/16ER/20EDR1/32ER/40EDR)

Item			Specification
Maximum switching capacity			2 A 250 VAC (cosϕ = 1), 2 A 24 VDC (4 A/common)
Minimum switching capacity			10 mA 5 VDC
Service life of relay	Electrical	Resistive load	150,000 operations (24 VDC)
		Inductive load	100,000 operations (240 VAC, cosϕ = 0.4)
	Mechanical		20,000,000 operations
ON response time			15 ms max.
OFF response time			15 ms max.
Circuit configuration			

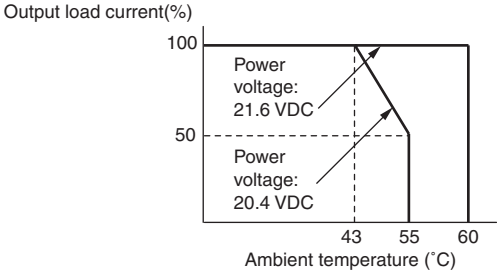
- Estimating the Service Life of Relays
  The service life of output contacts is as shown in the following diagram.



Switching frequency: 1,800 operations/hour

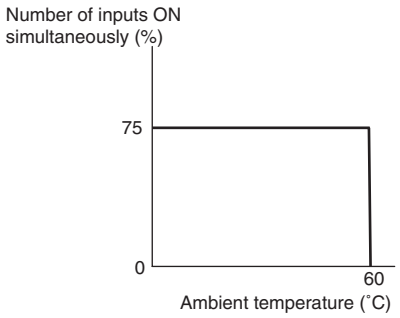
- Restrictions of CP1W-16ER/32ER
  Limit the output load current to satisfy the following derating curve.

CP1W-16ER/32ER



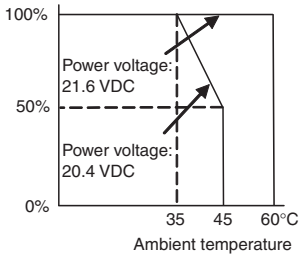
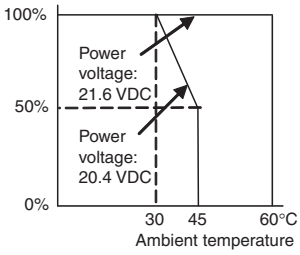
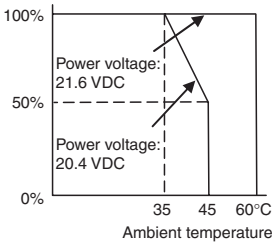
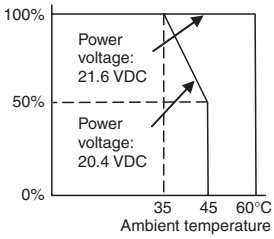
- CP1W-32ER's maximum number of simultaneously ON output points is 24 (75%).

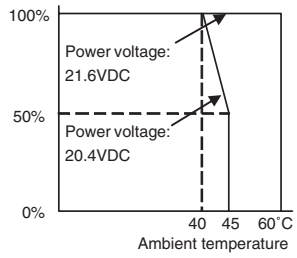
Relation between Number of ON Outputs and Ambient Temperature (CP1W-32ER)



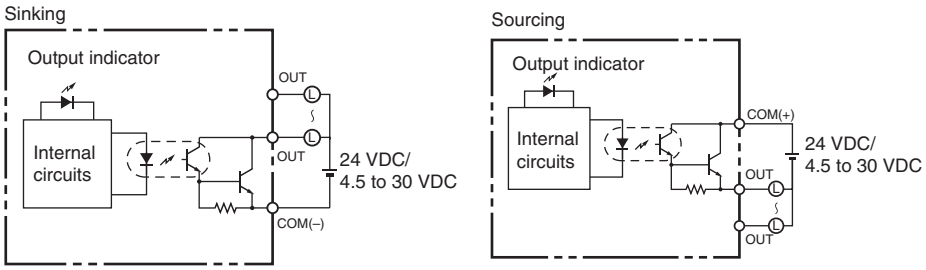
According to the ambient temperature, there are restrictions on power supply voltage and output load current for the CPU Units connected with the Expansion I/O Units (CP1W-8ER/16ER/20EDR1/ 32ER/40EDR). Use the PLC in the range of the power supply voltage and output load current as show below.

- The ambient temperature is restricted for the CPU Units.
  Derating curve of the output load current for Expansion I/O Units (CP1W-8ER/16ER/20EDR1/ 32ER/40EDR).

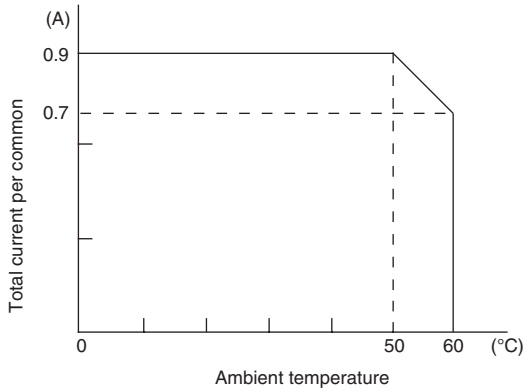
Connected to CP2E-N30DR-D	Connected to CP2E-N40DR-D	Connected to CP2E-□30DT□-D	Connected to CP2E-□40DT□-D
			

Connected to CP2E-N60DR-D CP2E-□60DT□-D


● Output Specifications for Transistor Outputs (Sinking or Sourcing)

Item	Specification				
	CP1W-40EDT CP1W-40EDT1	CP1W-32ET CP1W-32ET1	CP1W-20EDT CP1W-20EDT1	CP1W-16ET CP1W-16ET1	CP1W-8ET CP1W-8ET1
Maximum switching capacity*1	4.5 to 30 VDC 0.3 A/output 0.9 A/common 3.6 A/Unit	4.5 to 30 VDC 0.3 A/output 0.9 A/common 7.2 A/Unit	24 VDC +10%/-5% 0.3 A/output 0.9 A/common 1.8 A/Unit	4.5 to 30 VDC 0.3 A/output 0.9 A/common 3.6 A/Unit	4.5 to 30 VDC 0.3 A/output 0.9 A/common 1.8 A/Unit
Leakage current	0.1 mA max.	0.1 mA max.	0.1 mA max.	0.1 mA max.	0.1 mA max.
Residual voltage	1.5 V max.	1.5 V max.	1.5 V max.	1.5 V max.	1.5 V max.
ON response time	0.1 ms max.	0.1 ms max.	0.1 ms	0.1 ms max.	0.1 ms max.
OFF response time	1 ms max. At 24 VDC +10%/ -5%, 5 to 300 mA	1 ms max. At 24 VDC +10%/ -5%, 5 to 300 mA	1 ms max. At 24 VDC +10%/ -5%, 5 to 300 mA	1 ms max. At 24 VDC +10%/ -5%, 5 to 300 mA	1 ms max. At 24 VDC +10%/ -5%, 5 to 300 mA
Maximum number of simultaneously ON outputs	16 points (100% load)	24 points (100% load)	8 points (100% load)	16 points (100% load)	8 points (100% load)
Fuse*2	1 fuse/common				
Circuit configuration					

*1 If the ambient temperature is maintained below 50ºC, up to 0.9 A/common can be used.



*2 The fuse cannot be replaced by the user. Replace the Unit if the fuse breaks due to an short-circuit or overcurrent.

Precautions for Safe Use

Do not connect a load to an output terminal or apply a voltage in excess of the maximum switching capacity.

4

Programming Device

This section describes the features of the CX-Programmer used for programming and debugging PLCs, as well as how to connect the PLC with the Programming Device.

4-1 Applicable Programming Devices for CP2E 4-2
4-2 Connecting by USB 4-4
4-3 Connection Method with an Ethernet Port 4-6
4-4 Connection Method with a Serial Port 4-15

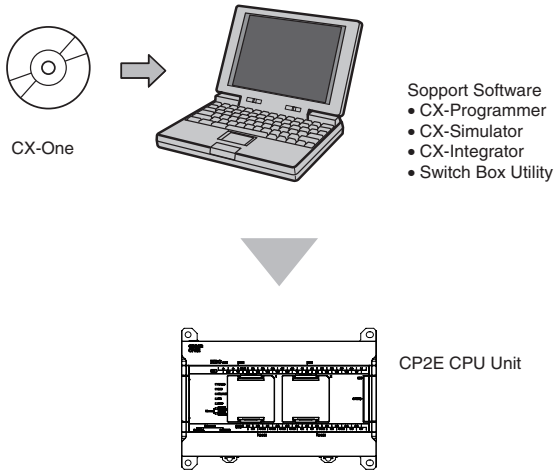
4-1 Applicable Programming Devices for CP2E

A programming device is a software application for initializing, programming, monitoring, and debugging PLCs. This section describes the programming device used by CP2E.

Applicable Programming Devices

The programming devices in the following table are used to program and monitor the CP2E Unit.

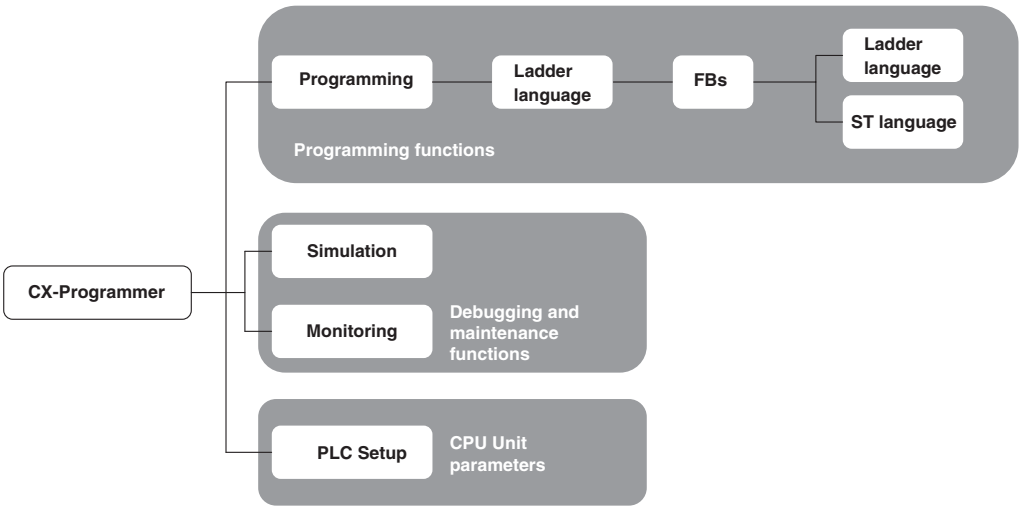
CP2E CPU Units are supported by CX-One version 4.51 or higher and CX-Programmer version 9.72 or higher.



Application	CX-One Software	Description
Programming	**CX-Programmer**	Basic software for creating and debugging PLC programs.
	SwitchBox Utility	Utility software to support PLC debugging operations.
Network settings	**CX-Integrator**	Software for starting and setting FA networks, such as Controller Link, DeviceNet, CompoWay/F, Ethernet, and CompoNet. Includes routing table components, data link components, and DeviceNet Configurator functions.
Simulation	**CX-Simulator**	Software for simulating PLC operations on a personal computer and debugging programs without requiring a CPU Unit.

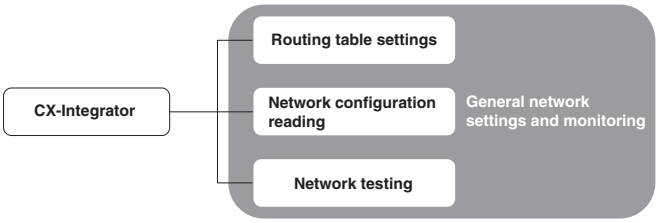
CX-Programmer

The CX-Programmer is a basic software application for creating and debugging PLC programs.



CX-Integrator

The CX-Integrator is a software application for setting up Ethernet.



4-2 Connecting by USB

This section describes how to connect the CX-Programmer with the CP2E E/S□□-type CPU Unit.

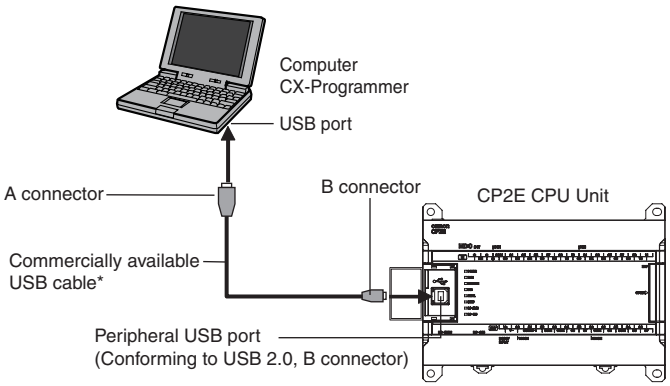
Preparations for Connection

In order to connect the PLC to a personal computer by USB, a USB driver must be installed in the personal computer. When installing the CX-One, the installer automatically stores the USB driver for USB connections in the following directory on the OS disc drive:
C:\ProgramFiles\OMRON\CX-Server\USB

When the personal computer is connected to the PLC by USB cable, the personal computer automatically recognizes the device and the USB driver installation is started. For details on how to install the USB driver, refer to CX-Programmer's manual.

Connection Methods

Using commercially available USB cable, connect the CX-Programmer to the peripheral USB port on the CPU Unit.



* Commercially available USB cable: 5 m max., for USB 2.0.

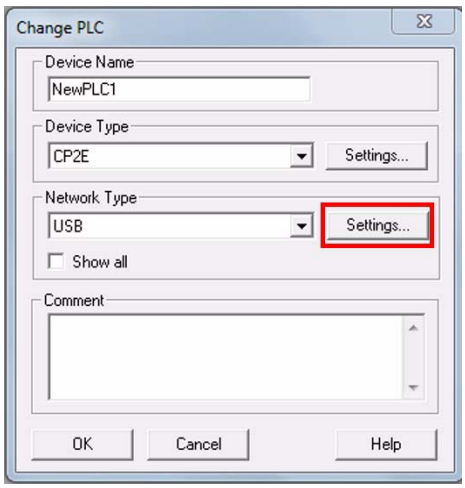
Use the following cable to connect the CP2E CPU Unit to the CX-Programmer.

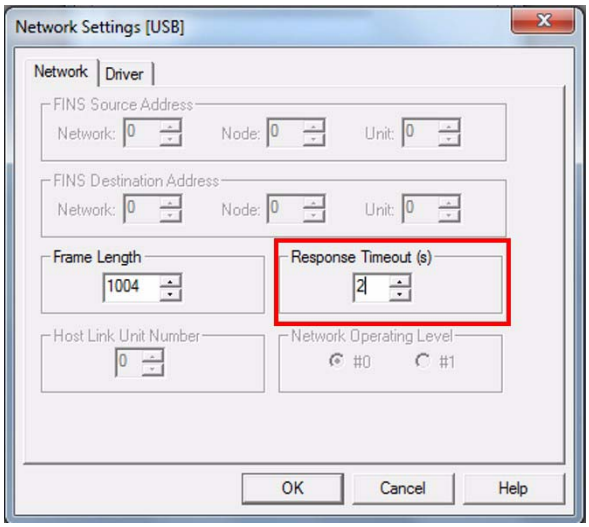
Port at Unit	Port at computer	Network type (communications mode)	Model numbers	Length
Peripheral USB port (Conforming to USB 2.0, B connector)	USB port	USB 2.0 (or 1.1)	Commercially available USB cable (A connector - B connector)	5m max.

Restrictions on Connecting by USB

The following restrictions apply to the connection of the CP2E to a computer due to the USB specifications. Keep these restrictions in mind when using the USB port.

- Only one CP2E CPU Unit can be connected by USB to a single personal computer. It is not possible to connect multiple CP2E CPU Units simultaneously.
- Do not remove the USB cable while connected online. The application must be offline before the cable is removed. The CX-Programmer will not go online simply by reinserting the USB cable. Place the CX-Programmer offline before reinserting the USB cable, then place it online again.
- If the cycle time is too long, it may result the communication failure when CX-Programmer tries to work online. In this case, click **the Settings** button on the right side of Network Type in the **Change PLC** dialog box and increase the value in **Response Timeout(s)**.



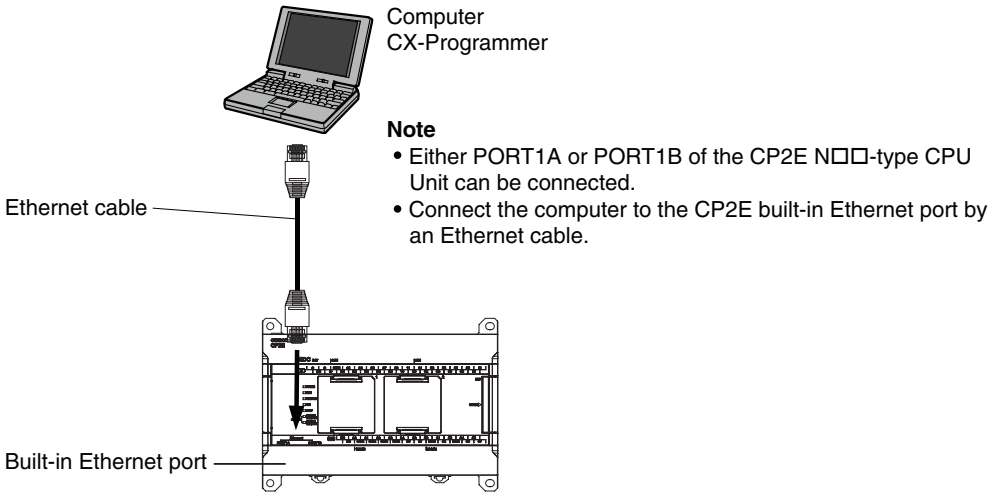


4-3 Connection Method with an Ethernet Port

This section describes how to connect the CX-Programmer with the CP2E N□□ -type CPU Unit.

Connection Method

Using commercially available Ethernet cable, connect the CX-Programmer to the built-in Ethernet port.



Use the following cable to connect the CP2E CPU Unit to the CX-Programmer.

- Twisted-pair cable

  UTP (Unshielded): Category 5, 5e

  STP (Shielded): Category 5, 5e

Connection Procedure

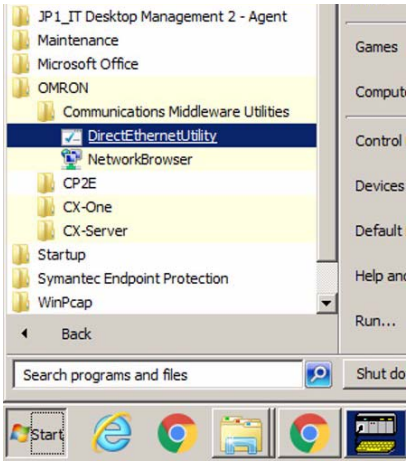
CX-Programmer supports two methods for connecting online to the target PLC, which are auto online and normal online.

● Auto Online

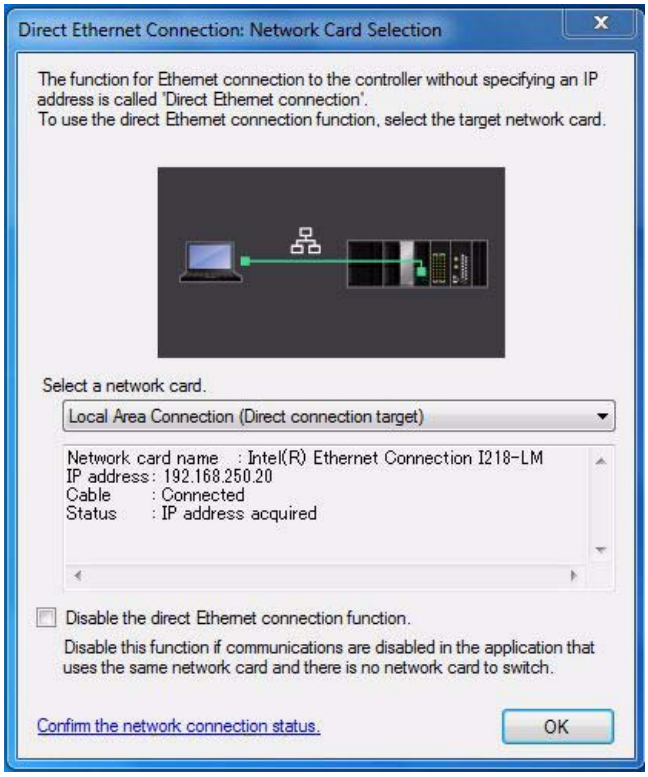
You can automatically and easily connect online to a PLC when PC and target PLC are in same local network by using auto online function.

1 Connect the Ethernet port to the computer via a twisted-pair cable or hub according to the connection type (Refer to *A-5 Network Installation*).

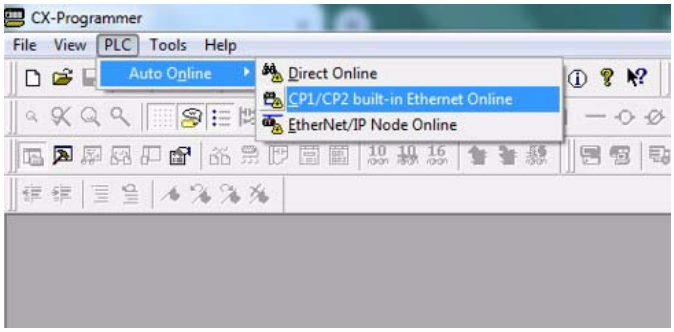
2 Select ***DirectEthernetUtility*** from the Menu as follow.



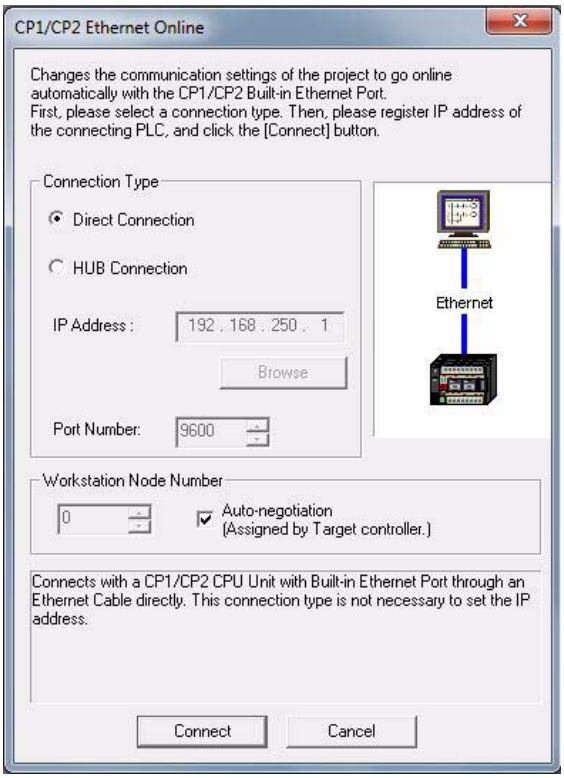
3 Select a target network card to connect with.



4 Open the CX-Programmer and click the **PLC** button as follow.



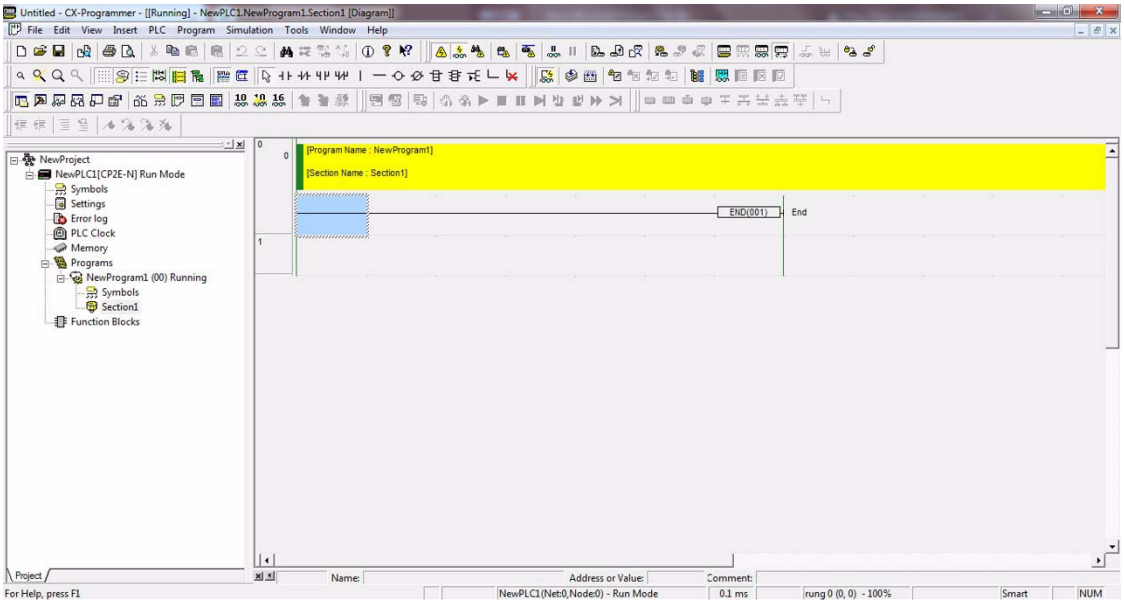
5 Select the ***CP1/CP2 Ethernet Online*** item. The user can also click the button in the Toolbars.



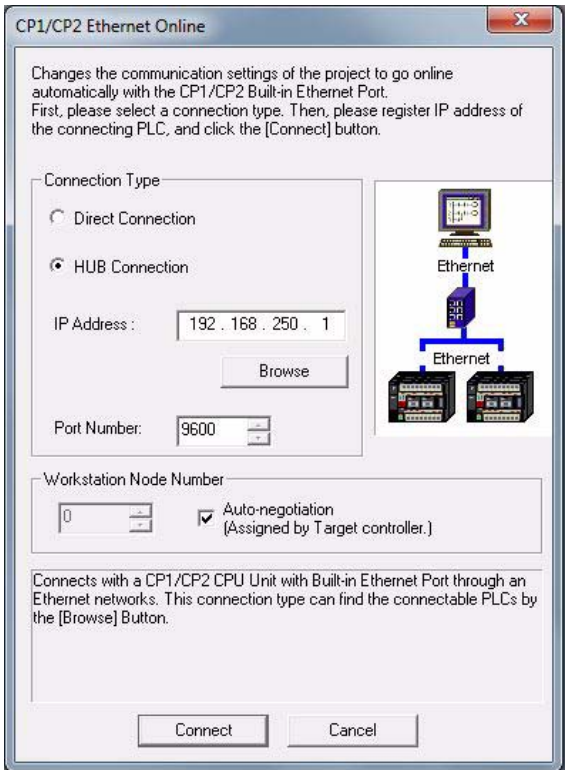
6 Select a connection type

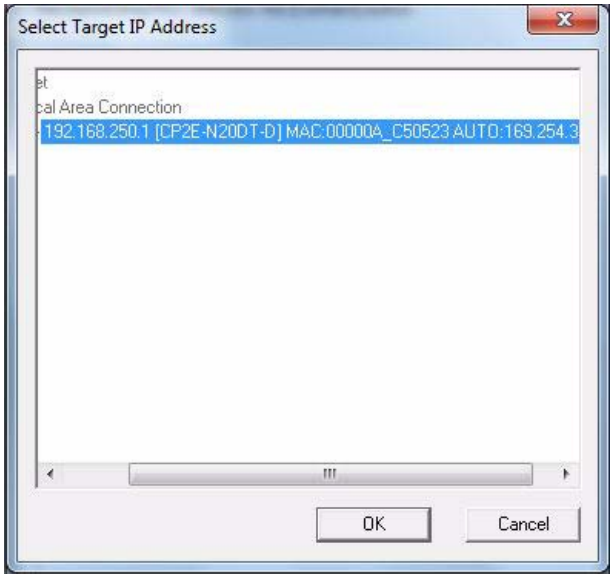
Direct connection is possible only when a PLC and a computer are connected 1:1. In other circumstances, select HUB connection.

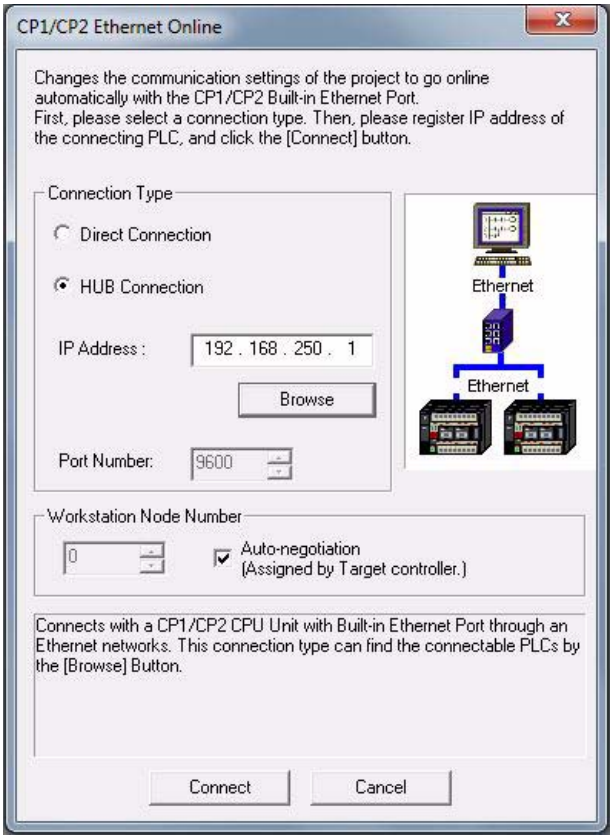
a. Choose the ***Direct Connection*** item and click the **Connect** button. Then connection online is completed.



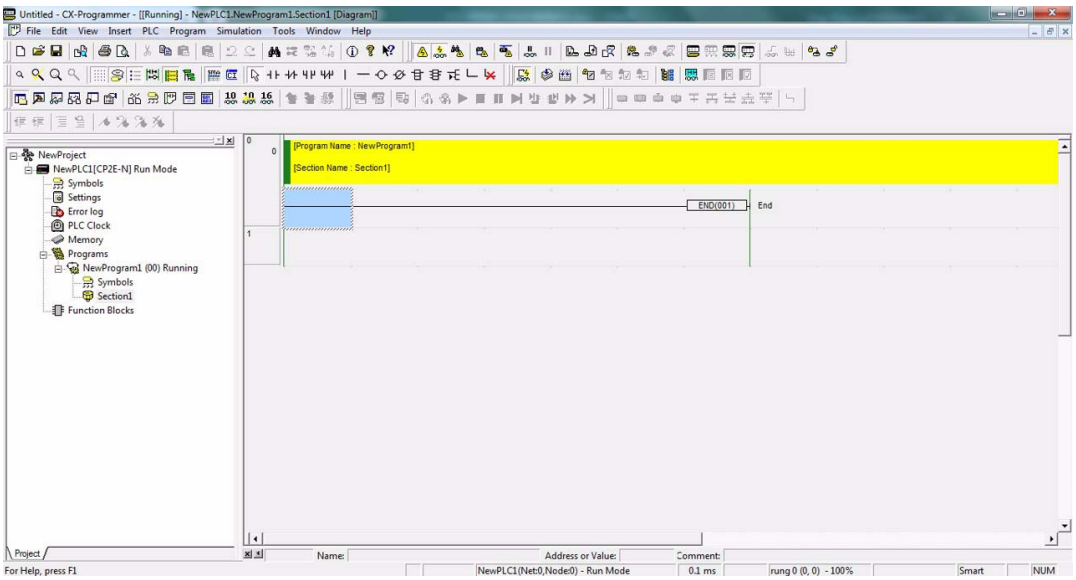
b. Choose the ***Hub Connection*** item and click **Browse** button to select the PLC which user wants to connect.





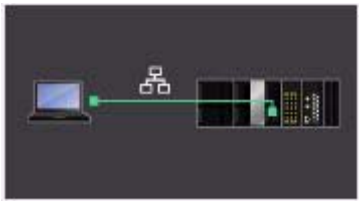
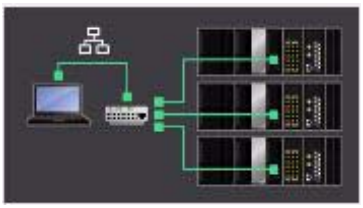


Click the **Connect** button to connect and then connection online is completed.



● Normal Online

To connect with a PLC via Ethernet, there are two types of hardware connections that can be used (Refer to *A-6 Network Installation*). These are described in the following table.

Connection Type	Ethernet - Direct connection	Ethernet - HUB connection
Connection diagram		
Description	The Ethernet port on the computer is connected directly to the Ethernet port on the PLC with a twisted-pair cable.	The Ethernet port on the computer is connected to a hub and then the CX-Programmer is placed online with a PLC through the Ethernet network.
Network Type	Ethernet (FINS/TCP)	Ethernet or Ethernet (FINS/TCP)
Destination PLC IP setting	No need	Need
PC IP setting	No need	Need

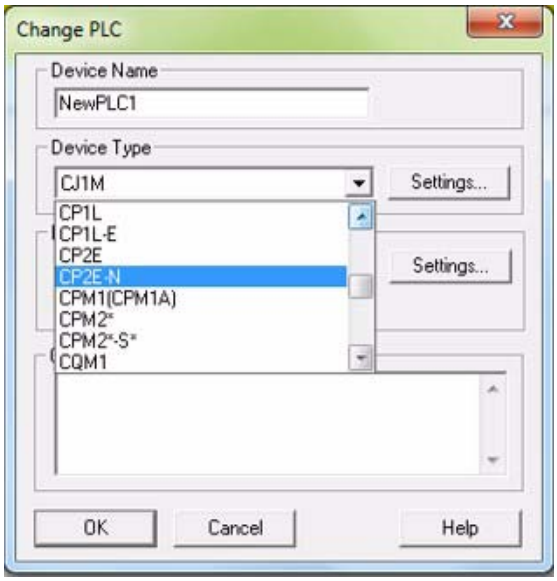
Network Type

Network Type	Ethernet	Ethernet (FINS/TCP)
Protocol	FINS/UDP	FINS/TCP
Features	A standard protocol for host computers with HUB connection only.	A standard protocol for host computers with either Direct connection or HUB connection.

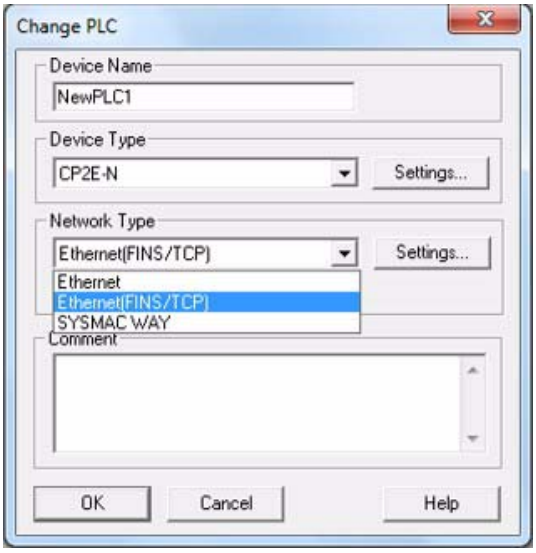
● Ethernet - Direct Connection

When the Ethernet port on the computer is connected directly to the Ethernet port on the PLC with a twisted-pair cable, this mode can be selected as the connection method.
In this mode, user need not change the IP setting in PC side.

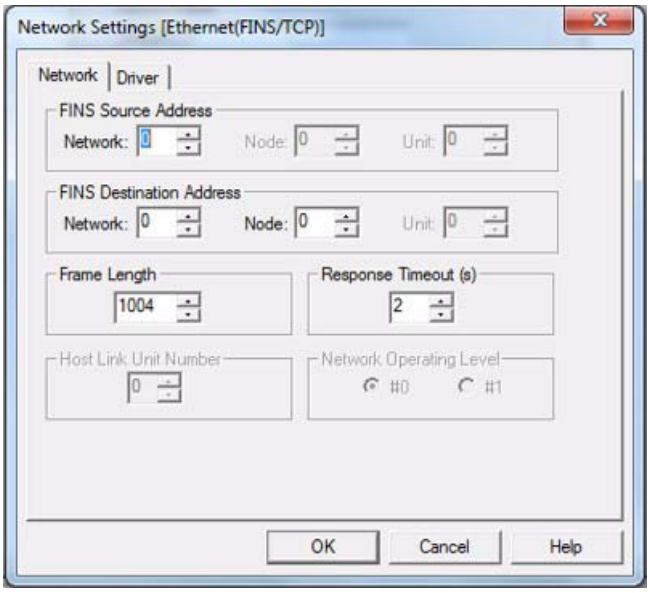
1 Select the PLC type as ***CP2E-N*** in Device Type in the CX-Programmer's **Change PLC** Dialog Box.

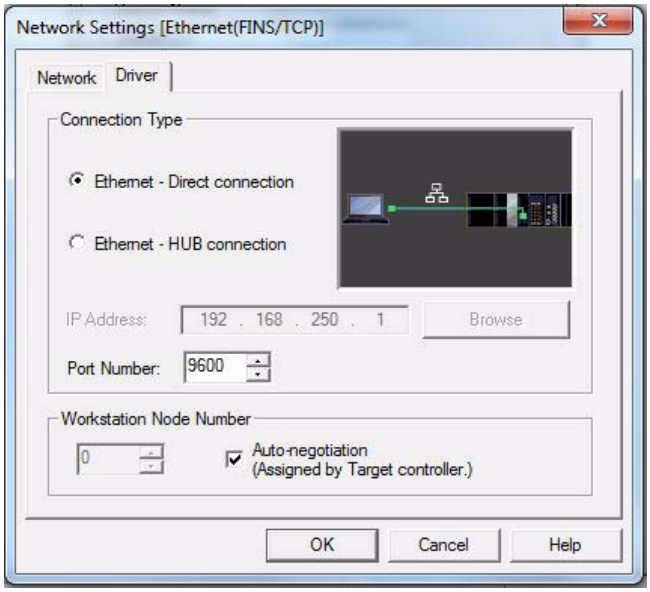


2 Set ***Ethernet (FINS/TCP)*** in **Network Type**.



3 Click the **Settings** button on the right side of **Network Type**. The settings in the Network Tab and in the Driver are as follow dialogue boxes.





4 Click the **OK** button and finish the settings of the direct connection.

5 Then connect to the CP2E by executing the CX-Programmer's online connection command.

● Ethernet - HUB connection

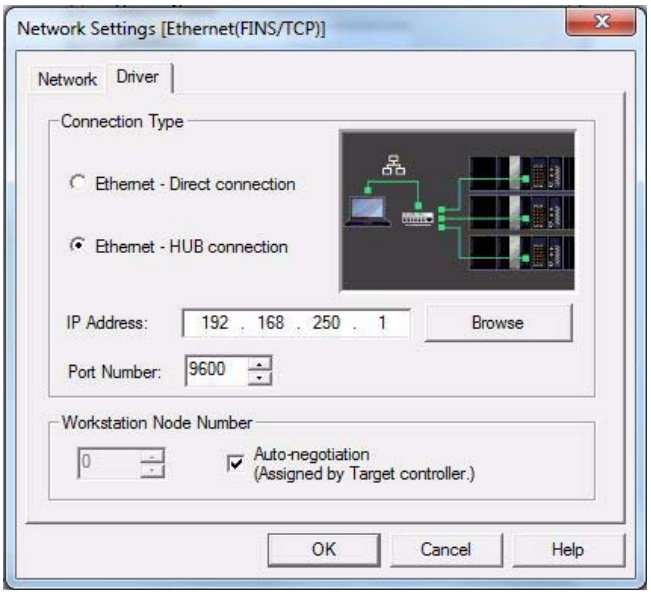
When the Ethernet port on the computer is connected to a hub and then the CX-Programmer is placed online with a PLC through the Ethernet network, this mode can be selected as the connection method.

In this mode, user should change the IP setting in PC side in a same subnet as PLC.

1 The settings of PLC type and CPU type are the same as Ethernet - Direct connection.

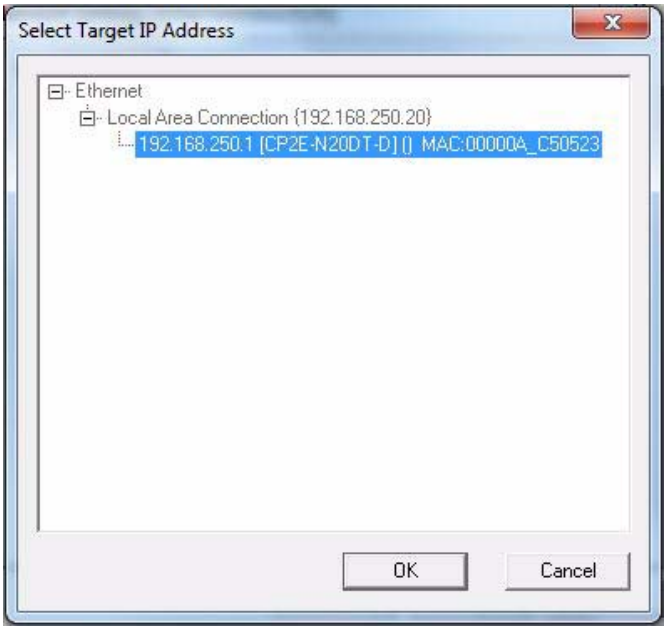
2 Set Network Type. Both Ethernet and Ethernet (FINS/TCP) are supported. In the following we will use Ethernet (FINS/TCP) as the sample.
The settings of Network Tab in Network Settings are also the same as those in the Ethernet - Direct connection.

3 Set the connection type as Ethernet - HUB connection in Driver Tab.



4 Set the target PLC's IP Address.

If do not know the target PLC's IP address, user can click the **Browse** button on the right side of **IP Address** and it will show a dialogue box as follow. The CX-Programmer will automatically search CP2E series PLCs under the same segment in the local area. All PLC found by CX-Programmer will be listed with the IP address, PLC's type and MAC ID in the **Select Target IP Address** dialogue box. Choose a target PLC to be connected and click the **OK** button.



5 Change the IP setting in PC side to an IP address in same subnet as the target PLC.

6 Click the **OK** button in the **Network Settings** dialogue box and finish the settings.

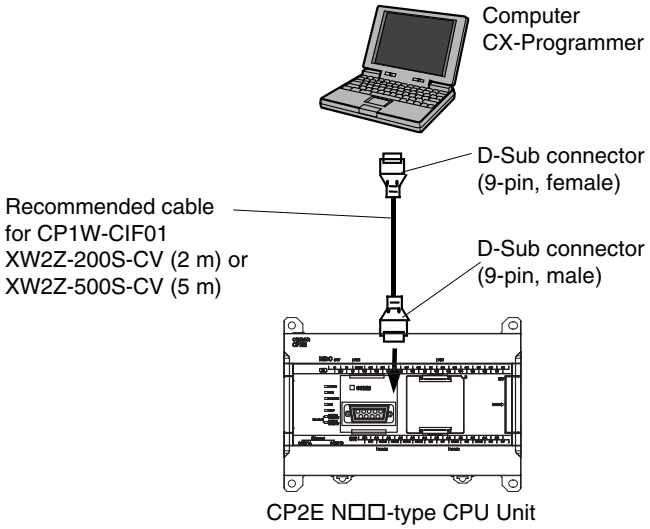
7 Then connect to the CP2E by executing the CX-Programmer's online connection command.

4-4 Connection Method with a Serial Port

This section describes how to connect the CX-Programmer with the CP2E CPU Unit.

Connection Method

Connect the CX-Programmer to the serial communication port.



CP2E N□□-type CPU Unit

Connect the Programming Device using the Connecting Cable that is appropriate for the serial communications mode of the computer and CPU Unit.

Computer	Connecting Cable		CP2E CPU Unit	
Connector	Model	Length	Connector	Serial communications mode
D-Sub 9 pin, male	XW2Z-200S-CV	2m	D-Sub 9 pin, female (With a CP1W-CIF01 mounted in option board slot)	Host Link (SYSWAY)
	XW2Z-500S-CV	5m		
	Refer to the cable mentioned in *A-3*		Terminal Block (With a built-in RS-232C port or a CP2W-CIFD□ mounted in option board slot)	

5

Installation and Wiring

This section describes how to install and wire CP2E Units.

5-1 Fail-safe Circuits 5-2

5-2 Installation 5-3

5-2-1 Installation Location 5-3

5-2-2 Unit Arrangement 5-6

5-2-3 Installation 5-7

5-2-4 Connecting Expansion I/O Units and Expansion Units 5-12

5-3 Wiring 5-14

5-3-1 Wiring Procedure 5-14

5-3-2 Wiring Power Supply and Ground Lines 5-14

5-3-3 I/O Wiring 5-17

5-3-4 Wiring Safety and Noise Controls 5-21

5-3-5 Relay Output Noise Reduction Methods 5-22

5-1 Fail-safe Circuits

This section describes the fail-safe circuits that must be set up outside the CP2E.

Always set up safety circuits outside of the PLC to prevent dangerous conditions in the event of errors in the CP2E CPU Unit or external power supply.

In particular, be careful of the following points.

Timing of Supplying Power to the PLC and the Controlled System

If the PLC's power supply is turned ON after the controlled system's power supply, outputs in Units such as DC Output Units may momentarily not function properly.

To prevent any malfunction, add an external circuit that prevents the power supply to the controlled system from going ON before the power supply to the PLC itself.

Safety Circuit for Errors (Outputs Turned OFF)

When any of the following errors occur, PLC operation (program execution) will stop and all outputs from the Units will be turned OFF.

- A CPU error (watchdog timer error) or CPU on standby
- A fatal error (memory error, I/O bus error, too many I/O points error, program error, cycle time exceeded error, FALS error or built-in Ethernet stop error)

Be sure to add any circuits necessary outside of the PLC to ensure the safety of the system in the event of an error that stops PLC operation.

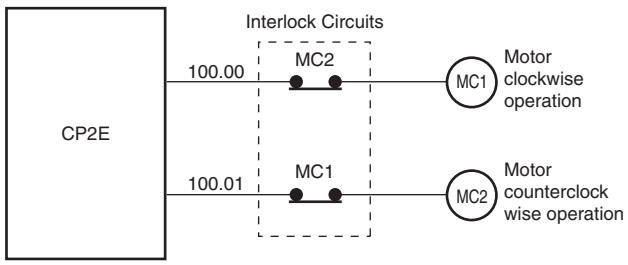
Safety Circuit after a Malfunction (When an Output Remains ON)

It is possible for an output to remain ON due to a malfunction in the internal circuitry of the Output Unit, such as a relay or transistor malfunction. Always add any circuits necessary outside of the PLC to ensure the safety of the system in the event that an output fails to go OFF.

External Interlock Circuits

When the PLC controls operation such as the clockwise and counterclockwise operation of a motor and if there is any possibility of an accident or mechanical damage due to faulty PLC operation, provide an external interlock such as the one shown below to prevent both the forward and reverse outputs from turning ON at the same time.

Example:



A circuit like the one shown in the diagram on the left is required to prevent outputs MC1 and MC2 from both being ON at the same time even if both PLC outputs CIO 100.00 and CIO 100.01 are both ON.

5-2 Installation

This section describes the environmental factors that must be considered and the installation location of each Unit.

5-2-1 Installation Location

Installation Environment

Do not install the Unit in the following locations.

- Locations subject to ambient temperatures lower than -20ºC or higher than 60ºC.
- Locations subject to drastic temperature changes or condensation.
- Locations subject to ambient humidity lower than 10% or higher than 90%.
- Locations subject to corrosive or flammable gases.
- Locations subject to excessive dust, salt, or metal filings.
- Locations that would subject the PLC to direct shock or vibration.
- Locations exposed to direct sunlight.
- Locations that would subject the PLC to water, oil, or chemical reagents.

Always enclose or protect the PLC sufficiently in the following locations.

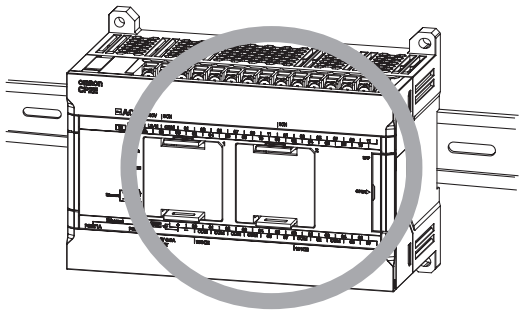
- Locations subject to static electricity or other forms of noise.
- Locations subject to strong electromagnetic fields.
- Locations subject to possible exposure to radioactivity.
- Locations close to power lines.

Installation in Cabinets or Control Panels

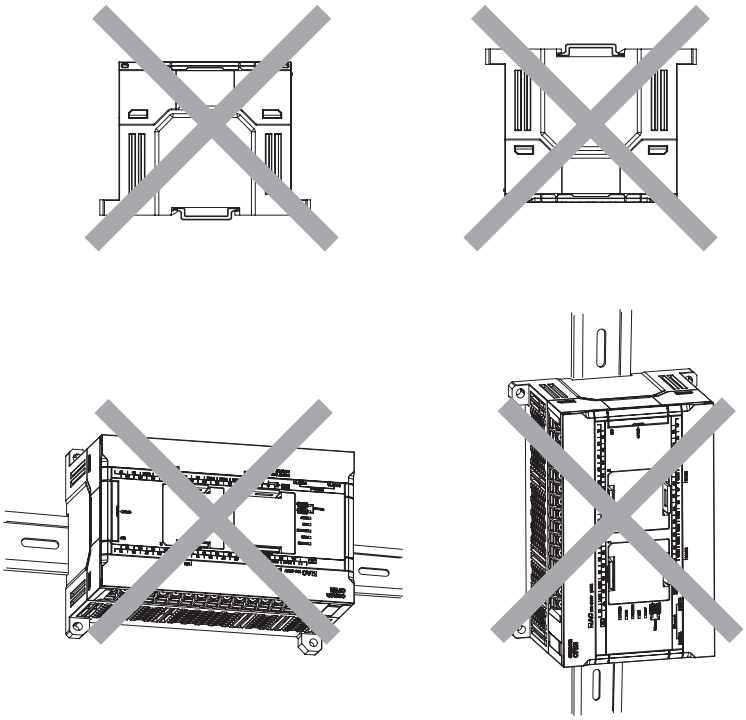
When the CP2E is being installed in a cabinet or control panel, be sure to provide proper ambient conditions as well as access for operation and maintenance.

● Installation Orientation

When installing the CP2E in a control panel, it must be installed with the side with indicators and communications ports facing the front to ensure proper heat dissipation.



OK



Not possible

● Accessibility for Operation and Maintenance

- To ensure safe access for operation and maintenance, separate the PLC as much as possible from high-voltage equipment and moving machinery.
- The PLC will be easiest to install and operate if it is mounted at a height of 1.0 to 1.6 m above the floor.

⚠WARNING

Do not touch the power supply or the area around the I/O terminals while power is being supplied or immediately after power has been turned OFF.
Doing so may result in burns.

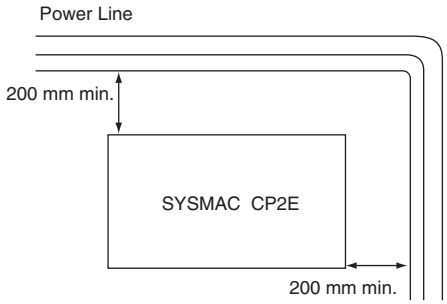
Precautions for Correct Use

After the power supply has been turned OFF, wait until the PLC has sufficiently cooled before touching it.

Improving Noise Resistance

Leave space between the CP2E and control panel or other devices to allow adequate dissipation of heat generated by the power supply.

- Do not mount the PLC in a control panel containing high-voltage equipment.
- Install the PLC at least 200 mm (6.5 feet) from power lines.

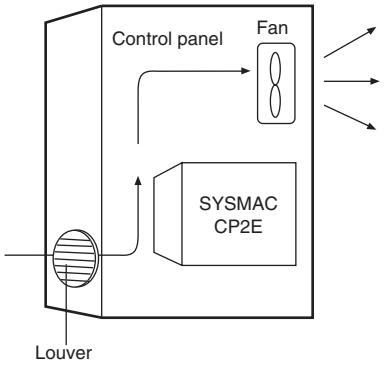


- Ground the mounting plate between the PLC and the mounting surface.

Temperature Control

The ambient operating temperature around the CP2E must be between -20 and 60ºC. Observe the following precautions.

- Provide enough space for good air flow.
- Do not install the PLC above equipment that generates a large amount of heat such as heaters, transformers, or high-capacity resistors.
- If the ambient temperature exceeds 60ºC, install a cooling fan or air conditioner.



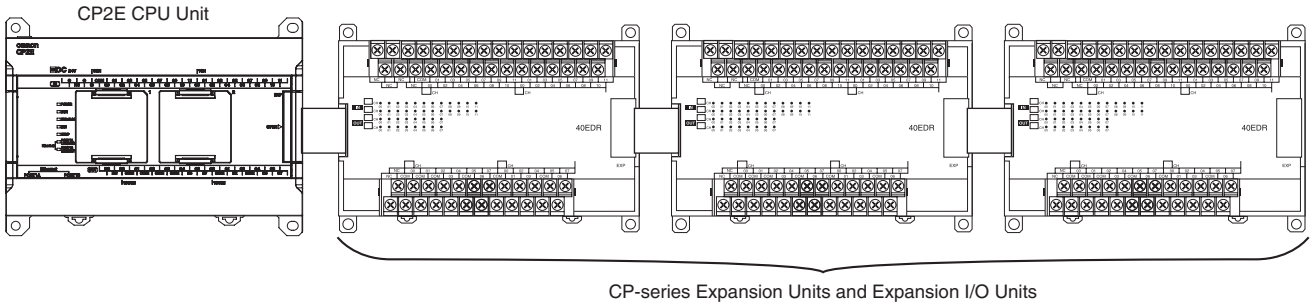
5-2-2 Unit Arrangement

This section describes how to arrange the CP2E Units.

As shown in the following diagrams, Units can be arranged in one or two rows when Expansion I/O Units or Expansion Units are used.

Arrangement in One Row

Expansion I/O Units and Expansion Units can be installed in a side-by-side arrangement.

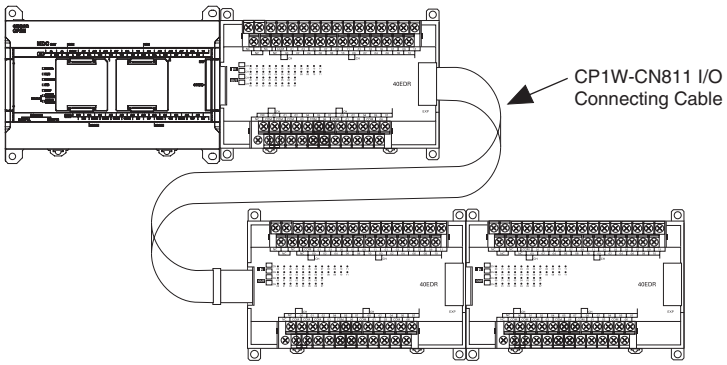


Precautions for Correct Use

When connecting CP-series Expansion Units or Expansion I/O Units to a CPU Unit with AC power, provide a space of approximately 10 mm between the CPU Unit and the first Expansion Unit or Expansion I/O Unit.
If sufficient space cannot be provided between the CPU Unit and the first Expansion Unit or Expansion I/O Unit, use the PLC in an ambient temperature of -20 to 50°C.

Arrangement in Two Rows

The Units can be arranged in two rows using the CP1W-CN811 I/O Connecting Cable (800 mm).



Precautions for Correct Use

I/O Connecting Cable can be used in one place only in each CP2E PLC. It cannot be used in more than one place in the same CP2E PLC.

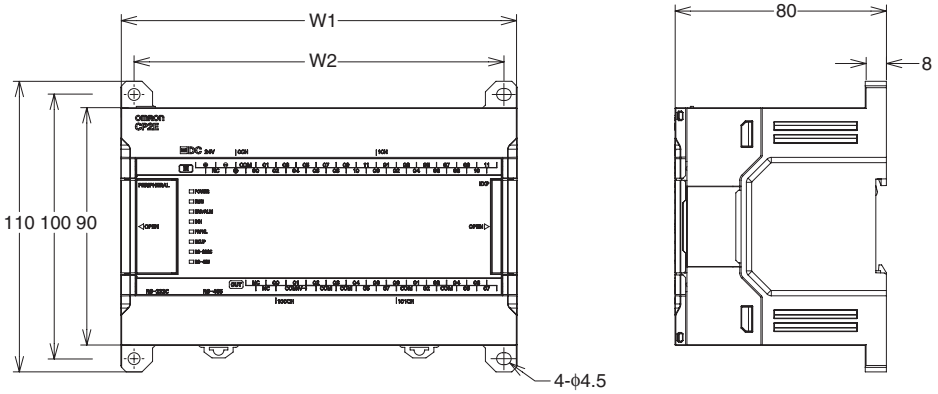
5-2-3 Installation

This section describes how to install the CP2E.

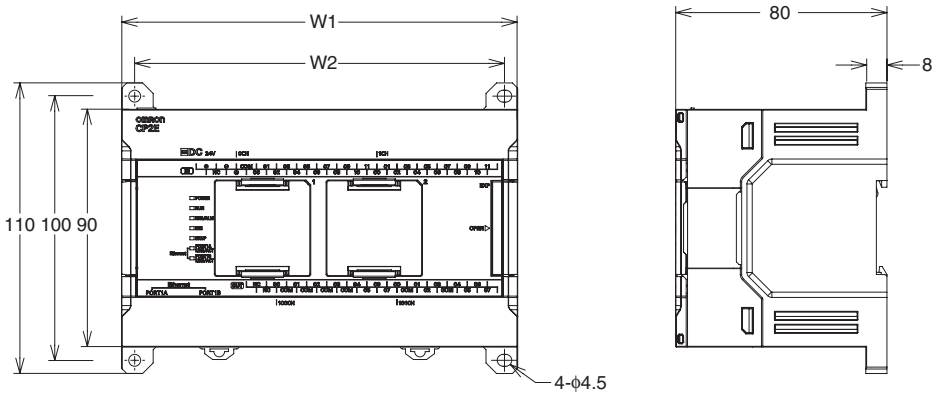
Dimensions and Installation Height

● Dimensions

- E/S□□-type CPU Units



- N□□-type CPU Units



Model number	W1	W2
CP2E-□14D□-□	86	76
CP2E-□20D□-□	86	76
CP2E-□30D□-□	130	120
CP2E-□40D□-□	150	140
CP2E-□60D□-□	195	185

● Installation Height

The installation height is approximately 90 mm.

When a cable is connected to an Option Board, however, the additional height must be included. Always allow for the additional height when considering the depth of the control panel in which the PLC is to be mounted.

Installation Methods

There are two installation methods.

● DIN Track Installation

- Units can be mounted to PEP-50N (50 cm) or PEP-100N/100N2 (100 cm) DIN Tracks.
- Units can be moved and removed easily.
- The installation height in the control panel will be increased depending on the type of DIN tracks used.

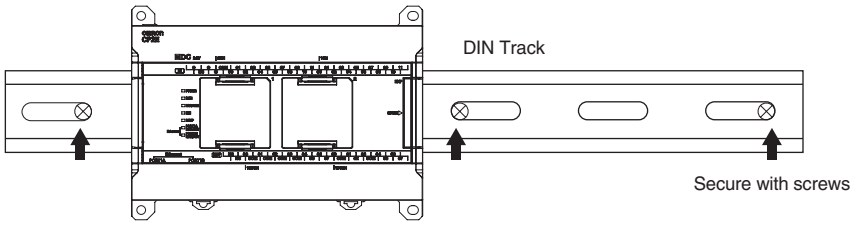
● Surface Installation

Units can be directly mounted in the control panel using M4 screws.

Installation Example

● DIN Track Installation

Secure the DIN Track with screws in at least three places.

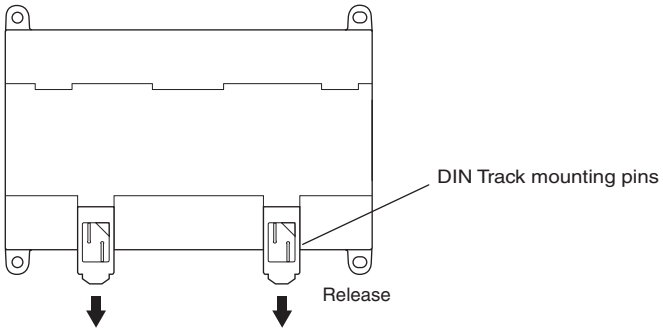


● Surface Installation

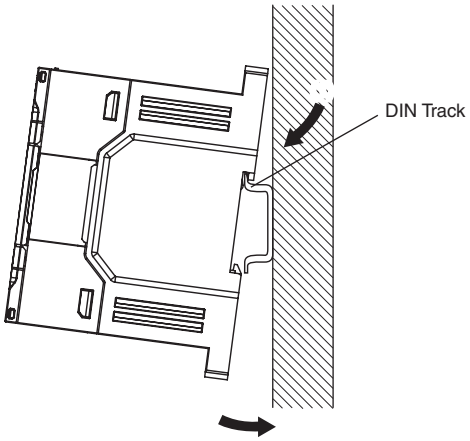
A CP2E CPU Unit and CP-series Expansion I/O Units and Expansion Units can be mounted using M4 screws. For restrictions on the number of Expansion I/O Units and Expansion Units that can be connected, refer to *2-3 Expansion I/O Unit or Expansion Unit.*

DIN Track Installation

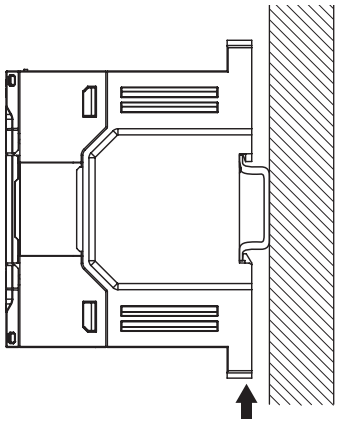
1 Use a screwdriver to pull down the DIN Track mounting pins from the back of the Units to release them, and mount the Units to the DIN Track.



2 Fit the back of the Units onto the DIN Track by catching (1) the top of the Units on the Track and then pressing (2) in at the bottom of the Units, as shown below.



3 Press in all of the DIN Track mounting pins to securely lock the Units in place.

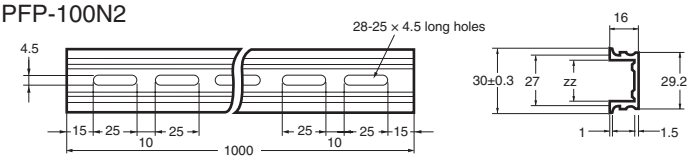


Mounting Brackets

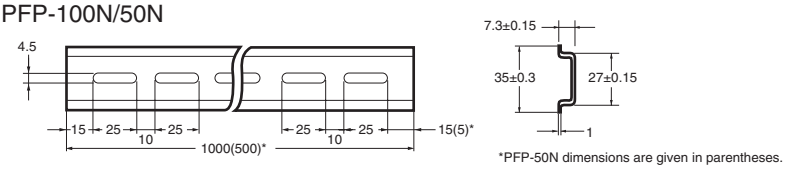
● DIN Track

Secure the DIN Track to the control panel using M4 screws at interval of 210 mm or less (6 holes or fewer). The tightening torque is 1.2 N·m.

PFP-100N2



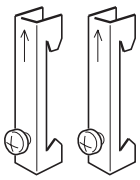
PFP-100N/50N



*PFP-50N dimensions are given in parentheses.

● End Plate

Use the PFP-M End Plates to secure the Units so that they do not move towards one end or the other of the DIN Track.



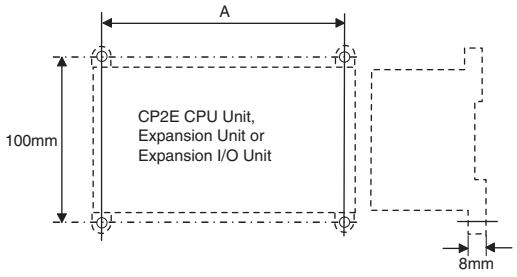
Surface Installation

● Surface Installation

- Create the mounting holes in the mounting surface as shown in the dimensions diagrams.
- Align the CP2E CPU Unit with the mounting holes and secure it in place with M4 screws.

● Surface Installation Mounting Hole Pitch

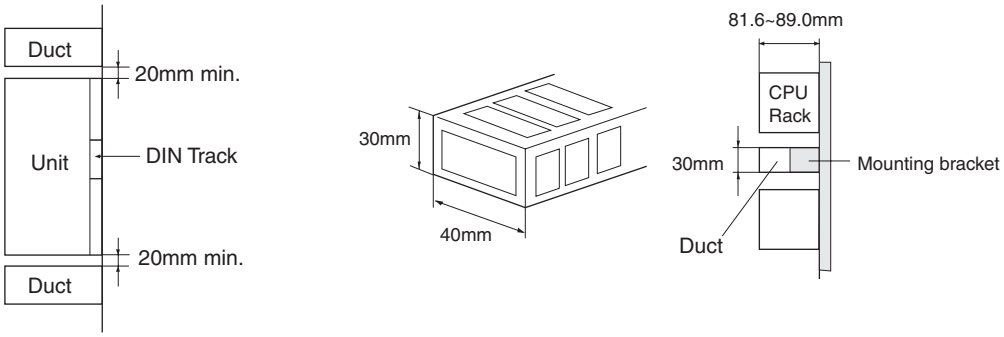
- CP2E CPU Units, Expansion Units or Expansion I/O Units



Unit		Mounting hole pitch A (mm)
CP2E CPU Units	Unit with 14 I/O points	76±0.5
	Unit with 20 I/O points	76±0.5
	Unit with 30 I/O points	120±0.5
	Unit with 40 I/O points	140±0.5
	Unit with 60 I/O points	185±0.5
Expansion I/O Units	Unit with 8 input points	56±0.2
	Unit with 8 output points	56±0.2
	Unit with 16 output points	76±0.2
	Unit with 20 I/O points	76±0.2
	Unit with 32 I/O points	140±0.2
	Unit with 40 I/O points	140±0.2
Analog I/O Units	Analog I/O Analog input Analog output	76±0.2
Temperature Sensor Units	Except CP1W-TS004	76±0.2
	CP1W-TS004	140±0.2

Using Wiring Ducts

Whenever possible, route I/O wiring through wiring ducts. Install the ducts so that it is easy to wire the I/O Units through the ducts. It is handy to have the ducts at the same height as the Racks. Use mounting bases if necessary to adjust the heights.

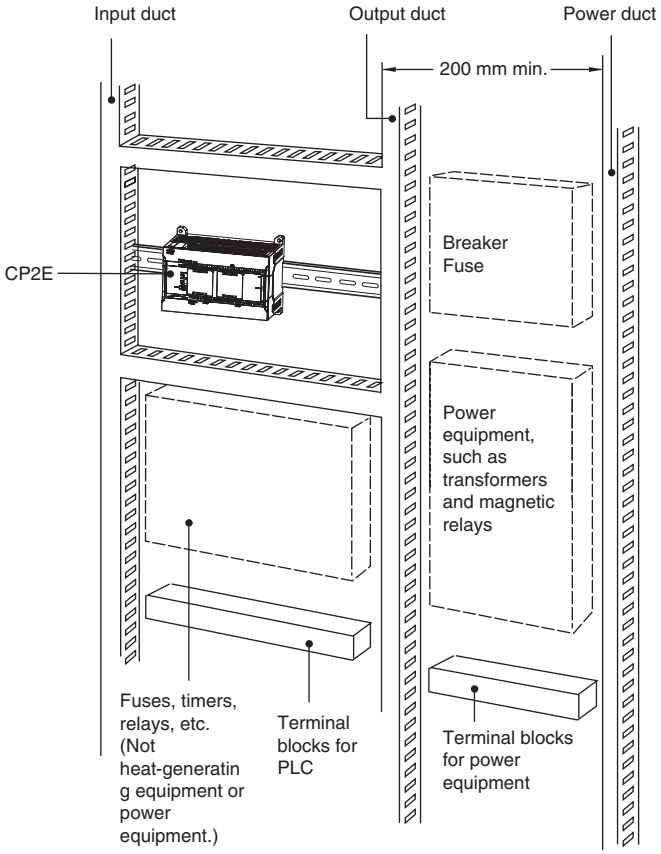


Precautions for Correct Use

Tighten terminal block screws and cable screws to the following torques.
M4: 1.2 N·m
M3: 0.5 N·m

Routing Wiring Ducts

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

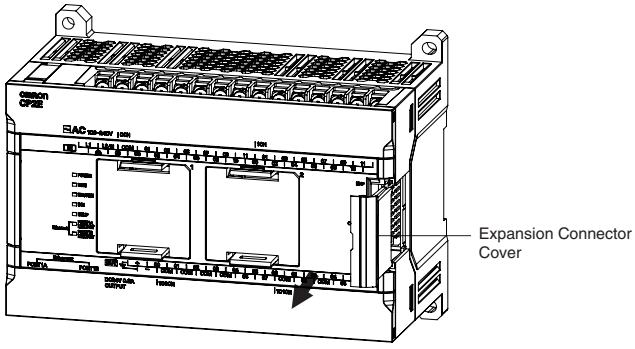


5-2-4 Connecting Expansion I/O Units and Expansion Units

This section describes how to connect Expansion I/O Units and Expansion Units.

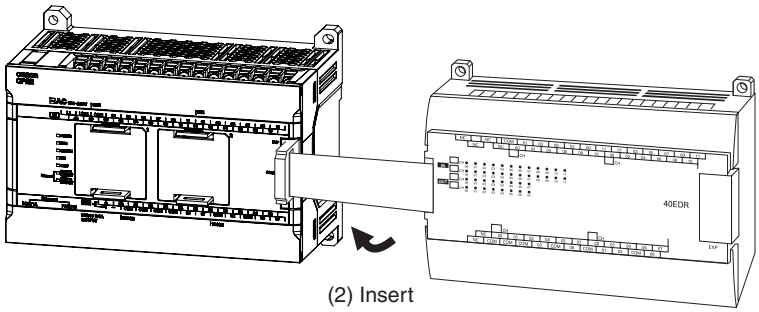
Connection Methods

1 Remove the cover from the CPU Unit's or the Expansion I/O Unit's expansion connector. Use a flat-head screwdriver to remove the cover from the Expansion I/O Connector.



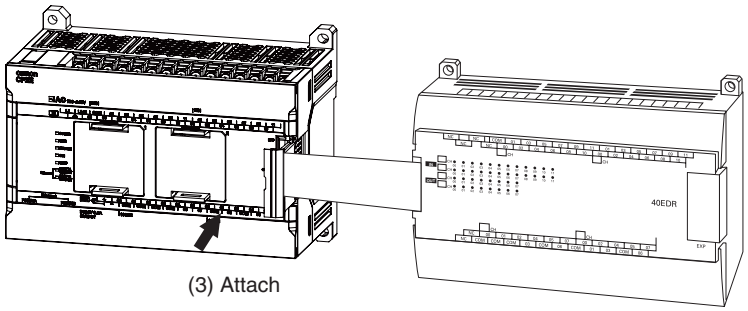
(1) Remove

2 Insert the Expansion I/O Unit's connecting cable into the CPU Unit's or the Expansion I/O Unit's expansion connector.



(2) Insert

3 Attach the cover to the CPU Unit's or the Expansion I/O Unit's expansion connector.



(3) Attach

Precautions on Connecting Units

The following restrictions apply to the CP-series Expansion Units and Expansion I/O Units that can be connected to CP2E CPU Units.

● Maximum Number of Connectable Units

With an E30/40/60, S30/40/60 or N30/40/60 CPU Unit, a total of up to three Expansion I/O Units and Expansion Units can be connected to one CPU Unit. It is not possible to connect Expansion I/O Units and Expansion Units to E14/20 or N14/20 CPU Units.

5-3 Wiring

This section describes wiring methods for the CPU Unit.

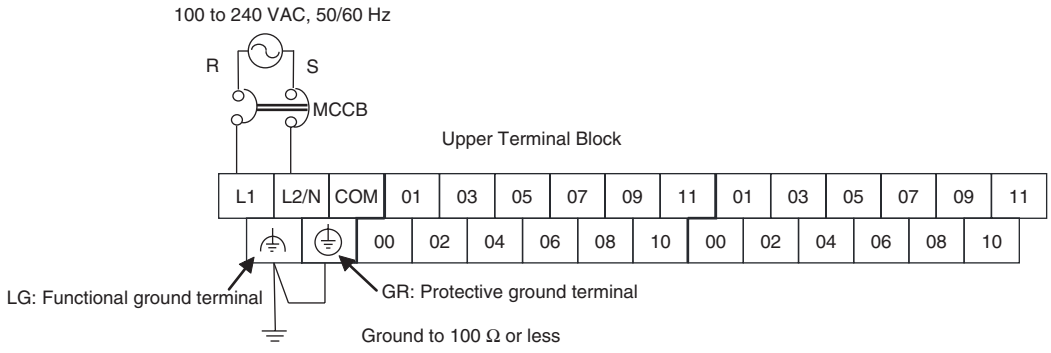
5-3-1 Wiring Procedure

Make sure that the power supply is OFF before beginning wiring.

1. Prepare the parts required for wiring.	Prepare crimp terminals and cables for wiring.	–
↓		
2. Connect the power supply terminals.	Connect power supply to power supply terminals L1 and L2/N.	Refer to *5-3-2 Wiring Power Supply and Ground Lines*.
↓		
3. Ground the ground terminal(⏚).	Ground to 100 Ω or less.	Refer to *5-3-2 Wiring Power Supply and Ground Lines*.
↓		
4. Connect the input terminals.	Connect sensors and switches to the terminals.	Refer to *5-3-3 I/O Wiring.*
↓		
5. Connect the output terminals.	Connect loads to the terminals.	Refer to *5-3-3 I/O Wiring.*

5-3-2 Wiring Power Supply and Ground Lines

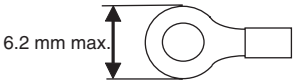
Wiring AC Power Supply and Ground



- Wire a separate circuit for the power supply circuit so that there is no voltage drop from the inrush current or startup current that flows when other equipment is turned ON.
- When several CP2E PLCs are being used, it is recommended to wire the PLCs on separate circuits to prevent a voltage drop from the inrush current or incorrect operation of the circuit breaker.

AC Power Supply Wiring

- Use twisted-pair power supply cables to prevent noise from the power supply lines. Adding a 1:1 isolating transformer reduces electrical noise even further.
- Consider the possibility of voltage drops and the allowable current, and always use thick power lines.
- Use round crimp terminals for AC power supply wiring.



- Use a power supply within the allowable voltage fluctuation range (85 to 264 VAC).

Grounding

- Always ground the ground terminal to 100 Ω or less to protect against electric shock and incorrect operation from electrical noise.
- If one phase of the power supply is grounded, connect the grounded phase to the L2/N terminal.
- The GR terminal is a ground terminal. To prevent electrical shock, use a dedicated ground line (2 mm^2 min.) of 100 Ω or less.
- The line ground terminal (LG) is a noise-filtered neutral terminal. If noise is a significant source of errors or if electrical shocks are a problem, connect the line ground terminal (LG) to the ground terminal (GR) and ground both with a ground resistance of 100 Ω or less.
- To prevent electrical shock when short-circuiting between the LG and GR terminals, always use a ground of 100 Ω or less.
- Do not connect ground lines to other devices or to the frame of a building. Doing so will reverse the effectiveness of the ground and instead have a bad influence.

Isolation Transformer

The PLC's internal noise isolation circuits are sufficient to control typical noise in power supply lines. Ground noise can be further reduced by providing the power supply through a 1:1 isolating transformer. Do not ground the secondary coil of the transformer.

⚠WARNING

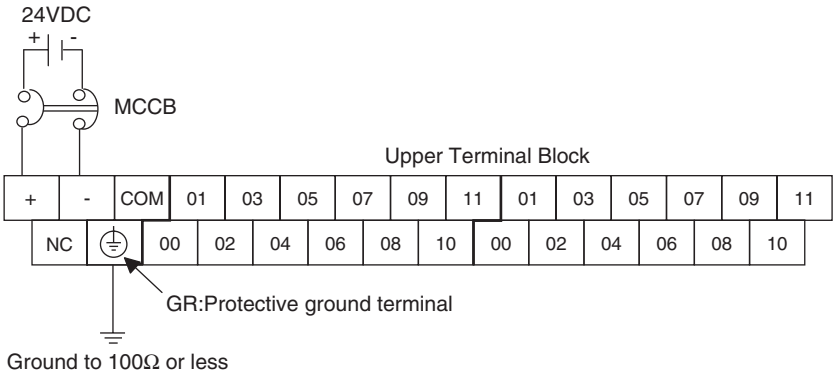
Tighten the AC power supply terminal screws to a torque of 0.5 N·m.

Loose screws may result in fire or malfunction.

Precautions for Correct Use

The power supply terminals are located at the top of the Unit. Do not connect a power supply to the 24-VDC external supply terminals on the bottom of the Unit. Internal circuits may be damaged if power is supplied to these terminals.

Wiring DC Power Supply and Ground



- Wire a separate circuit for the power supply circuit so that there is no voltage drop from the inrush current or startup current that flows when other equipment is turned ON.
- When several CP2E PLCs are being used, it is recommended to wire the PLCs on separate circuits to prevent a voltage drop from the inrush current or incorrect operation of the circuit breaker.

● DC Power Supply Wiring

- Use crimp terminals or solid wire for power supply wiring. Do not connect bare stranded wires directly to terminals.

- M3 self-rising terminal screws are used. Tighten the terminal block screws to the torque of 0.5 N·m.
- Use a power supply within the allowable voltage fluctuation range (20.4 to 26.4 VDC).
- The maximum power consumption is 20 W for E30/40/60, S30/40/60 or N30/40/60 CPU Units, 13 W for E14/20 or N14/20 CPU Units.
- There will be a inrush current of about five times that level when the power is turned ON.

● Grounding

- Always ground the ground terminal to 100Ω or less to protect against electric shock and incorrect operation from electrical noise.
- The GR terminal is a ground terminal. To prevent electrical shock, use a dedicated ground line ($2mm^2$ min.) of 100Ω or less.
- Do not connect ground lines to other devices or to the frame of a building. Doing so will reverse the effectiveness of the ground and instead have a bad influence.

Precautions for Safe Use

- Be sure not to reverse the positive and negative leads when wiring the power supply terminals.
- Supply power to all of the Power Supply Units from the same source.
- Use reinforced insulation or double insulation for the DC power supplies connected to DC Power Supply Units to comply with EC (Low Voltage Directive) Directives.

5-3-3 I/O Wiring

I/O Wiring

Precautions for Safe Use

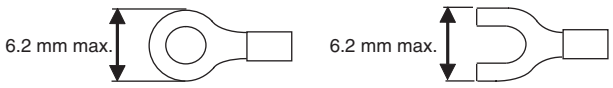
- Never apply a voltage that exceeds the input voltage for Input Units or the maximum switching capacity for Output Units.
- When the power supply has positive and negative terminals, always wire them correctly.
- Do not bend the I/O Connecting cable past its natural bending radius or pull in it with excessive force. Doing so will damage the cable.

● Wire Sizes

- AWG22 to AWG18 (0.32 to 0.82 mm^2) power lines are recommended.
- The current capacity of electric wire depends on factors such as the ambient temperature and insulation thickness, as well as the gauge of the wire.

● Crimp Terminals

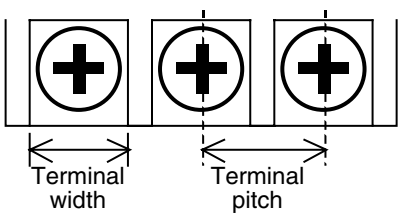
- M3 self-rising terminal screws are used.
- Use crimp terminals or solid wire for wiring.
- Do not connect bare stranded wires directly to terminals.
- Tighten the terminal block screws to the torque of 0.5 N·m.
- Use crimp terminals (M3) having the dimensions shown below.



● Wiring

- Wire the Units so that they can be easily replaced.
- Make sure that the I/O indicators are not covered by the wiring.
- Do not place the I/O wiring in the same conduits or ducts as high-voltage or power lines. Inductive noise can cause errors or damage.
- Tighten the terminal screws to the torque of 0.5 N·m.

Unit type	Terminal width	Terminal pitch
CPU Units	6.4mm	7.6mm
Expansion I/O Units 40ED□/32E□/20EDT□	6.4mm	7.7mm
Expansion I/O Units AD04□/DA0□□/MAD□□/TS□0□/ 20EDR1/16E□/8E□	6.8mm	8.4mm



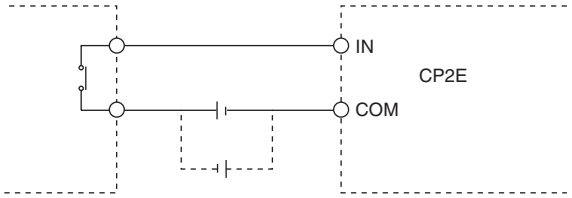
Example of Input Device Connections

Use the following information for reference when selecting or connecting input devices.

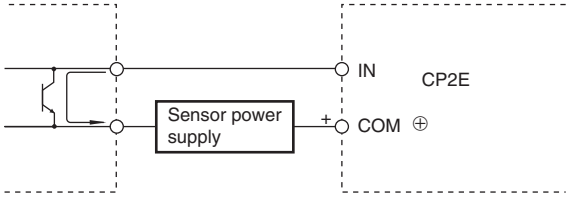
● DC Input Units

Connectable DC Input Devices (for DC Output Models)

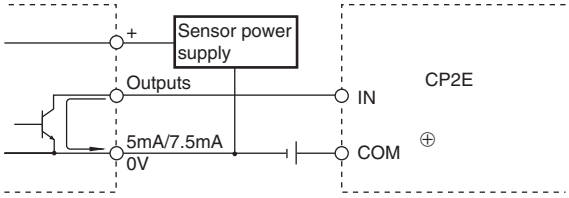
Contact outputs



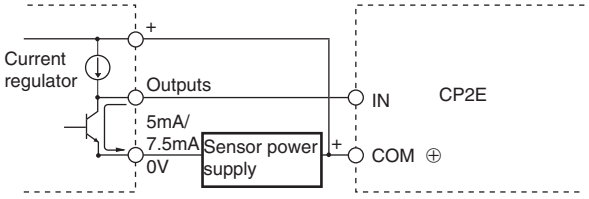
Two-wire, DC outputs



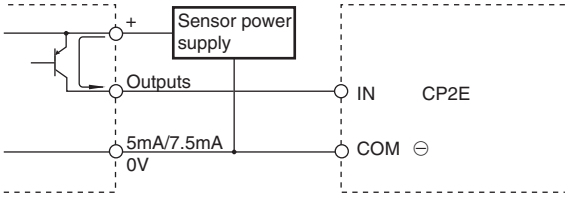
NPN open-collector outputs



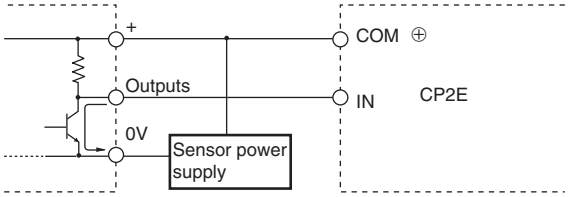
NPN current outputs



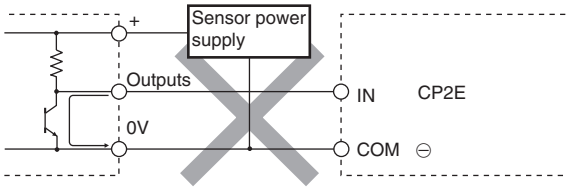
PNP current outputs



Voltage outputs



The circuit below should NOT be used for I/O devices having a voltage output.



Precautions When Connecting a Two-wire DC Sensor

When using a two-wire sensor with a 24-VDC input device, check that the following conditions have been met. Failure to meet these conditions may result in operating errors.

(1) Relation between voltage when the PLC is ON and the sensor residual voltage:

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

(2) Relation between current when the PLC is ON and sensor control output (load current):

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

$I_{ON} = (V_{CC} - V_R - 1.5[\text{PLC internal residual voltage}]^*)/R_{IN}$

When I_{ON} is smaller than I_{OUT} (min), connect a bleeder resistor R.

The bleeder resistor constant can be calculated as follows:

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

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

(3) Relation between current when the PLC is OFF and sensor leakage current:

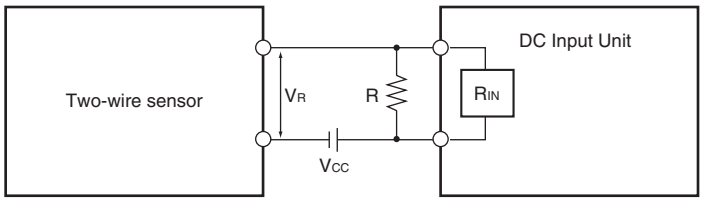
$I_{OFF} \geq I_{leak}$

Connect a bleeder resistor if I_{leak} is greater than I_{OFF}.

Use the following equation to calculate the bleeder resistance constant.

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

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



Vcc: Power voltage
Vr: Sensor output residual voltage
Von: PLC ON voltage
Iout: Sensor control current (load current)
Voff: PLC OFF voltage
Ion: PLC ON current
Ileak: Sensor leakage current
Ioff: PLC OFF current
R: Bleeder resistance
Rin: PLC input impedance

(4) Precautions on Sensor Inrush Current

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

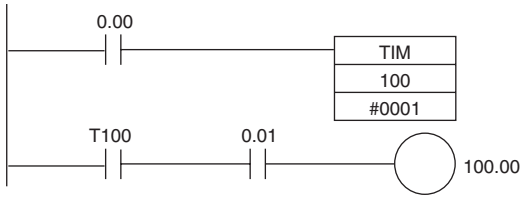
Determine the time required for sensor operation to stabilize after the sensor is turned ON and take appropriate measures, such as inserting into the program a timer delay after turning ON the sensor.

● Programming Example

In this example, the sensor's power supply voltage is used as the input to CIO 0.00.

A 100-ms timer delay (the time required for an OMRON Proximity Sensor to stabilize) is created in the program.

After the Completion Flag for the timer turns ON, the sensor input on input bit CIO 0.01 will cause output bit CIO 100.00 to turn ON.



Output Wiring

● Protective Circuit for Load Short-circuits

If a load connected to the output terminals is short-circuited, output components and the printed circuit boards may be damaged. To guard against this, incorporate a fuse in the external circuit. Use a fuse with a capacity of about twice the rated output.

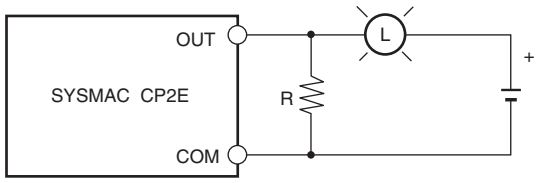
● Connecting to a TTL Circuit

A TTL circuit cannot be connected directly to a transistor output because of the transistor's residual voltage. Connect a TTL Unit through a CMOS-IC. It is necessary to connect a pull-up resistor for a transistor output.

● Precautions on Inrush Current

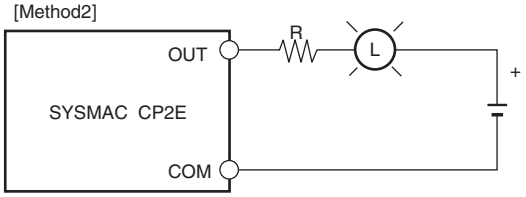
When connecting a transistor or triac output to a load having a high inrush current (such as an incandescent lamp), steps must be taken to avoid damage to the transistor or triac. Use either of the following methods to reduce the inrush current.

[Method1]



Providing a dark current of approx. one-third of the rated value through an incandescent lamp

[Method2]

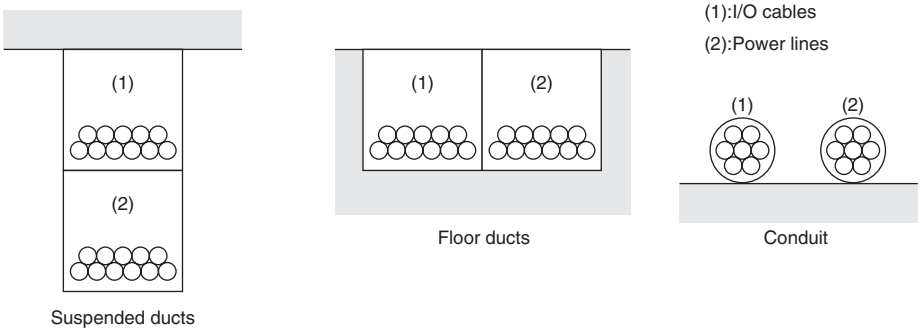


Installing a limiting resistor

5-3-4 Wiring Safety and Noise Controls

I/O Signal Wiring

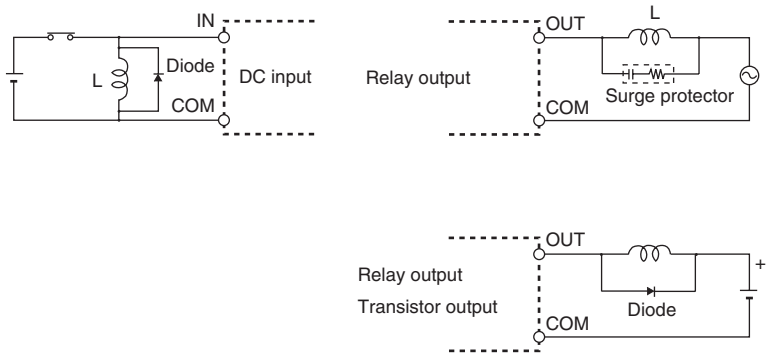
Whenever possible, place I/O signal lines and power lines in separate ducts or conduits both inside and outside of the control panel.



When wiring in the same duct, use shielded cables and connect the shields to the GR terminal to reduce noise.

Inductive Loads

When an inductive load is connected to an I/O Unit, connect a surge protector or diode in parallel with the load as shown below.



Precautions for Correct Use

Use surge protectors and diodes with the following specifications.

Surge protector

Resistance	: 50Ω
Capacitor	: 0.47μF
Voltage	: 200V

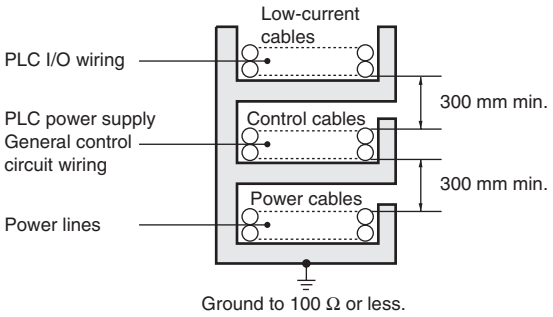
Diode

Breakdown voltage	: 3 times load voltage
Mean rectification current	: 1 A

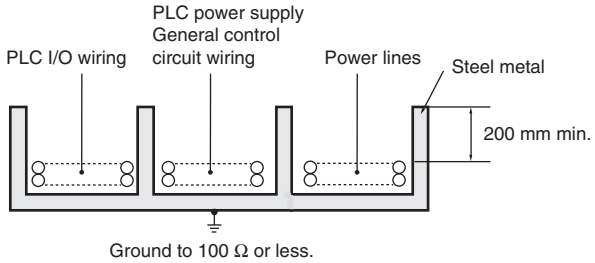
Reducing Electrical Noise for External Wiring

Take the following points into account when externally wiring I/O, power supply, and power lines.

- When multi-conductor signal cable is being used, do not combine I/O wires and other control wires in the same cable.
- If wiring racks are parallel, allow at least 300 mm between them.



- If the I/O wiring and power cables must be placed in the same duct, they must be shielded from each other using grounded steel sheet metal.



5-3-5 Relay Output Noise Reduction Methods

The CP2E PLCs conforms to the Common Emission Standards (EN61131-2) of the EMC Directives. However, noise generated by relay output switching may not satisfy these Standards.

In such a case, a surge protector must be connected to the load side or other appropriate countermeasures must be provided outside the PLC. Countermeasures taken to satisfy the standards vary depending on the devices on the load side, wiring, configuration of machines, etc.

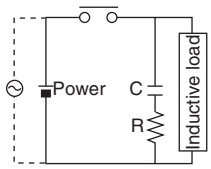
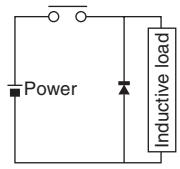
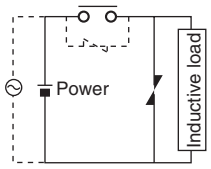
Following are examples of countermeasures for reducing the generated noise.

● Countermeasures (Refer to EN 61131-2 for details.)

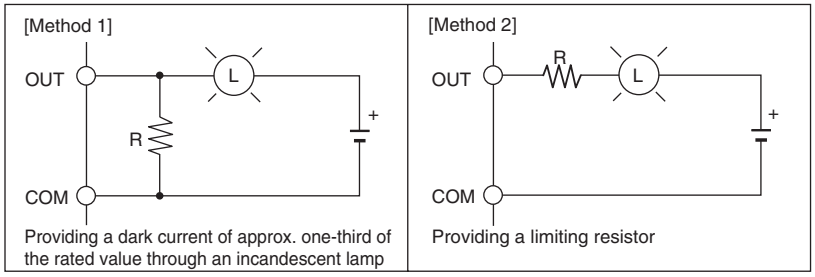
- Countermeasures are not required if the frequency of load switching for the whole system with the PLC included is less than 5 times per minute.
- Countermeasures are required if the frequency of load switching for the whole system with the PLC included is more than 5 times per minute.

● Countermeasure Examples

- When switching an inductive load, connect a surge protector, diodes, etc., in parallel with the load or contact as shown below.

Circuit	Current		Characteristic	Required element
	AC	DC		
CR method 	OK	OK	If the load is a relay or solenoid, there is a time lag between the moment the circuit is opened and the moment the load is reset. If the supply voltage is 24 or 48 V, insert the arc killer in parallel with the load. If the supply voltage is 100 to 200V, insert the arc killer between the contacts.	The capacitance of the capacitor must be 1 to 0.5 μF per contact current of 1 A and resistance of the resistor must be 0.5 to 1 Ω per contact voltage of 1 V. These values, however, vary with the load and the characteristics of the relay. Decide these values from experiments, and take into consideration that the capacitance suppresses spark discharge when the contacts are separated and the resistance limits the current that flows into the load when the circuit is closed again. The dielectric strength of the capacitor must be 200 to 300 V. If the circuit is an AC circuit, use a capacitor with no polarity.
Diode method 	---	OK	The diode connected in parallel with the load changes energy accumulated by the coil into a current, which then flows into the coil so that the current will be converted into Joule heat by the resistance of the inductive load. This time lag, between the moment the circuit is opened and the moment the load is reset, caused by this method is longer than that caused by the CR method.	The reversed dielectric strength value of the diode must be at least 10 times as large as the circuit voltage value. The forward current of the diode must be the same as or larger than the load current. The reversed dielectric strength value of the diode may be two to three times larger than the supply voltage if the surge protector is applied to electronic circuits with low circuit voltages.
Varistor method 	OK	OK	The varistor method prevents the imposition of high voltage between the contacts by using the constant voltage characteristic of the varistor. There is time lag between the moment the circuit is opened and the moment the load is reset. If the supply voltage is 24 or 48 V, insert the varistor in parallel with the load. If the supply voltage is 100 to 200 V, insert the varistor between the contacts.	–

- When switching a load with a high inrush current such as an incandescent lamp, suppress the inrush current as shown below.



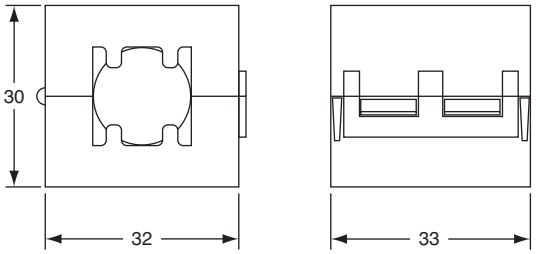
Conditions for Meeting EMC Directives when Using CP-series Relay Expansion I/O Units

EN61131-2 immunity testing conditions when using the CP1W-40EDR, CP1W-32ER, or CP1W-16ER with a CP1W-CN811 I/O Connecting Cable are given below.

- Recommended Ferrite Core

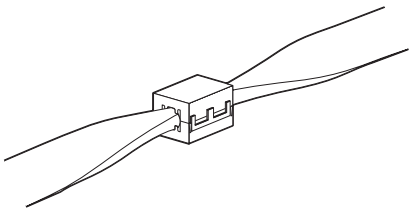
Ferrite Core (Data Line Filter): 0443-164151 manufactured by Nisshin Electric

Minimum impedance: 90 Ω at 25 MHz, 160 Ω at 100 MHz



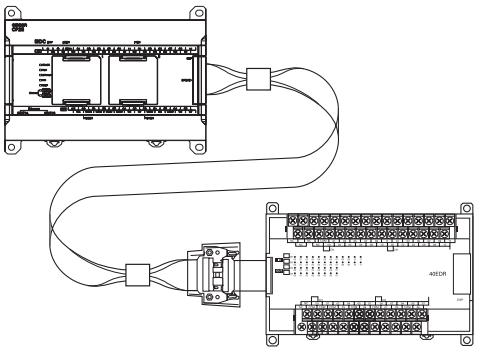
- Recommended Connection Method

(1) Cable Connection Method



(2) Connection Method

As shown below, connect a ferrite core to each end of the CP1W-CN811 I/O Connecting Cable.



6

Troubleshooting

This section describes how to troubleshoot problems that may occur with a CP2E PLC.

6-1 Troubleshooting CPU Unit Errors 6-2
6-1-1 Errors and Remedies 6-2
6-1-2 Checking Errors 6-2
6-1-3 Checking Detailed Status 6-3
6-1-4 Reading Error Log Information 6-3
6-1-5 Types of Errors 6-5
6-1-6 Error Processing Flowchart 6-7
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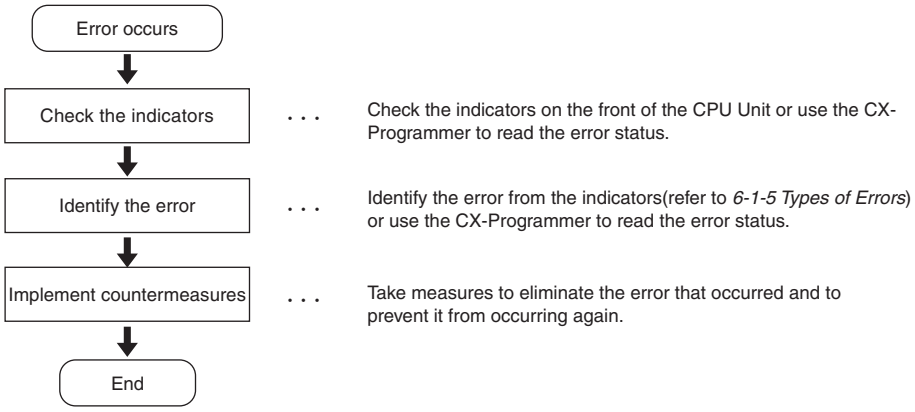
6-1 Troubleshooting CPU Unit Errors

This section describes how to troubleshoot errors that occur in the CP2E CPU Units.

6-1-1 Errors and Remedies

Use the following procedure when an error occurs.

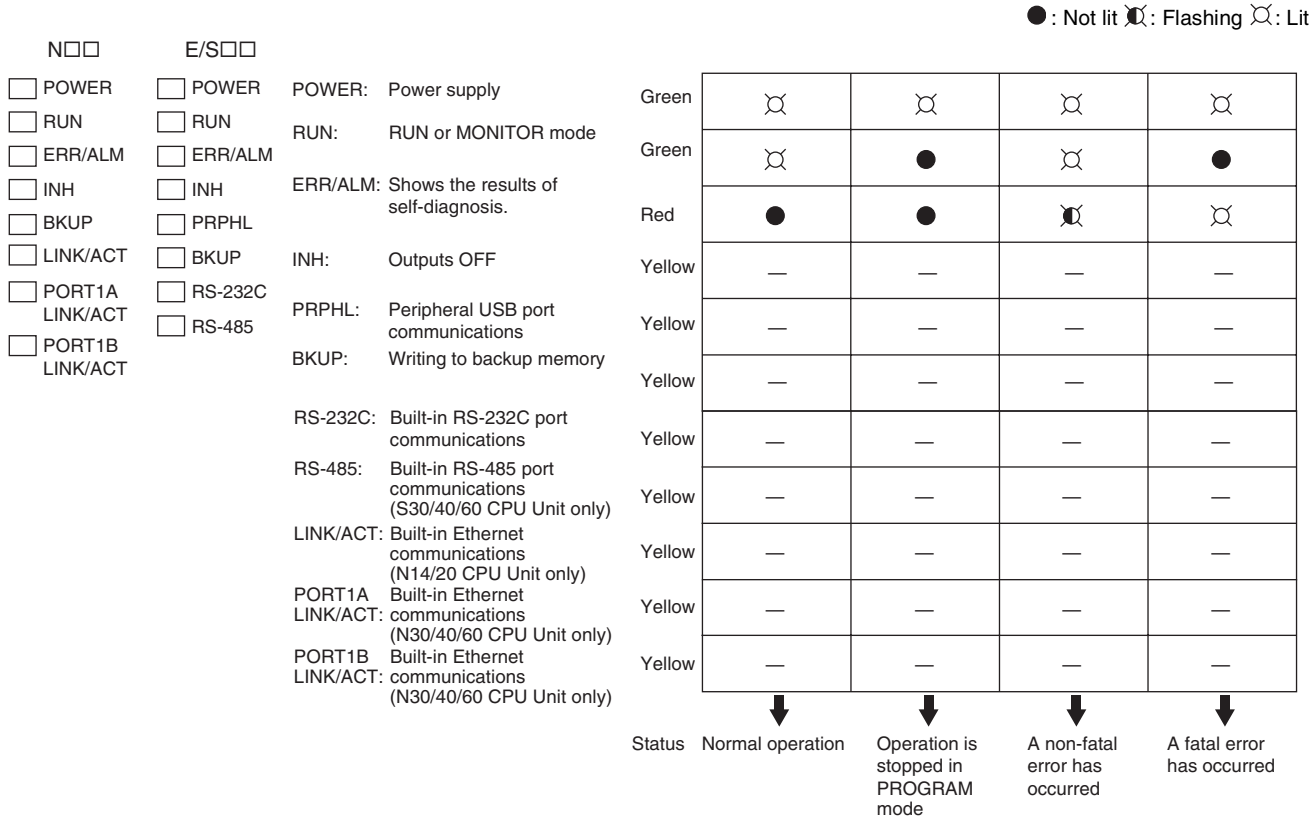


6-1-2 Checking Errors

The type of error that occurred can be determined by checking the indicators on the front of the CPU Unit or by using the CX-Programmer.

Refer to *6-1-5 Types of Errors* for details on the types of error status.

Checking the Indicators

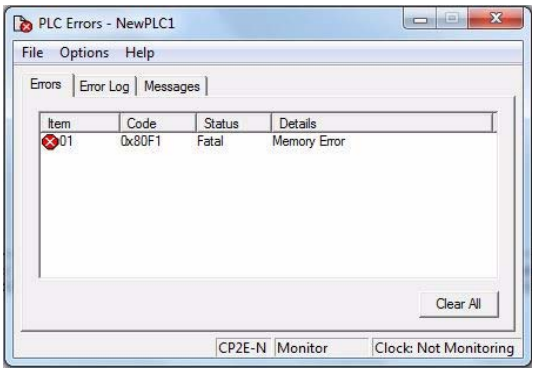


Checking Error Status with the CX-Programmer

Use the following procedure to read the error status.

1. Place the CX-Programmer online with the CPU Unit.
2. Double-click **Error Log** in the project tree in the main window.

   The PLC Errors Window will be displayed. Click the **Errors** Tab. The current errors will be displayed on the Errors Tab Page.



6-1-3 Checking Detailed Status

You can check detailed error status using information registered in the Auxiliary Area.

The following error details are registered.

Area	Description
Error flags	The Auxiliary Area contains flags that indicate the type of error. Error information is provided for various types of error.
Error information	The Auxiliary Area contains words that provide detailed information on current errors. Error information is provided for various types of error.
Error code	The Auxiliary Area contain a word that provides a code that describes the error that has occurred. The error code is stored in A400 for all errors. If two or more errors occur at the same time, the highest (most serious) error code will be stored in A400.

6-1-4 Reading Error Log Information

If the error status could not be checked when the error occurred, it can be checked by reading error log data.

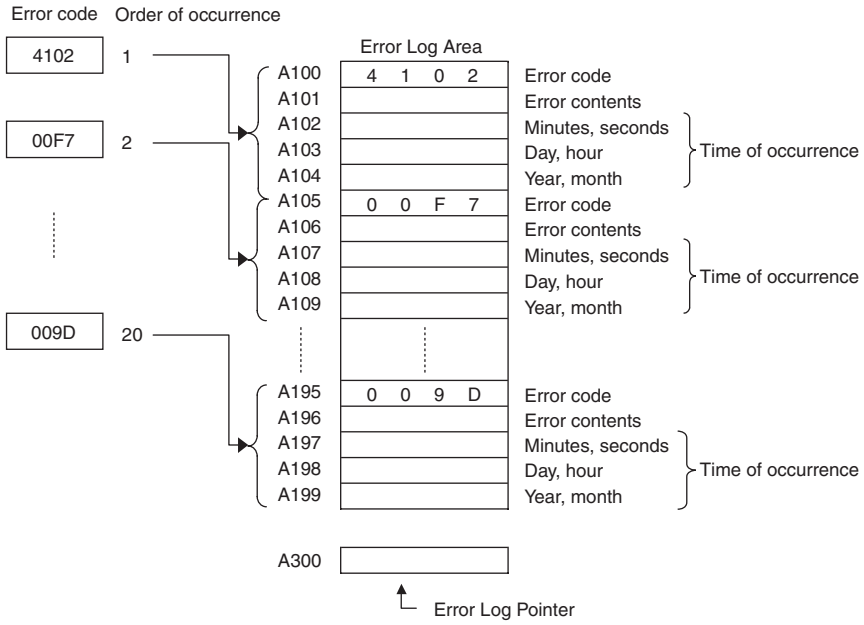
The following information is stored in the error log.

- Error code (This is the same error code as is stored in word A400.)
- Error contents
- Time of occurrence

Error Log Information

A maximum of 20 error records will be stored in the error log.

If more than 20 errors occur, the oldest error record (in A100 to A104) will be deleted and the 19 records stored in A105 to A199 will be shifted by one, with the newest record being stored in A195 to A199.



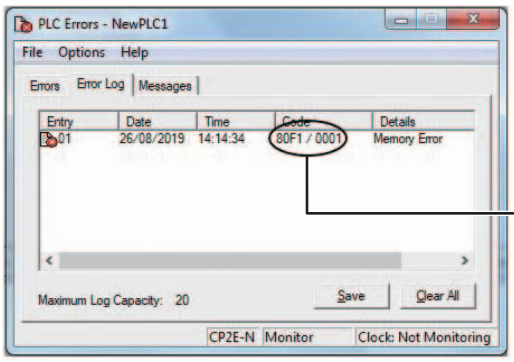
Note The E□□-type CPU Units do not support the clock function, so the time of occurrence cannot be confirmed. The display is always 01-01-01 01:01:01 Sunday.
When the clock in the N/S□□-type CPU Units stops, the display is also 01-01-01 01:01:01 Sunday.

Checking Error Log Information

The following methods can be used to check error log information with the CX-Programmer.

● CX-Programmer PLC Error Window

Check the error log by clicking the **Error Log** Tab in the PLC Errors Window of the CX-Programmer.



The error code is displayed here.

The example above shows that a memory error has occurred.

- Error code 80F1 → Memory error
- Error contents (A403) → 0001 → A403.00 is ON → A checksum error has occurred in the program.

● Directly Monitoring the Area where Error Log Information is Stored

1 Connect the CX-Programmer online.

2 Read words A100 to A199.

3 Check the error status from the registered data.

6-1-5 Types of Errors

The type of error that has occurred can be identified by checking the indicators on the front of the CPU Unit, or by using the CX-Programmer to check the error status.

The errors detected by the CPU Unit are listed in the following table.

Refer to *6-2 Troubleshooting Unit Errors* for errors not detected by the CPU Unit.

- Error code storage word: The error code is stored in A400 when an error occurs.
- Error flags: Flags that indicate the type of error are allocated in the Auxiliary Area.
- Error information: There are words in the Auxiliary Area that provide specific information on the meaning of error flags and information on the error location and error details.

●: Not lit ⌘: Flashing ⌘: Lit

Error		Indicator								Error code (A400)	Error flag	Error information		Operation status
		POWER	RUN	ERR/ ALM	INH	PRPHL	BKUP	LINK/ ACT	RS-232C RS-485			Error	Word	
Power supply error		● Not lit	● Not lit	● Not lit	● Not lit	● Not lit	–	● Not lit	● Not lit	–	–	–	–	Operation stops.
CPU error (WDT error)*1		⌘ Lit	● Not lit	⌘ Lit	–	–	–	–	–	–	–	–	–	Operation stops.
Peripheral USB port communications error		⌘ Lit	⌘ Lit	● Not lit	–	● Not lit	–	–	–	–	–	–	–	Operation continues.
Built-in RS-232C/ RS-485 port communications error		⌘ Lit	⌘ Lit	● Not lit	–	–	–	–	● Not lit	–	–	–	–	Operation continues.
Fatal errors *1*2	Memory error	⌘ Lit	● Not lit	⌘ Lit	–	–	–	–	–	0x80F1	A401.15	Memory Error Location	A403	Operation stops.
	I/O bus error									0x80CA	A401.14	Always 0x0A0A	A404	
	Too many I/O points error									0x80E1	A401.11	Always 0x4000	A407	
	Program error									0x80F0	A401.09	Program Error Details	A294 to A299	
	Cycle time exceeded error									0x809F	A401.08	–	–	
	FALS error									0xC101 to 0xC2FF	A401.06	–	–	
	Built-in Ethernet stop error									0x80F6	A401.04	Built-in Ethernet Stop Error Detaits	A313	

● : Not lit ☼: Flashing ☼: Lit

Error		Indicator								Error code (A400)	Error flag	Error information		Operation status
		POWER	RUN	ERR/ ALM	INH	PRPHL	BKUP	LINK/ ACT	RS-232C RS-485			Error	Word	
Non-fatal errors *2	FAL instruction executed	☼ Lit	☼ Lit	☼ Flash-ing	–	–	–	–	–	0x4101 to 0x42FF	A402.15	Executed FAL Number	A360 to A391	Operation continues.
	Backup mem-ory error									0x00F1	A315.15	–	–	
	PLC setup error									0x009B	A402.10	–	–	
	Option Board error (N□□-type only)									0x00D1 0x00D2	A315.13	Error Option Board Number	A424	
	Battery error									0x00F7	A402.04	–	–	
	Ethernet setting table error									0x021A	A315.11	Routing tables error or Ethernet address tables error	A313	
	FINS/TCP connection setup error									0x03C0	A315.10	An error in TCP connection setup including FINS/TCP connection setup.		
	Ethernet server setup error									0x03C1		An error in server setup, including DNS server and SNTP server.		
	Ethernet server connection error									0x03C4		An error in connecting with server, including DNS server and SNTP server.		

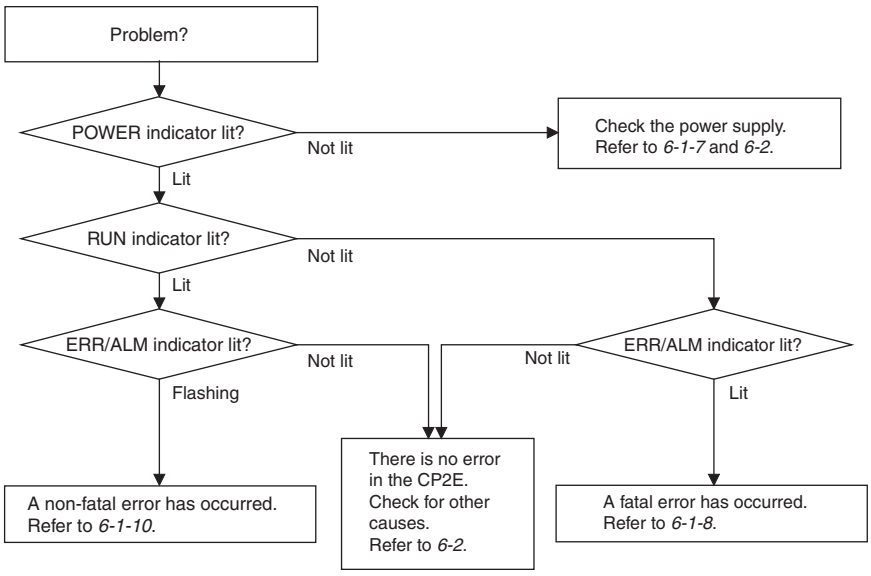
*1 The indicator status is the same for CPU errors and fatal errors, but they can be distinguished because a Programming Device can be connected when a fatal error occurs, but not when a CPU error occurs.

*2 Refer to *6-1-8 Fatal Errors* and *6-1-10 Non-fatal Errors* for details on fatal and non-fatal errors.

Note The indicator status shows the status of the errors that have occurred in RUN or MONITOR mode.

6-1-6 Error Processing Flowchart

Confirm the error category by referring to the status of the CPU Unit indicators, investigate the cause for the error in the error tables, and take corrective actions.



6-1-7 No Operation When Power is Supplied

First confirm that the POWER indicator (green) is lit.

● POWER Indicator Not Lit

The power supply may not match the Unit rating, wiring may not be correct, or the Unit may be faulty.

- Confirm the Unit rating (i.e., is it 24 VDC or 100 to 240 VAC?) and see if the supply power matches the rating.
- Check the wiring to see if it is correct and that nothing is disconnected.
- Check the voltage at the power supply terminals. If the voltage is normal and the POWER indicator is not lit, the Unit may be faulty. In that case, replace the Unit.

● POWER Indicator Flashing

There may be fluctuations in the power supply voltage, disconnected wiring, or poor contacts. Check the power supply system and wiring.

● POWER Indicator Lit but No Operation

Check the RUN indicator if the POWER indicator is lit but the CPU Unit does not operate.

The CPU Unit may be on standby if the RUN indicator is not lit.

6-1-8 Fatal Errors

● CPU Unit Indicators

●: Not lit ☼: Flashing ☼: Lit

N□□	E/S□□
POWER	POWER
RUN	RUN
ERR/ALM	ERR/ALM
INH	INH
BKUP	PRPHL
PORT1A LINK/ACT	BKUP
PORT1B LINK/ACT	RS-232C
	RS-485

POWER	☼
RUN	●
ERR/ALM	☼
INH	—
PRPHL	—
BKUP	—
RS-232C	—
RS-485	—
PORT1A LINK/ACT	—
PORT1B LINK/ACT	—

—: Irrelevant

There may be a CPU error or a fatal error if operation stops (i.e., the RUN indicator turns OFF) and the ERR/ALM indicator lights.

Data on fatal errors is displayed on the Errors Tab Page of the CX-Programmer's PLC Errors Window.

Take corrective actions after checking error details based on the CX-Programmer display message together with the Auxiliary Area Error Flags and error information.

- Errors are listed in order with the most serious errors first.
  - If two or more errors occur at the same time, the most serious error code will be stored in A400.
  - If the IOM Hold Bit has not been turned ON to protect I/O memory, all non-retained areas of I/O memory will be cleared when a fatal error other than FALS occurs.
  - I/O memory will be held when the I/O Memory Hold Bit is ON, but outputs will be turned OFF.

Memory Errors

Probable cause		Possible remedy
An error has occurred in memory. One or more bits in A403 will turn ON to indicate where the error has occurred. • Memory Error Location		See below.
A403.00 is ON	A checksum error has occurred in the ladder program. The power supply was turned OFF when backing up the user program to backup memory.	Transfer the ladder program again.
A403.04 is ON	A checksum error has occurred in the PLC Setup.	Transfer the PLC Setup again.
A403.07 is ON	A checksum error has occurred in the routing tables. (Only for N□□-type CPU Units)	Transfer the routing tables again.
A403.11 is ON	A checksum error has occurred in IP address table. (Only for N□□-type CPU Units)	Transfer the IP address table again.
A403.12 is ON	A checksum error has occurred in IP router table. (Only for N□□-type CPU Units)	Transfer the IP router table again.
A403.14 is ON	I/O memory has not been backed up When power was turned OFF.	Set I/O Memory again.

● Reference Information

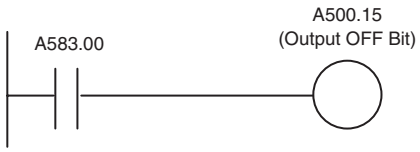
Error flag	Memory Error Flag, A401.15
Error code (A400)	80F1
Error information	Memory Error Location, A403

Precautions for Correct Use

As a memory error cannot be backed up in time due to Power OFF, it will be detected at the next Power ON. If the power supply is turned OFF after the memory error occurs, the program will execute with damaged memory data.

For applications that need to maintain DM, HR, CNT and other data during Power OFF, it is necessary to prevent the device from being powered on next time by inserting a ladder program (for example, using the I/O Memory Backup Error Flag to turn ON the Load Cutoff Flag).

If the ladder program is running without I/O memory, the device may malfunction.



A583.00 I/O Memory Backup Error Flag

The flag will be ON when the I/O memory is not held at power ON.

It will still be ON until the memory area is cleared or the flag is turned OFF manually.

I/O Bus Error

An I/O bus error has occurred in data transfer between the CPU Units and Units connected to the I/O bus.

Cycle the power supply. If operation is not restored when the power supply has been cycled, turn OFF the power supply and check that connections are proper and that there is no damage.

Probable cause	Possible remedy
An error occurred in data transfer between the CPU Unit and an Expansion Unit or Expansion I/O Unit. (A value of 0A0A hex will be stored in A404.)	• Cycle the power supply. • If the problem persists, turn OFF the power supply and check the Connecting Cables between the Units to see if they are connected properly. • Check the Unit connections to be sure they are ok (e.g., that there is no damage). • After correcting the problem, turn ON the power to the Units again.

● Reference Information

Error flag	I/O Bus Error Flag, A401.14
Error code (A400)	80CA
Error information	I/O Bus Error Details, A404

Too Many I/O Points Error

The number of CP-series Expansion Units and Expansion I/O Units connected exceeds the restriction for the number of Units or words for the system configuration.

Turn OFF the power supply and reconfigure the system within the restrictions.

Probable cause	Possible remedy
The number of CP-series Expansion Units and Expansion I/O Units exceeds the restriction. (A value of 4000 hex will be stored in A407.)	Connect a maximum of three Expansion Units or Expansion I/O Units to CPU Units with 30,40 or 60 I/O points.

● Reference Information

Error flag	Too Many I/O Points Flag, A401.11
Error code (A400)	80E1
Error information	Too Many I/O Points Details, A407

Program Errors

A program error indicates a problem with the user program. Refer to the error information, check the program, and correct the mistakes.

Clear the error once the problem has been corrected.

Probable cause	Possible remedy
Instruction Processing Error (A295.08 turns ON) The instruction could not be executed because of incorrect operand data, and the ER Flag was turned ON. (Only when the Stop CPU on Instruction Error parameter in the PLC Setup is set to Stop.)	• Refer to A298 and A299 (instruction program address when the program fails), check the specifications for the relevant instruction, and set the correct operand data. • Set the PLC Setup to not stop operation for an instruction error.
Indirect DM Addressing BCD Error (A295.09 turns ON) The operand of indirect DM Area addressing in BCD Mode did not contain a BCD value when the instruction was executed, and the AER Flag was turned ON. (Only when the Stop CPU on Instruction Error parameter in the PLC Setup is set to Stop.)	• Refer to A298 and A299 (instruction program address when the program fails), and correctly set the content for the indirectly addressed DM operand (BCD mode) to BCD or change the specified destination. Alternatively, change the indirect addressing to binary mode. • Set the PLC Setup to not stop operation for an instruction error.
Illegal Area Access Error (A295.10 turns ON) The AER flag is ON because an illegal area was specified for access when executing the instruction. (Only when the Stop CPU on Instruction Error parameter in the PLC Setup is set to Stop.) The following operations are considered illegal access: • Reading/writing the parameter area • Writing to an area without memory installed • Writing to a write-protected area • Indirect DM addressing BCD error	• Refer to A298 and A299 (instruction program address when the program fails) and take corrective actions so that illegal area access errors will not occur. • Set the PLC Setup to not stop operation for an instruction error.
No END Error (A295.11 turns ON) This error occurs when there is not an END instruction in the program.	Insert an END instruction at the end of the program allocated to the task stored in A294 (task number when the program fails).

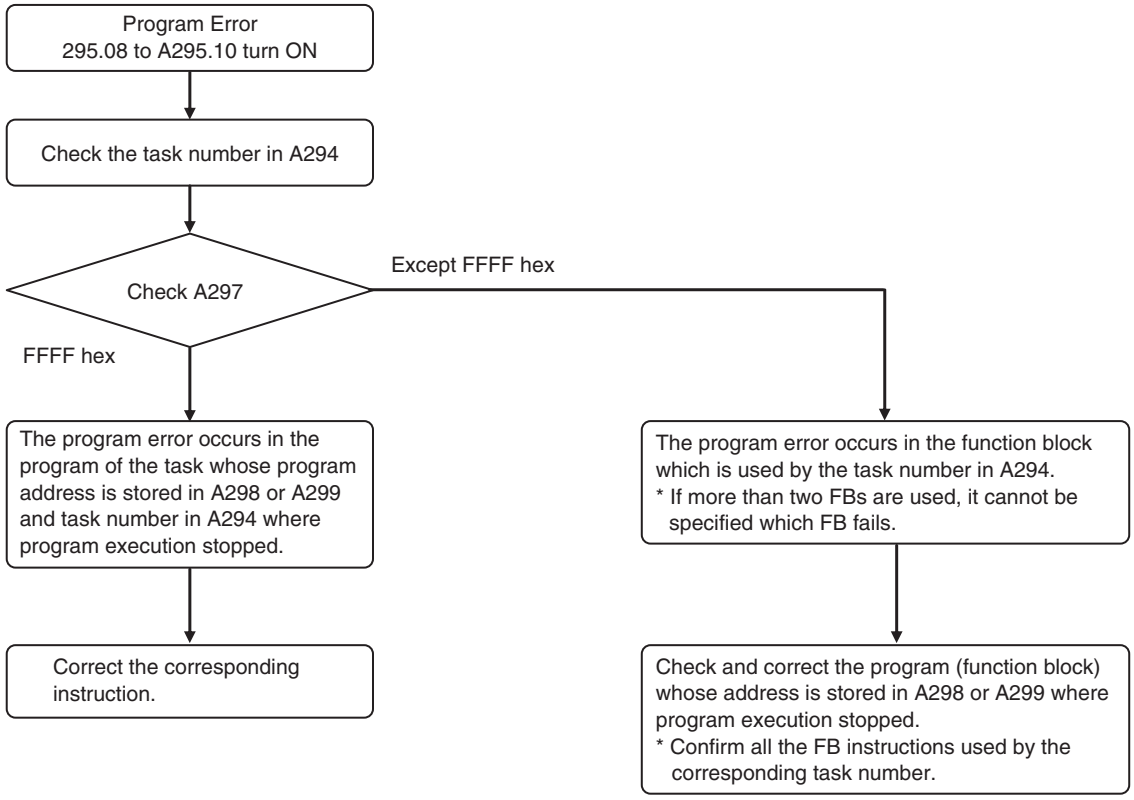
Probable cause	Possible remedy
Task Error (A295.12 turns ON) There is no specified interrupt task when an interrupt is generated (input interrupt, high-speed counter interrupt or scheduled interrupt.)	Create a task for the number stored in A294 (task number when the program fails).
Differentiation Overflow Error (A295.13 turns ON) Differentiation instructions were repeatedly inserted or deleted using the online editor and the system restriction was exceeded.	Change the operating mode to PROGRAM mode and then return to MONITOR mode.
Illegal Instruction Errors (A295.14 turns ON) Execution of an unexecutable instruction was attempted.	Transfer the program again using the CX-Programmer.
UM Overflow Error (A295.15 turns ON) An attempt was made to execute a program that exceeds the user program capacity.	Transfer the program again using the CX-Programmer.

● Reference Information

Error flag	Program Error Flag, A401.09
Error code (A400)	80F0
Error information	Program Error Details, A294 to A299

Error information	Contents
Task Number When Program Stopped A294	This word contains the task number of the task that was being executed when program execution was stopped because of a program error. Cyclic tasks: 0000 hex Interrupt tasks: 8000 to 800F hex (task 0 to 15)
Program Stop Error Identification Information A297	This word contains FFFF hex when the stop position is in the program except the function block. This word contains the data other than FFFF hex when the stop position is in the function block.
Program Address Where Program Stopped A298 to A299	These words contain the program address of the instruction where program execution was stopped due to a program error.

Confirm the Program Error When A295.08 to A295.10 Turn ON



Note Clicking Ctrl+G in the tasks and function blocks of the CX-Programmer, it is possible to search the instructions of the corresponding addresses.

Cycle Time Exceeded Error

Probable cause	Possible remedy
This error occurs when the cycle time PV exceeds the maximum cycle time set in the PLC Setup.	• Change the program to reduce the cycle time. • Change the maximum cycle time setting. • Refer to the Maximum Interrupt Task Processing Time (A440) and study the maximum cycle time. For example, use the JUMP instruction to skip sections that are not executed to shorten the cycle time. • The cycle time exceeded error may occur during the following situation in the use of high-speed counter. Please check the input signal of high-speed counter. • The Z-signal is input at high-frequency. • Change the direction of signal at high-frequency. • Change the direction of target matching at high-frequency. • The input interrupt (IN2 to IN9) signal is input at high-frequency.

● Reference Information

Error flag	Cycle Time Too Long Error, A401.08
Error code (A400)	809F
Error information	–

Errors Created with FALS Instructions

Probable cause	Possible remedy
FALS instruction executed (fatal error) in the program.	C100 hex will be added to the FALS number (001 to 1FF hex) and the result will be stored in A400 as the error code (C100 to C2FF hex). Check the conditions for executing FALS instructions and remove any causes for the user-defined error.

● Reference Information

Error flag	FALS Error Flag, A401.06
Error code (A400)	C101 to C2FF
Error information	–

Built-in Ethernet Stop Error (Only for N□□-type CPU Units)

Probable cause	Possible remedy
ON when the built-in Ethernet stops working because of sum value of MAC address error or controller error.	Cycle the power supply. The Unit may be faulty. Consult your OMRON representative.

● Reference Information

Error flag	Built-in Ethernet Stop Error, A401.04
Error code (A400)	80F6
Error information	–

6-1-9 CPU Errors

● CPU Unit Indicators

● : Not lit ☼: Flashing ☼: Lit

N□□	E/S□□		
POWER	POWER	POWER	☼
RUN	RUN	RUN	●
ERR/ALM	ERR/ALM	ERR/ALM	☼
INH	INH	INH	—
BKUP	PRPHL	PRPHL	—
PORT1A LINK/ACT	BKUP	BKUP	—
PORT1B LINK/ACT	RS-232C	RS-232C	—
	RS-485	RS-485	—
		PORT1A LINK/ACT	—
		PORT1B LINK/ACT	—

—: Irrelevant

A CPU error or fatal error may have occurred if the ERR/ALM indicator lights during operation (RUN mode or MONITOR mode), the RUN indicator turns OFF, and operation stops.

CPU Unit Errors

Probable cause	Possible remedy
A WDT (watchdog) error occurred in the CPU Unit. (This does not occur in normal use.)	Cycle the power supply. The Unit may be faulty. Consult your OMRON representative.

● Reference Information

Error flag	–
Error code (A400)	–
Error information	–

Note Just as when a CPU error occurs, the RUN indicator will turn OFF and the ERR/ALM indicator will light when a fatal error occurs. Connecting the CX-Programmer, however, is possible for fatal errors but not for CPU errors.

If the CX-Programmer cannot be connected (online), a CPU error has probably occurred.

6-1-10 Non-fatal Errors

A non-fatal error has occurred if both the RUN indicator is lit and the ERR/ALM indicator is flashing during operation (i.e., in RUN or MONITOR mode).

● CPU Unit Indicators

● : Not lit ☼: Flashing ☼: Lit

N□□	E/S□□	
POWER	POWER	☼
RUN	RUN	☼
ERR/ALM	ERR/ALM	☼
INH	INH	—
BKUP	PRPHL	—
PORT1A LINK/ACT	BKUP	—
PORT1B LINK/ACT	RS-232C	—
	RS-485	—
	PORT1A LINK/ACT	—
	PORT1B LINK/ACT	—

—: Irrelevant

Information on the non-fatal errors can be obtained from the Errors Tab Page of the CX-Programmer's PLC Errors Window.

Take corrective actions after checking error details using the display messages and the Auxiliary Area Error Flags and error information.

- Errors are listed in order with the most serious errors first.
- If two or more errors occur at the same time, the most serious error code will be stored in A400.

Errors Created with FAL Instructions

Probable cause	Possible remedy
A FAL instruction was executed in the program to create a non-fatal error. (The executed FAL number 001 to 511 will be stored in A360 to A391. The number 4 will be added to the front of 101 to 2FF (which correspond to executed FAL numbers 001 to 511) and the result will be stored in A400 as error code 4101 to 42FF.)	Check the conditions for executing FAL instructions and remove any causes of the user-defined error.

● Reference Information

Error flag	FAL Error Flag, A402.15
Error code (A400)	4101 to 42FF
Error information	–

Backup Memory Error

Probable cause	Possible remedy
Writing to the backup memory fails. (A315.15 will turn ON.)	The Flash Memory in which the user data is backed up has failed. The users data may be lost when the power supply is turned OFF. Save the user data (program, parameter and backup DM) before the power supply is turned OFF and then replace the CPU Unit.

● Reference Information

Error flag	Backup Memory Error Flag, A315.15
Error code (A400)	00F1
Error information	–

PLC Setup Errors

Probable cause	Possible remedy
A set value error occurred in the PLC Setup.	Correct the PLC Setup with correct values.

● Reference Information

Error flag	PLC Setup Error Flag, A402.10
Error code (A400)	009B
Error information	–

Option Board Errors (Only for N□□-type CPU Units)

Probable cause	Possible remedy
The Option Board is removed while the power is being supplied. (A315.13 will turn ON.)	Turn OFF the power supply and then install the Option Board again.
The Option Board is not supported by the CPU Unit. (A315.13 will turn ON.)	Turn OFF the power supply and then remove the Option Board. The CP1W-CIF41 or CP1W-DAM01 cannot be used on CP2E CPU Unit.
Two Analog Option Boards are mounted. (A315.13 will turn ON.)	Install one Aralog Option Board.

● Reference Information

Error flag	Option Board Error Flag, A315.13 Other Non-fatal Error Flag, A402.00
Error code (A400)	00D1: Option slot 1 00D2: Option slot 2
Error information	–

Battery Errors (Only for N/S□□-type CPU Units)

Probable cause	Possible remedy
If the PLC Setup is set to detect battery errors, this error will occur when there is an error in the battery in the CPU Unit (i.e., the voltage is low or a battery is not mounted).	Check the battery connections. Select the *Do not detect battery error* Check Box in the PLC Setup setting if battery-free operation is being used.

● Reference Information

Error flag	Battery Error Flag, A402.04
Error code (A400)	00F7
Error information	–

Ethernet Setting Table Error (Only for N□□-type CPU Units)

Probable cause	Possible remedy
An error occurs in routing table.	Set the routing table again by the CX-Integrator.
An error occurs in IP address table or IP router table.	Confirm the IP Router Table on the Built-in Ethernet Tab in the PLC Setup or the IP Address Table in the FINS/UDP Setup, and then transfer again.

● Reference Information

Error flag	Setting Table Logic Error Flag, A315.11 Other Non-fatal Flag, A402.00	
Error code (A400)	021A	
Error information (A313)	Error in IP address tables or IP router tables	0003
	Error in Ethernet address tables	0004

FINS/TCP Connection Setup Error, Ethernet Server Setup Error, Ethernet Server Connection Error (Only for N□□-type CPU Units)

Probable cause		Possible remedy
A Built-in Ethernet error has occurred. A315.10 will turn ON to indicate where the error has occurred. See below for details. • Error Information		See below.
A315.10 is ON Error code (A400): 03C0	FINS/TCP Connection Setup Error When there is an error in TCP connection setup including FINS/TCP connection setup, the error occurs.	Confirm the FINS/TCP Setting on the Built-in Ethernet Tab in the PLC Setup and transfer again.
A315.10 is ON Error code (A400): 03C1	Server Setup Error When there is an error in server setup, including DNS server and SNTP server, the error occurs.	Confirm the DNS and Clock Auto Adjustment Settings on the Built-in Ethernet Tab in the PLC Setup and transfer again.
A315.10 is ON Error code (A400): 03C4	Server Connection Error When there is an error in connecting with server, including DNS server and SNTP server, the error occurs.	Click the DNS Setting and the Clock Auto Adjustment on the Built-in Ethernet Tab in the PLC Setup and confirm the DNS and SNTP Server Settings.

● Reference Information

Error flag		Built-in Ethernet Error Flag, A315.10 Other Non-fatal Flag, A402.00
Error code (A400)		03C0: FINS/TCP connection setup error 03C1: Ethernet server setup error 03C4: Ethernet server connection error
Error information (A313)	03C0	Leftmost byte: FINS/TCP connection number 01: FINS/TCP connection No.1 02: FINS/TCP connection No.2 03: FINS/TCP connection No.3 Rightmost byte: Error causes 01: Automatic allocation of FINS node address error 02: Target IP address error 03: Target FINS/TCP Port No. error
	03C1	Leftmost byte: Server type 00: DNS server 01: SNTP server Rightmost byte: Error causes 01: IP address setting error 02: Host name error 03: Port No. error 04: Other setting error
	03C4	Leftmost byte: Server type 00: DNS server 01: SNTP server Rightmost byte: Error causes 01: Specified host does not existed 02: No service at specified host 03: Time out error 04: Closed unilaterally by host error 05: Cannot connect because account information does not match 06: Host name resolution error 07: Transmission error 08: Reception error

6-1-11 Other Errors

Communications Errors

● CPU Unit Indicators

●: Not lit ◐: Flashing ☼: Lit

N□□	E/S□□	
POWER	POWER	☼
RUN	RUN	☼
ERR/ALM	ERR/ALM	●
INH	INH	—
BKUP	PRPHL	—
PORT1A LINK/ACT	BKUP	—
PORT1B LINK/ACT	RS-232C	—
	RS-485	—
	PORT1A LINK/ACT	—
	PORT1B LINK/ACT	—

—: Irrelevant

Probable cause	Possible remedy
An error has occurred in the communications between the Ethernet port and connected device.	• Check the cable wiring. • Check the Ethernet cable and replace it if necessary.
An error has occurred in the communications between the peripheral USB port and connected device.	• Check the cable wiring. • Check the USB cable and replace it if necessary.
An error has occurred in the communications between the serial port and connected device.	• Confirm that the Built-in RS-232C Port, Built-in RS-485 Port or Serial Port Tab settings in the PLC Setup are correct. • Check the cable wiring. • If a host computer is connected, check the serial port settings and program in the host computer.
An error will be occurred if the cycle time is too long.	• Start the CX-Programmer. Select ***Change Model*** from the **PLC** Menu. The **Change PLC** Dialog Box will be displayed. • Click the **Settings** Button on the right side of **Network Type**. The **Network Settings [USB]** Dialog Box will be displayed. • Click the **Network** Tab and increase the value in **Response Timeout(s)**.

Ethernet Communication Error

When Ethernet Communication Error occurs during FINS communication service by built-in Ethernet port, the error code, error contents and error's time will be stored in A40 to A44.

The detail information of error code and error contents show as the following table.

Error code (Hex)	Error content	Detailed information	
		1st byte	2nd byte
0105	Node address setting error (send failed)	FINS Commands Bit 15: OFF Bits 08 to 14: Source network address Bits 00 to 07: Source node address FINS Responses Bit 15: ON Bits 08 to 14: Destination network address Bits 00 to 07: Destination node address	
0107	Remote node not in network (send failed)		
0108	No unit with specified unit address (send failed)		
010D	Destination address not in routing tables (send failed)		
010E	No routing table entry (send failed)		
010F	Routing table error (send failed)		
0111	Command too long (send failed)		
0112	Header error (send failed)		
0117	Internal buffers full; packet discarded		
0118	Illegal packet discarded		
0119	Local node busy (send failed)		
0120	Unexpected routing error		
0121	No setting in IP address table; packet discarded		
03C3	FINS/UDP packet discarded	01 to FE: Source node address	
03C2	FINS/TCP packet discarded	01 to 03: Connection number	02: Reopened because remote node closed 03: Reopened because of reception error 04: Reopened because of transmission error 05: Reopened because RST received from remote node 06: Reopened because of no keep-alive response 07: Illegal FINS/TCP procedure 08: Insufficient memory during server processing 09: Insufficient memory during client processing 0A: Insufficient memory during node switching
03C6	Clock data write error	0001: Clock data cannot be refreshed because of a CPU Unit error. 0002: Clock data cannot be refreshed because the current CPU mode do not support operation.	

6-2 Troubleshooting Unit Errors

This section describes how to troubleshoot errors that occur in devices other than the CP2E CPU Unit.

6-2-1 Inputs

No.	Symptom	Probable cause	Possible remedy
1	Not all inputs turn ON or indicators are not lit.	1. External power is not supplied for the input.	Supply power.
		2. Supply voltage is low.	Adjust supply voltage to within rated range.
		3. Terminal block screws are loose.	Tighten screws.
2	Not all inputs turn ON even though the indicator is lit.	Input circuit is faulty. (There is a short at the load or something else that caused an overcurrent to flow.)	Replace Unit.
3	Not all inputs turn OFF.	Input circuit is faulty.	Replace Unit.
4	Specific input bit does not turn ON.	1. Input device is faulty.	Replace input devices.
		2. Input wiring disconnected.	Check input wiring
		3. Terminal block screws are loose.	Tighten screws.
		4. Too short ON time of external input.	Adjust input device.
		5. Input circuit is faulty.	Replace Unit.
		6. Input bit number is used for output instruction.	Correct the ladder program.
5	Specific input bit does not turn OFF.	1. Input circuit is faulty.	Replace Unit.
		2. Input bit number is used for output instruction.	Correct the ladder program.
6	Input irregularly turns ON/OFF.	1. External input voltage is low or unstable.	Adjust external input voltage to within rated range.
		2. Malfunction due to noise.	Take protective measures against noise, such as: • Install surge suppressor. • Install insulation transformer. • Install shielded cables between the Input Unit and the loads.
		3. Terminal block screws are loose.	Tighten screws.
7	Error occurs in units of 8 points or 16 points, i.e., for the same common	1. Common terminal screws are loose.	Tighten screws.
		2. Faulty data bus	Replace Unit.
		3. Faulty CPU	Replace CPU Unit.
8	Input indicator is not lit in normal operation.	Faulty indicator or indicator circuit.	Replace Unit.

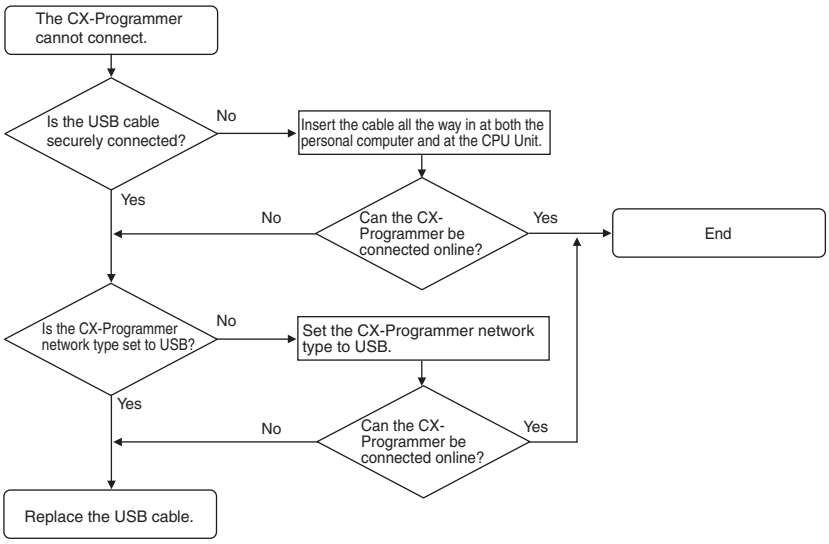
6-2-2 Outputs

No.	Symptom	Probable cause	Possible remedy
1	Not all outputs turn ON	1. Load is not supplied with power.	Supply power.
		2. Load voltage is low.	Adjust voltage to within rated range.
		3. Terminal block screws are loose.	Tighten screws.
		4. Unit failure caused by an overcurrent (possibly caused by a short at the load).	Replace Unit.
		5. Faulty I/O bus connector contact.	Replace Unit.
		6. Faulty output circuit.	Replace Unit.
		7. If the INH indicator is lit, the Output OFF Bit (A500.15) is ON.	Turn A500.15 OFF.
2	Not all outputs turn OFF	Output circuit is faulty.	Replace Unit.
3	Output of a specific bit number does not turn ON and indicator is not lit	1. Output ON time is too short because of a mistake in programming.	Correct program to increase the time that the output is ON.
		2. Bit status controlled by multiple instructions in a ladder program.	Correct program so that each output bit is controlled by only one instruction.
		3. Faulty output circuit.	Replace Unit.
4	Output of a specific bit number does not turn ON (indicator lit).	1. Faulty output device.	Replace output device.
		2. Break in output wiring.	Check output wiring.
		3. Loose terminal block screws.	Tighten screws.
		4. Faulty output bit (relay output only).	Replace Unit.
		5. Faulty output circuit.	Replace Unit.
5	Output of a specific bit number does not turn OFF (indicator is not lit).	1. Faulty output bit (relay output only).	Replace Unit.
		2. Bit does not turn OFF due to leakage current or residual voltage.	Replace external load or add dummy resistor.
6	Output of a specific bit number does not turn OFF (indicator lit).	1. Bit status controlled by multiple instructions in ladder program.	Correct the ladder program.
		2. Faulty output circuit.	Replace Unit.
7	Output irregularly turns ON/OFF.	1. Low or unstable load voltage.	Adjust load voltage to within rated range.
		2. Bit status controlled by multiple instructions in ladder program.	Correct program so that each output bit is controlled by only one instruction.
		3. Malfunction due to noise.	Take protective measures against noise, such as: • Install surge protector. • Install insulation transformer. • Use shielded cables between the output terminal and the load.
		4. Terminal block screws are loose.	Tighten screws.
8	Error occurs in units of 8 points or 16 points, i.e., for the same common.	1. Common terminal screws are loose.	Tighten screws.
		2. An overcurrent (possibly caused by a short at the load) resulted in a blown fuse for the output.	Replace Unit.
		3. Faulty data bus	Replace Unit.
		4. Faulty CPU	Replace CPU Unit.
9	Output indicator does not light during normal operation.	Faulty indicator.	Replace Unit.

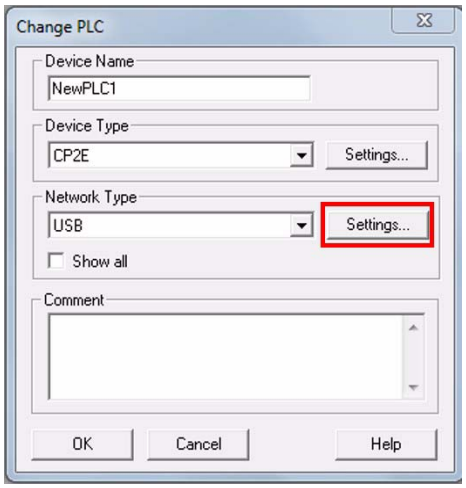
6-2-3 CX-Programmer Connection

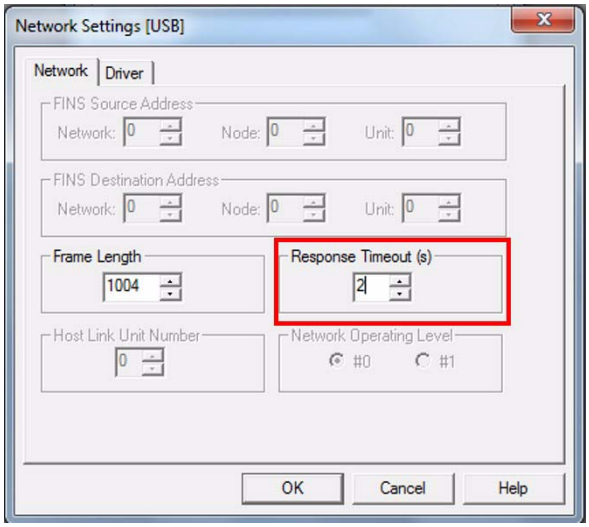
Use the following procedure if the CX-Programmer cannot connect to the PLC.

Connecting via the Peripheral USB Port

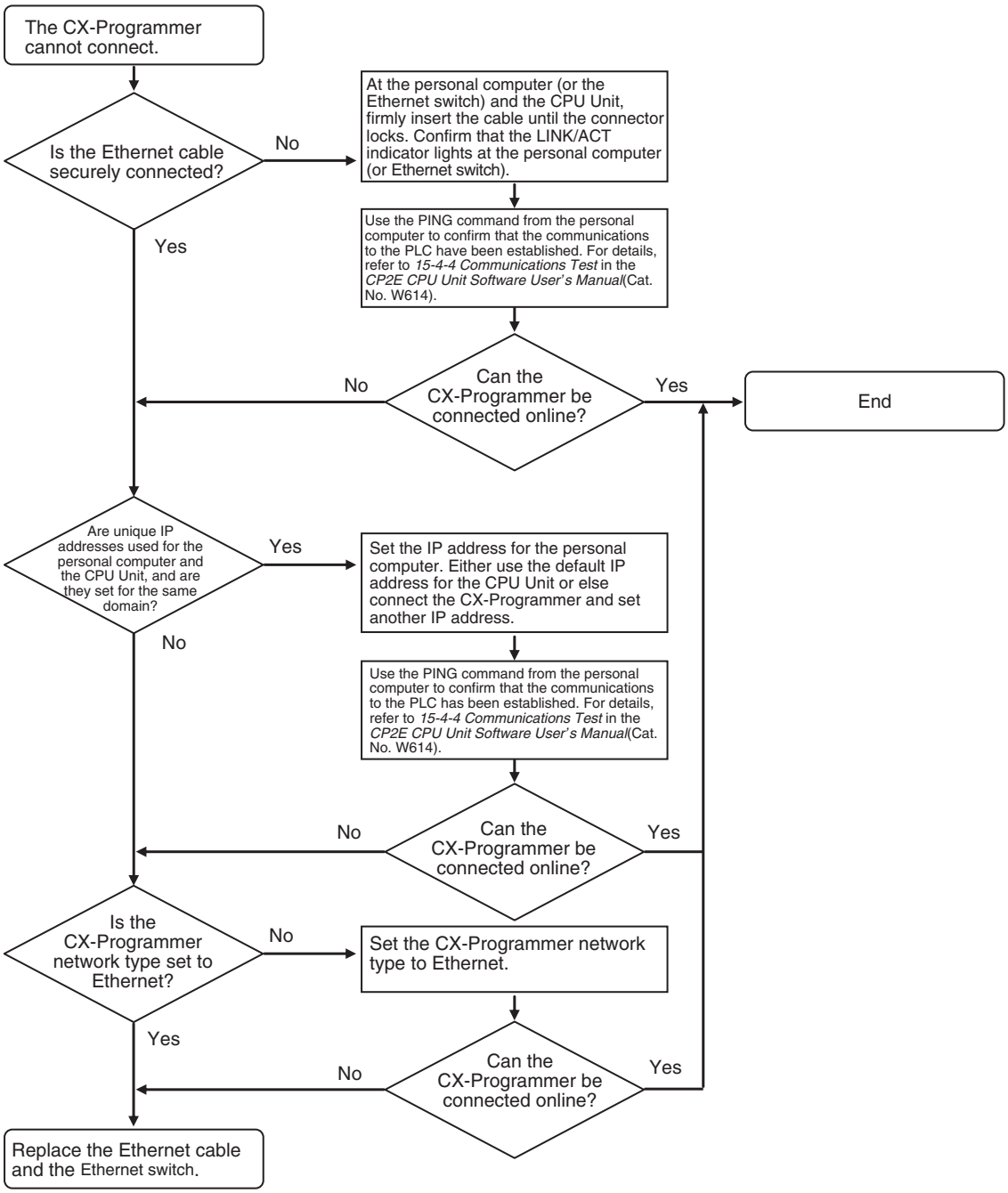


If the cycle time is too long, it may result the communication failure when CX-Programmer tries to work online. In this case, click **the Settings** button on the right side of Network Type in the **Change PLC** dialog box and increase the value in **Response Timeout(s)**.





Connecting via the Ethernet Port



7

Maintenance and Inspection

This section describes periodic inspections, the service life of the Battery, and how to replace the Battery.

7-1 Periodic Maintenance and Inspection 7-2

7-1-1 Tools Required for Inspections 7-2

7-1-2 Periodic Inspection 7-2

7-1-3 Inspection and Maintenance 7-3

7-1-4 Unit Replacement Precautions 7-4

7-2 Replacing the Battery in N/S□□-type CPU Units. 7-5

7-1 Periodic Maintenance and Inspection

This section describes periodic inspections and maintenance of CP2E PLCs.

Daily or periodic inspections are required in order to maintain the PLC's functions in peak operating condition.

7-1-1 Tools Required for Inspections

● Required Tools

- Phillips screwdrivers
- Voltage tester or digital voltmeter
- Industrial alcohol and clean cotton cloth

● Tools Required Occasionally

- Synchroscope
- Oscilloscope with pen plotter
- Thermometer and hygrometer (humidity meter)

7-1-2 Periodic Inspection

Although the major components in CP-series PLCs have an extremely long life time, they can deteriorate under improper environmental conditions. Periodic inspections are thus required to ensure that the required conditions are being kept.

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

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

● Battery

Item	Life	Remedy
Check whether the Battery has reached its service life (CP2W-BAT02 Battery).	Service life expectancy is 5 years at 25°C, less at higher temperatures. (From 1.5 to 5 years depending on model and ambient temperature.)	Replace the Battery when its service life has passed even if a Battery error has not occurred. The service life depends on the model and ambient temperature. Refer to *7-2 Replacing the Battery in N/S□□-type CPU Units.*

7-1-3 Inspection and Maintenance

No.	Inspection points	Inspection	Criteria	Remedy
1	Power supply voltage	Check for voltage fluctuations at the power supply terminals.	Allowable voltage range AC power supply: 85 to 264 VAC DC power supply: 20.4 to 26.4 VDC	Use a voltage tester to check the power supply at the terminals. Take necessary steps to bring voltage fluctuations within limits.
2	I/O power supply	Check for voltage fluctuations at the I/O terminals.	Voltages must be within I/O specifications for each Unit.	Use a voltage tester to check the power supply at the terminals. Take necessary steps to bring voltage fluctuations within limits.
3	Ambient environment	Check the ambient temperature. (Inside the control panel if the PLC is in a control panel.)	-20 to 60°C	Use a thermometer to check the temperature and make sure that the ambient temperature remains within the allowed range of -20 to 60ºC.
		Check the ambient humidity (inside the control panel if the PLC is in a control panel).	Relative humidity must be 10% to 90% with no condensation.	Use a hygrometer to check the operation humidity and ensure that the ambient humidity remains between 10% and 90%. Make sure that condensation does not occur due to rapid changes in temperature.
		Check that the PLC is not in direct sunlight.	Not in direct sunlight	Protect the PLC if necessary.
		Check for accumulation of dirt, dust, salt, metal filings, etc.	No significant accumulation	Clean and protect the PLC if necessary.
		Check for water, oil, or chemical spray.	No spray on the PLC	Clean and protect the PLC if necessary.
		Check for corrosive or flammable gases in the area of the PLC.	No corrosive or flammable gases	Check by smell or use a sensor.
		Check the level of vibration or shock.	Vibration and shock must be within specifications.	Install cushioning or shock absorbing equipment if necessary.
		Check for noise sources near the PLC.	No significant noise sources	Either separate the PLC and noise source or protect the PLC.
		Check that the PLC is not in direct UV.	Not in direct UV	Protect the PLC if necessary.
4	Installation and wiring	Check that the Option Boards and cable connectors are fully inserted and locked.	No looseness	Correct any improperly installed connectors.
		Check for loose screws in external wiring.	No looseness	Tighten loose screws with a Phillips screwdriver.
		Check crimp connectors in external wiring.	Adequate spacing between connectors	Check visually and adjust if necessary.
		Check for damaged external wiring cables.	No damage	Check visually and replace cables if necessary.

7-1-4 Unit Replacement Precautions

Check the following when replacing any faulty Units discovered during inspections.

- Do not replace a Unit until the power is turned OFF.
- Check the new Unit to make sure that there are no errors.
- If a faulty Unit is being returned for repair, describe the problem in as much detail as possible, enclose this description with the Unit, and return the Unit to your OMRON representative.
- For poor contact, take a clean cotton cloth, soak the cloth in industrial alcohol, and carefully wipe the contacts clean. Be sure to remove any lint prior to remounting the Unit.

Precautions for Correct Use

When replacing a CPU Unit, be sure that not only the user program but also all other data required for operation is transferred to or set in the new CPU Unit before starting operation, including DM Area and HR Area settings.

If data area and other data are not correct for the user program, unexpected accidents may occur.

7-2 Replacing the Battery in N/S□□-type CPU Units

For CP2E N/S□□-type CPU Units, the clock will stop when the power is turned OFF.
Mount the CP2W-BAT02 Battery (sold separately) to an N/S□□-type CPU Unit when using the clock function.

A Battery cannot be mounted to an E□□-type CPU Unit.

The procedure to replace the Battery on an N/S□□-type CPU Unit is given below.

Battery Service Life and Replacement Period

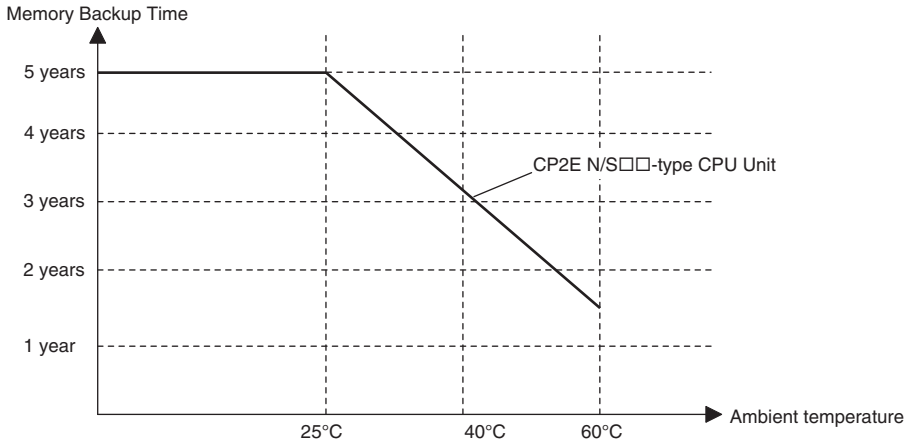
At 25°C, the maximum service life for the Battery is five years whether or not power is supplied to the CPU Unit while the Battery is installed.

The Battery's lifetime will be shorter when it is used at higher temperatures.

The following table shows the approximate minimum lifetimes and typical lifetimes for the backup Battery (total time with power not supplied).

Model number	Approx. maximum lifetime	Approx. minimum lifetime*	Typical lifetime*
CP2E-N□□D□-□ CP2E-S□□D□-□	5 years	13,000 hours (1.5 years)	43,000 hours (5 years)

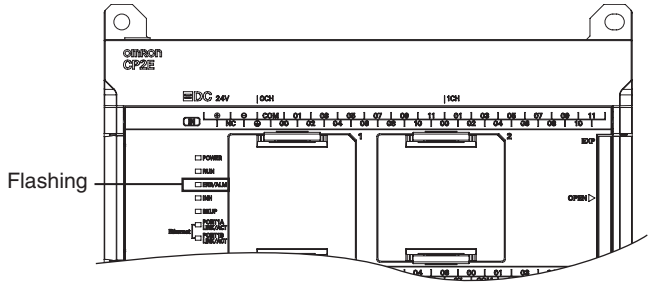
* The minimum lifetime is the memory backup time at an ambient temperature of 60°C.
The typical lifetime is the memory backup time at an ambient temperature of 25°C.



* This graphic is for reference only.

Low Battery Indications

The ERR/ALM indicator on the front of the CPU Unit will flash when the Battery is nearly discharged.



When the ERR/ALM indicator flashes, connect the CX-Programmer and read the error messages.
If a low Battery message appears on the CX-Programmer or the Battery Error Flag (A402.04) is ON, first check whether the Battery is properly connected to the CPU.
If the Battery is properly connected, replace the Battery as soon as possible.

Once a low battery error has been detected, it will take 5 days (at an ambient temperature of 25°C) before the Battery fails assuming that power has been supplied at least once a day.
You can prevent the clock from stopping by ensuring that the CPU Unit power is not turned OFF until the Battery is replaced.

Precautions for Correct Use

- The low battery message will appear on the CX-Programmer and the Battery Error Flag (A402.04) will turn ON only if the Detect Low Battery parameter in the PLC Setup has been set to detect a low-Battery error.
  If this setting has not been made, Battery errors will not be detected.
- The Battery will discharge faster at higher temperatures, e.g., 4 days at 40°C and 2 days at 60°C.

● Replacement Battery

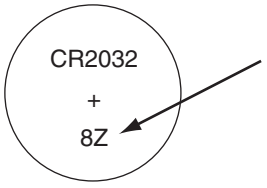
Name: Battery Unit

Model: CP2W-BAT02

Precautions for Correct Use

Be sure to install a replacement Battery within two years of the production date. shown on the Battery's label.

How to read production date.



Production Date
1st character: the rightmost digit of year
2nd character: month (0: Oct., Y: Nov., Z: Dec.)
For example, "8Z" indicates the Battery is manufactured in December 2018.

Replacing the Battery

Use the following procedure to replace the Battery when the previous Battery has become completely discharged.

Precautions for Safe Use

We recommend replacing the Battery with the power OFF to prevent the CPU Unit's sensitive internal components from being damaged by static electricity. The Battery can be replaced without turning OFF the power supply. To do so, always touch a grounded piece of metal to discharge static electricity from your body before starting the procedure.

After replacing the Battery, connect a Programming Device and clear the Battery error.

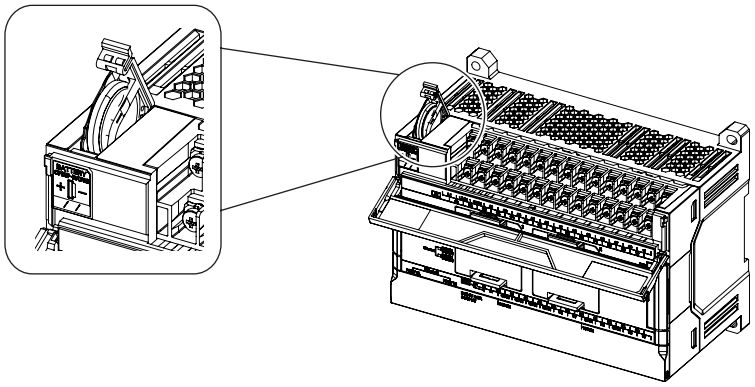
1 Turn OFF the power supply to the N/S□□-type CPU Unit.

If the CPU Unit has not been ON, turn it ON for at least 30 minutes and then turn it OFF.

Additional Information

There is a capacitor inside the N/S□□-type CPU Unit that keeps the clock working when the Battery is removed. If the power is not turned ON for at least 30 minutes before replacing the Battery, the capacitor will not be fully charged and the clock data may be reset to 2001-01-01 01:01:01 before the new Battery is inserted.

2 Open the Battery holder on the CPU Unit and draw out the Battery. Put the new Battery into the Battery holder and close it.



Precautions for Safe Use

- You must complete this procedure within 5 minutes after turning OFF the power to the CPU Unit to ensure memory backup.
  If the Battery is removed for more than 5 minutes, the time will be reset to 2001-01-01 01:01:01.
- Never short-circuit the Battery terminals; never charge the Battery; never disassemble the Battery; and never heat or incinerate the Battery. Doing any of these may cause the Battery to leak, heat, burn, or rupture, resulting in injury, fire, and possible loss of property.
  Also, never use a Battery that has been dropped on the floor or otherwise subject to shock. It may leak.
  UL standards require that batteries be replaced by experienced technicians. Always place an experienced technician in charge of Battery replacement.
- Turn ON the power after replacing the Battery for a CPU Unit that has been unused for a long time.
  Leaving the CPU Unit unused again without turning ON the power even once after the Battery is replaced may result in a shorter Battery life.

Additional Information

The Battery error will be cleared automatically the next time the CPU Unit is turned ON after replacing the Battery.

8

Using Expansion Units and Expansion I/O Units

This section describes the Analog Input Unit, Analog Output Unit, Temperature Sensor Units, CompoBus/S I/O Link Unit, and Expansion I/O Units.

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8-1 Analog Input Units

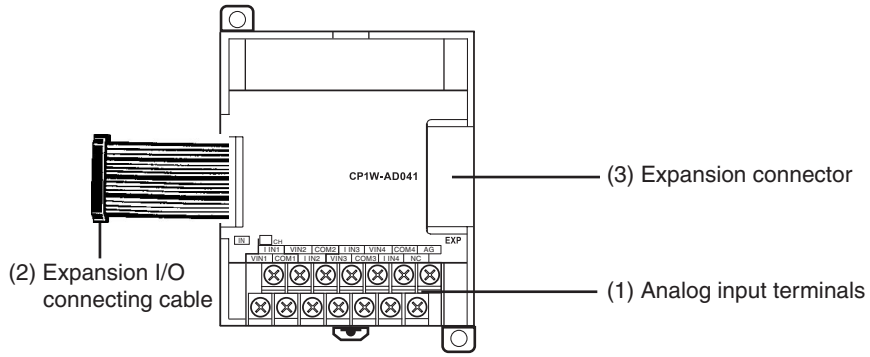
8-1-1 Overview

Each CP1W-AD041/CP1W-AD042 Analog Input Unit provides four analog inputs.

- The analog input signal ranges are 0 to 5 V, 1 to 5 V, 0 to 10 V, -10 to +10 V, 0 to 20 mA, and 4 to 20 mA.
  The resolution of CP1W-AD041 is 1/6,000.
  The resolution of CP1W-AD042 is 1/12,000.
  The open-circuit detection function is activated in the ranges of 1 to 5 V and 4 to 20 mA.
- The Analog Input Unit uses four input words and two output words.

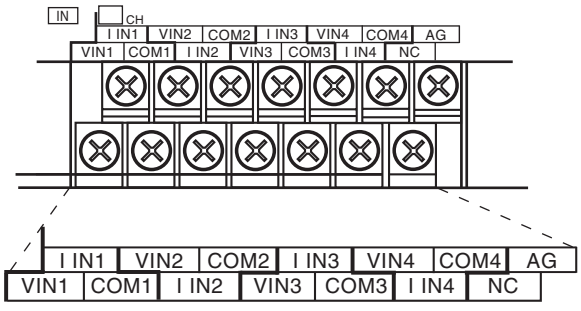
8-1-2 Part Names and Functions

● CP1W-AD041/CP1W-AD042



(1)Analog Input Terminals
Connected to analog output devices.

- Input Terminal Arrangement



V IN1	Voltage input 1
I IN1	Current input 1
COM1	Input common 1
V IN2	Voltage input 2
I IN2	Current input 2
COM2	Input common 2
V IN3	Voltage input 3
I IN3	Current input 3
COM3	Input common 3
V IN4	Voltage input 4
I IN4	Current input 4
COM4	Input common 4

Note When using current inputs, voltage input terminals must be short-circuited with current input terminals.

(2)Expansion I/O Connecting Cable
Connected to the CPU Unit or Expansion Unit expansion connector. The cable is attached to the Analog Input Unit and cannot be removed.

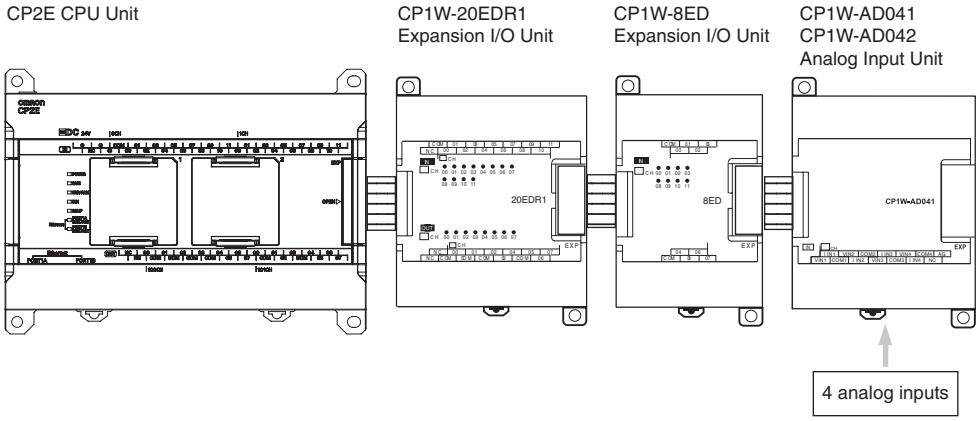
Precautions for Safe Use

Do not touch the cables during operation. Static electricity may cause operating errors.

(3)Expansion Connector
Connected to the next Expansion Unit or Expansion I/O Unit to enable expansion.

8-1-3 Specifications

CP1W-AD041/AD042 Analog Input Units are connected to a CP2E CPU Unit.



Model		CP1W-AD041		CP1W-AD042	
Item		Voltage input	Current input	Voltage input	Current input
Number of analog inputs		4 inputs (4 words allocated)			
Input signal range		0 to 5 V, 1 to 5 V, 0 to 10 V, or -10 to 10 V	0 to 20 mA or 4 to 20 mA	0 to 5 VDC, 1 to 5 VDC, 0 to 10 VDC, or -10 to 10 VDC	0 to 20 mA or 4 to 20 mA
Max. rated input		±15 V	±30 mA	±15 V	±30 mA
External input impedance		1 MΩ min.	Approx. 250 Ω	1 MΩ min.	Approx. 250 Ω
Resolution		1/6000 (full scale)		1/12000 (full scale)	
Overall accuracy	25°C	0.3% full scale	0.4% full scale	0.2% full scale	0.3% full scale
	0 to 55°C	0.6% full scale	0.8% full scale	0.5% full scale	0.7% full scale
	55 to 60°C	0.7% full scale	0.8% full scale	0.5% full scale	0.7% full scale
	-20 to 0°C	0.8% full scale	1% full scale	0.7% full scale	0.9% full scale
A/D conversion data		16-bit binary (4-digit hexadecimal) Full scale for -10 to 10 V: F448 to 0BB8 hex Full scale for other ranges: 0000 to 1770 hex		16-bit binary (4-digit hexadecimal) Full scale for -10 to 10 V: E890 to 1770 hex Full scale for other ranges: 0000 to 2EE0 hex	
Averaging function		Supported (Set in output words n+1 and n+2.)			
Open-circuit detection function		Supported			
Conversion time		2 ms/point (8 ms/all points)		1 ms/point (4 ms/all points)	
Isolation method		Photocoupler isolation between analog input terminals and internal circuits. No isolation between analog I/O signals.			
Current consumption		5 VDC: 100 mA max.; 24 VDC: 90 mA max.		5 VDC: 100 mA max.; 24 VDC: 50 mA max.	

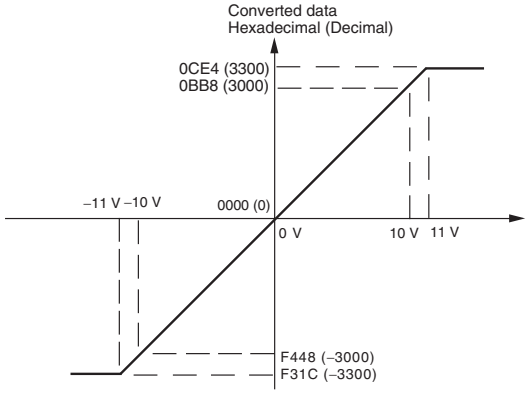
Analog Input Signal Ranges

Analog input data is digitally converted according to the input signal range as shown below.

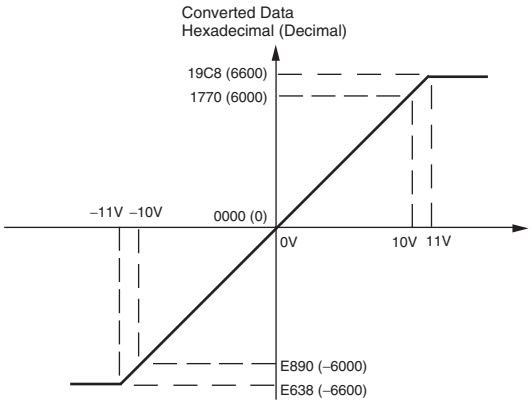
Additional Information

When the input exceeds the specified range, the A/D conversion data will be fixed at either the lower limit or upper limit.

-10 to 10 V Inputs

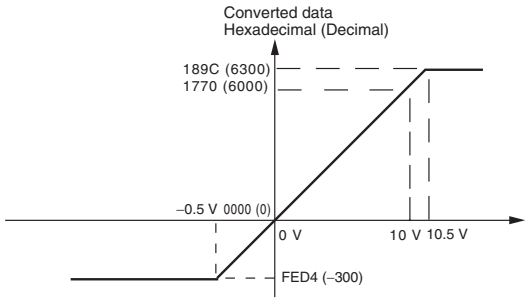


When the resolution is 1/6,000, the -10 to 10 V range correspond to hexadecimal values F448 to 0BB8 (-3,000 to 3,000). The range of data that can be converted is F31C to 0CE4 hex (-3,300 to 3,300). A negative voltage is expressed as a two's complement.

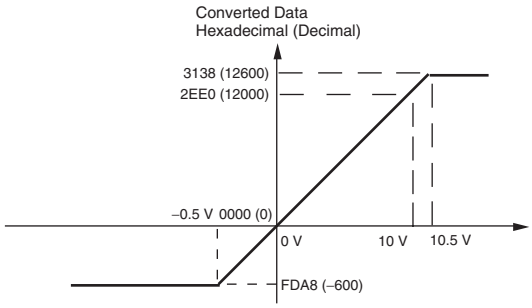


When the resolution is 1/12,000, the -10 to 10 V range correspond to hexadecimal values E890 to 1770 (-6,000 to 6,000). The entire data range is E638 to 19C8 hex (-6,600 to 6,600). A negative voltage is expressed as a two's complement.

0 to 10 V Inputs

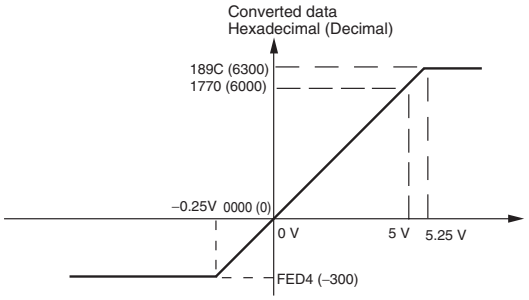


When the resolution is 1/6,000, the 0 to 10 V range correspond to hexadecimal values 0000 to 1770 (0 to 6,000). The range of data that can be converted is FED4 to 189C hex (-300 to 6,300). A negative voltage is expressed as a two's complement.

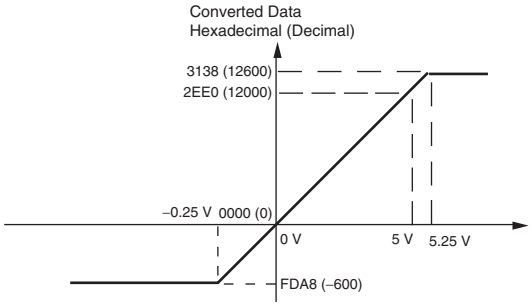


When the resolution is 1/12,000, the 0 to 10 V range correspond to hexadecimal values 0000 to 2EE0 (0 to 12,000). The entire data range is FDA8 to 3138 hex (-600 to 12,600). A negative voltage is expressed as a two's complement.

0 to 5 V Inputs

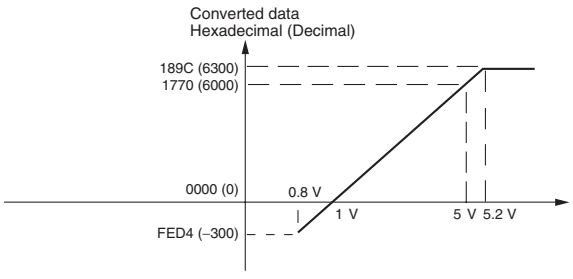


When the resolution is 1/6,000, the 0 to 5 V range correspond to hexadecimal values 0000 to 1770 (0 to 6,000). The range of data that can be converted is FED4 to 189C hex (-300 to 6,300). A negative voltage is expressed as a two's complement.



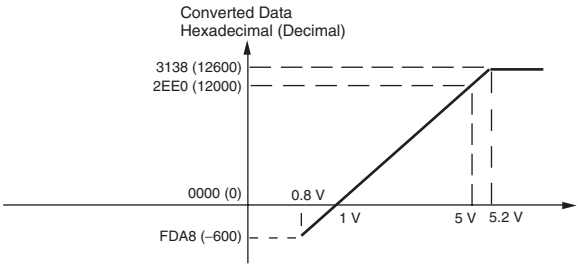
When the resolution is 1/12,000, the 0 to 5 V range correspond to hexadecimal values 0000 to 2EE0 (0 to 12,000). The entire data range is FDA8 to 3138 hex (-600 to 12,600). A negative voltage is expressed as a two's complement.

1 to 5 V Inputs



When the resolution is 1/6,000, the 1 to 5 V range correspond to hexadecimal values 0000 to 1770 (0 to 6,000). The range of data that can be converted is FED4 to 189C hex (-300 to 6,300).Voltage in the range of 0.8 to 1 V is expressed as a two's complement.

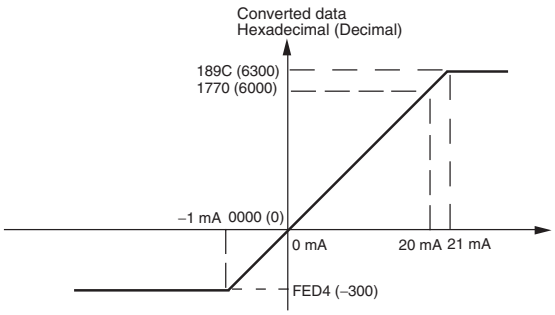
If an input is below the range (i.e., less than 0.8 V), the open-circuit detection function is activated and the data becomes 8,000.



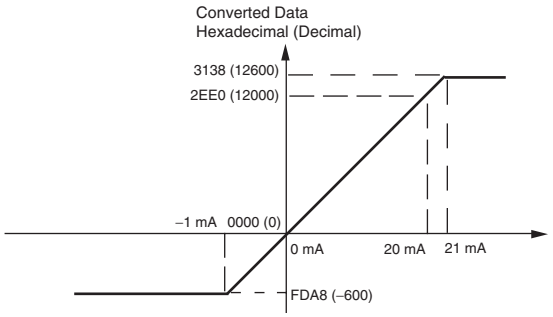
When the resolution is 1/12,000, the 1 to 5 V range correspond to hexadecimal values 0000 to 2EE0 (0 to 12,000). The entire data range is FDA8 to 3138 hex (-600 to 12,600). Voltage in the range of 0.8 to 1 V is expressed as two's complement.

If an input is below the range (i.e., less than 0.8 V), the open-circuit detection function is activated and the data becomes 8,000.

0 to 20 mA Inputs

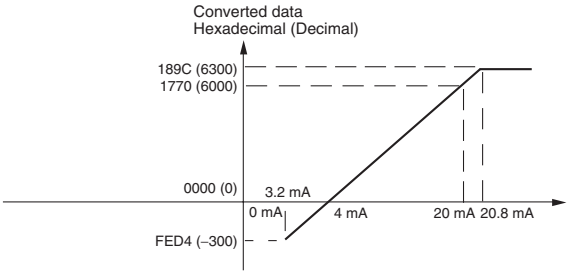


When the resolution is 1/6,000, the 0 to 20 mA range correspond to hexadecimal values 0000 to 1770 (0 to 6,000). The range of data that can be converted is FED4 to 189C hex (-300 to 6,300). A negative current is expressed as a two's complement.



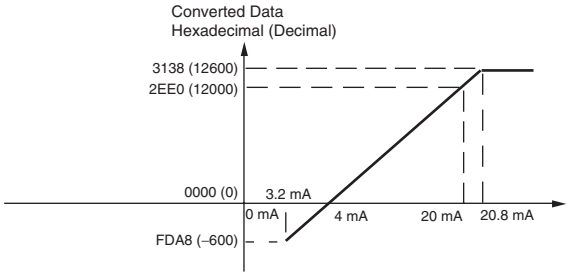
When the resolution is 1/12,000, the 0 to 20 mA range correspond to hexadecimal values 0000 to 2EE0 (0 to 12,000). The entire data range is FDA8 to 3138 hex (-600 to 12,600). A negative voltage is expressed as a two's complement.

4 to 20 mA Inputs



When the resolution is 1/6,000, the 4 to 20 mA range correspond to hexadecimal values 0000 to 1770 (0 to 6,000). The range of data that can be converted is FED4 to 189C hex (-300 to 6,300). Current in the range of 3.2 to 4 mA is expressed as a two's complement.

If an input is below the range (i.e., less than 3.2 mA), the open-circuit detection function is activated and the data becomes 8,000.



When the resolution is 1/12,000, the 4 to 20mA range correspond to hexadecimal values 0000 to 2EE0 (0 to 12,000). The entire data range is FDA8 to 3138 hex (-600 to 12,600). Current in the range of 3.2 to 4 mA is expressed as two's complement.

If an input is below the range (i.e., less than 3.2 mA), the open-circuit detection function is activated and the data becomes 8,000.

● Averaging Function

For analog inputs, the averaging function operates when the averaging bit is set to 1. The averaging function outputs the average (a moving average) of the last eight input values as the converted value.

Use this function to smooth inputs that vary at a short interval.

● Open-circuit Detection

The open-circuit detection function is activated when the input range is set to 1 to 5 V and the voltage drops below 0.8 V, or when the input range is set to 4 to 20 mA and the current drops below 3.2 mA.

When the open-circuit detection function is activated, the converted data will be set to 8,000.

The time for enabling or clearing the open-circuit detection function is the same as the time for converting the data. If the input returns to the convertible range, the open-circuit detection is cleared automatically and the output returns to the normal range.

8-1-4 Flow of Operation

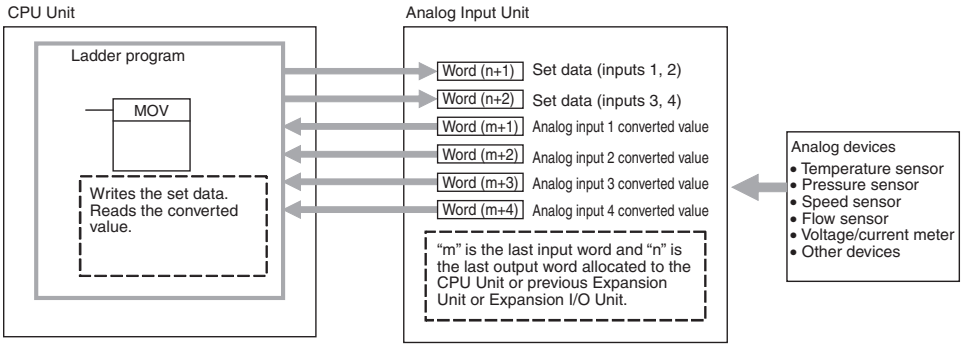
1 Connect and wire Units.

- Connect Analog Input Units.
- Wire to analog output devices.

2 Create a ladder program.

- Write set data to output words (n+1, n+2).
  - Set use of inputs.
  - Select input signals using range codes.
  - Set use of averaging.
- Read A/D converted values from input words (m+1 to m+4).
- For current inputs, confirm that there is no open circuit.

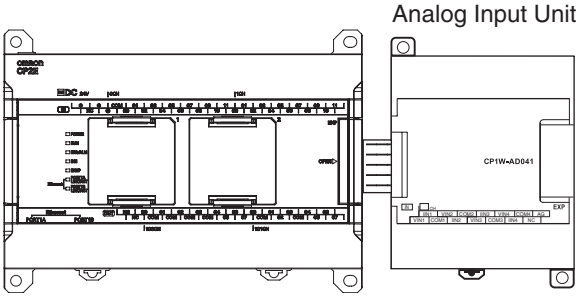
● Writing Set Data and Reading A/D Converted Values



1 Connect the Analog Input Unit to the CPU Unit.

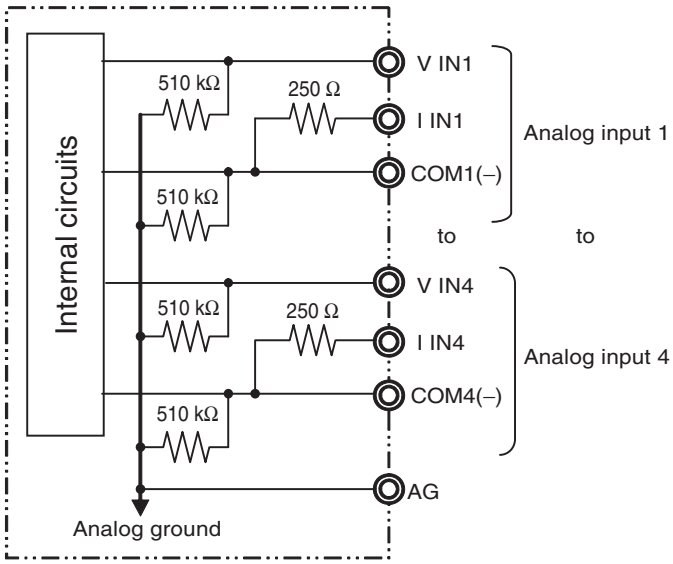
CP2E CPU Unit

CP1W-AD041/AD042
Analog Input Unit

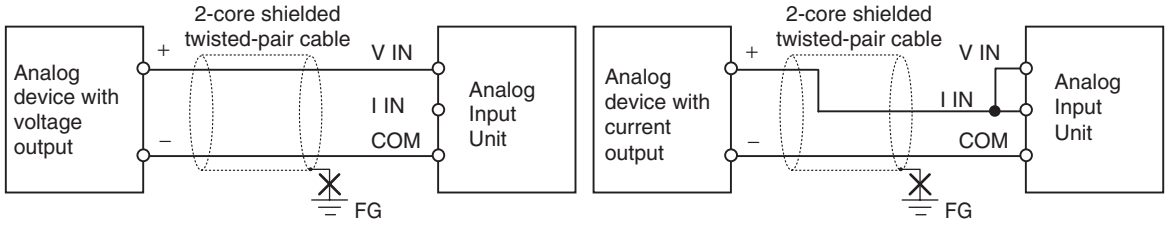


2 Wire to analog output devices.

(1) Wiring internal circuits of the CPU Unit



(2) Wiring analog output devices to the Analog Input Unit

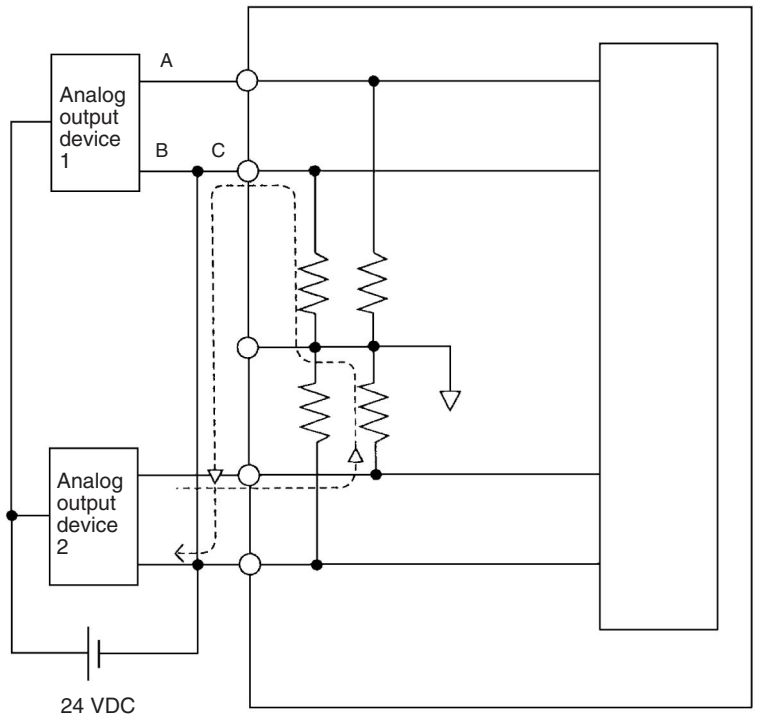


Precautions for Correct Use

- Do not connect the shield when using shielded twisted-pair cables.
- When an input is not being used, short V IN and I IN to COM terminals.
- Separate wiring from power lines (AC power supply lines, high-voltage lines, etc.)
- When there is noise in the power supply line, install a noise filter on the input section and the power supply.

Additional Information

Refer to the following information on open circuits when using voltage inputs.



For example, if connected device 2 is outputting 5 V and the same power supply is being used for both devices as shown above, approximately 1/3, or 1.6 V, will be applied to the input for input device 1.

If a wiring disconnection occurs when voltage input is being used, the situation described below will result. Either separate the power supplies for the connected devices, or use an isolator for each input.

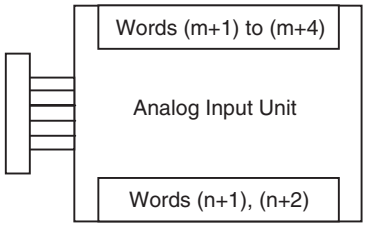
- If the same power supply is being used by the connected devices and a disconnection occurs at points A or B in the above diagram, an unwanted circuit path will occur as shown along the dotted line in the diagram. If that occurs, a voltage of approximately 1/3 to 1/2 of the output voltage of the other connected device will be generated.
- If that voltage is generated while the setting is for 1 to 5 V, open-circuit detection may not be possible.
- If a disconnection occurs at point C in the diagram, the negative (-) side will be used for both devices and open-circuit detection will not be possible.

This problem will not occur for current inputs even if the same power supply is used.

3 Create the ladder program.

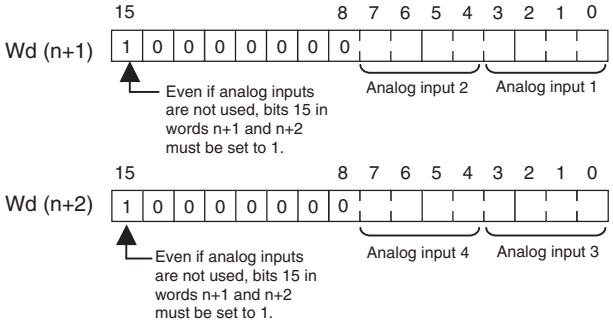
(1) Allocating I/O Words

Four input words and two output words are allocated from the next words following the last I/O words allocated to the CPU Unit or an existing Expansion Unit or Expansion I/O Unit.

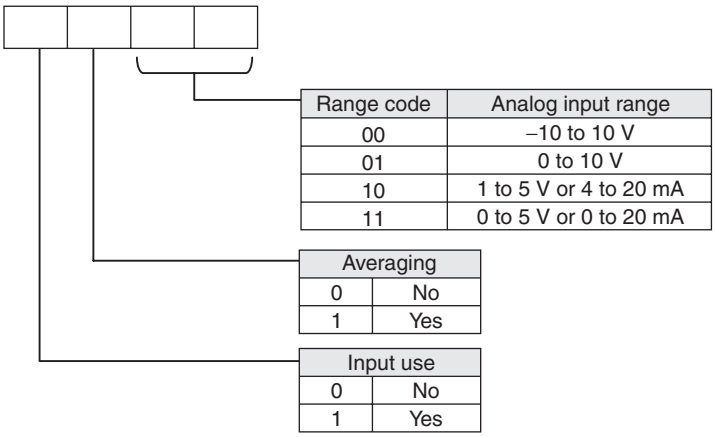


(2) Writing Set Data

Write the settings for input use, averaging use, and range codes for words n+1 and n+2. When the set data is transferred from the CPU Unit to the Analog Input Unit, the A/D conversion will be started.



- Set Data



Range code	Analog input range
00	–10 to 10 V
01	0 to 10 V
10	1 to 5 V or 4 to 20 mA
11	0 to 5 V or 0 to 20 mA

Averaging	
0	No
1	Yes

Input use	
0	No
1	Yes

- The Analog Input Unit will not start converting analog input values until the set data has been written.
  The conversion data will be 0000 until the range code is written.
- Once the settings have been made, it is not possible to be changed while power is being supplied to the CPU Unit. To change the range code or other settings, turn the CPU Unit OFF then ON again.

(3) Averaging

Set whether averaging is to be used for set data. When the averaging bit is set to 1, the average (moving average) for the past eight inputs is output as conversion data.

(4) Reading Analog Input Conversion Values

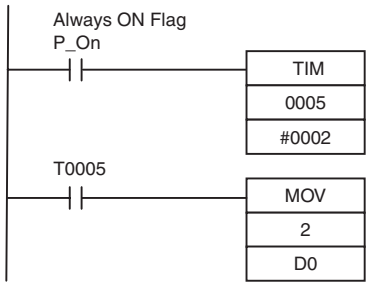
The ladder program can be used to read the memory area words where the converted values are stored.

With word m as the last input word allocated to the CPU Unit or an already-connected Expansion Unit, the A/D conversion data will be output to the following words m+1 to m+4.

(5) Startup Operation

After the power is turned ON, it will require two cycle times plus approximately 50 ms before the first conversion data is stored in the input words. Therefore, create a program as shown below, so that the ladder can start to operate with valid conversion data in input words.

The analog input data will be 0000 until the first conversion data is stored in the input words.



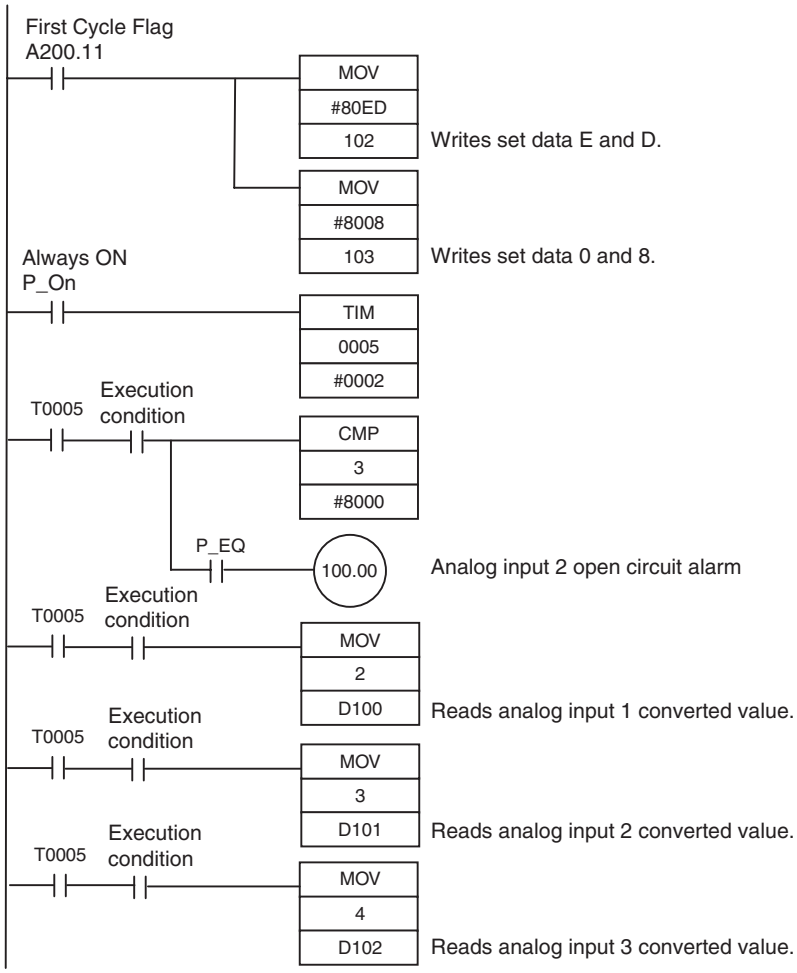
TIM0005 is started when the power is turned ON. After 0.2 s (200 ms) elapses, the TIM0005 contact turns ON and the analog input 1 conversion data stored in CIO 2 is transferred to D0.

(6) Handling Unit Errors

- When an error occurs in an Analog Input Unit, the analog input conversion data becomes 0000.
- Expansion Unit errors are output to bits 0 to 5 of word A436 for Units 1 to 3. The bits are allocated from A436.00 in order starting with the Unit nearest the CPU Unit. CP1W-AD041 is allocated two bits each. Use these flags in the program when it is necessary to detect errors.

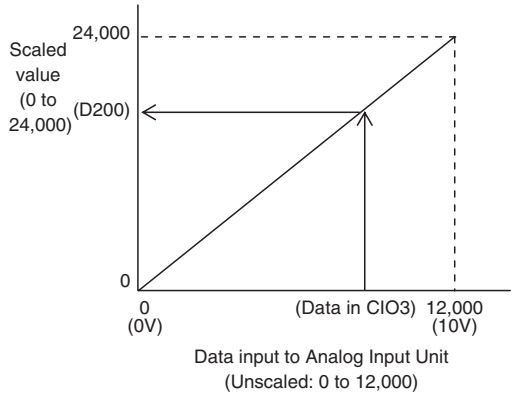
(7) Program Example

Analog input	Input range	Range code	Averaging	Set data	Destination word
Input 1	0 to 10 V	01	Yes	1101 (D hex)	n+1
Input 2	4 to 20 mA	10	Yes	1110 (E hex)	n+1
Input 3	-10 to +10 V	00	No	1000 (8 hex)	n+2
Input 4	Not used.	–(00)	–	0000 (0 hex)	n+2



- Example: Scaling analog input values

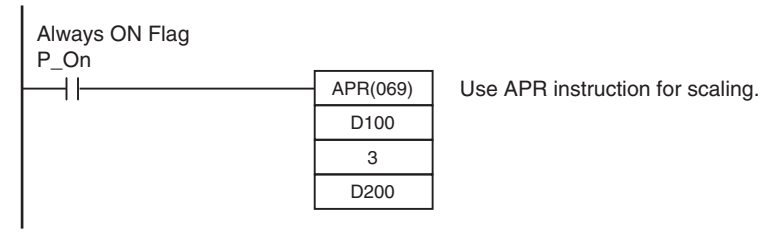
  When a 0 to 10V voltage is input to the analog input word (CIO 3) of CP1W-AD042 as 0 to 12,000, convert the value into a value between 0 and 24,000 and output the result to D200.



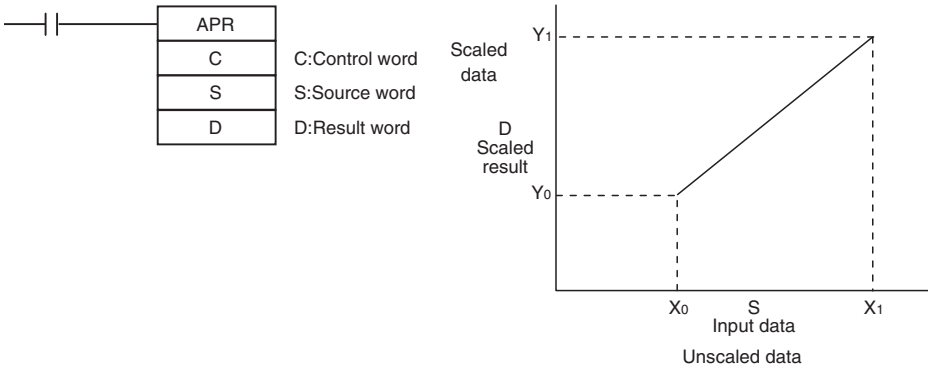
Data Memory Settings

Setting	Address	Data
Control word	D100	#0800
Unscaled minimum value (0)	D101	&0
Scaled minimum value (0)	D102	&0
Unscaled maximum value (12,000)	D103	&12,000
Scaled maximum value (24,000)	D104	&24,000

Ladder Program



Descriptions of APR Instruction

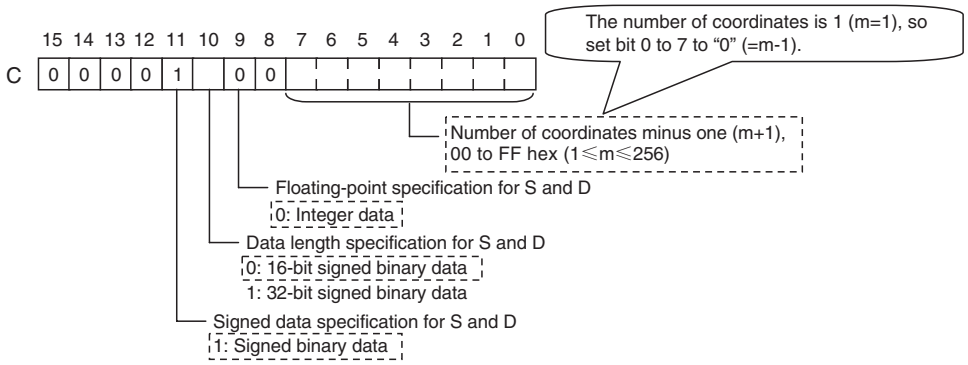


C: Control word

Set for “Signed Integer Data (Binary)”.

Control word setting

#0800: Binary numeral (0000 1000 0000 0000)



Setting	Address	Data
Control word	C	#0800
Unscaled minimum value (X_0)	C+1	X_0
Scaled minimum value (Y_0)	C+2	Y_0
Unscaled maximum value ($X_m = X_1$)	C+3	X_1
Scaled maximum value ($Y_m = Y_1$)	C+4	Y_1

S: Source data

Specify the word address of the input data before scaling.

R: Result word

Specify the word address where the data will be output after scaling.

8-2 Analog Output Units

8-2-1 Overview

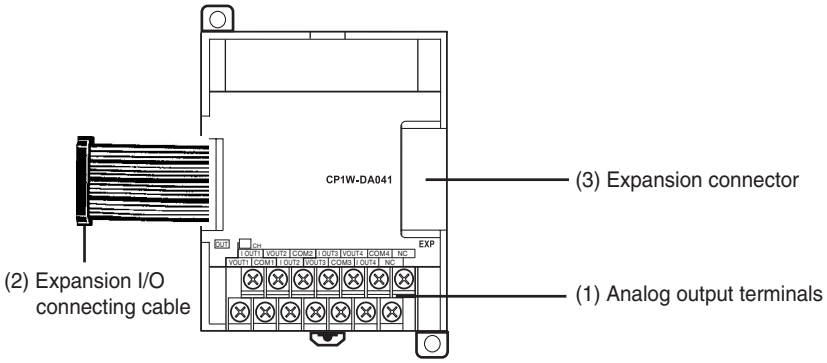
Each CP1W-DA021 Analog Output Unit provides two analog outputs.

Each CP1W-DA041/CP1W-DA042 Analog Output Unit provides four analog outputs.

- The analog output signal ranges are 1 to 5 V, 0 to 10 V, -10 to +10 V, 0 to 20 mA, and 4 to 20 mA.
  The resolution of CP1W-DA021/DA041 is 1/6,000.
  The resolution of CP1W-DA042 is 1/12,000.
- CP1W-DA021 uses two output words and CP1W-DA041/DA042 uses four output words.

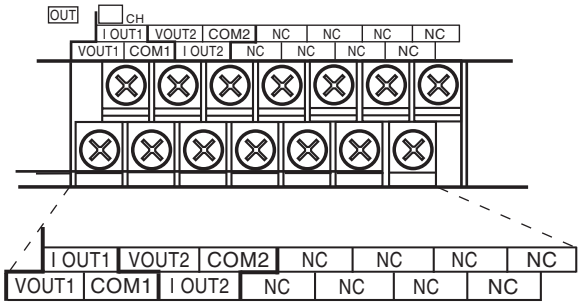
8-2-2 Part Names and Functions

● CP1W-DA021/CP1W-DA041/CP1W-DA042



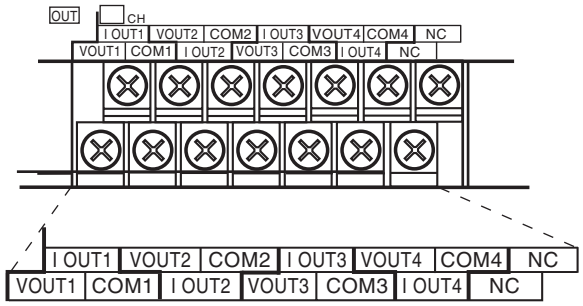
(1)Analog Output Terminals
Connected to analog input devices.

- I/O Terminal Arrangement for CP1W-DA021



V OUT1	Voltage output 1
I OUT1	Current output 1
COM1	Output common 1
V OUT2	Voltage output 2
I OUT2	Current output 2
COM2	Output common 2

- I/O Terminal Arrangement for CP1W-DA041/DA042



V OUT1	Voltage output 1
I OUT1	Current output 1
COM1	Output common 1
V OUT2	Voltage output 2
I OUT2	Current output 2
COM2	Output common 2
V OUT3	Voltage output 3
I OUT3	Current output 3
COM3	Output common 3
V OUT4	Voltage output 4
I OUT4	Current output 4
COM4	Output common 4

(2)Expansion I/O Connecting Cable

Connected to the expansion connector on the CPU Unit or previous Expansion Unit. The cable is provided with the Unit and cannot be removed.

Precautions for Safe Use

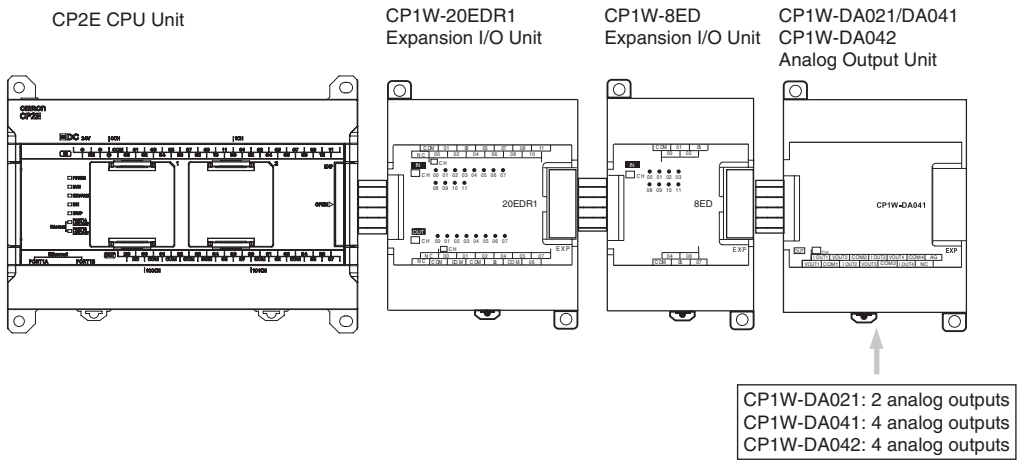
Do not touch the cables during operation. Static electricity may cause operating errors.

(3)Expansion Connector

Connected to the next Expansion Unit or Expansion I/O Unit.

8-2-3 Specifications

CP1W-DA021/DA041/DA042 Analog Output Units are connected to a CP2E CPU Unit.



Model			CP1W-DA021/CP1W-DA041		CP1W-DA042	
Item			Voltage output	Current output	Voltage output	Current output
Analog output section	Number of analog outputs		CP1W-DA021: 2 outputs (2 words allocated) CP1W-DA041: 4 outputs (4 words allocated)		4 outputs (4 words allocated)	
	Output signal range		1 to 5 V, 0 to 10 V, or -10 to 10 V	0 to 20 mA or 4 to 20 mA	1 to 5 V, 0 to 10 V, or -10 to 10 V	0 to 20 mA or 4 to 20 mA
	External output allowable load resistance		2 kΩ min.	350 Ω max.	2 kΩ min.	350 Ω max.
	External output impedance		0.5 Ω max.	–	0.5 Ω max.	–
	Resolution		1/6000 (full scale)		1/12000 (full scale)	
	Overall accuracy	25°C	0.4% full scale		0.3% full scale	
		0 to 60°C	0.8% full scale		0.7% full scale	
		-20 to 0°C	1% full scale		0.9% full scale	
	D/A conversion data		16-bit binary (4-digit hexadecimal) Full scale for -10 to 10 V: F448 to 0BB8 hex Full scale for other ranges: 0000 to 1770 hex		16-bit binary (4-digit hexadecimal) Full scale for -10 to 10 V: E890 to 1770 hex Full scale for other ranges: 0000 to 2EE0 hex	
Conversion time			CP1W-DA021: 2 ms/point (4 ms/all points) CP1W-DA041: 2 ms/point (8 ms/all points)		1 ms/point (4 ms/all points)	
Isolation method			Photocoupler isolation between analog I/O terminals and internal circuits. No isolation between analog I/O signals.			
Current consumption			CP1W-DA021: 5 VDC 40 mA max.; 24 VDC 95 mA max. CP1W-DA041: 5 VDC 80 mA max.; 24 VDC 124 mA max.		5 VDC: 70 mA max.; 24 VDC: 160 mA max.	

● Analog Output Signal Ranges

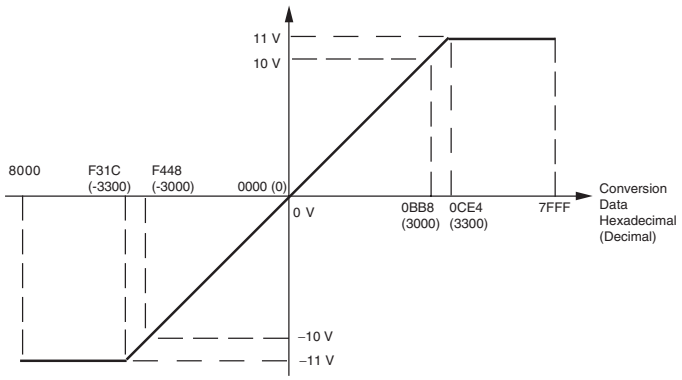
The output data is converted to analog according to the output signal range, as shown below.

Additional Information

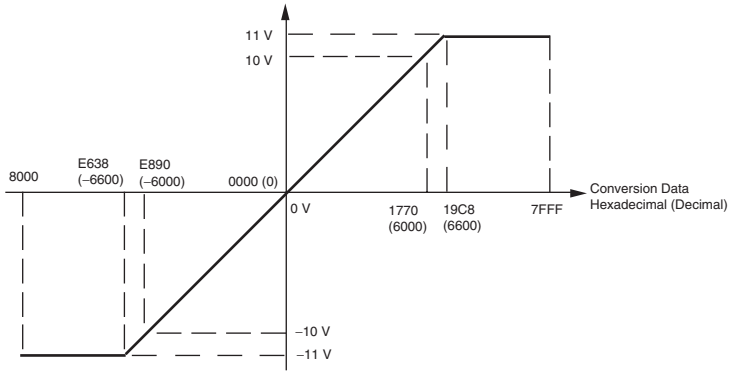
When the output exceeds the specified range, the output signal will be fixed at either the lower limit or upper limit.

-10 to 10 V

When the resolution is 1/6,000, the hexadecimal values F448 to 0BB8 (-3000 to 3000) correspond to an analog voltage range of -10 to 10 V.
The entire output range is -11 to 11 V.
Specify the DA conversion data as the two's complement if it is a negative value.

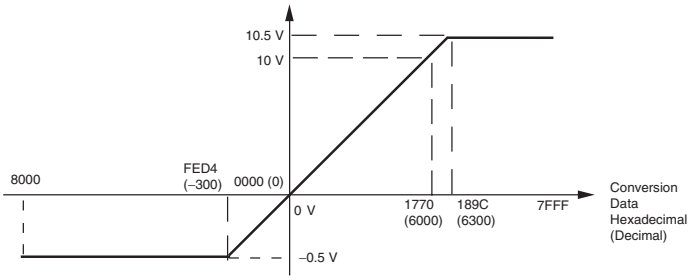


When the resolution is 1/12,000, the hexadecimal values E890 to 1770 (-6000 to 6000) correspond to an analog voltage range of -10 to 10 V.
The entire output range is -11 to 11 V.
Specify the DA conversion data as the two's complement if it is a negative value.

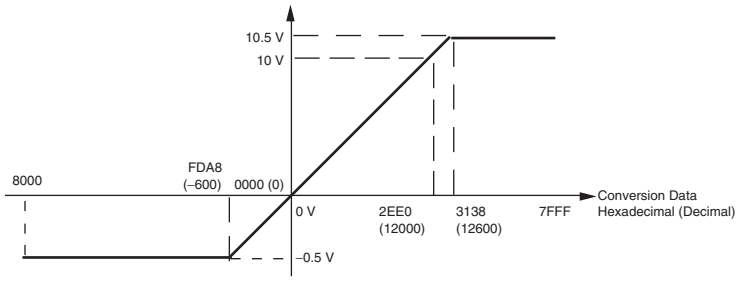


0 to 10 V

When the resolution is 1/6,000, the hexadecimal values 0000 to 1770 (0 to 6000) correspond to an analog voltage range of 0 to 10 V.
The entire output range is -0.5 to 10.5 V.
Specify the DA conversion data as the two's complement if it is a negative value.

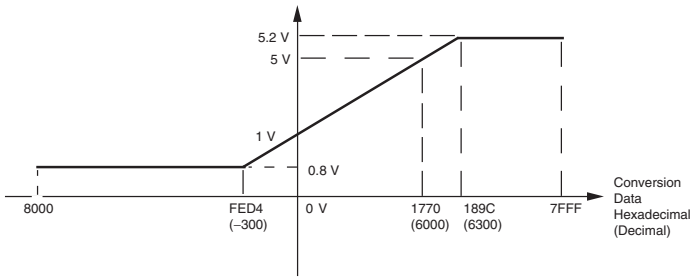


When the resolution is 1/12,000, the hexadecimal values 0000 to 2EE0 (0 to 12000) correspond to an analog voltage range of 0 to 10 V.
The entire output range is -0.5 to 10.5 V.
Specify the DA conversion data as the two's complement if it is a negative value.

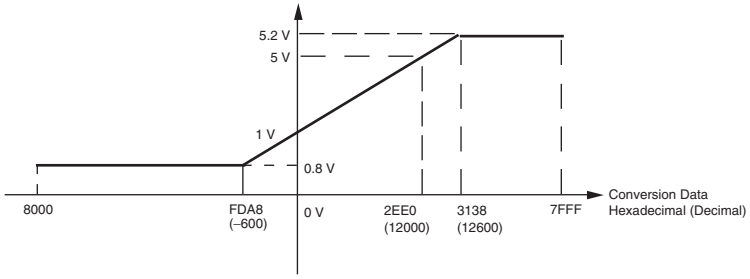


1 to 5 V

When the resolution is 1/6,000, the hexadecimal values 0000 to 1770 (0 to 6000) correspond to an analog voltage range of 1 to 5 V.
The entire output range is 0.8 to 5.2 V.

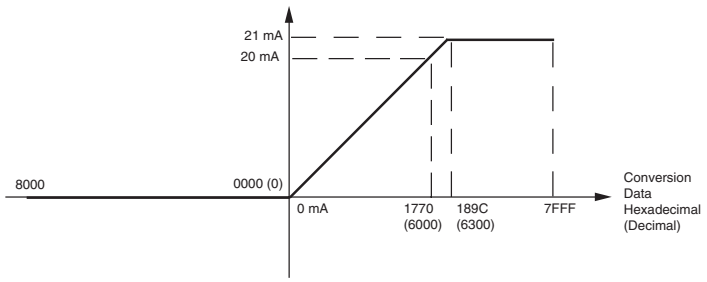


When the resolution is 1/12,000, the hexadecimal values 0000 to 2EE0 (0 to 12000) correspond to an analog voltage range of 1 to 5 V.
The entire output range is 0.8 to 5.2 V.

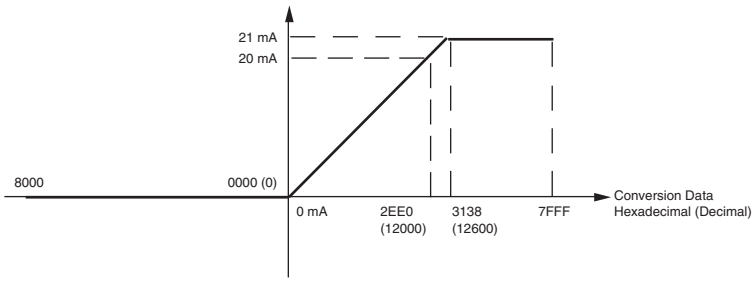


0 to 20 mA

When the resolution is 1/6,000, the hexadecimal values 0000 to 1770 (0 to 6000) correspond to an analog current range of 0 to 20 mA.
The entire output range is 0 to 21 mA.

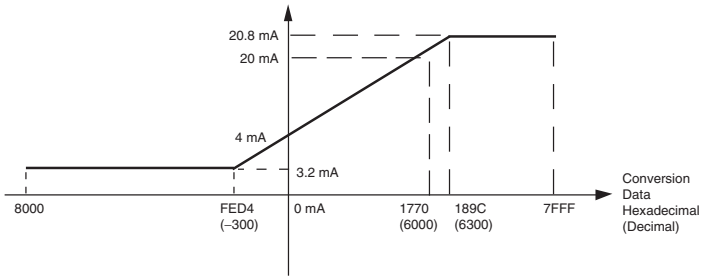


When the resolution is 1/12,000, the hexadecimal values 0000 to 2EE0 (0 to 12000) correspond to an analog voltage range of 0 to 20 mA.
The entire output range is 0 to 21 mA.

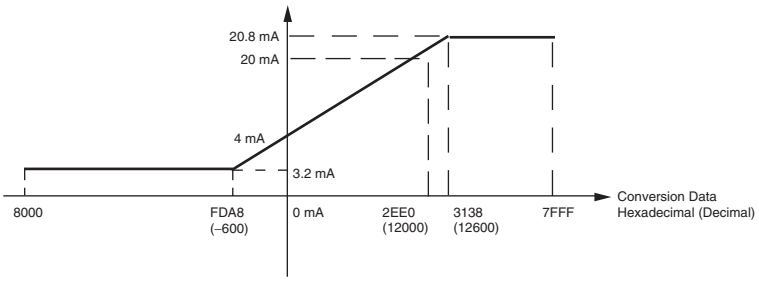


4 to 20 mA

When the resolution is 1/6,000, the hexadecimal values 0000 to 1770 (0 to 6000) correspond to an analog current range of 4 to 20 mA.
The entire output range is 3.2 to 20.8 mA.



When the resolution is 1/12,000, the hexadecimal values 0000 to 2EE0 (0 to 12000) correspond to an analog voltage range of 4 to 20 mA.
The entire output range is 3.2 to 20.8 mA.



8-2-4 Flow of Operation

1 Connect and wire Units.

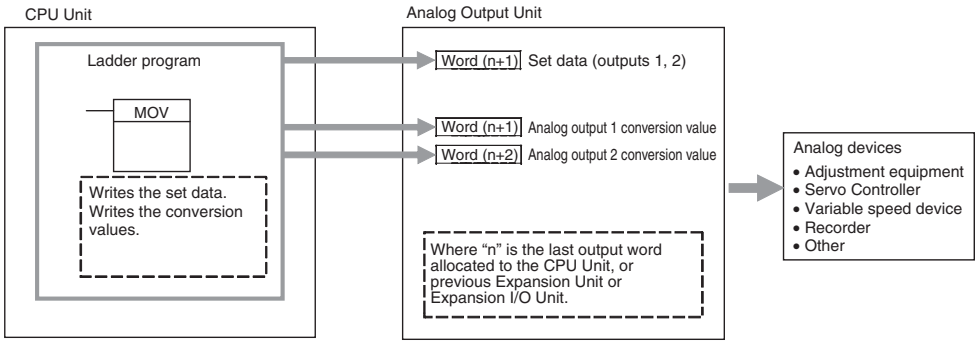
- Connect Analog Output Units.
- Wire to analog input devices.

2 Create a ladder program.

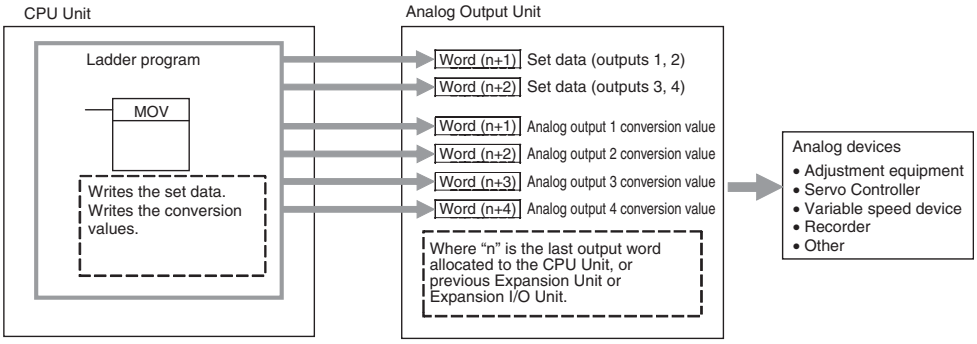
- Write range code to output words
  CP1W-DA021: Word n+1
  CP1W-DA041/DA042: Words n+1, n+2
  - Set use of outputs.
  - Select output signals using range codes.
- Write D/A conversion values to output words
  CP1W-DA021: Words n+1, n+2
  CP1W-DA041/DA042: Words n+1 to n+4

● Writing Set Data and Writing D/A Conversion Data

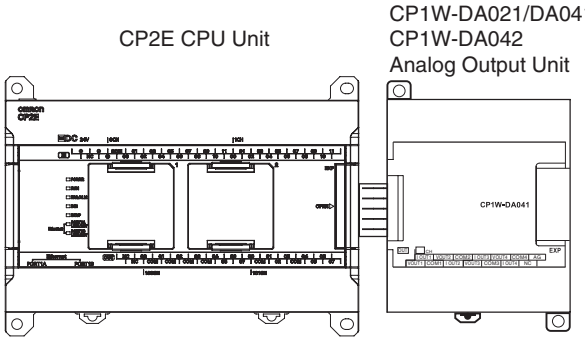
CP1W-DA021



CP1W-DA041/CP1W-DA042



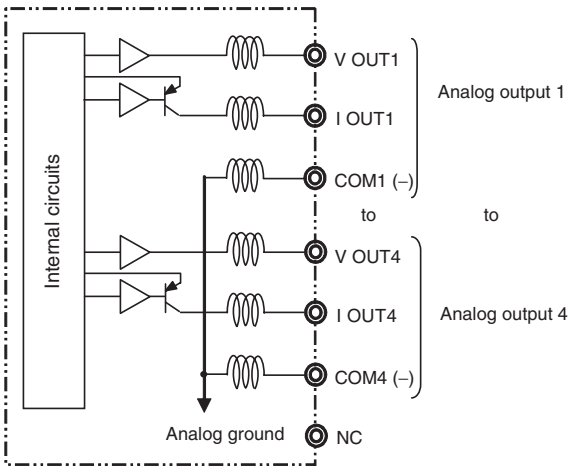
1 Connect the Analog Output Unit to the CPU Unit.



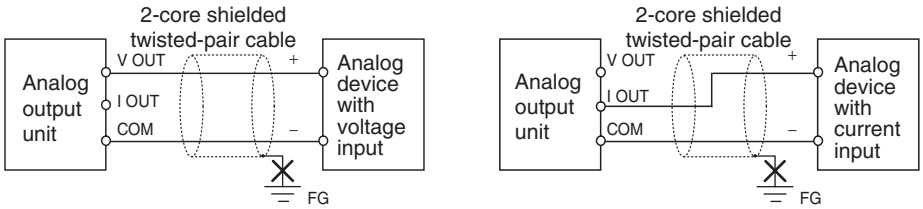
2 Wire to analog input devices.

(1) Wiring internal circuits of the CPU Unit

The following diagram shows the internal circuit using CP1W-DA041/DA042 as an example, which wires analog outputs 1 to 4. In the case of CP1W-DA021, analog outputs 1 to 2 can be used.



(2) Wiring analog input devices to the Analog Output Unit



Precautions for Correct Use

- Do not connect the shield when using shielded twisted-pair cables.
- Separate wiring from power lines (AC power supply lines, high-voltage lines, etc.)
- When there is noise in the power supply line, install a noise filter on the input section and the power supply.

Additional Information

When external power is supplied (when setting the range code), or when there is a power interruption, a pulse-form analog output may be generated.

If this causes problems with operation, take countermeasures such as those suggested below.

(1) Countermeasure 1

- Turn ON the power supply for the CP2E CPU Unit first, confirm correct operation, and then turn ON the power supply for the load.
- Turn OFF the power supply for the load before turning OFF the power supply for the CP2E CPU Unit.

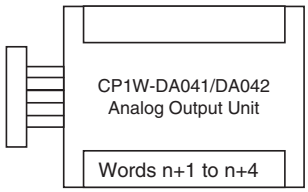
(2) Countermeasure 2

- Control the machine not only by analog output but also by other signals (additional start/stop control signal for machine).

3 Create the ladder program.

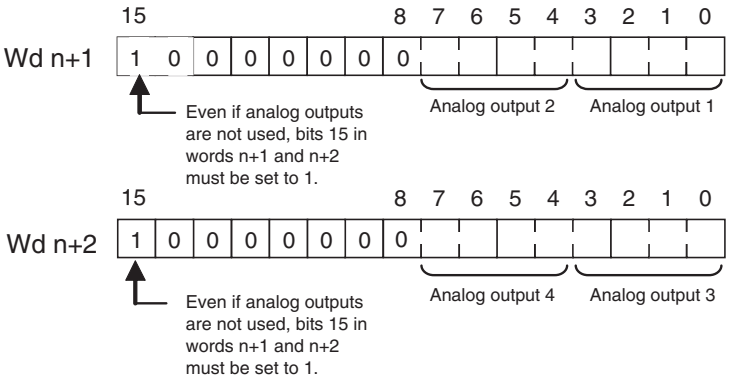
(1) Allocating Output Words

Four output words (n+1 to n+4) are allocated to the Analog Output Unit starting from the next word following the last word allocated to the CPU Unit or previous Expansion Unit or Expansion I/O Unit. For CP1W-DA021, two output words (n+1, n+2) are allocated.

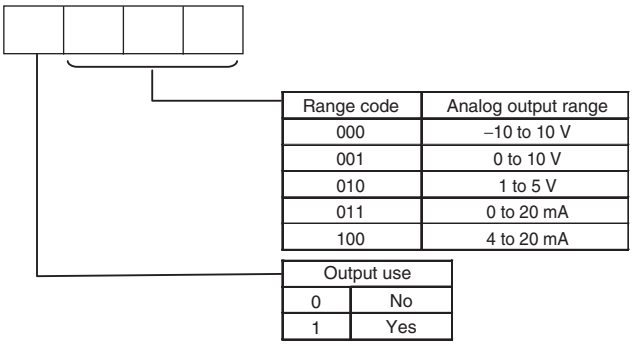


(2) Writing Set Data

Write the output use and the range code to words n+1 and n+2. For CP1W-DA021, only word n+1 can be used. The D/A conversion will start when the set data is transferred from the CPU Unit to the Analog Output Unit.



- Set Data



Range code	Analog output range
000	–10 to 10 V
001	0 to 10 V
010	1 to 5 V
011	0 to 20 mA
100	4 to 20 mA

Output use	
0	No
1	Yes

- The Analog Output Unit will not start converting analog output values until the set data has been written.
- Before the range code is written, 0 V or 0 mA will be output for the 0 to 10V, -10 to 10V, or 0 to 20 mA ranges, and 1 V or 4 mA will be output for the 1 to 5V and 4 to 20 mA ranges.
- Once the range code has been set, it is not possible to be changed while power is being supplied to the CPU Unit. To change the range code, turn the CPU Unit OFF then ON again.

(3) Writing Analog Output Conversion Values

The ladder program can be used to write conversion data to the output words.

When “n” is the last output word allocated to the CPU Unit, or previous Expansion Unit or Expansion I/O Unit, the output words will be n+1 to n+2 for CP1W-DA021 and n+1 to n+4 for CP1W-DA041/DA042.

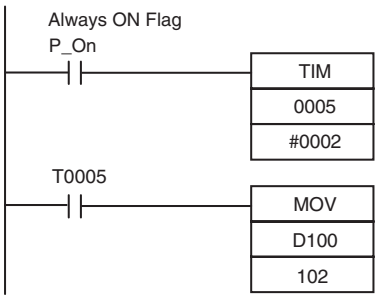
(4) Startup Operation

After power is turned ON, it will require two cycle times plus approximately 50 ms before the first conversion data is output.

The following table shows the output status after the initial processing is completed.

Output type	Voltage output		Current output	
Output range	0 to 10 V, -10 to +10 V	1 to 5 V	0 to 20 mA	4 to 20 mA
Before range code is written	0V		0mA	
After range code is written	0V	1V	0mA	4mA

Therefore, create a program as shown below, so that when operation begins simultaneously with startup it will wait for valid set data.



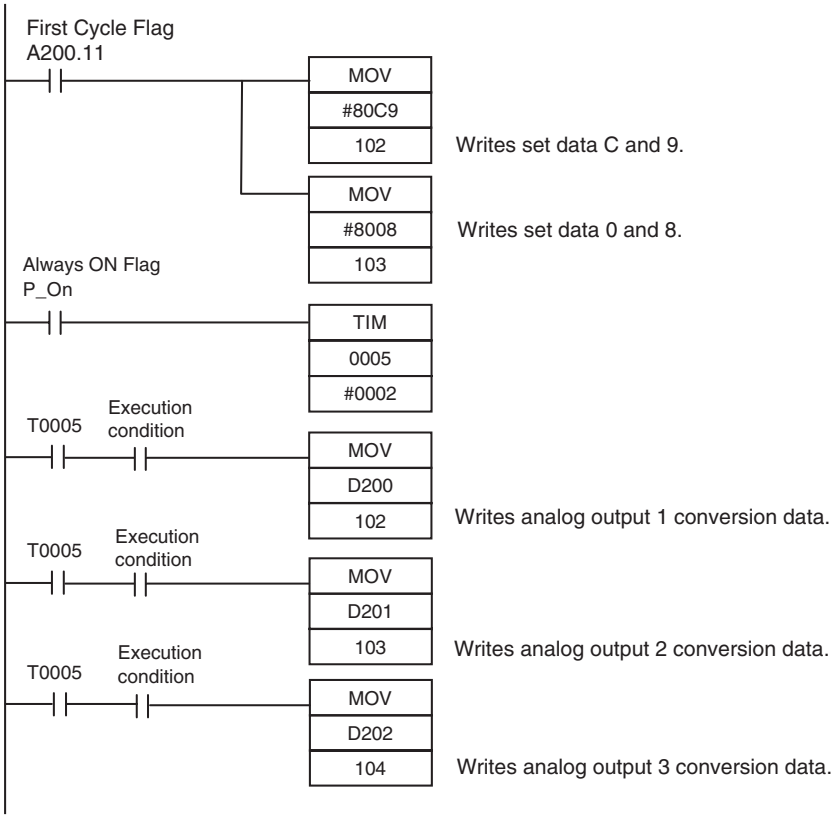
TIM0005 is started when the power is turned ON. After 0.2 s (200 ms) elapses, the TIM0005 contact turns ON and the data stored in D100 will be moved to CIO 102 as the conversion data for analog output 1.

(5) Handling Unit Errors

- When an error occurs at the Analog Output Unit, the analog output will be 0 V or 0 mA. If a CPU error or an I/O bus error (fatal errors) occurs at the CPU Unit and the analog output is set to 1 to 5 V or 4 to 20 mA, 0 V or 0 mA will be output. For any other fatal errors at the CPU Unit, 1 V or 4 mA will be output.
- Expansion Unit and Expansion I/O Unit errors are output to bits 0 to 5 of word A436 for units 1 to 3. The bits are allocated from A436.00 in order starting from the Unit nearest the CPU Unit. CP1W-DA041/DA042 is allocated two bits each and CP1W-DA021 is allocated one bit each. Use these flags in the probgram when it is necessary to detect errors.

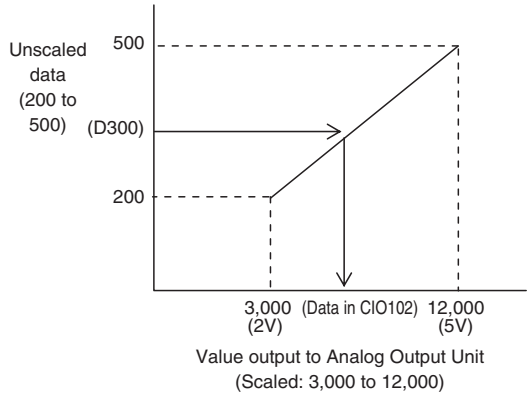
(6) Program Example (CP1W-DA041/DA042)

Analog output	Output range	Range code	Set data	Destination word
Output 1	0 to 10 V	001	1001 (9 hex)	n+1
Output 2	4 to 20 mA	100	1100 (C hex)	n+1
Output 3	-10 to 10 V	000	1000 (8 hex)	n+2
Output 4	Not used.	–(000)	0000 (0 hex)	n+2



- Example: Scaling analog output values

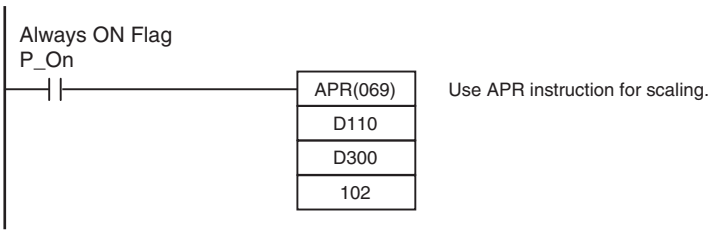
  Convert a value between 200 and 500 in D300 into 2 to 5 V to output the voltage from the analog output word (CIO 102) of CP1W-DA042.



Data memory settings

Setting	Address	Data
Control word	D110	#0800
Unscaled minimum value (200)	D111	&200
Scaled minimum value (3,000)	D112	&3,000
Unscaled maximum value (500)	D113	&500
Scaled maximum value (12,000)	D114	&12,000

Ladder program



Refer to *8-1 Example: Scaling analog input values* for the descriptions of APR instruction.

8-3 Analog I/O Units

8-3-1 CP1W-MAD11 Analog I/O Units

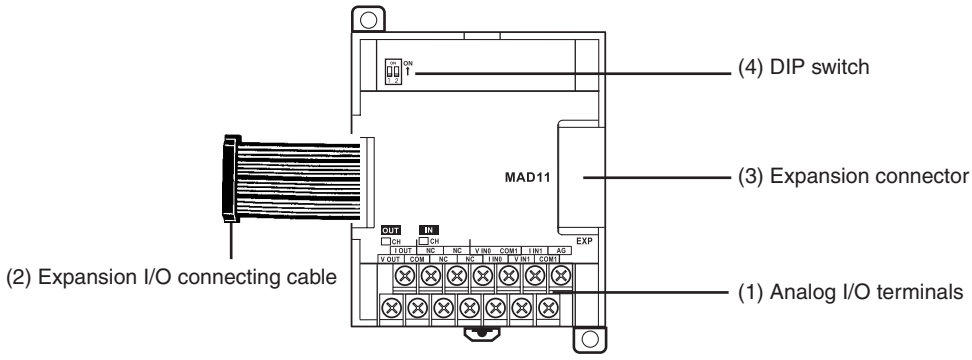
Overview

Each CP1W-MAD11 Analog I/O Unit provides 2 analog inputs and 1 analog output.

- The analog input range can be set to 0 to 5 V, 1 to 5 V, 0 to 10 V, -10 to 10 V, 0 to 20 mA, or 4 to 20 mA. The inputs have a resolution of 1/6000. An open-circuit detection function is activated in the ranges of 1 to 5 V and 4 to 20 mA.
- The analog output range can be set to 1 to 5 V, 0 to 10 V, -10 to 10 V, 0 to 20 mA, or 4 to 20 mA. The outputs have a resolution of 1/6000.

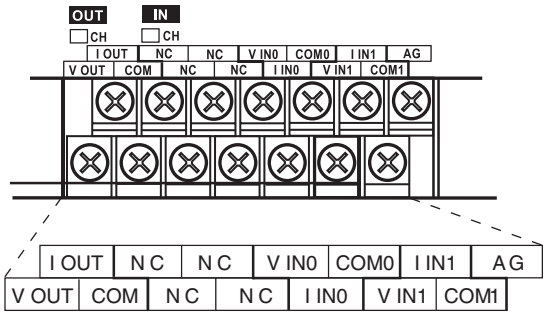
Part Names and Functions

● **CP1W-MAD11**



(1)Analog I/O Terminals
Connected to analog I/O devices.

- I/O Terminal Arrangements



V OUT	Voltage output
I OUT	Current output
COM	Output common
V IN0	Voltage input 0
I IN0	Current input 0
COM0	Input common 0
V IN1	Voltage input 1
I IN1	Current input 1
COM1	Input common 1

Note For current inputs, short V IN0 to I IN0 and V IN1 to I IN1.

(2)Expansion I/O Connecting Cable
Connected to the expansion connector of a CPU Unit or an Expansion Unit or Expansion I/O Unit. The cable is provided with the Analog I/O Unit and cannot be removed.

Precautions for Safe Use

Do not touch the cables during operation. Static electricity may cause operating errors.

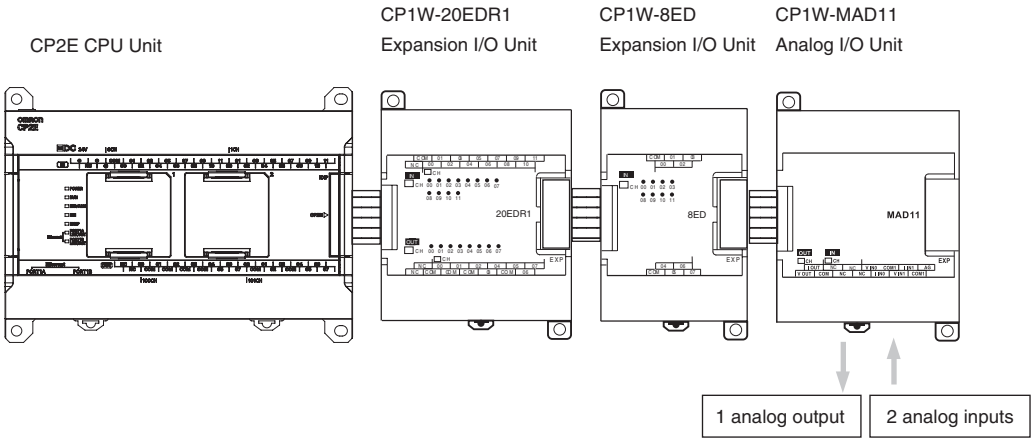
(3)Expansion Connector
Used for connecting Expansion Units or Expansion I/O Units.

(4)DIP Switch
Used to enable or disable averaging.

Pin 1: Average processing for analog input 0
(OFF: Average processing not performed; ON: Average processing performed)
Pin 2: Average processing for analog input 1
(OFF: Average processing not performed; ON: Average processing performed)

Specifications

CP1W-MAD11 Analog I/O Units are connected to the CP2E CPU Unit.



Model			CP1W-MAD11	
Item			Voltage I/O	Current I/O
Analog Input Section	Number of analog inputs		2 inputs (2 words allocated)	
	Input signal range		0 to 5 V, 1 to 5 V, 0 to 10 V, or -10 to 10 V	0 to 20 mA or 4 to 20 mA
	Max. rated input		±15 V	±30 mA
	External input impedance		1 MΩ min.	Approx. 250 Ω
	Resolution		1/6000 (full scale)	
	Overall accuracy	25°C	0.3% full scale	0.4% full scale
		0 to 60°C	0.6% full scale	0.8% full scale
		-20 to 0°C	0.8% full scale	1% full scale
	A/D conversion data		16-bit binary (4-digit hexadecimal) Full scale for -10 to 10 V: F448 to 0BB8 hex Full scale for other ranges: 0000 to 1770 hex	
	Averaging function		Supported (Settable for individual inputs via DIP switch)	
	Open-circuit detection function		Supported	
Analog Output Section	Number of outputs		1 output (1 word allocated)	
	Output signal range		1 to 5 VDC, 0 to 10 VDC, or -10 to 10 VDC	0 to 20 mA or 4 to 20 mA
	Allowable external output load resistance		1 kΩ min.	600 Ω max.
	External output impedance		0.5 Ω max.	–
	Resolution		1/6000 (full scale)	
	Overall accuracy	25°C	0.4% full scale	
		0 to 60°C	0.8% full scale	
		-20 to 0°C	1% full scale	
	Set data (D/A conversion)		16-bit binary (4-digit hexadecimal) Full scale for -10 to 10 V: F448 to 0BB8 hex Full scale for other ranges: 0000 to 1770 hex	
Conversion time			2 ms/point (6 ms/all points)	
Isolation method			Photocoupler isolation between analog I/O terminals and internal circuits. No isolation between analog I/O signals.	
Current consumption			5 VDC: 83 mA max., 24 VDC: 110 mA max.	

● Analog I/O Signal Ranges

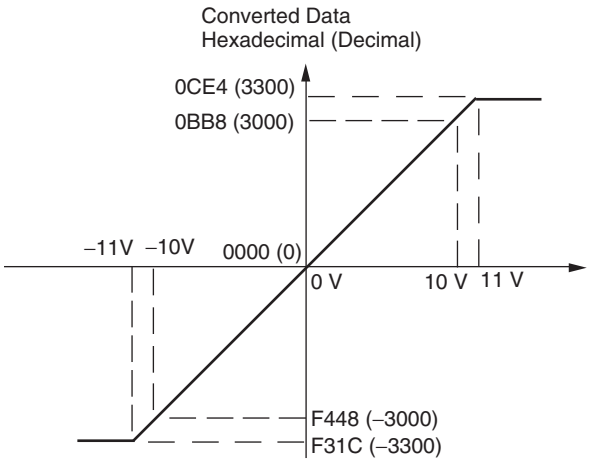
Analog I/O data is digitally converted according to the analog I/O signal range as shown below.

Additional Information

When the input/output exceeds the specified range, the AD/DA converted data will be fixed at either the lower limit or upper limit.

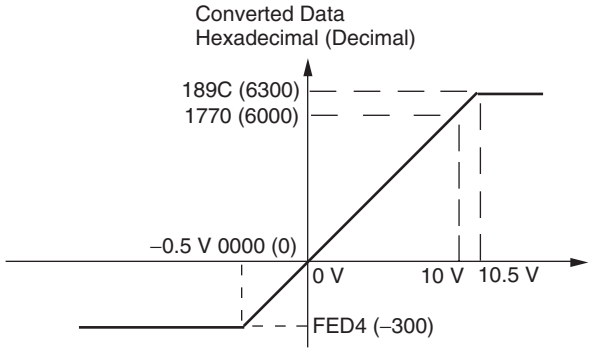
Analog Input Signal Ranges

-10 to 10 V



Voltages in the -10 to 10 V range correspond to hexadecimal values F448 to 0BB8 (-3,000 to 3,000). The range of data that can be converted is F31C to 0CE4 hex (-3,300 to 3,300). A negative voltage is expressed as a two's complement.

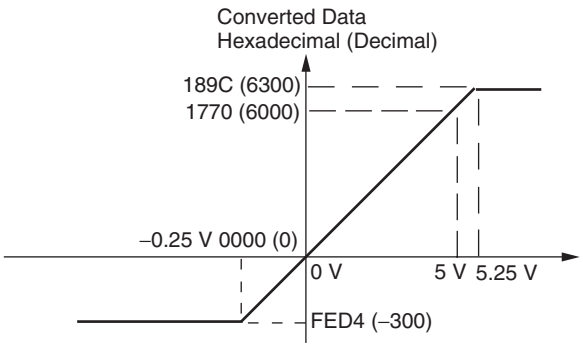
0 to 10 V



Voltages in the 0 to 10 V range correspond to hexadecimal values 0000 to 1770 (0 to 6,000). The range of data that can be converted is FED4 to 189C hex (-300 to 6,300).

A negative voltage is expressed as a two's complement.

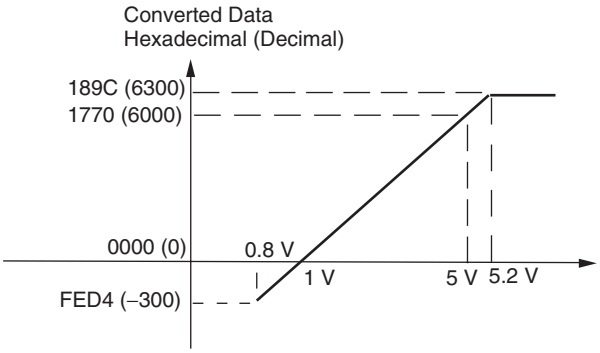
0 to 5 V



Voltages in the 0 to 5 V range correspond to hexadecimal values 0000 to 1770 (0 to 6,000). The range of data that can be converted is FED4 to 189C hex (-300 to 6,300).

A negative voltage is expressed as a two's complement.

1 to 5 V

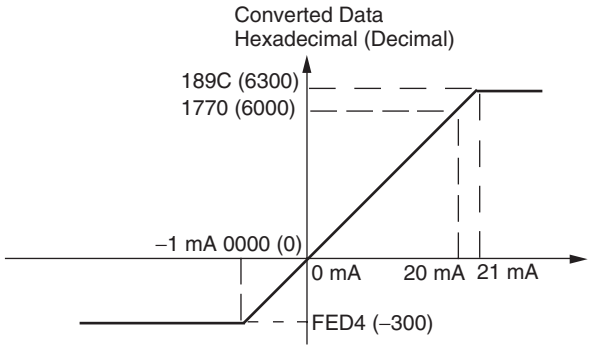


Voltages in the 1 to 5 V range correspond to hexadecimal values 0000 to 1770 (0 to 6,000). The range of data that can be converted is FED4 to 189C hex (-300 to 6,300).

Voltage in the range of 0.8 to 1 V is expressed as a two's complement.

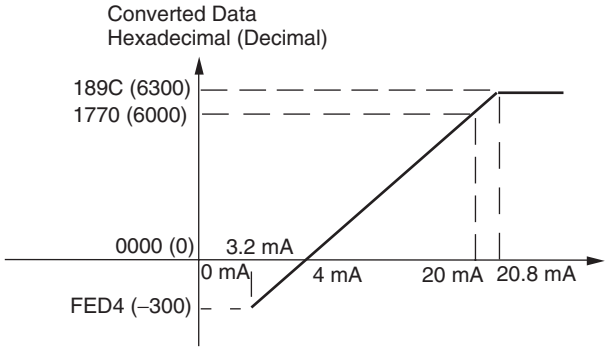
If an input is below the range (i.e., less than 0.8 V), the open-circuit detection function is activated and the data becomes 8,000.

0 to 20 mA



Currents in the 0 to 20 mA range correspond to hexadecimal values 0000 to 1770 (0 to 6,000). The range of data that can be converted is FED4 to 189C hex (-300 to 6,300). A negative current is expressed as a two's complement.

4 to 20 mA

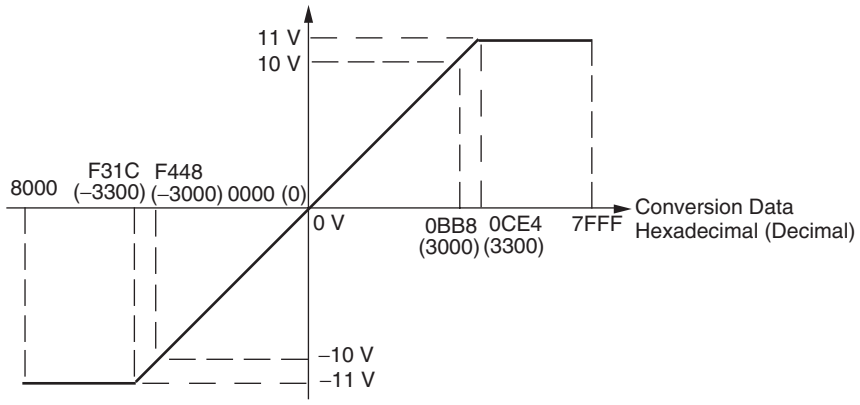


Currents in the 4 to 20 mA range correspond to hexadecimal values 0000 to 1770 (0 to 6,000). The range of data that can be converted is FED4 to 189C hex (-300 to 6,300). Current in the range of 3.2 to 4 mA is expressed as a two's complement. If an input is below the range (i.e., less than 3.2 mA), the open-circuit detection function is activated and the data becomes 8,000.

Analog Output Signal Ranges

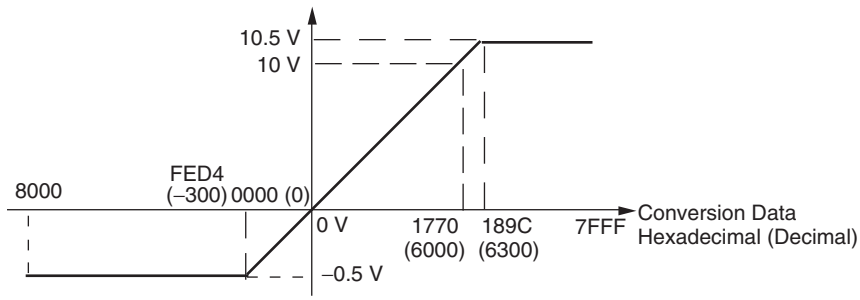
-10 to 10 V

The hexadecimal values F448 to 0BB8 (-3000 to 3000) correspond to an analog voltage range of -10 to 10 V.
The entire output range is -11 to 11V.
Specify the DA conversion data as the two's complement if it is a negative value.



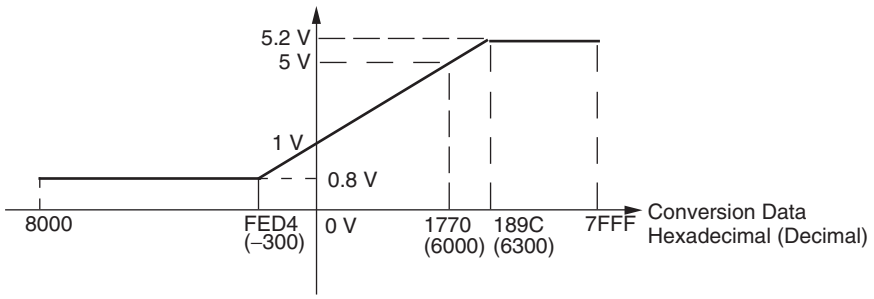
0 to 10 V

The hexadecimal values 0000 to 1770 (0 to 6000) correspond to an analog voltage range of 0 to 10 V.
The entire output range is -0.5 to 10.5 V.
Specify the DA conversion data as the two's complement if it is a negative value.



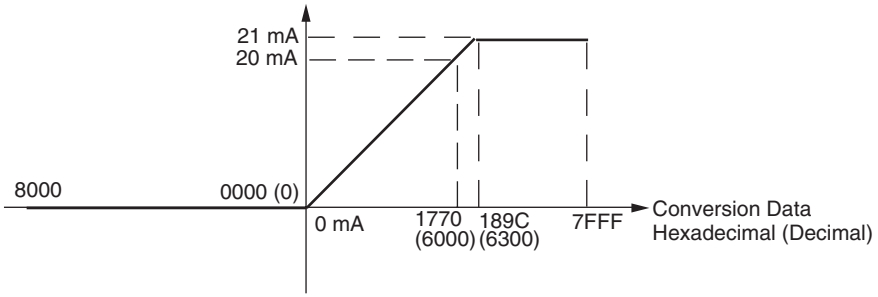
1 to 5 V

The hexadecimal values 0000 to 1770 (0 to 6000) correspond to an analog voltage range of 1 to 5 V.
The entire output range is 0.8 to 5.2 V.



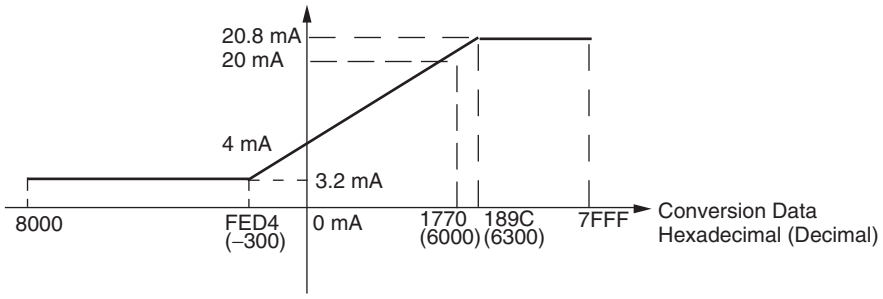
0 to 20 mA

The hexadecimal values 0000 to 1770 (0 to 6000) correspond to an analog current range of 0 to 20 mA. The entire output range is 0 to 21 mA.



4 to 20 mA

The hexadecimal values 0000 to 1770 (0 to 6000) correspond to an analog current range of 4 to 20 mA. The entire output range is 3.2 to 20.8 mA.



● Averaging Function for Analog Inputs

The averaging function can be enabled for inputs using the DIP switch. The averaging function outputs the average (a moving average) of the last eight input values as the converted value.

Use this function to smooth inputs that vary at a short interval.

● Open-circuit Detection Function for Analog Inputs

The open-circuit detection function is activated when the input range is set to 1 to 5 V and the voltage drops below 0.8 V, or when the input range is set to 4 to 20 mA and the current drops below 3.2 mA.

When the open-circuit detection function is activated, the converted data will be set to 8,000.

The time for enabling or clearing the open-circuit detection function is the same as the time for converting the data.

If the input returns to the convertible range, the open-circuit detection is cleared automatically and the output returns to the normal range.

Flow of Operation

1 Connect the Unit.

- Connect the Analog I/O Unit.
- Set analog inputs as voltage or current inputs and set the averaging function.

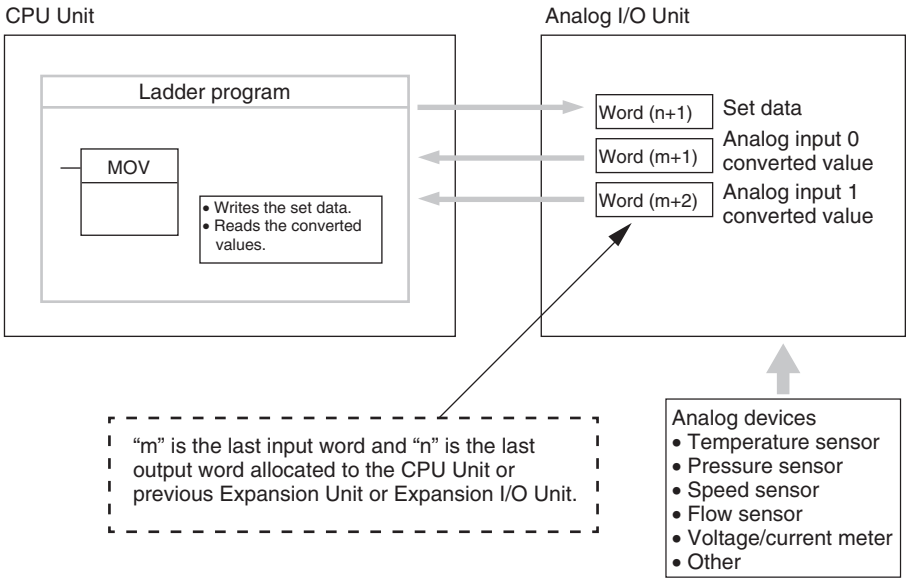
2 Wire the analog I/O.

- Connect analog I/O devices.

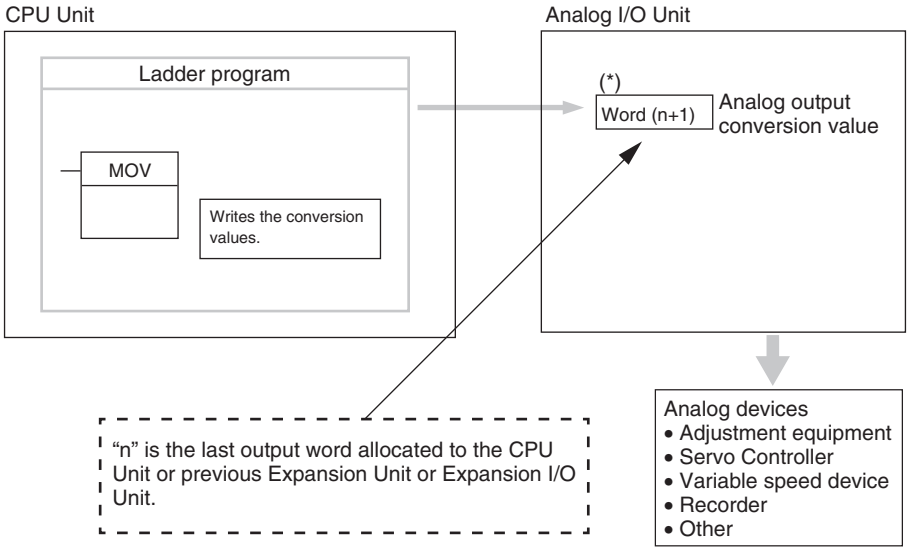
3 Create a ladder program.

- Write the range code.
- Analog inputs: Read converted values.
- Analog output: Write set data.

● Writing Set Data and Reading A/D Converted Values

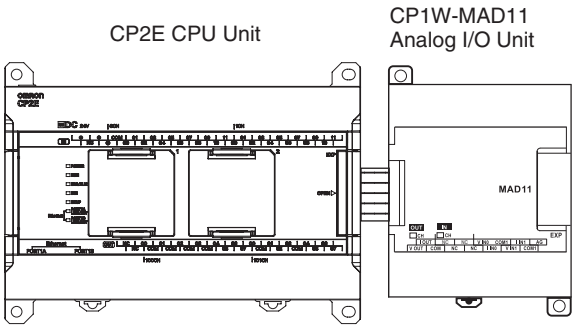


● Writing D/A Conversion Data



* Word (n+1) can be used for either the set data or the analog output conversion value.

1 Connect the Analog I/O Unit to the CPU Unit.



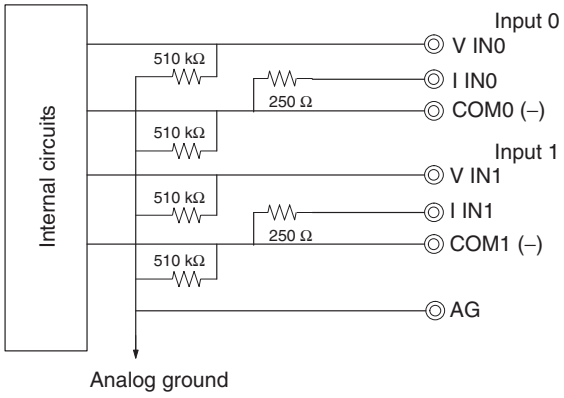
- Setting the Averaging Function
  DIP switch pins 1 and 2 are used to set the averaging function. When averaging is enabled, a moving average of the last eight input values is output as the converted value. The averaging function can be set separately for analog inputs 0 and 1.

DIP switch pin	Function	Setting	Default
1	Averaging	Analog input 0 OFF: Disabled; ON: Enabled	OFF
2		Analog input 1 OFF: Disabled; ON: Enabled	OFF

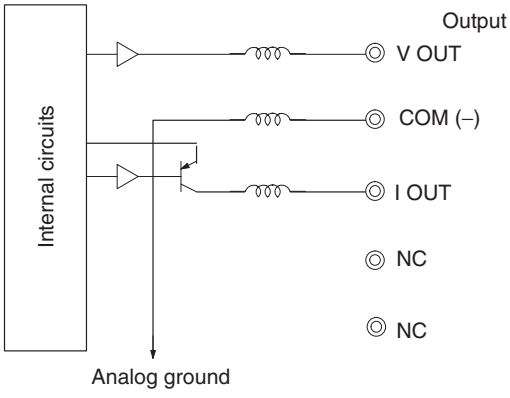
2 Wire to analog I/O devices.

(1) Wiring internal circuits of the CPU Unit

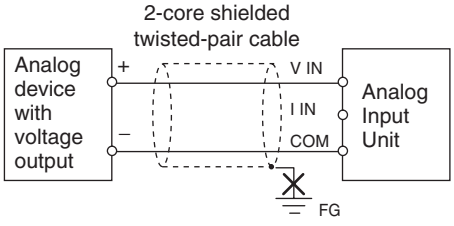
• Analog Inputs

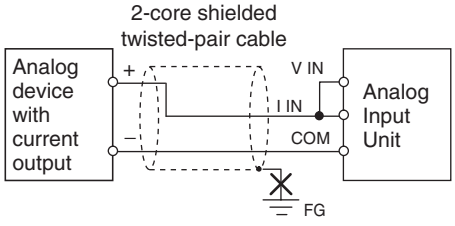


• Analog Outputs

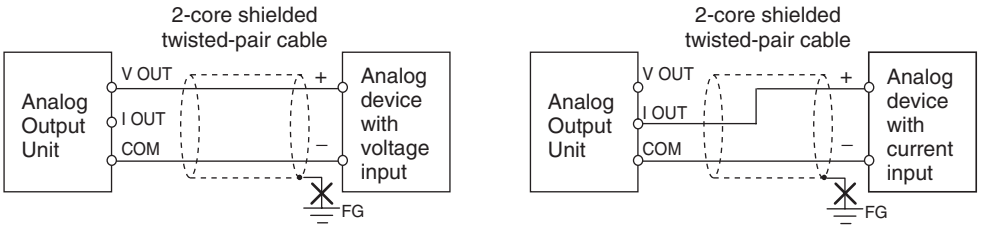


(2) Wiring analog output devices to the Analog I/O Unit





(3) Wiring analog input devices to the Analog I/O Unit

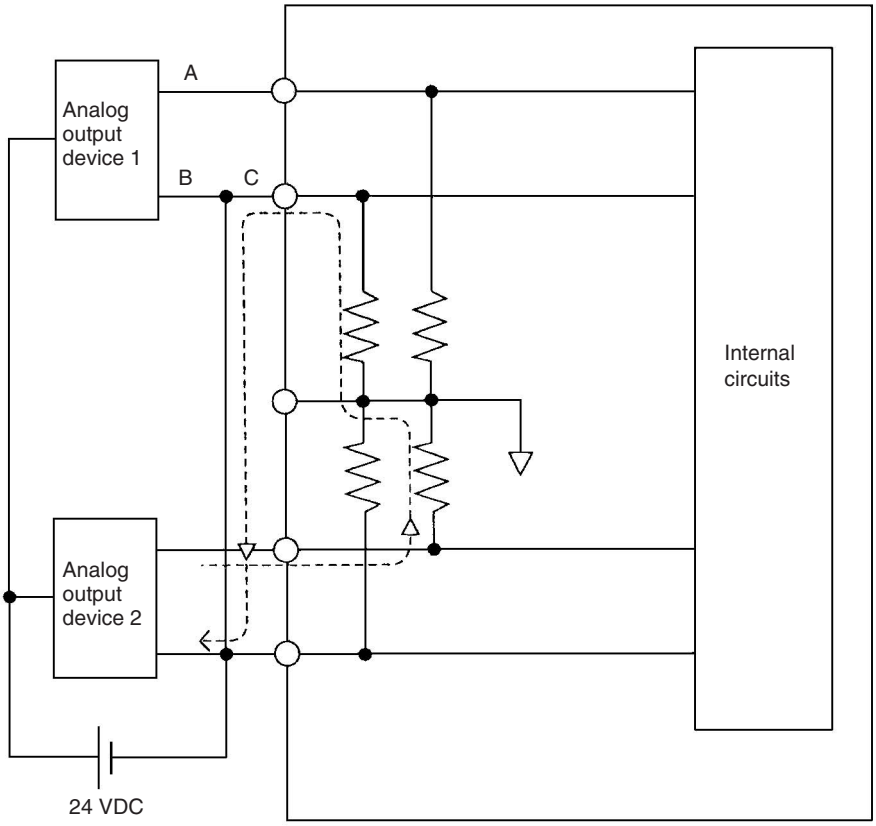


Precautions for Correct Use

- Do not connect the shield when using shielded twisted-pair cables.
- When an input is not being used, short V IN and I IN to COM terminals.
- Separate wiring from power lines (AC power supply lines, high-voltage lines, etc.)
- When there is noise in the power supply line, install a noise filter on the input section and the power supply terminals.

Additional Information

Refer to the following information on open circuits when using voltage inputs.



Example: If connected device 2 is outputting 5 V and the same power supply is being used for both devices as shown above, approximately 1/3, or 1.6 V, will be applied to the input for input device 1.

If a wiring disconnection occurs when voltage input is being used, the situation described below will result. Either separate the power supplies for the connected devices, or use an isolator for each input.

- If the same power supply is being used by the connected devices and a disconnection occurs at points A or B in the above diagram, an unwanted circuit path will occur as shown along the dotted line in the diagram. If that occurs, a voltage of approximately 1/3 to 1/2 of the output voltage of the other connected device will be generated.
- If that voltage is generated while the setting is for 1 to 5 V, open-circuit detection may not be possible.
- If a disconnection occurs at point C in the diagram, the negative (-) side will be used for both devices and open-circuit detection will not be possible.

This problem will not occur for current inputs even if the same power supply is used.

Additional Information

When external power is supplied (when setting the range code), or when there is a power interruption, a pulse-form analog output may be generated.
If this causes problems with operation, take countermeasures such as those suggested below.

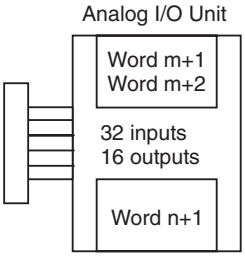
(1) Countermeasure 1
- Turn ON the power supply for the CP2E CPU Unit first, confirm correct operation, and then turn ON the power supply for the load.
- Turn OFF the power supply for the load before turning OFF the power supply for the CP2E CPU Unit.

(2) Countermeasure 2
- Control the machine not only by analog output but also by other signals (additional start/stop control signal for machine).

3 Create the ladder program.

(1) Allocating I/O Words

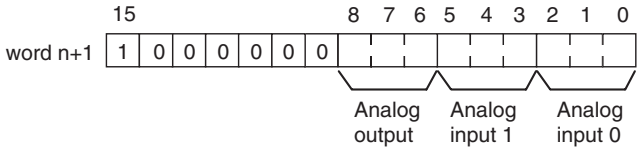
Two input words and one output word are allocated to the Analog I/O Unit starting from the next word following the last word allocated to the CPU Unit or previous Expansion Unit or Expansion I/O Unit.



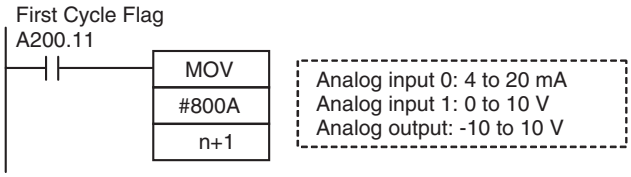
(2) Writing the Set Data

Write the set data to word n+1. A/D or D/A conversion begins when the set data is transferred from the CPU Unit to the Analog I/O Unit. There are five range codes, 000 to 100, that combine the analog input 0 and 1 and analog output ranges, as shown below.

Range code	Analog input 0 range	Analog input 1 range	Analog output range
000	-10 to 10 V	-10 to 10 V	-10 to 10 V
001	0 to 10 V	0 to 10 V	0 to 10 V
010	1 to 5 V/4 to 20 mA	1 to 5 V/4 to 20 mA	1 to 5 V
011	0 to 5 V/0 to 20 mA	0 to 5 V/0 to 20 mA	0 to 20 mA
100	–	–	4 to 20 mA



Example: The following instructions set analog input 0 to 4 to 20 mA, analog input 1 to 0 to 10 V, and the analog output to -10 to 10 V.



- The Analog I/O Unit will not start converting analog I/O values until the range code has been written. Inputs will be 0000, and 0 V or 0 mA will be output.
- After the range code has been set, 0 V or 0 mA will be output for the 0 to 10V, -10 to 10V, or 0 to 20mA ranges, and 1 V or 4 mA will be output for the 1 to 5V and 4 to 20mA ranges until a convertible value has been written to the output word.
- Once the range code has been set, it is not possible to change the setting while power is being supplied to the CPU Unit. To change the I/O range, turn the CPU Unit OFF then ON again.

(3) Reading Analog Input Converted Values

The ladder program can be used to read the memory area words where the converted values are stored.

Values are output to the next two words (m + 1, m + 2) following the last input word (m) allocated to the CPU Unit or previous Expansion Unit or Expansion I/O Unit.

(4) Writing Analog Output Converted Values

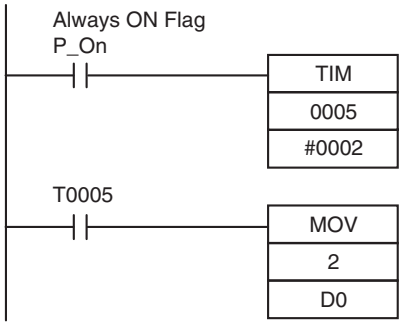
The ladder program can be used to write data to the memory area where the set value is stored.

The output word will be “n+1”, where “n” is the last output word allocated to the CPU Unit or previous Expansion Unit or Expansion I/O Unit.

(5) Startup Operation

After the power is turned ON, it will require two cycle times plus approximately 50 ms before the first conversion data is stored in the input words. Therefore, create a program as shown below, so that when operation begins simultaneously with startup it will wait for valid conversion data.

Analog input data will be 0000 until initial processing is completed. Analog output data will be 0 V or 0 mA until the range code has been written. After the range code has been written, the analog output data will be 0 V or 0 mA if the range is 0 to 10 V, -10 to 10 V, or 0 to 20 mA, or it will be 1 V or 4 mA if the range is 1 to 5 V or 4 to 20 mA.



TIM0005 is started when the power is turned ON. After 0.2 s (200 ms) elapses, the TIM0005 contact turns ON and the converted data from analog input 0 that is stored in CIO 2 will be transferred to D0.

(6) Handling Unit Errors

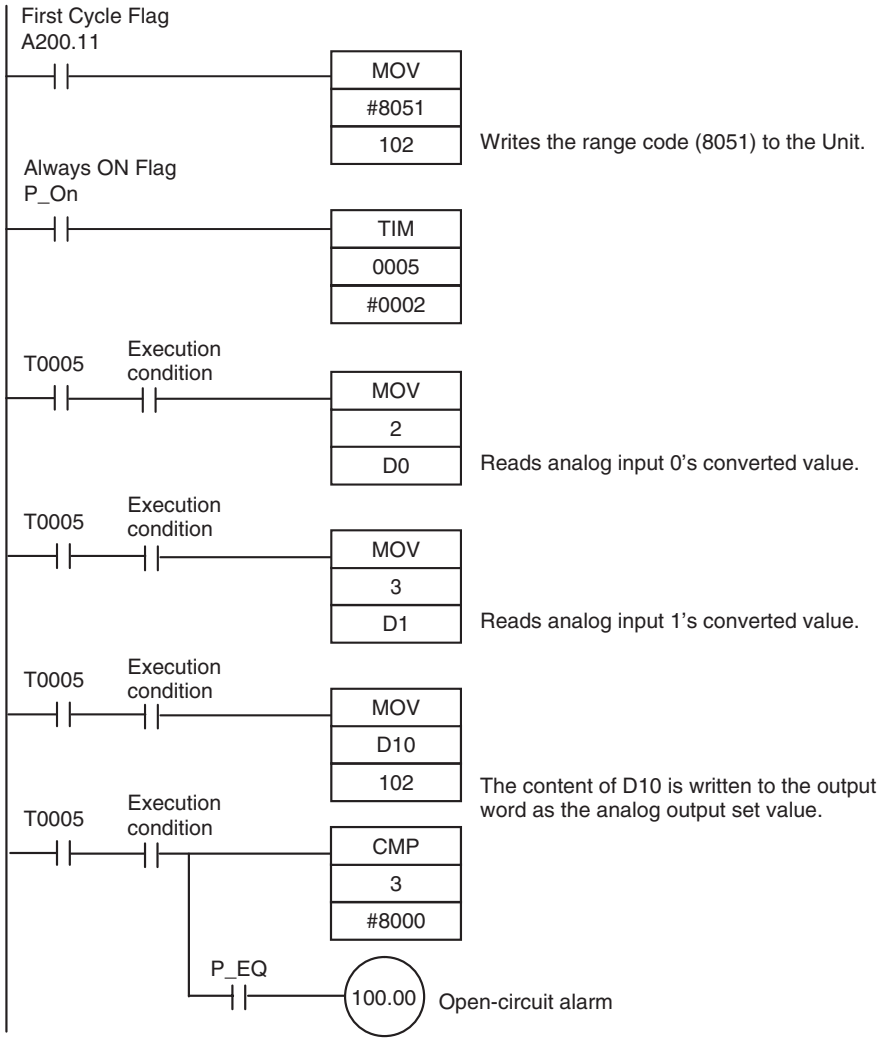
- When an error occurs in the Analog I/O Unit, analog input data will be 0000 and 0 V or 0 mA will be output as the analog output.
  If a CPU error or an I/O bus error (fatal errors) occurs at the CPU Unit and the analog output is set to 1 to 5 V or 4 to 20 mA, 0 V or 0 mA will be output. For any other fatal errors at the CPU Unit, 1 V or 4 mA will be output.
- Expansion Unit and Expansion I/O Unit errors are output to bits 0 to 5 of word A436. The bits are allocated from A436.00 in order starting from the Unit nearest the CPU Unit. Use these flags in the program when it is necessary to detect errors.

(7) Programming Example

Analog input 0: 0 to 10 V

Analog input 1: 4 to 20 mA

Analog output : 0 to 10 V



8-3-2 CP1W-MAD42/CP1W-MAD44 Analog I/O Units

Overview

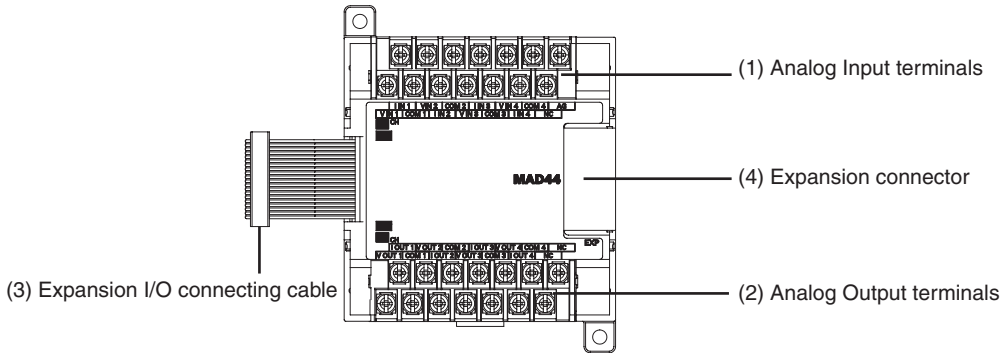
Each CP1W-MAD42 Analog I/O Unit provides 4 analog inputs and 2 analog outputs.

Each CP1W-MAD44 Analog I/O Unit provides 4 analog inputs and 4 analog outputs.

- The analog input range can be set to 0 to 5 VDC, 1 to 5 VDC, 0 to 10 VDC, −10 to 10 VDC, 0 to 20 mA, or 4 to 20 mA. The inputs have a resolution of 1/12000.
  An open-circuit detection function is activated in the ranges of 1 to 5 VDC and 4 to 20 mA.
- The analog output range can be set to 1 to 5 VDC, 0 to 10 VDC, −10 to 10 VDC, 0 to 20 mA, or 4 to 20 mA. The outputs have a resolution of 1/12000.

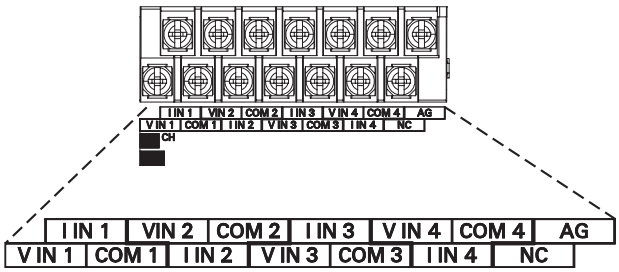
Part Names and Functions

● **CP1W-MAD42/CP1W-MAD44**



(1)Analog Input Terminals
Connected to analog output devices.

- Input Terminal Arrangement for CP1W-MAD42/MAD44

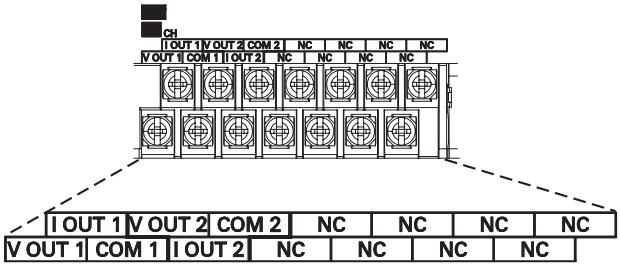


V IN1	Voltage input 1
I IN1	Current input 1
COM1	Input common 1
V IN2	Voltage input 2
I IN2	Current input 2
COM2	Input common 2
V IN3	Voltage input 3
I IN3	Current input 3
COM3	Input common 3
V IN4	Voltage input 4
I IN4	Current input 4
COM4	Input common 4

Note When using current inputs, voltage input terminals must be short-circuited with current input terminals.

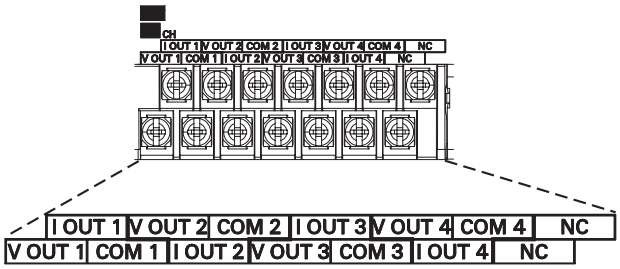
(2)Analog Output Terminals
Connected to analog input devices.

- Output Terminal Arrangement for CP1W-MAD42



V OUT1	Voltage output 1
I OUT1	Current output 1
COM1	Output common 1
V OUT2	Voltage output 2
I OUT2	Current output 2
COM2	Output common 2

- Output Terminal Arrangement for CP1W-MAD44



V OUT1	Voltage output 1
I OUT1	Current output 1
COM1	Output common 1
V OUT2	Voltage output 2
I OUT2	Current output 2
COM2	Output common 2
V OUT3	Voltage output 3
I OUT3	Current output 3
COM3	Output common 3
V OUT4	Voltage output 4
I OUT4	Current output 4
COM4	Output common 4

(3)Expansion I/O Connecting Cable
Connected to the expansion connector of a CPU Unit or an Expansion Unit or Expansion I/O Unit. The cable is provided with the Analog I/O Unit and cannot be removed.

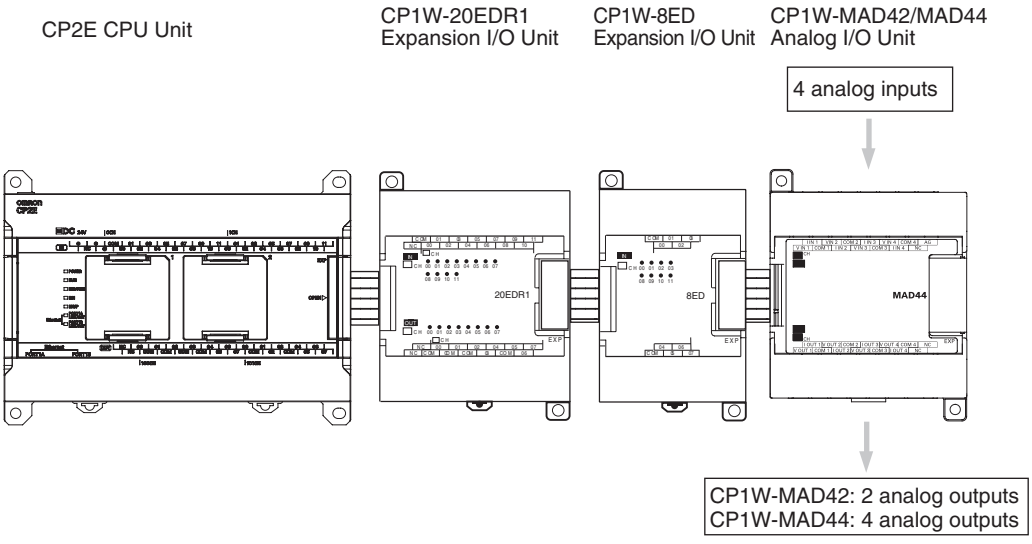
Precautions for Safe Use

Do not touch the cables during operation. Static electricity may cause operating errors.

(4)Expansion Connector
Used for connecting Expansion Units or Expansion I/O Units.

Specifications

CP1W-MAD42/MAD44 Analog I/O Units are connected to the CP2E CPU Unit.



Model			CP1W-MAD42/CP1W-MAD44	
Item			Voltage I/O	Current I/O
Analog Input Section	Number of inputs		4 inputs (4 words allocated)	
	Input signal range		0 to 5 VDC, 1 to 5 VDC, 0 to 10 VDC, or −10 to 10 VDC	0 to 20 mA or 4 to 20 mA
	Max. rated input		±15 V	±30 mA
	External input impedance		1 MΩ min.	Approx. 250 Ω
	Resolution		1/12000 (full scale)	
	Overall accuracy	25°C	0.2% full scale	0.3% full scale
		0 to 60°C	0.5% full scale	0.7% full scale
		-20 to 0°C	0.7% full scale	0.9% full scale
	A/D conversion data		16-bit binary (4-digit hexadecimal) Full scale for −10 to 10 V: E890 to 1770 hex Full scale for other ranges: 0000 to 2EE0 hex	
	Averaging function		Supported	
	Open-circuit detection function		Supported	
Analog Output Section	Number of outputs		CP1W-MAD42: 2 outputs (2 words allocated) CP1W-MAD44: 4 outputs (4 words allocated)	
	Output signal range		1 to 5 VDC, 0 to 10 VDC, or −10 to 10 VDC	0 to 20 mA or 4 to 20 mA
	Allowable external output load resistance		2 kΩ min.	350 Ω max.
	External output impedance		0.5 Ω max.	
	Resolution		1/12000 (full scale)	
	Overall accuracy	25°C	0.3% full scale	
		0 to 60°C	0.7% full scale	
		-20 to 0°C	0.9% full scale	
	Set data (D/A conversion)		16-bit binary (4-digit hexadecimal) Full scale for −10 to 10 V: E890 to 1770 hex Full scale for other ranges: 0000 to 2EE0 hex	
Conversion time			CP1W-MAD42: 1 ms/point (6 ms/all points) CP1W-MAD44: 1 ms/point (8 ms/all points)	
Isolation method			Photocoupler isolation between analog I/O terminals and internal circuits. No isolation between analog I/O signals.	
Current consumption			CP1W-MAD42: 5 VDC: 120 mA max., 24 VDC: 120 mA max. CP1W-MAD44: 5 VDC: 120 mA max., 24 VDC: 170 mA max.	

● Analog I/O Signal Ranges

Analog I/O data is digitally converted according to the analog I/O signal range as shown below.

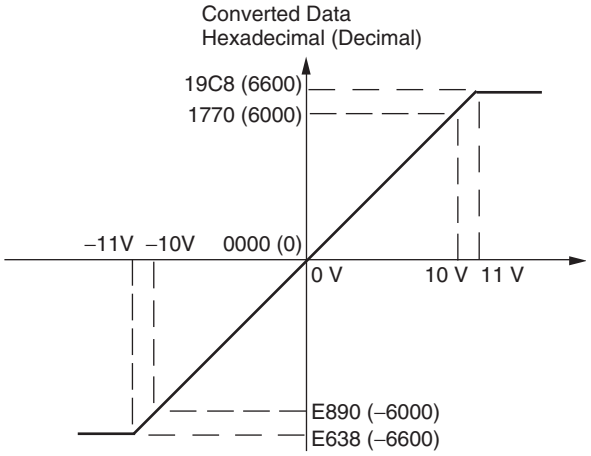
Additional Information

When the input/output exceeds the specified range, the AD/DA converted data will be fixed at either the lower limit or upper limit.

Analog Input Signal Ranges

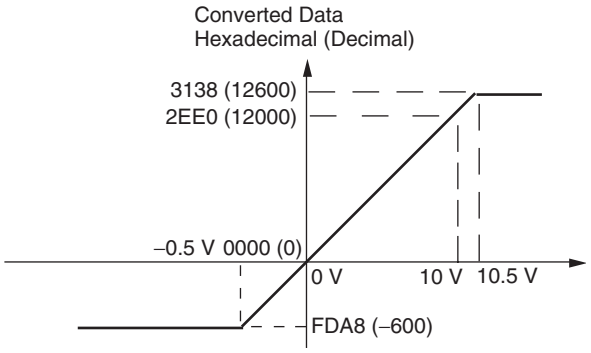
−10 to 10 V

The −10 to 10 V range corresponds to the hexadecimal values E890 to 1770 (−6000 to 6000). The entire data range is E638 to 19C8 (−6600 to 6600).
A negative voltage is expressed as a two's complement.



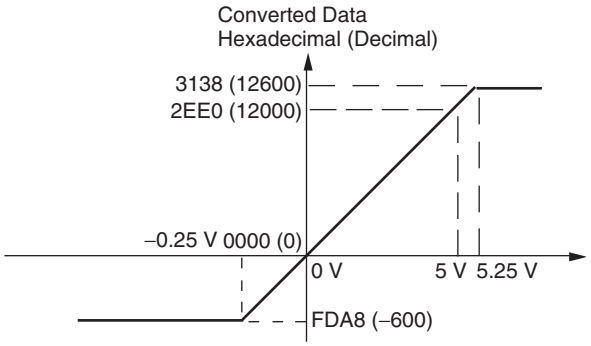
0 to 10 V

The 0 to 10 V range corresponds to the hexadecimal values 0000 to 2EE0 (0 to 12000). The entire data range is FDA8 to 3138 (−600 to 12600). A negative voltage is expressed as a two's complement.



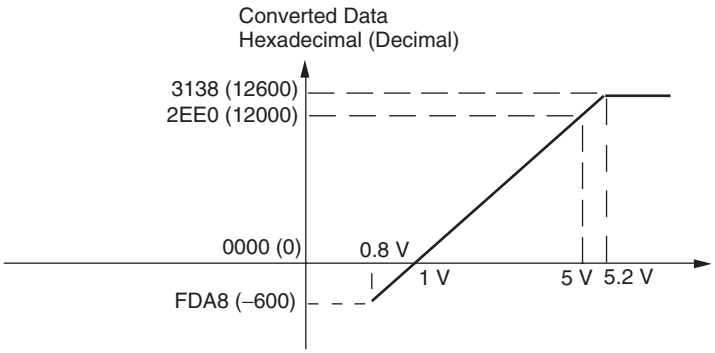
0 to 5 V

The 0 to 5 V range corresponds to the hexadecimal values 0000 to 2EE0 (0 to 12000). The entire data range is FDA8 to 3138 (−600 to 12600). A negative voltage is expressed as a two's complement.



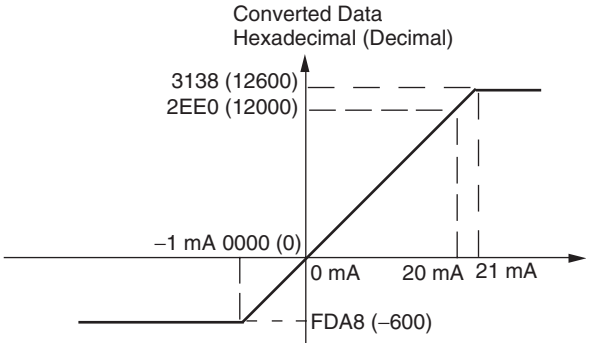
1 to 5 V

The 1 to 5 V range corresponds to the hexadecimal values 0000 to 2EE0 (0 to 12000). The entire data range is FDA8 to 3138 (−600 to 12600). Inputs between 0.8 and 1 V are expressed as two's complements. If the input falls below 0.8 V, open-circuit detection will activate and converted data will be 8000.



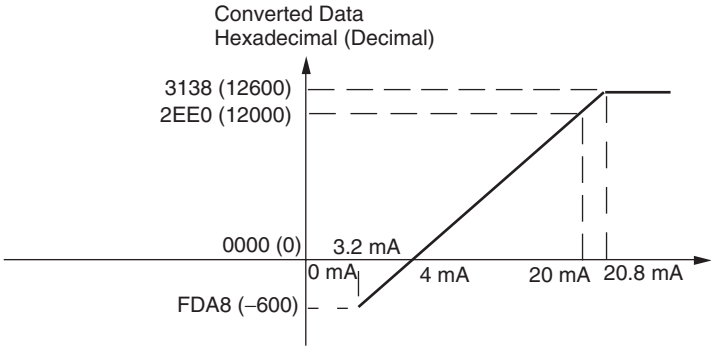
0 to 20 mA

The 0 to 20 mA range corresponds to the hexadecimal values 0000 to 2EE0 (0 to 12000). The entire data range is FDA8 to 3138 (−600 to 12600). A negative current is expressed as a two's complement.



4 to 20 mA

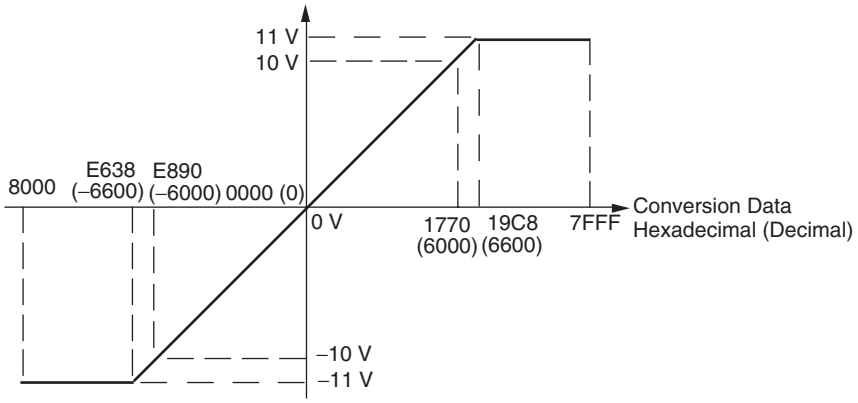
The 4 to 20 mA range corresponds to the hexadecimal values 0000 to 2EE0 (0 to 12000). The entire data range is FDA8 to 3138 (−600 to 12600). Inputs between 3.2 and 4 mA are expressed as two's complements. If the input falls below 3.2 mA, open-circuit detection will activate and converted data will be 8000.



Analog Output Signal Ranges

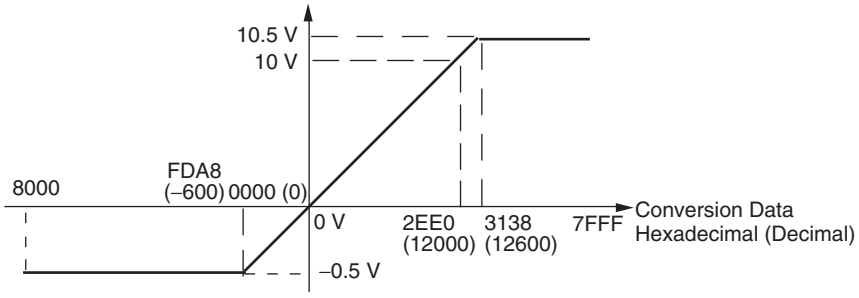
−10 to 10 V

The hexadecimal values E890 to 1770 (−6000 to 6000) correspond to an analog voltage range of −10 to 10 V. The entire output range is −11 to 11 V. Specify a negative voltage as a two's complement.



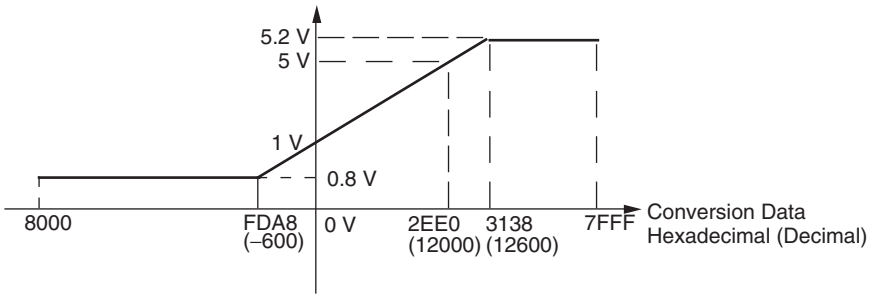
0 to 10 V

The hexadecimal values 0000 to 2EE0 (0 to 12000) correspond to an analog voltage range of 0 to 10 V. The entire output range is −0.5 to 10.5 V. Specify a negative voltage as a two's complement.



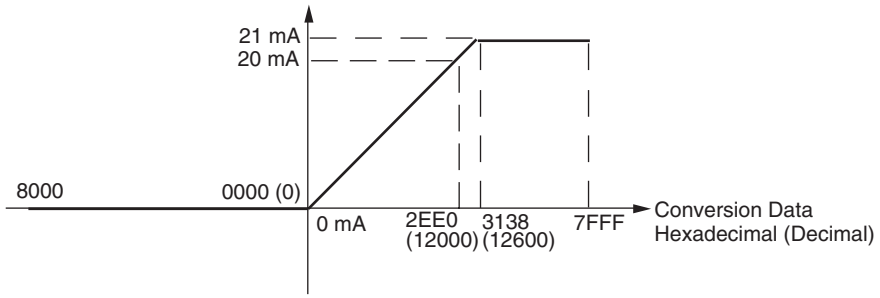
1 to 5 V

The hexadecimal values 0000 to 2EE0 (0 to 12000) correspond to an analog voltage range of 1 to 5 V. The entire output range is 0.8 to 5.2 V.



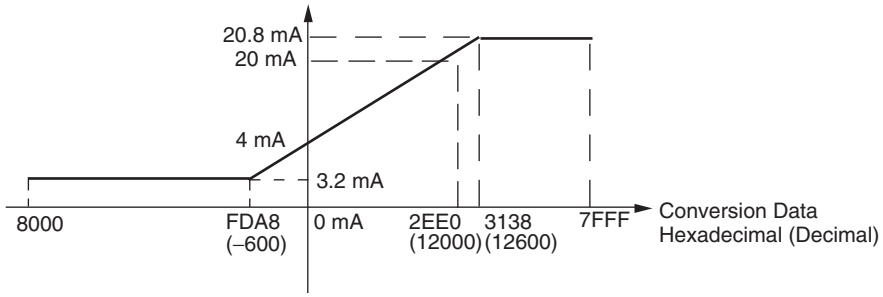
0 to 20 mA

The hexadecimal values 0000 to 2EE0 (0 to 12000) correspond to an analog current range of 0 to 20 mA. The entire output range is 0 to 21 mA.



4 to 20 mA

The hexadecimal values 0000 to 2EE0 (0 to 12000) correspond to an analog current range of 4 to 20 mA. The entire output range is 3.2 to 20.8 mA.



● Averaging Function for Analog Inputs

For analog inputs, the averaging function operates when the averaging bit is set to 1. The averaging function outputs the average (a moving average) of the last eight input values as the converted value. If there is only a slight variation in inputs, it is handled by the averaging function as a smooth input.

The averaging function stores the average (a moving average) of the last eight input values as the converted value. Use this function to smooth inputs that vary at a short interval.

● Open-circuit Detection Function for Analog Inputs

The open-circuit detection function is activated when the input range is set to 1 to 5 V and the voltage drops below 0.8 V, or when the input range is set to 4 to 20 mA and the current drops below 3.2 mA. When the open-circuit detection function is activated, the converted data will be set to 8,000.

The time for enabling or clearing the open-circuit detection function is the same as the time for converting the data. If the input returns to the convertible range, the open-circuit detection is cleared automatically and the output returns to the normal range.

Flow of Operation

1 Connect the Unit.

- Connect the Analog I/O Unit.
- Set analog inputs as voltage or current inputs and set the averaging function.

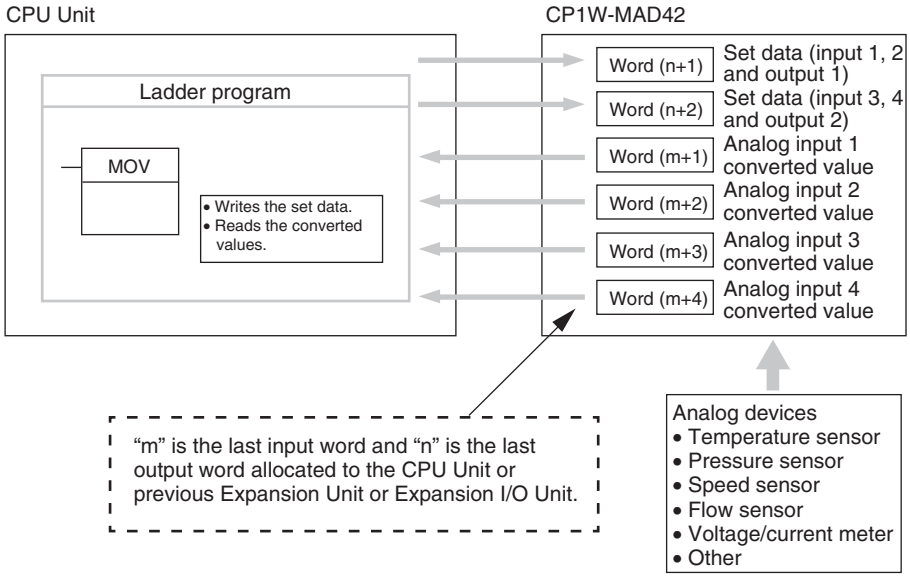
2 Wire the analog I/O.

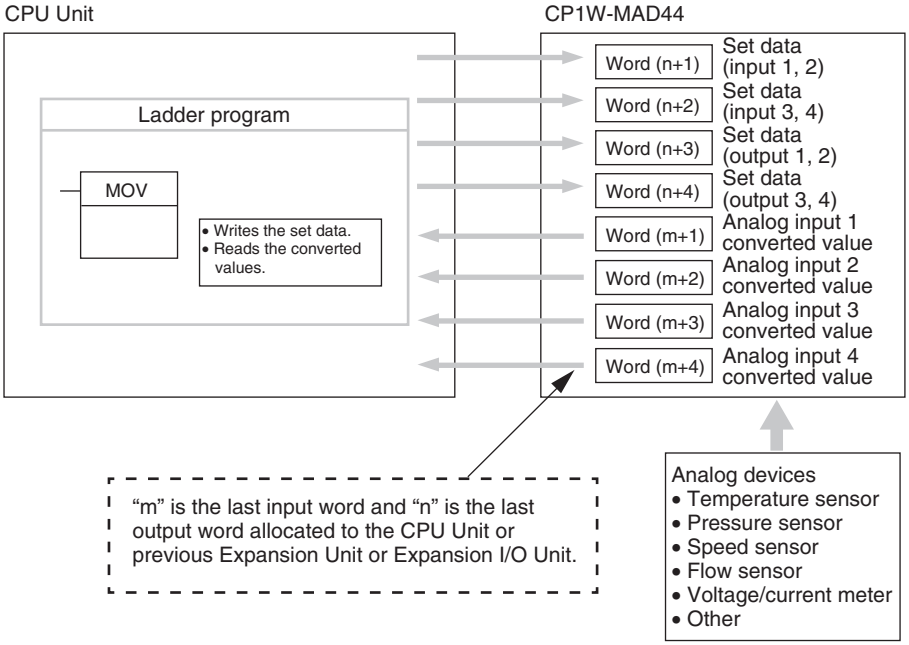
- Connect analog I/O devices.

3 Create a ladder program.

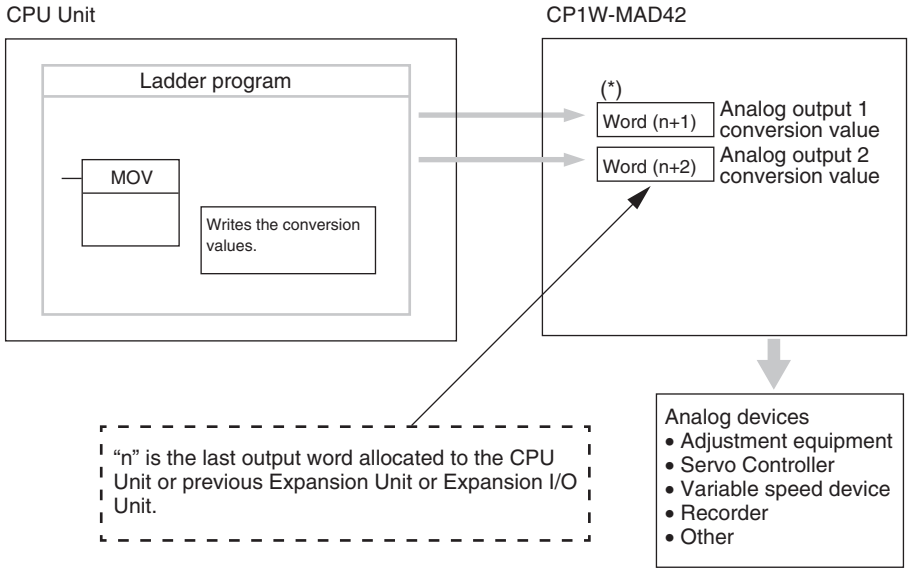
- Write the range code.
- Analog inputs: Read converted values.
- Analog output: Write set data.

● Writing Set Data and Reading A/D Converted Data

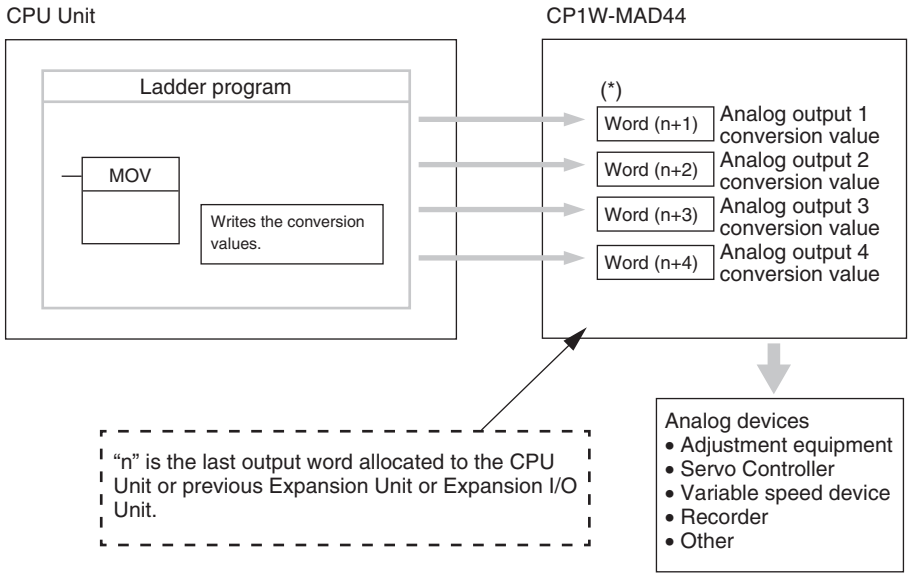




● Writing D/A Conversion Data

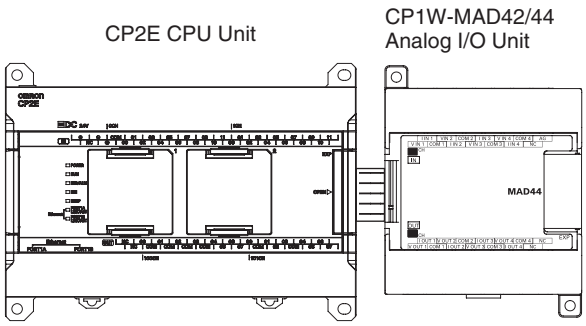


* Words (n+1, n+2) can be used for either the set data or the analog output conversion value.



* Words (n+1 to n+4) can be used for either the set data or the analog output conversion value.

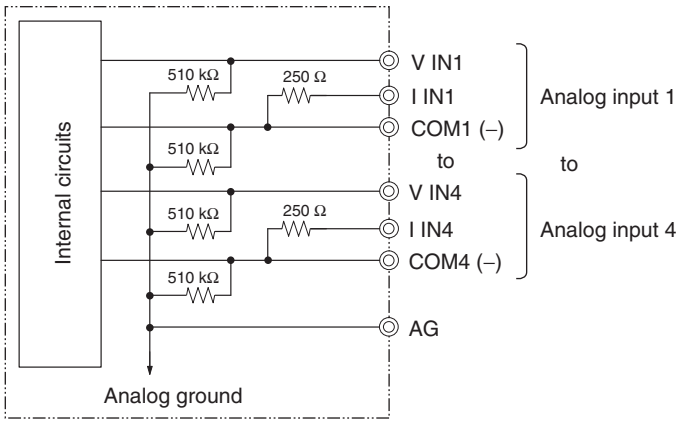
1 Connect the Analog I/O Unit to the CPU Unit.



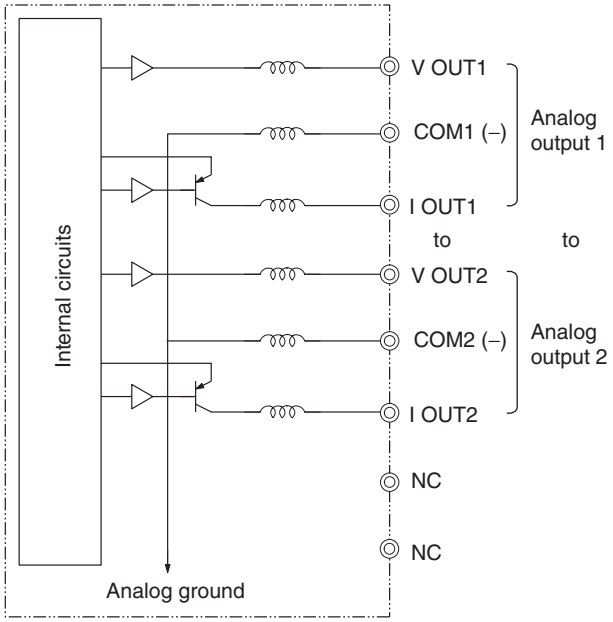
2 Wire to analog I/O devices.

(1) Wiring internal circuits of the CPU Unit

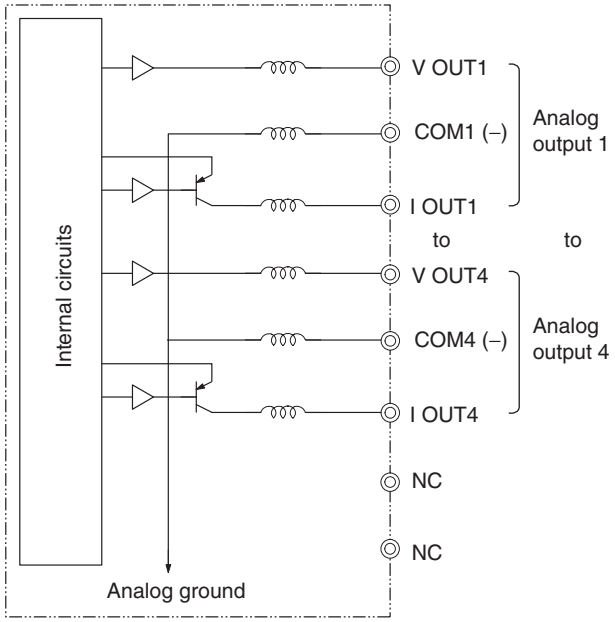
Analog Inputs



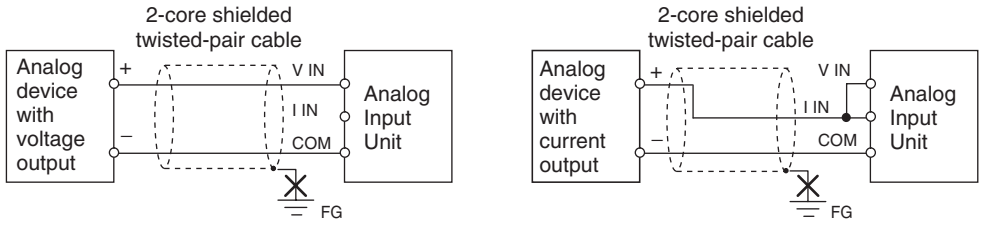
Analog Outputs (CP1W-MAD42)



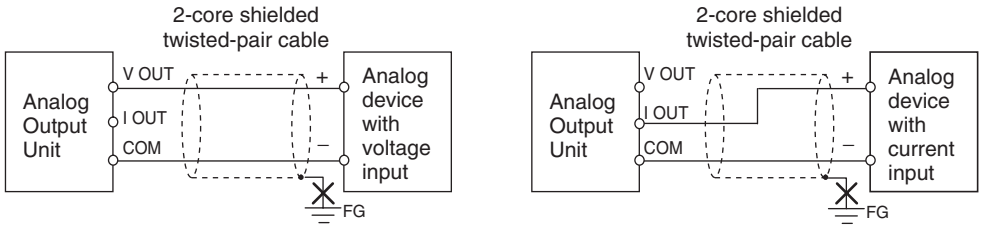
Analog Outputs (CP1W-MAD44)



(2) Wiring analog output devices to the Analog I/O Unit



(3) Wiring analog input devices to the Analog I/O Unit

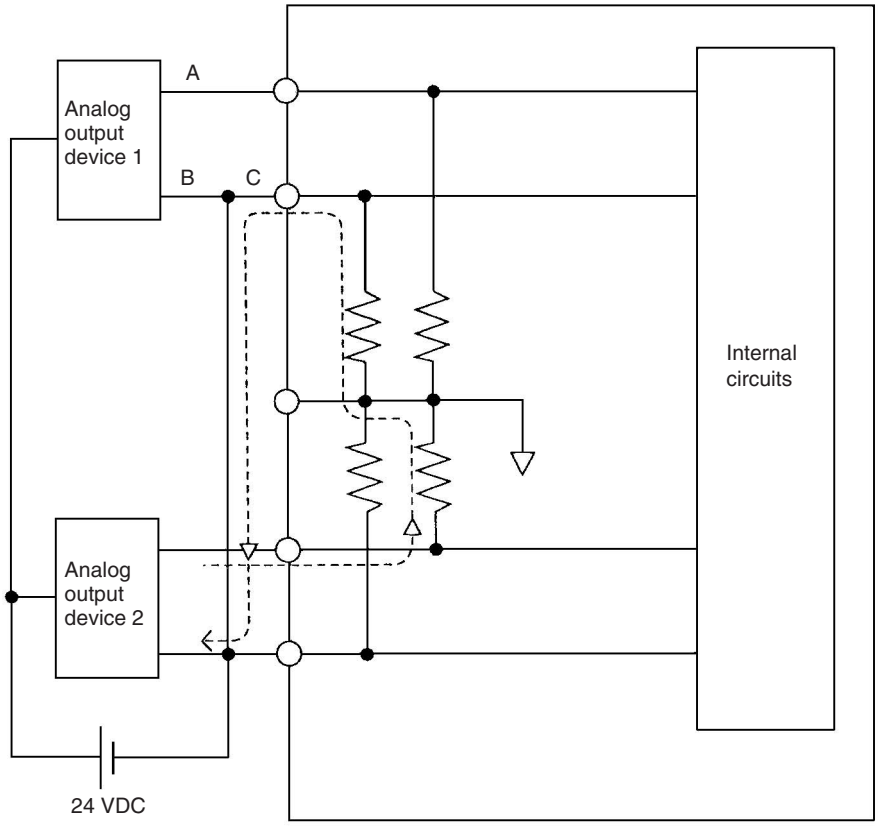


Precautions for Correct Use

- Do not connect the shield when using shielded twisted-pair cables.
- When an input is not being used, short V IN and I IN to COM terminals.
- Separate wiring from power lines (AC power supply lines, high-voltage lines, etc.)
- When there is noise in the power supply line, install a noise filter on the input section and the power supply terminals.

Additional Information

Refer to the following information on open circuits when using voltage inputs.



Example: If connected device 2 is outputting 5 V and the same power supply is being used for both devices as shown above, approximately 1/3, or 1.6 V, will be applied to the input for input device 1.

If a wiring disconnection occurs when voltage input is being used, the situation described below will result. Either separate the power supplies for the connected devices, or use an isolator for each input.

- If the same power supply is being used by the connected devices and a disconnection occurs at points A or B in the above diagram, an unwanted circuit path will occur as shown along the dotted line in the diagram. If that occurs, a voltage of approximately 1/3 to 1/2 of the output voltage of the other connected device will be generated.
- If that voltage is generated while the setting is for 1 to 5 V, open-circuit detection may not be possible.
- If a disconnection occurs at point C in the diagram, the negative (-) side will be used for both devices and open-circuit detection will not be possible.

This problem will not occur for current inputs even if the same power supply is used.

Additional Information

When external power is supplied (when setting the range code), or when there is a power interruption, a pulse-form analog output may be generated.
If this causes problems with operation, take countermeasures such as those suggested below.

(1) Countermeasure 1

- Turn ON the power supply for the CP2E CPU Unit first, confirm correct operation, and then turn ON the power supply for the load.
- Turn OFF the power supply for the load before turning OFF the power supply for the CP2E CPU Unit.

(2) Countermeasure 2

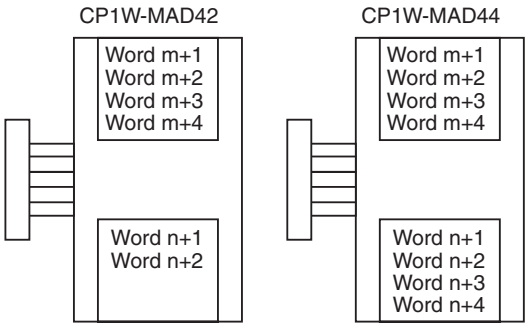
- Control the machine not only by analog output but also by other signals (additional start/stop control signal for machine).

3 Create the ladder program.

(1) Allocating I/O Words

Four input words and two output words are allocated to the CP1W-MAD42, starting from the next word following the last word allocated to the CPU Unit or previous Expansion Unit or Expansion I/O Unit.

Four input words and four output words are allocated to the CP1W-MAD44, starting from the next word following the last word allocated to the CPU Unit or previous Expansion Unit or Expansion I/O Unit.



(2) Writing the Range Code

(a) CP1W-MAD42

Write the set data to words (n+1 to n+2). A/D or D/A conversion begins when the set data is transferred from the CPU Unit to the Analog I/O Unit. Setting contents are shown as the following table.

Word (n+1)	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Value	1	0	0	0	Analog output 1				Analog input 2				Analog input 1			
Word (n+2)	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Value	1	0	0	0	Analog output 2				Analog input 4				Analog input 3			

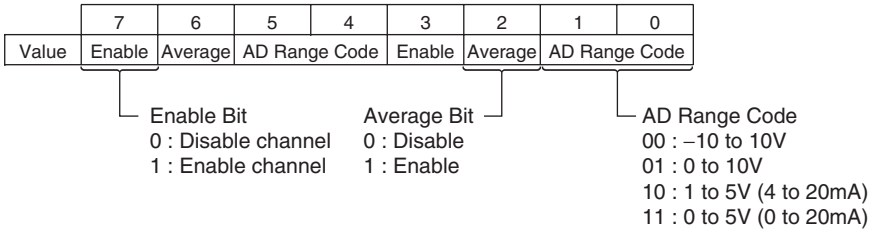
(b) CP1W-MAD44

Write the set data to words (n+1 to n+4). A/D or D/A conversion begins when the set data is transferred from the CPU Unit to the Analog I/O Unit. Setting contents are shown as the following table.

Word (n+1)	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Value	1	0	0	0	0	0	0	0	Analog input 2				Analog input 1			
Word (n+2)	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Value	1	0	0	0	0	0	0	0	Analog input 4				Analog input 3			
Word (n+3)	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Value	1	0	0	0	0	0	0	0	Analog output 2				Analog output 1			
Word (n+4)	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Value	1	0	0	0	0	0	0	0	Analog output 4				Analog output 3			

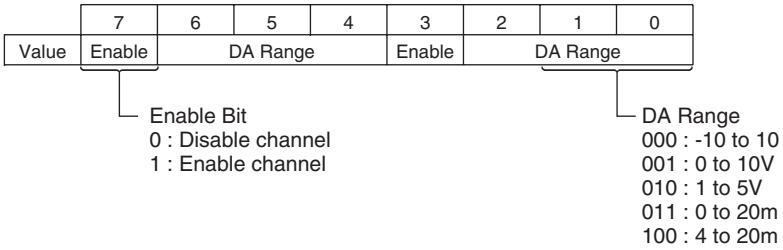
Even if analog inputs are not used, bit 15 in word (n+1) and (n+2) must be set to 1.

- Set Data of Analog Inputs



Range Code	Analog input range
00	−10 to 10 V
01	0 to 10 V
10	1 to 5 V (4 to 20 mA)
11	0 to 5 V (0 to 20 mA)

- Set Data of Analog Outputs



Range Code	Analog output range
000	−10 to 10 V
001	0 to 10 V
010	1 to 5 V
011	0 to 20 mA
100	4 to 20 mA

- The Analog I/O Unit will not start converting analog I/O values until the set data has been written.
- Before range code is written, 0 V or 0 mA will be output in the 0 to 10 V, −10 to +10 V, and 0 to 20 mA ranges, and 1 V or 4 mA will be output in the 1 to 5 V and 4 to 20 mA ranges.
- Once the range code has been set, it is not possible to be changed while power is being supplied to the CPU Unit. To change the code range, turn the CPU Unit OFF then ON again.

(3) Averaging

Set whether averaging is to be used for set data. When the averaging bit is set to 1, the average (moving average) for the past eight inputs is output as conversion data.

(4) Reading Analog Input Converted Values

Read the conversion value storage area with the ladder program. With word m as the last input word allocated to the CPU Unit or an already-connected Expansion Unit, the A/D conversion data will be output to the following words m+1 to m+4.

(5) Writing Analog Output Converted Values

The ladder program can be used to write conversion data to the output words. The output word start from “n+1” where “n” is the last output word allocated to the CPU Unit, or previous Expansion Unit or Expansion I/O Unit.

(6) Startup Operation

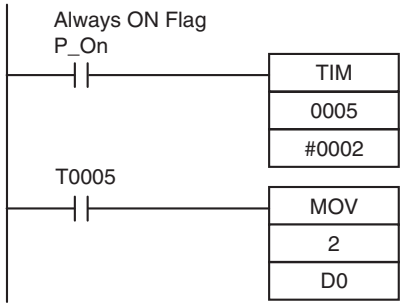
After power is turned ON, it will require two cycle times plus approximately 50ms before the first conversion data is output.

Analog input data will be 0000 until the first conversion data is stored in the input words.

The following table shows the output status after the initial processing is completed.

Output type	Voltage output		Current output	
Output range	0 to 10 V, -10 to +10 V	1 to 5 V	0 to 20 mA	4 to 20 mA
Before range code is written	0V		0mA	
After range code is written	0V	1V	0mA	4mA

Therefore, create a program as shown below, so that the ladder can start to operate with valid conversion data in input words.

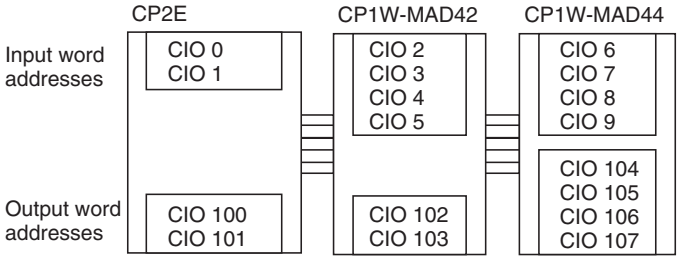


TIM0005 is started when the power is turned ON. After 0.2 s (200 ms) elapses, the TIM0005 contact turns ON and the converted data from analog input 0 that is stored in CIO 2 will be transferred to D0.

(7) Handling Unit Errors

When an error occurs in the Analog I/O Unit, analog input data will be 0000 and 0 V or 0 mA will be output as the analog output.
If a CPU error or an I/O bus error (fatal errors) occurs at the CPU Unit and the analog output is set to 1 to 5 V or 4 to 20 mA, 0 V or 0 mA will be output. For any other errors at the CPU Unit, 1 V or 4 mA will be output.

(8) Programming Example



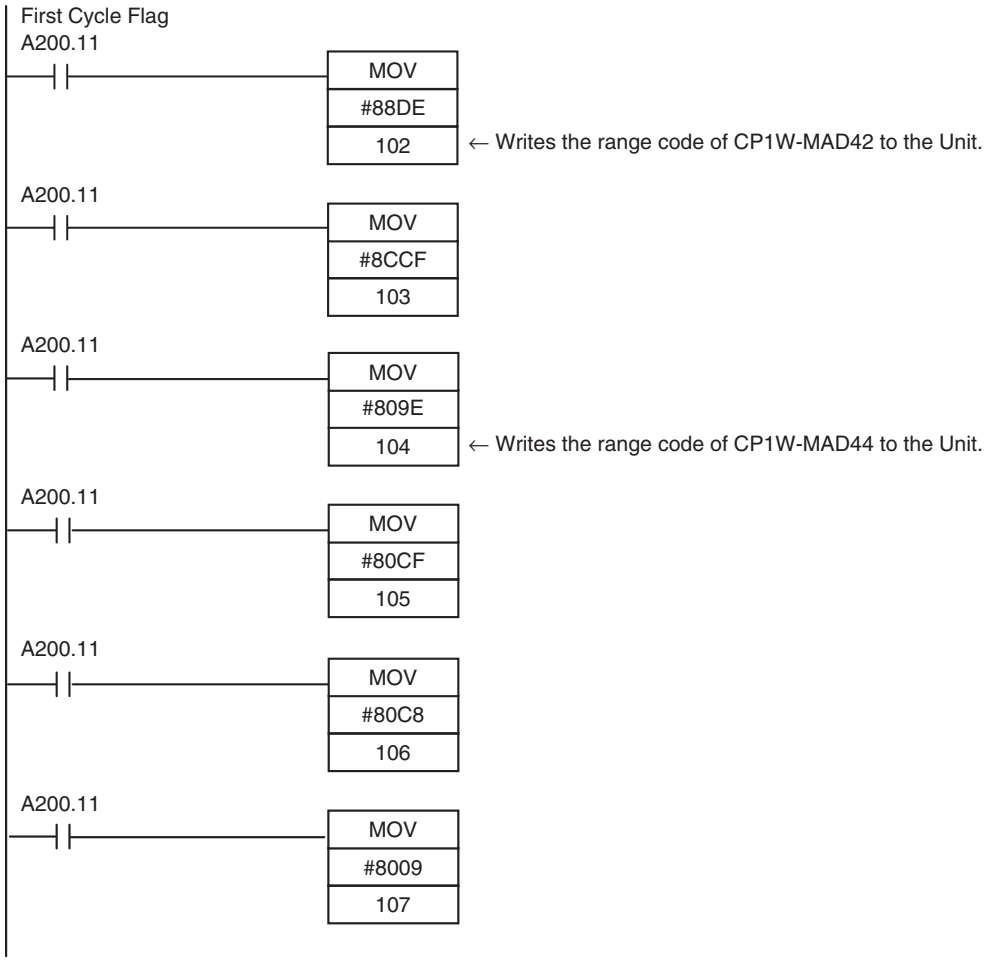
This programming example uses these ranges:

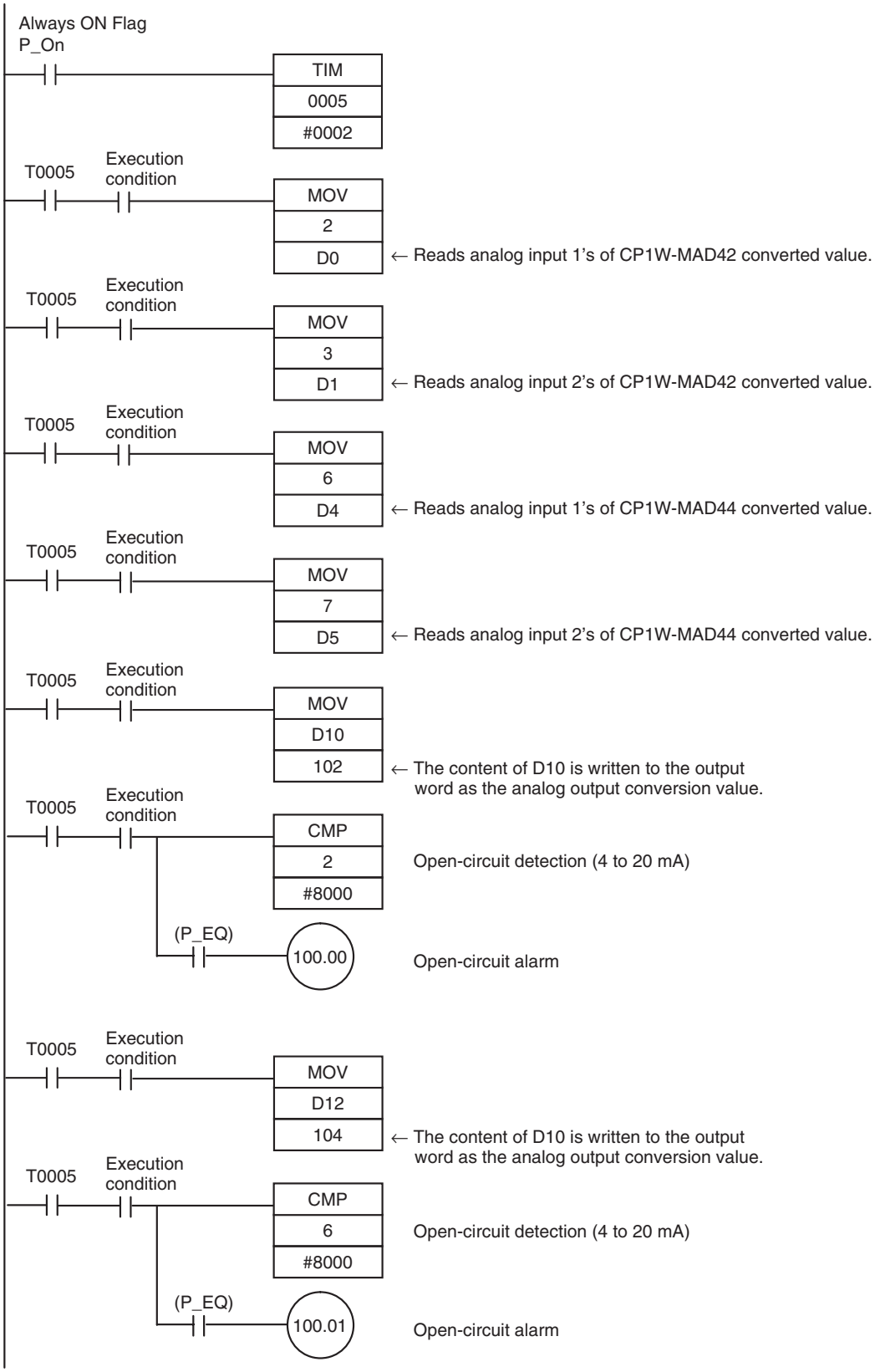
(a) CP1W-MAD42

Analog input	Input range	Range code	Averaging	Set data	Destination word
Input 1	4 to 20 mA	10	Yes	1110 (E hex)	n+1
Input 2	0 to 10 V	01	Yes	1101 (D hex)	n+1
Input 3	0 to 5 V	11	Yes	1111 (F hex)	n+2
Input 4	-10 to 10 V	00	Yes	1100 (C hex)	n+2
Output 1	-10 to 10 V	000	–	1000 (8 hex)	n+1
Output 2	4 to 20 mA	100	–	1100 (C hex)	n+2

(a) CP1W-MAD44

Analog input	Input range	Range code	Averaging	Set data	Destination word
Input 1	4 to 20 mA	10	Yes	1110 (E hex)	n+1
Input 2	0 to 10 V	01	No	1001 (9 hex)	n+1
Input 3	0 to 5 V	11	Yes	1111 (F hex)	n+2
Input 4	-10 to 10 V	00	Yes	1100 (C hex)	n+2
Output 1	-10 to 10 V	000	–	1000 (8 hex)	n+3
Output 2	4 to 20 mA	100	–	1100 (C hex)	n+3
Output 3	0 to 10 V	001	–	1001 (9 hex)	n+4
Output 4	Not use	–	–	0000 (0 hex)	n+4




Always ON Flag
P_On
TIM
0005
#0002
T0005
Execution condition
MOV
2
D0
← Reads analog input 1's of CP1W-MAD42 converted value.
T0005
Execution condition
MOV
3
D1
← Reads analog input 2's of CP1W-MAD42 converted value.
T0005
Execution condition
MOV
6
D4
← Reads analog input 1's of CP1W-MAD44 converted value.
T0005
Execution condition
MOV
7
D5
← Reads analog input 2's of CP1W-MAD44 converted value.
T0005
Execution condition
MOV
D10
102
← The content of D10 is written to the output word as the analog output conversion value.
T0005
Execution condition
CMP
2
#8000
Open-circuit detection (4 to 20 mA)
(P_EQ)
100.00
Open-circuit alarm
T0005
Execution condition
MOV
D12
104
← The content of D10 is written to the output word as the analog output conversion value.
T0005
Execution condition
CMP
6
#8000
Open-circuit detection (4 to 20 mA)
(P_EQ)
100.01
Open-circuit alarm

8-4 Temperature Sensor Units

8-4-1 CP1W-TS□1/TS□2 Temperature Sensor Units

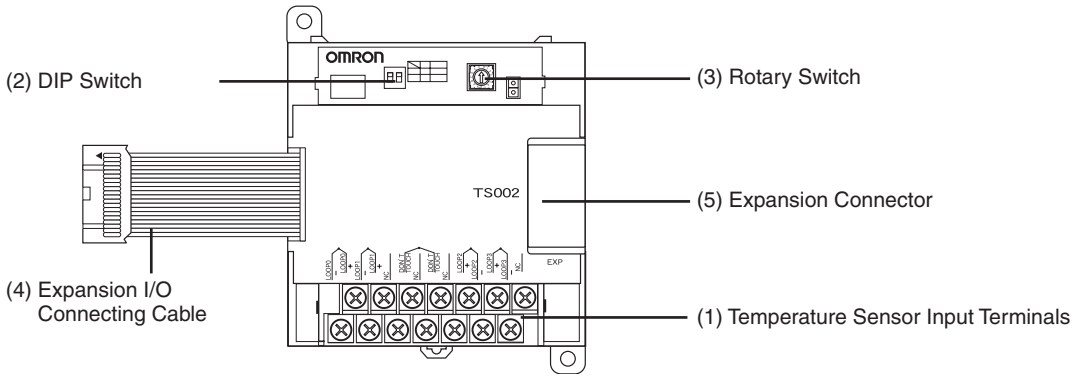
Overview

CP1W-TS002/TS102 Temperature Sensor Units each provide up to four input points, and CP1W-TS001/TS101 Temperature Sensor Units each provide up to two input points. The inputs can be from thermocouples or platinum resistance thermometers.

CP1W-TS002/TS102 Temperature Sensor Units are each allocated four input words.

Part Names and Functions

- **Temperature Sensor Units: CP1W-TS001/002/101/102**



(1)Temperature Sensor Input Terminals
Used to connect temperature sensors such as thermocouples or platinum resistance thermometers.

(2)DIP Switch
Used to set the temperature unit (°C or °F) and the number of decimal places used.

(3)Rotary Switch
Used to set the temperature input range. Make the setting according to the specifications of the temperature sensors that are connected.

(4)Expansion I/O Connecting Cable
Connected to the expansion connector of a CP2E CPU Unit or an Expansion Unit or Expansion I/O Unit. The cable is included with the Temperature Sensor Unit and cannot be removed.

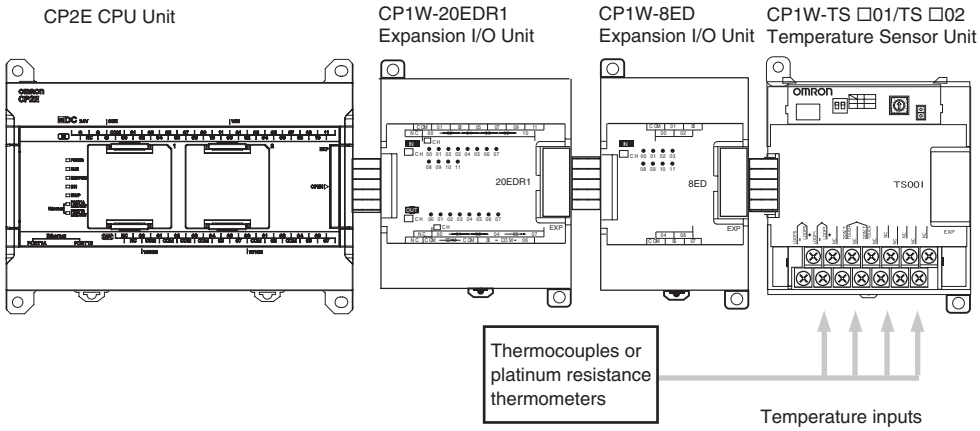
Precautions for Safe Use

Do not touch the cables during operation. Static electricity may cause operating errors.

(5)Expansion Connector
Used for connecting Expansion Units or Expansion I/O Units.

Specifications

A CP1W-TS□01/TS□02 Temperature Sensor Unit can be connected to a CP2E CPU Unit.



Model		CP1W-TS001	CP1W-TS002	CP1W-TS101	CP1W-TS102
Temperature sensors		Thermocouples		Platinum resistance thermometer	
		Switchable between K and J, but same type must be used for all inputs.		Switchable between Pt100 and JPt100, but same type must be used for all inputs.	
Number of inputs		2	4	2	4
Allocated input words		2	4	2	4
Accuracy	25°C	(The larger of ±0.5% of converted value or ±2°C) ±1 digit max. *		(The larger of ±0.5% of converted value or ±1°C) ±1 digit max. *	
	0 to 60°C	(The larger of ±1% of converted value or ±4°C) ±1 digit max. *		(The larger of ±1% of converted value or ±2°C) ±1 digit max. *	
	-20 to 0°C	(The larger of ±1.3% of converted value or ±5°C) ±1 digit max. *		(The larger of ±1.3% of converted value or ±3°C) ±1 digit max. *	
Conversion time		250 ms for 2 or 4 input points			
Converted temperature data		16-bit binary data (4-digit hexadecimal)			
Isolation		Photocouplers between all temperature input signals			
Current consumption		5 VDC: 40 mA max., 24 VDC: 59 mA max.		5 VDC: 54 mA max., 24 VDC: 73 mA max.	

* Accuracy for a K-type sensor at -100°C or less is ±4°C ±1 digit max.

Flow of Operation

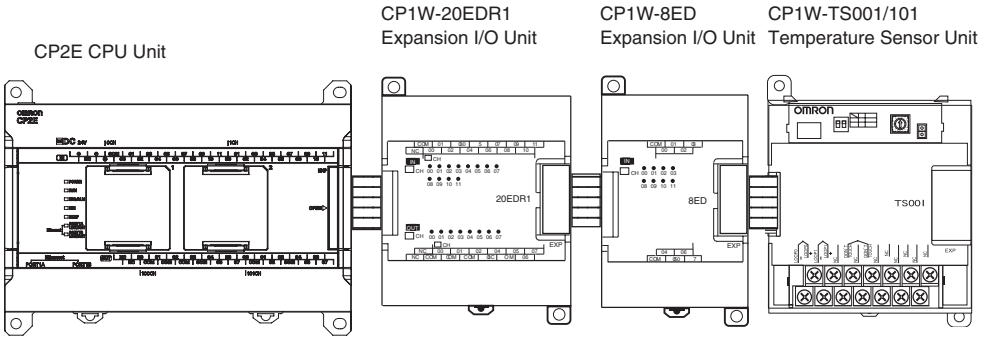
1 Connect the Temperature Sensor Units.
- Connect the Temperature Sensor Units to the CPU Unit.

2 Set the temperature ranges.
- Set the temperature unit, 2-decimal-place mode if required, and set the temperature input range.

3 Connect the temperature sensors.
- Connect temperature sensors.

4 Operation in the ladder program.
- Read temperature data stored in the input words.

1 Connect the Temperature Sensor Unit to the CPU Unit.



2 Set temperature ranges.

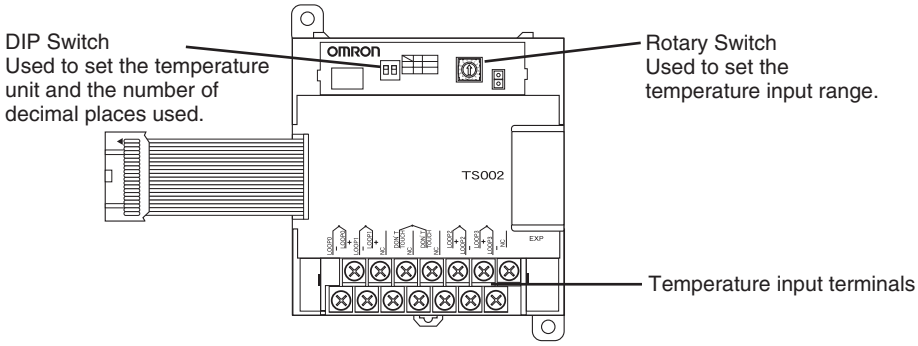
With the Temperature Sensor Unit's DIP switch and rotary switch, set the temperature unit, the number of decimal places, and the temperature input range.

Precautions for Safe Use

Do not touch the DIP switch or rotary switch while power is being supplied. Static electricity may cause operating errors.

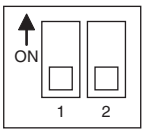
Precautions for Correct Use

Always turn OFF the power supply before setting the temperature range.



(1) DIP Switch Settings

The DIP switch is used to set the temperature unit (°C or °F) and the number of decimal places.



SW	Setting		
1	Temperature unit	OFF	°C
		ON	°F
2	Number of decimal places*	OFF	Normal (0 or 1 digit after the decimal point, depending on the input range)
		ON	2-decimal-place Mode

* For details on 2-decimal-place Mode, refer to *Two-decimal-place Mode* in *Function Descriptions.*

(2) Rotary Switch Setting

⚠Caution

Set the temperature range according to the type of temperature sensor connected to the Unit.
Temperature data will not be converted correctly if the temperature range does not match the sensor.

Do not set the temperature range to any values other than those for which temperature ranges are given in the following table.
An incorrect setting may cause operating errors.

The rotary switch is used to set the temperature range.

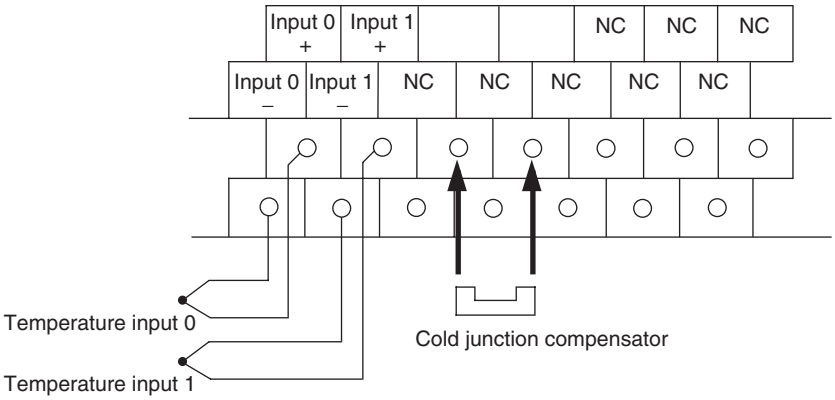
Setting	CP1W-TS001/TS002			CP1W-TS101/TS102		
	Input type	Range (°C)	Range (°F)	Input type	Range (°C)	Range (°F)
0	K	-200 to 1,300	-300 to 2,300	Pt100	-200.0 to 650.0	-300.0 to 1,200.0
1		0.0 to 500.0	0.0 to 900.0	JPt100	-200.0 to 650.0	-300.0 to 1,200.0
2	J	-100 to 850	-100 to 1,500	–	Cannot be set.	
3		0.0 to 400.0	0.0 to 750.0	–		
4 to F	–	Cannot be set.		–		

3 Connect Temperature Sensors.

(1) Thermocouples

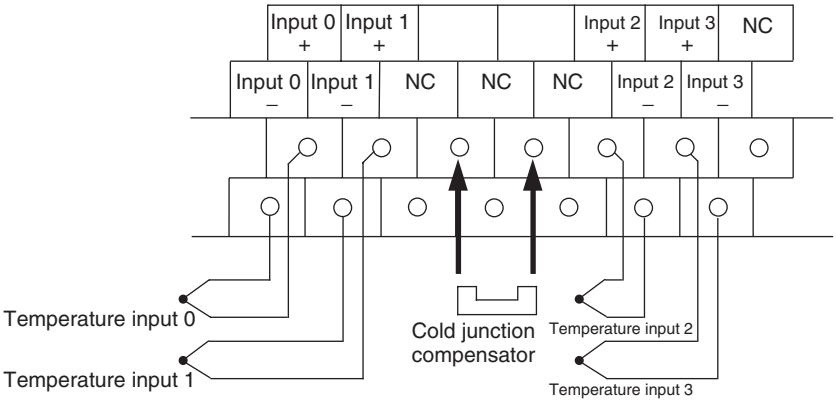
(a) CP1W-TS001

Either K or J thermocouples can be connected to the CP1W-TS001, but both thermocouples must be the same type and the same input range.



(b) CP1W-TS002

Up to four K or J thermocouples can be connected to the CP1W-TS002, but all four thermocouples must be the same type and the same input range.



Precautions for Correct Use

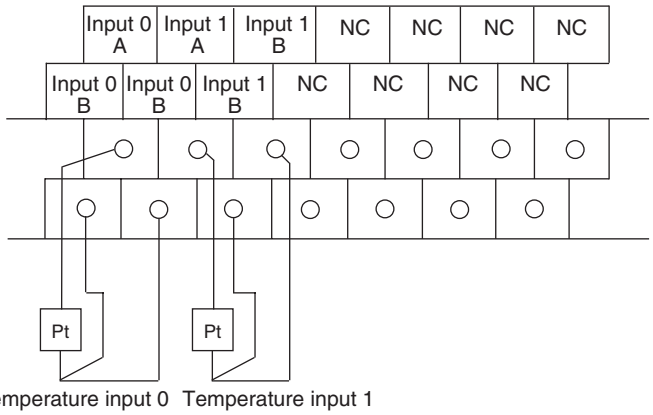
When connecting a thermocouple input, observe the following precautions:

- Do not remove the cold junction compensator attached at the time of delivery. If the cold junction compensator is removed, the Unit will not be able to measure temperatures correctly.
- Each of the input circuits is calibrated with the cold junction compensator attached to the Unit. If the Unit is used with the cold junction compensator from other Units, the Unit will not be able to measure temperatures correctly.
- Do not touch the cold junction compensator. Doing so may result in incorrect temperature measurement.

(2) Platinum Resistance Thermometers

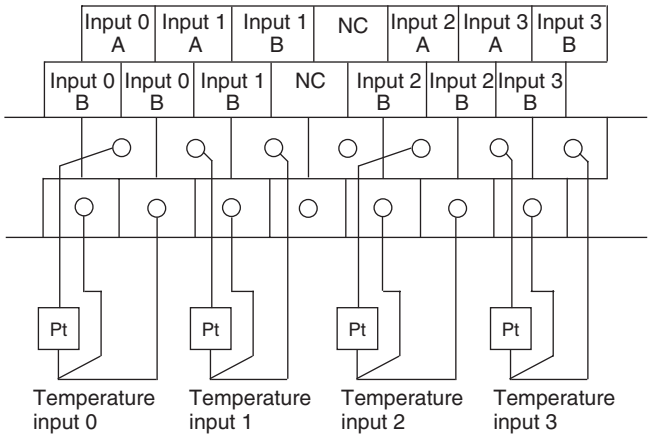
(a) CP1W-TS101

One or two Pt or JPt platinum resistance thermometers can be connected to the CP1W-TS101, but both of the thermometers must be of the same type and the same input range must be used for each.



(b) CP1W-TS102

Up to four Pt100 or JPt100 platinum resistance thermometers can be connected to the CP1W-TS102, but all four of the thermometers must be of the same type and the same input range must be used for each.



Precautions for Correct Use

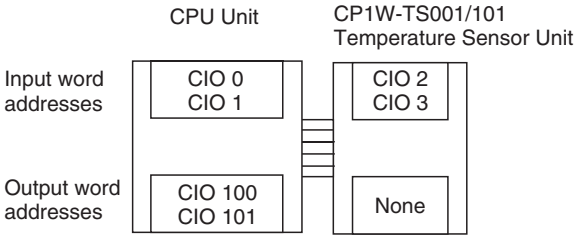
Do not connect anything to terminals not used for inputs.

4 Create the ladder program.

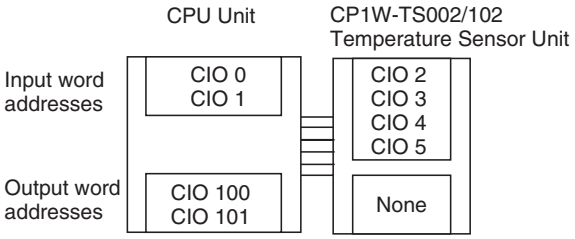
(1) Words Allocation

Temperature Sensor Units are allocated words in the same way as other CP-series Expansion Units or Expansion I/O Units, i.e., in order of connection. A Temperature Sensor Unit is allocated the next input words following the input words of the CPU Unit or previous Expansion Unit or Expansion I/O Unit. Two input words are allocated to the 2-input CP1W-TS001 or CP1W-TS101 and four input words are allocated to the 4-input CP1W-TS002 or CP1W-TS102. No output words are allocated.

- Example 1 (E30/40/60, S30/40/60 or N30/40/60 CPU Unit)



- Example 2 (E30/40/60, S30/40/60 or N30/40/60 CPU Unit)



(2) Reading Temperature Data

The temperature data will be stored in the input words allocated to the Temperature Sensor Unit in 4-digit hexadecimal.

CP1W-TS002/TS102

m+1	Converted temperature data from input 0
m+2	Converted temperature data from input 1
m+3	Converted temperature data from input 2
m+4	Converted temperature data from input 3

CP1W-TS001/TS101

m+1	Converted temperature data from input 0
m+2	Converted temperature data from input 1

“m” is the last input word allocated to the CPU Unit, Expansion I/O Unit, or Expansion Unit connected immediately before the Temperature Sensor Unit.

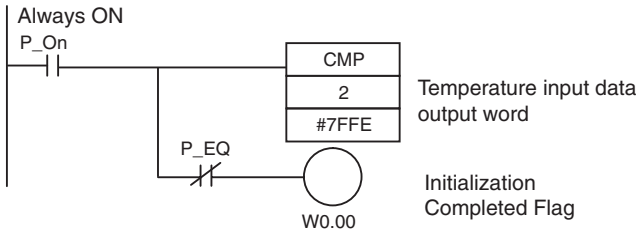
- If the converted value is a negative value, it will be stored as its two's complements.
- Data for range codes that include one digit after the decimal point are stored as binary without the decimal point, i.e., 10 times the actual value is stored.

Input		Data conversion examples
Unit: 1°C	K, J	850°C→0352 hex -200°C→FF38 hex
Unit: 0.1°C	Pt, JPt, K, J	×10 500.0°C→5000→1388 hex -20.0°C→-200→FF38 hex -200.0°C→-2000→F830 hex

- If the input temperature exceeds the maximum or minimum value in the temperature input range that has been set by ±20°C or ±20°F, the displayed value will be held.
- If the circuit is disconnected, the open-circuit detection function will operate and the converted temperature data will be set to 7FFF.
- The open-circuit detection function will be automatically cleared and normal input temperature conversion will begin automatically when the input temperature returns to the convertible range.

(3) Startup Operation

After power is turned ON, approximately 1 s is required for the first conversion data to be stored in the input word. During that period, the data will be 7FFE. Therefore, create a program as shown below, so that when operation begins simultaneously with startup it will wait for valid conversion data.

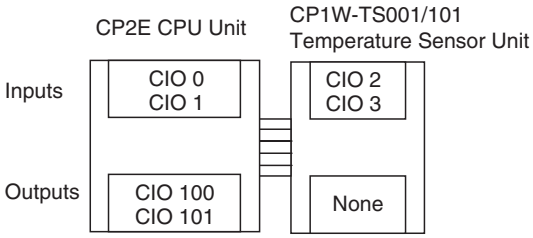


(4) Handling Unit Errors

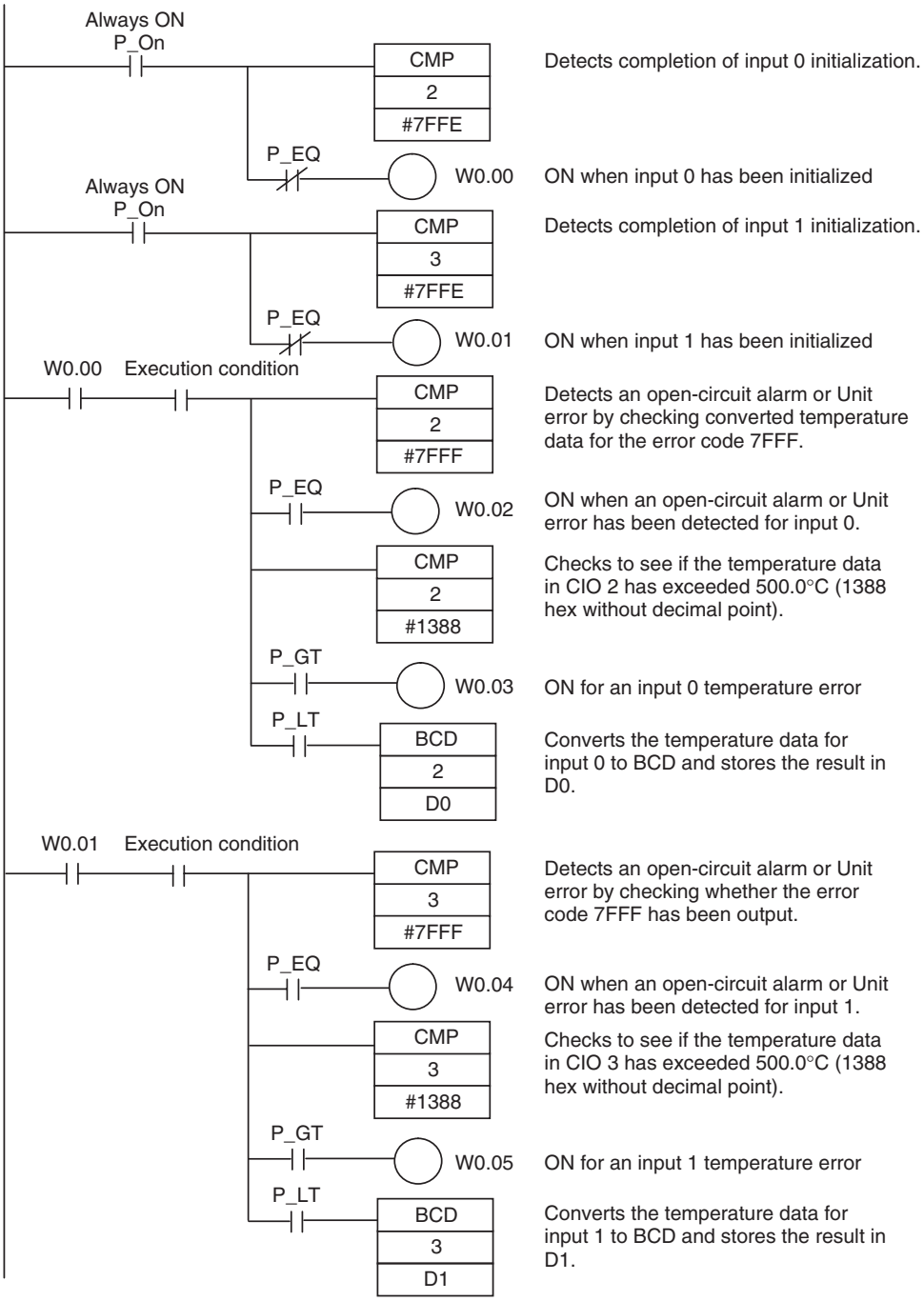
- Expansion Unit and Expansion I/O Unit errors are output to bits 0 to 5 of word A436. The bits are allocated from A436.00 in order starting from the Unit nearest the CPU Unit. CP1W-TS002 and CP1W-TS102 Temperature Sensor Units are allocated two bits each. Use these flags in the program when it is necessary to detect Expansion Unit/Expansion I/O Unit errors.
- When an error occurs, the Temperature Sensor Unit data becomes 7FFF hex (the same as for an open-circuit detection). With an open-circuit detection, it is not reflected in word A436.

(5) Programming Example (E30/40/60, S30/40/60 or N30/40/60 CPU Unit)

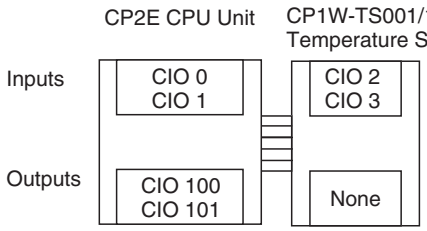
(a) The following programming example shows how to convert the input data from 2 temperature sensor inputs to BCD and store the result in D0 and D1.



Temperature unit	0 (°C)
Number of decimal places	0 (normal)
Input range setting	1 (K: 0.0 to 500.0°C)
Input 0	CIO 2
Input 1	CIO 3

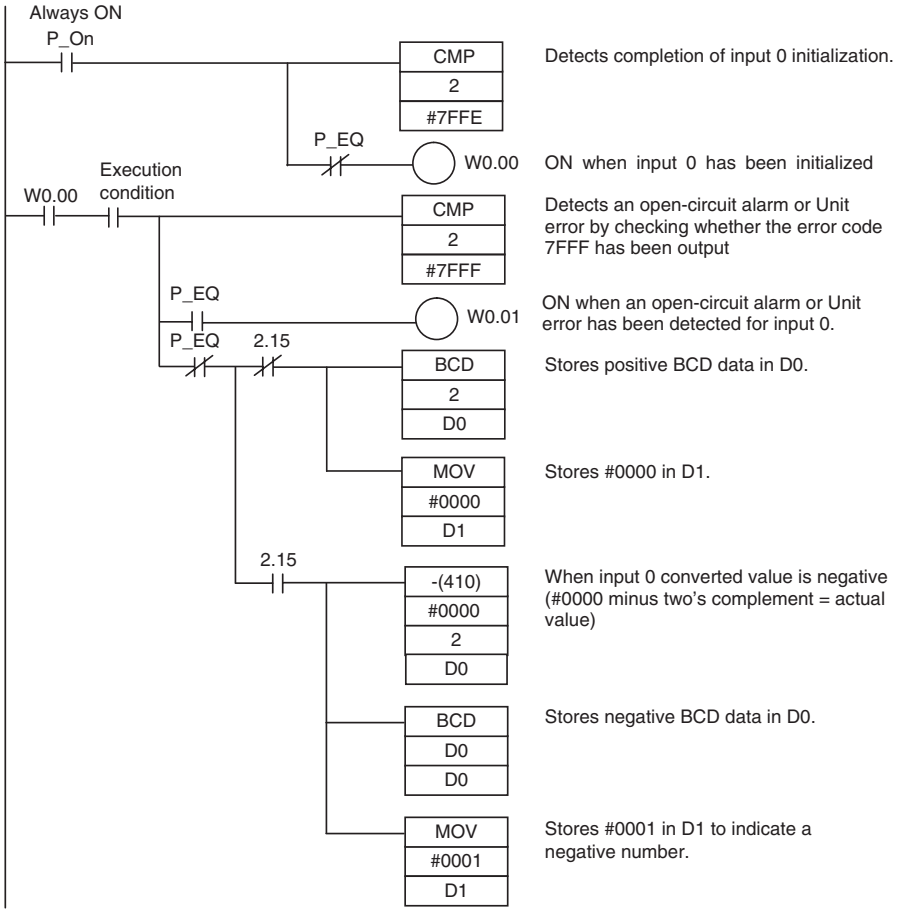

Always ON
P_On
CMP
2
#7FFE
Detects completion of input 0 initialization.
P_EQ
W0.00
ON when input 0 has been initialized
Always ON
P_On
CMP
3
#7FFE
Detects completion of input 1 initialization.
P_EQ
W0.01
ON when input 1 has been initialized
W0.00
Execution condition
CMP
2
#7FFF
Detects an open-circuit alarm or Unit error by checking converted temperature data for the error code 7FFF.
P_EQ
W0.02
ON when an open-circuit alarm or Unit error has been detected for input 0.
CMP
2
#1388
Checks to see if the temperature data in CIO 2 has exceeded 500.0°C (1388 hex without decimal point).
P_GT
W0.03
ON for an input 0 temperature error
P_LT
BCD
2
D0
Converts the temperature data for input 0 to BCD and stores the result in D0.
W0.01
Execution condition
CMP
3
#7FFF
Detects an open-circuit alarm or Unit error by checking whether the error code 7FFF has been output.
P_EQ
W0.04
ON when an open-circuit alarm or Unit error has been detected for input 1.
CMP
3
#1388
Checks to see if the temperature data in CIO 3 has exceeded 500.0°C (1388 hex without decimal point).
P_GT
W0.05
ON for an input 1 temperature error
P_LT
BCD
3
D1
Converts the temperature data for input 1 to BCD and stores the result in D1.

(b) The following programming example shows how to convert the data for temperature input 0 to BCD and store the result in D0 and D1. "#0001" is stored in D1 when the input data is a negative value. The following system configuration is used.

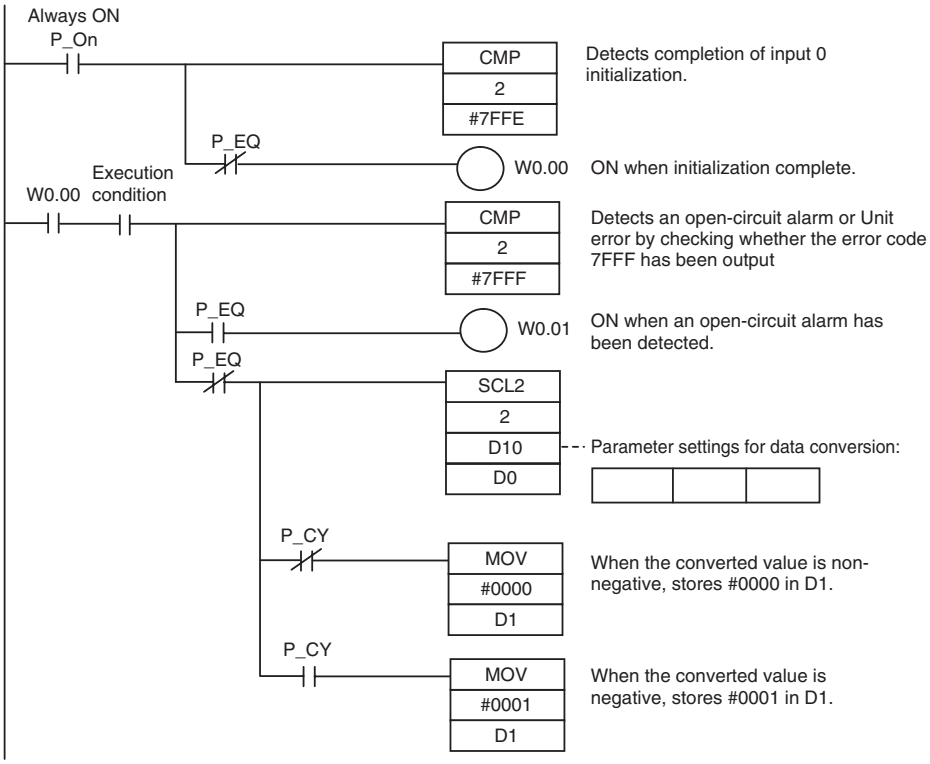


Temperature unit setting	0 (°C)
Two-decimal-place mode	0 (normal)
Input range setting	1 (Pt100: -200.0 to 650.0°C)
Input 0	CIO 2

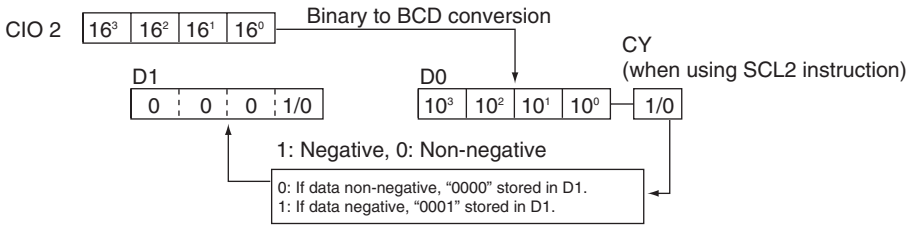
(6) Programming with BCD Instruction



(7) Programming with SCL2 Instruction



- Operation



Function Descriptions

● Two-decimal-place Mode

If pin 2 on the DIP switch is turned ON, values are stored to two decimal places. In this case, temperature data is stored as 6-digit signed hexadecimal (binary) data with 4 digits in the integer portion and 2 digits after the decimal point. The actual data stored in memory is 100 times the actual value, i.e., the decimal point is not indicated. Methods for handling this data are described in this section.

Additional Information

When set to store values to two decimal places, temperature data as far as two digits after the decimal point is converted to 6-digit binary data, but the actual resolution is not 0.01°C (°F). For this reason, there may be skipping and inaccuracies in the first digit after the decimal point 0.1°C (°F). Treat any resolution above that specified for the normal data format as reference data.

Temperature Data Partitioning and Structure

Temperature Data (Actual Temperature x 100 Binary)

□□□□□□

Leftmost 3 Digits and Flags

15	14	13	12	11 8	7 4	3 0
Leftmost/ Rightmost Flag	Temperature Unit Flag	Open-circuit Flag	Not used.	Temperature data		
0: Leftmost 1: Rightmost	0: °C 1: °F	0: Normal 1: Error	Always 0	$\times16^5$	$\times16^4$	$\times16^3$

Rightmost 3 Digits and Flags

15	14	13	12	11 8	7 4	3 0
Leftmost/ Rightmost Flag	Temperature Unit Flag	Open-circuit Flag	Not used.	Temperature data		
0: Leftmost 1: Rightmost	0: °C 1: °F	0: Normal 1: Error	Always 0	$\times16^2$	$\times16^1$	$\times16^0$

Leftmost/Rightmost Flag: Indicates whether the leftmost or rightmost 3 digits are provided.
Temperature Unit Flag: Indicates whether the temperature is in °C or °F.
Open-circuit Flag: Turns ON (1) when an open-circuit is detected. The temperature data will be 7FF FFF if this flag is ON.

Data Conversion Examples

Example 1

Temperature: 1,130.25°C
×100: 113025
Temperature Data: 01B981 (hexadecimal for 113025)

Leftmost 3 Digits and Flags

	Flags				$\times16^5$	$\times16^4$	$\times16^3$
Bits	15	14	13	12	11 to 08	07 to 04	03 to 00
Data	0	0	0	0	0	1	B

Leftmost, °C, Normal

→ 0 0 1 B

Flags, Temperature data

Rightmost 3 Digits and Flags

	Flags				$\times16^2$	$\times16^1$	$\times16^0$
Bits	15	14	13	12	11 to 08	07 to 04	0
Data	1	0	0	0	9	8	1

Rightmost, °C, Normal

→ 8 9 8 1

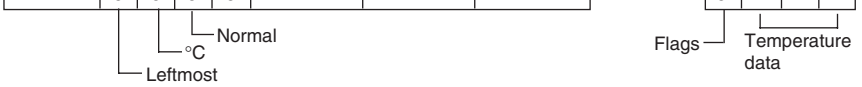
Flags, Temperature data

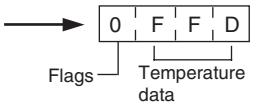
Example 2

Temperature: -100.12°C
×100: -10012
Temperature Data: FFD8E4 (hexadecimal for -10012)

Leftmost 3 Digits and Flags

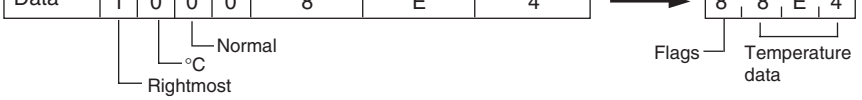
	Flags				$\times16^5$	$\times16^4$	$\times16^3$
Bits	15	14	13	12	11 to 08	07 to 04	03 to 00
Data	0	0	0	0	F	F	D

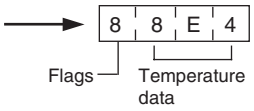




Rightmost 3 Digits and Flags

	Flags				$\times16^2$	$\times16^1$	$\times16^0$
Bits	15	14	13	12	11 to 08	07 to 04	03 to 00
Data	1	0	0	0	8	E	4



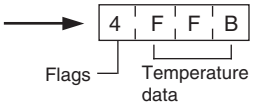


Example 3

Temperature: -200.12°F
×100: -20012
Temperature Data: FFB1D4 (hexadecimal for -20012)

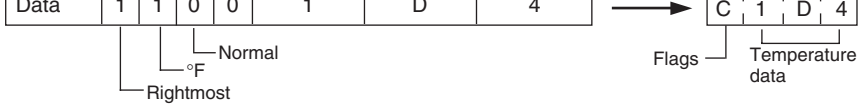
Leftmost 3 Digits and Flags

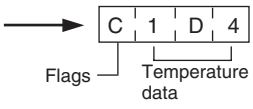
	Flags				$\times16^5$	$\times16^4$	$\times16^3$
Bits	15	14	13	12	11 to 08	07 to 04	03 to 00
Data	0	1	0	0	F	F	B



Rightmost 3 Digits and Flags

	Flags				$\times16^2$	$\times16^1$	$\times16^0$
Bits	15	14	13	12	11 to 08	07 to 04	03 to 00
Data	1	1	0	0	1	D	4



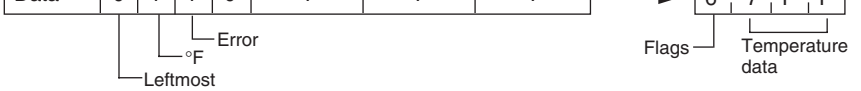


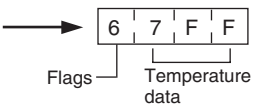
Example 4

Temperature: Open circuit (°F)
Temperature Data: 7FFFFF

Leftmost 3 Digits and Flags

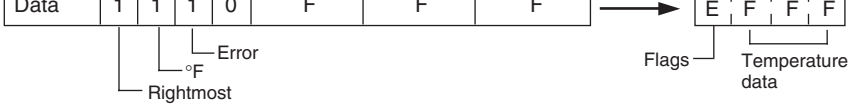
	Flags				$\times16^5$	$\times16^4$	$\times16^3$
Bits	15	14	13	12	11 to 08	07 to 04	03 to 00
Data	0	1	1	0	7	F	F

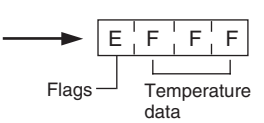




Rightmost 3 Digits and Flags

	Flags				$\times16^2$	$\times16^1$	$\times16^0$
Bits	15	14	13	12	11 to 08	07 to 04	03 to 00
Data	1	1	1	0	F	F	F



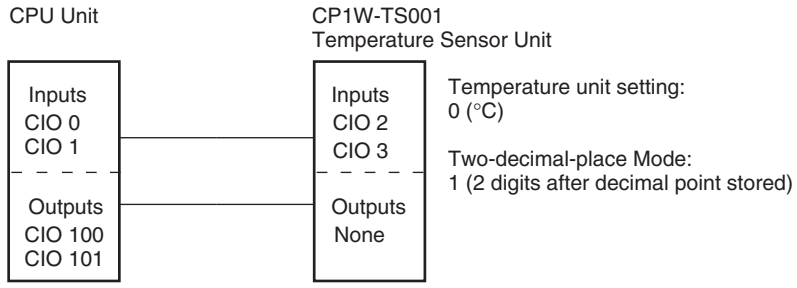


Additional Information

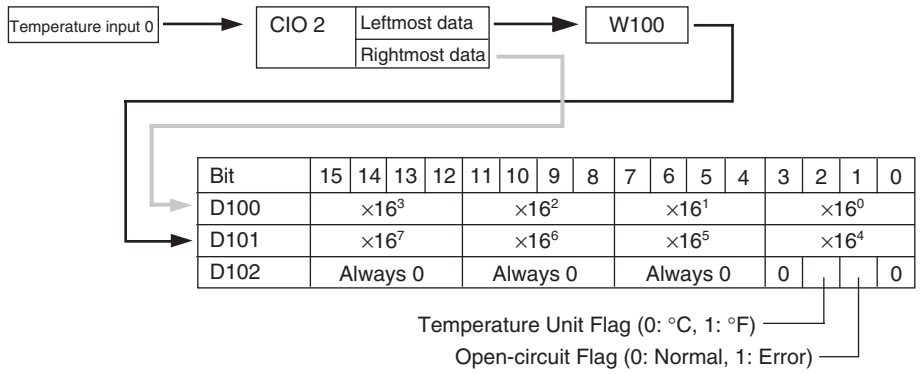
- Leftmost digits are stored in the lower memory addresses. Treat the data in the lower memory address as the leftmost digits when programming.
- Be sure that the data is read at least once every 125 ms to allow for the CPU Unit's cycle time and communications time. Correct data may not be obtained if the read cycle is greater than 125 ms.

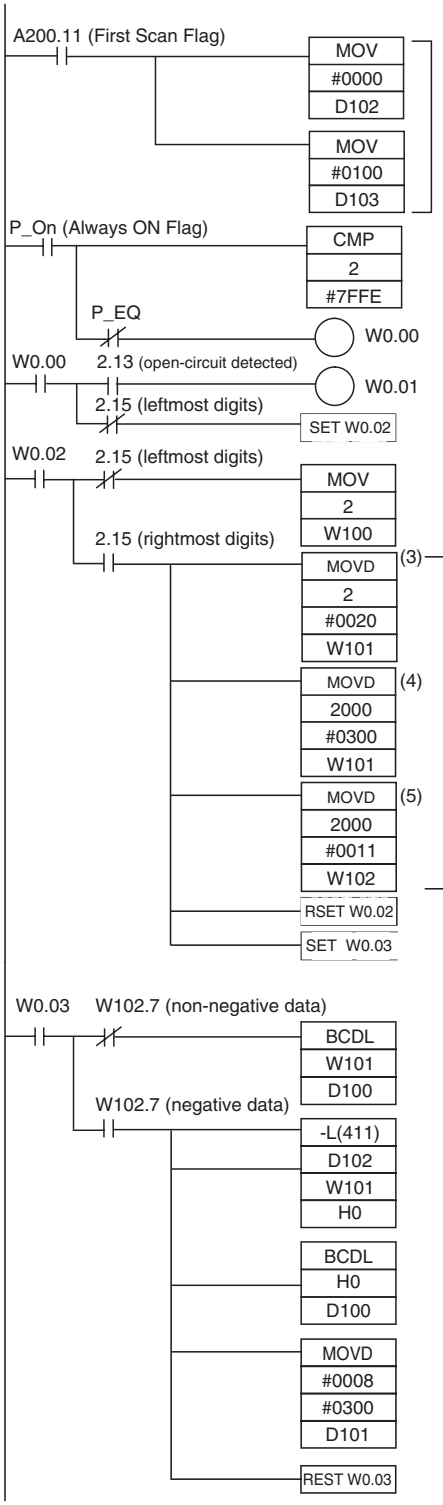
Programming Example

The following programming example shows how to use 2-decimal-place Mode for the following PLC configuration.

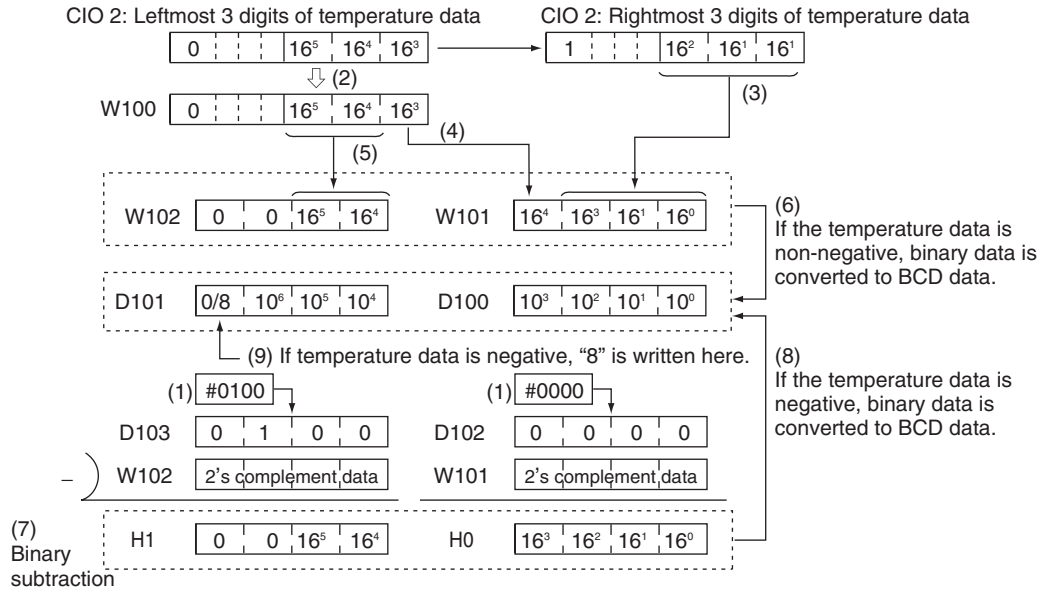


In this example, 100 times the temperature data for temperature input 0 (input to CIO 002) is stored in binary form in D100 to D102.




A200.11 (First Scan Flag)
MOV
#0000
D102
MOV
#0100
D103
(1)
Sets D103 and D102 to #0100 and #0000, respectively.
P_On (Always ON Flag)
CMP
2
#7FFE
Detects completion of input 0 initialization.
P_EQ
W0.00
ON when input 0 has been initialized.
W0.00
2.13 (open-circuit detected)
W0.01
Open-circuit alarm output
2.15 (leftmost digits)
SET W0.02
W0.02
2.15 (leftmost digits)
MOV
2
W100
(2)
Leftmost digits moved to W100.
2.15 (rightmost digits)
MOVD
2
#0020
W101
(3)
MOVD
2000
#0300
W101
(4)
MOVD
2000
#0011
W102
(5)
Leftmost and rightmost digits rearranged and moved to W102 and W101.
RSET W0.02
SET W0.03
Data rearrangement completed.
W0.03
W102.7 (non-negative data)
BCDL
W101
D100
(6)
If the temperature data is non-negative, the binary data in W102 and W101 is converted to BCD and placed in D101 and D100.
W102.7 (negative data)
-L(411)
D102
W101
H0
(7)
If the temperature data is negative, the 2's complement data in W102 and W101 is converted to binary data representing the absolute value of the temperature input and placed in H1 and H0.
BCDL
H0
D100
(8)
The binary data in H1 and H0 is converted to BCD and placed in D101 and D100.
MOVD
#0008
#0300
D101
(9)
"1" is written to the bit in D101 indicating negative data.
REST W0.03

Description of Operation



8-4-2 CP1W-TS003 Temperature Sensor Units

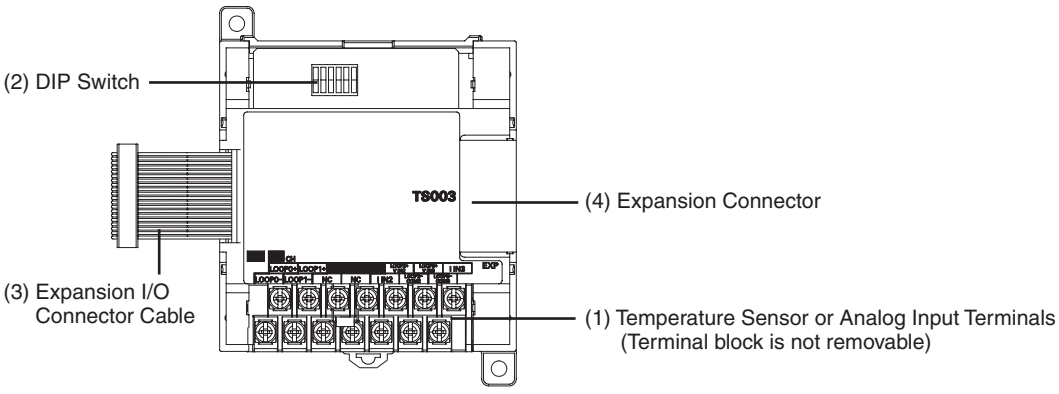
Overview

CP1W-TS003 Temperature Sensor Unit provides up to four input points. The inputs can be from thermocouples or analog inputs.

CP1W-TS003 Temperature Sensor Unit is allocated four input words, so no more than three Units can be connected.

Part Names and Functions

- **Temperature Sensor Units: CP1W-TS003**



(1)Temperature Sensor Input Terminals
Used to connect temperature sensors such as thermocouples or analog inputs.

(2)DIP Switch
Used to set the input type (temperature or analog input), the input thermocouple type (K or J) and the temperature unit (°C or °F). Make the setting according to the specifications of the temperature sensors or analog inputs that are connected.

(3)Expansion I/O Connecting Cable
Connected to the expansion connector of a CP2E CPU Unit or an Expansion Unit or Expansion I/O Unit.The cable is included with the Temperature Sensor Unit and cannot be removed.

Precautions for Safe Use

Do not touch the cables during operation. Static electricity may cause operating errors.

(4)Expansion Connector
Used for connecting Expansion Units or Expansion I/O Units.

Specifications

Item			CP1W-TS003
Temperature sensors			Thermocouples or analog input *1
			Switchable between K and J, but same type must be used for all inputs.
Number of inputs			4
Allocated input words			4
Max. number of Units			3
Accuracy	25°C	Thermocouple inputs	(The larger of ±0.5% of converted value or ±2°C) ±1 digit max. *2
		Analog voltage inputs	0.5% full scale
		Analog current inputs	0.6% full scale
	0 to 60 °C	Thermocouple inputs	(The larger of ±1% of converted value or ±4°C) ±1 digit max. *3
		Analog voltage inputs	1.0% full scale
		Analog current inputs	1.2% full scale
	-20 to 0 °C	Thermocouple inputs	(The larger of ±1.3% of converted value or ±5°C) ±1 digit max. *3
		Analog voltage inputs	1.2% full scale
		Analog current inputs	1.5% full scale
Input signal range		Thermocouple inputs	K: -200.0 to 1300.0°C or -300.0 to 2300.0°F J: -100.0 to 850.0°C or -100.0 to 1500.0°F
		Analog voltage inputs	0 to 10V, 1 to 5V
		Analog current inputs	4 to 20mA
Resolution		Thermocouple inputs	0.1°C or 0.1°F
		Analog inputs	1/12000 (full scale)
Max. rated input		Analog voltage inputs	±15V
		Analog current inputs	±30mA
External input impedance		Analog voltage inputs	1MΩ min.
		Analog current inputs	250 Ω
Open-circuit detection function			Supported
Averaging function			Unsupported
Conversion time			250 ms for 4 input points
Converted temperature data			16-bit binary data (4-digit hexadecimal) 2-decimal-place mode is not supported
Converted AD data			16-bit binary data (4-digit hexadecimal)
Isolation			Photocouplers between any two input signals
Current consumption			5 VDC: 70 mA max., 24 VDC: 30 mA max.

*1 Only last two channels can be used as analog input.

*2 Accuracy for a K-type sensor at −100°C or less is ±4°C ±1 digit max.

*3 Accuracy for a K-type sensor at −100°C or less is ±10°C ±1 digit max.

● Analog Input Signal Ranges

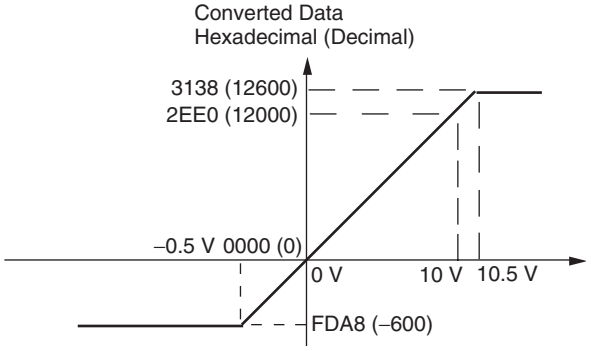
Analog input data is digitally converted according to the input signal range as shown below.

Additional Information

When the input exceeds the specified range, the A/D conversion data will be fixed at either the lower limit or upper limit.

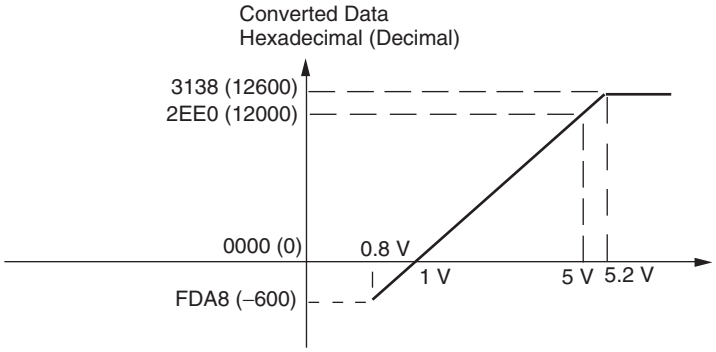
0 to 10 V

The 0 to 10 V range corresponds to the hexadecimal values 0000 to 2EE0 (0 to 12000). The entire data range is FDA8 to 3138 (−600 to 12600). A negative voltage is expressed as a two's complement.



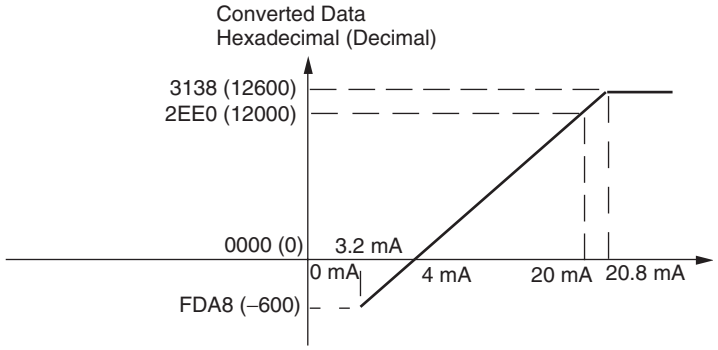
1 to 5 V

The 1 to 5 V range corresponds to the hexadecimal values 0000 to 2EE0 (0 to 12000). The entire data range is FDA8 to 3138 (−600 to 12600). Inputs between 0.8 and 1 V are expressed as two's complements. If the input falls below 0.8 V, open-circuit detection will activate and converted data will be 8000.



4 to 20 mA

The 4 to 20 mA range corresponds to the hexadecimal values 0000 to 2EE0 (0 to 12000). The entire data range is FDA8 to 3138 (−600 to 12600). Inputs between 3.2 and 4 mA are expressed as two's complements. If the input falls below 3.2 mA, open-circuit detection will activate and converted data will be 8000.



● Open-circuit Detection Function for Temperature

If the circuit is disconnected, the open-circuit detection function will operate and the converted temperature data will be set to 7FFF.

● Open-circuit Detection Function for Analog Inputs

The open-circuit detection function is activated when the input range is set to 1 to 5 V and the voltage drops below 0.8 V, or when the input range is set to 4 to 20 mA and the current drops below 3.2 mA. When the open-circuit detection function is activated, the converted data will be set to 8,000.

The time for enabling or clearing the open-circuit detection function is the same as the time for converting the data. If the input returns to the convertible range, the open-circuit detection is cleared automatically and the output returns to the normal range.

Flow of Operation

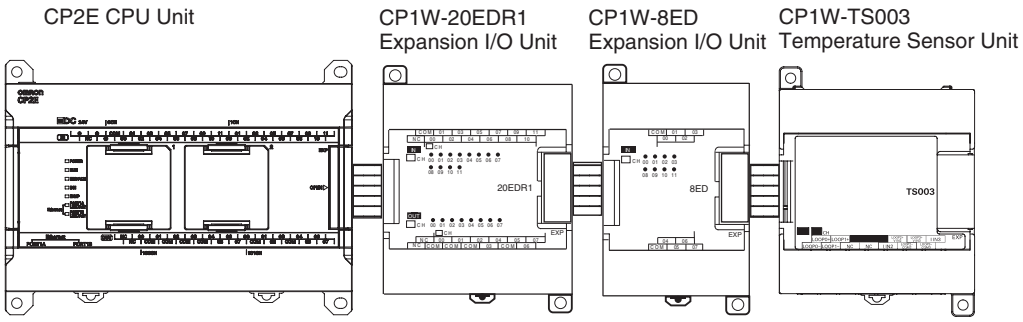
1 Connect the Temperature Sensor Units.
- Connect the Temperature Sensor Units to the CPU Unit.

2 Set the temperature or analog ranges.
- Set the input type (temperature or analog input), the input thermocouple type (K or J) and the temperature unit (°C or °F).

3 Connect the temperature sensors or analog devices.
- Connect temperature sensors or analog devices.

4 Operation in the ladder program.
- Read converted data stored in the input words.

1 Connect the Temperature Sensor Unit to the CPU Unit.



2 Set temperature or analog ranges.

Precautions for Safe Use

Do not touch the DIP switch while power is being supplied. Static electricity may cause operating errors.

Precautions for Correct Use

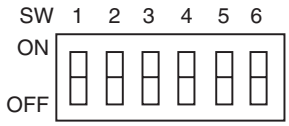
Always turn OFF the power supply before setting the temperature range.

⚠Caution

Set the temperature range according to the type of temperature sensor connected to the Unit.
Temperature data will not be converted correctly if the temperature range does not match the sensor.

Do not set the temperature range to any values other than those for which temperature ranges are given in the following table.
An incorrect setting may cause operating errors.

With the Temperature Sensor Unit's DIP switch, set the input type (temperature or analog input), the input thermocouple type (K or J) and the temperature unit (°C or °F).



SW	Setting		
1	Thermocouple type of temperature sensor	ON	J
		OFF	K
2	Temperature unit	ON	°F
		OFF	°C
3	NC		
4	Input type selection for the third input (Input 2)	ON	Analog input
		OFF	Thermocouple
5	Input type selection for the fourth input (Input 3)	ON	Analog input
		OFF	Thermocouple
6	Analog input signal range	ON	1 to 5V/4 to 20mA
		OFF	0 to 10V

Temperature input			Analog input	
Input type	Range (°C)	Range (°F)	Input type	Range
K	-200.0 to 1300.0	-300.0 to 2300.0	Voltage	0 to 10V/1 to 5V
J	-100.0 to 850.0	-100.0 to 1500.0	Current	4 to 20mA

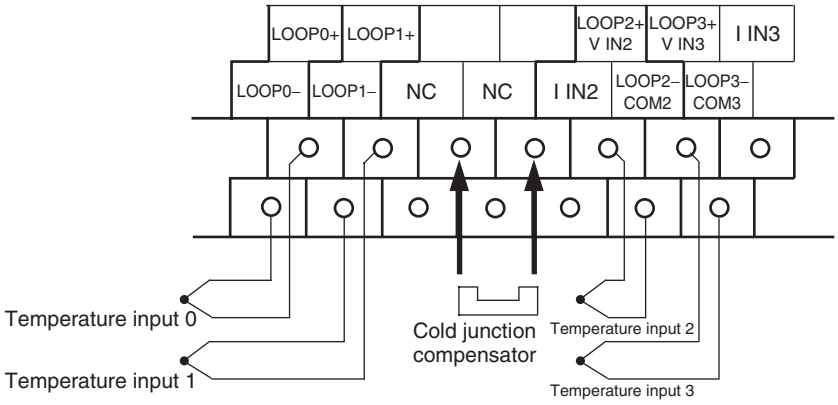
Additional Information

Fahrenheit temperature uses the following equation to convert the temperature unit from Celsius, but the temperature input range is different between Fahrenheit and Celsius.
Fahrenheit temperature (°F) = Celsius temperature (°C) x 1.8 + 32

3 Connect Temperature Sensors.

(1) Thermocouples

Either K or J thermocouples can be connected, but all four thermocouples must be the same type and the same input range. Only last two channels can be used as analog inputs.



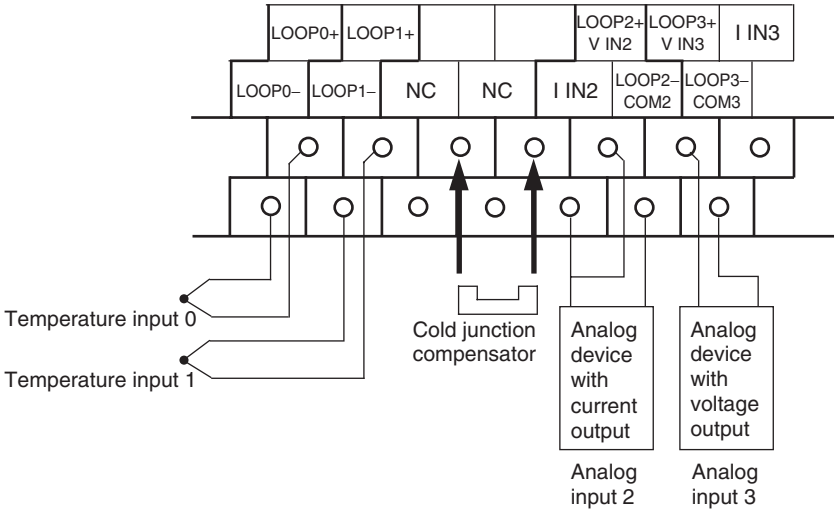
Precautions for Correct Use

When connecting a thermocouple input, observe the following precautions:

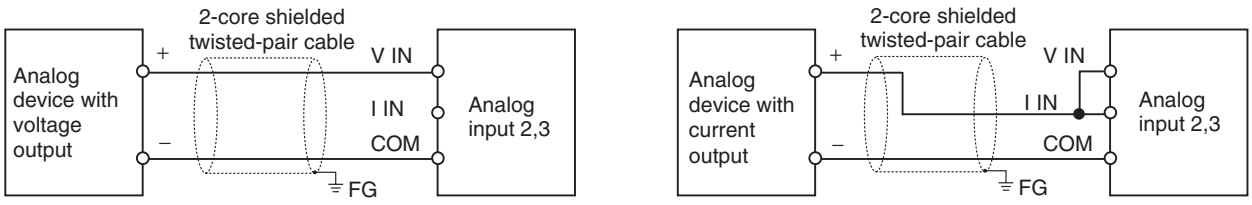
- Do not remove the cold junction compensator attached at the time of delivery. If the cold junction compensator is removed, the Unit will not be able to measure temperatures correctly.
- Each of the input circuits is calibrated with the cold junction compensator attached to the Unit. If the Unit is used with the cold junction compensator from other Units, the Unit will not be able to measure temperatures correctly.
- Do not touch the cold junction compensator. Doing so may result in incorrect temperature measurement.

(2) Analog Inputs

Last two channels can be used as analog inputs, but two of the analog inputs must be the same range.



- Wiring for Analog Inputs



Precautions for Correct Use

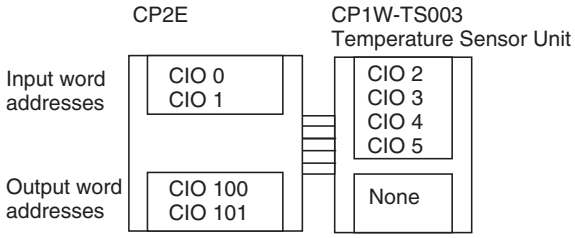
- When an input is not being used, short the + and – terminals.
- Separate wiring from power lines (AC power supply lines, high-voltage lines, etc.)
- When there is noise in the power supply line, install a noise filter on the input section and the power supply.

4 Create the ladder program.

(1) Word Allocations

Temperature Sensor Units are allocated words in the same way as other CP-series Expansion Units or Expansion I/O Units, in order of connection. A Temperature Sensor Unit is allocated the next input words following the input words of the CPU Unit or previous Expansion Unit or Expansion I/O Unit. Four input words are allocated to CP1W-TS003.

- Example



(2) Reading Temperature or Analog Data

The temperature or analog data will be stored in the input words allocated to the Temperature Sensor Unit in 4-digit hexadecimal.

Reading Temperature Data

m+1	Converted temperature data from input 0
m+2	Converted temperature data from input 1
m+3	Converted temperature data from input 2
m+4	Converted temperature data from input 3

Reading Analog Data

m+3	Converted analog data from input 2
m+4	Converted analog data from input 3

"m" is the last input word allocated to the CPU Unit, Expansion I/O Unit, or Expansion Unit connected immediately before the Temperature Sensor Unit.

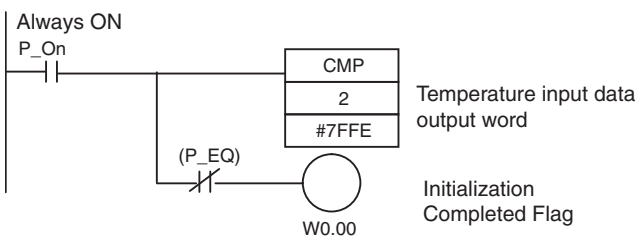
- Negative values are stored as 2's complements.
- Data for range codes that include one digit after the decimal point are stored without the decimal point, i.e., 10 times the actual value is stored.

Input		Data conversion examples	
Unit: 0.1°C	K or J	×10	500.0°C → 5000 → 1388 hex −20.0°C → −200 → FF38 hex −200.0°C → −2000 → F830 hex

- If the input temperature exceeds the maximum or minimum value in the temperature input range that has been set by ±20°C or ±20°F, the displayed value will be held.
- If the circuit is disconnected, the open-circuit detection function will operate and the converted temperature data will be set to 7FFF.
- The open-circuit detection function will be automatically cleared and normal input temperature conversion will begin automatically when the input temperature returns to the convertible range.

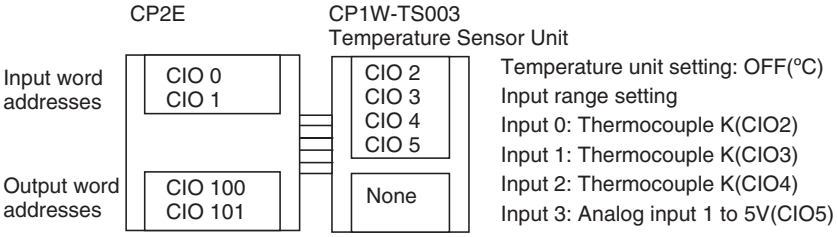
(3) Startup Operation

After power is turned ON, approximately 1 s is required for the first conversion data to be stored in the input word. During that period, the data will be 7FFE. Therefore, create a program as shown below, so that the ladder can start to operate with valid conversion data in input words.



(4) Programming Example

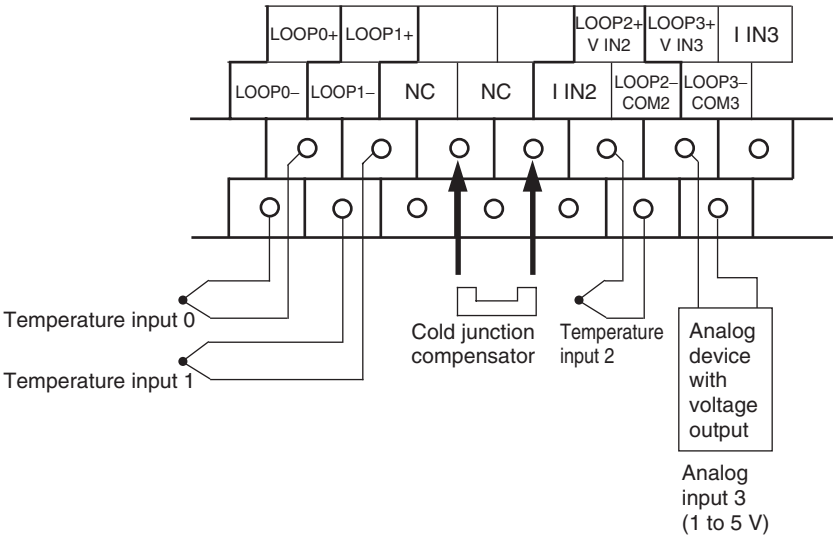
The following programming example shows how to store the input data of CP1W-TS003 (4 inputs) in D0 to D3, and W10.00 to W10.03 turn ON at the time of open-circuit detection.

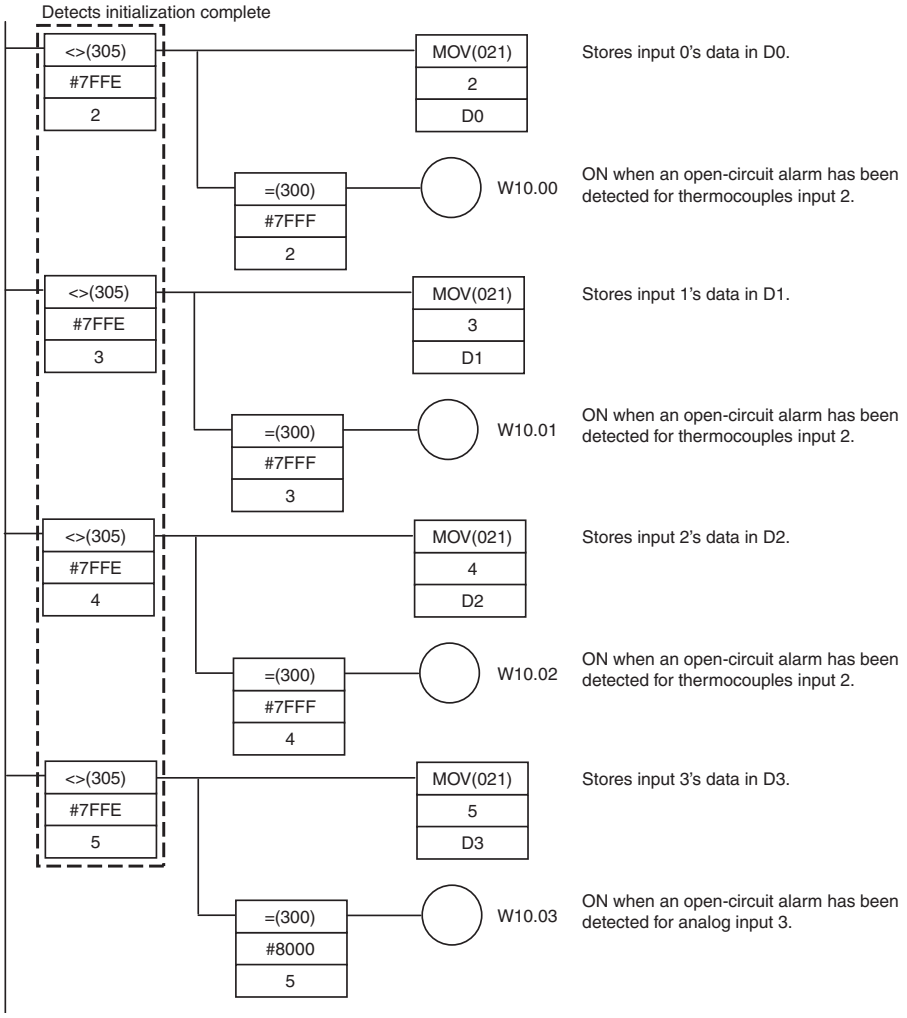


- DIP Switch Setting

SW1	OFF	K
SW2	OFF	°C
SW3	NC	
SW4	OFF	Thermocouple
SW5	ON	Analog
SW6	ON	1 to 5V/4 to 20mA

- Wiring Diagram




Detects initialization complete
<>(305)
#7FFE
2
MOV(021)
2
D0
Stores input 0's data in D0.
=(300)
#7FFF
2
W10.00
ON when an open-circuit alarm has been detected for thermocouples input 2.
<>(305)
#7FFE
3
MOV(021)
3
D1
Stores input 1's data in D1.
=(300)
#7FFF
3
W10.01
ON when an open-circuit alarm has been detected for thermocouples input 2.
<>(305)
#7FFE
4
MOV(021)
4
D2
Stores input 2's data in D2.
=(300)
#7FFF
4
W10.02
ON when an open-circuit alarm has been detected for thermocouples input 2.
<>(305)
#7FFE
5
MOV(021)
5
D3
Stores input 3's data in D3.
=(300)
#8000
5
W10.03
ON when an open-circuit alarm has been detected for analog input 3.

8-4-3 TS004 Temperature Sensor Units

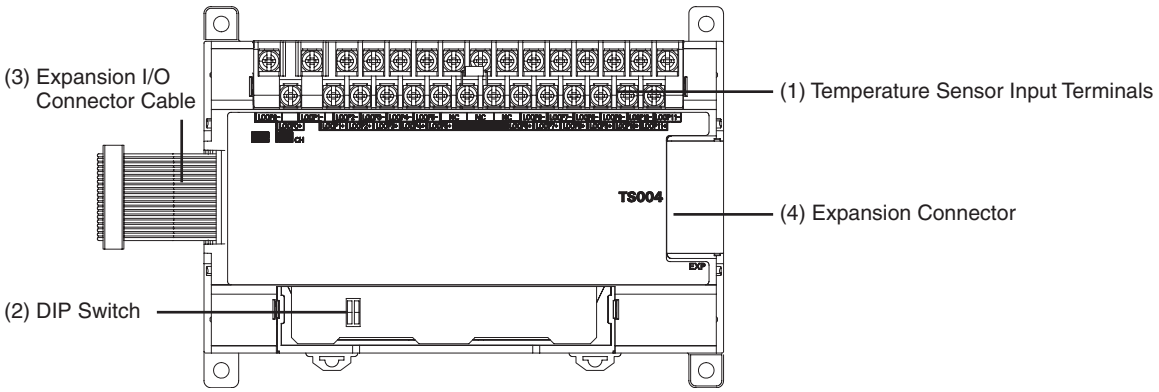
Overview

CP1W-TS004 Temperature Sensor Unit provide up to twelve input points. The inputs can be from thermocouples.

CP1W-TS004 Temperature Sensor Unit is allocated two input words and one output word, so no more than seven Units can be connected.

Part Names and Functions

- **Temperature Sensor Units: CP1W-TS004**



(1)Temperature Sensor Input Terminals
Used to connect temperature sensors such as thermocouples.

(2)DIP Switch
Used to set the temperature unit (°C or °F) and the temperature input range. Make the setting according to the specifications of the temperature sensors that are connected.

(3)Expansion I/O Connecting Cable
Connected to the expansion connector of a CP2E CPU Unit or an Expansion Unit or Expansion I/O Unit. The cable is included with the Temperature Sensor Unit and cannot be removed.

Precautions for Safe Use

Do not touch the cables during operation. Static electricity may cause operating errors.

(4)Expansion Connector
Used for connecting Expansion Units or Expansion I/O Units.

Specifications

Item		CP1W-TS004
Temperature sensors		Thermocouples
		Switchable between K and J, but same type must be used for all inputs.
Number of inputs		12
Allocated input words		2
Allocated output words		1
Accuracy	25°C	(The larger of ±0.5% of converted value or ±2°C) ±1 digit max. *1
	0 to 60°C	(The larger of ±1% of converted value or ±4°C) ±1 digit max. *2
	-20 to 0°C	(The larger of ±1.3% of converted value or ±5°C) ±1 digit max. *2
Conversion time		500 ms for 12 input points
Converted temperature data		16-bit binary data (4-digit hexadecimal) 2-decimal-place mode is not supported
Isolation		Photocouplers between any two input signals
Current consumption		5 VDC: 80 mA max., 24 VDC: 50 mA max.

*1 Accuracy for a K-type sensor at −100°C or less is ±4°C ±1 digit max.

*2 Accuracy for a K-type sensor at −100°C or less is ±10°C ±1 digit max.

● Open-circuit Detection Function for Temperature

If the circuit is disconnected, the open-circuit detection function will operate and the converted temperature data will be set to 7FFF.

Flow of Operation

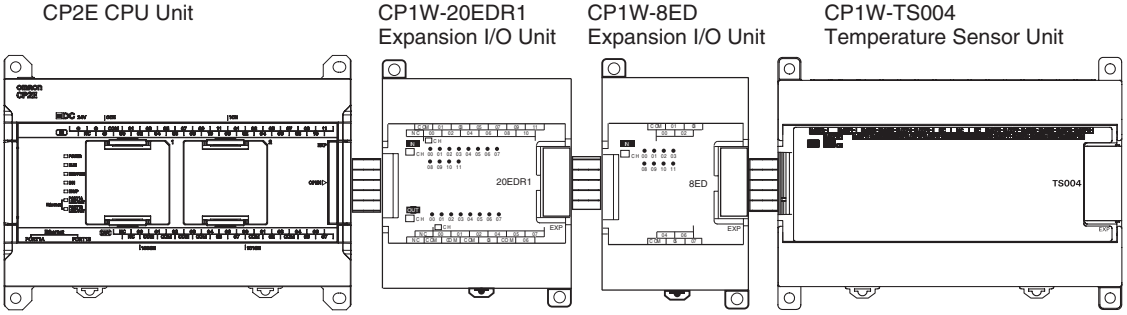
1 Connect the Temperature Sensor Units.
- Connect the Temperature Sensor Units to the CPU Unit.

2 Set the temperature ranges.
- Set the temperature unit and set the temperature input range.

3 Connect the temperature sensors.
- Connect temperature sensors.

4 Operation in the ladder program.
- Read converted data stored in the input words.

1 Connect the Temperature Sensor Unit to the CPU Unit.



2 Set temperature ranges.

Precautions for Safe Use

Do not touch the DIP switch while power is being supplied. Static electricity may cause operating errors.

Precautions for Correct Use

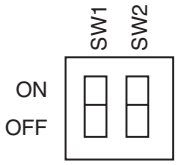
Always turn OFF the power supply before setting the temperature range.

⚠Caution

Set the temperature range according to the type of temperature sensor connected to the Unit.
Temperature data will not be converted correctly if the temperature range does not match the sensor.

Do not set the temperature range to any values other than those for which temperature ranges are given in the following table.
An incorrect setting may cause operating errors.

With the Temperature Sensor Unit's DIP switch, set the temperature unit and the temperature input range.



SW	Setting		
1	Input type	ON	J
		OFF	K
2	Temperature unit	ON	°F
		OFF	°C

Temperature input		
Input type	Range (°C)	Range (°F)
K	-200.0 to 1300.0	-300.0 to 2300.0
J	-100.0 to 850.0	-100.0 to 1500.0

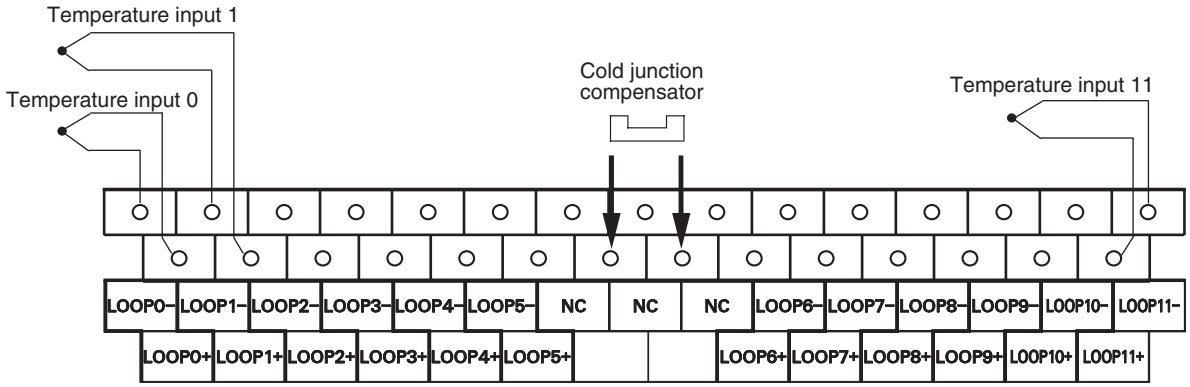
Additional Information

Fahrenheit temperature uses the following equation to convert the temperature unit from Celsius, but the temperature input range is different between Fahrenheit and Celsius.
Fahrenheit temperature (°F) = Celsius temperature (°C) × 1.8 + 32

3 Connecte Temperature Sensors.

(1) Thermocouples

Either K or J thermocouples can be connected, but all twelve thermocouples must be the same type and the same input range.



Precautions for Correct Use

When connecting a thermocouple input, observe the following precautions:

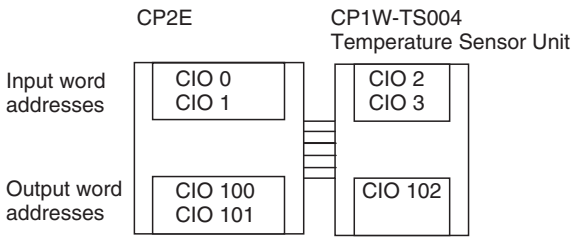
- Do not remove the cold junction compensator attached at the time of delivery. If the cold junction compensator is removed, the Unit will not be able to measure temperatures correctly.
- Each of the input circuits is calibrated with the cold junction compensator attached to the Unit. If the Unit is used with the cold junction compensator from other Units, the Unit will not be able to measure temperatures correctly.
- Do not touch the cold junction compensator. Doing so may result in incorrect temperature measurement.
- Use the thermocouple with metallic shield and connect the shield to ground.

4 Create the ladder program.

(1) Word Allocations

Temperature Sensor Units are allocated words in the same way as other CP-series Expansion Units or Expansion I/O Units, in order of connection. A Temperature Sensor Unit is allocated the next input words following the input words of the CPU Unit or previous Expansion Unit or Expansion I/O Unit. Two input words and one output word are allocated to CP1W-TS004.

- Example



(2) Reading Temperature Data

There are 12 temperature input data to be read, but only two input words are allocated to CP1W-TS004. The operation is shown as the following.

- Input Word

m+1	Response. Input words stored in CIO m+2
m+2	Temperature data of the specified input word

- Output Word

n+1	Read command data (input word specified)

- Read/Response Command and Temperature Data

Command	Output Word	Input Word	
	n+1	m+1	m+2
	Read command	Response command	Temperature data (4-digit hexadecimal)
Read temperature data from input 0	#9901	9901	Input 0 temperature data
Read temperature data from input 1	#9902	9902	Input 1 temperature data
Read temperature data from input 2	#9903	9903	Input 2 temperature data
Read temperature data from input 3	#9904	9904	Input 3 temperature data
Read temperature data from input 4	#9905	9905	Input 4 temperature data
Read temperature data from input 5	#9906	9906	Input 5 temperature data
Read temperature data from input 6	#9907	9907	Input 6 temperature data
Read temperature data from input 7	#9908	9908	Input 7 temperature data
Read temperature data from input 8	#9909	9909	Input 8 temperature data
Read temperature data from input 9	#990A	990A	Input 9 temperature data
Read temperature data from input 10	#990B	990B	Input 10 temperature data
Read temperature data from input 11	#990C	990C	Input 11 temperature data
Others	Others	No response for other commands	

- Negative values are stored as 2's complements.
- The converted temperature data CIO m+2 is stored in 16-bit binary data (4-digit hexadecimal).
- Data for range codes that include one digit after the decimal point are stored without the decimal point, i.e., 10 times the actual value is stored.

Input		Data conversion examples	
Unit: 0.1°C	K or J	×10	500.0°C → 5000 → 1388 hex -20.0°C → -200 → FF38 hex -200.0°C → -2000 → F830 hex

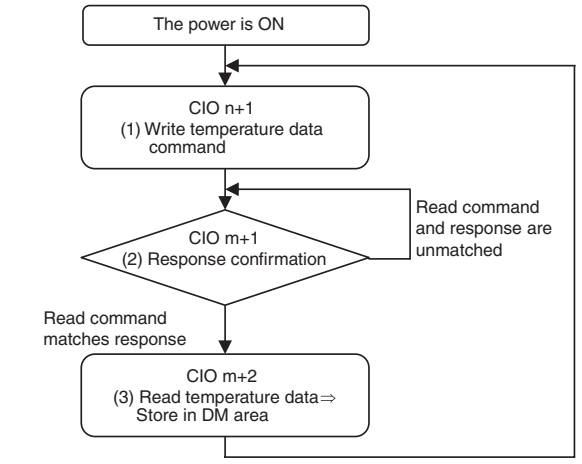
- IIf the input temperature exceeds the maximum or minimum value in the temperature input range that has been set by ±20×C or ±20×F, the displayed value will be held.
- If the circuit is disconnected, the open-circuit detection function will operrate and the converted temperature data will be set to 7FFF.
- The open-circuit detection function will be automatically cleared and normal input temperature conversion will begin automatically when the input temperature returns to the convertible range.

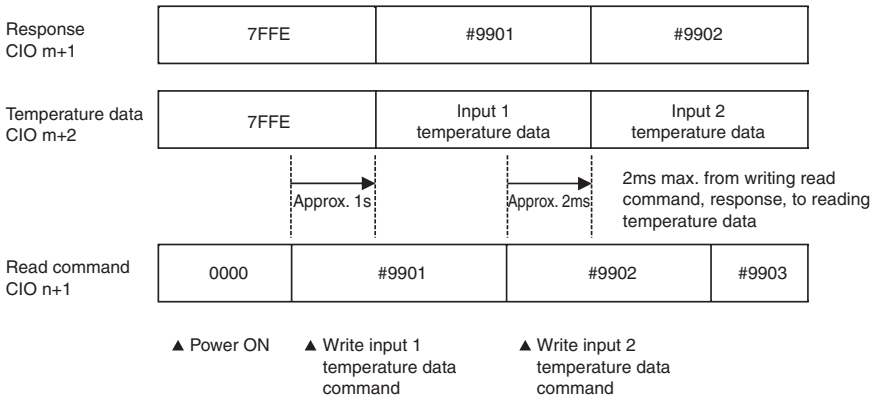
(3) Creating Ladder Program

(1) Write temperature data command
Write temperature data command which read temperature data from input word to CIO n+1.

(2) Response confirmation
After CP1W-TS004 receives CIO n+1 read command and CP1W-TS004's internally specified input temperature data is ready, the value which is the same as the read command will be stored in CIO m+1. The temperature data will be stored in CIO m+2 at the same time.

(3) Read temperature data
Store the temperature data from CIO m+2 in DM area.





Note 1 It takes about 2ms maximum until it is reflected to CIO m+1 and m+2 from writing the read command to CIO n+1.

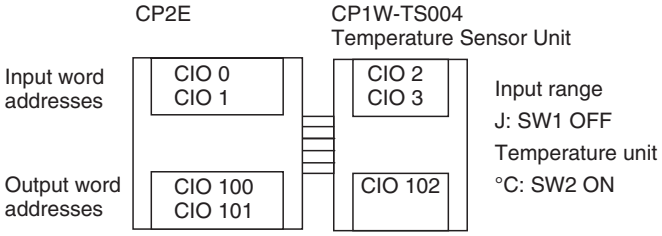
2 It takes about 1s after the power is turned ON, till a read command initial processing of CP1W-TS004 is completed, so a response to the read command after power ON takes only about 1s. After the power is turned ON, create a ladder program 1s later due to its control by temperature data.

3 When writing a command other than that specified in the temperature data read command, CIO m+1 and m+2 hold the previous value.

(4) Programming Example

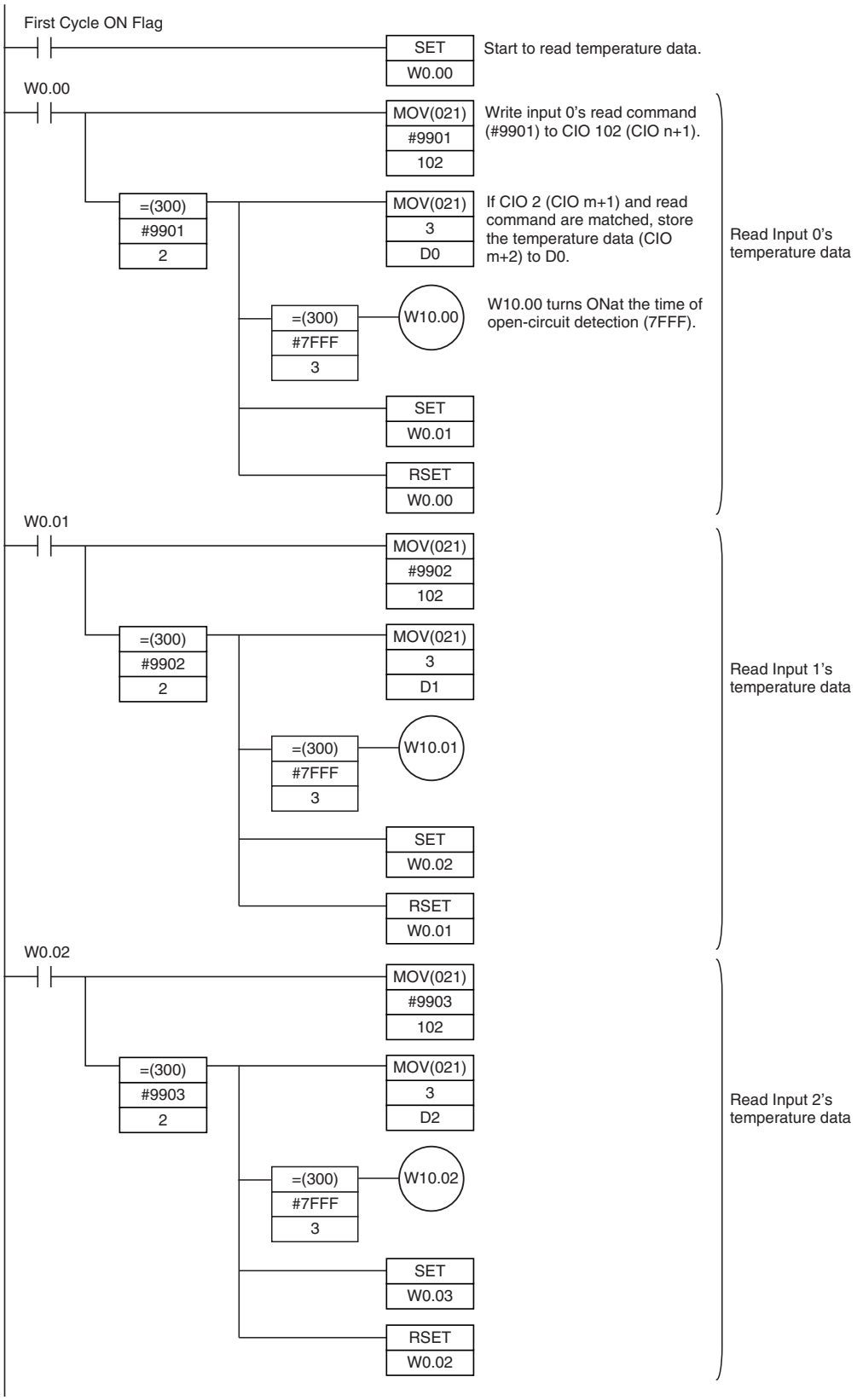
The temperature data of CP1W-TS004 (12 inputs, input type is J type and temperature unit is °C) is stored in D0 to D11.

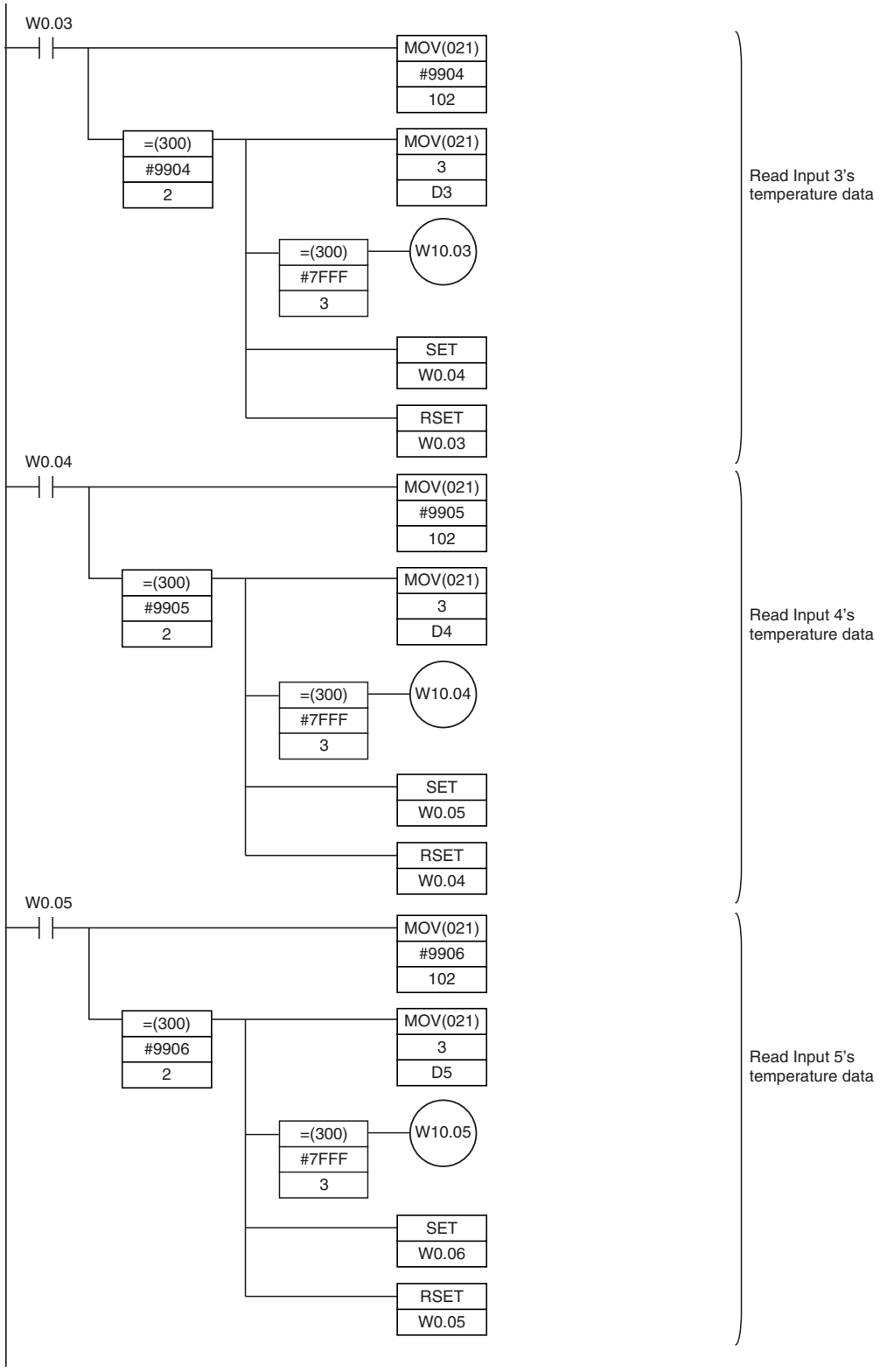
When it occurs open-circuit alarm, W10.00 to W10.11 is ON.

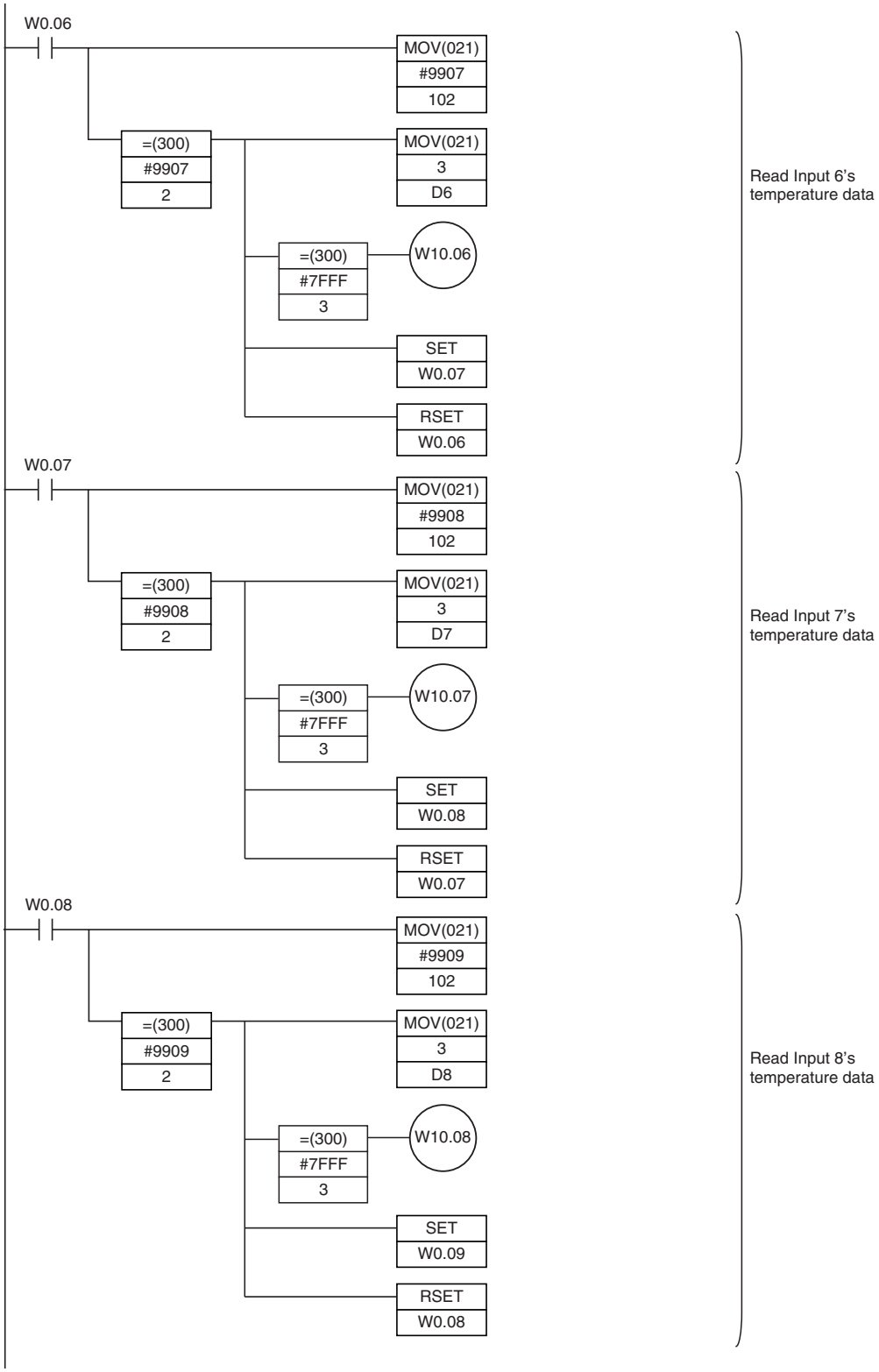


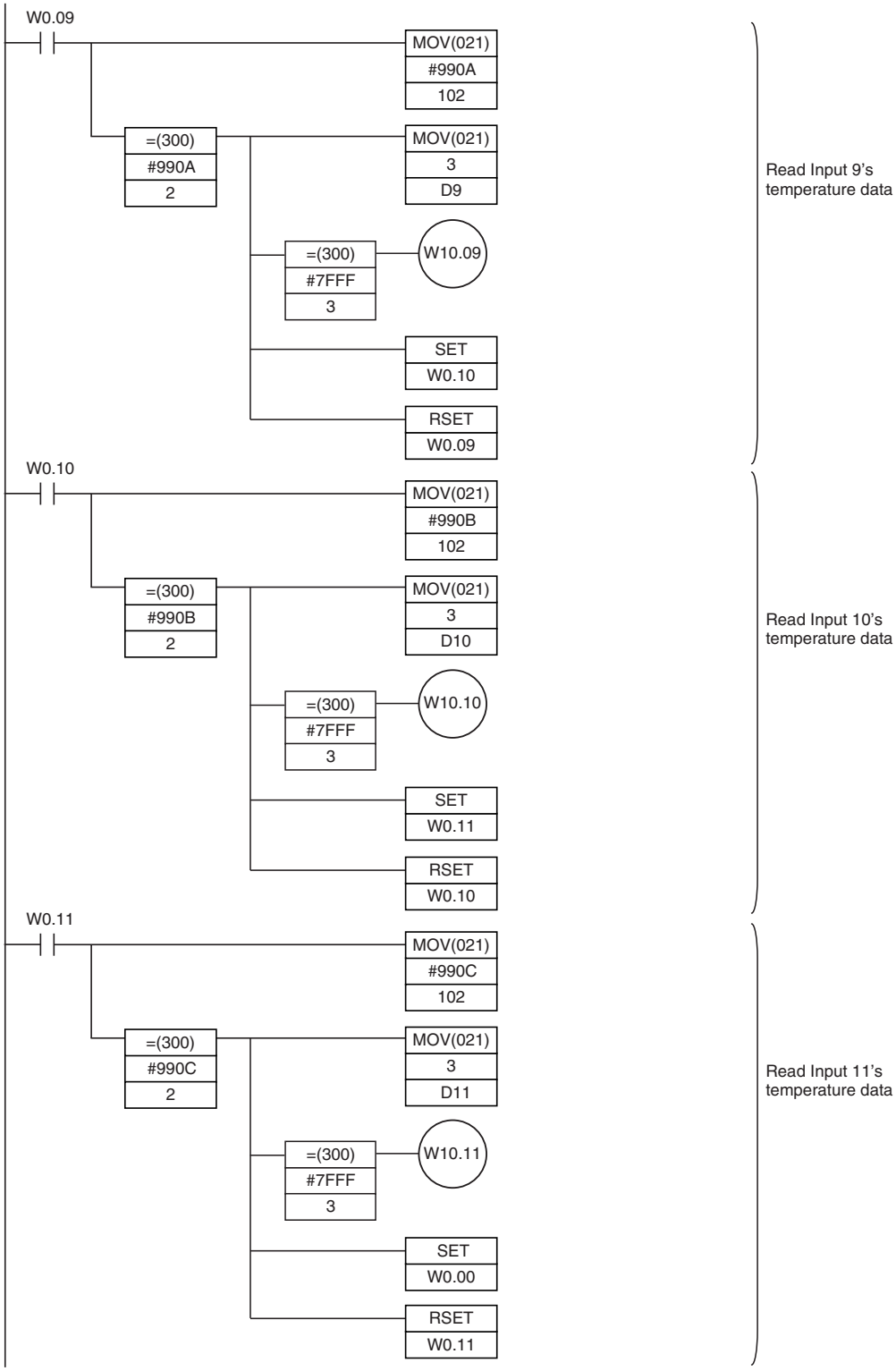
- Temperature Data Storage Address

Input word	Read command CIO n+1	Temperature data storage address	Open-circuit alarm
Input 0	#9901	D0	W0.00
Input 1	#9902	D1	W0.01
Input 2	#9903	D2	W0.02
Input 3	#9904	D3	W0.03
Input 4	#9905	D4	W0.04
Input 5	#9906	D5	W0.05
Input 6	#9907	D6	W0.06
Input 7	#9908	D7	W0.07
Input 8	#9909	D8	W0.08
Input 9	#990A	D9	W0.09
Input 10	#990B	D10	W0.10
Input 11	#990C	D11	W0.11


First Cycle ON Flag
SET
W0.00
Start to read temperature data.
W0.00
MOV(021)
#9901
102
Write input 0's read command (#9901) to CIO 102 (CIO n+1).
=(300)
#9901
2
MOV(021)
3
D0
If CIO 2 (CIO m+1) and read command are matched, store the temperature data (CIO m+2) to D0.
=(300)
#7FFF
3
W10.00
W10.00 turns ONat the time of open-circuit detection (7FFF).
SET
W0.01
RSET
W0.00
Read Input 0's temperature data
W0.01
MOV(021)
#9902
102
=(300)
#9902
2
MOV(021)
3
D1
=(300)
#7FFF
3
W10.01
SET
W0.02
RSET
W0.01
Read Input 1's temperature data
W0.02
MOV(021)
#9903
102
=(300)
#9903
2
MOV(021)
3
D2
=(300)
#7FFF
3
W10.02
SET
W0.03
RSET
W0.02
Read Input 2's temperature data


W0.03
MOV(021)
#9904
102
=(300)
#9904
2
MOV(021)
3
D3
=(300)
#7FFF
3
W10.03
SET
W0.04
RSET
W0.03
Read Input 3's temperature data
W0.04
MOV(021)
#9905
102
=(300)
#9905
2
MOV(021)
3
D4
=(300)
#7FFF
3
W10.04
SET
W0.05
RSET
W0.04
Read Input 4's temperature data
W0.05
MOV(021)
#9906
102
=(300)
#9906
2
MOV(021)
3
D5
=(300)
#7FFF
3
W10.05
SET
W0.06
RSET
W0.05
Read Input 5's temperature data


W0.06
MOV(021)
#9907
102
=(300)
#9907
2
MOV(021)
3
D6
=(300)
#7FFF
3
W10.06
SET
W0.07
RSET
W0.06
Read Input 6's temperature data
W0.07
MOV(021)
#9908
102
=(300)
#9908
2
MOV(021)
3
D7
=(300)
#7FFF
3
W10.07
SET
W0.08
RSET
W0.07
Read Input 7's temperature data
W0.08
MOV(021)
#9909
102
=(300)
#9909
2
MOV(021)
3
D8
=(300)
#7FFF
3
W10.08
SET
W0.09
RSET
W0.08
Read Input 8's temperature data


W0.09
MOV(021)
#990A
102
=(300)
#990A
2
MOV(021)
3
D9
=(300)
#7FFF
3
W10.09
SET
W0.10
RSET
W0.09
Read Input 9's temperature data
W0.10
MOV(021)
#990B
102
=(300)
#990B
2
MOV(021)
3
D10
=(300)
#7FFF
3
W10.10
SET
W0.11
RSET
W0.10
Read Input 10's temperature data
W0.11
MOV(021)
#990C
102
=(300)
#990C
2
MOV(021)
3
D11
=(300)
#7FFF
3
W10.11
SET
W0.00
RSET
W0.11
Read Input 11's temperature data

App

Appendices

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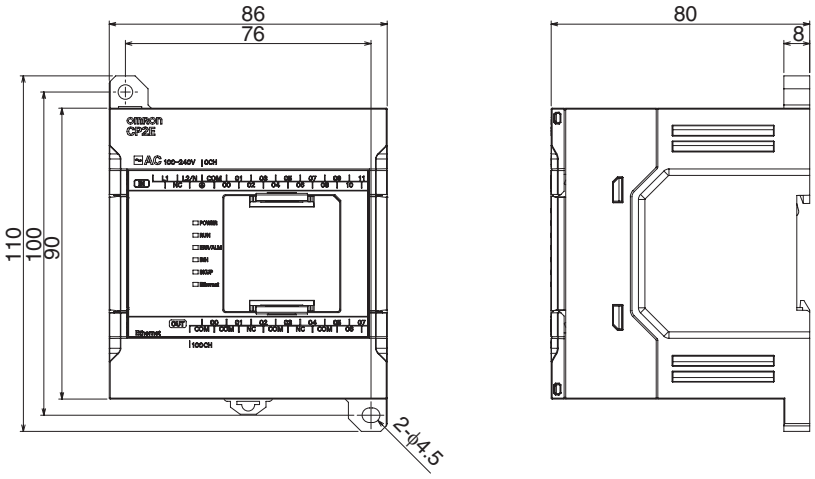
A-1 Dimensions

A-1-1 CPU Units

CPU Units with 14 or 20 I/O Points

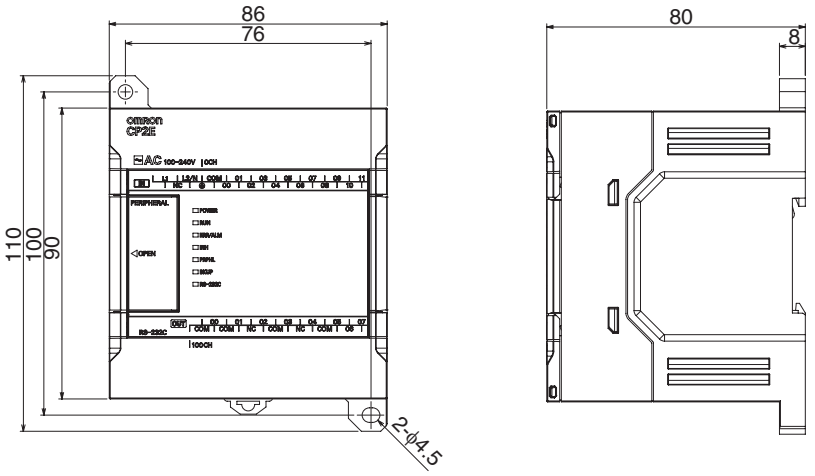
- **CP2E-N14/20D□-□**

Unit: mm



- **CP2E-E14/20D□-□**

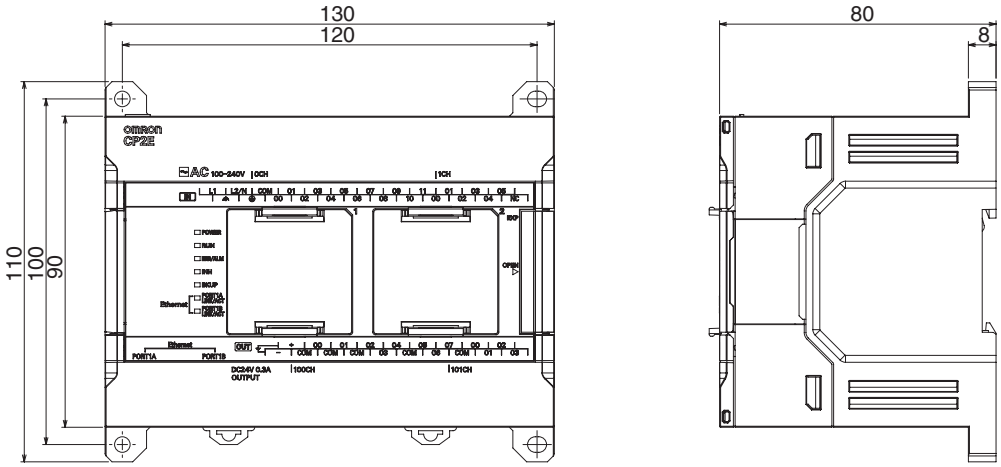
Unit: mm



CPU Units with 30 I/O Points

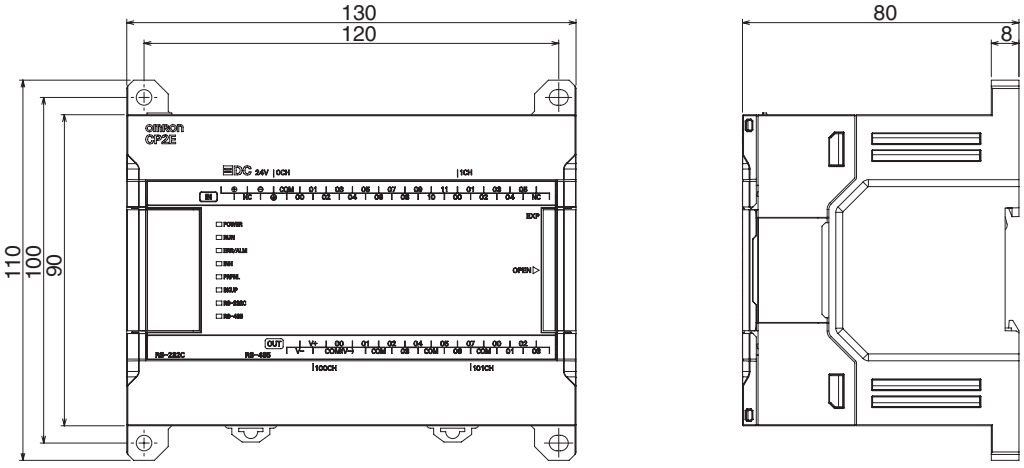
● CP2E-N30D□-□

Unit: mm



● CP2E-E30D□-□, CP2E-S30D□-□

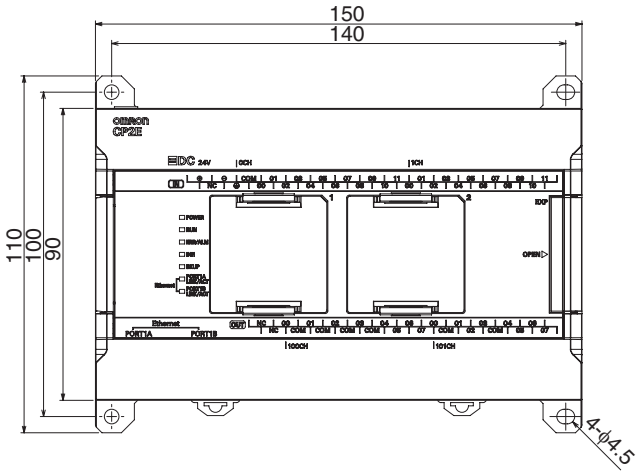
Unit: mm



CPU Units with 40 I/O Points

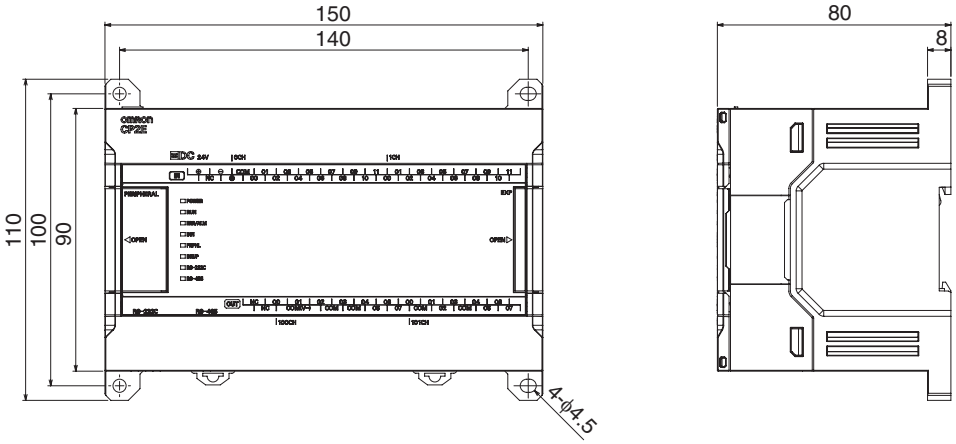
● CP2E-N40D□-□

Unit: mm



● CP2E-E40D□-□, CP2E-S40D□-□

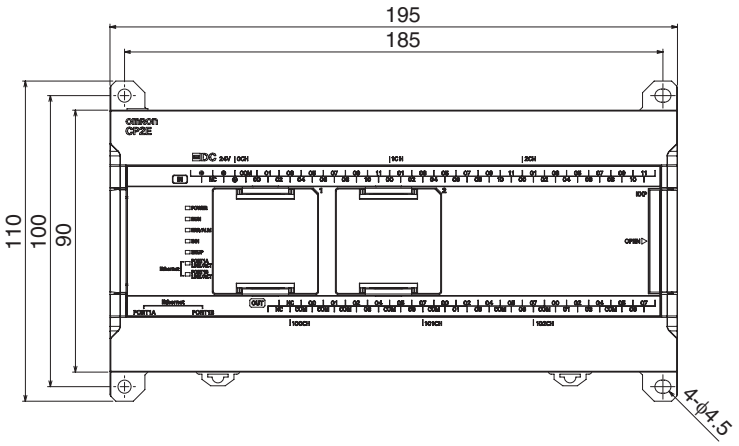
Unit: mm



CPU Units with 60 I/O Points

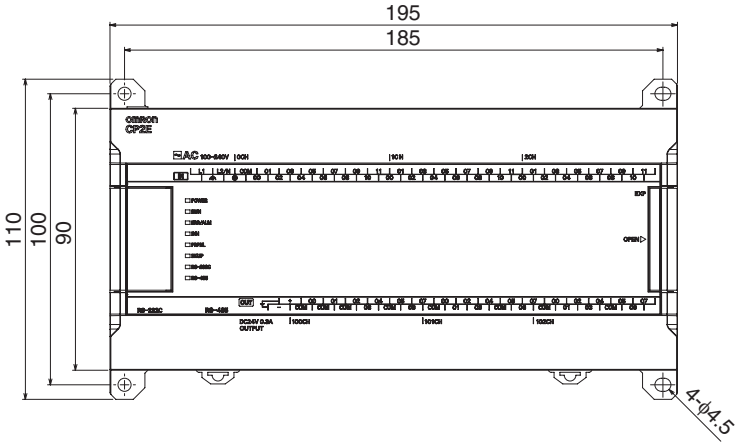
● CP2E-N60D□-□

Unit: mm



● CP2E-E60D□-□, CP2E-S60D□-□

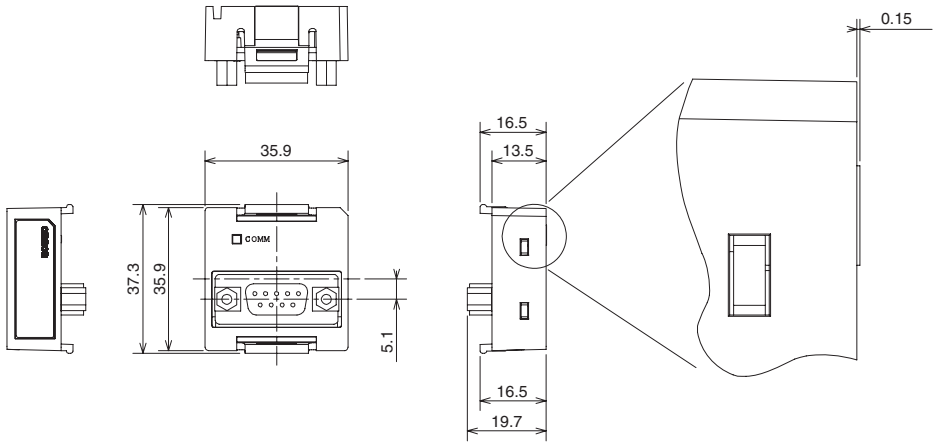
Unit: mm



A-1-2 Option Boards

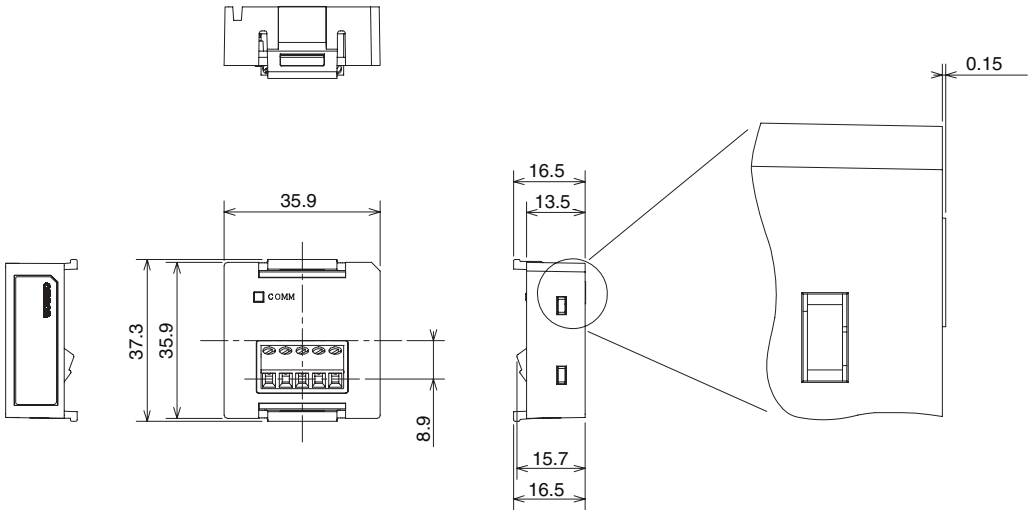
CP1W-CIF01 RS-232C Option Board

Unit: mm



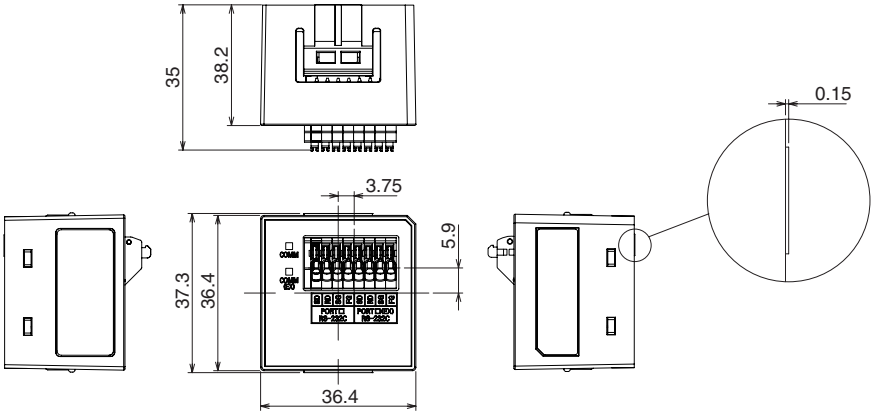
CP1W-CIF11/CIF12-V1 RS-422A/485 Option Board

Unit: mm



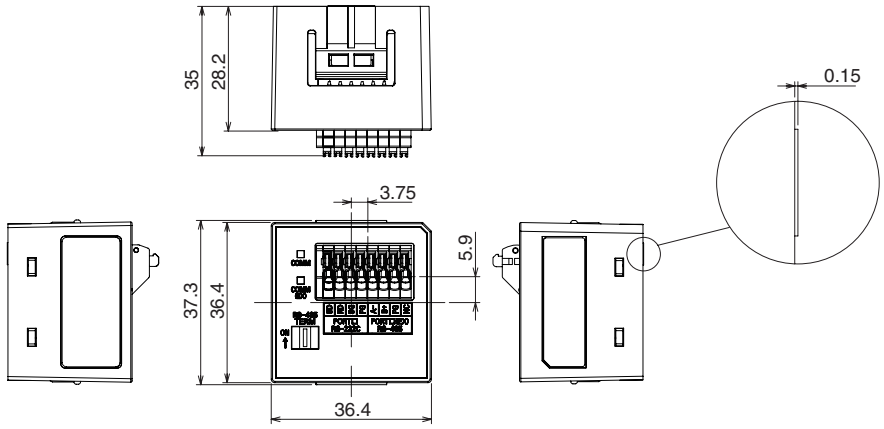
CP2W-CIFD1 RS-232C & RS-232C Option Board

Unit: mm



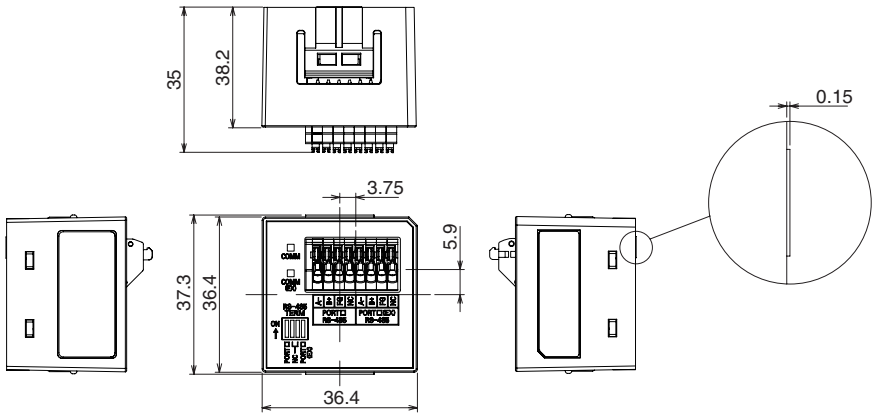
CP2W-CIFD2 RS-232C & RS485 Option Board

Unit: mm



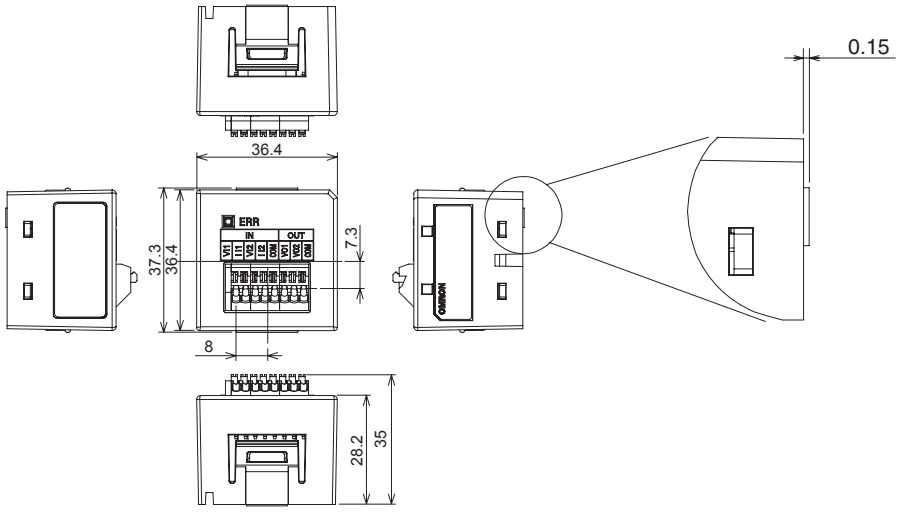
CP2W-CIFD3 RS-485 & RS-485 Option Board

Unit: mm



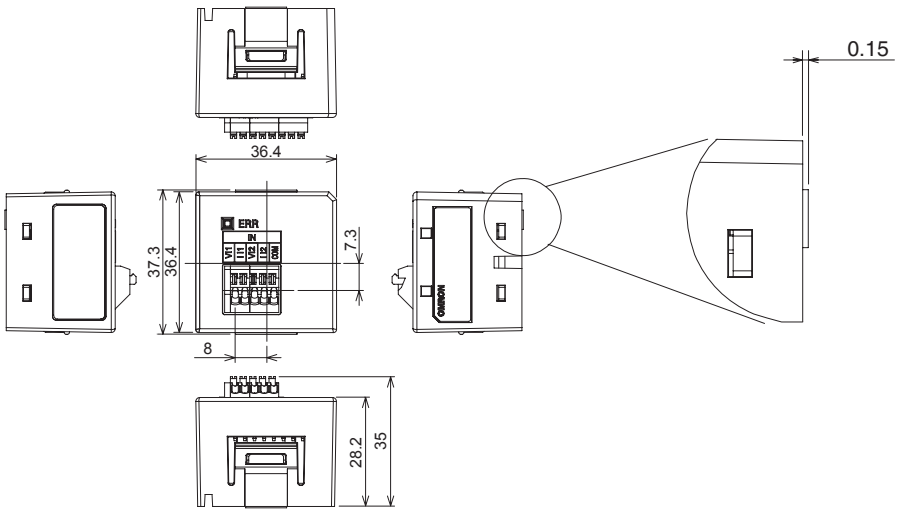
CP1W-MAB221 Analog Input/Output Option Board

Unit: mm



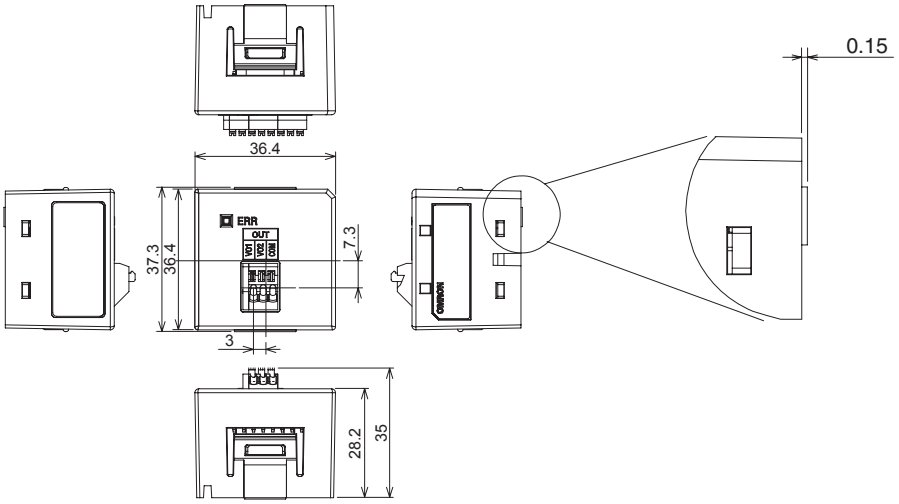
CP1W-ADB21 Analog Input Option Board

Unit: mm



CP1W-DAB21V Analog Output Option Board

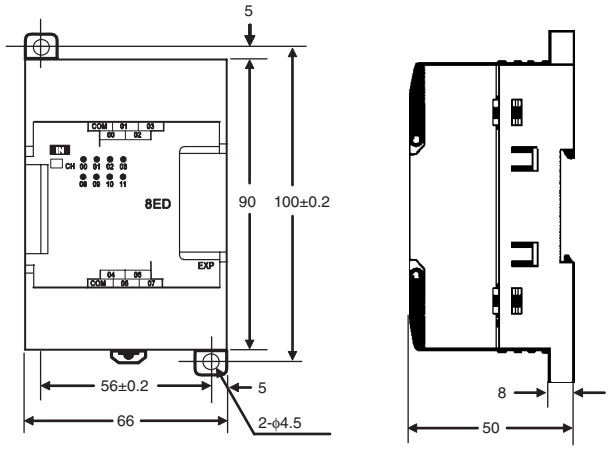
Unit: mm



A-1-3 Expansion I/O Units

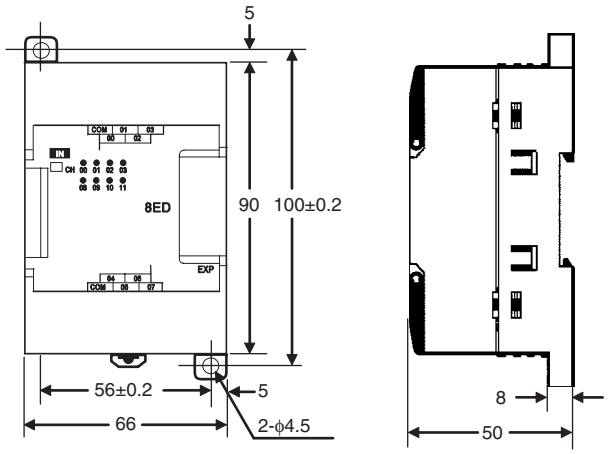
CP1W-8ED Expansion I/O Unit with 8 Input Points

Unit: mm



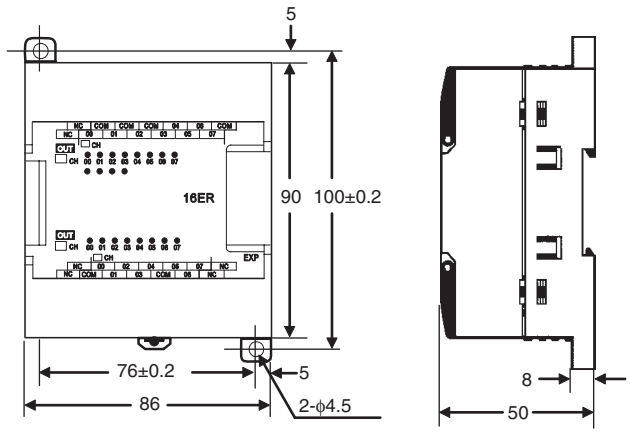
CP1W-8E□ Expansion I/O Units with 8 Output Points

Unit: mm



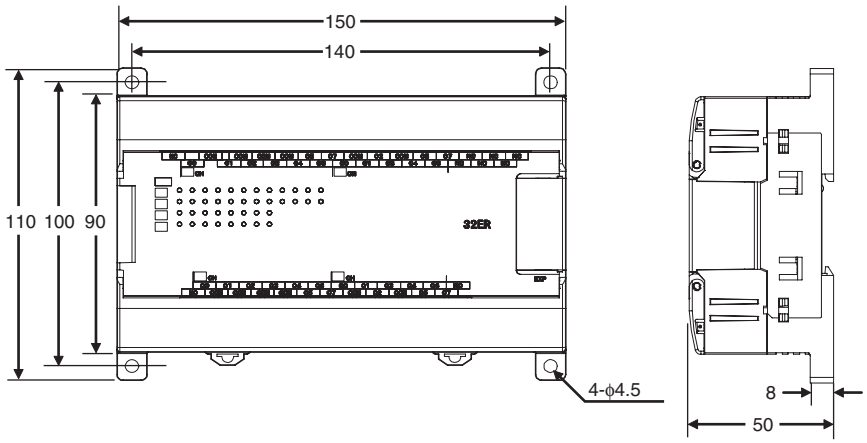
CP1W-16E□□ Expansion I/O Units with 16 Output Points

Unit: mm



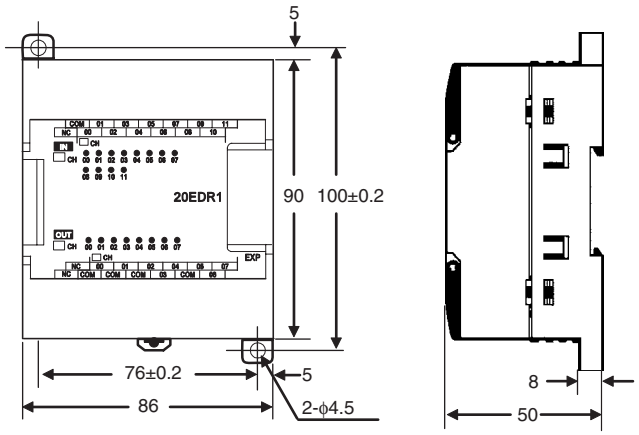
CP1W-32ER/ET/ET1 Expansion I/O Units with 32 Output Points

Unit: mm



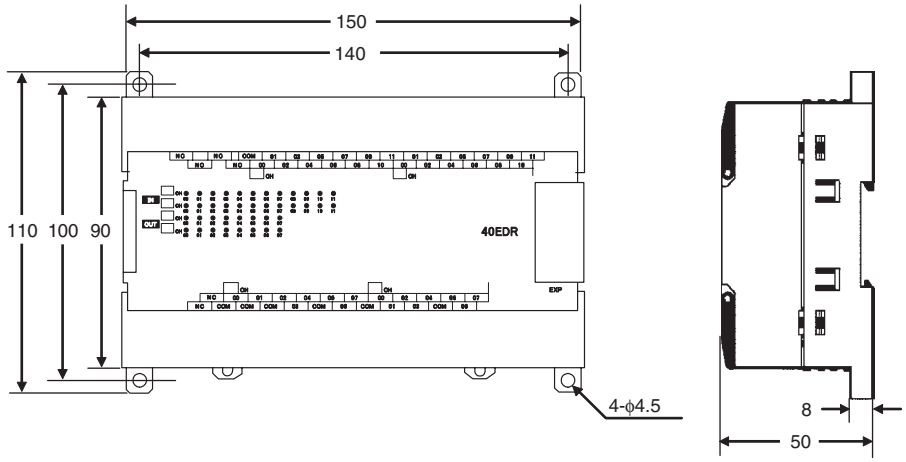
CP1W-20ED□□ Expansion I/O Units with 20 I/O Points

Unit: mm



CP1W-40ED□□ Expansion I/O Units with 40 I/O Points

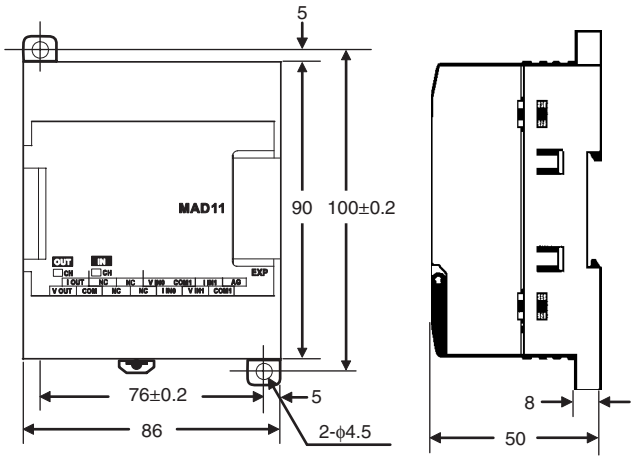
Unit: mm



A-1-4 Expansion Units

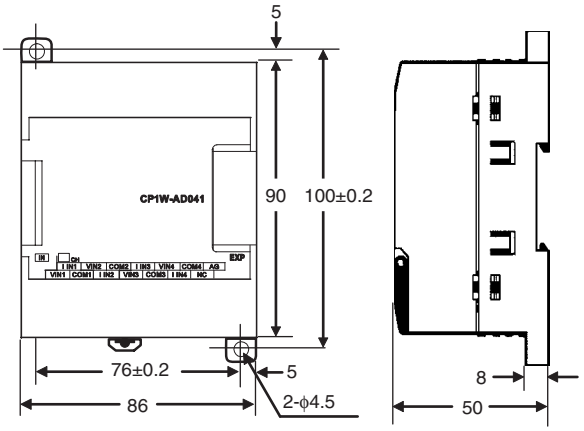
CP1W-MAD11/MAD42/MAD44 Analog I/O Units

Unit: mm



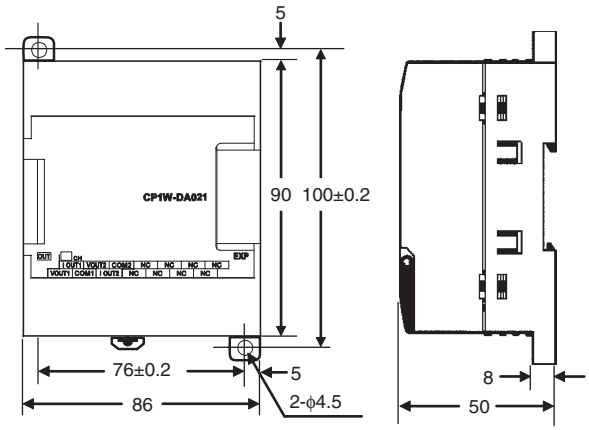
CP1W-AD041/AD042 Analog Input Unit

Unit: mm



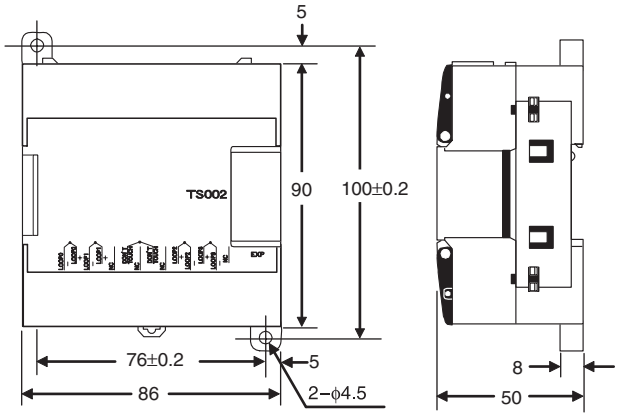
CP1W-DA021/DA041/DA042 Analog Output Unit

Unit: mm



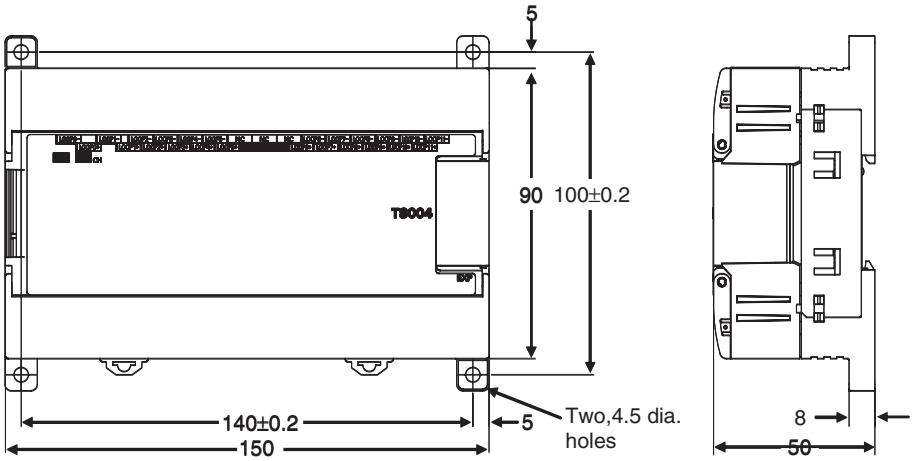
CP1W-TS□□1/2/3 Temperature Sensor Units

Unit: mm



CP1W-TS004 Temperature Sensor Units

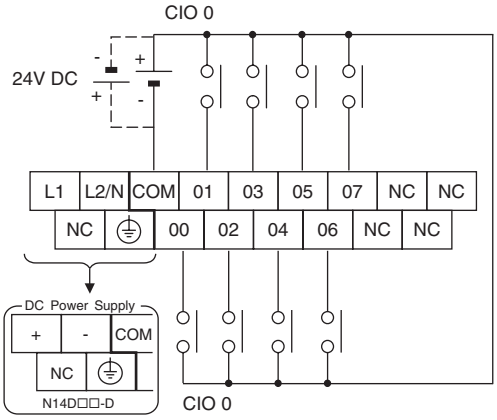
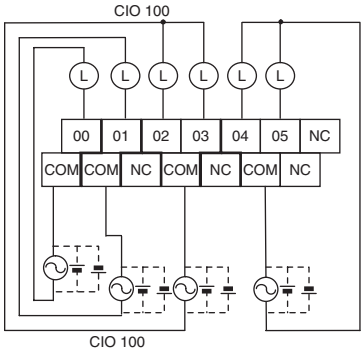
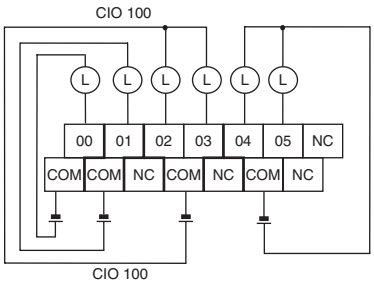
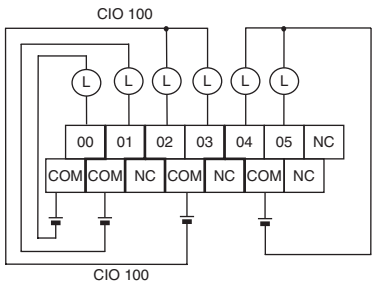
Unit: mm



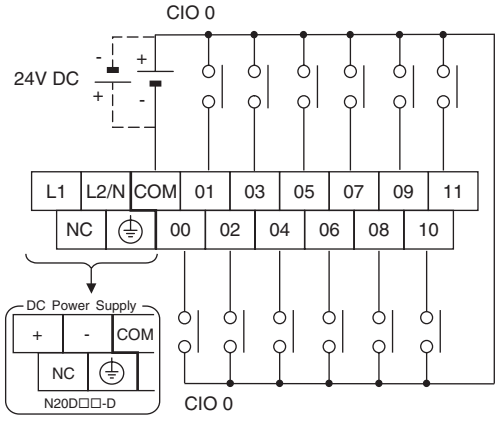
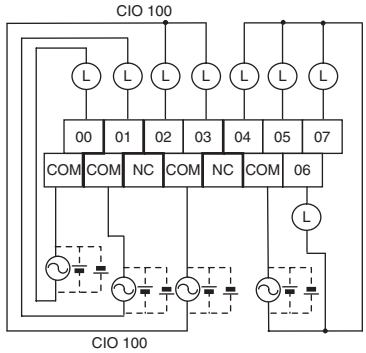
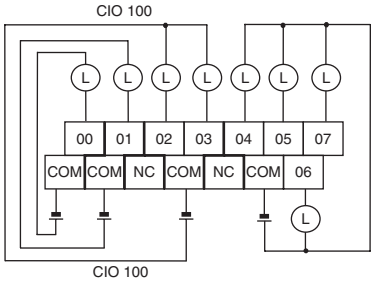
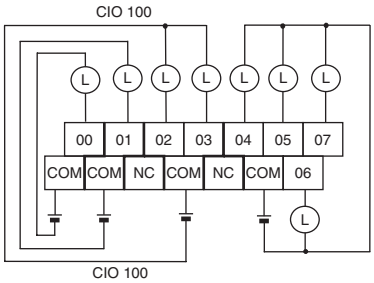
A-2 Wiring Diagrams

A-2-1 CPU Units

CPU Unit with 14 I/O Points (Terminal Block is not removable)

Input Wiring Diagram	Output Wiring Diagram
● **All Models** AC Power Supply CP2E-E14DR-A CP2E-N14D□-A DC Power Supply CP2E-N14D□□-D 	● **Relay Outputs** CP2E-E14DR-A CP2E-N14DR-□  ● **Transistor Outputs (Sinking)** CP2E-N14DT-□  ● **Transistor Outputs (Sourcing)** CP2E-N14DT1-D 

CPU Unit with 20 I/O Points (Terminal Block is not removable)

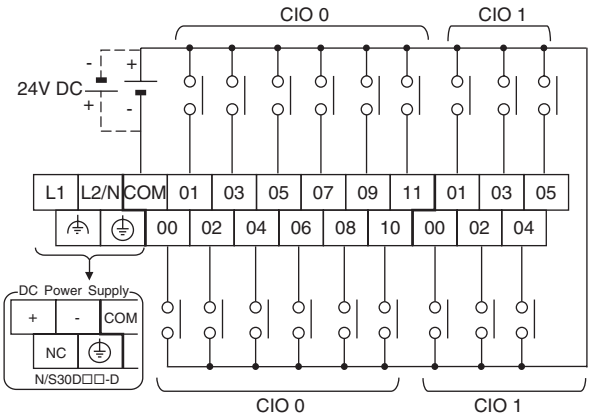
Input Wiring Diagram	Output Wiring Diagram
● **All Models** AC Power Supply CP2E-E20DR-A CP2E-N20D□-A DC Power Supply CP2E-N20D□□-D 	● **Relay Outputs** CP2E-E20DR-A CP2E-N20DR-□ 
	● **Transistor Outputs (Sinking)** CP2E-N20DT-□ 
	● **Transistor Outputs (Sourcing)** CP2E-N20DT1-D 

CPU Units with 30 I/O Points (Terminal Block is not removable)

Input Wiring Diagram	Output Wiring Diagram

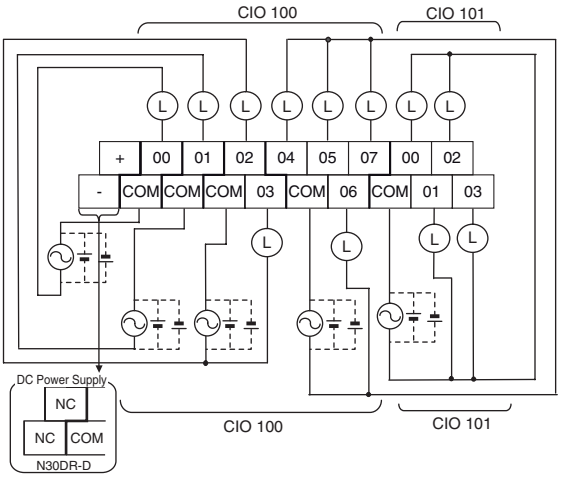
● All Models

AC Power Supply
CP2E-E30DR-A, CP2E-S30DR-A,
CP2E-N30D□-A
DC Power Supply
CP2E-S30D□□-D, CP2E-N30D□□-D



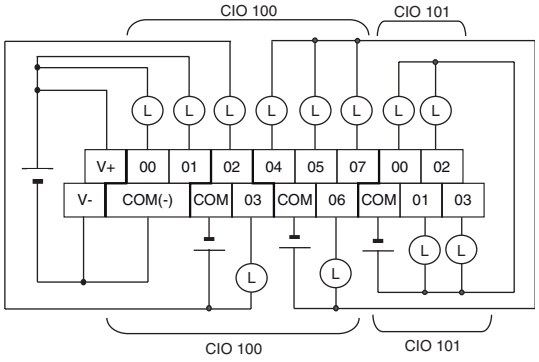
● Relay Outputs

CP2E-E30DR-A, CP2E-S30DR-A, CP2E-N30DR-□

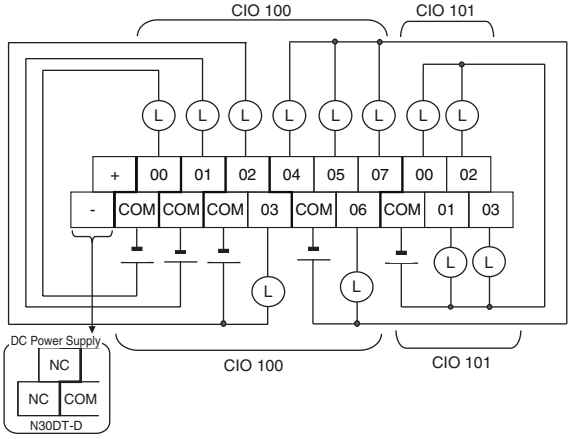


● Transistor Outputs (Sinking)

CP2E-S30DT-D

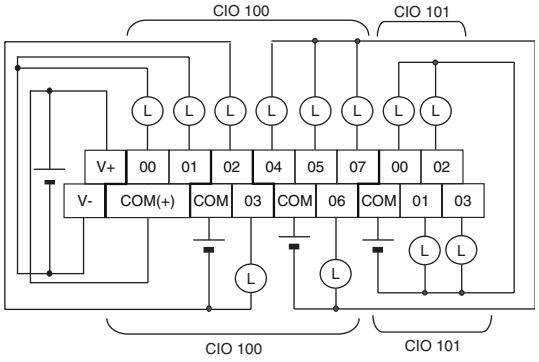


CP2E-N30DT-□

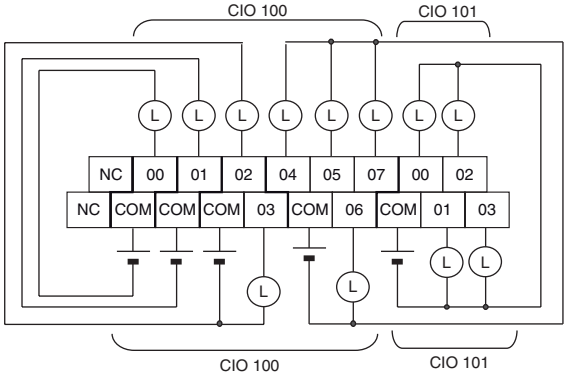


● Transistor Outputs (Sourcing)

CP2E-S30DT1-D



CP2E-N30DT1-D

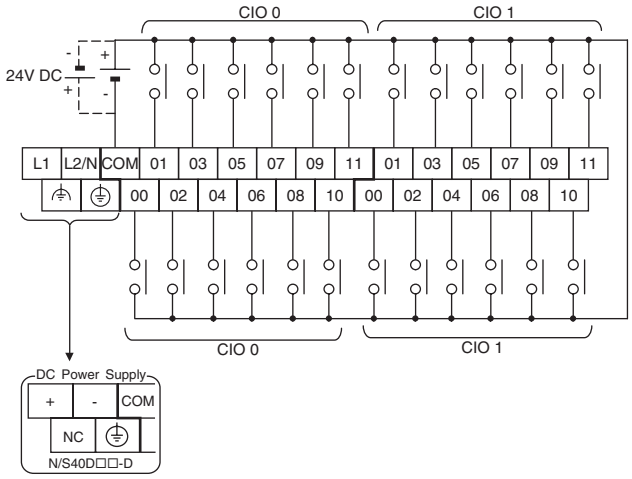


CPU Units with 40 I/O Points (Terminal Block is not removable)

Input Wiring Diagram	Output Wiring Diagram

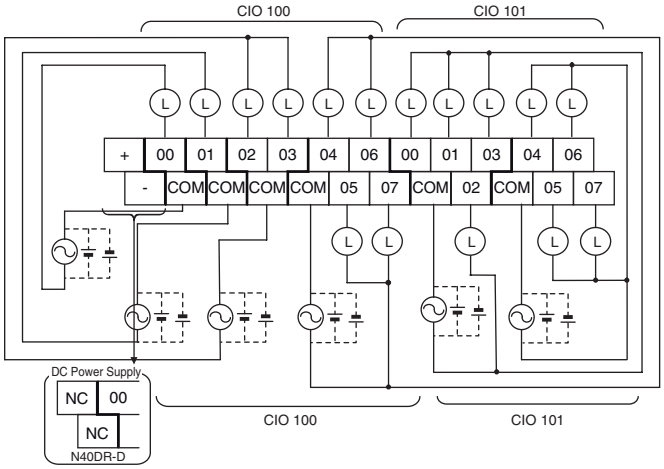
● All Models

AC Power Supply
CP2E-E40DR-A, CP2E-S40DR-A,
CP2E-N40D□-A
DC Power Supply
CP2E-S40D□□-D, CP2E-N40D□□-D



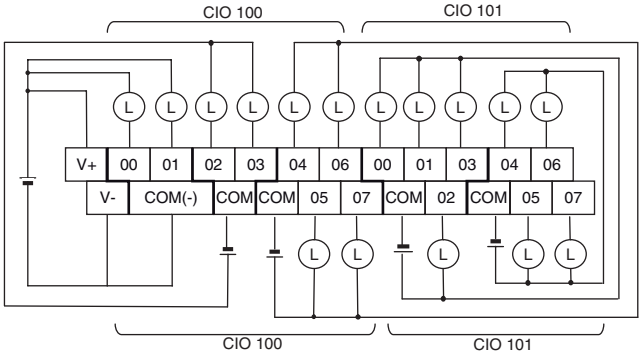
● Relay Outputs

CP2E-E40DR-A, CP2E-S40DR-A, CP2E-N40DR-□

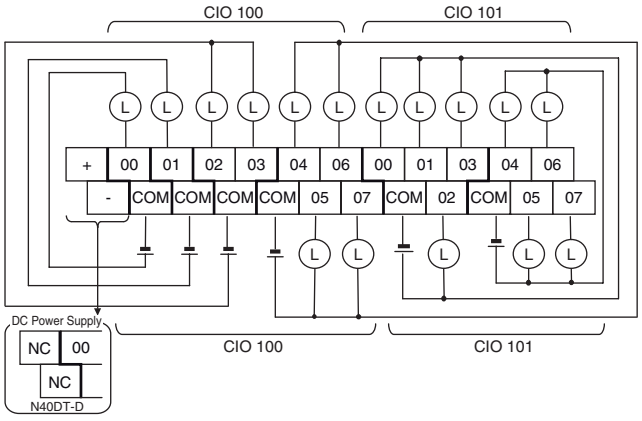


● Transistor Outputs (Sinking)

CP2E-S40DT-D

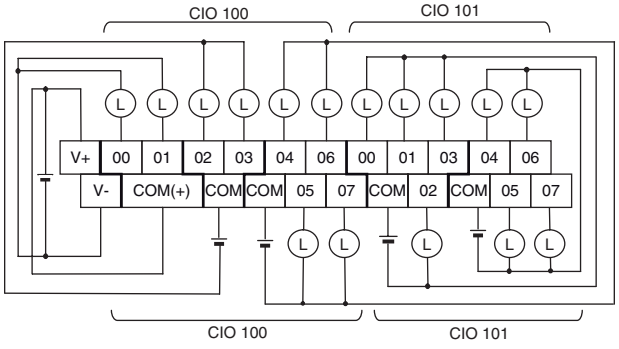


CP2E-N40DT-□

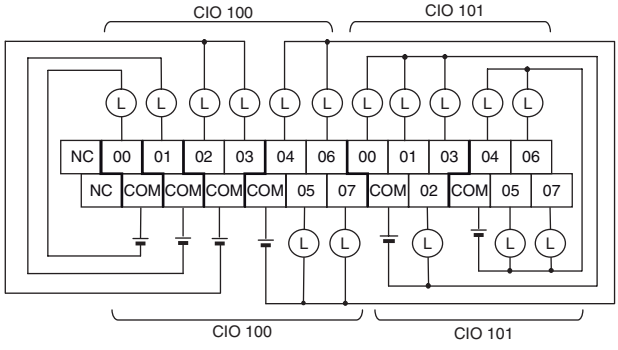


● Transistor Outputs (Sourcing)

CP2E-S40DT1-D



CP2E-N40DT1-D



CPU Units with 60 I/O Points (Terminal Block is not removable)

Input Wiring Diagram	Output Wiring Diagram

● All Models

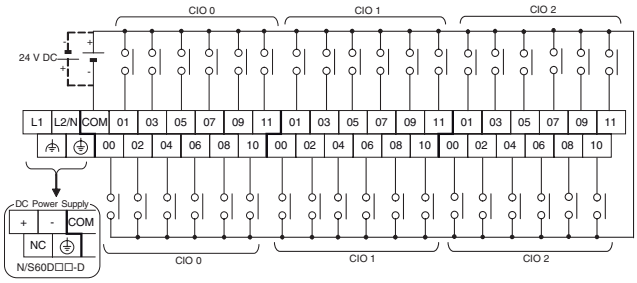
AC Power Supply

CP2E-E60DR-A, CP2E-S60DR-A,

CP2E-N60D□-A

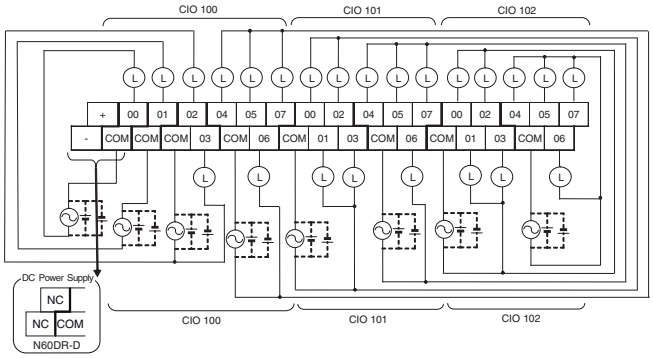
DC Power Supply

CP2E-S60D□□-D, CP2E-N60D□□-D



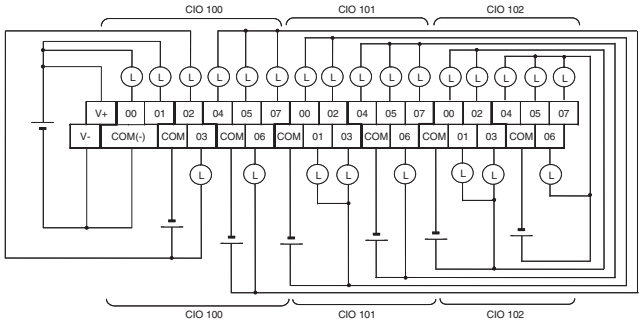
● Relay Outputs

CP2E-E60DR-A, CP2E-S60DR-A, CP2E-N60DR-□

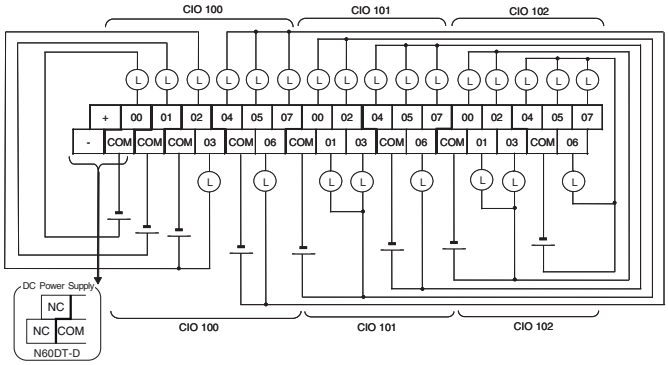


● Transistor Outputs (Sinking)

CP2E-S60DT-D

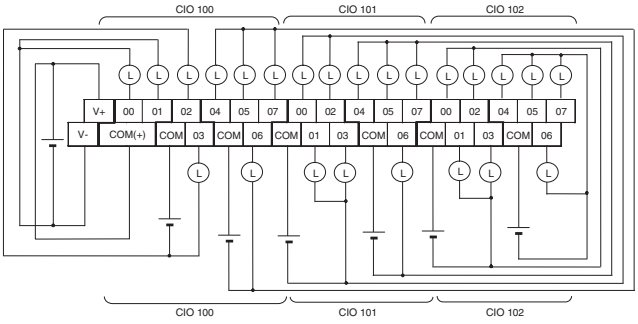


CP2E-N60DT-□

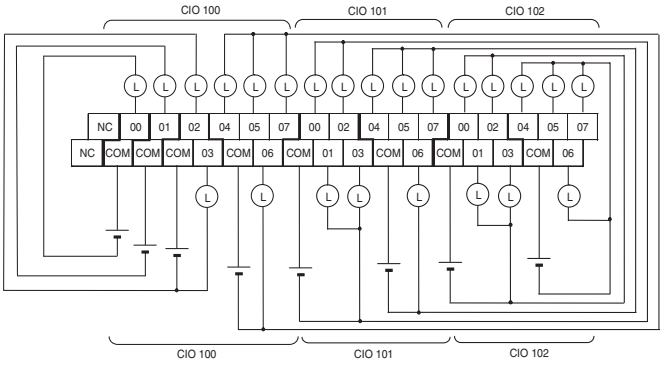


● Transistor Outputs (Sourcing)

CP2E-S60DT1-D



CP2E-N60DT1-D

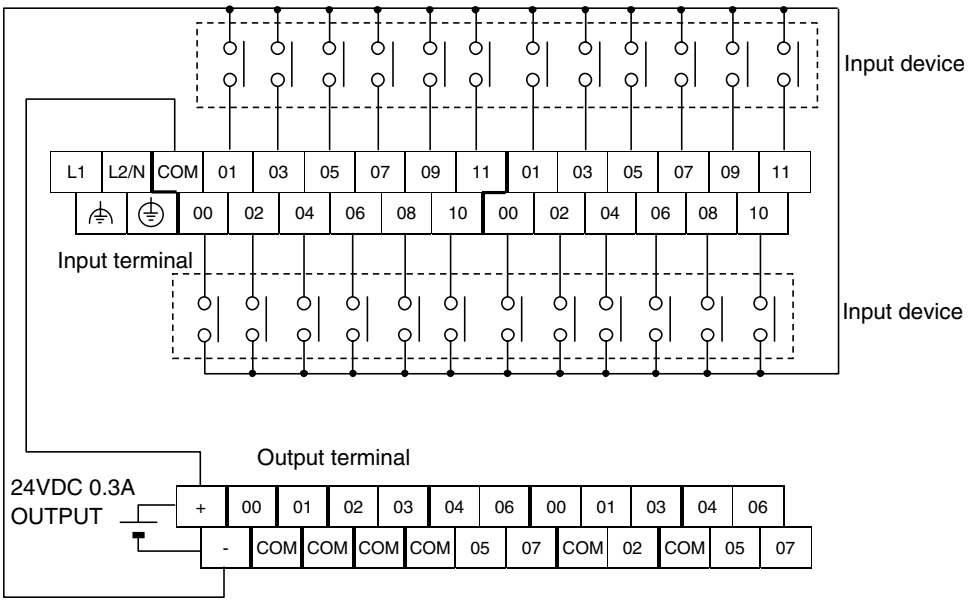


Input Wiring Example When Using External Power Supply

AC-power-supply CPU Units with 30, 40 or 60 I/O points have an external power supply (DC24V 0.3A), and can be used as a service power supply for input devices.

DC-power-supply CPU Units with 14 or 20 I/O points have no external power supply.

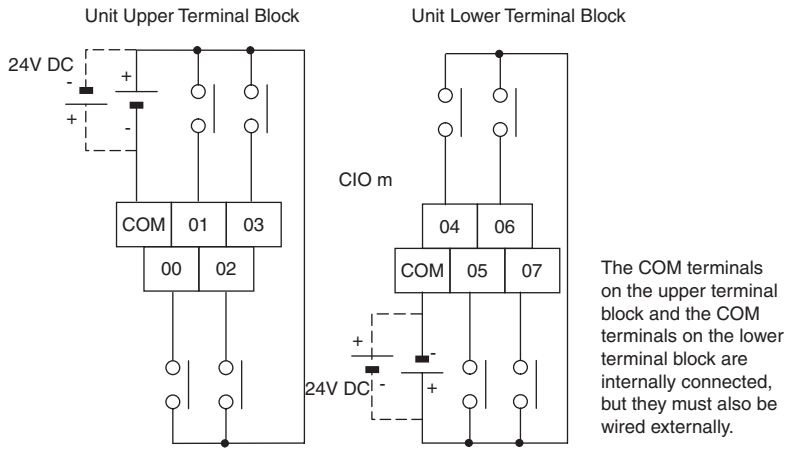
Wiring Example: AC-power-supply CPU Units with 40 I/O Points



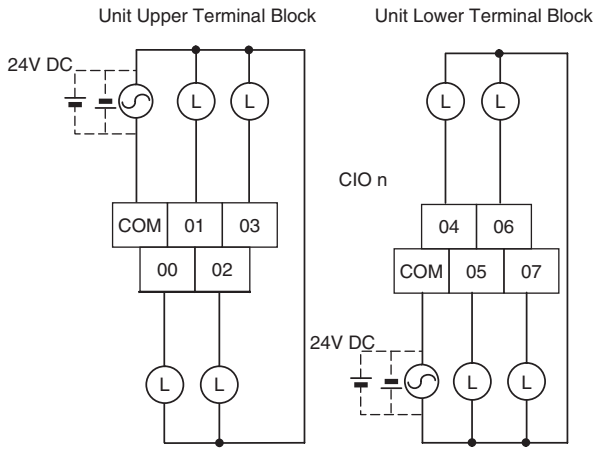
A-2-2 Expansion I/O Units

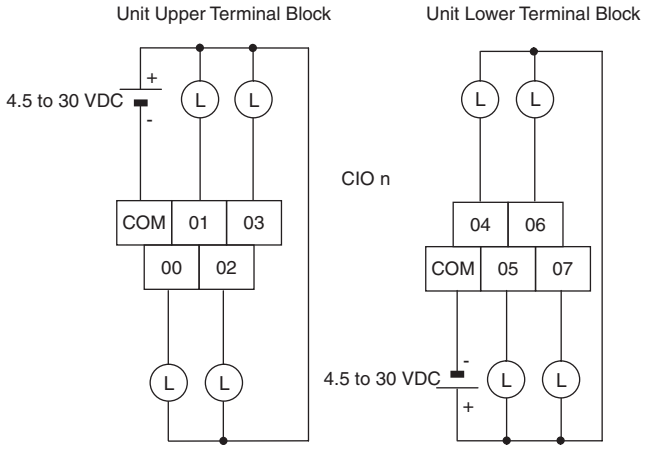
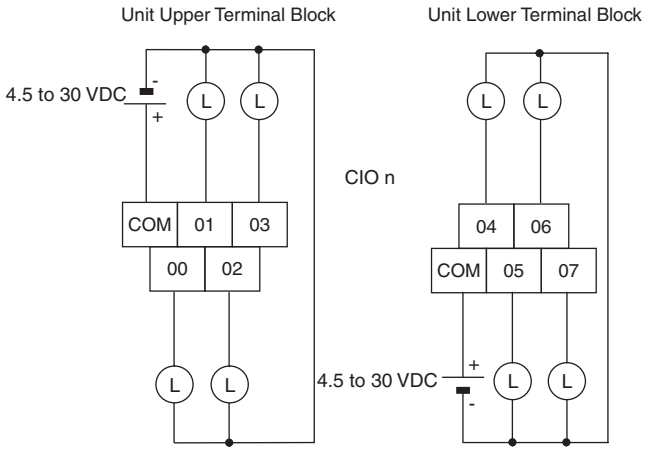
The first input word allocated to the Expansion I/O Unit is shown as CIO m and the first output word is shown as CIO n.

8-point Input Unit (Terminal Block is not removable)

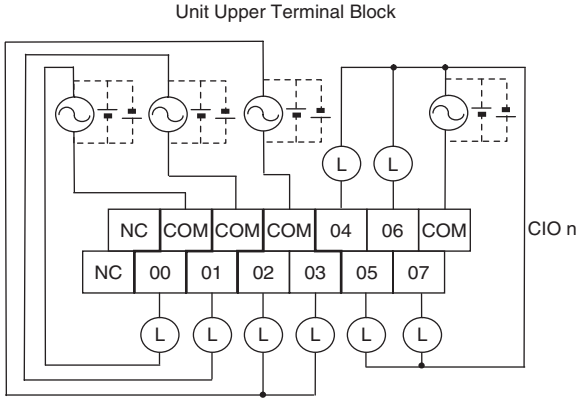
Input Wiring Diagram	Output Wiring Diagram
	Outputs not provided.

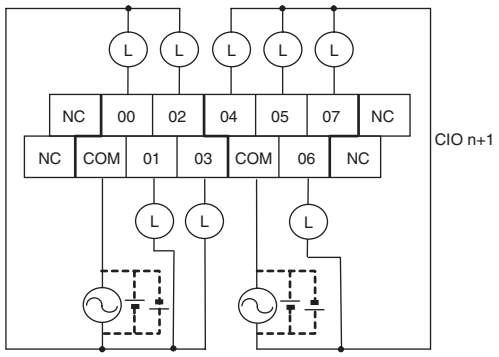
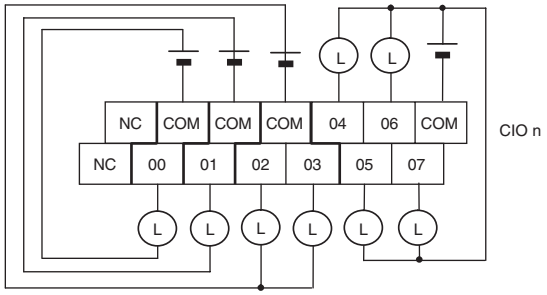
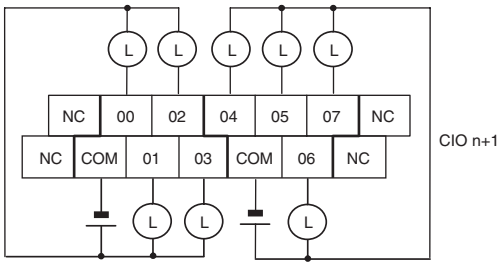
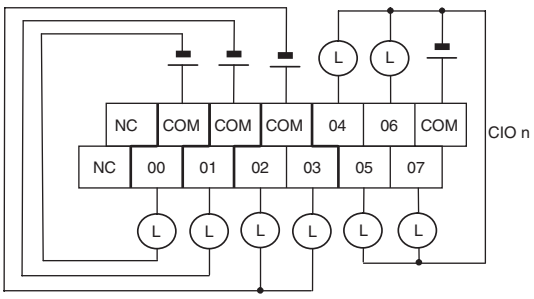
8-point Output Units (Terminal Block is not removable)

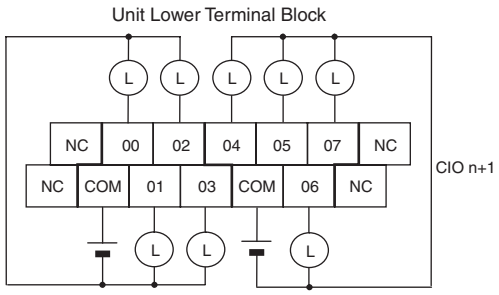
Input Wiring Diagram	Output Wiring Diagram
Inputs not provided.	● **Relay Outputs** CP1W-8ER 

Input Wiring Diagram	Output Wiring Diagram
Inputs not provided.	● **Transistor Outputs (Sinking)** CP1W-8ET  ● **Transistor Outputs (Sourcing)** CP1W-8ET1 

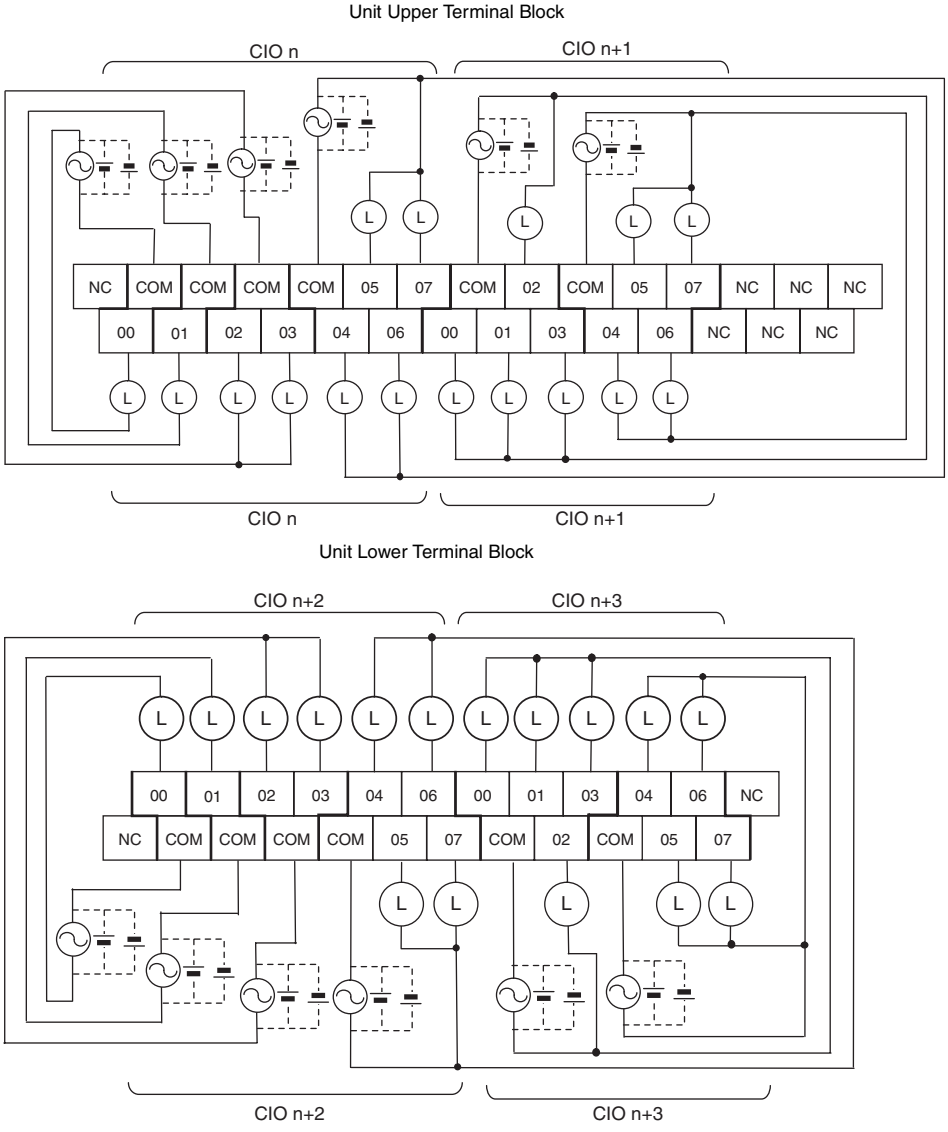
16-point Output Units (Terminal Block is not removable)

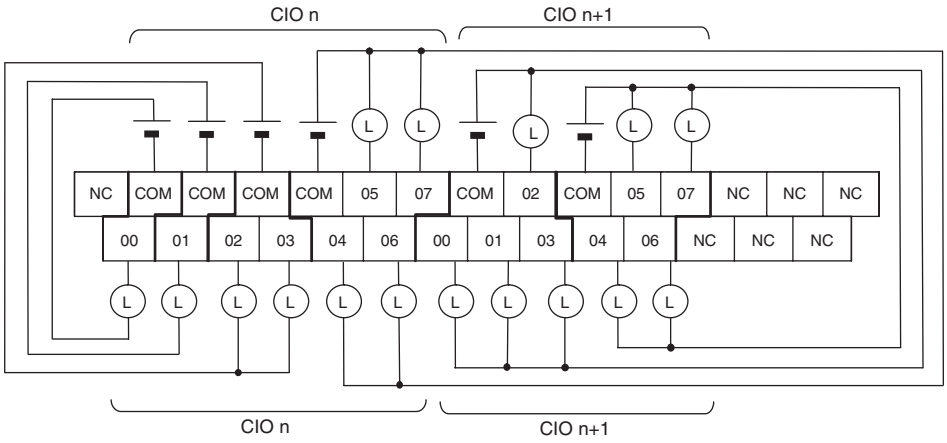
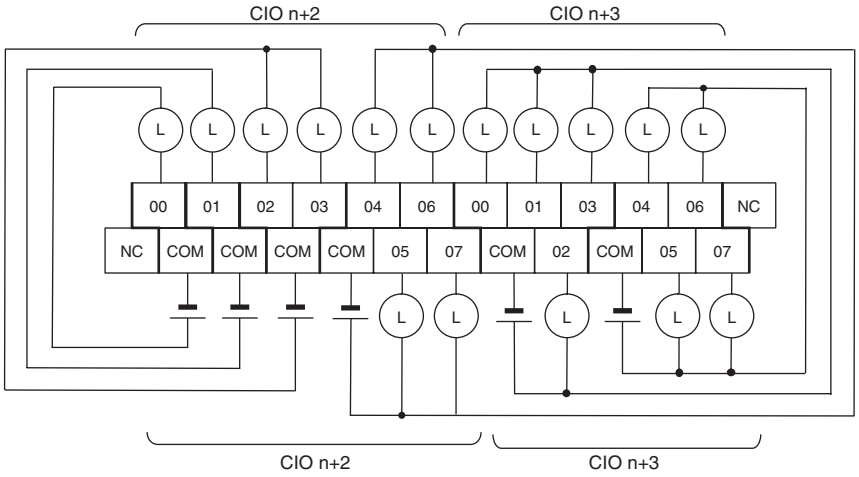
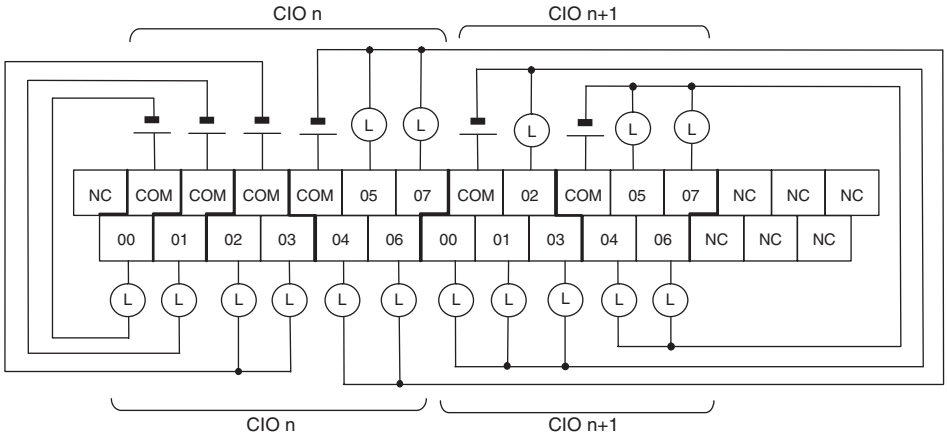
Input Wiring Diagram	Output Wiring Diagram
Inputs not provided.	● **Relay Outputs** CP1W-16ER 

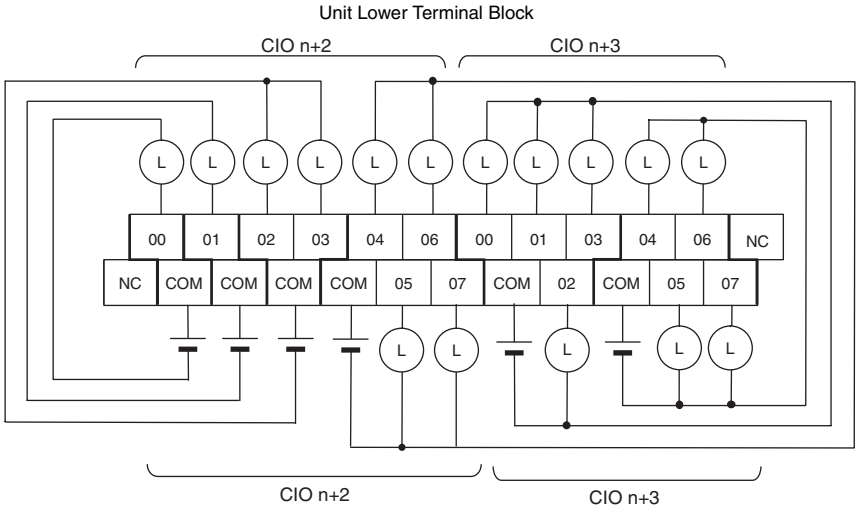
Input Wiring Diagram	Output Wiring Diagram
Inputs not provided.	Unit Lower Terminal Block  ● **Transistor Outputs (Sinking)** CP1W-16ET Unit Upper Terminal Block  Unit Lower Terminal Block  ● **Transistor Outputs (Sourcing)** CP1W-16ET1 Unit Upper Terminal Block 

Input Wiring Diagram	Output Wiring Diagram
Inputs not provided.	

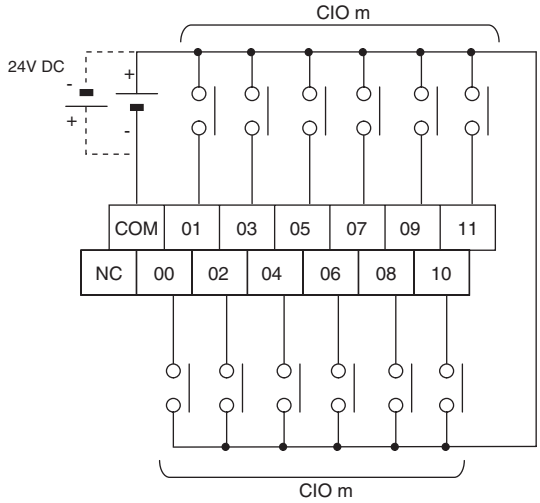
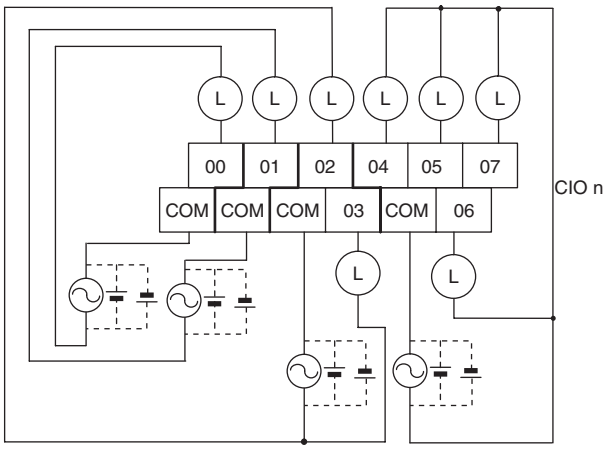
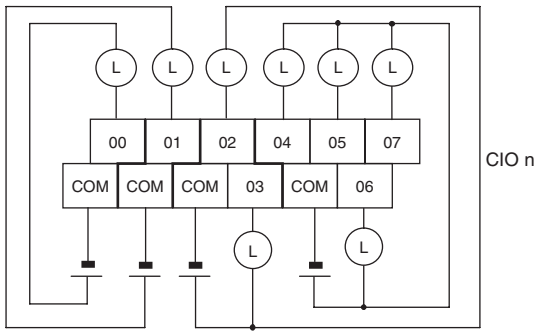
32-point Output Units (Terminal Block is not removable)

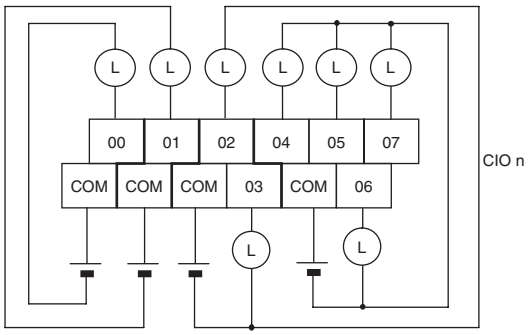
Input Wiring Diagram	Output Wiring Diagram
Inputs not provided.	● **Relay Outputs** CP1W-32ER 

Input Wiring Diagram	Output Wiring Diagram
Inputs not provided.	● **Transistor Outputs (Sinking)** CP1W-32ET Unit Upper Terminal Block  Unit Lower Terminal Block  ● **Transistor Outputs (Sourcing)** CP1W-32ET1 Unit Upper Terminal Block 

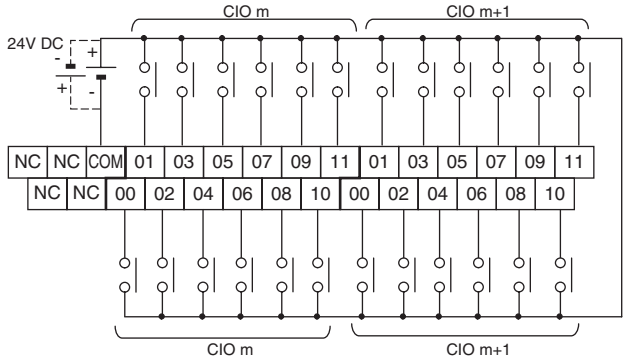
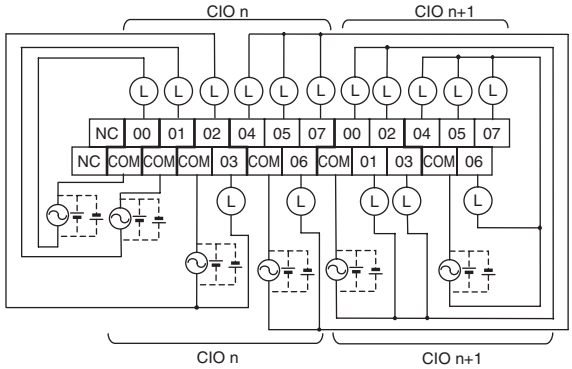
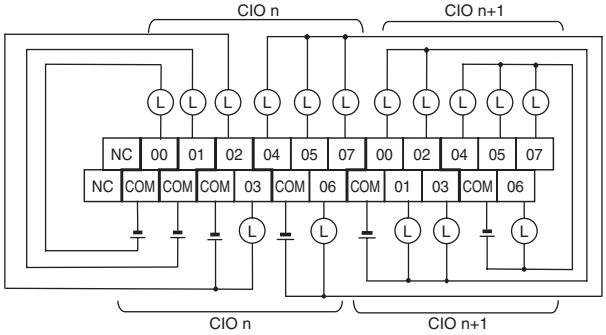
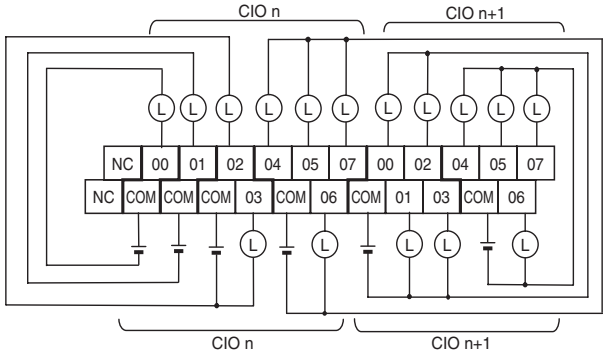
Input Wiring Diagram	Output Wiring Diagram
Inputs not provided.	

20-point I/O Units (Terminal Block is not removable)

Input Wiring Diagram	Output Wiring Diagram
● **All Models** 	● **Relay Outputs** CP1W-20EDR1  ● **Transistor Outputs (Sinking)** CP1W-20EDT 

Input Wiring Diagram	Output Wiring Diagram
	● **Transistor Outputs (Sourcing)** CP1W-20EDT1 

40-point I/O Units (Terminal Block is not removable)

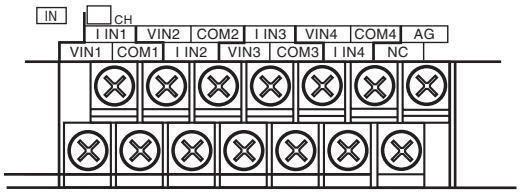
Input Wiring Diagram	Output Wiring Diagram
● **All Models** 	● **Relay Outputs** CP1W-40EDR  ● **Transistor Outputs (Sinking)** CP1W-40EDT  ● **Transistor Outputs (Sourcing)** CP1W-40EDT1 

A-2-3 Expansion Units

CP1W-AD041/AD042 Analog Input Unit (Terminal Block is not removable)

Wiring Diagrams

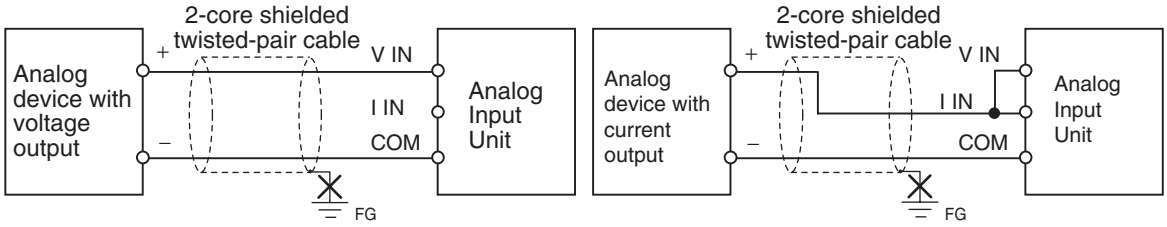
● Input Terminal Arrangement



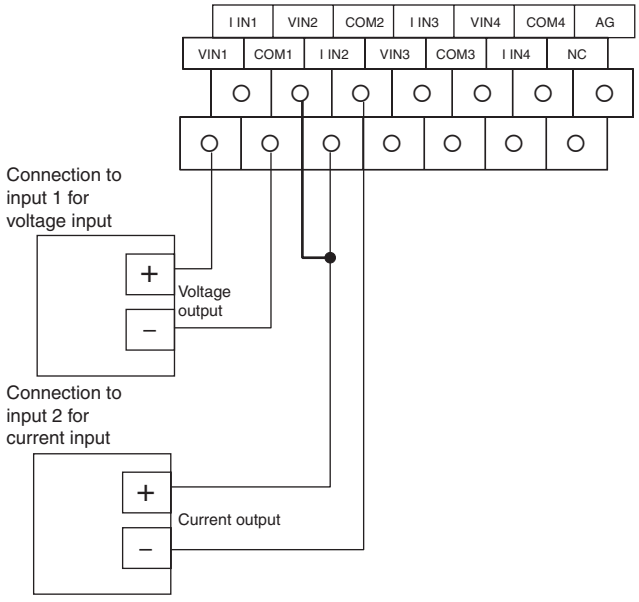
V IN1	Voltage input 1
I IN1	Current input 1
COM1	Input common 1
V IN2	Voltage input 2
I IN2	Current input 2
COM2	Input common 2
V IN3	Voltage input 3
I IN3	Current input 3
COM3	Input common 3
V IN4	Voltage input 4
I IN4	Current input 4
COM4	Input common 4

Note For current inputs, short V IN1 to I IN1, V IN2 to I IN2, V IN3 to I IN3, and V IN4 to I IN4.

● Wiring Methods



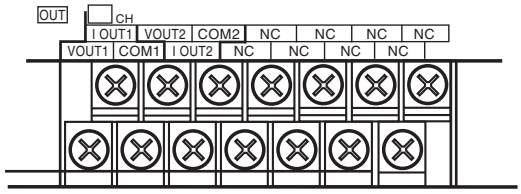
Example:



CP1W-DA021 Analog Output Unit (Terminal Block is not removable)

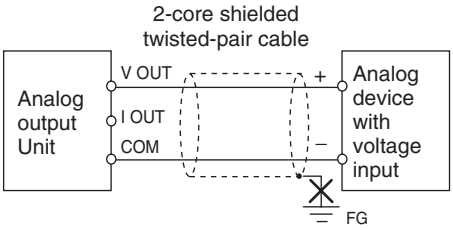
Wiring Diagrams

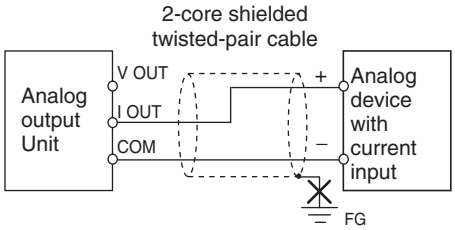
● Output Terminal Arrangement



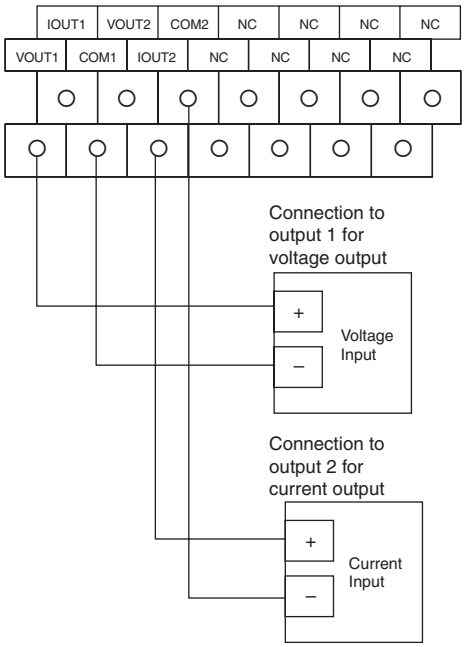
V OUT1	Voltage output 1
I OUT1	Current output 1
COM1	Output common 1
V OUT2	Voltage output 2
I OUT2	Current output 2
COM2	Output common 2

● Wiring Methods





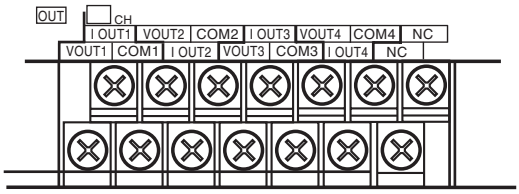
Example:



CP1W-DA041/DA042 Analog Output Unit (Terminal Block is not removable)

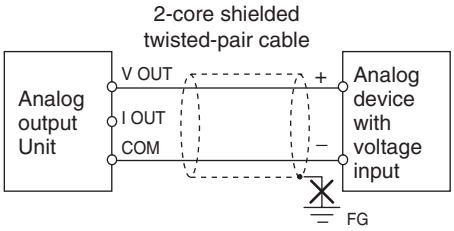
Wiring Diagrams

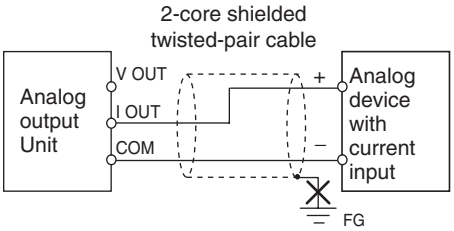
● Output Terminal Arrangement



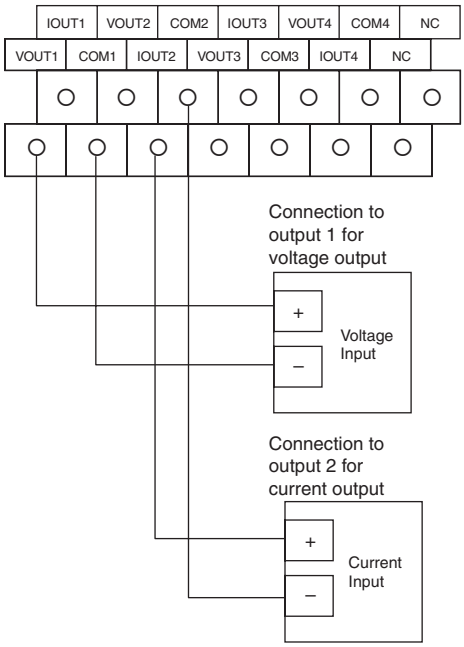
V OUT1	Voltage output 1
I OUT1	Current output 1
COM1	Output common 1
V OUT2	Voltage output 2
I OUT2	Current output 2
COM2	Output common 2
V OUT3	Voltage output 3
I OUT3	Current output 3
COM3	Output common 3
V OUT4	Voltage output 4
I OUT4	Current output 4
COM4	Output common 4

● Wiring Methods





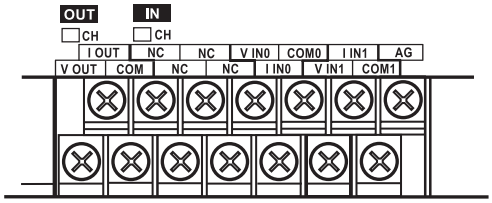
Example:



CP1W-MAD11 Analog I/O Unit (Terminal Block is not removable)

Wiring Diagrams

● I/O Terminal Arrangement

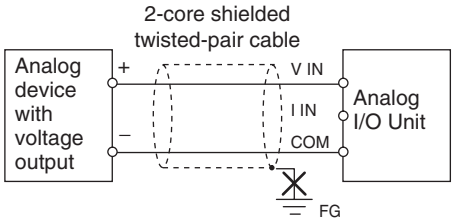


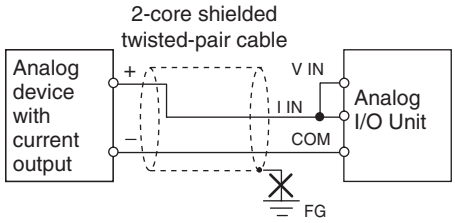
V OUT	Voltage output
I OUT	Current output
COM	Output common
V IN0	Voltage input 0
I IN0	Current input 0
COM0	Input common 0
V IN1	Voltage input 1
I IN1	Current input 1
COM1	Input common 1

Note For current inputs, short V IN0 to I IN0 and V IN1 to I IN1.

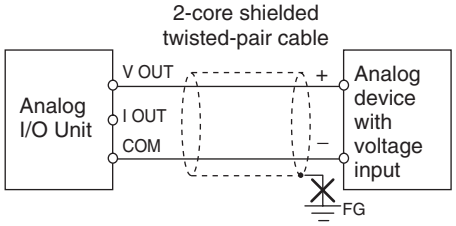
● Wiring Methods

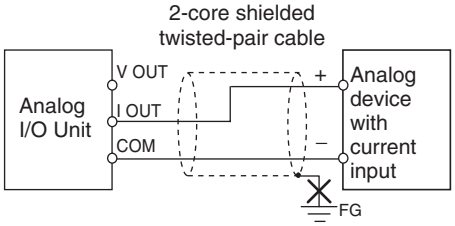
• Wiring Analog Inputs





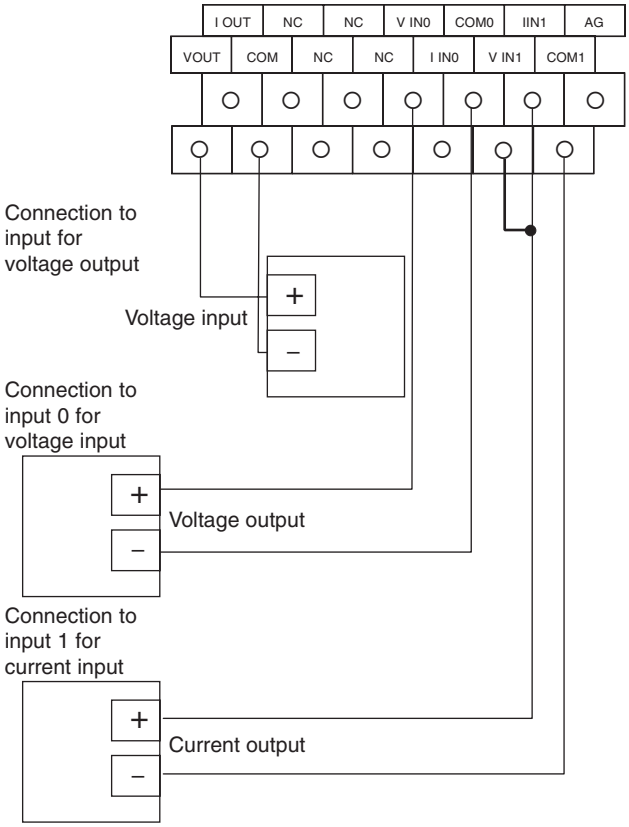
• Wiring Analog Outputs





Wiring Diagrams

Example:

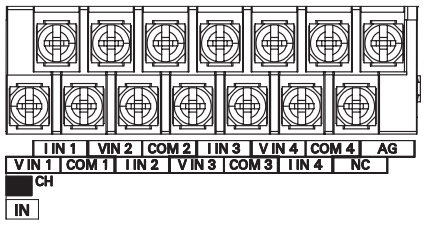


CP1W-MAD42 Analog I/O Unit (Terminal Block is not removable)

Wiring Diagrams

I/O Terminal Arrangement

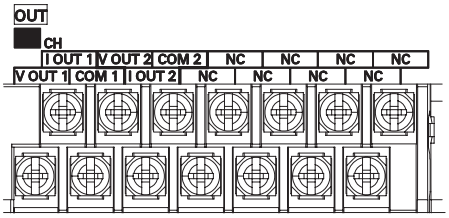
- Input Terminal Arrangement



V IN1	Voltage input 1
I IN1	Current input 1
COM1	Input common 1
V IN2	Voltage input 2
I IN2	Current input 2
COM2	Input common 2
V IN3	Voltage input 3
I IN3	Current input 3
COM3	Input common 3
V IN4	Voltage input 4
I IN4	Current input 4
COM4	Input common 4

Note For current inputs, short V IN1 to I IN1, V IN2 to I IN2, V IN3 to I IN3, and V IN4 to I IN4.

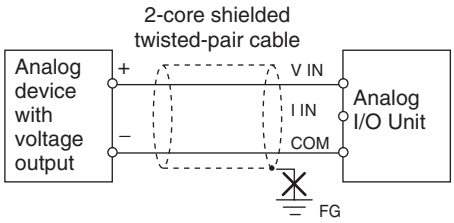
- Output Terminal Arrangement

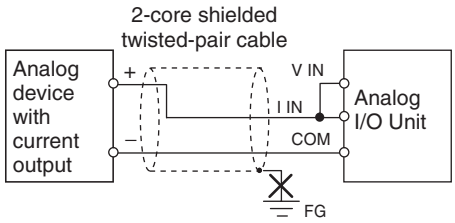


V OUT1	Voltage output 1
I OUT1	Current output 1
COM1	Output common 1
V OUT2	Voltage output 2
I OUT2	Current output 2
COM2	Output common 2

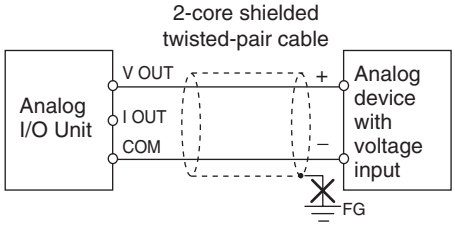
Wiring Methods

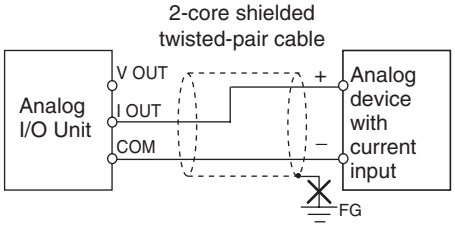
- Wiring Analog Inputs





- Wiring Analog Outputs



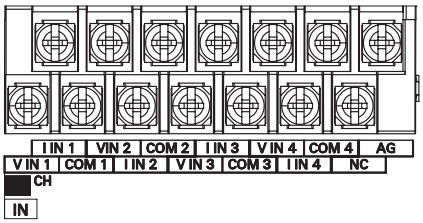


CP1W-MAD44 Analog I/O Unit (Terminal Block is not removable)

Wiring Diagrams

I/O Terminal Arrangement

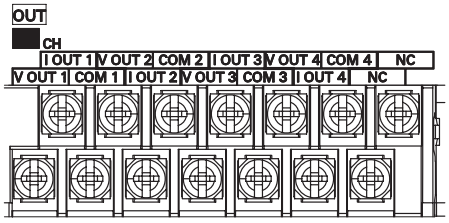
- Input Terminal Arrangement



V IN1	Voltage input 1
I IN1	Current input 1
COM1	Input common 1
V IN2	Voltage input 2
I IN2	Current input 2
COM2	Input common 2
V IN3	Voltage input 3
I IN3	Current input 3
COM3	Input common 3
V IN4	Voltage input 4
I IN4	Current input 4
COM4	Input common 4

Note For current inputs, short V IN1 to I IN1, V IN2 to I IN2, V IN3 to I IN3, and V IN4 to I IN4.

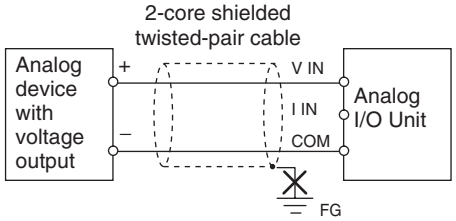
- Output Terminal Arrangement

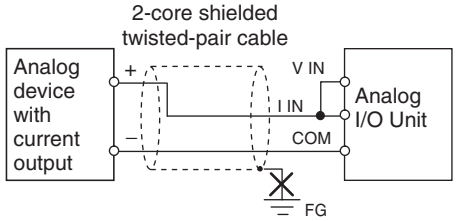


V OUT1	Voltage output 1
I OUT1	Current output 1
COM1	Output common 1
V OUT2	Voltage output 2
I OUT2	Current output 2
COM2	Output common 2
V OUT3	Voltage output 3
I OUT3	Current output 3
COM3	Output common 3
V OUT4	Voltage output 4
I OUT4	Current output 4
COM4	Output common 4

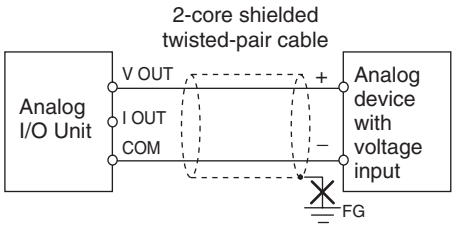
Wiring Methods

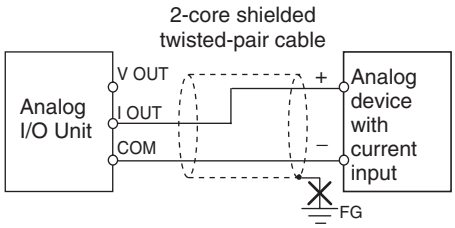
- Wiring Analog Inputs





- Wiring Analog Outputs



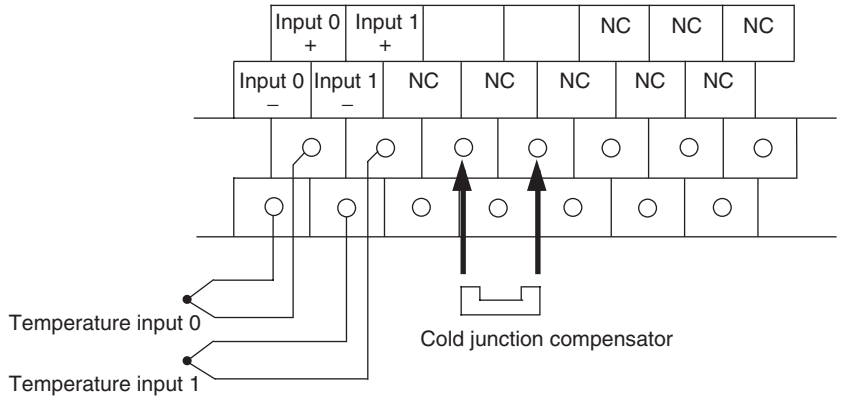


CP1W-TS001/TS002/TS101/TS102 Temperature Sensor Units (Terminal Block is not removable)

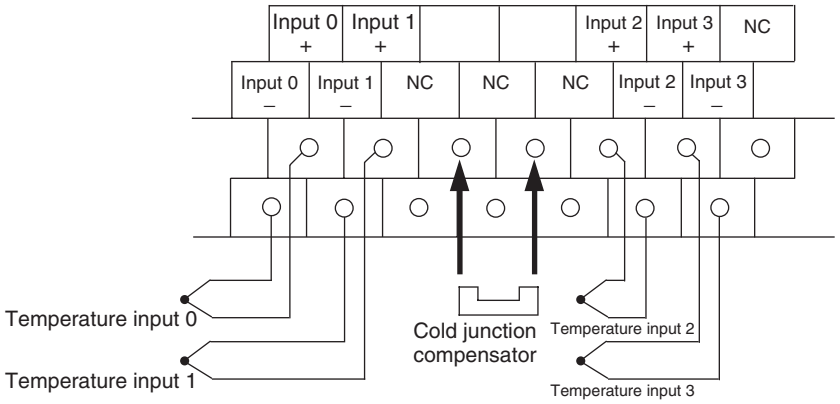
Wiring Diagrams

● Connecting a Thermocouple

- CP1W-TS001
  One or two K or J thermocouples can be connected to the CP1W-TS001.
  Both of the thermocouples must be of the same type and the same input range must be used for each.
  Example:



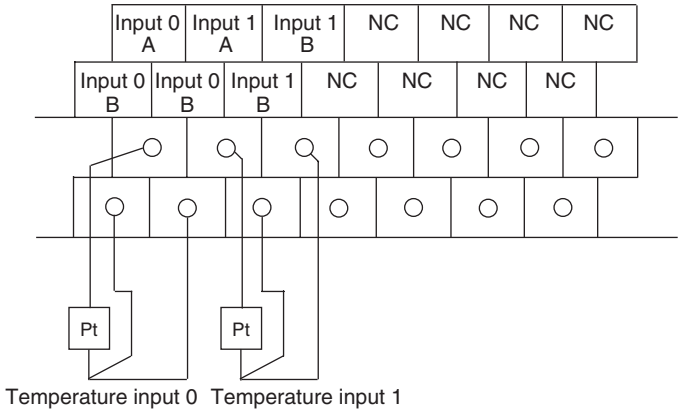
- CP1W-TS002
  One to four K or J thermocouples can be connected to the CP1W-TS002.
  All of the thermocouples must be of the same type and the same input range must be used for each.
  Example:



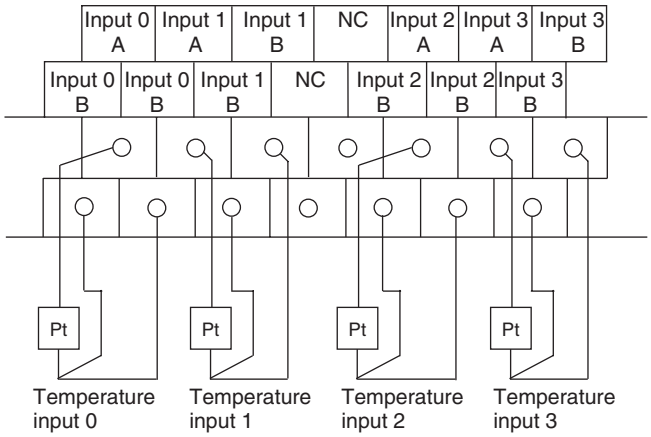
Wiring Diagrams

Connecting a Platinum Resistance Thermometer

- CP1W-TS101
  One or two Pt or JPt platinum resistance thermometers can be connected to the CP1W-TS101. Both of the thermometers must be of the same type and the same input range must be used for each.
  Example:



- CP1W-TS102
  One to four Pt or JPt platinum resistance thermometers can be connected to the CP1W-TS102. All of the thermometers must be of the same type and the same input range must be used for each.
  Example:



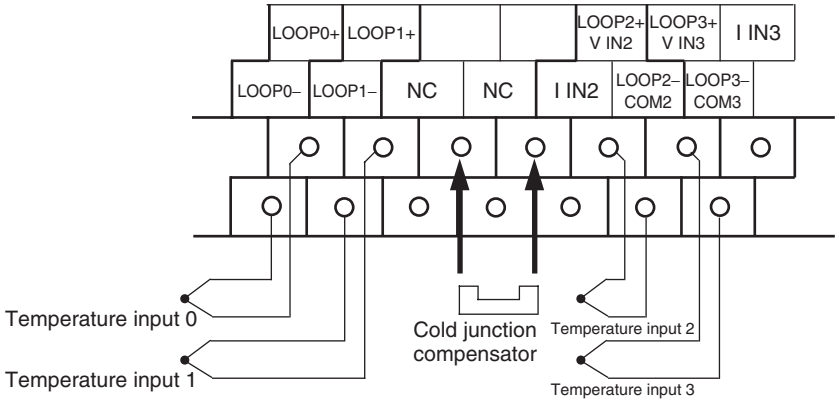
CP1W-TS003 Temperature Sensor Units (Terminal Block is not removable)

Wiring Diagrams

Connecting a Thermocouple

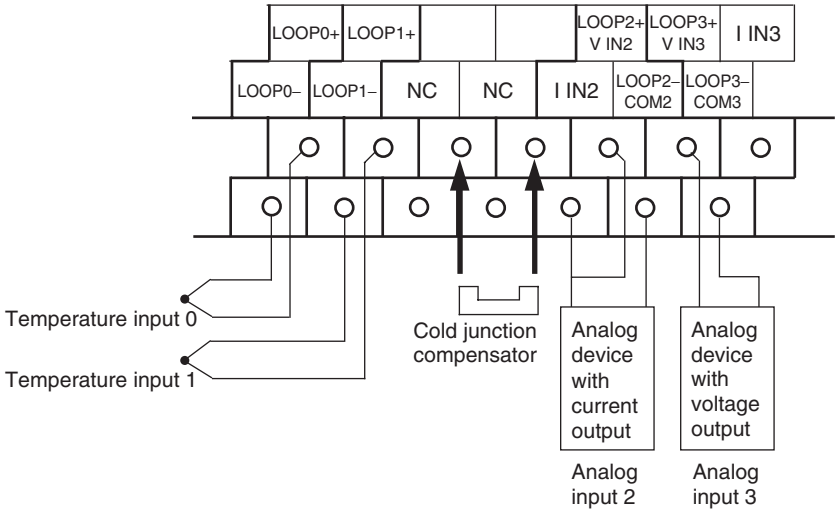
Either K or J thermocouples can be connected, but all four of the thermocouples must be of the same type and the same input range must be used for each. Only last two channels can be used as analog inputs.

Example:



Connecting Analog Inputs

Only last two channels can be used as analog inputs.

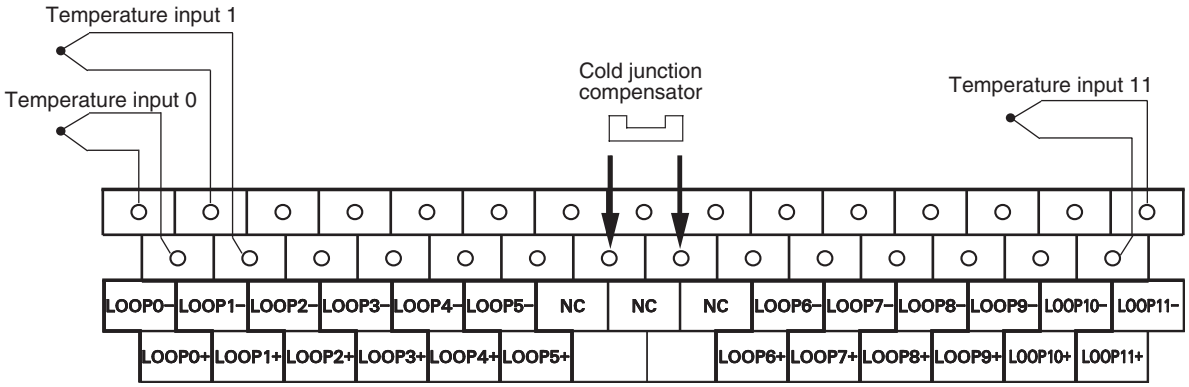


CP1W-TS004 Temperature Sensor Units (Terminal Block is not removable)

Wiring Diagrams

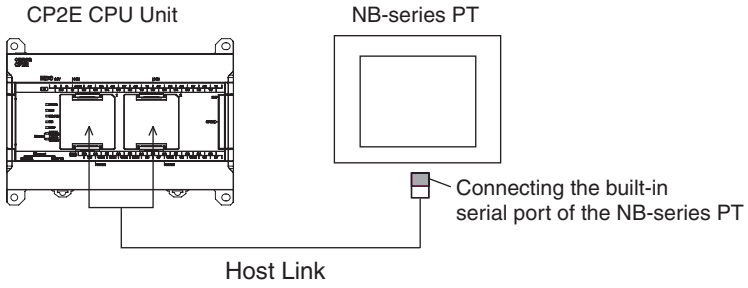
Connecting a Thermocouple

Either K or J thermocouples can be connected, but all twelve of the thermocouples must be of the same type and the same input range must be used for each.
Example:



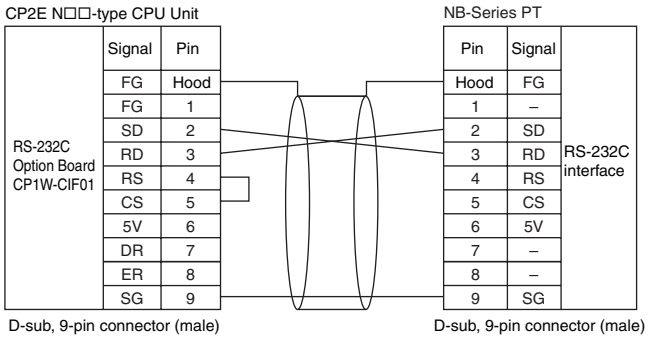
A-2-4 Serial Communications

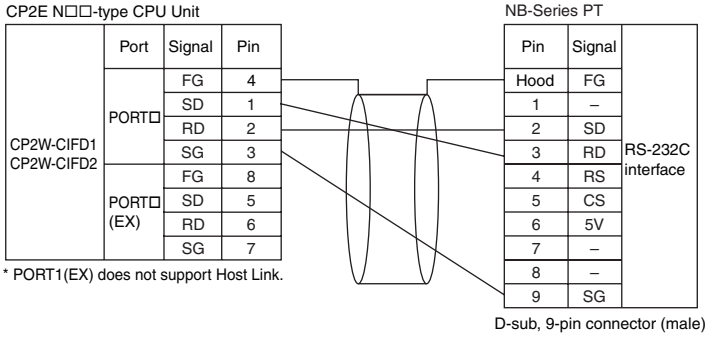
Wiring Examples for PTs Using Host Link

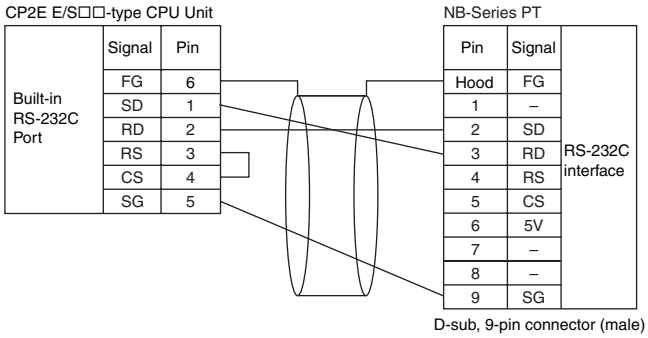


● Connecting a PT and a PLC 1:1 with RS-232C Ports

- Communications Mode: Host Link





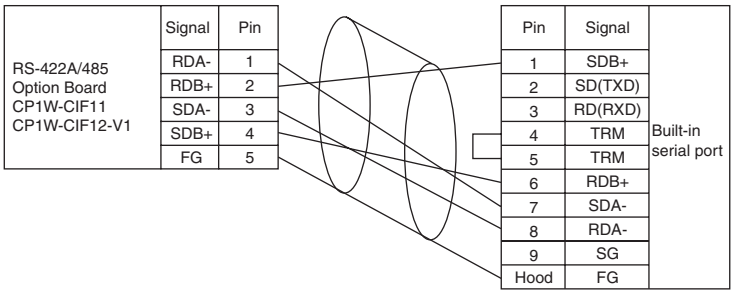


● Connecting a PT and a PLC with RS-422A/485 Ports Using 4-wire, RS-422A Communications

- Communication mode: Host Link

CP2E N□□-type CPU Unit
DIP SW
SW1: ON (with terminating resistance)
SW2: OFF (4-wire connection)
SW3: OFF (4-wire connection)
SW4: OFF
SW5: OFF (no control)
SW6: OFF (no control)

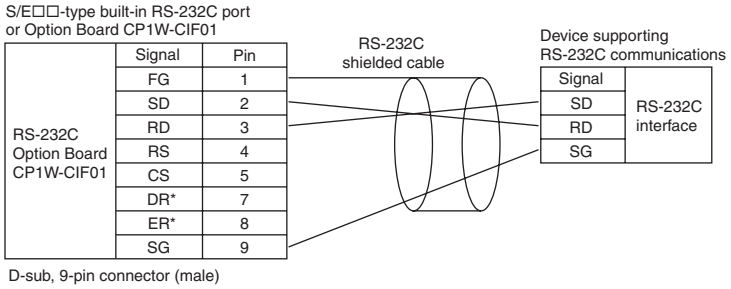
NB-Series PT



No-protocol Communications

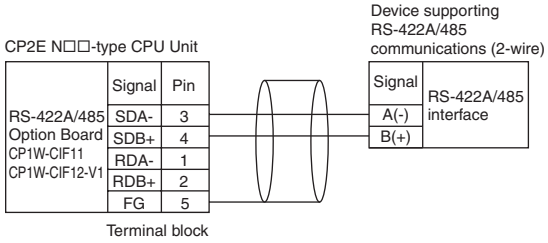
- Communications Mode: No-protocol

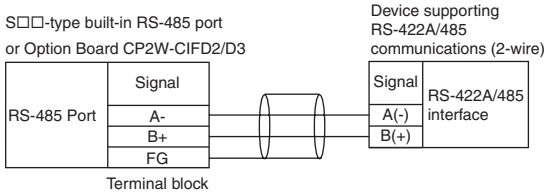
● Connecting RS-232C Ports 1:1



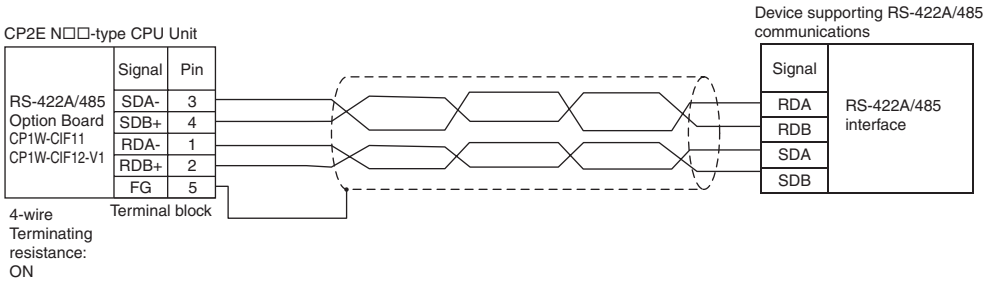
* DR and ER signals are not supported by the E/S□□-type CPU Unit.

● Connecting RS-422A/485 Ports 1:1 with 2-wire Connections



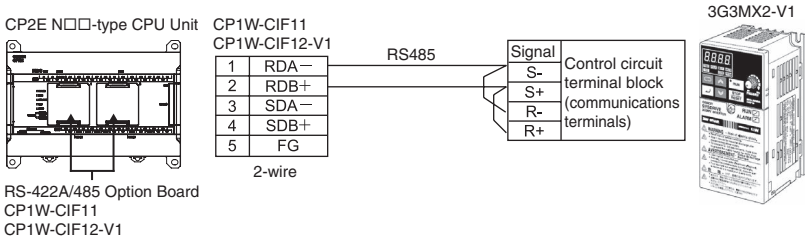


● Connecting RS-422A/485 Ports 1:1 with 4-wire Connections



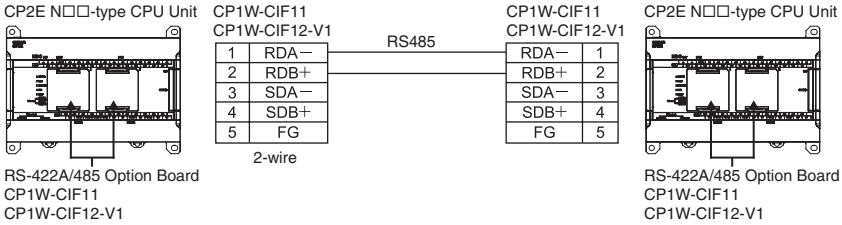
Modbus-RTU Easy Master Function

- Communications mode: Modbus-RTU Easy Master



Modbus-RTU Slave Function

- Communications mode: Modbus-RTU Slave

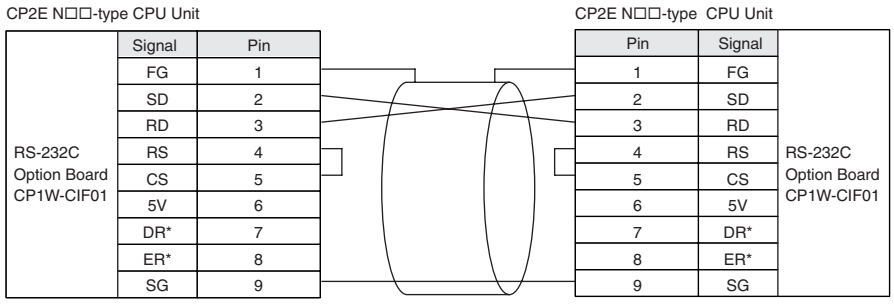


Serial PLC Links

- Communications mode: Serial PLC Link (Master) or Serial PLC Link (Slave)

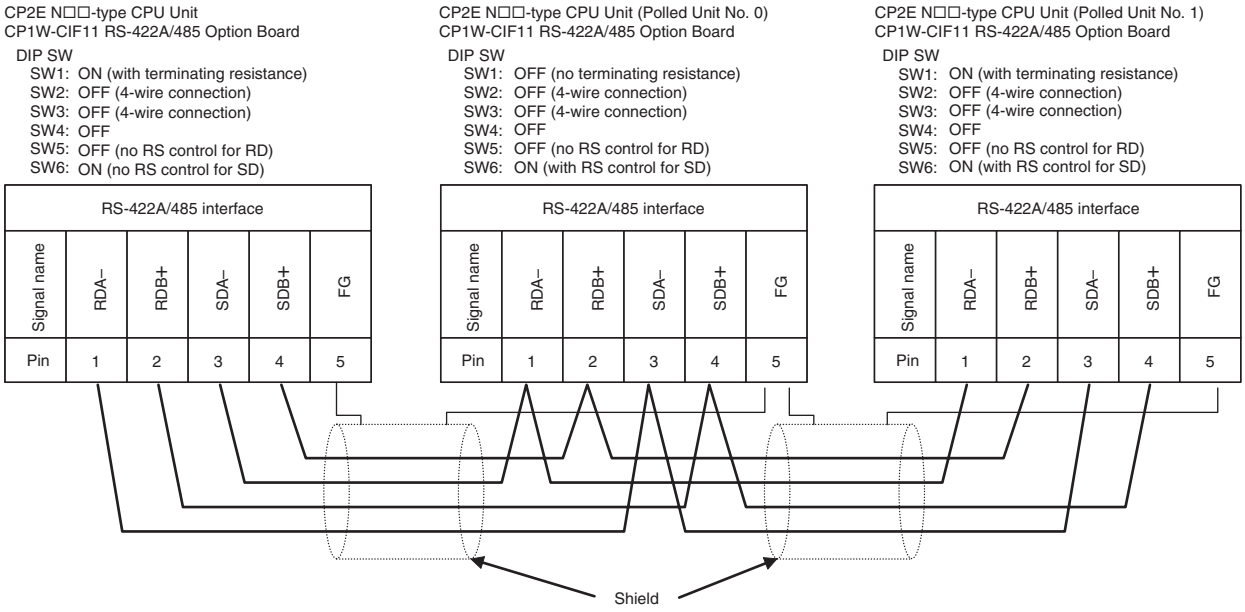
● Connecting RS-232C Ports

RS-232C connection is also possible when using a Serial PLC Link to connect two CP2E CPU Units.

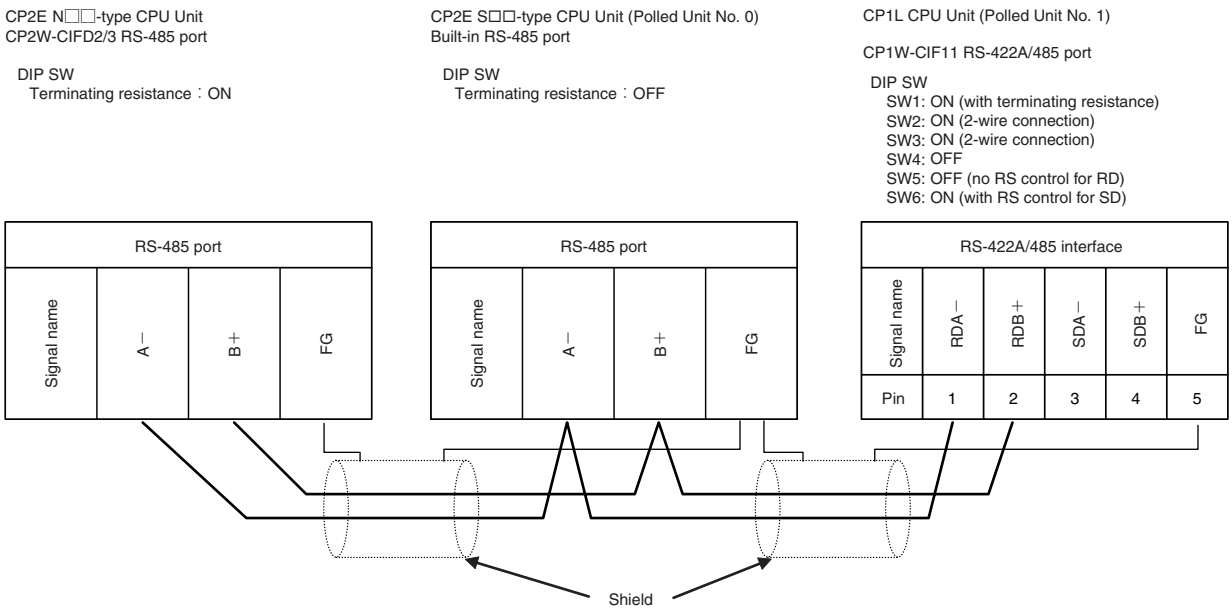


* DR and ER signals are not supported by the E/S□□-type CPU Unit.

● Connecting RS-422A/485 Ports with RS-422A, 4-wire Connections



● Connecting RS-422A/485 Ports with RS-485, 2-wire Connections



A-3 Wiring for Serial Communications

A-3-1 Recommended RS-232C Wiring

Recommended RS-232C Wiring

We recommend the following wiring method for the RS-232C, especially in environments prone to noise.

1 Use shielded twisted-pair cables for the communications cables.

- Recommended RS-232C Cables

Model numbers	Manufacturer
UL2464 AWG28x5P IFS-RVV-SB (UL product) AWG28x5P IFVV-SB (non-UL product)	Fujikura Ltd.
UL2464-SB (MA) 5Px28AWG (7/0.127) (UL product) CO-MA-VV-SB 5Px28AWG (7/0.127) (non-UL product)	Hitachi Cable, Ltd.

2 Combine a signal wire and SG (signal ground) wire in a twisted-pair cable.

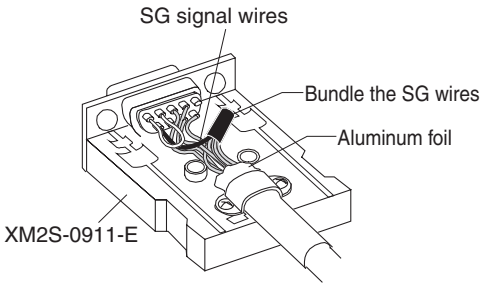
At the same time, bundle the SG wires at the connectors on Option Board and the remote device.

3 Connect the shield of the communications cable to the hood (FG) of the RS-232C connector on the Option Board.

At the same time, ground the ground terminal (GR) of the CPU Unit to 100 Ω or less.

● Connection Example

Example: Twisted-pair Cable Connecting SD-SG, and RD-SG Terminals in Host Link Mode



CP2E E/S□□-type CPU Unit

	Signal	Pin
Built-in RS-232C Port	FG	6
	SD	1
	RD	2
	CS	4
	RS	3
	SG	5

IBM PC/AT or compatible

Pin	Signal	
1	CD	RS-232C interface
2	RD	
3	SD	
4	ER	
5	SG	
6	DR	
7	RS	
8	CS	
9	CI	

D-sub, 9-pin connector (female)

CP2E N□□-type CPU Unit

	Port	Signal	Pin
CP2W-CIFD1	PORT□	FG	4
		SD	1
		RD	2
		SG	3
	PORT□ (EX)*1	FG	8
		SD	5
		RD	6
		SG	7

IBM PC/AT or compatible

Pin	Signal	
1	CD	RS-232C interface
2	RD	
3	SD	
4	ER	
5	SG	
6	DR	
7	RS	
8	CS	
9	CI	

D-sub, 9-pin connector (female)

CP2E N□□-type CPU Unit

	Signal	Pin
RS-232C Option Board CP1W-CIF01	FG*2	1
	SD	2
	RD	3
	RS	4
	CS	5
	5V	6
	DR	7
	ER	8
	SG	9

D-sub, 9-pin connector (male)

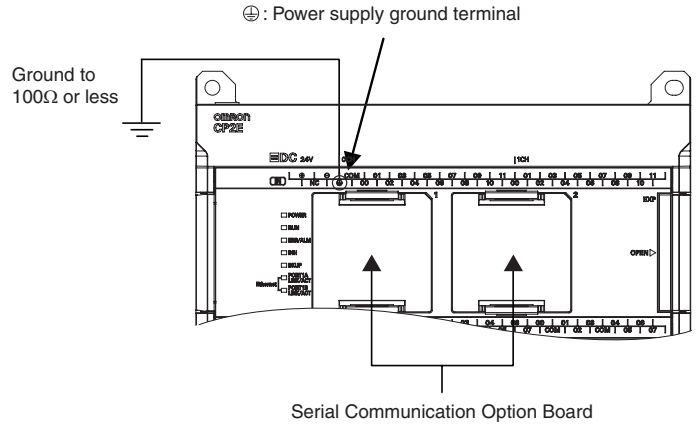
IBM PC/AT or compatible

Pin	Signal	
1	CD	RS-232C interface
2	RD	
3	SD	
4	ER	
5	SG	
6	DR	
7	RS	
8	CS	
9	CI	

D-sub, 9-pin connector (female)

*1 PORT1(EX) does not support Host Link.

*2 The hood (FG) is internally connected to the ground terminal (GR) on the CPU Unit.
Therefore, the FG is grounded by grounding the power supply ground terminal (GR). Although there is conductivity between the hood (FG) and pin 1 (FG), connect the shield to both the hood and pin 1 to reduce the contact resistance between the shield and FG and thus provide better noise resistance.



CP1W-CIF01 Wiring

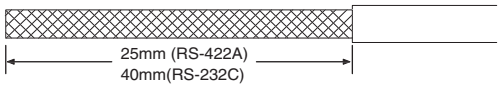
Use the following steps to wire connectors.

See the following diagrams for the length of the cable portion to be cut in each step.

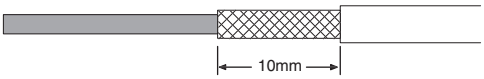
● Shield Connected to Hood (FG)

1 Cut the cable to the required length.

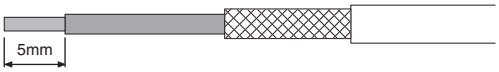
2 Remove the specified length of the sheath from the cable using a knife.
Be careful not to scratch the braided shield.



3 Trim off the braided shield using scissors.

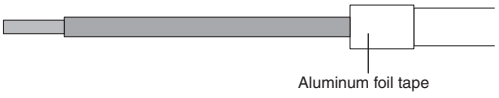


4 Remove the insulation from each conductor using a stripper.



5 Fold back the braided shield.

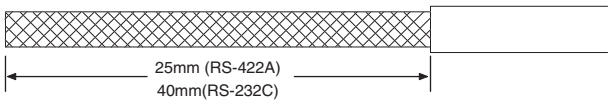
6 Wrap aluminum foil tape around the folded shield.



● Shield Not Connected to Hood (FG)

1 Cut the cable to the required length.

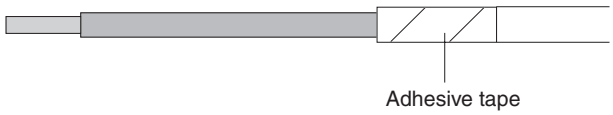
2 Remove the specified length of the sheath from the cable using a knife.
Be careful not to scratch the braided shield.



3 Trim off all the braided shield using scissors.

4 Remove the insulation from each conductor using a stripper.

5 Wrap adhesive tape around the conductor from which the braided shield was removed.

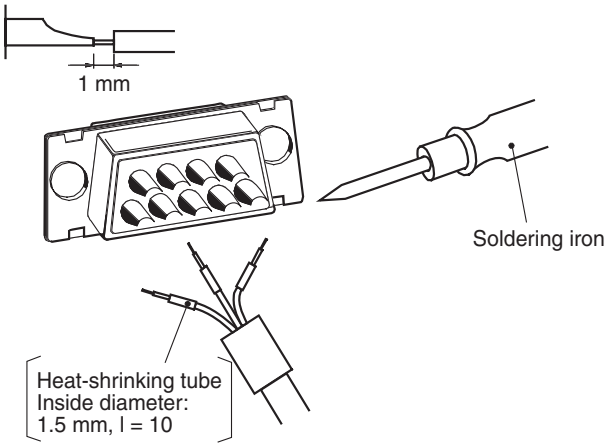


● Soldering

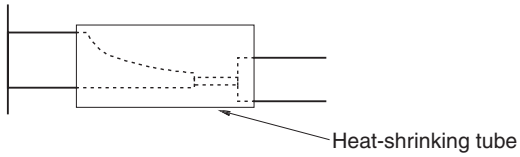
1 Place a heat-shrinking tube on each conductor.

2 Temporarily solder each conductor to the corresponding connector terminals.

3 Completely solder each conductor.

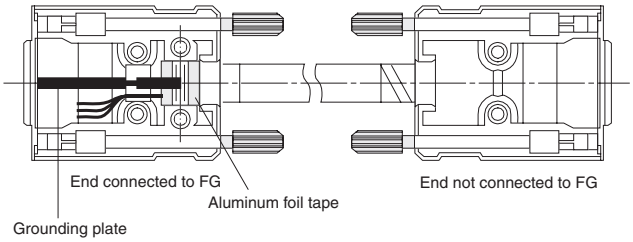


4 Return the heat-shrinking tube to the soldered portion, then heat the tube to shrink it in place.



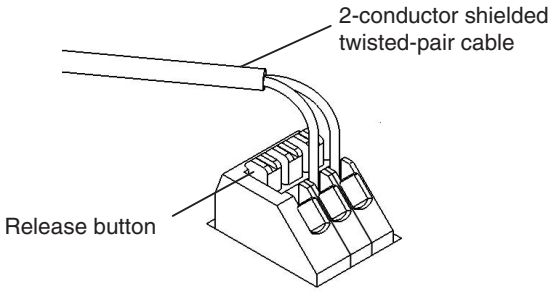
● Assembling Connector Hood

Assemble the connector hood as shown below.



Built-in RS-232C (CP2E-E/S□□D-□) or CP2W-CIFD1/2 RS-232C Wiring

When wiring the RS-232C terminal block, treat either solid or stranded wires directly.



- To make the connection, press the release button in with a small flat blade screwdriver and push the line in while the lock is released. Remove the screwdriver and lock it inside.
- To disconnect the wiring, press the release button in with a small flat blade screwdriver and pull the line out while the lock is released.

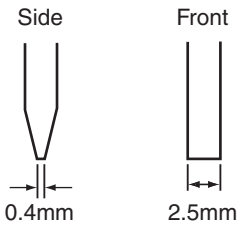
Note 1 Note 1 Ferrules with/without plastic sleeve cannot be used.

2 When using stranded wire, twist the core so that the barbed wires cannot protrude.

3 Do not solder-plate the end of cable.

The screwdriver shown below is recommended for wiring.

Model numbers	Manufacturer
SZS 0.4×2.5	Phoenix Contact



A-3-2 Recommended RS-422A/485 Wiring

Use the following wiring methods for RS-422A/485 to maintain transmission quality.

CP1W-CIF11/CIF12-V1 RS-422A/485 Wiring

1 Always use shielded twisted-pair cables as communications cables.

- Recommended RS-422A/485 Cables

Model numbers	Manufacturer
CO-HC-ESV-3P×7/0.2	Hirakawa Hewtech Corp.

2 Connect the shield of the communications cable to the FG terminal on the RS-422A/485 Option Board.
At the same time, ground the ground terminal (GR) of the CPU Unit to 100 Ω or less.

Built-in RS-485 (CP2E-S□□D□-□) or CP2W-CIFD2/3 RS-485 wiring

● Applicable Cables

Solid wire or ferrules can be used.

- Recommended RS-485 Cables

Model numbers	Manufacturer
CO-HC-ESV-3P×7/0.2	Hirakawa Hewtech Corp.

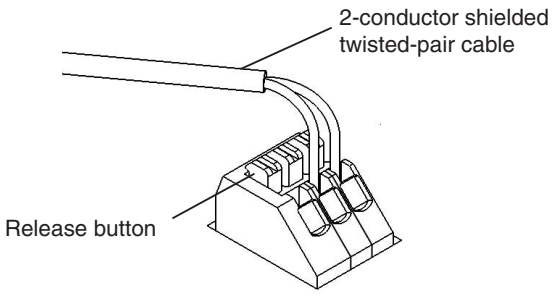
- Recommended ferrules

Manufacturer	Model numbers	Applicable wire
Phoenix Contact	AI-0.25-12	AWG24

Note Do not connect bare stranded wires directly to terminals.

● Terminal Wiring

When wiring the RS-485 terminal block, treat either solid or stranded wires directly.



- To make the connection, press the release button in with a small flat blade screwdriver and push the line in while the lock is released. Remove the screwdriver and lock it inside.
- To disconnect the wiring, press the release button in with a small flat blade screwdriver and pull the line out while the lock is released.

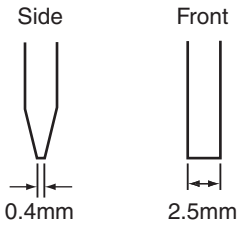
Note 1 Note 1 Ferrules with/without plastic sleeve cannot be used.

2 When using stranded wire, twist the core so that the barbed wires cannot protrude.

3 Do not solder-plate the end of cable.

The screwdriver shown below is recommended for wiring.

Model numbers	Manufacturer
SZS 0.4×2.5	Phoenix Contact



Precautions for Correct Use

Using the Built-in RS-485 Port or CP1W-CIF11 RS-422A/485 Option Board (Not Isolated)

Use the Built-in RS-485 Port or CP1W-CIF11 only when there is no difference in electrical potential between devices. Connect the shield on the communications cable at both ends to the FG terminals on the RS-422A/485 terminal blocks to ground it. Do not allow the communications distance to exceed 50m.

Using the CP1W-CIF12-V1 RS-422A/485 Option Board or CP2W-CIFD2/3 RS-485 Option Board (Isolated)

Use the CP1W-CIF12-V1 or CP2W-CIFD2/3 if there is a difference in electrical potential between devices or for long distance communications (500 m max.).

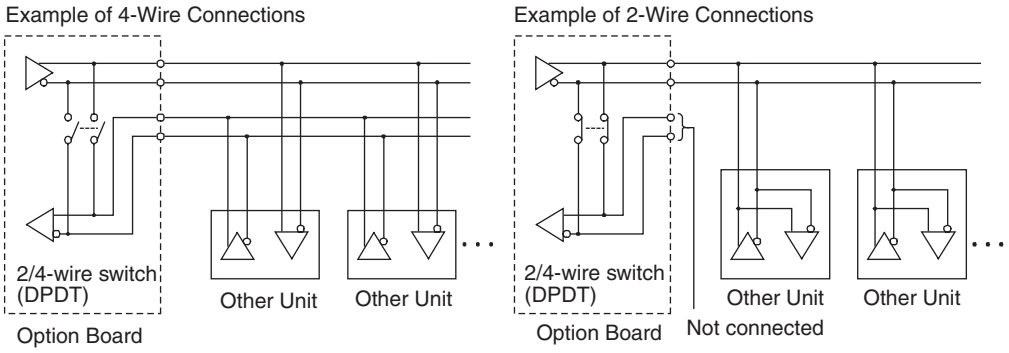
Connect the shield on the communications cable only at the Option Board to ground it. If the shield is connected at both ends of the cable when there is a difference in electrical potential, the devices may be damaged.

Connection Examples

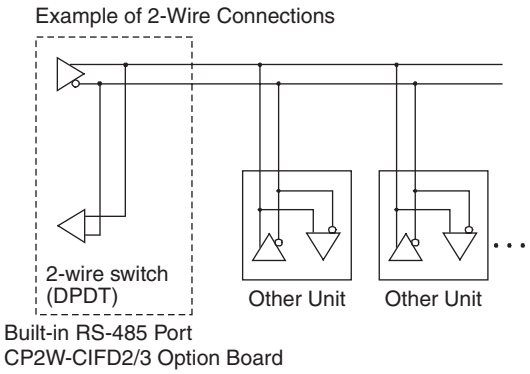
2-Wire and 4-Wire Transmission Circuits

The transmission circuits for 2-wire and 4-wire connections are different, as shown in the following diagram.

- CP1W-CIF11/CIF12-V1



- Built-in RS-485 port (CP2E-S□□D□-□) or CP2W-CIFD2/3

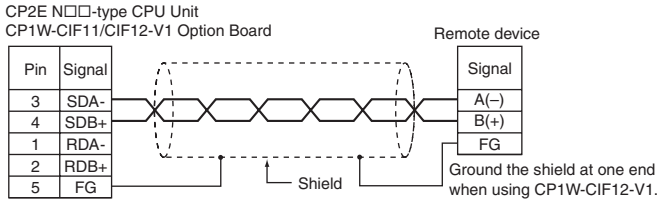


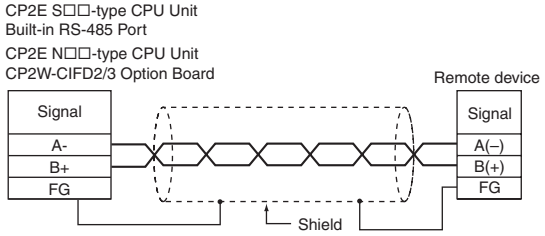
Precautions for Correct Use

Use the same type of transmission circuit (2-wire or 4-wire) for all nodes.
Do not use 4-wire connections when the 2/4-wire switch on the Board is set to 2-wire.

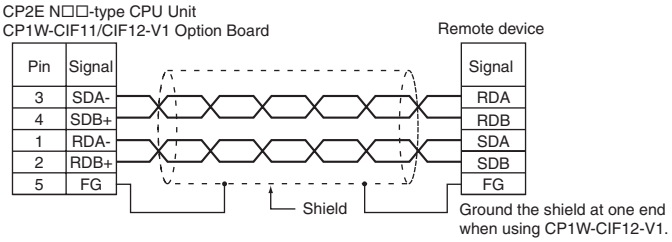
Wiring Example: 1:1 Connections

- Two-wire Connections





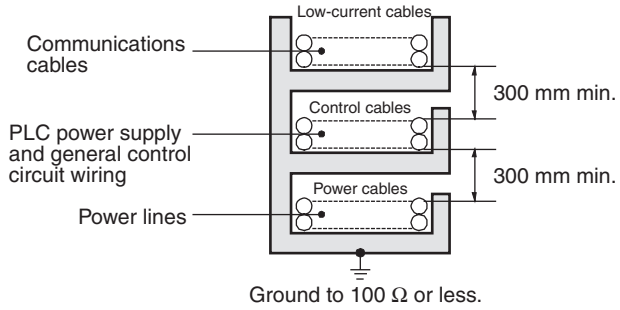
- Four-wire Connections



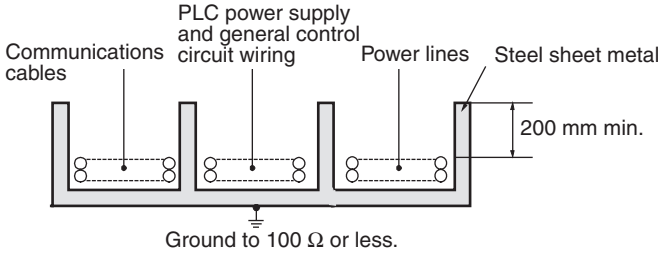
A-3-3 Reducing Electrical Noise for External Wiring

Observe the following precautions when wiring communications cables.

- When multi-conductor signal cable is being used, avoid combining I/O wires and other control wires in the same cable.
- If wiring racks are parallel, allow at least 300 mm between them.



- If the I/O wiring and power cables must be placed in the same duct, they must be shielded from each other using grounded steel sheet metal.



A-4 Network Installation

Basic Installation Precautions

- Take the greatest care when installing the Ethernet System, being sure to follow ISO 802-3 specifications. You must obtain a copy of these specifications and be sure you understand them before attempting to install an Ethernet System. Unless you are already experienced in installing communications systems, we strongly recommend that you employ a professional to install your system.
- Do not install Ethernet equipment near sources of noise. If noise-prone environments are unavoidable, be sure to take adequate measures against noise interference, such as installing network components in grounded metal cases, using optical links in the system, etc.

Recommended products

The following products are recommended for use with the CP2E series PLC.

Part	Maker	Model number	Specifications	Inquires
Hub	100BASE-TX			
	OMRON	W4S1-03B	10/100 Mbit/s 3-port hub	
	OMRON	W4S1-05B (C)	10/100 Mbit/s 5-port hub	
	PHOENIX CONTACT	SWITCH 5TX	10/100 Mbit/s 5-port hub	
	10BASE-T			
	Allied Telesis	MR820TLX	9-port hub with 10Base-5 backbone port	Allied Telesis (0120) 86-0442 (in Japan only)
Twisted-pair cable	100BASE-TX			
	Fujikura	F-LINK-E 0.5mm x 4P	STP (shielded twisted-pair) cable: Category 5, 5e **Note:** Impedance is limited to 100 Ω.	---
	Fujikura	CTP-LAN5 0.5mm x 4P	UTP (unshielded twisted-pair) cable: Category 5, 5e	
	10BASE-T			
	Fujikura	F-LINK-E 0.5mm x 4P	STP (shielded twisted-pair) cable: Category 3, 4, 5, 5e **Note:** Impedance is limited to 100 Ω.	
	Fujikura	CTP-LAN5 0.5mm x 4P	UTP (unshielded twisted-pair) cable: Category 3, 4, 5, 5e	
Connectors (Modular plug)	STP Plug			
	Panduit Corp	MPS588	---	
	UTP Plug			
	Panduit Corp	MP588-C	---	

Precautions on Laying Twisted-pair Cable

Basic Precautions

- Press the cable connector in firmly until it locks into place at both the hub and the PLC.
- After laying the twisted-pair cable, check the connection with a 10Base-T cable tester.

Environment Precautions

- The UTP cable is not shielded, and the hub is designed for use in OA environments. In environments subject to noise, construct a system with shielded twisted-pair (STP) cable and hubs suitable for an FA environment.
- Do not lay the twisted-pair cable together with high-voltage lines.
- Do not lay the twisted-pair cable near devices that generate noise.
- Do not lay the twisted-pair cable in locations subject to high temperature or high humidity.
- Do not lay the twisted-pair cable in locations subject to excessive dirt and dust or to oil mist or other contaminants.

Hub Installation Environment Precautions

- Do not install the hub near devices that generate noise.
- Do not install the hub in locations subject to high temperature or high humidity.
- Do not install the hub in locations subject to excessive dirt and dust or to oil mist or other contaminants.

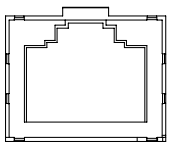
Hub Connection Methods

If more hub ports are required, they can be added by connecting more than one hub. There are two possible connection methods for hubs: Cascade and stacked.

Ethernet Connectors

The following standards and specifications apply to the connectors for the Ethernet twisted-pair cable.

- Electrical specifications: Conforming to IEEE802.3 standards
- Connector structure: RJ45 8-pin Modular Connector



(conforming to ISO8877)

Connector Pin	Signal Name	Abbr.	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	---

Connecting the Cable

Precautions for Safe Use

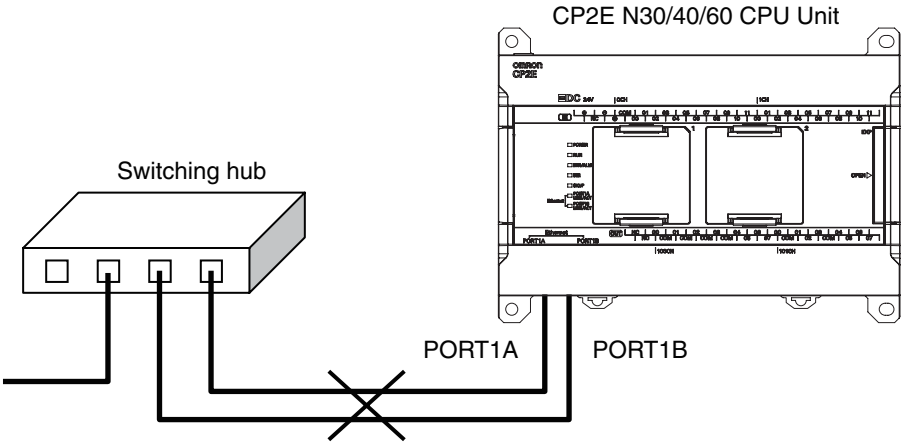
Turn OFF the PLC's power supply before connection or disconnecting twisted-pair cable.

Allow enough space for the bending radius of the twisted-pair cable.

1. Lay the twisted-pair cable.
2. Connect the cable to the hub. Be sure to press in the cable until it locks into place.
   Request cable installation from a qualified professional.
3. Connect the cable to the connector on the PLC. Be sure to press in the cable until it locks into place.

Precautions on Installing Ethernet System

When installing the Ethernet System between the CP2E N30/40/60 CPU Unit and swtiching hub, do not connect the two ports at the same time. Otherwise Ethernet communications may not be established.



A-5 Comparison between CP1E and CP2E

● Functional Specifications

Item		CP1E E/N□□S-type CPU Units	CP2E E/S□□-type CPU Units	CP1E N□□-type CPU Units	CP2E N□□-type CPU Units
Power supply		AC power supply 100 to 240 VAC DC power supply 24VDC			
Operation temperature		0°C~55°C	-20°C~60°C	0°C~55°C	-20°C~60°C
Power supply to external devices (service power)		Only AC power supply N30/40/60S CPU Unit: 300mA	Only AC power supply □30/40/60 CPU Unit: 300mA E14/20 CPU Unit: None	Only AC power supply N30/40/60 CPU Unit: 300mA N14/20 CPU Unit: None	Only AC power supply N30/40/60 CPU Unit: 300mA N14/20 CPU Unit: None
High-speed counter inputs		E□□S-type: Up/down or pulse plus direction inputs: 10kHz × 2 counters Or Differential phases (4x): 5kHz × 2 counters Or Increment inputs: 10kHz × 6 counters 10kHz × 5 counters (Only for 10 I/O Points) N□□S-type: Up/down inputs: 100kHz × 1 counter 10kHz × 1 counter Or Pulse plus direction inputs: 100 kHz × 2 counters Or Differential phase inputs (4x) 50 kHz × 1 counter 5 kHz × 1 counter Or Incremental pulse inputs 100 kHz × 2 counters 10 kHz × 4 counters	Up/down inputs: 100kHz × 1 counter 10kHz × 1 counter Or Pulse plus direction inputs: 100 kHz × 2 counters Or Differential phase inputs (4x) 50 kHz × 1 counter 5 kHz × 1 counter Or Incremental pulse inputs 100 kHz × 2 counters 10 kHz × 4 counters	Up/down inputs: 100kHz × 1 counter 10kHz × 1 counter Or Pulse plus direction inputs: 100 kHz × 2 counters Or Differential phase inputs (4x) 50 kHz × 1 counter 5 kHz × 1 counter Or Incremental pulse inputs 100 kHz × 2 counters 10 kHz × 4 counters	N14/20 CPU Unit: Up/down inputs: 100kHz × 1 counter 10kHz × 1 counter Or Pulse plus direction inputs: 100 kHz × 2 counters Or Differential phase inputs 50 kHz × 1 counter 5 kHz × 1 counter Or Incremental pulse inputs 100 kHz × 2 counters 10 kHz × 4 counters N30/40/60 CPU Unit: Up/down or pulse plus direction inputs: 100 kHz × 2 counters, Or Differential phase inputs 50 kHz × 2 counters Or Incremental pulse inputs 100 kHz × 3 counters 10 kHz × 3 counters
Quick-response / Interrupt inputs		6 inputs	6 inputs	6 inputs	8 inputs (6 inputs only for 14 I/O points)
Pulse outputs (Models with transistor outputs only)	Pulse output method	E□□S-type: Not supported N□□S-type: Pulse plus direction only	E□□-type: Not supported S□□-type: Pulse plus direction only, 2 axes max.	Pulse plus direction only 2 axes max.	Pulse plus direction only 4 axes max.
	Speed control	E□□S-type: Not supported N□□S-type: Supported	E□□-type: Not supported S□□-type: Supported	Supported	Supported
	Positioning	E□□S-type: Not supported N□□S-type: Supported	E□□-type: Not supported S□□-type: Supported	Supported	Supported
	Origin searches	E□□S-type: Not supported N□□S-type: Supported	E□□-type: Not supported S□□-type: Supported	Supported	Supported
PWM outputs (Models with transistor outputs only)		E□□S-type: Not supported N□□S-type: 1 output	E□□-type: Not supported S□□-type: 1 output	1 output	1 output
Analog I/O		Not supported	Not supported	Supported (Only for NA20)	Not supported
Analog volume		Not supported	Not supported	Supported	Not supported
USB port		Provided. USB2.0 Full-speed (12M)			Not provided
Ethernet port		Not provided			Provided With switch function * N14/20 is not supported.
Built-in serial communication port		E□□S-type: Not provided N□□S-type: RS-232C N□□S1-type: RS-232C and RS-485	Provided. E□□-type: RS-232C S□□-type: RS-232C and RS-485	Provided. N□□-type: RS-232C	Not provided Provided by installing Option Board.
Serial option port		Not provided		N14/20 CPU Unit: None N30/40/60 CPU Unit: 1 port	N14/20 CPU Unit: 2 ports N30/40/60 CPU Unit: 3 ports
Serial communication protocols	Baud rate	1200/2400/4800/9600/19.2k/38.4k/57.6k/115.2k			
	Supported protocol	• Host Link • 1:N NT Link • No-protocol mode • Serial PLC Links (master, slave) • Modbus-RTU easy master	• Host Link • 1:N NT Link • No-protocol mode • Serial PLC Links (master, slave) • Modbus-RTU Easy Master • Modbus-RTU Slave	• Host Link • 1:N NT Link • No-protocol mode • Serial PLC Links (master, slave) • Modbus-RTU easy master	• Host Link* • 1:N NT Link* • No-protocol mode • Serial PLC Links (master, slave) • Modbus-RTU Easy Master • Modbus-RTU Slave * PORT1(EX) is not supported.

Item	CP1E E/N□□S-type CPU Units	CP2E E/S□□-type CPU Units	CP1E N□□-type CPU Units	CP2E N□□-type CPU Units
Option Boards that can be mounted	Cannot be mounted.		• RS232C Option Board CP1W-CIF01 • RS422A/485 Option Board CP1W-CIF11/CIF12-V1 • Ethernet Option Board CP1W-CIF41 • Analog Option Board CP1W-MAB221/ADB21/DAB21V	Serial Communication Option Board with one port • RS232C Option Board CP1W-CIF01 • RS-422A/485 Option Board CP1W-CIF11/CIF12-V1 Serial Communication Option Board with two ports*1 • RS232C Option Board CP2W-CIFD1 • RS232C & RS-485 Option Board CP2W-CIFD2 • RS-485 Option Board CP2W-CIFD3 Analog Option Board CP1W-MAB221/ADB21/DAB21V *1 CP2W-CIFD□ can only be mounted on option slot 1. *2 Maximum one Analog Option Board can be mounted on an N□□-type CPU Unit.
Memory backup	Built-in EEPROM: Contains the user programs, parameters, DM Area initial values and comment files Built-in SRAM (Battery backup): DM/HR/CNT/AR Data memory area	Built-in Flash Memory: Contains the user programs, parameters, DM Area initial values and comment files Built-in non-volatile memory (Batteryless backup): DM/HR/CNT/AR Data memory area	Built-in EEPROM: Contains the user programs, parameters, DM Area initial values and comment files Built-in SRAM (Battery backup): DM/HR/CNT/AR Data memory area	Built-in Flash Memory: Contains the user programs, parameters, DM Area initial values and comment files Built-in non-volatile memory (Batteryless backup): DM/HR/CNT/AR Data memory area
Clock	E□□S-type: Not supported N□□S-type: Supported	E□□-type: Not supported S□□-type: Supported	Supported	Supported

Item	CP1E CPU Units	CP2E CPU Units
Program capacity	E□□-type: 2K steps N□□-type: 8K steps	E□□-type: 4K steps S□□-type: 8K steps N□□-type: 10K steps
FB capacity	Not provided	E□□-type: 4K steps S□□-type: 8K steps N□□-type: 10K steps
Program language	Ladder diagram	Ladder diagram
Function blocks	Not provided	Maximum number of function block definitions: 64 Maximum number of instances: 128 Languages usable in function block definitions: Ladder diagrams, structured text (ST)
Instructions	Approximately 200	Approximately 220
Instruction execution times	LD: 1.19μs MOV: 7.9μs	LD: 0.23μs MOV: 1.76μs
Number of tasks	17 • 1 cyclic task • 16 interrupt tasks	17 • 1 cyclic task • 16 interrupt tasks
Maximum subroutine number	128	128
Maximum jump number	128	128
Scheduled interrupt tasks	1	1
CIO Area	4,640 bits (290 words) CIO 0.00 to CIO 289.15 (CIO 0 to CIO 289)	4,640 bits (290 words) CIO 0.00 to CIO 289.15 (CIO 0 to CIO 289)
Work Area (W)	1,600 bits (100 words) W0.00 to W99.15 (W0 to W99)	2,048 bits (128 words) W0.00 to W127.15 (W0 to W127)
Holding Area (H)	800 bits (50 words) H0.00 to H49.15 (H0 to H49CH)	2048 bits (128 words) H0.00 to H127.15 (H0 to H127CH)
Auxiliary Area (A)	Read-only: 7,168 bits (448 words) A0.00 to A447.15 (A0 to A447) Read/write: 4,896 bits (306 words) A448.00 to A753.15 (A448 to A753)	Read-only: 7,168 bits (448 words) A0.00 to A447.15 (A0 to A447) Read/write: 8,192 bits (512 words) A448.00 to A959.15 (A448 to A959)
Temporary Area (TR)	16 bits: TR0 to TR15	16 bits: TR0 to TR15
Counter Area (C)	256 timer numbers: T0 to T255	256 timer numbers: T0 to T255
Timer Area (T)	256 counter numbers: C0 to C255	256 counter numbers: C0 to C255
Data Memory Area (D)	E□□-type: 2K words D0 to D2047 N□□-type: 8K words D0 to D8191	E□□-type: 4K words D0 to D4095 S□□-type: 8K words D0 to D8191 N□□-type: 16K words D0 to D16383
Data Registers (DR)	Not provided	16 registers: DR0 to DR15
Index Registers (IR)	Not provided	16 registers: IR0 to IR15

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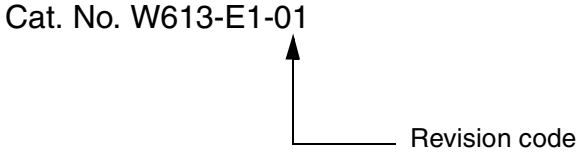

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