OMRON

Vision Sensor

FHV7-AI Series

AI Detection Camera

User's Manual

FHV7X-C016-S□□-W-01

Z507-E1-04

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Introduction

Thank you for purchasing the FHV7-AI series.
This manual contains information that is necessary to use the FHV7-AI series.
Please read this manual and make sure you understand the functionality and performance of the FHV7-AI series before you attempt to use it in a control system.
Keep this manual in a safe place where it will be available for reference during operation.

Intended Audience

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

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

Applicable Products

This manual covers the following products.

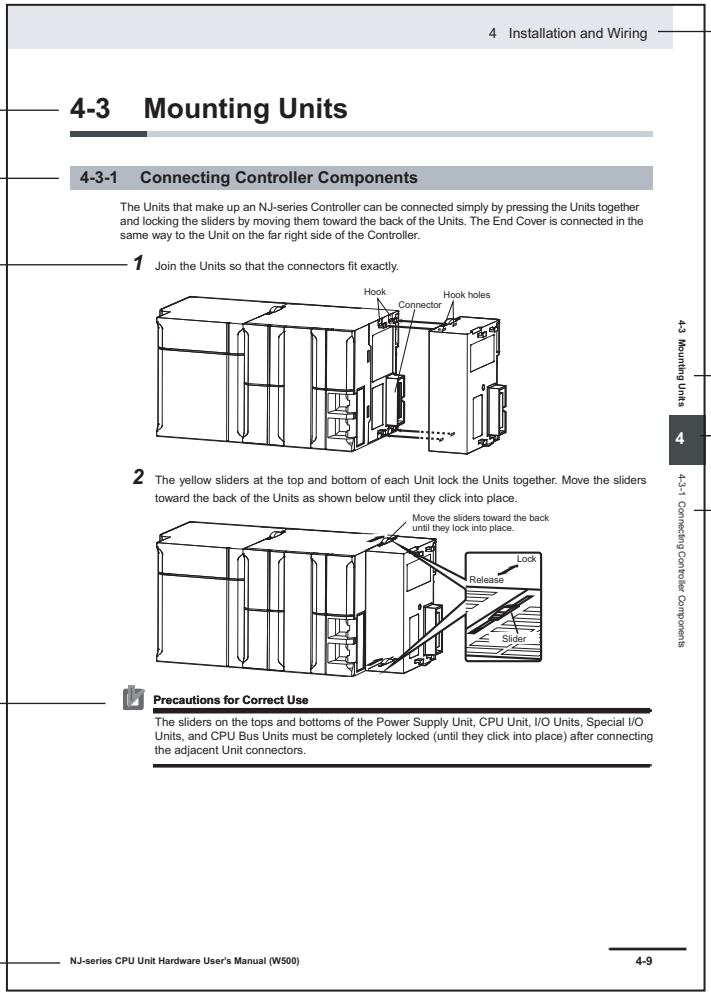
- FHV7X-C016-S□□-W-01

Part of the specifications and restrictions are given in other manuals. Refer to Relevant Manuals on *Related Manuals* on page 23.

Manual Structure

Page Structure

The following page structure is used in this manual.



Level 1 heading

Level 2 heading

Level 3 heading

Gives the current headings.

Page tab

Gives the number of the main section.

A step in a procedure

Indicates a procedure.

Special information

Icons indicate precautions, additional information, or reference information.

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

Special Information

Special information in this manual is classified as follows:

Precautions for Safe Use

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

Precautions for Correct Use

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

Additional Information

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

Sections in This Manual

CONTENTS

Section 1 Overview

Section 6 What to Do!

Appendices

Index

Terms and Conditions Agreement

Warranty, Limitations of Liability

Warranties

- **Exclusive Warranty**

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

- **Limitations**

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

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

- **Buyer Remedy**

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

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

Limitation on Liability; Etc

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

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

Application Considerations

Suitability of Use

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

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

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

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Performance Data

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

Change in Specifications

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

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

Errors and Omissions

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

Safety Precautions

Symbols and the Meanings for Safety Precautions Described in This Manual

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

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

Meanings of Alert Symbols

	General Prohibition Indicates general prohibitions, including warnings, for which there is no specific symbol
	General Caution Indicates general cautions, including warnings, for which there is no specific symbol.
	The filled circle symbol indicates operations that you must do. The specific operation is shown in the circle and explained in text. This example shows a general precaution for something that you must do.
	Electrical Hazard Indicates the possible danger of electric shock under specific conditions. The left-hand icon means a precaution of the above possibility (including warning).
	LED light Harm may be caused by LED light. The left-hand icon means a precaution of the above possibility (including warning).
	High Temperature Caution Indicates the possible danger of injury by high temperature under specific conditions. The left-hand icon means a precaution of the above possibility (including warning).

Warning

⚠ WARNING

This product must be used according to this manual and Instruction Sheet.
Failure to observe this may result in the impairment of functions and performance of the product.

This product is not designed or rated for ensuring the safety of persons.
Do not use it for such purposes.

Never connect the AC power supply with this product. When the AC power supply is connected, it causes the electric shock and a fire.

Visual impairment might be caused by continuously looking at LED light in rare cases. If a specular object is used, take care not to allow reflected light enter your eyes.

Do not touch the terminals while the power supply is ON.
Doing so may result in electrical shock.

Please take external safety measures so that the system as a whole should be on the safe side even if a failure of a smart camera or an error due to an external factor occurred. An abnormal operation may result in serious accident.

Please take fail-safe measures on your side in preparation for an abnormal signal due to signal conductor disconnection and/or momentary power interruption.
An abnormal operation may result in a serious accident.

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

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

- Install physical controls so that only authorized personnel can access control systems and equipment.
- Reduce connections to control systems and equipment via networks to prevent access from untrusted devices.
- Set strong passwords and change them frequently.
- Scan virus to ensure safety of USB drives or other external storages before connecting them to control systems and equipment.

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

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

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

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

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

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

⚠ Caution

Minor burn may occur. Do not touch the case as it is very hot while the product is operating or immediately after the power is turned OFF.

Tighten the screws securely when attaching the cover. Damage or malfunction to the main unit or injury may occur.

Precautions for Safe Use

Condition of the Fitness of OMRON Products

- *Omron products* are designed and manufactured as general-purpose products for use in general industrial applications. They are not intended to be used in the following critical applications. If you are using *Omron products* in the following applications, *Omron* shall not provide any warranty for such *Omron products*, unless otherwise specifically agreed or unless the specific applications are intended by Omron.
  a) Applications with stringent safety requirements, including but not limited to nuclear power control equipment, combustion equipment, aerospace equipment, railway equipment, elevator/lift equipment, amusement park equipment, medical equipment, safety devices and other applications that could cause danger/harm to people's body and life.
  b) Applications that require high reliability, including but not limited to supply systems for gas, water and electricity, etc., 24 hour continuous operating systems, financial settlement systems and other applications that handle rights and property.
  c) Applications under severe condition or in severe environment, including but not limited to outdoor equipment, equipment exposed to chemical contamination, equipment exposed to electromagnetic interference and equipment exposed to vibration and shocks.
  d) Applications under conditions and environment not described in specifications.

1. In addition to the applications listed from (a) to (d) above, *Omron products* (see definition) are not intended for use in vehicles designed human transport (including two wheel vehicles). Please do NOT use Omron products for vehicles designed human transport. Please contact the Omron sales staff for information on our automotive line of products.
2. The above is part of the Terms and Conditions Agreement. Please use carefully read the contents of the guarantee and disclaimers described in our latest version of the catalog, data sheets and manuals.

Installation Environment

- Do not use the product in areas where flammable or explosive gases are present.
- Do not install the product close to high-voltage devices and power devices in order to secure the safety of operation and maintenance.
- Avoid installation in a place exposed to vibration as much as possible.
- Do not install the product near to a device causing noises. if the product is installed in a noisy environment and operational errors are caused, be sure to take shielding measures.

Power Supply and Wiring

- Make sure to use the product with the power supply voltage specified. If a DC voltage exceeding the rating or an AC voltage is applied, the circuit parts may be burnt or exploded.
- Do not connect the power supply with polarity reversed.
- Use a DC power supply with safety measures against high-voltage spikes (safety extra low-voltage circuits on the secondary side).
- Use an independent power source for this product. Do not use a shared power source.

- Never apply more than the rated voltage or AC power supply to this product. It may cause malfunction.
- The recommended power supplies are as follows:
  - use S8VK-G12024 (OMRON) or S8VS-12024 (OMRON).
- Wire high-voltage cables or power cables are separated from the cables of this product. If the same cable or duct is used, the product may receive induction and it may cause malfunctioning or breakage.
- Do not short-circuit the load on the open collector output.
- Apply load not exceeding the rating.
- Before wiring an I/O cable, attach a crimping terminal. Do not connect cables just twisted together to the power supply or terminal block directly.
- Do not put load on the cables and connectors before wiring them.
- Insulate unnecessary signal cables so that they do not contact any other signal cables. Contact between RS-232C IN/RS-232C OUT/NC/RS-232C 0V and DC24V/COM IN/COM OUT may result in a failure.
- After wiring the cables, confirm if the power supply is appropriate, if there is miswiring such as short-circuit of load, if the load current is appropriate, and if FG is connected appropriately. Otherwise, the product may be broken due to miswiring etc.
- Take enough safety measures such as a failsafe circuit before using the product.
- Be sure to apply Class D grounding (100 Ω or lower grounding resistance) to the case of the smart camera and the ground wire of the I/O cable. Be sure to use the mounting screw hole when grounding the case.
  Be sure to apply Class D grounding (100Ω or lower grounding resistance) to the ground wire of the FHV-SDU body.
- Do not share the ground wire with some other devices or connect it to the beam of the building. The product may be adversely affected.
- Determine the contact point as near as possible to shorten the ground wire as much as possible. The product may be adversely affected.
- For positive ground, please refer to cautions described in this manual.

Mounting

- When doing the following, be sure to turn OFF the power of the smart camera main unit or connected peripheral devices. Not doing so leads to a product failure.
  - Cable connection and wiring
  - Connector mounting/removal
- Tighten the mounting screws securely using the defined torque and order described in this manual.
- After removing the cable, be sure to put the connector cap. If the connector cap is not put, the product may malfunction or be broken due to entering of foreign materials.
- For the component with a lock mechanism, be sure to confirm that it is locked before using the product.
- Do not apply torsional stress to the cable. Doing so may cause cable breakage.
- Secure the minimum bending radius of the cable. If it cannot be secured, the cable may be broken.

Others

- Use only the dedicated cable (FHV-VNB2/FHV-VDB2/FHV-VUB2/FHV-VNLB2/FHV-VDLB2/FHV-VULB2). Otherwise, the product may malfunction or be broken.
- If anything abnormal occurs, for example, strange smell/sound is detected, the main unit gets very hot, or a smoke comes, stop using the product, turn OFF the product, and consult OMRON's branch or sales office.
- Do not disassemble, deform by pressurizing, incinerate, repair, or alter this product.
- When disposing of the product, treat as industrial waste.
- Do not drop the product or expose it to abnormal vibration or impact. Doing so may lead to product failure.

Precautions for Correct Use

Installation Location

In order to prevent the product from becoming inoperable or malfunction, and to prevent other adverse effects to the performance or equipment, please observe the following.

- A location where the ambient temperature and relative humidity does not exceed the rated range.
- A location where the temperature does not vary sharply (condensation occurs).
- A location not exposed to corrosive gases or combustible gases.
- A location not exposed to dust, salt, or metal powder.
- A location not exposed to direct vibration or impact.
- A location not exposed to strong disturbance light (laser light, arc welding light, or ultraviolet light).
- A location not near a heating appliance or exposed to direct sunlight.
- A location not exposed to mist of water, oil, or chemicals or misty atmosphere.
- A location not exposed to strong magnetic/electric fields.
- A location not near a high-voltage device or power device.

Power Supply, Connection, and Wiring

- If the power supply line has surge, connect a surge absorber according to the operational environment to use the product.
- To use the product in an environment with strong noise, use a noise filter (Omron's S8V-NFS206 or equivalent) for the smart camera's power input block.
- If contacting a terminal or a signal cable inside the connector, use a wrist strap to take antistatic measures to prevent breakage due to static electricity.
- Attach the cable straight with the terminal correctly aligned. Forcibly attaching the cable may bend the terminal, resulting in failure or communication error.
- If using an I/O cable 20 m long, confirm that the power supply output is 24 VDC or higher. If it is lower than 24 VDC, the product does not operate.
- Do not turn OFF the power supply while data are being saved in the smart camera. Otherwise, data on the memory is broken, so the product does not operate normally when started up next time.
- When a message indicating that processing is being executed is displayed on the screen, do not turn OFF the power. Otherwise, data on the memory is broken, so the product does not operate normally when started up again.
- When turning OFF the power, confirm that data have been saved completely before starting operations.
  - When data are saved by operating the smart camera, the saving process must have been completed and the following user operations must be possible.
- After turning off the power, wait at least 1 second before restarting.
- Do not insert the microSD card inversely, obliquely, or as twisting it.
- While data are being read in or written to the microSD card, the SD ACCESS LED on the smart camera main unit is turned on for a while. Remove the card after confirming that the LED is completely turned off.
- Except when inserting or removing the microSD card, put the cover of the microSD card inserting connector and screw it up before using the product.

Maintenance

- Turn OFF the power and confirm safety before starting maintenance.
- Do not use thinner, alcohol, benzene, acetone, or kerosene to clean this product.

Optical axis

- The optical axis may vary product by product. When mounting this module, be sure to confirm the center position of the video on the monitor. The optical axis of this product may vary over a couple of pixels due to the variation of ambient temperature because of the material characteristics.
- Select the model by confirming the field of view and camera installation distance on the optical diagram. In addition, the field of view may vary product by product. When mounting this product, be sure to confirm video using the monitor.

Image Sensor

- For this product, a line may appear depending on the measurement condition or sensitivity because of the specification of the image sensor.
  However, this is not a fault or failure of the product. In addition, although there may be multiple defective pixels, this is not a fault or failure of the product. Use the product as confirming the actual image.

Communications with Upper Equipment

- Implement communication with upper equipment after confirming that this product has been started up. In addition, when this product is being started up, unstable signals may be issued by the upper interface. So, if operating this product initially, take action such as clearing the receiving buffer of the equipment used.

Warm-up

- Turn ON the power and wait for 60 minutes or more before conducting precise inspection. The correct focus may not be achieved or may fluctuate right after power-on.

Camera Installation

- If installing smart camera main units side by side, secure a space of 30 mm or more wide between them.

Others

- For better heat radiation, use the separately sold fitting (FHV-XMT-7) or mount the product to the metal frame (recommended size: 100 x 110 mm or more and thickness: 10 mm max.).
- If focus switching of the product is repeatedly performed for other than installation and adjustment, its performance may be degraded due to heat and/or wear of internal components.
- When turning on the this product, the date/time settings always returns to the default. Therefore, you need to re-set the date/time with an operation or a communication command every time at startup.

- This product does not support to recombine lens/lightning modules, or waterproof hoods, nor the exchange of accessories associated with such modifications.
- This product does not support to connect external light or FHV-SDU30 smart camera data unit.

LED Safety

This product is classified into the risk group 2 by IEC62471.

Regulations and Standards

Using Product Outside Japan

If you export (or provide a non-resident with) this product or a part of this product that falls under the category of goods (or technologies) specified by the Foreign Exchange and Foreign Trade Control Law as those which require permission or approval for export, you must obtain permission or approval or service transaction permission) pursuant to the law.

Conformance to EC/EU Directives and UK Legislations

The product is compliant with the standards below:

- EU Directive 2014/30/EU (After April 20 2016)/EU/UK legislations 2016 No 1091 Electromagnetic Compatibility Regulations 2016 EN61326-1
  Electromagnetic environment : Industrial electromagnetic environment (EN/IEC 61326-1 Table 2)
- This product complies with EC/EU Directives. EMC-related performance of the OMRON devices that comply with EC/EU Directives will vary depending on the configuration, wiring, and other conditions of the equipment or control panel on which the OMRON devices are installed.
- The customer must, therefore, perform the final check to confirm that devices and the overall machine conform to EMC standards.

Conformance to KC Standards

Observe the following precaution if you use this product in Korea.

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

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

WEEE Directive

Dispose of in accordance with WEEE Directive

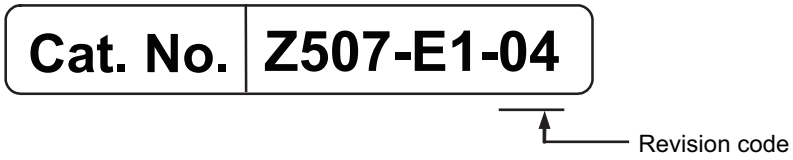
Related Manuals

The followings are the manuals related to this manual. Use these manuals for reference.

Name of Manual	Cat. No.	Model	Purpose	Contents
Smart Camera Model FHV7X-C016-S□□-W-01 FHV Instruction Sheet	5834967-9	FHV7X-C016-S□□-W-01	To confirm the safety and usage precautions of the smart camera FHV7X-C016-S□□-W-01.	Describes the definitions of basic terms, the meaning of signal words, and precautions for correct use of FHV7X-C016-S□□-W-01 in the manual.
FHV7-AI Series AI Detection Camera User's Manual FHV7X-C016-S□□-W-01	Z507	FHV7X-C016-S□□-W-01	When User want to know about the FHV7-AI series.	Describes the specifications, dimensions, part names, I/O information, installation information, wiring information, and functions to use FHV-AI series.

Revision History

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



Revision code	Date	Revised content
01	May 2025	Original production.
02	Sep. 2025	Manual name changed. Restructured as a user's manual.
03	Feb. 2026	Added FHV-XPL, FHV-XDF, FHV-XCV, FHV-XWP-LTM, FHV-XLS-LTM.
04	May 2026	Updated description by updating FHV7-AI_Launcher. (3-1-2 Installation, 3-1-3 Windows) Corrected mistakes.

1

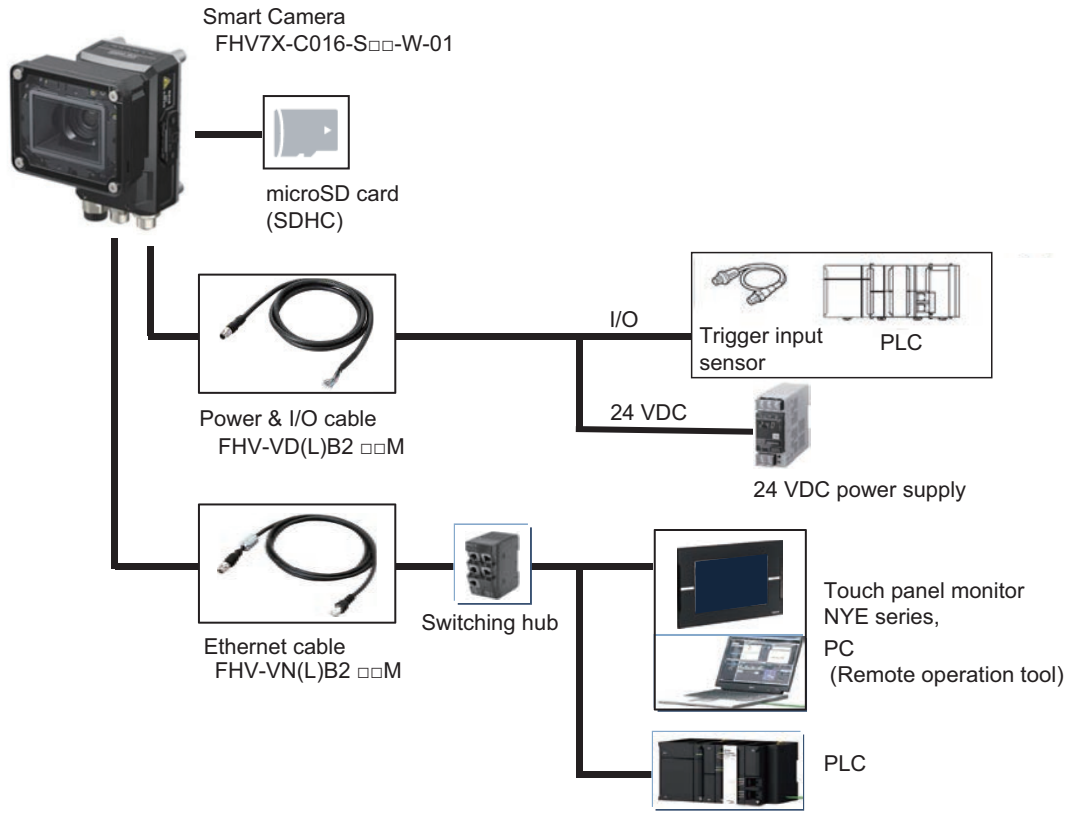
Overview

1-1 Overview of System

FHV7-AI series is an AI-equipped image sensor that inspects and processes captured objects.
It creates inspection programs for presence/absence inspection, defect detection, etc., and outputs judgment results (OK or NG) at the time of inspection execution via parallel I/O or Ethernet communication.

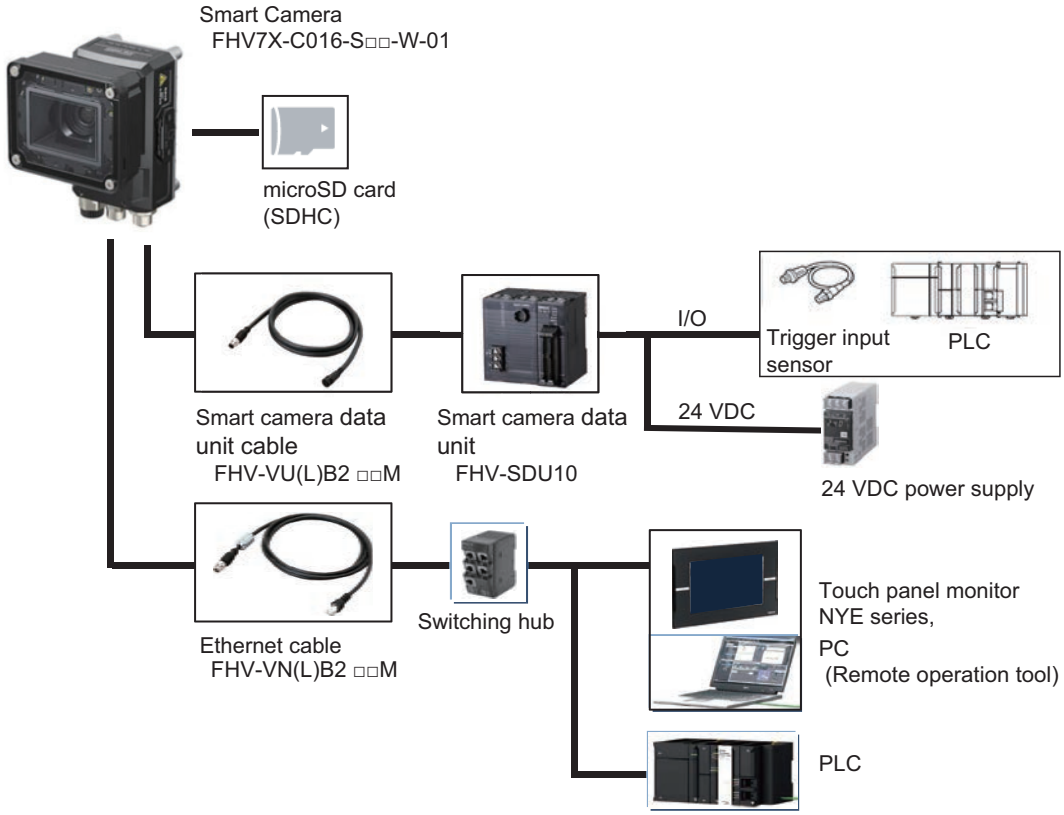
1-1-1 Example of the System Configuration

- When not using the Smart Camera Data Unit



A microSD card (SDHC) is used during adjustment and operation the smart camera. Be sure to use it with the microSD card attached.

- When using the Data Unit for the Smart Camera (Parallel Interface)

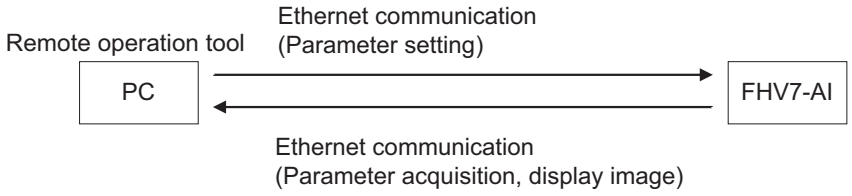


A microSD card (SDHC) is used during adjustment and operation the smart camera. Be sure to use it with the microSD card attached.

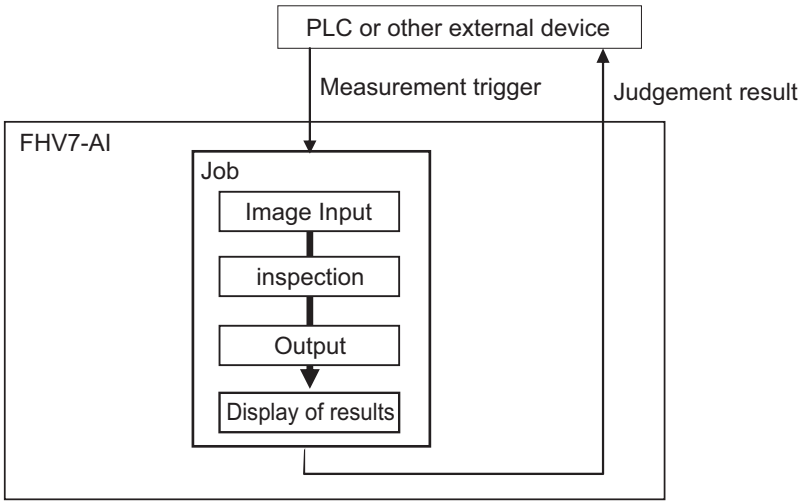
1-2 Concept of Inspection

In this product, the user creates the inspection program (job) according to the instruction on the screen display.
Execute inspection processing with the created job.

- Image of job creation



- Image of inspection processing



1-3 Flow of Application

The following table shows the flow for using the FHV7-AI series.

Procedure	Description	Reference
Preparations	Installation and Wiring	• *Smart camera FHV7X-C016-S□□-W-01 Instruction sheet* • *Section 2 Installation* on page 2-1
	Setting up the software	• *Section 3 Software Setup* on page 3-1
↓		
Adjustment	Creating an inspection program	• *Section 4 Basic Operations* on page 4-1
	Testing	
↓↑		
Run	Run the inspection	• *Section 4 Basic Operations* on page 4-1

2

Installation

2-1 Installing the Smart Camera

2-1-1 How to Connect

Precautions for Safe Use

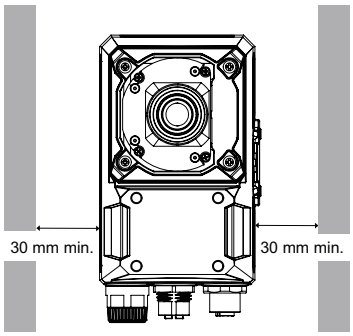
Installation

- Be sure to turn OFF the power of the smart camera itself and any peripheral devices connected to it when doing any of the following. Failing to do so can cause equipment malfunction and damage.
  - When connecting wires or cables
  - When connecting or disconnecting any connectors
- Tighten the mounting screws securely with the specified torque and in the order described in this manual.
- Be sure to attach the connector cap when removing the cable. Failure to do so may result in malfunction or equipment damage due to foreign matter getting in to the connector.
- Do not apply torsion stress to the cable. It may damage the cable.
- Secure the minimum bending radius of the cable. Otherwise the cable may be damaged.

Precautions for Correct Use

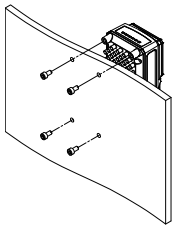
For good ventilation, provide a clearance of 30 mm or more.

- Do not let the ambient temperature exceed 40°C.
  Provide a forced-air fan cooling or air conditioning if the ambient temperature is near 40°C or higher so that the ambient temperature never exceeds 40°C.



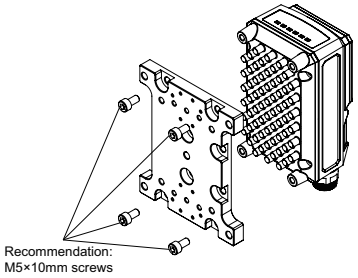
When Mounting the Smart Camera Directly (without Mounting Fixture)

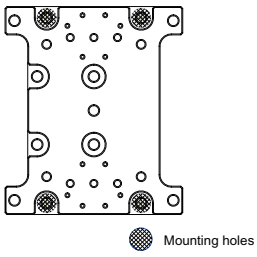
1 Attach with M5 screws.
Tightening torque: 2.3 N·m
Mounting screw hole depth: Effective depth 6 mm



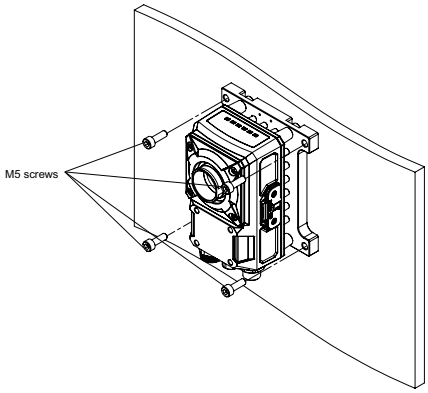
When Mounting the Smart Camera Using the Mounting Fixture

1 Attach the mounting fixture (FHV-XMT-7) to the back of the camera.
Recommended mounting screw size: M5 x 10 mm
Tightening torque: 2.3 N·m
* M5 screws for mounting are not included with this product. Please provide or purchase them separately.





2 Attach the mounting fixture to the desired position.
* M5 screws for mounting are not included with this product. Please provide or purchase them separately.



2-2 Inserting and Removing the MicroSD Card

A microSD card (SDHC) is used during adjustment and operation the smart camera. Be sure to use it with the microSD card attached.

Precautions for Correct Use

Handling the microSD card

- When touching a terminal part of the microSD card, antistatic measures such as a wrist strap or others is required.
- Do not insert a microSD card in the reverse direction, at an angle, or in a twisting manner.
- Do not insert or remove the microSD card during inspection, or while data is being loaded from, or written to the card. It could cause data to be corrupted, or adversely affect inspection speed.
- Shut down when operating files in the microSD card. If it is not restart, the operation of creating, moving, and deleting files may not be reflected correctly depending on the type of microSD card and file format.
  Refer to *Restart* on page 4-43 for restart instructions.

When removing the microSD card

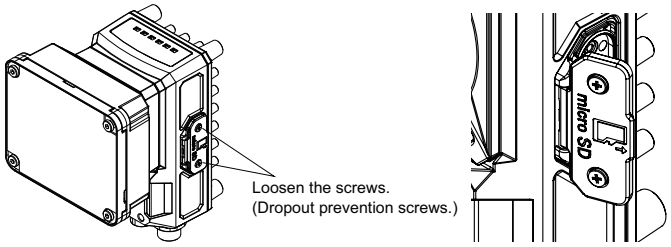
- first confirm that no Data Read or Data Write processing is in progress before removing the card.
- When using a microSD card, the SD ACCESS LED on the smart camera flashes while data is being read or written. Make sure that the LED stops flashing before removing the card.
- If any message is displayed on the screen indicating that a task is in progress, do not turn OFF the power.

Additional Information

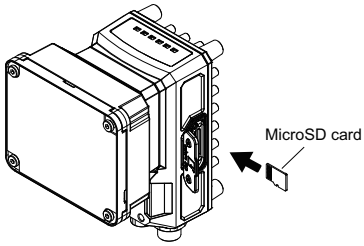
- For FHV7-AI series, FAT32 is recommended as the file format of the microSD card.
  There are limitations depending on the file format. In the case of FAT32, the total number of the Image file can be saved to the immediately below root file or to one folder is around 16,000.
  This limitation will be initialized at the restarting of the smart camera.

2-2-1 How to Insert/Remove the MicroSD Card

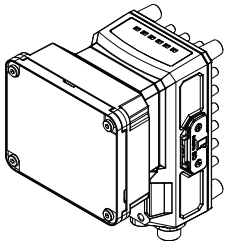
1 Loosen the screws on the microSD card slot cover and open it.



2 Insert/Remove the microSD card.

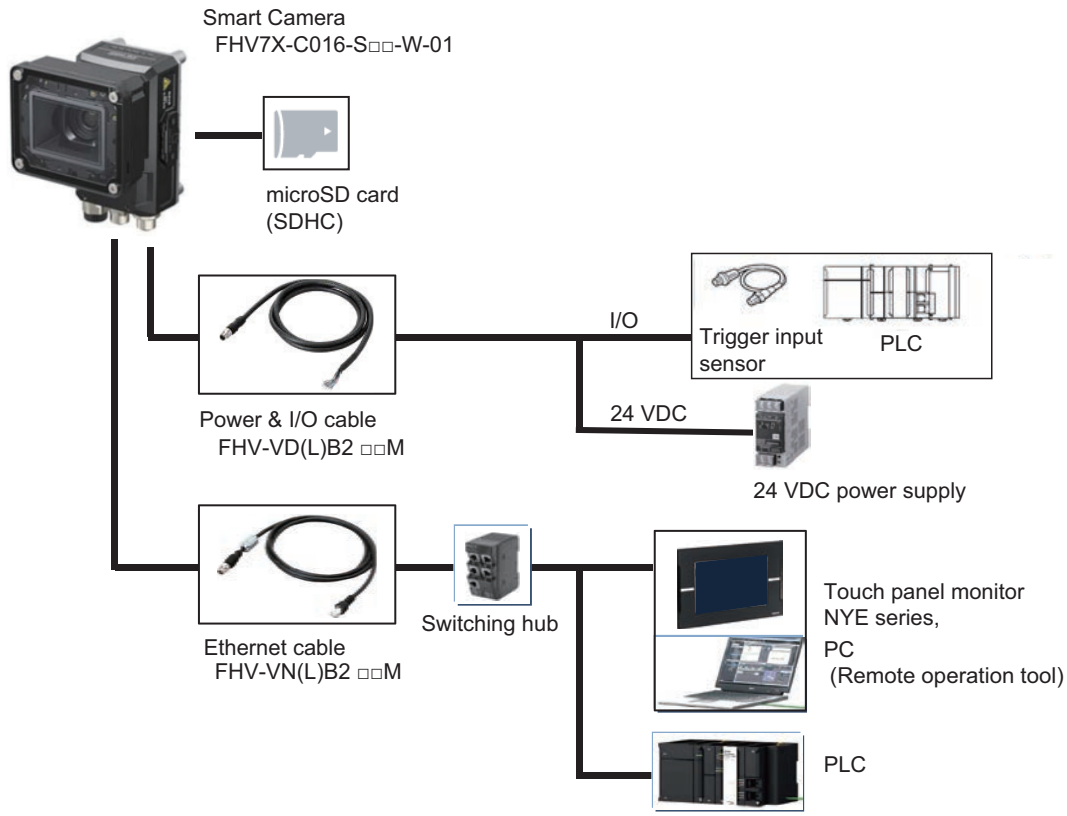


3 Close the cover and tighten the screws.
Recommended tightening torque: 0.15 N·m



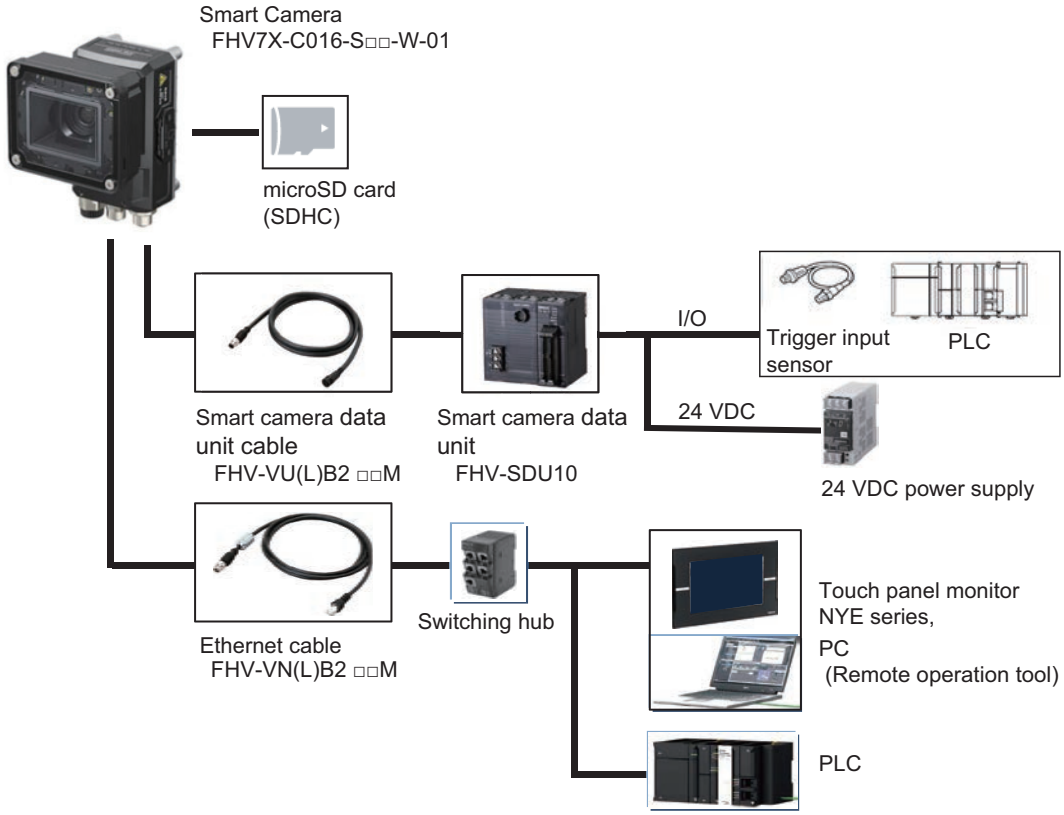
2-3 Wiring

- When not using the Smart Camera Data Unit



A microSD card (SDHC) is used during adjustment and operation the smart camera. Be sure to use it with the microSD card attached.

- When using the Data Unit for the Smart Camera (Parallel Interface)



A microSD card (SDHC) is used during adjustment and operation the smart camera. Be sure to use it with the microSD card attached.

3

Software Setup

3-1 Setting up the Software

This section describes the FHV7-AI_Launcher that launches the Remote Operation tool required to configure the smart camera.
The FHV7-AI_Launcher is possible to download with free by doing the member registration after purchasing the smart camera. For details, refer to the membership registration sheet packed with the smart camera.

3-1-1 Recommended Operational Environment

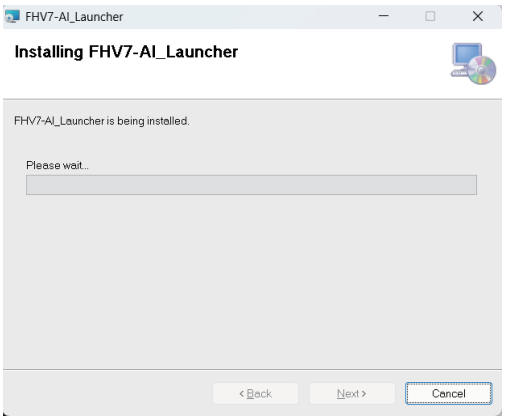
The recommended operational conditions are as follows.

Name	Description
CPU	Intel Pentium Processor (SSE2 or higher, supports AVX2)
OS	• Windows 10 Pro (32/64-bit) or Enterprise (32/64-bit) • Windows 11 Pro (64-bit) or Enterprise (64-bit)
Memory	8GB (16GB or more recommended)
Hard disk space	2GB or more
Display	Resolution: 1,280 x 800 dots or more Color: True Color (32-bit) Magnification: 100%
Network	10BASE-T (100BASE-TX recommended)

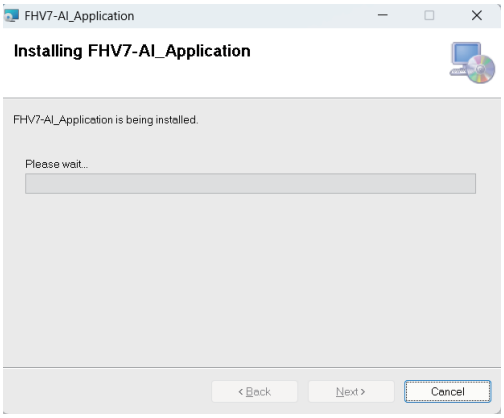
Using the FHV7-AI_Launcher requires Microsoft .NET Framework 3.5 installed.

3-1-2 Installation

1 Unzip the downloaded FHV7-AI_SetupLauncher_vxxx.zip file ("xxx" is a character string indicating the version) to the folder on the PC to be used and open setup.exe..
Install it according to the instructions displayed on the screen.



2 Then unzip the downloaded FHV7-AI_SetupApplication_vxxx.zip file ("xxx" is a character string indicating the version) to the folder and open setup.exe..
Install it according to the instructions displayed on the screen.

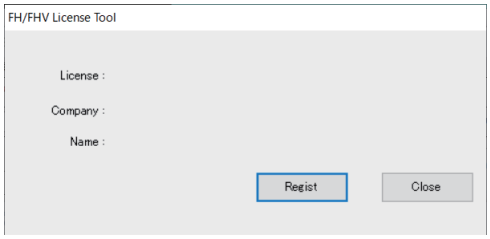


Registering the License

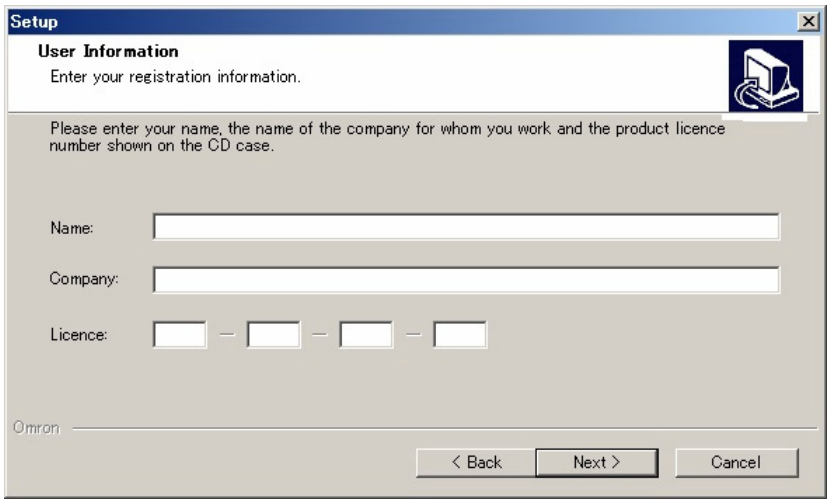
This software displays a *License error!* message at startup when it passes 30 days after the installation and does not launch. To use this continuously, register the license.
Input the license number using the **FH/FHV License Tool**. The FH_FHV License Tool should be executed with administrative rights.

1 Click **Start** on the task bar of Windows. And click **OMRON - FH_FHV License Tool**.

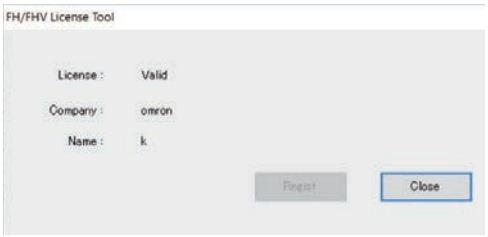
FH/FHV License Tool dialog appears.



2 Click **Regist**.
The Setup window appears.



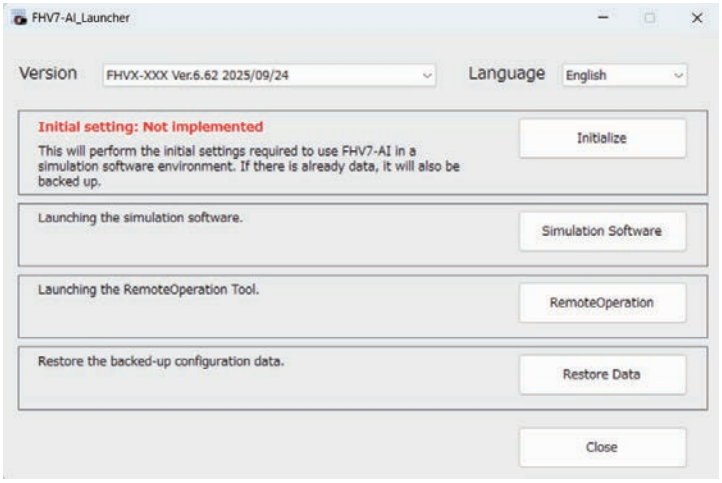
3 In the Setup window, input the Name, Company, and Serial Number) (License number) and click **Next**.
When *License: valid* is displayed, the input is completed.



4 Click **Close** to close the window.

3-1-3 Windows

Here describe the FHV7-AI_Launcher windows.



Name	Description
Version	Displays all versions installed as a candidate. When the **Simulation Software** or the **RemoteOperation** button is clicked, a simulator or remote operation tool with the selected and displayed version will launch.
Language	Select the display language of FHV7-AI_Launcher from Japanese or English. It is displayed in Japanese when it is launched for the first time. When changing the display language, the change is reflected immediately. This setting is saved and becomes the default setting at the next startup.
Initialize	Uses item to be set only when using simulation software. Performs the configuration data initialization. If there is data already stored, it will be backed up. Refer to *A-4 Using the Simulation Software [Simulation Software]* on page A-52.
Simulation Software	Launching the simulation software. Refer to *A-4 Using the Simulation Software [Simulation Software]* on page A-52 for simulation software.
RemoteOperation	Launching the Remote Operation Tool. Refer to *3-1-4 Operating the Smart Camera Remotely [Remote Operation Tool]* on page 3-7 for Remote Operation Tool.
Restore Data	Uses item to be set only when using simulation software. Restore the backed up configuration data. Refer to *A-4 Using the Simulation Software [Simulation Software]* on page A-52.
Close	Exits FHV7-AI_Launcher.

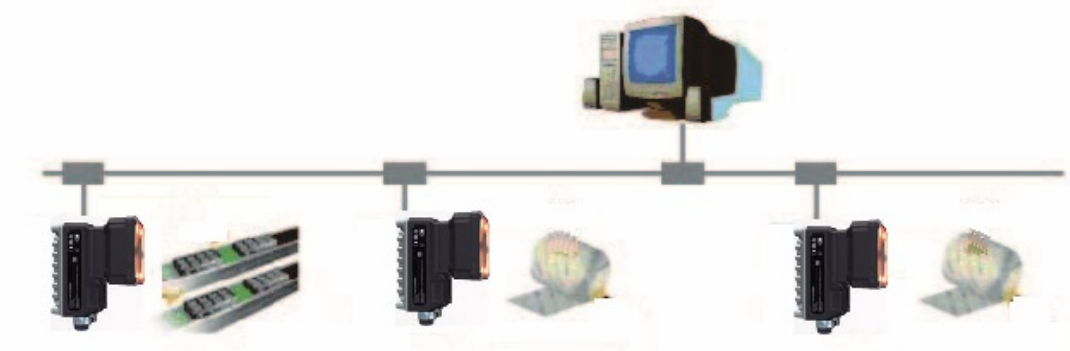
3-1-4 Operating the Smart Camera Remotely [Remote Operation Tool]

Summary

Smart cameras use Remote Operation tool from other PC on the network to create and edit inspection programs, perform adjustments to check operation, and perform inspection.

Precautions for Correct Use

- Smart camera windows cannot be operated or displayed simultaneously on multiple PCs on your network.
- The physical storage location of the setting data and data saving destination is on the smart camera.



Environment Settings

The following preparations are required on the smart camera and a remote operation PC respectively to launch the remote operation.

- Remote operation PC: Arrange communications and GUI environments for the remote operation.
- Smart camera: Set up a server for the remote operation.

Install a PC software to the remote operation PC.

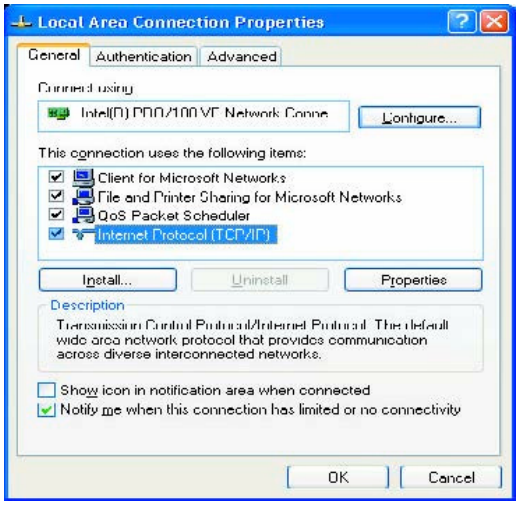
Precautions for Correct Use

- Make sure that the software version installed on the remote operation PC should be the same as that on the smart camera.
- In the remote operation, the following port numbers are used to communication with the smart camera.
  9900
  9910
  9920
  If these ports are disabled due to security settings of your PC or the domain security policy, the remote operation is not available.
  Reconsider the security settings of your PC or the domain security policy or ask your domain security administrator.

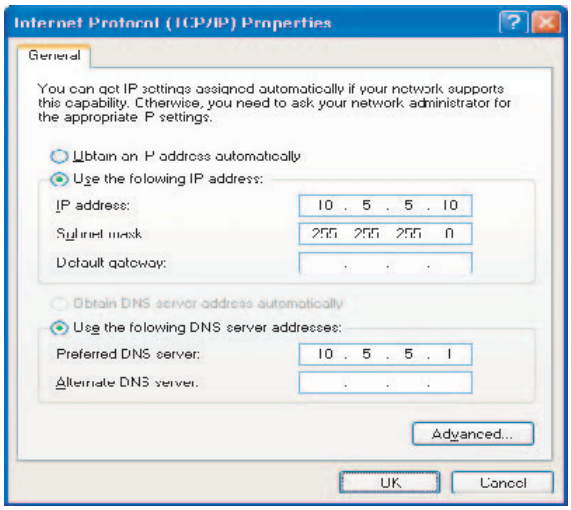
Network Settings for the Remote Operation PC

Set the IP address for the remote operation PC.

1 Open the Local Area Connection Properties on the remote operation PC.



2 Input the IP address.

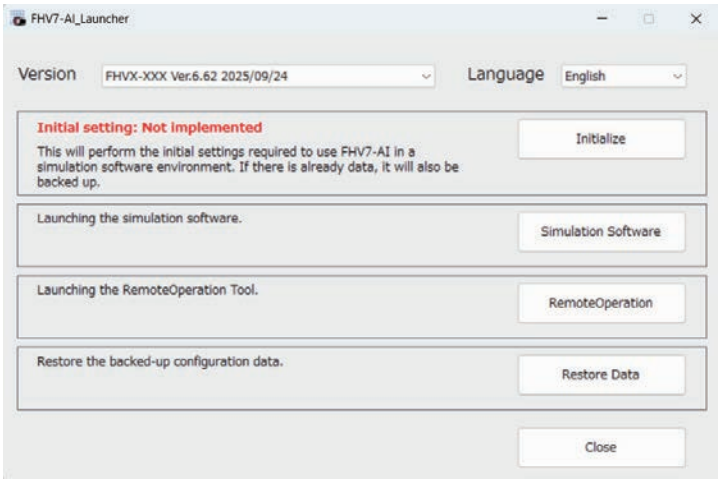


Network Settings for the Smart Camera

Precautions for Correct Use

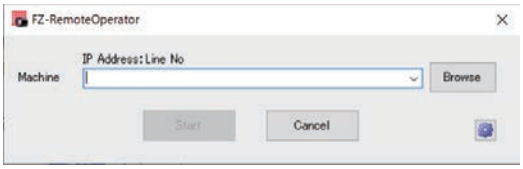
- The network settings for the smart camera set with this procedure is temporary. Since the settings are discarded with restarting the samrt camera or power off, perform the procedures of IP address setting after the remote operation connected.
- Do not connect or disconnect the Remote Operation Tool during adjustment or inspection.

1 On the remote operation PC, open "FHV7-AI_Launcher.exe" in the folder extracted with *3-1-2 Installation* on page 3-3.
The FHV7-AI_Launcher window appears.

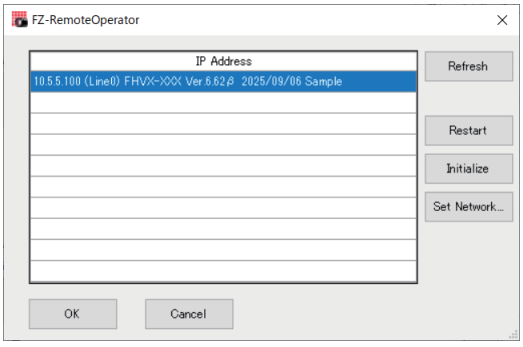


2 Click **RemoteOperation**.

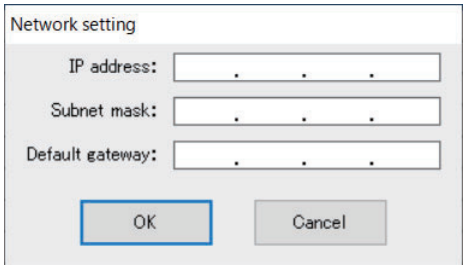
3 Click **Browse**.



4 Select your target smart camera in the list and click **Set Network...**.



5 Set the IP address for the smart camera on the Network setting.



6 Click **OK**.
The IP address is set to the smart camera.

7 On the network reference list, click **Refresh** to check the IP address setting is reflected.

Precautions for Correct Use

- The reflection of IP address settings may take time. If it were not reflected, click **Refresh** again.
- If a bad IP address or an IP address overlapped with a device on the same network are set, an IP address different from your Setting will be displayed on the list like (169.254. xx. xx). Perform this procedure to set a valid IP address.

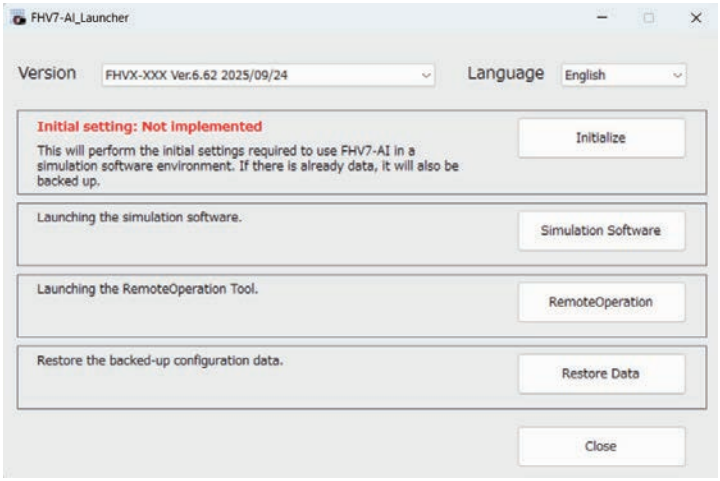
Launching the Remote Operation

Precautions for Correct Use

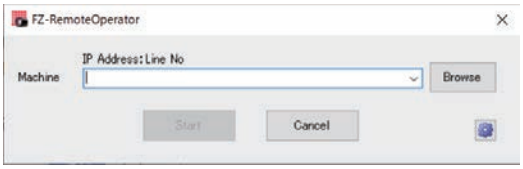
- If the connection is disconnected during the remote operation, the Remote Operation tool and the smart camera may not operate properly. After terminating the Remote Operation tool, return the smart camera to normal state with clicking **Restart** or **Initialize** on the Remote Operation tool. When using the **Initialize** button to restore, perform **Sensor Initialization** on the Maintenance screen. If the Remote Operation tool could not be terminated with **Close**, then terminate the process of *FZ-PanDA.exe* with the task manager.
- Do not connect or disconnect the Remote Operation Tool during adjustment or inspection.

1 On the remote operation PC, open "FHV7-AI_Launcher.exe" in the folder extracted with *3-1-2 Installation* on page 3-3.
Note that the smart camera must be placed in a inspection capable state.

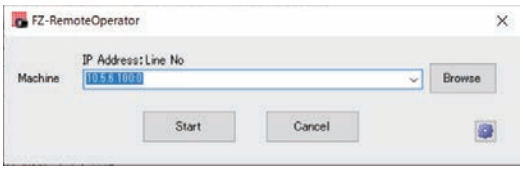
2 The FHV7-AI_Launcher window appears.



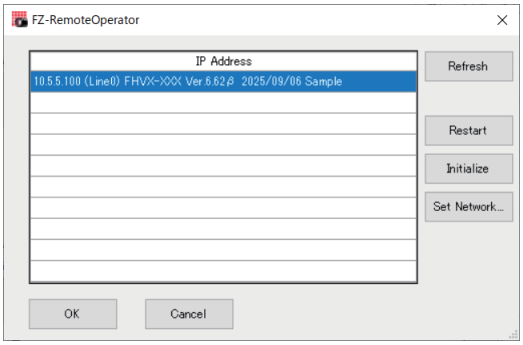
3 Click **RemoteOperation**.



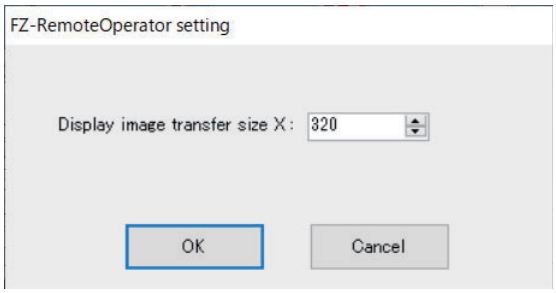
4 Select or directly input the IP address and *Line No.* for the smart camera to be connected. For FHV7-AI series, the *Line No.* is a fixed value of 0.



Click **Browse** to check the IP addresses and Line No. for connectable smart camera.



5 Change the size of an image to transfer with the remote operation as necessary. Select ( ) to set.



Setting item	Description
Display image transfer size (Size of an image to transfer)	Sets the size of the image displayed in the remote operation window. Depending on the "Display image transfer size (Size of the image to transfer)" setting, the roughness of the display image or figure display changes. Recommended setting value: 720 (for 50% of the resolution of a 1.6M camera)

6 Click **Start**.
The smart camera RUN screen is displayed.

Terminating the Remote Operation

1 To terminate the remote operation with the remote operation PC, click **Close** button (✕) at the top right of the screen.

Precautions for Correct Use

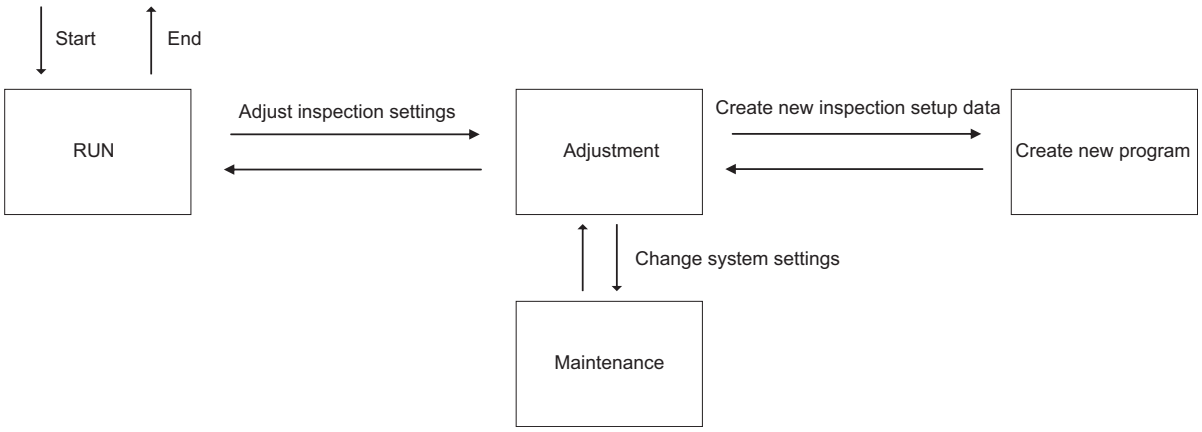
Follow the procedures above to terminate the *Remote Operation Tool*. If you do not follow the procedures above, such as shutting down the remote operation PC or using the task manager to terminate, the smart camera may not operate properly.

4

Basic Operations

4-1 Screen Transition

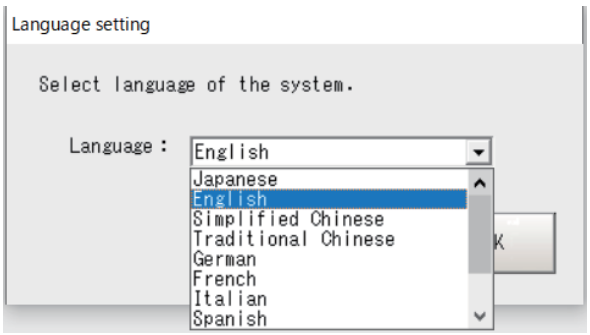
FHV7-AI series has four types of screens.



Screen Name	What you can do on this screen
RUN *4-2-3 RUN* on page 4-27	• Monitoring during Inspection (latest judgment results, statistical results) • Resetting statistical results • Switching to the Adjustment screen
Adjustment *4-2-2 Adjustment* on page 4-5	• Creation and operation check of inspection programs (jobs) such as camera settings and AI inspection settings • Creation, duplication, deletion, and switching of inspection programs (jobs) • Switching to the RUN screen
Create new program *4-2-1 Create new program* on page 4-3	• Setting the name of a newly created inspection program (job) and selecting inspection contents
Maintenance *4-2-4 Maintenance* on page 4-29	• Change of various system settings • Data transfer, setting initialization, software update • Restart the image sensor

Additional Information

- If it is started in the initialization state, a language selection dialog is displayed at startup. Select the language you want to use.



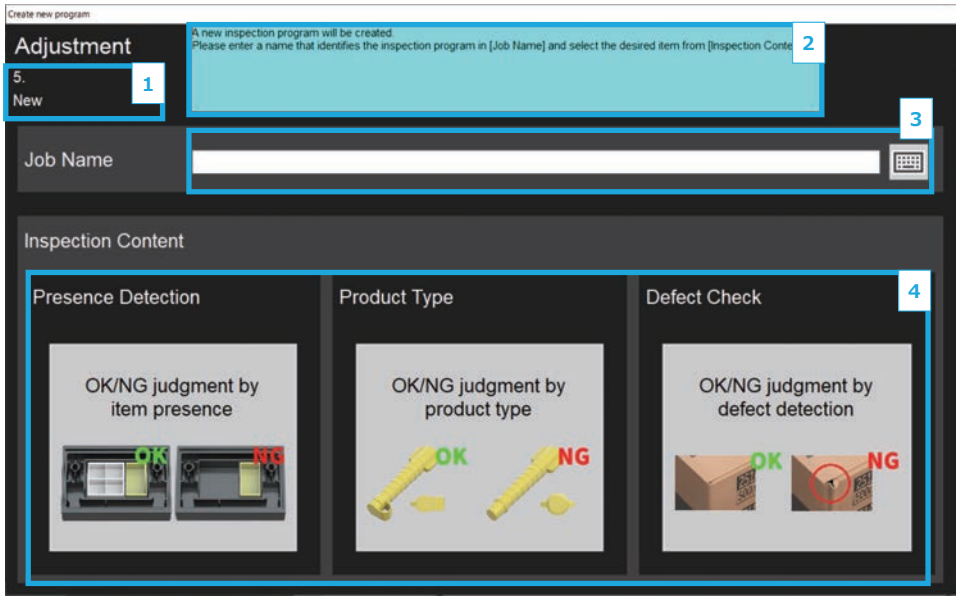
- If an inspection program has not been created, such as when it is started in the initialization state, **Create new program** screen is displayed.

4-2 Functions of Each Screen

4-2-1 Create new program

What you can do on this screen

- Setting the name of a newly created inspection program (job) and selecting inspection contents



Description of function

No.	Name of function	Description
1	Inspection program information display	Displays the inspection program number to be newly created.
2	Operation guidance display	A guidance message is displayed regarding the operation procedure on this screen.
3	Job name input box	This text box is for entering the inspection program name (job name). The job name set here is displayed on the RUN screen and Adjustment screen. You can also click  to view and type in the software keyboard. The ; (semicolon) and \ (back slash) cannot be used for the job name. Even if set, it is converted to _ (underscore). The inspection program name can be set from blank to 100 half-width characters. It can be changed from the Adjustment screen even after the inspection program is created.

No.	Name of function	Description
4	Inspection content selection button	Select the contents to be inspected. When selected, an inspection program is created and the screen returns to the Adjustment screen. The screen does not transition to other screens until it is selected. • Presence Detection: It inspects whether there is an object or not, and outputs OK or NG as the judgment result. Either OK judgment when there is an object or OK judgment when there is no object can be realized depending on the setting method of the inspection program. • Product Type: It inspects whether there is a correct object from among multiple types of varieties, and outputs OK or NG as the judgment result. Register all varieties to be judged as NG at the time of learning. • Defect Check: It inspects whether there is a registered defect or not, and outputs OK or NG as the judgment result. It judges NG if there is a feature similar to the registered defect in the image at the time of inspection, and judges OK if there is no similar feature. The inspection contents cannot be changed after the inspection program is created.

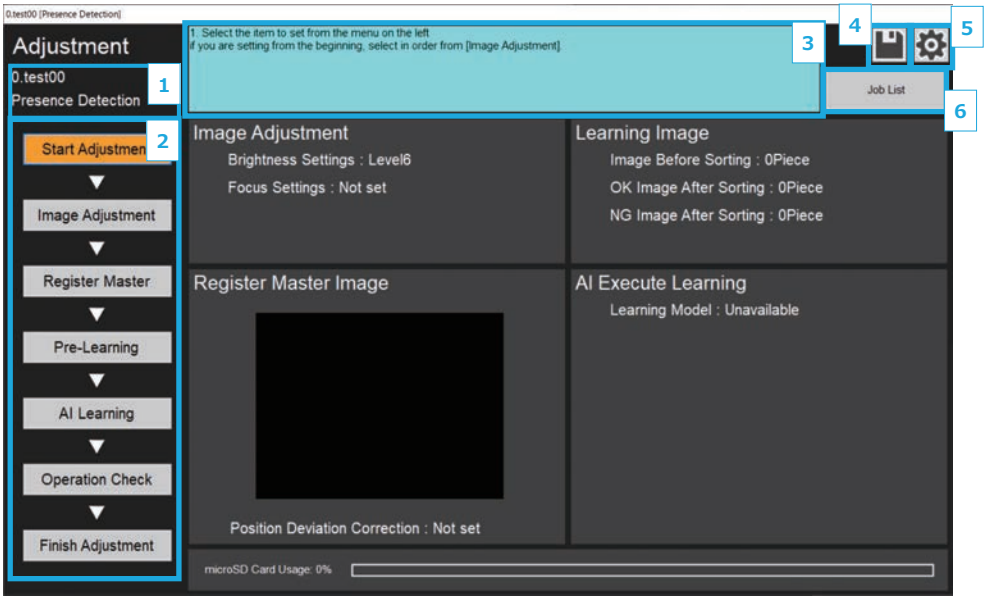
4-2-2 Adjustment

What you can do on this screen

- Creation and operation check of inspection programs (jobs) such as camera settings and AI inspection settings
- Creation, duplication, deletion, and switching of inspection programs (jobs)
- Switching to the RUN screen

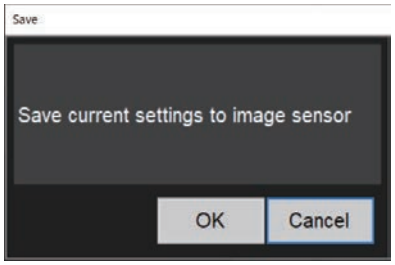
Precautions for Correct Use

- Each process screen on the Adjustment screen returns to the initial state with each screen transition.



Description of function

No.	Name of function	Description
1	Inspection program information display	Displays the job number, program name, and inspection type. If the program name is long, it will be omitted. You can see the entire name in the tooltip. 
2	Adjustment process switching button	Select the process to be adjusted. The background color of the currently selected process is highlighted. • *Start Adjustment* on page 4-10 • *Image Adjustment* on page 4-11 • *Register Master* on page 4-13 • *Pre-Learning* on page 4-18 • *AI Learning* on page 4-20 • *Operation Check* on page 4-24 • *Finish Adjustment* on page 4-26
3	Operation guidance display	A guidance message is displayed regarding the operation procedure on this screen.

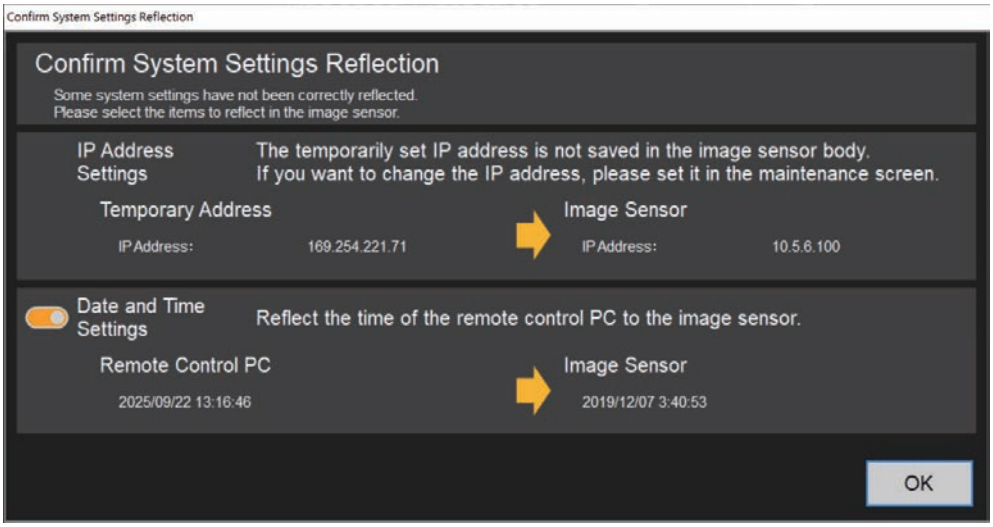
No.	Name of function	Description
4	Save button	The **Save** dialog is displayed.  Click *OK* to save the current settings to the image sensor. Click *Cancel* to return to the previous screen without doing anything.
5	Maintenance button	Displays the Maintenance screen. *4-2-4 Maintenance* on page 4-29
6	Job list button	Displays a list of inspection programs. It is used when creating or deleting inspection programs. *Job List* on page 4-8

Additional Information

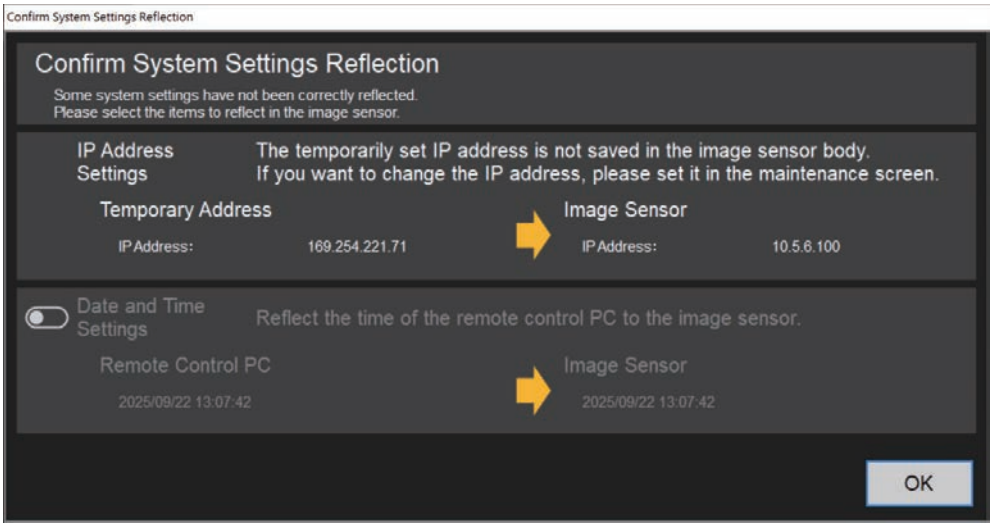
When any of the following conditions is satisfied, **Confirm System Settings Reflection** dialog is displayed.

- When displaying the Adjustment screen, the temporary IP address setting of the image sensor differs from the IP address setting of the setting parameter.
- When displaying the Adjustment screen, the date and time settings of the image sensor differs from the date and time settings of the remote control PC for 1 hour or more.

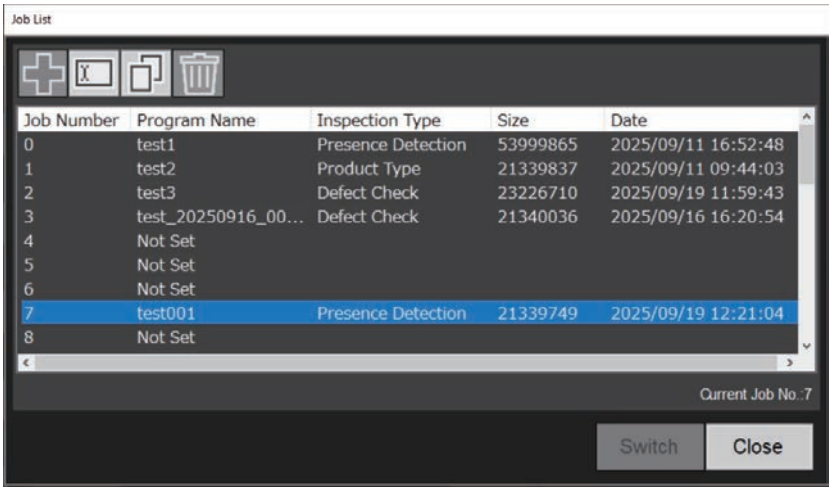
For FHV7-AI series, the date and time settings are reset when the power is turned off. The date and time can be set using this dialog, *Data and Time Settings* on page 4-36, or communication command (*DATE* on page 5-86).



If the date and time settings are not reflected, set it to *Off* and click **OK**.

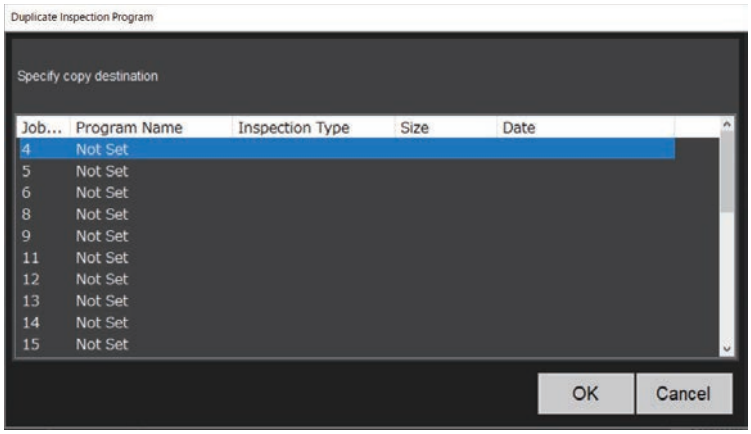
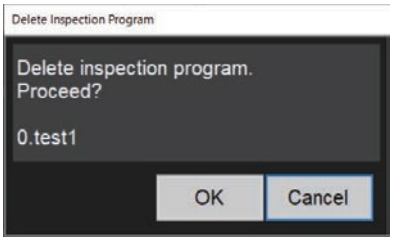


● Job List



Description of function

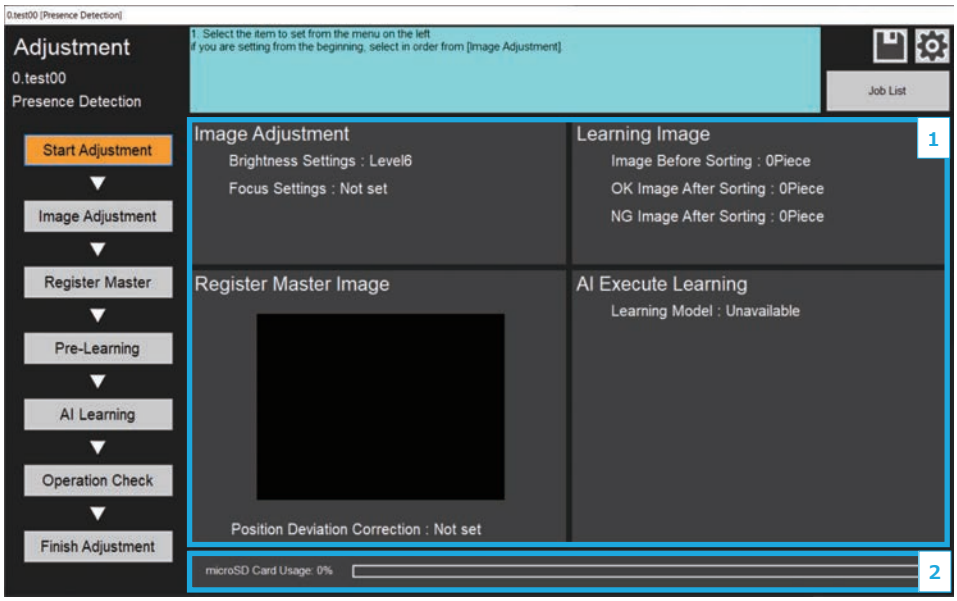
Name of function	Description
Job list	Displays the list of inspection programs (numbers 0 to 31).
New 	It can be operated only when a *Not Set* is selected in the job list. A new job is created for the job number selected in the list. **Create new program** screen opens. *4-2-1 Create new program* on page 4-3
Rename 	It can be operated only when a set job is selected in the list. Changes the program name of the job number selected in the list.  You can also click  to view and type in the software keyboard. The ; (semicolon) and \ (back slash) cannot be used for the job name. Even if set, it is converted to _ (underscore). The inspection program name can be set from blank to 100 half-width characters. It can be changed from the Adjustment screen even after the inspection program is created.

Name of function	Description
Duplicate 	It can be operated only when a set job is selected in the list. Duplicates the job selected in the list to a *Not Set* job.  Select the destination and click *OK*. The job that has already been set cannot be duplicated. The job also includes the image files used during learning. Therefore, depending on the size of the job, it may take some time to duplicate.
Delete 	It can be operated only when a set job is selected in the list. Also, the current job cannot be deleted. Deletes the job selected in the list. 
Switch button	It can be operated only when a set job is selected in the list. Also, it cannot be operated for the current job. Switches from the current job to the job selected in the list.
Close button	Returns to the Adjustment screen.

Start Adjustment

What you can do on this screen

- Checking the current setting status



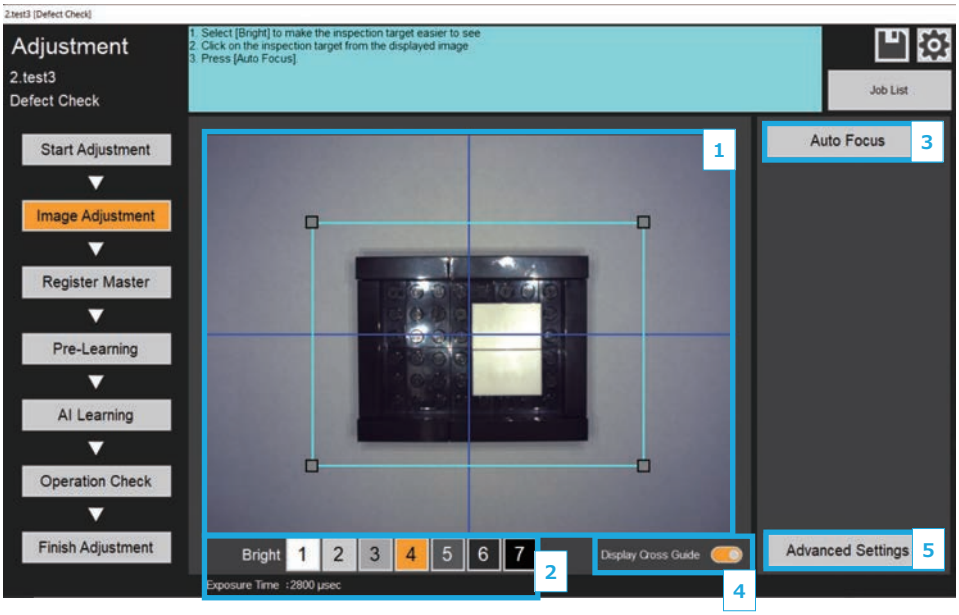
Description of function

No.	Name of function	Description
1	Setting status display	Displays the setting status of each process in the job.
2	microSD Card Usage display	Displays the capacity of the microSD card attached to the image sensor. When the microSD card is not attached, *No Drive* is displayed. The status is updated when the screen changes.

Image Adjustment

What you can do on this screen

- Brightness setting, focus setting
- Advanced settings: Lighting setting

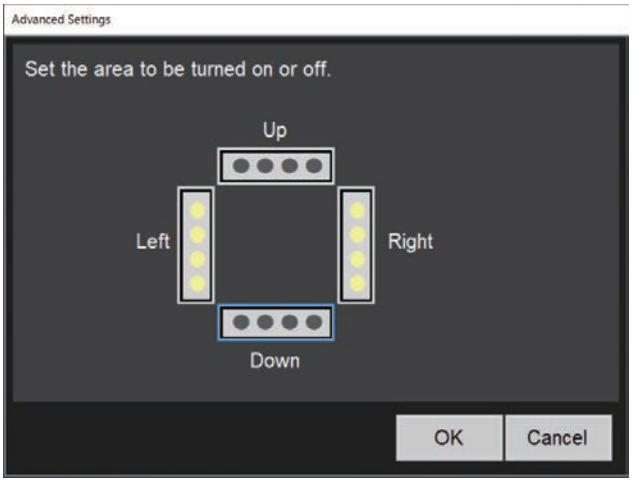


Description of function

No.	Name of function	Description
1	Image display	Displays the live image. Click to display a shape control that sets the target area for focus adjustment.
2	Bright buttons	Select the brightness of the image from 7 levels. The exposure time value for each parameter is displayed. The exposure time from brightness 1 to 4 is the same value. The brightness is set by exposure time and gain. When a job is newly registered, it is automatically adjusted according to the surrounding brightness.
3	Auto Focus button	Automatically adjusts the lens of the image sensor within the target area displayed on the image.
4	Display Cross Guide switch	Select whether to display a cross guide showing the center of the screen in the image display.
5	Advanced Settings button (for lighting setting)	In the case of an inspection object with unevenness, the ON/OFF of the lighting lighting area can be set in detail to create an image that is easy to inspect. Displays the **Advanced Settings** dialog for lighting setting. *Advanced Settings Dialog (for Lighting Setting)* on page 4-12

● Advanced Settings Dialog (for Lighting Setting)

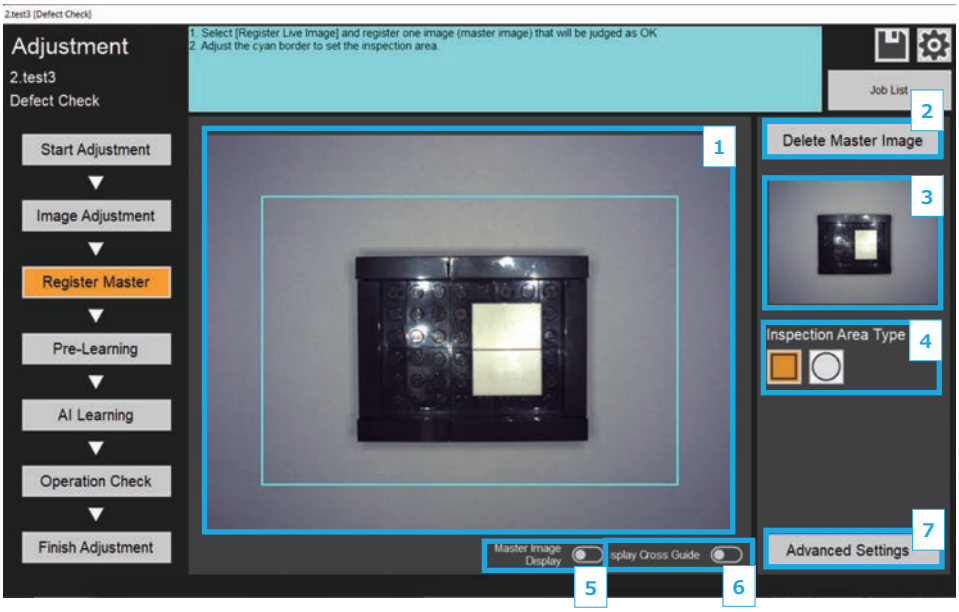
Turning on and off can be set individually for four lighting parts.



Register Master

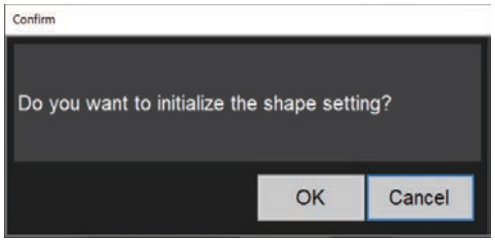
What you can do on this screen

- Registration of master image (reference image for inspection OK)
- Setting inspection area
- Advanced settings: Position compensation setting



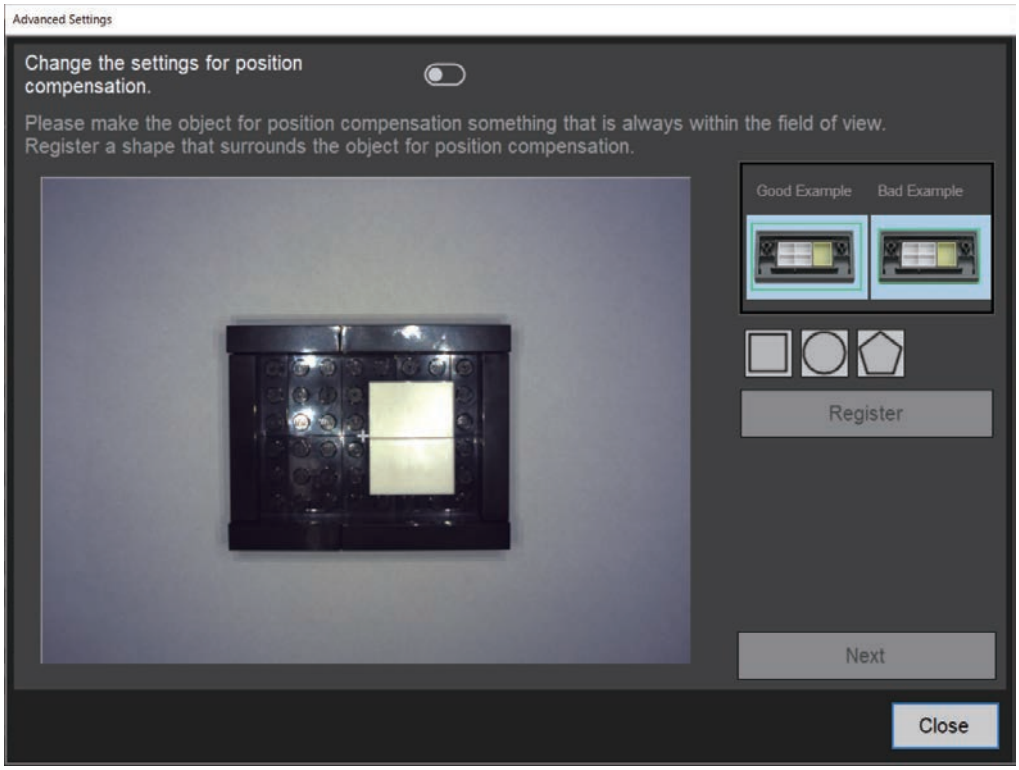
Description of function

No.	Name of function	Description
1	Image display	Displays the live image. The shape control for setting the inspection area is displayed in light blue.
2	Register Live Image button/ Delete Master Image button	When the master image is not registered, the **Register Live Image** button is displayed, and the live image can be registered as the master image. When the master image is registered, the **Delete Master Image** button is displayed, and the registered master image can be deleted. When deleting the master image, all position correction settings, AI learning settings, and learning image files are deleted.
3	Master image display	Displays the registered master image. When not registered, a black image is displayed.

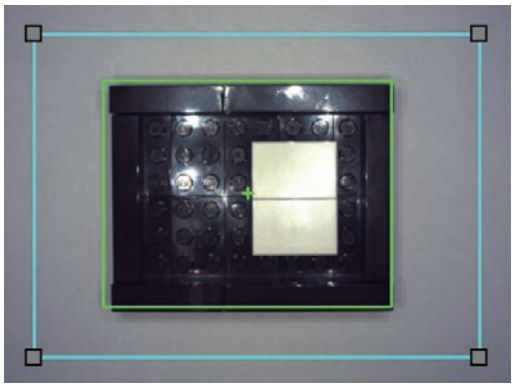
No.	Name of function	Description
4	Inspection Area Type	Displays the shape type of the inspection area. • When the **Inspection Type** is*Presence Detection* or*Product Type*: Rectangle • When the **Inspection Type** is *Defect Check*: Rectangle, Circle By clicking the icon, you can change the shape type of the inspection area. Click the icon of the selected shape type to initialize the shape in the inspection area. 
5	Master Image Display switch	The master image is displayed in the image display. If the master image is not registered, it cannot be selected.
6	Display Cross Guide switch	Select whether to display a cross guide showing the center of the screen in the image display.
7	Advanced Settings button (for position compensation setting)	If there is a misalignment with the master image, position compensation can be performed by image processing. If the master image is not registered, it cannot be selected. Displays the **Advanced Settings** dialog. *Advanced Settings (for Position Compensation Setting)* on page 4-15

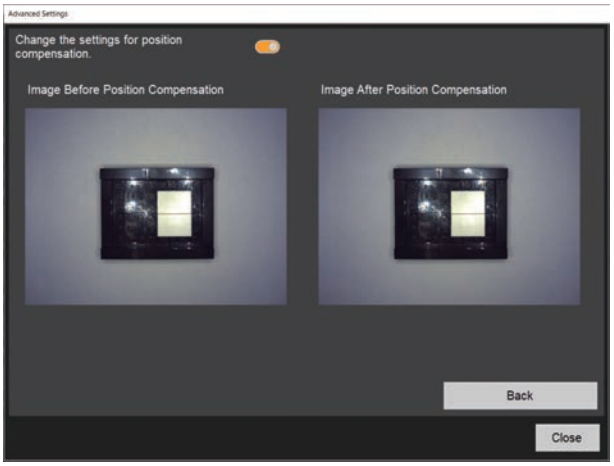
● Advanced Settings (for Position Compensation Setting)

If there is a misalignment with the master image, position compensation can be performed by image processing.
Enables position compensation and registers the object to be used for position compensation.



Description of function

Name of function	Description
Change the settings for position compensation.	Select enable/disable of position compensation setting.
Image display	The master image is displayed. The shape for the position compensation is displayed. The registered position compensation shape is displayed in green. The position compensation shape before registration is displayed in light blue. The position compensation shape before registration can be edited on the image display. For polygon, the number of vertices ranges from 3 to 10. Left-click on a polygon edge to add a vertex. Right-click on a vertex to remove it. 

Name of function	Description
Select a shape	The shape type of position compensation is displayed. By clicking the icon, you can change the shape type (square, circle, polygon) of position compensation. By clicking the icon of the selected shape type, you can initialize the shape of position compensation.
Register button	Register the position compensation figure. Do not register the position compensation figure while it protrudes out of the screen. In that case, registration fails.
Next button / Back button	You can click if the position compensation figure has already been registered. The **Next** button displays the image before and after position compensation.  The **Back** button returns to the previous screen.
Close button	Return to the Adjustment screen.

Additional Information

For example:

- Without position compensation setting

- With position compensation setting
  Master image

Image before position compensation

Image after position compensation

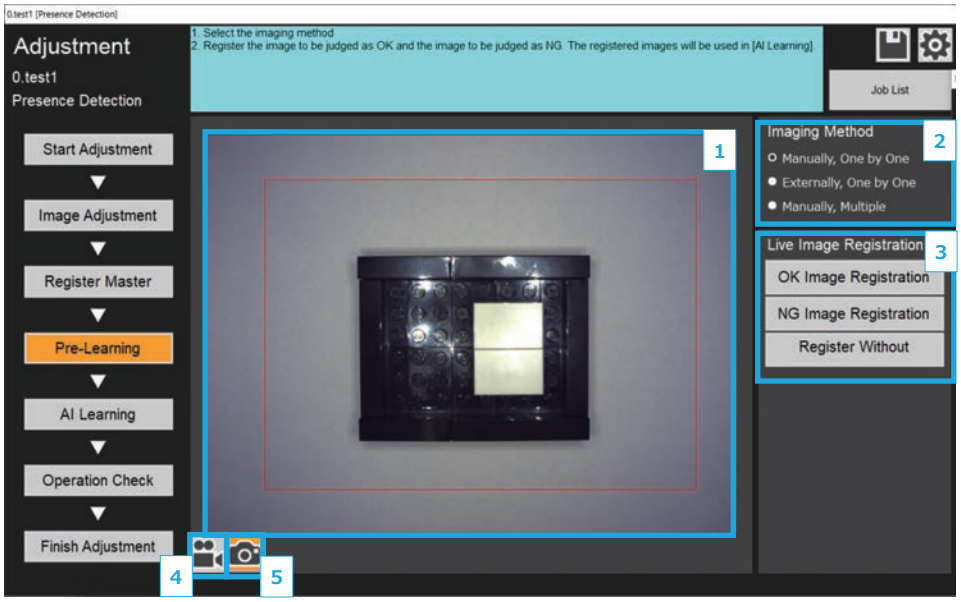
Pre-Learning

What you can do on this screen

- Registration of learning images to be used for AI learning
  The registered images are stored on a microSD card attached to the image sensor and used in the next **AI Learning** process.

Precautions for Correct Use

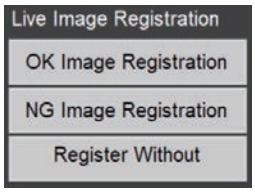
- Image files are saved on the microSD card while the registration process is running. Transition to another screen may not be possible while the file save is running.
- Do not duplicate the job while the registration process is running. It may not be possible to duplicate in the correct state.

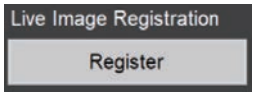


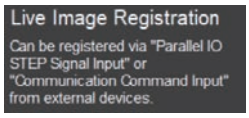
Description of function

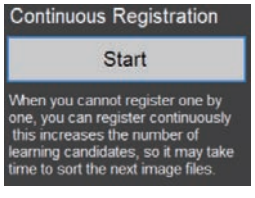
No.	Name of function	Description
1	Image display	Displays a live image or a still image. A shape showing the inspection area is displayed. (Only when position compensation setting is disabled.)
2	Imaging Mthod	Select the method for registering images for learning. • Manually, One by One: Select this option if inspection objects that are OK and NG can be imaged one by one. • Externally, One by One: Select this option when registering from an external device using an Ethernet communication command (Single Inspection) or STEP signal of parallel I/O. Select this option when adding a variety if the system has already been built. • Manually, Multiple: Used when the inspection object cannot be imaged one by one. It takes time to sort the image files used for learning.

<table>
<tr><th>No.</th><th>Name of function</th><th>Description</th></tr>
<tr><td>3</td><td>Live Image Registration</td><td>
• When Imaging Method is Manually, One by One

When Inspection Type is Presence Detection or Product Type
<table>
<tr><td>OK Image Registration</td><td>Allocate to OK images. It is used to register an inspection image that is judged as OK.</td></tr>
<tr><td>NG Image Registration</td><td>Allocate to NG images. It is used to register an inspection image that is judged as NG.</td></tr>
<tr><td>Register Without</td><td>It is registered in the image list before sorting. It is used when you want to sort them later.</td></tr>
</table>


When Inspection Type is Defect Check
<table>
<tr><td>Register</td><td>It is registered in the image list before sorting.</td></tr>
</table>


• When Imaging Method isExternally, One by One
<table>
<tr><td>-</td><td>It is registered in the image list before sorting.</td></tr>
</table>


For the communication method, refer to Section 5 Methods for Communicating with External Devices on page 5-1.
• When Imaging Method is Manually, Multiple
<table>
<tr><td>Start button / Stop button</td><td>Starts continuous image registration.
To finish, press the Stop button.
It is registered in the image list before sorting.</td></tr>
</table>


</td></tr>
<tr><td>4</td><td>Show Live Image button</td><td>Switches the image display to live image.</td></tr>
<tr><td>5</td><td>Show Still Image button</td><td>Switches the image display to still image.</td></tr>
</table>

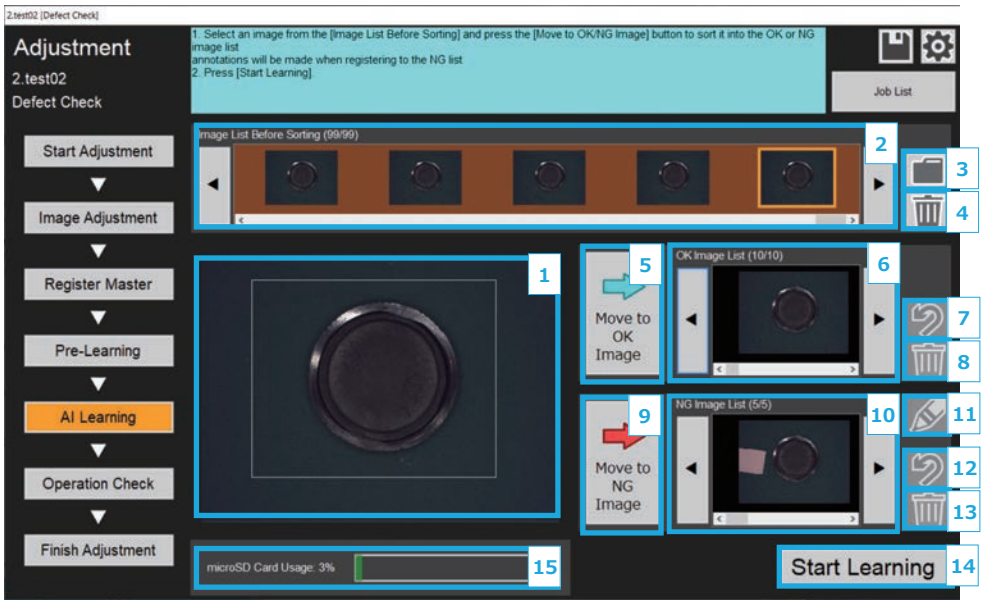
AI Learning

What you can do on this screen

- Sorting of learning images used for AI learning
- Registration of defects in learning images used for AI learning (Defect Check only)
- Execution of AI learning and display of learning results
- Additional registration of learning images

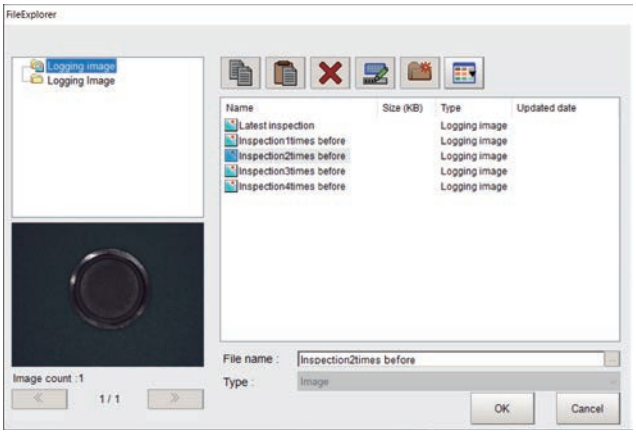
Precautions for Correct Use

- The number of learning images required for learning execution is as follows.
  - Presence Detection / Product Type: 1 or more OK images and 1 or more NG images
  - Defect Check: 2 or more OK images and 2 or more NG images
- If there are images with high similarity between OK and NG images, the learning results will not be stable. Check that the sorting status is correct.
- If the microSD card has insufficient free space, learning may fail. Increase the free space and try again.
- If the **File transfer failed, learning failed.** message is displayed, the following may be the cause.
  - Presence Detection / Product Type:
  The free space of the microSD card is insufficient.
  The microSD card is in the write-inhibited state.
  The microSD card is not inserted correctly.
  The microSD card is out of order.
  - Defect Check:
  FTP transfer (from sensor to remote operation PC) of temporary data for learning failed.
  The free space of the microSD card is insufficient.
  The microSD card is in the write-inhibited state.
  The microSD card is not inserted correctly.
  The microSD card is out of order.



Description of function

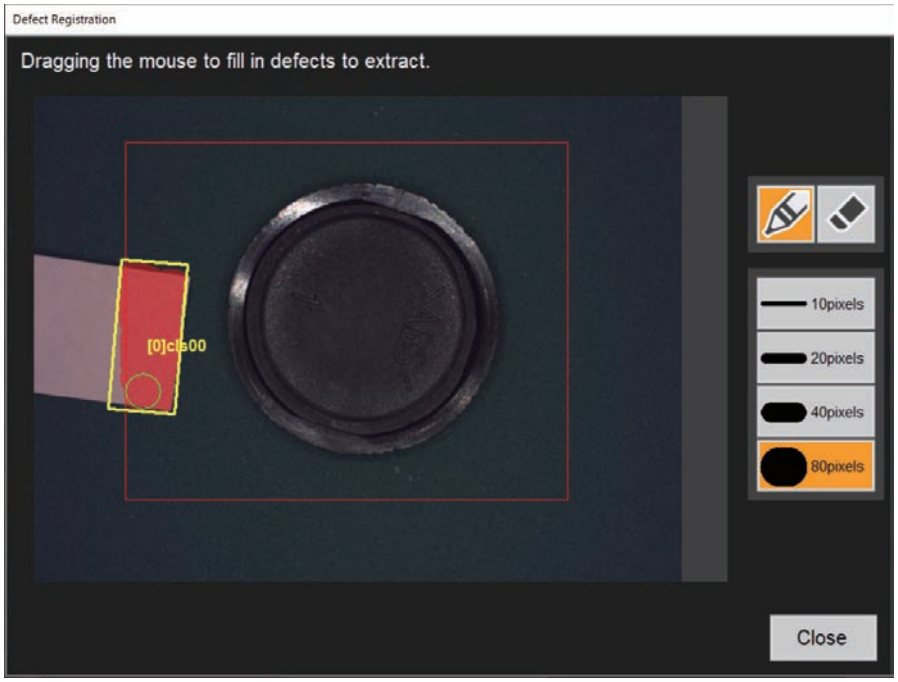
No.	Name of function	Description
1	Image display	Displays the image selected in the **Image List Before Sorting** / **OK Image List** / **NG Image List**.

No.	Name of function	Description
2	Image List Before Sorting	A list of candidate image files registered in the **Pre-Learning** process and used for learning is displayed. Also, "(number of selected files/total number of files in the image list)" is displayed as text. Example: If you select the third file in the image list of 20 files: "(3/20)"
3	Add Operation Images and Logging Images.	Select an image file on the **FileExplorer** dialog and add the image data to the **Image List Before Sorting**. The images that can be selected are as follows. • The images logged in the Operation Check process. • The images logged in the RUN screen.  Add one file in one operation. Multiple files cannot be added in one operation.
4	Remove the Image	Deletes the image file selected in the **Image List Before Sorting**.
5	Move to OK Image button	Moves the image file selected in the **Image List Before Sorting** to the **OK Image List**.
6	OK Image List	Learning is executed so that the image files included in this list are judged OK. Also, "(number of selected files/total number of files in the image list)" is displayed as text. Example: If you select the third file in the image list of 20 files: "(3/20)"
7	Reclassify the Images	Moves the selected image file to the **Image List Before Sorting**.
8	Remove the Image	Deletes the image file selected in the **OK Image List**.
9	Move to NG Image button	Moves the image file selected in the **Image List Before Sorting** to the **NG Image List**. Only when the **Inspection Type** is *Defect Check*, the defect part is registered for the selected image file in the **Defect Registration** dialog. *Defect Registration* on page 4-23
10	NG Image List	Learning is executed so that the image files included in this list are judged NG. Also, "(number of selected files/total number of files in the image list)" is displayed as text. Example: If you select the third file in the image list of 20 files: "(3/20)"

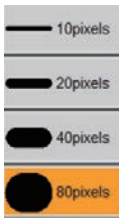
No.	Name of function	Description
11	Defect Registration	Displayed only when **Inspection Type** is *Defect Check*. For the selected image file, register the defect part in the **Defect Registration** dialog. *Defect Registration* on page 4-23
12	Reclassify the Images	Moves the selected image file to the **Image List Before Sorting**.
13	Remove the Image	Deletes the image file selected in the **NG Image List**.
14	Start Learning button	Executes the learning process using the image files of the **OK Image List** and the **NG Image List**. When the learning is finished, the **Show Results** dialog is displayed.  Good learning results under the following conditions: • All images for learning to be judged OK (displayed in green) are included in the left side of the threshold. • All images for learning to be judged NG (displayed in red) are included in the right side of the threshold. • There is some space to the right and left of the threshold. (The larger this space, the lower the possibility of false positives.)
15	microSD Card Usage display	Displays the capacity of the microSD card attached to the image sensor. When the microSD card is not attached, *No Drive* is displayed. The status is updated when the screen changes.

● Defect Registration

Register the part you want to register as a defect.



Description of function

Name of function	Description
Image display	The selected image is displayed. When a defect is registered, the registered part is displayed on the image.
Pen tool 	Used to register defects. Left-drag draws the defect area.
Eraser tool 	Used to correct defects registered with the pen tool. Left-drag deletes the defect area.
Change tool thickness button 	Change the thickness of the pen tool and eraser tool.
Close button	Finish the defect registration.

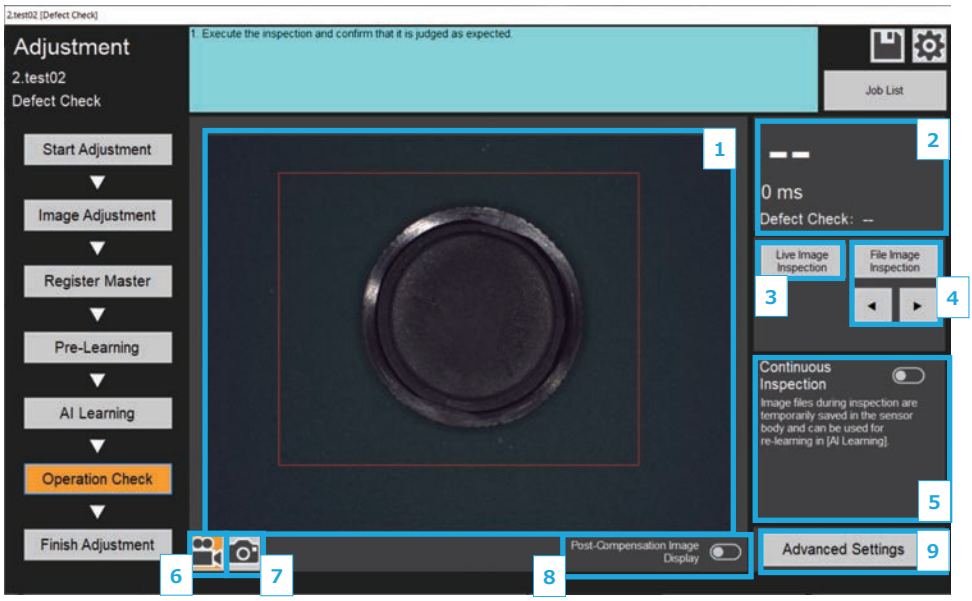
Operation Check

What you can do on this screen

- Operation check using live image
- Operation check using image files
- Operation check using external commands and parallel commands
- Advanced Settings: Data output setting

Precautions for Correct Use

- During continuous inspection, the contents of the image display and the judgment result display may not match.
- If position compensation is enabled, the graphic of the image display immediately after screen transition may not be correct. It is resolved by executing the inspection.



Description of function

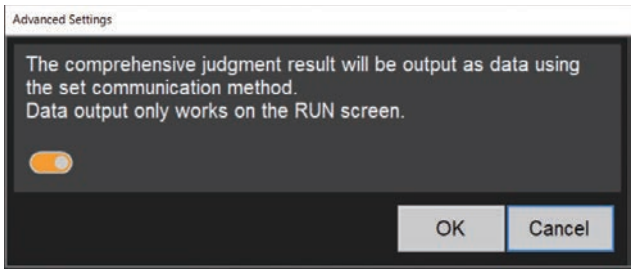
No.	Name of function	Description
1	Image display	Displays a live image or a still image. A shape showing the inspection area is displayed.
2	Judgment results display	Displays overall judgment results (OK, NG), processing time (msec), and individual judgment results (OK, NG, Error).
3	Live Image Inspection button	Executes operation check with live image. The inspected image is logged as a logging image. The logging image can be used as a learning image in *AI Learning* on page 4-20.
4	File Image Inspection button	Select an image file on the **FileExplorer** dialog and check the operation. Press the arrow button to check the operation of images in the selected folder by forward or reverse feed.
5	Continuous Inspection switch	Select whether to check the operation continuously. It is effective for both live image inspection and file image inspection.
6	Show Live Image button	Switches the image display to live image.

No.	Name of function	Description
7	Show Still Image button	Switches the image display to still image.
8	Post-Compensation Image Display switch	Selects whether to display the image after position compensation.
9	Advanced Settings (for data output setting)	Set data output. Displays the **Advanced Settings** dialog. *Advanced Settings (for Data Output Setting)* on page 4-25

● Advanced Settings (for Data Output Setting)

Set whether to output data.

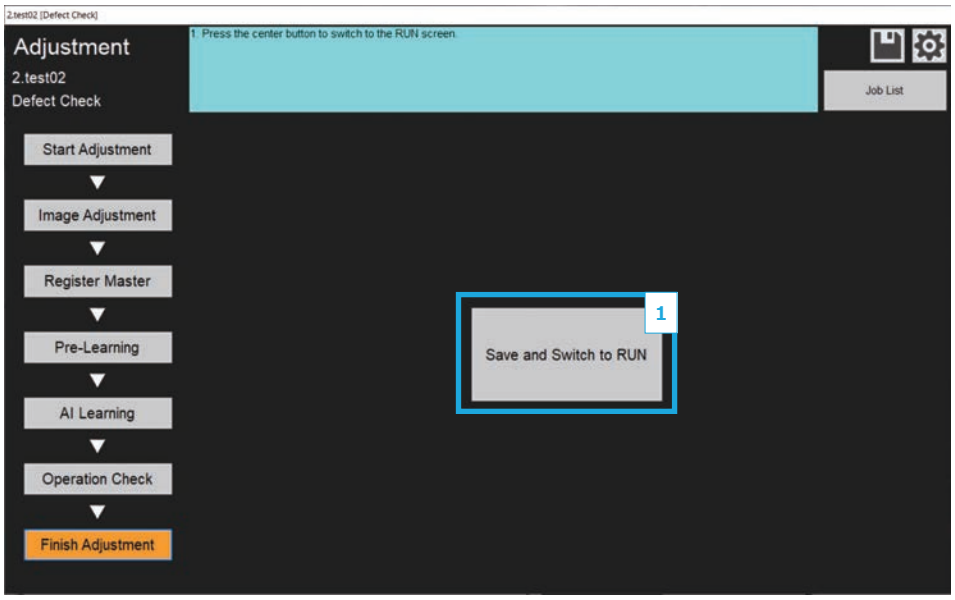
Data is output only on the RUN screen. Even if data output is turned *ON*, data is not output on the Adjustment screen.



Finish Adjustment

What you can do on this screen

- Switching to the RUN screen



Description of function

No.	Name of function	Description
1	Save and Switch to RUN	Save the settings on the image sensor and switch to the RUN screen.

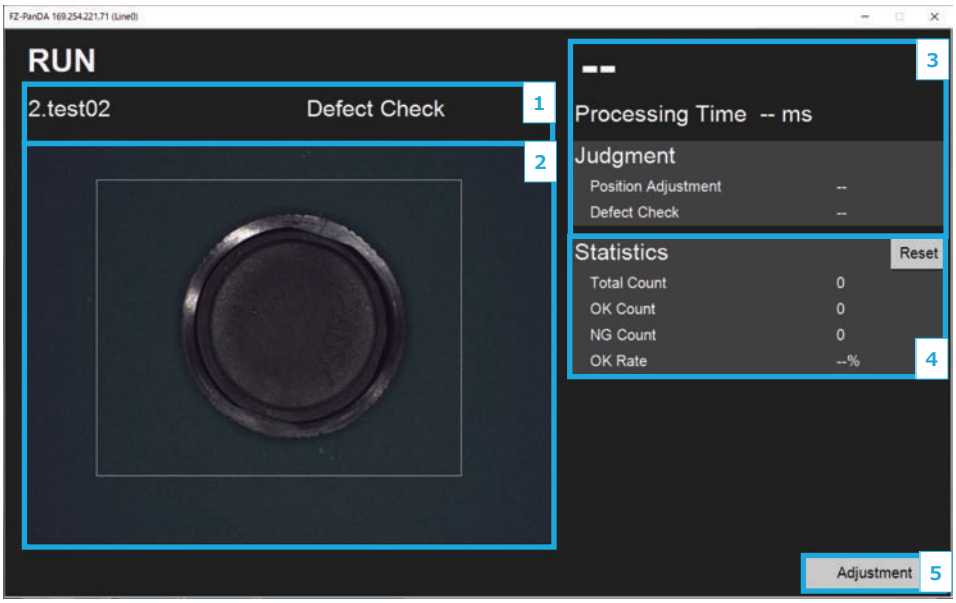
4-2-3 RUN

What you can do on this screen

- Monitoring during Inspection (latest judgment results, statistical results)
- Resetting statistical results
- Switching to the Adjustment screen

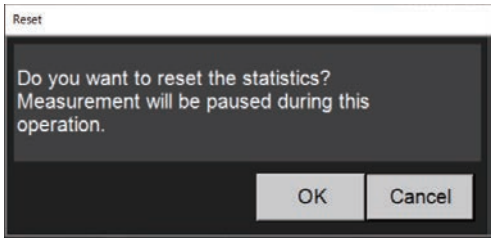
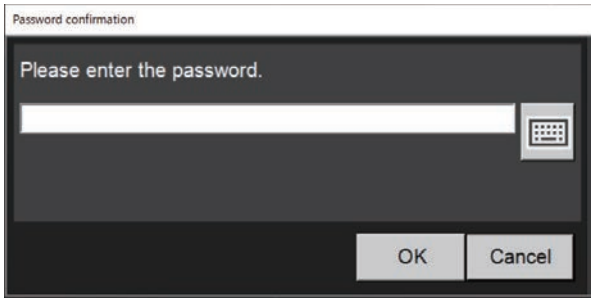
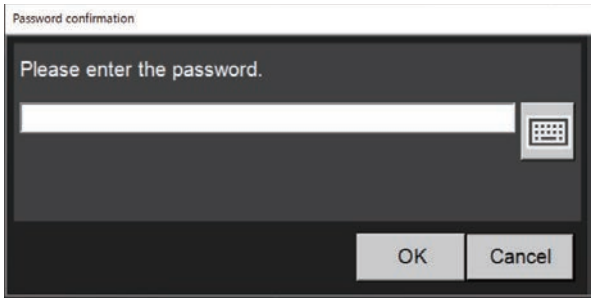
Precautions for Correct Use

- When transitioning to the Adjustment screen, the latest inspection result and statistics are reset.
- The maximum value of each item of inspection statistics information is 999,999,999. No more counts up.



Description of function

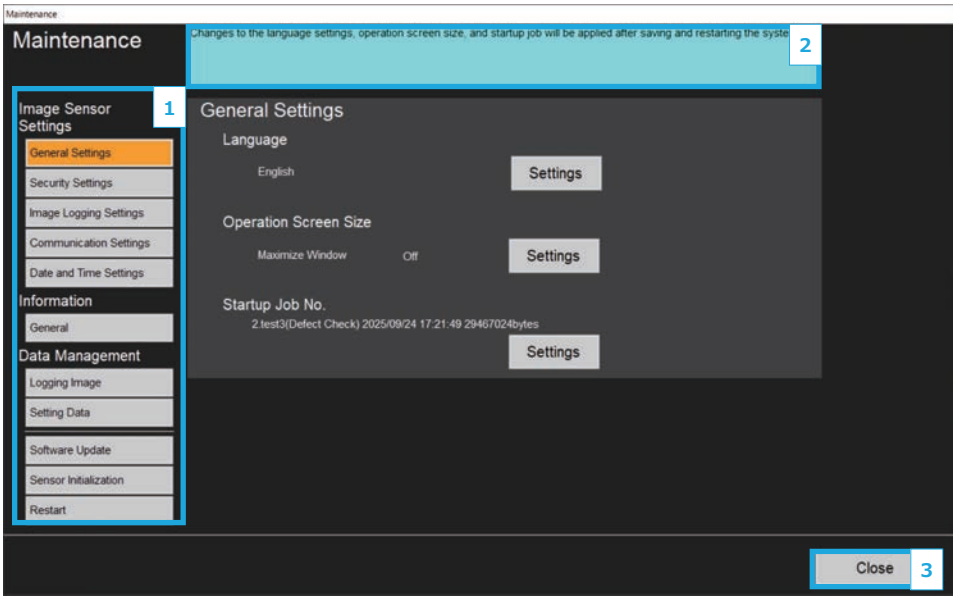
No.	Name of function	Description
1	Inspection program information display	Displays the job number, program name, and inspection type.
2	Latest inspection image display	Displays the latest inspection image.
3	Latest inspection result information display	Displays overall judgment results (OK, NG), processing time (msec), and individual judgment results (OK, NG, Error).

No.	Name of function	Description
4	Inspection statistics display	Displays the number of inspection runs, the number of non-defective products judged as OK, the number of defective products judged as NG, and the percentage of non-defective products in the number of inspection runs (rounded down to the second decimal place) as inspection information accumulated since the last reset. Pressing the **Reset** button on the screen resets the statistics.  When the security setting is enabled, **Password confirmation** dialog appears. Enter the password set in the security setting and click **OK** to display the Adjustment screen. 
5	Adjustment button	Used to display the Adjustment screen. *4-2-2 Adjustment* on page 4-5 When the security setting is enabled, **Password confirmation** dialog appears. Enter the password set in the security setting and click **OK** to display the Adjustment screen. 

4-2-4 Maintenance

What you can do on this screen

- Change of various system settings
- Data transfer, setting initialization, software update
- Restart the image sensor



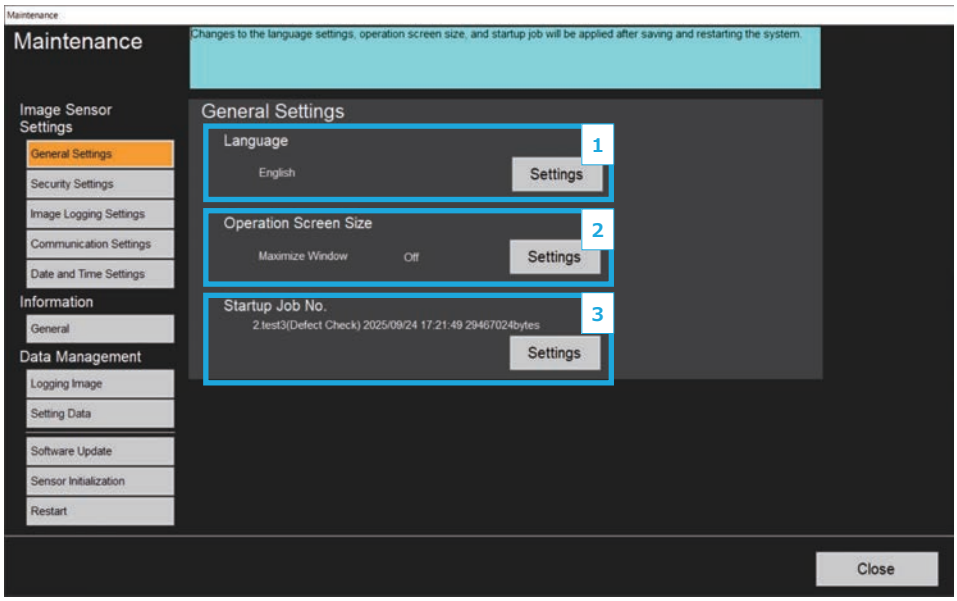
Description of function

No.	Name of function	Description
1	Meintenance menu button	Select the menu you want to configure. Shows a list of maintenance menus and highlights the currently selected menu. • Image Sensor Settings *General Settings* on page 4-30 *Security Settings* on page 4-32 *Image Logging Settings* on page 4-33 *Communication Settings* on page 4-34 *Data and Time Settings* on page 4-36 • Information *General* on page 4-37 • Data Management *Logging Image* on page 4-38 *Setting Data* on page 4-39 • *Software Upgrade* on page 4-41 • *Sensor Initialization* on page 4-42 • *Restart* on page 4-43
2	Operation guidance display	A guidance message is displayed regarding the operation procedure on this screen.
3	Close button	Returns to the Adjustment screen.

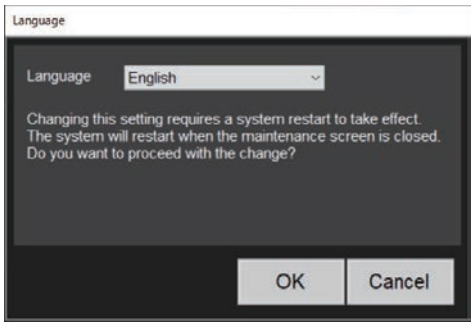
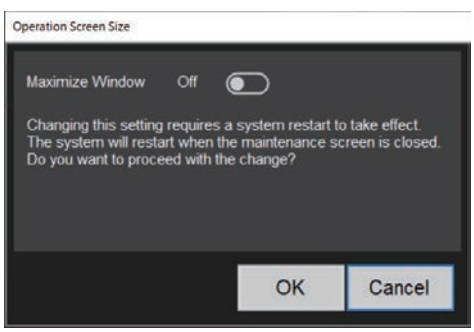
General Settings

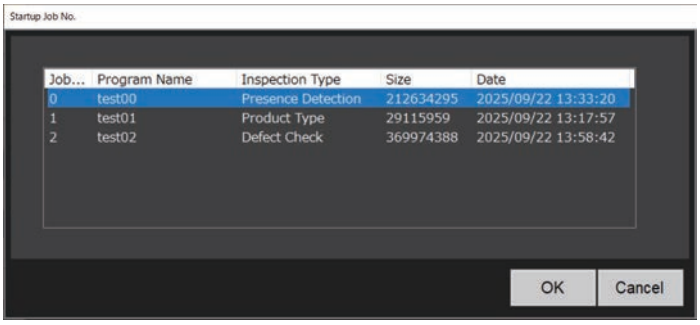
What you can do on this screen

- General settings (language, operation screen size, job at startup)
  The settings will be reflected when the image sensor is restarted after saving.



Description of function

No.	Name of function	Description
1	Language	Display language can be changed. Supported languages: Japanese, English, Simplified Chinese, Traditional Chinese, German, French, Italian, Spanish, Korean, Vietnamese and Polish 
2	Operation Screen Size	Set to *ON* to always maximize the operation screen. 

No.	Name of function	Description
3	Startup Job No.	Select the job to be displayed at startup from the created jobs. 

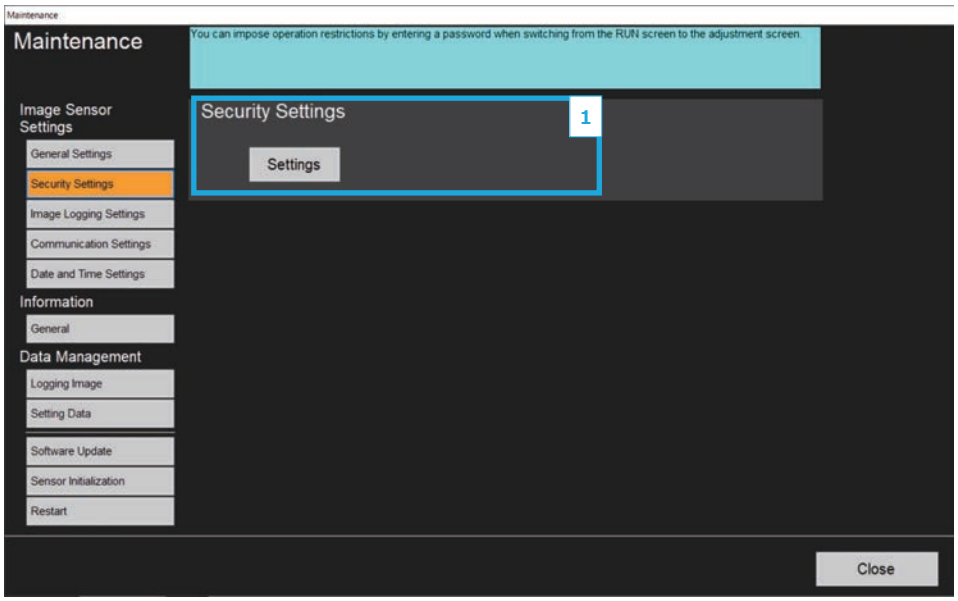
Security Settings

What you can do on this screen

- Password setting when operating the RUN screen (displaying the Adjustment screen, resetting statistics)

Precautions for Correct Use

- If you forget the password, you need to initialize the image sensor. If you set a password, do not forget it.



Description of function

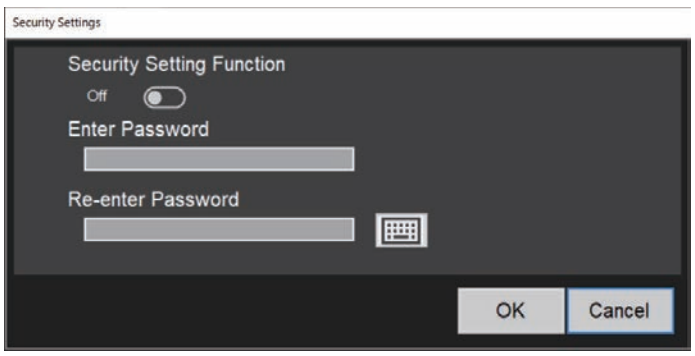
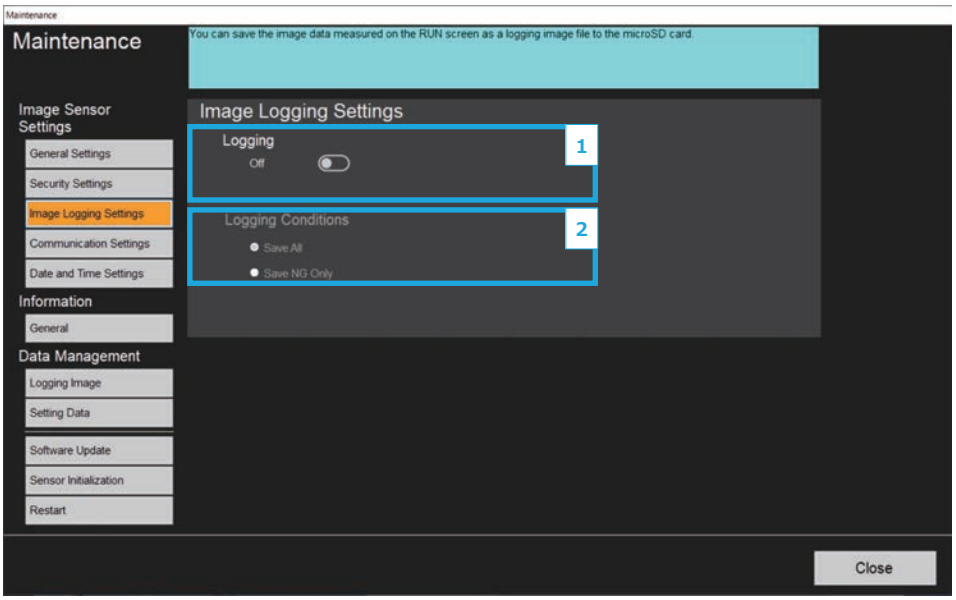
No.	Name of function	Description
1	Security Settings button	Displays the Security Settings dialog.  Change the presence or absence of the security function. If it is turned *ON*, you can set a password. It cannot be set if left blank. The maximum password length is 255 characters. Password input is required when operating the RUN screen (displaying the Adjustment screen, reseting statistics).

Image Logging Settings

What you can do on this screen

- Image logging settings on the RUN screen



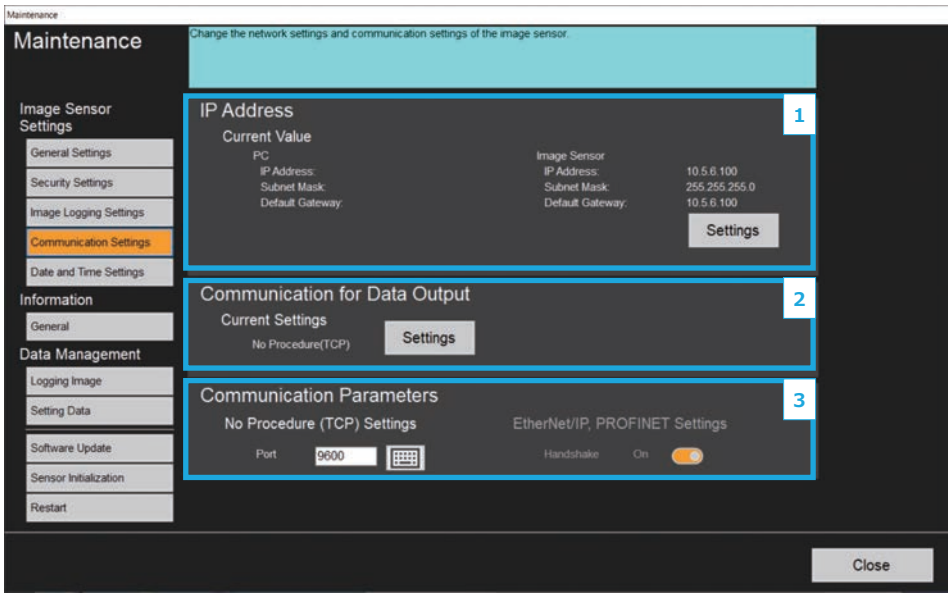
Description of function

No.	Name of function	Description
1	Image Logging Settings	Selects whether to execute image logging when executing inspection on the RUN screen. Logged image files are stored in the LOGGING folder of the microSD card attached to the image sensor. Logging format: ifz
2	Logging Conditions	Set when the Image Logging Setting is *ON*. Select whether to log regardless of the judgment result or only when the judgment is NG.

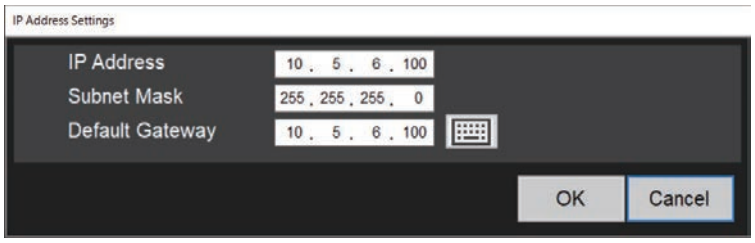
Communication Settings

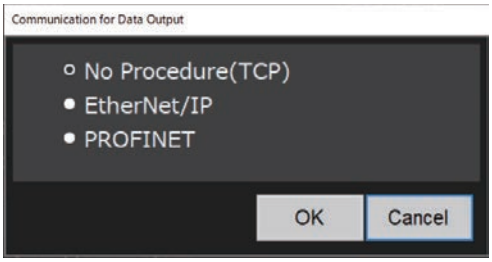
What you can do on this screen

- IP address setting
- Communication protocol selection and communication parameter setting



Description of function

No.	Name of function	Description
1	IP Address Settings	Displays the **IP address settings** dialog.  Sets the IP address, subnet mask, and default gateway of the image sensor.

No.	Name of function	Description
2	Communication for Data Output Settings	Displays the **Communication for Data Output** dialog.  The overall judgment result of the job is output with the selected communication protocol. Available communication protocols according to the selection are as follows. • No Procedure (TCP): No procedure (TCP) • EtherNet/IP: EtherNet/IP, No procedure (TCP) • PROFINET: PROFINET, No procedure (TCP)
3	Communication Parameters	Sets each communication protocol. • No Procedure (TCP) Settings Sets the port number of the image sensor. • EtherNet/IP, PROFINET Settings Sets whether or not the handshake function is enabled.

Additional Information

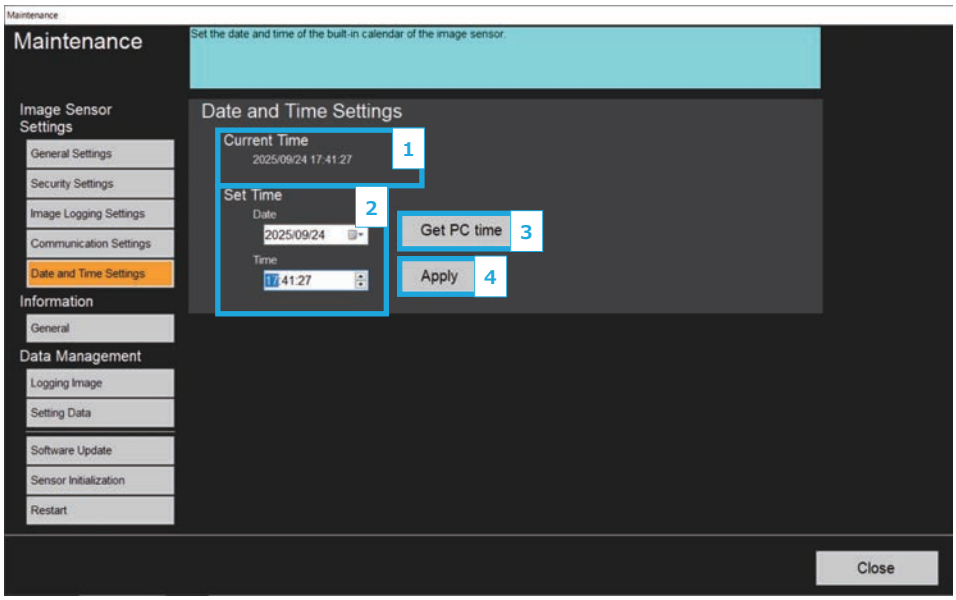
Other communication parameters operate as follows:
- Output time: 5 msec
  (Only when handshake is not set) ON time of data output completion signal (GATE bit)
- Timeout: 10 sec
  (Only when handshake is set) If there is no other response from the external device within the set time, a communication error occurs.
- Output data size: Result Data Format 0 (32 bytes)
  It is the size of data to be output as a inspection result.
- User area: None
  User area (user input/output area) is not used.
- Judgment result output polarity: ON when NG
  If the judgment result is NG, OR bit is turned ON.
- Error output polarity: ON when error occurs
  ERR bit is turned ON when error occurs.

For the communication method, refer to *Section 5 Methods for Communicating with External Devices* on page 5-1.

Data and Time Settings

What you can do on this screen

- Image sensor date and time setting



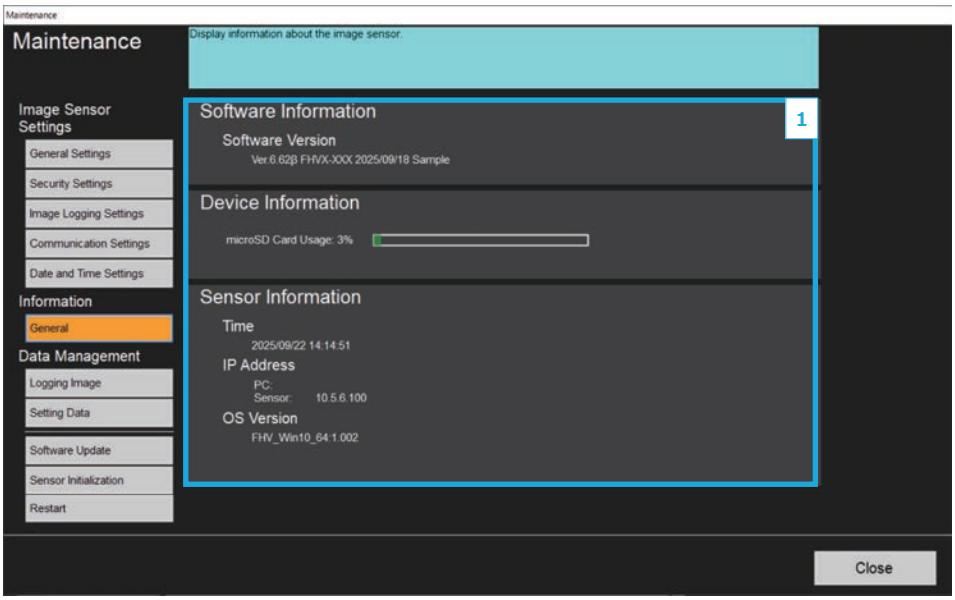
Description of function

No.	Name of function	Description
1	Current Time	Displays the date and time of the built-in calendar of the image sensor.
2	Set Time	Select the date and time to be set for the image sensor.
3	Get PC time button	Reflects the date and time of the remote control PC to the set time.
4	Apply button	Apply the value of the input set time to the built-in calendar of the image sensor.

General

What you can do on this screen

- Check sensor information



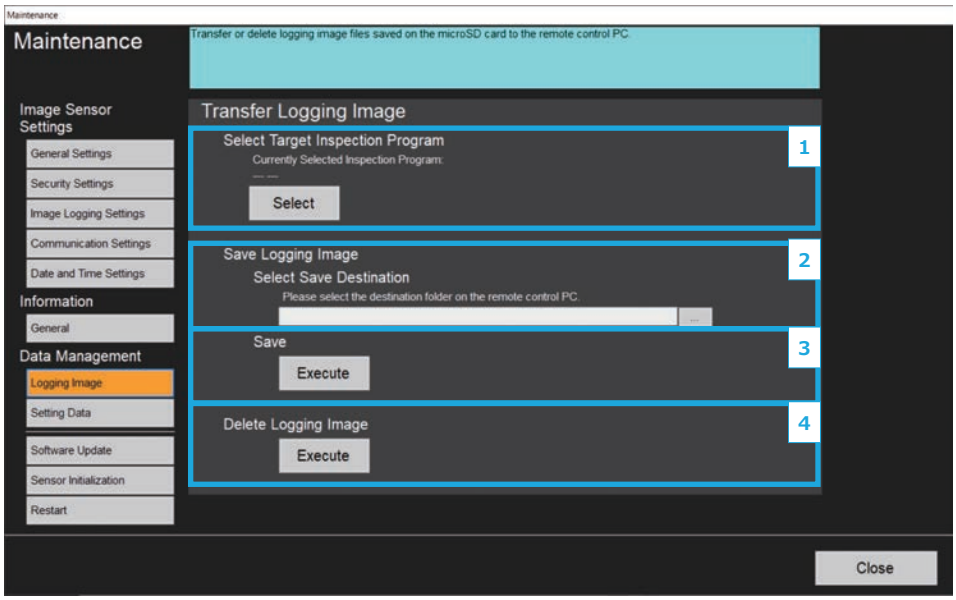
Description of function

No.	Name of function	Description
1	Software Information Device Information Sensor Information	Displays image sensor information.

Logging Image

What you can do on this screen

- Transfer of logging image files saved on the RUN screen to the remote control PC
- Delete the logging image file saved on the RUN screen



Description of function

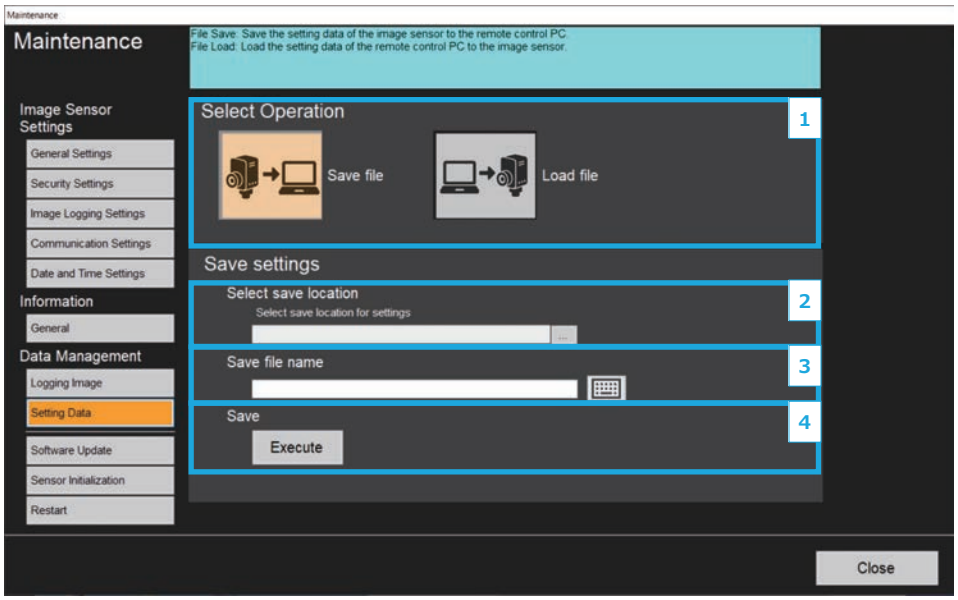
No.	Name of function	Description
1	Select Target Inspection Program button	Select the job to transfer or delete the logging image file.
2	Select Save Destination	Set the folder on the remote control PC to which the logging image file is transferred.
3	Save button	Transfer the logging image file.
4	Delete Logging Image button	Delete the logging image file.

Setting Data

● Save file

What you can do on this screen

- Transferring a set of configuration data files to a remote control PC



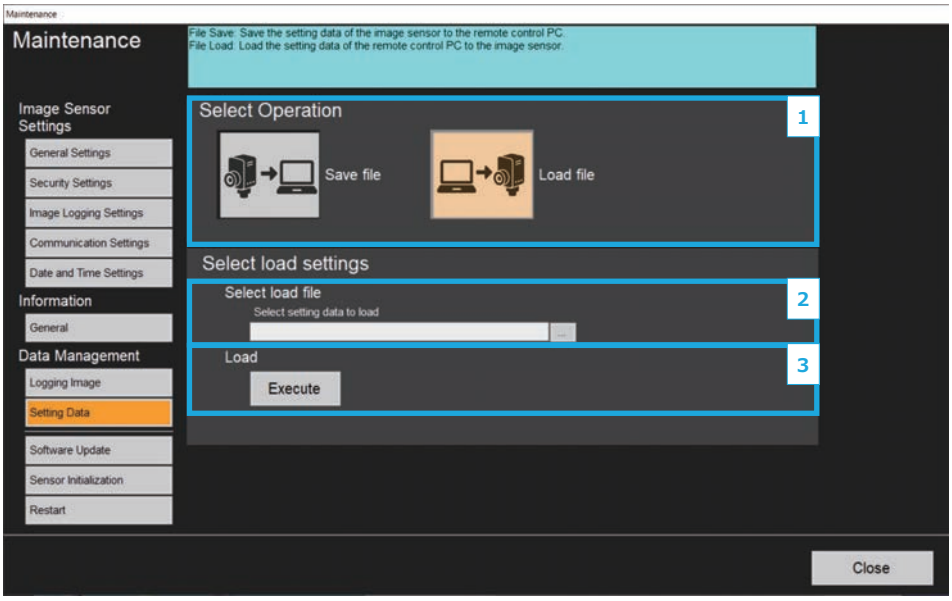
Description of function

No.	Name of function	Description
1	Select Operation button	Switch to *Load file*. *Load file* on page 4-40
2	Select save location	Set the folder on the remote control PC where the set of setting data files are saved.
3	Save file name	Set the file name of the set of setting data files. You can also click  to view and type in the software keyboard.
4	Save button	Save a set of configuration data files. A security warning dialog may appear. Click run to execute the save.

Load file

What you can do on this screen

- Load a set of setting data files stored on the remote control PC into the image sensor



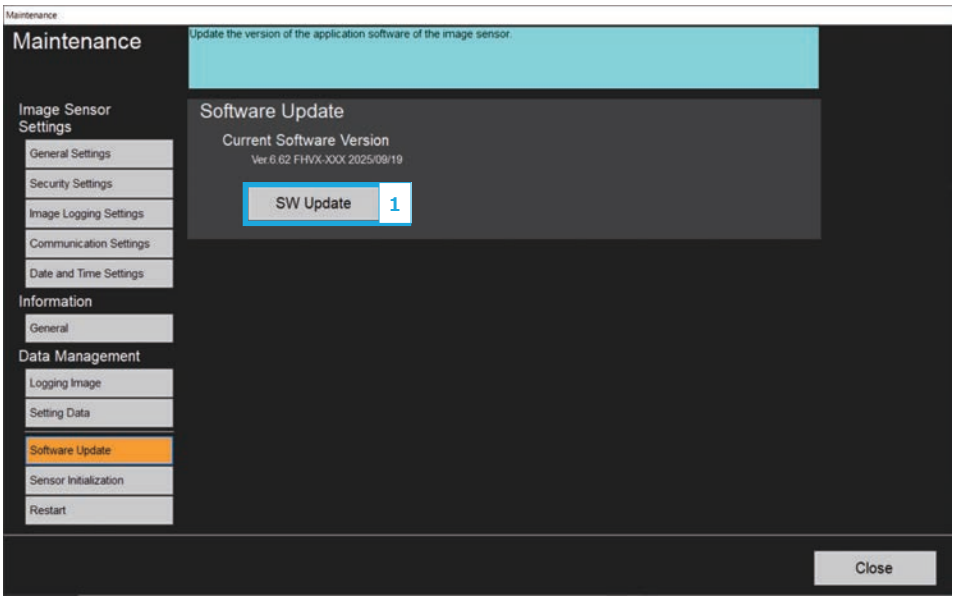
Description of function

No.	Name of function	Description
1	Select Operation button	Switch to *Save file*. *Save file* on page 4-39
2	Select load file	Select the folder on the remote control PC where the set of setting data files to be read are saved.
3	Load button	Executes loading of the set of setting data files.

Software Upgrade

What you can do on this screen

- Image sensor software version update



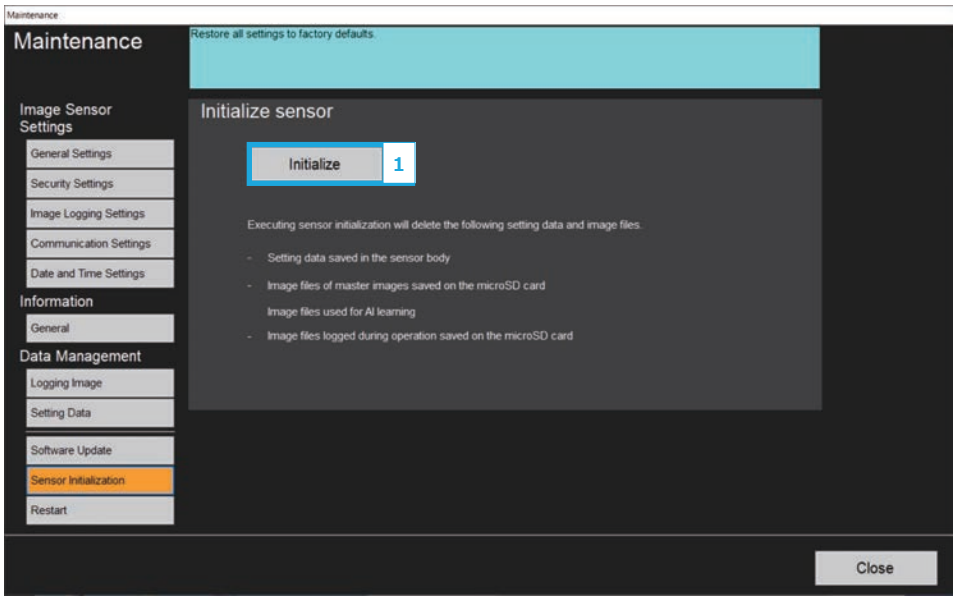
Description of function

No.	Name of function	Description
1	SW Update button	Update the software by selecting the software data file of the version upgrade tool. *A-5-1 By the Remote Operation* on page A-54

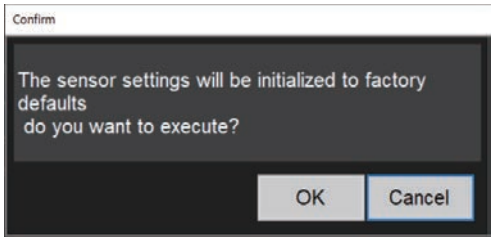
Sensor Initialization

What you can do on this screen

- Initialization of image sensor



Description of function

No.	Name of function	Description
1	Initialize button	Initialize the image sensor.  Executing sensor initialization will delete the following setting data and image files. • Setting data saved in the sensor body • Image files of master images saved on the microSD card Image files used for AI learning • Image files logged during operation saved on the microSD card The image file saved on the microSD card will also be deleted, so if necessary, save the file in *Setting Data* on page 4-39.

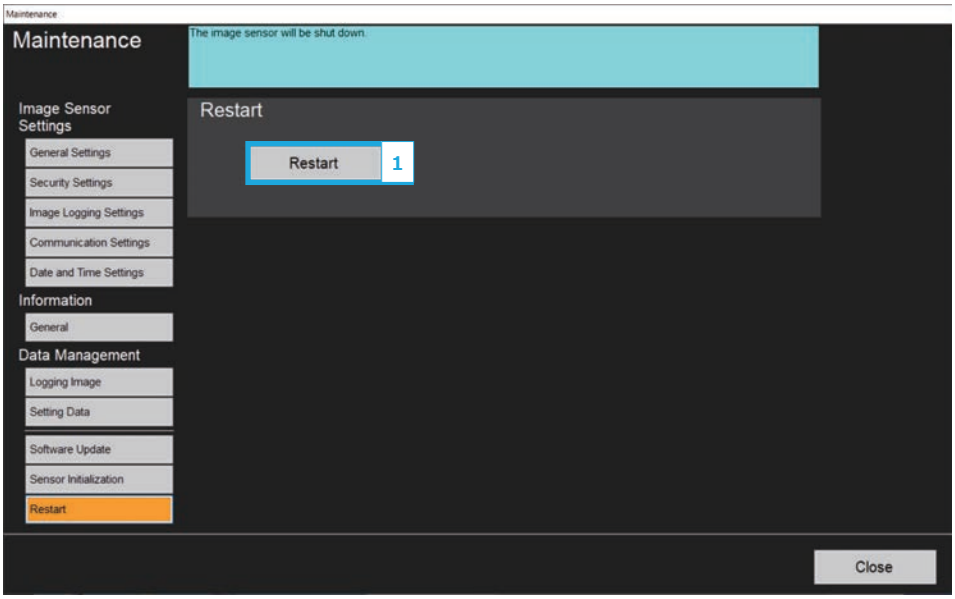
Restart

What you can do on this screen

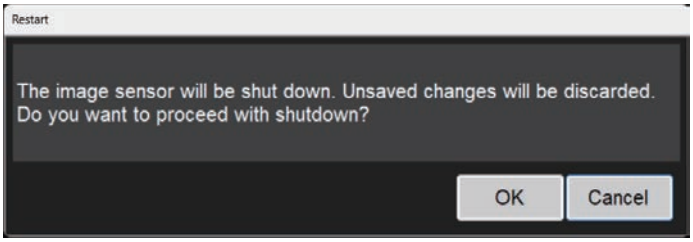
- Restart the image sensor

Precautions for Correct Use

- Shut down when operating files in the microSD card. If it is not restart, the operation of creating, moving, and deleting files may not be reflected correctly depending on the type of microSD card and file format.



Description of function

No.	Name of function	Description
1	Restart button	Restar the image sensor. 

5

Methods for Communicating with External Devices

5-1 Overview

This section describes communication specifications to be used for communications between the smart camera and an external device.

5-1-1 Confirming the System Configuration

This product is an image sensor that inspects and processes the captured object.
In a system configuration connected to an external device such as a PLC, inspection commands can be received from and inspection results can be output to the external device.
The smart camera and an external device (PLC, etc.) are connected with a communication cable and communicate with each other using various communication protocols.

Communications Protocol	Communication Cable
Parallel	I/O cable
EtherNet/IP	Ethernet cable
PROFINET	Ethernet cable
Non-procedure	Ethernet cable

Precautions for Correct Use

- Parallel commands can only be used when the parallel input/output signal expansion unit (FHV-SDU10) of the smart camera data unit is connected.
- Use communication commands only on the **RUN** screen. Other screens may not be usable or may become abnormal. (As an exception, the single inspection command can also be used in the **Pre-Learning** process and **Operation Check** process on the **Adjustment** screen.)

5-1-2 Communicating with an External Device

Basic Control Operations of the Smart Camera

The following figure shows basic communications, and the flow of signals and data, between an external device and the smart camera.

The following methods are used to exchange commands and data, between an external device and the smart camera.

From an external device to the smart camera

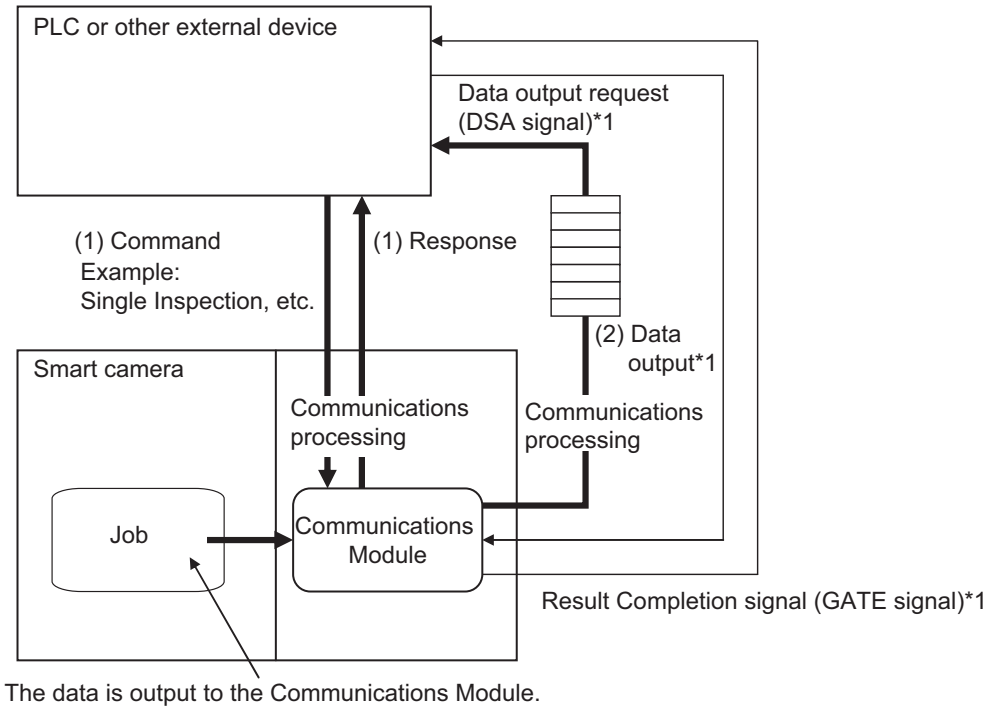
Type		Description
Control commands	Control signals (Input signal)	A inspection is performed when a measurement trigger (i.e., STEP signal: ON) is input. For information of control signals, refer to *Control Signals and Status Signals* on page 5-8.
	Communications command input	You can send commands to perform inspections, switch the jobs, or perform other tasks. The communication commands depend on the communication protocol used. For details, refer to the section for each communication protocol.

From the smart camera to an external device

Type	Description
Status signals	When the smart camera recognizes a control signal or communication command input and starts measurement processing, it reports its status to the external device using status signals such as a BUSY signal. For details, refer to *Control Signals and Status Signals* on page 5-8.
Overall judgment	NG is output whenever there is one or more NGs in the judgment results.

Communications between the Smart Caera and an External Device

Communications between the smart camera and an external device are performed as shown below. Here, describe how to start inspection with a communication command and to output data.



(1) When the smart camera receives a command from an external device such as a PLC, it performs the command and returns a response.

(2) The inspection data is output by the communication module.

*1 When **handshake** is set to *ON* in communication parameter setting (*Communication Settings* on page 4-34), data output is controlled by DSA signal and GATE signal.
When the handshake function is used, the inspection data is not held in the communication module until a data output request (DSA signal) is received from the external device.
For details, refer to *Data Output Control with Handshaking* on page 5-11.

Precautions for Correct Use

To output data, the data output setting must be turned ON. (*Advanced Settings (for Data Output Setting)* on page 4-25)

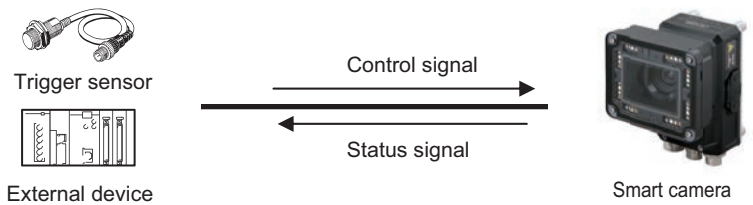
Control Methods for the Smart Camera

There are three methods below to control the smart camera with an external device such as a PLC. For details of each control method, refer to their corresponding section.

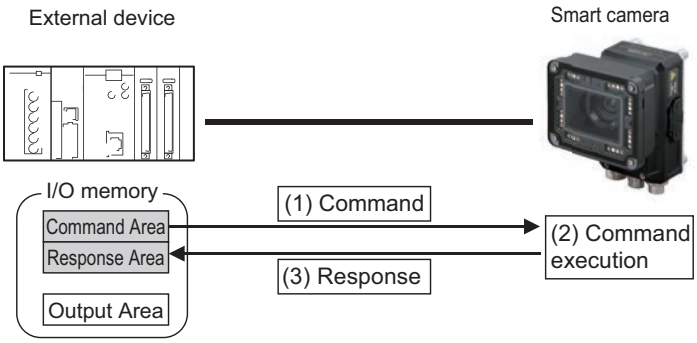
Control Methods

Method	Overview	Trigger type and area	Signal and area to be used
Control signals and status signals	Operation is controlled by the ON/OFF status of the Measurement Trigger Signal (STEP) and Command Request Bit (EXE).	ON/OFF status of the control signals and status signals	Control signals and status signals
Control with commands and responses	Operation is controlled by sending control commands. The results performed by the commands can be checked with responses from the smart camera.	The control command code is stored in the I/O memory of the PLC and then the Request bit is turned ON.	PLC I/O memory (Command and Response Areas)
Data output after inspection	After inspection was performed, the previously specified inspection data is automatically output.	Not required (Automatically output after inspection)	PLC I/O memory (Data Output Area)

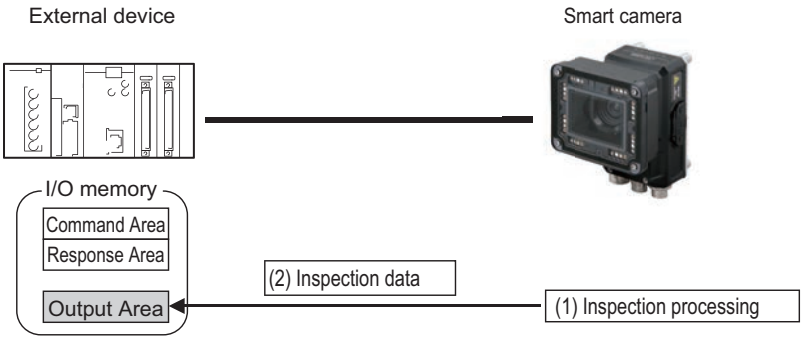
1. **Control with Control Signals and Status Signals (Refer to *Control with Control Signals and Status Signals* on page 5-7.)**
   Control and status check for the smart camera is performed with the ON/OFF status of the control and status signals.
   This method is best suited for basic operations such as measurement triggers or for checking the operating status of the smart camera.



2. **Control with Commands and Responses (Refer to *Command / Response Method* on page 5-9.)**
   Control is performed by storing a control command and the response to it to the PLC's I/O memory. This method is best suited to send multiple commands to the smart camera without using exclusive communication instructions for a PLC.

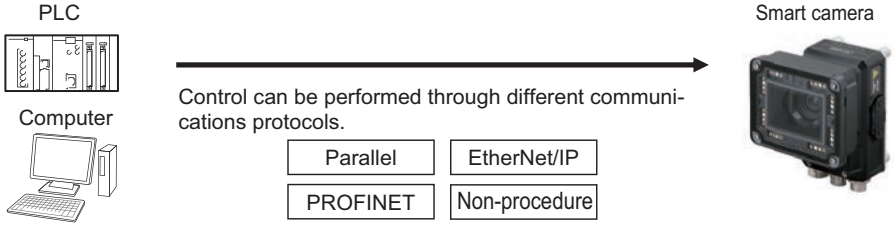


3. **Data Output after Inspection (Refer to *Data Output after Inspections* on page 5-10.)**
   After inspection was performed, the previously specified inspection data is automatically output to the PLC's specified I/O memory.
   This allows you to output inspection results from the smart camera to the PLC automatically without sending data requests from the PLC.



Communication Protocols for Communicating with the Smart Camera

The smart camera can be controlled using various communication protocols by an external device such as a PLC or a PC.
The communication protocols to control the smart camera by an external device are described below.



● Applicable Communications Protocols

The communication protocols and summary for each communication method available in the smart camera are below.

OK: Supported, - : Not supported

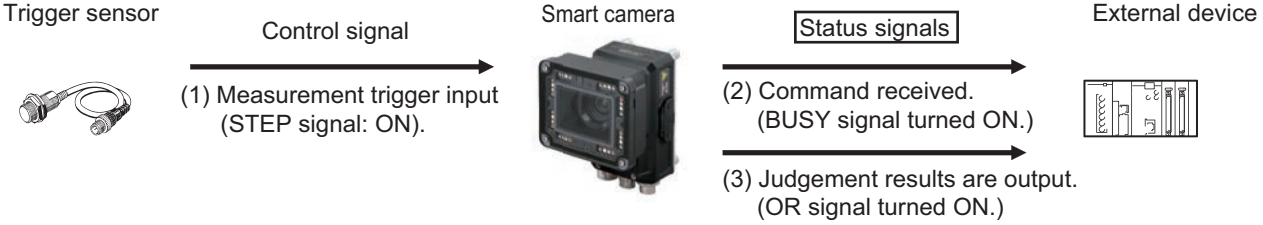
Communication method	Communication protocol	Overview	Communication Cable Type	
			Parallel I/O	Ethernet
Contract input	Parallel	Using a combination of ON and OFF signals of multiple physical contacts exchanges data between an external device and the smart camera.	OK	-
Frame transmission	Non-procedure	Without using any specific communication protocol, command frames are sent to the smart camera and response frames are received from it. By sending and receiving data in ASCII or binary formats, data is communicated between an external device such as a PLC or a PC and the smart camera.	-	OK
Data sharing	EtherNet/IP	This is an open communication protocol. Tag data links are used to communicate with the smart camera. Structure variables corresponding to the control signals, command data and response data, and inspection data are created on the PLC. Those variables are used as tags to input and output data via the tag data links to exchange data between the PLC and the smart camera.	-	OK
	PROFINET	This is an open communication protocol. Areas for control signals, Command, Response, and inspection data are assigned in the PLC's I/O memory, and data is exchanged between the PLC and the smart camera by sharing the data via IO data CR.	-	OK

5-1-3 Control Methods Using an External Device

This section describes how to control the smart camera from an external device such as a PLC.

Control with Control Signals and Status Signals

Control and status check for the smart camera is performed with the ON and OFF status of the control and status signals.
A PLC inputs measurement triggers or other commands as control signals.
The operating status of the smart camera, judgment results, and other status information can be checked with status signals output from the smart camera.



(1) The external device turns the STEP signal ON to input a measurement trigger to the smart camera.

(2) When the smart camera identifies that the STEP signal is turned ON, it outputs the BUSY signal to notify the external device and starts inspection.

(3) When the smart camera completes the inspection, it outputs the judgment results on the OR signal to notify the external device.

● Control Signals and Status Signals

The signal types that are input and output to the smart camera as control and status signals are described below.

Input Signals (External Device (PLC, etc.) to Smart Camera)

Signal	Name	Function
EXE	Control Command Execution Signal	This is turned ON when the PLC will issue a command to the smart camera.
STEP	Inspection Bit	This is turned ON when inspection will be performed.
DSA (Used only for handshaking output control)	Data Output Request Signal	During handshaking, the user (PLC) uses this signal to request to output data output results performed in the job to external from the smart camera.
ERCLR	Error Clear Bit	Clears the error signal (ERR bit). The ERROR signal of the parallel interface and the ERR LED of the indicator light are not cleared.
DI (DI0 to DI7)	Command Input Signals	These are used to input commands from a parallel interface.

Output Signals (Smart Camera to External Device (PLC, etc.))

Signal	Name	Function
BUSY	Busy Signal	This signal indicates that new requests cannot be accepted because an external input such as a command is currently handled. “ON” of this signal does not mean that a command is currently performed. To check whether a command is being executed, check the Command Completion (FLG) signal.
FLG	Control Command Completion Signal	The smart camera uses this signal to inform the user (PLC) that a command has been completed.
GATE	Data Output Completion Signal	This signal informs the user (PLC) of the timing to load output data. “ON” of this signal indicates that the smart camera is outputting the data.*1
READY	Camera Image Input Enabled Signal	This signal indicates that the STEP (Measurement Trigger) signal can be input.
OR	Overall Judgment Output Signal	This signal notifies the overall judgment results.
ERR	Error Signal	This signal indicates that the smart camera detects the following errors. The ERR signal does not turn OFF even after the error is eliminated. The signal turns OFF only when the error status is cleared by a control command. For details, refer to *6-1 Error Messages and Troubleshooting* on page 6-2.
RUN	Run Signal	The signal indicates that the smart camera is running.

Signal	Name	Function
ACK	Command Completion Flag	This signal indicates that the DI command execution has been completed.

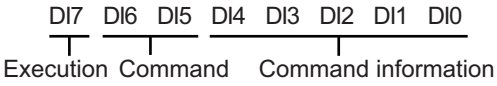
*1. This has no linkage relation with the BUSY signal. Also, this has no linkage relation with the OR signal in the parallel communication protocol.

Command / Response Method

● Parallel

Commands are input to the smart camera by turning the DI signals (DI0 through DI7) ON and OFF. Since there is no direct response for these commands, so check the ACK signal whether or not a command was accepted.

The command code is input with signals DI0 through DI6, and the command is performed by turning DI7 ON.

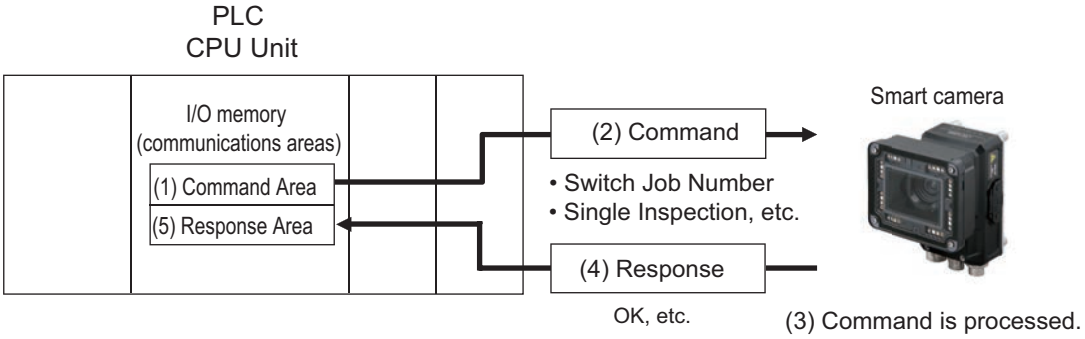


● EtherNet/IP or PROFINET

By storing control commands from the PLC to the smart camera and responses from the smart camera to the PLC into the PLC's I/O memory, command and response control signals are exchanged. This enables you to control the smart camera using commands such as single inspection and job switch without any sequence control such as issuing communication commands from the PLC.

Memory Areas Used by the Command/Response Method

Command Area	You write the control commands to execute for the smart camera to this area.
Response Areas	You read the performed results of the control commands written in the Command Area from this area.



Flow of Communications between the PLC and the smart camera

(1) The PLC (the user) writes a control command to a specified PLC's I/O memory area (the Command Area).
(2) The PLC (the user) then turns the EXE bit ON to send the control command to the smart camera.
(3) The smart camera perfoms the received control command.
(4) The smart camera returns a response to the PLC after the control command was performed.
(5) The PLC (the user) stores the response in a specified PLC's I/O memory area (the Response Area).

The communication commands depend on the communication protocol used. For details, refer to *Command List* on page 5-14.

● Non-procedure Communications

Communication commands are sent to the smart camera through sequence control in the PLC. An external device and the smart camera communicate through non-procedure (normal) communications.

Data Output after Inspections

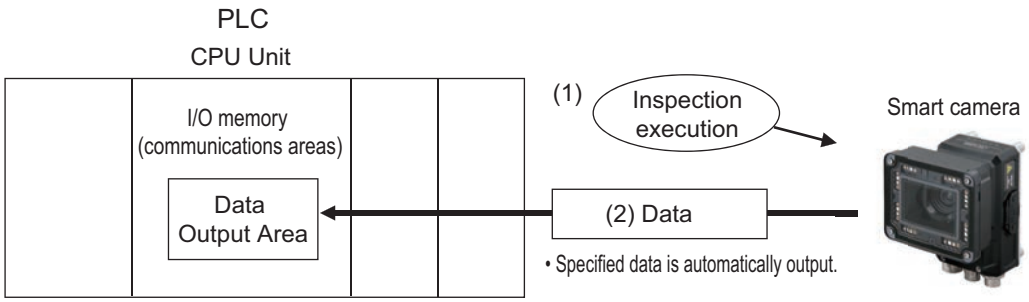
Just after a single inspection command is executed, the smart camera automatically outputs the data associated with the measurement specified in advance as output items to the PLC. This allows you to easily pass inspection results data to the PLC. You can also choose to output only when the PLC meets the conditions required to receive the data (i.e., when handshaking is enabled).
The output destination for data depends on the protocol that is used to communicate between the external device and the smart camera, as described below.

● EtherNet/IP or PROFINET

The output data is automatically output to the PLC's specified I/O memory below.

Area of Memory Used for Data Output after inspections:

Data output area	After inspection performed, the output data associated with the inspection is written to this area by the smart camera.



Flow of Communications between the PLC and the smart camera:

The data to output after inspection performed and the PLC I/O memory area (Data Output Area) to store that data need to be specified in advance. For details, refer to *Settings Required for Data Output* on page 5-11.

(1) Inspection is performed.
(2) After the inspection was performed, the specified inspection data is stored in the Data Output Area in the PLC.

● Parallel

The data is output to the PLC signal lines.

● Non-procedure Communications

The data is output to the PLC reception buffer through non-procedure (normal) communications.

● Items that can be Output as Output Data

● Inspection Data

The following items can be output.

- Judgment result

● Settings Required for Data Output

Set *Advanced Settings (for Data Output Setting)* on page 4-25 to output data.

● Data Output Control with Handshaking

The timing for data output can be controlled through the DSA and GATE signals. As the timing for transferring output data can be controlled.

● Requirements for Using Data Output Control with Handshaking

When controlling data output, set the **Handshaking** to *ON* in *Communication Settings* on page 4-34.

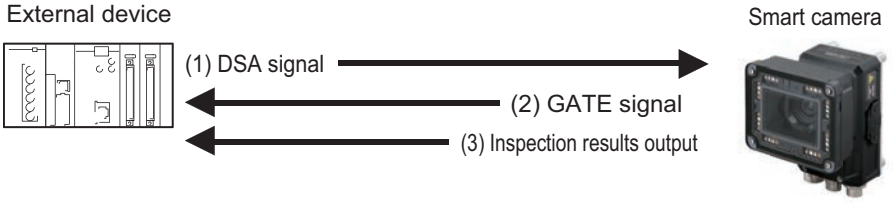
● Handshaking

When when the external device does not turn ON the DSA signal, the inspection data will not be output to the external device from the smart camera. While the DSA signal is ON, the GATE signal turns ON when the inspection data is output from the smart camera.
The external device takes in the inspection data when the GATE signal turns ON.

Signals Used for Handshaking

Signal	Name	Description
DSA	Data Output Request Signal	This signal is sent by the external device (PLC) to the smart camera to request data output.
GATE	Data Output Completion Signal	This signal is sent by the smart camera to inform the external device (PLC) of the timing to load output data. This signal is output only when the DSA signal is ON.*1

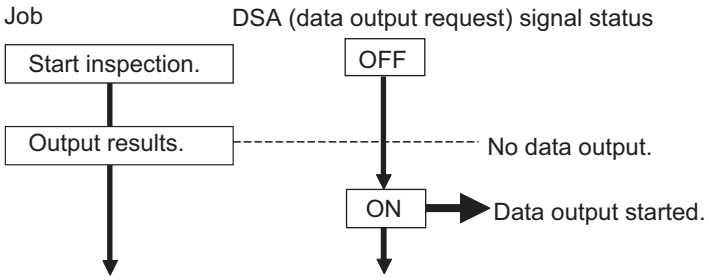
*1. When handshaking is not enabled for output control, the GATE signal will also be turned ON when data is output from the smart camera.



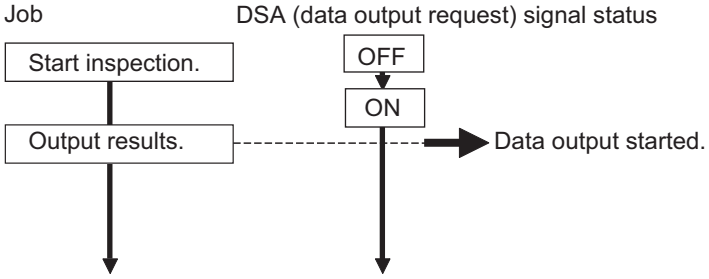
(1) The PLC turns ON the DSA signal and waits for the output data.
(2) The smart camera turns ON the GATE signal when the DSA signal is ON and it is ready to output the inspection results.
(3) The smart camera turns ON the GATE signal and outputs the output data.

● DSA Signal ON Timing

The DSA signal needs to be turned ON when data is required.
When an Output Unit has been performed and data to output is ready, the smart camera will output the data when it detected the DSA signal turned ON.



To output inspection results immediately, issue the measurement trigger and turn ON the DSA signal. The smart camera does not check the change from OFF to ON of the DSA signal but checks the ON state. As the inspection results are output from the smart camera to the external device immediately when the Output Unit is performed, the PLC takes in the output data at once.



5-1-4 Differences in Specifications Based on the Communications Protocol

This section describes the types and differences of communication protocols that are used for communications with the smart camera.

List of Supported Signals by Communications Protocol

Some of the control and status signals to be used depend on the communication protocol as shown below.
The table below can be used to check which *signals exist in each communication protocol* by means of a vertical arrangement.
Note that this table does not indicate whether signals of one communication protocol can be used simultaneously with signals of other communication protocols.
For restriction on communication protocols that can be used simultaneously, refer to *Restrictions when Using Different Communication Protocols Simultaneously* on page 5-13.

Precautions for Correct Use

The control signals and status signals cannot be used for control in Non-procedure communications.

● Input Signals (External Device (PLC, etc.) to Smart Camera)

OK: Can be used, - : Cannot be used

Signal	Name	Signals for each communication protocol		
		Parallel	EtherNet/IP	PROFINET
EXE	Control Command Execution Signal	-	OK	OK
STEP	Inspection Bit	OK	OK	OK
DSA (Used only for handshaking output control)	Data Output Request Signal	OK	OK	OK
ERCLR	Error Clear Bit	-	OK	-
DI (DI0 to DI7)	Command Input Signals	OK	-	-

● Output Signals (Smart Camera to External Device (PLC, etc.))

OK: Can be used, - : Cannot be used

Signal	Name	Signals for each communication protocol		
		Parallel	EtherNet/IP	PROFINET
BUSY	Busy Signal	OK*1	OK*1	OK*1
FLG	Control Command Completion Signal	-	OK	OK
GATE	Data Output Completion Signal	-	OK	OK
READY	Camera Image Input Enabled Signal	OK	-	-
OR	Overall Judgment Output Signal	OK	OK	OK
ERR	Error Signal	OK	OK	OK
RUN	Run Mode Signal	OK	OK	OK
ACK	Command Completion Flag	OK	-	-

*1. This will not be detected while commands received through any other protocol are processed. The BUSY signal in Parallel can be shared in all protocols. If you use more than one protocol and need to detect command execution, use the BUSY signal in Parallel.

Restrictions when Using Different Communication Protocols Simultaneously

- The Parallel Communication Module can be used with any other Communication Modules.

Precautions for Correct Use

If control signals or commands are input simultaneously to the smart camera from different Communications Modules, they may not be received correctly. Check the status signals for each Communications Module and input control signals and commands at different times for each.

Command List

This section lists the commands that you can use with the FHV7-AI series and the communications protocols for which each command is supported.

OK: Applicable command, NA: Non-applicable command

Function	Non-procedure (TCP)	EtherNet/IP PROFINET	Parallel
Single Inspection • Performs inspection one time.	OK *MEASURE or M* on page 5-85	OK *Single Inspection* on page 5-41	NA *1
Switch Job • Switches to the job with the specified number.	OK *JOB* on page 5-85	OK *Switch Job* on page 5-41	OK *Parallel Command Details* on page 5-94
Set Date and Time • Sets the date and time.	OK *DATE* on page 5-86	NA	NA
Reset Statistics Information • Reset the numerical value of the statistics displayed on the operation screen to zero.	OK *RESETCOUNTER* on page 5-87	OK *Reset Statistics Information* on page 5-42	NA

*1. Inspection can be executed with a measurement trigger (STEP signal).

Precautions for Correct Use

- Parallel commands can only be used when the parallel input/output signal expansion unit (FHV-SDU10) of the smart camera data unit is connected.
- Use communication commands only on the **RUN** screen. Other screens may not be usable or may become abnormal. (As an exception, the single inspection command can also be used in the **Pre-Learning** process and **Operation Check** process on the **Adjustment** screen.)

5-2 Communicating by EtherNet/IP

This section describes the communication settings, communication specifications, input/output formats, and the communication timing charts during communications, which are required for EtherNet/IP communications between the smart camera and an external device.

5-2-1 Introduction to EtherNet/IP

EtherNet/IP is an industrial multi-vendor network using Ethernet.
The specifications are open standards managed by the ODVA (Open DeviceNet Vendor Association).
EtherNet/IP is used in a wide range of industrial devices.
Since EtherNet/IP uses standard Ethernet technology, it can be mixed with various general-purpose Ethernet devices.

EtherNet/IP has mainly the following features.

- **High-speed and high-capacity data exchange through tag data links (Cyclic communication)**
  The EtherNet/IP protocol supports Implicit communications, which allows cyclic communication so-called tag data links with EtherNet/IP devices.
- **Tag data links at communication cycle specified for each application regardless of the number of nodes**
  Since data is exchanged over the network at the update period set for each connection, the update period for communications will not increase even if the number of nodes is increased. (The concurrency of data in connections is maintained.)
  Moreover, the update period can be set for each connection, each application can communicate at its optimum update period. (ex.: Interprocess interlocks can be transferred at high-speed, while production instructions and the status monitor information for production processes are transferred at low-speed.

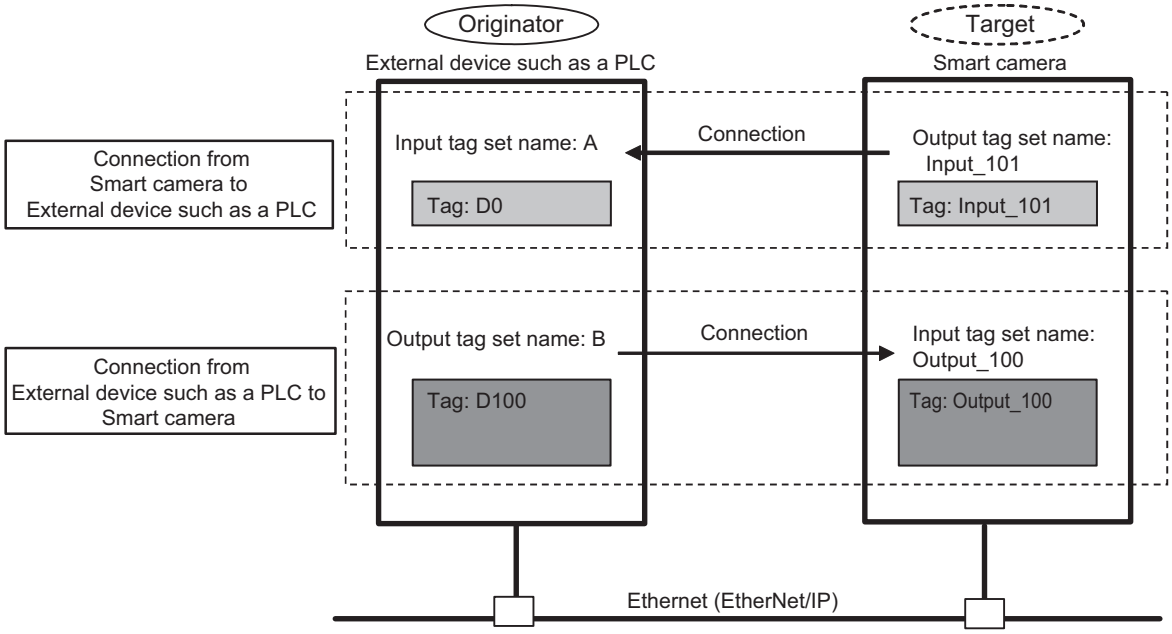
Precautions for Correct Use

- On a network to which many devices are connected, performance may drop (e.g., responses may be delayed or packets lost) or communications errors may occur when there is temporarily high traffic on the network. Test the operation under actual conditions before you start actual operation of the system.
- Since a reasonable amount of measurement takt time is required to have stable communications in an operation under high load, verify the operation under the conditions that are to be actually applied.

5-2-2 Data Exchange with EtherNet/IP

Communications with EtherNet/IP

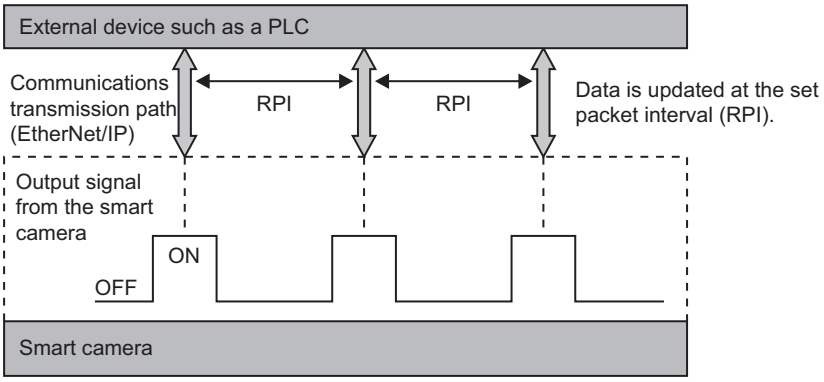
Data is cyclically exchanged between Ethernet devices on the EtherNet/IP network with tag data links below.



- **Data exchange method**
  To exchange data, a connection is opened between two EtherNet/IP devices.
  One of the nodes requests the connection to open a connection with a remote node.
  The node that requests the connection is called the *Originator*, and the node that receives the request is called the *Target*.
- **Data exchange memory locations**
  The memory locations used to exchange data across a connection are specified as tags.
  Memory locations or variables can be specified to tags.
  These grouped tags are called an output tag set and input tag set respectively.

EtherNet/IP Communication Cycle (RPI)

The tag data link communications by EtherNet/IP update data at a communication interval called RPI (Requested Packet Interval).
All data exchange between the smart camera and an external device such as a PLC is performed at the set RPI.



As changes in each signal from the smart camera are also affected by the RPI, the target device sometimes may not detect such changes depending on the RPI timing.
Therefore, set the relationship between the output signals from the smart camera and the RPI as follows.

Duration of change in smart camera signal > RPI

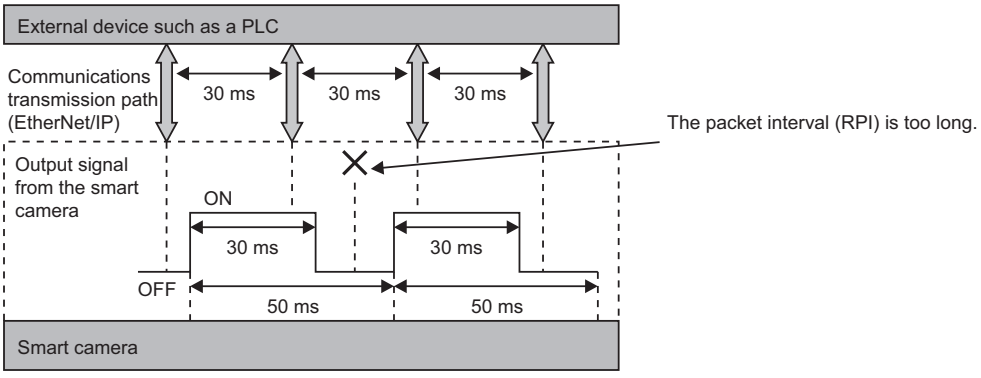
Precautions for Correct Use

Set the RPI to 4 [ms] or higher.

When the RPI is longer than the duration of a smart camera signal change, the signal change may not be detected.

Example 1: Duration of Change in Smart Camera Signal < RPI

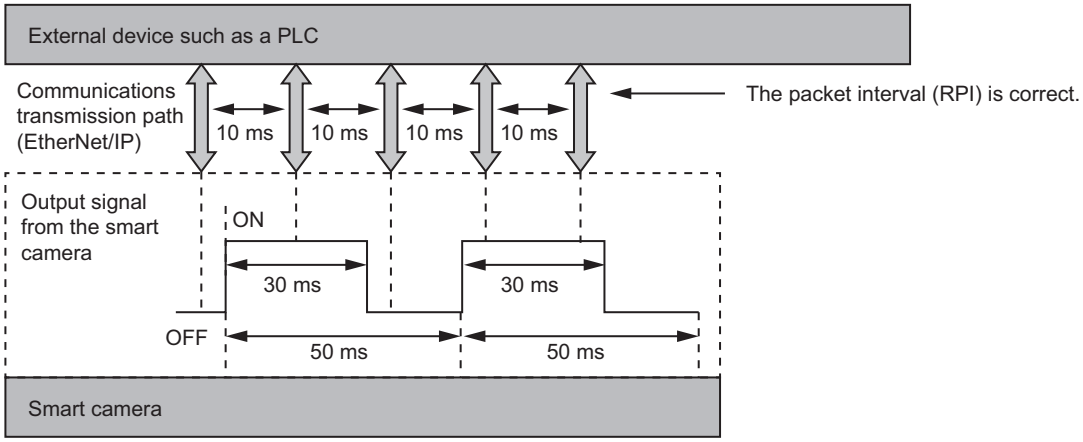
RPI		30 ms
Smart camera	Output period	50 ms
	Output time	30 ms (ON: 30 ms, OFF: 20 ms)
	Output control	None



The external device such as a PLC cannot detect some of the output signals from the smart camera.

Example 2: Duration of Change in Smart Camera Signal > RPI

RPI		10 ms
Smart camera	Output period	50 ms
	Output time	30 ms (ON: 30 ms, OFF: 20 ms)
	Output control	None



The RPI is shorter than the signal time (GATE OFF: 20 [ms]), so the external device such as a PLC can detect all output signals from the smart camera.

5-2-3 EtherNet/IP Communications

With commands and responses via communications between the external device such as a PLC and the smart camera using EtherNet/IP tag data link, the external device such as a PLC can control the smart camera and make it output data after inspections.

The smart camera supports EtherNet/IP conformance tests.

The settings for tag data links are performed with the support software dedicated to it.

When you connect to an OMRON Controller to communicate with it via EtherNet/IP, use the Network Configurator to perform the tag data link settings such as tag, tag set, and connection setting.

This section describes how to use the Network Configurator to perform tag data link settings.

For details of the tag data link settings using Network Configurator, refer to the following manuals.

- *NJ-series CPU Unit Built-in EtherNet/IP Port User's Manual (Cat. No. W506)*
- *CS/CJ series EtherNet/IP Units Operation Manual (Cat. No. W465)*
- *CJ-series EtherNet/IP Units Operation Manual for NJ-series CPU Unit (Cat. No. W495)*

Precautions for Correct Use

- Since a reasonable amount of measurement takt time is required to have stable communications in an operation under high load, verify the operation under the conditions that are to be actually applied.
- On a network to which many devices are connected, performance may drop (e.g., responses may be delayed or packets lost) or communications errors may occur when there is temporarily high traffic on the network. Test the operation under actual conditions before you start actual operation of the system.
- When the inspection processing load is high, or command processing for operations such as job changing is time-consuming, the smart camera prioritizes inspection processing and control processing over communication processing. As a result, communication between an external device and the smart camera may be temporarily interrupted, and a communication error may occur.
  In this case, set the communication error timeout time longer than the smart camera's processing time. Set the communication error timeout time in the tag data link connection settings*1as follows:
  Timeout value > Inspection time on smart camera.
  *1: Use Support Software, such as the Network Configurator, to change the tag data link connection settings.
  For details of setting the tag data links using the Network Configurator, refer to *5-2-7 Setting Tag Data Link* on page 5-22.

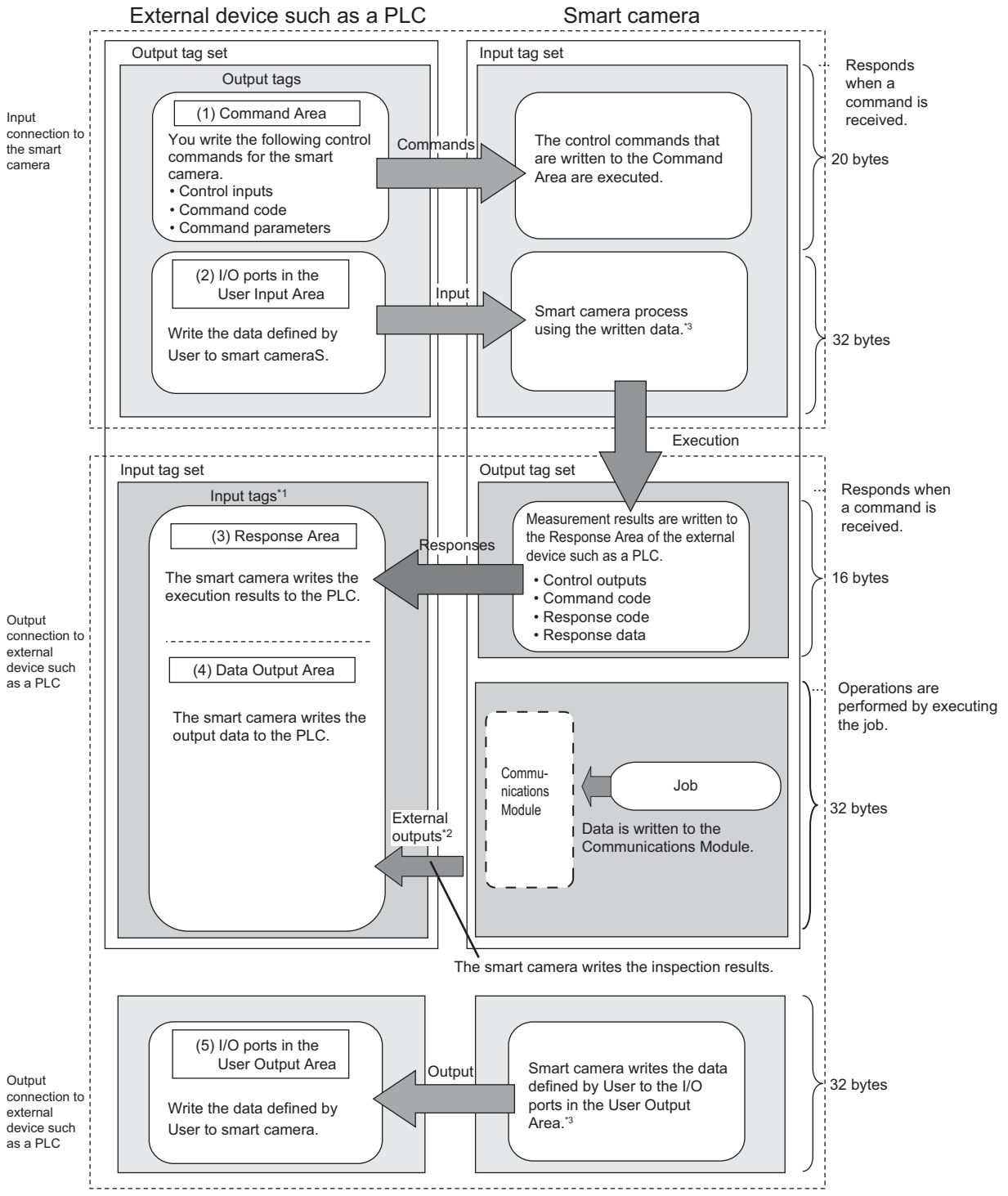
5-2-4 Communications Processing Flow

In EtherNet/IP communications, the following five communication areas are set in the external device such as a PLC.

Input tag set for the smart camera	(1) Command Area (Command/response method)	This area is used that you write control commands to perform for the smart camera.
	(2) User Input Area 0	This area is used that you write the data that you defined for the smart camera. The FHV7-AI series does not use the user area.
Output connection to external device such as a PLC	(3) Response Area (Command/response method)	This area is used that the smart camera writes the results which the control commands written in the Command Area were performed.
	(4) Data Output Area (Data output after inspection)	This area is used that the smart camera writes the output data accompanied with the inspection after inspection performed.
	(5) User Output Area	This area is used that the smart camera writes the data that you defined.The FHV7-AI series does not use the user area.

The above five areas are set by Support Software that can perform tag data link settings such as Sysmac Studio Ver. 1.10 or later, or Network Configurator. How to specify is either I/O memory addresses or variable names.
For details of the tag data link settings by Network Configurator, refer to *5-2-7 Setting Tag Data Link* on page 5-22.
Moreover, when a non-OMRON PLC or EtherNet/IP unit is connected, download the EDS file for the smart camera from our OMRON website and follow the procedures in the user's manual for the external devices to be connected and in the instruction for the software to set tag data link.

The flow of EtherNet/IP communications between an external device such as a PLC and the smart camera is as follows.



*1 : The Response Area (3) and Data Output Area (4) are assigned to continuous memory addresses or to variables.

*2 : You can use output controls (handshaking) to prevent output data from being externally output from the communications buffer until the PLC (master) turns ON the Result Set Request (DSA) signal to request the output data.

*3 : User areas (2)(5) are not used in FHV7-AI series.

5-2-5 Communications Settings

The following settings are required to use EtherNet/IP communications.

1. Communications specifications settings
↓
2. Tag data link settings
↓
3. Communications test

… Set the communication specifications of the smart camera.
For details, refer to *5-2-6 Communication Specifications Settings* on page 5-22.

… The tag data link settings are performed to exchange data with the external device.
This section describe an example of how to set the settings for tag data links with an OMRON PLC using the Network Configurator.
For details, refer to *5-2-7 Setting Tag Data Link* on page 5-22.

… If communications are not working properly, check the communications setup and perform a communications test to determine whether the smart camera can be detected on the network.
For details, refer to *5-2-8 Testing Communications* on page 5-26.
If that does not solve the problem, refer to the troubleshooting section for each communication protocol.

5-2-6 Communication Specifications Settings

Refer to *Communication Settings* on page 4-34 for how to set the communication specifications.

5-2-7 Setting Tag Data Link

This section describes how to set data links for EtherNet/IP.
The communication areas in the external device such as an external device such as a PLC to data-link with the smart camera are specified as tags (tag sets), and the connections are set for tag data link communications.
When you connect to an OMRON Controller to communicate with it via EtherNet/IP, use the Network Configurator to perform the tag data link settings such as tag, tag set, and connection setting.
Here, describes how to set tag data links using the Network Configurator.
For details of the tag data link settings using Network Configurator, refer to the following manuals.

- *NJ-series CPU Unit Built-in EtherNet/IP Port User's Manual (Cat. No. W506)*
- *CS/CJ series EtherNet/IP Units Operation Manual (Cat. No. W465)*
- *CJ series EtherNet/IP Units Operation Manual for NJ-series CPU Unit (Cat. No. W495)*

Precautions for Correct Use

- When connecting to a CPU Unit of NJ series or CJ series, install the EDS file that defines the connection information for the smart camera to the Support Software (e.g., Network Configurator). Download the EDS file from our OMRON's website.
- After the tag data link was set, the Vision Sensor is automatically restarted to apply the settings.

Settings Tags, Tag Sets, and Connection

Here, set each communication area in the external device such as a PLC as tag data link connections as shown in the following table.

● Tag and Tag Set Settings in the External Device such as a PLC

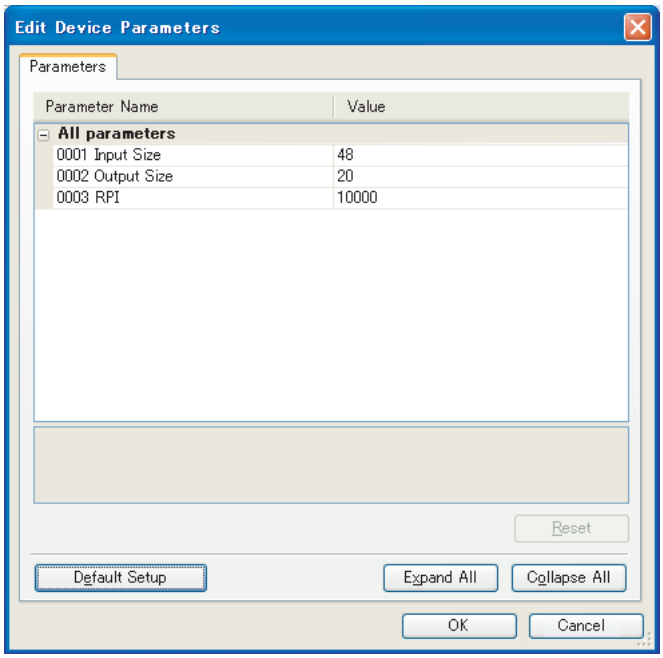
Setting item	Description	
	Command Area	Response Area and Output Area
Type of tags and tag sets	Output tag set	Input tag set
Name of tags and tag sets	I/O memory addresses or variable names	I/O memory addresses or variable names*1
Data size	The size will be the sum of the size of the Command Area and the User Input Area. • 20 bytes	The size will be the sum of the size of the Response Area, Data Output Area, and User Output Area. Result Data Format 0: • 48 bytes

*1. Specify the top of the I/O memory address in the Response Area.
The Output Area is allocated continuously following the Response Area.
When a variable name is used for it, the specified variable is allocated as including both the Response Area and Output Area.
For information about how to access each signal in the communication area assigned to the variable from the user program, refer to *Accessing Communication Areas Using Variables by NJ Series Controllers* on page 5-31.

● Settings the Smart Camera (Device parameters Settings)

1 Right-click the smart camera on the network in the Network Configurator and select **Parameter → Edit**.

2 As the Edit Device Parameter dialog box will open, perform the settings as necessary.



Parameter name	Description	Setting value
0001 Input Size*1	The size will be the sum of the size of the Response Area, Data Output Area, and User Output Area.	Set the following values. Result Data Format 0: • 48 bytes
0002 Output Size*2	The size will be the sum of the size of the Command Area and the User Input Area.	Set the following values. • 20 bytes
0003 RPI*3	The required packet interval	10,000

*1. Although the data size can be set up to 502 bytes, use the above setting.
*2. Although the data size can be set up to 502 bytes, use the above setting.
*3. The packet interval (RPI) is set in the connection settings between the external device such as a PLC and the smart camera. No additional setting is required here.

● Connection Settings

Setting item			Description
Originator device (PLC)	Input tag set		External device such as a PLC_tag_set_name - [48 bytes]*1
		Connection type	Any (default: Point to Point connection)
	Output tag set		External device such as a PLC_tag_set_name - [20 bytes]*1
Target device (Smart camera)	Output tag set		Input_101 - [48 Bytes]*1
	Input tag set		Output_100 - [20 Bytes]*1
Packet interval (RPI)			Any (default: 50.0)*2
Timeout value			Any (default: Packet interval (RPI) x 4) Set this value so that it is longer than the inspection processing time of the smart camera.

*1. Tags and tag sets in the external device such as a PLC need to be the same.

*2. Adjust the value based on the communication settings of the smart camera such as the output period and output time.
For details, refer to *EtherNet/IP Communication Cycle (RPI)* on page 5-17.

Precautions for Correct Use

- If the CIO memory area that holds contents were not specified when I/O memory addresses are specified for communication areas, the information in each communication area will be cleared when the operating mode of the external device such as a PLC is changed.
- The settings for the following Assembly Object are required to specify instances without using the EDS file.

Assembly Object Settings:

Setting item	Setting value	Description	Size
Instance	100	Output connection (for normal control)	20 bytes
	101	Input connection (for normal control)	48 bytes

5-2-8 Testing Communications

Here, check whether or not the EtherNet/IP communication settings are correct.
For the communication settings, refer to *5-2-6 Communication Specifications Settings* on page 5-22.
If communications cannot be established after the setup, use the following procedures to check the setting details and the communication status.

Checking the Communication Status

Use the ping command to check whether or not the smart camera exists on the Ethernet network. With it, check that the smart camera IP address has been correctly set and is correctly connected to the Ethernet network.

Additional Information

The ping command uses the ICMP protocol to send a response request to a device connected through an Ethernet network and determines the time required to respond to that request.
If you properly receive a response from the destination device, the network connection and network settings are correctly set.

1 Connect the smart camera and a computer with an Ethernet cable.
Set the high-order digits of the computer IP address to the same values as the smart camera and the low-order one digit to a different value.

<IP Address Setting Example>

Device	Example
Smart camera	10.5.6.100 (default)
Computer	10.5.6.101

2 Open the Windows command prompt on the computer and perform the ping command.
At the > prompt, type *ping*, followed by a space and the smart camera IP address, and then press *Enter*.
Example:
C:\>ping 10.5.6.100

3 After a few seconds, *Reply from* followed by the IP address of the smart camera (e.g., 10.5.6.100) are displayed, it means that the smart camera is connected to the Ethernet network properly.
Example:
Reply from 10.5.6.100: byte=32
Time<1 ms TTL=128

If anything other than *Reply from* is displayed:
The smart camera is not connected to the Ethernet network for some reason. Check the following.

- Are the high-order three digits of the IP addresses for the computer and the smart camera the same?
- Is the Ethernet cable correctly connected?

4 Use the ping command to check the communication status of the external device such as a PLC as well.
After you have confirmed the communication status as described above, transmit a inspection command to the smart camera in practice to check the communication operations as the image sensor.

5-2-9 Memory Allocation

This section describes the assignments of the Command Area for the input connection to the smart camera and the Response Area and Output Area for the output connection to the external device such as a PLC.

Input Connection to the Smart Camera (External Device such as a PLC (Originator) to Smart Camera (Target))

For the input connections to the smart camera, specifies the control inputs, command codes, command parameters, and User Input Area, which are the Command Area parameters.

● Command Area

Set the first channel in Command Area.	Bit																Name
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
+0	ERCLR														STEP	EXE	Control input (2 CH)
+1																DSA	
+2	CMD-CODE																Command Code (2 CH)
+3																	
+4	CMD-PARAM																Command parameters (Max. 6 CH)
+5																	
+6																	
+7																	
+8																	
+9																	
+10	User Input Area 0																User Input Area 0
+11																	
+12	User Input Area 1																User Input Area 1
+13																	
+14	User Input Area 2																User Input Area 2
+15																	
+16	User Input Area 3																User Input Area 3
+17																	
+18	User Input Area 4																User Input Area 4
+19																	
+20																	
+21																	

Set the first channel in Command Area.	Bit																Name
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
+22	User Input Area 5																User Input Area 5
+23																	
+24																	
+25																	

Signal	Signal name	Function
EXE	Command Execution Bit	Performs a command. For details, refer to*5-2-12 Command List* on page 5-41.
DSA	Data Output Request Bit	Requests the next data output.
STEP	Inspection Bit	Performs inspection one time.
ERCLR	Error Clear Bit	Clears the error signal (ERR bit). The ERROR signal of the parallel interface and the ERR LED of the indicator light are not cleared.
CMD-CODE	Command Code	Stores the command code.
CMD-PARAM	Command parameters	Stores the command parameters.
User Input Area 0 to 5	User Input Area 0 5	The user area is not used in FHV7-AI series.

Output Connection to External Device such as a PLC (Smart Camera (Originator) to External Device such as a PLC (Target))

For output connections to the external device such as a PLC, execution results and output data from the smart camera are set. The execution results such as control outputs, command codes, response codes, and response data are output to the Response Area, and the output data from the smart camera or the User Output Area is output to the Data Output Area.

Additional Information

The order in which data is stored depends on the manufacturer of the connected external device such as an external device such as a PLC.
For details, refer to *Parameter Notation Examples for Command Control* on page 5-40.

● Response Area

First channel in Response Area	Bit																Name
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
+0	ERR										ACK	RUN	OR		BUSY	FLG	Control output (2 CH)
+1																GATE	
+2	CMD-CODE																Command Code (2 CH)
+3																	
+4	RES-CODE																Response Code (2CH)
+5																	
+6	RES-DATA																Response Data (2 CH)
+7																	

● Data Output Area

When the User Area is used, data set as the number of output data in the EtherNet/IP output specifications are output followed by the data of the User Output Area. Therefore, the first channel of the User Output Area will be changed according to the number of output data.
The following table indicates the mapping of the Data Output Area and User Output Area when Result Data Format 0 (32 bytes) is selected as the number of the output data.

First channel in Data Output Area	Bit																Name
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
+8	DATA0																Output data 0
+9																	
+10	DATA1																Output data 1
+11																	
+12	DATA2																Output data 2
+13																	
+14	DATA3																Output data 3
+15																	
+16	DATA4																Output data 4
+17																	
+18	DATA5																Output data 5
+19																	
+20	DATA6																Output data 6
+21																	

First channel in Data Output Area	Bit																Name
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
+22	DATA7																Output data 7
+23																	
+24	User Output Area 0																User Output Area 0
+25																	
+26	User Output Area 1																User Output Area 1
+27																	
+28	User Output Area 2																User Output Area 2
+29																	
+30	User Output Area 3																User Output Area 3
+31																	
+32	User Output Area 4																User Output Area 4
+33																	
+34																	
+35																	
+36	User Output Area 5																User Output Area 5
+37																	
+38																	
+39																	

Signal	Signal name	Function
FLG	Command Completion Bit	Turns ON when command execution is completed.
GATE	Data Output Completion Bit	Turns ON when data output is completed.
BUSY	Command Busy Bit	Turns ON when command execution is in progress and turns OFF automatically when the execution was competed.
OR	Overall judgment	Turns ON when the overall judgment is NG.
RUN	Run Mode	Turns ON when the smart camera is in Run Mode.
ACK	Command Reception bit	Turns ON when Inspection Bit (STEP) or Command Execution Bit is turned ON. Turns OFF after the command execution was completed and either the STEP Bit or EXE Bit is OFF.
ERR	Error Signal	Turns ON when the smart camera detects an error signal.
CMD-CODE	Command Code	Returns the executed command code.
RES-CODE	Response Code	Stores the response data for the executed command.
RES-DATA	Response Data	Stores the response data for the executed command.
DATA0 to 7	Output data 0 to 7	Outputs the data.
User Output Area 0 to 5	User Output Area 0 to 5	The user area is not used in FHV7-AI series.

Accessing Communication Areas Using Variables by NJ Series Controllers

In Controllers of the NJ series, I/O memory addresses assigned to each communication area can be accessed from the user program only via variables.

Follow the procedures below.

● Accessing with Network Variables

Customize and define variables based on the structure of each communication area of the smart camera. Use Sysmac Studio to define the variables.
For operations of Sysmac Studio, refer to *Sysmac Studio Version1 Operation manual (Cat. No. W504)*.

1 Define the data types for the variables.
Define the data types for the variables based on the structure of each communication area of the smart camera.

1) Definition of data type to access a signal
First, define the data type for a BOOL array to access the control signals and status signals.
Here, define the data type called *U_EIPFlag*.
Name of data type: U_EIPFlag
Kind of derived data type: Union

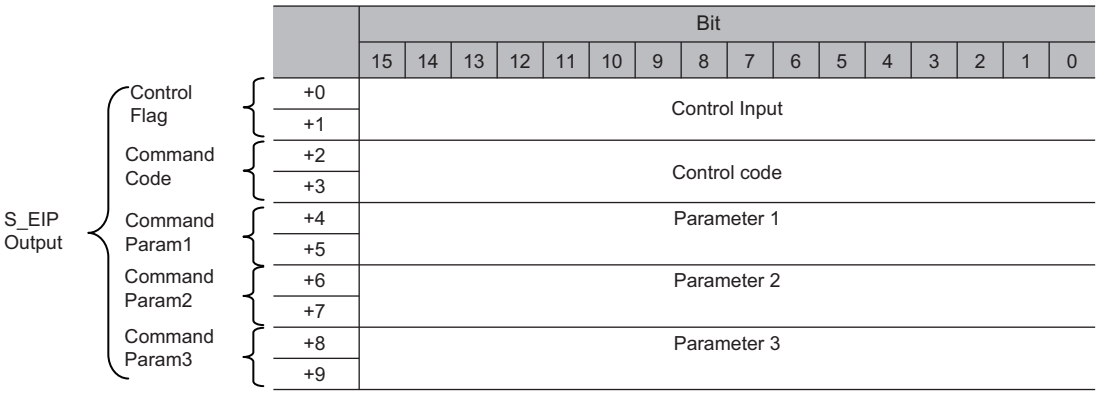
Name of data type	Data type	
U_EIPFlag	UNION	
F	ARRAY[0..31]OF BOOL	·····Specifies an array of BOOL data from 0 to 31.
W	DWORD	·····32-bit bit string data

2) Definition of data type for each communication area access
Define data types to access each communication area for the Command Area and Response and Output Areas respectively.
Here, define two kinds of data type: *S_EIPOutput* and *S_EIPInput*.

3) • Data type to access the Command Area
Name of data type: S_EIPOutput
Kind of derived data type: Structure

Name of data type	Data type	
S_EIPOutput	STRUCT	
ControlFlag	U_EIPFlag	·····The data type that was defined above (1)
CommandCode	DWORD	·····32-bit bit string data
CommandParam1	DINT	·····32-bit integer data
CommandParam2	DINT	·····32-bit integer data
CommandParam3	DINT	·····32-bit integer data

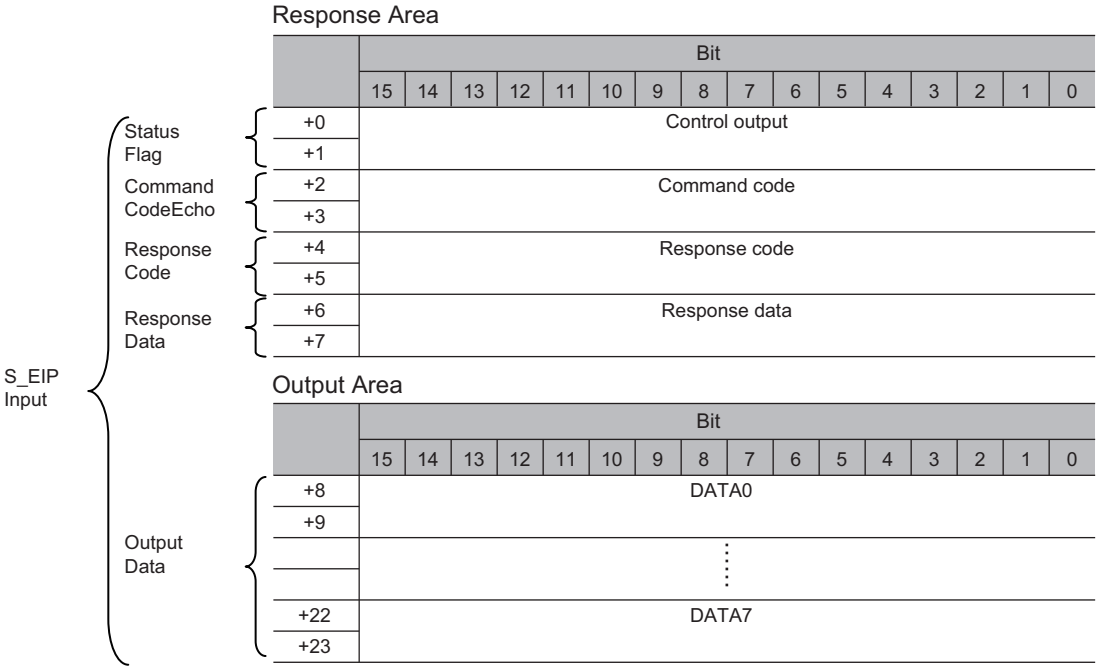
• Assignment example for the variable data type according to the Command Area.
For details, refer to *Input Connection to the Smart Camera (External Device such as a PLC (Originator) to Smart Camera (Target))* on page 5-28.



- Data type to access the Response and Output Areas
  Name of data type: S_EIPInput
  Kind of derived data type: Structure

Name of data type	Data type	
S_EIPInput	STRUCT	
StatusFlag	U_EIPFlag	·····The data type that was defined above (1)
CommandCodeEcho	DWORD	·····32-bit bit string data
ResponseCode	DWORD	·····32-bit bit string data
ResponseData	DINT	·····32-bit integer data
OutputData	ARRAY[0..7]OF DINT	·····Specifies an array of DINT data from 0 to 7.

- Assignment example for the variable data type according to the Response and Output Areas.
  For details, refer to *Output Connection to External Device such as a PLC (Smart Camera (Originator) to External Device such as a PLC (Target))* on page 5-29.



2 Define variables

Define variables to perform data links for data in each communication area through EtherNet/IP communications.

For these variables, the data types defined in step 1 are used.

Variable	Variable type	Network publish attribute	Data type	Application
EIPOutput	Global variable	Output	S_EIPOutput	For data links for the Command Area
EIPInput	Global variable	Input	S_EIPInput	For data links for the Response and Output Areas

3 Export the variables defined by Sysmac Studio.
Export the defined variables to use on the Network Configurator.
An CSV file is created for exporting.

4 Set Network Configurator

1) Import the CSV file, which was exported by Sysmac Studio, to Network Configurator.
   The imported variables are automatically registered as tags.
2) Configure the connections as shown below.

Originator device (External device such as a PLC) settings	Target device (Smart camera) settings
Input tag set: EIPOutput	Output tag set: Input101
Output tag set: EIPInput	Input tag set: Output100

5 Access each communication area from user program
The defined variables are used to access each communication area of the smart camera as shown below.

- Command Area

Signal name	Variable name
EXE	EIPOutput.ControlFlag.F[0]
STEP	EIPOutput.ControlFlag.F[1]
ERCLR	EIPOutput.ControlFlag.F[15]
DSA	EIPOutput.ControlFlag.F[16]
Command Code	EIPOutput.CommandCode
Command parameter 1	EIPOutput.CommandParam1
Command parameter 2	EIPOutput.CommandParam2
Command parameter 3	EIPOutput.CommandParam3

- Response Area

Signal name	Variable name
FLG	EIPInput.StatusFlag.F[0]
BUSY	EIPInput.StatusFlag.F[1]
OR	EIPInput.StatusFlag.F[3]
RUN	EIPInput.StatusFlag.F[4]
ACK	EIPInput.StatusFlag.F[5]
ERR	EIPInput.StatusFlag.F[15]

Signal name	Variable name
GATE	EIPInput.StatusFlag.F[16]
Command Code	EIPInput.CommandCodeEcho
Response Code	EIPInput.ResposeCode
Response Data	EIPInput.ResposeData

- Output area

Signal name	Variable name
Output data 1	EIPInput.OutputData[0]
.	.
.	.
.	.
Output data 8	EIPInput.OutputData[7]

● Specify the I/O memory addresses to access each communication area

By setting AT specifications to variables, assigned destination to each communication area can be specified in the unit of the I/O memory address.

1 Setting the tag sets (by Network Configurator)

Directly specify the tag names in the PLC by using the I/O memory addresses that each communication area is assigned to. (The output tags are specified for the input connections to the smart camera and the input tags are specified for the output connections to the PLC.)

Setting example

Tag kind	Assigned I/O memory address
Output tag	D0
Input tag	D100

2 Setting Variables (by Sysmac Studio)

Define variables with AT (assigned destination) specifications to the I/O memory addresses assigned to each communication area as shown below.

Setting example

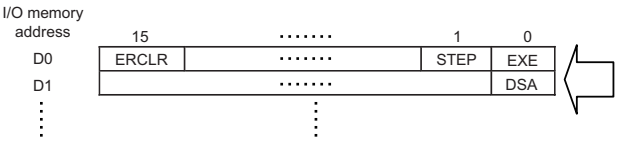
Variable	AT specification
a	D0.0
b	D0.1
c	D0.15
d	D1.0

3 Setting Connections

Configure the connections as shown below.

Originator device (PLC) settings	Target device (smart camera) settings
Input tag set: D0	Output tag set: Input101
Output tag set: D100	Input tag set: Output100

Command Area (External device such as a PLC Output Tag D0)



Variables Used to Access the Command Area in the external device such as a PLC from the User Program

Variable name	Settings	
	AT specification	Data type
a (Assigned to the EXE signal.)	D0.0	BOOL
b (Assigned to the STEP signal.)	D0.1	BOOL
c (Assigned to the ERCLR signal.)	D0.15	BOOL
d (Assigned to the DSA signal.)	D1.0	BOOL

5-2-10 I/O Signals

The following tables list the signals used to control I/O for EtherNet/IP.

Input Signals

Signal	Signal name	Function	ON/OFF timing	
			OFF to ON	ON to OFF
EXE	Command Request Signal	The user (PLC) turns this signal ON when issuing a command to the smart camera.	The user (PLC) turns this signal ON when issuing a command (instruct the execution) to the smart camera based on the command code and command parameters.	The user (PLC) switches this signal from ON to OFF when the smart camera turns the Command Completion (FLG) signal ON.*1
DSA (Used only for handshaking output control)	Data Output Request Signal	During handshaking, the user (PLC) issues this signal to the smart camera to request to output externally the measured results performed in the job.	• The user (PLC) turns this signal ON when requesting the measurement data to output externally.*3 • This DSA signal is turned ON at the same time as the Trigger (STEP) or Command Request (EXE) signal switches from OFF to ON.	The user (PLC) switches this signal from ON to OFF when the smart camera turns the GATE signal ON.*2
ERCLR	Error Clear Bit	Clears the error signal (ERR bit). The ERROR signal of the parallel interface and the ERR LED of the indicator light are not cleared.	The user (PLC) switches the signal from OFF to ON when the Error (ERR) signal from the smart camera is turned OFF.	This signal is turned OFF when the user (PLC) detected the Error (ERR) signal turned OFF.
STEP	Measurement Trigger	This is turned on when inspection will be performed.	This signal turns ON from the PLC) to perform inspection after confirming that the BUSY signal and the Command Execution Completion (FLG) signal have turned OFF.	The user (PLC) switches this signal from ON to OFF after detecting that the smart camera turned the BUSY signal ON.

*1. If the Command Request (EXE) signal does not switch from ON to OFF within 10 seconds after the Command Completion (FLG) signal was turned ON, a timeout error will occur, and the FLG signal is forced to be turned OFF.

*2. If the Data Output Request (DSA) signal does not switch from OFF to ON within the time set at the “Timeout” in the settings after the Data Output Completion (GATE) signal turned ON, a timeout error will occur and the inspection data prepared for output will be discarded.

*3. If the Data Output Request (DSA) signal does not switch from OFF to ON within the time set at the “Timeout” in the settings after the inspection processing started by the Measurement Trigger (STEP) signal or the

Command Request (EXE) signal turned ON, a timeout error will occur and the inspection data prepared for output will be discarded.

Output Signals

Signal	Signal name	Function	ON/OFF timing	
			OFF to ON	ON to OFF
BUSY	Busy	This signal indicates that external inputs such as commands cannot be accepted. Issue a command when this signal is OFF. *1*2	This signal turns ON when the smart camera receives a command from the user (PLC). (After the EXE signal switches from OFF to ON.)	The signal turns OFF when the command execution is completed.
FLG	Command Execution Completion	The smart camera uses this signal to inform the PLC that command execution has been completed.	The signal turns ON when the smart camera completes execution of a received command.	This signal is turned OFF when the user (PLC) switches the Command Request (EXE) signal from ON to OFF.
GATE	Data Output Completion Signal	The signal informs the PLC of the timing to load output data. "ON" of this signal indicates that the smart camera is outputting the data. The user (PLC) starts to load the data when the signal turns ON.	• Without handshaking The signal turns ON when the smart camera performs the job and is ready for the data output. • With handshaking The signal turns ON when the smart camera performs the job and is ready for the data output and the Data Output Request (DSA) signal is ON.	• Without handshaking The signal turns OFF after the *Output Time* set in the settings has passed. • With handshaking This signal is turned OFF when the user (PLC) switches the Data Output Request (DSA) signal from ON to OFF.
ERR	Error Signal	The signal indicates that the smart camera detects the following errors. For details of the errors, refer to *6-1 Error Messages and Troubleshooting* on page 6-2.	The signal turns ON if the smart camera detects an error.	The signal turns OFF when the error is fixed and the user (PLC) turns the Error Clear (ERCLR) signal ON.
RUN	Run Mode	The signal indicates that the smart camera is running.	The signal turns ON when the smart camera is running.	The signal turns OFF when the smart camera is not running.
OR	Overall judgment	The signal indicates the overall judgment results.	The signal turns ON when the overall judgment is NG.	The signal turns OFF when the overall judgment is OK.

Signal	Signal name	Function	ON/OFF timing	
			OFF to ON	ON to OFF
ACK	Command Reception	The signal indicates that a command is received. Even BUSY is not output due to a heavy load, it surely detects the completion of the command processing execution.	The signal is turned ON when Inspection Bit (STEP) or Command Execution Bit (EXE) is received.	The signal switches from ON to OFF after the execution completed and either the STEP Bit or EXE Bit is OFF.

*1. This will not be detected while commands received through any other protocol are processed. (Ex.: This signal remains OFF during inspection with the STEP signal in the Parallel communications.) If you use more than one protocol and need to detect command execution, use the BUSY signal in Parallel communications.

*2. “ON” of this signal does not mean that a command is currently performed. To check whether a command is being executed, refer to the Command Execution Completion (FLG) signal.

5-2-11 Command Control

This section describes the commands that are used to control the smart camera from an external device.

Parameter Notation Examples for Command Control

This section provides examples of binary inputs of parameters such as arguments for command control.

Additional Information

The command code is the same, but the order in which the command parameters are stored depends on the manufacturer of the connected PLC as follows:

- OMRON and Yaskawa Electric PLCs: Upper byte followed by lower byte
- Mitsubishi Electric PLCs: Lower byte followed by upper byte*1

*1: The order of displayed sequence program may be from upper byte to low byte. If it does not perform correctly, confirm the order of upper and low byte.

● Four-byte Data

The following example shows the input to switch the job to job number 5 with the Switch job command.

First word in Command Area	Description
+2 and +3 words	Command code
+4 and +5 words	Job number (Command parameters)

- **OMRON or Yaskawa Electric PLCs**

  Command (PLC to smart camera)

First word in Command Area	Hexadecimal notation	Bit				Description
		15 - 12	11 - 8	7 - 4	3 - 0	
+2	1000	0001	0000	0000	0000	Command code
+3	0030	0000	0000	0011	0000	
+4	0005	0000	0000	0000	0101	Job number (Command parameters)
+5	0000	0000	0000	0000	0000	

- **Mitsubishi Electric PLCs**

  Command (PLC to smart camera)

First word in Command Area	Hexadecimal notation	Bit				Description
		15 - 12	11 - 8	7 - 4	3 - 0	
+2	1000	0001	0000	0000	0000	Command code
+3	0030	0000	0000	0011	0000	
+4	0500	0000	0101	0000	0000	Job number (Command parameters)
+5	0000	0000	0000	0000	0000	

5-2-12 Command List

This section describes the commands used in EtherNet/IP.
For details of commands in tag data link, refer to *Command Details for EtherNet/IP and PROFINET* on page 5-41.

First word in Response Area		Function
+3	+2	
0010	1010	Performs inspection one time.
0030	2000	Switches to the job with the specified number.
0050	1010	Reset the numerical value of the statistics displayed on the operation screen to zero.

Command Details for EtherNet/IP and PROFINET

This section provides details on the communications commands.

● Single Inspection

Performs inspection one time.

Command (PLC to smart camera)

First word in Command Area	Hexa-decimal nota-tion	Bit				Description
		15 - 12	11 - 8	7 - 4	3 - 0	
+2	1010	0001	0000	0001	0000	Command code
+3	0010	0000	0000	0001	0000	

Response (Smart camera to PLC)

First word in Response Area	Hexa-decimal nota-tion	Bit				Description
		15 - 12	11 - 8	7 - 4	3 - 0	
+2	1010	0001	0000	0001	0000	Command code
+3	0010	0000	0000	0001	0000	Response target command codes
+4	—	0000	0000	0000	0000	Response code Command execution result OK: 0 (0000 0000) NG: Not 0 (0000 0000)
+5	—	0000	0000	0000	0000	

● Switch Job

Switches to the job with the specified number.

Command (PLC to smart camera)

First word in Command Area	Hexa-decimal nota-tion	Bit				Description
		15 - 12	11 - 8	7 - 4	3 - 0	
+2	2000	0010	0000	0000	0000	Command code
+3	0030	0000	0000	0011	0000	
+4	—	0000	0000	0000	0000	Job number
+5	—	0000	0000	0000	0000	

Response (Smart camera to PLC)

First word in Response Area	Hexa-decimal nota-tion	Bit				Description
		15 - 12	11 - 8	7 - 4	3 - 0	
+2	2000	0010	0000	0000	0000	Command code
+3	0030	0000	0000	0011	0000	Response target command codes
+4	—	0000	0000	0000	0000	Response code
+5	—	0000	0000	0000	0000	Command execution result OK: 0 (0000 0000) NG: Not 0 (0000 0000)

Precautions for Correct Use

- Do not switch the job while the inspection is being executed.
- Do not switch the job except on the **RUN** screen.

● Reset Statistics Information

Reset the numerical value of the statistics displayed on the operation screen to zero.

Command (PLC to smart camera)

First word in Command Area	Hexa-decimal nota-tion	Bit				Description
		15 - 12	11 - 8	7 - 4	3 - 0	
+2	1010	0001	0000	0001	0000	Command code
+3	0050	0000	0000	0101	0000	

Response (Smart camera to PLC)

First word in Response Area	Hexa-decimal nota-tion	Bit				Description
		15 - 12	11 - 8	7 - 4	3 - 0	
+2	1010	0001	0000	0001	0000	Command code
+3	0050	0000	0000	0101	0000	Response target command codes
+4	—	0000	0000	0000	0000	Response code
+5	—	0000	0000	0000	0000	Command execution result OK: 0 (0000 0000) NG: Not 0 (0000 0000)

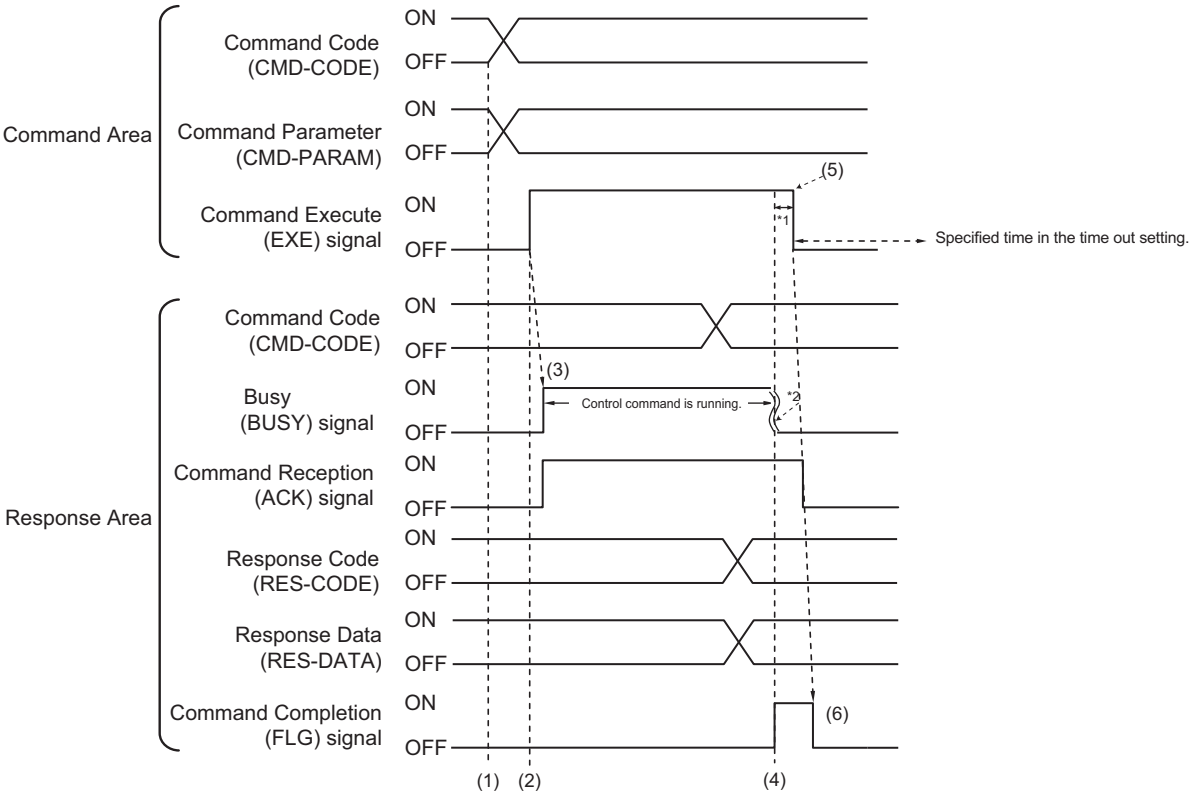
5-2-13 Command Response Processing

About control command response processing, the following timing chart describes the ON/OFF timing of signals related to commands to be input.

● Timing Chart for Command Execution

The Command Request (EXE) signal is used as the trigger to input and execute various commands such as inspection execution stored in advance in the external device (such as a PLC) memory.

The Command Completion (FLG) signal turns ON when execution of the control command is completed. Use this as the trigger to turn OFF the Command Request (EXE) signal.



*1: A timeout error will occur if you do not turn off the Command Execution (EXE) signal within 10 seconds after the Command Completion (FLG) signal is turned ON.
Command Completion (FLG) signal and BUSY signal will be forcefully turned OFF.

*2: Busy (BUSY) signal is automatically switched ON to OFF when the command execution is completed.

(1) The external device such as a PLC sets the command code and command parameters.

(2) After checking that the BUSY signal and the Command Completion (FLG) signal have turned OFF, the PLC turns ON the Command Request (EXE) signal again to instruct the smart camera to perform it.

(3) When receiving the instruction the smart camera performs the command and turns ON the ACK signal and the BUSY signal.

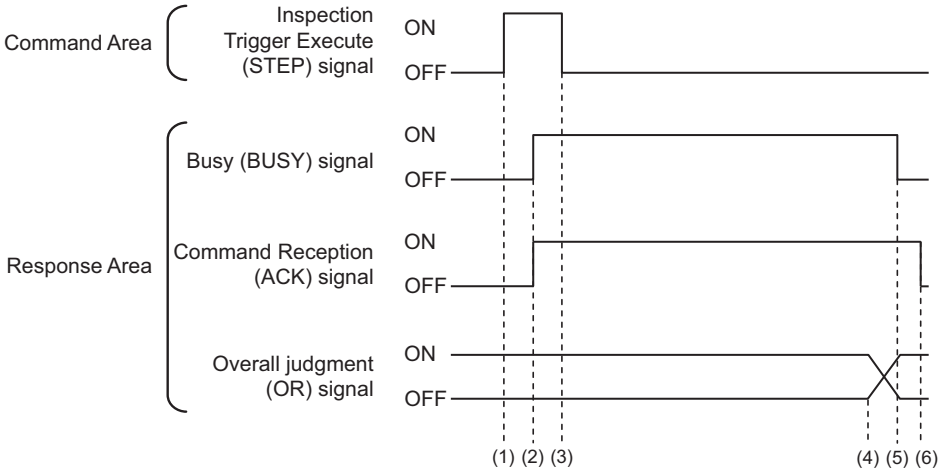
(4) When completing the execution, the smart camera sets the command code, response code, and response data.
The Command Completion (FLG) signal is turned ON.

(5) The PLC (user) turns OFF the Command Request (EXE) signal when the Command Completion (FLG) signal turns ON.

(6) When detecting that the Command Request (EXE) signal is OFF, the smart camera automatically turns OFF the Command Reception (ACK) signal and the Command Completion (FLG) signal automatically.

● Performing Inspection wit the STEP Signal

In addition to inputting and executing the Command Request (EXE) as a trigger, the Inspection Trigger Execute (STEP) signal can be used to perform inspection.

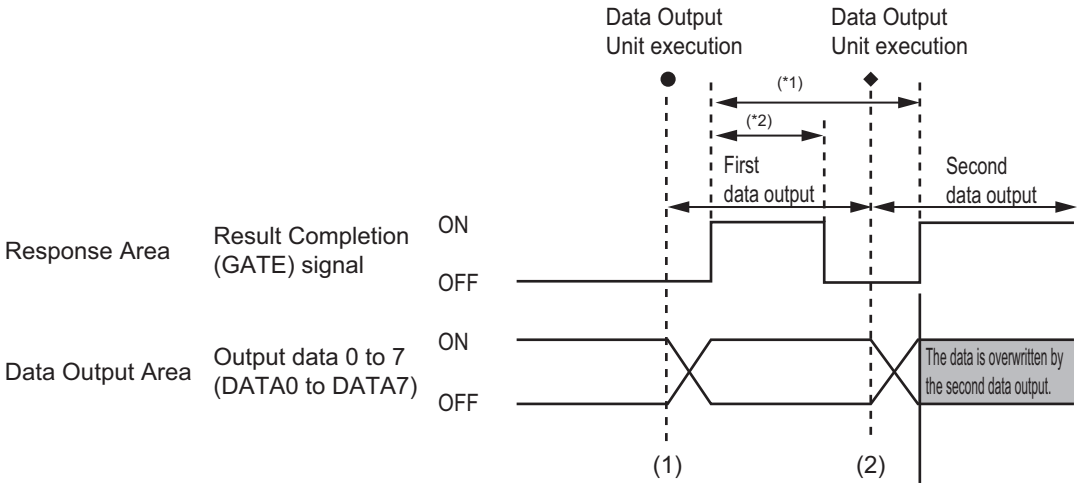


(1) While the ACK signal is OFF, inspection starts by the rising edge of the Inspection Trigger Execute (STEP) signal.
(2) The starting inspection turns ON the ACK signal.
(3) The Inspection Trigger Execute (STEP) signal is turned OFF when the ACK signal turns ON.
(4) The Overall Judgement (OR) signal is output when inspection is completed.
(5) The ACK signal is turned OFF when the job is completed.
(6) When the measurement flow ends and the measurement execution bit (STEP) is OFF, the processing acceptance (ACK) signal turns OFF.

5-2-14 Data Output

This section describes the ON/OFF timing for signals related to inspection data output after inspection completion using the following timing chart.

● Without handshaking



*1, *2: Data is output at the set output period[*1] and for the set output time.[*2]
After the data is output, the GATE signal is turned ON and the data is held for the data output time.

(1) The smart camera outputs data.

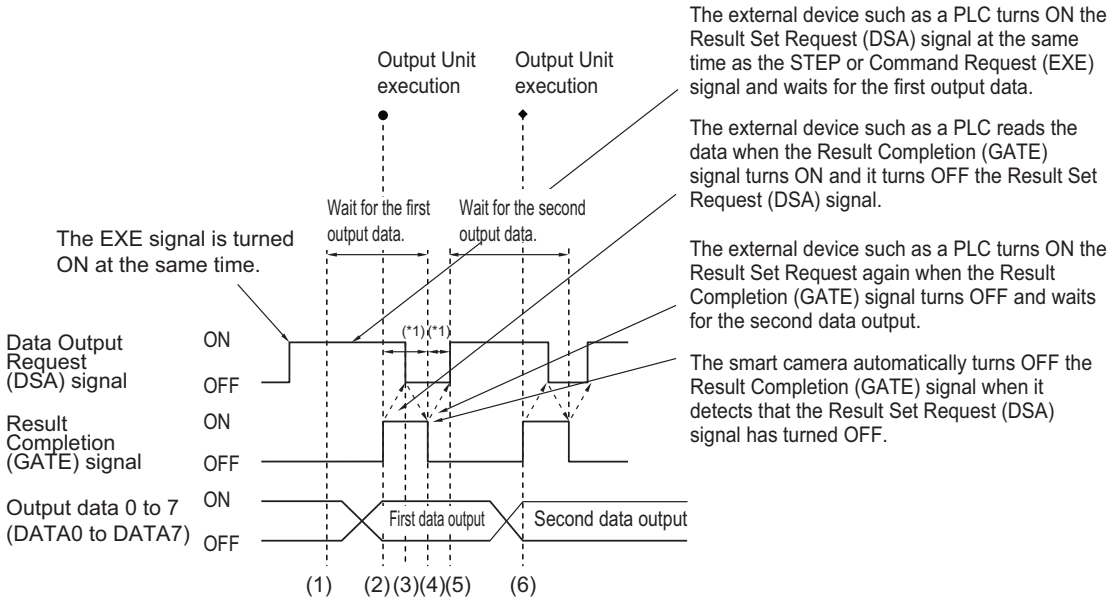
(2) Data is output each time that the job is performed for the second time. In that time, the output data for the first time is overwritten.

Precautions for Correct Use

- To receive all the output data, set **Handshaking** to *ON*, and then output data.

● With handshaking

The Result Completion (GATE) signal switches from OFF to ON when the PLC (user) switches the Result Set Request (DSA) signal from OFF to ON.
At that time, data that is possible to output will be output.
The PLC (user) switches the DSA signal from ON to OFF under the conditions whether it has received the output data and the Result Completion (GATE) signal has been turned ON.
In the case where multiple Output Units perform the data output, the PLC (user) turns the Data Output Request (DSA) signal ON again to instruct it to output the following data, when the smart camera switched the Data Output Completion (GATE) signal from ON to OFF.



*1 A timeout error will occur if any of the following states continues for longer than the timeout time.
- If the DSA signal is not turned ON after a certain time elapses from when the Output Unit was executed. (Turn ON the DSA signal at the same time as the measurement trigger command.)
- If the DSA signal is not turned OFF after a certain time elapses from when the GATE signal turns ON.

(1) The PLC (user) turns ON the Command Request (EXE) signal and the Data Output Request (DSA) signal at the same time. The output data for the first Output Unit (Fieldbus Data Output Unit / Result output (I/O) Unit) can be surely received.

(2) The smart camera performs the output in the job. Since the Data Output Request (DSA) signal is ON after the data is written, the Data Output Completion (GATE) signal becomes ON.

(3) The PLC (user) reads the data when the Result Completion (GATE) signal turns ON and it turns OFF the Result Set Request (DSA) signal.

(4) The smart camera automatically turns OFF the Result Completion (GATE) signal when it detects that the Result Set Request (DSA) signal has turned OFF.

(5) The PLC (user) turns ON the Data Output Request (DSA) signal when the Data Output Completion (GATE) signal turns OFF, and then it waits for execution of the next Data Output.

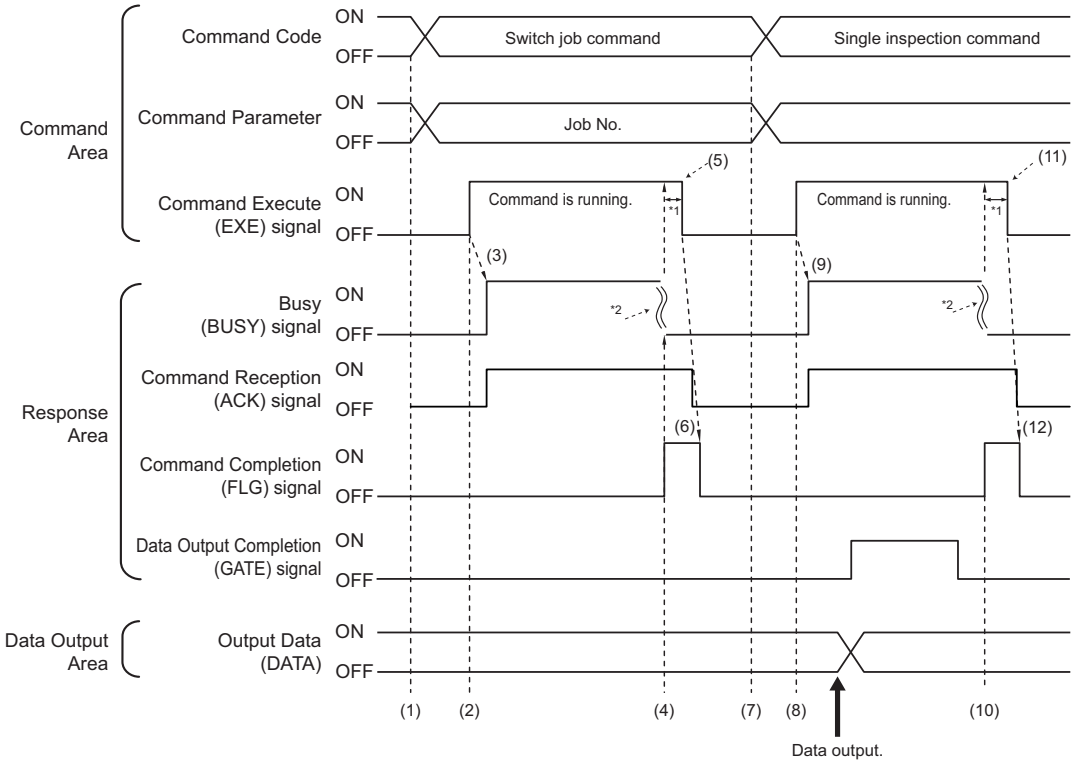
(6) When the next Data Output is executed, the GATE signal turns ON and the data is output. Receive the second output data and then repeat steps 3 to 5, above.

Repeat steps 3 to 5 for any other data outputs.

5-2-15 Timing Chart

This section describes the ON/OFF timing for signals related to the sequence of operation from control command input until inspection data output after inspection completion using the following timing chart.

● Example 1: Inputting a Measurement Trigger after Switching a Job without Handshaking



*1: A timeout error will occur if you do not turn off the Command Execution (EXE) signal from external device such as a PLC (master) within 10 seconds. Then Command Completion (FLG) signal and Busy (BUSY) signal will be forced to turn off.

*2: Busy (BUSY) signal is automatically switched ON to OFF when the command execution is completed.

(1) The external device such as a PLC sets the command code and command parameters for the switch job.

(2) Next, confirm that the BUSY signal and the Command Completion (FLG) signal have turned OFF and then turn ON the Command Request (EXE) signal. A request is sent to the smart camera.

(3) The smart camera turns ON the Command Reception (ACK) signal and BUSY signal and switches the job when the request is received.

(4) The Command Completion (FLG) signal is turned ON when the job switching is completed.

(5) The PLC (user) turns the Command Request (EXE) signal OFF when the Command Completion (FLG) signal is switched from OFF to ON.

(6) After detecting that the Command Request (EXE) signal has turned OFF, the smart camera automatically turns OFF the Command Reception (ACK) signal and Command Completion (FLG) signal.

(7) The single inspection command code and command parameters are set from the external device such as a PLC.

(8) The Command Request (EXE) signal is turned ON to execute the single inspection command.

Additional Information

To execute a measurement trigger after changing the job, first confirm that the Command Completion (FLG) signal and the BUSY signal that turned ON for execution of the switch job command have turned OFF.

(9) The smart camera turns ON the Command Reception (ACK) signal and BUSY signal and performs inspection when the request is received.

(10) The Command Completion (FLG) signal is turned ON when the inspection was completed.

(11) The PLC (user) turns the Command Request (EXE) signal OFF when the Command Completion (FLG) signal turns ON.

(12) When the smart camera detects that the Command Request (EXE) signal is OFF, it automatically turns OFF the Command Reception (ACK) signal and Command Execution Completion (FLG) signal.

5-2-16 EtherNet/IP Troubleshooting

Cannot Input to the Smart Camera

Problem	Cause	Action
Any input is not accepted.	The EDS file version is different from the firmware one.	Make sure that the EDS file version matches the firmware version.

No Data is Output from the Smart Camera

Problem	Cause	Action
The GATE signal is not output.	The relationship between the RPI (packet interval) and the output period for the smart camera is improper.	The RPI needs to be set shorter than the output period.
No data is output at all.	The EDS file version is different from the firmware one.	Make sure that the EDS file version matches the firmware version.
	The communication module is set incorrectly.	Verify that the communication module is set to EtherNet/IP.

A Timeout Error Occurred

Problem	Cause	Action
A handshaking timeout error occurred.	The timing to switch the DSA signal is too slow. The following patterns are considered. • The DSA signal is not turned ON even after inspection has been completed. • The DSA signal is not switched from ON to OFF even after the GATE signal has been turned ON. • The DSA signal is not turned ON even after the GATE signal has been turned OFF.	After the single inspection command is performed, turn the Data Output Request (DSA) signal ON and OFF within the timeout time (10sec).

Problem	Cause	Action
A timeout error for tag data link occurred	Communications between an external device and the smart camera has been temporarily interrupted. The smart camera prioritizes inspection and control processing over communication processing. Therefore, as the result of the communication processing delayed due to the heavy loads of the internal processing, communications between an external device and the smart camera may be temporarily interrupted and a communication error may occur.	Set the timeout time for the communication error longer than the processing time of the smart camera.

Slow Operation

Problem	Cause	Action
Response and data output is slow.	You try to use a wrong combination for communication protocols.	Use a proper combination of communication protocols.

5-3 Communicating by PROFINET

This section describes the communication settings, communication specifications, input/output formats, and the communication timing chart required for communications by PROFINET between the smart camera and an external device.

5-3-1 Overview of PROFINET

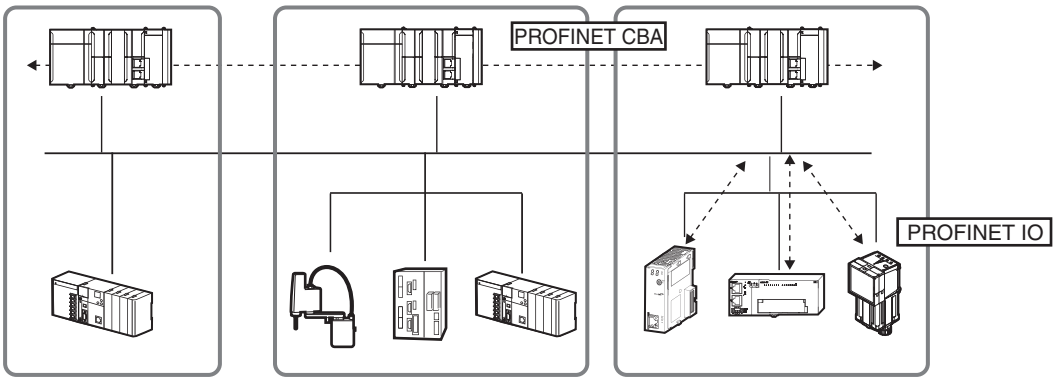
PROFINET is a network for industrial use that applies industrial Ethernet (100 Mbps, Full duplex) to PROFIBUS DP. The specifications are open standards managed by PI (PROFIBUS and PROFINET International), and is used in a wide range of industrial devices.
Since PROFINET uses standard Ethernet technology, it can be mixed with various general-purpose Ethernet devices.

This section describes an overview of PROFINET required to use the FHV7-AI series with PROFINET. For details of the PROFINET specifications, refer to documents from IEC1158, ICE61784, and PI.

Types of PROFINET

PROFINET has two types of standards: PROFINET IO and PROFINET CBA.

- PROFINET CBA
  This is inter-device communication using components and mainly used between controllers.
- PROFINET IO
  This controls between a controller and peripheral devices by I/O data.



The FHV7-AI series support PROFINET IO.
PROFINET IO adopts the same device model as PROFINET DP.
The information for each device is described in a GSD (General Station Description) file based on EML (Extensible Markup Language).

Precautions for Correct Use

- For a network that many devices are connected, temporal heavy load on the network may cause communication errors or lower performance such as response delay or packet loss. Perform the verification under actual conditions before use.
- When operating the network under high load condition, perform the verification under actual conditions before use because a certain margin in measurement cycle time is necessary for stable communications.
- Do not use PROFINET communications together with functions that use PLC Link, Non-procedure, or other Ethernet communications.

PROFINET IO

● Communication Specifications for PROFINET IO

Here, describe the communication specifications for PROFINET IO.

Communication specifications	Method	Description	Support on the FHV series
Periodic data communication method	RT (real-time) communication	Uses standard Ethernet hardware and achieves the same level of performance as the existing Fieldbus.	Supported
	IRT (Isochronous real-time) communication	Provides a higher level of assurance about executing communication within a particular time than RT communication. This is assumed to be used in a system requiring strict real-time such as motion control.	Not supported

PROFINET IO has specified the supported functions per conformance class with an awareness of applications.

Class	Overview	Support on the FHV series
Class A	Supports the basic functions of RT communication.	Supported
Class B	Network diagnosis and redundancy functions used in process automation are added.	Not supported
Class C	Supports IRT communication achieving reliable synchronization.	Not supported

The following functions are defined in Class A.

Function	Overview
Cyclic data exchange	This is real-time data communication between the IO controller and IO devices performed at a determined cycle. This is set by IO data CR.
Acyclic parameter data/device identification	This is used for parameter settings, IO device configuration, and reading device information. This is set by record data CR.

Function	Overview
Device/network diagnosis	This is communication to upload alarms and status from IO devices to the IO controller. This is set by alarm CR.

● Device Types Used in PROFINET IO

The following devices are defined in PROFINET IO.

Method	Description
IO controller	A controller for external devices.
IO device	Sensor devices connected to the IO controller. The FHV series correspond to IO devices.
IO supervisor	A PC or other device to be used for maintenance and diagnosis.

● IO device

IO devices consist of DAPs and IO modules.

The functions and characteristics for the devices are described in a GSD file.

- DAP (Device Access Point):
  This is an Ethernet access point to be used in a communication program.
- IO module:
  This is composed of the following Slot, Sub-slot, and Index and has one or multiple slots.
- Slot:
  This indicates the location for IO modules located in the IO device.
- Sub-slot:
  This is an IO interface in the Slot. This defines data types such as bit data and byte data, and the meanings for the data.
- Index:
  This is data in the Sub-slot.

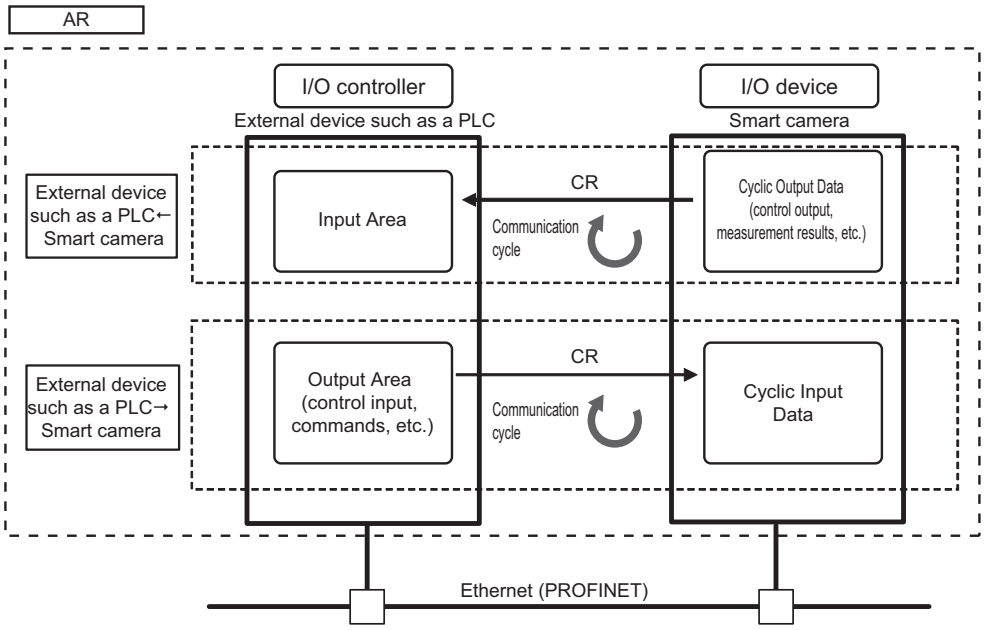
Additional Information

When an I/O device is used in PROFINET, the GSD file that describes the device functions and properties is used to configure the network configuration settings.
When the FHV series are used in PROFINET as an I/O device, the GSD file of the FHV series must be installed in the Engineering Tool.

● Data Exchange in PROFINET IO

A connection so-called AR (Application Relation) must be first established to communicate between an IO controller and an IO device.
When the AR connection has once established, data communication between the IO controller and IO device is performed with CR (Communication Relation) that defines the details of the data communication

An IO device can establish an AR with each communication device.
Moreover, multiple CRs can be defined in one AR.
Defining multiple CRs in one AR enables communications when multiple profiles and/or different Sub-slot are required.
Cycle time can be set per each CR and IO too.



CR is classified into IO data CR, record data CR, and alarm CR.
Within the IO data CR, data communication is performed per an updating task period. Within the other CRs than the IO data CR, communication is performed in between the cyclic data communications.
Within the record data CR, the IO controller transmits commands to the IO devices at any timing and the IO devices send back responses to the IO controller.

5-3-2 PROFINET Communications

You can use PROFINET IO data CR to communicate between the external device such as a PLC and the smart camera to perform control via command/response communications or to output data after inspections.
This smart camera complies with PROFINET conformance class A.
To connect to external devices and communicate using PROFINET, configure the PROFINET IO data CR settings with the engineering tool.
For details on the IO data CR settings in the engineering tool, refer to the manual for each engineering tool.

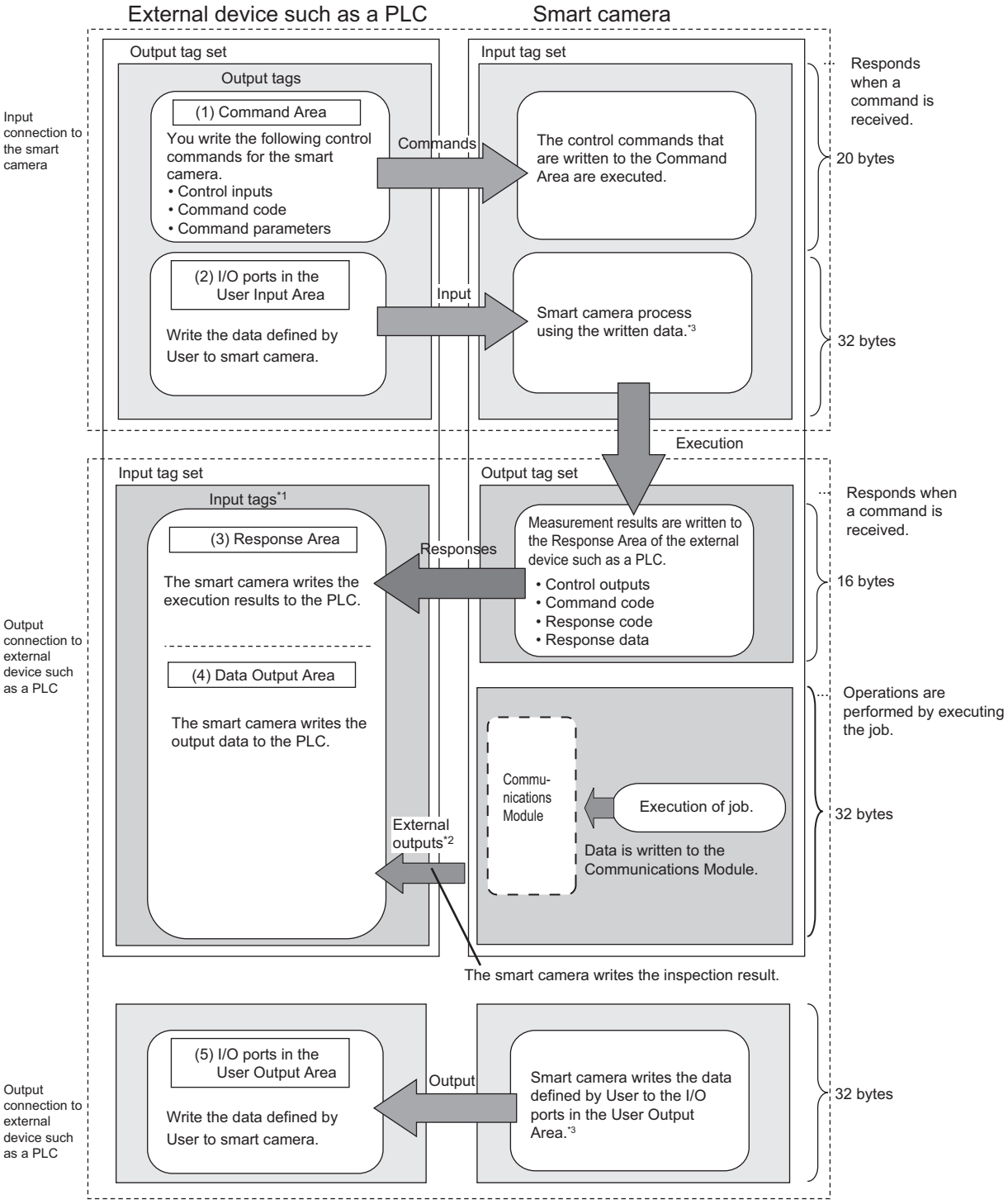
5-3-3 Communications Processing Flow

In PROFINET communications, the following five communication areas are set in the external device such as a PLC (IO controller).

Input module for the smart camera (Input Data)	(1) Command Area (Command/response method)	This area is used that you write control commands to perform for the smart camera.
	(2) User Input Area	This area is used that you write the data that you defined for the smart camera. The FHV7-AI series does not use the user area.
Output module from the smart camera (Output Data)	(3) Response Area (Command/response method)	This area is used that the smart camera writes the results which the control commands written in the Command Area were performed.
	(4) Data Output Area (Data output after inspection)	This area is used that the smart camera writes the output data accompanied with the inspection after inspection performed.
	(5) User Output Area	This area is used that the smart camera writes the data that you defined. The FHV7-AI series does not use the user area.

The above five areas are set using an engineering tool such as CX Configurator FDT that can set IO data CR of PROFINET. The areas can be specified by using I/O memory addresses such as CIO or DM.
For details of the IO data CR settings by CX Configurator FDT, refer to *5-3-6 IO Data Communication Settings* on page 5-58.
Moreover, when a non-OMRON PLC or PROFINET unit is connected, download the EDS file for the smart camera from our OMRON website and follow the procedures in the user's manual for the external devices to be connected and in the instruction for the software to set IO data CR.

The flow of PROFINET communications between a external device such as a PLC and the smart camera is as follows.



*1 : The Response Area (3) and Data Output Area (4) are assigned to continuous memory addresses or to variables.

*2 : You can use output controls (handshaking) to prevent output data from being externally output from the communications buffer until the PLC (master) turns ON the Result Set Request (DSA) signal to request the output data.

*3 : User areas (2)(5) are not used in FHV7-AI series.

5-3-4 Communications Settings

The following settings are required to use PROFINET.

1. Communications specifications settings
↓
2. IO data CR settings
↓
3. Communications test

… Set the communication specifications of the smart camera.
For details, refer to *5-3-5 Communication Specifications Settings* on page 5-57.

… The IO data CR settings are performed to exchange data with the external device.
This section describes an example of how to set IO data CR with an OMRON PLC using the CX Configurator FDT.
For details, refer to*5-3-6 IO Data Communication Settings* on page 5-58.

… If communications are not working properly, check the communications setup and perform a communications test to determine whether the smart camera can be detected on the network.
If that does not solve the problem, refer to the troubleshooting section for each communication protocol.
For details, refer to *5-3-7 Testing Communications* on page 5-60.

5-3-5 Communication Specifications Settings

Refer to *Communication Settings* on page 4-34 for how to set the communication specifications.

5-3-6 IO Data Communication Settings

This section describes how to set data links for PROFINET.
The communication areas in the external device such as a PLC used for IO data communications with the smart camera are set by assigning the I/O memory address with an engineering tool such as CX Configurator FDT.
When an OMRON controller is connected and communicate via PROFINET, use CX Configurator FDT to assign the I/O memory address.
Here, describes how to set the I/O memory address using CX Configurator FDT. For details, refer to *CJ series PROFINET I/O Controller Unit Operation Manual for NJ series CPU Unit(W511-E2-01)*.

Precautions for Correct Use

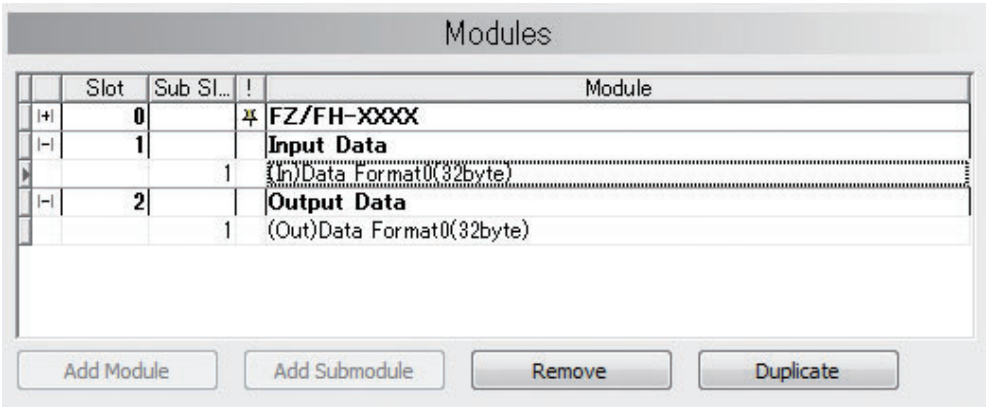
When connecting to a CPU Unit of NJ series or CJ series, install the GSD file that defines the IO data CR connection information for the smart camera to a tool (e.g. CX Configurator FDT). Download the GSD file from OMRON's website.

IO Data CR Connection Settings for the Smart Camera

Each communication area in the external device such as a PLC is set as IO data CR connections as shown below

Settings for the Smart Camera (Module Settings)

1. Add an IO device (FZ/FH-XXXX/FHV7) to the IO controller of the CX Configurator FDT.
2. Select **Configuration** -> **Modules** in the IO device (FZ/FH-XXXX/FHV7).
3. Add **Input Data** to the slot 1 and **Output Data** to the slot 2.
4. Add a Sub-module to the Sub-slot in Slot 1 and set the data format. Likewise, do slot 2.
   The types of the data format must be the same as the *Output data size* set at PROFINET of the smart camera.



Sub-module setting for the smart camera

Data format		Description	
Size	User area	Command Area	Response Area and Output Area
32 bytes	No	(Out) Data Format 0 (32 bytes)	(In) Data Format 0 (32 bytes)
64 bytes		(Out) Data Format 10 (64 bytes)	(In) Data Format 1 (64 bytes)
128 bytes		(Out) Data Format 2 (128 bytes)	(In) Data Format 2 (128 bytes)
256 bytes		(Out) Data Format 3 (256 bytes)	(In) Data Format 3 (256 bytes)
32 bytes	Yes	(Out) Data Format 0 (32 bytes) + User Area	(Out) Data Format 0 (32 bytes) + User Area
64 bytes		(Out) Data Format 1 (64 bytes) + User Area	(In) Data Format 1 (64 bytes) + User Area
128 bytes		(Out) Data Format 2 (128 bytes) + User Area	(In) Data Format 2 (128 bytes) + User Area
256 bytes		(Out) Data Format 3 (256 bytes) + User Area	(In) Data Format 3 (256 bytes) + User Area

Precautions for Correct Use

- For the settings for *IO Device Area* on the IO controller (external device such as a PLC), set the data length to be assigned to the I/O memory address so that it is same or longer than the value indicated in the *Occupied*.
- If the IO data communications were interrupted, increase the value of *Data Hold Factor* and *Watchdog Factor* respectively by clicking **Configuration** - **IO Device Setup**.

5-3-7 Testing Communications

Here, check whether or not the PROFINET communication settings are correct.
For the communication settings, refer to *5-3-5 Communication Specifications Settings* on page 5-57.
If communications cannot be established after the setup, use the following procedures to check the setting details and the communication status.

Checking the Communication Status

Use the ping command to check whether or not the smart camera exists on the Ethernet network. With it, check that the smart camera IP address has been correctly set and is correctly connected to the Ethernet network.

Additional Information

The ping command uses the ICMP protocol to send a response request to a device connected through an Ethernet network and determines the time required to respond to that request.
If you properly receive a response from the destination device, the network connection and network settings are correctly set.

1 Connect the smart camera and a computer with an Ethernet cable.
Set the high-order digits of the computer IP address to the same values as the smart camera and the low-order one digit to a different value.

<IP Address Setting Example>

Device	Example
Smart camera	10.5.6.100 (default)
Computer	10.5.6.101

2 Open the Windows command prompt on the computer and perform the ping command.
At the > prompt, type *ping*, followed by a space and the smart camera IP address, and then press *Enter*.
Example:
C:\>ping 10.5.6.100

3 After a few seconds, *Reply from* followed by the IP address of the smart camera (e.g., 10.5.6.100) are displayed, it means that the smart camera is connected to the Ethernet network properly.
Example:
Reply from 10.5.6.100: byte=32
Time<1 ms TTL=128

If anything other than *Reply from* is displayed:
The smart camera is not connected to the Ethernet network for some reason. Check the following.

- Are the high-order three digits of the IP addresses for the computer and the smart camera the same?
- Is the Ethernet cable correctly connected?

4 Use the ping command to check the communication status of the external device such as a PLC as well.
After you have confirmed the communication status as described above, transmit a inspection command to the smart camera in practice to check the communication operations as the image sensor.

5-3-8 Memory Allocation

This section describes the assignments of the Command Area for the input connection to the smart camera and the Response Area and Output Area for the output connection to the external device such as a PLC.

Input Connection to the Smart Camera (External device such as a PLC (IO Controller) to Smart Camera (IO Device))

For the input connections to the smart camera, specifies the control inputs, command codes, command parameters, and User Input Area, which are the Command Area parameters.

● Command Area

Set the first channel in Command Area.	Bit																Name
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
+0	ERCLR														STEP	EXE	Control input (2 CH)
+1																DSA	
+2	CMD-CODE																Command Code (2 CH)
+3																	
+4	CMD-PARAM																Command parameters (Max. 6 CH)
+5																	
+6																	
+7																	
+8																	
+9																	
+10	User Input Area 0																User Input Area 0
+11																	
+12	User Input Area 1																User Input Area 1
+13																	
+14	User Input Area 2																User Input Area 2
+15																	
+16	User Input Area 3																User Input Area 3
+17																	
+18	User Input Area 4																User Input Area 4
+19																	
+20																	
+21																	

Set the first channel in Command Area.	Bit																Name
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
+22	User Input Area 5																User Input Area 5
+23																	
+24																	
+25																	

Signal	Signal name	Function
EXE	Command Execution Bit	Performs a command. For details, refer to*5-3-11 Command List* on page 5-71.
DSA	Data Output Request Bit	Requests the next data output.
STEP	Measure Bit	Performs measurement one time.
ERCLR	Error Clear Bit	Clears the error signal (ERR bit). The ERROR signal of the parallel interface and the ERR LED of the indicator light are not cleared.
CMD-CODE	Command Code	Stores the command code.
CMD-PARAM	Command parameters	Stores the command parameters.
User Input Area 0 to 5	User Input Area 0 5	The user area is not used in FHV7-AI series.

Output Connection to PLC (Smart Camera (IO Device) to PLC (IO Controller))

For output connections to the external device such as a PLC, execution results and output data from the smart camera are set. The execution results such as control outputs, command codes, response codes, and response data are output to the Response Area, and the output data from the smart camera or the User Output Area is output to the Data Output Area.

Additional Information

The order in which data is stored depends on the manufacturer of the connected external device such as an external device such as a PLC.
For details, refer to *Parameter Notation Examples for Command Control* on page 5-40.

● Response Area

First channel in Response Area	Bit																Name
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
+0	ERR										ACK	RUN	OR		BUSY	FLG	Control output (2 CH)
+1																GATE	
+2	CMD-CODE																Command Code (2 CH)
+3																	
+4	RES-CODE																Response Code (2CH)
+5																	
+6	RES-DATA																Response Data (2 CH)
+7																	

● Data Output Area

When the User Area is used, data set as the number of output data in the PROFINET output specifications are output followed by the data of the User Output Area. Therefore, the first channel of the User Output Area will be changed according to the number of output data.
The following table indicates the mapping of the Data Output Area and User Output Area when Result Data Format 0 (32 bytes) is selected as the number of the output data.

First channel in Data Output Area	Bit																Name
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
+8	DATA0																Output data 0
+9																	
+10	DATA1																Output data 1
+11																	
+12	DATA2																Output data 2
+13																	
+14	DATA3																Output data 3
+15																	
+16	DATA4																Output data 4
+17																	
+18	DATA5																Output data 5
+19																	
+20	DATA6																Output data 6
+21																	

First channel in Data Output Area	Bit																Name
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
+22	DATA7																Output data 7
+23																	
+24	User Output Area 0																User Output Area 0
+25																	
+26	User Output Area 1																User Output Area 1
+27																	
+28	User Output Area 2																User Output Area 2
+29																	
+30	User Output Area 3																User Output Area 3
+31																	
+32	User Output Area 4																User Output Area 4
+33																	
+34																	
+35																	
+36	User Output Area 5																User Output Area 5
+37																	
+38																	
+39																	

Signal	Signal name	Function
FLG	Command Completion Bit	Turns ON when command execution is completed.
GATE	Data Output Completion Bit	Turns ON when data output is completed.
BUSY	Command Busy Bit	Turns ON when command execution is in progress and turns OFF automatically when the execution was competed.
OR	Overall judgment	Turns ON when the overall judgment is NG.
RUN	Run Mode	Turns ON when the smart camera is in Run Mode.
ACK	Command Reception bit	Turns ON when Inspection Bit (STEP) or Command Execution Bit is turned ON. Turns OFF after the command execution was completed and either the STEP Bit or EXE Bit is OFF.
ERR	Error Signal	Turns ON when the smart camera detects an error signal.
CMD-CODE	Command Code	Returns the executed command code.
RES-CODE	Response Code	Stores the response data for the executed command.
RES-DATA	Response Data	Stores the response data for the executed command.
DATA0 to 7	Output data 0 to 7	Outputs the data.
User Output Area 0 to 5	User Output Area 0 to 5	The user area is not used in FHV7-AI series.

Accessing Communication Areas Using Variables by NJ series Controllers

In Controllers of the NJ series, I/O memory addresses assigned to each communication area can be accessed from the user program only via variables.

Follow the procedures below.

● Specify the I/O memory addresses to access each communication area

By setting AT specifications to variables, assigned destination to each communication area can be specified in the unit of the I/O memory address.

1 Setting IO Device Area (CX Configurator FDT)

Directly specify the input and output allocation from the IO controller to the IO device by using the I/O memory addresses allocated to each communication area. (Output Allocation: Command Area to the smart camera, Input Allocation: Response Area and Data Output Area from the smart camera)

Setting example

IO Device Area	Area	Start Address	Length
Output Allocation	DM	0	100
Input Allocation	DM	100	100

2 Setting Variables

Define variables with AT (assigned destination) specifications to the I/O memory addresses assigned to each communication area as shown below.

Setting example

Variable	AT specification	Data type
SensorOut_EXE	D0.0	BOOL
SensorOut_STEP	D0.1	BOOL
SensorOut_ERCLR	D0.15	BOOL
SensorOut_DSA	D1.0	BOOL
SensorIn_FLG	D100.0	BOOL
SensorIn_BUSY	D100.1	BOOL
SensorIn_GATE	D101.0	BOOL
SensorOut_CommandCode	D2	BOOL
SensorIn_ResponseData	D106	DINT
SensorIn_Data	D108	ARRAY[0..7] OF DINT

5-3-9 I/O Signals

The following tables list the signals used to control I/O for PROFINET.

Input Signals

Signal	Signal name	Function	ON/OFF timing	
			OFF to ON	ON to OFF
EXE	Command Request Signal	The user (PLC) turns this signal ON when issuing a command to the smart camera.	The user (PLC) turns this signal ON when issuing a command (instruct the execution) to the smart camera based on the command code and command parameters.	The user (PLC) switches this signal from ON to OFF when the smart camera turns the Command Completion (FLG) signal ON.*1
DSA (Used only for handshaking output control)	Data Output Request Signal	During handshaking, the user (PLC) issues this signal to the smart camera to request to output externally the measured results performed in the job.	• The user (PLC) turns this signal ON when requesting the measurement data to output externally.*3 • This DSA signal is turned ON at the same time as the Trigger (STEP) or Command Request (EXE) signal switches from OFF to ON.	The user (PLC) switches this signal from ON to OFF when the smart camera turns the GATE signal ON.*2
ERCLR	Error Clear Bit	Clears the error signal (ERR bit). The ERROR signal of the parallel interface and the ERR LED of the indicator light are not cleared.	The user (PLC) switches the signal from OFF to ON when the Error (ERR) signal from the smart camera is turned OFF.	This signal is turned OFF when the user (PLC) detected the Error (ERR) signal turned OFF.
STEP	Measurement Trigger	This is turned on when inspection will be performed.	This signal turns ON from the PLC) to perform inspection after confirming that the BUSY signal and the Command Execution Completion (FLG) signal have turned OFF.	The user (PLC) switches this signal from ON to OFF after detecting that the smart camera turned the BUSY signal ON.

*1. If the Command Request (EXE) signal does not switch from ON to OFF within 10 seconds after the Command Completion (FLG) signal was turned ON, a timeout error will occur, and the FLG signal is forced to be turned OFF.

*2. If the Data Output Request (DSA) signal does not switch from OFF to ON within the time set at the “Timeout” in the settings after the Data Output Completion (GATE) signal turned ON, a timeout error will occur and the inspection data prepared for output will be discarded.

*3. If the Data Output Request (DSA) signal does not switch from OFF to ON within the time set at the “Timeout” in the settings after the inspection processing started by the Measurement Trigger (STEP) signal or the

Command Request (EXE) signal turned ON, a timeout error will occur and the inspection data prepared for output will be discarded.

Output Signals

Signal	Signal name	Function	ON/OFF timing	
			OFF to ON	ON to OFF
BUSY	Busy	This signal indicates that external inputs such as commands cannot be accepted. Issue a command when this signal is OFF. *1*2	This signal turns ON when the smart camera receives a command from the user (PLC). (After the EXE signal switches from OFF to ON.)	The signal turns OFF when the command execution is completed.
FLG	Command Execution Completion	The smart camera uses this signal to inform the PLC that command execution has been completed.	The signal turns ON when the smart camera completes execution of a received command.	This signal is turned OFF when the user (PLC) switches the Command Request (EXE) signal from ON to OFF.
GATE	Data Output Completion Signal	The signal informs the PLC of the timing to load output data. "ON" of this signal indicates that the smart camera is outputting the data. The user (PLC) starts to load the data when the signal turns ON.	• Without handshaking The signal turns ON when the smart camera performs the job and is ready for the data output. • With handshaking The signal turns ON when the smart camera performs the job and is ready for the data output and the Data Output Request (DSA) signal is ON.	• Without handshaking The signal turns OFF after the *Output Time* set in the settings has passed. • With handshaking This signal is turned OFF when the user (PLC) switches the Data Output Request (DSA) signal from ON to OFF.
ERR	Error Signal	The signal indicates that the smart camera detects the following errors. For details of the errors, refer to *6-1 Error Messages and Troubleshooting* on page 6-2.	The signal turns ON if the smart camera detects an error.	The signal turns OFF when the error is fixed and the user (PLC) turns the Error Clear (ERCLR) signal ON.
RUN	Run Mode	The signal indicates that the smart camera is running.	The signal turns ON when the smart camera is running.	The signal turns OFF when the smart camera is not running.
OR	Overall judgment	The signal indicates the overall judgment results.	The signal turns ON when the overall judgment is NG.	The signal turns OFF when the overall judgment is OK.

Signal	Signal name	Function	ON/OFF timing	
			OFF to ON	ON to OFF
ACK	Command Reception	The signal indicates that a command is received. Even BUSY is not output due to a heavy load, it surely detects the completion of the command processing execution.	The signal is turned ON when Inspection Bit (STEP) or Command Execution Bit (EXE) is received.	The signal switches from ON to OFF after the execution completed and either the STEP Bit or EXE Bit is OFF.

*1. This will not be detected while commands received through any other protocol are processed. (Ex.: This signal remains OFF during inspection with the STEP signal in the Parallel communications.) If you use more than one protocol and need to detect command execution, use the BUSY signal in Parallel communications.

*2. “ON” of this signal does not mean that a command is currently performed. To check whether a command is being executed, refer to the Command Execution Completion (FLG) signal.

5-3-10 Command Control

This section describes the commands that are used to control the smart camera from an external device.

Parameter Notation Examples for Command Control

This section provides examples of binary inputs of parameters such as arguments for command control.

Additional Information

The command code is the same, but the order in which the command parameters are stored depends on the manufacturer of the connected PLC as follows:

- OMRON and Yaskawa Electric PLCs: Upper byte followed by lower byte
- Mitsubishi Electric PLCs: Lower byte followed by upper byte*1

*1: The order of displayed sequence program may be from upper byte to low byte. If it does not perform correctly, confirm the order of upper and low byte.

● Four-byte Data

The following example shows the input to switch the job to job number 5 with the Switch job command.

First word in Command Area	Description
+2 and +3 words	Command code
+4 and +5 words	Job number (Command parameters)

- **OMRON or Yaskawa Electric PLCs**

  Command (PLC to smart camera)

First word in Command Area	Hexadecimal notation	Bit				Description
		15 - 12	11 - 8	7 - 4	3 - 0	
+2	1000	0001	0000	0000	0000	Command code
+3	0030	0000	0000	0011	0000	
+4	0005	0000	0000	0000	0101	Job number (Command parameters)
+5	0000	0000	0000	0000	0000	

- **Mitsubishi Electric PLCs**

  Command (PLC to smart camera)

First word in Command Area	Hexadecimal notation	Bit				Description
		15 - 12	11 - 8	7 - 4	3 - 0	
+2	1000	0001	0000	0000	0000	Command code
+3	0030	0000	0000	0011	0000	
+4	0500	0000	0101	0000	0000	Job number (Command parameters)
+5	0000	0000	0000	0000	0000	

5-3-11 Command List

This section describes the commands used in PROFINET.
A command with command words in the Command Area first channel can be performed in IO data communications.
For details of commands in IO data communications, refer to *Command Details for EtherNet/IP and PROFINET* on page 5-41.

First word in Response Area		Function
+3	+2	
0010	1010	Performs inspection one time.
0030	2000	Switches to the job with the specified number.
0050	1010	Reset the numerical value of the statistics displayed on the operation screen to zero.

Command Details for EtherNet/IP and PROFINET

This section provides details on the communications commands.

● Single Inspection

Performs inspection one time.

Command (PLC to smart camera)

First word in Command Area	Hexa-decimal nota-tion	Bit				Description
		15 - 12	11 - 8	7 - 4	3 - 0	
+2	1010	0001	0000	0001	0000	Command code
+3	0010	0000	0000	0001	0000	

Response (Smart camera to PLC)

First word in Response Area	Hexa-decimal nota-tion	Bit				Description
		15 - 12	11 - 8	7 - 4	3 - 0	
+2	1010	0001	0000	0001	0000	Command code
+3	0010	0000	0000	0001	0000	Response target command codes
+4	—	0000	0000	0000	0000	Response code
+5	—	0000	0000	0000	0000	Command execution result OK: 0 (0000 0000) NG: Not 0 (0000 0000)

● Switch Job

Switches to the job with the specified number.

Command (PLC to smart camera)

First word in Command Area	Hexa-decimal nota-tion	Bit				Description
		15 - 12	11 - 8	7 - 4	3 - 0	
+2	2000	0010	0000	0000	0000	Command code
+3	0030	0000	0000	0011	0000	
+4	—	0000	0000	0000	0000	Job number
+5	—	0000	0000	0000	0000	

Response (Smart camera to PLC)

First word in Response Area	Hexa-decimal nota-tion	Bit				Description
		15 - 12	11 - 8	7 - 4	3 - 0	
+2	2000	0010	0000	0000	0000	Command code
+3	0030	0000	0000	0011	0000	Response target command codes
+4	—	0000	0000	0000	0000	Response code
+5	—	0000	0000	0000	0000	Command execution result OK: 0 (0000 0000) NG: Not 0 (0000 0000)

Precautions for Correct Use

- Do not switch the job while the inspection is being executed.
- Do not switch the job except on the **RUN** screen.

● Reset Statistics Information

Reset the numerical value of the statistics displayed on the operation screen to zero.

Command (PLC to smart camera)

First word in Command Area	Hexa-decimal nota-tion	Bit				Description
		15 - 12	11 - 8	7 - 4	3 - 0	
+2	1010	0001	0000	0001	0000	Command code
+3	0050	0000	0000	0101	0000	

Response (Smart camera to PLC)

First word in Response Area	Hexa-decimal nota-tion	Bit				Description
		15 - 12	11 - 8	7 - 4	3 - 0	
+2	1010	0001	0000	0001	0000	Command code
+3	0050	0000	0000	0101	0000	Response target command codes
+4	—	0000	0000	0000	0000	Response code
+5	—	0000	0000	0000	0000	Command execution result OK: 0 (0000 0000) NG: Not 0 (0000 0000)

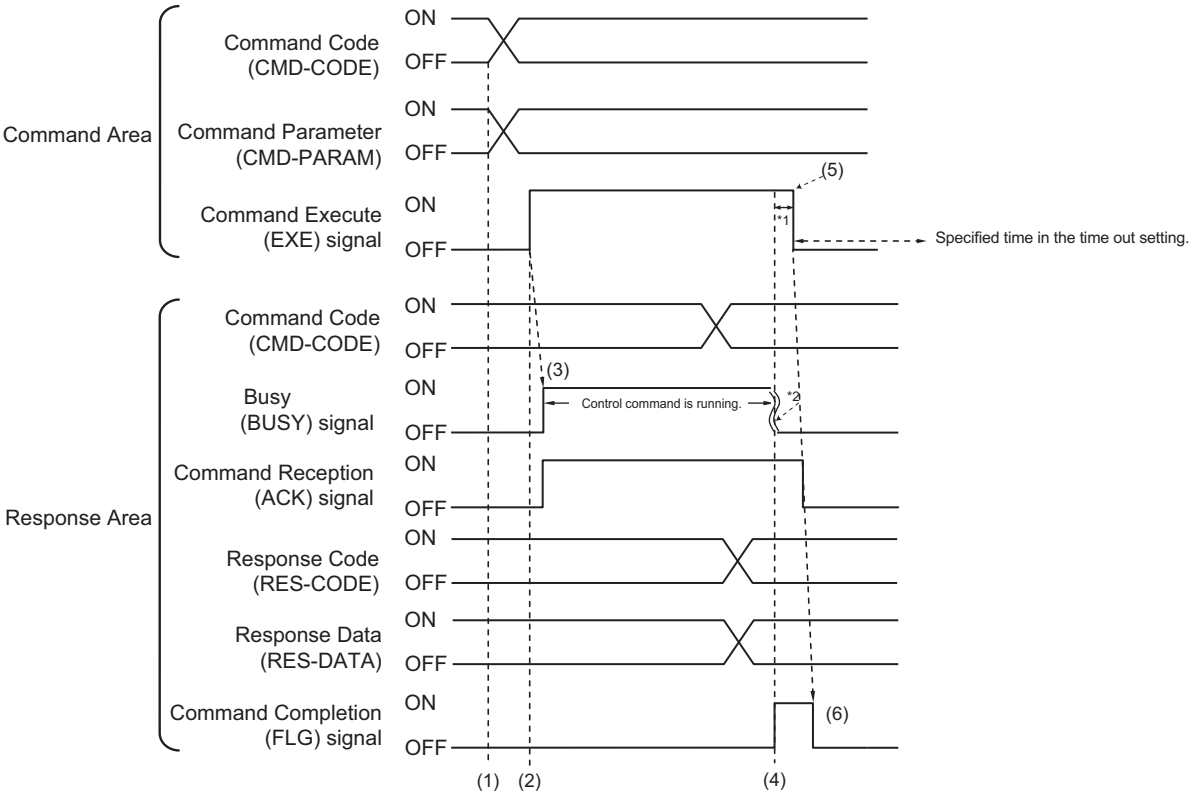
5-3-12 Command Response Processing

About control command response processing, the following timing chart describes the ON/OFF timing of signals related to commands to be input.

● Timing Chart for Command Execution

The Command Request (EXE) signal is used as the trigger to input and execute various commands such as inspection execution stored in advance in the external device (such as a PLC) memory.

The Command Completion (FLG) signal turns ON when execution of the control command is completed. Use this as the trigger to turn OFF the Command Request (EXE) signal.



*1: A timeout error will occur if you do not turn off the Command Execution (EXE) signal within 10 seconds after the Command Completion (FLG) signal is turned ON.
Command Completion (FLG) signal and BUSY signal will be forcefully turned OFF.

*2: Busy (BUSY) signal is automatically switched ON to OFF when the command execution is completed.

(1) The external device such as a PLC sets the command code and command parameters.

(2) After checking that the BUSY signal and the Command Completion (FLG) signal have turned OFF, the PLC turns ON the Command Request (EXE) signal again to instruct the smart camera to perform it.

(3) When receiving the instruction the smart camera performs the command and turns ON the ACK signal and the BUSY signal.

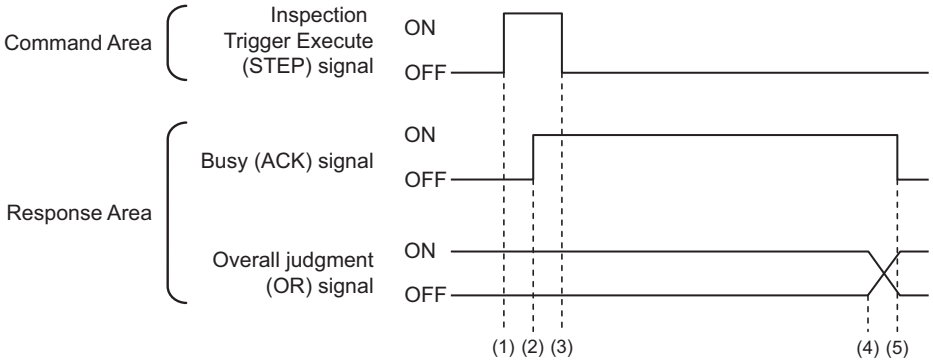
(4) When completing the execution, the smart camera sets the command code, response code, and response data.
The Command Completion (FLG) signal is turned ON.

(5) The PLC (user) turns OFF the Command Request (EXE) signal when the Command Completion (FLG) signal turns ON.

(6) When detecting that the Command Request (EXE) signal is OFF, the smart camera automatically turns OFF the Command Reception (ACK) signal and the Command Completion (FLG) signal automatically.

● Performing Inspection with the STEP Signal

In addition to inputting and executing the Command Request (EXE) as a trigger, the Inspection Trigger Execute (STEP) signal can be used to perform inspection.

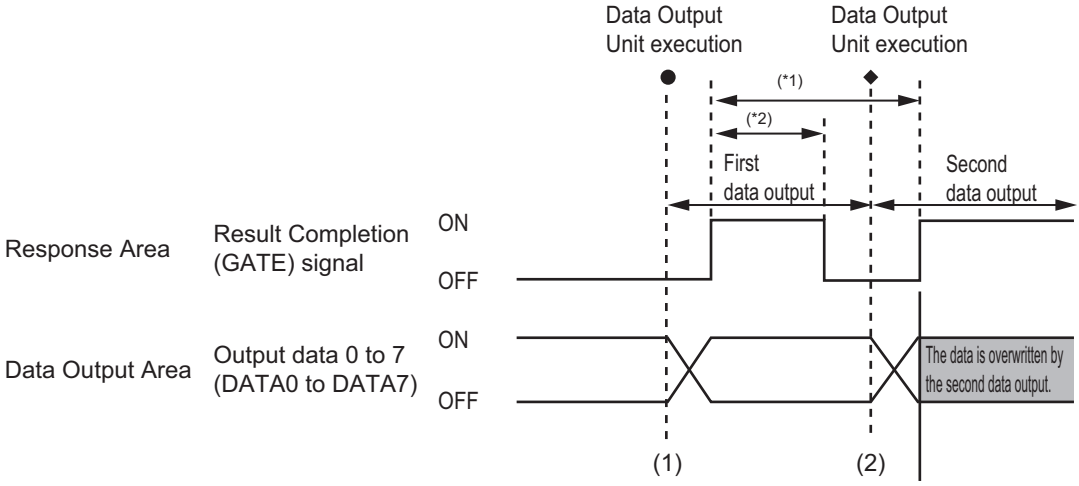


(1) While the ACK signal is OFF, inspection starts by the rising edge of the Inspection Trigger Execute (STEP) signal.
(2) The starting inspection turns ON the ACK signal.
(3) The Inspection Trigger Execute (STEP) signal is turned OFF when the ACK signal turns ON.
(4) The Overall Judgement (OR) signal is output when inspection is completed.
(5) The ACK signal is turned OFF when the job is completed.

5-3-13 Data Output

This section describes the ON/OFF timing for signals related to inspection data output after inspection completion using the following timing chart.

● Without handshaking



*1, *2: Data is output at the set output period[*1] and for the set output time.[*2]
After the data is output, the GATE signal is turned ON and the data is held for the data output time.

(1) The smart camera outputs data.

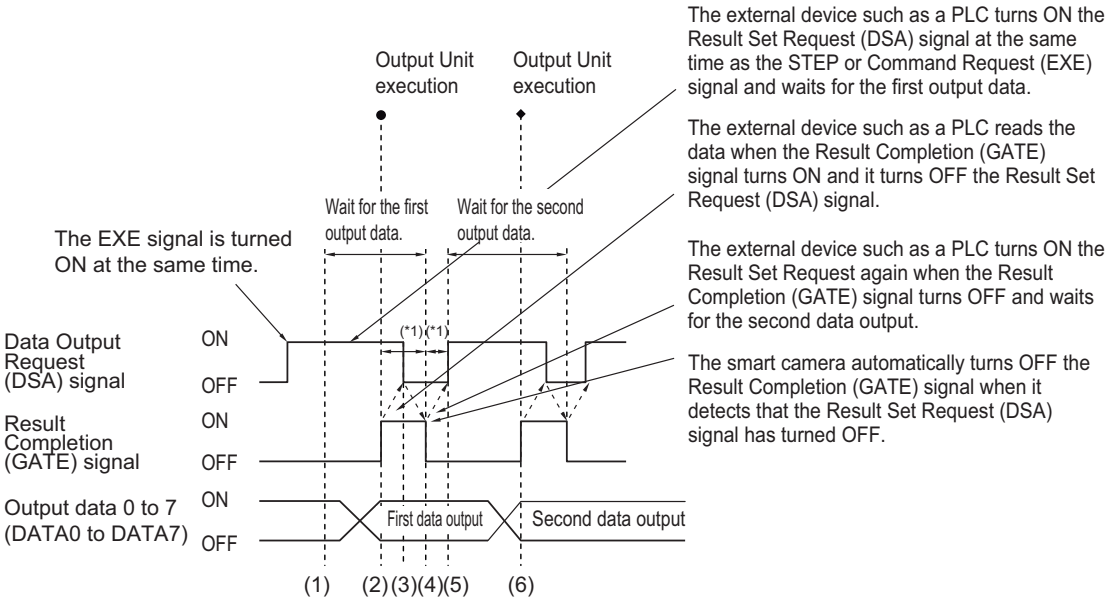
(2) Data is output each time that the job is performed for the second time. In that time, the output data for the first time is overwritten.

Precautions for Correct Use

- To receive all the output data, set **Handshaking** to *ON*, and then output data.

● With handshaking

The Result Completion (GATE) signal switches from OFF to ON when the PLC (user) switches the Result Set Request (DSA) signal from OFF to ON.
At that time, data that is possible to output will be output.
The PLC (user) switches the DSA signal from ON to OFF under the conditions whether it has received the output data and the Result Completion (GATE) signal has been turned ON.
In the case where multiple Output Units perform the data output, the PLC (user) turns the Data Output Request (DSA) signal ON again to instruct it to output the following data, when the smart camera switched the Data Output Completion (GATE) signal from ON to OFF.



*1 A timeout error will occur if any of the following states continues for longer than the timeout time.
- If the DSA signal is not turned ON after a certain time elapses from when the Output Unit was executed. (Turn ON the DSA signal at the same time as the measurement trigger command.)
- If the DSA signal is not turned OFF after a certain time elapses from when the GATE signal turns ON.

(1) The PLC (user) turns ON the Command Request (EXE) signal and the Data Output Request (DSA) signal at the same time. The output data for the first Output Unit (Fieldbus Data Output Unit / Result output (I/O) Unit) can be surely received.

(2) The smart camera performs the output in the job. Since the Data Output Request (DSA) signal is ON after the data is written, the Data Output Completion (GATE) signal becomes ON.

(3) The PLC (user) reads the data when the Result Completion (GATE) signal turns ON and it turns OFF the Result Set Request (DSA) signal.

(4) The smart camera automatically turns OFF the Result Completion (GATE) signal when it detects that the Result Set Request (DSA) signal has turned OFF.

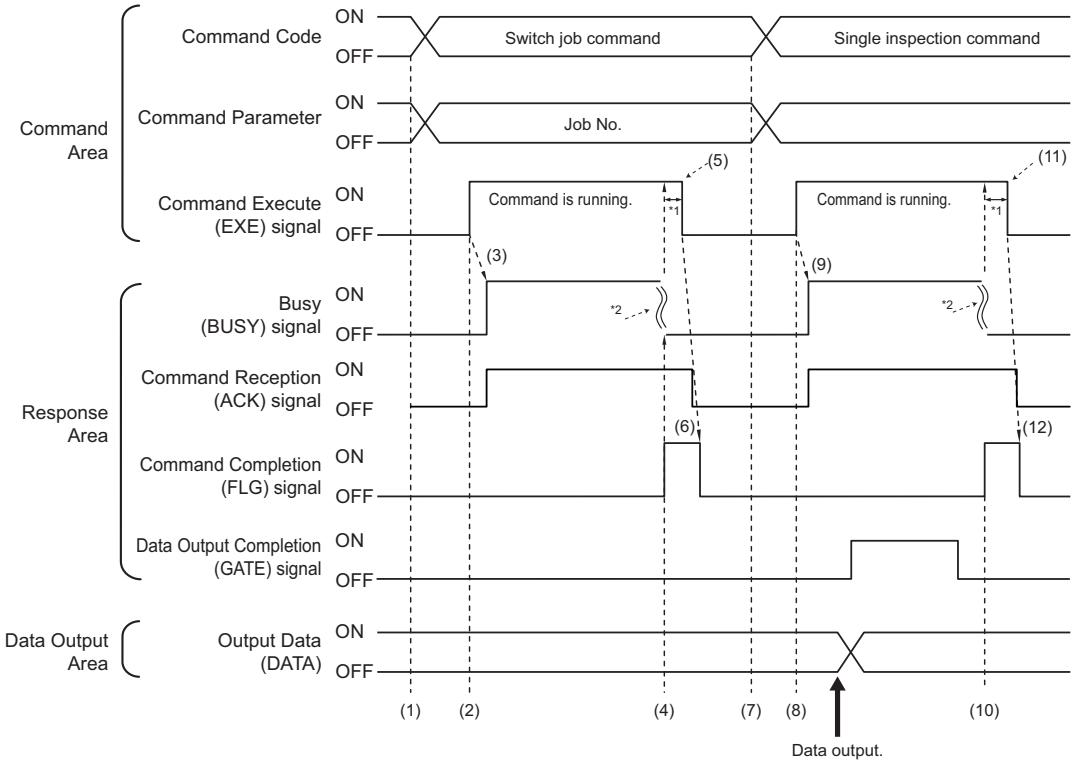
(5) The PLC (user) turns ON the Data Output Request (DSA) signal when the Data Output Completion (GATE) signal turns OFF, and then it waits for execution of the next Data Output.

(6) When the next Data Output is executed, the GATE signal turns ON and the data is output. Receive the second output data and then repeat steps 3 to 5, above.
Repeat steps 3 to 5 for any other data outputs.

5-3-14 Timing Chart

This section describes the ON/OFF timing for signals related to the sequence of operation from control command input until inspection data output after inspection completion using the following timing chart.

● Example 1: Inputting a Inspection Trigger after Switching a Job without Handshaking



*1: A timeout error will occur if you do not turn off the Command Execution (EXE) signal from external device such as a PLC (master) within 10 seconds. Then Command Completion (FLG) signal and Busy (BUSY) signal will be forced to turn off.

*2: Busy (BUSY) signal is automatically switched ON to OFF when the command execution is completed.

(1) The external device such as a PLC sets the command code and command parameters for the switch job.

(2) Next, confirm that the BUSY signal and the Command Completion (FLG) signal have turned OFF and then turn ON the Command Request (EXE) signal. A request is sent to the smart camera.

(3) The smart camera turns ON the Command Reception (ACK) signal and BUSY signal and switches the job when the request is received.

(4) The Command Completion (FLG) signal is turned ON when the job switching is completed.

(5) The PLC (user) turns the Command Request (EXE) signal OFF when the Command Completion (FLG) signal is switched from OFF to ON.

(6) After detecting that the Command Request (EXE) signal has turned OFF, the smart camera automatically turns OFF the Command Reception (ACK) signal and Command Completion (FLG) signal.

(7) The single inspection command code and command parameters are set from the external device such as a PLC.

(8) The Command Request (EXE) signal is turned ON to execute the single inspection command.

Additional Information

To execute a measurement trigger after changing the job, first confirm that the Command Completion (FLG) signal and the BUSY signal that turned ON for execution of the switch job command have turned OFF.

(9) The smart camera turns ON the Command Reception (ACK) signal and BUSY signal and performs inspection when the request is received.

(10) The Command Completion (FLG) signal is turned ON when the inspection was completed.

(11) The PLC (user) turns the Command Request (EXE) signal OFF when the Command Completion (FLG) signal turns ON.

(12) When the smart camera detects that the Command Request (EXE) signal is OFF, it automatically turns OFF the Command Reception (ACK) signal and Command Execution Completion (FLG) signal.

5-3-15 PROFINET Troubleshooting

Cannot Connect with the Smart Camera

Problem	Cause	Action
Cannot establish the IO link with the smart camera.	The GSD file version is different from the firmware one.	Make sure that the EDS file version matches the firmware version.

No Data is Output from the Smart Camera

Problem	Cause	Action
The GATE signal is not output.	The relationship between the *Update Rate* of the IO controller and the output time and output period for the smart camera is improper.	Decrease the value set at the *Update Rate* of the IO controller.
No data is output at all.	The communication module is set incorrectly.	Check that PROFINET is set in the communication module settings.
	The output data size (Data Format) of the Sub-module in the IO controller is different from that of the smart camera.	Match the both output data size (Data Format).

A Timeout Error Occurred

Problem	Cause	Action
A handshaking timeout error occurred.	The timing to switch the DSA signal is too slow. The following patterns are considered. • The DSA signal is not turned ON even after inspection has been completed. • The DSA signal is not switched from ON to OFF even after the GATE signal has been turned ON. • The DSA signal is not turned ON even after the GATE signal has been turned OFF.	After the single inspection command is performed, turn the Data Output Request (DSA) signal ON and OFF within the timeout time (10sec).

Problem	Cause	Action
A timeout error for the IO controller occurred and the connection was disconnected.	The watchdog in the IO controller operated and a timeout error occurred. The smart camera prioritizes inspection and control processing over communication processing. Therefore, as the result of the communication processing delayed due to the heavy loads of the internal processing, communications between an external device and the smart camera may be temporarily interrupted and a communication error may occur.	Increase the value set at the Update Rate of the IO controller or make the value for *Watchdog Factor* and *Data Hold Factor* to large respectively.

Slow Operation

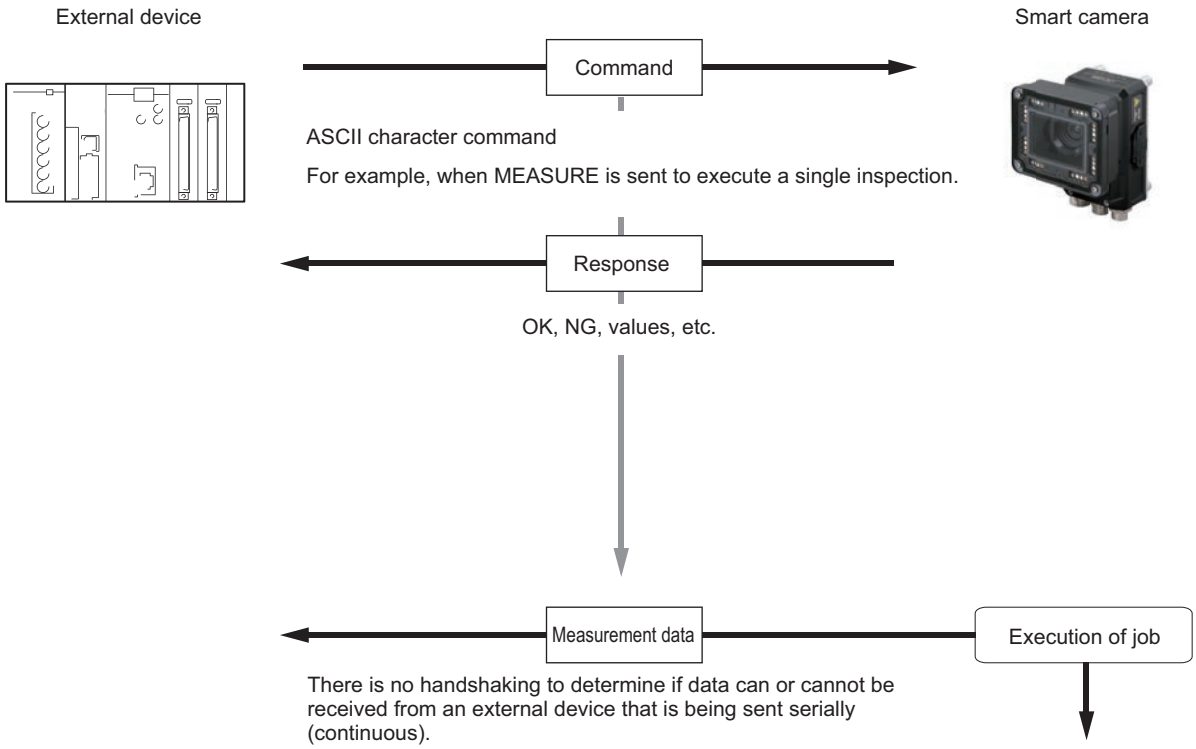
Problem	Cause	Action
Response and data output is slow.	You try to use a wrong combination for communication protocols, like a combination of PLC Link and PROFINET.	Use a proper combination of communication protocols.

5-4 Non-procedure Communications

This section provides the communications settings, communications specifications, input formats, and other information required to perform Non-procedure (normal) communications between the smart camera and an external device.

5-4-1 Communications Processing Flow

The smart camera communicates with an external device using command-based Non-procedure communications via Ethernet or RS-232C.
In Ethernet, TCP/IP protocol is used for the communications.



5-4-2 Communications Setup Procedures

The following settings are required to use Non-procedure.

1. Communications specifications settings
↓
2. Communications test

… The communications specifications are set for the communications method.
For details, refer to *5-4-3 Communications Specifications Settings* on page 5-82.

… If communications are not working properly, check the communications setup and perform a communications test to determine whether the smart camera can be detected on the network.
If that does not solve the problem, refer to the troubleshooting section for each communication protocol.
For details, refer to *5-4-4 Testing Communications* on page 5-82.

5-4-3 Communications Specifications Settings

Refer to *Communication Settings* on page 4-34 for how to set the communication specifications.

5-4-4 Testing Communications

When checking the communication settings, stop the program on the external device such as a PLC.

Checking the Communications Status

Use the ping command to check whether or not the smart camera exists on the Ethernet network. With it, check that the smart camera IP address has been correctly set and is correctly connected to the Ethernet network.

Additional Information

The ping command uses the ICMP protocol to send a response request to a device connected through an Ethernet network and determines the time required to respond to that request.
If you properly receive a response from the destination device, the network connection and network settings are correctly set.

1 Connect the smart camera and a computer with an Ethernet cable.
Set the high-order digits of the computer IP address to the same values as the smart camera and the low-order one digit to a different value.

<IP Address Setting Example>

Device	Example
Smart camera	10.5.6.100 (default)
Computer	10.5.6.101

2 Open the Windows command prompt on the computer and perform the ping command.
At the > prompt, type *ping*, followed by a space and the smart camera IP address, and then press *Enter*.

Example:
C:\>ping 10.5.6.100

3 After a few seconds, *Reply from* followed by the IP address of the smart camera (e.g., 10.5.6.100) are displayed, it means that the smart camera is connected to the Ethernet network properly.
Example:
Reply from 10.5.6.100: byte=32
Time<1 ms TTL=128

If anything other than *Reply from* is displayed:
The smart camera is not connected to the Ethernet network for some reason. Check the following.

- Are the high-order three digits of the IP addresses for the computer and the smart camera the same?
- Is the Ethernet cable correctly connected?

4 Use the ping command to check the communication status of the external device such as a PLC as well.
After you have confirmed the communication status as described above, transmit a inspection command to the smart camera in practice to check the communication operations as the image sensor.

5-4-5 Command Formats

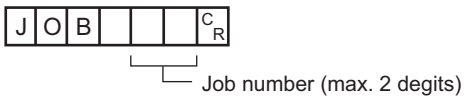
This section describes the format of commands to be used in Non-procedure communicaitons.

An Input Format Example

● When the parameter is a numeric

Example: Change the job number with JOB command.

<Command Format>



Enter a delimiter at the end of commands. In this manual, delimiters are expressed with CR.

Separate parameters with spaces (Not required before delimiters).

<Response Format>

The command was processed correctly:

Only OK is returned when there is no data.

<Response Format>

The command was not correctly processed:

ER is returned at the following cases:

- When a command which does not exist was specified.
- When the number of parameters is not correct.
- When the specified parameter range is not correct.
- When the contents of the specified parameter are not correct.
- When the specified operation did not correctly terminate.

Additional Information

In Ethernet, when the acquired data and the OK response are continuous, those are transmitted as a separate packet.

5-4-6 Command List

This section explains the input format for each command used for serial Non-procedure (normal) communications. Commands are input with ASCII text. Both lowercase and uppercase letters can be used. For details of commands, refer to *Non-procedure Command Details* on page 5-85.

Command	Abbreviation	Function
MEASURE	M	Single Inspection • Performs inspection one time.
JOB	(None)	Switch Job • Switches to the job with the specified number.
DATE	(None)	Set Date and Time • Sets the date and time.
RESETCOUNTER	(None)	Reset Statistics Information • Reset the numerical value of the statistics displayed on the operation screen to zero.

Non-procedure Command Details

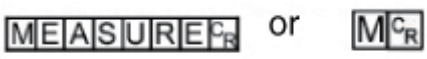
This section describes details of commands used in Non-procedure communications.

● MEASURE or M

Executing inspection

Performs inspection one time.

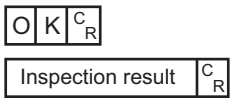
<Command format>



<Response format>

When processing is performed normally:

• Non-procedure



When processing is not performed normally:

<Parameters explanation>

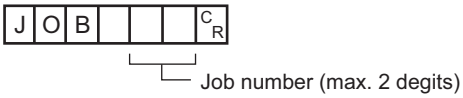
Inspection result	When **Data Output** is set to **ON** in the inspection program, the inspection result OK(1) or NG(-1) is output. When it is not set, the inspection result is not output.

● JOB

Switches the job number

Switches the job number to be used.

<Command format>



<Response format>
When processing is performed normally:

When processing is not performed normally:

<Parameters explanation>

Job number	Specifies the job number after switching (0 to 31).

(Example)
When switching to job 2:

<Command>

<Response>

Precautions for Correct Use

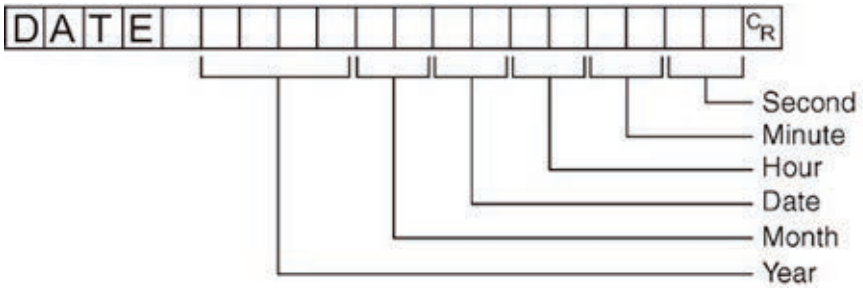
- Do not switch the job while the inspection is being executed.
- Do not switch the job except on the **RUN** screen.

● DATE

Setting date and time

Changes the date and time of the sensor.

<Command format>



<Response format>
When processing is performed normally:

OK CR

When processing is not performed normally:

ER CR

(Example)
When changing the date and time to 8/30/2007, 12:30:00:

<Command>

DATE 20070830123000 CR

<Response>

OK CR

● RESETCOUNTER

Reset Statistics Information

Reset the numerical value of the statistics displayed on the operation screen to zero.

<Command format>

RESETCOUNTER CR

<Response format>
When processing is performed normally:

OK CR

When processing is not performed normally:

ER CR

5-4-7 Non-procedure Communications Troubleshooting

Cannot Input to the Smart Camera

Problem	Cause	Action
No response is received after sending communication commands.	The wiring is incorrect.	Check the wiring. Check the cable connections.
	There is a problem with the communication specification settings.	Make sure that the settings are correct.
	Communications has not been established just after the smart camera start-up. (It requires more time to establish the communications.)	Check whether or not the communications are available between the smart camera and external devices after the smart camera turned on. Then start communications and inspection for ordinary operations.
No response is received after sending communications commands. (Communications were properly working previously.)	Commands are sent while the BUSY signal is ON.	Send commands while the BUSY signal is OFF.
	A cable is broken.	Check the cable connections.
	A connector has been disconnected.	Check the connector connections.

No Data Is Output from the Smart Camera

Problem	Cause	Action
	The wiring is incorrect or a cable is broken.	Check the wiring. Check the cable.
	A connector has been disconnected.	Check the connector connections.
	The output setting is not *ON* in the *Advanced Settings (for Data Output Setting)* on page 4-25.	Set to *ON*.
	Communications has not been established just after the smart camera start-up. (It requires more time to establish the communications.)	Check whether or not the communications are available between the smart camera and external devices after the smart camera turned on. Then start communications and inspection for ordinary operations.

Communications Fail just After Start-up of the Smart Camera

Problem	Cause	Action
The smart camera does not respond even serial commands are sent to it just after its start-up.	Communications are not established just after start-up of the smart camera. (To establish communications between the smart camera and external devices takes time.)	After confirming that communications are available between the smart camera and external devices after startup of it, send serial commands and start inspection.
No data is output from the smart camera just after its start-up.		

5-5 Parallel Communications

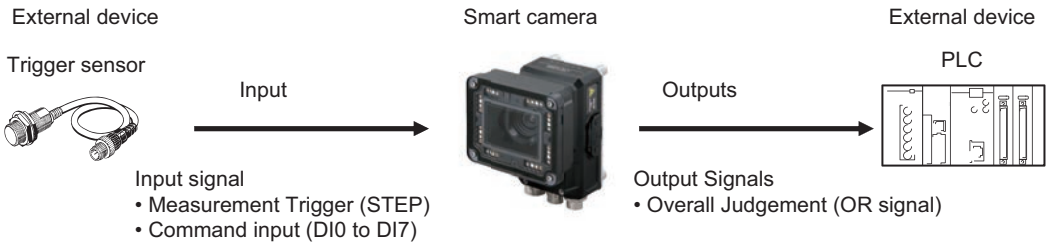
This section describes the communication settings, communication specifications, input/output format, and communication timing chart required for parallel communications between the smart camera and external devices.

5-5-1 Communications Processing Flow

The smart camera communicates with external devices via a parallel interface.

I/O Signals and Data for Communicating with External Devices

This section describes the basic connections and signal flow with external devices.



● Inputs

You can input the following signals to the smart camera while the Main window is displayed.

- **Measurement Trigger (STEP signal)**
  Inspection is performed once when STEP signal turns ON.
- **Command Input (DI0 to DI7 Signals)**
  You can send commands and control the smart camera by turning the DI0 to DI7 signals ON and OFF. For details of smart camera control commands, refer to *5-5-3 Command Formats* on page 5-94.

Precautions for Correct Use

Note that if DI7 is ON after the command is executed, the command will be executed repeatedly. For details, refer to *DI0 to DI7 (Command Execution) Timing* on page 5-93 *Multi-line Random-trigger Mode*

● Outputs

Each time inspection is performed, the inspection results are output.
The following inspection results can be output:

- **Overall Judgement (OR signal)**

5-5-2 I/O Signals

The following tables list the signals that are used to control I/O for parallel communications.

Input Signals

Signal	Signal name	Function	ON/OFF timing	
			OFF to ON	ON to OFF
STEP	Measurement Trigger Input signal	Input measurement triggers from external devices, such as optic switches. Inspection is performed once by synchronizing with the STEP signal rising (OFF to ON).	Switch from OFF to ON (rising) to perform a inspection.	Switch from ON to OFF when the user (PLC) detected that the smart camera turns the BUSY signal ON.
DI0 to DI7	Command Input signals	Input commands from the external device.	-	-

Output Signals

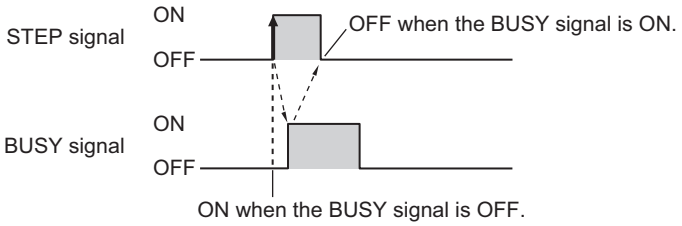
Signal	Signal name	Function	ON/OFF timing	
			OFF to ON	ON to OFF
RUN	Run Mode Signal	The signal indicates that the smart camera is running.	The signal turns ON when the smart camera is running.	The signal turns OFF when the smart camera is not running.
BUSY	Busy signal	This signal indicates when external inputs such as commands cannot be accepted. Make sure this signal is OFF before you request a command. While this signal is ON, no commands will be accepted even if they are sent.	Turn ON when the smart camera receives a command from the user (PLC). (The signal turns ON after the DI7 signal turned ON.) It is also turned on during inspection execution or transitioning to the **Adjustment** screen.	It turns OFF when inspection or command execution is completed or when transitioning to the **RUN** screen.
OR	Overall Judgment signal	Output the overall judgment. This is determined when the inspection is completed.	Turn ON based on the judgment results when inspection is completed.	The status of the OR signal is maintained until the next OR signal is output.
READY	Ready signal	This signal indicates when the STEP signal can be input. Turn ON the STEP signal when the READY signal turns ON.	Turn ON when the STEP signal can be input.	Turn OFF when the STEP signal cannot be input.

Signal	Signal name	Function	ON/OFF timing	
			OFF to ON	ON to OFF
ACK	Command Completion Flag	This flag indicates when DI command execution is completed.	Turn ON when execution of the DI command is completed	Turn OFF when the user (PLC) turns OFF the DI7 signal.
ERR	Error Signal	This signal indicates when the smart camera detects errors. For details of the errors, refer to *6-1 Error Messages and Troubleshooting* on page 6-2.	It will turn ON in any of the following cases. • Turn ON when the smart camera detects an error. • Turns ON when a STEP signal is input while the READY signal is OFF. • Turns ON when a command which does not exist is issued.	Regardless of the OFF to ON condition set, it will turn OFF in any of the following cases. • When the STEP signal is input while the READY signal is ON • When a valid command is issued

Input Timing of Input Signals

● STEP Signal Input Timing

The measurement trigger STEP signal is input with the following timing.



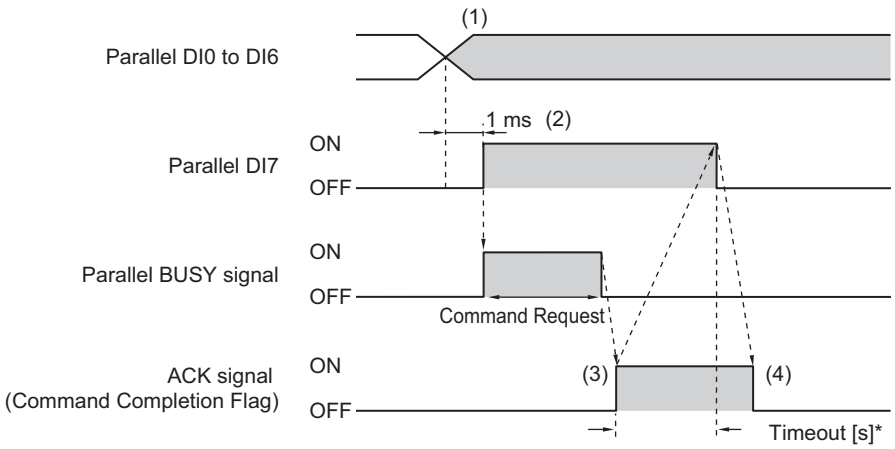
(1) Turn ON the STEP signal when the BUSY signal is OFF.
When multiple inputs are used, the STEP signal can be turned ON when the READY signal is ON. However, when the image mode is set to *Through Mode*, the READY signal will always be OFF, so check the status of the BUSY signal to determine when to input the STEP signal.

(2) Check that the BUSY signal is ON, then turn OFF the STEP signal.

Additional Information

If the STEP signal is turned ON when the READY signal is OFF, no inspections will be executed and the ERROR signal will turn ON.

● DI0 to DI7 (Command Execution) Timing



(1) Set the DI0 to DI6 signals to ON or OFF based on the command to input.

(2) After you have set the DI0 to DI6 signals, wait for at least 1 [ms] and then turn ON DI7.

(3) The command will be executed, and the ACK signal will turn ON after execution of the command is completed.

(4) Check that the ACK signal has turned ON, then turn OFF DI7.
When the DI7 signal is turned OFF, the ACK signal will turn OFF.

* A timeout error will occur if the DI7 signal is not turned OFF within the set timeout interval from when the ACK signal is turned ON.

Precautions for Correct Use

If the DI7 is still ON after execution of a command is completed, the same command will be executed again.
Confirm that the ACK signal is turned ON from OFF, and then create the program of the PLC side to turn the DI7 signal OFF from ON.

Additional Information

From the PLC, set signals DI0 to DI6 and turn ON the DI7 signal only when the BUSY, ACK, and DI7 signals are all OFF.
From the PLC, you can check if a command was acknowledged by confirming that the BUSY signal turned ON.
From the PLC, you can check if execution of a command was completed by confirming that the ACK signal turned ON.
After these conditions have all been met, turn OFF the DI7 signal.

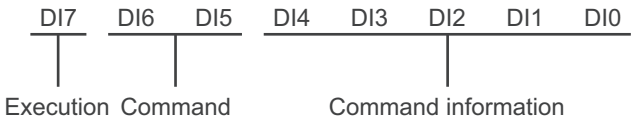
5-5-3 Command Formats

You can input commands to control the Sensor from an external device using the DI0 to DI7 signals.

Input Format

Commands are input in the following formats.

Input format (DI7 to DI0)



Set 0 (OFF) or 1 (ON) for each DI signal.
Confirm commands and command information, and turn DI7 (execution) ON with an interval of at least 1 [ms].

Parallel Command Details

This section describes details of commands used in Parallel communications.

Precautions for Correct Use

- Parallel commands can only be used when the parallel input/output signal expansion unit (FHV-SDU10) of the smart camera data unit is connected.
- Use communication commands only on the **RUN** screen. Other screens may not be usable or may become abnormal. (As an exception, the single inspection command can also be used in the **Pre-Learning** process and **Operation Check** process on the **Adjustment** screen.)

● Command Lists

The commands and command formats are described in the following tables.

Data	Description	Input format (DI7 to DI0)			Input example
		Execute (DI7)	Command (DI6, DI5)	Command information (DI4 to DI0)	
Switch Job	Switches to the job with the specified number.	1	11	Input job number in binary format (0 to 31).	Switching to job 2: 11100010

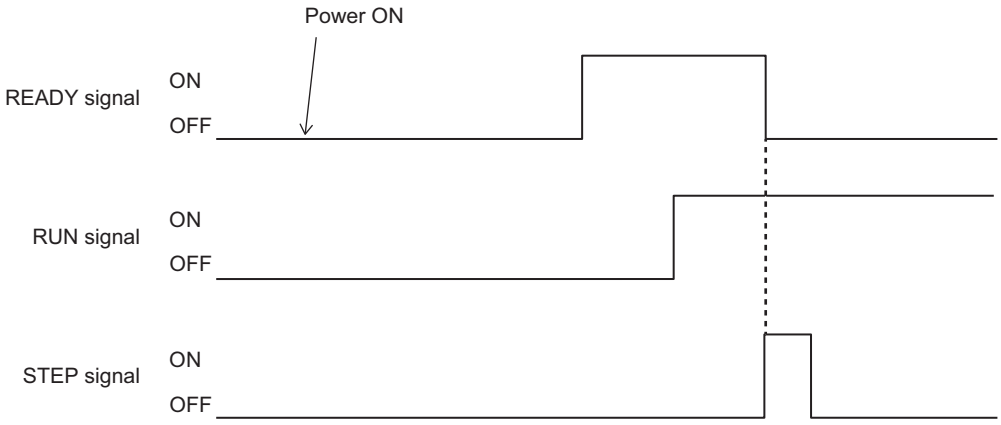
5-5-4 Time Charts

The ON/OFF timing of related signals is indicated below in a timing chart.

Precautions for Correct Use

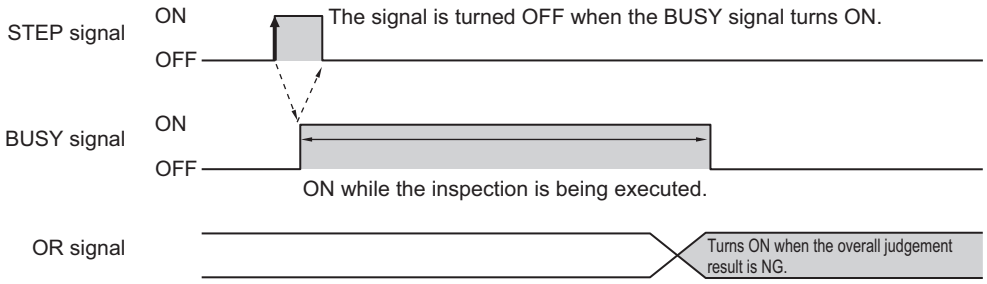
- For details of functions and operation of each signal, refer to *5-5-2 I/O Signals* on page 5-91.

Timing chart at startup



(1) Turn ON power.
(2) The READY signal turns ON when the trigger signal becomes acceptable.
(3) The STEP signal is input after checking the RUN signal is ON.

Timing Chart at Inspection



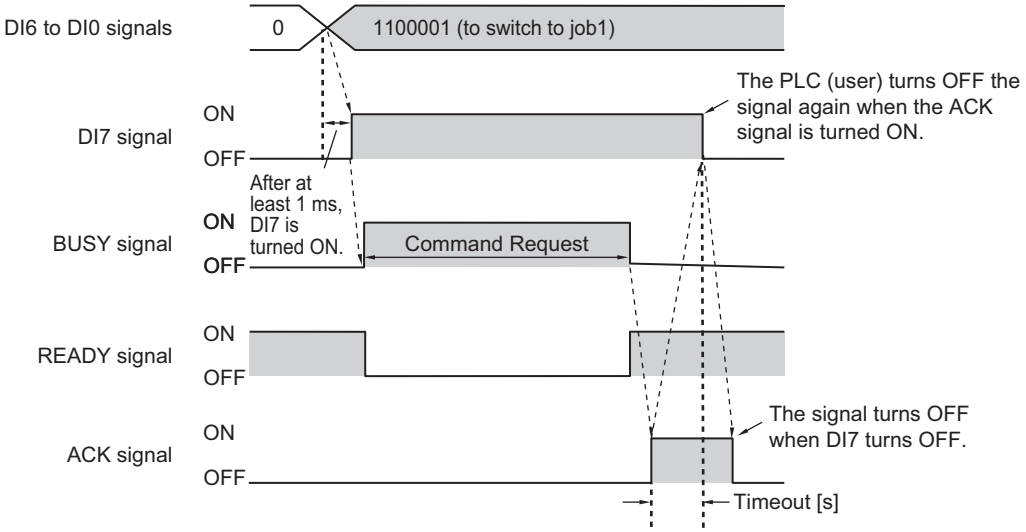
(1) Turn ON the STEP signal while the BUSY signal is OFF.
(2) Inspection begins and the BUSY signal is turned ON during the inspection process.
(3) After inspection is completed, the OR signal is output based on the inspection results and the BUSY signal is turned OFF.

Command Timing Charts

● Switch Job

Job is switched as follows.

After the number of the desired job is set in DI0 to DI6, turning ON DI7 switches the job to the number set.



- **Output Signals**

Signal	Description
BUSY	Indicates that the smart camera is currently switching the job. Do not input next command while the BUSY signal is ON. Otherwise, on-going processing or commands that are input will not be performed correctly.
READY	Turns OFF while a job is being switched. Turns OFF as long as the BUSY signal is ON.
ACK	Turns ON when execution of the DI command is completed.

Additional Information

When the input command is not received correctly, the ERROR signal turns ON.

- **Input Signals**

Signal	Description
DI0 to DI4	Sets the job number (0 to 31). When a DI terminal offset is set, the set offset is added.
DI5	ON
DI6	ON
DI7	This is the execution trigger. After DI0 to DI6 are set, turn ON DI7 after an interval over 1 [ms]. After checking that the ACK signal has turned ON, turn DI7 OFF and then turn DI0 to DI6 OFF.

5-5-5 Parallel Troubleshooting

Problem	Cause	Action
Inspection is not executed even when a STEP signal is input.	The STEP signal is chattering.	Check the contacts and input method used to prevent chattering.
The STEP signal is input at random.	Unintended STEP signals are being input due to noise.	Perform noise prevention measures.

6

What to Do!

6-1 Error Messages and Troubleshooting

This section lists error messages that are displayed on the screen and the solutions for them.
Check the screen display on the remote operation PC.

ERR When a message with this symbol is displayed, the ERROR signal for each communication and the ERROR indicator on the smart camera will turn ON.

Error message	Troubleshooting
The overlay area is exhausted. If it is completely exhausted, the system will not work properly. Save the data needed to recover and reboot the system. ERR	The overlay area is exhausted. If it is completely exhausted, the system will not work properly. Save the data needed to recover and reboot the system.
The overlay area is exhausted. Reboot the system to recover space. Unsaved settings will be lost. Do you want to save the settings to the main unit?	Free data memory of the overlay is low. If the over lay memory is completely exhausted, the system may not work properly, causing issues such as decrease in processing speed. Overlay memory can be deallocated by rebooting the system. • Yes: Saves data in the flash memory and reboots the system. • No: Reboots the system without saving data in the flash memory. • Cancel: Closes the message without rebooting the system.
The problem occurred in the system. ERR	This is displayed when the significant abnormality occurs in the smart camera system. Please contact one of our branches or regional offices.
The communication time-out is occurred. ERR	Switch off smart camera, verify the following contents and then restart. • Is cable connected correctly? • Does it comply with communication specifications of external devices? • Are external devices functioning normally? If error is not resolved after confirmation, the smart camera may be damaged. Please discuss this with one of our branches or regional offices.
Logging error ERR	Image logging failed due to insufficient memory at the save destination. • If the save destination is an external storage, make sure that the external storage is recognized. • If the save destination does not have sufficient space, either delete unnecessary files from the save destination, or arrange for a new external storage.

6-2 FAQ

6-2-1 During Start-up

POWER LED is not lit.

- Is the power supply connected correctly?
- Is the supply voltage low (24 V DC +10%, -15%)?

MicroSD card cannot be recognized.

- Is there no failure in the MicroSD card?
- Is the MicroSD card firmly stuck in till the end?
- Are foreign matter or other impurities deposited on the MicroSD card?

The date and time are abnormal.

- Do you set the date and time?
  In the FHV series, it is necessary to set the date and time each time it is activated.

6-2-2 During Operation

Operations cannot be performed (Screen operations cannot be performed).

- Is an error dialog box displayed behind the main screen?
  Make sure no error dialog box is displayed in the task bar.

6-2-3 For Inspection

Inspections cannot be performed (Screen operations cannot be performed).

- Is an error dialog box displayed behind the main screen?
  Make sure no error dialog box is displayed in the task bar.

6-2-4 About Parallel Interface

Trigger signal (input signal) not accepted.

- Are the cables connected correctly?
- Is the signal cable disconnected?

Signals cannot be output to external devices.

- Is the trigger signal input?
- Are the cables connected correctly?
- Is the signal cable disconnected?
- Is the **Adjustment** - **Operation confirmation** displayed?
  No data is output to external devices on the **Operation confirmation** screen.

A

Appendices

A-1 Configuration

A-1-1 Confirm the Package

First, please check to see whether the package has all the necessary AI detection camera parts.

FHV7X-C016-S□□-W-01

- Smart camera main unit: 1
- Cap for Ethernet connector (mounted on the body): 1
- Cap for lighting connector (mounted on the body): 1
- Instruction sheet: 1
- Membership registration: 1
- General Compliance Information and Instructions for EU: 1

A-1-2 Sold Separately

Smart Camera Data Unit

Appearance	Description	Model
	Parallel interface for Smart Camera data unit Extension unit for Parallel I/O signals	FHV-SDU10

Cables

● Power & I/O Cables

Appearance	Description	Model
	Power & I/O cable bending resistance straight Cable length: 2 m, 3 m, 5 m, 10 m, 20 m	FHV-VDB2 2M FHV-VDB2 3M FHV-VDB2 5M FHV-VDB2 10M FHV-VDB2 20M
	Power & I/O cable bending resistance right-angle Cable length: 2 m, 3 m, 5 m, 10 m, 20 m	FHV-VDLB2 2M FHV-VDLB2 3M FHV-VDLB2 5M FHV-VDLB2 10M FHV-VDLB2 20M

● Ethernet Cables

Appearance	Description	Model
	Ethernet cable bending resistance straight Cable length: 2 m, 3 m, 5 m, 10 m, 20 m	FHV-VNB2 2M FHV-VNB2 3M FHV-VNB2 5M FHV-VNB2 10M FHV-VNB2 20M
	Ethernet cable bending resistance right-angle Cable length: 2 m, 3 m, 5 m, 10 m, 20 m	FHV-VNLB2 2M FHV-VNLB2 3M FHV-VNLB2 5M FHV-VNLB2 10M FHV-VNLB2 20M

● Smart Camera Data Unit Cable

Appearance	Description	Model
	Smart Camera data unit cable bending resistance straight Cable length: 2 m, 3 m, 5 m, 10 m, 20 m	FHV-VUB2 2M FHV-VUB2 3M FHV-VUB2 5M FHV-VUB2 10M FHV-VUB2 20M
	Smart Camera data unit cable bending resistance right-angle Cable length: 2 m, 3 m, 5 m, 10 m, 20 m	FHV-VULB2 2M FHV-VULB2 3M FHV-VULB2 5M FHV-VULB2 10M FHV-VULB2 20M
	Parallel I/O cable Cable length: 2 m, 5 m	XW2Z-S013-2 XW2Z-S013-5
	Parallel I/O cable for connector-terminal block conversion units Cable length: 0.5 m, 1 m, 1.5 m, 2 m, 3 m, 5 m	XW2Z-050EE XW2Z-100EE XW2Z-150EE XW2Z-200EE XW2Z-300EE XW2Z-500EE
	Connector-terminal block conversion units Push-in type	XW2K-34G-T
	Connector-terminal block conversion units Phillips screw type	XW2D-34G6
	Connector-terminal block conversion units Slotted screw type	XW2R-E34GD-T

For information about connector-terminal block conversion units, refer to the respective data sheets.

Accessories

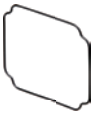
● Optical Filters

Appearance	Type	Model
	Polarization filter	FHV-XPL
	Diffusion filter	FHV-XDF
	Lighting cover	FHV-XCV

● Mounting Fixtures

Appearance	Description	Model
	For smart camera body and lighting controller mounting	FHV-XMT-7

● Waterproof Packings

Appearance	Description	Model
	For internal lighting: 5*1	FHV-XWP-LTM

*1. It is considered a consumable item that will deteriorate. Please replace as needed.

● Waterproof Caps

Appearance	Description	Model
	For lighting connector	FHV-XWC-LCN
	For Ethernet connector	FHV-XWC-ECN

● Light-shielding Sheet

Appearance	Description	Model
	For lighting module: 3	FHV-XLS-LTM

● Replacement Screws for Micro SD Card Cover

Appearance	Description	Model
	Replacement screws for microSD card cover, 10 screws	FHV-XSCR-MSD

● Others

Appearance	Description	Model
	Industrial switching hubs for EtherNet/IP and Ethernet 5 ports Current consumption: 0.07A	W4S1-05D

Touch Panel Monitor

Appearance	Description	Model
	Touch Panel Monitor for smart camera 15.4 inch, Black	NYE2A-20F11-15WR1200
	Touch Panel Monitor for smart camera 12.1 inch, Black	NYE2A-20F11-12WR1200
	High-Pressure Waterproof Attachment (PWA) 15.4 inch	NA-15WATW01
	High-Pressure Waterproof Attachment (PWA) 12.1 inch	NA-12WATW01
	Anti-reflection Sheets 15.4 inch	NA-15WKBA04
	Anti-reflection Sheets 12.1 inch	NA-12WKBA04

For information about touch panel monitors, refer to the respective instruction manuals.

A-2 Specifications

A-2-1 Smart Camera

FHV7-AI series: FHV7X-C016-S□□-W-01

● Specifications

Item		FHV7X-C016-S06-W-01	FHV7X-C016-S09-W-01	FHV7X-C016-S12-W-01	FHV7X-C016-S16-W-01	FHV7X-C016-S25-W-01
Imaging	CMOS image elements	1/2.9-inch equivalent				
	Color/Monochrome	Color				
	Effective pixels	1440(H) x 1080(V)				
	Pixel size	3.45 x 3.45 um				
	Shutter system	Global Shutter				
	Frame rate (image acquisition time)	224 fps (4.5 ms)				
	Color of light	White				
	LED risk group	Risk group 2				
	Lens focal length	6 mm	9 mm	12 mm	16 mm	25 mm
	Field of view, Installation distance	Refer to *Optical Chart* on page A-9.				
External interface	Ethernet	I/F: 1000BASE-T Protocol: Non-procedure (TCP)				
	EtherNet/IP	Yes (Target/Ethernet port)				
	PROFINET	Yes (Slave/Ethernet port), Conformance class A				
	EtherCAT	N/A				
	Serial	N/A				
	Parallel I/O	NPN/PNP common				
	Parallel I/F	High-speed input: 1, General input: 3, High-speed output: 1, General output: 4				
	SD Card I/F	microSD card: SDHC				
Indicator lamps	Main	PWR: Green, RUN: Green, LINK: Yellow, BUSY: Green, OR: Yellow, ERR: Red				
	SD	SD ACCESS: Yellow				
Supply voltage		21.6 VDC to 26.4 VDC When a Power & I/O cable with 20 m is connected, it is 24.0 VDC to 26.4 VDC.				
Current consumption		4.2 A or less				

Item		FHV7X-C016-S06-W-01	FHV7X-C016-S09-W-01	FHV7X-C016-S12-W-01	FHV7X-C016-S16-W-01	FHV7X-C016-S25-W-01
Usage environment	Ambient temperature range	Operating: 0 to +40°C, Storage: -25 to +65°C (with no icing or condensation)				
	Ambient humidity range	Operating & Storage: 35 to 85%RH (with no condensation)				
	Ambient atmosphere	No corrosive gases				
	Vibration tolerance	Oscillation frequency: 10 to 150Hz, Half amplitude: 0.15 mm, Vibration direction: X/Y/Z, Sweep time: 8 minute/count, Sweep count: 10				
	Shock resistance	Impact force: 150 m/s^2, Test direction: 6 directions, three time each (up/down, front/behind, left/right)				
	Noise immunity	Fast transient burst • DC power Direct infusion: 2 kV, Pulse rising: 5 ns, Pulse width: 50 ns, Burst continuation time: 15 ms/0.75 ms, Period: 300 ms, Application time: 1 min. • I/O line Direct infusion: 1 kV, Pulse rising: 5 ns, Pulse width: 50 ns, Burst continuation time: 15 ms/0.75 ms, Period: 300 ms, Application time: 1 min.				
	Grounding	Class D grounding (100 Ω or less grounding resistance)				
External shape	Dimensions	113.5 mm × 91.0 mm × 103.4 mm (H x W x D)				
	Weight	Approx. 990 g				
	Ingress protection rating	IEC60529 - IP67 When a connector cap removed, IEC60529 - IP40				
	Case material	Housing: Aluminum die-casting (ADC12) Imaging part: Polycarbonate				
Specifications	Included items	• Cap for Ethernet connector (mounted on the body): 1 • Cap for lighting connector (mounted on the body): 1 • Instruction sheet: 1 • Membership registration: 1 • General Compliance Information and Instructions for EU: 1				
	UI operation	Remote Operation Tool				
	Language	English, Japanese, Simplified Chinese, Traditional Chinese, German, French, Italian, Spanish, Korean, Vietnamese, Polish				

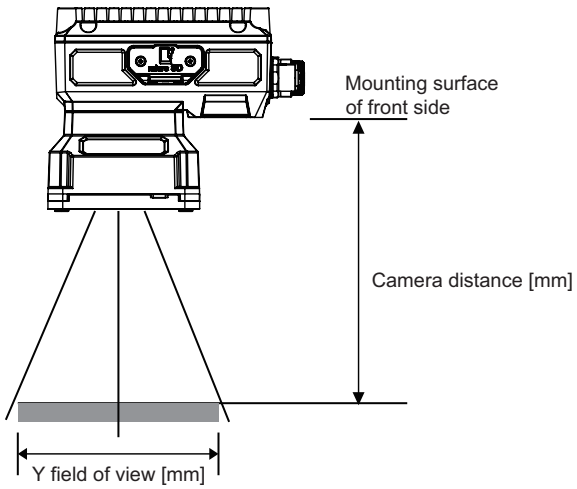
● Available List of Smart Camera and Software Versions

Below is a list of correspondence between each smart camera and the software version of the smart camera.

Model	Software version that can be used with smart camera
FHV7X-C016-S□□-W-01	Only dedicated custom software for FHV7-AI

● How to View the Optical Chart

The X axis of the optical chart shows the field of view (mm).
The Y axis of the optical chart shows the camera installation distance (mm).

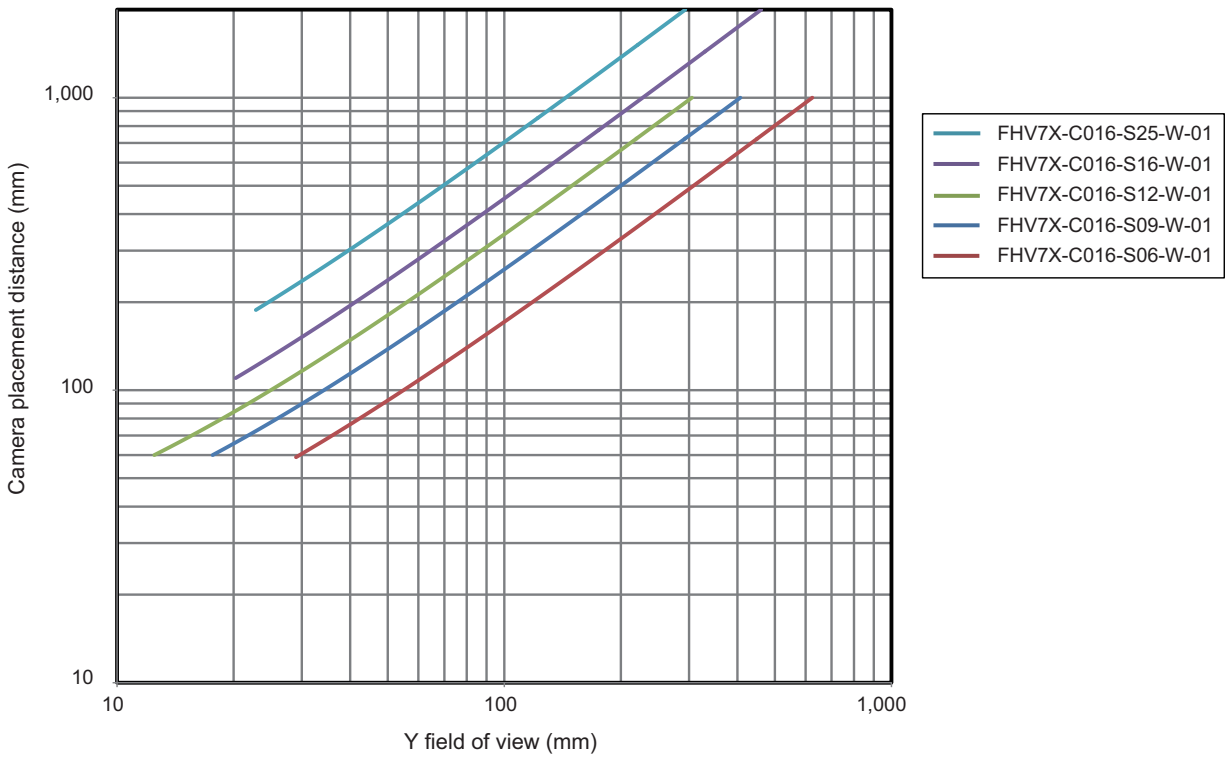


The lengths of the fields of view given in the optical charts are the lengths of the Y axis.

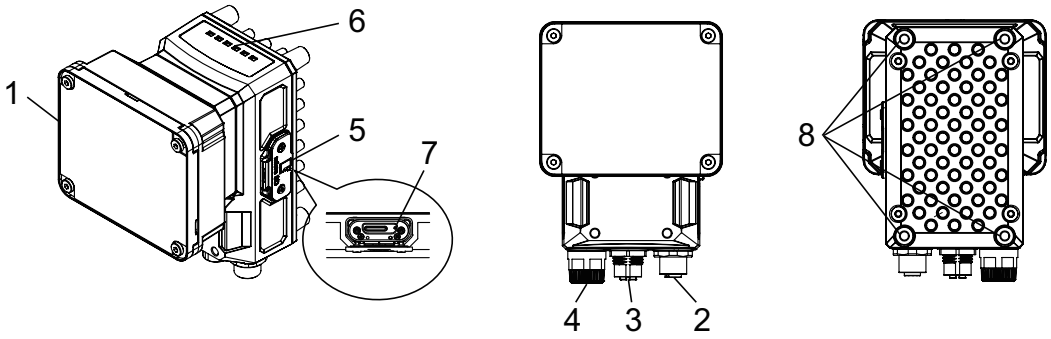
Precautions for Correct Use

- The optical axis may vary product by product. When mounting this module, be sure to confirm the center position of the video on the monitor. The optical axis of this product may vary over a couple of pixels due to the variation of ambient temperature because of the material characteristics.
- Select the model by confirming the field of view and camera installation distance on the optical diagram. In addition, the field of view may vary product by product.
  When mounting this product, be sure to confirm video using the monitor.

● Optical Chart



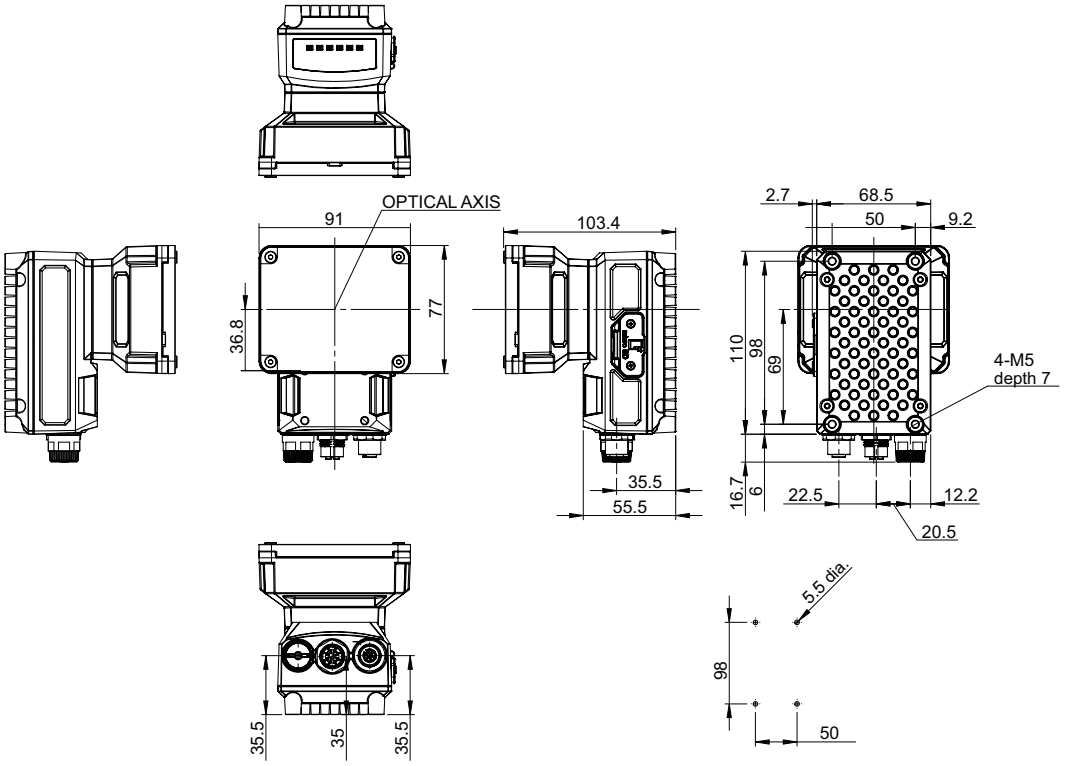
● Component Names and Functions



No.	Name		Description
1	Imaging unit		Captures images.
2	Power & I/O cable, Smart camera data unit cable connector		Use this connector when connecting the smart camera with a power supply or an external device. Dedicated Power & I/O cable: FHV-VD(L)B2 □□M Or, use this connector when connecting the smart camera data unit FHV-SDU10. Dedicated smart camera data unit cable: FHV-VU(L)B2 □□M
3	Ethernet connector		Use this connector when connecting the smart camera with a personal computer and so on. Dedicated Ethernet cable: FHV-VN(L)B2 □□M
4	Lighting connector		Not used with this product. (This product does not support connecting external lighting.)
5	MicroSD card slot		Use this connector to attach a microSD card. Do not extract/insert the microSD card during processing. Otherwise, measurement time may be influenced or data may be broken.
6	Operation indicator	PWR (Green)	Lights while power is supplied.
		RUN (Green)	Lights when switching to the layout in which the RUN signal output is set ON.
		LINK (Yellow)	Lights when connected with Ethernet equipment and blinks during communication.
		BUSY (Green)	Lights while processing is in progress.
		OR (Yellow)	Lights when the overall judgment output signal is ON.
		ERR (Red)	Lights when an error occurs.
7		SD ACCESS (Yellow)	Lights when accessing to the microSD card.
8	Mounting screw holes		Use them to screw up the smart camera. Recommended tightening torque : 2.3 N·m

● Dimensions

• FHV7X-C016-S□□-W-01



Mounting screw holes (The tolerance: ± 0.1 mm)
Recommended tightening torque: 2.3N·m

(Unit: mm)

Additional Information

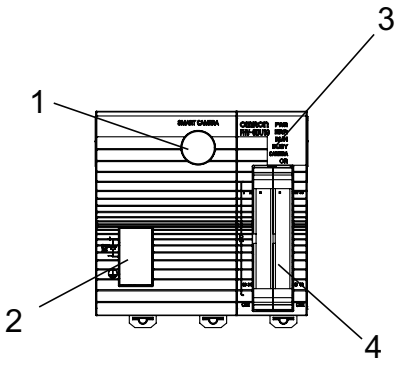
We have the 2D CAD data or 3D CAD data.
You can download CAD data from www.fa.omron.co.jp.

A-2-2 Smart Camera Data Unit

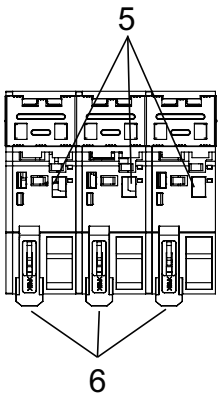
Specifications

Item		FHV-SDU10
Input/output specifications	Parallel I/O	Input: 12 Output: 24 (NPN/PNP combined use)
	Encoder I/F	Not supported by FHV7-AI series.
Smart Camera Interface		Special cable to connect No. of connectable cameras: 1
Indicator		POWER: Green, ERROR: Red, RUN: Green, BUSY: Green, CAMERA: Yellow, OR: Yellow
Power supply voltage		21.6 to 26.4 VDC (Note: 24.0 to 26.4 VDC when a data unit cable with 20 m is connected.)
Insulation resistance		Between DC terminal block and FG terminal: 0.5 MΩ (250V Megger)
Current consumption		4.5 A or less
Usage environment	Ambient temperature range	Operating: 0 to +50°C, Storage: -25 to +65°C (with no icing or condensation)
	Ambient humidity range	Operating and storage: 35 to 85% (with no condensation)
	Ambient atmosphere	No corrosive gases
	Vibration tolerance	Oscillation frequency: 10 to 150 Hz, Half amplitude: 0.1 mm, Vibration direction: X/Y/Z, Sweep time: 8 minutes, Sweep count: 10 times
	Shock resistance	Impact force: 150 m/s^2, Test direction: 6 directions, Three times each (up/down, front/behind, left/right)
	Noise immunity	Fast transient burst • DC power Direct infusion: 2 kV, Pulse rising: 5 ns, Pulse width: 50 ns, Burst continuation time: 15 ms / 0.75 ms, Period: 300 ms, Application time: 1 minute • I/O line Coupling clamp: 1 kV, Pulse rising: 5 ns, Pulse width: 50 ns, Burst continuation time: 15 ms / 0.75 ms, Period: 300 ms, Application time: 1 minute
	Grounding	Class D grounding (100 Ω or less grounding resistance) * Existing the third class grounding
External shape	Dimensions	H (90 mm) × W (93 mm) × D (65 mm)
	Weight	Approx. 250 g
	Degree of protection	IEC60529 - IP20
	Material	Case: PC+ABS, PC
Accessories		• Instruction sheet: 1 • Compliance sheet: 1

Component Names and Functions



FHV-SDU10 Front

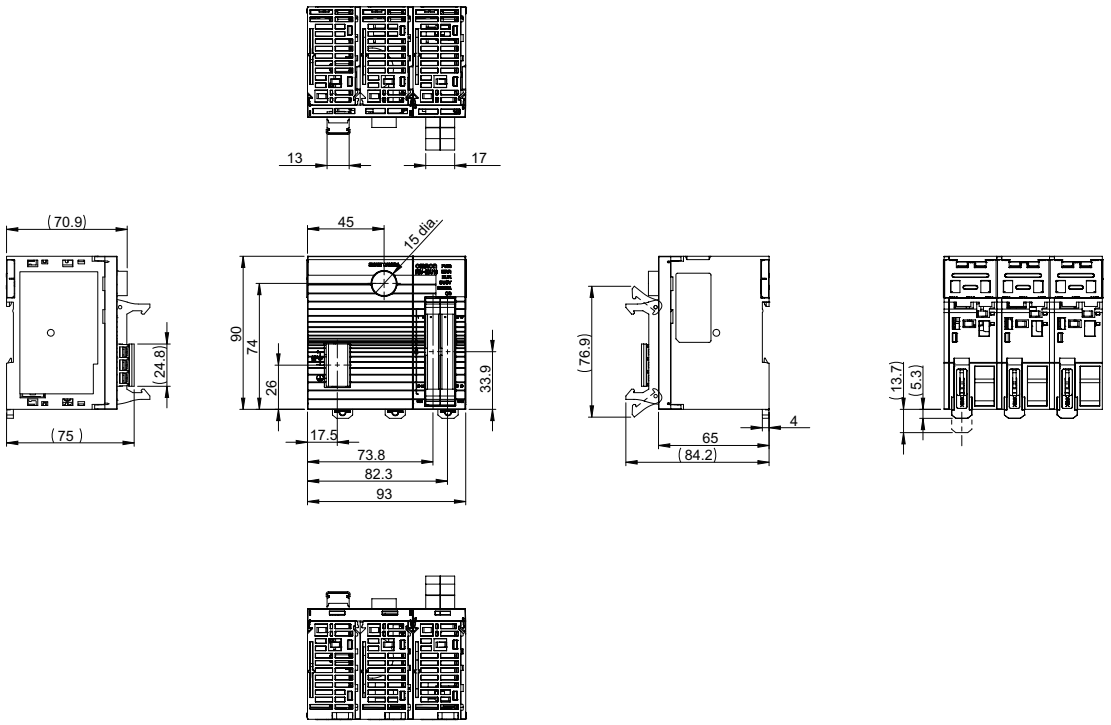


FHV-SDU10 Back

No.	Name		Description
1	Smart Camera connector		Connects the FHV series. (Special cable: FHV-VU□)
2	Power supply and grounding terminals		Connects 24 VDC power supply and grounding lines.
3	I/O indicator	POWER	Lights green while the power is supplied.
		ERROR	Lights Red when an error occurs.
		RUN	Lights green when the RUN signal output is switched to a layout set to ON.
		BUSY	Lights green while the Smart Camera is processing.
		CAMERA	Blinks yellow while the Smart Camera is preparing to connect. Lights yellow while the Smart Camera is connected.
		OR	Lights yellow when the overall judgment result is ON.
4	Parallel I/O connector		Connects external devices such as a synchronizing sensor or a programmable controller.
5	DIN rail mounting		Fits into the DIN rail on the body.
6	Slider		Uses this to fix the body to the DIN rail.

Dimensions

- FHV-SDU10



(Unit: mm)

Additional Information

We have the 2D CAD data or 3D CAD data.
You can download CAD data from www.fa.omron.co.jp.

Mounting to DIN Rail

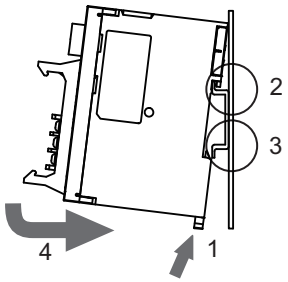
● How to Mount

1 Fix the data unit using the upper and lower tabs of the data unit for the Smart Camera.

2 Push the slider of the data unit for the Smart Camera to the upper part.

3 Hook the upper tab of the data unit for the Smart Camera to the DIN rail.

4 Push the data unit until the lower tab of it is clicked.



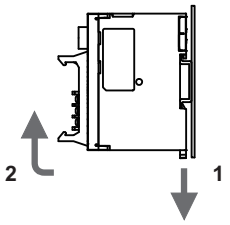
Precautions for Correct Use

- nd plates (sold separately) to both sides of the data unit for the Smart Camera mounted on the DIN rail.
- Be sure to hook the upper tab to the DIN rail first, and then mount the data unit for the Smart Camera to it. If the lower tab were hooked to the DIN rail first, the mounting strength will be lower.

● How to Remove

1 Pull the slider of the data unit downward.

2 Lift the data unit from the bottom to remove it from the DIN rail.



A-2-3 Cables

Power & I/O Cables

● Specifications

- Power & I/O cables (straight, bending resistance)

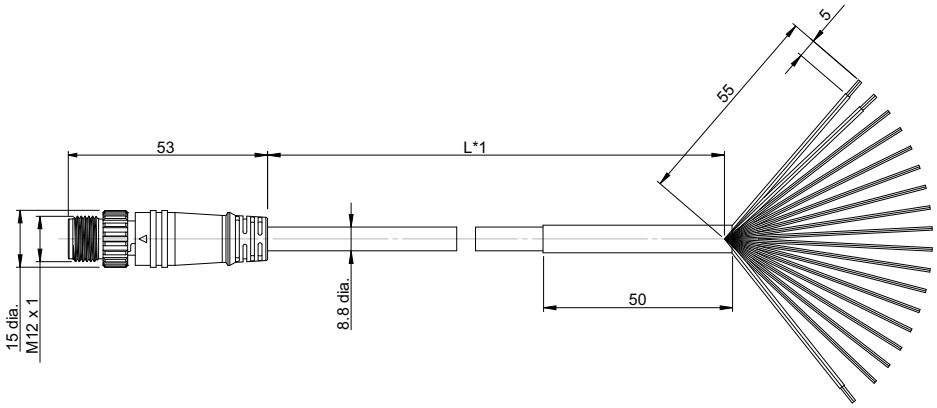
Item		FHV-VDB2 2M	FHV-VDB2 3M	FHV-VDB2 5M	FHV-VDB2 10M	FHV-VDB2 20M
Cable length		2 m	3 m	5 m	10 m	20 m
Cable type		Bending resistance cable				
Connector type		Straight connector				
Size	Power line	AWG21				
	Others	AWG26				
Outer diameter		8.8±0.3 mm dia.				
Min. bending radius		Fixed use: 40 mm, Sliding use: 70 mm				
Usage environment	Ambient temperature range	Operating: -10 to +70°C, Storage: -25 to +85°C (with no icing or condensation)				
	Ambient humidity range	Operating & Storage: 0 to 93% (with no condensation)				
	Ambient atmosphere	No corrosive gases				
	Vibration tolerance	Oscillation frequency: 10 to 150Hz, Half amplitude: 0.35 mm, Vibration direction: X/Y/Z, Sweep time: 8 minutes/count, Sweep count: 10 times				
	Shock resistance	Impact force: 150 m/s^2, Test direction: 6 directions, three time each (up/down, front/behind, left/right)				
Material		Mold part: Nylon, PVC, Sheath part: PVC				
Weight		Approx. 250 g	Approx. 370 g	Approx. 590 g	Approx. 1170 g	Approx. 2310 g

• Power & I/O cables (right angle, bending resistance)

Item		FHV-VDLB2 2M	FHV-VDLB2 3M	FHV-VDLB2 5M	FHV-VDLB2 10M	FHV-VDLB2 20M
Cable length		2 m	3 m	5 m	10 m	20 m
Cable type		Bending resistance cable				
Connector type		Right angle connector				
Size	Power line	AWG21				
	Others	AWG26				
Outer diameter		8.8±0.3 mm dia.				
Min. bending radius		Fixed use: 40 mm, Sliding use: 70 mm				
Usage environment	Ambient temperature range	Operating: -10 to +70°C, Storage: -25 to +85°C (with no icing or condensation)				
	Ambient humidity range	Operating & Storage: 0 to 93% (with no condensation)				
	Ambient atmosphere	No corrosive gases				
	Vibration tolerance	Oscillation frequency: 10 to 150Hz, Half amplitude: 0.35 mm, Vibration direction: X/Y/Z, Sweep time: 8 minutes/count, Sweep count: 10 times				
	Shock resistance	Impact force: 150 m/s^2, Test direction: 6 directions, three time each (up/down, front/behind, left/right)				
Material		Mold part: Nylon, PVC, Sheath part: PVC				
Weight		Approx. 250 g	Approx. 370 g	Approx. 590 g	Approx. 1170 g	Approx. 2310 g

● Dimensions

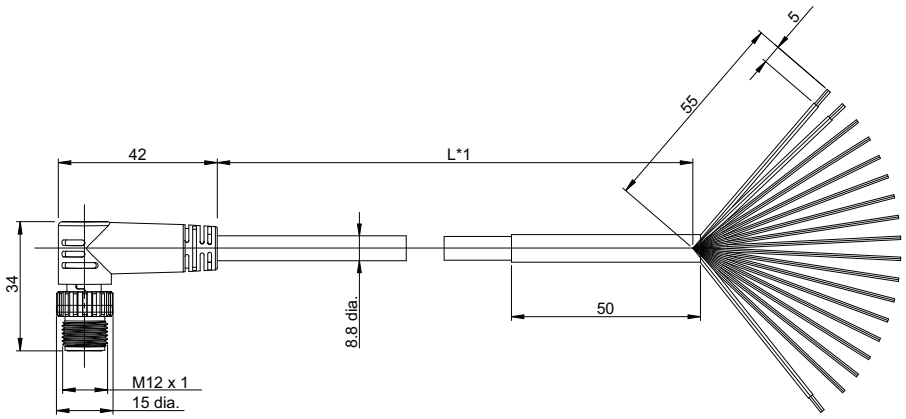
• Power & I/O cable (Straight, bending resistance)
FHV-VDB2

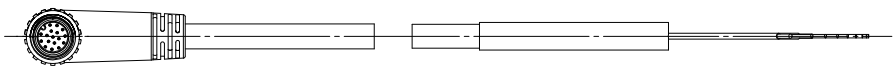


(Unit: mm)

*1. Cable lengths (L) are 2 m/3 m/5 m/10 m/20 m.

• Power & I/O cable (Right angle, bending resistance)
FHV-VDLB2





(Unit: mm)

*1. Cable lengths (L) are 2 m/3 m/5 m/10 m/20 m.

Ethernet Cables

● Specifications

• Ethernet cables (straight, bending resistance)

Item		FHV-VNB2 2M	FHV-VNB2 3M	FHV-VNB2 5M	FHV-VNB2 10M	FHV-VNB2 20M
Cable length		2 m	3 m	5 m	10 m	20 m
Cable type		Bending resistance cable				
Connector type		Straight connector				
Outer diameter		6.7 ± 0.3 mm dia.				
Min. bending radius		Fixed use: 35 mm, Sliding use: 50 mm				
Usage environment	Ambient temperature range	Operating: -10 to +70°C, Storage: -25 to +85· (with no icing or condensation)				
	Ambient humidity range	Operating & Storage: 0 to 93% (with no condensation)				
	Ambient atmosphere	No corrosive gases				
	Vibration tolerance	Oscillation frequency: 10 to 150Hz, Half amplitude: 0.35 mm, Vibration direction: X/Y/Z, Sweep time: 8 minutes/count, Sweep count: 10 times				
	Shock resistance	Impact force: 150 m/s^2, Test direction: 6 directions, three time each (up/down, front/behind, left/right)				
Material		Mold part: PVC, Sheath part: PVC				
Weight		Approx. 140 g	Approx. 200 g	Approx. 310 g	Approx. 590 g	Approx. 1150 g

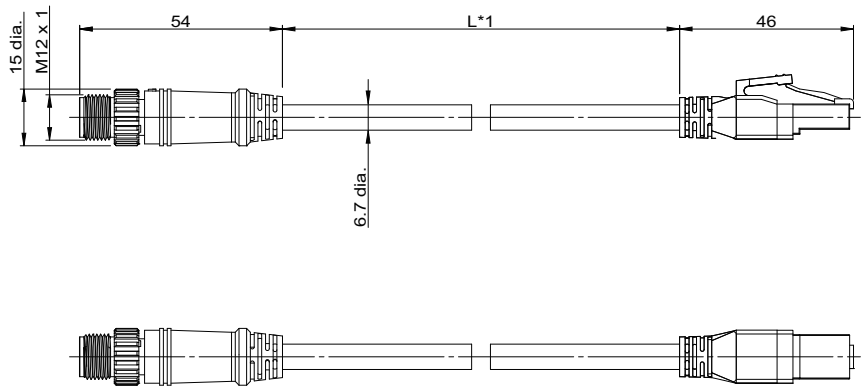
• Ethernet cables (right angle, bending resistance)

Item		FHV-VNLB2 2M	FHV-VNLB2 3M	FHV-VNLB2 5M	FHV-VNLB2 10M	FHV-VNLB2 20M
Cable length		2 m	3 m	5 m	10 m	20 m
Cable type		Bending resistance cable				
Connector type		Right angle connector				
Outer diameter		6.7 ± 0.3 mm dia.				
Min. bending radius		Fixed use: 35 mm, Sliding use: 50 mm				
Usage environment	Ambient temperature range	Operating: -10 to +70°C, Storage: -25 to +85°C (with no icing or condensation)				
	Ambient humidity range	Operating & Storage: 0 to 93% (with no condensation)				
	Ambient atmosphere	No corrosive gases				
	Vibration tolerance	Oscillation frequency: 10 to 150Hz, Half amplitude: 0.35 mm, Vibration direction: X/Y/Z, Sweep time: 8 minutes/count, Sweep count: 10 times				
	Shock resistance	Impact force: 150 m/s^2, Test direction: 6 directions, three time each (up/down, front/behind, left/right)				
Material		Mold part: PVC, Sheath part: PVC				
Weight		Approx. 140 g	Approx. 200 g	Approx. 310 g	Approx. 590 g	Approx. 1150 g

● Dimensions

• Ethernet cable (Straight, bending resistance)

FHV-VNB2

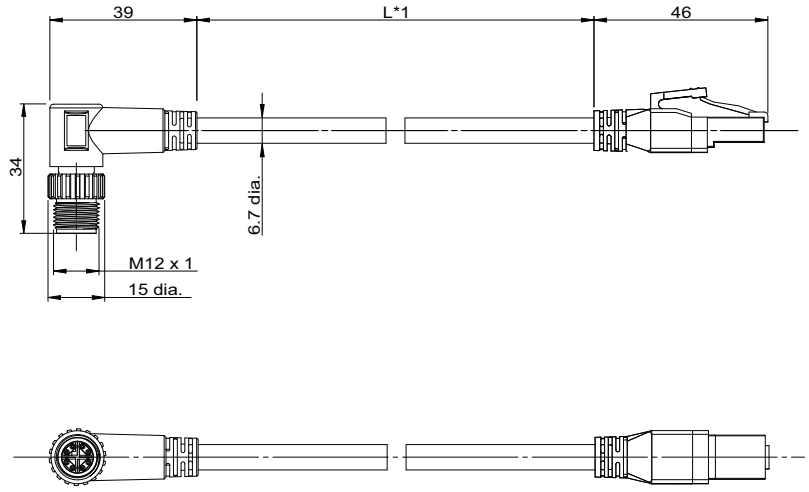


(Unit: mm)

*1. Cable lengths (L) are 2 m/3 m/5 m/10 m/20 m.

• Ethernet cable (Right angle, bending resistance)

FHV-VNLB2



(Unit: mm)

*1. Cable lengths (L) are 2 m/3 m/5 m/10 m/20 m.

Smart Camera Data Unit Cables

● Specifications

• Smart Camera Unit Cables (Straight, bending resistance)

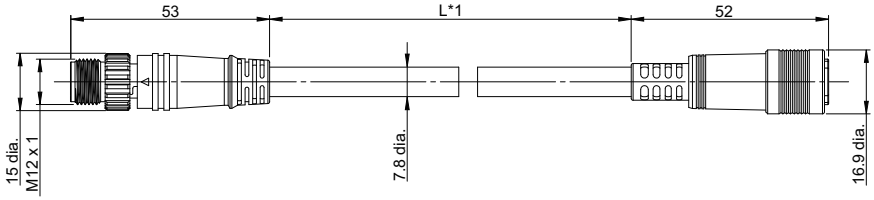
Item		FHV-VUB2 2M	FHV-VUB2 3M	FHV-VUB2 5M	FHV-VUB2 10M	FHV-VUB2 20M
Cable length		2 m	3 m	5 m	10 m	20 m
Cable type		Bending resistance cable				
Connector type		Straight connector				
Outer diameter		7.8 ± 0.3 mm dia.				
Min. bending radius		Fixed use: 40 mm, Sliding use: 65 mm				
Usage environment	Ambient temperature range	Operating: -10 to +70°C, Storage: -25 to +85°C (with no icing or condensation)				
	Ambient humidity range	Operating & Storage: 0 to 93% (with no condensation)				
	Ambinent atmosphere	No corrosive gases				
	Vibration tolerance	Oscillation frequency: 10 to 150Hz, Half amplitude: 0.35 mm, Vibration direction: X/Y/Z, Sweep time: 8 minutes/count, Sweep count: 10 times				
	Shock resistance	Impact force: 150 m/s^2, Test direction: 6 directions, three time each (up/down, front/behind, left/right)				
Material		Mold part: PVC, Sheath part: PVC				
Weight		Approx. 200 g	Approx. 290 g	Approx. 470 g	Approx. 900 g	Approx. 1780 g

• Smart Camera Data Unit Cables (Right-angle, bending resistance)

Item		FHV-VULB2 2M	FHV-VULB2 3M	FHV-VULB2 5M	FHV-VULB2 10M	FHV-VULB2 20M
Cable length		2 m	3 m	5 m	10 m	20 m
Cable type		Bending resistance cable				
Connector type		Right-angle connector				
Outer diameter		7.8 ± 0.3 mm dia.				
Min. bending radius		Fixed use: 40 mm, Sliding use: 65 mm				
Usage environment	Ambient temperature range	Operating: -10 to +70°C, Storage: -25 to +85°C (with no icing or condensation)				
	Ambient humidity range	Operating & Storage: 0 to 93% (with no condensation)				
	Ambinent atmosphere	No corrosive gases				
	Vibration tolerance	Oscillation frequency: 10 to 150Hz, Half amplitude: 0.35 mm, Vibration direction: X/Y/Z, Sweep time: 8 minutes/count, Sweep count: 10 times				
	Shock resistance	Impact force: 150 m/s^2, Test direction: 6 directions, three time each (up/down, front/behind, left/right)				
Material		Mold part: PVC, Sheath part: PVC				
Weight		Approx. 200 g	Approx. 290 g	Approx. 470 g	Approx. 900 g	Approx. 1780 g

● Dimensions

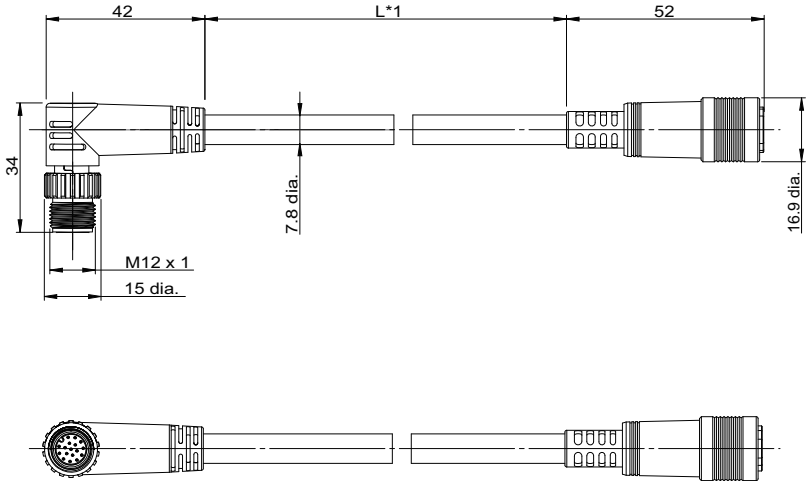
• Smart Camera Data Unit Cable (Straight, bending resistance)
FHV-VUB2



(Unit: mm)

*1. Cable lengths (L) are 2 m/3 m/5 m/10 m/20 m.

• Smart Camera Data Unit Cable (Right-angle, bending resistance)
FHV-VULB2



(Unit: mm)

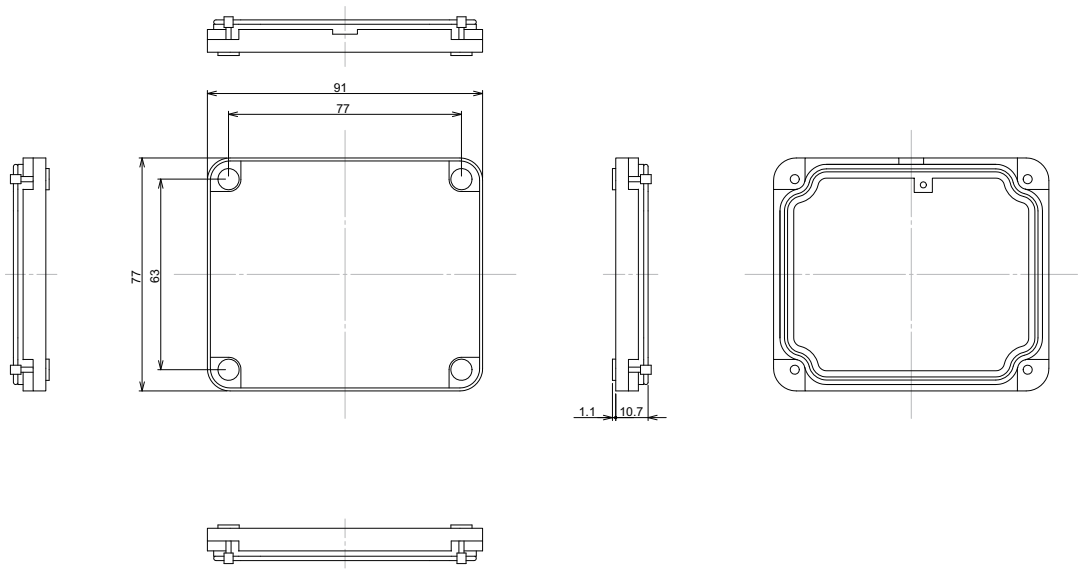
*1. Cable lengths (L) are 2 m/3 m/5 m/10 m/20 m.

A-2-4 Optical Filters

Specifications

Item		FHV-XDF	FHV-XPL	FHV-XCV
Filter type		Diffusion filter	Polarization filter	Lighting cover for replacement
Usage environment	Ambient temperature range	Operating: 0 to +40°C, Storage: -25 to +65°C (with no icing or condensation)		
	Ambient humidity range	Operating & Storage: 35 to 85% (with no condensation)		
	Vibration tolerance	No corrosive gases		
	Shock resistance	Oscillation frequency: 10 to 150Hz, Half amplitude: 0.35 mm, Vibration direction: X/Y/Z, Sweep time: 8 minutes/count, Sweep count: 10 times		
	Vibration tolerance	Impact force: 150 m/s^2, Test direction: 6 directions, three time each (up/down, front/behind, left/right)		
Material		Aluminum (A6061), polycarbonate		
Weight		Approx. 70 g	Approx. 70 g	Approx. 70 g

Dimensions



(Unit: mm)

Additional Information

We have the 2D CAD data or 3D CAD data.
You can download CAD data from www.fa.omron.co.jp.

Attaching the Optical Filter

Please attach it following these procedures.

⚠ WARNING

This product must be used according to this manual or instruction sheet. Failure to do so may result in impairment of functions and performance of the product.

Continually look at the LED light may in rare cases cause visual impairment. Do not stare directly into the light emitted from the lighting module. Likewise, if an object with a reflective surface is used, take care not to allow the reflected light to enter your eyes.

⚠ Caution

In rare events, there is a possibility of mild burns. Do not touch the camera body while it is in operation, or just after power is turned OFF, since it can be extremely hot.

When attaching the lighting module or cover, make sure to tighten all attaching screws securely. Failure to do so may damage the unit, causing malfunction, or injury.

Precautions for Safe Use

Installation

- This product is the module exclusively used for smart camera FHV series. Do not use it for other purposes.
- Be sure to turn OFF the power of the smart camera itself and any peripheral devices connected to it when attaching or removing the lighting module. Failing to do so can cause equipment malfunction or damage.
- To ensure waterproofing, follow the correct mounting method and use it only after it has been attached in the correct order.
- Tighten the mounting screws securely with the specified torque and in the order described in this manual.
- Take care that waterproof packing and harnesses do not catch on, or get pinched between any parts of the case when assembling.
- Do not use waterproof packing or light shielding sheet that has been scratched, or has any foreign matter adhering to it.

Other

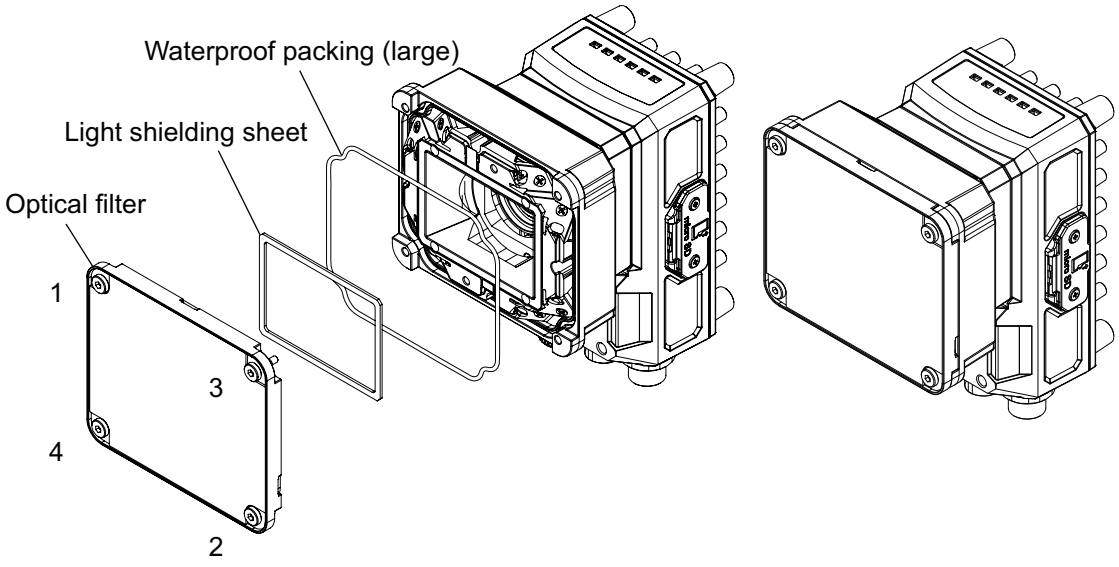
- Do not touch the face plate of the lighting with bare hands.
- Do not touch any exposed circuit board or electronic components with bare hands. It may result in damage to the product.
- Should you notice any abnormal odor, sound, smoke, or excessive heat emitting from the product, immediately stop use, turn OFF the power supply, and contact your OMRON representative.
- Do not attempt to dismantle, repair, modify, or deform the product in any way.
- When disposing of the product, treat it as industrial waste.
- Do not drop the product nor apply excessive vibration or shock to the product. Doing so may damage the product.
- The waterproof packing is made of a rubber material. Avoid storing it in a location where rubber may deteriorate easily.

1 Remove the lighting cover.

2 Install an optical filter instead of the removed lighting cover.

Precautions for Correct Use

- Place the waterproof packing and light shielding sheet along the groove, being careful not to twist them.
- Pass the included hexagon wrench through the holes and tighten the screws in order of 1 to 4 as shown in the figure below.
- Recommended tightening torque (M2.5 Hexagon socket screw Hole size 2.5 mm): 0.3 N·m



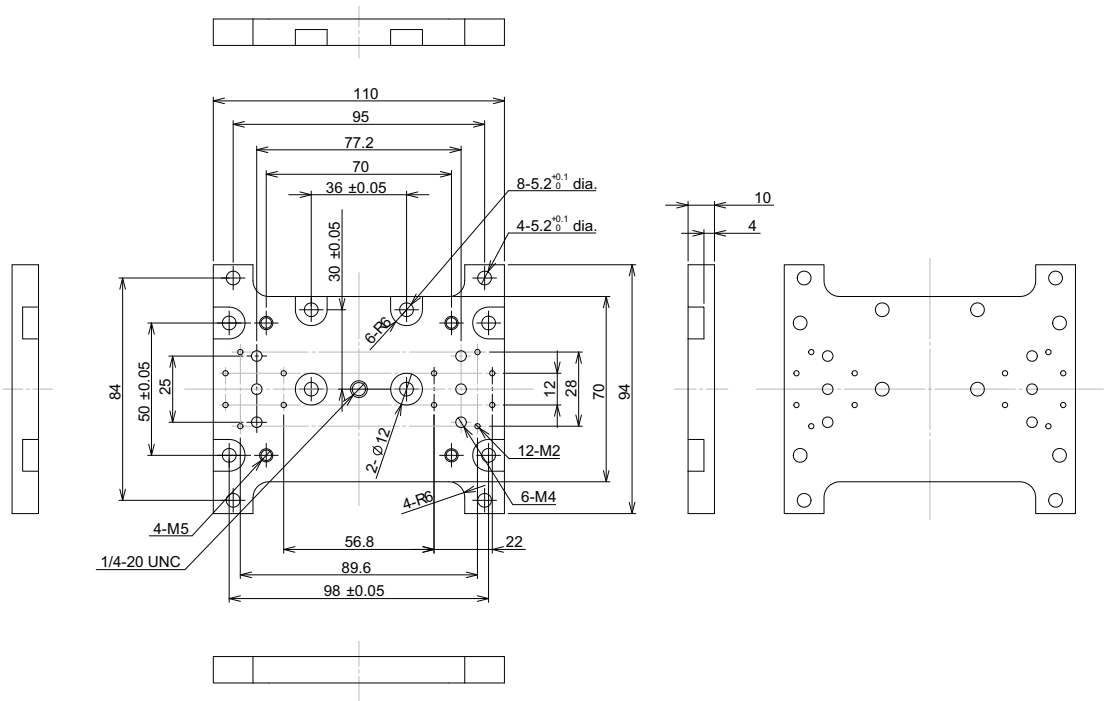
A-2-5 Mounting Fixtures

Specifications

Item		FHV-XMT-7
Purpose		Special fixture
		For smart camera body mounting
Usage environment	Ambient temperature range	Operating: 0 to +40°C, Storage: -25 to +65°C (with no icing or condensation)
	Ambient humidity range	Operating & Storage: 35 to 85% (with no condensation)
	Vibration tolerance	No corrosive gases
	Shock resistance	Oscillation frequency: 10 to 150Hz, Half amplitude: 0.35 mm, Vibration direction: X/Y/Z, Sweep time: 8 minutes/count, Sweep count: 10 times
	Vibration tolerance	Impact force: 150 m/s^2, Test direction: 6 directions, three time each (up/down, front/behind, left/right)
Material		Aluminum (A6061)
Weight		Approx. 220 g

Dimensions

- FHV-XMT-7



(Unit: mm)

A-2-6 Waterproof Packings

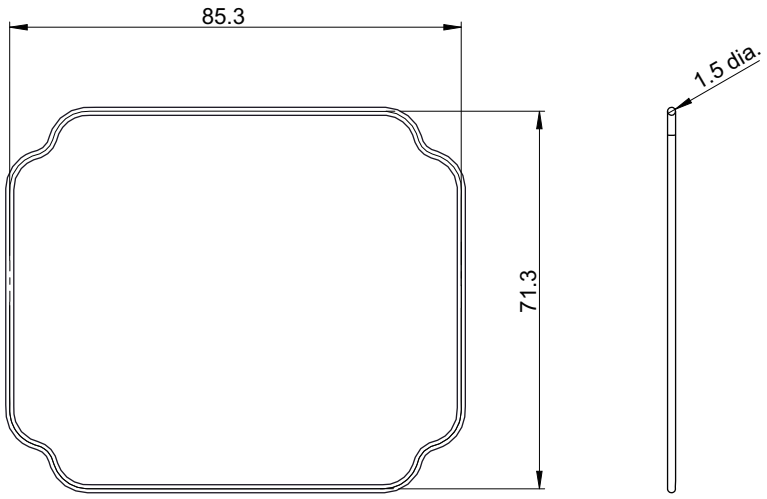
Specifications

Model		FHV-XWP-LTM
Application		For lighting module
Usage environment	Ambient temperature range	Operating: 0 to +40°C, Storage: -25 to +65°C (With no icing or condensation)
	Ambient humidity range	Operating & storage: 35 to 85% (With no condensation)
	Ambient atmosphere	No corrosive gases
	Vibration tolerance	Oscillation frequency: 10 to 150Hz, Half amplitude: 0.35 mm, Vibration direction: X/Y/Z, Sweep time: 8 minutes/count, Sweep count: 10 times
	Shock resistance	Impact force: 150 m/s^2, Test direction: 6 directions, three time each (up/down, front/behind, left/right)
Material		NBA
Weight		Approx. 5 g

*1. It is considered a consumable item that will deteriorate. Please replace as needed.

Dimensions

FHV-XWP-LTM



(Unit: mm)

Additional Information

We have the 2D CAD data or 3D CAD data.
You can download CAD data from www.fa.omron.co.jp.

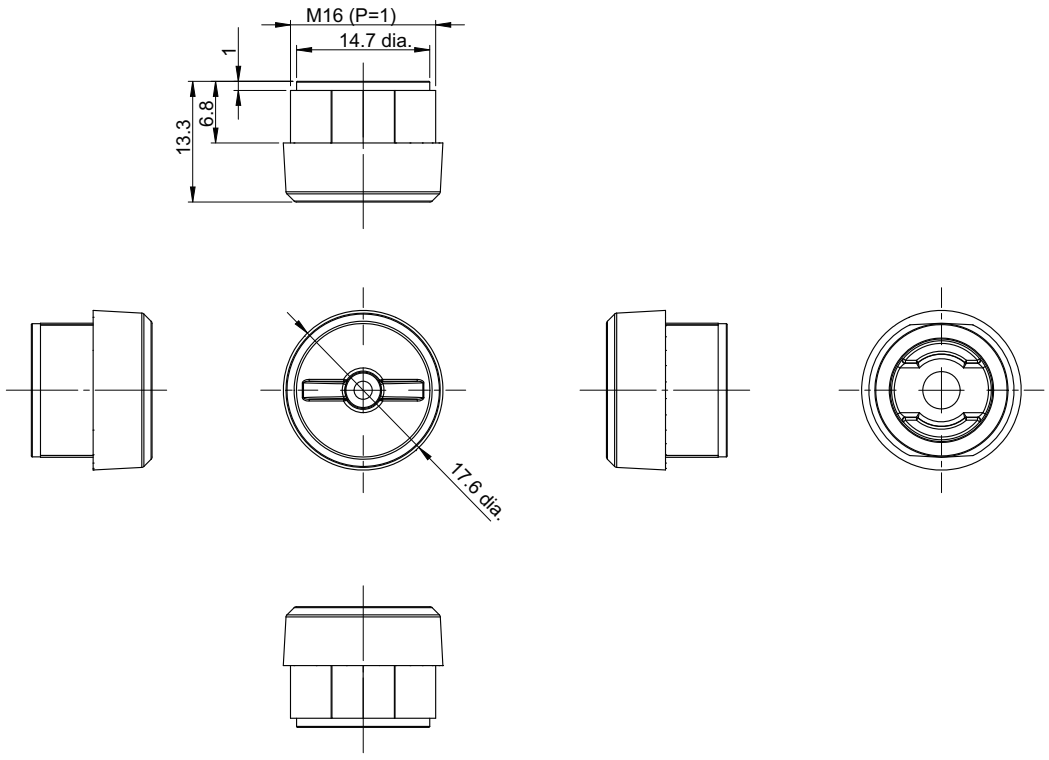
A-2-7 Waterproof Caps

Specifications

Item		FHV-XWC-ECN	FHV-XWC-LCN
Application		For Ethernet connector	For lighting connector
Usage environment	Ambient temperature range	Operating: 0 to +40°C, Storage: -25 to +65°C (with no icing or condensation)	
	Ambient humidity range	Operating & storage: 35 to 85% (with no condensation)	
	Ambient atmosphere	No corrosive gases	
	Vibration tolerance	Oscillation frequency: 10 to 150Hz, Half amplitude: 0.35 mm, Vibration direction: X/Y/Z, Sweep time: 8 minutes/count, Sweep count: 10 times	
	Shock resistance	Impact force: 150 m/s^2, Test direction: 6 directions, three time each (up/down, front/behind, left/right)	
Material		Polyamide	Polycarbonate
Weight		Approx. 5 g	Approx. 5 g

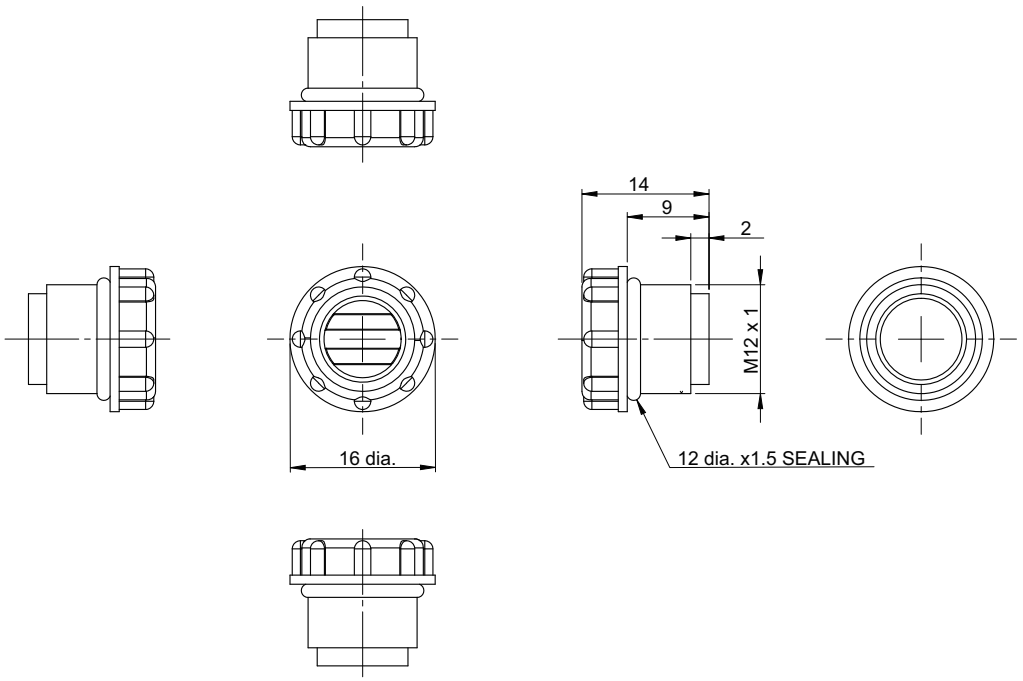
Dimensions

- FHV-XWC-ECN



(Unit: mm)

- FHV-XWC-LCN



(Unit: mm)

A-2-8 Lightproof Sheet

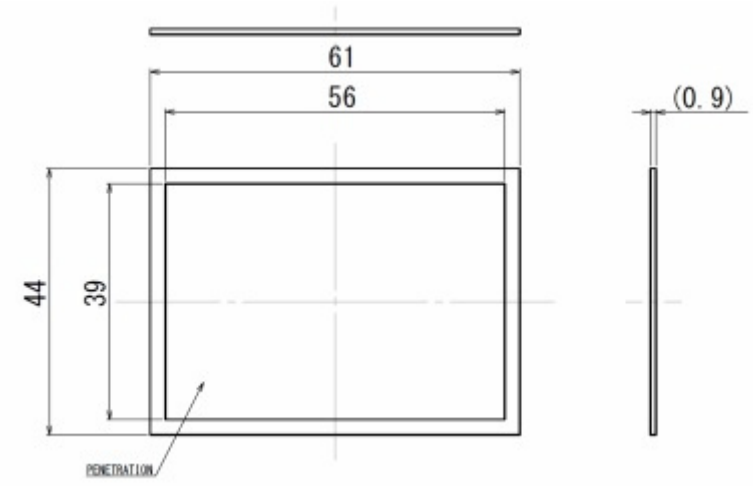
Specifications

Model		FHV-XLS-LTM
Application		For lighting module
Usage environment	Ambient temperature range	Operating: 0 to +40°C, Storage: -25 to +65°C (With no icing or condensation)
	Ambient humidity range	Operating & storage: 35 to 85% (With no condensation)
	Ambient atmosphere	No corrosive gases
	Vibration tolerance	Oscillation frequency: 10 to 150Hz, Half amplitude: 0.35 mm, Vibration direction: X/Y/Z, Sweep time: 8 minutes/count, Sweep count: 10 times
	Shock resistance	Impact force: 150 m/s^2, Test direction: 6 directions, three time each (up/down, front/behind, left/right)
Material		Urethane
Weight		Approx. 5 g

It is considered a consumable item that will deteriorate. Please replace as needed.

Dimensions

- FHV-XLS-LTM



(Unit: mm)

Additional Information

We have the 2D CAD data or 3D CAD data.
You can download CAD data from www.fa.omron.co.jp.

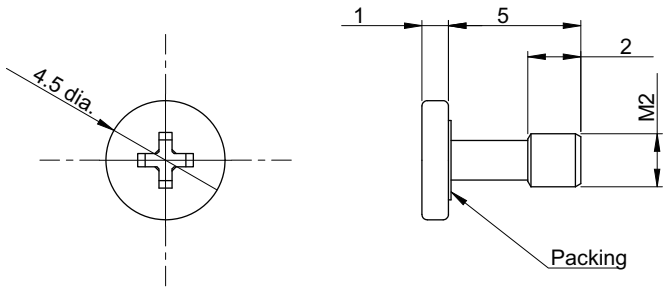
A-2-9 Replacement Screws for MicroSD Card Cover

Specifications

Item		FHV-XSCR-MSD
Application		Special screws for MicroSD card cover
Usage environment	Usage environment	Operating: 0 to +40°C, Storage: -25 to +65°C (with no icing or condensation)
	Ambient humidity range	Operating & storage: 35 to 85% (with no condensation)
	Ambient atmosphere	No corrosive gases
	Vibration tolerance	Oscillation frequency: 10 to 150Hz, Half amplitude: 0.35 mm, Vibration direction: X/Y/Z, Sweep time: 8 minutes/count, Sweep count: 10 times
	Shock resistance	Impact force: 150 m/s^2, Test direction: 6 directions, three time each (up/down, front/behind, left/right)
Material		Stainless (screw), EPDM (packing)
Weight		Approx. 0.3 g

Dimensions

- FHV-XSCR-MSD



(Unit: mm)

A-3 Power Supply and I/O Interface

A-3-1 When Turning Power ON and OFF

⚠ WARNING

Never connect the AC power supply with this product. When the AC power supply is connected, it causes the electric shock and a fire.

Do not touch the terminals while the power supply is ON. Doing so could cause electrical shock.

⚠ Caution

Minor burn may occur. Do not touch the case as it is very hot while the product is operating or immediately after the power is turned OFF.

Precautions for Safe Use

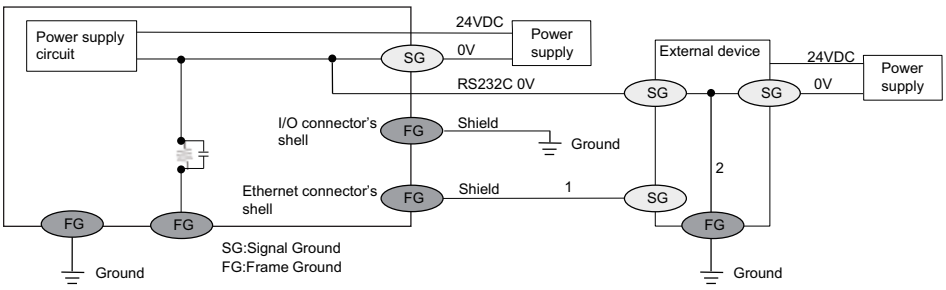
Check the following again before turning on the power supply.

- Make sure to use the product with the power supply voltage specified. If a DC voltage exceeding the rating or an AC voltage is applied, the circuit parts may be burnt or exploded.
- Do not connect the power supply with polarity reversed.
- Use a DC power supply with safety measures against high-voltage spikes (safety extra low-voltage circuits on the secondary side).
- Use an independent power source for this product. Do not use a shared power source.
- Never apply more than the rated voltage or AC power supply to this product. It may cause malfunction.
- The recommended power supplies are as follows:
  - use S8VK-G12024 (OMRON) or S8VS-12024 (OMRON).
- Make sure that wiring for this product is separated from high-voltage lines and other power lines. If the same wiring or the same duct is used, there may be electrical induction, causing malfunction or damage.
- Do not short-circuit the load with the open collector output.
- Apply load not exceeding the rating.
- When wiring, attach a crimp terminal of the specified size. Do not connect wires simply twisted together to the power supply or terminal block directly.
- Do not put load on the cables and connectors before wiring them.
- Cut off unnecessary signal wires so that they do not contact any other signal wires.
  If the RS-232C IN, RS-232C out, RS-232C, NC, or RS-232C 0V touches 24 VDC, COMIN, or COMOUT, it may cause damage or malfunction.
- Before turning on the power supply, check whether there is incorrect connection such as power supply error, load short circuit, etc., and that there is the proper load current and FG connection. Malfunction, or damage may occur due to incorrect wiring etc.

Precautions for Safe Use

Grounding

- The smart camera casing and grounding wire of the input output cable must be grounded according to Class D grounding (grounding resistance of 100 Ω or less).
- Do not share the ground wire with other equipment or connect it to the beams of the building. It could be adversely affected.
- Keep the ground line as short as possible by setting the grounding point as close as possible.
- The smart camera's body enclosure, the I/O connector enclosure, the Ethernet connector enclosure, and the lighting connector enclosure are all at the same potential (FG) and are connected to 0V via a capacitor and a resistor in the internal circuit.
- When connecting to a PLC, or other external device, ensure that FG of the smart camera and the FG of the external device are grounded so as to have the same electric potential. Depending on the grounding method, a potential difference may occur between the smart camera and the external device, which may result in equipment failure, or malfunction.
- When the positive (+) terminal of 24 VDC power supply is grounded.
  - Inside of an external device, the shell of an Ethernet connector and SG should not be connected. [(1)]
  - Inside of an external device, 0V and FG should not be connected. [(2)]
  Since FG and 0V will make short-circuit like below diagram, do not ground the positive (+) terminal.



Precautions for Correct Use

Power Supply and Wiring

- If there is a surge on the power supply line, please use a surge absorber, depending on the usage environment it is connected in.
- If using an I/O cable 20 m long, confirm that the power supply output is 24 VDC or higher. If it is lower than 24 VDC, the product does not operate.
- Do not turn off the power while saving data to the smart camera. Doing so causes the data in the memory to be corrupted, resulting in the product not operating properly upon the next start-up.
- Before turning power OFF, confirm that data save processing is completed according to the following guidelines.
  -When the data save process is performed by operation on the smart camera: The data save process is completed and the next operation is enabled.
- When touching a terminal part or a signal wire in a connector, take anti-static measures using a wrist strap or another device to prevent damage from static electricity.
- Do not turn OFF the power while any message is displayed indicating that a task is in progress. Doing so causes the data in the memory to be corrupted, resulting in the product not operating properly upon the next start-up.
- After turning off the power, wait at least 1 second before restarting.

A-3-2 Fail-safe Measures

⚠ WARNING

Please take external safety measures to ensure safety for the system as a whole should any failure or error occur on the smart camera due to external factors. An abnormal equipment operation could result in a serious accident.

Please take fail-safe measures in preparation for any abnormal signal due to signal conductor disconnection and/or momentary power failure. An abnormal equipment operation could result in a serious accident.

A-3-3 Precautions for I/O Interface

Precautions for Safe Use

- Use only the cables designed specifically for the product. Use of other cables may result in malfunction or damage to the product.
- Always turn OFF the power to the smart camera before connecting or disconnecting a cable. Connecting the cable while power is being supplied may result in damage to the camera or peripheral devices.
- Do not apply torsion stress to the cable. It may damage the cable.
- Secure the minimum bending radius of the cable. Otherwise, the cable may be damaged.

Precautions for Correct Use

- Check the following items on the communications cables that are used in the network.
  - Are there any breaks?
  - Are there any shorts?
  - Are there any connector problems?
- When you connect the cable to the communications connectors on devices, firmly insert the communications cable connector until it locks in place.
- Do not lay the communications cables together with high-voltage lines.
- Do not lay the communications cable near devices that generate noise.
- Do not lay the communications cables in locations subject to high temperatures or high humidity.
- Do not lay the communications cables in locations subject to excessive dirt and dust or to oil mist or other contaminants.

A-3-4 Power & I/O Cable Interface

Recommended Power Supply

The recommended power supplies are as follows:

- S8VK-G12024 (OMRON)
- S8VS-12024 (OMRON)

Cables

Please use the following Power & I/O cables.

Model	Description	Note
FHV-VDB2 FHV-VDLB2	Cable lengths: 2 m, 3 m, 5 m, 10 m, 20 m Minimum bending radius: Fixed use 40 mm, Sliding use 70 mm	• One end of the cable is a connector and other end is non-terminated wires. • Connect with the cable, ensuring not to exceed the minimum bending radius.

Pin Layout

Precautions for Correct Use

FHV7X-C016-S□□-W-01 does not support RS-232C.

- FHV-VDB2/FHV-VDLB2

Wire Color	Stripe	Part		Signal Name	Function
Brown (Heavy gauge)	None	Power supply	-	24 VDC	External power supply (24VDC)
Blue (Heavy gauge)	None		-	0V	
Black (Heavy gauge)	None	Ground	-	FG	Ground
White	Yes	I/O	-	COMIN	Common for input signals
Pink	Yes		-	COMOUT	Common for output signals
Orange	None		OUT	ERROR	ON when there is an error
White	None		OUT	OR	Overall Judgement Result
Yellow	None		OUT	BUSY	Processing in progress
Purple	None		OUT	READY	ON when Image input is allowed
Black	None		-	-	-
Red	None		IN	DI2	Serial Data *1 DI7 (Run) during operation.
Green	None		IN	DI1	Command input signal
Gray	None		IN	DI0	Command input signal
Pink	None		IN	STEP	Measurement trigger input

Wire Color	Stripe	Part		Signal Name	Function
Green	Yes	RS-232C	OUT	RS-232C OUT	RS-232C transmission data (do not touch other power lines, grounding lines, and signal lines.)
Purple	Yes		IN	RS-232C IN	RS-232C reception data (do not touch other power lines, grounding lines, and signal lines.)
Light blue	Yes		-	RS-232C 0V	RS-232C GND (do not touch other power lines, grounding lines, and signal lines.)
Yellow	Yes	-	-	NC	Not used (do not touch other power lines, grounding lines, and signal lines.)

Interface Specifications

Specifications differ according to the signal type.

● [Input]

Signals: DI0, DI1, DI2

Connect to COMIN terminal when using these signals.

Item	Specification
Input voltage	24 VDC±10%
ON current*1	5 mA min.
ON voltage*1	8.8 V min.
OFF current*2	0.5 mA max.
OFF voltage*2	1.1 V max.
ON delay	5 ms max.
OFF delay	0.7 ms max.

*1. ON current / ON voltage
It is the current or voltage that will change the state from OFF to ON. The ON voltage is the potential difference between COM IN and each input terminal.

*2. OFF current / OFF voltage
It is the current or voltage that will change the state from ON to OFF. The ON voltage is the potential difference between COM IN and each input terminal.

Precautions for Correct Use

Chattering measures
Although the smart camera has equipped chattering measures function, erroneous inputs by chattering cannot be prevented when chattering occurred for 100 µs or more. (Input signal changes less than 100 µs are ignored. Input signals are determined when the same or higher level is held 100 µs or longer.) We recommend using components with no contact such as SSR or PLC transistor output. When using components with contact like a relay, rebounds of a contact may generate input signals again.

● [Input (High-speed)]

Signal: STEP

Connect to COMIN terminal when using this signal.

Item	Specification
Input voltage	24 VDC±10%
ON current*1	5 mA min.
ON voltage*1	8.8 V min.
OFF current*2	0.5 mA max.
OFF voltage*2	0.8 V max.
ON delay	0.1 ms max.
OFF delay	0.1 ms max.

*1. ON current / ON voltage
It is the current or voltage that will change the state from OFF to ON. The ON voltage is the potential difference between COM IN and each input terminal.

*2. OFF current / OFF voltage
It is the current or voltage that will change the state from ON to OFF. The ON voltage is the potential difference between COM IN and each input terminal.

Precautions for Correct Use

Chattering measures
Although the smart camera has equipped chattering measures function, erroneous inputs by chattering cannot be prevented when chattering occurred for 100 μs or more. (Input signal changes less than 100 μs are ignored. Input signals are determined when the same or higher level is held 100 μs or longer.) We recommend using components with no contact such as SSR or PLC transistor output. When using components with contact like a relay, rebounds of a contact may generate input signals again.

● [Output]

Signal: READY, BUSY, OR, and ERROR

Connect to the COMOUT terminal when using these signals.

Item	Specification
Output voltage	24 VDC±10%
Load current*1	45 mA max.
ON residual voltage	2 V max.
OFF leakage current	0.2 mA max.

*1. Please use a load current at or below the specified value for current. Exceeding the specified current may cause damage of the output circuit.

I/O Interface Input/Output Circuit Diagram

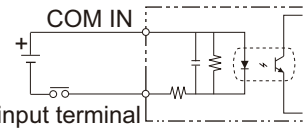
The I/O interface is a combined use type for NPN/PNP. Wire appropriately according to the external device specifications.

● [Input]

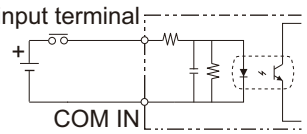
Signal

- DI0 to DI2
  Connect to COMIN when using these signals.

a) Internal specifications for NPN connection

Item	Specifications
Internal circuit diagram	

b) Internal specifications for PNP connection

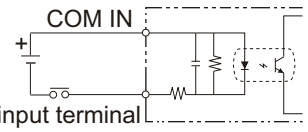
Item	Specification
Internal circuit diagram	

● [Input (High-speed)]

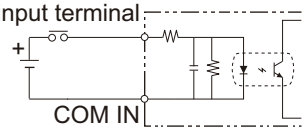
Signal

- STEP
  Connect to COMIN when using this signal.

a) Internal specifications for NPN connection

Item	Specifications
Internal circuit diagram	

b) Internal specifications for PNP connection

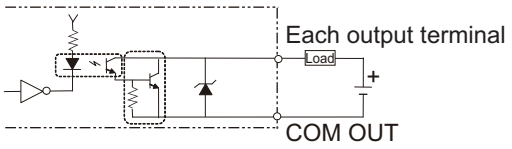
Item	Specification
Internal circuit diagram	

● [Output]

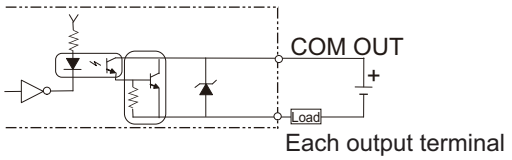
Signal

- READY, BUSY, OR, and ERROR
  Connect to COMOUT when using these signals.

a) Internal specifications for NPN connection

Item	Specification
Internal circuit diagram	

b) Internal specifications for PNP connection

Item	Specification
Internal circuit diagram	

A-3-5 Ethernet Interface

The Ethernet port on the smart camera can be used for Serial (Ethernet) communication.

Precautions for Safe Use

- Use only the cables designed specifically for the product. Use of other cables may result in malfunction or damage to the product.
- Always turn OFF the power to the smart camera before connecting or disconnecting a cable. Connecting the cable while power is being supplied may result in damage to the camera or peripheral devices.
- Do not apply torsion stress to the cable. It may damage the cable.
- Secure the minimum bending radius of the cable. Otherwise the cable may be damaged.

Precautions for Correct Use

- Check the following items on the communications cables that are used in the network.
  - Are there any breaks?
  - Are there any shorts?
  - Are there any connector problems?
- When you connect the cable to the communications connectors on devices, firmly insert the communications cable connector until it locks in place.
- Do not lay the communications cables together with high-voltage lines.
- Do not lay the communications cable near devices that generate noise.
- Do not lay the communications cables in locations subject to high temperatures or high humidity.
- Do not lay the communications cables in locations subject to excessive dirt and dust or to oil mist or other contaminants.

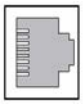
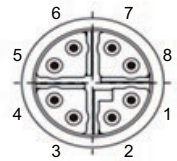
Cables

Please use the following Ethernet cables.

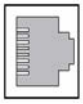
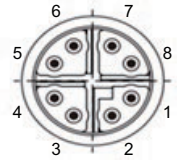
Model	Description	Note
FHV-VNB2 FHV-VNLB2	Cable lengths: 2 m, 3 m, 5 m, 10 m, 20 m Minimum bending radius: Fixed 35 mm, Sliding 50 mm	• Connect with the cable, ensuring not to exceed the minimum bending radius.

Pin Layout

● 10BASE-T / 100BASE-T

RJ45	Pin No. (RJ45)	Signal name	Abbr.	Signal direction	Pin No. (M12)	M12
	1	Transmit data +	TD+	Output	1	
	2	Transmit data -	TD-	Output	2	
	3	Received data +	RD+	Input	3	
	4	Not used	-	-	8	
	5	Not used	-	-	7	
	6	Received data-	RD-	Input	4	
	7	Not used	-	-	5	
	8	Not used	-	-	6	

● 1000Base-T

RJ45	Pin No. (RJ45)	Signal name	Abbr.	Signal direction	Pin No. (M12)	M12
	1	Communication data DA +	BI_DA +	Output	1	
	2	Communication data DA -	BI_DA -	Output	2	
	3	Communication data DB +	BI_DB +	Input/Output	3	
	4	Communication data DB -	BI_DB -	Input/Output -	8	
	5	Communication data DC +	BI_DC +	Input/Output	7	
	6	Communication data DC-	BI_DC -	Input/Output	4	
	7	Communication data DD +	BI_DD +	Input/Output	5	
	8	Communication data DD-	BI_DD -	Input/Output	6	

A-3-6 Interface for the Data Unit for Smart Camera

Precautions for Safe Use

- Use only the cables designed specifically for the product. Use of other cables may result in malfunction or damage to the product.
- Always turn OFF the power to the Smart Camera before connecting or disconnecting cables. Connecting cables while the power is being supplied may result in damage to the camera or peripheral devices.
- Do not apply torsional stress to the cable. Doing so may cause cable breakage.
- Secure the minimum bending radius of the cable. If it cannot be secured, the cable may be broken.

Precautions for Correct Use

- Check the following items on the communications cables that are used in the network.
  - Are there any breaks?
  - Are there any shorts?
  - Are there any connector problems?
- When you connect communication cables to the communication connectors on devices, firmly insert the communication cable connectors until it locks in place.
- Do not lay the communication cables together with high-voltage lines.
- Do not lay the communication cables near devices that generate noise.
- Do not lay the communication cables in locations subject to high temperatures or high humidity.
- Do not lay the communication cables in locations subject to excessive dirt and dust or to oil mist or other contaminants.

Cables / I/O Connectors, and Terminals

Use the following cables for the data unit.

Name	Model	Description	Note
Cable for Data unit	FHV-VUB2 FHV-VULB2	Cable length: 2 m, 3 m, 5 m, 10 m, 20 m Minimum bending radius Fixed use: 40 mm, Sliding use: 65 mm	• Connect with the cable, ensuring not to exceed the minimum bending radius.

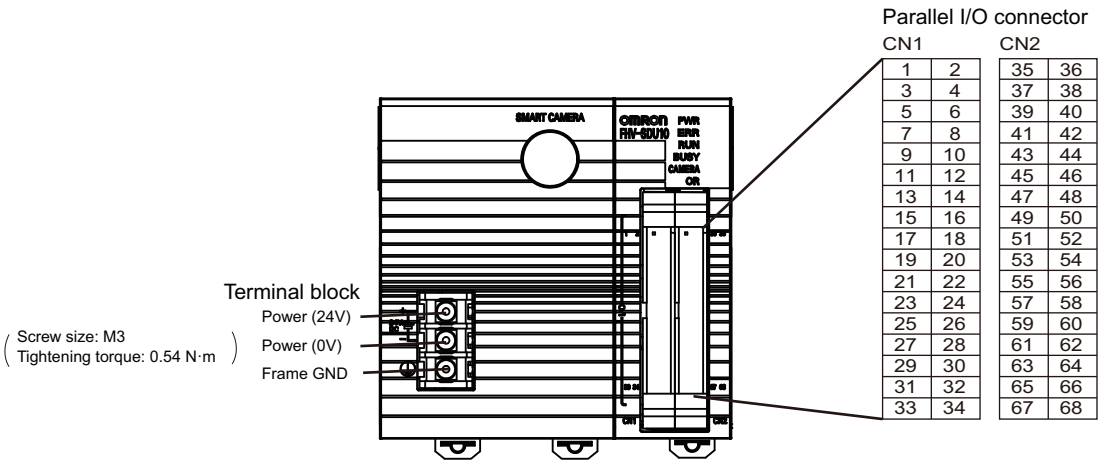
Use the following special parallel I/O cables for FHV-SDU10.

Name	Model	Description	Note
Parallel I/O cable	XW2Z-S013-□	Cable length: 2 m, 5 m Minimum bending radius: 10 mm	• Using all I/O signals requires two of this cable. • One end of the cable is a connector and other end is flat cable. • Connect with the cable, ensuring not to exceed the minimum bending radius. • □ in the model name, the cable length is indicated. (2 = 2 m and 5 = 5 m)

Name	Model	Description	Note
Parallel I/O cable for the conversion unit for connector terminal block	XW2Z-☐ ☐☐EE	Cable length: 0.5 m, 1 m, 1.5 m, 2 m, 3 m, 5 m Minimum bending radius: 83.2 mm	• Using all I/O signals requires two of this cable. • Connect with the cable, ensuring not to exceed the minimum bending radius. • ☐ in the model name, the cable length is indicated. (050 = 0.5 m, 100 = 1 m, 150 = 1.5 m, 200 = 2 m, 300 = 3 m, 500 = 5 m) • Terminal Blocks Recommended Products: OMRON XW2K-34G-T
Ultra-Compact Interface Wiring System (General-Purpose)	XW2K-34G-T	-	Refer to the *XW2K Series Datasheet (Cat. No. G152)* for details.

Pin Layout

- FHV-SDU10



CN1		CN2	
1	2	35	36
3	4	37	38
5	6	39	40
7	8	41	42
9	10	43	44
11	12	45	46
13	14	47	48
15	16	49	50
17	18	51	52
19	20	53	54
21	22	55	56
23	24	57	58
25	26	59	60
27	28	61	62
29	30	63	64
31	32	65	66
33	34	67	68

For the power supply lines, use two meters or less in length and AWG14 to 20 in size.

CN1

No.	Signal name	XW2Z-SD13-☐ Color	XW2K-34G-T Ultra-Compact Interface Wiring System (General-Purpose)	I/O	COM	Function
1	COMIN0	Red	A1	-	-	Common 0 for input signals
2	COMIN1	Gray	B1	-	-	Common 1 for input signals
3	NC	Gray	A2	-	-	-
4	STEP	Gray	B2	IN	COMIN1	Measurement execution bit
5	NC	Green	A3	-	-	-

No.	Signal name	XW2Z-SD13-□ Color	XW2K-34G-T Ultra-Compact Interface Wiring System (General-Purpose)	I/O	COM	Function
6	NC	Gray	B3	-	-	-
7	NC	Gray	A4	-	-	-
8	ENCTRIG_A	Gray	B4	IN	COMIN0	Not used with FHV7-AI series.
9	NC	Gray	A5	-	-	-
10	NC	Green	B5	-	-	-
11	NC	Gray	A6	-	-	-
12	NC	Gray	B6	-	-	-
13	ENCTRIG_B	Gray	A7	IN	COMIN0	Not used with FHV7-AI series.
14	NC	Gray	B7	-	-	-
15	RUN	Green	A8	OUT	COMOUT0	ON when smart camera is running
16	READY	Gray	B8	OUT	COMOUT0	ON when not in inspection on the RUN screen or on the Create new program screen
17	BUSY	Gray	A9	OUT	COMOUT0	Signal for processing in progress
18	OR	Gray	B9	OUT	COMOUT0	Signal for overall judgment results
19	ERROR	Gray	A10	OUT	COMOUT0	ON when an error occurs.
20	STGOUT/ SHTOUT	Green	B10	OUT	COMIN0/ COMOUT1	Not used with FHV7-AI series.
21	NC	Gray	A11	-	-	-
22	NC	Gray	B11	-	-	-
23	NC	Gray	A12	-	-	-
24	NC	Gray	B12	-	-	-
25	NC	Green	A13	-	-	-
26	NC	Gray	B13	-	-	-
27	NC	Gray	A14	-	-	-
28	NC	Gray	B14	-	-	-
29	NC	Gray	A15	-		
30	NC	Green	B15	-	-	-
31	NC	Gray	A16	-	-	-
32	NC	Gray	B16	-	-	-
33	COMOUT0	Gray	A17	-	-	Common 0 for output signals
34	COMOUT1	Gray	B17	-	-	Common 1 for output signals

CN2

No.	Signal name	XW2Z-SD13-□ Color	XW2K-34G-T Ultra-Compact Interface Wiring System (General-Purpose)	I/O	COM	Function
35	COMIN2	Red	A1	-	-	Common 2 for input signals
36	NC	Gray	B1	-	-	-
37	DSA	Gray	A2	IN	COMIN2	Data Output Request signal
38	NC	Gray	B2	-	-	-
39	DI0	Green	A3	IN	COMIN2	Signal for command input
40	DI1	Gray	B3	IN	COMIN2	Signal for command input
41	DI2	Gray	A4	IN	COMIN2	Signal for command input
42	DI3	Gray	B4	IN	COMIN2	Signal for command input
43	DI4	Gray	A5	IN	COMIN2	Signal for command input
44	DI5	Green	B5	IN	COMIN2	Signal for command input
45	DI6	Gray	A6	IN	COMIN2	Signal for command input
46	DI7	Gray	B6	IN	COMIN2	Signal for command input
47	NC	Gray	A7	-	-	-
48	ACK	Gray	B7	OUT	COMOUT2	Command Completion flag
49	GATE	Green	A8	OUT	COMOUT2	Not used with FHV7-AI series.
50	NC	Gray	B8		-	-

No.	Signal name	XW2Z-SD13-☐ Color	XW2K-34G-T Ultra-Compact Interface Wiring System (General-Purpose)	I/O	COM	Function
51	DO0	Gray	A9	OUT	COMOUT2	Not used with FHV7-AI series.
52	DO1	Gray	B9	OUT	COMOUT2	
53	DO2	Gray	A10	OUT	COMOUT2	
54	DO3	Green	B10	OUT	COMOUT2	
55	DO4	Gray	A11	OUT	COMOUT2	
56	DO5	Gray	B11	OUT	COMOUT2	
57	DO6	Gray	A12	OUT	COMOUT2	
58	DO7	Gray	B12	OUT	COMOUT3	
59	DO8	Green	A13	OUT	COMOUT3	
60	DO9	Gray	B13	OUT	COMOUT3	
61	DO10	Gray	A14	OUT	COMOUT3	
62	DO11	Gray	B14	OUT	COMOUT3	
63	DO12	Gray	A15	OUT	COMOUT3	
64	DO13	Green	B15	OUT	COMOUT3	
65	DO14	Gray	A16	OUT	COMOUT3	
66	DO15	Gray	B16	OUT	COMOUT3	
67	COMOUT2	Gray	A17	-	-	Common 2 for output signals
68	COMOUT3	Gray	B17	-	-	Common 3 for output signals

■ How to connect the parallel I/O electric wires

1. Insert the tip of a slotted screwdriver to the square part at the left of the green connector.
2. Insert an electric wire meeting the wire requirements to the circle part at the right side of the green connector.
3. Pull out the slotted screwdriver.

■ How to remove the parallel I/O electric wires

1. Insert the tip of a slotted screwdriver to the square part at the left of the green connector.
2. Remove the electric wire from the circle part at the right of the green connector.
3. Pull out the slotted screwdriver.

Parallel Interface Specifications

The parallel interface is a combined use type for NPN/PNP. Wire appropriately according to the external device specifications.

● [Input]

Signals

- No. 37 and No. 39 to 46 pins:

Connect to COMIN2 terminal when using these signals.

Item	Specification
Input voltage	24 VDC±10%
ON current*1	5 mA min.
ON voltage*1	8.8 V min.
OFF current*2	0.5 mA max.
OFF voltage*2	1.1 V max.
ON delay	5 ms max.
OFF delay	0.7 ms max.

*1. ON current / ON voltage
It is the current or voltage that will change the state from OFF to ON. The ON voltage is the potential difference between COM IN and each input terminal.

*2. OFF current / OFF voltage
It is the current or voltage that will change the state from ON to OFF. The ON voltage is the potential difference between COM IN and each input terminal.

Precautions for Correct Use

Chattering measures
Although the smart camera has equipped chattering measures function, erroneous inputs by chattering cannot be prevented when chattering occurred for 100 µs or more. (Input signal changes less than 100 µs are ignored. Input signals are determined when the same or higher level is held 100 µs or longer.) We recommend using components with no contact such as SSR or PLC transistor output. When using components with contact like a relay, rebounds of a contact may generate input signals again.

● [Input]

Signals

- No.4 pin:

Connect to COMIN1 terminal when using this signal.

Item	Specification
Input voltage	24 VDC±10%
ON current*1	5 mA min.
ON voltage*1	8.8 V min.
OFF current*2	0.5 mA max.
OFF voltage*2	0.8 V max.
ON delay	0.1 ms max.

Item	Specification
OFF delay	0.1 ms max.

*1. ON current / ON voltage
It is the current or voltage that will change the state from OFF to ON. The ON voltage is the potential difference between COM IN and each input terminal.

*2. OFF current / OFF voltage
It is the current or voltage that will change the state from ON to OFF. The ON voltage is the potential difference between COM IN and each input terminal.

Precautions for Correct Use

Chattering measures
Although the smart camera has equipped chattering measures function, erroneous inputs by chattering cannot be prevented when chattering occurred for 100 μs or more. (Input signal changes less than 100 μs are ignored. Input signals are determined when the same or higher level is held 100 μs or longer.) We recommend using components with no contact such as SSR or PLC transistor output. When using components with contact like a relay, rebounds of a contact may generate input signals again.

● [Output]

Signals

- No.15 to 19 pins:
  Connect to COMOUT0 terminal when using these signals.
- No.48, 49, and 51 to 57 pins:
  Connect to COMOUT2 terminal when using these signals.

Item	Specification
Output voltage	24 VDC±10%
Load current*1	45 mA max.
ON residual voltage	2 V max.
OFF leakage current	0.2 mA max.

*1. Please use a load current at or below the specified value for current. Exceeding the specified current may cause damage of the output circuit.

I/O Interface Input/Output Circuit Diagrams

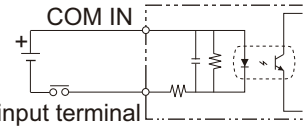
The I/O interface is a combined use type for NPN/PNP. Wire appropriately according to the external device specifications.

● [Input]

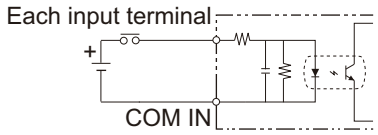
Signals

- No.37 and 39 to 46 pins
  Connect to COMIN2 terminal when using these signals.

a) Internal specifications for NPN connection

Item	Specifications
Internal circuit diagram	

b) Internal specifications for PNP connection

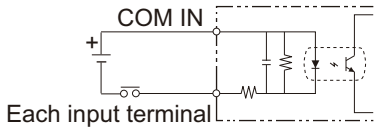
Item	Specifications
Internal circuit diagram	

● [Input]

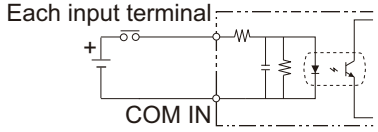
Signals

- No.4 pin
  Connect to COMIN1 terminal when using this signal.

a) Internal specifications for NPN connection

Item	Specifications
Internal circuit diagram	

b) Internal specifications for PNP connection

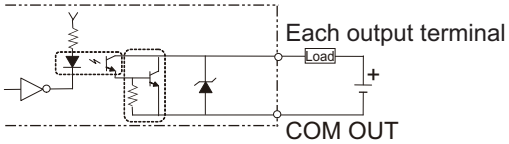
Item	Specification
Internal circuit diagram	

● [Output]

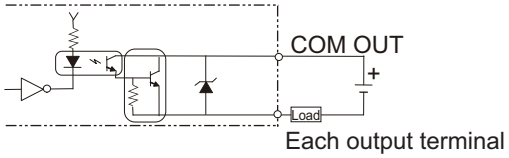
Signals

- No.15 to 19 pins
  Connect to COMOUT0 terminal when using these signals.
- No.48, 49, and 51 to 57 pins
  Connect to COMOUT2 terminal when using these signals.

a) Internal specifications for NPN connection

Item	Specifications
Internal circuit diagram	

b) Internal specifications for PNP connection

Item	Specifications
Internal circuit diagram	

A-4 Using the Simulation Software [Simulation Software]

A-4-1 Introduction

With the simulation software, you experience the operability of the Smart Camera FHV7-AI series on a PC.

A-4-2 Available Image Formats

Image formats that are available in this simulation software are below. Before use, store them to an external storage beforehand and copy them to a folder generated in a specified location. (For creating a folder, refer below.)

- File type: ifz (OMRON image logging file format for this product).
- Color: 256 (monochrome) or 24-bit (color)
- File name: Half-width alphanumeric only

A-4-3 Operational Precautions

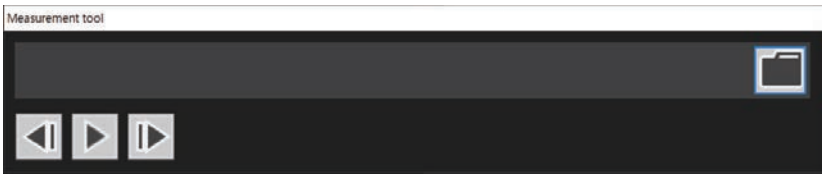
The simulation software allows you to experience functions of the smart camera FHV7-AI series on a PC.
Please note that operations on the simulation software may be different from those on the actual FHV7-AI series.

■ Unavailable operations with the simulation software

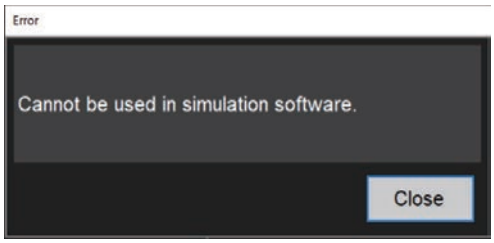
- Image input and inspection with a camera connected.

■ Different Operations from the smart camera.

- Performing inspections
  Since a inspection with a connected camera is unavailable, the inspection is always performed on file images using the measurement tool dialog.
  The measurement tool dialog is automatically displayed when the simulation software is started.



- Settings for camera image input
  Changing values are only available.
- Saving data to the smart camera memory.
  The data is saved in the following folder.
  C:\Documents and Settings\Computer name\My Documents\OMRON FZ\SettingData
- There are other functions that cannot be used. The dialog box shown below appears.



■ Initialize

- Before starting simulation software, be sure to perform **Initialize**.
- If a PC has used simulation software of FH/FHV series, the setting data stored in the PC is backed up. The folders to be backed up are as follows.
  C:\Documents and Settings\Computer name\My Documents\OMRON FZ

■ Restore Data

- Setting data backed up in the **Initialize** is restored.
- When switching between simulation software of FH/FHV series and simulation software of the FHV7-AI series, perform **Restore Data**.
- When performing **Restore Data**, after backing up the setting data stored in the PC, change the backed up folder name. The folders to be backed up are as follows.
  C:\Documents and Settings\Computer name\My Documents\OMRON FZ

A-5 Updating Inspection Application [Version-up]

The inspection application is possible to update.

A-5-1 By the Remote Operation

Items to Prepare

- PC
- Power supply for the smart camera of FHV
- FHV smart camera
- Remote Operation Tool
- Software data for the version-up tool.

Precautions for Correct Use

- Prepare the software for the model to be updated.
- Use the same version of the smart camera of FHV and the Remote Operation Tool.

Preparation

Precautions for Correct Use

Do not apply any changes to the software data file. The tool will check its size stored in the PC. If there are unnecessary files or folder in it,the update will fail.

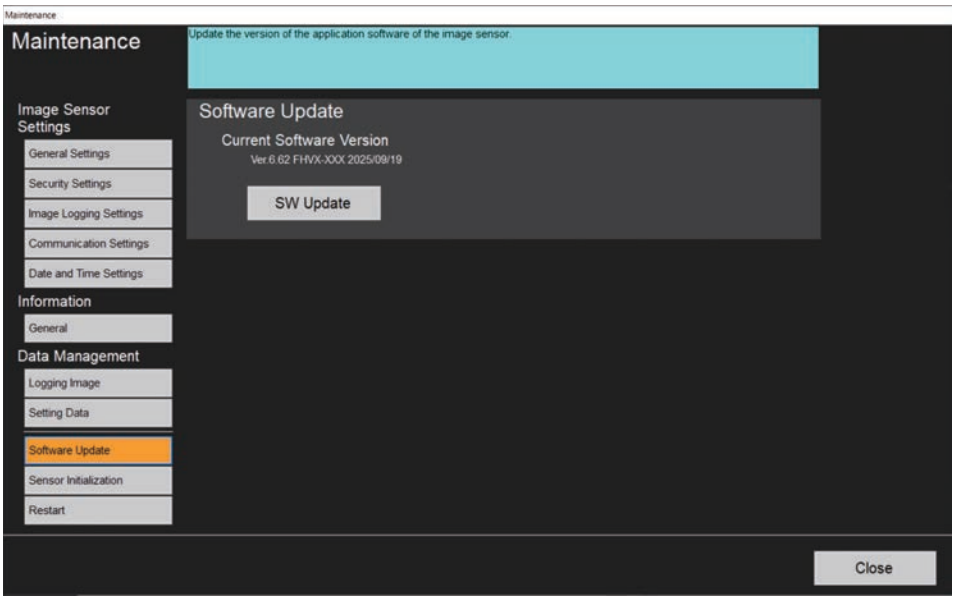
1 The same version of the Remote Operation tool as the current smart camera inspection application will be available on the PC.

2 Store the software data for the version-up tool of the Remote Operation on the same PC.
The version-up tool can use the software data to update even if it is stored in any storage on its network where the PC can access.
If the software data is stored in an FTP server, the tool cannot use it to update.

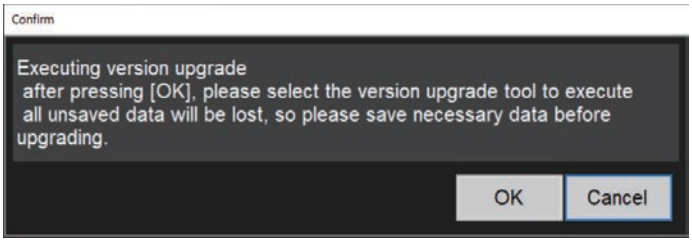
Updating the Version

1 Connect to the smart camera using the Remote Operation tool.

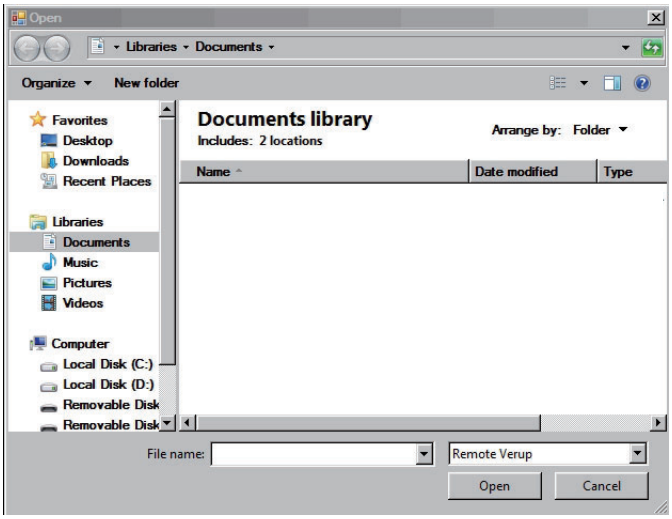
2 On the maintenance screen, click the **software update execution** button.



3 Click **OK** in the confirmation dialog of version upgrade.

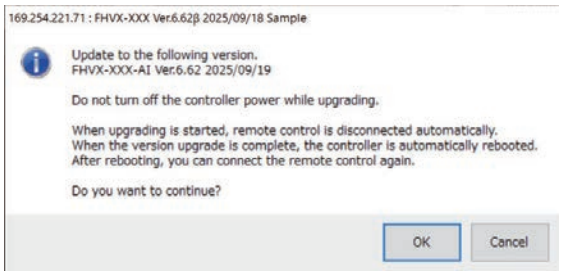


4 Determine a version-up tool to launch.
In the file selection dialog, select the version-up tool stored.
In the case where the Remote Operation tool is for 32-bit, select *RemoteVerup_x86.exe*. For 64-bit, select *RemoteVerup_x64.exe*.

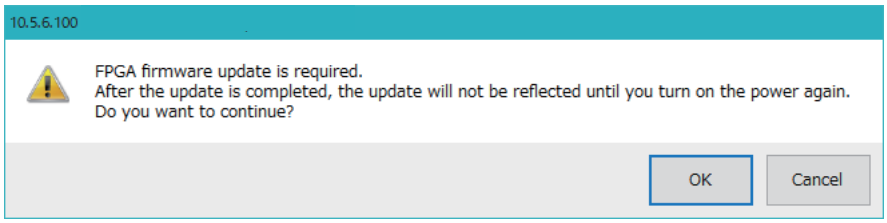


When the version-up tool was selected, a version-up confirmation dialog appears.

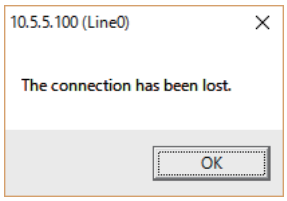
5 Click **OK** in the dialog.



Sometimes, the following dialog may appear to prompt the FPGA update. In that case, click **OK**.



The following dialog appears and then the update starts.
When you click **OK**, the Remote Operation tool will be terminated.



When the smart camera has completed the restart, the update is complete.
When the firmware of the FPGA was also updated, once turn the power off. Turning it on makes the smart camera operate correctly.

Troubleshooting

Case	Possible cause	Measures
A dialog message of "There is no corresponding firmware." is displayed.	You may have specified another version-up tool not to support the target product.	Specify the appropriate version-up tool corresponding to the target product. For details, refer to *Updating the Version* on page A-54.
A dialog message of "The application software for the smart camera does not support the Remote Operation tool. Execute the version-up tool in the local environment." is displayed.	The version of the inspection application for the smart camera does not support the version-up tool.	Execute the version-up tool on the smart camera. For details, refer to *A-5-2 By the Smart Camera (FHV Series)* on page A-57.
A dialog message of "Drivers need to be updated. Execute the version-up tool in the local environment." is displayed.	The Remote Operation tool does not support the update of the inspection application requiring the update of drivers.	
A dialog message of "Failed to file transfer. There are some issues on the network environment or less free capacity in the RAMDisk on the sensor controller." is displayed.	The software data for the version-up tool failed to transfer to the smart camera.	Check the network environment. Restart the smart camera. Execute the version-up tool again.

Case	Possible cause	Measures
A dialog message of "Failed to extract Zip." is displayed.	The smart camera has failed to deploy the software data for the version-up tool.	Check the following first and then proceed the update again. • Are there approximately 500 MB of free space in the smart camera? • Is the software data for the version-up tool broken?
A dialog message of "Hash value does not match." is displayed.		Check the software data for the tool whether or not to have missing or broken, and then proceed the update again.
A dialog message of "Package does not exist." is displayed.	Some of the software data for the version-up tool is missing.	
The smart camera does not operate correctly after the update.	The update of FPGA may not be enabled.	When FPGA has been updated, turn the power off once, and then turn it on again.

A-5-2 By the Smart Camera (FHV Series)

Items to Prepare

Precautions for Correct Use

Set the microSD card to the read/write status to be used for the update . Otherwise, the update will not be successfully completed.

- microSD card
  Recommended microSD card: SDHC Class 10 or less
- PC
- Smart camera
- Power supply for smart camera
- Software data for the version-up tool.

Preparation

1 Prepare the recommended microSD card.

2 Store the software data file for the version-up tool into the microSD card.

Precautions for Correct Use

- Do not apply any changes to the software data file. The tool will check its size stored in the microSD card. If there are unnecessary files or folder in it, the update will fail.
- Be sure to arrange a file of **VerupXP.exe** just under the microSD card. Otherwise, the update will not start.

Updating the Version

Start the procedures in the state the smart camera is turned off.

1. Turn off the smart camera.
2. Insert the microSD card in which the version-up tool is stored to the smart camera.
3. Turn on the smart camera.
   Blinking the *BUSY* indicator on the smart camera indicates the start of the update.
4. Blinking the *RUN* indicator on the smart camera indicates the successful completion of the update. Unplug the microSD card.
   Turn off the smart camera and restart it to check its operation.

Troubleshooting

Case	Possible cause	Measures
The BUSY indicator on the smart camera does not blink.	The file for the version-up tool stored in external storage may be corrupted.	Format the external storage storing the version-up tool, and then save the version-up tool again to run it.
	VerupXP.exe file is not arranged just under the microSD card. Therefore, the update may not be executed.	Arrange **VerupXP.exe** just under the microSD card and run the version-up tool again. For details, refer to *Preparation* on page A-57.
The Error indicator on the smart camera is blinking.	The version-up tool installed in the external storage may not have some of the required files.	After storing the version-up tool again in the external storage, run it.
The update is not complete	The external storage may have been used with write protection status.	Run the version-up tool again after setting the external storage to the read/write status.
The smart camera does not start.	• Power failure during installation occurs and may have caused files or hardware for the smart camera damaged. • Some of the files for the Version-up tool stored in the external storage may have been corrupted. • The update may have failed due to the external storage removed during the installation.	• Turn off the smart camera and restart it to run the tool again. If the measures do not work, the files or hardware for the smart camera may be damaged. Contact one of our branches or regional offices. • For external storage, use the OMRON recommended product. Format the external storage in which the version-up tool has been installed. Install the tool again to run it. • If you remove the external storage during the installation, turn off the smart camera and restart it to run the tool again.
The camera and I/O do not work normally after the update.	The external storage might be attached or removed during the smart camera start-up. Some of the files may not have been updated due to that.	Turn off the smart camera and run the tool again.

I

Index

Index

A

B

C

D

E

F

G

H

I

J

L

M

N

O

P

R

S

T

U

W

X

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