

EtherNet/IP™ Communication Unit**KV-EP02****User's Manual**

Please read this Manual before use.
Keep this Manual in a safe place for later reference.

Chapter 1	Overview
Chapter 2	Specifications
Chapter 3	Installation and maintenance of the unit
Chapter 4	Connection and settings
Chapter 5	EtherNet/IP communication
Chapter 6	Sensor Application
Chapter 7	APPENDIX



Preface

Information and basic operations of KV-EP02 are described in this manual. Read this manual thoroughly to understand functions of KV-EP02 before use.

In addition, store this manual in a safe place so that you can retrieve it whenever you need. Be sure end users can get this manual.

■ Related manuals

Please also refer to the following manuals when using KV-EP02.

All the following PDF manuals can be found in the help file of KV STUDIO. The latest version of PDF manuals can be downloaded from the Keyence web site.

Name	Description
KV-EP02 User's Manual	This manual. Explains the system configuration, specifications, and methods for creating ladder programs for KV-EP02.
KV-XLE02 User's Manual	Explains the system configuration, specifications, and methods for creating ladder programs for KV-XLE02.
KV Series EtherNet/IP Function User's Manual	Explains specifications and methods for creating ladder programs for EtherNet/IP function built into the CPU unit.
KV Nano Series (terminal block type) User's Manual	Explains the system configuration, specifications, CPU built-in functions, methods for creating ladder programs, and an expansion input/output unit for KV Nano Series (terminal block type).
KV Nano Series (connector type) User's Manual	Explains the system configuration, specifications, CPU built-in functions, methods for creating ladder programs, and an expansion input/output unit for KV Nano Series (connector type).
KV Nano Series analog/temperature unit User's Manual	Explains the system configuration, specifications, methods for creating ladder programs, and expansion input/output unit for KV Nano Series analog/temperature unit.
KV-7000/5000/3000/1000 Series KV Nano Series Instructional Reference Manual	Explains each instruction that can be used in ladder programming.
KV-7000/5000/3000/1000 Series KV Nano Series Script Programming Manual	Explains the script program creation method and possible operators, control statements, and functions.
KV STUDIO User's Manual	Explains the operation method for KV STUDIO.

Safety Precautions

■ Symbols

This document contains notices which you should observe to ensure your own personal safety, as well as to protect the product and connected equipment.

 DANGER	It indicates a hazardous situation which, if not avoided, will result in death or serious injury.
 WARNING	It indicates a hazardous situation which, if not avoided, could result in death or serious injury.
 CAUTION	It indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
 NOTICE	It indicates a situation which, if not avoided, could result in product damage as well as property damage.



It indicates cautions and limitations that must be followed during operation.



It indicates cautions about erroneous operation etc.



It indicates tips for better understanding or useful information.

Indicates a page to be referred to in this manual or other manuals.

The system names and product names mentioned in this manual are registered trademark or trademark of each company.

EtherNet/IP™ is a registered trademark or a trademark of ODVA.

■ General precautions

 DANGER	<ul style="list-style-type: none">Do not use the product with the purpose of protecting humans or parts of the human body.Never use this product in explosion-proof area as this product is not intended for use in such areas.
 WARNING	<ul style="list-style-type: none">Provide a safety circuit that bypasses PLC to enable failsafe operation of the entire system in the event that the PLC fails.Output circuit or internal circuit malfunctions sometimes prevent control from being performed normally. Be sure to provide a safety circuit in control systems where circuit malfunction may lead to fire or other serious accidents.
 CAUTION	<ul style="list-style-type: none">Verify that this device functions correctly at startup and during operation.When using our products in any methods other than those specified in this instruction manual, the provided protection in these products may be compromised.
 NOTICE	<ul style="list-style-type: none">Proceed with care when modifying our products, or when using them in a manner that falls outside of the ranges indicated in its specifications, since KEYENCE is unable to guarantee device functionality or performance in such situations.Use this product in combination with other devices only after careful consideration, since the product may fail to satisfy its functionality and performance capabilities as a result of the conditions and environment in which it is used.

Precautions related to regulations and standards

■ CE Marking

KEYENCE has confirmed that this product complies with the essential requirements of the applicable EU directives, based on the following specifications. Be sure to consider the following specifications when using this product in the member states of the European Union.

● EMC directive

Applicable standard: EN61131-2

- Be sure to install the KV-EP02 in a conductive enclosure (such as an industrial control panel) with IP54 or higher.
- Ground the enclosure to FG. (It cannot be positively grounded.)
- Ground the FG terminal of KV-EP02 to the enclosure.
- Be sure to use a shield cable for the signal wire that is outside the enclosure and ground the shield cable to the enclosure.
- Use a double shielded cable of category 5e or above for KV-EP02.

Be sure that these specifications do not guarantee that all the system including KV-EP02 complies with the essential requirements of the EMC directive. The manufacturer of each product incorporated in the system is solely responsible for ensuring that the system complies with the EMC directive.

Remarks regarding compliance

<Industrial control panel>

- If the industrial control panel has joints inside the control panel, remove the coating present to maintain the conductivity.
- To ground the industrial control panel, use a thick grounding cable, so that the impedance is low even at high frequencies.
- Before touching the devices inside the industrial control panel for maintenance, be sure to eliminate static electricity so that it does not affect the internal devices.

<Grounding the shielded cables>

- Ground the shielded cables close to the expansion units, and ensure that grounded cables do not receive electromagnetic induction from ungrounded cables.
- When removing a portion of the outer covering of the shielded cables, ground the stripped part of the shielded cables against a wide surface of the industrial control panel. (If you use clamps or similar metal fixtures, remove the coating from the parts where the metal fixtures contact.)
- Do not solder the wires to the shielded cables, as grounding the wires will increase the high frequency impedance, which will negate the shielding effect.

■ UL Certificate

This product complies with the following UL and CSA standards and has been certified by UL.

- UL file number: E207185
- Category: NRAQ, NRAQ7
- Applicable standards: UL61010-1
 UL61010-2-201
 CAN/CSA C22.2 No.61010-1
 CAN/CSA C22.2 No.61010-2-201

Be sure to consider the following specifications when using this product as a product specified by UL.

- Be sure to install the product in a conductive enclosure (such as an industrial control panel) with IP54 or higher.
- Use the product under pollution degree 2.
- Use the product inside.
- Use the product at the altitude of 2000 m or less.
- Use the product with one of the following power supplies.
 - UL/CSA certified power supply that provides Class 2 output as defined in the NFPA70(NEC: National Electrical Code) and CEC (Canadian Electrical Code).
 - UL/CSA certified power supply that has been evaluated as a Limited Power Source as defined in UL60950-1 and CAN/CSA-C22.2 No.60950-1.

■ KC Mark (Korea)

Class A equipment

This is a class A product. Using the product in a domestic environment may cause radio interference. In that case, the user may be required to take adequate measures.

A급 기기 (업무용 방송통신기자재)

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

Components of this manual

Chapter 1	Overview	This chapter describes functions and system configuration of KV-EP02.
Chapter 2	Specifications	This chapter describes specifications and wiring of KV-EP02.
Chapter 3	Installation and maintenance of the unit	This chapter describes installation, cautions for wiring and maintenance procedure.
Chapter 4	Connection and settings	This chapter describes the connection between KV-EP02 and KV Nano expansion unit and communication settings.
Chapter 5	EtherNet/IP communication	This chapter describes the configuration of the memory to communicate with an EtherNet/IP unit.
Chapter 6	Sensor application	This chapter describes the sensor application.
Chapter 7	Appendix	This chapter describes error lists and the device list available for KV-EP02.

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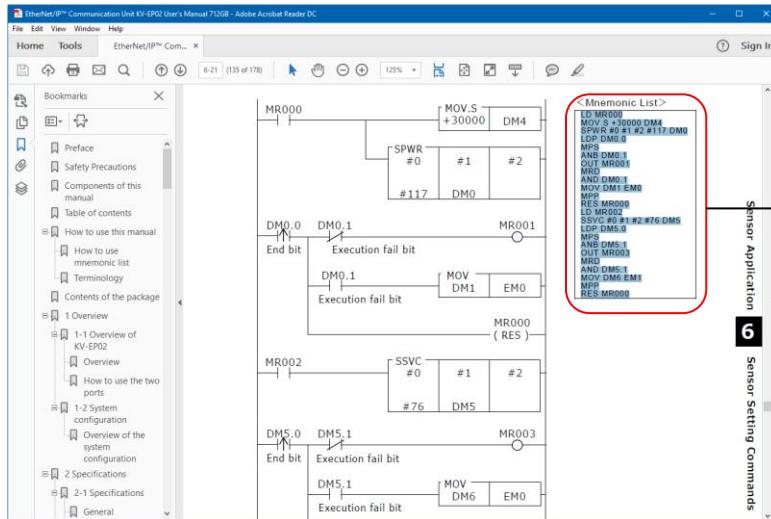
How to use this manual

The following describes how to use the mnemonic lists and terms used in this manual.

How to use mnemonic list

Mnemonic lists are recorded in the pages describing reference ladder program.
With the mnemonic lists, ladder program can be input conveniently.

- 1** Display manual in "Adobe Reader".
- 2** Copy a mnemonic list using "Selection Tool".



Drag the entire
mnemonic list
and copy.

- 3** Click a cell for inserting the reference ladder program in ladder edit area of KV STUDIO, select "Edit (E)", "Edit list (L)" from the menu to display "Edit list" dialog box.

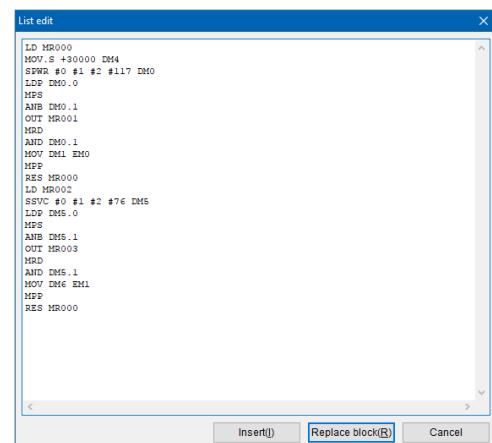
Other procedure

Ctrl + D

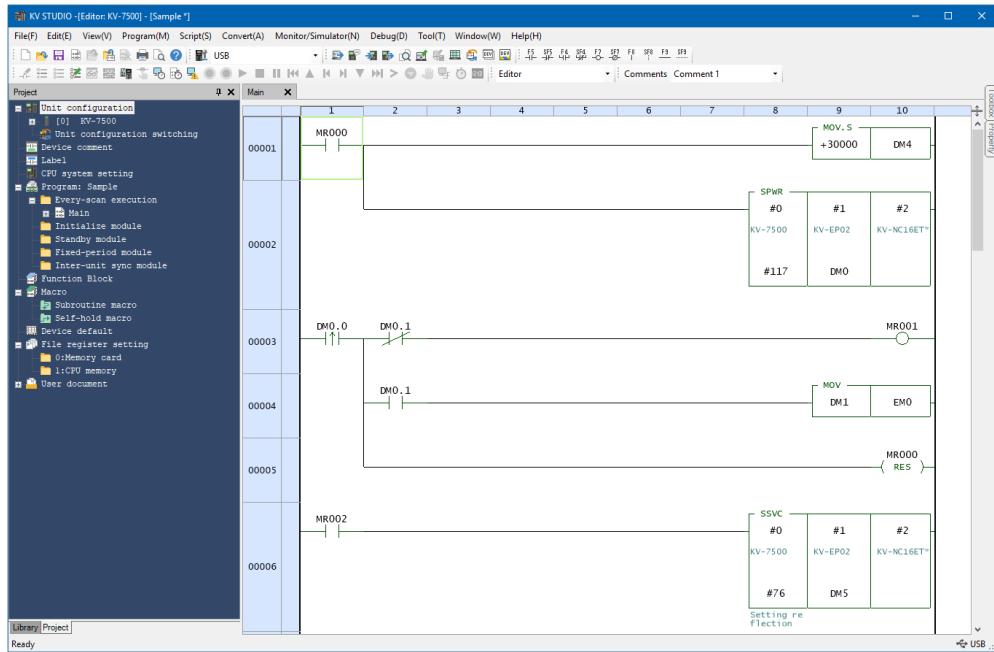
Paste the copied mnemonic list in the

displayed "Edit list" dialog box.

Select "Paste (P)" from the right-click menu
of "Edit list" dialog box.



4 Click "Insert (I)" to display the reference ladder program.



Terminology

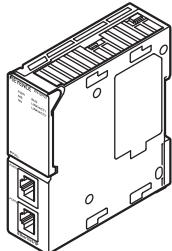
The following terminologies are used for description through this manual except for some contents.

Terminology	Description
Programmable controller	Controller to change programs of a unit. It is also called PLC (Programmable Logic Controller).
KV-7000 series	Programmable controller of Keyence
KV Nano series	Programmable controller KV-N14□□/KV-N24□□/KV-N40□□/KV-N60A□/KV-NC32T of Keyence
CPU unit	KV-7500/7300 and KV-5500/5000/3000 Series of Keyence
Scanner	Scanner for EtherNet/IP
Adapter	Adapter for EtherNet/IP
Expansion unit	Expansion I/O unit, analog unit, and temperature unit for KV Nano Series
Expansion bus	Bus for the connection between KV Nano Series/KV-EP02 and an expansion unit
KV STUDIO	Support software for KV-7500/7300/5500/5000/3000/KV Nano Series
Ladder program	Control program for PLC
EtherNet/IP setting	Setting tool used for EtherNet/IP communication of KV STUDIO.

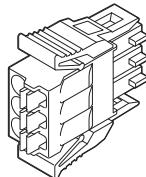
Contents of the package

The package contains the following items. Before you use the unit, make sure that all the items are contained.

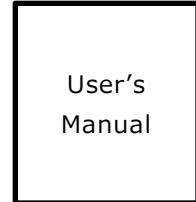
KV-EP02 Unit



Power connector*



User's manual

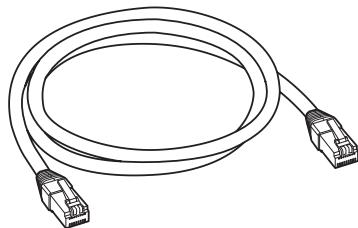


* When shipped, the power supply connection connector is packaged in a connected state. The utmost care has been exercised in packing the items, however, in the event that items malfunction or are damaged, please contact a KEYENCE office.

■ Optional items

- STP cable (shielded twisted pair cable) (category 5e, straight)
 - OP-51504(0.2m)
 - OP-51505(0.5m)
 - OP-51506(1m)
 - OP-51507(3m)
 - OP-51508(5m)

* Surrounding air temperature for STP cables is 0 to 50 °C.



MEMO

1 Overview

This chapter describes functions and specifications of KV-EP02.

1-1 Overview of KV-EP02	1-2
1-2 System configuration	1-3

1-1 Overview of KV-EP02

Overview

KV-EP02 functions as an adapter for EtherNet/IP communication. With EtherNet/IP communication, ON/OFF input signals and current values from the connected KV Nano Series expansion unit can be output to PLC.

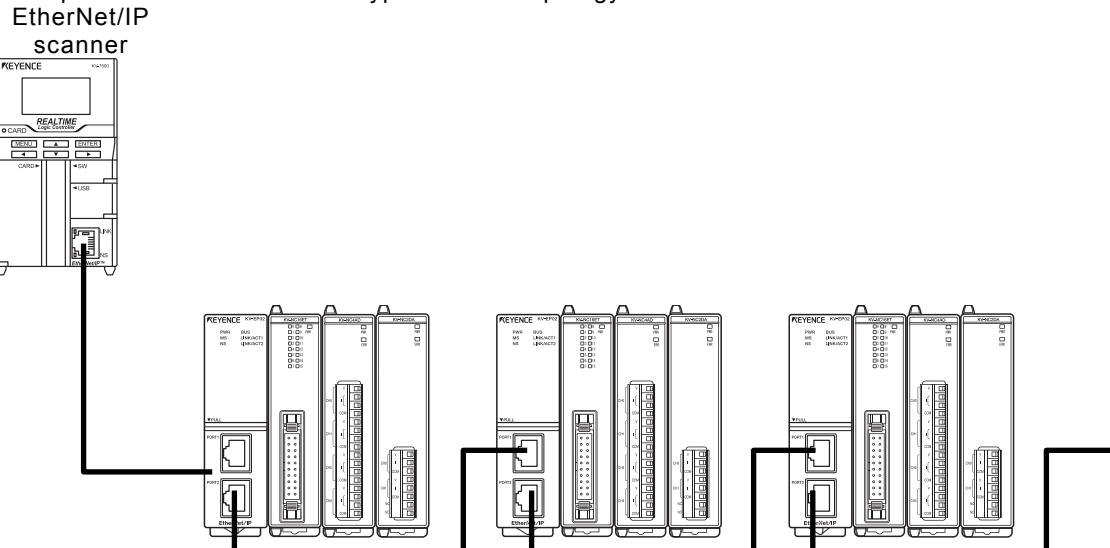
KV-EP02 is compatible with the cyclic (I/O) messages (implicit messages) and message communication (explicit messages) of EtherNet/IP. The cyclic (I/O) messages can make data communication without ladder programs. With the message communication, the parameters of an expansion unit can be read and written.

How to use the two ports

KV-EP02 is equipped with two Ethernet ports and built-in switch. It is compatible with both the star type and line type network topology (incompatible with ring type). When connecting more than one KV-EP02 unit, LAN device such as an external switch or a hub can be omitted by using the line type network topology.

As KV-EP02 has a built-in switch, set only one IP address. You can set the address using the rotary switch or BOOTP. The rotary switch is easier to make setting and to distinguish for maintenance.

Example: Connection with line type network topology



*The two ports can be used similar to an Ethernet switch without restriction (such as order for wiring).

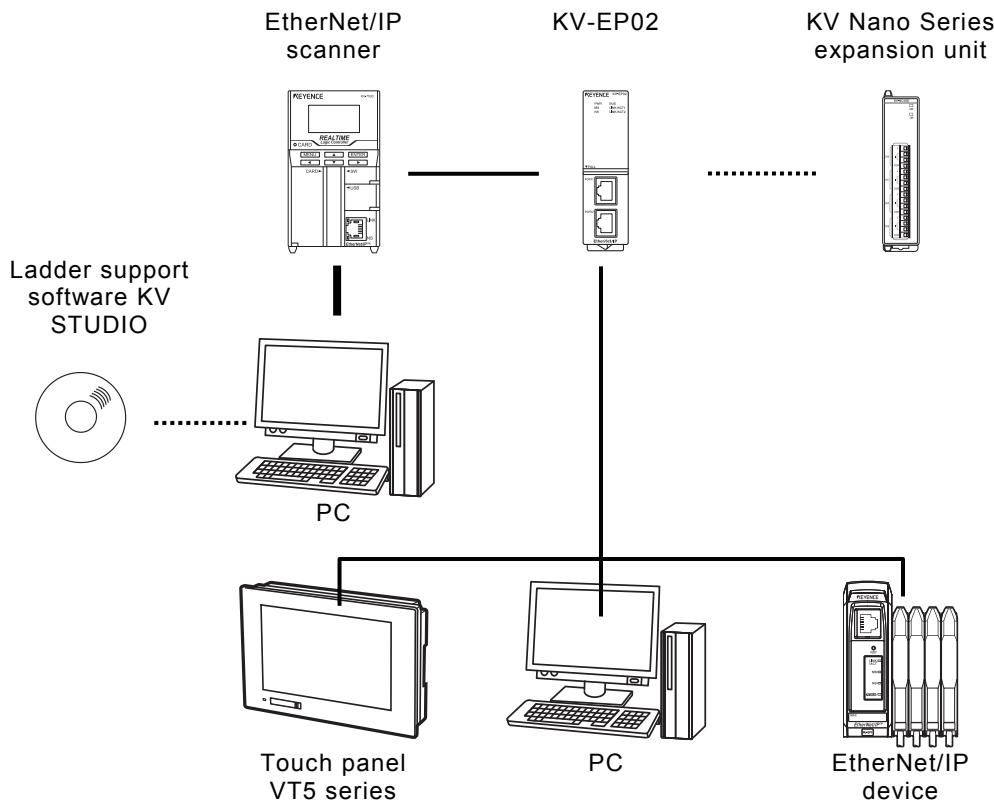
1-2 System configuration

Overview of the system configuration

The system configuration for KV-EP02 is as follows.

Make sure each unit is tuned off before connecting.

EtherNet/IP communication can be used with general Ethernet in combination.



Up to 15 KV Nano Series expansion units can be connected.

□ “Connectable KV Nano expansion units” (Page 3-3)

KV-EP02 is equipped with nonvolatile memory and can save the settings of the KV-Nano series expansion unit.

MEMO

2 Specifications

This chapter describes specifications and names of parts of KV-EP02.

2-1 Specifications	2-2
2-2 Switches and indicators	2-5

2-1 Specifications

General specifications

Item	Specification																				
Power supply voltage	24V DC (+10%/-15%)																				
Surrounding air temperature	0 to +55°C (no freezing) ^{※1※2}																				
Relative humidity	5 to 95%RH (no condensation) ^{※1}																				
Storage ambient temperature	-25 to 75°C																				
Storage humidity	5 to 95%RH (no condensation) ^{※1}																				
Operating atmosphere	No excessive dust and corrosive gases																				
Operating altitude	2000m or less																				
Pollution degree	2																				
Over voltage category	I																				
Noise immunity	1500Vp-p or above, pulse width 1μs, 50 ns (by noise simulator) Conforms to IEC standards (IEC61000, 4-2/3/4/6)																				
Withstand voltage	1500 V AC for 1 minute, between power supply terminal and I/O terminals and between all external terminals and case																				
Insulation resistance	50 MΩ or more (500V DC megger used to perform measurements between power terminal and input terminals, and between all external terminals and case)																				
Vibration resistance ^{※3}	JIS B 3502 Conforms to IEC61131-2	Intermittent vibration <table border="1"><thead><tr><th>Frequency</th><th>Acceleration</th><th>Amplitude</th></tr></thead><tbody><tr><td>5 to 9Hz</td><td>—</td><td>3.5mm</td></tr><tr><td>9 to 150Hz</td><td>9.8m/s²</td><td>—</td></tr></tbody></table> Continuous vibration <table border="1"><thead><tr><th>Frequency</th><th>Acceleration</th><th>Amplitude</th></tr></thead><tbody><tr><td>5 to 9Hz</td><td>—</td><td>1.75mm</td></tr><tr><td>9 to 150Hz</td><td>4.9m/s²</td><td>—</td></tr></tbody></table>	Frequency	Acceleration	Amplitude	5 to 9Hz	—	3.5mm	9 to 150Hz	9.8m/s ²	—	Frequency	Acceleration	Amplitude	5 to 9Hz	—	1.75mm	9 to 150Hz	4.9m/s ²	—	10 times (100 minutes) in each of the X, Y, and Z directions
Frequency	Acceleration	Amplitude																			
5 to 9Hz	—	3.5mm																			
9 to 150Hz	9.8m/s ²	—																			
Frequency	Acceleration	Amplitude																			
5 to 9Hz	—	1.75mm																			
9 to 150Hz	4.9m/s ²	—																			
Shock resistance ^{※3}	Acceleration: 150m/s ² , Application time: 11ms, Three times in each of the X, Y, and Z directions.																				
Internal consumption current ^{※4}	120mA or less																				
Weight	130g																				

※1 Guarantee range as a system

※2 On the lower and central part of the unit (30mm)

※3 When a DIN rail is attached to the unit.

※4 The maximum consumption current including expansion units: 1.8A

Performance specification

Items	Specifications	
	10BASE-T	100BASE-TX
Connection interface	RJ-45 8-poles modular connector x 2PORT	
Transmission rate ^{※1}	10Mbps	100Mbps
Transmission media ^{※2}	UTP (Category 3 or above) or STP (STP recommended)	UTP (Category 5 or above) or STP (STP recommended)
Max. cable length ^{※3}	100m	100m
Max. number of connected segments of hub ^{※4}	4	2

※1 10Mbps/100Mbps/1000Mbps MDI/MDI-X Auto switching function supported

※2 STP: Shielded twisted pair cable, UTP: Unshielded twisted pair cable

※3 Max. cable length is the distance between KV-EP02 and Ethernet switch

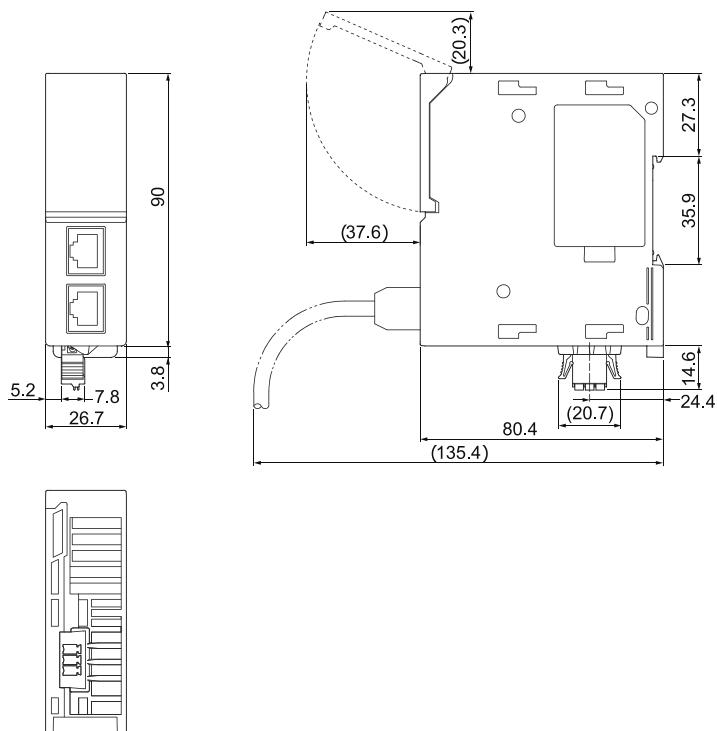
※4 There is no restriction on the number of connected segments in case of using an Ethernet switch.

EtherNet/IP communication specifications

EtherNet/IP specifications	Corresponded function	Cyclic(I/O) messages Explicit message communication Compatible with UCMM and Class3
	Number of connections	64
	RPI(communication cycle)	0.5 to 10000ms (increment: 0.5ms)
	Trigger	Cyclic
	Conformance test	Comply with CT14

EtherNet/IP is a registered trademark or a trademark of ODVA.

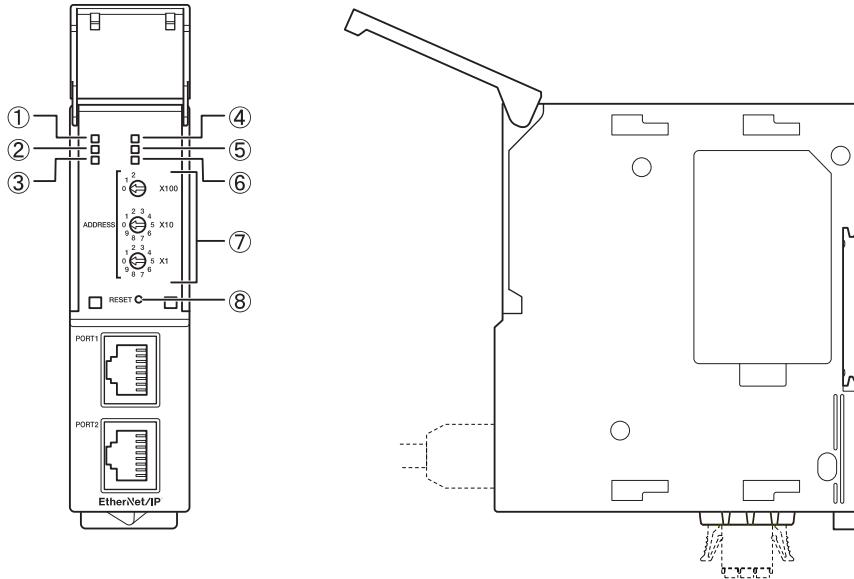
Dimensions of outline



Unit: mm

2-2 Switches and indicators

This section describes switches and indications on KV-EP02.



	Name	Function
①	Power indicator(PWR)	Indicates the power status of KV-EP02. For details, see □ "Power indicator (PWR)" (page 2-6).
②	Module status indicator(MS)	Indicates the operation status of KV-EP02. For details, see □ "Module status indicator (MS)" (page 2-6).
③	Network status indicator (NS)	Indicates the EtherNet/IP communication status of KV-EP02. For details, see □ "Network status indicator (NS)" (page 2-7).
④	Bus connection indicator (BUS)	Indicates the bus communication status of KV-EP02. For details, see □ "Bus connection indicator (BUS)" (page 2-8).
⑤	Link/activity indicator 1	Indicates the port condition of KV-EP02. For details, see □ "Link/activity indicators 1 and 2 (LINK/ACT1,LINK/ACT2)" (page 2-9).
⑥	Link/activity indicator 2	
⑦	Rotary switch	Sets the IP address. For details, see □ "Setting the IP address of KV-EP02" (page 4-10).
⑧	Reset switch	Resets the unit to the factory setting. Press and hold the switch for more than 3 seconds.

*Refer to □ "Reset (initialize) Settings" (page 7-10) for the factory setting.

2-2 Switches and indicators

Operation indicators

The operation indicators show a cause and measure of an error.

		KEYENCE KV-EP02		
		PWR	BUS	Bus connection indicator (BUS) (green or red)
		MS	LINK/ACT1	Link/activity indicator 1(green)
		NS	LINK/ACT2	Link/activity indicator 2(green)
Power indicator (green)				
Module status indicator (MS) (green or red)				
Network status indicator (NS) (green or red)				

■ Power indicator (PWR)

It indicates the power status of KV-EP02.

LED	Status		Measure
Green	On	Powered on.	—
Off		Powered off.	—

■ Module status indicator (MS)

It indicates the operation status of KV-EP02.

LED	Status		Measure
Green	On	Normal operation	—
Red	On	System error occurs.	Reset the unit. If the error occurs frequently, please consult the nearest office of KEYENCE.
	Blinking	Rotary switch setting is wrong.	<ul style="list-style-type: none"> • When NS LED is off The rotary switch setting was other than the range of 0 to 254 when the power was turn on. Turn off the power and set the value to the range of 0 to 254. • When NS LED is not off The rotary switch setting is different from the current IP address because the setting was changed during operation. Reset the setting.
Off		No power supply	Check the connection of the power terminal.

When the power is tuned on, the indicators are tuned on as the following sequence:
green MS (0.25 seconds) → red MS (0.25 seconds) → green MS → green NS (0.25 seconds) → red NS (0.25seconds).

■ Network status indicator (NS)

It indicates the EtherNet/IP communication status of KV-EP02.

LED		Status	Measure
Green	On	More than one connection is opened.	In case that more than one connection is used, communication may be unavailable even when the green NS is on.
	Blinking	No connection is opened.	Check the power status of devices, wiring, and if KV-EP02 is registered on the scanner.
Red	On	IP address is duplicated.	Check if the duplicate IP address is set among KV-EP02, scanner and other adapters. To recovery the unit, turn off and on the power.
	Blinking	Timeout occurs to more than one connection.	Check the connection timeout occurs. Then check the power status of devices and wiring.
Off		No power supply.	Check the connection of the power terminal.
		No IP address assigned or IP address is incorrect.	<ul style="list-style-type: none"> · When the rotary switch setting is 0: assign IP address. □ Setting the IP address of KV-EP02 (page4- 10) · When the rotary switch setting is above 254: turn off the power and change the setting to within 254, then turn on the power.

When the power is tuned on, the indicators are tuned on as the following sequence:
green MS (0.25 seconds) → red MS (0.25 seconds) → green MS → green NS (0.25 seconds) → red NS (0.25seconds).

■ Bus connection indicator (BUS)

It indicates the bus communication status of KV-EP02.

LED		Status	Measure
Green	On	Normal operation	—
Red	On	Bus communication error occurs.	<p>One of the following errors occurs. It can be distinguished by the error code on the scanner. Turn off the power before taking a measure for the error.</p> <ul style="list-style-type: none"> • Some bus communication trouble is detected between KV-EP02 and expansion unit. Check the connection of the expansion unit. If a source of noise is near to the unit, keep it away from the unit. (“Cyclic (I/O) communication inter-sensor communication error” (Error code: 1, detailed error code: 802)) • The number of expansion units exceeds the limit, or more than one KV-NC1 or KV-N1 is connected. (“Cyclic (I/O) communication beyond max. number of sensors error” (Error code: 1, detailed error code: 802)) • Unsupported expansion unit is connected. (“Cyclic (I/O) communication unsupported sensor error” (Error code: 1, detailed error code: 805))
Off		No power supply	Check the connection of the power terminal.

■ Link/activity indicators 1 and 2 (LINK/ACT1,LINK/ACT2)

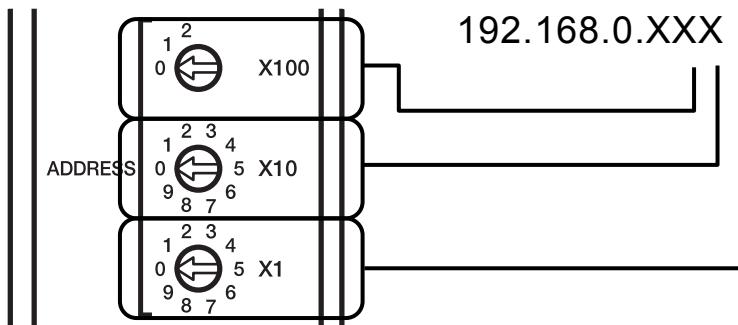
It indicates the port condition of KV-EP02.

LED		Status	Measure
Green	On	Link is normal	—
	Blinking	Link is normal and data communication is being opened.	—
Off		No power supply or no link	<ul style="list-style-type: none"> • Check the connection of the power terminal. • Check if the connected device or Ethernet switch is powered on. • Check the cable connection. • Check if the communication setting on the connected device is proper.

2-2 Switches and indicators

Rotary switch

Using the rotary switch, you can select the IP address setting method of KV-EP02. Turn off the unit before setting the rotary switch.



Value (The decimal system)	IP address setting procedure
000	Setup with BOOTP server
001 to 254	Set the lower byte of IP address within the range of 001 to 254. Set the switch “×100” for the hundreds digit, “×10” for the tens digit, and “×1” for the ones digit. The higher 3 bytes are assigned automatically by the last setting made with BOOTP. When the value is the factory setting and the lower byte is set to other than 000, the higher 3 bytes are fixed to 192.168.0.
255 or above	As the value is out of the range, the module status indicator (MS) blinks red. □ “Operation indicators” (page 2-6)

The rotary switch is set to 000 when shipped from the factory.
IP address is not assigned when shipped from the factory.

3 Installation and maintenance of the unit

This chapter describes installation of the unit, cautions for wiring and maintenance procedure.

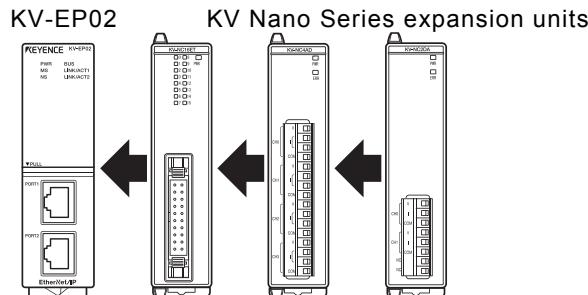
3-1 Installation and connecting to an expansion unit	3-2
3-2 Installing units	3-7
3-3 Cautions for wiring.....	3-9
3-4 Connecting to Ethernet	3-12
3-5 Maintenance	3-15

3-1 Installation and connecting to an expansion unit

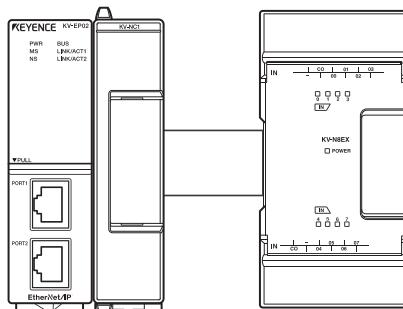
This section describes installation of each unit and attachment to a DIN rail.

Cautions for connecting units

Be sure to follow the explanation below to connect each unit,
Turn off each unit before connecting.



- Conversion unit KV-NC1 and KV-N1 can be connected up to one each.
- Up to two expansion codes can be used for expansion unit connection.
(Do not join the two codes.)
- With the conversion unit KV-NC1, you can also connect a terminal block type unit.



■ Maximum number of the connected units

When the CPU unit connected to a scanner is KV-7000/5000/3000 Series, up to 15 expansion units for KV Nano Series can be connected to one KV-EP02. (For an analog unit and temperature unit for KV Nano Series, up to 7 units can be connected.)

When the CPU unit is other than the above, up to 8 expansion units for KV Nano Series can be connected to one KV-EP02. (For an analog unit and temperature unit for KV Nano Series, up to 4 units can be connected.)

□ “Connectable KV Nano expansion units” (page 3-3)

Connectable KV Nano expansion units

You can connect up to 15 expansion units for KV Nano Series to KV-EP02. The connectable models are as follows.

Name	Model	Number of used slots (Number of used IDs)
Expansion input unit	KV-N8EX / KV-N16EX KV-NC16EX*(KV-NC16EX / KV-NC16EXE) KV-NC32EX	1
Expansion output unit	KV-N8ER / KV-NC8ER / KV-N16ER KV-N8ET*(KV-N8ET / KV-N8ETP) KV-N16ET*(KV-N16ET / KV-N16ETP) KV-NC16ET*(KV-NC16ET / KV-NC16ETP / KV-NC16ETE / KV-NC16ETPE) KV-NC32ET*(KV-NC32ET / KV-NC32ETP)	1
Expansion I/O unit	KV-N8EXR / KV-N8EXT KV-NC16EXT / KV-NC32EXT	1
Analog unit or Temperature unit	KV-NC4AD / KV-NC2DA KV-N3AM / KV-NC4TP	2
Conversion unit	KV-NC1 / KV-N1 (Up to one each)	0

- Up to two expansion codes (OP-87581) can be used for expansion unit connection.
(Do not join the two codes.)

You cannot connect the model below.

Name	Model
Network unit	KV-NC1EP

■ The number of the connectable units

The number of the connectable units depends on the number of the used slots (number of the used ID). The maximum number of the used slots is 15. When the number of used slots is 16 or above, BUS LED turns red.

In case KV-NC1EP or other company's scanner is used, the number of the connectable units is limited so that the number of the used slots is within 8.

If KV-NC1EP is used and the number of the used slots is above 8, an error occurs in Ethernet/IP setting. If other company's scanner is used and the number of the used slots is above 8, an error occurs against the Forward_Open service (error code: 1, detailed error code: 801).

3-1 Installation and connecting to an expansion unit**Connecting an expansion unit**

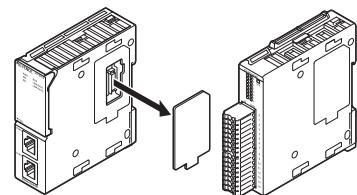
This section describes how to connect an expansion unit to KV-EP02.

NOTICE

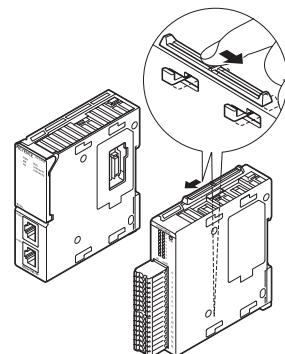
Turn off the unit before connecting.

■ Connecting an expansion unit of connector type

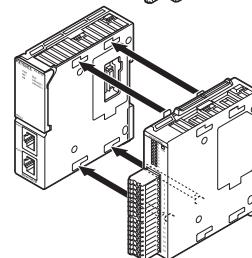
- 1 Remove the connector cover on the right side of KV-EP02.



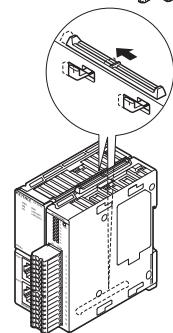
- 2 Remove the lock levers on the top and bottom of the expansion unit.
Put your finger on the lever and slide it toward front of the unit.



- 3 Insert the lock lever of the expansion unit into the slot of KV-EP02.
You can easily connect by holding the two units in parallel and aligning the connectors.

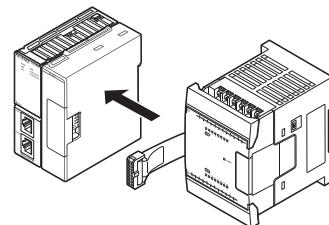


- 4 Lock the levers on the top and bottom of the expansion unit.
In the same way as step 1, put your finger on the lever and slide it toward back of the unit. Be sure there is no gap between the units. If there is a gap, they are not properly connected.

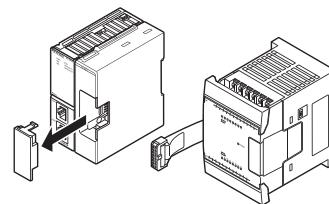


■ Connecting an expansion unit of terminal block type

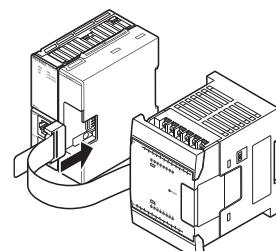
- 1** Attach a conversion unit KV-NC1 to the right side of KV-EP02.



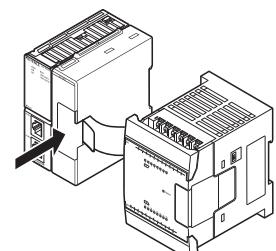
- 2** Remove the connector cover on the right side of KV-EP02.



- 3** Insert the connector cable on the left side of the expansion unit into the connector of KV-EP02.



- 4** Attach the connector cover to KV-EP02.



Point Be sure the KV-EP02 and the expansion unit are properly connected. If they are not connected in parallel or the connector is not inserted tightly, the units may be damaged when they are turned on.

Reference

The power of each expansion unit is supplied through KV-EP02.

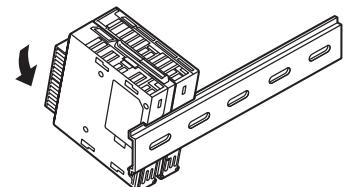
3-1 Installation and connecting to an expansion unit

Installing to a DIN rail

This section describes how to install the connected unit to a DIN rail.

■ Installation

- 1** Hang the groove of the upper part of DIN rail onto the upper claws for DIN rail attachment of each unit.

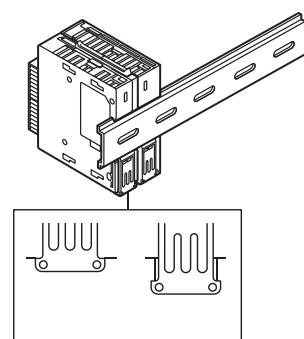


- 2** Fix the lower part of DIN rail to the lower claws for DIN rail attachment of each unit.

The lower black claws can be moved under action of spring. Press it down until it clicks.

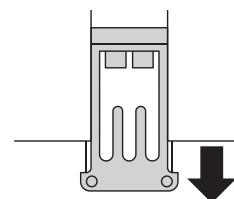
If you cannot install the unit easily in a certain place, remove all locks first, attach to the DIN rail, then lock the claws again.

- 3** Ensure that the lower claws are inserted (locked).

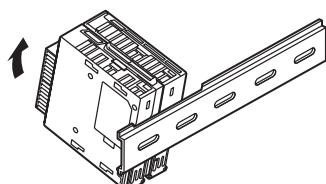


■ To remove

- 1** Pull out the lower claws.



- 2** Remove the DIN rail from the unit in the reverse order from attachment.

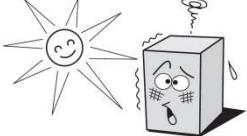
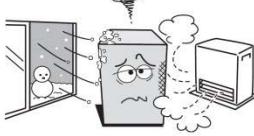
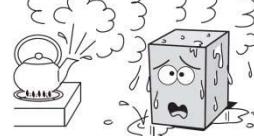
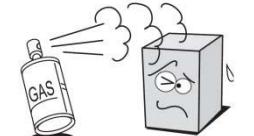
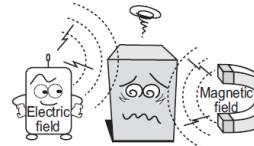


3-2 Installing units

This section describes the installation environment and the attachment inside the control panel.

Installation environment

Do not install units in the following locations.

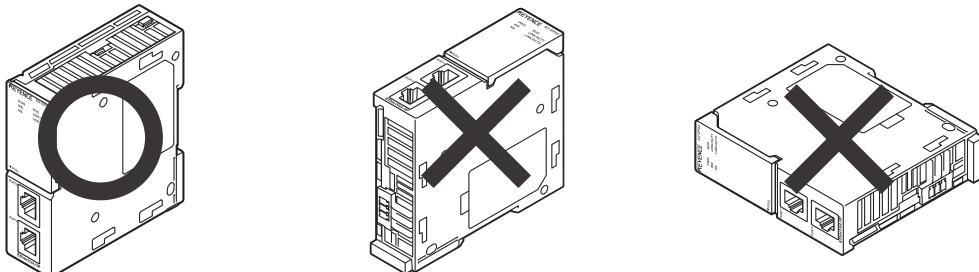
Location under direct sunshine	Location with ambient temperature beyond the range of 0 to +55°C*	Location with ambient humidity beyond the range of 5 to 95% RH
		
Location where condensation may occur due to a sudden change in temperature	Location where corrosive gases or inflammable gases exist	Location where heavy dust, salt, iron chip, or oil smoke exist
		
Location subject to direct vibration or shock	Location where water, oil, or chemicals is sprayed	Location where strong magnetic or electric field exists
		

* Location where elevation is above 2000 m

Installing conditions

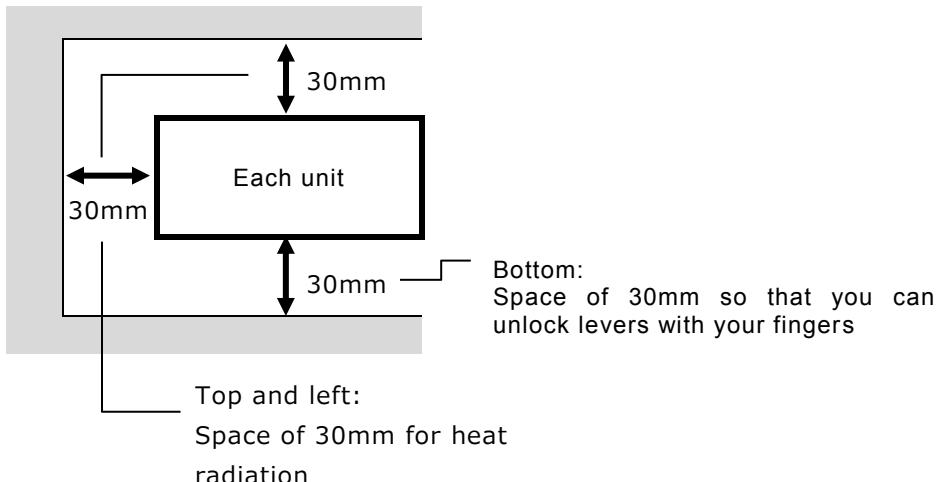
■ Direction of the unit

When installing the unit, be sure the front panel of KV-EP02 faces the front as illustrated.



3-2 Installing units**■ Space between units**

Keep a space of more than 30mm between units or between a unit and its surrounding objects.

**Point**

In case the surrounding air temperature (around the lower and central part of the unit) exceeds the limit (55 degrees), lower it by cooling the air or widening the space between the unit and its surrounding objects.

3-3 Cautions for wiring

Power supply

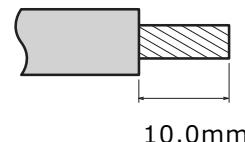
The power of KV-EP02 is supplied through the power connector.
This unit does not have PoE (Power over Ethernet) function.

Reference

The power of each expansion unit is supplied through KV-EP02.

■ Terminal block

Item	Specification
Compatible cable size	AWG24 to 16 (0.2 to 1.3mm ²)
Length of striped cable	10.0mm



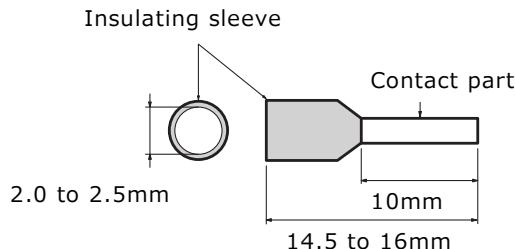
■ Cables used for the terminal block

(1) When using a standard wire or single wire as is

- (a) Twist the tip of the standard wire so that no loose wire is left.
- (b) Do not solder the tips of the wires.

(2) When using a rod terminal with insulating sleeve

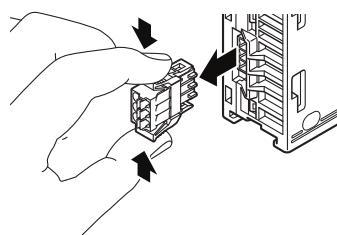
It may be difficult to insert the wire into the insulating sleeve depending on the thickness of the wire's sheath. Refer to the outline diagram below for selecting wires.



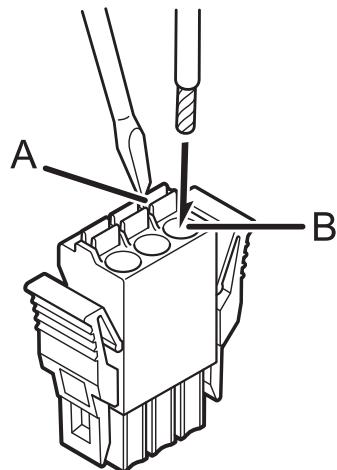
Manufacturer	Model	Cross-sectional area of the contact part	Length of the contact part
Phoenix Contact GmbH & Co. KG	AI 0.25-10YE	0.25mm ²	10mm
	AI 0.34-10TQ	0.34mm ²	10mm
	AI 0.5-10WH	0.5mm ²	10mm

3-3 Cautions for wiring**■ Connecting a cable**

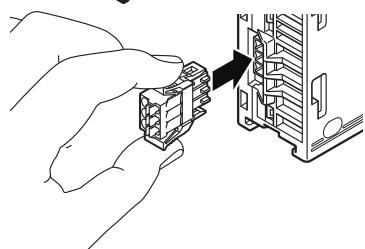
- 1** Detach the terminal block from the controller.



- 2** While holding A with a driver, insert a wire into B.



- 3** Remove the driver after the wire is inserted to the bottom of the hole.
Pull the wire lightly to check if it is fixed.



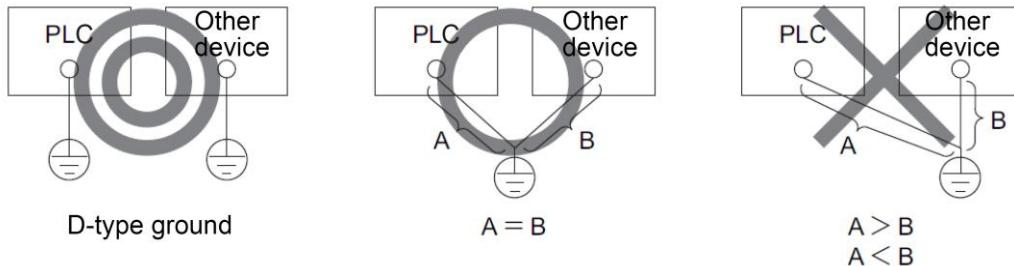
- 4** Attach the terminal block to the controller.

■ Cautions for grounding

Ground each device separately using D-type grounding facilities. Ensure that the grounding resistance in this situation is 100 Ω or less.

If separate grounding is not possible, ground all the devices from a common point. In this situation, all cables must be the same length.

Use the FG terminals to ground the devices (do not ground the power supply terminals).



3-4 Connecting to Ethernet

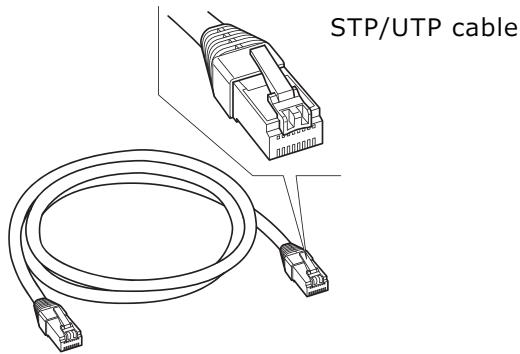
This section describes how to connect KV-EP02 to Ethernet.

Applicable cable

To connect KV-EP02 to Ethernet, an applicable cable depends on the communication rate of Ethernet.

For building 10BASE-T Ethernet

Shielded twisted pair (STP) or unshielded twisted pair (UTP) of category 3 or above should be used.



For building 100BASE-TX Ethernet

STP or UTP of category 5 or above should be used.

Do not use a UTP cable of category 3 or 4.

Point

When building 10BASE-T Ethernet, communication conditions may be unstable depending on the data volume of cyclic (I/O) messages.
If there is noise in installation environment, use a STP cable.

Reference

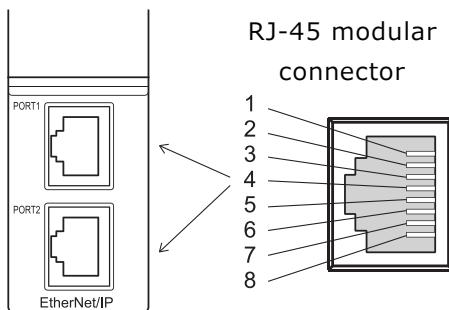
Either a straight-through cable or crossover cable can be used since it is compatible with AUTO MDI / MDI-X.

In case of building Ethernet other than 10BASE-T and 100BASE-TX (ex.: 10BASE-2 and 10BASE-5 etc.), use a hub with AUI (MAU) connector or BNC connector, or a media converter (10BASE5 ->10BASE-T and 10BASE2 -> 10BASE-T).

Connector of KV-EP02

The connector of KV-EP02 is a RJ-45 8-pin modular connector (in accordance to ISO 8877) applicable to 10BASE-T and 100BASE-TX, and its specification complies with IEEE802.3.

Signal assignment of RJ-45 modular connector is described below.



Pin No.	Signal	Signal function
1	TD +	Send data (+)
2	TD -	Send data (-)
3	RD +	Receive data (+)
4	-	-
5	-	-
6	RD -	Receive data (-)
7	-	-
8	-	-

Cautions on connecting a STP/UTP cable to the connector

Do not place any strain on the connector when connecting a STP/UTP cable to KV-EP02.



Cables may be bent when installing or laying them. However, bending a cable excessively may cause wires inside the cable to break. That must be taken into consideration when install or lay cables.

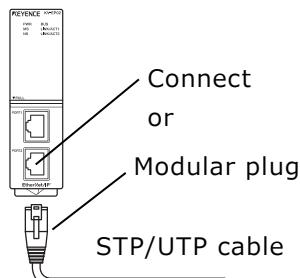
3-4 Connecting to Ethernet**Connecting to Ethernet**

Connect KV-EP02 to Ethernet as follows.

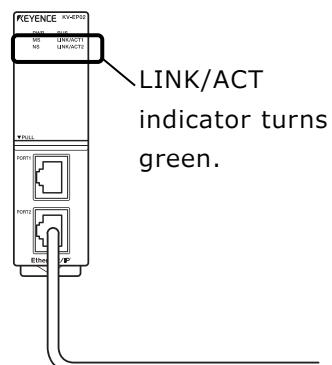
- 1** Turn off the power of KV-EP02.
- 2** Connect the modular plug on one end of the STP/UTP cable to the 10BASE-T/100BASE-TX port of the Ethernet switch.
Insert the modular plug until it clicks. The modular plug and connector are locked in place.

The length of STP/UTP cable should be within 100m.
When connecting KV-EP02 to an Ethernet switch, thoroughly check the status of the Ethernet connector (port) of the switch before connection.
! Point
Various connectors are available for an Ethernet switch, such as connectors different from RJ-45 in shape (AUI connector and BNC connector etc.), and connectors used for connecting two Ethernet switches (hereinafter referred to as cascade port).

- 3** Connect the modular plug on the other end of the STP/UTP cable to the connector on KV-EP02. Insert the modular plug until it clicks. The modular plug and connector are locked in place.



- 4** Turn on the power of KV-EP02. Then check if the LINK/ACT indicator turns green. It may take about 4 to 5 seconds until the indicator turns on.



3-5 Maintenance

This section describes check and maintenance of the unit.

Check and maintenance

■ Check

By using the unit for a long time, the connecting part of connectors may become loose. If it is used continuously in this status, operation failure may occur.

Therefore make a regular inspection for the units and cables.

The main inspection items are as follows:

- Check the locking piece at each unit's connection part for disconnection or looseness.
- Check the connector's connection part for disconnection or looseness.
- Check the screws on the communication terminals for looseness.
- Check the wiring cables between units and other equipment for damage.

■ Maintenance

Dirt adheres on the units when they are used for a long time. Clean off any dirt on the units using a clean and dry cloth.

For fine parts such as a connector, detach the connector and then remove dust and dirt with a cotton bud.

MEMO

4 Connection and settings

This chapter describes the connection between KV-EP02 and KV Nano expansion unit and communication settings.

4-1 Setting procedure.....	4-2
4-2 Communication settings of KV-EP02.....	4-3
4-3 Communication settings of a scanner.....	4-5
4-4 Communication with PLC of KEYENCE	4-6

4-1 Setting procedure

This section describes procedures for starting KV-EP02.

Setting procedure of KV-EP02

Installing units

Connect KV-EP02 to a KV Nano Series expansion unit. [Installation and maintenance of the unit] (page 3-1)



Communication setting on KV-EP02

Set the IP address of KV-EP02. Communication settings of KV-EP02 (page 4-3)



Communication setting on EtherNet/IP scanner

Refer to the manual of the scanner.



Starting communication

Connect KV-EP02 to EtherNet/IP scanner and start communication.

Communication between KV-EP02 and the connected scanner is available. When using PLC (EtherNet/IP scanner) of Keyence corporation, refer to "Communication with PLC of KEYENCE" (page 4-6) for the scanner settings.

Make the settings on a connected expansion unit such as constant configuration during input, input range and the maximum/minimum of scaling if necessary. "Settings of expansion units" (page 4-19)

4-2 Communication settings of KV-EP02

This section describes the settings on KV-EP02 to connect to EtherNet/IP system.

Setting on KV-EP02

Communication settings of KV-EP02 are as follows.

■ IP address setting

You can choose the IP address setting method between rotary switch and BOOTP.

● Setting with the rotary switch

□ “Setting the IP address of KV-EP02” (page 4-10)

● Setting with BOOTP

While the unit is turned off set the rotary switch to 0, then turn on the unit. Press and hold the reset switch for more than 3 seconds so that the network status indicator (NS) turns off (same as the factory setting).

There are three ways for setting the IP address with BOOTP.

- Using EtherNet/IP setting of KV STUDIO
 - “Setting the IP address of KV-EP02” (page 4-10)
- Using the IP address setting tool downloaded from the Keyence web site
 - IP Setting Tool User's Manual
- Using a tool for IP address setting of other company
 - Refer to the manual of each company.

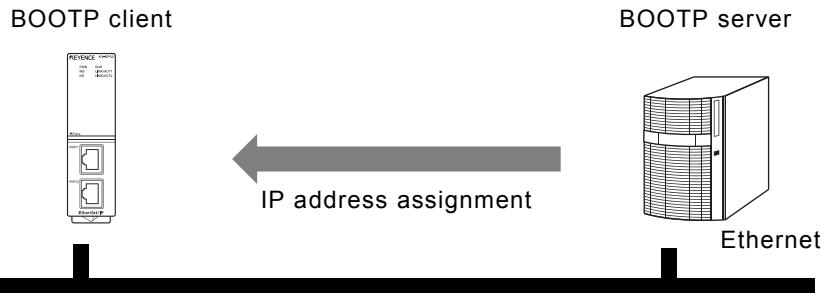
4-2 Communication settings of KV-EP02

Point

After setting the IP address to “fixed IP address” by using BOOTP, turning off the unit to set the rotary switch to the range of 1 to 254 and turning on the unit, you can change the lower 1byte to the value of the rotary switch with inheriting the settings of the upper 3 bytes, subnet mask and default gateway.

Reference

- BOOTP is the abbreviation of BOOTstrap Protocol. Information of a unit such as IP address can be set from BOOTP server automatically.
- If BOOTP server and a unit serving as BOOTP client are in the same network, IP address corresponding to MAC address is assigned to the BOOTP client according to the preset MAC address and IP address mapping table.



4-3 Communication settings of a scanner

This section describes the settings on a scanner for connecting KV-EP02 to EtherNet/IP system.

When using PLC (EtherNet/IP scanner) of Keyence, refer to □ "Communication with PLC of KEYENCE" (page 4-6).

Settings on a scanner

Communication settings on a scanner for connecting KV-EP02 to Ethernet/IP system are as follows.

■ IP address setting

Set the IP address of a scanner.

■ Register for device profile of KV-EP02

Register for the device profile of KV-EP02 with setting software of a scanner. You can choose the method for register between manual setting and importing an EDS file (Electronic Data Sheet). EDS file of KV-EP02 can be downloaded from the Keyence web site.

(When using PLC (EtherNet/IP scanner) of Keyence, the register is unnecessary since EDS file of KV-EP02 has imported into the ladder support software KV STUDIO of version 9.4 or later.)

■ Communication settings with KV-EP02

KV-EP02 communicates with a scanner using the cyclic (I/O) messages and message communication of EtherNet/IP.

● Cyclic(I/O) messages (**Implicit** message)

It is a function to send and receive data with the specified RPI (communication period). This function enables data communication without creating a ladder program by selecting a communication method called 'Connection' and setting the device assignment to send/receive data on the scanner side.

● Message communication (**Explicit** message)

It is a function to send and receive data that does not require punctuality. It is used to change the settings of the expansion unit, and create a message for communication by using the ladder program on a scanner.

(When using a PLC (EtherNet/IP scanner of Keyence), you can change the setting with a sensor application for adapter setting transmission etc.)

For settings of each communication, refer to □ "Cyclic(I/O) messages" (page 5-3) and □ "Message communication" (page 5-19). Refer also to the manual of each scanner.

Reference

In this manual, only the functions of EtherNet/IP scanner to communicate with KV-EP02 are described. For detailed functions, refer to the manuals of the EtherNet/IP scanner and CPU unit.

4-4 Communication with PLC of KEYENCE

This section describes the communication between KV-EP02 and a PLC (EtherNet/IP scanner) of Keyence.

When connecting to a PLC (EtherNet/IP scanner) of Keyence, you can use the following communication method on KV-EP02.

■ Cyclic(I/O) messages (Implicit message)

□ “Cyclic(I/O) messages” (page5-3)

■ Message communication (Explicit message)

□ “Message communication” (page 5-19)

With EtherNet/IP setting of the ladder support software KV STUDIO of version 9.4 or later, you can set IP address for KV-EP02 whose IP address is not assigned.

Setting procedures for cyclic (I/O) messages (implicit messages)

The following describes the setting procedures for when using KV-7500 as a scanner and assigning the IP address of KV-EP02 with BOOTP through KV-7500.

Installing units

Connect KV-EP02 to a KV Nano Series expansion unit.

□ 「Installation and maintenance of the unit」(page 3-1)



Setting the IP address of KV-7500 (EtherNet/IP scanner)

Set the IP address of KV-7500 with Unit Editor of KV STUDIO and transfer the project (unit setting) to KV-7500.



Communication settings on KV-EP02

Set the IP address of KV-EP02.

□ 「Setting the IP address of KV-EP02」(page 4-10)



Making a scan list with EtherNet/IP setting

Make a scan list with auto-configuration of EtherNet/IP setting of KV STUDIO.



Transferring the project to KV-7500

Transfer the project (unit setting) to KV-7500.



Starting communication

Communication starts automatically.

If necessary

Settings on an expansion unit

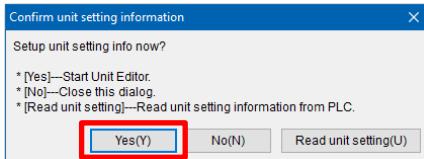
Make settings on an expansion unit with transmission adapter setting.

⇒ 「Settings of expansion units」 (page 4-19)

Setting the IP address of KV-7500

The following is an example for making a new project and setting the IP address of KV-7500.

- 1 Startup KV STUDIO (version 9.4 or later) and select KV-7500 as a supported model to make a new project.
- 2 Click “Yes (Y)” or “Read unit setting (U)” to start “Unit Editor”.



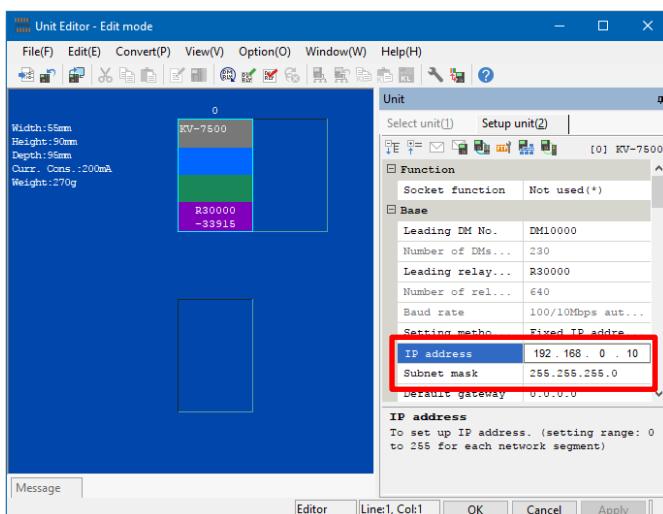
Other procedure

Select “Tool” > “Unit Editor” on the menu of KV STUDIO.

Click button

Refer to KV STUDIO User’s Manual for details.

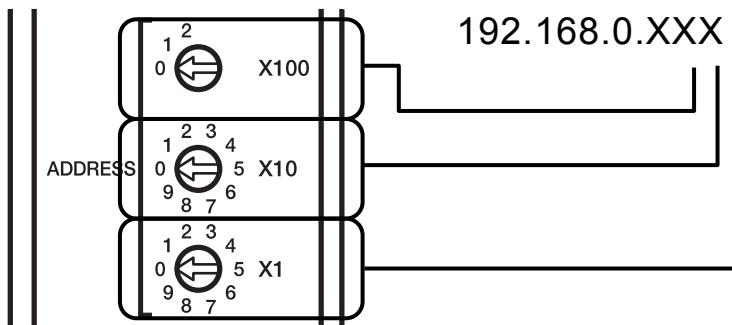
- 3 In “Unit Editor” of KV STUDIO, select KV-7500 and set the IP address and subnet mask on “Setup unit (2)” tab.
Set the IP address and subnet mask corresponding to the IP address set to KV-EP02.



- 4 Save the Unit Editor to end the setting.
- 5 Select “Monitor/Simulator (N)” > “Transfer to PLC (W)” on the menu of KV STUDIO to transfer the project.

Setting the IP address of KV-EP02

Using the rotary switch, you can select the IP address setting method of KV-EP02. Turn off the unit before setting the rotary switch.



Value (The decimal system)	IP address setting procedure
000	Setup with BOOTP server
001 to 254	Set the lower byte of IP address with the rotary switch.
255 or above	As the value is out of the range, the module status indicator (MS) blinks red. □ "Operation indicators" (page 2-6)

The rotary switch is set to 000 when shipped from the factory.
IP address is not assigned when shipped from the factory.

■ Setting with the rotary switch

- When the current IP address is the factory setting

The IP address is set to 192.168.0.xxx (1 to 254: setting value of the rotary switch)

- When the IP address has set with BOOTP

The higher 3 bytes are assigned automatically by the setting made with BOOTP and the lower byte is set by the rotary switch.

Ex.) When setting the IP address to 172.10.0.12 with BOOTP first and change the rotary switch, the address is changed to 172.10.0.xxx (1 to 254: setting value of the rotary switch)

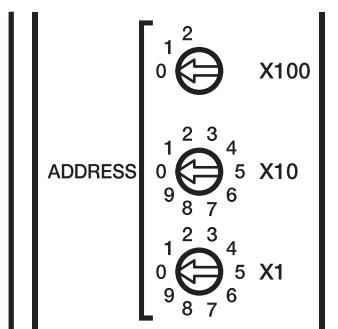
■ Setting with BOOTP using auto configuration of KV STUDIO

By setting Auto configuration from EtherNet/IP setting of KV STUDIO via an EtherNet/IP scanner, you can easily set the IP address of KV-EP02 and make a scan list.

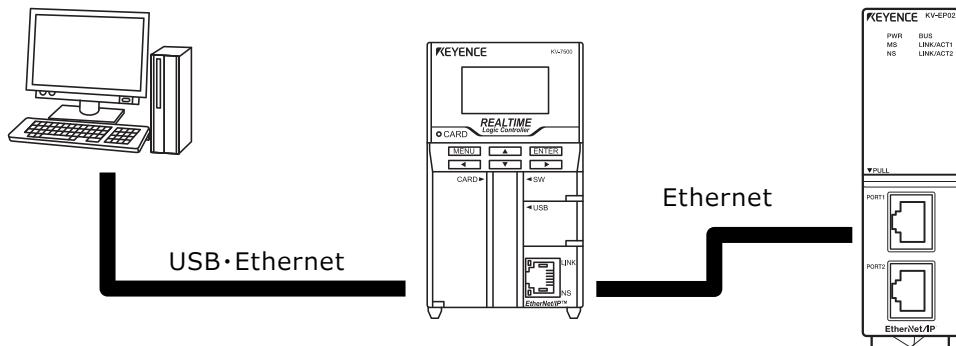
- 1 Set the rotary switches to 0 (factory setting).

If the IP address of KV-EP02 has already set and it is different from the network address of KV-7500, the units cannot communicate. Change the network address of KV-7500 or reset KV-EP02 to the factory settings.

□ “Reset (initialize) Settings” (page 7-10)



- 2 Connect KV-7500 to KV-EP02 with an Ethernet cable.

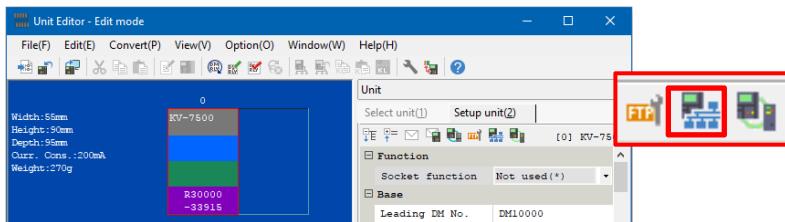


Point Auto configuration is available only for the communication line via a PLC.

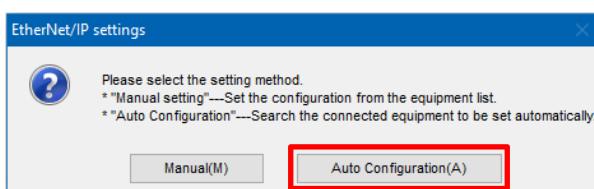
- 3 Turn on the power of KV-EP02.

4-4 Communication with PLC of KEYENCE

- 4 In “Unit Editor” of KV STUDIO, select KV-7500 and click the icon to startup EtherNet/IP setting on “Setup unit (2) tab.

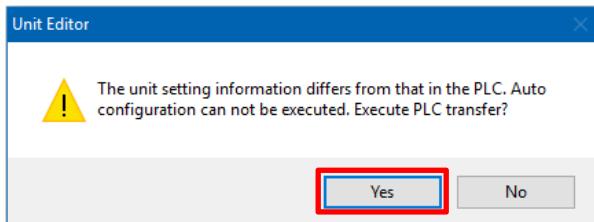


- 5 Carry out auto configuration.
In the dialog below, click “Auto configuration (A)”.



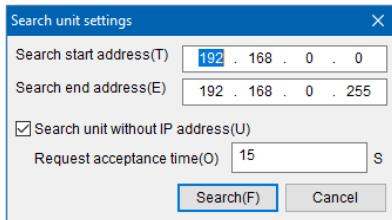
Other procedure
Select “File (F)”> “Auto configuration (S)” in EtherNet/IP setting menu.
Click

Click “Yes” to transfer the project (unit setting) to the PLC.



Auto configuration cannot be carried out if the project is not transferred to the PLC.

6 With “Search unit settings” dialog, search for a device.



Point

- When shipped from the factory, the IP address of KV-EP02 is not assigned.
- To search for a device without assigning the IP address, KV-EP02 should be turned on and the network status indicator (NS) should be off.
- If the network status indicator (NS) keeps on, it means that IP address has already been assigned. In this case, the IP address should be contained within the range of IP address set in “Search Unit” dialog.

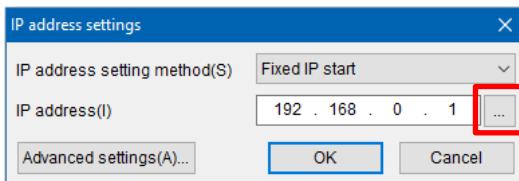
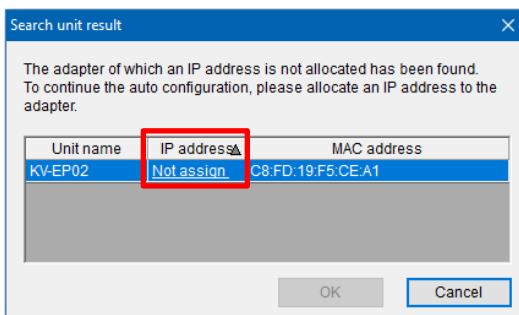
4-4 Communication with PLC of KEYENCE

7

Set the IP address. When the IP address of KV-EP02 has already assigned, you can skip this procedure.

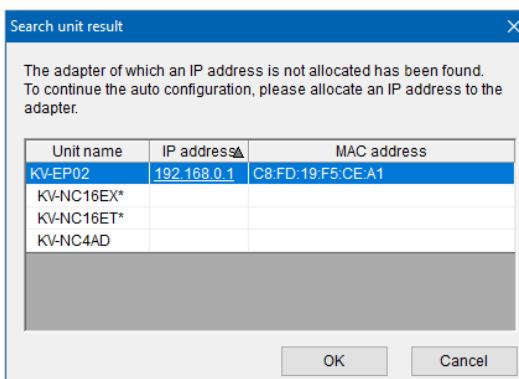
In "Search unit result", click "Not assign" to open "IP address setting" dialog. Set the IP address.

If more than one KV-EP02 is connected, check the MAC address on the side of the unit to set the IP address.



To search for unassigned IP addresses

After the IP address of KV-EP02 is assigned, the IP address, MAC address and connected expansion units are displayed in "Search unit result".



IP address setting of KV-EP02 is completed.

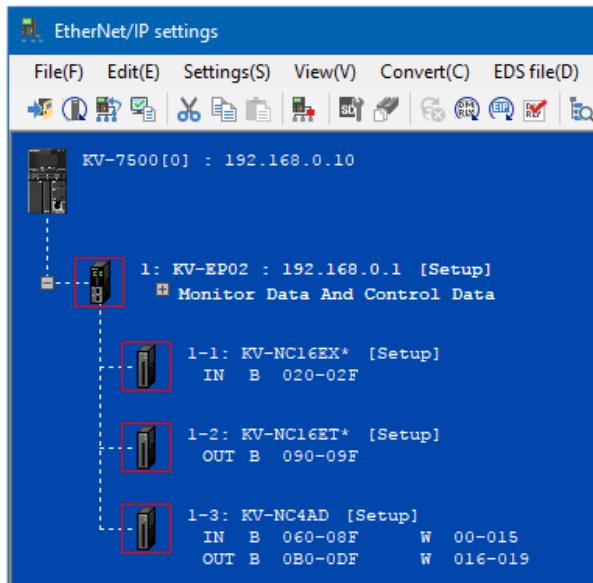
Click "OK" in "Search unit result" and KV-EP02 is registered to the scan list of EtherNet/IP setting.

Making a scan list

- 1 Make a scan list with EtherNet/IP settings.

When setting the IP address with BOOTP using auto configuration of KV STUDIO (Setting with BOOTP using auto configuration of KV STUDIO page 4-11), a scan list is made automatically.

When setting IP address of KV-EP02 with rotary switch, similarly a scan list is made automatically by selecting “File (F)”> “Auto configuration (S)” in EtherNet/IP setting menu.



Point

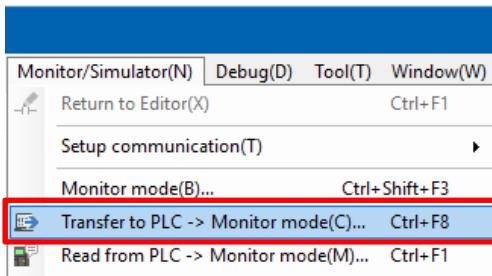
Relays and devices assigned to expansion units are set automatically.
To set manually, refer to KV-XLE02 User's Manual or EtherNet/IP Function User's Manual.

- 2 Save the EtherNet IP setting and Unit Editor to finish the scan list.

4-4 Communication with PLC of KEYENCE

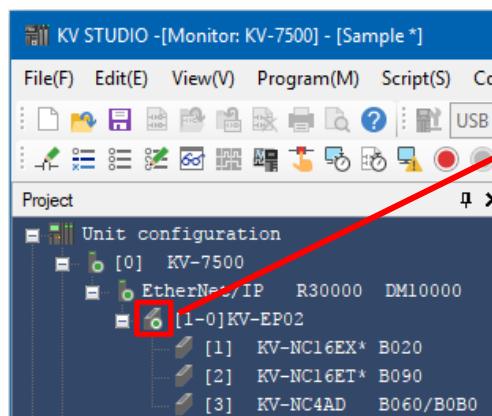
Transferring the project and checking cyclic (I/O) messages

- 1** Set the IP address of KV-EP02 and make a scan list referring to “Setting with BOOTP using auto configuration of KV STUDIO” (page 4-11) and “Making a scan list” (page 4-15)
- 2** Select “Monitor/Simulator (N)” > “Transfer to PLC -> Monitor mode(C)” in KV STUDIO menu to start transfer.



Click “Execute (E)” in “Transfer program” dialog.

- 3** The monitor mode is activated and it checks if the cyclic (I/O) messages works properly.
Set the RUN/PROG switch on the PLC to RUN. If the switch has already been set to the RUN, use KV STUDIO to switch to RUN mode.



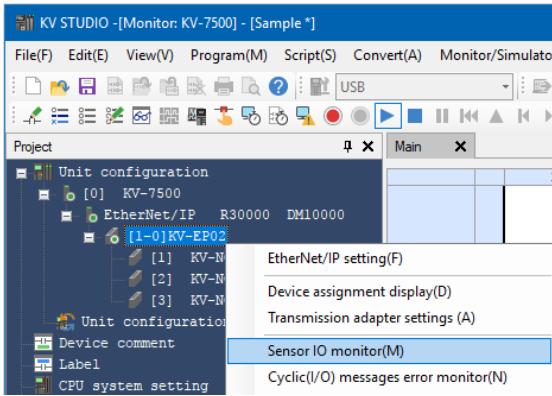
When the icon for KV-EP02 turns green, cyclic (I/O) messages with KV-7500 works properly.

In case of the icon turns red , check the detail in “Cyclic(I/O) messages error monitor”.



When the mode is switched to RUN, the PLC starts operation.

- 4 In the monitor mode, right-click “KV-EP02” in workspace and select “Sensor IO monitor” from the menu



Other procedure

Double click “KV-EP02”.

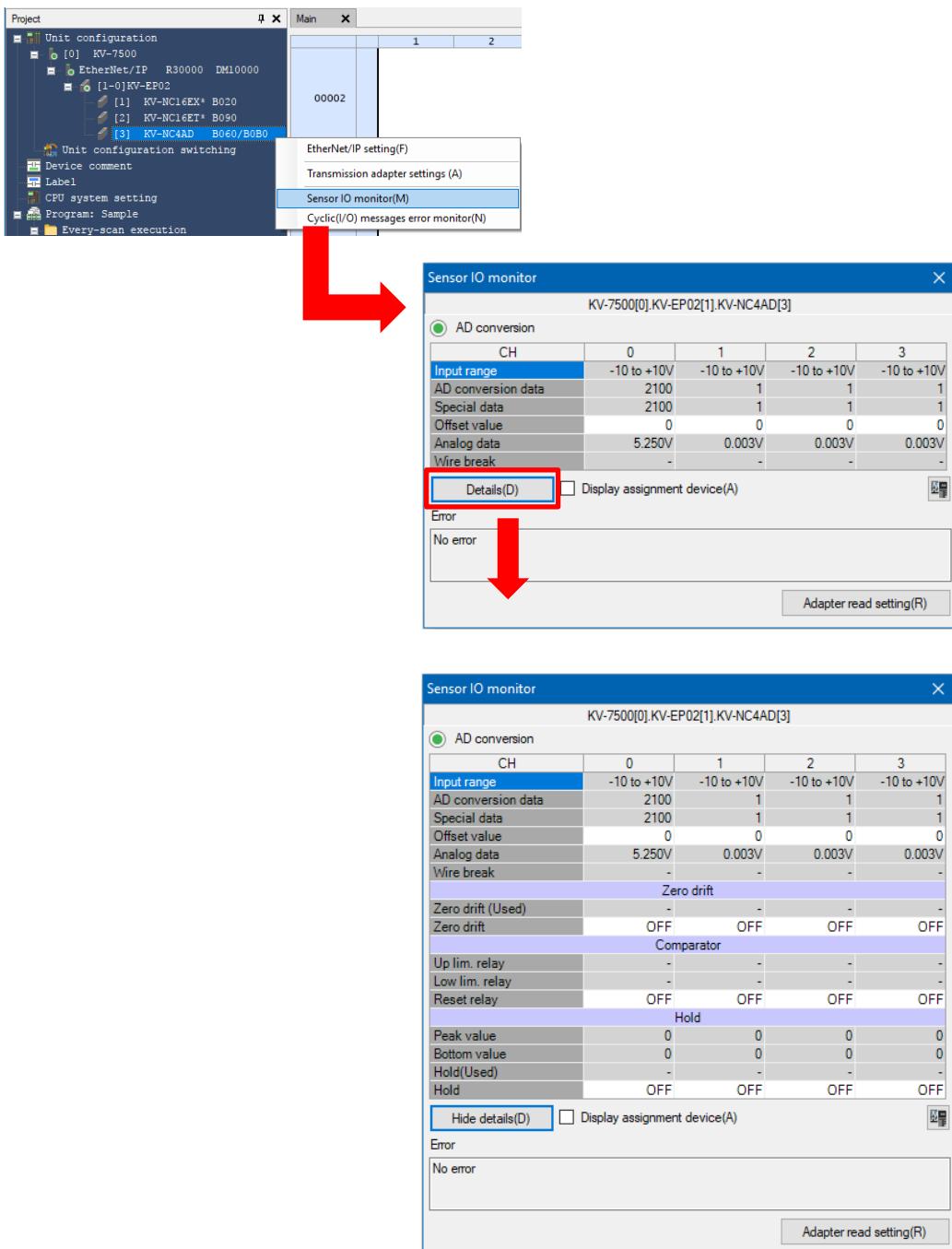
You can monitor devices assigned for cyclic (I/O) messages.

Device	Current value	Display format	Comments
B00	-	1-bit BIN	KV-7500[0].KV-EP02[1]Error
B01	-	1-bit BIN	
B02	-	1-bit BIN	
B03	-	1-bit BIN	
B04	-	1-bit BIN	
B05	-	1-bit BIN	
B06	-	1-bit BIN	
B07	-	1-bit BIN	
B08	-	1-bit BIN	KV-7500[0].KV-EP02[1]IP ad duplicate
B09	-	1-bit BIN	KV-7500[0].KV-EP02[1]Rotary sw invalid
B0A	-	1-bit BIN	
B0B	-	1-bit BIN	
B0C	-	1-bit BIN	
B0D	-	1-bit BIN	
B0E	-	1-bit BIN	
B0F	-	1-bit BIN	
B010	-	1-bit BIN	KV-7500[0].KV-EP02[1]ID0 Error
B011	-	1-bit BIN	KV-7500[0].KV-EP02[1]ID1 Error
B012	-	1-bit BIN	KV-7500[0].KV-EP02[1]ID2 Error

4-4 Communication with PLC of KEYENCE



If you right-click one of icons of expansion units and select “Sensor IO monitor”, only the selected device is monitored.



Settings of expansion units

Use message communication function for settings of expansion units connected to KV-EP02 (ex.: constant configuration during input of an expansion I/O unit, and input range and the maximum/minimum value of scaling of an analog unit).

With KV STUDIO, settings of EtherNet/IP adapters registered to a scan list can be read/written. For details of transmission adapter settings, refer to □“Adapter Setting Transmission” (page 6-14).

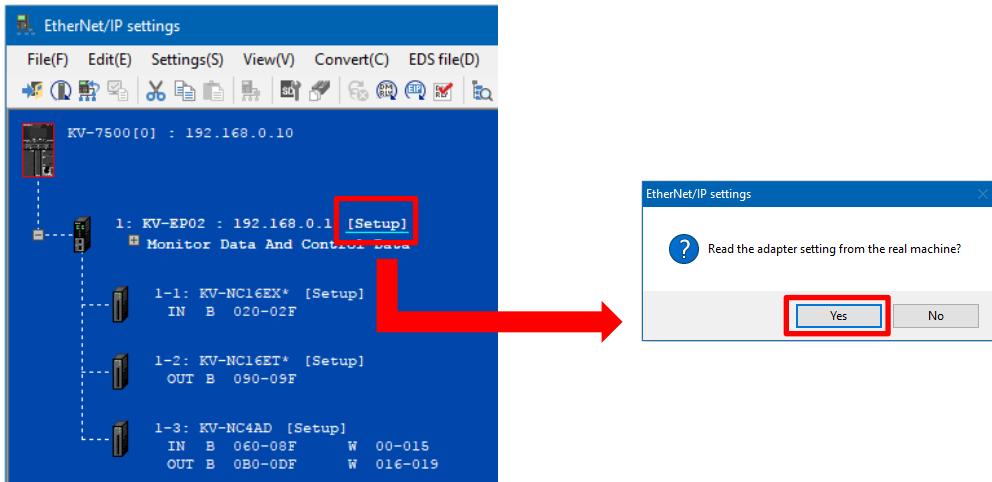
The following describes how to set an expansion unit with transmission adapter settings.

- 1** Register an EtherNet/IP adapter (KV-EP02 and an expansion unit) referring to □“Making a scan list” (page 4-15).
- 2** Select “Tool (T)” > “Built-in Ethernet setting(T)” > “EtherNet/IP setting(W)” in KV STUDIO menu.

Other procedure

Double click EtherNet/IP in workspace.

- 3** Select “Setup” of KV-EP02 in the scan list and click “Yes” to read parameters.



Other procedure

Right-click “KV-EP02” in the workspace and select “Transmission adapter settings”.

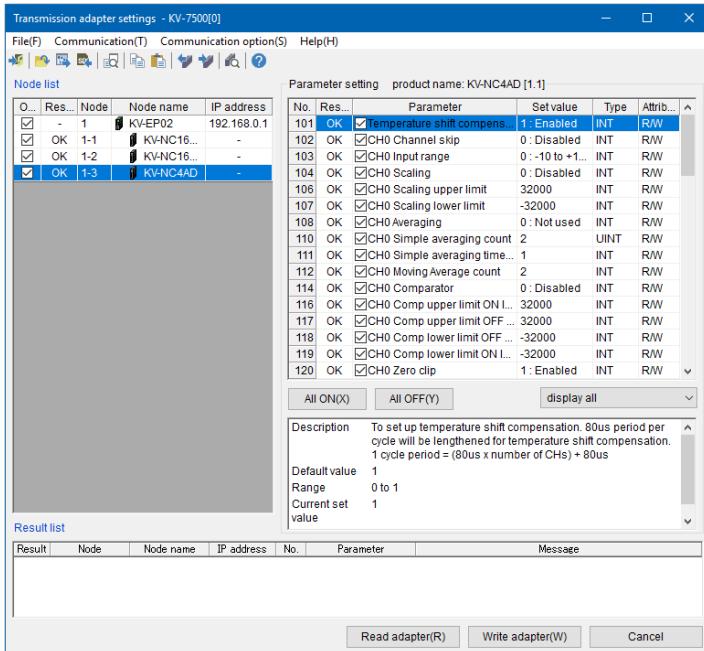
Point

When selecting “Setup” of KV-EP02, parameters of all the connected expansion units are read.

When selecting “Setup” of one of the connected expansion unit, only the parameters of the unit are read.

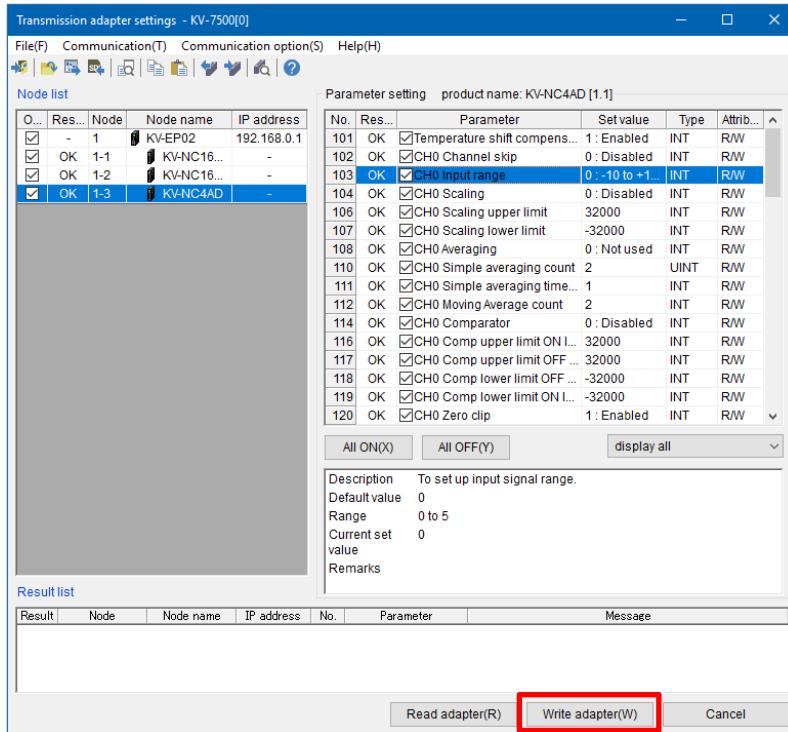
4-4 Communication with PLC of KEYENCE

When reading is completed, the results of transmission are displayed in “Node list” and “Parameter setting” areas, and the properly read parameters are displayed in “Set value”.



If an error occurs during the reading process, causes are displayed in “Result list”. For details, refer to □ “KV Series EtherNet/IP Function User’s Manual”.

- 4** Change the value and click “Write adapter (W)” to write the parameters to the adapter. Checked parameters can be written.



Point You can save the settings by selecting “File(F) > “Save backup sensor settings file(B)”

- 5** Select “File(F) > “Close(C)” to close the transmission window.

You can also change the parameters of expansion units with message communication of ladder program.

When using PLC (EtherNet/IP scanner) of Keyence, parameters can be easily read/written with commands of ladder program without writing complicated programs.

For details, refer to “Sensor Setting Commands” (page 6-16).

MEMO

5 EtherNet/IP communication

This chapter describes the memory structure for EtherNet/IP communication.

5-1 EtherNet/IP communication	5-2
5-2 EtherNet/IP communication of KV-EP02	5-3
5-3 Cyclic(I/O) messages.....	5-5
5-4 Message communication	5-19
5-5 Parameter list	5-29

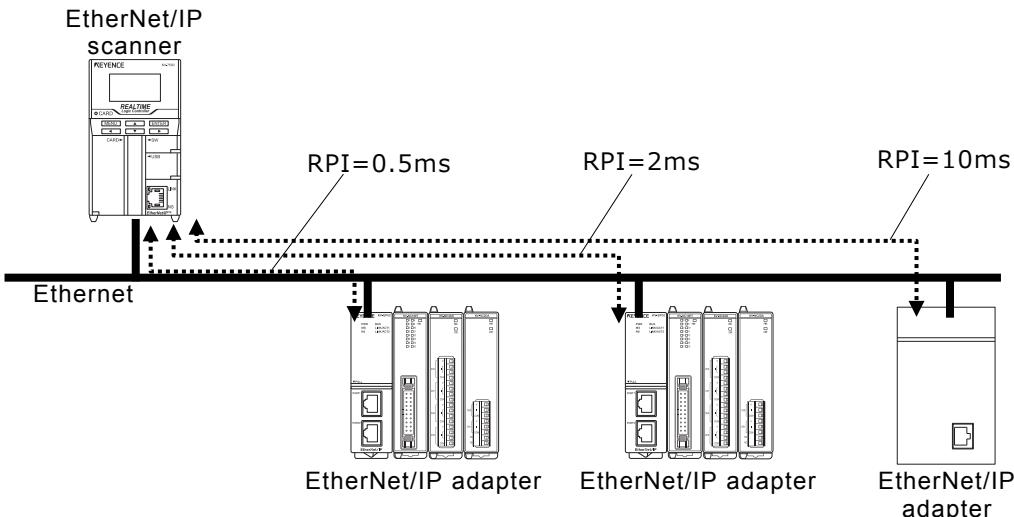
5-1 EtherNet/IP communication

Overview of EtherNet/IP

As worldwide specifications, EtherNet/IP™ is an industrial, multivendor network system, which adopts open-sourced Ethernet and is maintained/extended by ODVA (Open DeviceNet Vendor Association, inc.). EtherNet/IP enables to build controller-level network and device-level field network among EtherNet/IP Devices. Meanwhile, as lower layer protocol, it allows to be used together with the network of general Ethernet units due to standard Ethernet adopted.

EtherNet/IP includes Cyclic(I/O) messages (Implicit message) for sending/receiving data periodically, and Message communication (Explicit message) for sending/receiving commands/responses arbitrarily. With Cyclic(I/O) messages, the overall communication load can be adjusted and sent/received by setting PRI depending on the data priority. With Message communication, command/response communication can be performed at necessary timing. Compared with periodical Cyclic(I/O) messages, Message communication is used for reading/writing general (nonperiodical) messages such as adapter settings.

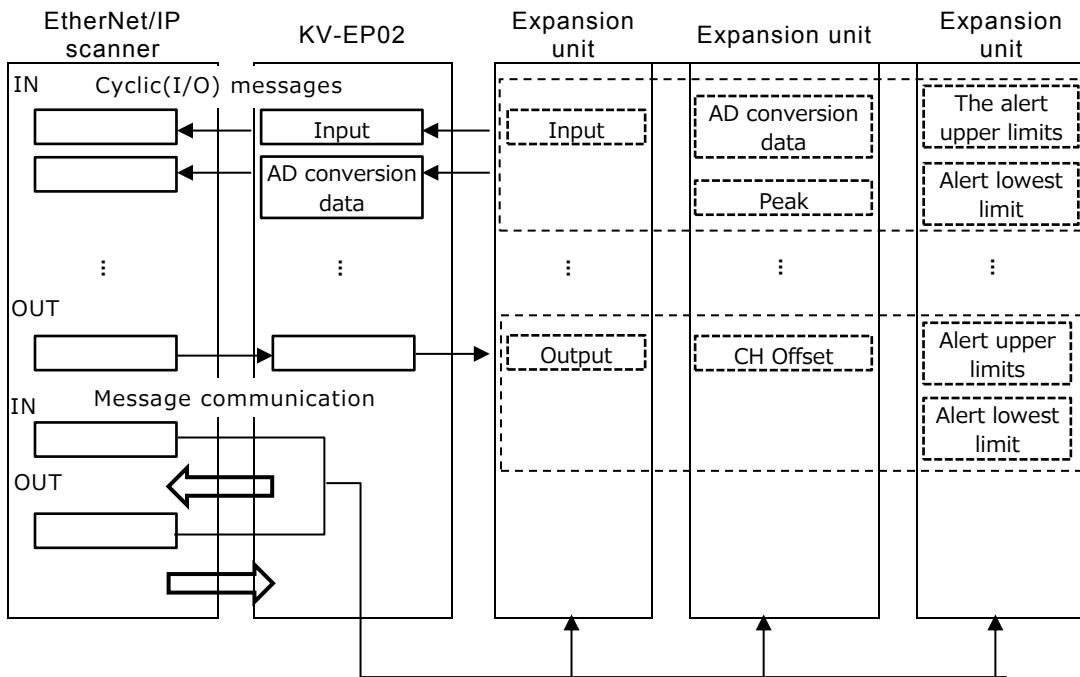
During cyclic (I/O) messages, the unit at one end opens a logic communication line (i.e., connection) to the target unit. If opening is successful, data communication is executed. The terminal that opens the connection is called originator, while the terminal which connection is opened is called target. Generally, the unit working as the originator is called scanner, and the unit working only as a target is called adapter. (A scanner can be not only originator, but also target.)



RPI (communication period) can be set separately for each adapter.

5-2 EtherNet/IP communication of KV-EP02

KV-EP02 functions as an EtherNet/IP adapter and it is compatible with the Cyclic(I/O) messages and Message communication of EtherNet/IP.



■ Cyclic(I/O) messages

It functions to send/receive messages according to RPI (communication period) set between the scanner and KV-EP02.

Without ladder programs, output signals, judgment values and error information from an expansion unit can be sent/received.

■ Message communication

It functions to send/receive general (nonperiodical) messages. Various kinds of parameters can be read and written.

5-2 EtherNet/IP communication of KV-EP02

Assigning slot numbers to expansion units

You can connect more than one KV Nano expansion unit. A slot number for identification is assigned to each unit.

The method of assigning a slot number is as follows.

Available slot numbers are 0 to 15. (You can connect 15 units at the maximum.)

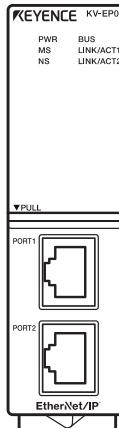
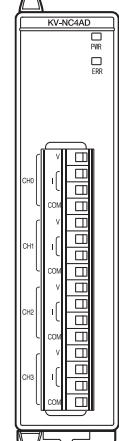
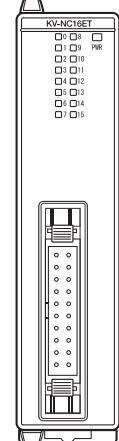
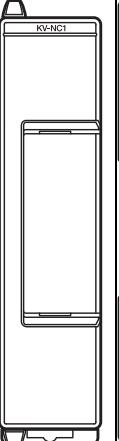
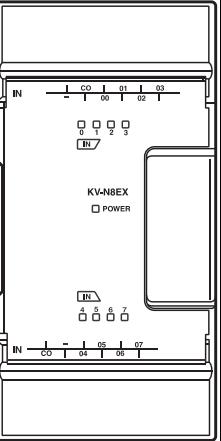
Slot numbers are assigned in order from KV-EP02.

Some expansion unit requires more than one slot number.

□ Connectable KV Nano expansion units (page 3-3)

An examination of slot number assignment is shown below. In this case KV-NC4AD has 2 slot numbers.

Ex.)

Model	KV-EP02	KV-NC4AD	KV-NC16ET	KV-NC1	KV-N8EX
Number of Slot No.	1	2	1	0	1
Slot No.	0	1	3	—	4
	 ▼PULL				

Point

Slot numbers are assigned automatically. After you change the number or order of the connected expansion units, you may have to change the control program.

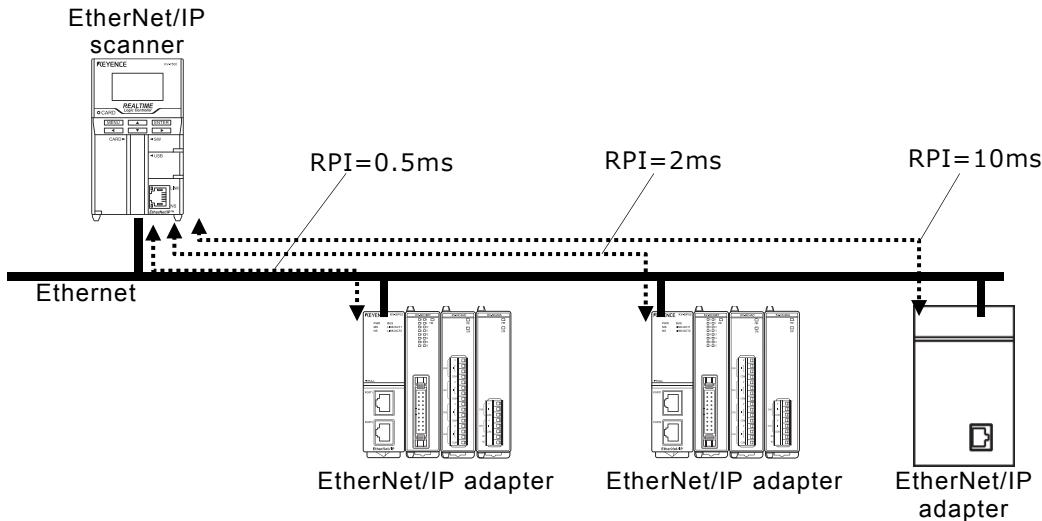
If the number of connected expansion units exceeds the limit, an error occurs and BUS indicator turns red.

5-3 Cyclic(I/O) messages

This section describes functions and operations of Cyclic(I/O) messages.

■ Overview of Cyclic(I/O) messages

An EtherNet/IP scanner communicates with the adapters periodically (fixed period).



RPI (communication period) can be set separately for each adapter.

Communication settings (PRI and data size etc.) are made on the scanner.



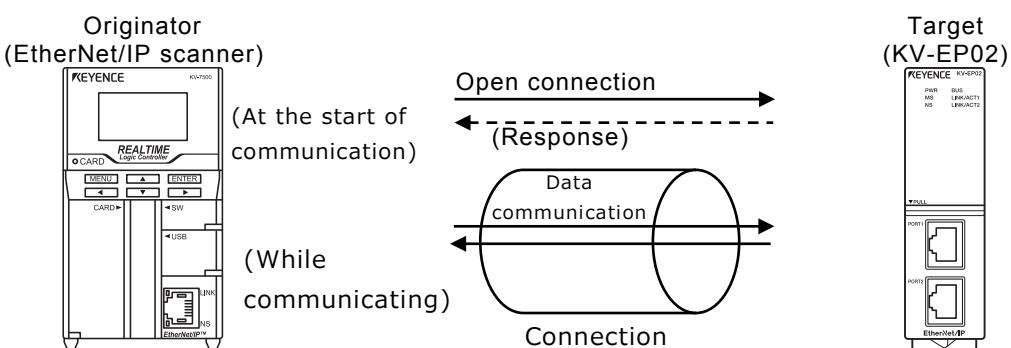
If many devices including EtherNet/IP devices are connected, delay or loss of packets may occur in case the network is under a heavy load. Please inspect the network before operation.

5-3 Cyclic(I/O) messages

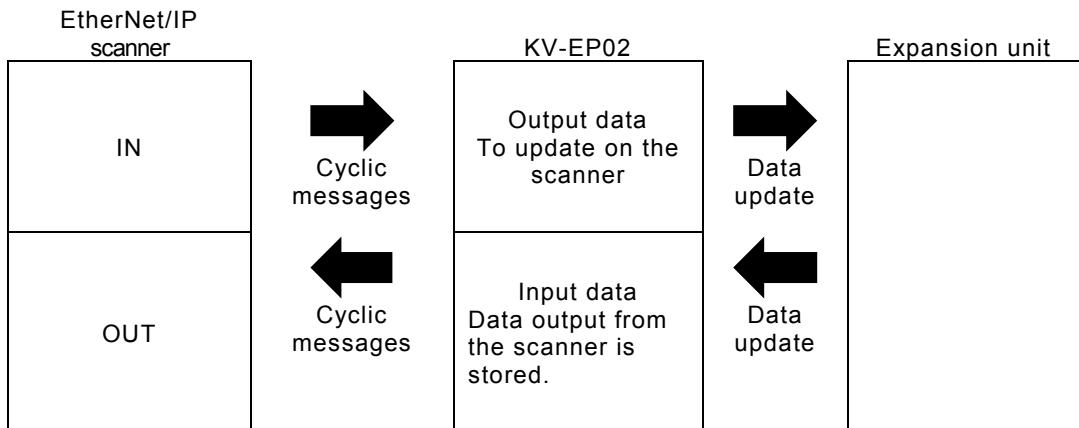
During Cyclic(I/O) messages, the unit at one end opens a logic communication line (i.e., connection) to the target unit. If opening is successful, data communication is executed. The terminal that opens the connection is called originator, while the terminal which connection is opened is called target. Generally, the unit working as the originator is called scanner, and the unit working only as a target is called adapter. (A scanner can be not only originator, but also target.) KV-EP02 functions as an adapter.

Communication starts through the processes below.

- ① The scanner requires an adapter to open connection.
 - ② The adapter checks the compatibility.
 - ③ When no error is detected, connection is opened.
(*If any error is detected, connection is not opened.)
- “Checking the compatibility” (page 5-17)



Communication among the EtherNet/IP scanner, KV-EP02 and expansion units is shown below.



Available connections

Communication data is different for each connection. Select a connection.

Available connections for KV-EP02 are as follows.

No.	Connection name	Communication data	Input/Output	Assembly instance	Size (byte)	RPI range (unit: 0.5ms)	Application type	See page
1	Monitor Data And Control Data ^{*1}	Input, current value	Input: KV-EP02 to scanner	64H (100)	400	0.5ms to 10000ms	Exclusive Owner	5-11
		Output, control value	Output: Scanner to KV-EP02	65H (101)	240			5-14
2	Monitor Data (Input Only) ^{*1}	Input, current value	Input: KV-EP02 to scanner	64H (100)	400	0.5ms to 10000ms	Input Only	5-11
		-	Output: Scanner to KV-EP02	FEH (254)	0			-

1 When using an EtherNet/IP scanner and Ethernet/IP software of Keyence, the connection names are displayed as follows.

- 1 Monitor Data And Control Data: "Monitor Data/Control Data"
- 2 Monitor Data (Input Only): "Monitor Data"



Trigger timing of each connection is cyclic and connection types are compatible with both Point to Point and Multicast.

- Functions of each application type are as follows.

Exclusive Owner :

This connection enables to make settings for transmission both from the scanner to KV-EP02 and from KV-EP02 to the scanner simultaneously. Select this when the scanner not only monitors the data of KV-EP02 but also controls output signals of an expansion output unit. Only one connection of this type can be opened for one adapter (KV-EP02).

5-3 Cyclic(I/O) messages

Input Only :

This connection enables to make settings only for transmission from KV-EP02 to the scanner. Select this when the scanner only monitors the data of KV-EP02. More than one scanner can establish connection of this type for one adapter (KV-EP02). In this case, set the connection type to Multicast.

When using a PLC of other company and selecting the configuration is necessary, select 1 for instance ID and 0 for size in "Assembly Object".

Assignment to IN area (KV-EP02 to scanner)

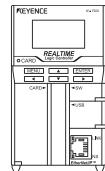
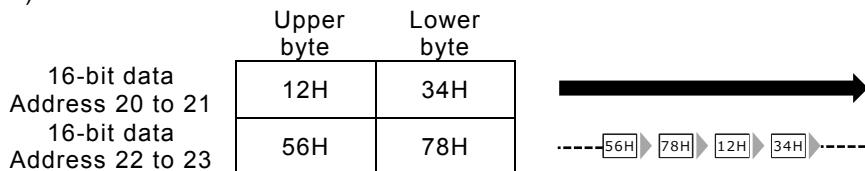
Data from KV-EP02 is assigned to the IN area of the EtherNet/IP scanner.

Reference

In EtherNet/IP communication, sent/received data is processed as byte array of Little-Endian format.

For data of multiple bytes (such as 16-bit), it is sequentially stored from the lower byte to the area starting from an even address.

Ex.)



■ Monitor data (200 words/400 bytes) Assembly Instance:64H(100)

□ “Assigning slot numbers to expansion units” (page 5-4)

Name	Address (byte)	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	
Status of the adapter	0	Reserved for system								Error*
	1	Reserved for system								Rotary switch error
	2	ID7 Error	ID6 Error	ID5 Error	ID4 Error	ID3 Error	ID2 Error	ID1 Error	ID0 Error	
	3	ID15 Error	ID14 Error	ID13 Error	ID12 Error	ID11 Error	ID10 Error	ID9 Error	ID8 Error	
Bit Slot No. 1	4	Bit 7						Bit 0	
	:	:								
	7	Bit 31						Bit 24	
:	:	:								

Name	Address (byte)	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
Bit Slot No. 15	60	Bit 7						Bit 0
	:	:							
	63	Bit 31						Bit 24
Adapter reservation	64								
	:								
	69								
Word Slot No. 1	70								Word 0
	71								
	:								:
	90								
	91								Word 10
:	:								:
Word Slot No. 15	378								Word 0
	379								
	:								:
	398								
	399								Word 10

* Activates when an error occurs on KV-EP02 or an expansion unit.

For concrete data, refer to □ “Assignment of cyclic (I/O) messages data” (page 5-11).
For communication time, refer to □ “Data processing time” (page 7-11).

Assignment to OUT area (scanner to KV-EP02)

Data sent to an expansion unit is assigned to the OUT area of the EtherNet/IP scanner.

■ Control data (120 words/24 bytes) Assembly Instance:65H(101)

[II] "Assigning slot numbers to expansion units" (page 5-4)

Name	Address (Byte)	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
Bit Slot No. 1	0	Bit 7						Bit 0
	:	:							
	3	Bit 31						Bit 24
:	:	:							
Bit Slot No. 15	56	Bit 7						Bit 0
	:	:							
	59	Bit 31						Bit 24
Word Slot No. 1	60								Word 0
	61								
	:								:
	70								Word 5
	71								
:	:								:
Word Slot No. 15	228								Word 0
	229								
	:								:
	238								Word 5
	239								

Assignment of cyclic (I/O) messages data

KV-EP02 enables to get information (ex.: input data of an expansion input unit and analog data of an analog unit) via communication. The method for assigning the information to cyclic (I/O) messages data field differs depending on expansion units. See the table below for details.

■ Monitor data

Name	KV-N8EX KV-N8EXR KV-N8EXT	KV-N16EX KV-NC16EX* KV-NC16EXT	KV-NC32EX KV-NC32EXT	Expansion output unit
Bit 0	Input	Input	Input	Reserved for system
:				
Bit 7				
Bit 8				
:				
Bit 15				
Bit 16				
:				
Bit 23				
Bit 24				
:	Reserved for system	Reserved for system	Reserved for system	Reserved for system
Bit 31				
Word 0				
:	Reserved for system	Reserved for system	Reserved for system	Reserved for system
Word 10				

5-3 Cyclic(I/O) messages

Slot No.	Name	KV-NC4AD	KV-NC2DA	KV-N3AM	KV-NC4TP	
First	Bit 0	A/D conversion	D/A conversion	A/D conversion	A/D conversion	
	Bit 1	Reserved for system	Reserved for system	Reserved for system	Reserved for system	
	:			D/A conversion		
	Bit 7			Reserved for system		
	Bit 8			Reserved for system		
	Bit 9			Reserved for system		
	:			Reserved for system		
	Bit 14			Reserved for system		
	Bit 15	Error relay	Error relay	Error relay	Error relay	
	Bit 16	CH0 Zero shift	CH0 Alert upper limit	CH0 Zero shift	Reserved for system	
	Bit 17	CH0 Hold	CH0 Alert lowest limit	CH0 Hold	CH0 Hold	
	Bit 18	CH0 Disconnection detection	Reserved for system	CH0 Disconnection detection	CH0 Disconnection detection	
	Bit 19	CH0 Comparator upper limit		CH0 Comparator upper limit	CH0 Alert upper limit	
	Bit 20	CH0 Comparator lowest limit		CH0 Comparator lowest limit	CH0 Alert lowest limit	
	Bit 21	Reserved for system		Reserved for system	Reserved for system	
	Bit 22				CH0 Special data effective	
	Bit 23				CH0 Special data effective	
	Bit 24	CH1 Zero shift	CH1 Alert upper limit	CH1 Zero shift	Reserved for system	
	Bit 25	CH1 Hold	CH1 Alert lowest limit	CH1 Hold	CH1 Hold	
	Bit 26	CH1 Disconnection detection	Reserved for system	CH1 Disconnection detection	CH1 Disconnection detection	
	Bit 27	CH1 Comparator upper limit		CH1 Comparator upper limit	CH1 Alert upper limit	
	Bit 28	CH1 Comparator lowest limit		CH1 Comparator lowest limit	CH1 Alert lowest limit	
	Bit 29	Reserved for system		Reserved for system	Reserved for system	
	Bit 30				CH1 Special data effective	
	Bit 31				CH1 Special data effective	
Second	Bit 0	CH2 Zero shift	Reserved for system	CH2 Alert upper limit	Reserved for system	
	Bit 1	CH2 Hold		CH2 Alert lowest limit	CH2 Hold	
	Bit 2	CH2 Disconnection detection		Reserved for system	CH2 Disconnection detection	
	Bit 3	CH2 Comparator upper limit			CH2 Alert upper limit	
	Bit 4	CH2 Comparator lowest limit			CH2 Alert lowest limit	
	Bit 5	Reserved for system			Reserved for system	
	Bit 6	Reserved for system			Reserved for system	

Slot No.	Name	KV-NC4AD	KV-NC2DA	KV-N3AM	KV-NC4TP
First	Bit 7		Reserved for system	Reserved for system	CH2 Special data effective
	Bit 8	CH3 Zero shift			Reserved for system
	Bit 9	CH3 Hold			CH3 Hold
	Bit 10	CH3 Disconnection detection			CH3 Disconnection detection
	Bit 11	CH3 Comparator upper limit			CH3 Alert upper limit
	Bit 12	CH3 Comparator lowest limit			CH3 Alert lowest limit
	Bit 13				Reserved for system
	Bit 14				CH3 Special data effective
	Bit 15				Reserved for system
	Bit 16				Reserved for system
Second	:				
	Bit 31				
	Word 0	CH0 A/D conversion data	CH0 Analog data	CH0 A/D CONVERSION DATA	CH0 Measured input value
	Word 1	CH0 Special data		CH0 Special data	CH0 Special data
	Word 2	CH0 Analog data		CH0 Analog data	CH0 Analog data
	Word 3	CH0 Peak		CH0 Peak	CH0 Peak
	Word 4	CH0 Bottom		CH0 Bottom	CH0 Bottom
	Word 5	CH1 A/D CONVERSION DATA	CH1 Analog data	CH1 A/D conversion data	CH1 Measured input value
	Word 6	CH1 Special data		CH1 Special data	CH1 Special data
	Word 7	CH1 Analog data		CH1 Analog data	CH1 Analog data
	Word 8	CH1 Peak		CH1 Peak	CH1 Peak
	Word 9	CH1 Bottom		CH1 Bottom	CH1 Bottom
	Word 10	CH2 A/D conversion data	CH2 Analog data		CH2 Measured input value
	Word 0	CH2 Special data			CH2 Special data
	Word 1	CH2 Analog data			CH2 Analog data
	Word 2	CH2 Peak			CH2 Peak
	Word 3	CH2 Bottom			CH2 Bottom
	Word 4	CH3 A/D conversion data	Reserved for system	Reserved for system	CH3 Measured input value
	Word 5	CH3 Special data			CH3 Special data
	Word 6	CH3 Analog data			CH3 Analog data
	Word 7	CH3 Peak			CH3 Peak
	Word 8	CH3 Bottom			CH3 Bottom
	Word 9	Reserved for system			Reserved for system
	Word 10	Error code	Error code	Error code	Error code

■ Control data

Name	KV-N8ER KV-N8ET* KV-N8EXR KV-N8EXT KV-NC8ER	KV-N16ER KV-N16ET* KV-NC16ET*	KV-NC32ET* KV-NC32EXT	Expansion input unit
Bit 0				
:				
Bit 7				
Bit 8				
:				
Bit 15				
Bit 16				
:				
Bit 23				
Bit 24				
:				
Bit 31				
Word 0				
:				
Word 5				

Slot No.	Name	KV-NC4AD	KV-NC2DA	KV-N3AM	KV-NC4TP	
First	Bit 0	Reserved for system	Reserved for system	Reserved for system	Reserved for system	
	Bit 1					
	:					
	Bit 7					
	Bit 8					
	Bit 9					
	:					
	Bit 14					
	Bit 15	Error clear	Error clear	Error clear	Error clear	
	Bit 16	CH0 Zero shift	CH0 Alert upper/lowest limit clear	CH0 Zero shift	Reserved for system	
	Bit 17	CH0 Hold	Reserved for system	CH0 Hold	CH0 Hold	
	Bit 18	CH0 Disconnection detection clear		CH0 Disconnection detection clear	CH0 Disconnection detection clear	
	Bit 19	CH0 Comparator reset		CH0 Comparator reset	CH0 Alert clear	
	Bit 20	Reserved for system		Reserved for system	Reserved for system	
	Bit 21					
	Bit 22					
	Bit 23					
Second	Bit 24	CH1 Zero shift	CH1 Alert upper/lowest limit clear	CH1 Zero shift	Reserved for system	
	Bit 25	CH1 Hold	Reserved for system	CH1 Hold	CH1 Hold	
	Bit 26	CH1 Disconnection detection clear		CH1 Disconnection detection clear	CH1 Disconnection detection clear	
	Bit 27	CH1 Comparator reset		CH1 Comparator reset	CH1 Alert clear	
	Bit 28	Reserved for system		Reserved for system	Reserved for system	
	Bit 29					
	Bit 30					
	Bit 31					
	Bit 0	CH2 Zero shift	Reserved for system	CH2 Alert upper/lowest limit clear	Reserved for system	
	Bit 1	CH2 Hold		Reserved for system	CH2 Hold	
	Bit 2	CH2 Disconnection detection clear			CH2 Disconnection detection clear	
	Bit 3	CH2 Comparator reset			CH2 Alert clear	
	Bit 4	Reserved for system		Reserved for system	Reserved for system	
	Bit 5					
	Bit 6					

5-3 Cyclic(I/O) messages

Slot No.	Name	KV-NC4AD	KV-NC2DA	KV-N3AM	KV-NC4TP		
First	Bit 7						
	Bit 8	CH3 Zero shift			CH3 Hold		
	Bit 9	CH3 Hold			CH3 Disconnection detection clear		
	Bit 10	CH3 Disconnection detection clear			CH3 Alert clear		
	Bit 11	CH3 Comparator reset			Reserved for system		
	Bit 12	Reserved for system					
	Bit 13						
	Bit 14						
	Bit 15						
	Bit 16	Reserved for system	Reserved for system	Reserved for system	Reserved for system		
	:						
	Bit 31						
Second	Word 0	CH0 Special data offset	CH0 Output data	CH0 Special data offset	CH0 Special data offset		
	Word 1	CH1 Special data offset	CH0 Output data offset	CH1 Special data offset	CH0 Alert upper limit		
	Word 2	CH2 Special data offset	CH1 Output data	CH2 Output data	CH0 Alert lowest limit		
	Word 3	CH3 Special data offset	CH1 Output data offset	CH2 Output data offset	CH1 Special data offset		
	Word 4	Reserved for system	Reserved for system	Reserved for system	CH1 Alert upper limit		
	Word 5				CH1 Alert lowest limit		
Second	Word 0	Reserved for system	Reserved for system	Reserved for system	CH2 Special data offset		
	Word 1				CH2 Alert upper limit		
	Word 2				CH2 Alert lowest limit		
	Word 3				CH3 Special data offset		
	Word 4				CH3 Alert upper limit		
	Word 5				CH3 Alert lowest limit		

Though the communication area for setting values such as the scaling upper limit value of KV-NC4AD is not assigned to the cyclic (I/O) messages area, the setting can be changed with Sensor application.

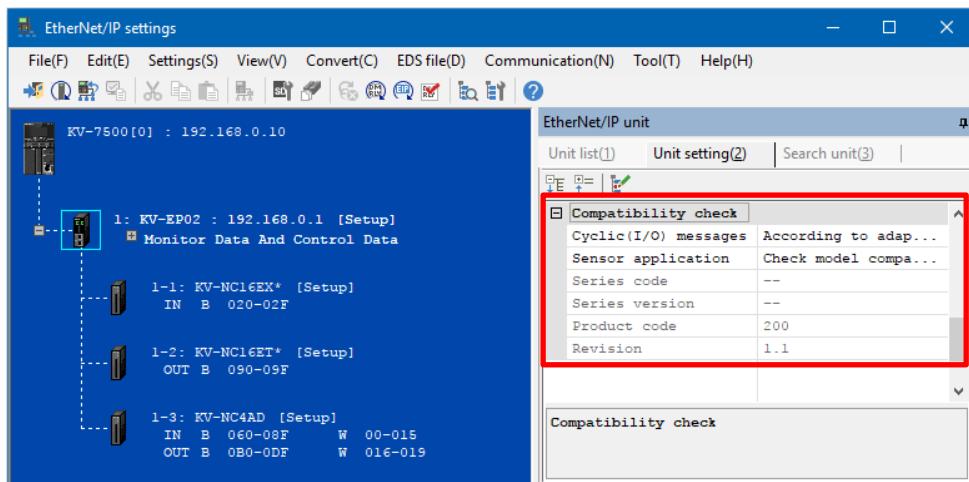
For KV-NC4AD, KV-NC2DA, KV-N3AM and KV-NC4TP, refer to KV Nano Series Analog/Temperature Unit User's Manual.

Checking the compatibility

When the scanner starts communication with KV-EP02, the compatibility between KV-EP02 and the device registered on the scanner is checked to prevent the scanner from communicating with a wrong device. Compatibility check functions when connection is opened.

When using a PLC of Keyence

Select a method for Compatibility check with “Unit setting(2)” tab of EtherNet/IP setting.



You can change check items for Compatibility check between when starting Cyclic(I/O) messages and when starting Sensor application.

Cyclic(I/O) messages

Set for the Compatibility check for starting/restarting Cyclic(I/O) messages. Check items for each option are as follows.

Option	Product code	Major revision	Number of slot No.
Check for the consistency of model	○	○	○
According to adapter rules (default)	—* ¹	—* ¹	—* ¹
Not check	—	—	—

- 1 When selecting “Check model compatibility”, it functions the same as “Check model compatibility” for communication between KV-EP02 and an expansion unit.

● Sensor application

Set for the Compatibility check for starting sensor application.
Check items for each option are as follows.

Option	Product code	Major revision	Number of slot No.
Check for the consistency of model	○	○	○
According to adapter rules (default)	○	○ ^{※1}	○
Not check	—	—	—

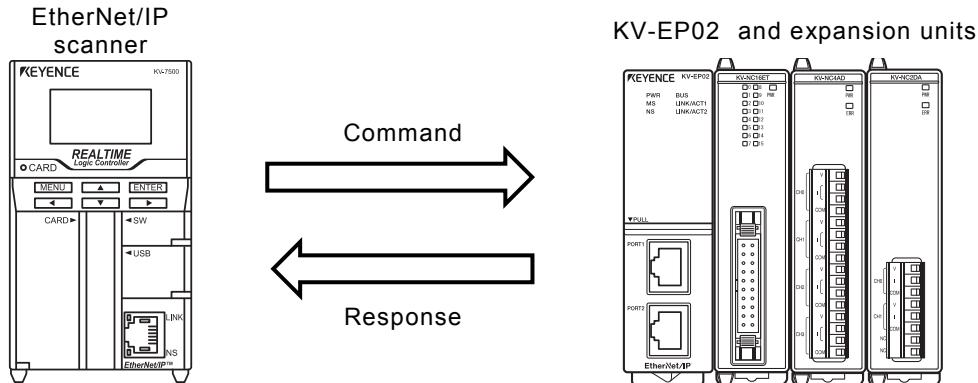
※1 Checking if the setting value of the scanner is consistent with the actual device.
For details of the compatibility check, refer to KV Series EtherNet/IP Function User's Manual or KV-XLE02 User's Manual.
When using a scanner of other company, see the manual of the scanner.

5-4 Message communication

This section describes functions and operations of Message communication.

■ Overview of Message communication

With the Message communication, commands are sent spontaneously using objects and services (Service Code) prepared for each EtherNet/IP device. This function is used to send/receive general explicit messages such as settings of an adapter. The objects and services used for the Message communication contain both those of the standard and those peculiar to the device. With the objects and services peculiar to KV-EP02, you can monitor data, read/write parameters, reset settings and so on.



Reference

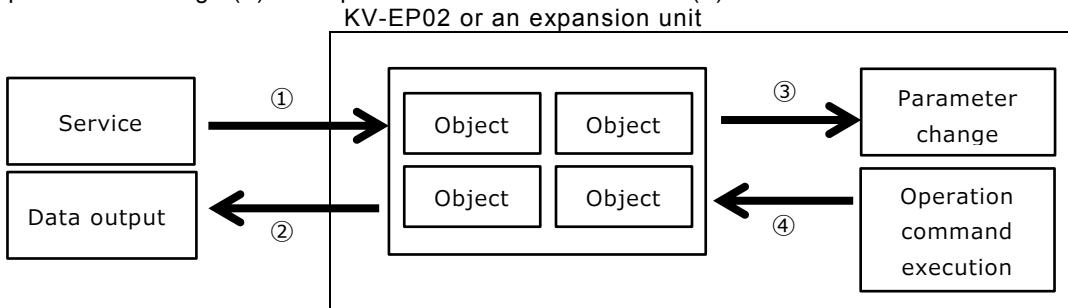
Explicit messages connection of KV-EP02 supports UCMM (non-connection type) specified by CIP and Class 3 (connection type).

5-4 Message communication

Objects and services

Message communication sends/receives data using objects and services.

When the scanner executes a service (1) to an object of KV-EP02, data output (2), parameter change (3) and operation command execution (4) are carried out.

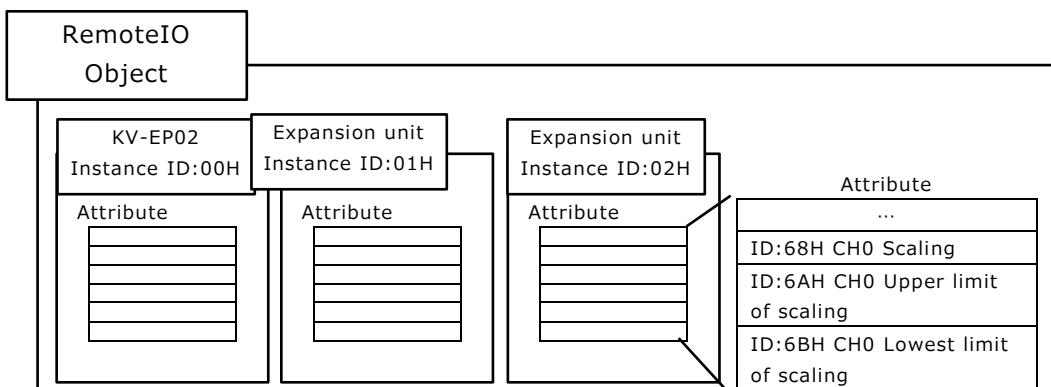


Ex.: RemoteIO Object

Instance is prepared for each expansion unit connected to KV-EP02.

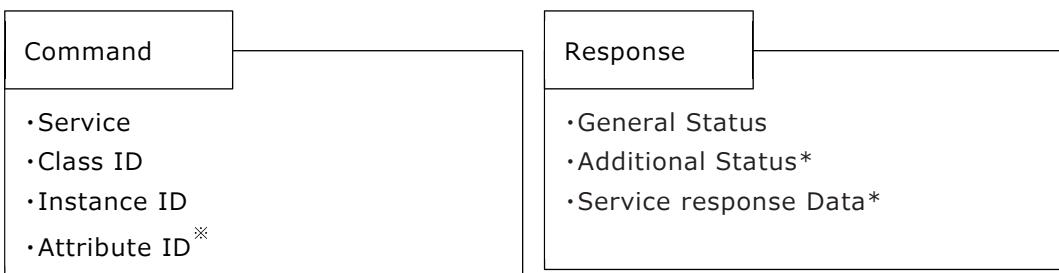
By using a service for reading an attribute with setting value of each instance, the setting value of each expansion unit corresponding to the instance can be read.

By reading the attribute with setting value of each instance using the service, it is possible to read the set value of each extension unit corresponding to that instance.



Reference

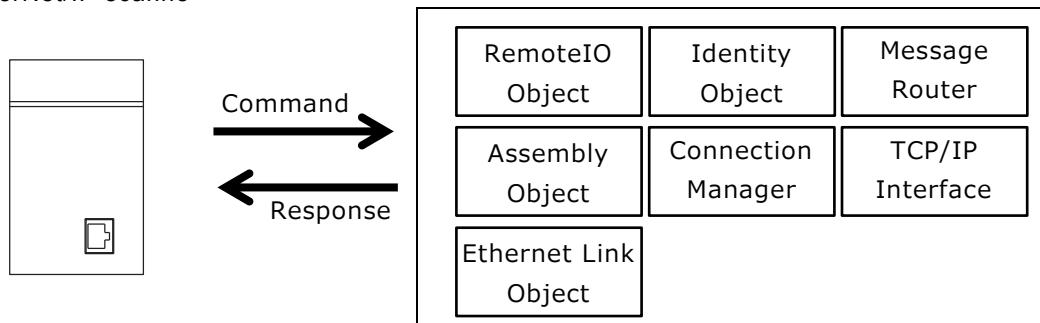
- EtherNet/IP (CIP) uses “object modeling” to display devices. A device is regarded as a collection of objects. “Object” represents an abstract component in a device. “Class” represents a collection of objects with the same kind of components. “Instance” actually represents a certain object contained in a class. Each instance in a class has the same attribute collection but values of the attribute are different each other.
- To execute a service to KV-EP02, the scanner sends a command and KV-EP02 sends the response as a result. Commands require class ID, instance ID, and attribute ID*. Additionally setting value (service data) is required to write a parameter.



*Not necessary depending on a command □“Basic format and processing flow of the Message communication” (page 5-23)

Available objects of KV-EP02

Available objects of KV-EP02 are listed below.
EtherNet/IP scanner



Object name	Class ID	Description	Page
RemoteIO Object	70H	It provides the status of KV-EP02 and connected expansion units and writes/reads setting values. This object is peculiar to KV-EP02.	5-25
Identity Object	01H	It provides identification information, general information and reset service etc.	7-14
Message Router Object	02H	It provides a connection point of Message communication.	7-18
Assembly Object	04H	It provides access to devices with Cyclic(I/O) messages. It is used to send data to a device that is not compatible with Cyclic(I/O) messages.	7-20
Connection Manager Object	06H	It is used for connection type communication.	7-22
TCP/IP Interface Object	F5H	It provides the mechanism for setting the TCP/IP network interface. IP address, subnet mask and default gateway can be set.	7-25
Ethernet Link Object	F6H	It provides Ethernet status information.	7-30

Basic format and processing flow of the Message communication

EtherNet/IP scanner and KV-EP02 communicates by sending/receiving explicit messages. Basic examples of the command formats of explicit messages sent from the scanner and the response formats from KV-EP02 are as follows.

● Command

• Command format

Item	Description
Service Code ^{*1}	Specify a service code to be used.
Class ID	Specify class ID according to the used service.
Instance ID	Specify instance ID according to the used service.
Attribute ID	Specify attribute ID according to the used service.
Service Data	Specify service data according to the used service.

1 For available services, see □□“Using RemoteIO Object”(page 5-25), or □□“Available objects of KV-EP02” (page 5-22).

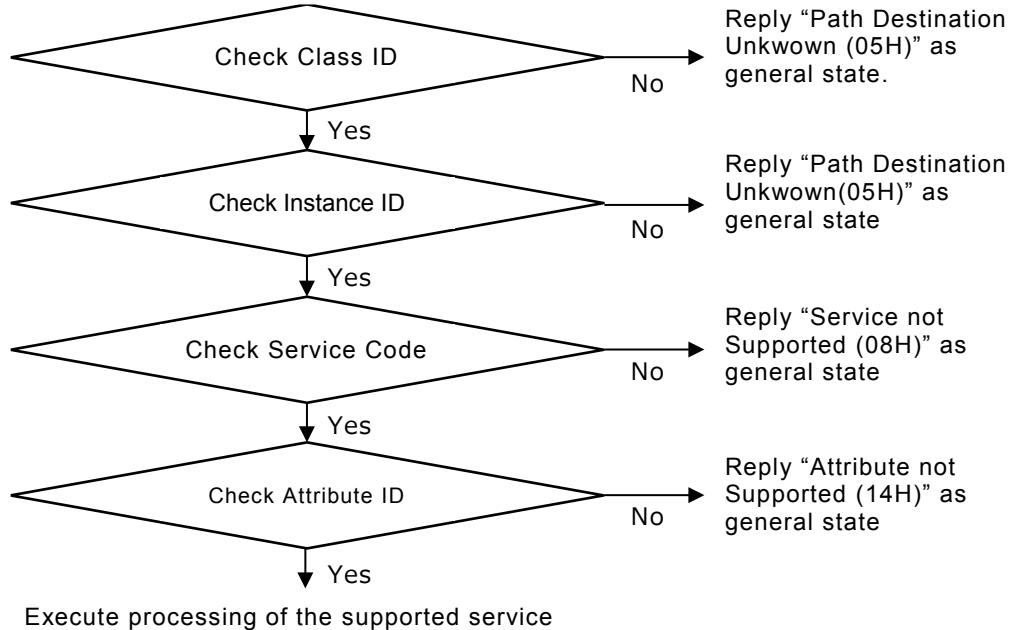
● Response

• Response format

Item	Description
General Status	General status corresponding to the command is returned. Normally 00H is returned.
Additional Status	Additional status is returned.
Service Response Data	Service response data corresponding to the command is returned.

■ Processing flow and error responses

Processing flow for checking if each ID is compatible with the supported service is shown below.



● Supplementary matters for the object processing

- When executing “Get_Attribute_Single and Get_Attributes_All”, send service data is ignored.
- When executing a service with no AttributeID specified. (“Get_Attributes_All, Reset”), AttributeID is ignored.
- When specifying “Set_Attribute_Single” for an attribute that cannot be written, 0EH (“Attribute not settable”), or 08H (“Service not Supported”) is returned.
- When specifying “Set_Attribute_Single” for a writable attribute and the written size is less than attribute size, 13H (“Not enough data”) is returned. If the written size is larger than attribute size, the extra objects is ignored.

Using RemoteIO Object

This section describes how to use RemoteIO Object for Message communication.

①Reading monitor values/settings of expansion units

Reads monitor values/settings for KV-EP02 and expansion units connected to KV-EP02.

● Command format

Referring to □“Parameter list” (page 5-29), specify the instance ID and attribute ID according data to read.

Item	Value
Service Code (HEX)	0EH (Get_Attribute_Single)
Class ID (HEX)	70H
Instance ID (DEC)	00: KV-EP02 01 to 15: Slot numbers of expansion units □“Assigning slot numbers to expansion units” (page 5-4)
Attribute ID (HEX)	□“Parameter list” (page 5-29)
Service Data	—

● Response format

Item	Value
General Status (HEX)	□“General Status” (page 5-28)
Service Response Data	—

When using a PLC (EtherNet/IP scanner) of Keyence, sensor setting commands (SPRD) can be used. □“Sensor Setting Commands” (page 6-16)

②Writing setting values to expansion units

Setting values for KV-EP02 and expansion units connected to KV-EP02 are written. To update the setting, see “③Updating settings” on the next page.

● Command format

- Referring to □ “Parameter list” (page 5-29), specify the instance ID, attribute ID and service data according data to read.

Item	Value
Service Code (HEX)	10H (Set_Attribute_Single)
Class ID (HEX)	70H
Instance ID (DEC)	00: KV-EP02 01 to 15: Slot numbers of expansion unit □ “Assigning slot numbers to expansion units” (page 5-4)
Attribute ID (HEX)	□ “Parameter list” (page 5-29)
Service Data	□ “Parameter list” (page 5-29)

● Response format

Item	Value
General Status (HEX)	□ “General Status” (page 5-28)
Service Response Data	—

When using a PLC (EtherNet/IP scanner) of Keyence, sensor setting commands (SPRD) can be used. □ “Sensor Setting Commands” (page 6-16)

③Updating settings

To save the RemotelIO Object setting in a nonvolatile memory and update it, this function executes the setting update service for all target expansion units.

Since the updated setting for all expansion units is saved in KV-EP02, you do not need to transmit the setting again when replacing the expansion unit with the same one. To replace KV-EP02, you need to transmit the setting.

The setting update service is executed automatically when using functions of Sensor setting backup/restore, Sensor setting batch transmission, and Adapter setting transmission.

If the target expansion units are replaced after the service is executed, the settings are kept only for the units whose slot number matches from the slot No. 1 with that of when this service is executed. For other expansion units unmatched first and from then, default settings are applied.

Also, when PROG output is set to "Clear" for KV-NC2DA/KV-N3AM, analog output pauses during this service.

The settings saved in KV-EP02 will be updated for expansion units until after receiving an Ethernet packet. Therefore, if Analog Temperature Unit is connected, ERROR LED indicator on the analog unit turns on until the unit receives an Ethernet packet.

● Command format

Item	Value
Service Code (HEX)	4CH
Class ID (HEX)	70H
Instance ID (DEC)	00: KV-EP02 01 to 15: Slot numbers of expansion unit ⇒ "Assigning slot numbers to expansion units" (page 5-4)
Attribute ID (HEX)	–
Service Data	–

● Response format

Item	Value
General Status (HEX)	⇒ "General Status" (page 5-28)
Additional Status (DEC)	It is added when general status is D0H. ⇒ "Additional Status (DEC)" (page 5-28)
Service Response Data	–

When using a PLC (EtherNet/IP scanner) of Keyence, sensor setting commands (SPRD) can be used. ⇒ "Sensor Setting Commands" (page 6-16)

5-4 Message communication**● General Status**

Responses using each service are as follows.

- ① Service code for reading parameters: 0EH
- ② Service code for writing parameters: 10H
- ③ Service code for updating settings: 4CH

Code	Command			Description
	(1)	(2)	(3)	
00H	○	○	○	Executed normally.
05H	○	○	○	Specified instance ID is out of the range or no compatible unit is connected.
09H	—	○	—	The written data is out of the range.
0EH	—	○	—	Attribute ID to be written is not writable.
10H	○	○	○	Expansion bus is under preparation or error status.
13H	—	○	—	Size of the service data is smaller than the regulation.
14H	○	○	—	Specified attribute ID is out of the range.
D0H	—	—	○	There is incorrect combination of parameters. Detailed information is stored in the additional status.

● Additional Status (DEC)

Code	Description	KV-NC4AD	KV-NC2DA	KV-NC4TP	KV-N3AM
XXY01	Scaling is set to incorrect value (The upper limit \leq the lowest limit).	○	○	—	○
XXY02	Comparator is set to incorrect value (the upper limit ON level < the upper limit OFF level or the lowest limit OFF level < the lowest limit ON level).	○	—	—	○
XXY03	The alert upper/lowest limit is set to incorrect value (the upper limit \leq the lowest limit).	—	○	—	○
XXY04	Though disconnection detection function is effective, the input range is set to other value than "1 to 5V" or "4 to 20mA".	○	—	—	○
XXY05	Though output limit function is effective, the alert upper/lowest limit is not specified.	—	○	—	○

XX: slot No., Y:CH No.

5-5 Parameter list

This section describes attribute ID used for Message communication with each expansion unit.

How to read the lists

■ How to read attribute IDs

Ex.: Attribute ID of RemotelO Object

②	②	③	④	⑤	⑥	⑦
Attribute ID	Name	Description	Date type	Attribute	Value	Sensor application compatible
64H (100)	Input constant	Stores the input constant.	2byte INT	R/W	0:10ms Default 1:1ms 2:25us 3:300us	○

Item	Value
① Attribute ID	Attribute ID is represented by hexadecimal number (decimal number). When using the sensor parameter read/write command of a PLC (EtherNet/IP scanner) of Keyence, apply the attribute ID for parameter number.
② Name	Name of an attribute is displayed.
③ Description	Description of an attribute, data read from the attribute or setting range of parameter is displayed.
④ Data type	Data type of an attribute is displayed.
⑤ Attribute	Service direction against an attribute ID is displayed. R (Read) : "Get_Attribute_Single" can be used to read the value of attribute. W (Write) : "Set_Attribute_Single" can be used to write the value in attribute.
⑥ Value	Setting value for parameter is displayed.
⑦ Sensor application compatible	○: When using a PLC (EtherNet/IP scanner) of Keyence, "Sensor setting backup", "Setup batch transmission sensor settings", "Adapter setting transmission" and "Sensor setting command" can be used. –: When using a PLC (EtherNet/IP scanner) of Keyence, only "Sensor setting command" can be used. □ "Sensor Setting Backup" (page 6-9), □ "Sensor Setting Batch Transmission" (page 6-12), □ "Adapter Setting Transmission" (page 6-14), □ "Sensor Setting Commands" (page 6-16)

5-5 Parameter list**■ Data type**

Data types are provided under the specification of EtherNet/IP.

Data type	Description	Range	
		Minimum	Maximum
INT	Signed 16-bit integer	-32768	32767
UINT	Unsigned 16-bit integer	0	65535
WORD	Bit array: 16 bits	-	-
STRING	Character string (2 bytes length information + 1 byte array per character)	-	-

KV-EP02 (Instance ID:0)

Attribute ID	Name	Description	Date type	Attribute	Value	Sensor application compatible
64H (100)	Status	Status of KV-EP02 is stored.	2byte WORD	R	bit0:IP address duplicate bit1: incorrect rotary switch bit2 to bit7: reserved for system bit8: abnormal expansion bus communication bit9: number of the units is incorrect bit10: unsupported unit bit11 to bit15: reserved for system	-

Expansion input unit (Instance ID:1 to 15)

Parameters of Message communication corresponds to attributes of RemoteIO Object. Refer to “Using RemoteIO Object” (page 5-25) for how to read the list and how to use parameters.

For instance ID, select the same number as the slot number of the expansion unit.

Attribute ID	Name	Description	Date type	Attribute	Value	Sensor application compatible
64H (100)	Input constant	Sets the input constant.	2byte INT	R/W	0:10ms Default 1:1ms 2:25us 3:300us	○
65H to FFH	Reserved for system	—	—	—	—	—
0100H (256)	Number of used IDs	Number of used slots is stored.	2byte INT	R	1	—
0101H (257)	Product code	Product code is stored.	2byte INT	R	KV-N8EX : 210 KV-N16EX : 211 KV-NC16EX* : 212 KV-NC32EX : 213	—
0102H (258)	Revision	Revision is stored. (Major revision in the upper byte and minor revision in the lower byte)	2byte INT	R	0101H	—
0103H (259)	Model name	Model name is stored.	STRING	R	KV-N8EX KV-N16EX KV-NC16EX* KV-NC32EX	—
0104H (260)	Device type	Device type is stored.	2byte INT	R	43	—

5-5 Parameter list

Expansion output unit (Instance ID: 1 to 15)

Parameters of Message communication corresponds to attributes of RemoteIO Object. Refer to “Using RemoteIO Object” (page 5-25) for how to read the list and how to use parameters.

For instance ID, select the same number as the slot number of the expansion unit.

Attribute ID	Name	Description	Date type	Attribute	Value	Sensor application compatible
65H (101)	Output hold at communication stop	Sets if output data is held in case cyclic (I/O) messages is not opened.	2byte INT	R/W	0: Stops data output. Default 1: Holds data output.	O
66H to FFH	Reserved for system	—	—	—	—	—
0100H (256)	Number of used IDs	Number of used slots is stored.	2byte INT	R	1	—
0101H (257)	Product code	Product code is stored.	2byte INT	R	KV-N8ER : 214 KV-NC8ER : 215 KV-N8ET* : 216 KV-N16ER : 217 KV-N16ET* : 218 KV-NC16ET* : 219 KV-NC32ET* : 220	—
0102H (258)	Revision	Revision is stored. (Major revision in the upper byte and minor revision in the lower byte)	2byte INT	R	0101H	—
0103H (259)	Model name	Model name is stored.	STRING	R	KV-N8ER, KV-NC8ER KV-N8ET* KV-N16ER, KV-N16ET* KV-NC16ET* KV-NC32ET*	—
0104H (260)	Device type	Device type is stored.	2byte INT	R	43	—

Expansion input/output unit (Instance ID: 1 to 15)

Parameters of Message communication corresponds to attributes of RemoteIO Object. Refer to “Using RemoteIO Object” (page 5-25) for how to read the list and how to use parameters.

For instance ID, select the same number as the slot number of the expansion unit.

Attribute ID	Name	Description	Date type	Attribute	Value	Sensor application compatible
64H (100)	Input constant	Sets the Input constant.	2byte INT	R/W	0:10ms 1:1ms 2:25us 3:300us Default	O
65H (101)	Output hold at communication stop	Sets if output data is hold in case cyclic (I/O) messages is not opened.	2byte INT	R/W	0: Stops output. 1: Holds output. Default	O
66H to FFH	Reserved for system	—	—	—	—	—
0100H (256)	Number of used IDs	Number of used slots is stored.	2byte INT	R	1	—
0101H (257)	Product code	Product code is stored.	2byte INT	R	KV-N8EXR : 221 KV-N8EXT : 222 KV-N16CEXT:223 KV-NC32EXT : 224	—
0102H (258)	Revision	Revision is stored. (Major revision in the upper byte and minor revision in the lower byte)	2byte INT	R	0101H	—
0103H (259)	Model name	Model name is stored.	STRING	R	KV-N8EXR, KV-N8EXT KV-N16CEXT, KV-NC32EXT	—
0104H (260)	Device type	Device type is stored.	2byte INT	R	43	—

5-5 Parameter list

KV-NC4AD (Instance ID: 1 to 14)

Parameters of Message communication corresponds to attributes of RemoteIO Object. Refer to "Using RemoteIO Object" (page 5-25) for how to read the list and how to use parameters. For the setting items which "DM selection" is selectable in KV STUDIO, settings can be changed with the sensor application functions.

For instance ID, select the same number as the slot number of the expansion unit.

Attribute ID	Name	Description	Date type	Attribute	Value	Sensor application compatible
64H (100)	Reserved for system	—	—	—	—	—
65H (101)	Temperature drift correction	Sets whether or not temperature drift correction is available. When "Enable" is selected, conversion period is lengthened by 80us per cycle. 1 cycle of conversion period = (80us × number of used channels) + 80us	2byte INT	R/W	0: Disable 1: Enable Default	○
66H (102)	CH0 Channel skip	When "Skip" is selected, A/D conversion does not work for this channel.	2byte INT	R/W	0: Not skip Default 1: Skip	○
67H (103)	CH0 Input range	Sets the range of input signal.	2byte INT	R/W	0: -10 to +10V Default 1: 0 to 10V 2: 0 to 5V 3: 0 to 20mA 4: 1 to 5V 5: 4 to 20mA	○
68H (104)	CH0 Scaling	When "Enable" is selected, scaled value is stored in special data.	2byte INT	R/W	0: Disable Default 1: Enable	○
69H (105)	Reserved for system	—	—	—	—	—
6AH (106)	CH0 Scaling upper limit	Sets the scaling upper limit. When using a sensor setting command, update the setting.	2byte INT	R/W	-31999 to 32000 Default 32000	○
6BH (107)	CH0 Scaling lowest limit	Sets the scaling lowest limit. When using a sensor setting command, update the setting.	2byte INT	R/W	-32000 to 31999 Default -32000	○
6CH (108)	CH0 Average	Sets the method of averaging data after	2byte INT	R/W	0: Disable Default 1: Simple average	○

Attribute ID	Name	Description	Date type	Attribute	Value	Sensor application compatible
	processin g	A/D conversion.			(frequency is specified) 2: Simple average (time is specified) 3: Moving average	
6DH (109)	Reserved for system	—	—	—	—	—
6EH (110)	CH0 Simple average frequency	Executes simple average processing in each set number of A/D conversion. When changing with the sensor setting command, the setting update service is necessary.	2byte UINT	R/W	2 to 60000 <input type="text" value="Default"/> 2	○
6FH (111)	CH0 Simple average time (ms)	Executes simple average processing in each set time (ms). When changing with the sensor setting command, the setting update service is necessary.	2byte INT	R/W	1 to 1500 <input type="text" value="Default"/> 1	○
70H (112)	CH0 Moving average frequency	Executes moving average processing in each set number of A/D conversion. When changing with the sensor setting command, the setting update service is necessary.	2byte INT	R/W	2 to 64 <input type="text" value="Default"/> 2	○
71H (113)	Reserved for system	—	—	—	—	—
72H (114)	CH0 Comparator	When special data is out of the range, the corresponding relay is activated.	2byte INT	R/W	0: Disable <input type="text" value="Default"/> 1: Enable	○
73H (115)	Reserved for system	—	—	—	—	—
74H (116)	CH0 Comparator upper limit ON level	Sets the comparator upper limit (OFF to ON). When using a sensor setting command, update the	2byte INT	R/W	-32000 to 32000 <input type="text" value="Default"/> 32000	○

5-5 Parameter list

Attribute ID	Name	Description	Date type	Attribute	Value	Sensor application compatible
		setting.				
75H (117)	CH0 Comparat or upper limit OFF level	Sets the comparator upper limit (ON to OFF). When using a sensor setting command, update the setting.	2byte INT	R/W	-32000 to 32000 Default 32000	○
76H (118)	Comparat or lowest limit OFF level	Sets the comparator lowest limit (ON to OFF). When using a sensor setting command, update the setting.	2byte INT	R/W	-32000 to 32000 Default -32000	○
77H (119)	Comparat or lowest limit ON level	Sets the comparator lowest limit (OFF to ON). When using a sensor setting command, update the setting.	2byte INT	R/W	-32000 to 32000 Default -32000	○
78H (120)	CH0 Zero clip	When input analog signal is out of the input range, the maximum/minimum value of the range is stored in special data.	2byte INT	R/W	0: Disable 1: Enable Default	○
79H (121)	CH0 Disconnection detection	When input signal is lower than a specific value, the corresponding relay is activated. This setting is effective only when the input range is set to "1 to 5V" or "4 to 20mA".	2byte INT	R/W	0: Disable Default 1: Enable	○
7AH (122) to 8DH (141)	CH1 setting	The same setting as CH0				
8EH (142) to A1H (161)	CH2 setting	The same setting as CH0				
A2H (162) to B5H (181)	CH3 setting	The same setting as CH0				
0100H (256)	Number of used IDs	Number of used slots is stored.	2byte INT	R	2	—
0101H	Product	Product code is	2byte	R	226	—

Attribute ID	Name	Description	Date type	Attribute	Value	Sensor application compatible
(257)	code	stored.	INT			
0102H (258)	Revision	Revision is stored. (Major revision in the upper byte and minor revision in the lower byte)	2byte INT	R	0101H	-
0103H (259)	Model name	Model name is stored.	STRING	R	KV-NC4AD	-
0104H (260)	Device type	Device type is stored.	2byte INT	R	43	-

5-5 Parameter list

KV-NC2DA (Instance ID: 1 to 14)

Parameters of Message communication corresponds to attributes of RemoteIO Object. Refer to "Using RemoteIO Object" (page 5-25) for how to read the list and how to use parameters. For the setting items which "DM selection" is selectable in KV STUDIO, settings can be changed with the sensor application functions.

For instance ID, select the same number as the slot number of the expansion unit.

Attribute ID	Item	Description	Date type	Attribute	Value	Sensor application compatible
64H (100)	Reserved for system	—	—	—	—	—
65H (101)	Reserved for system	—	—	—	—	—
66H (102)	CH0 Channel skip	When "Skip" is selected, D/A conversion does not work for this channel.	2byte INT	R/W	0: Not skip Default 1: Skip	○
67H (103)	CH0 Output range	Sets the range of output signal.	2byte INT	R/W	0:-10 to +10V Default 1:0 to 10V 2:0 to 5V 3:0 to 20mA 4:1 to 5V 5:4 to 20mA	○
68H (104)	CH0 Scaling	When "Enable" is selected, output data can be specified by scaled value.	2byte INT	R/W	0: Disable Default 1: Enable	○
69H (105)	Reserved for system	—	—	—	—	—
6AH (106)	CH0 Scaling upper limit	Sets the scaling upper limit. When using a sensor setting command, update the setting.	2byte INT	R/W	-31999 to 32000 Default 32000	○
6BH (107)	CH0 Scaling lowest limit	Sets the scaling lowest limit. When using a sensor setting command, update the setting.	2byte INT	R/W	-32000 to 31999 Default -32000	○
6CH (108)	CH0 Alert upper/lowest limit	When output data is out of the range, corresponding relay is activated.	2byte INT	R/W	0: Disable Default 1: Enable	○
6DH (109)	Reserved for system	—	—	—	—	—

Attribute ID	Item	Description	Date type	Attribute	Value	Sensor application compatible
6EH (110)	CH0 Alert upper limit	Sets the alert upper limit. When using a sensor setting command, update the setting.	2byte INT	R/W	-31999 to 32000 Default 32000	○
6FH (111)	CH0 Alert lowest limit	Sets the alert lowest limit. When using a sensor setting command, update the setting.	2byte INT	R/W	-32000 to 31999 Default -32000	○
70H (112)	CH0 Output limit	When output signal is out of the output range, the maximum/minimum value of the range is output.	2byte INT	R/W	0:OFF Default 1:ON	○
71H (113)	CH0 Error Hold	When "ON" is selected, output is hold in case an error occurs. When "OFF" is selected, output it stopped.	2byte INT	R/W	0:OFF Default 1:ON	○
72H (114)	CH0 Output in PROG	When "Clear" is selected, output is stopped in case the cyclic connection is not opened or the scanner is in PROGRAM mode. When executing the update setting service, output is paused. When "Output" is selected, the output when it can't be opened is hold in case Cyclic(I/O) messages is not opened. In PROGRAM mode of the scanner, output status is the same as RUN mode.	2byte INT	R/W	0: Clear Default 1: Output	○
73H (115)	Reserved for system	—	—	—	—	—

5-5 Parameter list

Attribute ID	Item	Description	Date type	Attribute	Value	Sensor application compatible
74H (116) to 81H (129)	CH1 setting	The same setting as CH0				
75H to FFH	Reserved for system	—	—	—	—	—
0100H (256)	Number of used IDs	Number of used slots is stored.	2byte INT	R	2	—
0101H (257)	Product code	Product code is stored.	2byte INT	R	227	—
0102H (258)	Revision	Revision is stored. (Major revision in the upper byte and minor revision in the lower byte)	2byte INT	R	0101H	—
0103H (259)	Model name	Model name is stored.	STRING	R	KV-NC2DA	—
0104H (260)	Device type	Device type is stored.	2byte INT	R	43	—

KV-NC4TP (Instance ID: 1 to 14)

Parameters of Message communication corresponds to attributes of RemoteIO Object. Refer to "RemoteUsing RemoteIO Object" (page 5-25) for how to read the list and how to use parameters. For the setting items which "DM selection" is selectable in KV STUDIO, settings can be changed with the sensor application functions.

For instance ID, select the same number as the slot number of the expansion unit.

Attribute ID	Item	Description	Date type	Attribute	Value	Sensor application compatible
64H (100)	CH0 Channel skip	When "Skip" is selected, temperature conversion does not work for this channel.	2byte INT	R/W	0: Not skip Default 1: Skip	○
65H (101)	CH0 Thermocouple / RTD type	Sets the type of sensor to input.	2byte INT	R/W	0:K Default 1:J 2:T 3:E 4:N 5:R 6:S 7:B 8:WRe5-26 9:Pt100 10:JPt100	○
66H (102)	CH0 Average processing	Sets the method of averaging data after temperature conversion.	2byte INT	R/W	0: Disable 1: Simple average (frequency is specified) 2: Simple average (time is specified) 3: Moving average Default	○
67H (103)	Reserved for system	-	-	-	-	-
68H (104)	CH0 Simple average frequency	Executes simple average processing in each set number of temperature conversion times. When changing with the sensor setting command, the setting update service is necessary.	2byte INT	R/W	3 to 1200 Default 3	○
69H (105)	CH0 Simple average time (ms)	Executes simple average processing in each set time (ms). When changing with the sensor setting command, the setting update service is necessary.	2byte UINT	R/W	1500 to 60000 Default 1500	○

5-5 Parameter list

Attribute ID	Item	Description	Date type	Attribute	Value	Sensor application compatible
6AH (106)	CH0 Moving average frequency	Executes moving average processing in each set number of temperature conversion times. When changing with the sensor setting command, the setting update service is necessary.	2byte INT	R/W	3 to 64 Default 3	○
6BH (107)	CH0 Alert	When special data is out of the range, the corresponding relay is activated.	2byte INT	R/W	0: Disable 1: Enable(not standby) 2: Enable (standby)	○
6CH (108)	CH0 Alert upper/lowest limit specifying	Selects the method of specifying the alert upper/lowest limit.	2byte INT	R/W	0 : Not assign to cyclic (I/O) messages data Default 1: Assign to cyclic (I/O) messages data	○
6DH (109)	CH0 Alert upper limit	Sets the alert upper limit.	2byte INT	R/W	-32000 to 32000 Default 32000	○
6EH (110)	CH0 Alert lowest limit	Sets the alert lowest limit.	2byte INT	R/W	-32000 to 32000 Default -32000	○
6FH (111)	CH0 Alert hysteresis	Sets alert hysteresis. When using a sensor setting command, update the setting.	2byte INT	R/W	0 to 32000 Default 0	○
70H (112)	Reserved for system	—	—	—	—	—
71H (113)	CH0 Number of disconnection times	The disconnection detection relay turns ON when the disconnection state continues for the set number of disconnection detection times.	2byte INT	R/W	1 to 1200 Default 1	○
72H (114)	CH0 Input error setting	Selects value to store in "Measured input value" for input errors.	2byte INT	R/W	0: Scaling up 1: Scaling down	○
73H (115)	Reserved for system	—	—	—	—	—

Attribute ID	Item	Description	Date type	Attribute	Value	Sensor application compatible
74H to 83H	CH1 setting	The same setting as CH0				
84H to 93H	CH2 setting	The same setting as CH0				
94H to A3H(163)	CH3 setting	The same setting as CH0				
A4H to FFH	Reserved for system	—	—	—	—	—
0100H (256)	Number of used IDs	Number of used slots is stored.	2byte INT	R	2	—
0101H (257)	Product code	Product code is stored.	2byte INT	R	228	—
0102H (258)	Revision	Revision is stored. (Major revision in the upper byte and minor revision in the lower byte)	2byte INT	R	0101H	—
0103H (259)	Model name	Model name is stored.	STRING	R	KV-NC4TP	—
0104H (260)	Device type	Device type is stored.	2byte INT	R	43	—

5-5 Parameter list

KV-N3AM (Instance ID: 1 to 14)

Parameters of Message communication corresponds to attributes of RemoteIO Object. Refer to "Using RemoteIO Object" (page 5-25) for how to read the list and how to use parameters. For the setting items which "DM selection" is selectable in KV STUDIO, settings can be changed with the sensor application functions.

For instance ID, select the same number as the slot number of the expansion unit.

Attribute ID	Item	Description	Date type	Attribute	Value	Sensor application compatible
64H (100)	Reserved for system	—	—	—	—	—
65H (101)	Temperature drift correction	Sets whether or not temperature drift correction is available. When "Enable" is selected, conversion period is lengthened by 80us per cycle. 1 cycle of A/D conversion period = (80us × number of channels used for A/D or D/A conversion) + 80us	2byte INT	R/W	0: Disable 1: Enable Default	○
66H (102)	CH0 Channel skip	When "Skip" is selected, A/D conversion does not work for this channel.	2byte INT	R/W	0: Not skip Default 1: Skip	○
67H (103)	CH0 Input range	Sets the range of input signal.	2byte INT	R/W	0:-10 to +10V Default 1:0 to 10V 2:0 to 5V 3:0 to 20mA 4:1 to 5V 5:4 to 20mA	○
68H (104)	CH0 Scaling	When "Enable" is selected, scaled value is stored in special data.	2byte INT	R/W	0: Disable Default 1: Enable	○
69H (105)	Reserved for system	—	—	—	—	—
6AH (106)	CH0 Scaling upper limit	Sets the scaling upper limit. When using a sensor setting command, update the setting.	2byte INT	R/W	-31999 to 32000 Default 32000	○
6BH (107)	CH0 Scaling lowest limit	Sets the scaling lowest limit. When using a sensor setting command, update the setting.	2byte INT	R/W	-32000 to 31999 Default -32000	○

Attribute ID	Item	Description	Date type	Attribute	Value	Sensor application compatible
6CH (108)	CH0 Average processing	Sets the method of averaging data after A/D conversion.	2byte INT	R/W	0: Disable Default 1: Simple average (frequency is specified) 2: Simple average (time is specified) 3: Moving average	○
6DH (109)	Reserved for system	—	—	—	—	—
6EH (110)	CH0 Simple average frequency	Executes simple average processing in each set number of A/D conversion times. When changing with the sensor setting command, the setting update service is necessary.	2byte UINT	R/W	2 to 60000 Default 2	○
6FH (111)	CH0 Simple average time (ms)	Executes simple average processing in each set time (ms). When changing with the sensor setting command, the setting update service is necessary.	2byte INT	R/W	1 to 1500 Default 1	○
70H (112)	CH0 Moving average frequency	Executes moving average processing in each set number of A/D conversion times. When changing with the sensor setting command, the setting update service is necessary.	2byte INT	R/W	2 to 64 Default 2	○
71H (113)	Reserved for system	—	—	—	—	—
72H (114)	CH0 Comparator	When special data is out of the range, the corresponding relay is activated.	2byte INT	R/W	0: Disable Default 1: Enable	○
73H (115)	Reserved for system	—	—	—	—	—
74H (116)	CH0 Comparator upper limit ON level	Sets the comparator upper limit (OFF to ON). When using a sensor setting command, update the setting.	2byte INT	R/W	-32000 to 32000 Default 32000	○

5-5 Parameter list

Attribute ID	Item	Description	Date type	Attribute	Value	Sensor application compatible
75H (117)	CH0 Comparat or upper limit OFF level	Sets the comparator upper limit (ON to OFF). When using a sensor setting command, update the setting.	2byte INT	R/W	-32000 to 32000 Default 32000	○
76H (118)	Comparat or lowest limit OFF level	Sets the comparator lowest limit (ON to OFF). When using a sensor setting command, update the setting.	2byte INT	R/W	-32000 to 32000 Default -32000	○
77H (119)	Comparat or lowest limit ON level	Sets the comparator lowest limit (OFF to ON). When using a sensor setting command, update the setting. When input analog signal is out of the input range, the maximum/minimum value of the range is stored in special data.	2byte INT	R/W	-32000 to 32000 Default -32000	○
78H (120)	CH0 Zero clip		2byte INT	R/W	0: Disable 1: Enable Default	○
79H (121)	CH0 Disconnection detection	When input signal is lower than a specific value, the corresponding relay is activated. This setting is effective only when the input range is set to "1 to 5V" or "4 to 20mA".	2byte INT	R/W	0: Disable Default 1: Use	○
7AH (122) to 8DH (141)	CH1 Setting	The same setting as CH0				
8EH (142)	CH2 Channel skip	When "Skip" is selected, D/A conversion will not work for this channel.	2byte INT	R/W	0: Not skip Default 1: Skip	○
8FH (143)	CH2 Output range	Sets the range of output signal.	2byte INT	R/W	0:-10 to +10V Default 1:0 to 10V 2:0 to 5V 3:0 to 20mA 4:1 to 5V 5:4 to 20mA	○

Attribute ID	Item	Description	Date type	Attribute	Value	Sensor application compatible
90H (144)	CH2 Scaling	When “Enable” is selected, output data can be specified by scaled value.	2byte INT	R/W	0: Disable Default 1: Enable	○
91H (145)	Reserved for system	—	—	—	—	—
92H (146)	CH2 Scaling upper limit	Sets the scaling upper limit. When using a sensor setting command, update the setting.	2byte INT	R/W	-31999 to 32000 Default 32000	○
93H (147)	CH2 Scaling lowest limit	Sets the scaling lowest limit. When using a sensor setting command, update the setting.	2byte INT	R/W	-32000 to 31999 Default -32000	○
94H (148)	CH2 Alert upper/lowest limit	When output data is out of the range, corresponding relay is activated.	2byte INT	R/W	0: Disable Default 1: Enable	○
95H (149)	Reserved for system	—	—	—	—	—
96H (150)	CH2 Alert upper limit	Sets the alert upper limit. When using a sensor setting command, update the setting.	2byte INT	R/W	-31999 to 32000 Default 32000	○
97H (151)	CH2 Alert lowest limit	Sets the alert lowest limit. When using a sensor setting command, update the setting.	2byte INT	R/W	-32000 to 31999 Default -32000	○
98H (152)	CH2 Output limit	When output signal is out of the output range, the maximum/minimum value of the range is output.	2byte INT	R/W	0:OFF Default 1:ON	○
99H (153)	CH2 Error Hold	When “ON” is selected, output is hold in case an error occurs. When “OFF” is selected, output it stopped.	2byte INT	R/W	0:OFF Default 1:ON	○

5-5 Parameter list

Attribute ID	Item	Description	Date type	Attribute	Value	Sensor application compatible
9AH (154)	CH2 Output in PROG	When “Clear” is selected, output is stopped in case the cyclic connection is not opened or the scanner is in PROGRAM mode. When executing the update setting service, output is paused. When “Output” is selected, the output when it can’t be opened is hold in case Cyclic(I/O) messages is not opened. In PROGRAM mode of the scanner, output status is the same as RUN mode.	2byte INT	R/W	0: Clear Default 1: Output	O
9BH to FFH	Reserved for system	—	—	—	—	—
0100H (256)	Number of used IDs	Number of used slots is stored.	2byte INT	R	2	—
0101H (257)	Product code	Product code is stored. Revision is stored. (Major revision in the upper byte and minor revision in the lower byte)	2byte INT	R	225	—
0102H (258)	Revision	Model name is stored.	2byte INT	R	0101H	—
0103H (259)	Model name	Device type is stored.	STRING	R	KV-N3AM	—
0104H (260)	Device type	—	2byte INT	R	43	—

MEMO

6 Sensor Application

This chapter describes the sensor application function.

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6-1 Sensor Application Function

What is Sensor Application Function

This function is available when "KV-EP02" is connected to a PLC of Keyence. Since the application is built in the scanner, troublesome programs and drawing tasks are unnecessary.

■ Sensor Monitor

This function is provided with a system that connects Keyence's touch panel to Keyence's PLC (EtherNet/IP scanner). You can monitor the current value of the expansion unit connected to "KV-EP02", error/warning status etc. on the touch panel.

■ Sensor Setting Backup

You can backup (save) the settings of "KV-EP02" including the connected expansion unit settings to the memory card of PLC. In addition, you can also restore the saved file and write it back to the settings saved.

■ Sensor Setting Batch Transmission

It is a function to read the setting information of "KV-EP02" and for the connected expansion unit to a PLC device, and to write it from the PLC device. You can register parameters to change settings at once. By using the PLC data folder function of Keyence's touch panel as an HMI (Human Machine Interface), you can easily build a system that performs a setup change for expansion unit settings of each type.

■ Adapter Setting Transmission

It is a function to read the setting information of "KV-EP02" and the connected expansion unit to display on a PC, and to edit/write it on the PC. It is also possible to check the settings on a PC against them on "KV-EP02". You can retrieve the data backed up to a memory card and restore it from a PC by using the sensor configuration backup function. On the contrary, you can save the setting information backed up by a PC into a memory card as a file, and restore it from the memory card without via a PC. This function is provided by Keyence's ladder support software "KV STUDIO".

■ Sensor Setting Commands

They are dedicated commands prepared for reading/writing settings of "KV-EP02" and also the connected expansion unit, and for executing the specific service (function). Sensor setting commands enable the message communication program easy, and to execute each function.

Operating environment of sensor application

The following environment is necessary to use the sensor application function.

PLC

Item	Description
EtherNet/IP Scanner	KV-7500/5500/XLE02/EP21V/NC1EP
PLC (CPU unit)	"KV-7500/7300/5500/5000/3000 series" "KV Nano series" of Keyence
Ladder support software	KV STUDIO(Ver. 9.4 or later)
SD memory card※1	KV-M1G

Touch panel

Item	Description
Touch panel ※ 2	"VT5/VT3 series" of Keyence (models with resolution VGA or higher) (System program version 3.03 or later for VT 5, system program version 4.89 or later for VT 3)
Touch panel design tool * 2	VT STUDIO

* 1 A memory card is indispensable when using sensor setting backup.

Install it in a SD card slot built in the CPU unit.

* 2 A touch panel is indispensable when using a sensor monitor.

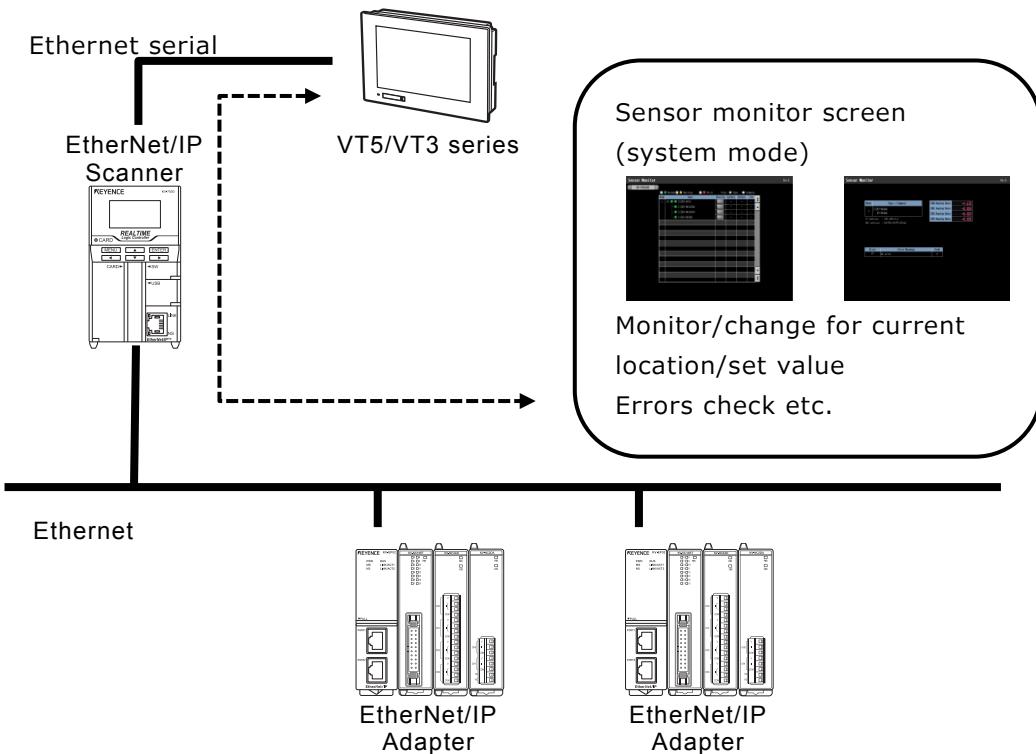
It can also be used as a HMI (Human Machine Interface) for sensor setting backup.

6-2 Sensor Monitor

This section describes sensor monitors function that can be used when combining a PLC (EtherNet/IP scanner) and a touch panel of "VT5 series" or "VT3 series" of Keyence.

What is Sensor monitor

It is a function to monitor the status of the adapter device "KV-EP02" including the connected expansion unit by using "VT5 series" or "VT3 series". The monitor screen can be found in the system mode, and also can be called from the user drawing screen. Since you can use pre-registered screens, screen creation operations can be greatly reduced. "KV-EP02" and the expansion unit connected to "KV-EP02" support the sensor monitor function.



Available functions with the sensor monitor
to display the information of "KV-EP02" (IP address etc.)
to monitor the error status of "KV-EP02"
to monitor the error condition, input/output status and the analog data of the expansion unit connected to "KV-EP02"

Sensor monitor supports "VT5 series" or "VT3 series" with screen resolution of VGA or higher.

Reference
Sensor monitor would not be used when "VT5 series" or "VT3 series" is connected via Keyence's "Data Storage Terminal DT series".

The cyclic (I/O) messages and message communication are used in a combination by the sensor monitor.

For details of sensor monitor, refer to "KV Series EtherNet/IP Function User's Manual".

Sensor monitor screen

■ Sensor monitor list screen (common)

This is the first screen displayed when starting the sensor monitor to display the list of sensors. You can monitor the error/warning status, current value, and output etc. of each sensor.



No.	Description
①	Displays model names of the adapter ("KV-EP02") and expansion units and error/warning status.
②	Displays the detailed screens for the adapter "KV-EP02" and the expansion units.
③	Only displays the model of the checked state.
④	Displays the current value, setting value, and I/O output status of each adapter. "KV-EP02" and expansion units are all be displayed as "-".
⑤	Returns to the TOP screen.
⑥	If there are multiple PLCs, touch + or - to change the PLC to be monitored.
⑦	If there are multiple scanners, touch + or - to change the scanner to be monitored.
⑧	Switches the display name of the adapter "KV-EP02" or expansion units between the model and comments.

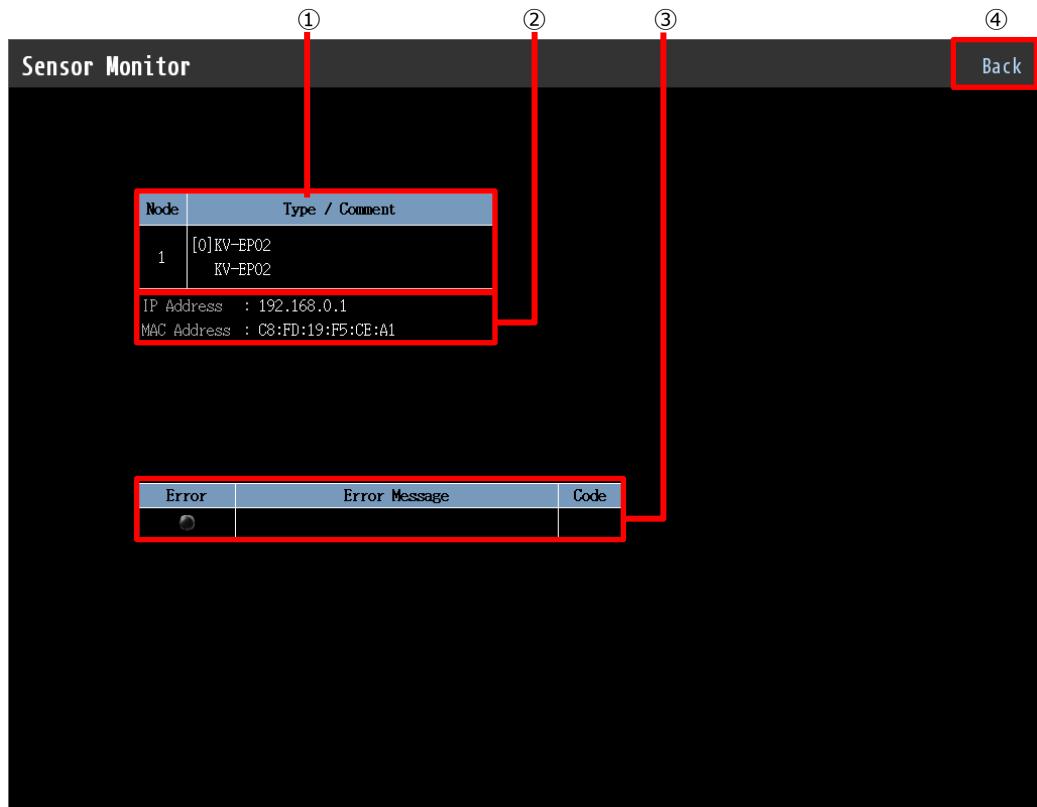
6-2 Sensor Monitor

■ Detail screens of sensor monitor

Touch the detail button  from the list screen to display.

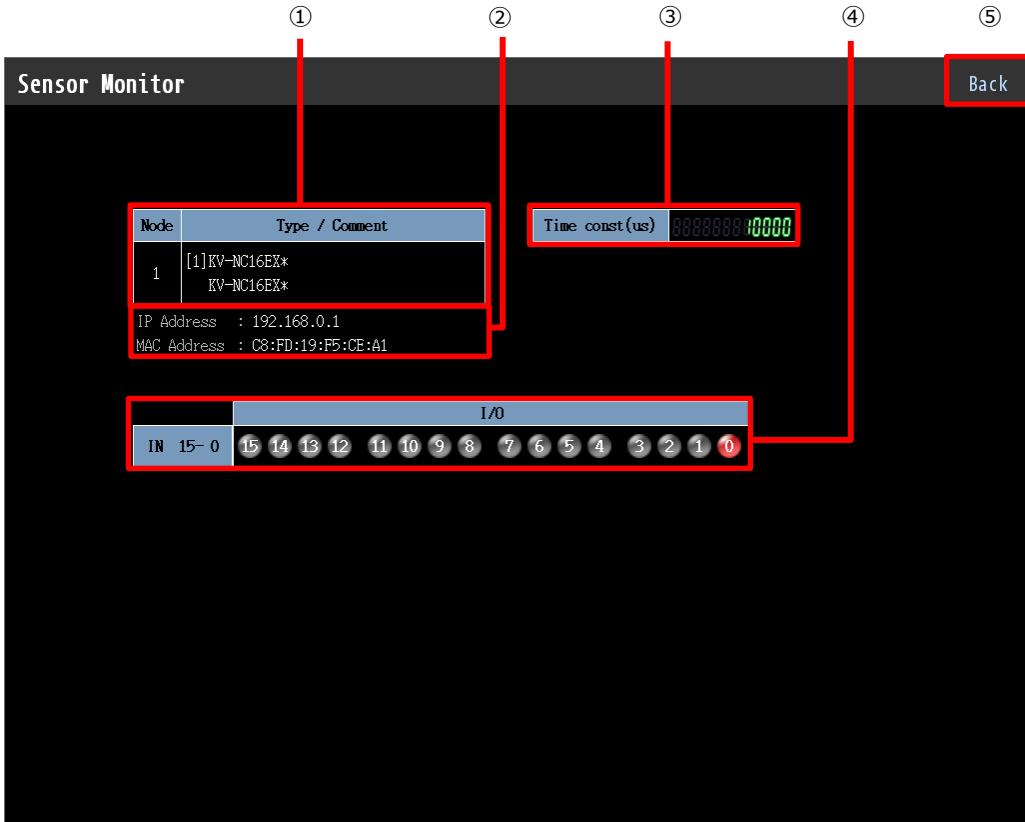
Detailed information for "KV-EP02" or the expansion unit connected to "KV-EP02" is displayed. Depending on the model, some items may be not displayed.

● KV-EP02



No.	Description
①	Displays the node number and model/comment. In the comment, the slot name set in "EtherNet/IP setting" is displayed.
②	Displays IP address and MAC address.
③	Displays error status. Error message will not be displayed. Please confirm the errors with the operation indicators.  "Operation indicators" (page 2-6)
④	Returns to the list screen.

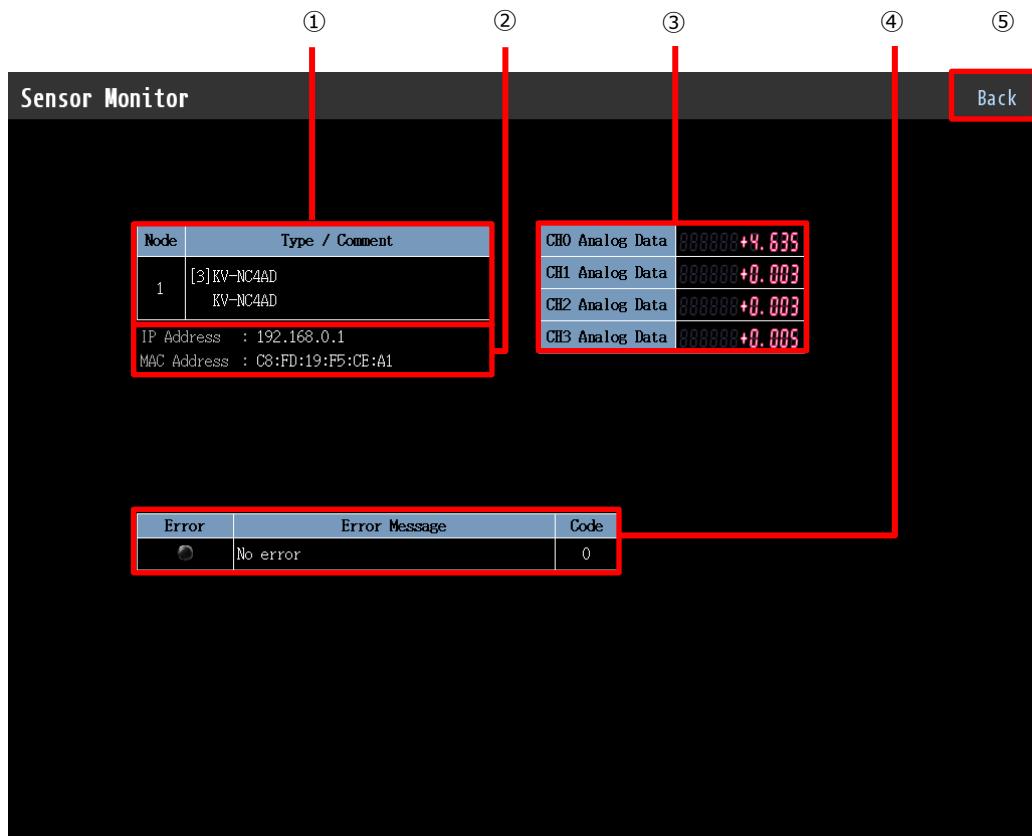
● Expansion I/O unit



No.	Description
①	Displays the node number and model/comment. In the comment, the slot name set in "EtherNet/IP setting" is displayed.
②	Displays IP address and MAC address of the connected "KV-EP02".
③	Displays the input constant when using an expansion I/O unit (input).
④	Displays the input/output status of the expansion I/O unit. The number of inputs and outputs displayed varies depending on the expansion unit.
⑤	Returns to the list screen.

6-2 Sensor Monitor

● Analog/Temperature unit



No.	Description
①	Displays the node number and model/comment. In the comment, the slot name set in "EtherNet/IP setting" is displayed.
②	Displays IP address and MAC address of the connected "KV-EP02".
③	Displays analog data of each channel for the analog/temperature unit.
④	Displays error status and error messages.
⑤	Returns to the list screen.

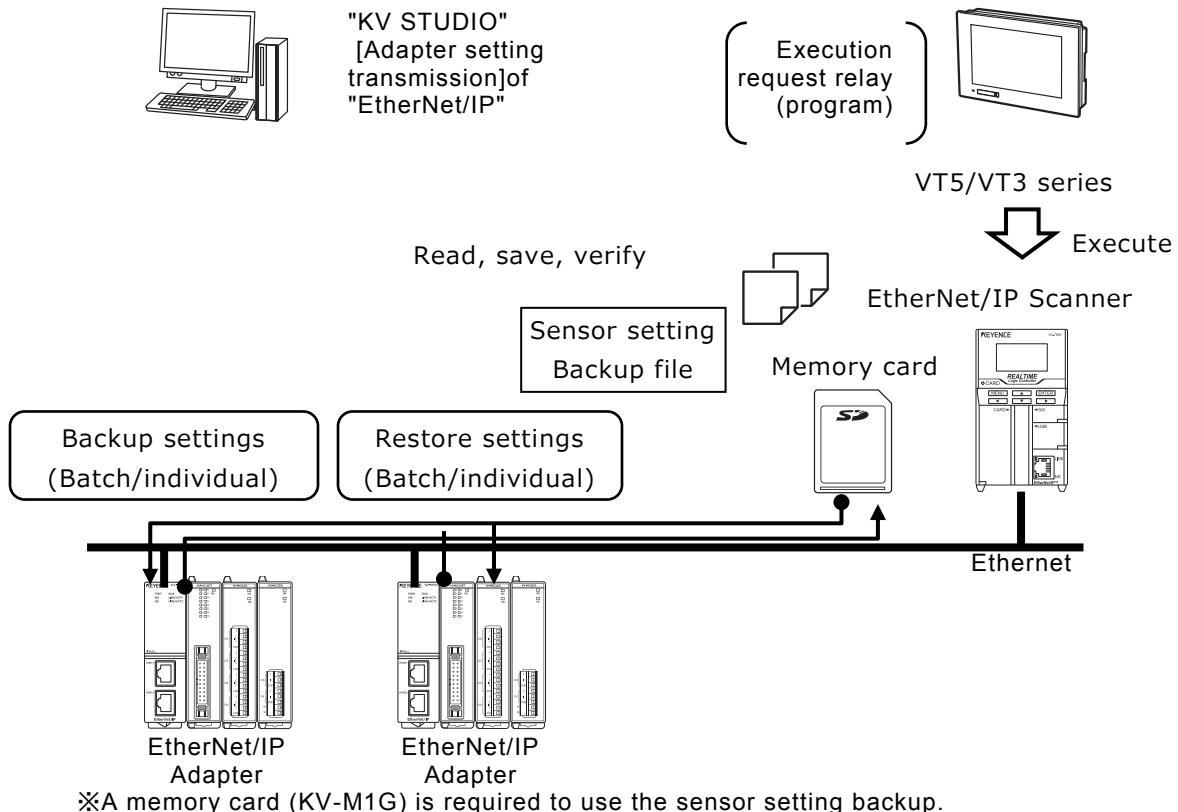
6-3 Sensor Setting Backup

This section describes the functions and usage of sensor setting backup that can be used by connecting with PLCs (EtherNet/IP scanner) of Keyence.

Sensor setting backup function is a generic name that collectively refers to sensor setting batch backup, sensor setting individual backup, sensor setting batch restore, and sensor setting individual restore.

What is sensor setting backup?

This function is for reading the adapter device settings on the network and backing up it to the memory card attached to Keyence's PLC all at once or individually, as well as restoring the backed up settings to the adapter device on the network. "KV-EP02" and the expansion unit connected to "KV-EP02" support sensor setting backup function.



Reference

Sensor setting backup and restoration should be performed from the PLC ladder program or from Keyence's touch panel display "VT5/VT3 series". When using the sensor setting backup function from Keyence's touch panel display "VT5/VT3 series", execute it using the dedicated screen (system mode screen). Special settings for using the dedicated screen are unnecessary.

The dedicated system screen is supported by models with resolution VGA or higher.

When "VT 3 series" is connected via Keyence's "DT series", the dedicated system screen for sensor setting backup can not be used.

Targets of sensor setting backup

The sensor setting backup function can be used for parameters displayed in the [Adapter setting transmission] dialog box of "EtherNet/IP setting". Save and transfer parameter setting values whose attributes are displayed in R/W (Readable/writable) collectively or individually.

■ Target parameters

For parameters that can use sensor setting backup, Please check RemotelO Object and parameters of each expansion unit.

- "Using RemotelO Object" (page 5-25)
- "Parameter list" (page 5-29)

For how to use sensor setting backup function, refer to "EtherNet/IP Function User's Manual".

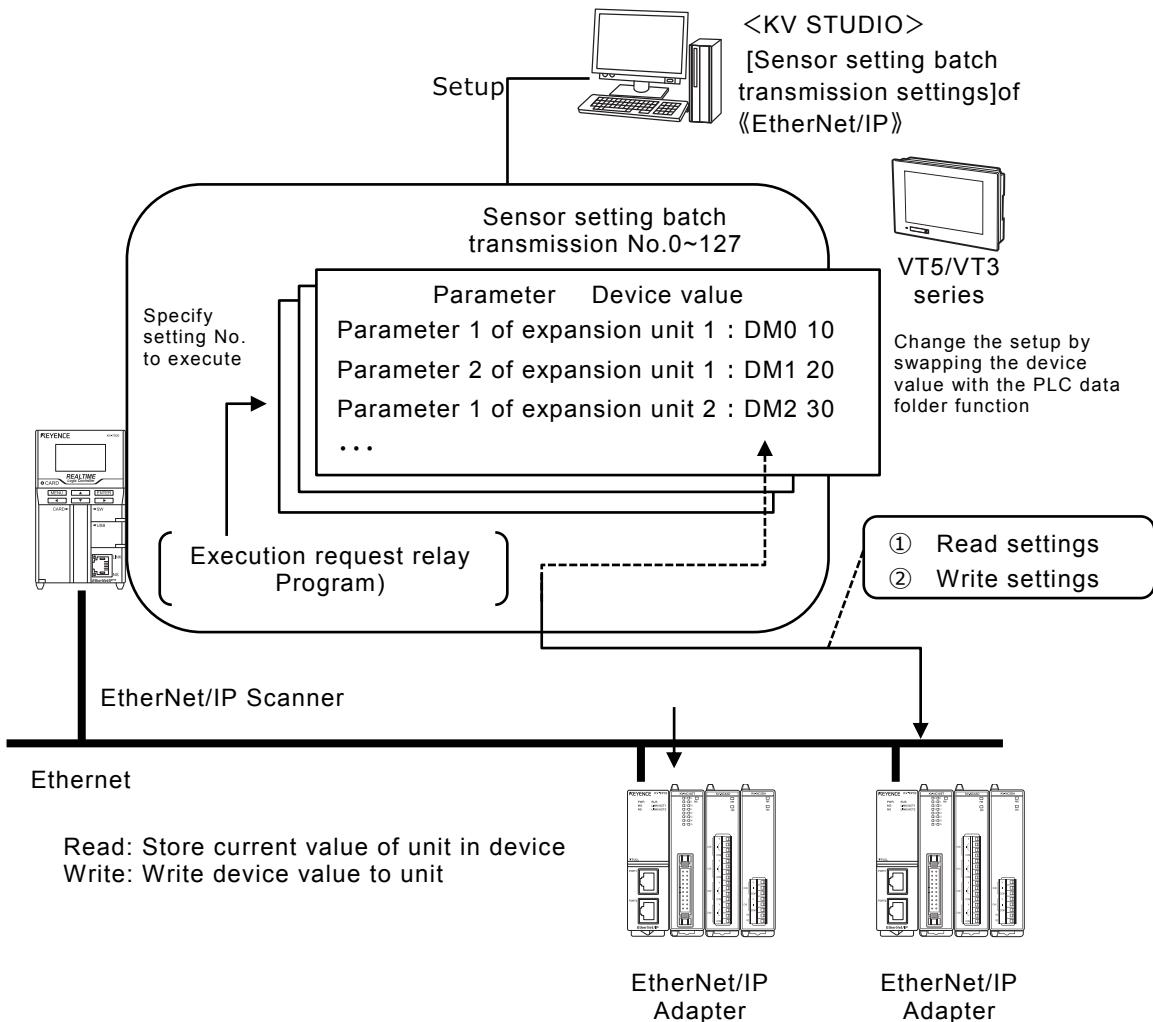
6-4 Sensor Setting Batch Transmission

This section describes the sensor setting batch transmission that can be used by connecting with PLCs (EtherNet/IP scanner) of Keyence.

What is sensor setting batch transmission

This function transfers settings of the adapter device connected to the network to a PLC device, or transfers the data stored in the PLC device to the adapter device setting. Unlike sensor setting backup, memory card is unnecessary by exchanging data with PLC device.

This function can be used for changing the setup of sensor settings. "KV-EP02" and the expansion unit connected to "KV-EP02" support the sensor setting batch transmission function. Setting items to be transferred in batch can be set for each sensor.



By using the PLC data folder function of Keyence's touch panel "VT3 series" or "VT5 series" together, it is easy to build a system for changing the sensor settings for each model. For the PLC data folder function, refer to the "VT STUDIO Reference Manual".

Targets of sensor setting batch transmission

■ Target parameters

For parameters that can use sensor batch transmission, please check RemoteIO Object and parameters of each expansion unit.

□ "Using RemoteIO Object" (page 5-25)

□ "Parameter list" (page 5-29)

For details of sensor setting batch transmission function, refer to □ "KV Series EtherNet/IP Function User's Manual".

6-5 Adapter Setting Transmission

This section describes the adapter setting transmission function which is supported by Keyence's ladder support software "KV STUDIO".

What is adapter setting transmission

It is a function to read the settings of the expansion unit connected by using a PC and transfer the settings to "KV-EP02". It is also possible to check the settings on a PC against those of "KV-EP02", as well as, enable to retrieve the data backed up to a memory card and restore it from a PC by using the sensor configuration backup function. On the contrary, save the setting information backed up by a PC into a memory card as a file, and restore it from the memory card without via a PC. This function is provided by Keyence's ladder support software "KV STUDIO". You can't use the method of communicating directly with a PC.

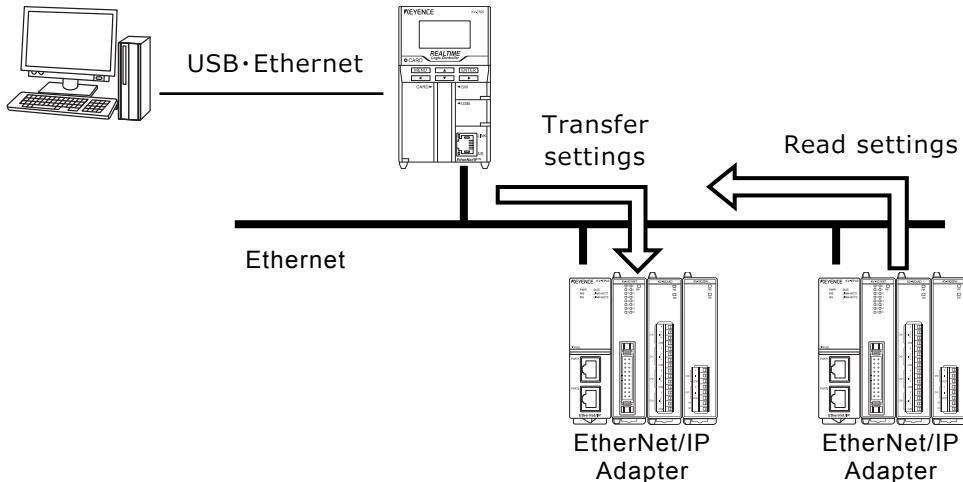
«KV STUDIO»

[Adapter setting

transmission] of

«EtherNet/IP»

EtherNet/IP Scanner



Targets of adapter setting transmission

■ Target parameters

For parameters that can use adapter setting transmission, please check RemoteIO Object and parameters of each expansion unit.

□ "Using RemoteIO Object" (page 5-25)

□ "Parameter list" (page 5-29)

For details of adapter setting transmission function, refer to □ "KV Series EtherNet/IP Function User's Manual".

6-6 Sensor Setting Commands

This section describes the contents and usage of the sensor setting commands that can be used by connecting with Keyence's PLC (EtherNet / IP scanner).

Overview

The sensor setting command is a dedicated command prepared for reading/writing the adapter settings registered in the scan list, and executing the specific adapter service (function) by using the message communication supported by Keyence's PLC (EtherNet/IP scanner).

By using the sensor setting commands, message communication can be executed without conscious of complex EtherNet/IP communication specifications.

The following three sensor setting commands can be used.

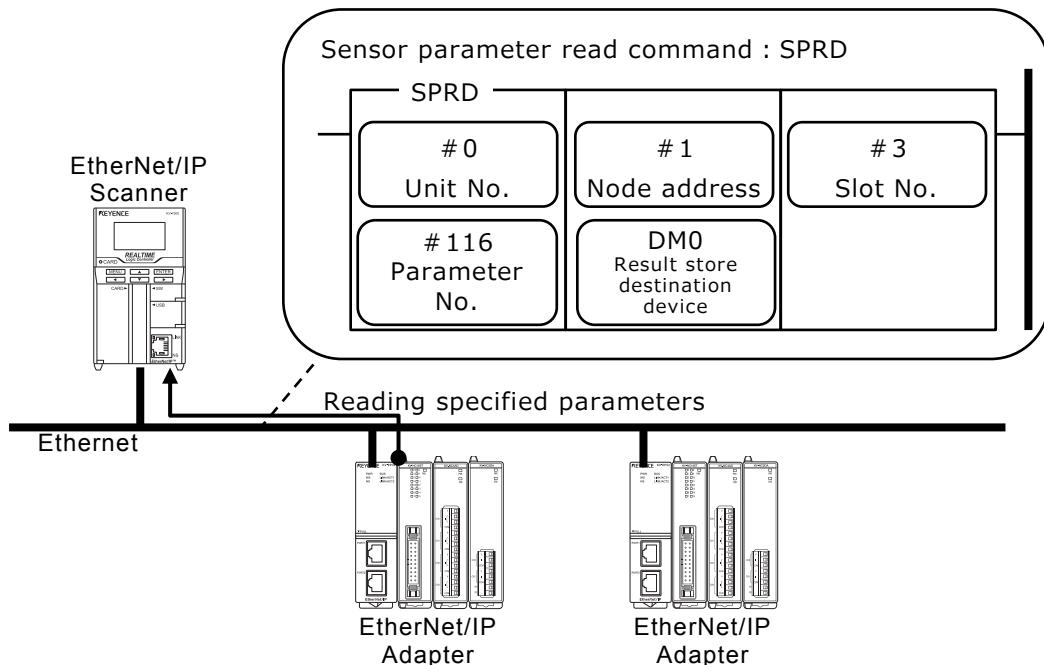
Sensor parameter read command (SPRD command)

Sensor parameter write command (SPWR command)

Sensor service execution command (SSVC command)

■ Sensor parameter read command : SPRD

When using the SPRD command (sensor parameter read), parameters of the specified "KV-EP02" (adapter) and the extension unit connected to "KV-EP02" are read out and stored in the device specified by the command word.



Only one parameter can be read at a time with the sensor parameter read command.

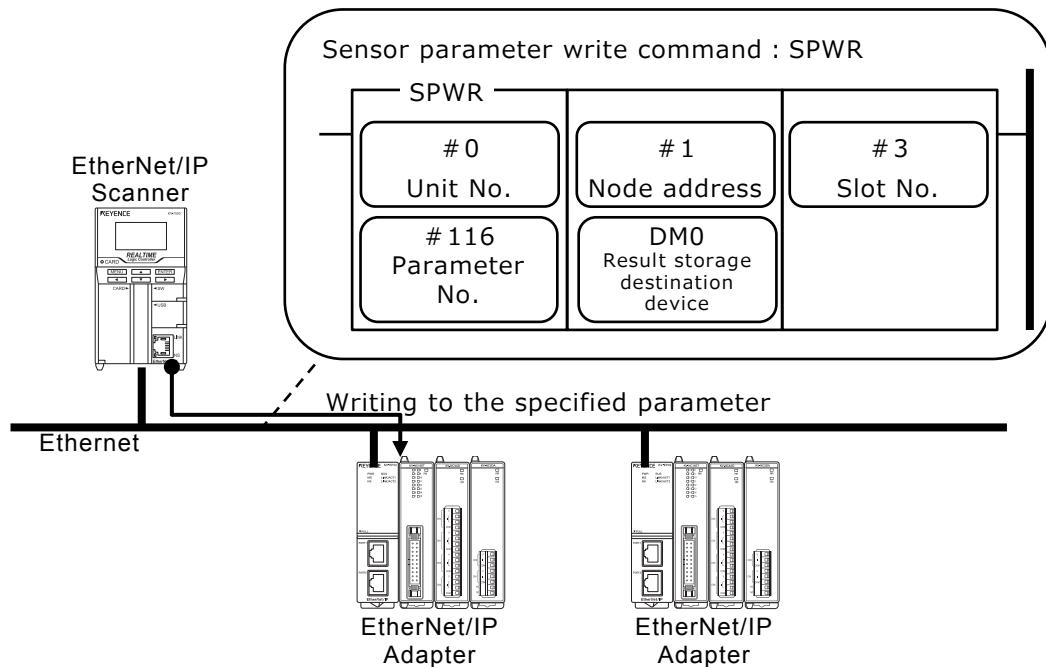


The sensor parameter read command executes the Get_Attribute_Single service for each sensor (adapter). (In case of Keyence's EtherNet/IP devices, different services may be executed.)

6-6 Sensor Setting Commands

■ Sensor parameter write command : SPWR

When use the SPWR command (sensor parameter write), the device values specified by the command word are written into parameters of the specified "KV-EP02" (adapter) and the expansion unit connected to "KV-EP02".



Only one parameter can be written at a time with the sensor parameter write command.

The sensor parameter write command executes the Get_Attribute_Single service for each sensor (adapter). (In case of Keyence's EtherNet/IP devices, different services may be executed)

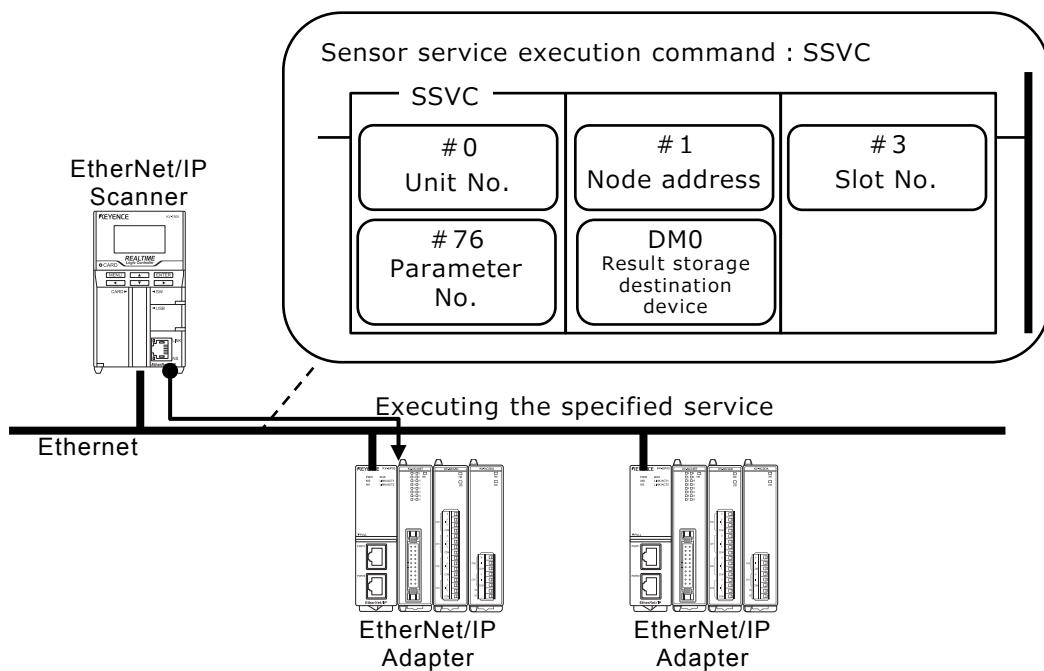


When writing to the parameter with the sensor parameter write command, data will be written to the RAM area of "KV-EP02", but the settings is not reflected. To reflect the setting, execution of the sensor service execution command is necessary.

■ Sensor service execution command : SSVC

Each service can be executed by specifying a service No. dedicated for sensor service execution commands provided in "KV-EP02" (adapter) and expansion units connected to "KV-EP02".

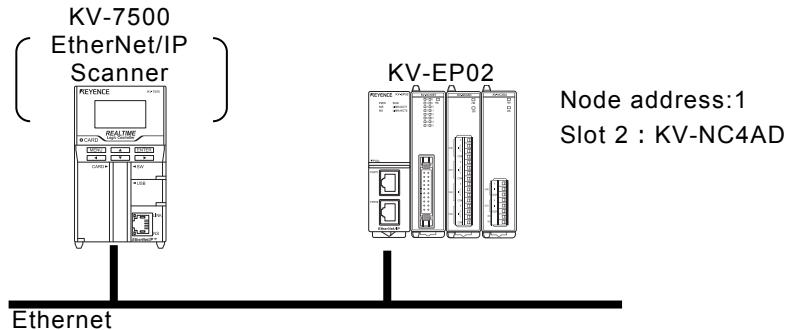
For the services provided for "KV-EP02", refer to □ "Objects and services" (page 5-20).



For details of precautions on sensor setting commands, sensor setting command words and sensor setting command functions, refer to
 □ "KV-7000/5000/3000/1000 series KV Nano Series Command Words Reference Manual",
 □ "KV Series EtherNet/IP Function User's Manual" and "KV-XLE02 User's Manual".

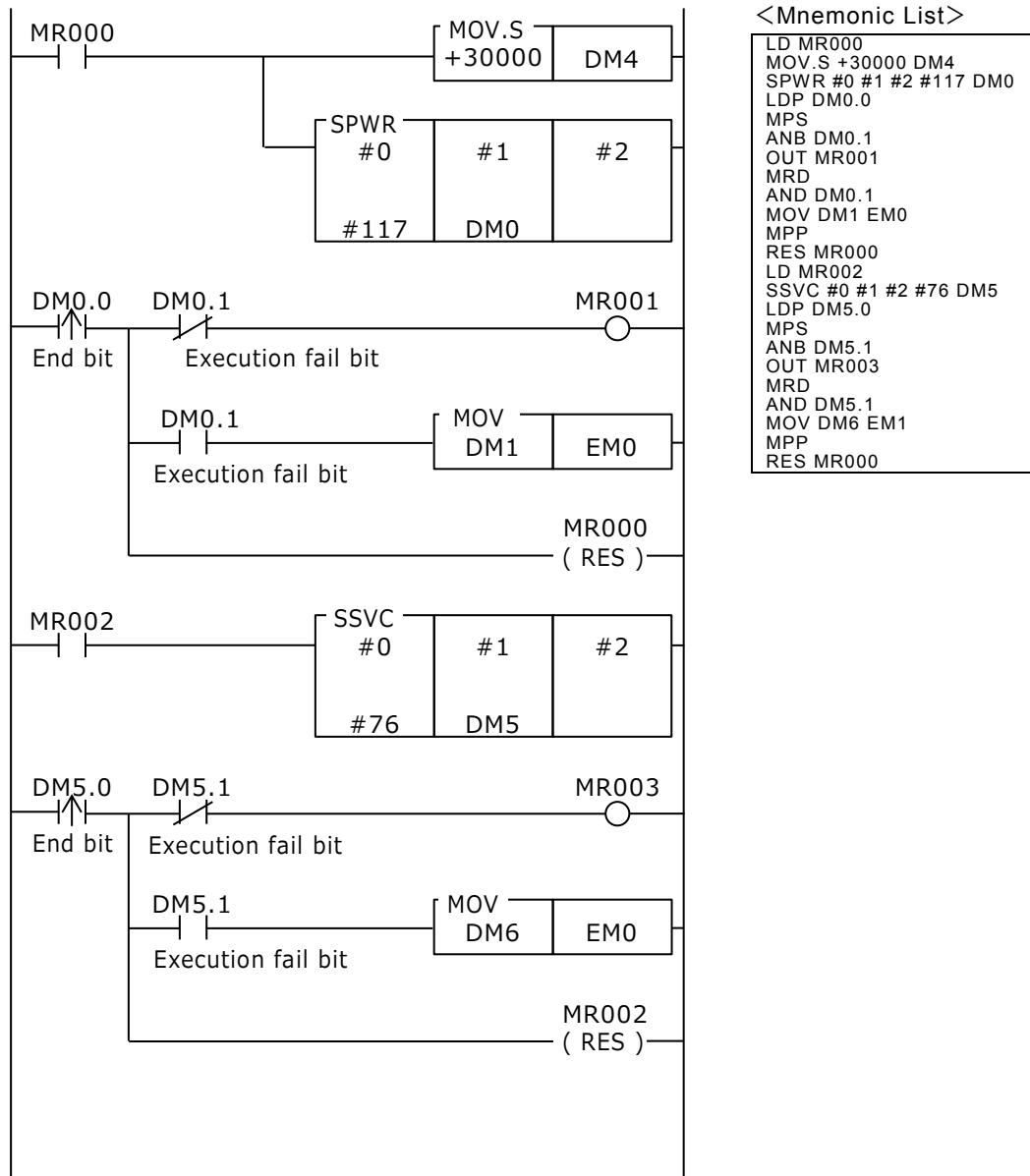
Sample program

This section describes a sample program to change the CH0 comparator upper limit OFF level of KV-NC4AD (Slot No. 2) connected to "KV-EP02" (node address: 1) registered in the scan list of KV-7500 (EtherNet/IP scanner).



Settings on unit editor

Item	Description
Leading DM No.	DM10000
Leading relay No.	R30000



Point When writing to the parameter with the sensor parameter write command, data is written to the RAM area of "KV-EP02", but the setting is not reflected. To reflect the setting, execution of the sensor service execution command is necessary.

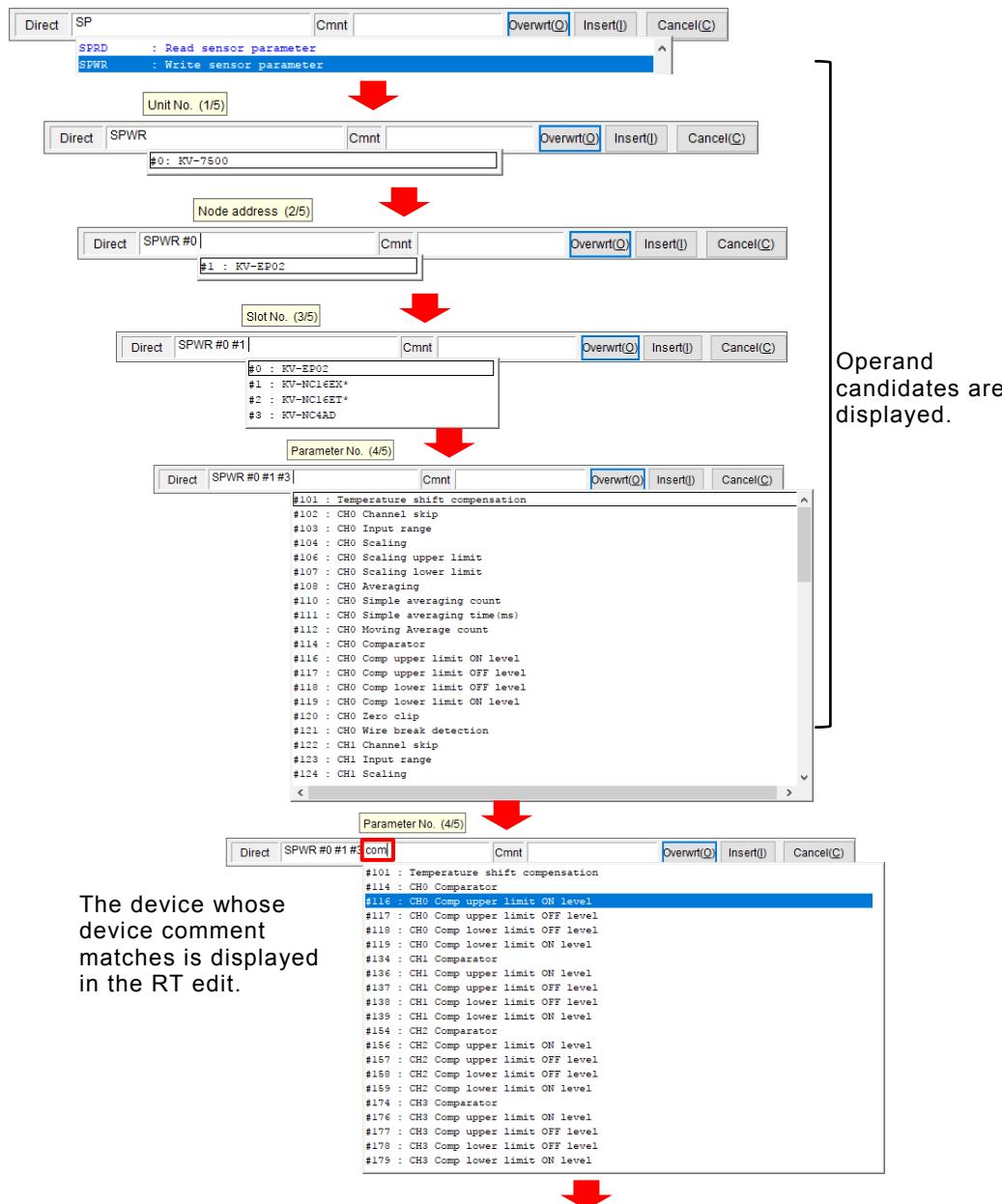
6-6 Sensor Setting Commands

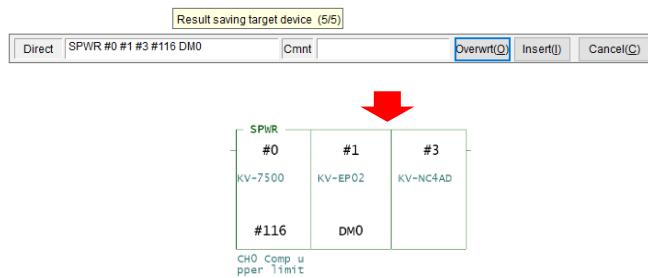
Reference

By using operand candidate display function and RT edit function, you can easily fill in ladder without referring to the manual.

■ Operand candidate display and RT edit function

The operand candidate display function is to display the contents to be entered in the parameter and the selectable candidates when entering the command word. RT edit function is to input operands with device comment, label and unit information when entering command words and devices. While confirming the parameter candidates to be input, you can input the device by entering a part of the device comment. It eliminates the extra time to check the manual and reduces the programming operations.





MEMO

7 APPENDIX

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7-5 Available objects of KV-EP02	7-12

7-1 Error List

Cyclic(I/O) messages error list

If the problem can't be solved with the measures below, refer to the description of the troubleshooting No. described in "KV Series EtherNet/IP Function User's Manual".

Error code	Detailed error code	Error message	Cause/Measure
0H (0)	—	—	Normal
1H (1)	0100H (256)	Cyclic(I/O) messages error	Connection serial number is duplicated. Change the connection serial number.
1H (1)	0103H (259)	Cyclic(I/O) messages error	The specified trigger can't be used. Change the trigger to cyclic.
1H (1)	0106H (262)	Cyclic(I/O) messages error	Connection Point in the direction of Originator ⇒ Target specified with Connection Path of Forward_Open is already in use. Stop the connection, or connect with Input Only.
1H (1)	0111H (273)	Cyclic(I/O) messages unsupported RPI err	The timeout multiplier is larger than 7, or an unsupported RPI (less than 500 μs and larger than 10s) is specified. Correct invalid parameters.
1H (1)	0112H (274)	Cyclic(I/O) messages error	RPI in use and RPI to be opened are different. Match the RPI to be opened to the RPI in use.
1H (1)	0113H (275)	Cyclic(I/O) msgs out of connections err	Connection Point in the direction of Target ⇒ Originator specified with Connection Path of Forward_Open is already in use as Point To Point. To open multiple connections, change to multicast.
1H (1)	0114H (276)	Cyclic(I/O) msgs compatibility check err	Vendor ID or product code (EDS) does not match the target device. Make sure that the device set on the scanner is "KV-EP02".
1H (1)	0115H (277)	Cyclic(I/O) msgs compatibility check err	The device type (EDS) does not match the target device. Make sure that the device set on the scanner is "KV-EP02".

Error code	Detailed error code	Error message	Cause/Measure
1H (1)	0116H (278)	Cyclic(I/O) msgs compatibility check err	The revision (EDS) does not match the target device. Make sure that the device set on the scanner is "KV-EP02".
1H (1)	011DH (285)	Cyclic(I/O) messages error	The specified trigger can't be used. Please change the trigger to cyclic.
1H (1)	0120H (288)	Cyclic(I/O) messages error	The size type in use and the size type to be opened are different. Match the size type to be opened to the size type in use.
1H (1)	0122H (290)	Cyclic(I/O) messages error	The priority in use and the priority to be opened are different. Match the priority to be opened to the priority in use.
1H (1)	0123H (291)	Cyclic(I/O) messages error	The specified Connection in the direction of Originator ⇒ Target is not Point to Point. Change to Point to Point.
1H (1)	0124H (292)	Cyclic(I/O) messages error	The specified Connection in the direction of Originator ⇒ Target is not Point to Point or Multicast. Change to Point to Point, or change to Multicast.
1H (1)	0127H (295)	Cyclic(I/O) messages size error	Size of the specified Connection in the direction of Originator ⇒ Target is too large. Specify the size as 240 bytes.
1H (1)	0128H (296)	Cyclic(I/O) messages size error	Size of the specified Connection in the direction of Originator ⇒ Target is too large. Specify the size as 400 bytes.
1H (1)	012AH (298)	Cyclic(I/O) messages error	The specified Connection Point in the direction of Originator ⇒ Target is incorrect. Select 101 (Exclusive Owner) or 254 (Input Only) for Connection Point.
1H (1)	012BH (299)	Cyclic(I/O) messages error	The specified Connection Point in the direction of Target ⇒ Originator is incorrect. Select 100 for Connection Point.
1H (1)	0134H (308)	Cyclic(I/O) messages error	The size in use and the size to be opened are different. Match the size to be opened to the size in use.
1H (1)	0137H (311)	Cyclic(I/O) messages error	The specified class is not Class 1 or Class 3. Select to Class 1 or Class 3.
1H (1)	0302H (770)	Cyclic(I/O) msgs Network bandwidth err	There is not enough communication allowable bandwidth. Reduce the number of connections to "KV-EP02".

7-1 Error List

Error code	Detailed error code	Error message	Cause/Measure
1H (1)	0315H (789)	Cyclic(I/O) messages error	The specified Connection Point can't be found. Select 101 (Exclusive Owner) or 254 (Input Only) for Connection Point which in Originator ⇒ Target direction. Specify 100 for Connection Point in Target ⇒ Originator direction. Specify 1 for Connection Point of Configuration (the product specific setting).
1H (1)	0321H (801)	Cyclic(I/O) msgs number of sensors error	The number of expansion units exceeds the limit number, or two or more KV-NC1, KV-N1 are connected. Reduce the number while the power supply is off.
1H (1)	0322H (802)	Cyclic(I/O) msgs sensor connection error	An error occurred in expansion bus communication. Check the connection of the expansion unit with the power off. Keep it away from noise sources.
1H (1)	0325H (805)	Cyclic(I/O) msgs sensor unsupported err	Unsupported expansion unit is connected. Remove the unsupported expansion unit while the power is off.
1H (1)	04C2H (1218)	Product specific setting error	Configuration (the product specific setting) size is abnormal. When using a PLC of another company, select 0 for the size.
1H (1)	0640H~ 067FH (1600~ 1663)	Cyclic(I/O) msgs compatibility check err	The setting value of number of devices does not match the number of connected devices. Make sure they match.
1H (1)	0680H~ 06BFH (1664~ 1727)	Cyclic(I/O) msgs compatibility check err	The device placed in the error slot is allocated to the slot area occupied by other device in this slot. Make sure that the set device matches the connected device.
1H (1)	06C0H~ 06FFH (1728~ 1791)	Cyclic(I/O) msgs compatibility check err	The number of occupied slots (EDS) of the device placed in the error slot does not match the target device. Make sure that the set device matches the connected device.
1H (1)	0700H~ 073FH (1792~ 1855)	Cyclic(I/O) msgs compatibility check err	The product code (EDS) of the device placed in the error slot does not match the target device. Make sure that the set device matches the connected device.
1H (1)	0740H~ 077FH (1856~ 1919)	Cyclic(I/O) msgs compatibility check err	The revision (EDS) of the device placed in the error slot does not match the target device. Make sure that the set device matches the connected device.

Error code	Detailed error code	Error message	Cause/Measure
2H (2)	—	Cyclic(I/O) resource unavailable err	The maximum number of connections has already been used. Reduce the number of connections connected to "KV-EP02".
4H (4)	—	Cyclic(I/O) messages error	Attribute ID is specified. Do not specify the attribute ID for Forward_Open.
5H (5)	—	Cyclic(I/O) messages error	The specified instance ID does not exist. For Forward_Open, select 1 for the instance ID.
10H (16)	—	Cyclic(I/O) messages device state error	"KV-EP02" is in preparation. Please issue again.
13H (19)	—	Cyclic(I/O) messages error	Transmission data length is too small. Check the size of Forward_Open.
15H (21)	—	Cyclic(I/O) messages error	Transmission data length is too large. Check the size of Forward_Open.

Message communication error list

Error code	Status name	Description
00H (0)	Success	Service execution is successful.
01H (1)	Connection failure	Connection open failed.
02H (2)	Resource unavailable	Service execution is impossible because the resource of object is insufficient.
03H (3)	Invalid parameter value	The value of the specified parameter is invalid.
04H (4)	Path segment error	Path is invalid.
05H (5)	Path destination unknown	The service destination indicated by the specified path does not exist in the target node.
06H (6)	Partial transfer	Information necessary for the service is insufficient.
07H (7)	Connection lost	The message transmission connection has been disconnected.
08H (8)	Service not supported	The requested service is not supported.
09H (9)	Invalid attribute value	The value specified for attribute is invalid.
0AH (10)	Attribute list error	The attribute list specified with Get_Attribute_List or Set_Attribute_List service contains attributes that can't be set or retrieved.
0BH (11)	Already in requested mode/state	The object is already set to the specified mode/state.
0CH (12)	Object state conflict	The object can't execute the requested service in current state.
0DH (13)	Object already exists	The specified instance already exists.
0EH (14)	Attribute not settable	The value of the specified attribute is for read-only.
0FH (15)	Privilege violation	There is no permission to execute this service.
10H (16)	Device state conflict	The target node can't execute the requested service in the current mode.
11H (17)	Reply data too large	Response data size is too large.
12H (18)	Fragmentation of a primitive value	The service can't divide basic data type values.
13H (19)	Not enough data	Size of service data is insufficient.
14H (20)	Attribute not supported	The specified attribute is not supported.
15H (21)	Too much data	The service was not executed because size of the service data is too large.
16H (22)	Object does not exist	The specified object does not exist.

Error code	Status name	Description
17H (23)	Service fragmentation sequence not in progress	The target node failed to receive the message fragment correctly.
18H (24)	No stored attribute data	Data is not set for the specified attribute.
19H (25)	Store operation failure	An error occurred while saving attribute data on the target node.
1AH (26)	Routing failure, request packet too large	The request message could not be sent to the target node in the current network because its size is too large.
1BH (27)	Routing failure, response packet too large	The response message could not be received from the target node in the current network because its size is too large.
1CH (28)	Missing attribute list entry data	Required attributes for service are not contained in the specified attribute list.
1DH (29)	Invalid attribute value list	Invalid attributes are included in the specified attribute list.
1EH (30)	Embedded service error	An error occurred in the embedded service.
1FH (31)	Vendor specific error	A vendor specific error occurred in the target node.
20H (32)	Invalid parameter	The specified parameter is invalid.
21H (33)	Write-once value or medium already written	The target node can't write for the set value.
22H (34)	Invalid Reply Received	An invalid response message was received.
23H (35)	Buffer Overflow	Reception failed because the size of the response message exceeded the receive buffer size.
24H (36)	Message Format Error	Message format is not supported.
25H (37)	Key Failure in path	The specified electronic key did not match the target node.
26H (38)	Path Size Invalid	Messages couldn't be routed because the request path size is insufficient or the path is too long.
27H (39)	Unexpected attribute in list	The specified attribute is not ready to set the value.
28H (40)	Invalid Member ID	The specified member does not exist.
29H (41)	Member not settable	The specified member is for read-only.
2EH (42)	Service Not Supported for Specified Path	The object supports the requested service, but it is not supported on the specified path (attribute).

7-1 Error List

Error code	Status name	Description
D0H (208)	Invalid parameter combination	(RemoteIO object only) There are invalid combination parameters. Detailed information is stored in expansion status. ③Updating settings (page 5-27)

7-2 Device Profile

Classification	Item	Description
General data	Vendor name	Keyence Corporation
	Vendor ID	367
	Device Type	43 (Generic Device)
	Revision	1.1
	Product code	200
	Product name	KV-EP02

7-3 Reset (initialize) Settings

You can restart "KV-EP 02" to initialize to the factory default settings by pressing and holding the reset switch for 3 seconds or more, or by using the Identity Object Reset service of message communication.

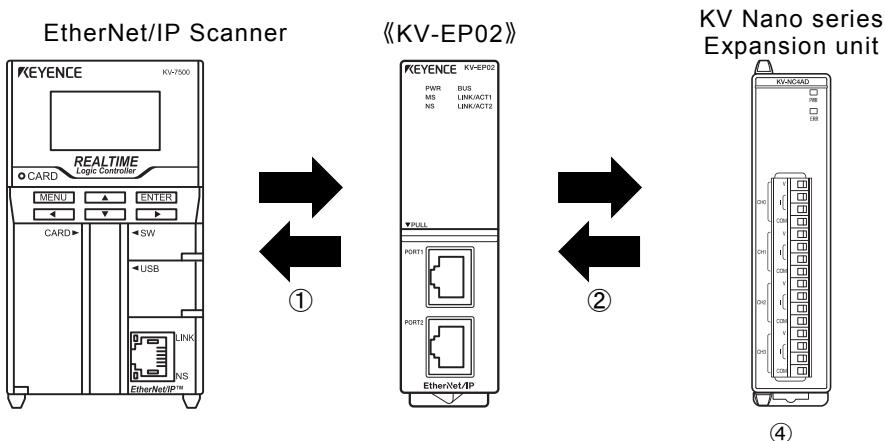
The factory default settings are as follows.

Setting item	Initialization value
Communication rate	10/100Mbps Auto
IP address setting method	BOOTP
IP address	Unassigned ※
Subnet mask	255.255.255.0
Default gateway	0.0.0.0
TTL for multicast	1
Multicast assign method	0 (Auto)
Number of multicast addresses	32
Multicast address	239.255.0.0
Expansion unit settings	None

※ When the IP address is unassigned, only the BOOTP client function can be used.
In order to use other functions, IP address setting is necessary.
If you set the rotary switch to 1 to 254, IP address is set to 192.168.0. □ (□ is the rotary switch setting).

7-4 Data processing time

An example of data processing time for cyclic (I/O) messages is shown below.



$$\text{Max. data processing time} = ① + ② + ③$$

- ① Scan time of PLC + RPI (Communication period)
- ② Data communication time between "KV-EP02" and expansion units
- ③ Expansion unit response time of Expansion unit.

- ① RPI is set on EtherNet/IP scanner side. The setting range is 0.5ms to 10000ms and can be set every 0.5ms.
- ② Estimated data communication time between "KV-EP02" and expansion unit is as follows.

$$50 + 8 \times (\text{number of expansion I/O units}) + 30 \times (\text{number of analog and temperature units}) [\mu\text{s}]$$

(It may be worse than the above depending on the Ethernet reception condition)

For the time of ① and ③, refer to the manual of each unit.

7-5 Available objects of KV-EP02

This section describes the available objects of "KV-EP02".

List of the available objects

Available objects of "KV-EP02" are as follows.

Object name	Class ID	Instance ID
Identity Object	1(01H)	1(01H)
Message Router Object	2(02H)	1(01H)
Assembly Object	4(04H)	100(64H)~101(65H)
Connection Manager Object	6(06H)	1(01H)
RemoteIO Object	112(70H)	0(00H)~15(0FH)
TCP/IP Interface Object	245(F5H)	1(01H)
Ethernet Link Object	246(F6H)	1(01H) ~2(02H)

For RemoteIO Objects, refer to □ "Using RemoteIO Object" (page 5-25)

How to read the table of each Object

How to read the class attribute/instance attribute

Ex) Select a part of the instance attribute of Identity Object

①	②	③	④	⑤	⑥
Attribute ID	Name	Description	Attribute	Data type	Parameter range

Item	Description
①Attribute ID	Displays the attribute ID in hex.
②Name	Displays the attribute name.
③Description	Displays the description for attribute.
④Attribute	Displays the service direction for the attribute ID. R (Read) : Get_Attribute_Single, Get_Attributes_All can be used to read the attribute value. W (Write) : Get_Attribute_Single can be used to write a value to the attribute.
⑤Data type	Displays the data type for attribute.
⑥Parameter range	Displays readable data from the attribute, or the settable parameter range.

Data type

The type of data is specified by EtherNet / IP specification as follows.

Data type	Description	Range	
		Minimum	Maximum
INT	16 bit integer, with sign	- 32768	32767
UINT	16 bit integer, no sign	0	65535
USINT	8 bit integer, no sign	0	255
UDINT	32 bit integer, no sign	0	$2^{32} - 1$
WORD	Bit string: 16 bits	-	-
DWORD	Bit string: 32 bits	-	-
BYTE	Bit string: 8 bits	-	-
SHORT_STRING	Character string (1 byte length information + One byte array per character)	-	-
STRING	Character string (2 byte length information + One byte array per character)	-	-

Identity Object (Class ID : 01H)

This is an object that provides identification information, general information and reset service for "KV-EP02".

■ Class

- Class service

Supports Get_Attribute_Single (0EH) and Get_Attributes_All (01H).

- Class Attribute (Instance ID : 00H)

Attribute ID	Name	Description	Attribute	Data type	Parameter range
01H	Revision	Object revision	R	UINT	0001H
02H	Max Instance	Max. instance number	R	UINT	0001H
03H	Number of Instances	Number of generated object instances	R	UINT	0001H
06H	Maximum ID Number Class Attributes	Largest attribute ID of class attribute	R	UINT	0007H
07H	Maximum ID Number Instance Attributes	Largest attribute ID of instance attribute	R	UINT	0007H

■ Instance

- Instance service

Supports Get_Attribute_Single (0EH) Get_Attributes_All (01H) and Reset service (05H). □ "Reset service" (page 7-16)

- Instance Attribute (Instance ID : 01H)

Attribute ID	Name	Description	Attribute	Data type	Parameter range
01H	Vendor ID	Vendor identification number	R	UINT	016FH
02H	Device Type	Common device type	R	UINT	002BH
03H	Product Code	Product identification code	R	UINT	00C8H
04H	Revision	Identity object revision	R	Structure	—
	Major Revision	Major revision		USINT	01H
	Minor Revision	Minor revision		USINT	01H
05H	Status	Status of "KV-EP 02"	R	WORD	Document 1
06H	Serial Number	Serial number	R	UDINT	Serial number
07H	Product Name	Product name	R	SHORT-STRING	"KV-EP02"

Document 1 Contents of **Status (16bit)**

Bit	Name	Description
0	Owned	Turns on when one or more connections of class 1 or class 3 are opened.
1	Reservation	Always OFF.
2	Reservation	Always ON.
3	Reservation	Always OFF.
4~7	Extended Device Status	4 to 7 bits display device status as follows depending on the state of KV-EP02. 0101 ① : Unrecoverable fault state (1) 0010 ② : State that one or more connections are timed out (except for ①) 0011 ③ : State that there is no connection (except for ① and ②). 0110 ④ : State that one or more connections are in RUN state (except for ①, ② and ③) 0111 : States other than ① to ④
8	Minor Recoverable Fault	Always OFF.
9	Minor Unrecoverable Fault	Always OFF.
10	Major Recoverable Fault	ON : Turns ON when recoverable unit error occurs. MS LED flashes in red.
11	Major Unrecoverable Fault	ON : Turns ON when unrecoverable unit error (eg EEPROM read error) occurs. MS LED lights in red.
12~15	Reservation	Always OFF.

Reset service

The Reset service is one of CIP standard services, as well as a function to restart the power supply and realize (emulate) the same operation as much as possible. When KV-EP02 accepts this service to stop each function, disconnect communication and reload settings. The Reset service is used as a restart request to reflect changed parameters (eg IP address, Ethernet communication rate etc). Execute the Reset service by specifying the Instance ID of Identity object as 01H.



Commands received during Reset processing may be discarded.
Responses for Reset service will reply before "KV-EP02" starts to reset.

Service code	Service name	Service data (1 byte)
05H	Reset	00H : Emulates power reset. 01H : Resets to factory default and emulates power reset. For factory default settings, refer to □ “Reset (initialize) Settings” (page 7-10) • If you select anything other than the above, 03H (Invalid parameter value) will be replied as the general status.

■ List of general status and expansion status replied to each service

Service	General status	Expansion status	Description
Get_Attributes_All	00H	—	Ended normally.
	05H	—	The specified instance ID does not exist.
Reset	00H	—	Ended normally.
	03H	—	The specified reset method is incorrect.
	05H	—	The specified instance ID does not exist.
Get_Attribute_Single	00H	—	Ended normally.
	05H	—	The specified instance ID does not exist.
	14H	—	The specified attribute ID does not exist.
Others	08H	—	Does not support the specified service.

Message Router Object (Class ID : 02H)

This is an object that provides a connection point for message communication.

■ Class

- Class service

Supports Get_Attribute_Single (0EH) .

- Class Attribute (Instance ID : 00H)

Attribute ID	Name	Description	Attribute	Data type	Parameter range
01H	Revision	Object revision	R	UINT	0001H
02H	Max Instance	Maximum instance number	R	UINT	0001H
03H	Number of Instances	Number of generated object instances	R	UINT	0001H
06H	Maximum ID Number Class Attributes	Largest attribute ID of class attribute	R	UINT	0007H
07H	Maximum ID Number Instance Attributes	Largest attribute ID of instance attribute	R	UINT	0002H

■ Instance

- Instance service

Supports Get_Attribute_Single (0EH) .

- Instance Attribute (Instance ID : 01H)

Attribute ID	Name	Description	Attribute	Data type	Parameter range
01H	Object_list	List of supported objects	R	Structure	—
	Number	Number of classes supported in class array		UINT	0007H
	Classes	Class ID list		Array of type UINT	0001H, 0002H, 0004H, 0006H, 00F5H, 00F6H, 0070H
02H	Number Available	Maximum number of connections	R	UINT	0040H

■ List of general status and expansion status replied to each service

Service	General status	Expansion status	Description
Get_Attribute_Single	00H	–	Ended normally.
	05H	–	The specified instance ID does not exist.
	14H	–	The specified attribute ID does not exist.
Others	08H	–	Does not support the specified service.

Assembly Object (Class ID : 04H)

This is an object for directly accessing and controlling the same data sent and received by cyclic (I/O) messages, by using message communication. It can be used for sending data to devices not supporting cyclic (I/O) messages.

■ Class

- Class service

Supports Get_Attribute_Single (0EH) .

- Class Attributes (Instance ID : 00H)

Attribute ID	Name	Description	Attribute	Data type	Parameter range
01H	Revision	Object revision	R	UINT	0002H

■ Instance

- Instance service

Supports Get_Attribute_Single (0EH) and Set_Attribute_Single.

- Instance Attribute (Instance ID : 64H ~ 65H)

Attribute ID	Name	Description	Attribute	Data type	Parameter range
03H	Data	Data assigned to Instance ID	R/W ^{※1}	BYTE array	Data of the setting assigned to Instance ID ^{※2※3}
04H	Size	Number of bytes assigned to Instance ID	R	UINT	Size (in byte) of the setting assigned to Instance ID

※1 If the target Instance ID is 64H, the attribute is R.

※2 If reading with Get_Attribute_Single, simultaneity is guaranteed every instance ID.

※3 For the data assigned to each Instance ID, refer to the following.

Instance ID : 64H □ “Monitor data” (page 5-11)

Instance ID : 65H □ “Monitor data” (page 5-11)

■ List of general status and expansion status replied to each service

Service	General status	Expansion status	Description
Get_Attribute_Single	00H	—	Ended normally.
	05H	—	The specified instance ID does not exist.
	14H	—	The specified attribute ID does not exist.
Set_Attribute_Single	00H	—	Ended normally.
	05H	—	The specified instance ID does not exist.
	08H	—	The Instance ID whose attribute is read (R) was specified.
	0CH	—	The instance to execute a service is in cyclic (I/O) messages.
	0EH	—	You can't write to the specified attribute ID.
	14Z	—	The specified attribute ID does not exist.
Others	15H	—	Data larger than the defined size was tried to write.
	08H	—	Does not support the specified service.

Connection Manager Object (Class ID : 06H)

This is an object used for connection type communication, and used for opening a connection for "KV-EP02".

■ Class

- Class service/Class attributes
Has no Class service/Class attributes.

■ Instance

- Instance service

Supports Forward_Close (4EH) , Forward_Open (54H) . For details of the service, refer to the CIP specification document.

- Instance attribute

Has no Instance attribute.

■ List of general status and expansion status replied to each service

Service	General status	Expansion status	Description
Forward_Close	00H	—	Ended normally.
	04H	—	Attribute ID was specified.
	05H	—	The specified instance ID does not exist.
	13H	—	The send data length is too small.
Forward_Open	00H	—	Ended normally.
	01H	0100H	The specified connection is already in use.
		0103H	The specified trigger can't be used.
		0106H	<ul style="list-style-type: none"> The Connection Point in the direction of Originator ⇒ Target specified by Connection Path of Forward_Open in cyclic (I/O) messages is already in use.
		0111H	<ul style="list-style-type: none"> Timeout multiplier is larger than 7. RPI less than 500μs, or larger than 10s was specified. ※2
		0112H	RPI in use and RPI to be opened are different.
		0113H	The Connection Point in the direction of Target ⇒ Originator specified by Connection Path of Forward_Open is already in use by Point To Point.
		0114H	VendorID does not match. ProductCode does not match.
		0115H	DeviceType does not match.
		0116H	Revisions do not match.
		011DH	The specified trigger can't be used.
		0120H	The specified size type can't be used.
		0122H	The specified priority can't be used.
		0123H	The specified Connection in the direction of Originator ⇒ Target is not Point To Point.

Service	General status	Expansion status	Description
01H	0124H 0127H 0128H 012AH 012BH 0134H 0137H 0302H 0315H 0321H 0322H 0325H 04C2H 0640H-067FH 0680H-06BFH 06C0H-06FFH 0700H-073FH 0740H-077FH	0124H	The specified Connection in the direction of Target ⇒ Originator is not Point to Point or Multicast.
		0127H	Size of the specified Connection in the direction of Originator ⇒ Target is too large. *1
		0128H	Size of the specified Connection in the direction of Target ⇒ Originator is too large. *1
		012AH	Path of the specified Connection in the direction of Originator ⇒ Target is incorrect.
		012BH	Path of the specified Connection in the direction of Target ⇒ Originator is incorrect.
		0134H	The size in use and the size to be opened are different.
		0137H	The specified class is not Class 1 or Class 3.
		0302H	There is not enough communication allowable bandwidth.
		0315H	<p>Connection Size of Forward_Open network connection parameter is 0.</p> <ul style="list-style-type: none"> ConnectionPoint is not included in the Connection Path of Forward_Open. In the Connection Path of Forward_Open, Class ID is set to other than 04H for Cyclic and set to other than 02H for Class 3. In Class 3, Forward_Open Connection Path Instance ID is set to other than 1. In the cyclic (I/O) messages, a value other than 2 is selected as the Connection Size of the network connection parameter in the direction of Forward_Open transmission.
		0321H	<ul style="list-style-type: none"> The number of expansion units exceeds the limit number. Two or more KV-NC1 and KV-N1 are connected.
		0322H	An error occurred in expansion bus communication.
		0325H	Unsupported expansion unit is connected.
		04C2H	Specific settings of the product are abnormal.
		0640H-067FH	The specified device is not connected.
		0680H-06BFH	Other than the leading is specified on the unit with 2 or more occupied slots.
		06C0H-06FFH	The number of occupied slots is different.
		0700H-073FH	For when the compatibility is checked to "check model match," the ProductCode does not match.
		0740H-077FH	For when the compatibility is checked to "check model match," the major revision or minor revision does not match.

7-5 Available objects of KV-EP02

Service	General status	Expansion status	Description
	02H	—	Maximum number of connections has already been used.
	04H	—	Attribute ID is specified.
	05H	—	The specified Instance ID does not exist.
	10H	—	"KV-EP 02" is in preparation. Please issue again.
	13H	—	The send data length is too small.
	15H	—	The send data length is too large.
Others	08H	—	Does not support the specified service.

※1 It will succeed if the size is smaller than the connection size of "KV-EP02". If this error occurs, an expansion status is added, and the data size defined in the second expansion status will be replied.

※2 RPI is set in 500μs unit. If it is set to a value that can't be divided by 500μs, the RPI rounded up to the nearest 500μs will be specified.

TCP/IP Interface Object (Class ID : F5H)

This is an object that provides a mechanism to set the TCP/IP network interfaces such as IP address, subnet mask and gateway, etc.

■ Class

- Class service

Supports Get_Attribute_Single (0EH) Get_Attributes_All (01H) .

- Class Attributes (Instance ID : 00H)

Attribute ID	Name	Description	Attribute	Data type	Parameter range
01H	Revision	Object revision	R	UINT	0004H
02H	Max Instance	Maximum instance number	R	UINT	0001H
03H	Number of Instances	Number of generated object instances	R	UINT	0001H

■ Instance

- Instance service

Supports Get_Attribute_Single (0EH) , Set_Attribute_Single (10H) and Get_Attributes_All (01H) .

If the previous internal processing for Set_Attribute_Single has not been completed yet with the Set_Attribute_Single executed for the writable attribute ID, the general status "0CH" (Object State Conflict) is replied.

Changes of the writable attribute ID will be reflected when power is restarted or reset service is executed.

- Instance Attribute (Instance ID : 01H)

Attribute ID	Name	Description	Attribute	Data type	Parameter range
01H	Status	Interface status	R	DWORD	(Document 1)
02H	Configuration Capability	Getting default IP address	R	DWORD	(Document 2)
03H	Configuration Control	Getting default settings at startup by Device	R/W	DWORD	(Document 3)
04H	PhysicalLink Object	Path to physical layer link object	R	Structure	–
	Path size	Path size (bytes)		UINT	0002H
	Path	Segment to identify the physical layer link object		Padded EPATH	20F62401H
05H	Interface Configuration	TCP/IP network interface settings	R/W	Structure	–
	IP Address	Device IP address		UDINT	Setting value ^{※1}
	Network Mask	Device network mask (Subnet mask)		UDINT	Setting value ^{※1}
	Gateway Address	Default gateway address (Gateway address)		UDINT	Setting value ^{※1}

7-5 Available objects of KV-EP02

Attribute ID	Name	Description	Attribute	Data type	Parameter range
06H	Name Server	Primary name server (DNS server)		UDINT	Setting value ^{※1}
	Name Server 2	Secondary name server (Reservation)		UDINT	0 fixed
	Domain Name	Default domain name (Reservation)		STRING	0 fixed
06H	Host Name	Host name	R/W	STRING	0 fixed
08H	TTL Value	Multicast TTL value	R/W	USINT	1 (1 to 255) Setting value ^{※1}
09H	Mcast Config	Multicast address setting	R/W	Structure	—
	Alloc Control	Multicast address setting function (Multicast assignment)		USINT	0: Auto assignment 1: User-specified assignment
	Reserved	Reservation		USINT	00H
	Num Mcast	Number of multicast addresses (Multicast address number)		UINT	With Auto assignment : 0020H With User-specified assignment : 1 to 256 ^{※1}
	Mcast Start Addr	Multicast startup address (Assignment startup multicast address)		UDINT	With Auto assignment : ^{※2} With User-specified assignment : Setting value ^{※1}
0DH	Encapsulation Inactivity Timeout	Encapsulation layer timeout time [sec]	R/W	UINT	Default value : 120

※1 If an incorrect value is written, general status 09H (Invalid Attribute Value) will be repalyed.

※2 Multicast startup address for Auto assignment is calculated as $239.192.1.0 + (((\text{Host part of IP address} - 1) \& 03FFH) \times 32)$.

(Example)

If the IP address is 192.168.0.10, it becomes as follows.

$$\begin{aligned}\text{Startup address} &= 239.192.1.0 + (((192.168.0.10 - 1) \& 0x3FF) \times 32) \\ &= 239.192.1.0 + ((192.168.0.9 \& 0x3FF) \times 32) \\ &= 239.192.1.0 + (0.0.0.9 \times 32) \\ &= 239.192.1.0 + 0.0.1.32 \\ &= 239.192.2.32\end{aligned}$$

Document 1) Status list

Bit	Name	Description
0 to 3	Interface ConfigurationStatus	0 : IP address is not set (BOOTP activated state). 1 : IP address is set from BOOTP server. 2 : IP address is set by rotary switch. 3 or more: "KV - EP 02" will not reply.
4	Mcast Pending	It turns to 1 when "TTL Value" or "Mcast Config" is set. It is cleared to 0 when the power supply is turned on again.
5~31	Reservation	All OFF (fixed) .

Document 2) Configuration Capability list

Bit	Name	Description	
		Rotary switch is 0	Rotary switch isn't 0
0	BOOTP Client	ON (fixed)	OFF (fixed)
1	DNS Client	OFF (fixed)	OFF (fixed)
2	DHCP Client	OFF (fixed)	OFF (fixed)
3	DHCP-DNS Update	OFF (fixed)	OFF (fixed)
4	Configuration Settable	ON (fixed)	OFF (fixed)
5	Hardware Configurable	ON (fixed)	ON (fixed)
6 to 31	Reservation	OFF (fixed)	OFF (fixed)

Document 3) Configuration Control list (This attribute can be changed only when the rotary switch is 0)

Bit	Name	Description
0 to 3	Startup Configuration	Displays/sets □ "IP address setting method" of IP address setting tool. 0 : Fixed IP address 1 : BOOTP 2 to 15 : Can't be set. If set, it will replay a general status 09H (Bad attribute data value)
4	DNS Enable	OFF (fixed) : Ignores this bit operation when setting.
5 to 31	Reservation	All OFF (fixed) .

■ List of general status and expansion status replied to each service

Service	General status	Expansion status	Description
Get_Attributes_All	00H	—	Ended normally.
	05H	—	The specified Instance ID does not exist.
Get_Attribute_Single	00H	—	Ended normally.
	05H	—	The specified Instance ID does not exist.
	14H	—	The specified attribute ID does not exist.
Set_Attribute_Single	00H	—	Ended normally.
	05H	—	The specified Instance ID does not exist.
	09H	—	The written value is incorrect.
	0EH	—	Writing to the specified attribute ID is impossible.
	13H	—	The send data length is too small.
	14H	—	The specified attribute ID does not exist.
Others	08H	—	Does not support the specified service.

Ethernet Link Object (Class ID : F6H)

This is an object to provide Ethernet status information.

■ Class

- Class service
Supports Get_Attribute_Single (0EH) , Get_Attributes_All (01H) .
- Class Attributes (Instance ID : 00H)

Attribute ID	Name	Description	Attribute	Data type	Parameter range
01H	Revision	Object revision	R	UINT	0004H
02H	Max Instance	Maximum instance number	R	UINT	0002H
03H	Number of Instances	Number of generated object instances	R	UINT	0002H

■ Instance

- Instance service
Supports Get_Attribute_Single (0EH) , Set_Attribute_Single (10H) and Get_Attributes_All (01H) .
- Instance Attribute (Instance ID : 01H, Instance ID : 02H)
Interface Counters and Media Counters have the same value regardless of which instance they are accessed.

Attribute ID	Name	Description	Attribute	Data type	Parameter range
01H	Interface Speed	Interface communication rate.	R	UDINT	10 / 100
02H	Interface Flags	Interface status flag.	R	DWORD	Document 1)
03H	Physical Address	MAC address.	R	ARRAY of 6USINTs	Present value
04H	Interface Counters	Interface counter.	R	Structure	—
	In Octets	The number of octets received on the interface. Includes unnecessary multicast packets and discarded packets counted by In Discards.		UDINT	Present value
	In Ucast Packets	The number of unicast packets received on the interface. Discarded packets counted by In Discards are not included.		UDINT	Present value
	In NUCast Packets	Number of packets other than unicast received on the interface. Includes unnecessary multicast packets but does not include discarded packets counted by In Discards.		UDINT	Present value

Attribute ID	Name	Description	Attribute	Data type	Parameter range
	In Discards	Number of incoming packets discarded after receiving on the interface.		UDINT	Present value
	In Errors	Number of incoming packets including errors. It is not included in In Discards.		UDINT	Present value
	In Unknown Protos	Number of incoming packets including unknown protocol.		UDINT	0 (fixed)
	Out Octets	Number of octets sent on the interface.		UDINT	Present value
	Out Ucast Packets	Number of unicast packets sent on the interface.		UDINT	Present value
	Out NUCast Packets	Number of packets other than unicast sent on the interface.		UDINT	Present value
	Out Discards	Number of outgoing packets discarded.		UDINT	Present value
	Out Errors	Number of outgoing packets including errors.		UDINT	Present value
05H	Media Counters	Specific counters of the media.	R	Structure	-
	Alignment Errors	Number of received frames whose length is not an integer.		UDINT	Present value
	FCS Errors	Number of received frames that do not pass the FCS check.		UDINT	Present value
	Single Collisions	Number of successful transmission frames with only one collision.		UDINT	0 (fixed)
	Multiple Collisions	Number of successful transmission frames with more than two collisions.		UDINT	0 (fixed)
	SQE Test Errors	The number of times SQE test error message generated.		UDINT	0 (fixed)
	Deferred Transmissions	Number of frames delayed for the first send attempt because of the busy medium.		UDINT	0 (fixed)
	Late Collisions	Number of collisions detected after 512bit time in packet transmission.		UDINT	0 (fixed)
	Excessive Collisions	Number of frames failed to be sent because of excessive collisions.		UDINT	0 (fixed)

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Attribute ID	Name	Description	Attribute	Data type	Parameter range
	MAC Transmit Errors	Number of frames failed to be sent because of an internal MAC sublayer transmission error.		UDINT	0 (fixed)
	Carrier Sense Errors	The number of times carrier sense condition was lost or not asserted when trying to send a frame.		UDINT	Present value
	Frame Too Long	Number of received frames exceeding the maximum allowable frame size.		UDINT	Present value
	MAC Receive Errors	Number of frames failed to receive on the interface because of internal MAC sublayer receive errors.		UDINT	0 (fixed)
07H	Interface Type	Physical interface types	R	USINT	2=Twisted-pair (fixed)
0AH	Interface Label	Interface label	R	SHORT_STRING	Instance ID 01H : "port1" 02H : "port2"
0BH	Interface Capability		R	Structure	
	Capability Bits	Speed/non-duplex functions		DWORD	Document 2 6 (fixed)
	Speed/Duplex Options	Support speed/Duplex state		Structure	
	Speed/Duplex Array Count	Number of array		USINT	4 (fixed)
	Speed/Duplex Array	Speed/duplex array			
	Interface Speed	Speed		UINT	10, 100
	Interface Duplex Mode	Duplex mode		USINT	0 = half duplex 1 = full duplex

Document 1) Interface Flags list

Bit	Name	Description
0	Link Status	OFF : Inactive link ON : Active link
1	Half/FullDuplex	OFF : Half duplex ON : Full duplex (OFF when Link Status = 0)
2 to 4	Negotiation Status	0 : Auto negotiation is in progress. 1 : Auto negotiation and Speed detection failed. 2 : Auto negotiation failed but Speed detection succeeded. 3 : Negotiations in speed and duplex mode succeeded. 4 : Auto negotiation can't be performed (When the communication setting is fixed at 10 Mbps).
5	Manual Setting Requires Speed	OFF : The change can be automatically reflected. ON : Reset service is required for reflecting the change (fixed).
6	Local Hardware Fault	OFF (fixed)
7 to 31	Reservation	OFF (fixed)

Document 2) Capability Bits list

Bit	Name	Description
0	Manual Setting Requires Reset	OFF : Restarting is unnecessary to reflect Interface Control change. ON : Restarting is necessary to reflect Interface Control change.
1	Auto-negotiate	OFF : Does not support Auto-negotiation ON : Supports Auto-negotiation
2	Auto-MDIX	OFF : Does not support Auto-MDIX ON : Supports Auto-MDIX
3	Manual Speed/Duplex	OFF : Does not support Interface Control change ON : Supports Interface Control change
4 to 31	Reservation	0 fixed

■ List of general status and expansion status replied to each service

Error code	General status	Expansion status	Description
Get_Attributes_All	00H	—	Ended normally.
	05H	—	The specified Instance ID does not exist.
Get_Attribute_Single	00H	—	Ended normally.
	05H	—	The specified Instance ID does not exist.
	14H	—	The specified attribute ID does not exist.
Set_Attribute_Single	00H	—	Ended normally.
	05H	—	The specified Instance ID does not exist.
	09H	—	The written value is incorrect.
	0CH	—	The object can't execute the requested service in current state.
	0EH	—	Writing to the specified attribute ID is impossible.
	13H	—	The send data length is too small.
Others	14H	—	The specified attribute ID does not exist.
	08H	—	Does not support the specified service.

7-6 Index

The index of terms used in this document. It is arranged in alphabetical order.

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Revision History

Printing Date	Version	Details of Revision
Dec 2017	Initial version	

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