KEYENCE

K80GB

Vision Sensor

IV4 Series

User's Manual

Read this manual before use.
Keep this manual in a safe place after reading it so that it can be used at any time.



1 Getting Started
2 Installation and Connection
3 Basic Operation
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A Status Table, Troubleshooting

Device setup videos (Video manuals)
www.keyence.com/iv4_video_manuals

Emergency support (error number search)
www.keyence.com/iv4_trouble_support

Introduction

Read this manual before using the product in order to achieve maximum performance.
Keep this manual in a safe place after reading it so that it can be used at any time.

You can download details of individual functions from the following website:

www.keyence.com/support_iv4

For error messages, you can also check the following error number search page:

www.keyence.com/iv4_trouble_support

Symbols

The following symbols alert you to important messages.
Be sure to read these messages carefully.

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

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

Point **It indicates additional information on proper operation.**

Reference Indicates tips for better understanding or useful information.

Indicates the reference pages in this manual or the reference pages in separate manuals.

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Safety Information

General Precautions

DANGER	• Do not use this product for the purpose to protect a human body or a part of a human body. • Do not use this product in a hazardous location and/or potentially explosive atmosphere. • Do not use this product in an application that may cause death, serious injury or serious property damage should a failure with this product occur, such as nuclear power plants, on aircraft, trains, ships, or vehicles, used within medical equipment, playground equipment, roller coasters and other rides, etc.

WARNING	• If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. • You must perform a sufficient risk assessment for the machine where this product is to be installed prior to installing this product. Provide appropriate protective fail-safe measures on the machine independent from this product in case a failure with this product should occur.

CAUTION	Before starting or operating the system, check to make sure all system functions are working properly.

NOTICE	• KEYENCE never warrants the function or performance of the IV4 Series if it is used in manner that differs from the IV4 Series specifications contained in this instruction manual or if the IV4 Series is modified by yourself. • When the IV4 Series is used in combination with other instruments, functions and performance may be degraded, depending on operating conditions and the surrounding environment. • Do not subject the controller or connected devices to a sudden change in temperature. It may cause condensation and may damage instruments or peripherals. • Remove the power cable from the power supply if you do not use this product for a long time.

Important Instructions

Observe the following precautions to prevent malfunction and to ensure proper use.

Precautions on use

WARNING	**The power of this product and instruments connected to this product must be turned off when the cable is to be installed or removed. Failure to do so may cause an electric shock or product damage.**

NOTICE	• Use this product with the correct voltage. Failure to do so may cause a malfunction.
	• For instructions
	  • Do not turn OFF the power while setting the items or saving the settings. Otherwise, all or part of the setting data may be lost.
	  • Do not let water, dust or oil stick to the camera/light of the sensor head/sensor. Failure to do so may cause a malfunction.
	  • The enclosure rating of the control panel (IV4-CP70) is IP40. This product is not designed to be waterproof, so use with care when operating it around water.
	  • When this product becomes dirty, do not rub it with a wet cloth, benzene, thinner, or alcohol. Doing so may change the color or shape of the unit.
	  • If the unit is heavily contaminated, disconnect all the cables including the power supply cable, wipe off the dirt with a cloth soaked with mild detergent, and then wipe with a soft dry cloth.
	• For an LCD panel
	  • Do not press the touch panel with the tip of your nail or anything that has a sharp tip such as a pen or a screwdriver. Doing so may cause damage.
	  • Do not apply shock to the touch panel or press it with excessive force. Doing so may cause damage.
	  • The LCD panel may have some dots that are always lit (bright dots) or ones that are always unlit (black dots). This phenomenon is not a problem.
	  • Due to the unique characteristics of the LCD, displaying the same image for a long time may cause an afterimage.
	• For the USB memory
	  • Use a KEYENCE recommended product.
	  • A USB memory with a security function cannot be used.
	  • Unplug the USB memory when turning on or off the power of the IV4 Series.
	  • Do not remove the USB memory while it is being written on. Otherwise, all or part of the setting data may be lost or the memory may be damaged.
	• For external master image registration
	If the external master image registration is to be performed frequently, set [Write to ROM when using Ext. Master Save] of the input option to [Disable] to protect the nonvolatile memory of the internal sensor. When the option is set to [Enable], the nonvolatile memory is guaranteed to write for 100,000 times.
	• For automatic focus function
	  • Automatic focus function is used for adjusting the focusing position at the time of installation. Disabled during operation.
	  • Focusing position can be registered in each program. The program configurations are guaranteed to switch for 100,000 times. If the focusing position does not need to be changed in each program, set [Auto Focus Adjustment Position] to [Common] to extend its duration.
	  • Do not apply shock or vibration to the sensor head/sensor during the focusing position adjustment. Failure to do so may cause a malfunction.
	• About SD cards
	  • Use a KEYENCE recommended product.
	  • Close the SD card slot cover while the sensor amplifier (IV4-G120) and/or control panel (IV4-CP70) is in use.
	  • When removing the SD card from the sensor amplifier (IV4-G120), always perform the [Remove SD Card] procedure before removing the card.
	  • Do not remove the SD card while accessing the SD card. Also do not turn off the system power while the SD card is being accessed. Otherwise, all or part of the setting data may be lost or the memory may be damaged.
	  • To prevent data loss, periodically backing up to another storage device is recommended.

Measures to be taken when an abnormality occurs

WARNING	In the following cases, turn the power OFF immediately. Using the IV4 Series in an abnormal condition could cause fire, electric shock, or malfunction. Contact your local Keyence representative for repair. • If water or debris enters the IV4 Series. • If the IV4 Series is dropped or the case is damaged. • If abnormal smoke or odor emanates from the IV4 Series.

Precautions on installation

WARNING	To use this product correctly and safely, avoid installing it in the following locations. Failure to do so may cause fire, electric shock, or malfunction. • Outdoors • Altitude above 2500 m • Locations that are humid, dusty or poorly ventilated • Locations where the temperature is high such as those exposed to direct sunlight • Locations where there are flammable or corrosive gases • Locations where the unit may be directly subjected to vibration or impact • Locations where water, oil, or chemicals may splash onto the unit

CAUTION	When mounting the sensor with the built-in amplifier type, sensor head of the ultra-compact model that is connected with the AI Lighting unit, and communication unit for models equipped with internal amplifier, use them by mounting them on a metal plate. Failure to do so may cause a burn injury due to the high surface temperature.

NOTICE	• To improve the anti-noise feature, install the unit following the precautions below. Otherwise, a malfunction may occur.
	  • Ground the FG cable of the sensor amplifier (IV4-G120).
	  • Do not mount the unit in a cabinet where high-voltage equipment is already installed.
	  • Mount the unit as far from power lines as possible.
	  • Separate the unit as far as possible from the devices that emit strong electric or magnetic field (such as solenoid or chopper).
	  • Separate the I/O signal line from the power line or high-voltage line.
	• For power supply
	  • Noise superimposed on the power supply could cause malfunction. Use a stabilized DC power supply configured with an isolation transformer.
	  • When using a commercially available switching regulator, be sure to ground the frame ground terminal.
	• Devices including this unit are precision components. Do not apply shock or vibration.
	• When connecting to a network, let engineers who are knowledgeable about networks handle it.

Safety Precautions on LED Product

The degree of risk of this product is shown below.

Product	Model	Light source	Risk group*
Ultra-compact model Sensor head	IV4-G400CA	White LED	Risk Group 1
	IV4-G500CA		
	IV4-G600CA		
	IV4-G400MA	Infrared LED	Exempt Group
	IV4-G500MA		
	IV4-G600MA		
Built-in amplifier model sensor	IV4-400CA	White LED	Risk Group 1
	IV4-500CA		
	IV4-600CA		
	IV4-400MA	Infrared LED	Exempt Group
	IV4-500MA		
	IV4-600MA		
AI Lighting unit	IV4-L4C	White LED	Risk Group 1
	IV4-L5C		
	IV4-L6C		
	IV4-LG4C		
	IV4-LG5C		
	IV4-LG6C		
	IV4-L4M	Infrared LED	Exempt Group
	IV4-L5M		
	IV4-L6M		
	IV4-LG4M		
	IV4-LG5M		
	IV4-LG6M		

Note: The LED product is classified as shown below according to IEC 62471.

- Exempt Group — Does not pose any photobiological hazard.
- Risk Group 1 (Low-Risk) — Does not pose a hazard due to normal behavioral limitations on exposure.
- Risk Group 2 (Moderate-Risk) — Does not pose a hazard due to the aversion response to very bright light sources or due to thermal discomfort.
- Risk Group 3 (High-Risk) — May pose a hazard even for momentary or brief exposure.

Precautions on Regulations and Standards

CE and UKCA Markings

KEYENCE Corporation has confirmed that this product complies with the essential requirements of the applicable EU Directive(s) and UK regulations, based on the following specifications. Be sure to consider the following specifications when using this product in the Member States of European Union and in the United Kingdom.

EMC Directive (CE) and Electromagnetic Compatibility Regulations (UKCA)

- Applicable standard : (BS) EN61326-1, Class A
- When using the built-in amplifier models (IV4-400CA/IV4-400MA/IV4-500CA/IV4-500MA/IV4-600CA/IV4-600MA), make sure the length of the power cable, I/O cable and Ethernet cable are less than 30 meters long.
- When using the ultra-compact models (IV4-G400CA/IV4-G400MA/IV4-G500CA/IV4-G500MA/IV4-G600CA/IV4-G6000MA), make sure the length of the power cable, I/O cable and Ethernet cable are less than 30 meters long.
- When using a control panel (IV4-CP70), make sure the length of the power cable and Ethernet cable are less than 30 meters long.
- When using the display expansion unit (IV4-DU10), make sure the length of the cable used for connecting to the external device is less than 30 meters long.
- When using a communication unit (IV4-CU1/IV4-GCU1), make sure that the length of the Ethernet cable is less than 30 meters.

These specifications do not give any guarantee that the end-product with this product incorporated complies with the essential requirements of EMC Directive and
Electromagnetic Compatibility Regulations. The manufacturer of the end-product is solely responsible for the compliance on the end-product itself according to EMC Directive and Electromagnetic Compatibility Regulations.

CSA Certificate

This product complies with the following CSA and UL standards and has been certified by CSA.
- Applicable standard: CAN/CSA C22.2 No. 61010-1
  UL61010-1

Be sure to consider the following specifications when using this product as a product certified by CSA.

❍ Built-in amplifier models (IV4-400CA/IV4-400MA/IV4-500CA/IV4-500MA/IV4-600CA/IV4-600MA)
- Overvoltage category I
- Use this product under pollution degree 3.
- Use this product at the altitude of 2500 m or less.
- Indoor use only.
- To supply power via PoE electric power supply, prepare an Ethernet cable that supports PoE.

❍ Ultra-compact models (IV4-G400CA/IV4-G400MA/IV4-G500CA/IV4-G500MA/IV4-G600CA/IV4-G600MA)
- Use the following power supply.
  CSA/UL certified power supply that provides Class 2 output as defined in the CEC (Canadian Electrical Code) and NEC (National Electrical Code)
- Connect the sensor amplifier power supply and I/O connector to the same power supply that has Class 2 output.
- Overvoltage category I
- Use this product under pollution degree 3.
- Use this product at the altitude of 2500 m or less.
- Indoor use only.

❍ Control panel (IV4-CP70)
- Use the following power supply.
  CSA/UL certified power supply that provides Class 2 output as defined in the CEC (Canadian Electrical Code) and NEC (National Electrical Code)
- Overvoltage category I
- Use this product under pollution degree 3.
- Use this product at an altitude of 2500 m or less
- Indoor use only.

❍ AI Lighting units (IV4-L4C/IV4-L4M/IV4-L5C/IV4-L5M/IV4-L6C/IV4-L6M/IV4-LG4C/IV4-LG4M/IV4-LG5C/IV4-LG5M/IV4-LG6C/IV4-LG6M)
- Overvoltage category I
- Use this product under pollution degree 3.
- Use this product at an altitude of 2500 m or less
- Indoor use only.

❍ Display expansion unit (IV4-DU10)
- Overvoltage category I
- Use this product under pollution degree 3.
- Use this product at an altitude of 2500 m or less
- Indoor use only.

❍ Communication unit (IV4-CU1/IV4-GCU1)
- Overvoltage category I
- Use this product under pollution degree 3.
- Use this product at an altitude of 2500 m or less
- Indoor use only.

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About the Software (IV4-CP70/IV4-DU10)

This product incorporates the software files developed independently by or for KEYENCE CORPORATION, software files owned and licensed by a third party, and software files subject to certain open source license agreements.

- The open source software files are subject to the notices and additional terms and conditions. For information about such open source software files, please refer to the license that is displayed when selecting [Panel Settings] > [Panel Information] > [License Information].
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- You may obtain a copy of the source code corresponding to the binaries for GPL/LGPL-licensed file by sending a request to Keyence customer service at “soft-license@keyence.co.jp”. There will be a charge to cover the costs of providing the source code.

Version of the IV4 Series

You can download the most recent operation software for the sensor (IV4-G120, IV4-400CA, IV4-400MA, IV4-500CA, IV4-500MA, IV4-600CA, IV4-600MA), control panel (IV4-CP70), display expansion unit (IV4-DU10), communication units (IV4-CU1/GCU1), and software for the IV4 Series IV Smart Navigator (IV-H1SN) from the KEYENCE website.
Please refer to the description on the homepage for the introduction method.
URL: www.keyence.com/glb

Operation Software for the Sensor

Version	Description
R1.30.**	This is the version of this document.

Operation Software for the Display Expansion Unit

Version	Description
R1.30.**	This is the version of this document.

Communication unit (IV4-CU1/GCU1) working software

Version	Description
R1.30.**	This is the version of this document.

Operation Software for the Control Panel

Version	Description
R1.30.**	This is the version of this document.

Software for the IV Smart Navigator (IV-H1SN)

Version	Description
R1.30.**	This is the version of this document.

Revision history of Software Version

Version	Description
R1.00.**	The initial version.
R1.10.**	• Screen capture is available. • Display in English and Simplified Chinese are available.
R1.20.**	• Supports communication units (IV4-CU1/GCU1). • Provides additional support for Korean, German, French, Italian, and Spanish. • The Missing Part Detection function is added to the AI Count tool. • The Show Matching Rate tool and Printer Check tool have been added to the AI OCR Tool. • Supports connection from IV4-CP70 (IV4-CP70 mode), IV4-DU10 (IV4-CP70 mode), and IV Smart Navigator to the IV3 series.
R1.30.**	Supports the following functions: • [Mask] of [Search Range] of AI Identify and AI Count • Function for accessing the mirco SD card in the sensor from the IV4-CP70/IV4-DU10/PC software • FTP/SD file name setting function • Operation Information output function • IoT protocol • Security enhancement mode • Communication bypass function of the communication unit (IV4-CU1/GCU1) • Update function when the sensor is connected for the first time Supports the following languages: • Czech, Hungarian, Polish, Portuguese, Thai, and Chinese (Traditional)

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1

Getting Started

This chapter explains the system configurations and overview of the IV4 Series, how to check package contents, and the name and function of each part.

System Configuration 1-2
IV4 Series Overview 1-4
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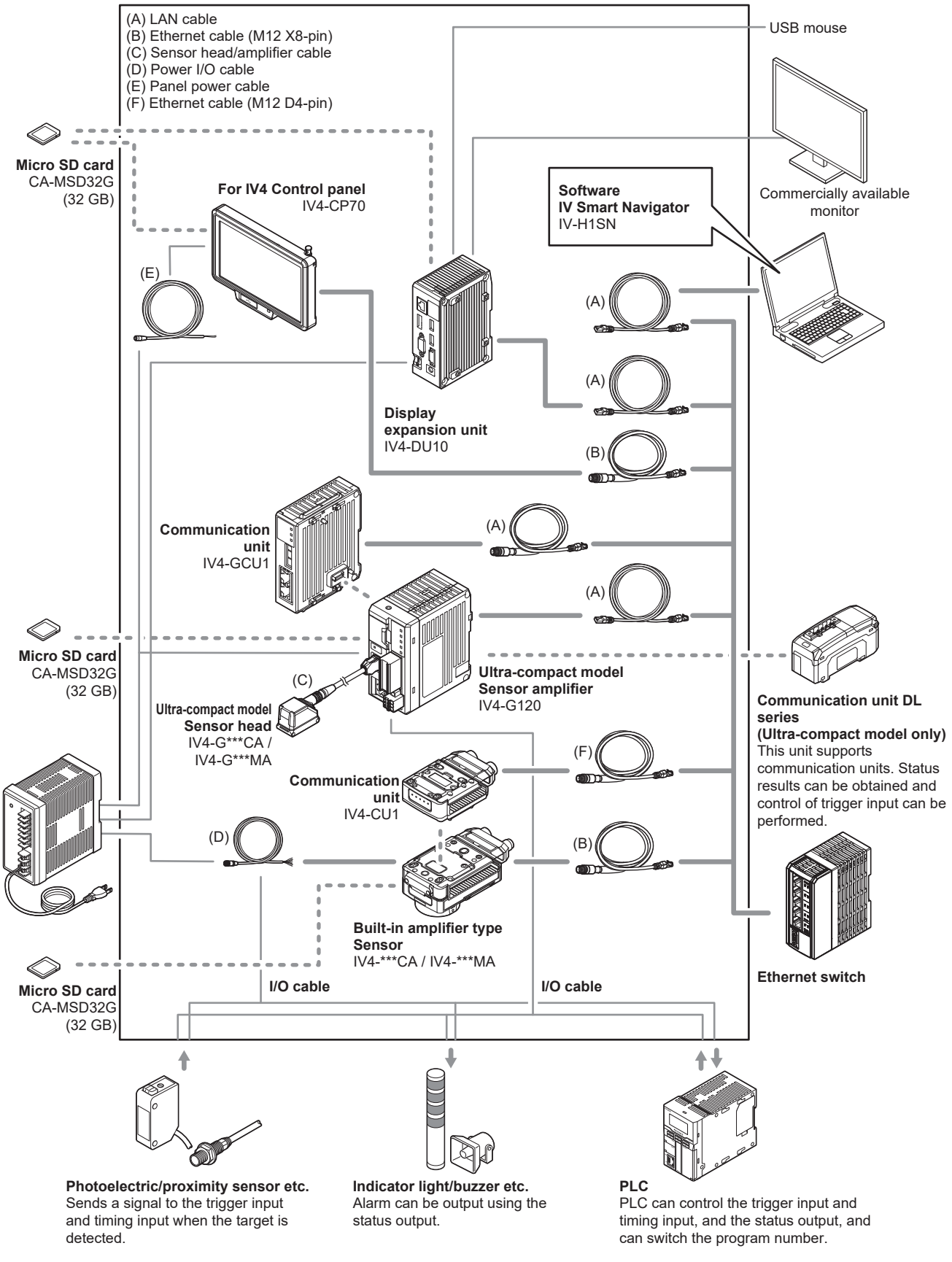
Name and Function of Each Part 1-12

System Configuration

Example Configuration of the IV4 Series

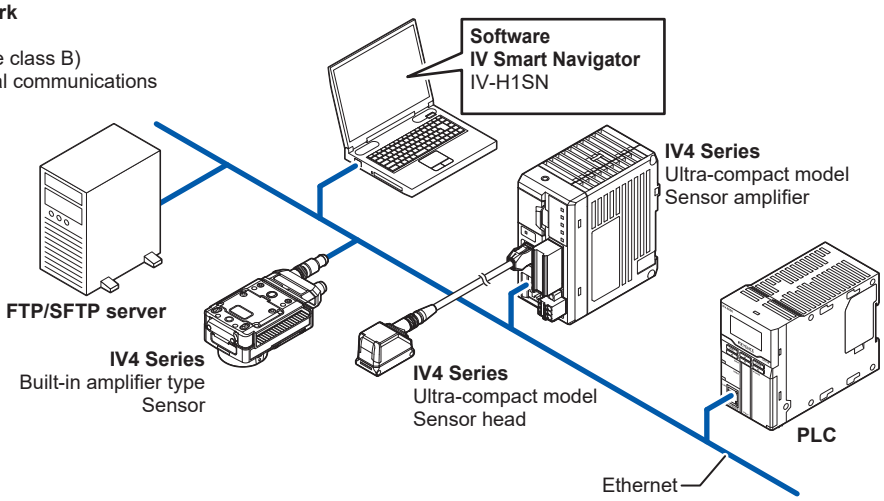
When connecting multiple sensors with a network, you can select a single sensor from a computer, control panel, or display expansion unit.



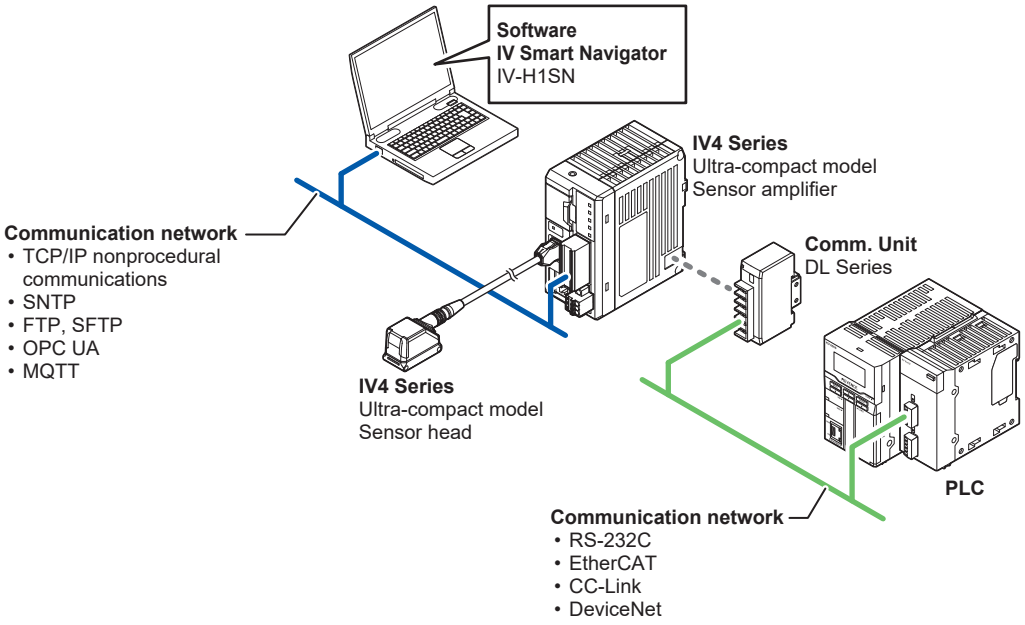
Configuration of the IV4 Series network function

The following functions can be used by configuring a network with the IV4 Series.
- Connecting to FTP/SFTP server to transfer image files and judgment results
- Trigger input, judgment result acquisition, program number switch (changeover) by connection with PLC on the field Network

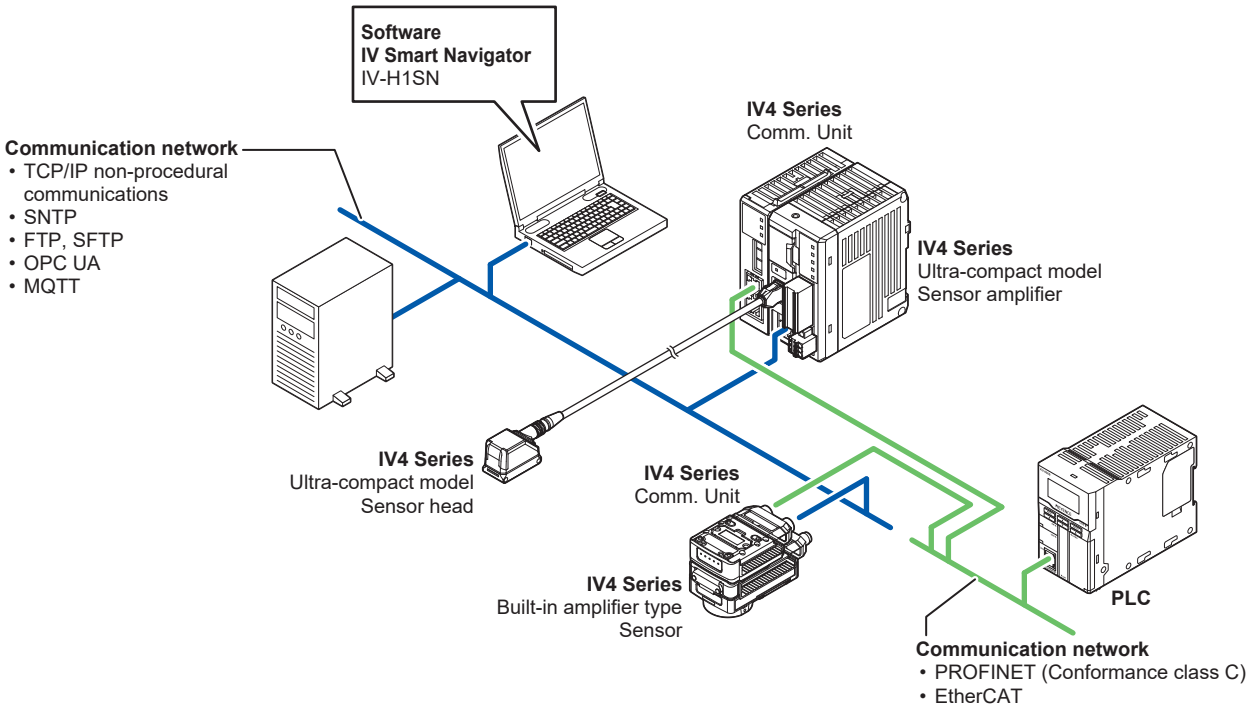
Communication network
- EtherNet/IP™
- Profinet (Conformance class B)
- TCP/IP non-procedural communications
- SNTP
- FTP, SFTP
- OPC UA
- MQTT



When using a field network (DL unit) (ultra-compact model only)

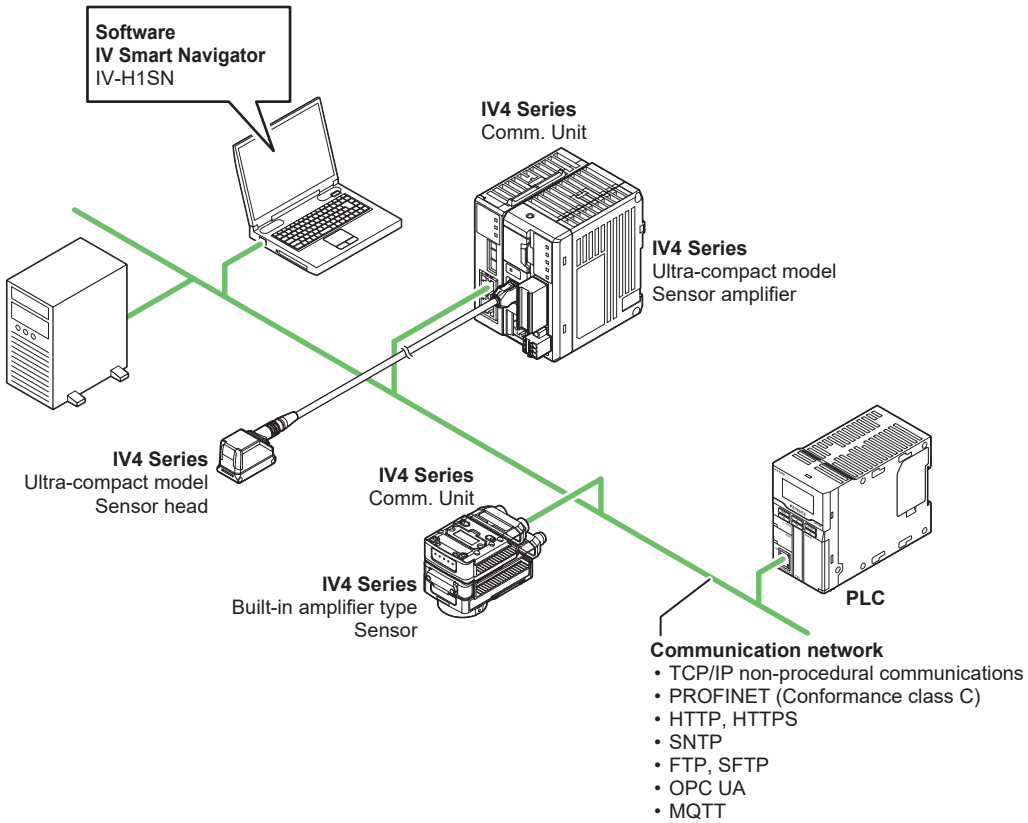


When using the field network (communication unit: IV4-CU1/IV4-GCU1) to separate the IT network and the control network



When using the field network (communication unit: IV4-CU1/IV4-GCU1) without separating the IT network and the control network

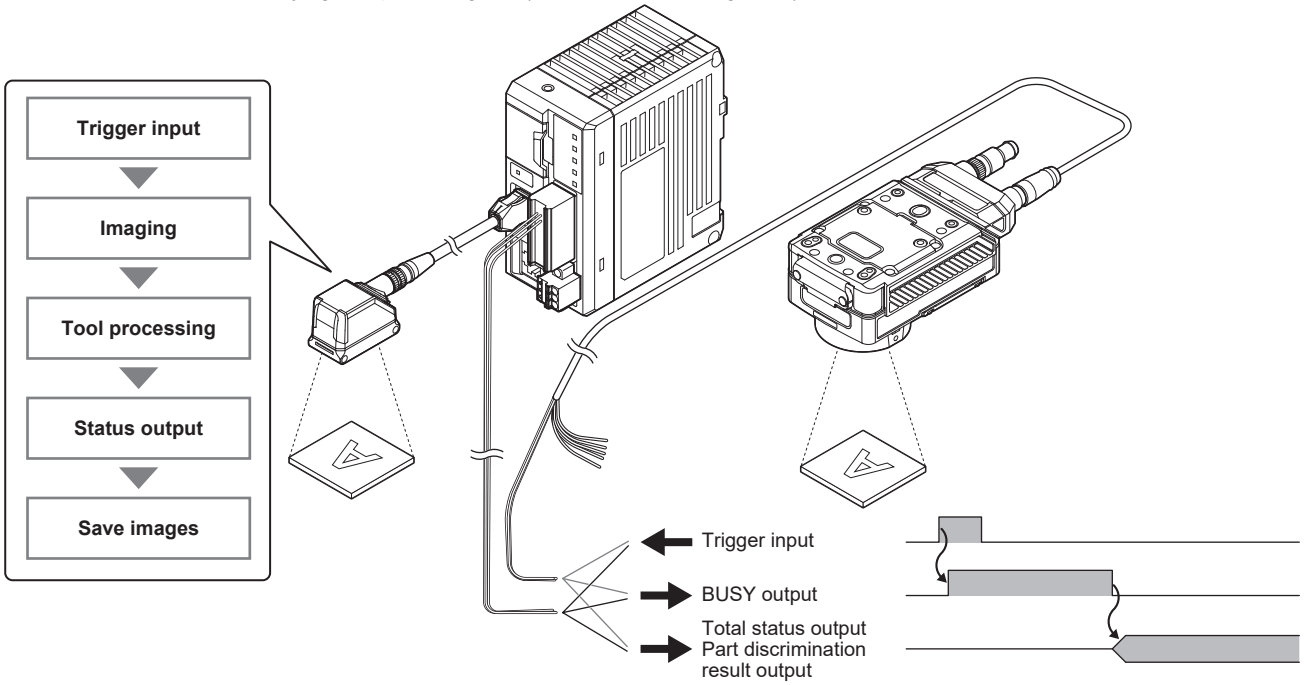
“Connection Settings” (page 7-24)



IV4 Series Overview

Judgment processing flow

This section describes the basic judgment processing flow (Standard mode/Sorting mode) of this device.

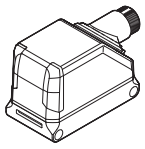
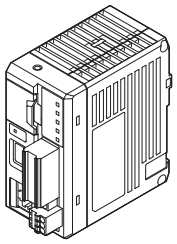


Reference By using the data transfer function, images and judgment results can be transferred to SD cards and FTP/SFTP servers.

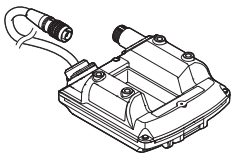
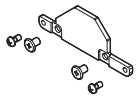
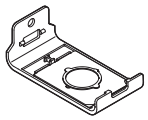
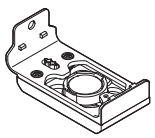
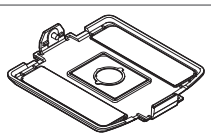
Checking the package contents

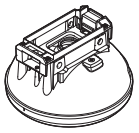
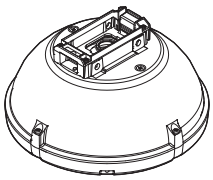
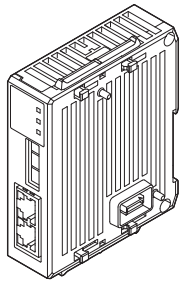
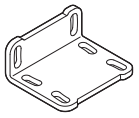
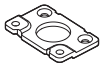
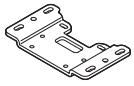
The IV4 Series consists of the models below. Check that all of the bundled items below are included with each model before use.

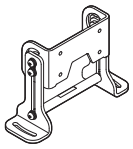
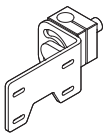
Ultra-compact model

Name	Model	Description	Quantity	Illustration
Ultra-compact model sensor head	IV4-G400CA IV4-G400MA IV4-G500CA IV4-G500MA IV4-G600CA IV4-G600MA	Sensor head	1	
Ultra-compact model sensor amplifier	IV4-G120	Sensor amplifier	1	
		Power terminal block (mounted in the amplifier)	1	
		I/O terminal block (mounted in the amplifier)	1	
		Instruction Manual	1	-

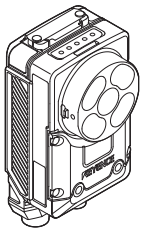
Options for the ultra-compact model

Name	Model	Description	Quantity	Illustration
AI Lighting unit	IV4-LG4C IV4-LG4M IV4-LG5C IV4-LG5M IV4-LG6C IV4-LG6M	AI Lighting unit	1	
		Sensor head mounting bracket	1	
		Slim head screw (M4 x L6)	2	
		Double-washer sems screw (M3 x L6)	2	
		Instruction Manual	1	-
Polarizing filter (sensor head)	OP-88642 (color) OP-88643 (monochrome)	Polarizing filter	1	
		Mounting screw M3 × L5 (Double-washer sems)	1	
		Instruction Manual	1	-
Magnifying lens attachment (for the standard model)	OP-88909	Magnifying lens attachment	1	
		Mounting screw M3 × L5 (Double-washer sems)	1	
		Instruction Manual	1	-
Polarizing filter for the AI Lighting unit	OP-88646 (color) OP-88647 (monochrome)	Polarizing filter (with fall prevention screws)	1	
		Instruction Manual	1	-

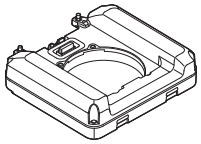
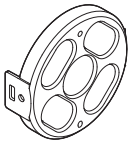
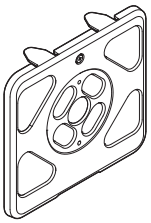
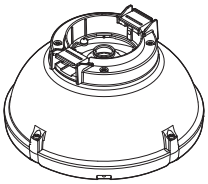
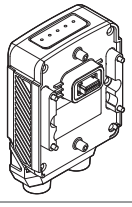
Name	Model	Description	Quantity	Illustration
Dome attachment (small)	IV2-GD05	Attachment	1	
		Mounting screw (M4 x L8) Double-washer sems screw	2	
		Mounting screw (M4 x L10) Double-washer sems screw	2	
		Instruction Manual	1	-
Dome attachment (large)	IV2-GD10	Attachment	1	
		Mounting screw (M4 x L8) Double-washer sems screw	2	
		Mounting screw (M4 x L10) Double-washer sems screw	2	
		Instruction Manual	1	-
Communication unit	IV4-GCU1	Communication unit	1	
		Instruction Manual	1	-
Sensor head/amplifier cable	OP-88648 (2 m) OP-88649 (5 m) OP-88650 (10 m) OP-88965 (20 m) * OP-88962 (2 m: flexible) OP-88963 (5 m: flexible) OP-88964 (10 m: flexible)	Sensor head/amplifier cable * OP-88965 is shipped with one caution sheet.	1	
Vertical mounting bracket	OP-87908	Mounting bracket	1	
		Mounting screw (M4 x L8) Double-washer sems screw	2	
Transverse mounting bracket	OP-87909	Mounting bracket	1	
		Mounting screw (M4 x L8) Double-washer sems screw	2	
Adjustable bracket	OP-87910	Mounting bracket	1	
		Mounting screw (M4 x L8) Double-washer sems screw	2	
		Bracket	1	
Common mounting bracket (Common to built-in amplifier models)	OP-88911	Common mounting bracket	1	
		Mounting screw (M3 x L7)	4	

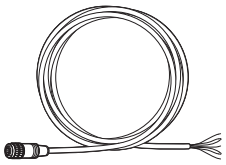
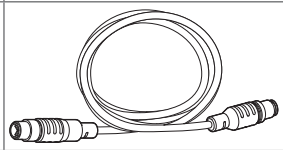
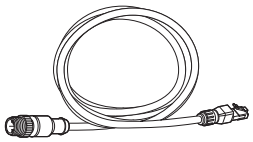
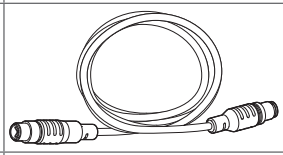
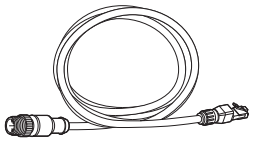
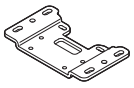
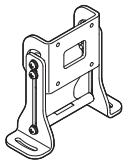
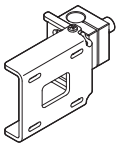
Name	Model	Description	Quantity	Illustration
2-axis adjustment mounting bracket for the AI Lighting unit	OP-88638	Mounting bracket	1	
		Mounting screw (M3 x L7)	4	
Adjustable bracket for the AI Lighting unit	OP-88639	Mounting bracket	1	
		Mounting screw (M3 x L7)	4	
SD card	CA-MSD32G (32GB)	Micro SD card	1	
		Conversion adapter * Stored in the dedicated case	1	

Built-in amplifier type

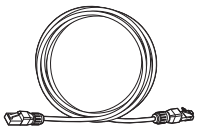
Name	Model	Description	Quantity	Illustration
Built-in amplifier model sensor	IV4-400CA IV4-400MA IV4-500CA IV4-500MA IV4-600CA IV4-600MA	Sensor	1	
		Waterproof cap for the power I/O cable connector Waterproof cap (Attached to the unit)	1	
		Ethernet cable Waterproof cap for the connector (Attached to the unit)	1	
		Instruction Manual	1	-

Options for the built-in amplifier type

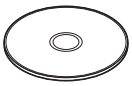
Name	Model	Description	Quantity	Illustration
AI Lighting unit	IV4-L4C IV4-L4M IV4-L5C IV4-L5M IV4-L6C IV4-L6M	AI Lighting unit	1	
		Instruction Manual	1	-
Polarizing filter	OP-88640 (color) OP-88641 (monochrome)	Polarizing filter (sensor main unit)	1	
		Mounting screw M2.5 × L5 (Double-washer sems)	2	
		Instruction Manual	1	-
Polarizing filter for the AI Lighting unit	OP-88644 (color) OP-88645 (monochrome)	Polarizing filter	1	
		Instruction Manual	1	-
Dome attachment for the built-in amplifier model	IV3-D10	Dome attachment	1	
		Mounting screw (M2.5 x L8)	2	
		Instruction Manual	1	-
Communication unit	IV4-CU1	Communication unit	1	
		Waterproof cap for Ethernet cable connector (Attached to the EtherCAT OUT connector of the unit)	1	
		Instruction Manual	1	-

Name	Model	Description	Quantity	Illustration
Power I/O cable (M12 A12 pin - strand wire)	OP-88654 (2 m) OP-88655 (5 m) OP-88656 (10 m)	Power I/O cable	1	
Ethernet cable (M12 X8-pin - M12 X8-pin)	OP-88831 (2 m) OP-88832 (5 m) OP-88833 (10 m)	M12-M12 Ethernet cable	1	
Ethernet cable (M12 X8-pin - RJ45)	OP-88835 (2 m) OP-88836 (5 m) OP-88837 (10 m) OP-88838 (20 m)	Ethernet cable	1	
Ethernet cable (M12 D4-pin - M12 D4-pin)	OP-87450 (2 m) OP-87451 (5 m) OP-87452 (10 m) OP-87453 (20 m)	M12-M12 Ethernet cable (When using a communication unit (IV4-CU1))	1	
Ethernet cable (M12 D4-pin - RJ45)	OP-87907 (1 m) OP-87457 (2 m) OP-87458 (5 m) OP-87459 (10 m)	Ethernet cable (When using a communication unit (IV4-CU1))	1	
Common mounting bracket (common to all ultra-compact models)	OP-88911	Common mounting bracket	1	
		Mounting screw (M3 × L7)	4	
2-axis adjustment mounting bracket	OP-88912	Biaxial adjustable mounting bracket	1	
		Mounting screw (M3 × L7)	4	
Adjustable bracket	OP-88913	Adjustable bracket	1	
		Mounting screw (M3 × L7)	4	
SD card	CA-MSD32G (32 GB: Micro SD)	Micro SD card	1	
		Conversion adapter * Stored in the dedicated case	1	
Conversion connector for power I/O cable	OP-88631	M12 A12-pin - A4-pin male	1	
	OP-88632	M12 A12-pin - L5-pin male	1	
Conversion connector for Ethernet cable	OP-88633	M12 X8-pin - D4-pin female	1	

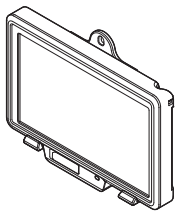
Communication cable

Name	Model	Description	Quantity	Illustration
LAN cable	OP-87950 (1m) OP-87951 (3m) OP-87952 (5m) OP-87953 (10m)	LAN cable (RJ45 - RJ45)	1	

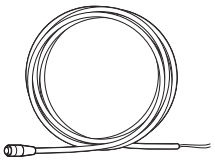
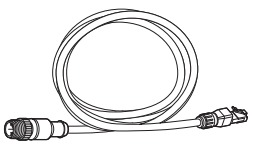
Software

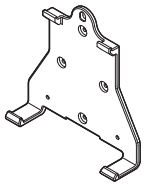
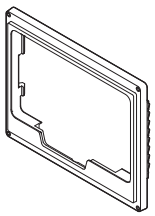
Name	Model	Description	Quantity	Illustration
Software	IV-H1SN	DVD	1	

Control panel

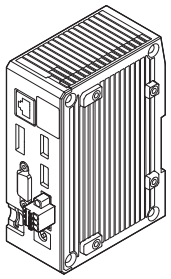
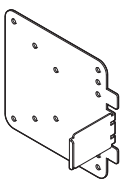
Name	Model	Description	Quantity	Illustration
Control panel	IV4-CP70	Control panel (Wall mounting adapter (OP-88914) attached)	1	
		Stylus	1	
		String for hanging the stylus	1	
		Screw (M3 x L5)	2	
		Screw for the adapter (M3 x L10)	4	
		Hexagon nut (M3)	4	
		Instruction Manual	1	-

Control panel options

Name	Model	Description	Quantity	Illustration
Panel power cable (M8 4-pin - strand wire)	OP-87443 (2m) OP-87444 (5m) OP-87445 (10m)	Panel power cable (M8 4-pin - strand wire)	1	
Ethernet cable (M12 8-pin - RJ45)	OP-88835 (2m) OP-88836 (5m) OP-88837 (10m) OP-88838 (20m)	Ethernet cable (M12 8-pin - RJ45)	1	
Stylus	OP-88352	Stylus	1	
		String for hanging the stylus	1	

Name	Model	Description	Quantity	Illustration
Wall mounting adapter	OP-88914	Wall mounting adapter	1	
		Screw (M3 x L5)	2	
		Screw for the adapter (M3 x L10)	4	
		Hexagon nut (M3)	4	
Control board mounting bracket	OP-88915	Control board mounting bracket	1	
		CP70 fixture	1	
		Stylus holder	1	
		Mounting screw (M3 x L8)	8	
USB memory (1 GB)	OP-87502	USB memory	1	

Display expansion unit

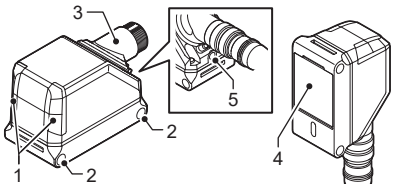
Name	Model	Description	Quantity	Illustration
Display expansion unit	IV4-DU10	Display expansion unit	1	
		Power terminal block (mounted in the amplifier)	1	
		Instruction Manual	1	-
VESA mounting adapter	OP-88917	VESA mounting adapter	1	

Name and Function of Each Part

Ultra-compact model sensor head

- IV4-G400CA
- IV4-G400MA
- IV4-G500CA
- IV4-G500MA
- IV4-G600CA
- IV4-G600MA

Name and function of each part of the ultra-compact model sensor head



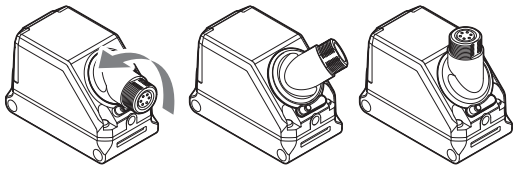
1 Status indicators
Indicates the operating status of the sensor.

Green (ON)	The total status result is “OK”.
Green (Blink)	• Under startup or setting in progress. Operation stopped. Blinks once a second. • During AI Through Count Mode, blinks once (0.1 seconds) when counting up.
Red (ON)	The total status result is “NG”.
Red (Blink)	An error has occurred.
(OFF)	• Standby status until the first judgment finishes after starting the operation or after switching the program number. • The versions of the sensor head and sensor amplifier do not match. • An incompatible sensor head is connected.
Green and red are blinking alternately.	“LED Blinking” is requested.

For the state of the indicator light when the Field Network function is used, see “Indicator Light Operation” (page 9-14).

2 Sensor head mounting part

3 Connector for Sensor head/amplifier cable
The connector can rotate.



Example of rotating

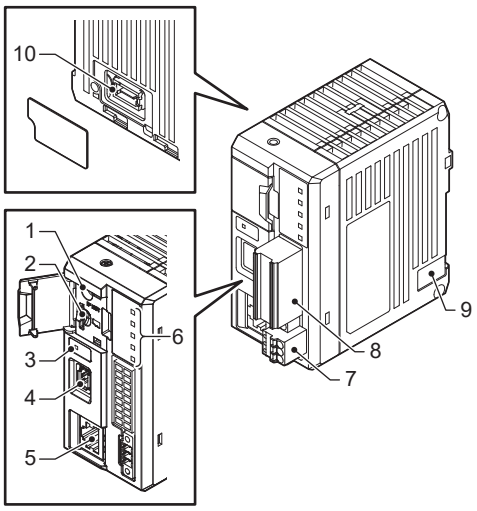
4 Camera and built-in light

5 Mounting part for the polarizing filter/spread lens attachment

Ultra-compact model sensor amplifier

- **IV4-G120**

Name and function of each part: Ultra-compact model sensor amplifier



1 IP reset switch
Used for resetting the IP address assigned to this sensor amplifier.

2 SD card slot
A micro SD card is inserted into this slot.

3 SD card indicator light
Indicates the operating status of the micro SD card.

Green (ON)	The SD card is recognized.
Green (Blink)	The SD card is accessed.
(OFF)	The SD card is not mounted, or not recognized.

4 Connector for the sensor head/amplifier cable

5 Ethernet connector

6 Indicator light
“Name and function of each part of the ultra-compact model sensor head” (page 1-13)

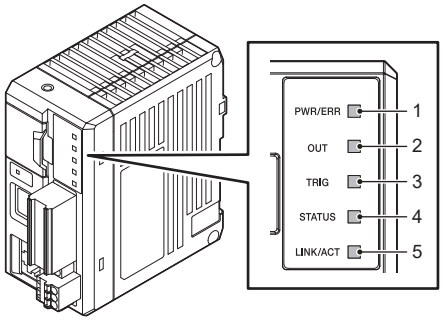
7 Power terminal block

8 I/O terminal block

9 Connector on the communications unit (DL Series)
The protection cover is attached during shipment.

10 Connector on the communications unit (IV4-GCU1)
The protection cover is attached during shipment.

Operation of the indicator light: Ultra-compact model sensor amplifier



For the state of the indicator light when the Field Network function is used, see “Indicator Light Operation” (page 9-14).

1 PWR/ERR

Green (ON)	Operation is in progress.
Green (Blink)	Setting in progress. Operation stopped. Blinks once a second.
Red (ON)	Unrecoverable error has occurred.
Red (Blink)	Recoverable error has occurred.
Orange (Blink)	“LED Blinking” is requested. Blinks four times a second.
(OFF)	Power is not supplied.

2 OUT
Indicates the comprehensive result.

Green (ON)	The total status result is “OK”.
Green (Blink)	Startup is in progress. Alternatively, a program is not set.
Red (ON)	The total status result is “NG”.
Orange (Blink)	• “LED Blinking” is requested. Blinks four times a second. • Settings are being restored from the micro SD card. Blinks once a second.
(OFF)	Setting in progress. Standby status until the first judgment finishes after starting the operation or after switching the program number.

3 TRIG

Green (ON)	Green light lights up (one-shot) according to input of the internal or external trigger.
Orange (Blink)	“LED Blinking” is requested. Blinks four times a second.

4 STATUS
Indicates the Ethernet connection status.

Green (ON)	Connected normally to the sensor.
Green (Blink)	IP address has been retrieved but the sensor is not correctly connected.
Red (ON)	The IP address coincides with other device or a network loop is detected.
(OFF)	IP address is not assigned. No correct connection with the PC.

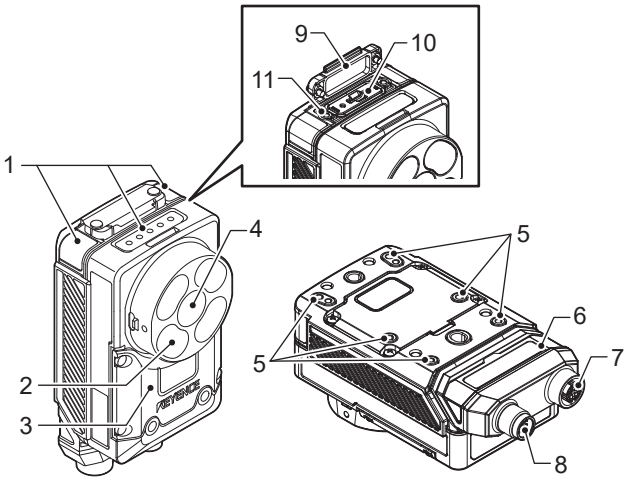
5 LINK/ACT
Indicates the link status to the Ethernet.

Green (ON)	Normally linked.
Green (Blink)	Normally linked, and the data is sending/ receiving.
(OFF)	Sensor is not normally linked.

Built-in amplifier type sensor

- IV4-400CA
- IV4-400MA
- IV4-500CA
- IV4-500MA
- IV4-600CA
- IV4-600MA

Built-in amplifier type: Name and function of each part of the sensor



1 Indicator light
“Name and function of each part of the ultra-compact model sensor head” (page 1-13)

2 Built-in light

3 Connector cover
Remove when mounting the AI Lighting unit.

4 Camera

5 Sensor mounting part

6 Rotating connector
The direction of the cables can be changed.

7 Connector for Ethernet cable

8 Connector for power I/O cable
“Cables” (page 2-21)

9 SD card cover
- Tightening torque: 0.15 to 0.20 N·m

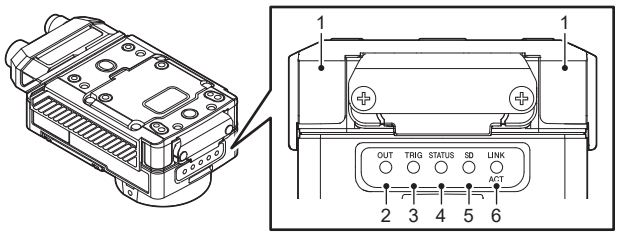
10 SD card slot (inside the SD card cover)

11 IP reset switch (inside the SD card cover)
Used for resetting the IP address assigned to this sensor amplifier.

12 Connector on the communications unit (IV4-CU1)
The protection cover is attached during shipment.

NOTICE	**When the cable is not connected to the connector for the power I/O cable or the connector for the Ethernet cable, attach the waterproof cap for included with the connector to maintain the enclosure rating. Tightening torque: 0.45 to 0.55 N·m**

Built-in amplifier type: Operation of the indicator light of the sensor



Reference For the state of the indicator light when the Field Network function is used, see “Indicator Light Operation” (page 9-14).

1 Status indicators

Green (ON)	The total status result is “OK”.
Green (Blink)	• Under startup or setting in progress. Operation stopped. Blinks once a second. • During AI Through Count Mode, blinks once (0.1 seconds) when counting up.
Red (ON)	The total status result is “NG”.
Red (Blink)	An error has occurred.
(OFF)	Standby status until the first judgment finishes after starting the operation or after switching the program number.
Green and red are blinking alternately.	“LED Blinking” is requested.

2 OUT
Indicates the comprehensive result.

Green	The total status result is “OK”.
Green (Blink)	Startup is in progress. Alternatively, a program is not set.
Orange (Blink)	• “LED Blinking” is requested. Blinks four times a second. • Settings are being restored from the micro SD card. Blinks once a second.
Red	The total status result is “NG”.
(OFF)	Setting in progress. Standby status until the first judgment finishes after starting the operation or after switching the program number.

3 TRIG

Green (ON)	Green light lights up (one-shot) according to input of the internal or external trigger.
Orange (Blink)	“LED Blinking” is requested. Blinks four times a second.

4 STATUS
Indicates the Ethernet connection status.

Green (ON)	Connected normally to the sensor.
Green (Blink)	IP address has been retrieved but the sensor is not correctly connected.
Red (ON)	The IP address coincides with other device or a network loop is detected.
(OFF)	IP address is not assigned. No correct connection with the PC.

5 SD
Indicates the operating status of the micro SD card.

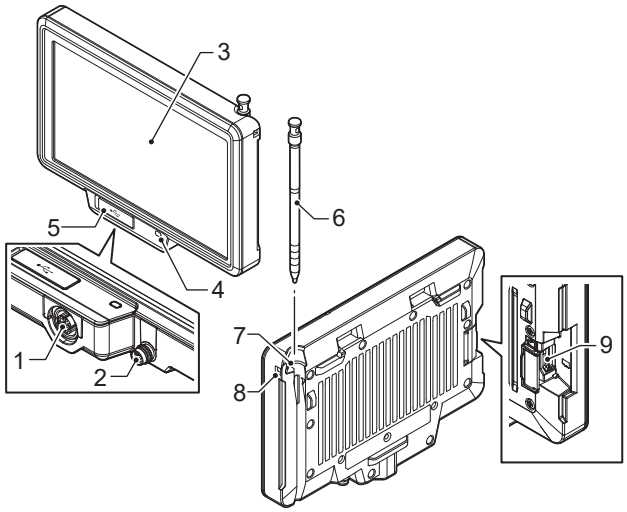
Green (ON)	The micro SD card is recognized.
Green (Blink)	The micro SD card is being accessed.
(OFF)	The micro SD card is not inserted, or not recognized.

6 LINK/ACT
Indicates the link status to the Ethernet.

Green (ON)	Normally linked.
Green (Blink)	Normally linked, and the data is sending/ receiving.
(OFF)	Sensor is not normally linked.

Control panel

• **IV4-CP70**



1 Connector for Ethernet cable
“Cables” (page 2-21)

2 Power connector
“Cables” (page 2-21)

3 LCD monitor/Stylus

4 Indicator light (POWER)
Indicates the operating status of the control panel.
- Green (ON) The power is turned ON.
- (OFF) The power is turned OFF.

5 USB connecting connector

6 Stylus

7 Stylus holder

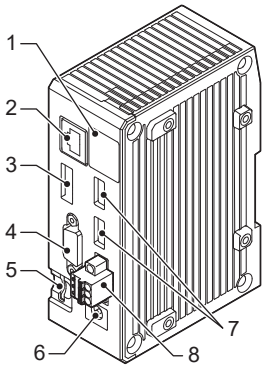
8 Strap holder

9 SD card slot

Reference The control panel is not intended for direct connection to the internet, but rather for use within a local network. Additionally, KEYENCE recommends that a control panel be installed within a network where security measures, including firewalls, have already been implemented.

Display expansion unit

• **IV4-DU10**



1. Indicator light
Indicates the operating status of the display expansion unit.

2. Ethernet connector
“Cables” (page 2-21)

3. HDMI port
Used for connecting to the display. It cannot be used in conjunction with the VGA port.

4. VGA port (D-sub 15pin)
Used for connecting to the display. It cannot be used in conjunction with the HDMI port.

5. SD card slot

6. AC adapter connector (DC IN 24 V)*

7. USB-A port (x 2)
Used to connect a mouse, touch panel, and USB memory stick.

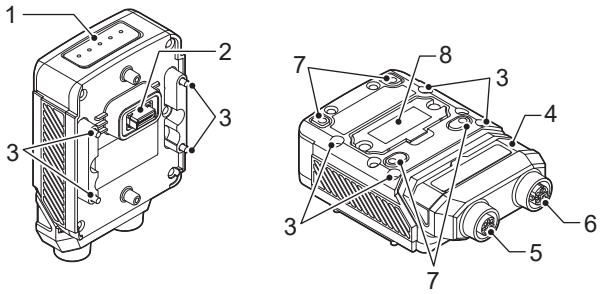
8. Power terminal block*
Supplies power (24 V DC) to this unit.

* Power supply is either DC24V connection or AC adapter connection. They cannot be connected at the same time.

Reference The display expansion unit is not intended for direct connection to the internet, but rather for use within a local network. Additionally, KEYENCE recommends that a display expansion unit be installed within a network where security measures, including firewalls, have already been implemented.

Communication unit for built-in amplifier model

• **IV4-CU1**



1 Indicator light
Indicates the operating status of the communication unit.

Reference For details, refer to “Indicator Light Operation” (page 9-14).

2 Sensor connecting connector

3 Sensor mounting screws
Use them for combining the sensor and communication unit.

4 Rotating connector
The direction of the cables can be changed.

5 Connector for Ethernet cable (EtherCAT IN)
Use for connecting to a network such as the PROFINET and EtherCAT.

6 Connector for Ethernet cable (EtherCAT OUT)
Use for connecting to a network such as the PROFINET and EtherCAT.

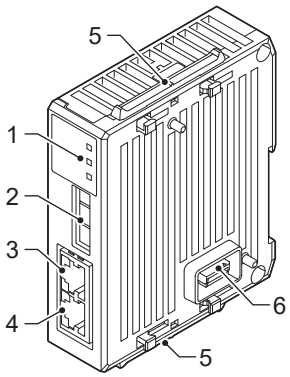
7 Mounting part
Use for mounting the communication unit.

8 Device ID setting switch for EtherCAT
Use for setting the device ID of EtherCAT.

NOTICE	**When the cable is not connected to the connector for the Ethernet cable, put the included waterproof connector cap to maintain the enclosure rating. Tightening torque: 0.45 to 0.55 N·m**

Communication unit for ultra-compact models

• **IV4-GCU1**



1 Indicator light
Indicates the operating status of the communication unit.

Reference For details, refer to “Indicator Light Operation” (page 9-14).

2 Device ID setting switch for EtherCAT
Use for setting the device ID of EtherCAT.

3 Connector for Ethernet cable (EtherCAT IN)
Use for connecting to a network such as the PROFINET and EtherCAT.

4 Connector for Ethernet cable (EtherCAT OUT)
Use for connecting to a network such as the PROFINET and EtherCAT.

5 Lock lever
Use for combining the sensor amplifier and communication unit.

6 Sensor connecting connector

MEMO

2

Installation and Connection

This chapter explains how to mount the sensor, how to set up the PC, and how to connect the cables.

Mounting the Sensor 2-2
Mounting the control panel 2-18
Mounting the Display Expansion Unit.....2-20
Cables 2-21
Setting up the PC 2-31

Mounting the Sensor

About sensor

Mounting the sensor head/sensor

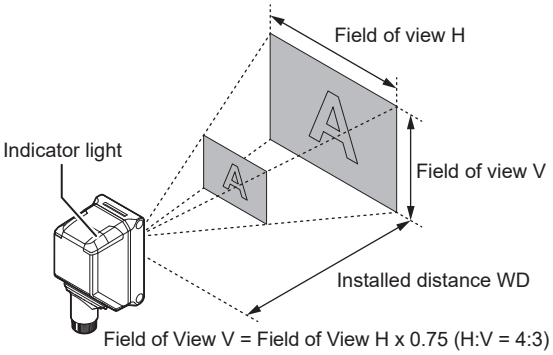
NOTICE	Do not place the sensor head/sensor in an environment that exceeds the limit of its environmental resistance, or an environment that propagates vibration directly to the sensor head/ sensor. Those may cause a damage or malfunction.

Point

- View and optical axis have individual differences. Adjust the sensor position by checking the actual image at the time of installation.
- Place the sensor in a location where ambient light will not affect the image. Ambient light includes solar light, lights of other devices, and photoelectric sensors. Also, be careful when the light intensity of the ambient light changes. Use a shield to protect when the location cannot be changed.
- Place the sensor where no object can block out the internal light or the view of the sensor.
- Detection may become unstable if multiple sensors are placed nearby each other, due to the lighting of each sensor. Take measures as described below.
  - Delay the timing of external trigger inputs.
  - Use a shield to avoid interference.

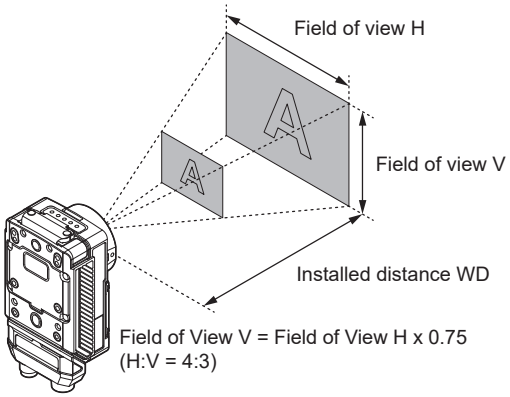
Checking the field of view and installed distance

Ultra-compact model



Field of View V = Field of View H x 0.75 (H:V = 4:3)

Built-in amplifier type



Field of View V = Field of View H x 0.75 (H:V = 4:3)

Model	Installed distance WD	Field of View H	Field of View V
• IV4-400CA • IV4-400MA • IV4-G400CA • IV4-G400MA	400	58	44
	500	74	56
	600	90	67
	800	121	91
	1000	152	114
	1200	183	137
	1400	214	161
	1600	246	184
	1800	277	208
	2000	308	231
	2500	386	290
	3000	464	348
• IV4-500CA • IV4-500MA • IV4-G500CA • IV4-G500MA	50	22	16
	100	42	31
	200	81	61
	300	121	90
	400	160	120
	500	199	149
	600	238	179
	800	317	238
	1000	396	297
	1200	474	356
	1400	553	415
	1600	631	474
	1800	710	533
	2000	789	592
	2500	987	740
	3000	1184	888
IV4-G500CA/IV4-G500MA/ +OP-88909	23	9.8	7.3
	25	10.4	7.8
	30	12.0	9.0
	35	13.5	10.1
	40	15.0	11.2
• IV4-600CA • IV4-600MA • IV4-G600CA • IV4-G600MA	50	51	38
	100	96	72
	200	187	140
	300	278	208
	400	369	276
	500	460	344
	600	550	412
	800	732	548
	1000	914	684
	1200	1095	820
	1400	1277	956
	1600	1458	1092
	1800	1640	1228
	2000	1822	1364
	2500	2276	1704
	3000	2730	2044

(mm)

Mounting the ultra-compact model sensor head

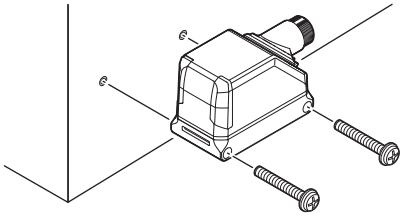
- IV4-G400CA
- IV4-G500CA
- IV4-G600CA
- IV4-G400MA
- IV4-G500MA
- IV4-G600MA

NOTICE	**If the operating ambient temperature exceeds 40°C, confirm that the case temperature does not exceed the rated 65°C by appropriate heat dissipation measures after installation as specified by KEYENCE. Measure the case temperature at the side marked "IV4 Series".**

Mounting the ultra-compact model sensor head

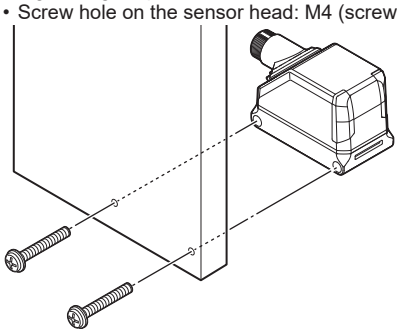
When screws are secured from the sensor head

- Screw: M3 x 2
- Tightening torque: 0.3 to 0.6 N·m



When screws are secured from the wall

- Screw: M4 x 2
- Tightening torque: 0.7 to 1.5 N·m
- Screw hole on the sensor head: M4 (screw depth : 3.5 mm)



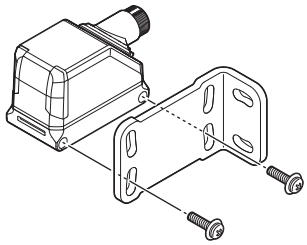
Attaching the optional mounting bracket

Vertical mounting bracket (OP-87908)

Attach the bracket using the screws attached to OP-87908.

- Tightening torque: 0.7 to 1.5 N·m

Mounting examples

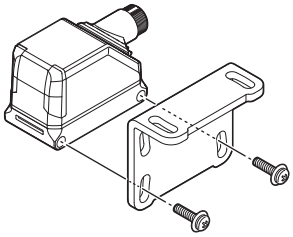


Rear mounting bracket (OP-87909)

Attach the bracket using the screws included with the adjustable bracket (OP-87909).

- Tightening torque: 0.7 to 1.5 N·m

Mounting examples

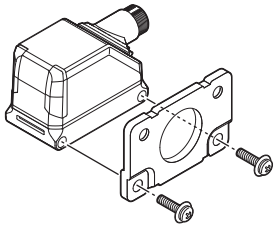


Adjustable bracket (OP-87910)

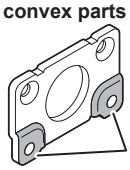
1 Attach the bracket using the screws included with the Adjustable bracket (OP-87910).

- Tightening torque: 0.7 to 1.5 N·m

Mounting examples



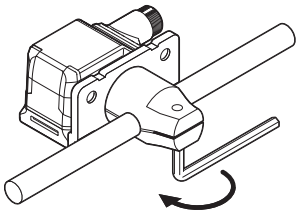
Point **Connect the convex parts to the sensor head.**



2 Attach and fix the bracket on the brace side.

- Tightening torque: 5 N·m

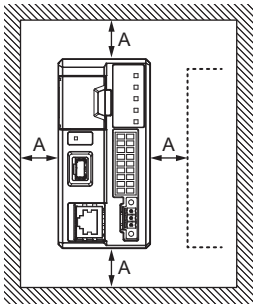
Mounting examples

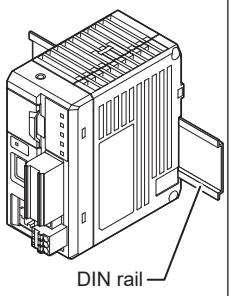


Mounting the ultra-compact model sensor amplifier

NOTICE

- **Mount the sensor amplifier as follows for heat release.**
  - **For the mounting direction, place the indicator light toward the front.**
  - **Provide the sensor with space of 30 mm or more on all sides.**
  - **Set it on DIN rail mounted on sheet metal.**

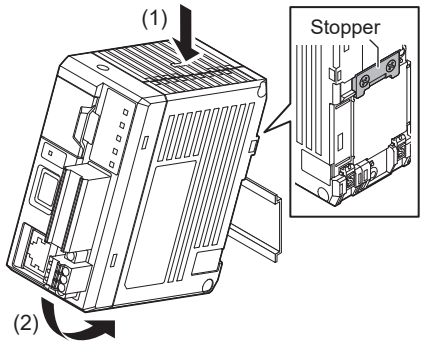




A: 30 mm or more

- **If the operating ambient temperature exceeds 40°C, confirm that the case temperature does not exceed the rated 65°C by appropriate heat dissipation measures after installation as specified by KEYENCE.**
  Measure the case temperature at the metal on the back of the sensor amplifier.

1 **Hook the stopper on the back of the sensor amplifier (center side) over the DIN rail (1) firmly, and then push the sensor amplifier in the arrow mark direction (2) until you hear a clicking sound.**



When detaching the sensor amplifier, push the upper part down to the front while pushing the sensor amplifier in the reverse direction of the (1) arrow mark (top).

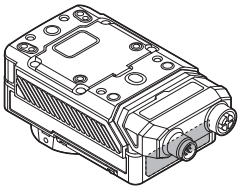
Mounting the built-in amplifier type sensor

- IV4-400CA
- IV4-500CA
- IV4-600CA
- IV4-400MA
- IV4-500MA
- IV4-600MA

Mounting the sensor

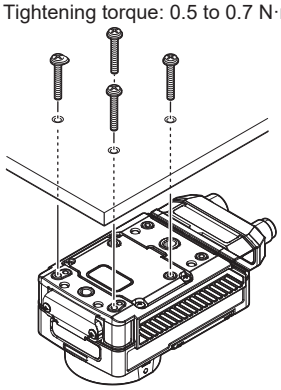
CAUTION

- For heat dissipation, attach the sensor to metal.
- When the temperature exceeds an operating ambient temperature of 40°C, after carrying out the installation stipulated by us, take an appropriate heat dissipation measure, and ensure that the case temperature does not exceed the rating of 75°C. Measure the case temperature on the side that has a sticker with the sensor model name.



Mounting onto mounting holes

- Mounting hole size: M3 depth 3.3 mm
- Tightening torque: 0.5 to 0.7 N·m



Reference In addition to the back M3 mounting hole, the sensor can be mounted on the back M2.5 (depth 3.4 mm, tightening torque: 0.2 to 0.3 N·m) and the front M4 (depth 4.1 mm, tightening torque: 0.8 to 1.2 N·m) hole.

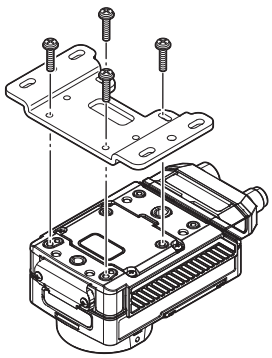
Attaching the optional mounting bracket

Common mounting bracket (OP-88911)

Attach the bracket using the screws included with the common mounting bracket (OP-88911).

- Tightening torque: 0.5 to 0.7 N·m

Mounting examples

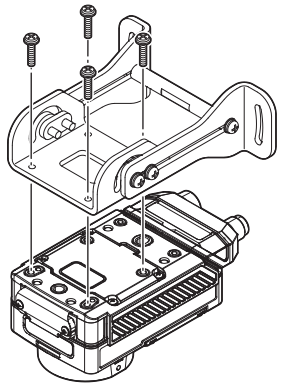


2-axis adjustment bracket (OP-88912)

1 Attach the bracket using the screws included with the 2-axis adjustment bracket (OP-88912).

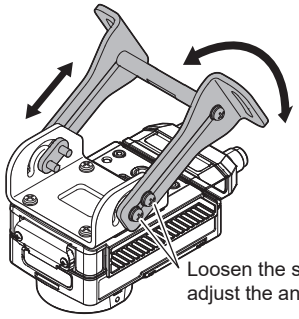
- Tightening torque: 0.5 to 0.7 N·m

Mounting examples



2 Loosen the screws on the left and right side of the mounting bracket, and adjust the angle and distance.

- Tightening torque: 1.0 to 1.5 N·m

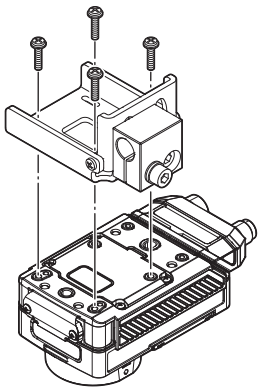


Adjustable bracket (OP-88913)

1 Attach the bracket using the screws included with the adjustable bracket (OP-88913).

- Tightening torque: 0.5 to 0.7 N·m

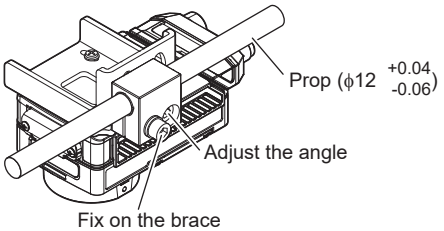
Mounting examples



2 Attach the bracket on the brace side, adjust the angle, and then fix the bracket with a bolt.

- Tightening torque: 10 to 12 N m

Mounting examples



Mounting the AI Lighting unit

NOTICE	When mounting or detaching the AI Lighting unit, turn off the power of the IV4 Series. Mounting or detaching the attachment while the power is on may cause a malfunction.

Mounting the AI Lighting unit onto the ultra-compact model sensor head

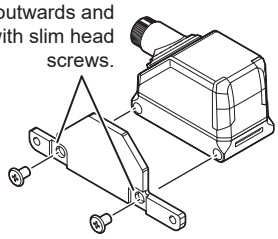
- IV4-LG4C
- IV4-LG5C
- IV4-LG6C
- IV4-LG4M
- IV4-LG5M
- IV4-LG6M

Mounting the AI Lighting unit (for the ultra-compact model)

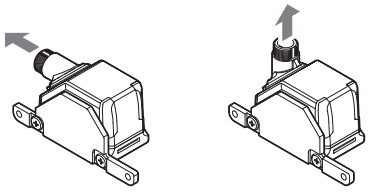
1 Mount the sensor head onto the head mounting bracket.

- Tightening torque: 0.6 to 0.8 N·m

Face the concave surface outwards and secure with slim head screws.

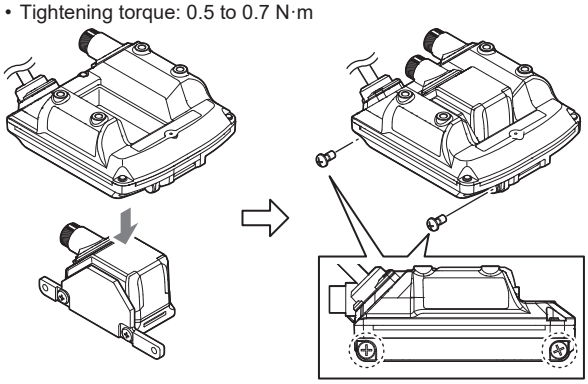


2 Rotate the head cable connector in the direction the cable will be extracted.



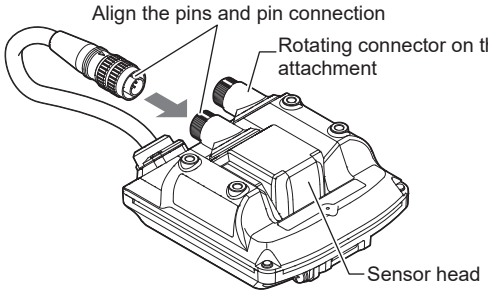
3 Mount the sensor head from the light side of the AI Lighting unit and then fix to the mounting holes with screws.

- Tightening torque: 0.5 to 0.7 N·m



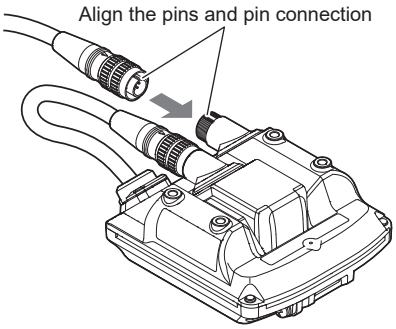
4 Connect the AI Lighting unit cable to the sensor head.

- Tightening torque: 0.6 to 0.8 N·m



5 Connect the sensor head/amplifier cable to the rotating connector on the AI Lighting unit.

- Tightening torque: 0.6 to 0.8 N·m



NOTICE	• To tighten the screw by hand, turn it until the connector of the cable touches the sensor head firmly. Then turn it more about by 5° using a tool such as pliers. • Do not rotate the rotating connector with the cable connected. Doing so may interfere with the base of the cable, causing damage. To rotate the rotating connector, make sure to disconnect the cable first.

Removing the AI Lighting unit (for the ultra-compact model)

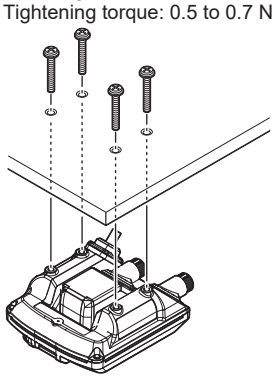
Perform removal in the reverse order.

Mounting the AI Lighting unit (for the ultra-compact model)

CAUTION	• For heat dissipation, attach the sensor to metal. • If the operating ambient temperature exceeds 40°C, confirm that the case temperature does not exceed the rated 65°C by appropriate heat dissipation measures after installation as specified by KEYENCE. Measure the case temperature at the side marked "IV4 Series".

Mounting onto mounting holes

- Mounting hole size: M3 depth 4.4mm
- Tightening torque: 0.5 to 0.7 N·m



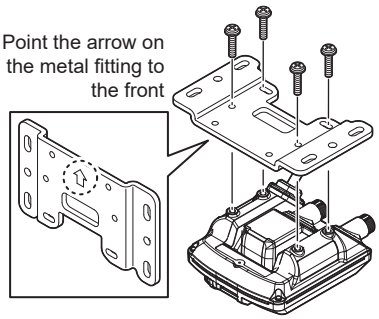
Attaching the optional mounting bracket

Common mounting bracket (OP-88911)

Attach the bracket using the screws included with the common mounting bracket (OP-88911).

- Tightening torque: 0.5 to 0.7 N·m

Mounting examples

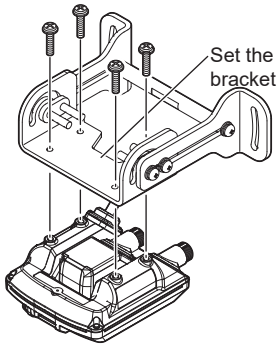


2-axis adjustment bracket for the AI Lighting unit (OP-88638)

1 Attach the bracket using the screws included with the 2-axis adjustment bracket (OP-88638).

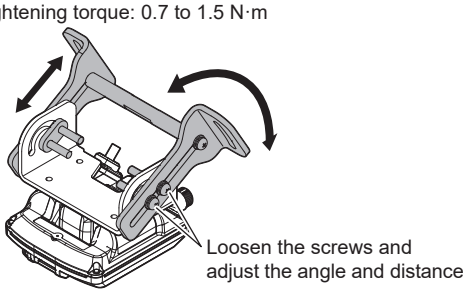
- Tightening torque: 0.5 to 0.7 N·m

Mounting examples



2 Loosen the screws on the left and right side of the mounting bracket, and adjust the angle and distance.

- Tightening torque: 0.7 to 1.5 N·m

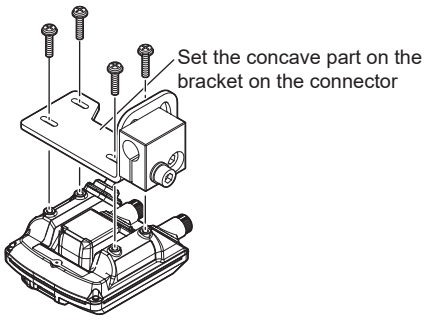


Adjustable bracket for the AI Lighting unit (OP-88639)

1 Attach the bracket using the screws included with the Adjustable bracket (OP-88639).

- Tightening torque: 0.5 to 0.7 N·m

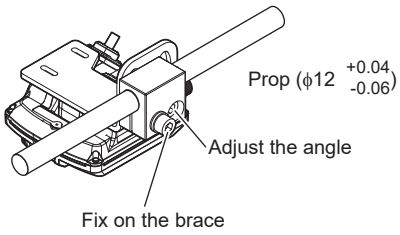
Mounting examples



2 Attach the bracket on the brace side, adjust the angle, and then fix the bracket with a bolt.

- Tightening torque: 7 to 9 N m

Mounting examples

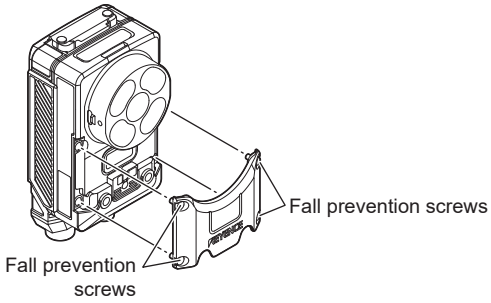


Mounting the AI Lighting unit onto the built-in amplifier type sensor

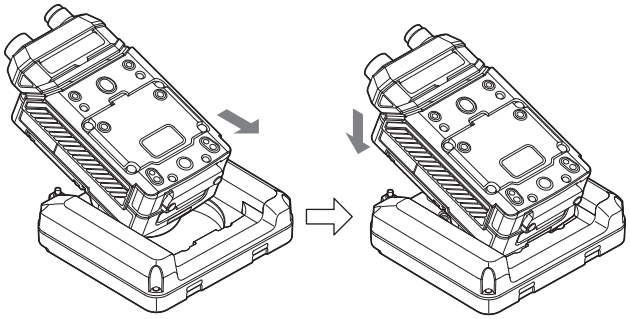
- IV4-L4C
- IV4-L5C
- IV4-L6C
- IV4-L4M
- IV4-L5M
- IV4-L6M

Mounting the AI Lighting unit (for the built-in amplifier type)

1 **Remove the connector cover on the front of the sensor.**



2 **Hook the groove on the sensor onto the hook of the AI Lighting unit, and push it in until it makes a clicking sound.**

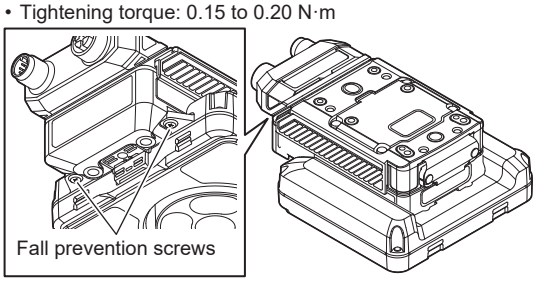


Hook the groove on the sensor onto the hook of the AI Lighting unit

Push until you hear the clicking sound.

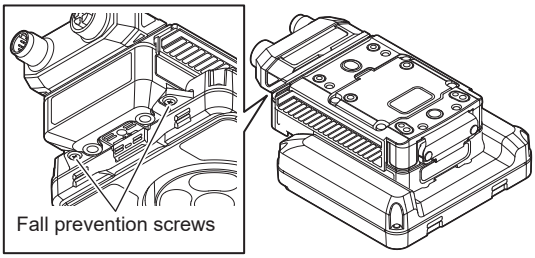
3 **Fix the sensor with two fall prevention screws.**

- Tightening torque: 0.15 to 0.20 N·m

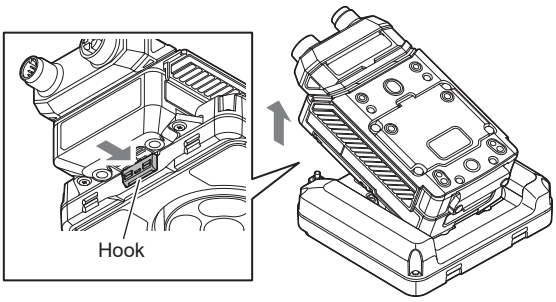


Removing the AI Lighting unit (for the built-in amplifier type)

1 **Loosen the fall prevention screws.**



2 **Remove the AI Lighting unit while pressing the hook at the bottom of the attachment.**



3 **Attach the connector cover on the front of the sensor.**

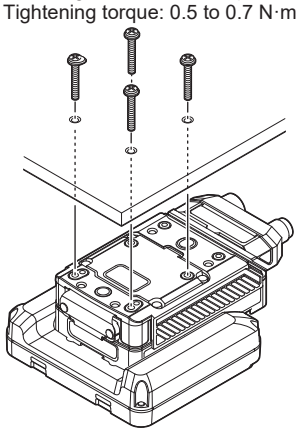
- Tightening torque: 0.15 to 0.20 N·m

Mounting the AI Lighting unit (for the built-in amplifier type)

CAUTION	For heat dissipation, attach the sensor to metal.

Mounting onto mounting holes

- Mounting hole size: M3 depth 3.3 mm
- Tightening torque: 0.5 to 0.7 N·m



Reference In addition to the back M3 mounting hole, the sensor can be mounted on the back M2.5 (depth 3.4 mm, tightening torque: 0.2 to 0.3 N·m) and the front M4 (depth 4.1 mm, tightening torque: 0.8 to 1.2 N·m) hole.

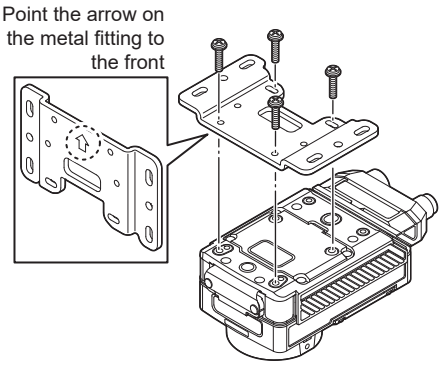
Attaching the optional mounting bracket

Common mounting bracket (OP-88911)

1 Attach the bracket using the screws included with the common mounting bracket (OP-88911).

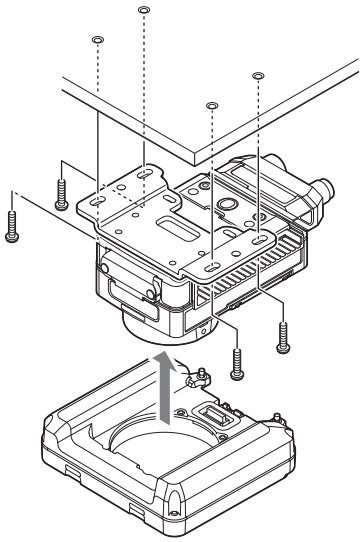
- Tightening torque: 0.5 to 0.7 N·m

Mounting examples



2 After fixing the common mounting bracket (OP-88911) to the mounting position, mount the AI imaging illumination unit onto the sensor.

Mounting examples

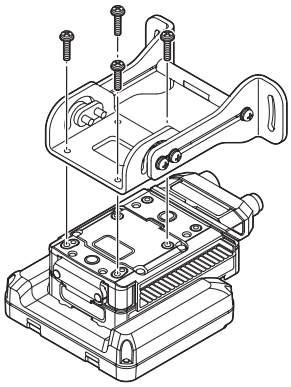


2-axis adjustment bracket (OP-88912)

1 Attach the bracket using the screws included with the 2-axis adjustment bracket (OP-88912).

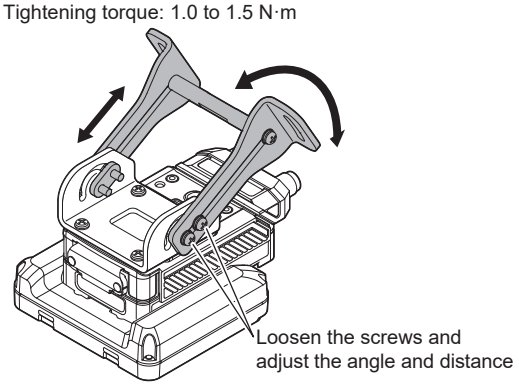
- Tightening torque: 0.5 to 0.7 N·m

Mounting examples



2 Loosen the screws on the left and right side of the mounting bracket, and adjust the angle and distance.

- Tightening torque: 1.0 to 1.5 N·m

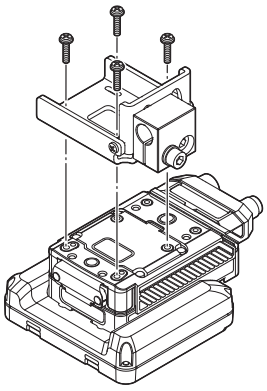


Adjustable bracket (OP-88913)

1 Attach the bracket using the screws included with the Adjustable bracket (OP-88913).

- Tightening torque: 0.5 to 0.7 N·m

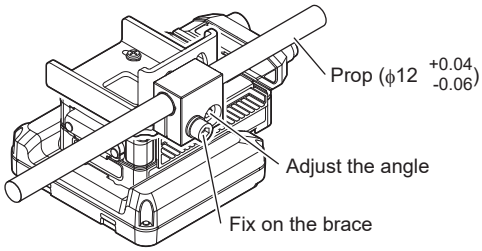
Mounting examples



2 Attach the bracket on the brace side, adjust the angle, and then fix the bracket with a bolt.

- Tightening torque: 10 to 12 N m

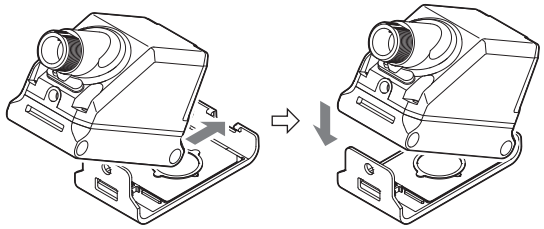
Mounting examples



Using the polarizing filter/magnifying lens attachment

Installing the polarizing filter for the ultra compact type (OP-88642/OP-88643)/ magnifying lens attachment for the ultra compact type (for standard type) (OP-88909)

1 **Hook the groove on the sensor head onto the hook of the polarizing filter, and push it in until you hear the clicking sound.**

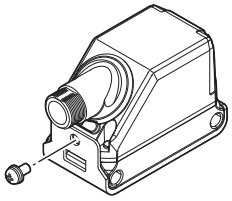


Hook the groove on the sensor head onto the hook

Push until you hear the clicking sound.

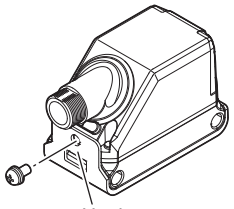
2 **Secure the polarizing filter/spread lens attachment with the included screw.**

- Tightening torque: 0.3 to 0.6 N•m



Removing the polarizing filter for the ultra compact type (OP-88642/OP-88643)/magnifying lens attachment for the ultra compact type (for standard type) (OP-88909)

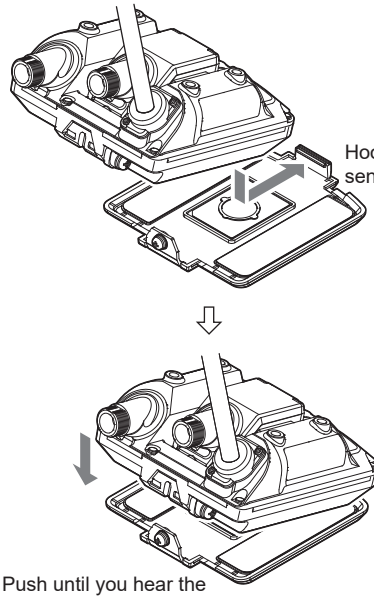
1 **Remove the screw and then remove the polarizing filter/spread lens attachment while pulling the hook forward.**



Hook

Mounting the polarizing filter for the AI Lighting unit (OP-88646/OP-88647): Ultra-compact model

1 **Hook the groove on the sensor head onto the hook of the polarizing filter, and push it in until you hear the clicking sound.**

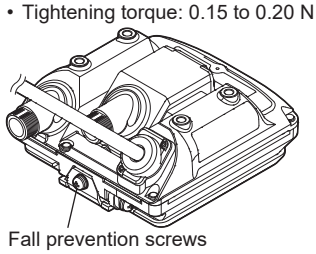


Hook the groove on the sensor head onto the hook

Push until you hear the clicking sound.

2 **Secure the polarizing filter.**

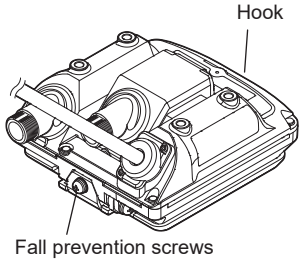
- Tightening torque: 0.15 to 0.20 N·m



Fall prevention screws

Removing the polarizing filter for the AI Lighting unit (OP-88646/OP-88647): Ultra-compact model

1 **Loosen the screw and then remove the polarizing filter while pulling the hook forward.**

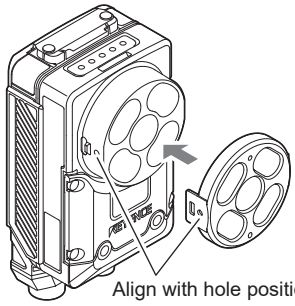


Hook

Fall prevention screws

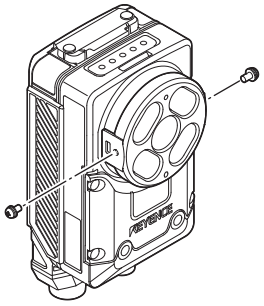
Mounting the polarizing filter for the built-in amplifier type (OP-88640/OP-88641)

1 Mount the polarizing filter by aligning the mounting hole on the polarizing filter with the mounting hole on the front of the sensor.



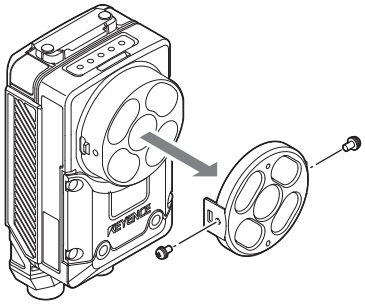
2 Secure the polarizing filter with the included screws.

- Tightening torque: 0.15 to 0.2N·m



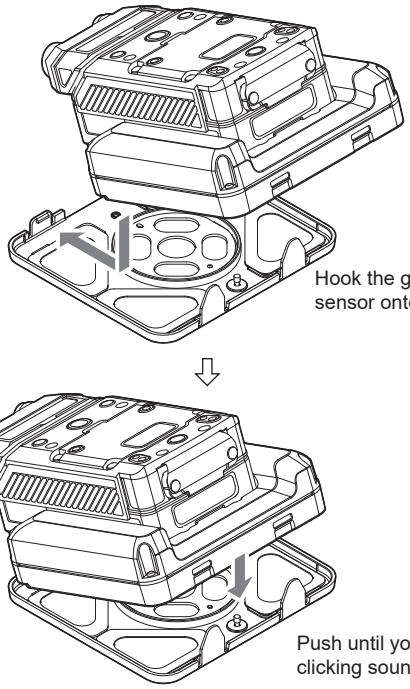
Removing the polarizing filter for the built-in amplifier type (OP-88640/OP-88641)

1 Remove the screws and then remove the polarizing filter.



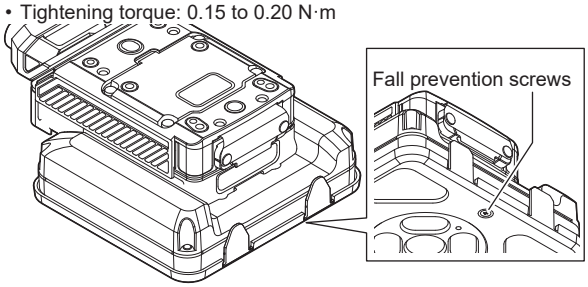
Mounting the polarizing filter for the AI Lighting unit for the built-in amplifier type (OP-88644/OP-88645)

1 Hook the groove on the sensor onto the hook of the polarizing filter, and push it in until you hear the clicking sound.



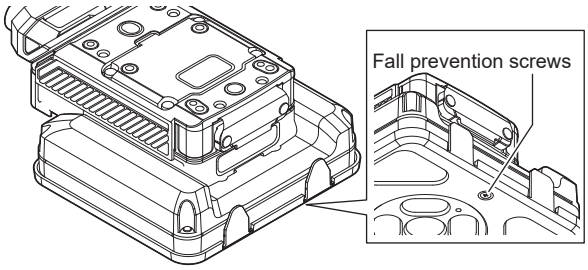
2 Secure the polarizing filter.

- Tightening torque: 0.15 to 0.20 N·m

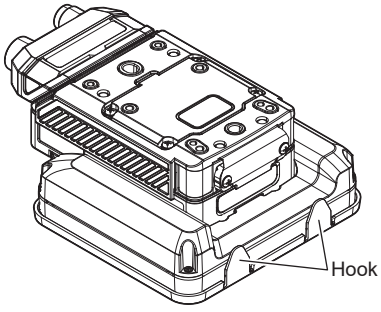


Removing the polarizing filter for the AI Lighting unit for the built-in amplifier type (OP-88644/OP-88645)

1 Loosen the screw on the polarizing filter.



2 Remove the polarizing filter while pulling the hook forward.



Mounting the dome attachment

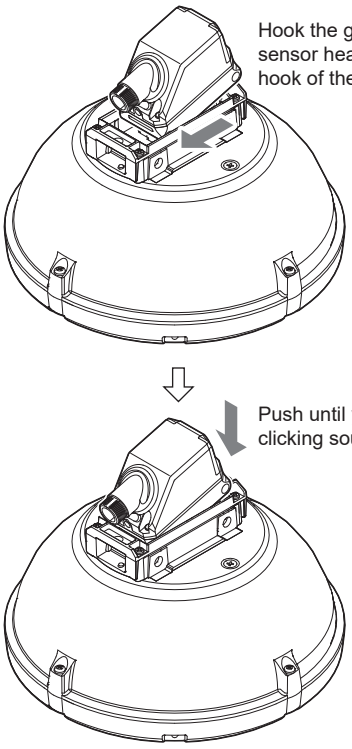
Mounting the dome attachment for the ultra-compact model (IV2-GD05/IV2-GD10)

Point

- **Use the dome attachment at a proper installation distance. Failure to do so may mitigate the effect.**
- **For the color type, adjust the white balance with the dome attachment mounted.**
  "White Balance (for color type only)" (page 7-23)

Mounting the dome attachment for the ultra-compact model

1 Hook the groove on the sensor head onto the hook of the dome attachment for the IV4 series, and push it in until you hear the clicking sound.

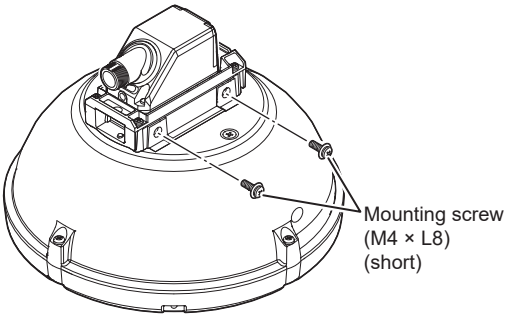


Point

- **Attach the sensor head so that the light-receiving part of the sensor head fits into the hole of the dome attachment for the IV4 series.**
- **If the engagement between the sensor head and the dome attachment is too tight, please spread the hook of the dome attachment by hand.**

2 Secure the dome attachment for the IV4 series with the included mounting screws.

- Tightening torque : 0.5N·m



NOTICE

Make sure to fix the dome attachment for the IV4 series with the mounting screws (M4 x L8) to prevent it from falling down.

- **If the attached mounting screws (M4 x L10) or screws with no double-washer sems are used, the sensor head may be damaged.**
- **The attached mounting screws (M4 x L10) are used for securing the mounting bracket.**
- **If the included mounting screws are not to be used, use double-washer sems screws (M4 x L8).**

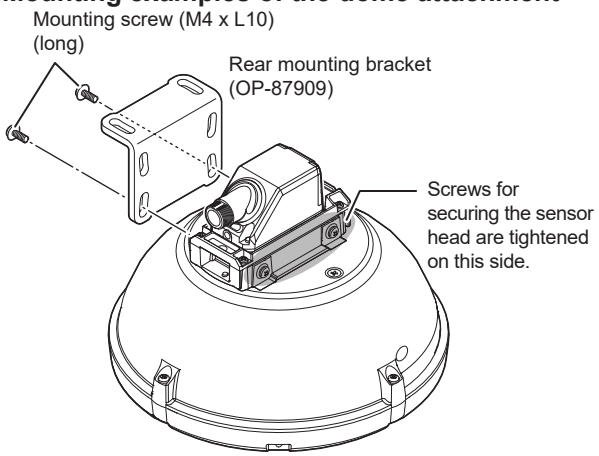
Point

- **Tighten the mounting screws on the one side of the sensor head. If they are to be used on the opposite side, tighten them on the same side.**
- **The mounting method for the IV2-GD10 is described here. The IV-2GD05 can also be mounted in the same way.**

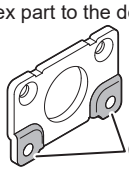
Reference

The vertical mounting bracket for the IV4 series (OP-87908), rear mounting bracket for the IV4 series (OP-87909), or adjustable bracket for the IV4 series (OP-87910) can be used with the dome attachment for the IV4 series mounted on the sensor head.
To use the bracket, attach it on the other side of the sensor head on which the mounting screws (M4 x L8) were tightened in step 2.
To attach the bracket, use the two attached mounting screws (M4 x L10).

Mounting examples of the dome attachment



To attach the adjustable bracket for the IV4 series (OP-87910), connect the convex part to the dome attachment for the IV4 series.

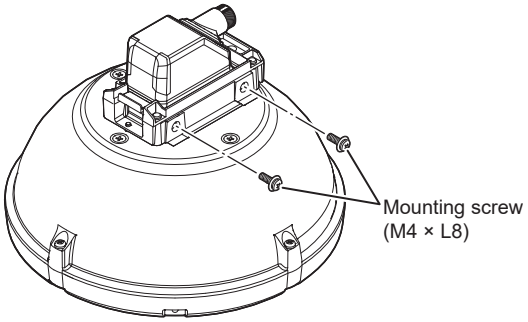


NOTICE	**If a sensor head with the dome attachment for the IV4 series attached is to be directly mounted to sheet metal, pay attention to the following items:** **• If they are to be secured from the sheet metal side with screws, be sure to use M4 screws (whose length of screw engagement should be 2.5 to 3.5 mm), and the tightening torque should be 0.7 to 1.5 N·m.** **• If the screws are to be secured from the sensor head side, be sure to use the M3 screws "double-washer sems screws" or else "screws with spring washer and flat washer" should be used, and the tightening torque should be 0.5 N·m. If screws larger than M4 are used, the sensor head will be damaged.**

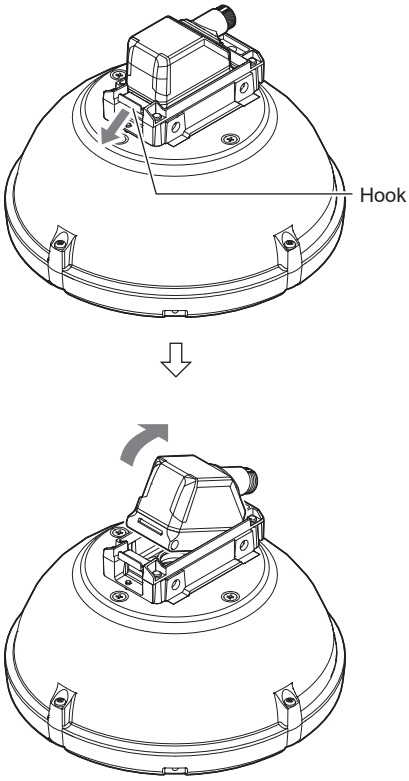
Reference When the dome attachment is used for the wide field of view sensor model of the IV series, the field of view will be narrower than the case when the dome attachment is not used, because an area that cannot be viewed will exist in a corner of the field of view. Confirm that there is no problem before using it.

Removing the dome attachment

1 Dismount the screw.



2 Dismount by lifting the front part of the sensor head, while pulling out the hook of the dome attachment for the IV4 series.



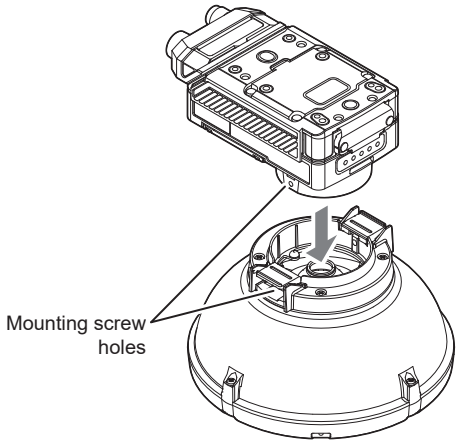
Mounting the dome attachment for built-in amplifier type (IV3-D10)

Point

- Use the dome attachment at a proper installation distance. Failure to do so may mitigate the effect.
- For the color type, adjust the white balance with the dome attachment mounted.
  "White Balance (for color type only)" (page 7-23)

Mounting the dome attachment for the built-in amplifier type

1 Align the mounting screw holes on the sensor with the mounting screw holes on the dome attachment, push the sensor all the way into the attachment.

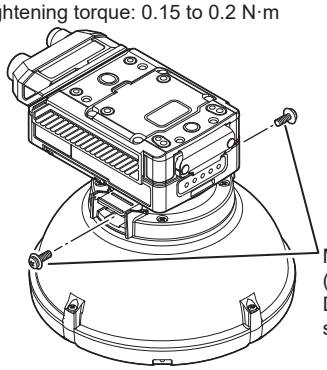


Point

If the engagement between the sensor head and the dome attachment is too tight, please spread the hook of the dome attachment by hand.

2 Secure the dome attachment for the IV4 series with the included mounting screws.

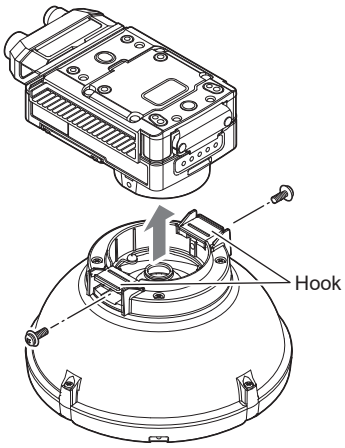
- Tightening torque: 0.15 to 0.2 N·m



NOTICE	Make sure to fix the dome attachment with the mounting screws (M2.5 x L8) to prevent it from falling down. • If screws with no double-washer sems are used, the sensor head may be damaged. • If the included mounting screws are not to be used, use double-washer sems screws (M2.5 x L8).

Removing the dome attachment

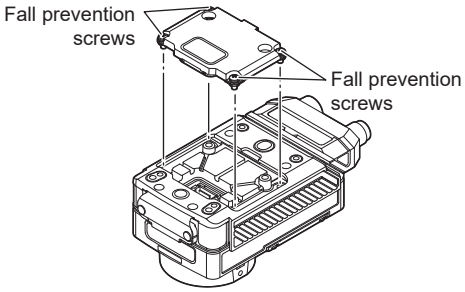
1 Remove the mounting screws and lift the sensor to remove it while pushing out the hooks of the dome attachment.



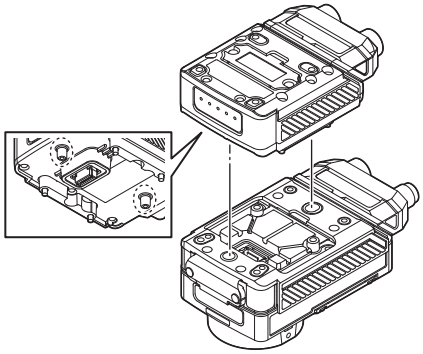
Mounting the communication unit

Mounting on the built-in amplifier model

1 **Remove the connector cover on the top of the sensor.**

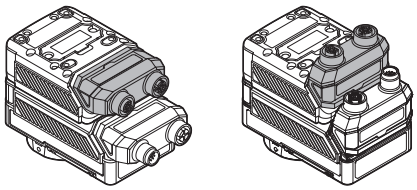


2 **Insert the convex points of the communication unit to the concave points of the sensor to connect them.**



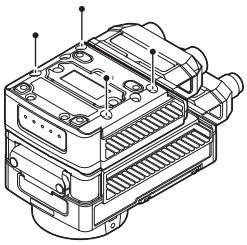
Point

To change the direction of the cables extended from the sensor and the communication unit, rotate the connectors before mounting the communication unit. Once the communication unit is connected, you cannot rotate the connectors because they block each other.



3 **Fix the sensor with four fall prevention screws.**

- Tightening torque: 0.25 to 0.3 N·m



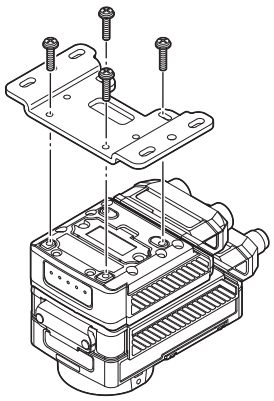
Attaching the optional mounting bracket

Common mounting bracket (OP-88911)

Attach the bracket using the screws included with the common mounting bracket (OP-88911).

- Tightening torque: 0.5 to 0.7 N·m

Mounting examples

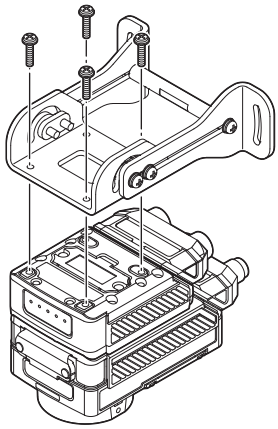


2-axis adjustment bracket (OP-88912)

1 **Attach the bracket using the screws included with the 2-axis adjustment bracket (OP-88912).**

- Tightening torque: 0.5 to 0.7 N·m

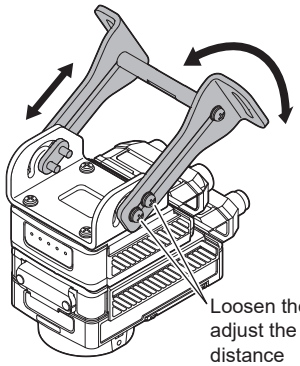
Mounting examples



2 **Loosen the screws on the left and right side of the mounting bracket, and adjust the angle and distance.**

- Tightening torque: 1.0 to 1.5 N·m

Mounting examples

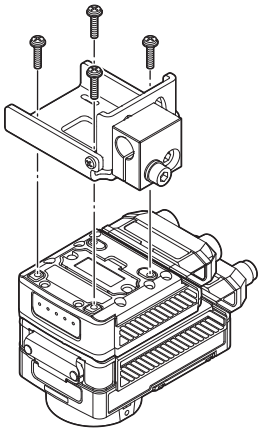


Adjustable bracket (OP-88913)

1 Attach the bracket using the screws included with the adjustable bracket (OP-88913).

- Tightening torque: 0.5 to 0.7 N·m

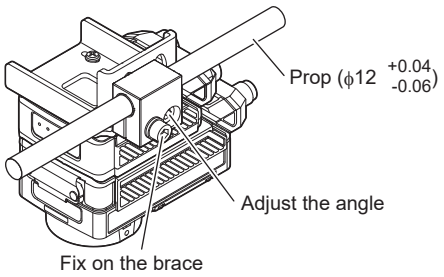
Mounting examples



2 Attach the bracket on the brace side, adjust the angle, and then fix the bracket with a bolt.

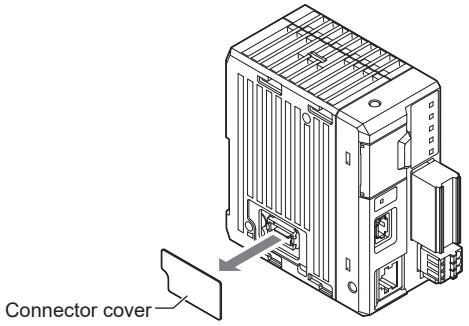
- Tightening torque: 10 to 12 N·m

Mounting examples

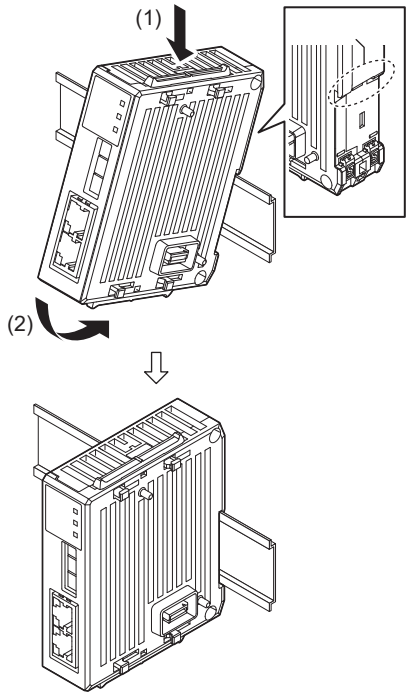


Mounting on the ultra-compact model sensor amplifier

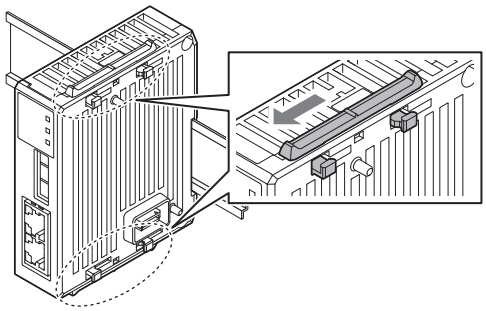
1 **Remove the connector cover on the side of the sensor amplifier.**



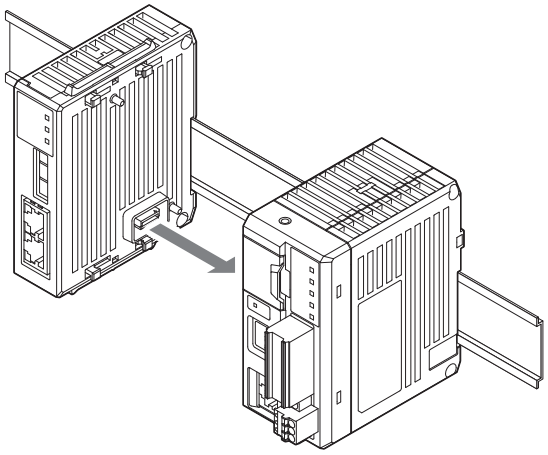
2 **Hook the stopper on the back of the communication unit (center side) over the DIN rail (1) firmly, and then push the communication unit in the arrow mark direction (2) until you hear the clicking sound.**



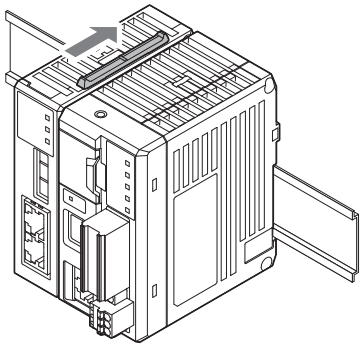
3 **Slide forward the lock levers at the top and bottom of the communication unit to unlock the rail.**



4 **Insert the lock lever of the communication unit into the lock lever slot of the sensor amplifier to connect them.**



5 **Slide backward the lock levers at the top and bottom of the communication unit to lock the rail.**



Mounting the control panel

Mounting to a wall

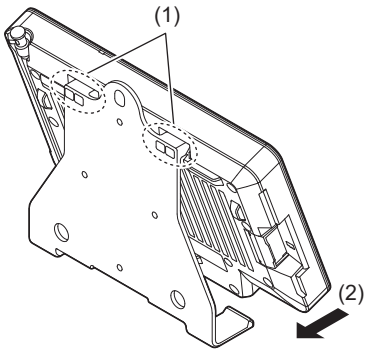
Use the wall mounting adapter (accessories or OP-88914).
Hang the control panel on a hook with the wall mounting adapter mounted to the control panel, or mount the control panel to the wall mounting adapter that is mounted on the wall.

Reference The control panel is shipped installed on the wall mounting adapter.

Hanging on a hook

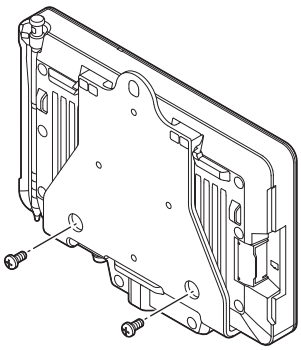
While operating, take the control panel from the hook and hold it in your hands.

1 Mount the control panel to the wall mounting adapter by hooking the stopper of the wall mounting adapter to the groove on the rear control panel (1) and then pushing the control panel in the direction of the arrow (2).

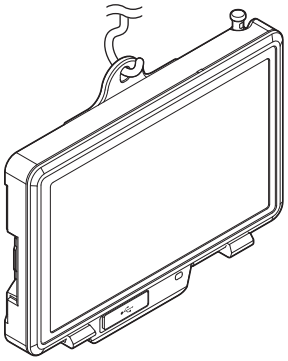


2 Secure the wall board mounting adapter to the control panel with screws.

- Screws: M3 x 2 (use the included screws)
- Tightening torque: 0.3 to 0.5 N·m



3 Hang the control panel on a hook.



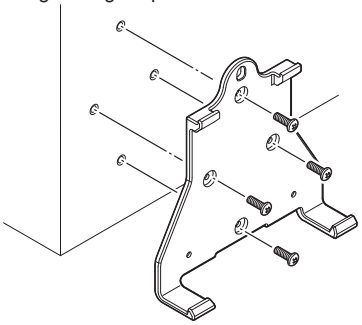
Mounting with the wall mounting adapter

The monitor can be operated using the following methods:
- Remove the control panel from the wall mounting adapter and operate while holding in your hand.
- Operate the control panel while mounted on the wall.

1 Mount the wall mounting adapter to the wall.

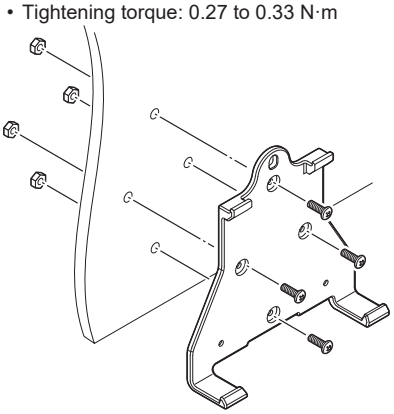
Mounting by creating a screw hole in the wall

- Screw: M3 x 4
  Use the attached screws.
- Tightening torque: 0.27 to 0.33 N·m



Mounting by creating a plated through hole on a panel

- Screw: M3 x 4, Nut: M3 x 4
  Use the attached screws and nuts.
- Mountable board thickness: 5 mm or less
- Tightening torque: 0.27 to 0.33 N·m

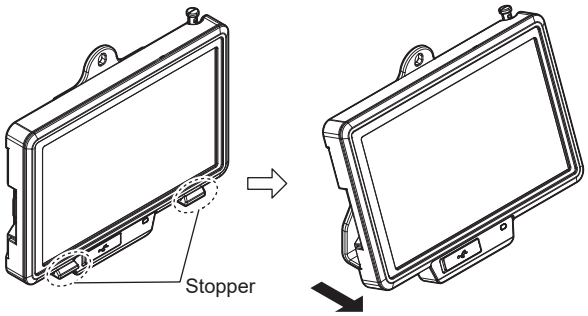


2 Mount the control panel onto the wall mounting adapter.

Mount it using the same procedure as “Hanging on a hook” (page 2-18).

Detaching from the wall mounting adapter

Release the stopper on the wall mounting adapter and pull the lower part of the control panel toward the arrow to remove it.



Mounting on a control board

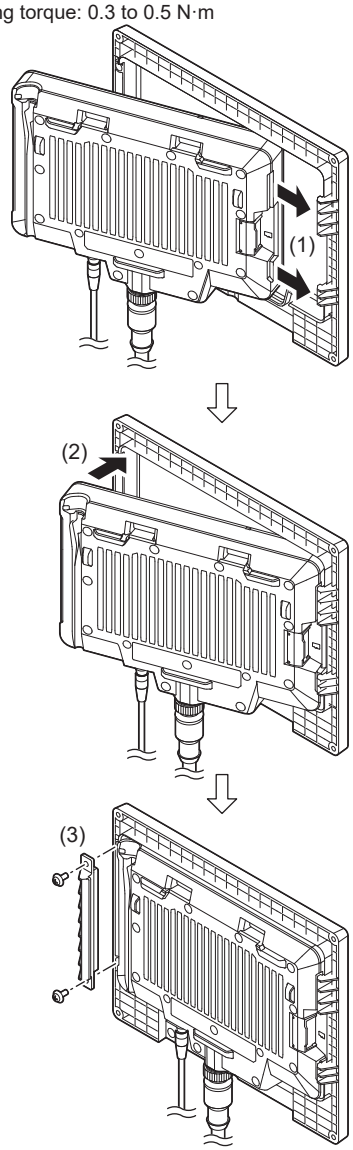
Secure the control panel on a control board or similar device to operate it.
Mount the control board mounting adapter (OP-88915) on the control panel to be mounted on the board surface.

1 Connect the power cable and Ethernet cable to the control panel.

“Cables” (page 2-21)

2 Hook the control panel onto the stopper on the control panel mounting bracket (1), push the control panel toward the arrow (2) to mount it, and then attach and secure the fixture (3).

- Tightening torque: 0.3 to 0.5 N·m



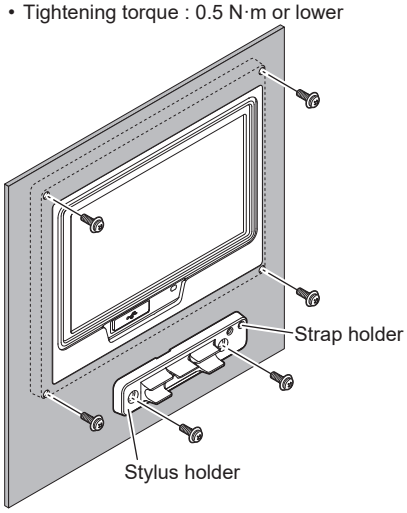
3 Mount the control panel where the control board mounting bracket is installed from the rear and secure it with the screws. Also secure the stylus holder in any desired position.

Control board mounting bracket

- Open the hole for embedding with 140 mm x 189 mm on the board surface.
- Mountable board thickness: 1 to 4 mm
- Screw : M3, 8 mm long, with a washer x4
  Use the attached screws.
- Tightening torque : 0.5 N·m or lower

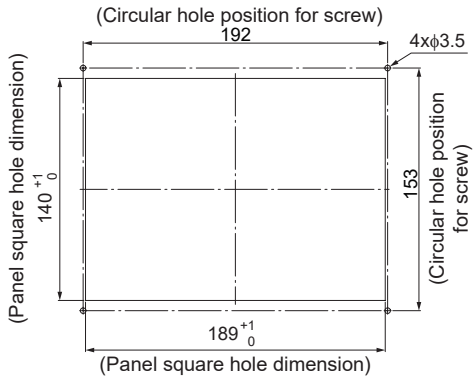
Stylus holder

- Screw: M3, 8 mm long, with a washer x 2
  Use the attached screws.
- Tightening torque : 0.5 N·m or lower



Reference The stylus can be hung from the strap holder on the stylus holder using the hanging string (accessory).

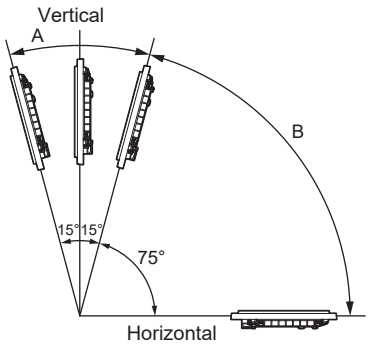
Panel cutting dimensions



Installation angle

The installation angle is limited by the operating ambient temperature.
Adjust the angle to suit your needs.

	Operating ambient temperature
Range A	0 to 50˚C
Range B	0 to 40˚C

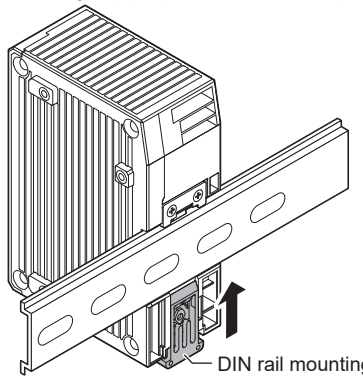


Mounting the Display Expansion Unit

NOTICE	**Do not install the display expansion unit in an environment that exceeds its environmental resistance limit, or an environment that propagates vibration directly to the unit. Those may cause a damage or malfunction.**

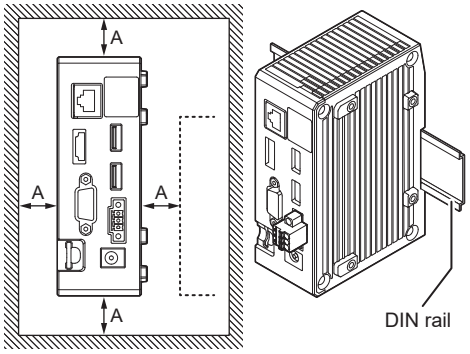
Mounting the unit on a DIN rail

Hook the display expansion unit to the DIN rail with the DIN rail mounting stopper pulled out, and then push the stopper in to secure.



NOTICE

- **Mount the display expansion unit as follows for heat release.**
  - **For the mounting direction, place the indicator light toward the front.**
  - **Provide the sensor with space of 30 mm or more on all sides.**
  - **Set it on DIN rail mounted on sheet metal.**

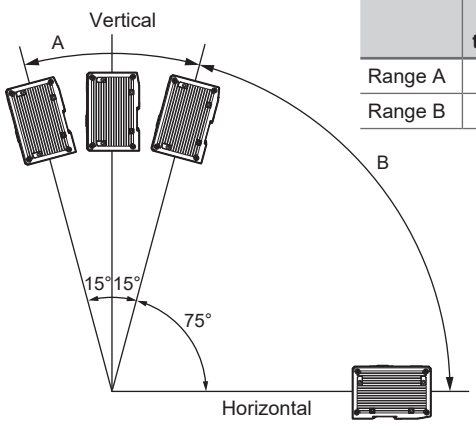


A: 30 mm or more

- **When installed horizontally, the operating ambient temperature is up to 40°C.**

Installation angle

The installation angle is limited by the operating ambient temperature.
Adjust the angle to suit your needs.

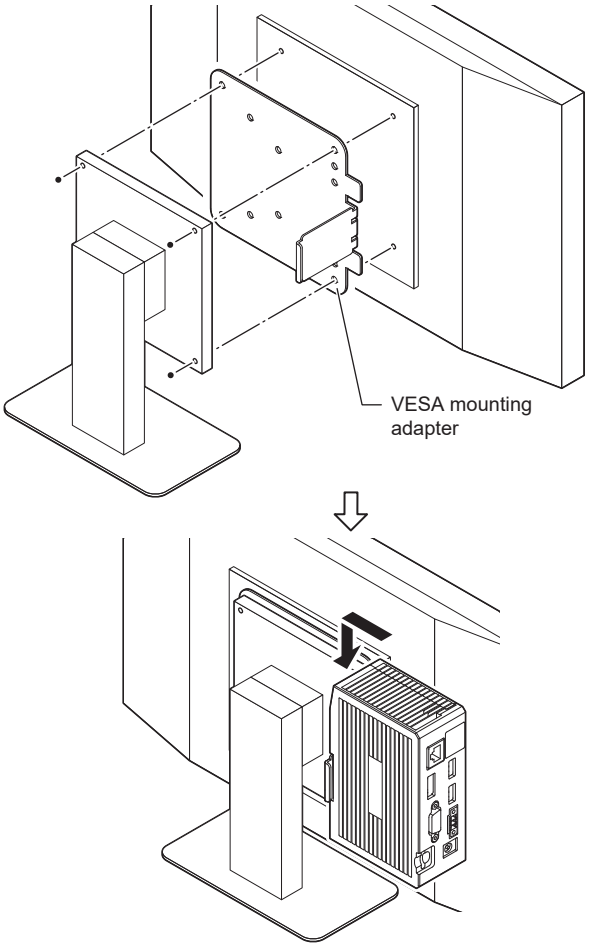


	Operating ambient temperature
Range A	0 to 50˚C
Range B	0 to 40˚C

Mounting the unit on a commercially available monitor (Using OP-88917 (VESA mounting adapter))

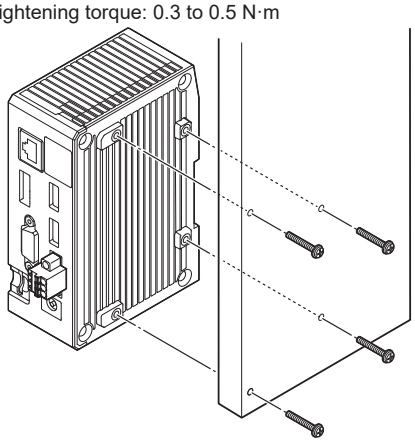
1 **Mount the commercially available monitor on a VESA mounting adapter.**

2 **Mount the display expansion unit to the VESA mounting adapter using the same procedure as mounting on a DIN rail.**



To use the mounting holes

- Screw: M3 x 4
- Tightening torque: 0.3 to 0.5 N·m

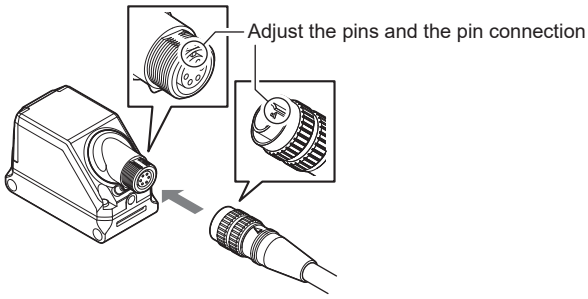


Cables

Wiring the ultra-compact model

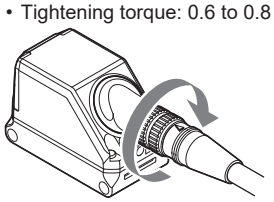
Connecting the sensor head/amplifier cable and sensor head

1 Connect the cable to the sensor head as shown below.



2 Tighten the connector by turning the screw on the connector in the clockwise direction.

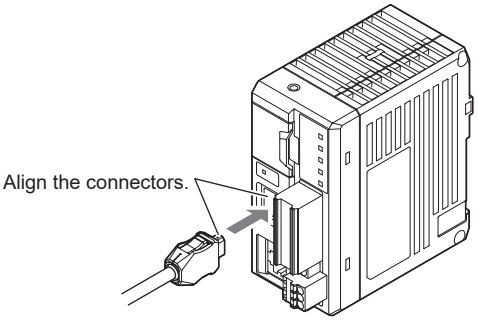
- Tightening torque: 0.6 to 0.8 N·m



NOTICE	**To tighten the screw by hand, turn it until the connector of the cable touches the sensor head firmly. Then turn it more about by 5° using a tool such as pliers.**

Connecting the sensor head/amplifier cable and sensor amplifier

Align the connectors and insert the cable until a clicking sound is made.

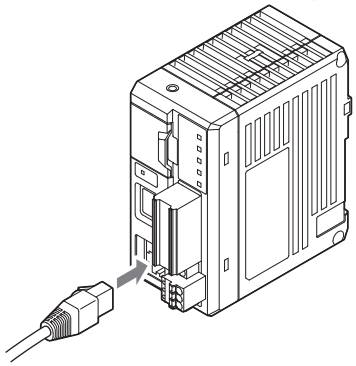


To disconnect the cable, push in the tabs on both sides of the connector and pull out the connector.

Connecting the cable to the sensor amplifier

Connecting the Ethernet cable or LAN cable

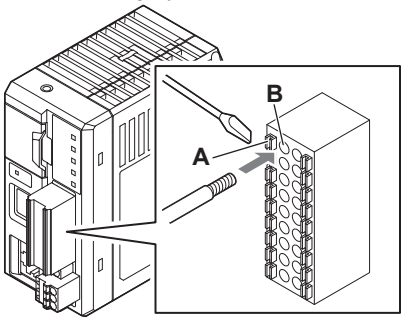
Connect the cable to the sensor amplifier as shown below.



To disconnect the cable, pull the cable while pushing in the tab on the Ethernet cable.

Wiring the I/O terminal block

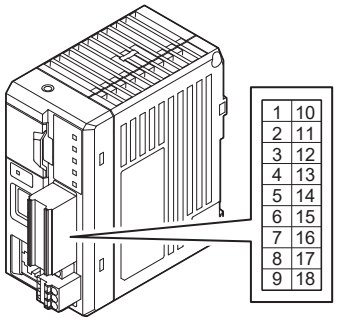
Insert the wire to B by pushing A in with a screwdriver.
Pull the wire slightly to confirm that it is secured.



CAUTION	**Use a wire with 60°C or higher temperature rating as the electrical wire.**

NOTICE	**Follow the instructions shown below to avoid damage caused by bad connections.** **• The nominal cross-sectional area of the wire for connecting the push type terminal block should be 0.2 mm^2 to 1.5 mm^2 (AWG16 to 26).** **• The stripped part of the wire should not be soldered (pre-soldered).** **• Length of the insulation removed from the wire should be around 10 mm.** **• Insert the wires all the way into the power terminal block.** **• Wire the power cables directly or using bar terminals into the terminal block.**

Connector pin layout



Terminal No.	Name	Assigning default value	Description
1	IN1	Ext. Trigger ↑	Set external trigger. Rising timing (↑) or falling timing (↓) can be set.
2	IN2	OFF	Input assignable function • Program bit0 to bit6 • Clear Error • Ext. Master Save • SD Card Save Stop • OCR Sequential Number Count-up • Reset Count • OFF (not used)
3	IN3	OFF	
4	IN4	OFF	
5	IN5	OFF	
6	IN6	OFF	
7	IN7	OFF	
8	IN8	OFF	
9	Unused	Unused	Unused
10	OUT1	Total Status OK (N.O.)	Output assignable function • Total Status OK/NG • RUN • BUSY • Error • SD card error • Status result of each tool • Logical operation result of each tool • Type discrimination result • Master judgment result • Trigger Ready • Strobe • Transfer file • Insufficient SD card capacity • AI Trigger Output • OFF (not used) (In AI Through Count Mode) • Count up for each tool • Status Output 1 • Status Output 2
11	OUT2	BUSY (N.O.)	
12	OUT3	Error (N.C.)	
13	OUT4	OFF	
14	OUT5	OFF	
15	OUT6	OFF	
16	OUT7	OFF	
17	OUT8	OFF	
18	OUT COM	OUT COM	Output Common

Compatible cable specification: AWG16 to 26

Reference The output assignment, N.O./N.C., and input line assignment can be changed.
“I/O Settings” (page 7-13)

NOTICE	**For input cables of this sensor, connect with non-contact output (transistor output/SSR output). For contact output (relay output), incorrect input may occur due to contact bouncing.**

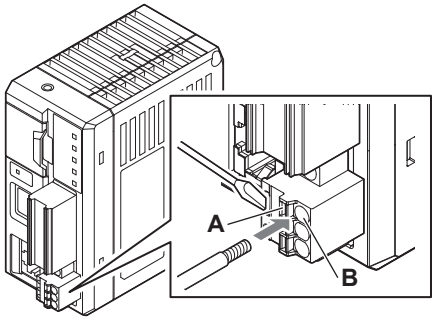
Supplying power to the sensor amplifier

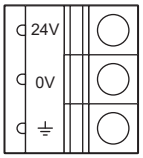
The power terminal block is mounted on the front of the sensor amplifier.

CAUTION	**Use a wire with 60°C or higher temperature rating for the power source.**
NOTICE	**Follow the instructions shown below to avoid damage caused by bad connections.** **• The nominal cross-sectional area of the wire for connecting the power should be 0.8 mm² to 1.3 mm² (AWG16 to 18).** **• The length of the insulation removed from the wire should be around 9 mm.** **• The stripped part of the wire should not be soldered (pre-soldered).** **• Insert the wires all the way into the power terminal block.** **• Wire the power cables directly or using bar terminals into the terminal block.**

1 Insert the wire to B by pushing A in with a screwdriver.

Pull the wire slightly to confirm that it is secured.





24V Insert a wire into the 24 V DC slot on the power supply.

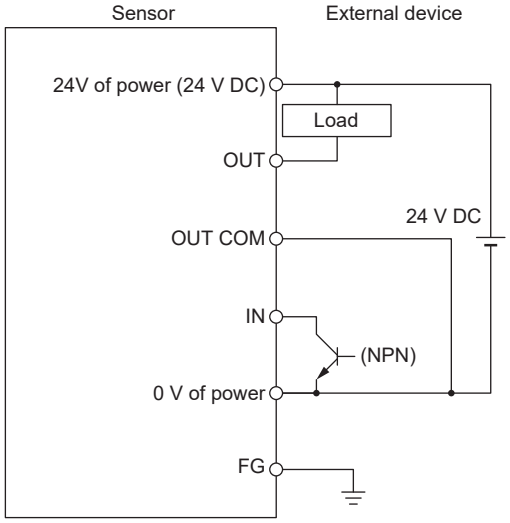
0V Insert a wire into the 0 V slot on the power supply.

⏚ Ground.

Connection diagram

Selecting NPN output

When NPN is selected as the Polarity



Point **OUT COM is a common terminal for OUT. Be sure to connect it to 0V of the power supply.**

Electrical specifications

Input circuit: non-voltage input
- ON voltage : 2 V or lower
- OFF current : 0.1 mA or lower
- ON current : 2 mA (short circuit)

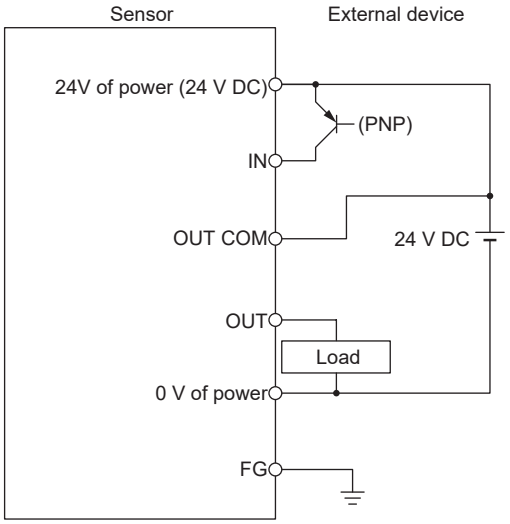
Output circuit
- Maximum rating : 30 V, 50 mA
- Remaining voltage : 1.5 V or lower (at 20 mA)

NOTICE **Make sure to keep a total of each output with 160 mA or less.**

Reference
- 0 V (power supply) and FG are insulated.
- The residual voltage is 2.0 V at 50 mA.

Selecting PNP output

When PNP is selected as the Polarity



Point **OUT COM is a common terminal for OUT. Be sure to connect it to 24V of the power supply.**

Electrical specifications

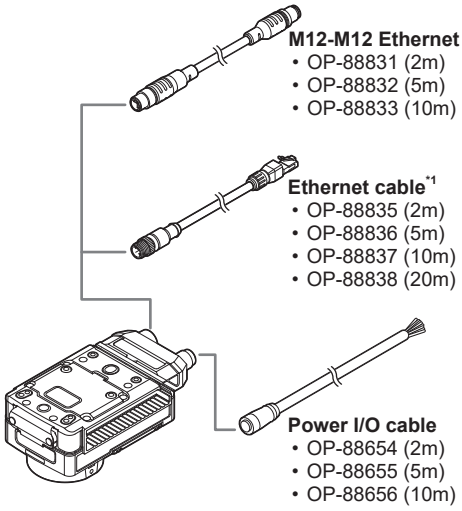
Input circuit: voltage input
- Maximum input rating : 30 V
- ON voltage : 18 V or higher
- OFF current : 0.15 mA or lower
- ON current : 2 mA (at 24 V)

Output circuit
- Maximum rating : 30 V, 50 mA
- Remaining voltage : 1.5 V or lower (at 20 mA)

NOTICE **Make sure to keep a total of each output with 160 mA or less.**

Reference
- 0 V (power supply) and FG are insulated.
- Use OUTCOM and 0 V of power with a potential difference of 30 V or low.
- The residual voltage is 2.0 V at 50 mA.

Wiring the built-in amplifier type



M12-M12 Ethernet cable[*1]
- OP-88831 (2m)
- OP-88832 (5m)
- OP-88833 (10m)

Ethernet cable[*1]
- OP-88835 (2m)
- OP-88836 (5m)
- OP-88837 (10m)
- OP-88838 (20m)

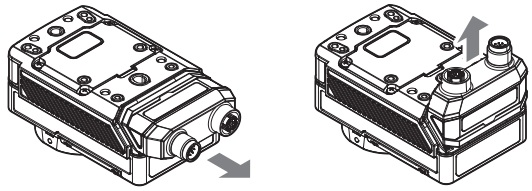
Power I/O cable
- OP-88654 (2m)
- OP-88655 (5m)
- OP-88656 (10m)

*1 Supports PoE (Power over Ethernet)

Reference "When supplying power with the PoE (Power over Ethernet)" (page 2-26)

Changing the direction of the cable

1 Rotate the rotating connector to determine the direction the cable is to be pulled out.



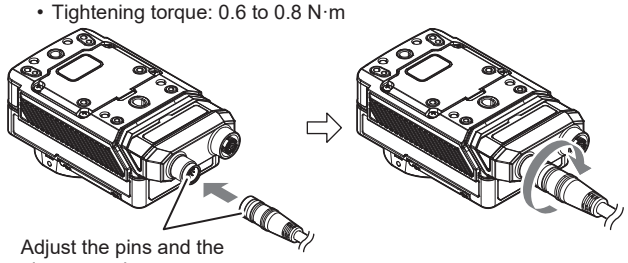
Connecting the cable

NOTICE	**When supplying the power with PoE, do not connect the power I/O cable.**

When supplying power with the Power I/O cable

1 Align the pins of the connector for the power I/O cable with the protrusion connection of the cable connector, and connect the cable to the sensor. And then, tighten the connector by turning the screw on the connector in the clockwise direction.

- Tightening torque: 0.6 to 0.8 N·m



Adjust the pins and the pin connection

NOTICE	**When connecting the connector, insert it without tipping and tighten it well.** **If the tightening is weak, vibration can loosen the connector and cause bad connections.** **Also, the enclosure rating may not be maintained with loose connection.** *** After tightening the connector screw by hand, retighten it approximately 90° to 120° with pliers or similar tool.**

Connect the Ethernet cable in the same way as needed.

2 Wire each cable according to its intended purpose.

Wiring color

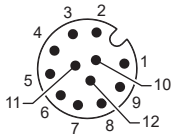
Wiring color	Pin No.	Name	Assigning default value	Description
Brown	1	DC24	-	+ side of power
Blue	2	0V	-	- side of power
Pink	6	IN1	Ext. Trigger ↑	Set external trigger. Rising timing (↑) or falling timing (↓) can be set.
Yellow	4	IN2	OFF	Input assignable function • Program bit0 to bit6 • Clear Error • Ext. Master Save • SD Card Save Stop • OCR Sequential Number Count-up • Reset Count • OFF (not used)
Light blue	5	IN3	OFF	
Black	9	OUT1	Total Status OK	Output assignable function • Total Status OK/NG • RUN • BUSY • Error • SD card error • Status result of each tool • Logical operation result of each tool • Type discrimination result • Master judgment result • Trigger Ready • Strobe • Transfer file • Insufficient SD card capacity • AI Trigger Output • OFF (not used)
White	10	OUT2	BUSY	
Gray	11	OUT3	Error	
Purple	3	I/O1*	OFF	
Green	7	I/O2*	OFF	
Red	8	I/O3*	OFF	(In AI Through Count Mode) • Count up for each tool • Status Output 1 • Status Output 2
Orange	12	OUTCOM	-	Output Common

*The I/O1 to I/O3 can be used by individually selecting IN/OUT.

Cable specification

- Brown / Blue : AWG22
- Black / White / Gray / Orange : AWG25
- Peach / Yellow / Light blue / Purple / Green / Red: AWG28 (without shield)

Connector pin layout



Reference The output assignment, N.O./N.C., and input/output cable assignment can be changed.

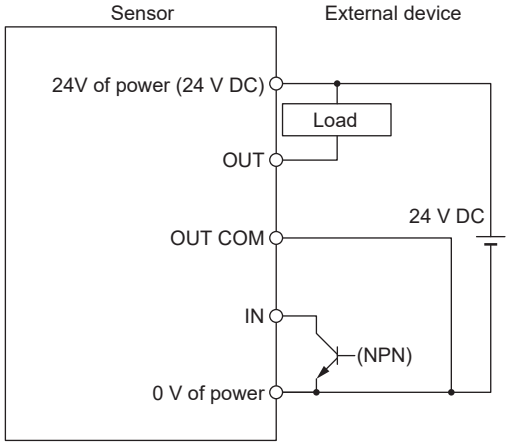
Use by assigning the optional function to IN1 to IN3, OUT1 to OUT3, and I/O1 to I/O3.
For the input-output switching method of I/O1 to I/O3, refer to "I/O Mapping (Built-In Amplifier Type)" (page 7-16).

NOTICE	**• Individually insulate the unused input-output cables.** **• For input cables of this sensor, connect with non-contact output (transistor output/SSR output). For contact output (relay output), incorrect input may occur due to contact bouncing.**

Connection diagram

Selecting NPN output

When NPN is selected as the Polarity



Point **OUT COM is a common terminal for OUT. Be sure to connect it to 0V of the power supply.**

Electrical specifications

Input circuit: non-voltage input
- ON voltage : 2 V or lower
- OFF current : 0.1 mA or lower
- ON current : 2 mA (short circuit)

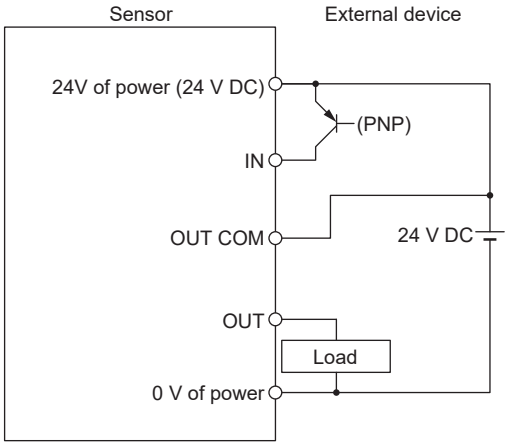
Output circuit
- Maximum rating : 30 V, 20mA
- Remaining voltage : 1.5 V or lower (at 20 mA)

NOTICE **Make sure to keep a total of each output with 120mA or less.**

Reference
- 0 V (power supply) and FG are insulated.
- The residual voltage is 2.0 V at 50 mA.

Selecting PNP output

When PNP is selected as the Polarity



Point **OUT COM is a common terminal for OUT. Be sure to connect it to 24V of the power supply.**

Electrical specifications

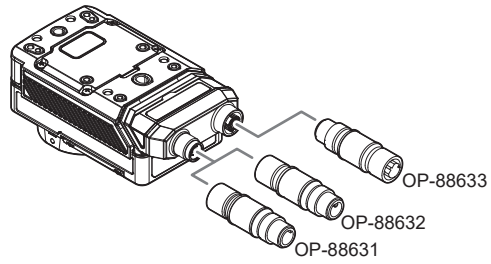
Input circuit: voltage input
- Maximum input rating : 30 V
- ON voltage : 18 V or higher
- OFF current : 0.15 mA or lower
- ON current : 2 mA (at 24 V)

Output circuit
- Maximum rating : 30 V, 20mA
- Remaining voltage : 1.5 V or lower (at 20 mA)

NOTICE **Make sure to keep a total of each output with 120mA or less.**

Reference
- Use OUTCOM and 0 V of power with a potential difference of 30 V or low.
- For the wiring color when using the power I/O cable, refer to "Wiring color" (page 2-24).
- The residual voltage is 2.0 V at 50 mA.

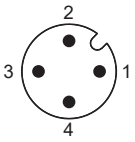
Connect the conversion connector



Align the recessed part of the conversion connector with the protruding part of the connector on the sensor side, and connect the conversion connector to the sensor. Then, tighten the connector by turning the screw on the connector in the clockwise direction.
Tightening torque : 0.6 to 0.8 N·m

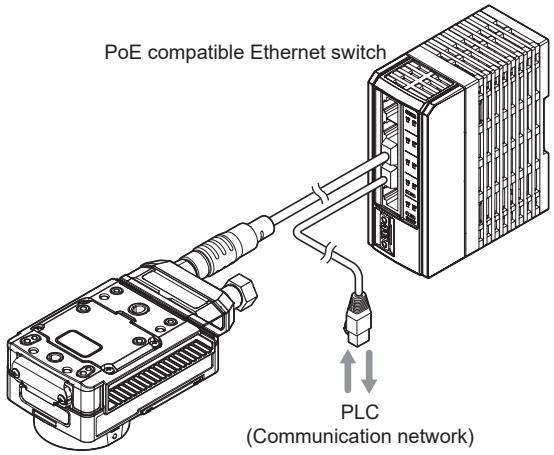
NOTICE	**When connecting the connector, insert it without tipping and tighten it well. If the tightening is weak, vibration can loosen the connector and cause bad connections. Also, the enclosure rating may not be maintained with loose connection. * After tightening the connector screw by hand, retighten it approximately 90° to 120° with pliers or similar tool.**

Connection diagram when using the conversion connector for power I/O cable

Connector pin layout	Pin No. 1	2	3	4	5
OP-88631 	DC24V	IN1	0V	OUT1	-
OP-88632 	DC24V	Unused	0V	Unused	Unused

NOTICE	**• Use a cable with conductor resistance adapted to the cable length to use. • 10 m or less : 50 Ω/km or less • 20 m or less: 25 Ω/km or less • 30m or less: 16Ω/km or less • When using the conversion connector for power I/O cable (OP-88631), change [Sensor Advanced] > [I/O Settings] > [I/O Format] > [Cable Specification] to 4-pin using the IV Smart Navigator (on the control panel, display expansion unit, or computer). “Polarity” (page 7-16)**

When supplying power with the PoE (Power over Ethernet)



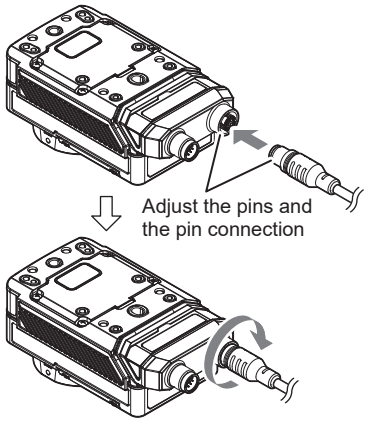
Specifications of the PoE power supply device

Applicable standard	IEEE802.3at/bt
When not using the AI Lighting unit	Power class 4 or higher (class 6 or higher recommended)
When using the AI Lighting unit	Power class 4 or higher

NOTICE	**• Power should be supplied from either the power I/O cable (24V DC) or PoE. • When using PoE, do not connect the power I/O cable. Connecting both may cause a malfunction. • When using PoE, operation may be restricted due to power limitation. • Use OP-88835/OP-88836/OP-88837/OP-88838 or CAT 5e or higher for the Ethernet cable. • Before connecting or disconnecting the Ethernet cable, turn off the power of the PoE power supply device connected to the IV4 Series.**

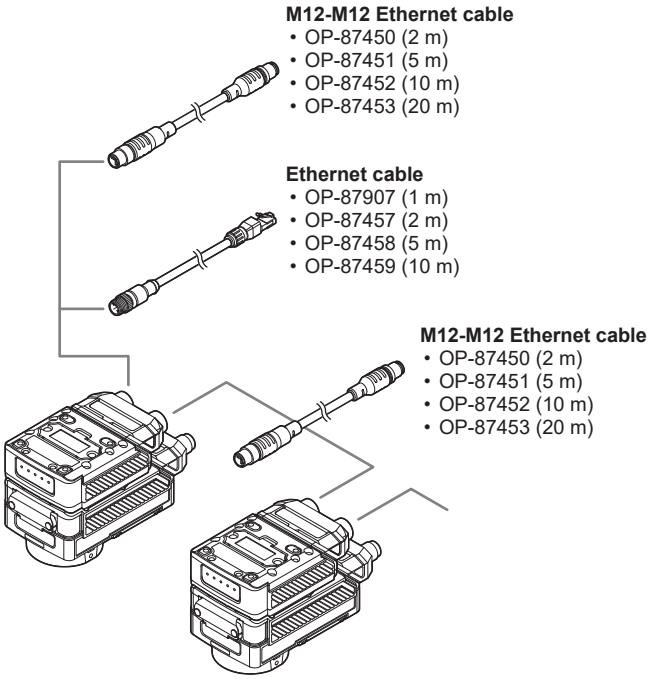
1 Align the pins of the connector for the Ethernet cable with the protrusion connection of the cable connector, and connect the cable to the sensor. Then, tighten the connector by turning the screw on the connector in the clockwise direction.

• Tightening torque: 0.6 to 0.8 N·m



NOTICE	**When connecting the connector, insert it without tipping and tighten it well. If you do not sufficiently tighten the connector, vibration can loosen the connector and cause bad connections and/or susceptibility to noise. Also, the enclosure rating may not be maintained with loose connection. * After tightening the connector screw by hand, retighten it approximately 90° to 120° with pliers or similar tool. * For the connector for the power I/O cable, attach the waterproof cap for the attached connector to maintain the enclosure rating. Tightening torque: 0.45 to 0.55 N·m**

Cabling of communication units



When using EtherCAT

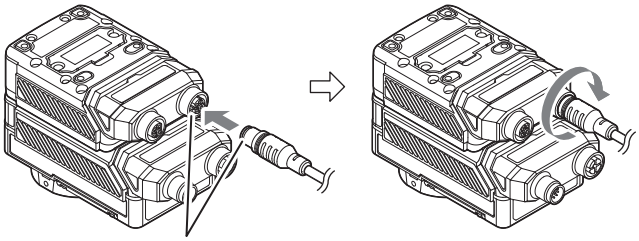
Connect the master-side network cable to the IN port.
If there is a slave device in the downstream of this unit, connect a network cable to the OUT port.

Connecting a cable to a communication unit of built-in amplifier model

Connecting an Ethernet cable

Align the pins of the connector for the Ethernet cable with the protrusion connection of the cable connector, and connect the cable to the sensor. Then, tighten the connector by turning the screw on the connector in the clockwise direction.

- Tightening torque: 0.6 to 0.8 N·m



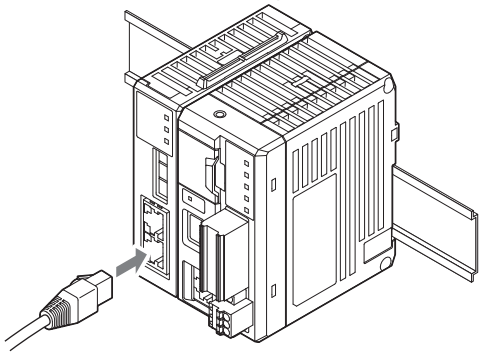
Adjust the pins and the pin connection

NOTICE	**When connecting the connector, insert it without tipping and tighten it well.** **If the tightening is weak, vibration can loosen the connector and cause bad connections.** **Also, the enclosure rating may not be maintained with loose connection.** *** After tightening the connector screw by hand, retighten it approximately 90° to 120° with pliers or similar tool.**

Connecting a cable to a communication unit for ultra-compact model

Connecting the Ethernet cable or LAN cable

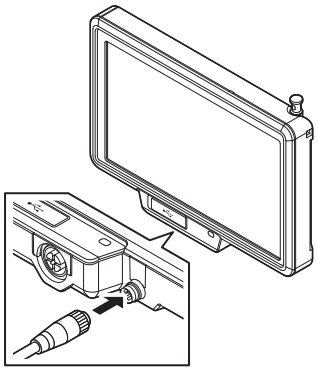
Connect the cable to the sensor amplifier as shown below.



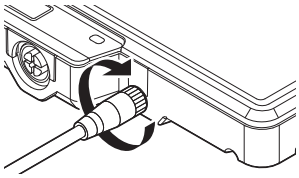
To disconnect the cable, pull the cable while pushing in the tab on the Ethernet cable.

Connecting the power cable of the control panel

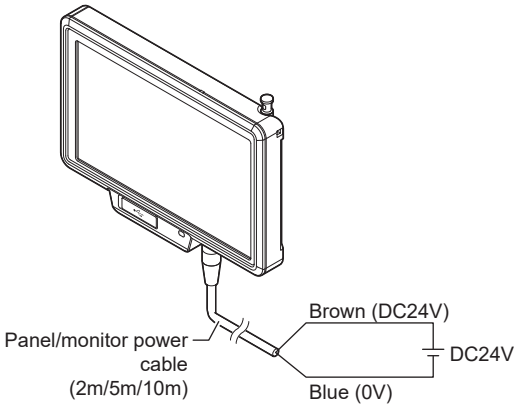
1 **Align the arrow mark of the power cable in the direction of the front of the control panel, and connect the cable to the control panel.**



2 **Tighten the connector by turning the screw on the connector in the clockwise direction.**



3 **Wire to the power supply.**



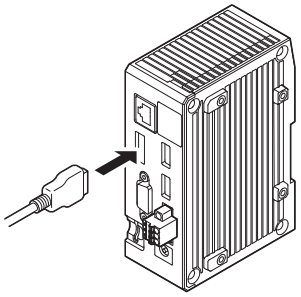
Cable specification Brown/Blue : AWG24

Connecting the Display Expansion Unit

Connecting the unit to the display

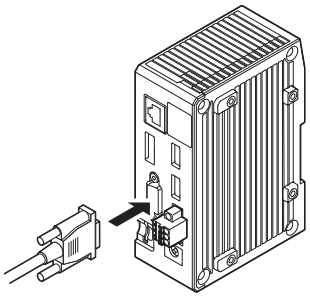
To use an HDMI cable

Connect the cable to the unit as shown in the figure.



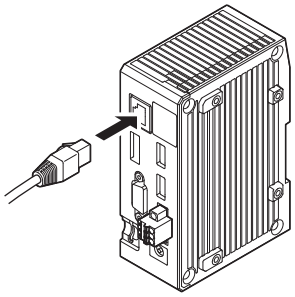
To use a VGA cable

Connect the cable to the unit as shown in the figure.



Connecting the unit using an Ethernet cable or LAN cable

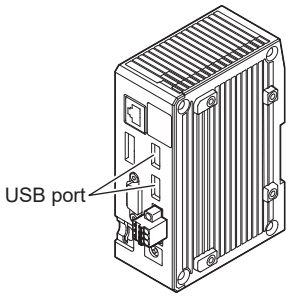
Connect the cable to the unit as shown in the figure.



To disconnect the cable, pull the cable while pushing in the tab on the Ethernet cable.

Connecting a mouse or USB memory stick

Connect the cable to the unit as shown in the figure.



This unit supports the control of the external touch panel via USB. However, it does not guarantee the operation on all devices.

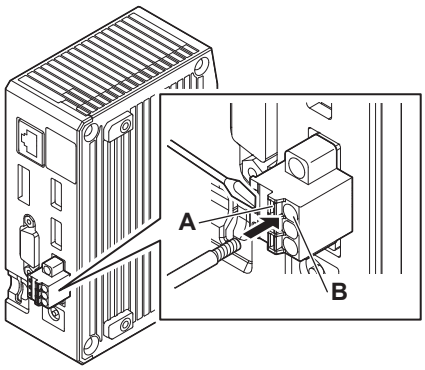
Supplying power to the display expansion unit

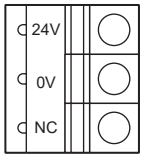
To use a terminal block

The power terminal block is mounted on the front of the display expansion unit.

CAUTION	**Use a wire with 60°C or higher temperature rating for the power source.**

NOTICE	**Follow the instructions shown below to avoid damage caused by bad connections.** **• The nominal cross-sectional area of the wire for connecting the power should be 0.8 mm² to 1.3 mm² (AWG16 to 18).** **• The length of the insulation removed from the wire should be around 9 mm.** **• The stripped part of the wire should not be soldered (pre-soldered).** **• Insert the wires all the way into the power terminal block.** **• Wire the power cables directly or using bar terminals into the terminal block.**

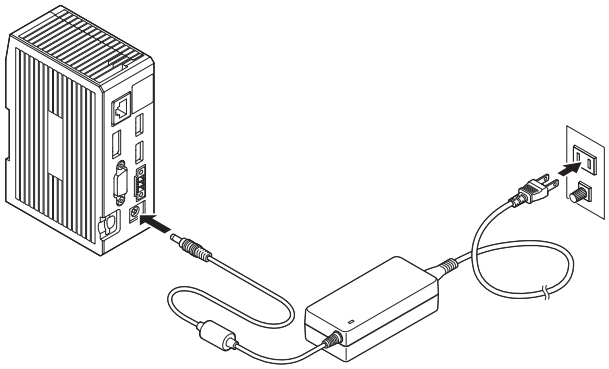




24V	Insert a wire into the 24 V DC slot on the power supply.
0V	Insert a wire into the 0 V slot on the power supply.
NC	Do not connect anything to this terminal.

To use an AC adapter (OP-88766)

Connect the unit to the AC adapter connector as shown in the figure.



Connecting the Sensor with the Control Panel

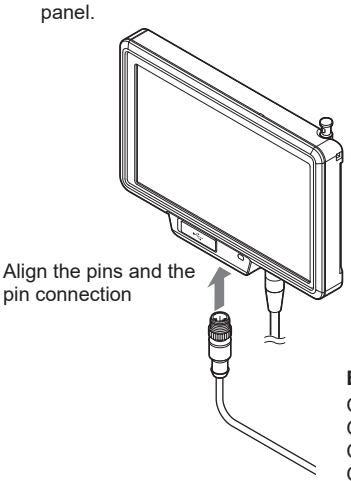
Reference

The sensors to which the IV4-CP70 can connect are the IV4 series, IV3 Series, IV2 series, and IV series.

- If connecting to an IV3 Series sensor, IV4-CP70 enters IV3-CP50 mode. For IV3 series sensors of R1.30 or later, the IV4-CP70 mode can be connected.
  For details, refer to the “IV4 Series User’s Manual (Control Panel).” Please replace the description of IV3-CP50 with IV4-CP70.
- If connecting to an IV2 series sensor, IV4-CP70 enters IV2-CP50 mode.
  For details, refer to the “IV2 Series User’s Manual (Control Panel).” Please replace the description of IV2-CP50 with IV4-CP70.
- If connecting to an IV series sensor, the IV4-CP70 enters IV-M30 mode.
  For details on connecting to an IV-HG/IV-H series sensor, see “IV-HG/IV-H Series User’s Manual (Monitor).” Please replace the description of IV-M30 with IV4-CP70.

Connecting the Ethernet cable with the control panel

Connects the Ethernet cable with the connector of the control panel.



Ethernet cable
OP-88835 (2 m)
OP-88836 (5 m)
OP-88837 (10 m)
OP-88838 (20 m)

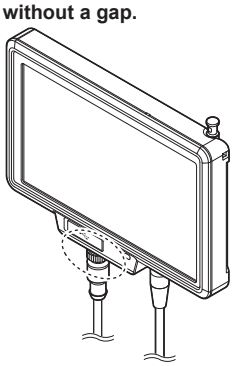
Tighten the connector by turning the screw-on connector in the clockwise direction. When you cannot tighten the screw by hand any more, use a tool such as pliers for further tightening. Tightening torque, retorque degree, and acceptable spaces between connectors are shown below.

- Tightening torque : 0.8 to 1.0 N m
- Retightening degree : 5 to 10°

NOTICE	**If you do not sufficiently tighten the connector cable, vibration can loosen the connector causing bad connections, the cable to be disconnected, and/or susceptibility to noise. Also, the enclosure rating may not be maintained with loose connection. Properly follow the procedures above and tighten the connector completely.**

Point

Check that the Ethernet cable connector is connected without a gap.



Setting up the PC

This section explains how to install/uninstall the IV Smart Navigator (IV-H1SN) software and how to configure the software settings on a computer.

Required environment for the PC to be connected

To connect the sensor and PC, the environment which satisfies the following conditions is required.

OS

One of the following OS's must be pre-installed.
(Windows 10 is the 64-bit version)

- Windows 11..... Home/Pro/Enterprise
- Windows 10..... Home/Pro/Enterprise

Hardware

Interface

Must be equipped with Ethernet (1000BASE-T/100BASE-TX).

Processor

- Needs to be compliant with system requirements for OS.
- Recommended CPU (when using the simulator): Intel® Core™ i5 processor or equivalent or higher

Memory capacity

8GB or more

Monitor

- Resolution: 1024 × 768 pixel or higher
- Display color: High Color (16bit) or higher

HDD free space required for installation

4 GB or more

Operating conditions

Microsoft Visual Studio C++2019 Distribution Package Update needs to be installed.

Reference If this software is not installed, it will be automatically installed when IV-H1SN is installed.

Installation destination of the software (reference)

Installation destination of the application software (default settings) are as follows.

Windows 11/10 64-bit version

C:\Program Files\KEYENCE\IV-SmartNavigator

Application

IV-SmartNavigator.exe: IV Smart Navigator

Data saving destination

Document for the logon user\IV-SmartNavigator

Installing IV Smart Navigator (IV-H1SN)

Point

- **This section describes the installation using Windows 11 as an example.**
- **Exit or finish all other running software before the installation.**
- **Log on with a user who has administrative privileges.**
- **If the user account control screen appears during the installation, press [Yes].**
- **If the current user is a user account that does not have administrative privileges, input a user account with administrative privileges and the password.**

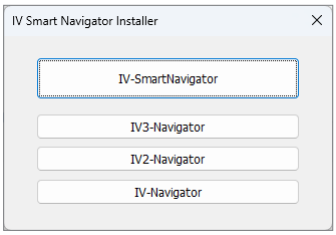
1 Start Windows.

2 Insert the "IV-H1SN" disc into the media drive.

The installation program activates using the auto run function of the PC, and the install program selection screen opens. If the selection window does not display, open the media drive from My Computer and double-click "IV-SmartLauncher.exe".

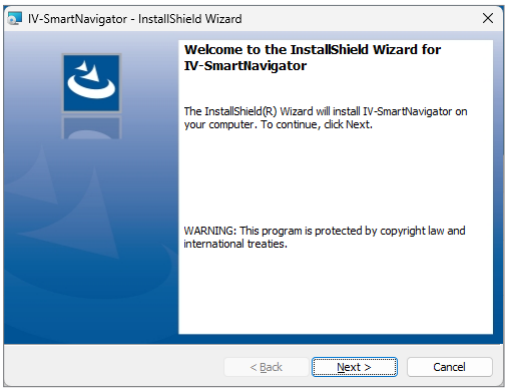
Reference IV-H1SN can also be downloaded from our website.

3 Press [IV-SmartNavigator].



The InstallShield wizard screen opens.

4 Follow the instructions in the window.



5 After completion window for InstallShield Wizard is displayed, press [Finish].

- After installation is finished, close the selection screen.
- Install IV3-Navigator, IV2-Navigator, and IV-Navigator if you are using a combination of IV4, IV3, IV2, and IV Series devices. On the selection screen, press [IV3-Navigator], [IV2-Navigator], or [IV-Navigator]. Follow the instructions in the window.

6 Remove the media.

Uninstalling IV Smart Navigator (IV-H1SN)

Point

- This section describes the installation using Windows 11 as an example.
- If the user account control screen appears during the installation in the Windows 11 environment, press [Yes].
- Log on with a user who has administrative privileges.

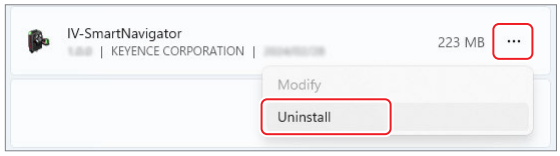
1 **Start Windows.**

2 **Press [Settings] from the start menu.**

3 **Select [Apps].**

4 **Select [Installed Apps].**

5 **Select [IV-SmartNavigator] and press [Uninstall].**



6 **After the confirmation dialog is displayed, press [Uninstall].**

When IV Smart Navigator disappears from the list, uninstallation is completed.

Changing the PC Settings (IP Address Settings)

Point

- Log on with a user who has administrative privileges.
- Auto acquisition of IP address (DHCP server) cannot be used due to the inability to connect with the sensor.

For Windows 11

1 **Press [Settings] from the start menu.**

2 **Press [Network & internet].**

3 **Press [Ethernet].**

4 **Press [Edit] for IPv4.**

5 **Select [Manual] and input the IP address and subnet mask.**

- IP address: 192.168.10.1
- Subnet mask: 255.255.255.0

Reference Set a user-defined IP address (The above is an example). To connect with the existing network, input the IP address that was assigned by the network administrator.

6 **After setting is completed, press [Save] and close all the windows.**

For Windows 10

1 **Press [Settings] from the start menu.**

2 **Press [Network & Internet].**

3 **Press [Change adapter options].**

4 **Right-click the [Ethernet] icon and select [Properties] from the displayed menu.**

5 **Select [Internet Protocol Version 4 (TCP/IPv4)] and press [Properties].**

6 **Select [Use the following IP address] and input the IP address and Subnet mask.**

- IP address: 192.168.10.1
- Subnet mask: 255.255.255.0

Reference Set a user-defined IP address (The above is an example). To connect with the existing network, input the IP address that was assigned by the network administrator.

7 **After setting is completed, press [OK] and close all the windows.**

3

Basic Operation

This chapter provides an overview of the screens and operation of the IV4 series, basic operation flow, and operation when turning on the power for the first time.
This chapter also explains how to switch the connected sensor and the procedure to return the sensor to the factory default.

Overview of screen and operation 3-2
Basic operation flow 3-4
Operation when the Power is Turned on 3-5
Switching and Disconnecting the Sensor to be Connected 3-10
Multiple Sensors Monitoring 3-12
Basic operation for tools 3-14

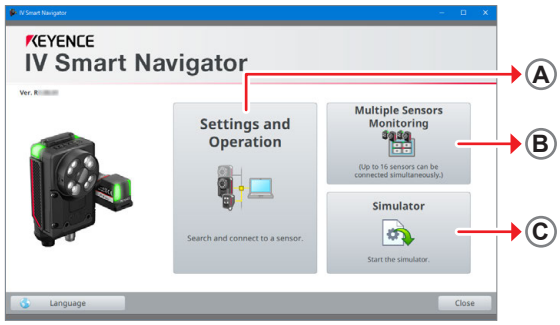
Overview of screen and operation

This section provides an overview of the displayed screens and device operation.
For details of what can be set on each screen and its operations, refer to the applicable section.

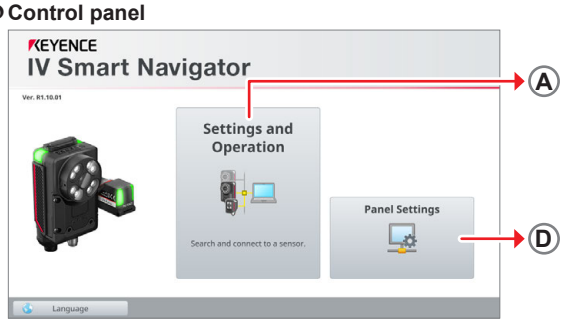
Activation Menu

Selects the connection with the sensor or the Simulator. You can also change the display language.
The menus that are displayed differ depending on the device used.
“Operation when the Power is Turned on” (page 3-5)

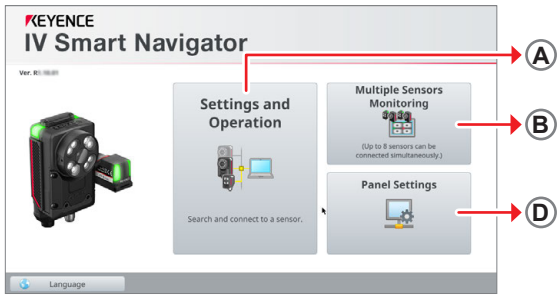
PC



Control panel



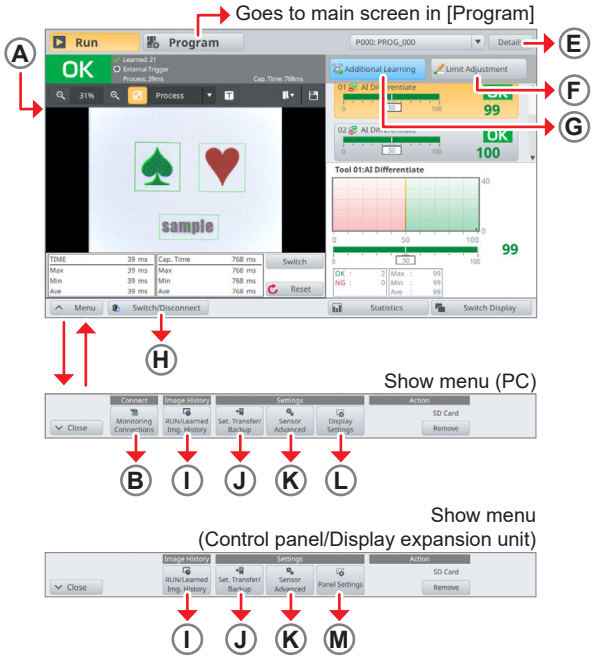
Display expansion unit



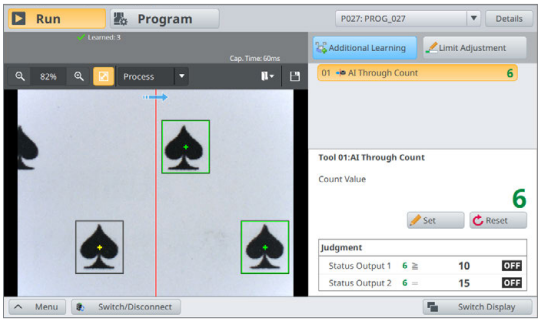
Main screen in [Run]

Captures images and judges based on the judgment conditions.
“Names and Functions of the Screen in [Run] / [Program]” (page 5-3)

Standard mode / Sorting mode

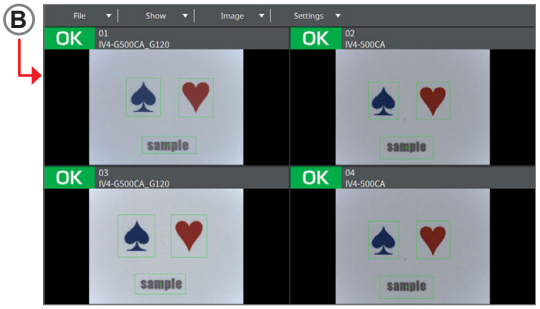


AI Through Count Mode



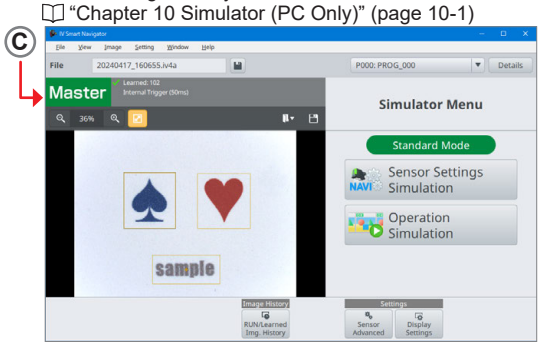
Multiple Sensors Monitoring (PC/Display Expansion Unit)

Displays the running status of multiple sensors that are connectable.
“Multiple Sensors Monitoring” (page 3-12)



Simulator

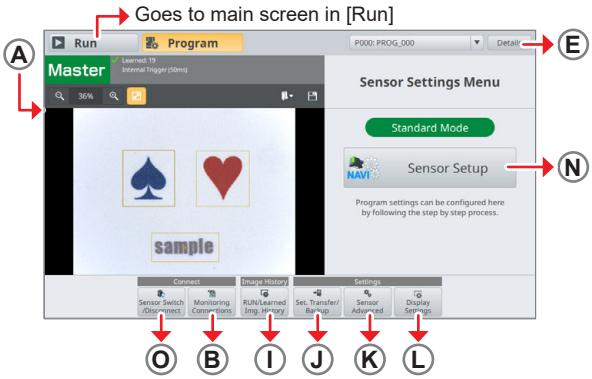
The settings of a program saved in a batch backup file or an individual program backup (*.iv4a) can be confirmed or changed, and the image history can be confirmed.
“Chapter 10 Simulator (PC Only)” (page 10-1)



Main screen in [Program]

Configures the program settings, sensor settings, and reference of the image history.

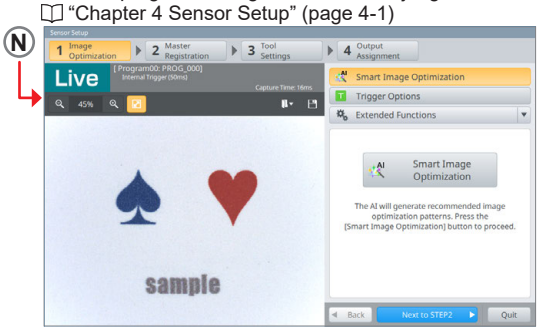
“Names and Functions of the Screen in [Run] / [Program]” (page 5-3)



Sensor Setup

Sets the program settings to be used for judgment.

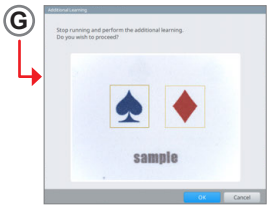
“Chapter 4 Sensor Setup” (page 4-1)



Additional Learning

Perform additional learning of images.

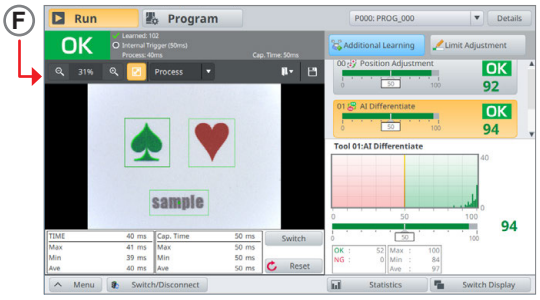
“Auto Adjustment by the Additional Learning” (page 6-2)



Limit Adjustment

Adjusts the judgment threshold.

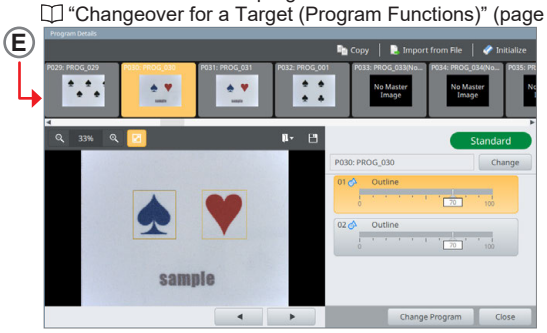
“Adjusting Thresholds for Judgment” (page 6-15)



Program Details

Checks or initializes the program.

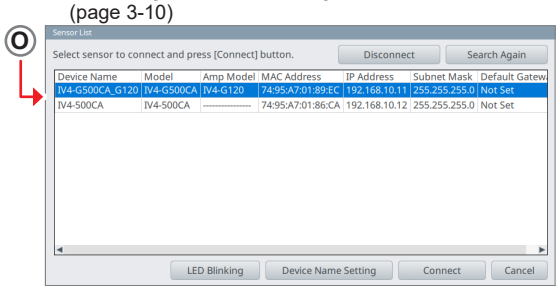
“Changeover for a Target (Program Functions)” (page 7-2)



Sensor List

Switches the connected sensor. Or, terminates the sensor connection.

“Switching and Disconnecting the Sensor to be Connected” (page 3-10)



Running/Learned Image History

Opens the running image and learned image history of the sensor.

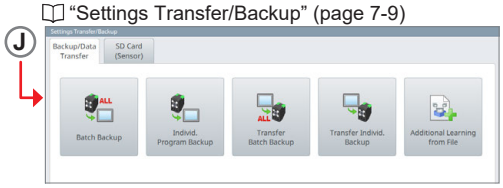
“Running Image History” (page 5-14)



Settings Transfer/Backup

Backs up the data saved in the sensor and transfers the setting data.

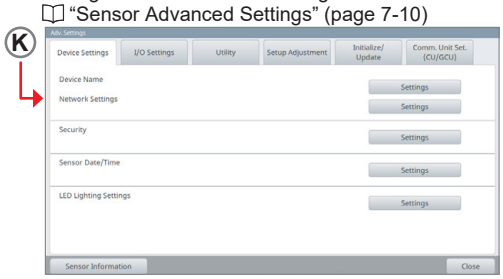
“Settings Transfer/Backup” (page 7-9)



Advanced Settings

Configures the advanced settings for the sensor.

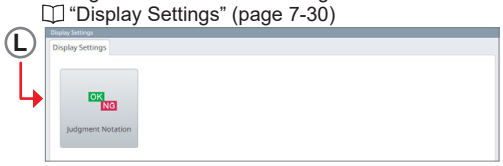
“Sensor Advanced Settings” (page 7-10)



Display Settings (PC)

Configures the advanced settings for the sensor.

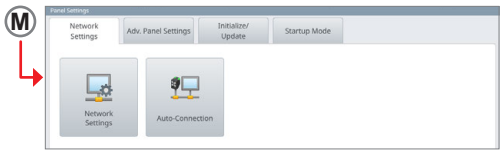
“Display Settings” (page 7-30)



Panel Settings (Control Panel/Display Expansion Unit)

Configures the control panel/display expansion unit settings.

“Panel Settings” (page 7-25)



Basic operation flow

Installing, connecting, and wiring the sensor
Mount the sensor, and then connect and wire the cable.
Also install the IV Smart Navigator.
“Chapter 2 Installation and Connection” (page 2-1)

Turn on the power
Perform the initial start-up operation.
“Operation when the Power is Turned on” (page 3-5)

Sensor Setup

STEP 1: Setting of image optimization
Set the image optimization settings for clearly imaging a target. Adjust the image for defining differences in an “OK” and “NG” image or Part image.
Set the trigger options, adjust the brightness and camera focal distance.
“1. Image Optimization” (page 4-6)

STEP 2: Registration of a master image
Registers a master image used as the reference for judgment.
“2. Master Image Registration” (page 4-14)

STEP 3: Tool settings/Part Registration settings
Sets the conditions to judge a target.
“3. Tool Settings (Standard Mode)” (page 4-20)
“3. Part Registration (Sorting Mode)” (page 4-76)
“3. Tool Settings (AI Through Count Mode)” (page 4-82)

STEP 4: Output assignment
“4. Output Assignment” (page 4-88)

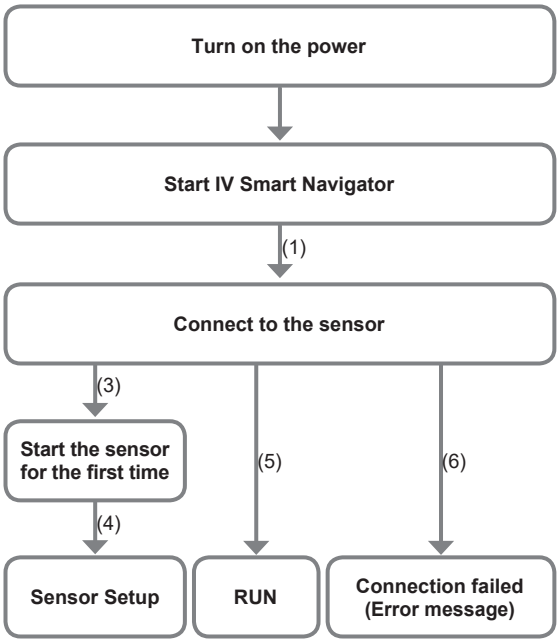
Starting the operation/adjustment
Switch the settings screen to the run screen, and start the operation.
“Chapter 5 Running” (page 5-1)

If the settings are not appropriate, perform the additional learning or limit adjustment.
“Chapter 6 Adjusting” (page 6-1)

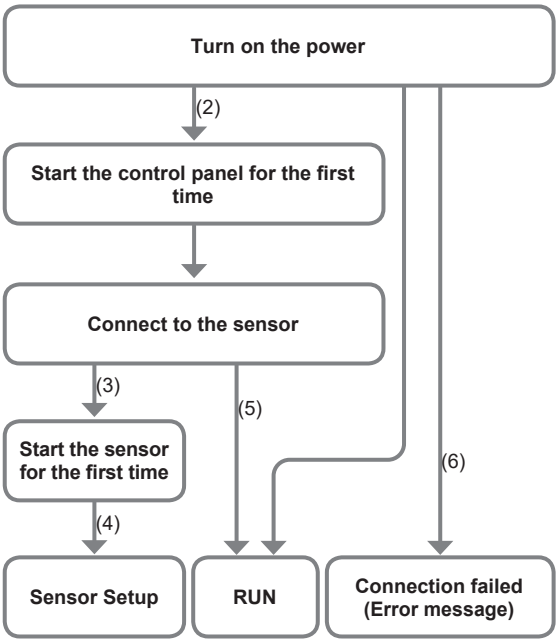
Operation when the Power is Turned on

Operation flow when the power is turned on

PC



Control panel/Display expansion unit



(1) To connect to a sensor, set a static IP address on the PC.
“Operation for Initial Startup of the IV Smart Navigator” (page 3-6)

(2) When the power of the control panel/display expansion unit is turned on for the first time, set the display language, and date and time.
“Searching for a Sensor to Connect to” (page 3-6)

(3) When the sensor is turned on for the first time, perform the Initial Sensor Setup.
“Operation for Initial Startup of the Sensor” (page 3-8)

(4) The [Sensor Settings Menu] screen opens. Create a program in [Sensor Setup]. After being created, operation begins.
“Chapter 4 Sensor Setup” (page 4-1)

(5) If the software and the sensor setup have already been performed, move to operation automatically by turning on the power.
“Chapter 5 Running” (page 5-1)

(6) When the connection process fails, the software will remain in the connecting screen.
“Remedy when the Software cannot be Connected with the Sensor” (page A-18)

Reference The sensor can be independently operated.

Startup mode for the control panel

To connect to a series model other than IV4, switch to the operation mode corresponding to the applicable series model.
Startup mode can be changed using “Startup Mode” (page 7-29) in [Panel Settings].

Series	Startup Mode	Reference Manual
IV3 *	IV3-CP50 Mode	IV3 Series User’s Manual (Control Panel)
IV2	IV2-CP50 Mode	IV2 Series User’s Manual (Control Panel)
IV-HG/IV-H	IV-M30 Mode	IV-HG/IV-H Series User’s Manual (Monitor)
IV-G/IV	IV-M30 Mode	IV-G/IV Series User’s Manual (Monitor)

* For IV3 series sensors of R1.30 or later, the IV4-CP70 mode can be connected.

Operation for Initial Startup of the IV Smart Navigator

Point **Only engineers who are knowledgeable about networks should attempt connection when connecting the IV4 Series to a network.**

1 Turn on the power of the sensor.

2 Start [IV Smart Navigator].

Using a PC

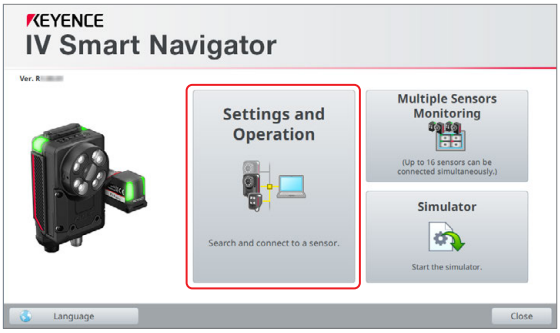
Double-click the [IV Smart Navigator] icon.



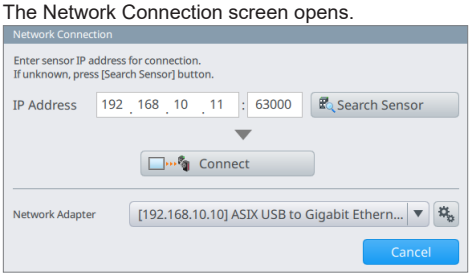
Using a control panel/display expansion unit

Turn on the power of the control panel/display expansion unit.
If starting the device for the first time, perform the initial start-up operation.
“Operating the Control Panel/Display Expansion Unit for the First Time” (page 3-7)

3 Press [Settings and Operation].

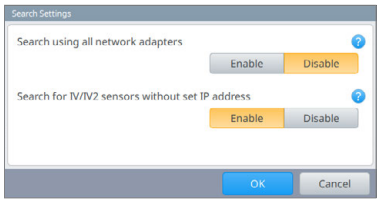


The Network Connection screen opens.



Reference If multiple network adapters are installed on the PC, perform the following:

- Select a network adapter from the drop-down menu.
- Press the search settings button ( ) and set the search conditions for the network adapter and sensor.



4 Set up the sensor to be connected.

“Searching for a Sensor to Connect to” (page 3-6)
“Specifying the Sensor to be Connected by IP Address” (page 3-7)

5 Perform the following.

- When connecting to the sensor for the first time, perform [Initial sensor setup].
  “Operation for Initial Startup of the Sensor” (page 3-8)
- When you connect to the sensor for the second time onwards, the main screen in [Run] or [Program] opens.
  “Chapter 4 Sensor Setup” (page 4-1)
  “Chapter 5 Running” (page 5-1)

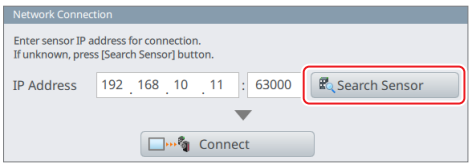
Searching for a Sensor to Connect to

Automatically searches for a sensor on the network and connects with it.

Reference
- The approximate time to search is 15 seconds or less if the [Search using all network adapters] setting is [Disable], and 105 seconds or less if it is [Enable] (up to eight network adapters can be searched for).
- Up to 64 sensors can be searched (common to IV4-CP70/IV4-DU10/PC software).

1 Turn on the power of the sensor.

2 Press [Search Sensor].

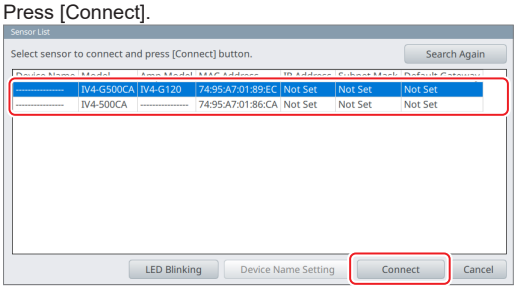


Point **If no sensor is found, refer to “Remedy when the Software cannot be Connected with the Sensor” (page A-18).**

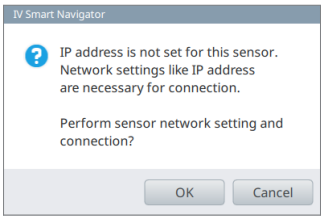
3 Select the sensor to be connected.

When connecting to the sensor without an IP address

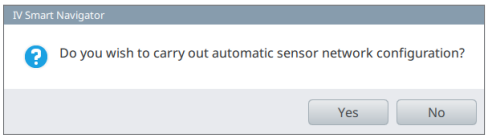
Press [Connect].



The following screen appears. Press [OK].

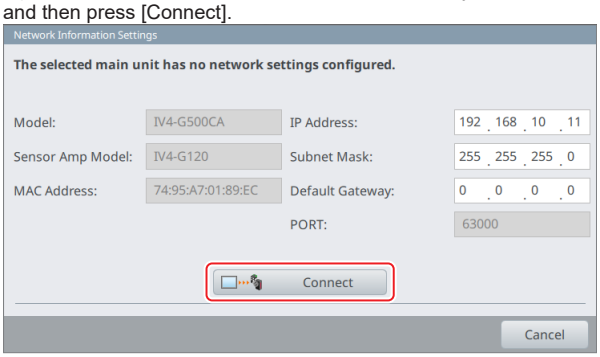


Press [Yes] to automatically configure the sensor network settings.



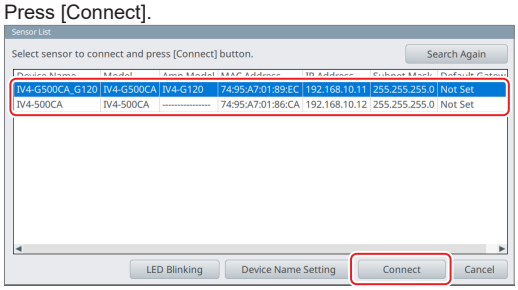
The Network Settings screen opens.

Input the IP Address, Subnet Mask, Default Gateway, and PORT, and then press [Connect].



When connecting to the sensor with set IP address

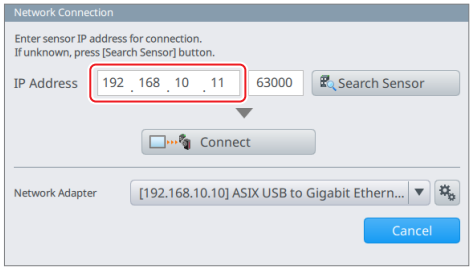
Press [Connect].



Specifying the Sensor to be Connected by IP Address

Used when the IP address of the sensor to be connected is defined beforehand.

1 Input the IP address of the sensor to be connected.



2 Press [Connect].

Operating the Control Panel/Display Expansion Unit for the First Time

1 Turn on the power of the control panel/display expansion unit.

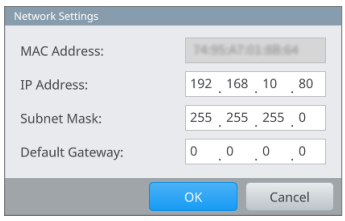
2 Select the display language and press [OK].

3 Set the current date and time, and press [OK].

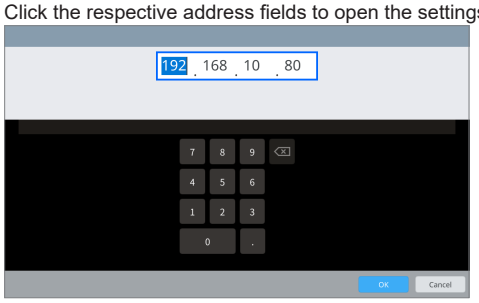


4 When initial setup is completed, press [OK].

5 Set the IP Address, Subnet Mask, and Default Gateway individually, and then press [OK].



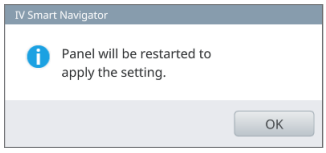
Click the respective address fields to open the settings screen.



Point

At initial startup or initialization of the control panel/display expansion unit, the control panel starts up with “192.168.10.80” as the IP address. If there is a device with the same IP address on the network, change the IP address before connecting the monitor to the network.

6 Press [OK].

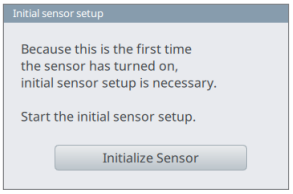


After restart, the Activation Menu screen opens.

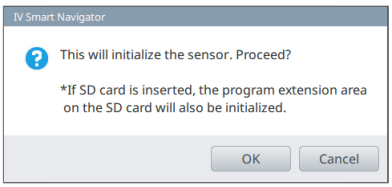
Operation for Initial Startup of the Sensor

When the sensor in the default setting is to be connected, perform the [Initial sensor setup] and select the polarity of the sensor (NPN or PNP) and date settings.
After the polarity is selected, set up the sensor in the sensor settings.
For details on polarity, refer to “Cables” (page 2-21).

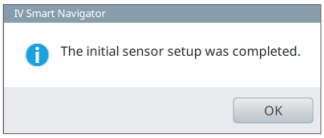
1 Press [Initialize Sensor].



2 Press [OK].

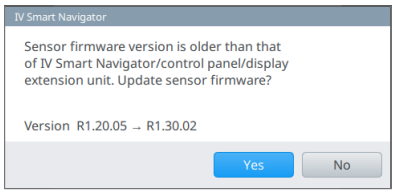


3 After initialization has been completed, press [OK].

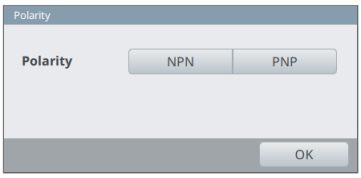


Point

The update screen will be displayed when connecting the control panel/display extension unit/PC software of R1.30 or later to the factory shipment sensor of the R1.20. or earlier.**

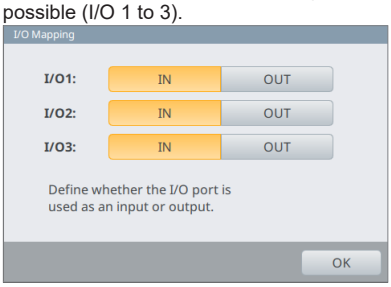


4 Select the polarity of the sensor, and press [OK].



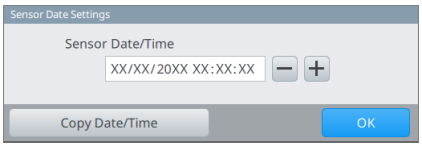
❍ Built-in amplifier model only

Sets whether to use IN or OUT for ports where I/O mapping is possible (I/O 1 to 3).

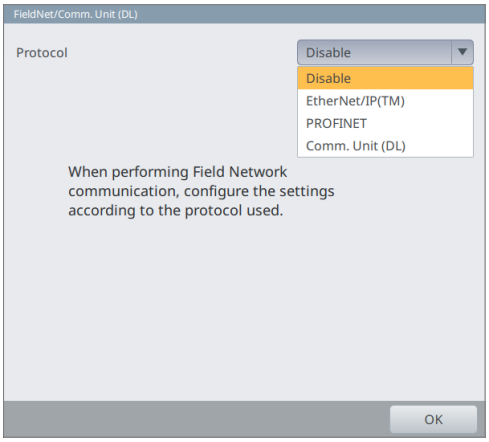


5 Set the current date and time, and press [OK].

When pressing [Copy Date/Time], the date and time of the connection source (PC/control panel/display expansion unit) can be copied to the sensor.



6 When performing Field Network communication, select the protocol to be used and configure the settings.



“Connecting to a Field Network” (page 9-12)

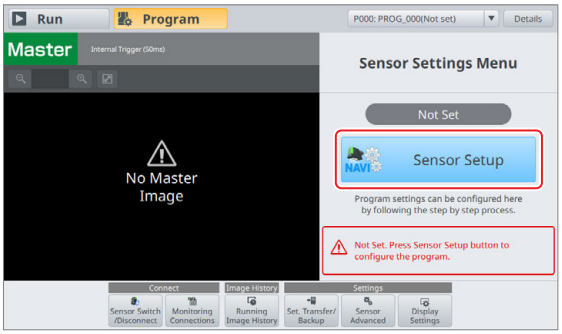
Reference

When using PROFINET (Conformance Class C) or EtherCAT of communication unit IV4-CU1/IV4-GCU1, select [Disable] in [Protocol], finish the initial sensor startup setup, and then adjust settings in [Sensor Advanced] > [Comm. Unit Set. (CU/GCU)].

7 Press [OK].

The main screen in [Program] opens.

8 Press [Sensor Setup], and set up the program.



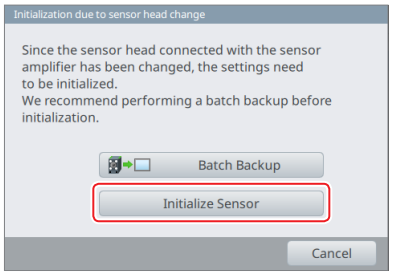
“Chapter 4 Sensor Setup” (page 4-1)

Operation when changing the sensor head (ultra-compact model only)

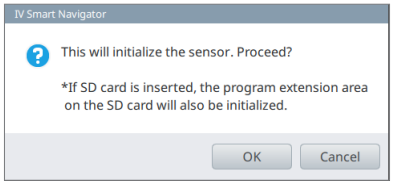
If the sensor head connected to a sensor amplifier is changed, initialization of the sensor amplifier is required.
Initialize the sensor amplifier following the instructions on the displayed screen.

Important **The setting information of the sensor is saved in the sensor amplifier. Before initializing the sensor amplifier, KEYENCE recommends that you perform “Batch Backup” (page 7-9).**

1 Press [Initialize Sensor].

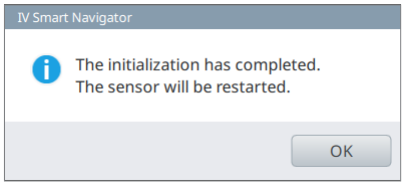


2 Press [OK].



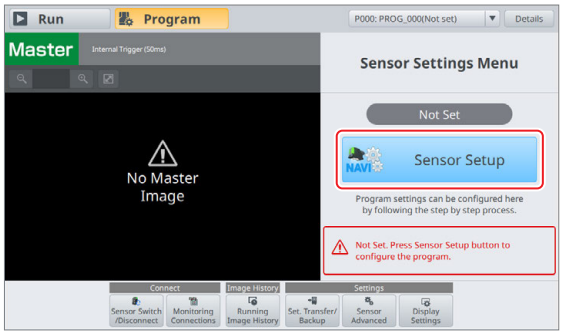
The process to initialize the sensor begins. After initialization is completed, the initialization completion screen opens.

3 Press [OK].



The main screen in [Program] opens.

4 Press [Sensor Setup], and set up the program.



“Chapter 4 Sensor Setup” (page 4-1)

Switching Languages

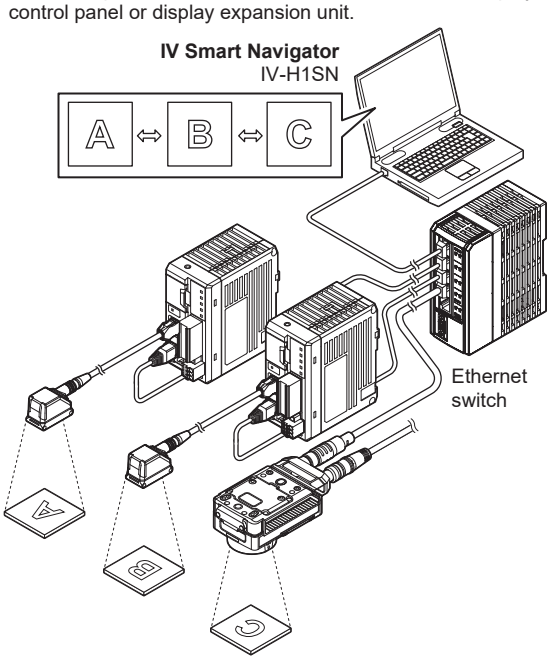
The display language can be switched on the Activation Menu screen.
Select a language, and restart IV Smart Navigator.



Switching and Disconnecting the Sensor to be Connected

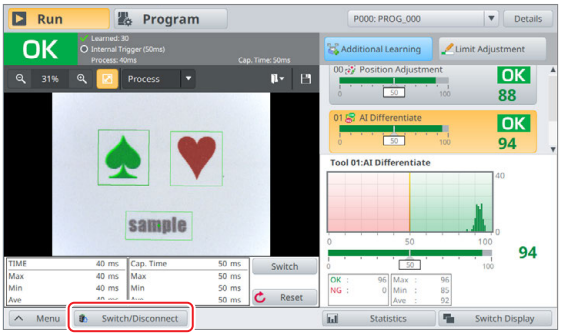
Switching the Sensor to be Connected

When multiple sensors are connected to a PC, the sensor displayed can be changed.
The same procedure can be used to switch sensors displayed on a control panel or display expansion unit.



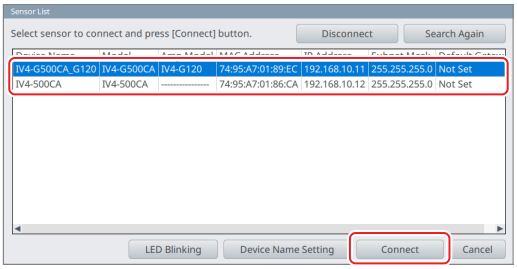
1 Connect the PC with the sensor.

2 Press [Switch/Disconnect].



The list of connected sensors is displayed.

3 Select the sensor to be displayed on the software and press [Connect].



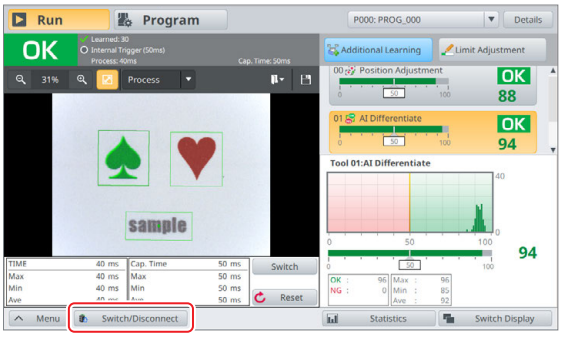
The screen for the selected sensor opens.

Point

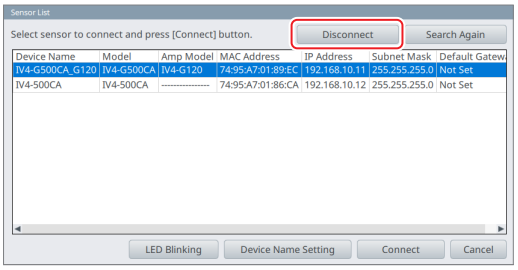
- **If the settings for the selected sensor have not been made, the [Sensor Settings Menu] screen will be displayed.**
- **The sensor to be connected can be switched in the main screen of [Program].**

Disconnecting from the sensor

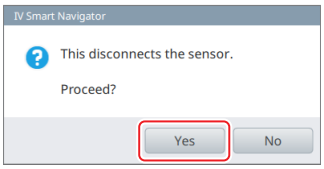
1 Press [Switch/Disconnect].



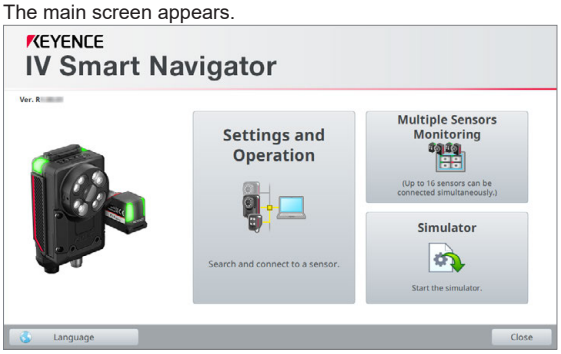
2 Press [Disconnect].



3 Press [Yes].



The main screen appears.



Connecting multiple devices to one sensor (control panel, display expansion unit, or computer)

You can simultaneously connect a maximum of three devices of the control panel, display expansion unit, or computer (here after collectively referred to as "monitor devices") to one IV4 series sensor to monitor operating statuses (captured images, judgments, etc.).

Point

Supported devices are sensors, control panels, display expansion units, and computers (IV Smart Navigator) of Ver1.20. or later.**

Sensor Setup

Sensor setting can only be made by one sensor device that has the operation permission. Other monitor devices that do not have operation permission will be in the [Running on hold] state.
Pressing [Run] on the monitor device that has operation permission displays the operation screen on all monitor devices.



❍ Obtaining the operation permission

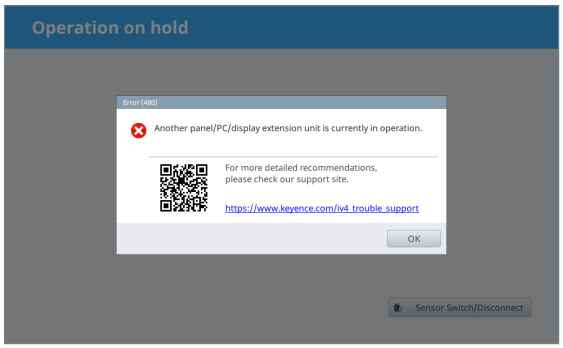
While the sensor is running, the first monitor device that pressed [Program] obtains the operation permission of the senor. The device loses the operation permission when it presses [Run].

Connecting to the running sensor

When connection is made from one, two, or three monitor devices, connection is established normally and the operation screen is displayed.
When a fourth monitor device attempts connection, connection is rejected with an error screen.

Connecting to the sensor that is being configured

If the senor that is selected as the connection destination has already been connected from another monitor device and the sensor's state is [Program], pressing [Connect] results in an error screen (error 480). Pressing [OK] on the Error screen brings the device to the [Running on hold] state.



Multiple Sensors Monitoring
(PC/Display Expansion Unit)

Monitors the running status of each sensor that is connected and connectable.
For the PC software, up to 16 units can be connected simultaneously. For the display expansion unit, up to eight units can be connected simultaneously.

Reference The sensor models that allow connection from multiple monitoring devices are IV4 series and IV3 series (R1.30 or later).

Displaying the Operation Monitoring Screen

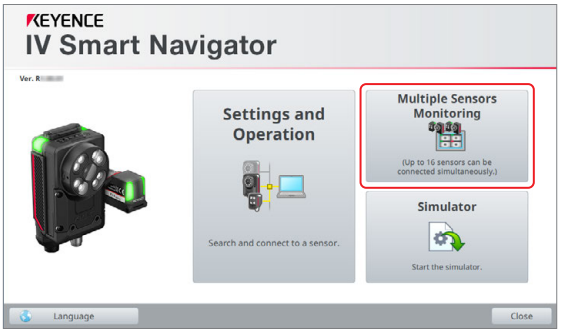
This section describes how to display the Operation Monitoring screen.



Reference If [Auto Connection Settings] is set to [Monitoring Connections] on the PC, the monitoring screen will appear when IV Smart Navigator starts.
“Auto Connection Settings” (page 7-33)

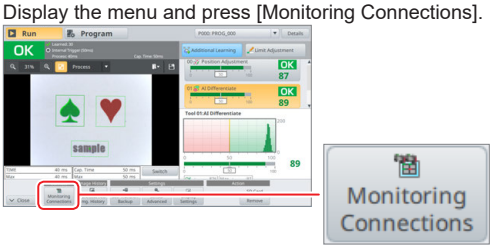
Displaying the screen from the Activation Menu screen

Press [Multiple Sensors Monitoring] from the Activation Menu screen.



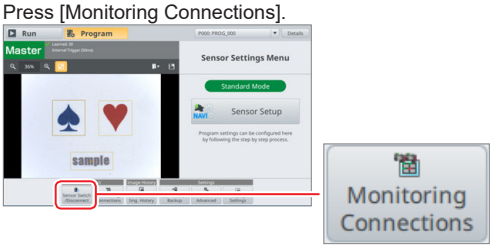
Displaying the screen from the [Run] screen

Display the menu and press [Monitoring Connections].

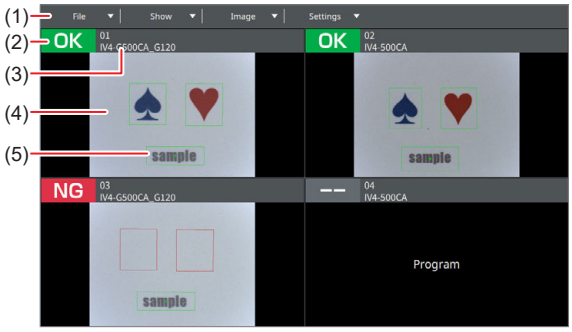


Displaying the screen from the [Program] screen

Press [Monitoring Connections].



Operation on the operation monitoring screen



(1) Menu

❍ **File**
- End Operation Monitoring
- Exiting IV Smart Navigator

❍ **Show**
- Sensor list

❍ **Image**
- Controlling whether to display or hide the tool

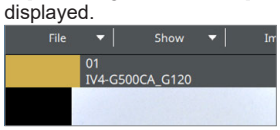
❍ **Settings**
- Network Adapter
- Clear Monitored Sensors
- Auto Connection Settings

(2) Sensor judgment condition

Displays the judgment condition of the sensor.

OK	Status OK in [Standard Mode]
NG	• Status NG in [Standard Mode] • No type matching in [Sorting Mode]
M0 to M7	Type matching in [Sorting Mode]
--	The condition is not yet judged, unable to be judged, error, or in setting

Reference In [AI Through Count Mode], the judgment state is not displayed.



(3) Number and device name

Displays the names of the connected sensors.
When one of them is selected, the sensor name and the area around the image turns orange.

(4) Taken image

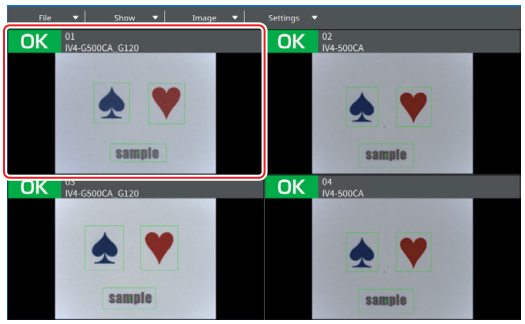
The sensor image is displayed during the operation.
[Program] is displayed during setup.

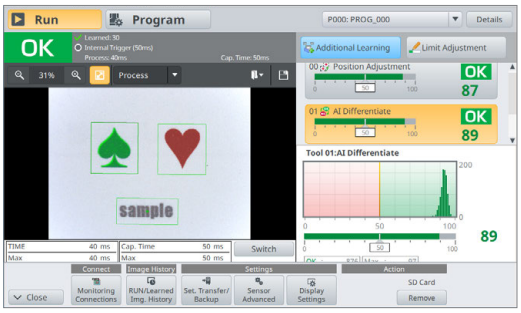
(5) Display Tools

Displays the tool window set to the sensor.
- The tool window can be displayed or hidden using [Display Tools] in the [Image] menu.
- In [AI Through Count Mode], although the image captured during operation is displayed, the tool window is not displayed.

Displaying the screen during the operation/ setup of the selected sensor

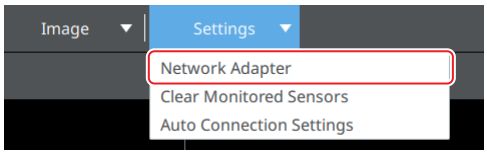
Double-click the selected sensor screen to switch to one-on-one connection with that sensor.
Depending on the status of the sensor, the [Run] or [Program] screen will appear.



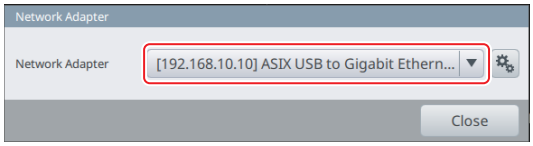


Switching the network adapter

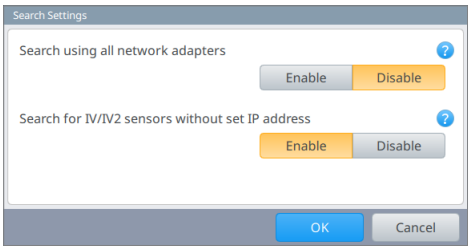
1 Press the [Settings] menu → [Network Adapter].



2 Select a network adapter, and press [Close].



Reference Pressing the search settings button ( ) to open [Search Settings] enables you to set the search conditions for the network adapter and sensor.

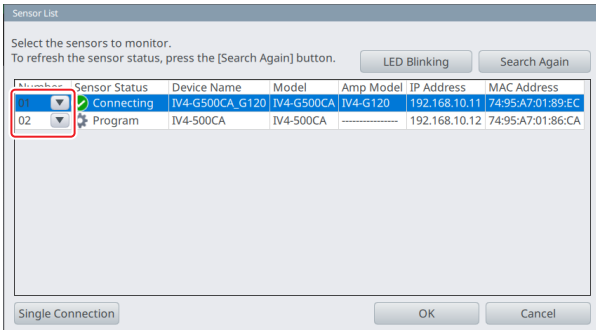


Monitoring Settings

Specify the sensor to be monitoring target.

1 Press [Show] > [Sensor List] on the Sensor List screen.

2 Press in the [Number] column to specify the sensor to be monitoring target.



Reference Press [LED Blinking] to blink the LED of the selected sensor.

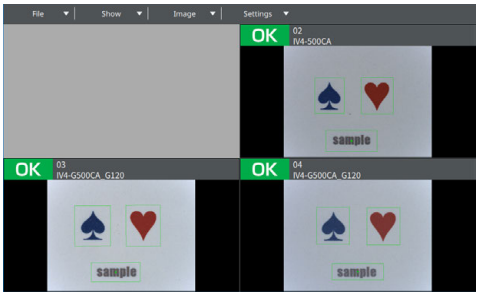
❍ **The sensor to be monitoring target**

Select a number from 1 to 16.
On the Operation Monitoring screen, the sensor will appear at the location matching to the number.

❍ **The sensor not to be monitoring target**

Select OFF.
The sensor being OFF will not appear on the Operation Monitoring screen.

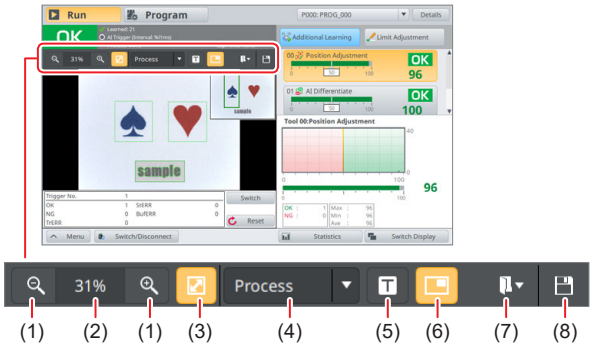
Reference Each of the selected numbers matches the specified location on the Operation Monitoring screen. Even if the number is omitted, it is not padded.
For example, if “2”, “3”, and “4” are selected without selecting “1”, on the Operation Monitoring screen, No. 1 (upper left of the 4-split screen) is not displayed, and the selected sensors are displayed in No. 2 (upper right of the 4-split screen), No. 3 (lower left of the 4-split screen) and No. 4 (lower right of the 4-split screen).



3 Press [OK].

Basic operation for tools

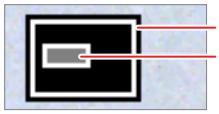
Operation of the Image Tool Bar



(1) [Zoom In] / [Zoom Out] button

Displayable zooming rates are as follows.
25%/50%/75%/100%/150%/250%/500%

Reference If an entire image cannot be displayed, the amount of the image currently displayed will be displayed at the lower left of the screen.



(2) Image Display Magnification

Displays the image display magnification.

(3) [Fit Window] button

Makes the display size of the image fit to the window size.

(4) Button to switch the display method for tools

Switches the display method for the tools.
“Selecting the Display Method of the Tool Window” (page 5-6)

(5) [Manual Trigger] / [Trigger ON] button

The button is displayed in the following cases:
- [External Trigger]/[AI Trigger] is set in Trigger Options.
- is set in Trigger Options.
- [Internal Trigger Control/AI Trigger Control] is set to [Enable].

Reference This button is not displayed on the simulator screen.

[Manual Trigger] button

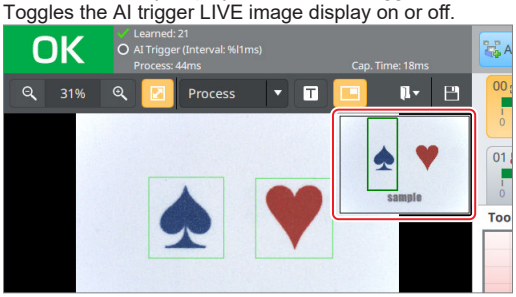
Displayed while in [Run] mode. Outputs the trigger once for each press of the button.

[Trigger ON] button

Displayed while in [Program] mode. Switches the continuous trigger to ON/OFF for each press of the button.

(6) Button to switch to AI trigger LIVE image display

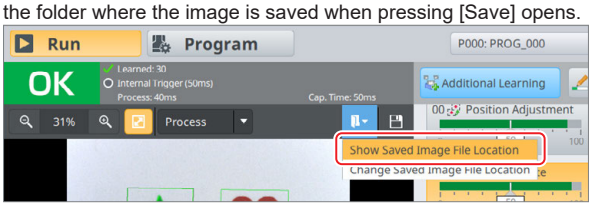
This button is only displayed when an AI trigger is set.
Toggles the AI trigger LIVE image display on or off.



(7) [Image File Location] button (PC only)

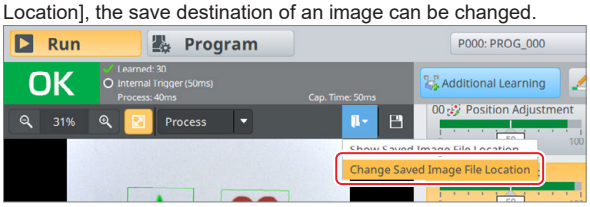
Confirming the save destination of an image

By pressing and selecting [Show Saved Image File Location], the folder where the image is saved when pressing [Save] opens.



Changing the save destination of an image

By pressing and selecting [Change Saved Image File Location], the save destination of an image can be changed.



(8) [Save] button

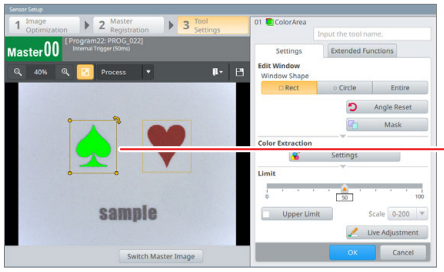
The following items can be saved on the screen button on which is displayed on the image tool bar.
- Displayed image (iv4p file format)
- IV Smart Navigator screen (screen capture: bmp format)

Reference An iv4p format file can be used for [Master Registration] and [Additional Learning].

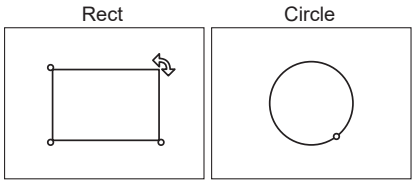
The screens on which the button is displayed are as follows:
- Main screen in [Run]
- Main screen in [Program]
- Sensor Setup
- Limit Adjustment
- Program Details
- Running Image History
- Learned Image History
- Additional Learning

Editing the Window

The window displayed when the tool (Standard mode/AI Through Count mode) or the part (Sorting mode) is set can be edited to any size or direction.

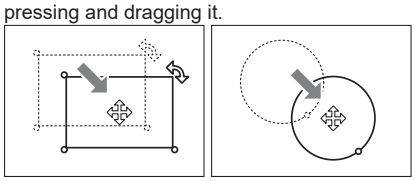


Selecting the shape of the window

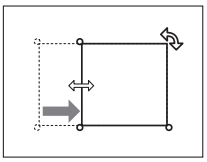


Moving the window

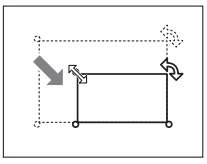
Pressing inside the window will display ✥. Move the window by pressing and dragging it.



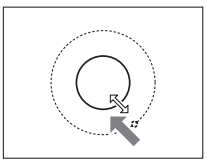
Changing the size of the window



Pressing either side of the window will display ↕ or ⟺. The height or width of the window can be changed by pressing and dragging it.

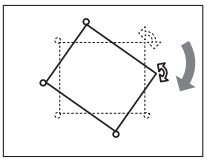


Pressing one of the corners of the window except the upper right corner will display ⤢. The size of the window can be changed by pressing and dragging it.



When [○ Circle] is selected in the window shape settings, the size of the circle can be changed by pressing and dragging the outline of the circle.

Changing the direction (angle) of the window



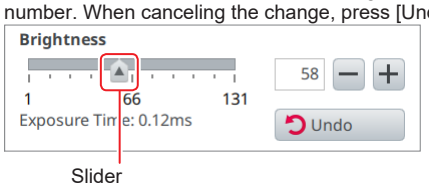
By pressing and dragging the arrow mark on the upper right of the window, the direction (angle) of the window can be changed.

Editing Numbers

The numbers such as the trigger interval value and the threshold of each tool can be edited by multiple methods.

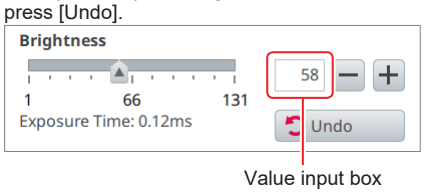
Setting by the Slider

Press the slider, and then slide it to the right or left to set the number. When canceling the change, press [Undo].



Adjust settings using the value input box

Using the value input box, input values for the selected option or specify them by pressing the buttons. When canceling the change, press [Undo].

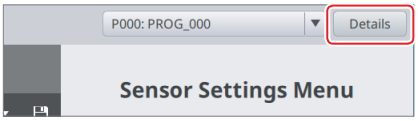


Point **If there a range for the displayed option, the value input cannot exceed the range.**

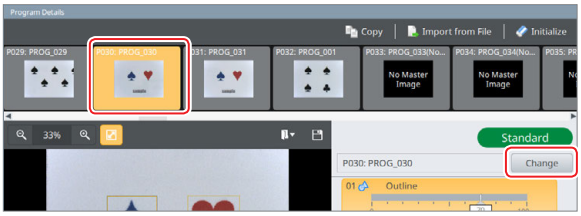
Inputting Characters (Control Panel/Display Expansion Unit)

The programs or tools to be displayed can be given a user-defined name.
This section explains how to input characters using the example of [Program Name].

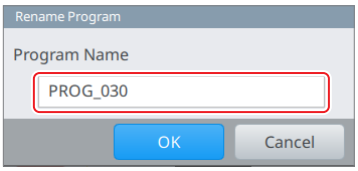
1 Press [Details] on the main screen in [Program].



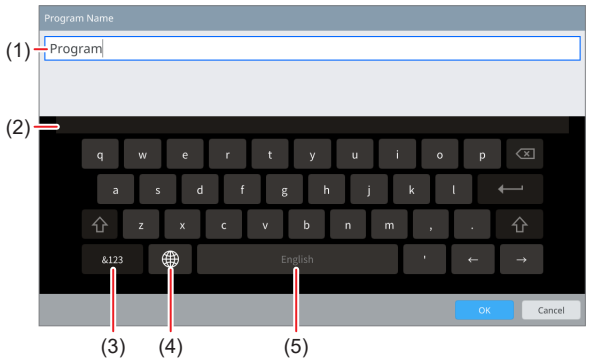
2 Select the program to change the name and press the [Change] button.



3 Press the name.



4 Edit the program name.



(1) Name
Display the name of the program.

(2) Input candidates
Displays input candidates for the entered characters.

(3) Keyboard
- ABC: Displays a keyboard with the English alphabet.
- &123: Displays a keyboard with numbers and symbols.

(4) Change languages
Switches between Japanese, English, Simplified Chinese, and German.

(5) Convert/Space
Converts input characters or enters a space.

5 After editing the name has completed, press [OK].

Selecting the File/Folder in the USB Memory/Micro SD Card (Control Panel/Display Expansion Unit)

This section describes how to select a file in the USB memory/ micro SD card connected to the control panel/display expansion unit using [Batch Backup] as an example.

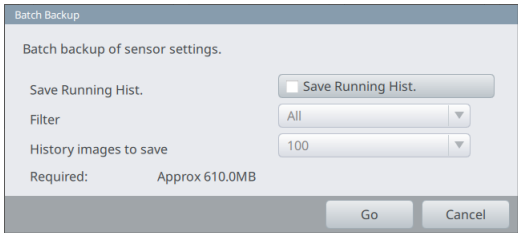
1 Press [Set. Transfer/Backup] on the main screen in [Program].



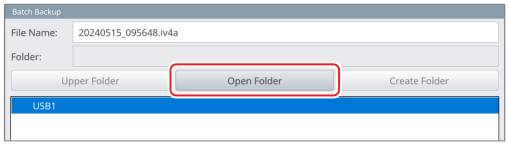
2 Press [Batch Backup].



3 Configure the settings and then press [Go].

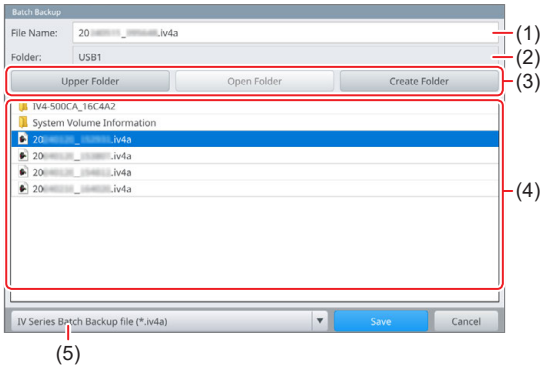


4 Select a folder (shown as USB1 in the figure below but displayed as SD for micro SD cards) and press [Open Folder].



The folders and files stored in the folder will be displayed.

5 Specify the save folder and file name, and press [Save].



(1) File name

Displays the file name.
The name can be changed to a user-defined name.

(2) Folder

Displays the path of currently displayed folder.

(3) Folder operations

[Upper Folder]
Goes to the folder one level above the currently displayed folder.

[Open Folder]
Opens the currently selected folder.

[Create Folder]
Creates a folder on the displayed hierarchal level.

(4) File / Folder display

Displays the files and folders stored in the currently displayed folder.

(5) File type

Select the file type for the file to be saved.

MEMO

4

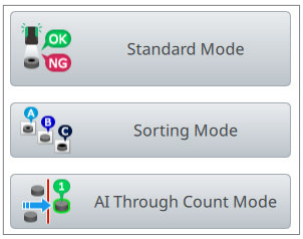
Sensor Setup
(Setting the Status Conditions)

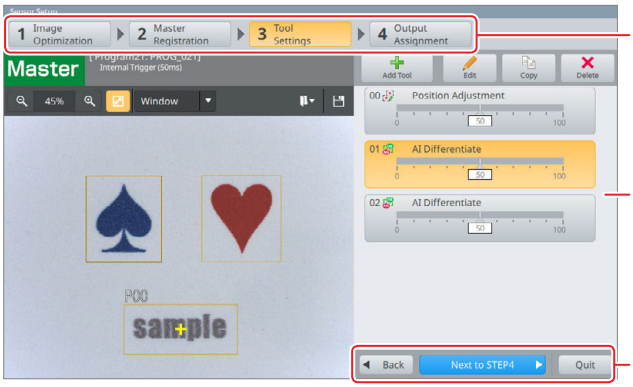
This chapter describes the functions and how to operate Sensor Setup.

What is Sensor Setup?....4-2
Basic Operations for Sensor Setup....4-4
1. Image Optimization....4-6
2. Master Image Registration....4-14
3. Tool Settings (Standard Mode)....4-20
3. Part Registration (Sorting Mode)....4-76
3. Tool Settings (AI Through Count Mode)....4-82
4. Output Assignment....4-88

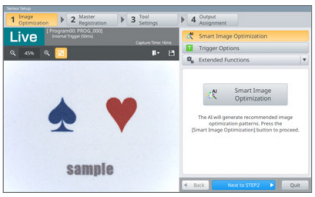
What is Sensor Setup?

Sensor Setup is a feature that enables the user to configure the settings of the program required for judging the target with the sensor in steps. Select the Sensor Setup mode ([Standard Mode], [Sorting Mode], or [AI Through Count Mode]) and adjust the settings on the menu while sequentially following the steps with the navigation buttons.



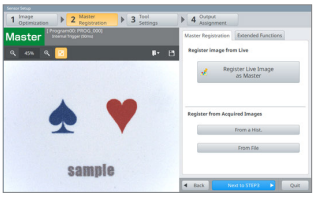


Flow of Sensor Setup: Standard Mode



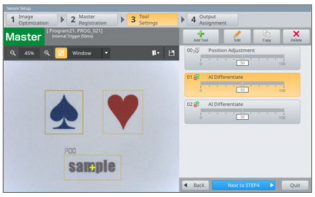
Step 1: Image optimization settings

Set the image optimization settings for clearly imaging a target. Adjust the image settings to clearly define the differences between an “OK” and “NG” image.
Set the trigger options, adjust the brightness, camera focus, and other settings.
“1. Image Optimization” (page 4-6)



Step 2: Registration of a master image

Capture an “OK” image and register the master image to serve as the reference of judgment.
“2. Master Image Registration” (page 4-14)



Step 3: Tool settings

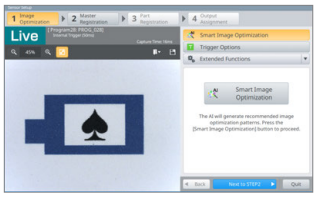
Set tools to judge a target.
Set the tools onto the master image and set the threshold for judgment. Up to 65 detection tools and position adjustment tools in one program can be set.
“3. Tool Settings (Standard Mode)” (page 4-20)



Step 4: Output assignment

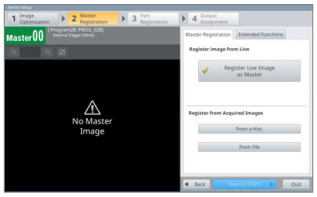
Assign the content to output to each output line.
“4. Output Assignment” (page 4-88)

Flow of Sensor Setup: Sorting Mode



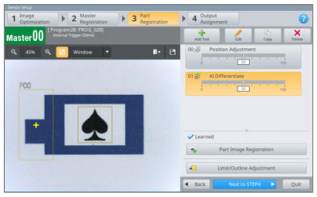
Step 1: Image optimization settings

Set the image optimization settings for clearly imaging a target. Adjust the image settings to clearly define the difference of the target part type.
Set the trigger options, adjust the brightness, camera focus, and other settings.
“1. Image Optimization” (page 4-6)



Step 2: Registration of a master image

Capture an image and register the master image to serve as the basis to identify part types.
“2. Master Image Registration” (page 4-14)



Step 3: Part Registration Settings

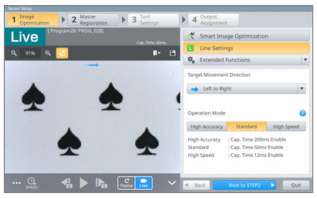
Set the tool to identify a part type. Also register the image for the part type to be identified.
Up to 8 detection tools and 1 position adjustment tool in one program can be set.
“3. Part Registration (Sorting Mode)” (page 4-76)



Step 4: Output assignment

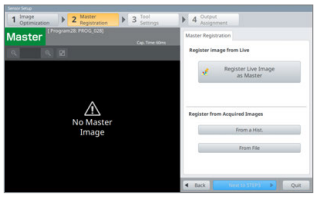
Assign the content to output to each output line.
“4. Output Assignment” (page 4-88)

Flow of Sensor Setup: AI Through Count Mode



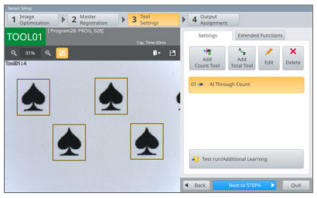
Step 1: Image optimization settings

Set the image optimization settings for clearly imaging a target.
Set the target movement direction, adjust the brightness, camera focus, and other settings.
“1. Image Optimization” (page 4-6)



Step 2: Registration of a master image

Capture an image and register the master image to serve as the basis for the count target.
“2. Master Image Registration” (page 4-14)



Step 3: Tool settings

Sets the AI through count tool.
Place the tools onto the master image and check the judgment status.
The following number of tools can be set for a single program, depending on [Operation Mode].
- High Speed/Standard: Two counting tools, one total tool
- High Accuracy: Six counting tools, two total tools

“3. Tool Settings (AI Through Count Mode)” (page 4-82)



Step 4: Output assignment

Assign the content to output to each output line.
“4. Output Assignment” (page 4-88)

Basic Operations for Sensor Setup

Starting Sensor Setup

1 Turn on the power of the sensor.

2 Start IV Smart Navigator.

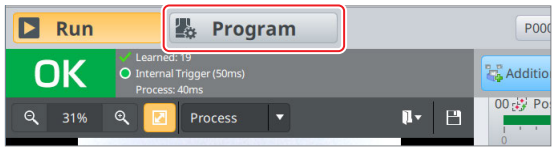
“Operation for Initial Startup of the IV Smart Navigator” (page 3-6)

Point

When the sensor is in one of the following conditions, the main screen in [Program] opens. Proceed to step 5.

- **When the power is turned on for the first time**
- **If a program has not been set**
- **If the initial setup is being performed on the sensor**
- **When the sensor head is changed**

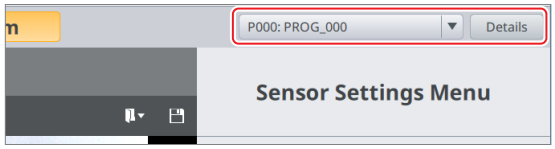
3 Press [Program].



4 Press [OK].

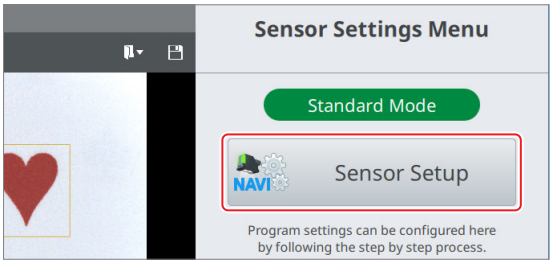
IV Smart Navigator switches to [Program].

5 Select the program to be set.



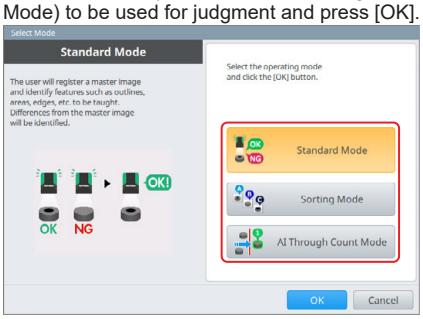
“Changeover for a Target (Program Functions)” (page 7-2)

6 Press [Sensor Setup].



When a program which has not been set is selected

Select the mode (Standard Mode/Sorting Mode/AI Through Count Mode) to be used for judgment and press [OK].

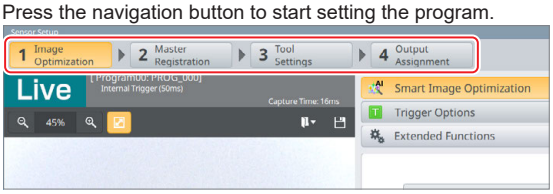


Start setting [1. Image Optimization].

“1. Image Optimization” (page 4-6)

When the program which has been set is selected

Press the navigation button to start setting the program.



“1. Image Optimization” (page 4-6)
“2. Master Image Registration” (page 4-14)
“3. Tool Settings (Standard Mode)” (page 4-20)
“3. Part Registration (Sorting Mode)” (page 4-76)
“3. Tool Settings (AI Through Count Mode)” (page 4-82)
“4. Output Assignment” (page 4-88)

Point

To change the mode of a program that has already been setup, that program must be initialized.
Example: Switching from Standard Mode to Sorting Mode
“Initializing a Program” (page 7-8)

Exiting Sensor Setup

Finishing by completing all steps

1 **Set all steps in Sensor Setup.**

2 **Press [Complete].**



The confirmation screen opens.

3 **Press [Yes].**

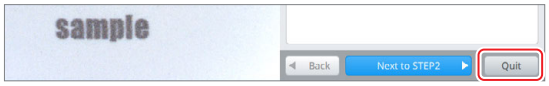
The settings in Sensor Setup will be saved into the program, and the system returns to the main screen in [Program].

Reference

- By pressing [No], the confirmation dialog to cancel the settings opens. By pressing [Yes], Sensor Setup closes without saving the settings.
- By pressing [Cancel], the system returns to the Sensor Setup screen.

Finishing without completing all steps

1 **Press [Quit] at the lower right of the screen.**



When the required settings are completed

The confirmation dialog to save appears.

When the required settings are not completed

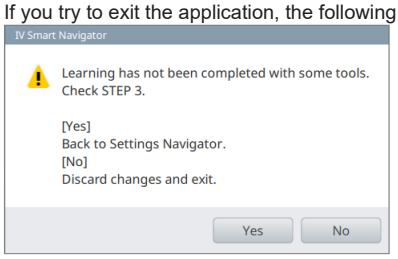
The confirmation dialog to finish appears.
By pressing [No], the confirmation dialog to save appears.

Point

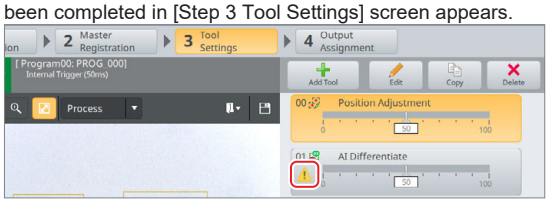
The required settings have not completed yet. Even if [Yes] is pressed and the setting contents are saved in the program, proper operation cannot be performed.

When there are tools for which learning has not completed

If you try to exit the application, the following message will appear.



The symbol ⚠ will appear on tools for which learning has not yet been completed in [Step 3 Tool Settings] screen appears.



2 **Press [Yes].**

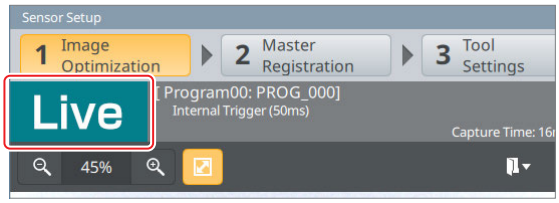
The settings in Sensor Setup will be saved into the program, and the system returns to the main screen in [Program].

Reference

By pressing [No], the confirmation dialog to cancel the settings opens. By pressing [Yes], Sensor Setup closes without saving the settings.

Image Types Displayed in Sensor Setup

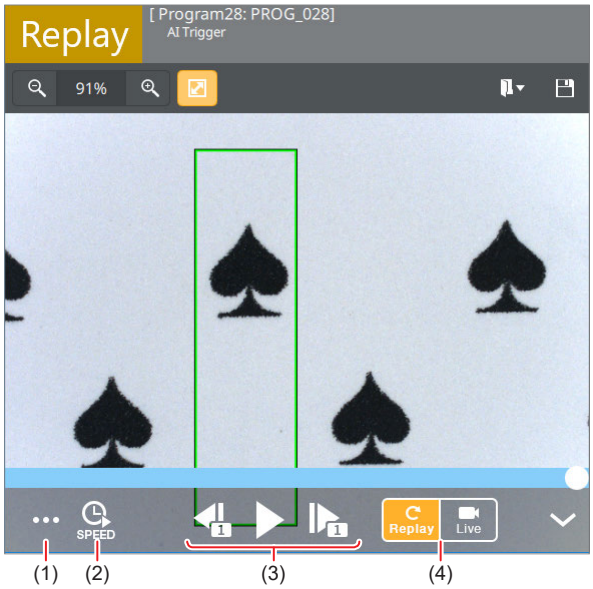
The image types displayed in the Sensor Setup screen are shown below.



Type	Description
Live	The current taken image.
Replay	Image or video in Replay mode.
Master	The image registered as the master. When multiple master image settings are disabled, "Master" will be displayed; when the master image settings are enabled or in Sorting Mode, "Master00 to 07" will be displayed; and when the master name is changed, the master name will be displayed.
Test	Test operation screen. Displays the taken image.
Log	The image viewed from files or image history.

Replay Mode

In Replay mode, the image displayed in Live mode can be viewed as a movie.
Switching to Replay starts loading the image that was displayed immediately beforehand. When loading is complete, the video can be displayed and the image can be viewed at any position.



(1) Load/Save

IV4 Series Video files (*.iv4m) can be loaded and saved.

(2) SPEED

The playback speed of the video can be changed.

(3) Operation buttons

Plays and stops the video as well as forwards and rewinds the video by one frame.
The frame advance/back buttons can be pressed and held for continuous forwarding/rewinding.

(4) Replay/Live

Toggles between Replay mode and Live mode.

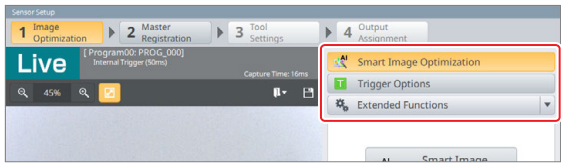
1. Image Optimization

Clearly capture a target

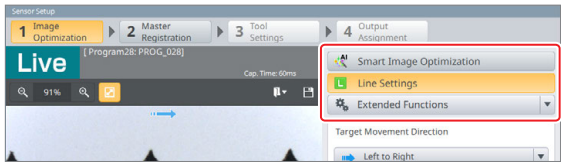
Adjust the image optimization for defining differences in an “OK” and “NG” image or part image.

Settings for Image Optimization

❍ **Standard Mode/Sorting Mode**



❍ **AI Through Count Mode**



Smart Image Optimization

By specifying an area on the target, the AI will automatically generate recommended optimized images. One of multiple recommended optimized images can be selected.
“Smart Image Optimization” (page 4-6)

Trigger Options

A trigger in this manual indicates the timing to start imaging with the built-in camera of the sensor. In the Trigger Options, set the timing to image a target within the field of view of this device. This device can image a target at any timing and can image continuously.
“Trigger Options” (page 4-7)
“Checking the field of view and installed distance” (page 2-2)

Line Settings

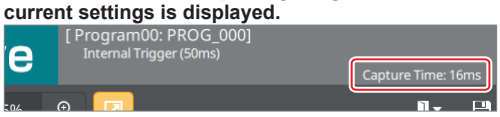
Sets the target movement direction and operation mode.
“Line Settings” (page 4-10)

Extended Functions

Sets the extended functions for image optimization.
“Extended Functions for Image Optimization” (page 4-11)

Point

- **The time it takes for capturing images with the current settings is displayed.**



- **When the master image is registered and image optimization other than Trigger Options are changed, the confirmation message that recommends you to re-register the master image opens. Press [OK] and re-register the master image.**
“2. Master Image Registration” (page 4-14)

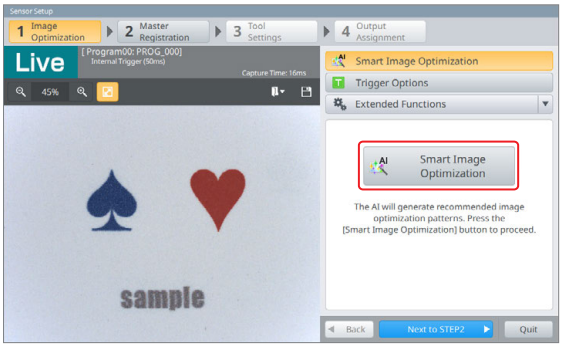
Smart Image Optimization

1 Start Sensor Setup.

“Starting Sensor Setup” (page 4-4)

An image for which brightness and focus has automatically been adjusted appears.

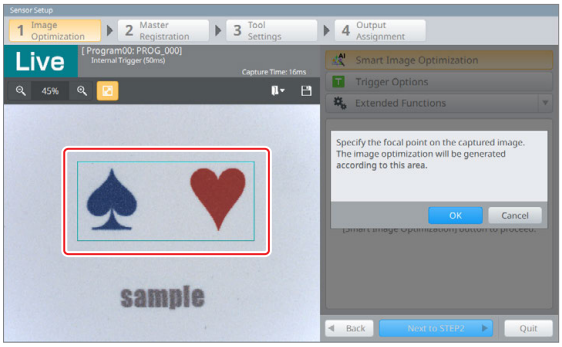
2 To recapture the image, press [Smart Image Optimization].



3 Specify the target area and press [OK].

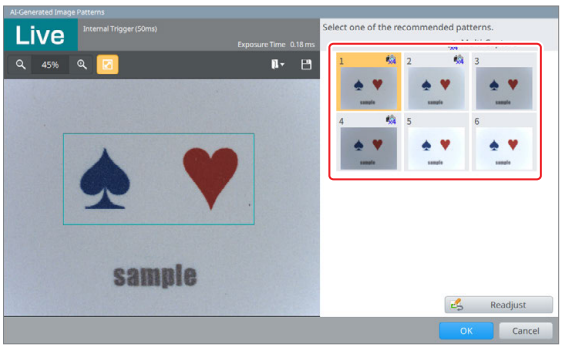
To determine the optimized image, specify the area to be optimized by the AI on the Live image.

Point **Stop the target during Smart Image Optimization.**



4 Select one optimized image, and press [OK].

By pressing [Readjust], the system returns to the procedure to specify the target area.
The AI will be able to generate optimized images again based on settings changes.



Point **When using [Multi-Capture], stop the target for the exposure time starting from the trigger input. Since an image is combined from images resulted from multi-capture, if the target moves during its capturing, the image will not be combined correctly.**

The system returns to the main screen for Image Optimization.

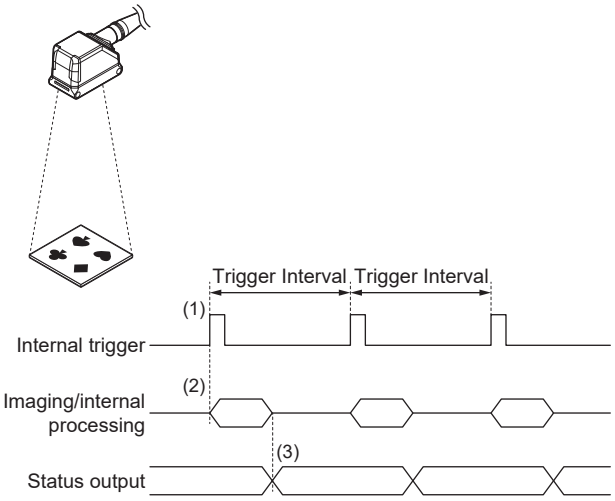
Trigger Options

Point **This item can be set in standard mode or sorting mode.**

A trigger in this manual indicates the timing to start imaging with the built-in camera of the sensor. In the Trigger Options, set the timing to image a target within the field of view of this device. This device can image a target at any timing and can image continuously.

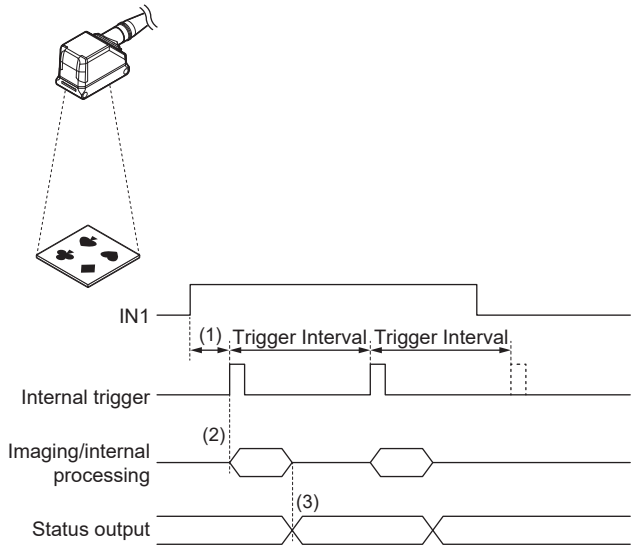
Trigger Type

Internal trigger



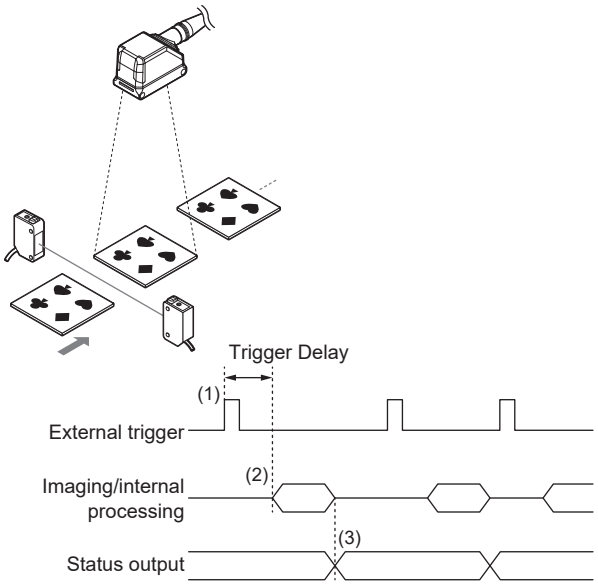
(1) The trigger interval is determined according to the trigger interval settings.
(2) Perform internal processing after imaging.
(3) Output the status result.

When [Internal Trigger Control/AI Trigger Control] is set to [Enable] in Internal Trigger



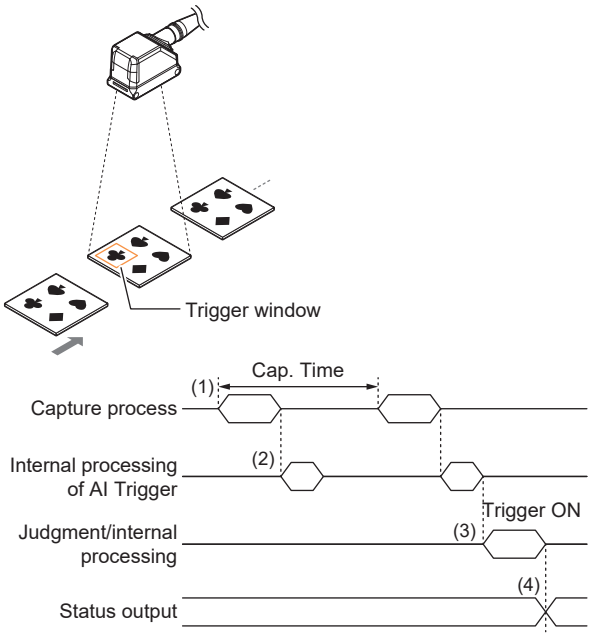
(1) The trigger will be input within the period of "within internal trigger intervals +1 ms" after IN1 is input (the trigger is input while IN1 is input). Thereafter the trigger will be input according to the trigger interval settings.
(2) Perform internal processing after the imaging.
(3) Output the status result.
"Internal Trigger Control/AI Trigger Control" (page 7-14)

External Trigger



(1) Start imaging by inputting the trigger signal from another device.
When the trigger delay interval is set, the imaging start time will be delayed by the specified period.
(2) Perform internal processing after the imaging.
(3) Output the status result.

AI Trigger



(1) Performs image processing at a fixed interval.
(2) Performs internal processing for AI trigger judgment for each imaging process. Checks against what is shown in the trigger window and what was registered ON/OFF in advance.
- The closer to ON registration, the higher the match and judgment processing is performed.
- If it is close to OFF registration, the match will not increase and judgment processing is not performed.

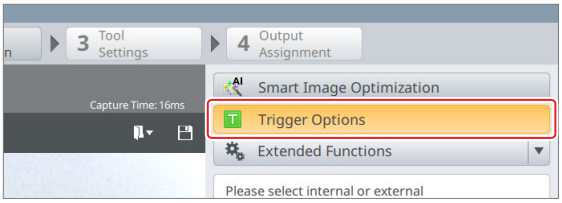
(3) When the degree of match increases and it is determined that a target has entered, the judgment process is performed.
(4) Output the status result.

Setting Trigger Options

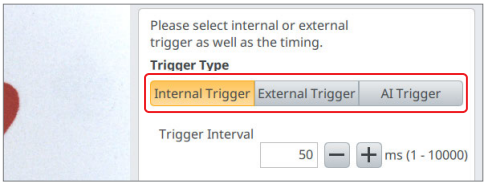
1 Start Sensor Setup.

“Starting Sensor Setup” (page 4-4)

2 Press [Trigger Options].



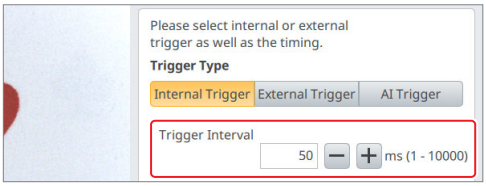
3 Set [Trigger Type].



“Internal Trigger” (page 4-8)
“External Trigger” (page 4-8)
“AI Trigger” (page 4-8)

Internal Trigger

1 Set [Trigger Interval].



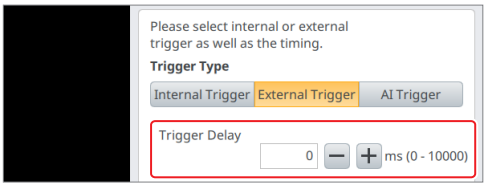
If [Internal Trigger Control / AI Trigger Control] is set to [Enable], an external input / field network (cyclic communication trigger request) can control the internal trigger.

Point

- **If the internal trigger is input while BUSY is ON, a trigger error occurs.**
  “Internal Trigger” (page 11-4)
- **When the lighting mode is set to continuous lighting, the trigger interval can be selected from 1 ms, 25 ms, 50 ms, or 100 ms. For 100 ms or more, values can be selected in 100 ms intervals. The maximum value is 10000 ms.**

External Trigger

1 Set [Trigger Delay].



Starts imaging when receiving an external trigger from a photoelectric sensor or a PLC. The external trigger can be synchronized with a target’s motion.

Reference Used when the output timing of the sensor used as an external trigger and the imaging timing of this device cannot be synchronized.

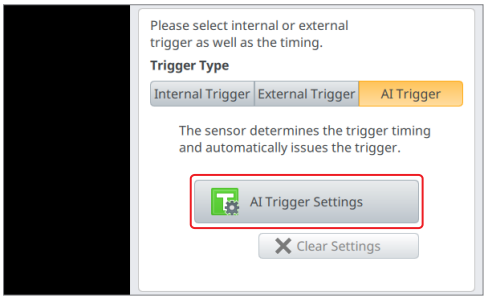
AI Trigger

Configure the setting in which the sensor determines the trigger timing and automatically issues the trigger.

Point

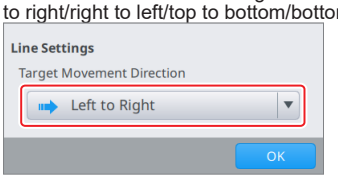
- **When [AI Trigger] is used, [Preliminary Capture] is automatically enabled.**
- **When [AI Trigger] is used, the following are disabled:**
  - **[Distortion Correction] of [Image Correction]**
  - **[Trapezoidal Shape Correction]**
  - **[Multi-Capture]**
  - **[Program Auto-Switching]**

1 Press [AI Trigger Settings].

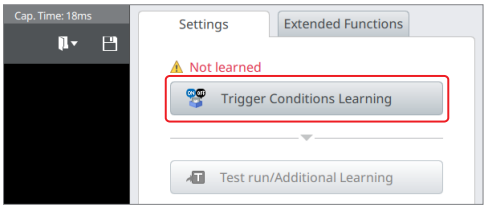


2 Configure [Line Settings].

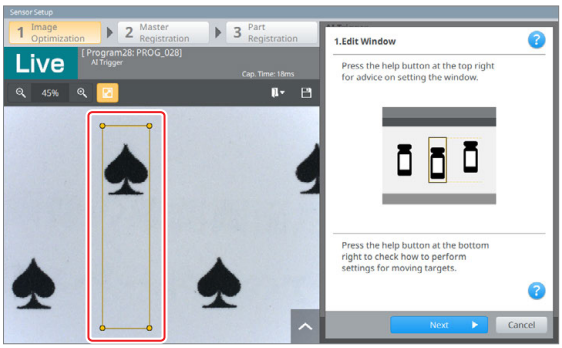
Select the direction according to the target movement direction (left to right/right to left/top to bottom/bottom to top) and press [OK].



3 Press [Trigger Conditions Learning].

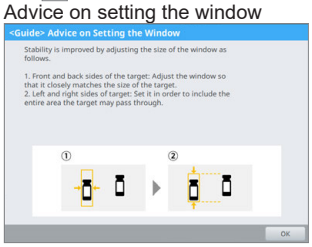


4 Set the window and press [Next].

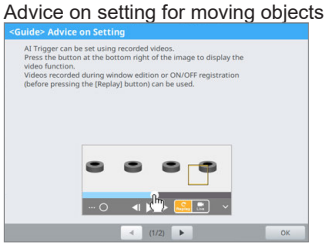


Reference Press ? to check the guide.

- Advice on setting the window



- Advice on setting for moving objects



5 Press [ON Registration] and [OFF Registration] to register the image of the target to be triggered ON/OFF.

❍ **ON Registration**

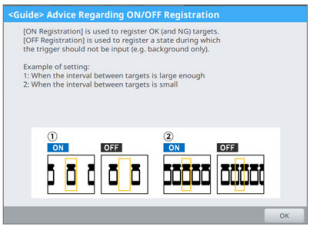
Registers images for which the tool judgment is OK or NG by inputting a trigger.

❍ **OFF Registration**

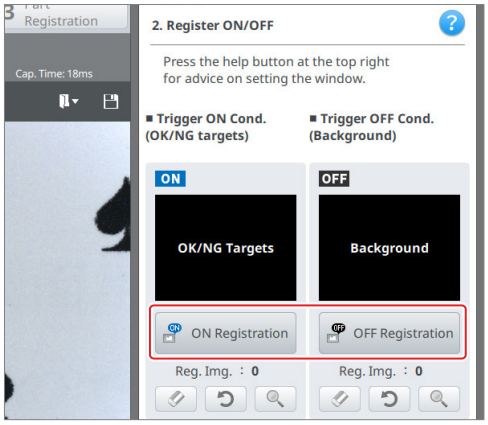
Registers images (e.g., backgrounds) for which you do not want to input a trigger.

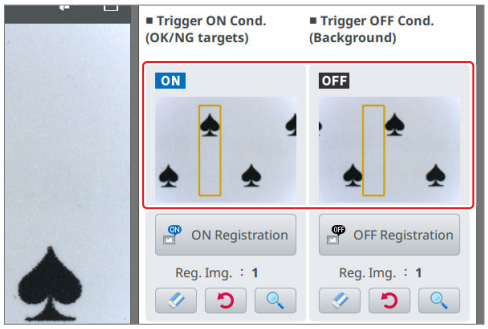
Point

- **For advice on settings for narrow workpiece spacing, check the guide ( ) in the upper right corner of the screen.**

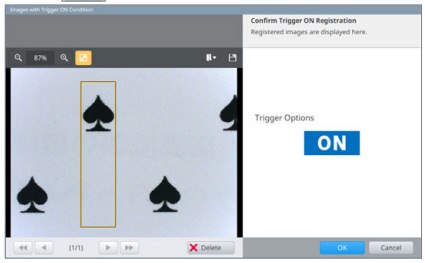


- **Up to 200 learned images can be registered in one program, including learned images registered with other learn tools. As for [AI Trigger], a maximum of 100 images can be registered.**





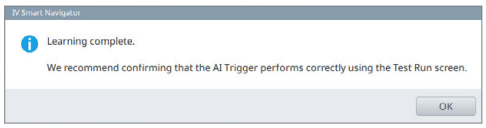
Reference Press to check/delete the registered image.



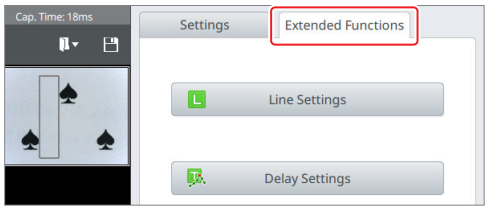
6 When image registration is completed, press [Start Learning].



7 Press [OK].

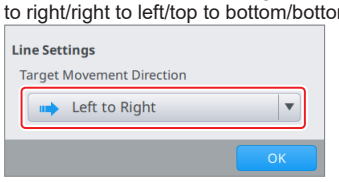


8 Set [Extended Functions] as necessary.



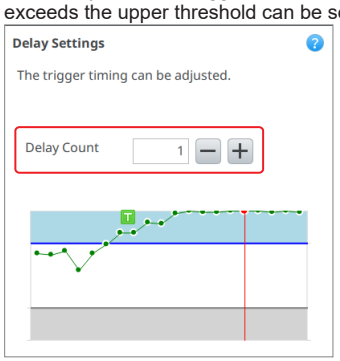
Line Settings

Selects the direction according to the target movement direction (left to right/right to left/top to bottom/bottom to top).

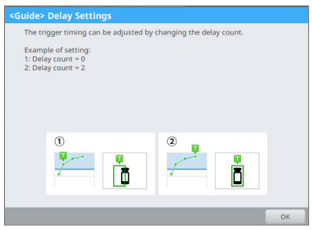


Delay Settings

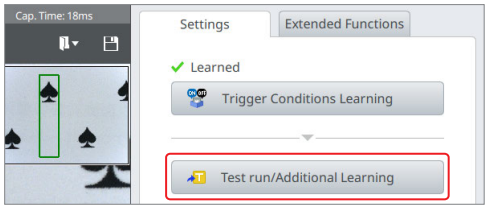
Adjusts when the AI trigger turns on.
How many times the trigger is to be input after the AI trigger match exceeds the upper threshold can be set.



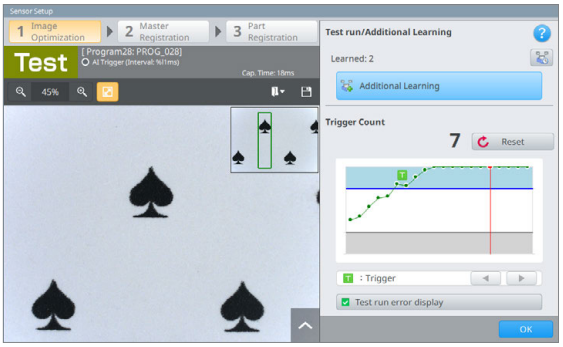
Reference Press to check the guide.



9 Press [Test run/Additional Learning].



10 Check the input status of AI triggers on the match graph.

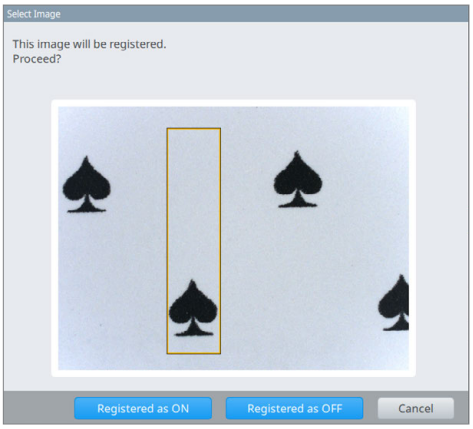


Additional Learning

Additional learning can be performed with the displayed image.

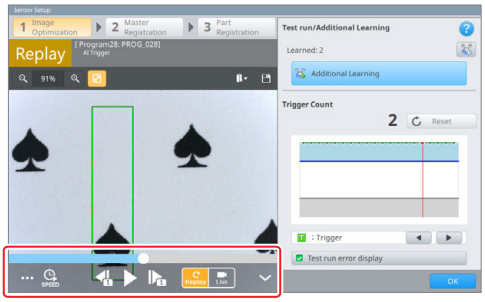
Point

If the trigger is not stable, perform additional learning. You can select images recommended for learning from past images by pressing the [Replay] button.



Reference

Additional learning can be performed with an image in any position by switching the display to Replay mode.



11 When setting is completed, press [OK].

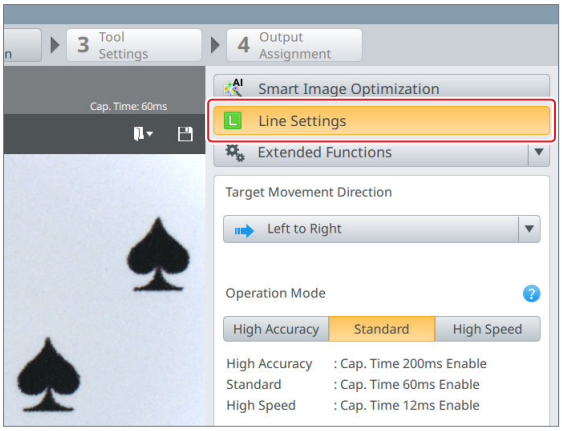
The system returns to the main screen for Image Optimization.

Line Settings

Point

This item can be set in AI Through Count mode.

Sets the target movement direction and operation mode.



Target Movement Direction

Selects the direction according to the target movement direction (left to right/right to left/top to bottom/bottom to top).

Operation Mode

Sets the operation mode (image capture interval) in AI Through Count mode.
The image capture interval and the maximum number of detections on one screen in each operation mode are as follows.

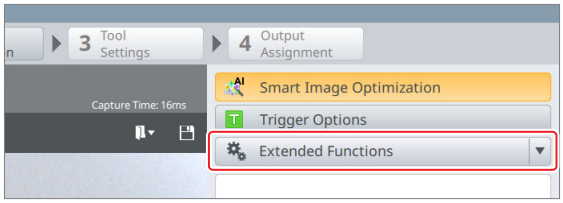
Operation Mode	Cap. Time	Max. No. of Detections
High Accuracy	200ms	160
Standard	60ms	40
High Speed	12ms	10

Point

The maximum number of tools that can be used in each operating mode is as follows:
High Speed/Standard: Up to two counting tools, one total tool
High Accuracy: Up to six counting tools, two total tools

Extended Functions for Image Optimization

Sets the extended functions for image optimization.

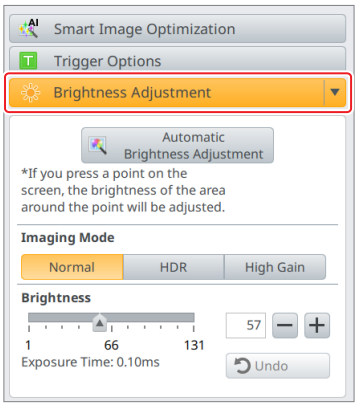


"Brightness Adjustment" (page 4-11)
"Lighting" (page 4-11)
"Lighting Mode" (page 4-11)
"Focus Adjustment" (page 4-12)
"Zoom" (page 4-12)
"Filter (Color Type Only)" (page 4-12)
"Image Correction" (page 4-13)
"High-Speed Capture" (page 4-13)

Point

When the master image is registered and the extended functions for image optimization are changed, a confirmation message that recommends you re-register the master image appears. Press [OK] and re-register the master image.
"2. Master Image Registration" (page 4-14)

Brightness Adjustment



Automatic Brightness Adjustment

By pressing [Automatic Brightness Adjustment], the brightness is automatically adjusted so that the brightness of the entire image becomes optimal.
By specifying (pressing) a position on the image, the brightness is adjusted automatically so that the brightness of the specified surrounding area becomes optimal.

Point

Do not move the target during auto brightness adjustment. The brightness may not be adjusted correctly.

Imaging Mode

Normal (default)

This mode is the basic imaging mode. The target can be imaged with less noise.

HDR

Select to image a target such as metal that reflects light and has high contrast.

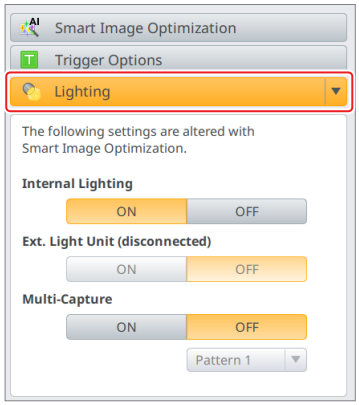
High Gain

Select to shorten the exposure time or when the imaging environment is in a dark place. Lowers image quality due to high gain.

Brightness

Adjusts brightness of an image manually by combining imaging modes.

Lighting



Internal Lighting

Sets the light built into the sensor to turn on or off.

Reference

Select [OFF] when you want to detect the luminescence of a target, such as to confirm LED lighting.

External Light Unit (only when connected)

Sets whether to turn the AI Lighting unit on or off.

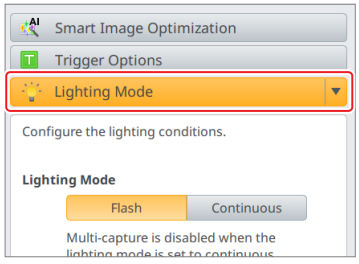
Multi-Capture

Selecting [ON] turns on only a part of the light of the main unit and the AI Lighting unit, and combining images with different emitting directions, a more ideal image can be obtained.
Selects a pattern (1 to 4) based on the brightness of the images obtained from multiple imaging.

Point

- **When using [Multi-Capture], stop the target for the exposure time starting from the trigger input. Since an image is combined from images resulted from multi-capture, if the target moves during its capturing, the image will not be combined correctly.**
- **When in AI Trigger/AI Through Count mode, [Multi-Capture] is not available. When AI Trigger/ AI Through Count mode is used, the imaging conditions using [Multi-Capture] are not presented as AI imaging candidates.**

Lighting Mode



Point

If the lighting mode is changed, re-register the master image and re-set the tool. Otherwise correct judgment may not be possible.

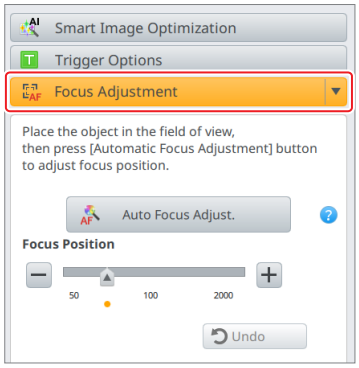
Flash

The built-in light turns on within the exposure when imaging.

Continuous (color type only)

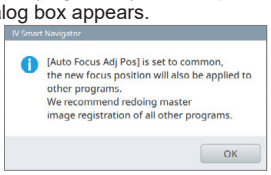
The built-in light lights regardless of specified exposure time when imaging a target.

Focus Adjustment



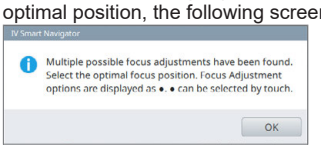
Point **Do not move the target during focus adjustment. The brightness may not be adjusted correctly.**

Reference When [Focus Adjustment] is selected and 📖 "Auto Focus Adj Pos" (page 7-23) is set to [Common], the following dialog box appears.

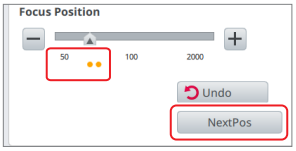


When [Auto Focus Adjust.] is pressed, the focusing position is adjusted automatically. You can also adjust the focus position manually with the slider.

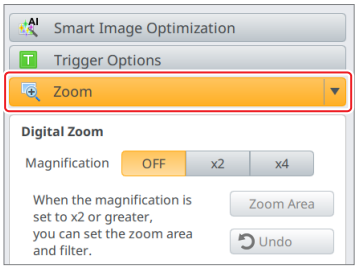
When there are multiple positions that were identified as the optimal position, the following screen opens.



By pressing [OK], the focus is adjusted to the closest position to the sensor, and the options of the positions that can be focused are indicated by (●).
To change the focusing position to a different position, press the markers (●) for the focusing positions. Alternatively, press [NextPos] and select the focusing position.



Zoom



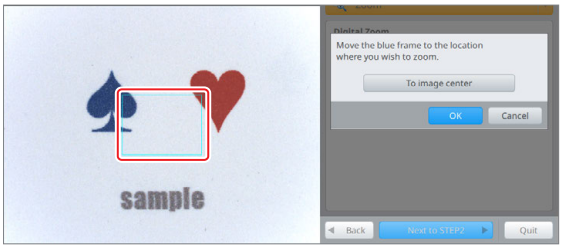
Magnification

Select the magnification of digital zoom.

Point **The following functions are initialized or deleted when the digital zoom magnification is changed.**
- **Initialized: AI trigger settings, imaging area, high-speed filter**
- **Deleted: Learned image history**

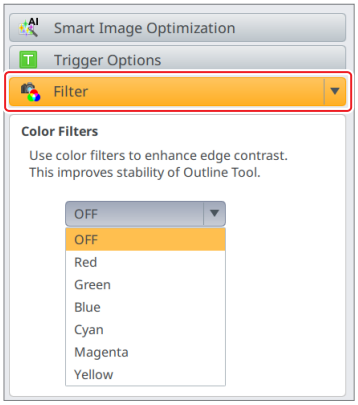
Zoom Area

The zoom area for digital zoom is specified.
To move the zoom area to the center of the screen, press [To image center].

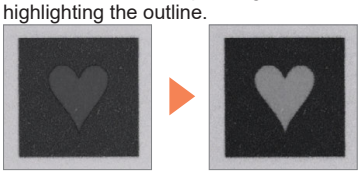


Point **If the zoom area is moved, the imaging area and tool window are moved together. It is recommended to re-register the master image and re-set the tools when moving the zoom area.**

Filter (Color Type Only)

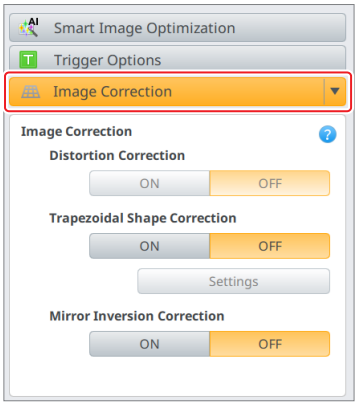


Select the filter for the color or the complementary color to be detected.
The color filter corresponding to the selected color will be applied, highlighting the outline.



Point **Color filters are not applied to the following:**
AI Differentiate/AI Identify/AI Count /AI OCR*/ Color Area Tool/Color Average Tool/Color Prohibit Tool/Blob Count Tool
*** However, color filters are applied to [Show Matching Rate] and [Line Detection Tool] of AI OCR.**

Image Correction



Point **When all types of correction are set to [ON], the processing time may slow down.**

Distortion Correction

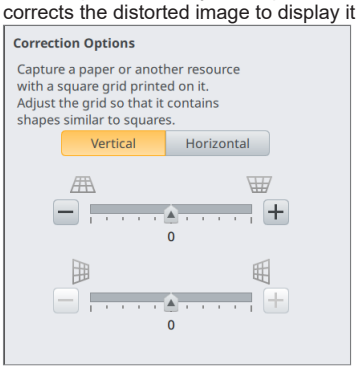
Corrects image distortion automatically. Use this when you are concerned about the distortion.

Point

- **This option can be set to [ON] only for the wide field of view sensor model.**
- **Setting is automatically turned off when [AI Trigger] is used.**

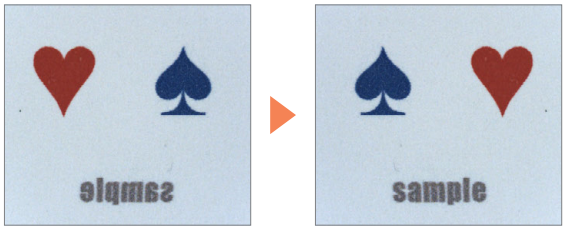
Trapezoidal Shape Correction

If an image displays a target appearing in a trapezoidal shape, due, for example, to the way it was placed during installation, this option corrects the distorted image to display it with its correct shape.



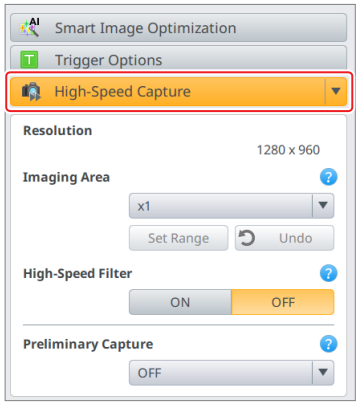
Mirror Inversion Correction

Inverts the captures image in the horizontal direction.
Set this option when, for example, photographing the print on a transparent target from the reverse side (that is, when the print is reversed).



High-Speed Capture

Point **This item can be set in standard mode or sorting mode.**



Resolution

Displays the resolution of the current image (the size of the image used by the sensor).

Imaging Area

Sets the image capture range (the size of the sensor's image capture field of view).
Narrowing the imaging area increases both the imaging speed and the judgment processing speed.
When 1/4x (vertical: 1/2, horizontal: 1/2), 1/16x (vertical: 1/4, horizontal: 1/4), or 1/64x (vertical: 1/8, horizontal: 1/8) is selected, the imaging area can be specified in [Partial].

Point

- **When [Digital Zoom] is set to 2x, 1x cannot be selected for [Imaging Area].**
- **When [Digital Zoom] is set to 4x, 1x or 1/4x cannot be selected for [Imaging Area].**
- **When the set range is changed, the following items must be reset.**
  - **AI Trigger Settings**
  - **Master Image**
  - **Tool Settings**
  - **Learned Image History**

High-Speed Filter

The number of images is reduced to 1/4 (vertical: 1/2, horizontal: 1/2) while the imaging area remains the same.
This increases both the imaging speed and the judgment processing speed.

Preliminary Capture

This function performs image capture processing and judgment processing in parallel.
By using preliminary capture, the next trigger can be input before the judgment process for the previous trigger input is completed and the judgment result is output.
As a result, images can be captured at shorter intervals.

❍ **OFF**
Preliminary capture is not performed.

❍ **ON (2-image Buffer)**
Preliminary capture is performed with a double buffer.

❍ **ON (10-image Buffer)**
Preliminary capture is performed with the maximum number of buffer images.

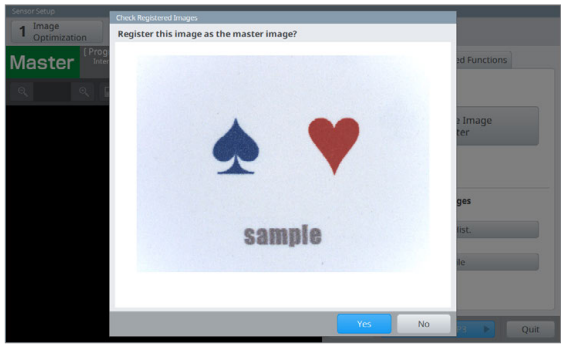
2. Master Image Registration

Registering an Image as a Reference

Master Registration

Standard Mode

After setting "1. Image Optimization," press [Next to STEP2] to display a confirmation screen asking whether the image adjusted in Step 1 is to be registered as the master image or not.



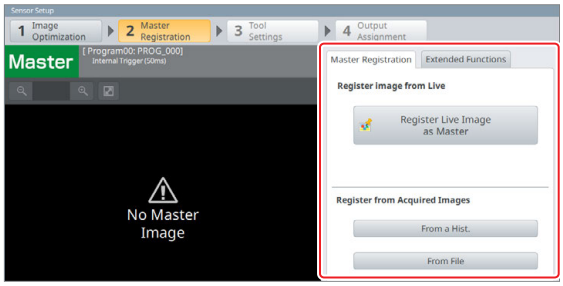
Press [Yes] to register image as the master image and proceed to Step 3.
Press [No] to go to Step 2 (capture a master image).

Reference When [External Trigger] or [AI Trigger] is set in Trigger Options and there are no images to be captured (waiting for trigger), the above screen will not appear because there are no images to be displayed.

Sorting Mode/AI Through Count Mode

After setting "1. Image Optimization," capture and register a master image.

Settings for Master Image Registration



Master Registration

“Register Live Image as Master” (page 4-14)
“Registering a Master Image from Image History” (page 4-15)
“Registering a Master Image from a File” (page 4-16)

Extended Functions

“Extended Functions for the Master Image Registration” (page 4-17)

Register Live Image as Master

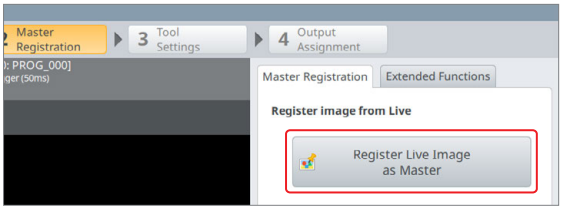
Standard mode / Sorting mode

1 **Display the main screen for the Master Registration.**

“Starting Sensor Setup” (page 4-4)

2 **Place the target that will be used as the reference for judgment in the imaging position.**

3 **Press [Register Live Image as Master].**



The screen switches to [Live].

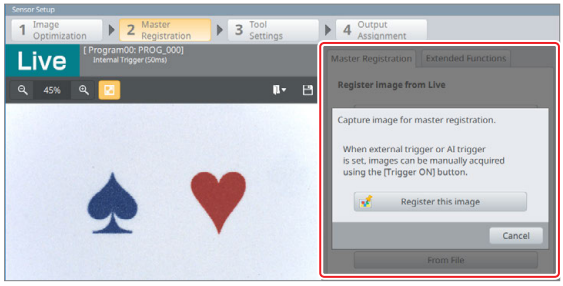
4 **Captures an image of the target.**

In the following cases, the actual trigger input is used for imaging (recommended):
- When [External Trigger] or [AI Trigger] is set in Trigger Options
- When [Internal Trigger Control/AI Trigger Control] is set to [Enable]

If a trigger cannot be input, press [Trigger ON] to take an image of the target by temporarily using the internal trigger.



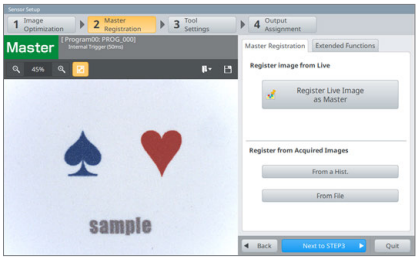
5 **Check the displayed captured image and press [Register this image].**



The confirmation dialog for the Master Registration opens.

6 **Press [OK].**

The image is registered as a master image.



Point **The settings for the disabled outlines will be initialized. Set the outlines that will be disabled again as needed.**

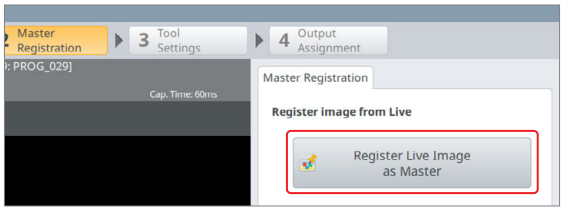
AI Through Count Mode

1 Display the main screen for the Master Registration.

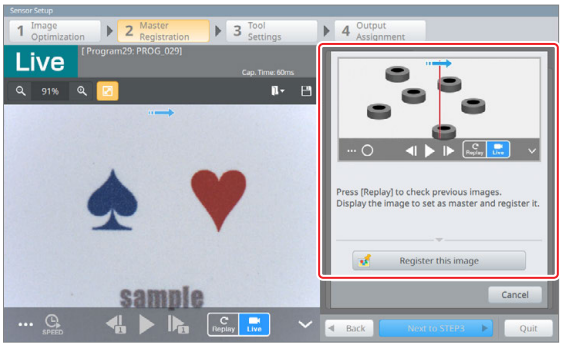
“Starting Sensor Setup” (page 4-4)

2 Capture an image of the target (non-defective workpiece) that will be used as the basis for judgment.

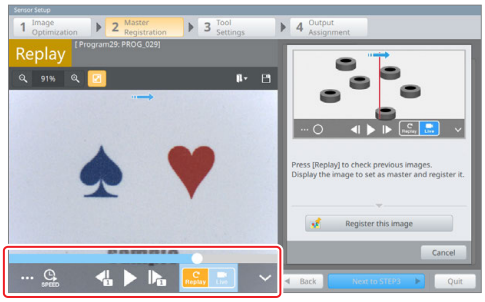
3 Press [Register Live Image as Master].



4 Check the displayed captured image and press [Register this image].



Reference Press the [Replay] button to check previous images. You can display the image to be registered as the master image and register it.

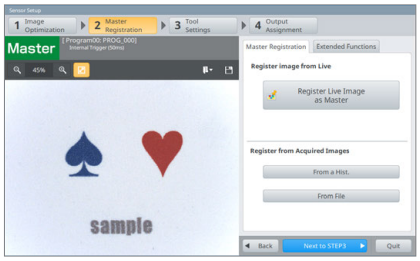


“Replay Mode” (page 4-5)

The confirmation dialog for the Master Registration opens.

5 Press [OK].

The image is registered as a master image.



Registering a Master Image from Image History

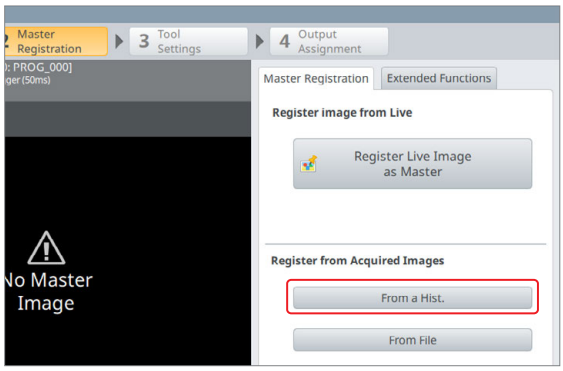
Registers an image from the image history saved in the memory within the sensor as a master image.

Point **The image to be registered as the master image must be saved in “Running Image History” (page 5-14).**

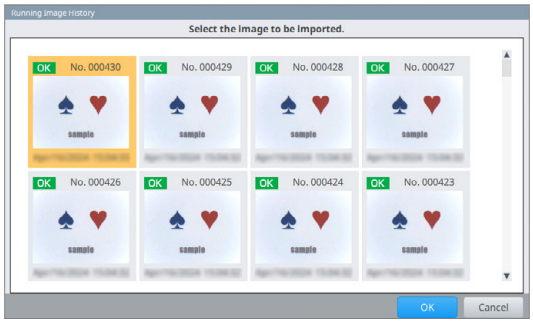
1 Display the main screen for the Master Registration.

“Starting Sensor Setup” (page 4-4)

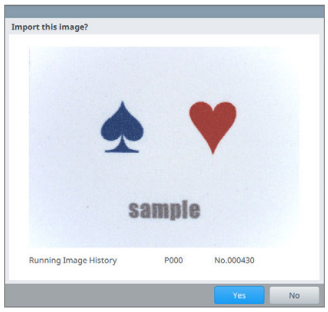
2 Press [From a Hist.].



3 Select the image to be registered as the master image and press [OK].



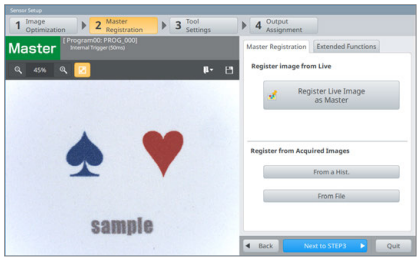
4 Check the displayed image and press [Yes].



The confirmation screen opens.

5 Press [OK].

The image is registered as a master image.



Registering a Master Image from a File

Register a saved image as the master image.

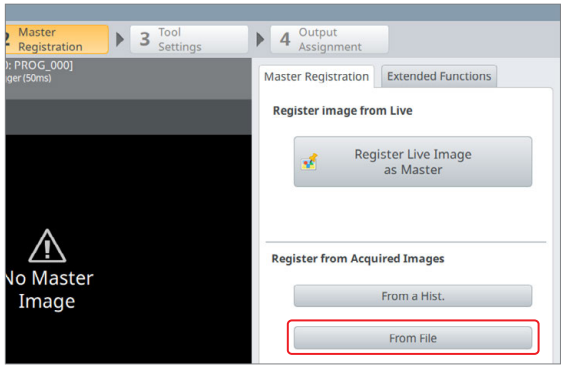
Point

- **Prepare the file to be registered as the master image in advance.**
- **The files which can be registered as a master image are batch backup files (*.iv4a), individual program backup file (*.iv4a) or image capture files (*.iv4p).**

1 Display the main screen for the Master Registration.

“Starting Sensor Setup” (page 4-4)

2 Press [From File].

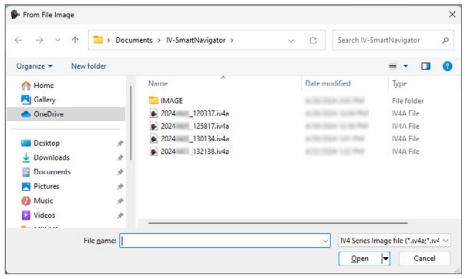


3 Select the file to be registered as the master image.

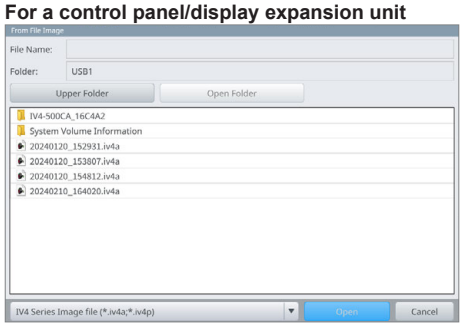
When using a batch backup file (*.iv4a) or individual program backup file (*.iv4a)

Select a file and press [Open].

- **For a PC**

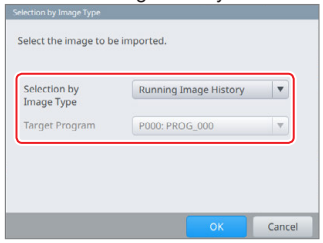


- **For a control panel/display expansion unit**

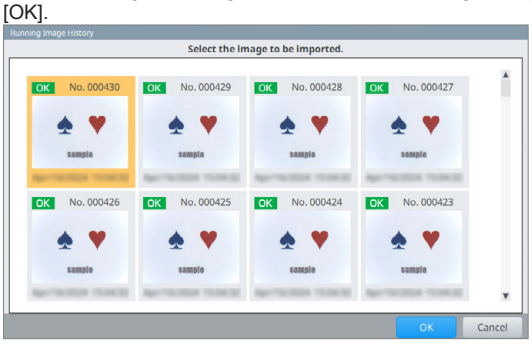


Select the type of the image to be imported from the following. Select the target program when the Learned Image History is selected.

- Running Image History
- Master Image
- Learned Image History



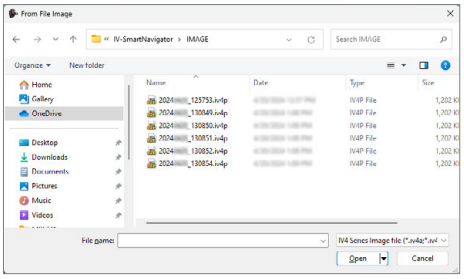
Displays a list of images.
Select the image to be registered as the master image and press [OK].



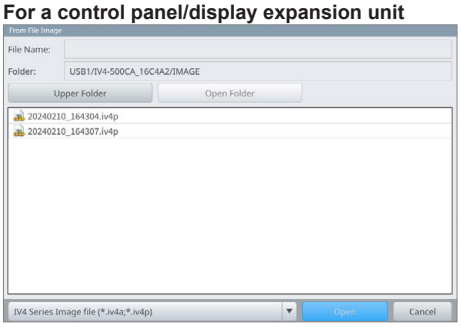
When using an image capture file (*.iv4p)

Select a file and press [Open].

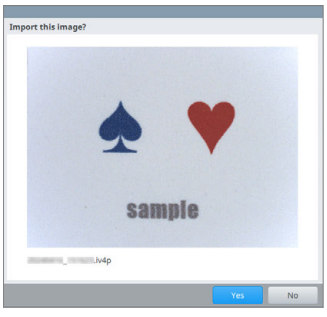
- **For a PC**



- **For a control panel/display expansion unit**



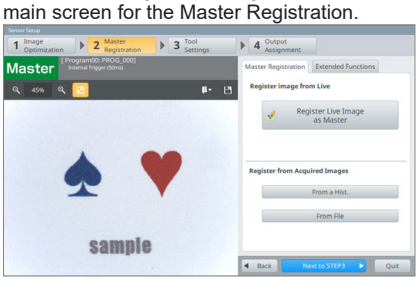
4 Check the displayed image and press [Yes].



The confirmation screen opens.

5 Press [OK].

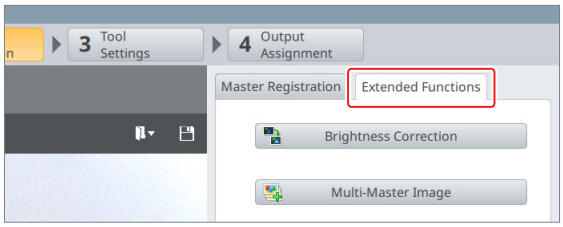
The master image will be registered and the sensor returns to the main screen for the Master Registration.



Extended Functions for the Master Image Registration

Point **This item can be set in standard mode or sorting mode.**

Sets the extended functions for image optimization.



"Brightness Correction" (page 4-17)
"Multi-Master Image" (page 4-17)
"Master IMG Name" (page 4-18)

Brightness Correction

Point

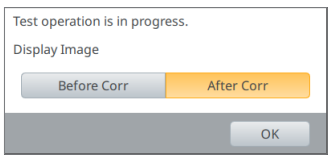
- **For a monochrome type, AI Trigger/AI Differentiate/AI Identify/AI Count are not available when [Brightness Correction] is set to [Enable]. Moreover, [Brightness Correction] cannot be set to [Enable] when AI Trigger/AI Differentiate/AI Identify/AI Count is set.**
- **[Brightness Correction] can be set only when a master image is registered.**
- **Brightness correction is performed for the image registered as master image 0 when [Multi-Master Image] is set to [Enable].**
- **For color type, [Brightness Correction] is not applied to the following functions and tools: AI Trigger/AI Differentiate/AI Identify/AI Count/AI OCR*/Color Area/Color Average/Color Prohibit/ Blob Count**
  *** However, [Brightness Correction] is applied to [Show Matching Rate] and [Line Detection Tool] of AI OCR.**

The impact from changes in lighting can be reduced by setting the brightness level for the master image.
Select [Enable] to set the tool window to be the basis for brightness correction.



Region to be the brightness correction standard

Press [Test Adjustment] to check the operation status before and after brightness correction.
Insert a shield or something similar and if the brightness in the specified standard region changes, check that the brightness for the entire image is corrected.



Point **For the region to be a reference of brightness correction, specify the following.**

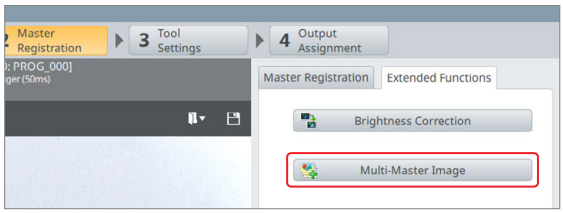
- **A region with average medium brightness. A region with strong shininess and reflection or a region which is too dark may not be corrected properly.**
- **A region with a constant imaging status which does not change, such as device parts other than the Targets.**

Multi-Master Image

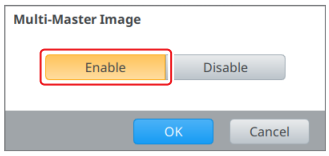
Up to eight master images can be registered.
(Standard mode only)

Point **When [Multi-Master Image] is set to [Enable], [AI Differentiate], [AI Identify], and [AI Count] are unavailable.**

1 Press [Multi-Master Image].

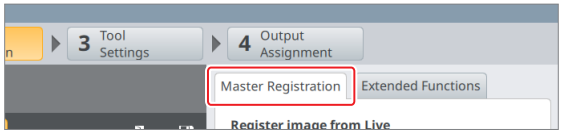


2 Select [Enable] and press [OK].



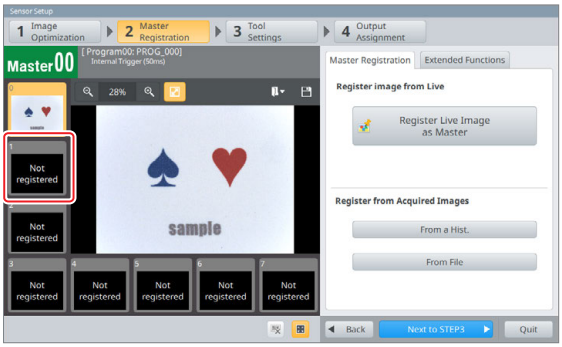
Reference By pressing [Disable], master images other than the master image 0 are deleted.

3 Press the [Master Registration] tab.



4 Select a master image (0 to 7) to be registered from the master image list.

The master image 0 must be registered.



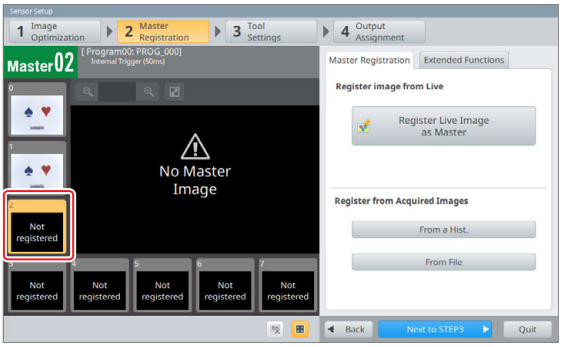
5 Register the master image.

"Register Live Image as Master" (page 4-14)
"Registering a Master Image from Image History" (page 4-15)
"Registering a Master Image from a File" (page 4-16)

When the registration ends, a confirmation screen to switch to the next master image appears.



6 By pressing [Yes], the next master image is selected.

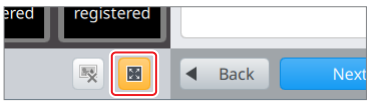


By pressing [No], the registered master image remains selected.

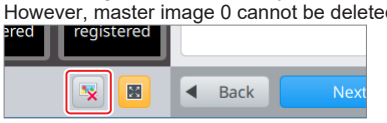
7 Repeat steps 4 to 6 to register all the master images you want to register (up to 8).

Reference

- By pressing the "Switch to Display All Master Images <=> Single Master Image" button below the master image, whether the master image list is displayed or hidden can be changed.



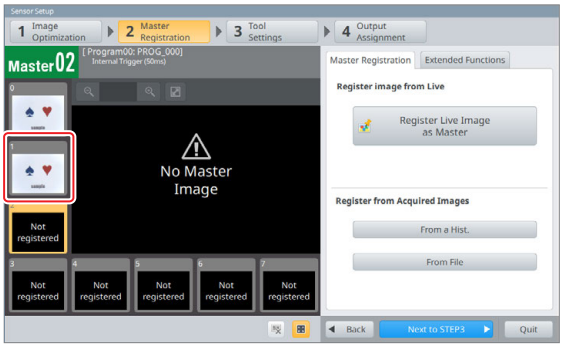
- By pressing the "Delete Master Image" button, the master image selected currently can be deleted. However, master image 0 cannot be deleted.



Master IMG Name

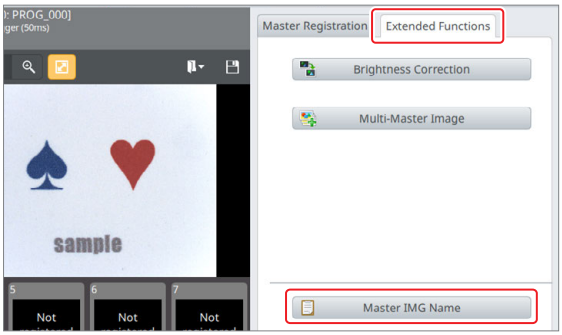
If [Multi-Master Image] is set to [Enable], master names can be set for master images.

1 Select the master image for which you want to edit the master name.



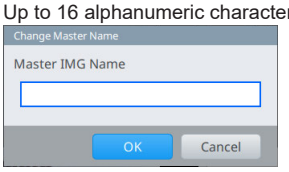
If the master image is not registered, the master name cannot be edited. Register the master image first.

2 Select the [Extended Functions] tab and press [Master IMG Name].



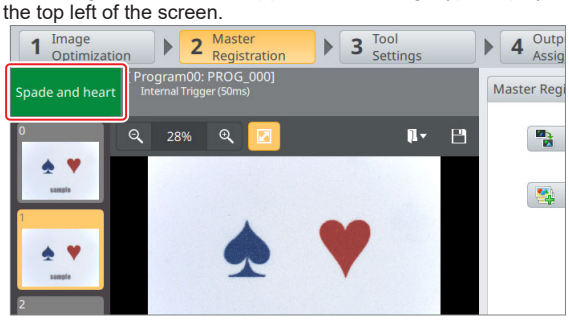
3 Edit the master name.

Up to 16 alphanumeric characters can be set.



4 Press [OK].

The changed master name appears in the image type display on the top left of the screen.



MEMO

3. Tool Settings (Standard Mode)

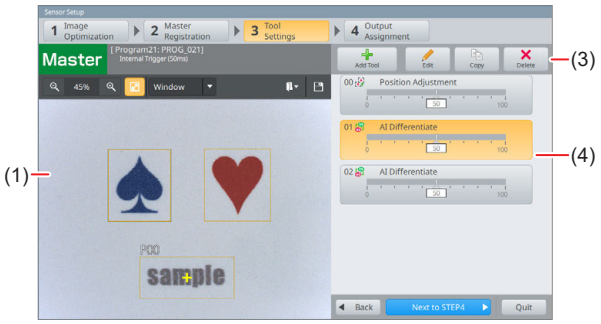
Setting the Judgment Method for the Target

In [Standard Mode], set tools in the master image to judge whether a target is OK or No Good.
The aspects of the target registered as the master image are set as an “OK” image. During operation, the sensor judges whether it is an “OK” image or “NG” image by judging the differences in the registered master image and the target to be examined.

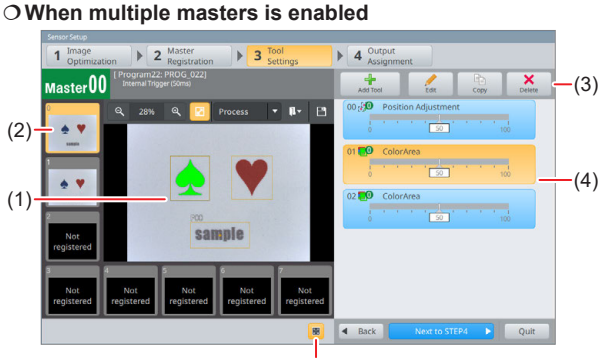
The number of tools that can be set in one program are as follows:
- Up to 65 tools can be set.
- For AI Count and AI OCR, up to 16 tools can be set respectively.
- If the position adjustment tool or outline tool are included:
  - There is a limit to the total number of tools for the position adjustment tool and outline tool.
  - The number of tools that can be set vary depending on the tool settings. Generally, this is about 40 tools.
  - Generally about 20 tools if the search algorithm for the position adjustment tool is set to high accuracy.

Main Screen for Tool Settings

❍When multiple masters is disabled



❍When multiple masters is enabled



(1) Master Image
Displays the master image and tool window. If a search range is set, a tool window which indicates the range (light blue) will be displayed.

(2) Master image list (only when multiple masters is enabled)
Displays the list of all master images.

(3) Tool settings button
Adds, edits, copies, or deletes the tool.
“Adding/Editing/Copying/Deleting a Tool” (page 4-21)

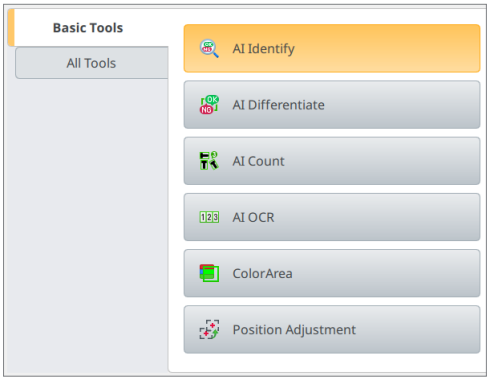
(4) Tool list
Displays a list of tools set in the program and a threshold for each tool.
When multiple masters is enabled, the master number (00 01 etc.) will be displayed for each tool, and the tools for unselected master images will be displayed in gray.

(5) All master images display <-> Single master image display switching button (only when multiple masters is enabled)
Controls whether to display or hide the master image list.

Tool list

List of Tools for Standard Mode

Tools that can be set in standard mode are shown below.



● Basic Tools

“AI Identify” (page 4-24)
“AI Differentiate” (page 4-26)
“AI Count” (page 4-30)
“AI OCR” (page 4-34)
“Color Area/Area tool” (page 4-48)
“Position Adjustment Tool” (page 4-52)

● All Tools

❍Position Adjustment
“Position Adjustment Tool” (page 4-52)
“High-Speed Position Adjustment (Hi-Sp.Adj) Tool” (page 4-54)

❍Learn
“AI Differentiate” (page 4-26)
“AI Identify” (page 4-24)
“AI Count” (page 4-30)
“AI OCR” (page 4-34)

❍Color
“Color Area/Area tool” (page 4-48)
“Color Prohibition/Brightness Prohibition Tool” (page 4-56)
“Color/Brightness Averaging Tool” (page 4-58)

❍Character
“AI OCR” (page 4-34)

❍Count
“AI Count” (page 4-30)
“Blob Count Tool” (page 4-62)
“Edge Tool” (page 4-64)

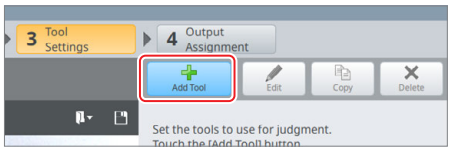
❍Width
“Width Tool” (page 4-66)
“Diameter Tool” (page 4-68)
“Pitch tool” (page 4-70)

❍Shape
“Outline Tool” (page 4-72)
“Edge Tool” (page 4-64)
“EdgePixels tool” (page 4-74)

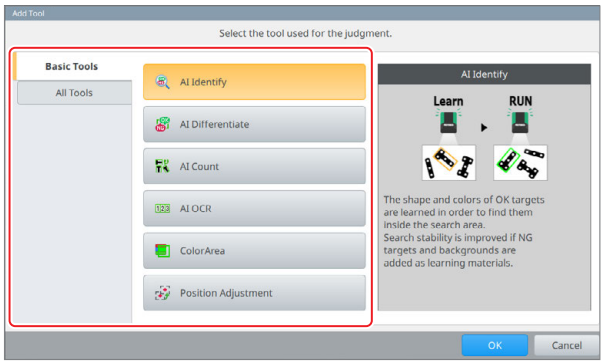
Adding/Editing/Copying/Deleting a Tool

Adding a Tool

1 Press [Add Tool].



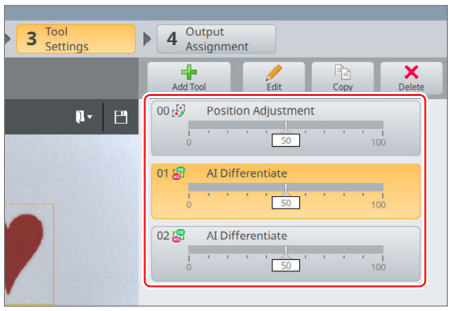
2 Select the tool to be added and press [OK].



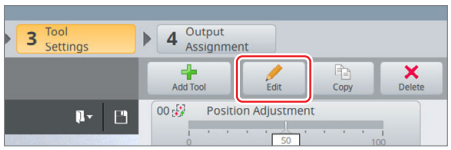
3 Configure the settings for the tool.

Editing a tool

1 Select a tool to edit the settings.



2 Press [Edit].



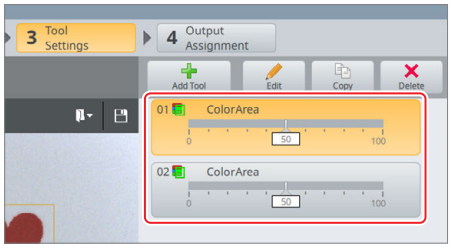
3 Edit settings for the tool.

Copying a tool

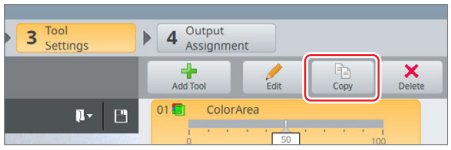
Point

- **If 64 tools are set, tools cannot be copied.**
- **When setting the [AI OCR] tool while it has [Line Detection Tool] enabled, setting is made for two tools. Therefore, copying fails if 63 tools have already been set.**

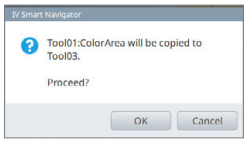
1 Select a tool to be copied.



2 Press [Copy].



3 Press [OK].



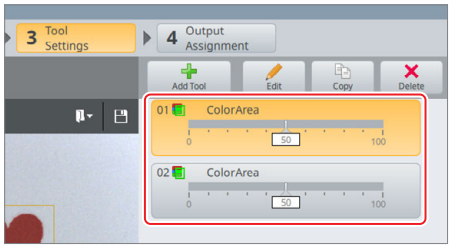
The copied tool window will be selected and displayed on the copy source tool window.

Reference The next available tool number which has not been set will be automatically assigned as the copied tool number.

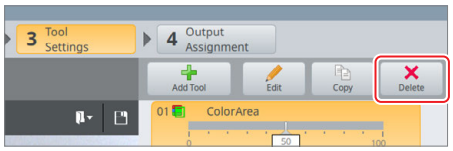
4 Press [Edit] and adjust the settings of the copied tool.

Deleting a tool

1 Select a tool to be deleted.



2 Press [Delete].



The confirmation screen opens.

3 Press [OK].

The selected tool will be deleted and the sensor returns to the main screen for the Tool settings.

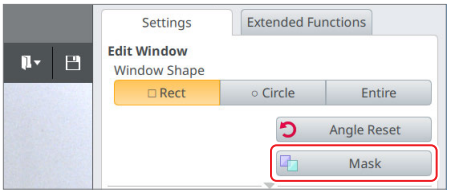
Common Setting Items for the Tool Settings

Mask Settings

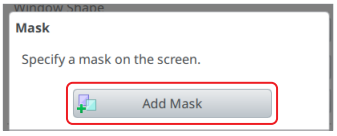
Add a rectangular/circular mask region.

Reference
- Some tools do not have this function.
- The [Mask] of the AI Identify and AI Count is used to apply mask settings to the search range. Be sure not to mask the tool window.

1 Press [Mask].

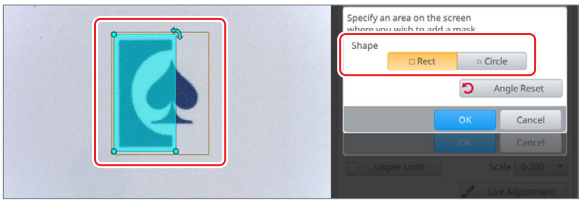


2 Press [Add Mask].



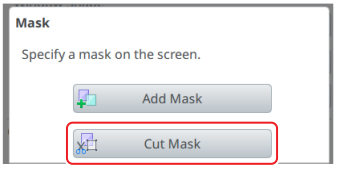
3 Select the mask shape, position, size, and angle according to the target.

Area inside the mask region is excluded from a detection target.



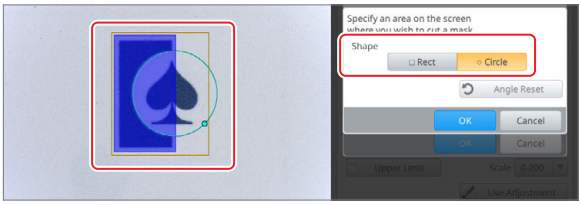
4 Press [OK].

5 Press [Cut Mask] to cut a mask region.



6 Select the shape, position, size, and angle of the area to remove from the mask according to the target.

Inside the region removed from the mask, the mask is disabled and detection is enabled.

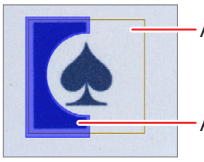


7 Press [OK].

8 Repeat steps 2 to 7 as needed to set the mask region.

Adding a mask or removing sections of the mask can be performed up to 20 times.

9 Press [OK].

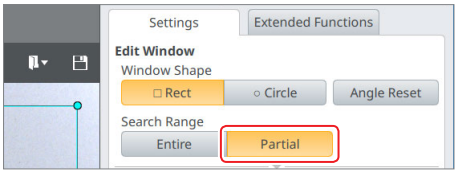


Search Range Settings

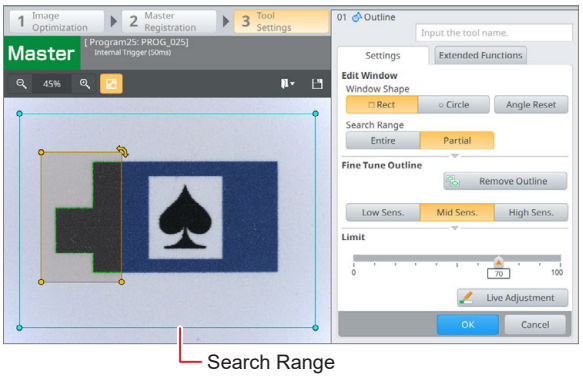
Specify an area in which to search for a target.
By using a narrower area for the search range, the processing time will be shortened.

Reference Some tools do not have this function.

1 Press [Partial].



2 Set the tool window that indicates the search range.

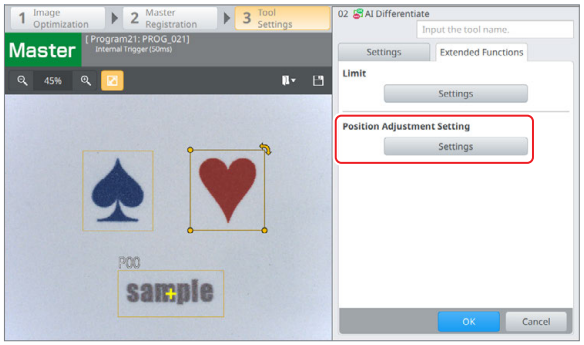


Reference The search range cannot be rotated.

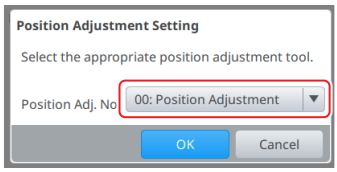
Position Adjustment Setting

If multiple position adjustment tools or high-speed position adjustment tools are set, you can select a position adjustment / high-speed position adjustment tool to be applied by each detection tool.

1 Press the [Extended Functions] tab → [Position Adjustment Setting] tab of the detection tool.



2 Select the number of the Position Adjustment/High-Speed Position Adjustment tool to be applied.



Multi-Master Image: Disabled

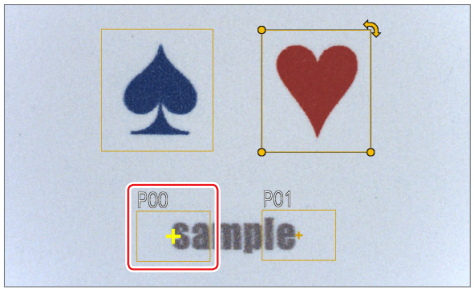
- The default value when setting the Position Adjustment /High-Speed Position Adjustment tool is [00: Position Adjustment].
- The default value when not setting the Position Adjustment / High-Speed Position Adjustment tool is [00: (Not Set)].
- If [None] is selected, the Position Adjustment/High-Speed Position Adjustment tool will not be applied (Position adjustment will not be done).

Multi-Master Image: Enabled

- Only the Position Adjustment/High-Speed Position Adjustment tool on the same master image can be selected.
- The default is [None].
- If [None] is selected, the Position Adjustment/High-Speed Position Adjustment tool will not be applied (Position adjustment will not be done).

3 Press [OK].

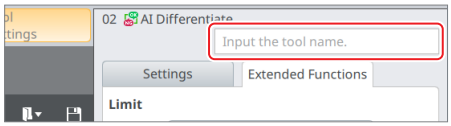
A "+" will appear on the position adjustment/high-speed position adjustment window applied to the currently selected detection tool.



Tool Name Setting

Point **If the display language is changed, characters may become unreadable.**

A user-defined name, such as the name of a target, can be set for tools.
(Up to 16 alphanumeric characters)
Enter the desired name into the text box.



The tool name can be confirmed in the main screen in [Run].
"Chapter 5 Running" (page 5-1)

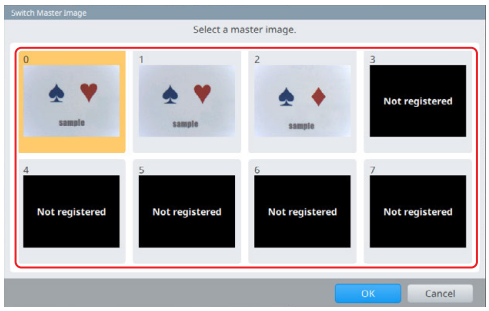
Switch Master Image (only when multi-master image settings are enabled)

When [Multi-Master Image] is set to [Enable], the master image to which to add a tool can be switched.

1 Press [Switch Master Image].



2 Select a master image and press [OK].



The master image will be switched.

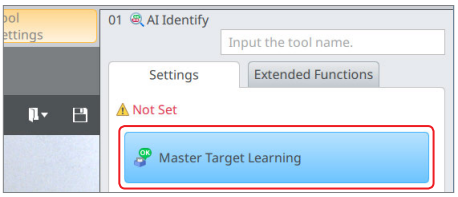
AI Identify

AI Identify Settings

1 Add the [AI Identify] tool.

“Adding a Tool” (page 4-21)

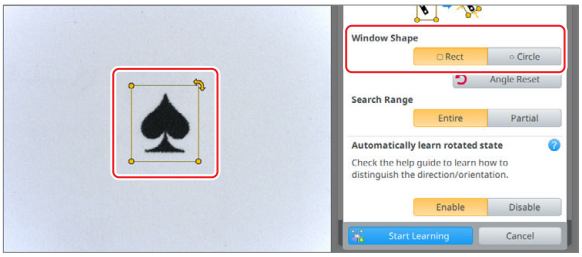
2 Press [Master Target Learning].



3 Enclose the master target inside the window.

Window Shape

Select [Window Shape] and set the position, size, and angle according to the target.



Search Range

Specify an area in which to search for a target.
By specifying a narrower area for the search range with [Partial], the processing time will be shortened.

“Search Range Settings” (page 4-22)

Automatically learn rotated state

Enable

Select this option when you want a target to be judged as OK even if it has been rotated.

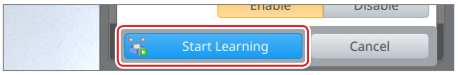
Disable

Select this option when you want the orientation of the target to be taken into account.

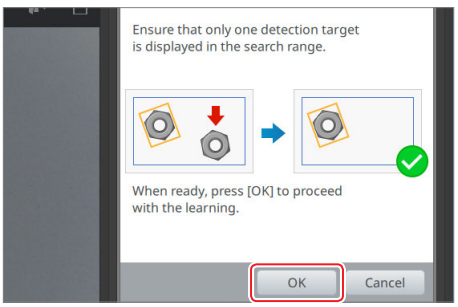
4 Configure the [Mask] of [Search Range] as needed.

“Mask Settings” (page 4-22)

5 Press [Start Learning].

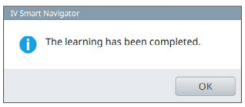


6 Check the status of the window settings and press [OK].

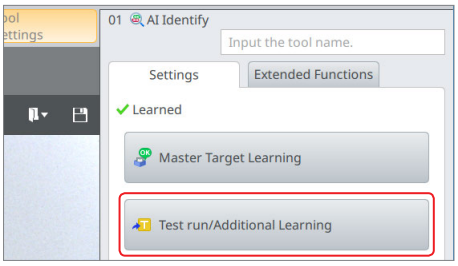


Point **Ensure that there is only one target that you want to detect in the search range when performing learning.**

7 After learning has been completed, press [OK].



8 Press [Test run/Additional Learning].

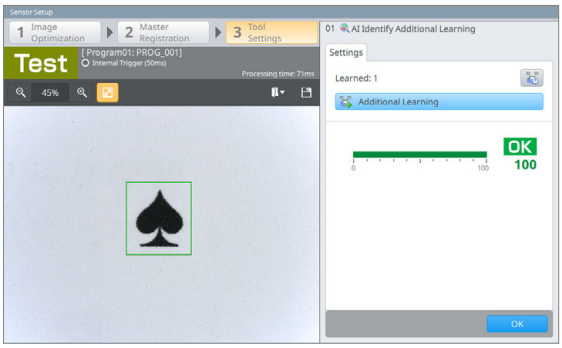


9 Take an “OK” image and a “NG” image.

In the following cases, input an external trigger:
- When [External Trigger] is set in Trigger Options
- When [Internal Trigger Control/AI Trigger Control] is set to [Enable]

If a trigger cannot be input, press [Trigger ON] to take an image of the target by temporarily using the internal trigger.

10 Check the OK/NG judgment status. When you have finished checking, press [OK].



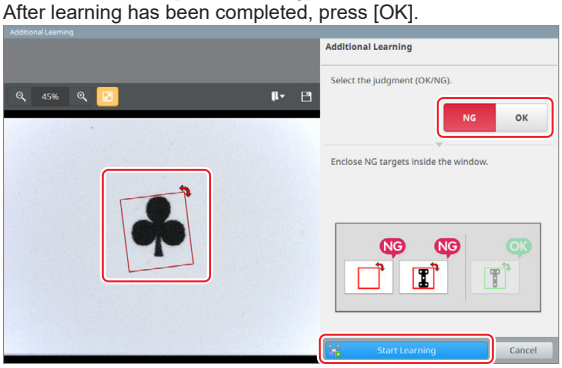


You can check the learned image history.

“Confirming Learned Image History” (page 6-8)

Additional Learning

Additional learning can be performed with the displayed image. Select the judgment (OK/NG), enclose the target with the tool window, and press [Start Learning].
After learning has been completed, press [OK].



Reference When learning as NG, everything in the search region, including the tool window, is subject to learning as NG. Therefore, no matter where the tool window position is set, it is recognized as NG.

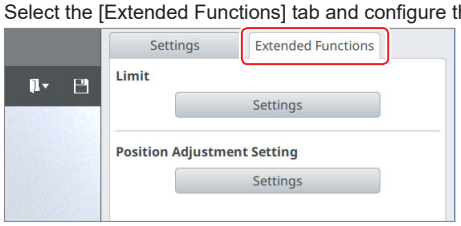
11 Configure the following settings as needed.

“Limit” (page 4-25)
“Position Adjustment Setting” (page 4-23)
“Tool Name Setting” (page 4-23)

12 Press [OK].

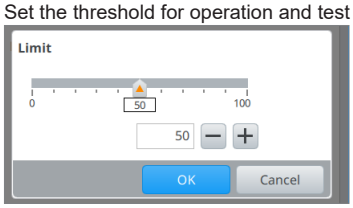
Extended Functions for AI Identify

Select the [Extended Functions] tab and configure the settings.



Limit

Set the threshold for operation and test runs.



Position Adjustment Setting

You can select the Position Adjustment/High-Speed Position Adjustment tool to be applied.

“Position Adjustment Setting” (page 4-23)

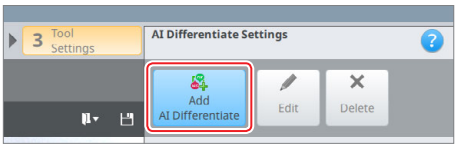
AI Differentiate

AI Differentiate Settings

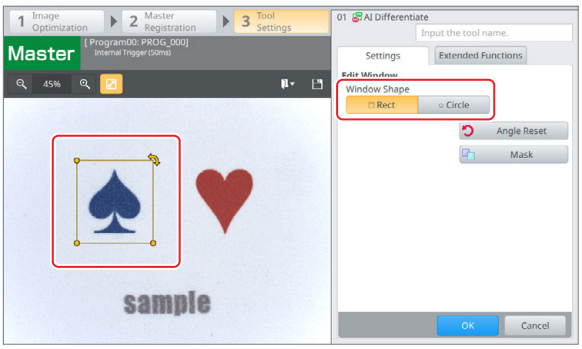
1 Add [AI Differentiate].

“Adding a Tool” (page 4-21)

2 Press [Add AI Differentiate].



3 Select [Window Shape] and set the position, size, and angle according to the target.



Point

- **The tool window size should be set according to the size of the image where the difference between an “OK” and “NG” target is clear.**
  “Optimizing the Size of the Tool Window” (page 6-19)
- **If misalignment of the tool window occurs because of target position misalignment when optimizing the window, set the position adjustment tool.**
  “Position Adjustment Tool” (page 4-52)

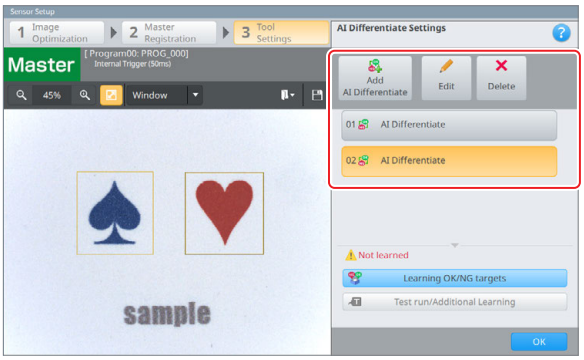
4 Configure the following settings as needed.

“Mask Settings” (page 4-22)
“Position Adjustment Setting” (page 4-23)
“Tool Name Setting” (page 4-23)

5 Press [OK].

The system returns to the [AI Differentiate Settings] screen.

6 Repeat steps 2 to 5 to set the AI Differentiate.



7 Perform [Learning OK/NG targets].

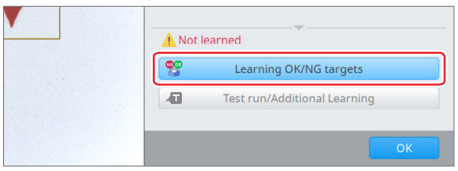
“Learning OK/NG Targets” (page 4-26)

Learning OK/NG Targets

1 Set [AI Differentiate].

“AI Differentiate Settings” (page 4-26)

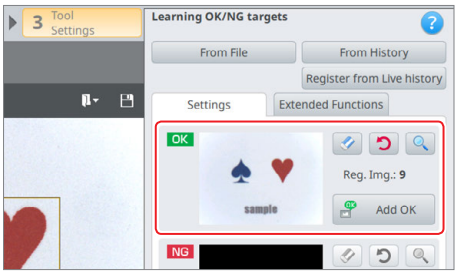
2 Press [Learning OK/NG Targets].

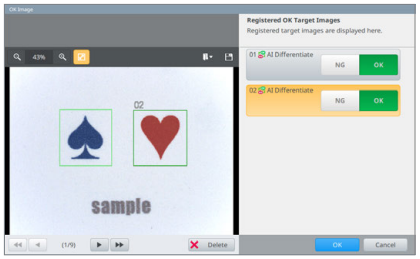


3 Register an OK target.

Point

If multiple AI Differentiate tools are set, capture a target where all AI Differentiate judgments are OK. Learning cannot be performed correctly on a target with mixed OK and NG judgments.
In this case, perform additional learning.
“Learning Multiple Images for Stability” (page 6-20)



	Deletes all registered images.
	Deletes the last registered image so that it can be redone.
	The registered image can be expanded and checked. When registering multiple images, they can be checked or deleted with the move buttons. 

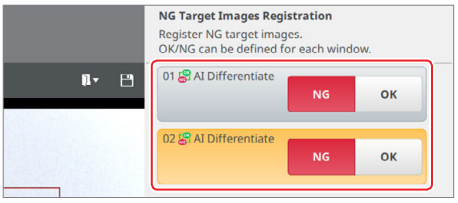
- **Registration of Taken Image**
  “Registration of Taken Image” (page 4-28)
- **Registration of image saved in a file**
  “Registration of image saved in a file” (page 4-28)
- **Registration of Image from the Image History**
  “Registration of Image from the Image History” (page 4-29)
- **Registration of Image from the Live Image History**
  “Registration of Image from the Live Image History” (page 4-29)

4 Register an NG target.

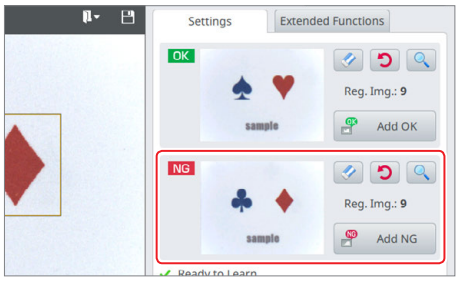
The registration method is the same as step 3.

Point

- **When setting multiple AI Differentiate tools, a screen for selecting OK or NG will appear for each AI Differentiate at registering an NG target. Select OK or NG.**



- **Be sure to register a target or background to be judged as an NG in one of the multiple AI Differentiates.**

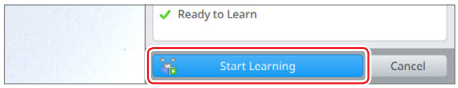


5 Repeat step 3 or step 4 when registering multiple images.

Point

By capturing multiple images of different judgment criteria, the judgment stability will be improved automatically.
“Learning Multiple Images for Stability” (page 6-20)

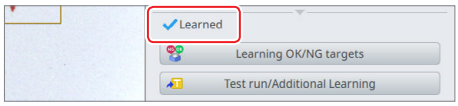
6 Press [Start Learning].



7 Check the image and press [OK].



The system returns to the [AI Differentiate Settings] screen.
When learning is completed, [Learned] will be displayed.

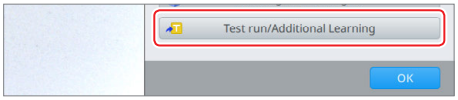


Reference

The following statuses for the AI Differentiate are displayed:

- **AI Differentiate Not Set**
  The tool window for the AI Differentiate is not set.
- **Ready to Learn**
  OK target and NG target image registration have been completed, and the sensor is ready to start learning.
- **Not learned**
  OK work/NG work learning has not been completed.
- **Learned**
  OK target/NG target learning has been learned.
- **Relearning required**
  Relearning is needed because of a setting change.

8 Press [Test run/Additional Learning].

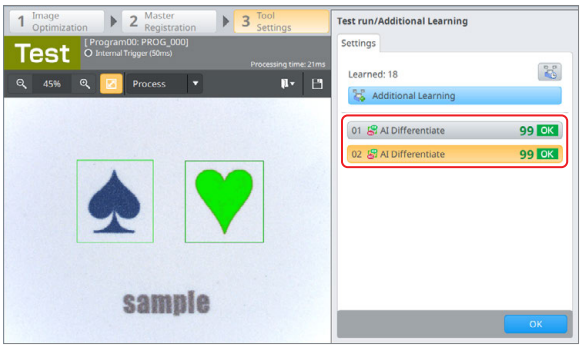


9 Take an “OK” image and a “NG” image.

In the following cases, input an external trigger:
- When [External Trigger] is set in Trigger Options
- When [Internal Trigger Control/AI Trigger Control] is set to [Enable]

If a trigger cannot be input, press [Trigger ON] to take an image of the target by temporarily using the internal trigger.

10 Check the matching rate.

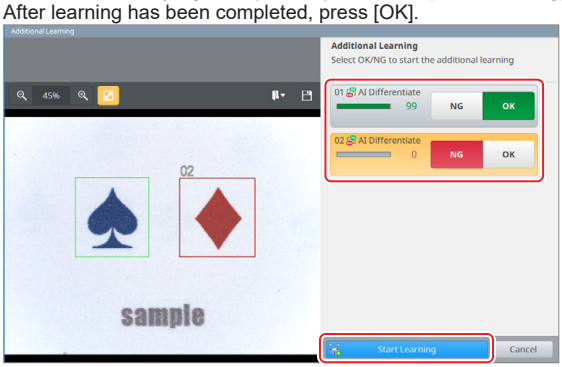




You can check the learned image history.
“Confirming Learned Image History” (page 6-8)

Additional Learning

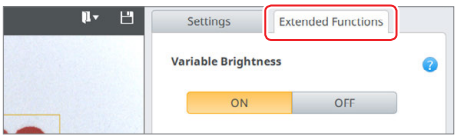
Additional learning can be performed with the displayed image. Select the correct judgment (OK/NG) and press [Start Learning]. After learning has been completed, press [OK].



11 Press [OK].

Registration of Taken Image

1 When changing the [Variable Brightness] setting, select the [Extended Functions] tab.



Reference

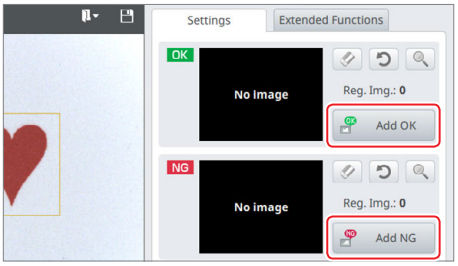
Variable brightness can be ON in the following cases.
- During internal trigger
- When pressing [T] with external trigger/AI trigger set to image by using the internal trigger.

2 Image a target to be registered.

In the following cases, input an external trigger:
- When [External Trigger] is set in Trigger Options
- When [Internal Trigger Control/AI Trigger Control] is set to [Enable]

If a trigger cannot be input, press [Trigger ON] to take an image of the target by temporarily using the internal trigger.

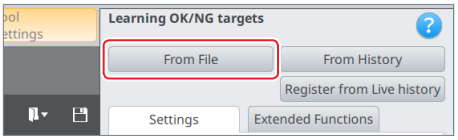
3 Press [Add OK] or [Add NG].



The captured image will be displayed.

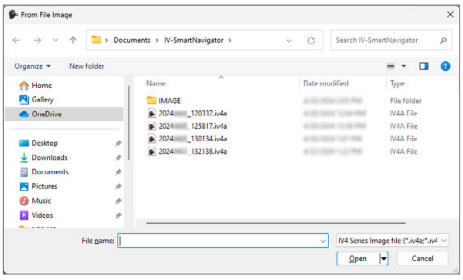
Registration of image saved in a file

1 Press [From File].

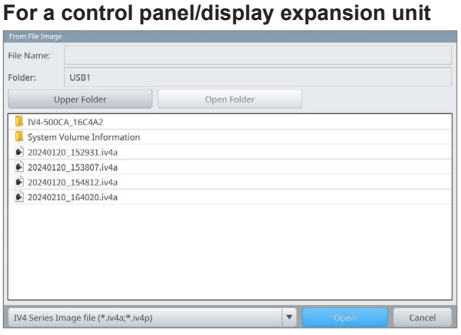


2 Select the file to be imported, and press [Open].

❍ For a PC



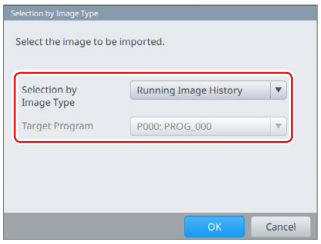
❍ For a control panel/display expansion unit



3 If a batch backup file (*.iv4a) or individual program backup file (*.iv4a) is selected, select the image type to be imported from the following.

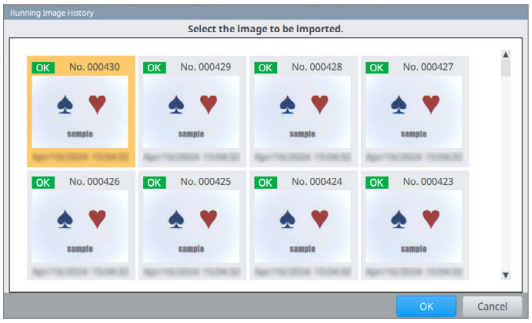
- Running Image History
- Master Image
- Learned Image History

Select the target program when the Learned Image History is selected.

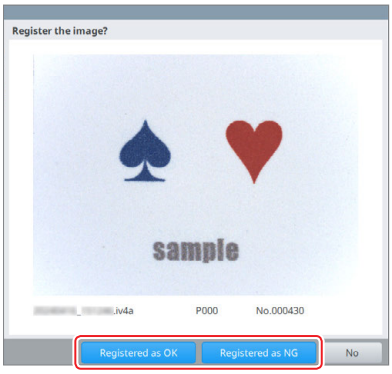


Displays a list of images.

4 Select the image to be registered, and press [OK].



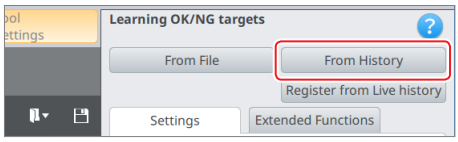
5 Press [Registered as OK] or [Registered as NG].



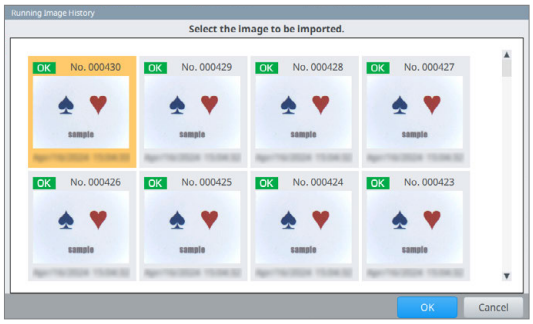
The registered image will be displayed.

Registration of Image from the Image History

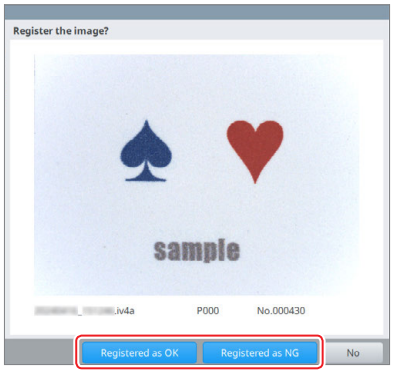
1 Press [From History].



2 Select the image to be registered, and press [OK].



3 Press [Registered as OK] or [Registered as NG].

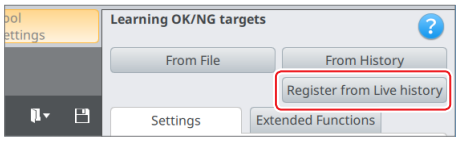


The registered image will be displayed.

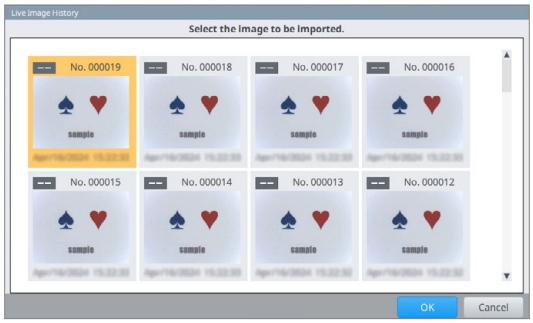
Registration of Image from the Live Image History

This setting is used when it is not possible to capture OK/NG images by keeping the target still, such as when using AI trigger. You can select and register images from the most recently captured images.

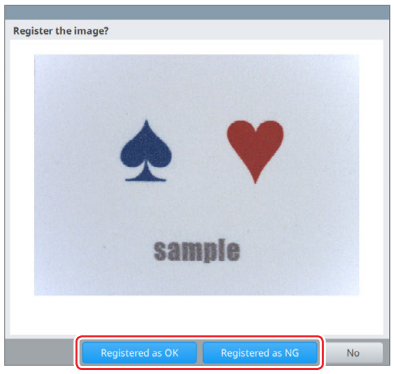
1 Press [Register from Live history].



2 Select the image to be registered, and press [OK].



3 Press [Registered as OK] or [Registered as NG].



The registered image will be displayed.

AI Count

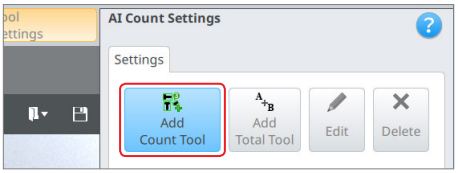
The upper limit of the number of counts is 201 per tool.
The upper limit of the number of counts for the total tool is 999.

Setting the Count Tool

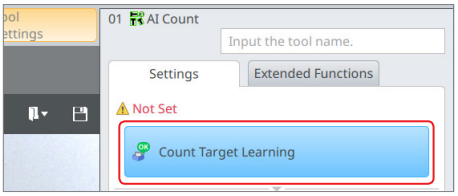
1 Add the [AI Count] tool.

“Adding a Tool” (page 4-21)

2 Press [Add Count Tool].



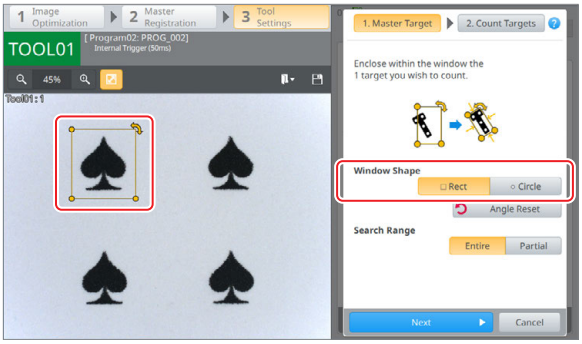
3 Press [Count Target Learning].



4 Select [Window Shape] and set the position, size, and angle according to the target.

Point

- **Select one target to become the detection reference and then set the window.**
- **Detection stability improves when the window closely matches the perimeter of the target.**



- **Search Range**

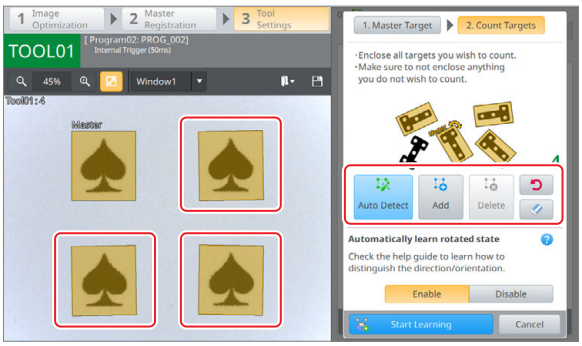
Specify an area in which to search for a target.
“Search Range Settings” (page 4-22)

5 Configure the [Mask] of [Search Range] as needed.

“Mask Settings” (page 4-22)

6 Press [Next].

7 Completely enclose the target that you want to count.



- **Auto Detect**

[Master] automatically detects targets that have the same shape as the displayed target.
If all targets are not enclosed in one automatic detection cycle, press [Auto Detect] repeatedly.

Point

When the orientation of the target is aligned at ±10 degrees or less, KEYENCE recommends that you set [Automatically learn rotated state] to [Disable] and then press [Auto Detect]. The first target to be enclosed becomes the basis of the angle, so KEYENCE recommends that you enclose the target closest to 0 degrees.

- **Add**

Adds a window to enclose the target.

- **Delete**

Deletes the selected window.

- 

Undoes the previous operation.

- 

Deletes all windows.

- **Automatically learn rotated state**

❍ **Enable**

Select this option when you want a target to be judged as OK even if it has been rotated.

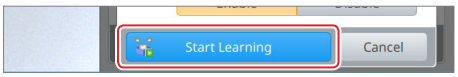
❍ **Disable**

Select this option when you want the orientation of the target to be taken into account.

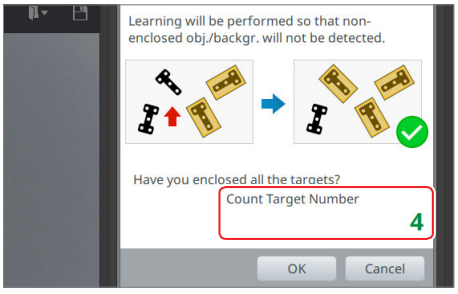
Point

- **For advice on settings for judging the orientation, check the guide (?) in the upper right corner of the screen.**
- **When [Disable] is selected, the window rotation angle is limited to ±10 degrees. If the rotation range of the target is known to be less than ±10 degrees, select [Disable]. The angle of the first enclosed target is used as the reference.**

8 Press [Start Learning].



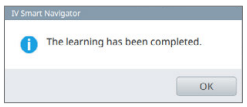
9 Check [Count Target Number] and press [OK].



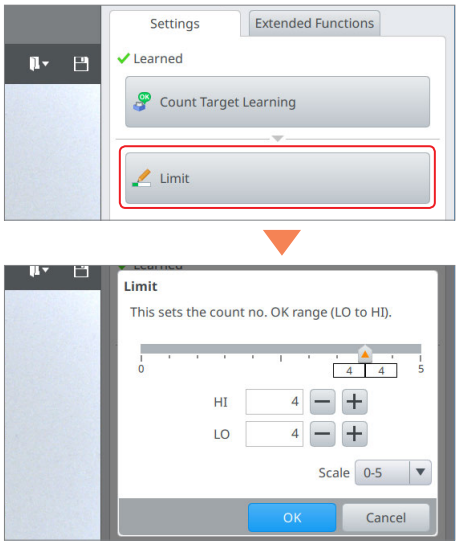
Point

- **Enclose all targets that you want to count within the window.**
- **Make sure to not enclose any targets that you do not want to count within the window.**

10 After learning has been completed, press [OK].



11 Press [Limit] and set the threshold for operation and test runs. When setting is completed, press [OK].



Reference The target is judged OK when the count number is within a threshold range, and NG when it is outside the range.

Scale

Select the scale for the threshold according to the range of matching rates requires for judgment.
You can select from the following ranges:
0-5/0-10/0-20/0-50/0-100/0-200/0-999

12 Configure the following settings as needed.

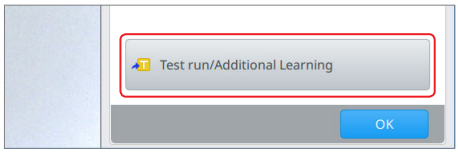
“Learning Image” (page 4-32)
“Detection Threshold” (page 4-32)
“Position Adjustment Setting” (page 4-23)
“Tool Name Setting” (page 4-23)
“Missing Part Detection” (page 4-32)

13 To add a total tool, repeat steps 2 to 11.

“Total Tool Settings” (page 4-33)

14 Press [OK].

15 Press [Test run/Additional Learning].

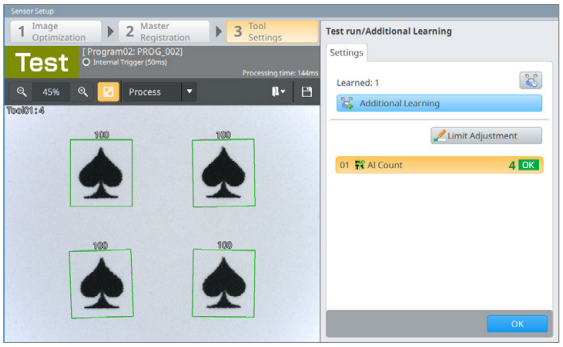


16 Take an “OK” image and a “NG” image.

In the following cases, input an external trigger:
- When [External Trigger] is set in Trigger Options
- When [Internal Trigger Control/AI Trigger Control] is set to [Enable]

If a trigger cannot be input, press [Trigger ON] to take an image of the target by temporarily using the internal trigger.

17 Check the OK/NG judgment status. When you have finished checking, press [OK].



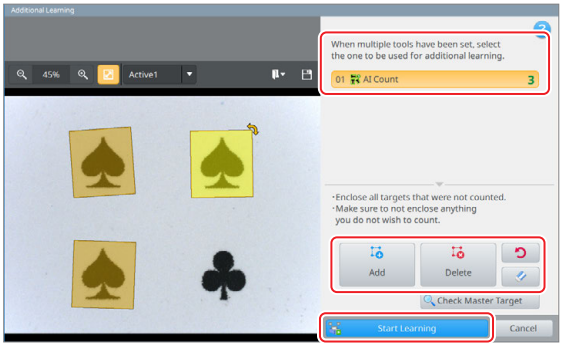


You can check the learned image history.
“Confirming Learned Image History” (page 6-8)

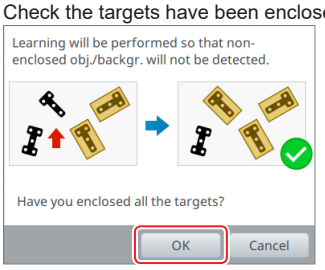
Additional Learning

Additional learning can be performed with the displayed image.
- When multiple AI Count tools have been set, select the one to be used for additional learning.
- When multiple AI Count tools are set, check that the window is correctly enclosed by all tools.
- [Add] and [Delete] will leave only the target to be counted enclosed.

Once you have configured the settings, press [Start Learning].



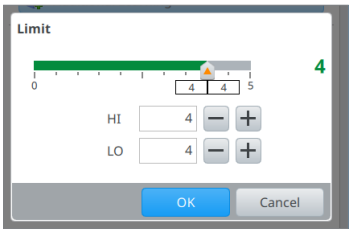
Check the targets have been enclosed, and then press [OK].



After learning has been completed, press [OK].

Limit Adjustment

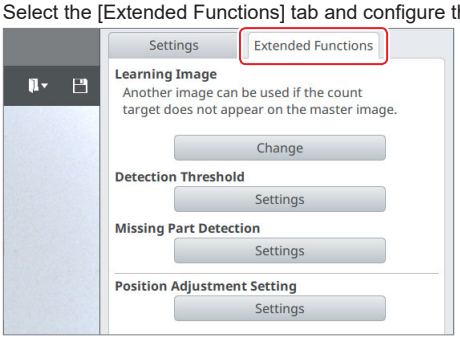
Adjust the threshold to judge whether or not AI Count succeeds while checking the count number.



18 Press [OK].

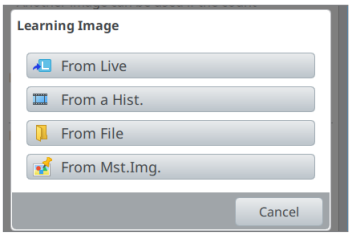
Extended Functions for the Count Tool

Select the [Extended Functions] tab and configure the settings.



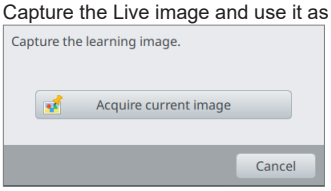
Learning Image

Another image can be used if the count target does not appear on the master image.



From Live

Capture the Live image and use it as the learning image.



From a Hist.

Selects an image from the running image history to be used as the learning image.

“When importing from the running image history” (page 4-49)

From File

Selects an image saved in a file to be used as the learning image.

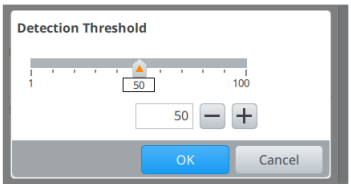
“When an image is loaded from a file” (page 4-49)

From Mst.Img.

Uses a master image as the learning image.

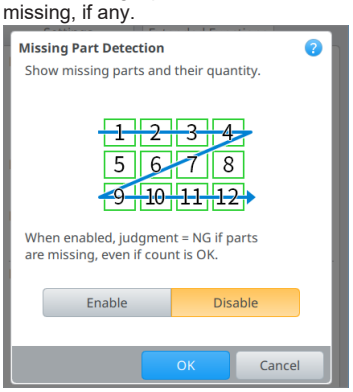
Detection Threshold

Sets the threshold for detection as the AI Count target.



Missing Part Detection

When [Enable] is selected, a number is assigned to each window frame, making it possible to detect which window number is missing, if any.

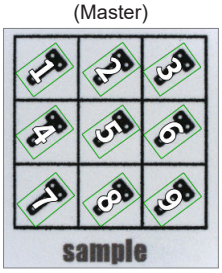


Reference

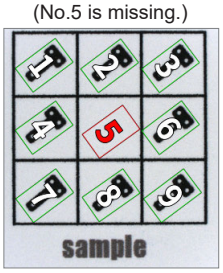
- Window numbers are allocated sequentially from the top left of the screen.
- When [Missing Part Detection] is enabled, judgment is made in combination with [Detection Threshold].

❍ Example 1: Detecting the missing of a detection target

OK (Master)

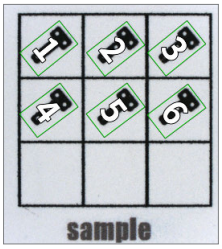


NG (No.5 is missing.)

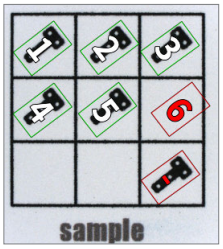


❍ Example 2: Detecting that the position of the detected target is invalid

OK (Master)



NG (The position of No. 6 is invalid).



Position Adjustment Setting

You can select the Position Adjustment/High-Speed Position Adjustment tool to be applied.

“Position Adjustment Setting” (page 4-23)

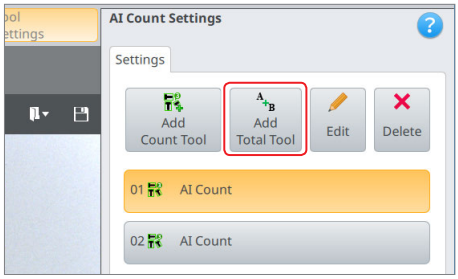
Total Tool Settings

Set the tool that totals the count results of the count tool.

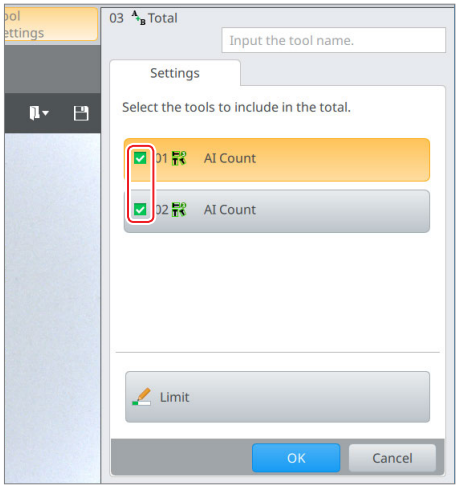
1 Set multiple instances of [Count Tool].

“Setting the Count Tool” (page 4-30)

2 Press [Add Total Tool].



3 Select the total target tool.

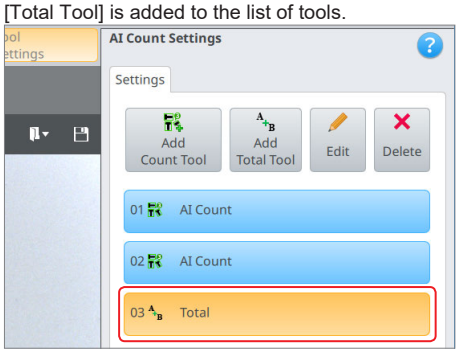


4 Configure the following settings as needed.

“Limit” (page 4-33)
“Tool Name Setting” (page 4-23)

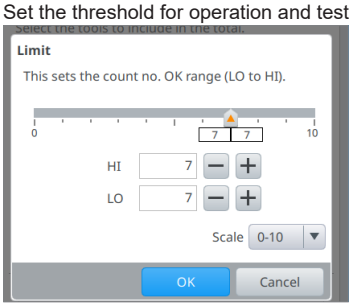
5 Press [OK].

[Total Tool] is added to the list of tools.



Limit

Set the threshold for operation and test runs.



Scale

Select the scale for the threshold according to the range of matching rates requires for judgment.

AI OCR

Characters that can be recognized by the AI OCR Tool

Character types

The characters that can be recognized by the AI OCR tool are as follows.

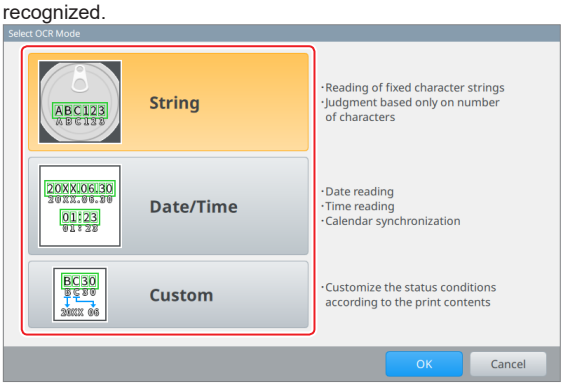
UpperCase	ABCDEFGHIJKLMNOPQRSTUVWXYZ
LowerCase	abcdefghijklmnopqrstuvwxyz
Numbers	0123456789
Symbols	. / - ( ) # * : + (9 types)
User Diction.	Any character registered by the user

Number of characters

The maximum number of characters that can be read by one tool is 32.
Additionally, a single tool can read multiple lines of text (but does not break the read text).

Select OCR Mode

Select the appropriate mode according to the character to be recognized.



"AI OCR Tool (String) Settings" (page 4-34)
"AI OCR Tool (Date/Time) Settings" (page 4-36)
"AI OCR Tool (Custom) Settings" (page 4-38)

AI OCR Tool (String) Settings

The AI OCR Tool (String) can perform the following tasks:
- Read fixed character strings
- Judgment based only on number of characters

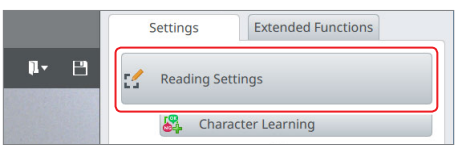
1 Add the [AI OCR] tool.

"Adding a Tool" (page 4-21)

2 Select [String] and press [OK].



3 Press [Reading Settings].

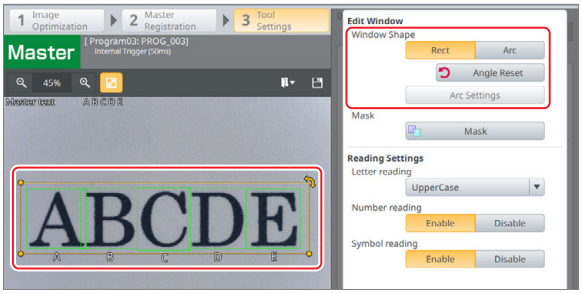


Reference: Pressing the window directly will also allow for editing of the window.

4 Set the shape, position, size, and angle of the tool window according to the target text.

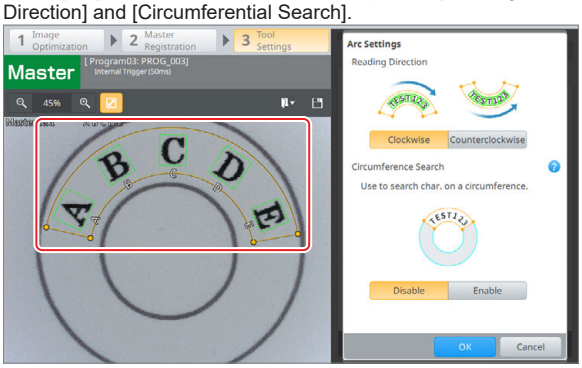
Selecting the target text with the tool window automatically reads the master string.

Window Shape: Rectangle

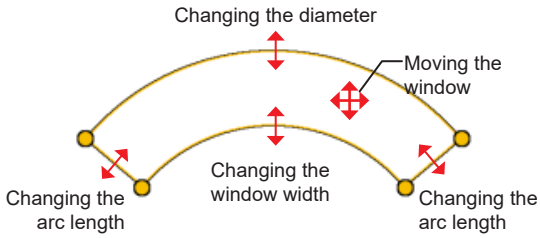


Window Shape: Arc

When [Arc] is selected as the window shape, set [Reading Direction] and [Circumferential Search].



❍ Manipulating the window shape

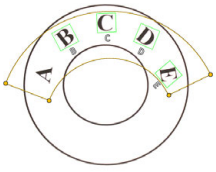


Point **Set the window to match the diameter of the arc.**

- **Example of correct diameter**



- **Example of incorrect diameter**

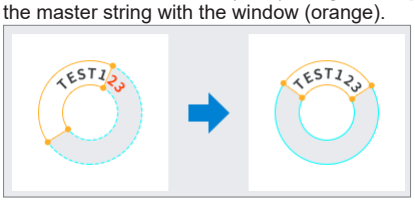


❍ Reading Direction

Select [Clockwise] or [Counterclockwise].

❍ Circumference Search

To read a circumferential (360°) string, select [Enable] and enclose the master string with the window (orange).

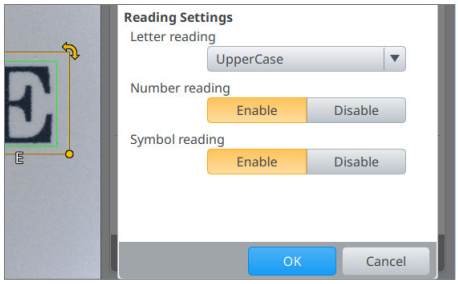


5 Configure the following settings as needed.

"Mask Settings" (page 4-22)

6 Configure [Reading Settings].

The default values are shown in the screen below.



Letter reading

Select [Disable], [Uppercase], [Upper/Lower] or [Lowercase].

Number reading, Symbol reading, Read date/month

Select [Enable] or [Disable].

Point

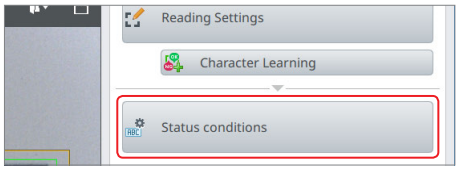
- **Selecting [Disable] for character types that do not need to be read stabilizes reading.**
- **Character types that have [Disable] selected for [Reading Settings] will not be read even if [Reading Learning] is performed in “Character Learning (Additional Learning)” (page 4-41).**

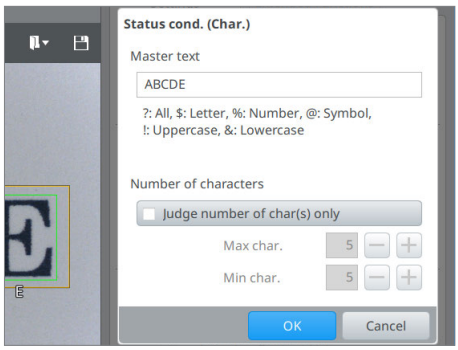
7 Press [OK].

8 Configure the following settings as needed.

“Character Learning (Additional Learning)” (page 4-41)

9 Configure the [Status conditions] settings.





Master text

Configure this setting if you want to judge text other than the read text.
You can set arbitrary characters (all letters, numbers, and symbols) not included in the specified letters, numbers, and symbols.

- ? : Judges all letters, numbers, and symbols as OK.
- $: Judges all letters as OK.
- % : Judges all numbers as OK.
- @ : Judges all symbols as OK.
- ! : Judges any uppercase English letter as OK.
- & : Judges any lowercase English letter as OK.

Point

Arbitrary characters (? , $, %, @, !, &) cannot be registered in the user dictionary with [Character Learning].

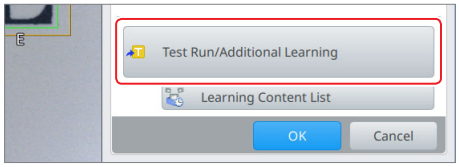
❍ **[Arbitrary characters] usage example**

- **Master text: AB$DE**
  ABCDE : OK
  ABFDE : OK
  AB5DE : NG
- **Master text: AB?DE**
  ABCDE : OK
  ABFDE : OK
  AB5DE : OK

Number of characters

If it is necessary to only judge if the number of characters matches the master text, set [Judge number of char(s) only] to [ON] and input [Max char.] and [Min char.]. The judgment is OK when the number of characters is within the range of [Max char.] and [Min char.].

10 Press [Test Run/Additional Learning].



Learning Content List

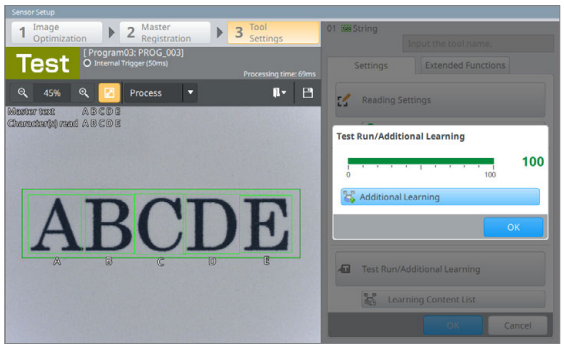
You can view the learned images and letters.
“Learning content list / List of learned characters” (page 4-43)

11 Check the string judgment status. When you have finished checking, press [OK].

A character string is judged as OK if the string matches the master text and NG if the string does not match the master text.

Reference

To hide the reading results (characters and dates), select [Window] by pressing the [Process] button above the image.



Additional Learning

Additional learning can be performed with the displayed image.
“Character Learning (Additional Learning)” (page 4-41)

12 Configure the following settings as needed.

“Delimiter Settings” (page 4-44)
“String Search” (page 4-44)
“High-Speed Mode” (page 4-44)
“Show Matching Rate” (page 4-44)
“Built-in Dictionary Settings” (page 4-44)
“Printer Condition Check Tool” (page 4-44)
“Position Adjustment Setting” (page 4-23)
“Tool Name Setting” (page 4-23)

13 Press [OK].

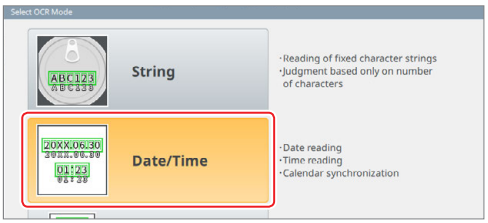
AI OCR Tool (Date/Time) Settings

The following options can be set for AI OCR Tool (Date/Time):
- Date reading
- Time reading
- Calendar sync

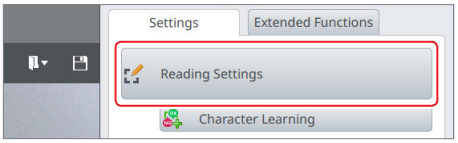
1 Add the [AI OCR] tool.

“Adding a Tool” (page 4-21)

2 Select [Date/Time] and press [OK].



3 Press [Reading Settings].

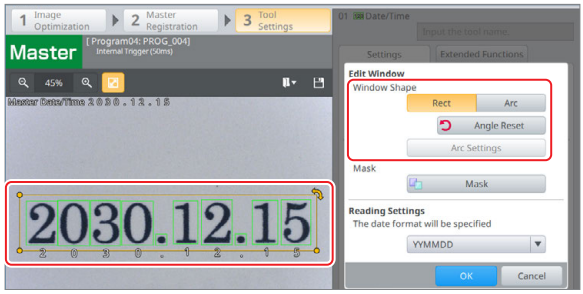


Reference Pressing the window directly will also allow for editing of the window.

4 Set the shape, position, size, and angle of the tool window according to the target text.

Selecting the target text with the tool window automatically reads the master date and time.

Window Shape: Rectangle



Window Shape: Arc

When [Arc] is selected as the window shape, set [Reading Direction] and [Circumferential Search].

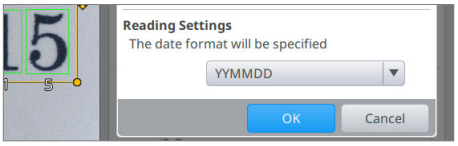
“Window Shape: Arc” (page 4-34)

5 Configure the following settings as needed.

“Mask Settings” (page 4-22)

6 Set the date format in [Reading Settings].

The following options can be selected:
YYMMDD/DDMMYY/MMDDYY/YYMM/MMYY/hhmm/hh/mm



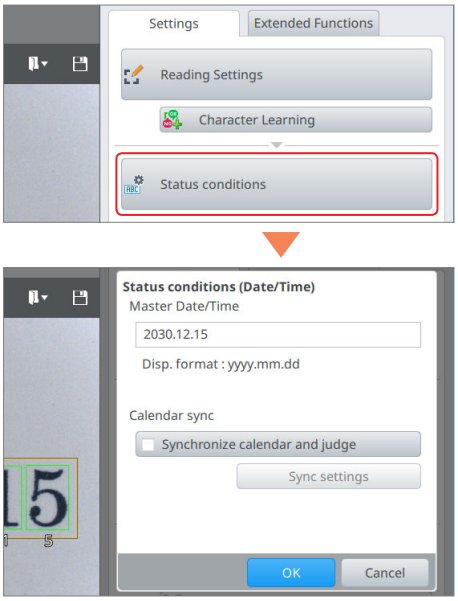
Point **Set the date format to match that of the reading target.**
Dates that differ from the set date format will not be read.

7 Press [OK].

8 Configure the following settings as needed.

“Character Learning (Additional Learning)” (page 4-41)

9 Configure the [Status conditions] settings.



Master Date/Time

Configure this setting if you want to change the master date and time used for the master image in [Master Date/Time] to a different date and time.
Editing [Master Date/Time] allows you to update [Master Date/Time] without having to read the image again.

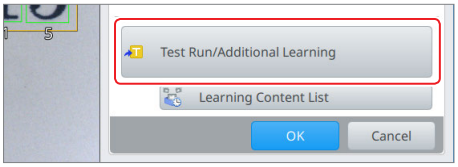
Point **Make sure that the format of the edited master date and time is the same as [Reading Settings].**
If the master date and time format order for the [Reading Settings] date format could not be interpreted, the display format will be unknown and the master date and time will not be set correctly.

Calendar sync

Set this option to link the reading target date to the current date and time.

“Calendar Sync” (page 4-42)

10 Press [Test Run/Additional Learning].



Learning Content List

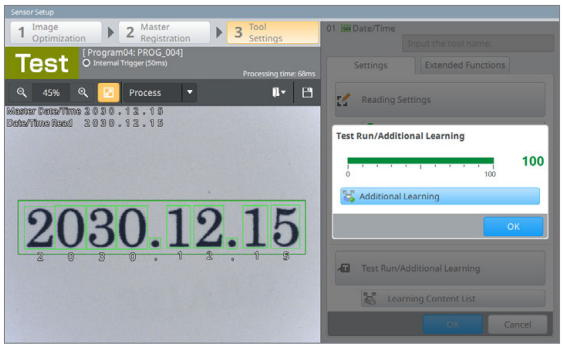
You can view the learned images and letters.

“Learning content list / List of learned characters” (page 4-43)

11 Check the string judgment status. When you have finished checking, press [OK].

A character string is judged as OK if the string matches the master text and NG if the string does not match the master text.

Reference To hide the reading results (characters and dates), select [Window] by pressing the [Process] button above the image.



Additional Learning

Additional learning can be performed with the displayed image.

“Character Learning (Additional Learning)” (page 4-41)

12 Configure the following settings as needed.

“Delimiter Settings” (page 4-44)
“String Search” (page 4-44)
“High-Speed Mode” (page 4-44)
“Show Matching Rate” (page 4-44)
“Built-in Dictionary Settings” (page 4-44)
“Printer Condition Check Tool” (page 4-44)
“Position Adjustment Setting” (page 4-23)
“Tool Name Setting” (page 4-23)

13 Press [OK].

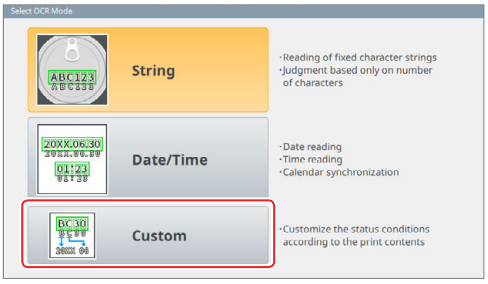
AI OCR Tool (Custom) Settings

You can set the status conditions to any desired value according to the print contents.
The following settings are available:
- Combine letters and dates
- Convert the date to characters
- Read the sequential number count-up

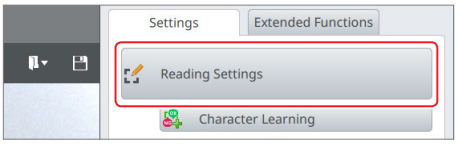
1 Add the [AI OCR] tool.

“Adding a Tool” (page 4-21)

2 Select [Custom] and press [OK].



3 Press [Reading Settings].

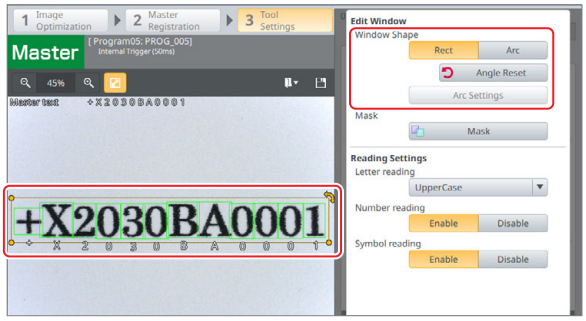


Reference Pressing the window directly will also allow for editing of the window.

4 Set the shape, position, size, and angle of the tool window according to the target text.

Selecting the target text with the tool window automatically reads the master string.

- **Window Shape: Rectangle**



- **Window Shape: Arc**

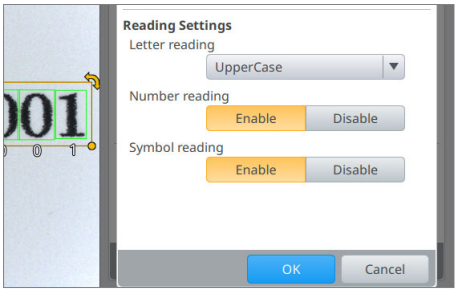
When [Arc] is selected as the window shape, set [Reading Direction] and [Circumferential Search].
“Window Shape: Arc” (page 4-34)

5 Configure the following settings as needed.

“Mask Settings” (page 4-22)

6 Configure [Reading Settings].

The default values are shown in the screen below.



- **Letter reading**

Select [Disable], [Uppercase], [Upper/Lower] or [Lowercase].

- **Number reading, Symbol reading, Read date/month**

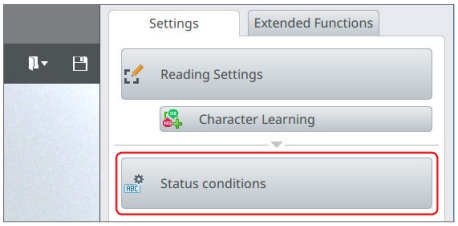
Select [Enable] or [Disable].

7 Press [OK].

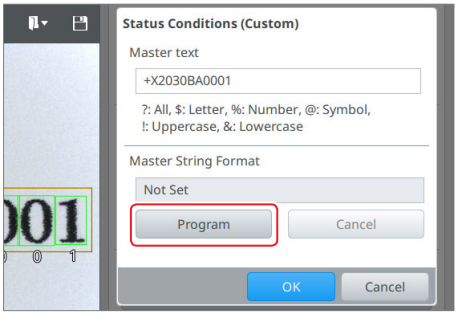
8 Configure the following settings as needed.

“Character Learning (Additional Learning)” (page 4-41)

9 Press [Status conditions].

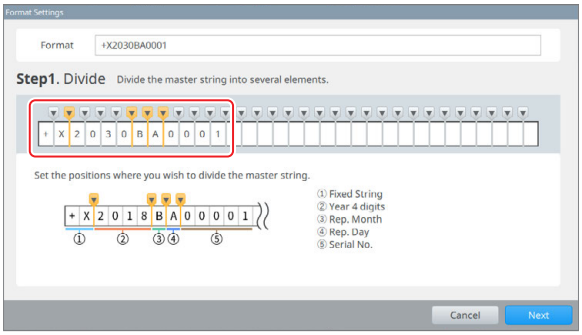


10 Press [Program] and configure the master string format settings.



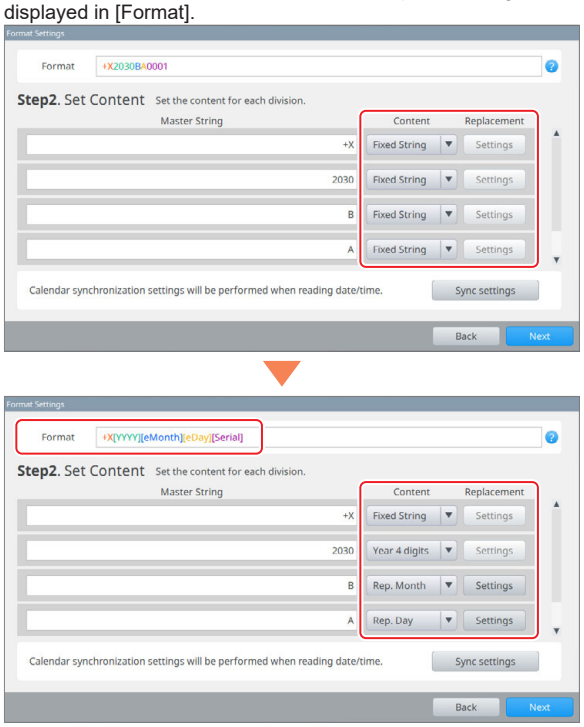
11 Perform [Step 1. Divide] and then press [Next].

Sets to divide the read master string into several elements.



12 Perform [Step 2. Set Content] and then press [Next].

After the content for each divide is set, the replaced string will be displayed in [Format].



Fixed String

Treats the specified divide as a fixed string.

Year 4 digits

Treats the specified divide as year 4 digits.

Year last 2d/MM/DD/hh/mm

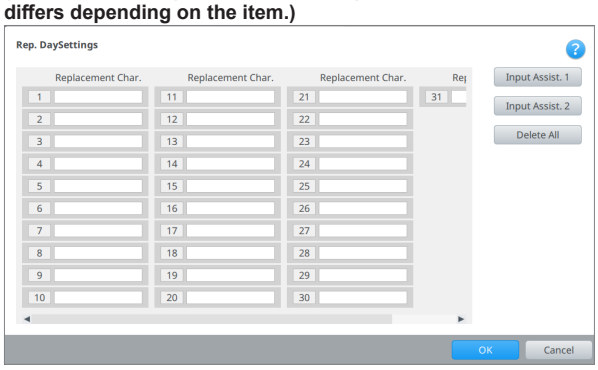
Treats the specified divide as year last 2d/MM/DD/hh/mm.

Rep. Year 1d/Year 2d/Month/Day/Hour/Minute

Sets the characters for Rep. Year 1d/Year 2d/MM/DD/hh/mm after replacement.

Rep. Year 1d	Sets the replacement characters for the numbers 0 to 9.
Rep. Year 2d	Sets the replacement characters for the numbers 00 to 99.
Rep. Month	Sets the replacement characters for the numbers 1 to 12.
Rep. Day	Sets the replacement characters for the numbers 1 to 31.
Rep. Hour	Sets the replacement characters for the numbers 0 to 23.
Rep. Minute	Sets the replacement characters for the numbers 0 to 59.

Example screen for [Rep. Day]
(The number of input fields for the replacement characters differs depending on the item.)



Input Assistance 1

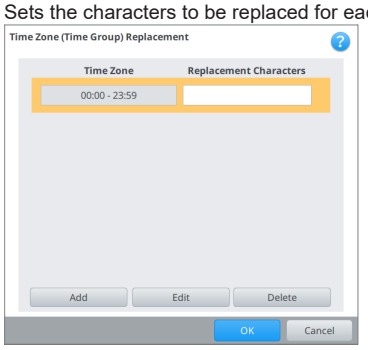
Numbers from start to end can be batch input using the same replacement characters.

Input Assistance 2

If the relation between numbers 0-9 and replacement characters is made uniform, batch input using replacement characters is possible.

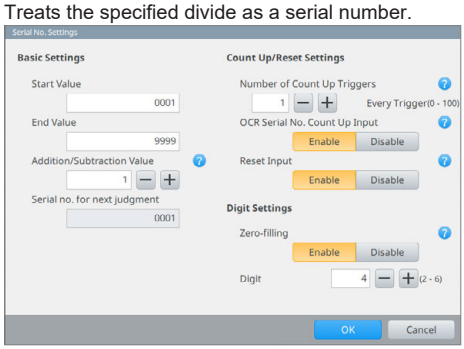
Rep. T. Zone

Sets the characters to be replaced for each shift (time period).



Serial No.

Treats the specified divide as a serial number.



Start Value

Sets the start value of the replacement string.

End Value

Sets the end value of the replacement string.

Addition/Subtraction Value

Sets the addition/subtraction value of the replacement string.

Serial no. for next judgment

Displays the serial number for the value to be judged at the next trigger.

Number of Count Up Triggers

Sets how many trigger inputs are needed to count up or down the serial number.
If "0" is specified, the count is not modified by trigger inputs.

OCR Serial No. Count Up Input

Sets whether the serial number for [Current Value] is modified by external inputs.

> **Point**
> **To use OCR serial number count-up input, assign [OCR Serial No. Count Up Input] under [Sensor Advanced] > [I/O Settings] > [Input Settings].**
> **“Input Settings” (page 7-13)**

Reset Input

Sets whether the serial number for [Current Value] is reset by external inputs.

> **Point**
> **To use reset input, assign [Reset Count Input] under [Sensor Advanced] > [I/O Settings] > [Input Settings].**
> **“Input Settings” (page 7-13)**

Zero-filling

Sets whether the replaced serial numbers are filled by zeros with the specified number of digits.

Digit

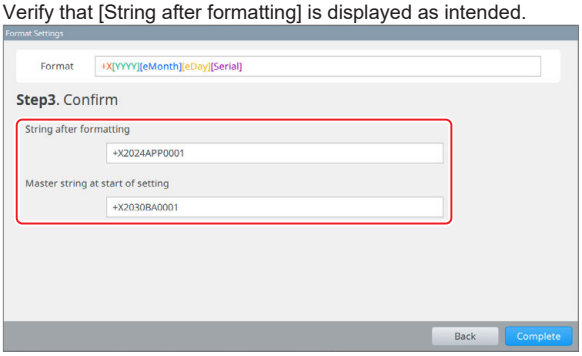
Specifies the number of digits when [Zero-filling] is enabled.

Sync settings

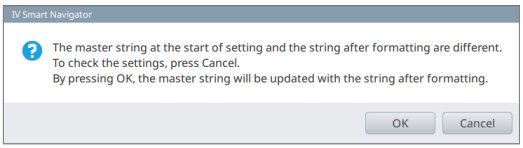
Configure calendar synchronization.
“Calendar Sync” (page 4-42)

13 Perform [Step 3. Confirm] and press [Complete].

Verify that [String after formatting] is displayed as intended.

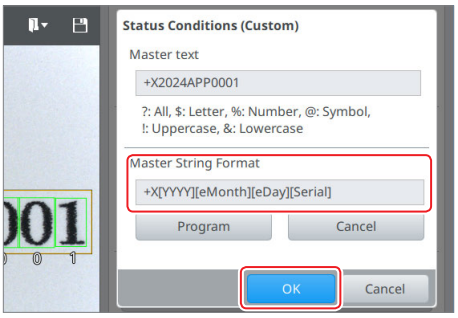


14 Press [OK].

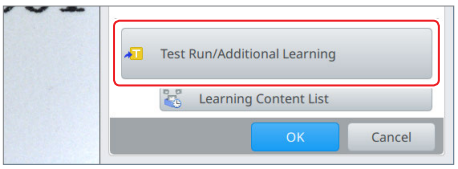


Reference The above message will not appear if the set [String after formatting] and [Master string at start of setting] match.

15 Confirm that [Master String Format] has been updated and press [OK].



16 Press [Test Run/Additional Learning].



Learning Content List

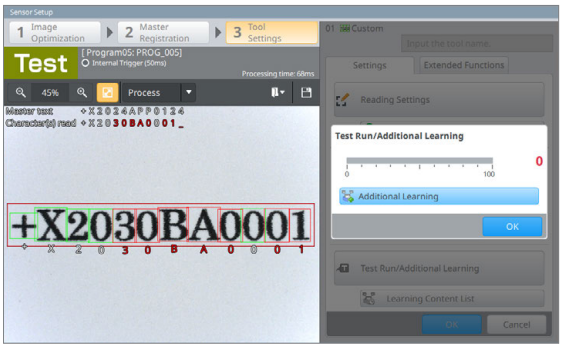
You can view the learned images and letters.

“Learning content list / List of learned characters” (page 4-43)

17 Check the string judgment status. When you have finished checking, press [OK].

A character string is judged as OK if the string matches the master text and NG if the string does not match the master text.

Reference To hide the reading results (characters and dates), select [Window] by pressing the [Process] button above the image.



Additional Learning

Additional learning can be performed with the displayed image.

“Character Learning (Additional Learning)” (page 4-41)

18 Configure the following settings as needed.

“Delimiter Settings” (page 4-44)
“String Search” (page 4-44)
“High-Speed Mode” (page 4-44)
“Show Matching Rate” (page 4-44)
“Built-in Dictionary Settings” (page 4-44)
“Printer Condition Check Tool” (page 4-44)
“Position Adjustment Setting” (page 4-23)
“Tool Name Setting” (page 4-23)

19 Press [OK].

Character Learning (Additional Learning)

In the below cases, perform [Character Learning] (Additional Learning).

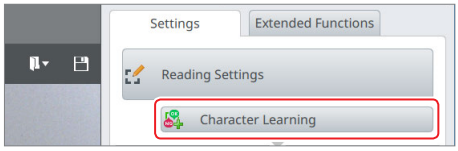
❍ **Reading Learning**

- When you want to be able to read the correct letters that were misread or could not be read.
- When you want to register characters that do not exist in the built-in dictionary.

❍ **Exclude from Reading**

- Set the characters you do not want to read as characters.

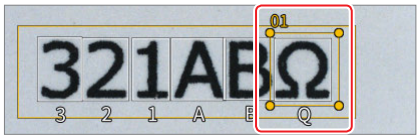
1 Press [Character Learning].



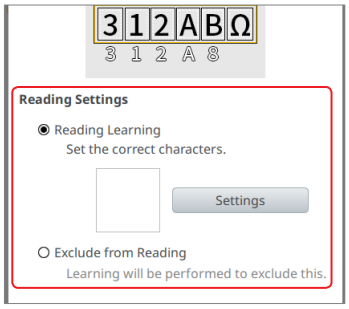
2 Press [Add].



3 Enclose characters to be learned inside the tool window.

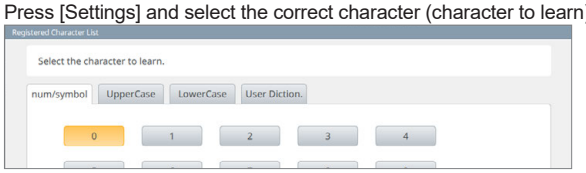


4 Configure [Reading Settings].



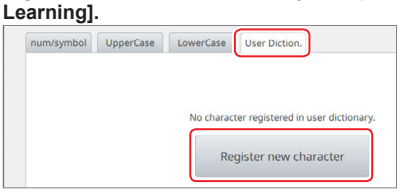
Reading Learning

Press [Settings] and select the correct character (character to learn).



Point

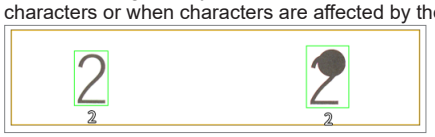
- **If the target character is not in the list, you can register any character in [User Diction.].**
- **Arbitrary characters (? , $, %, @, !, &) cannot be registered in the user dictionary with [Character Learning].**





Exclude from Reading

Exclude characters enclosed in the tool window from being read. Use this setting when you do not want to read large, smudged characters or when characters are affected by the background.



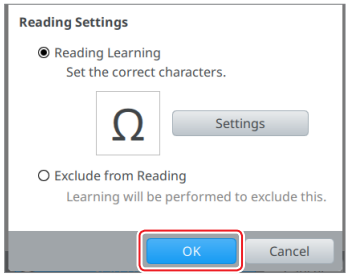
Enclose characters you want to [Exclude from Reading].



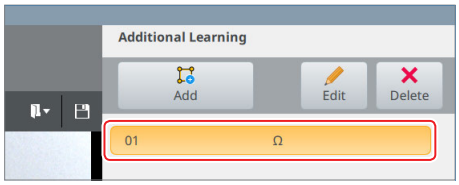
Check the results.



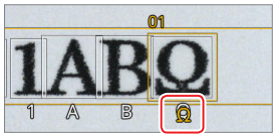
5 When setting is completed, press [OK].



The characters to be learned are added.

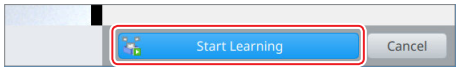


Reference When you add a character to be learned, the corresponding character will appear in orange at the bottom of the tool window.

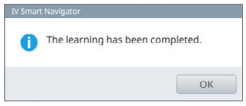


6 Repeat steps 2 to 5 to set characters to be learned.

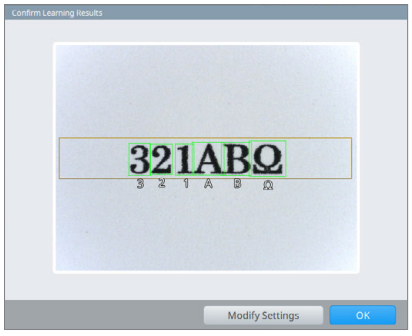
7 Press [Start Learning].



8 After learning has been completed, press [OK].



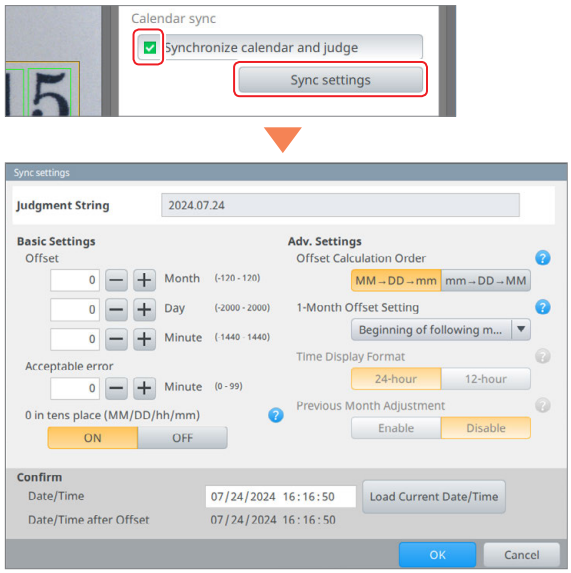
9 Check the learning results and press [OK].



Calendar Sync

Select the [Synchronize calendar and judge] check box and then press [Sync settings].

Point **When using [Calendar sync], the time on the internal clock can be synchronized with an SNTP server by setting “SNTP Settings” (page 7-17) to [Enable].**



Basic Settings

Offset

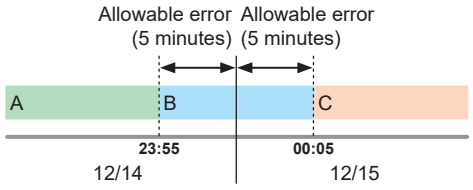
Offsets the master date by the desired month, day, and minute away from the current date on the sensor.

Acceptable error

Sets the time error (allowable error) in minutes for dates to be judged as OK both before and after the date changes.
This setting is used when there is a discrepancy between the timing at which the master date in the [AI OCR] is switched and the timing at which the date printed on the object is switched.

❍ **When the allowable error set to 5 minutes**

When switching from 12/14 to 12/15



Time Zone	Master date setting	Printing of target judged OK
A (up to 23:54:59)	12/14	12/14
B (23:55:00 - 00:05:00)	12/14	12/14, 12/15
	12/15	12/14, 12/15
C (00:05:01 onwards)	12/15	12/15

0 in tens place (MM/DD/hh/mm)

Sets whether to add a leading [0] when the date or time in the reading target date is a single digit.
Select this setting according to the date format of the target date.

Advanced Settings

Offset Calculation Order

Depending on the offset order, the date and time after offset may change. Make sure the offset result is as intended.

1-Month Offset Setting

Sets the date calculation method when offsetting the month against the last day of the month results in a date that does not exist.

Time Display Format

Sets whether time is displayed in the 24-hour format or the 12-hour format.

Previous Month Adjustment

Set if the best-before date is displayed in “YYMM”.
When set to [Enable], the "month" of the master date and time can be set to one month before.
However, one month is defined as any day other than the last day of the month. In the case of last day of the month, it will not be one month earlier.

❍ **When the month offset is set to "3" and [Previous Month Adjustment] is set to [Enable]**

Current Date/Time		Master Date/Time
May 30, 20xx	→	July 20xx
May 31, 20xx	→	August 20xx

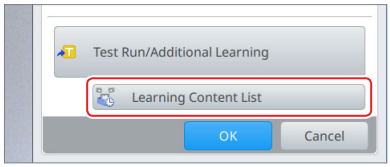
Confirm

Displays the master date and time, and the offset date and time.
Press [Load Current Date/Time] to load the current date and time.
Any desired date and time can be set.

Learning content list / List of learned characters

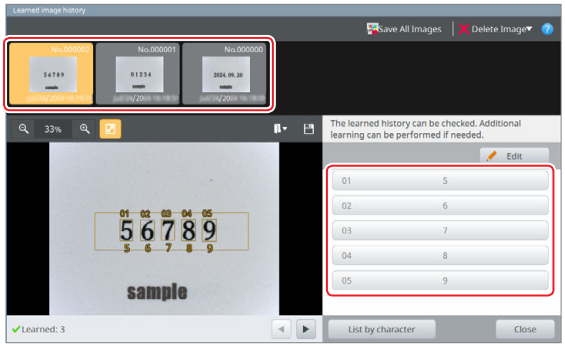
You can view the learned images and letters on the AI OCR Tool.

1 Press [Learning Content List].



2 Check the learned images and letters in [Learned image history].

To change the learned content, press [Edit] > [Change Settings] to make additional learning.

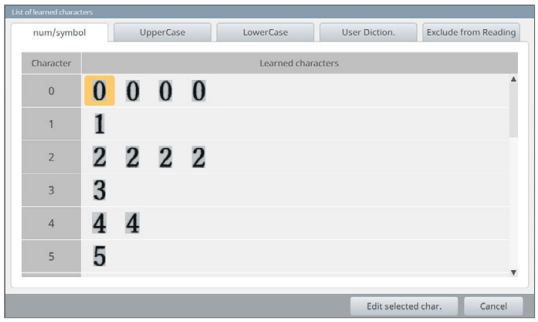


3 Press [List by character].



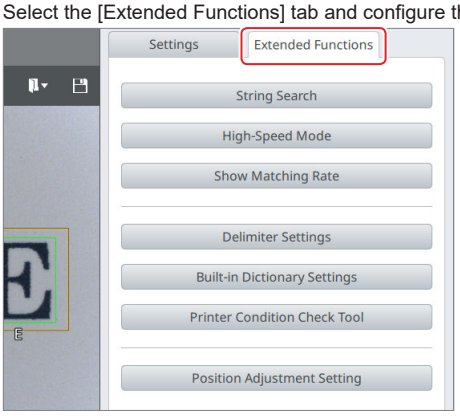
4 Check learned characters by [List of learned characters].

You can find which characters have been learned.
In the example below, characters 0 to 4 have been leaned, but letter 5 has not been learned.
You can correct learned content by pressing [Edit selected char.].



Extended Functions for the OCR Tool

Select the [Extended Functions] tab and configure the settings.

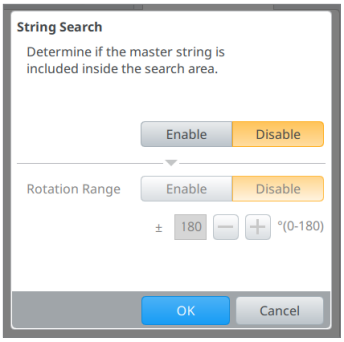


String Search

Determines if the master string is included inside the search area.
When [Enable] is selected, the search range (light blue frame) can be set.
When the rotation range is set to [Enable], the master string is read within the set angle range.

Point

If the tool window shape is [Arc], [String Search] cannot be enabled.
If you want to search for characters within an arc, use [Circumference Search] under [Arc Settings].

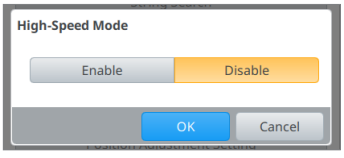


Rotation Range

Set if the string is tilted within the search range.

High-Speed Mode

Enables or disables high-speed mode.
When [Enable] is selected, priority is given to reading speed.
Select this to shorten the processing time.



Point

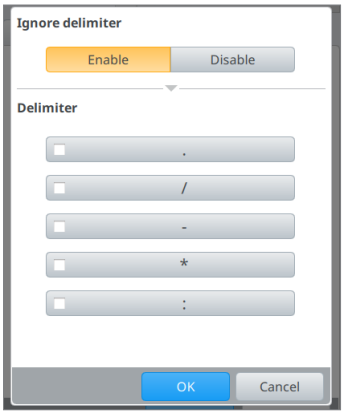
When high speed mode is set to [Enable], the minimum size of characters that can be scanned is larger than when it is set to [Disable].

Show Matching Rate

You can display the matching rate of each character.
“Show Matching Rate” (page 4-45)

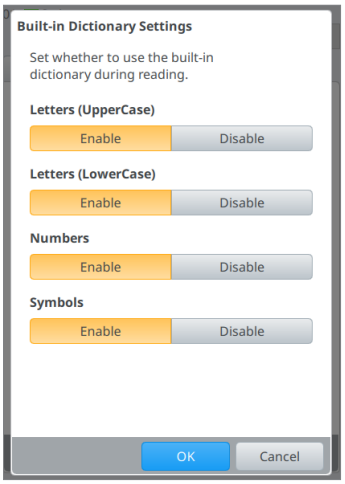
Delimiter Settings

Enables and disables reading of specific characters.
If you select [Enable], select the check boxes for the characters to be excluded from reading.



Built-in Dictionary Settings

Set whether to use the built-in dictionary during reading.
The target characters are those registered in the built-in dictionary with the exception of characters learned in “Character Learning (Additional Learning)” (page 4-41).



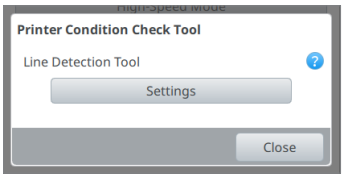
Point

Characters that have been [Reading Learning] in [Character Learning] will be read even if the character type has been set to [Disable] in [Built-in Dictionary Settings].

Example
Even if you set [Letters (Uppercase)] to [Disable] while the letter "A" is added in [Reading Learning], the learned shape of "A" can still be read.

Printer Condition Check Tool

While you are configuring the AI OCR Tool, you can set the Line Detection Tool for the AI OCR Tool.



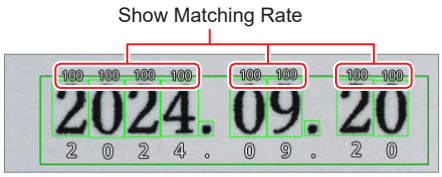
“Line Detection Tool” (page 4-47)

Position Adjustment Setting

You can select the Position Adjustment/High-Speed Position Adjustment tool to be applied.
“Position Adjustment Setting” (page 4-23)

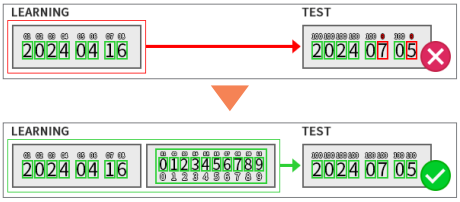
Show Matching Rate

Pressing [Enable] displays the matching rate for each character.



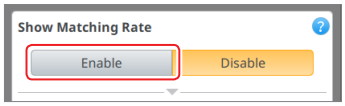
Point

- **If you enable [Show Matching Rate], the matching rates of the characters that have been learned are displayed.**
  Therefore, characters that have not been learned always have matching rate 0, resulting in judgment NG.
  Execute learning for all characters to be read.
  For characters used for learning, you can use a format different from that of master text.

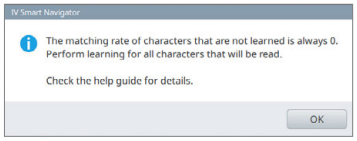


- **This function is supposed be used with a single-color background. Using a different background may change the matching rate.**
- **Matching rates are not displayed for the delimiters dot (.) and colon (:).**

1 Press [Enable].



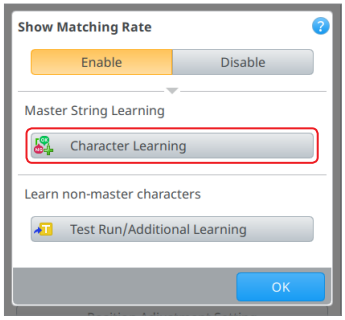
2 Press [OK].



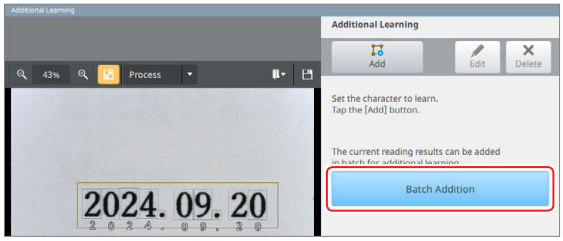
3 Press [Character Learning] to execute the learning of the master string.

Point

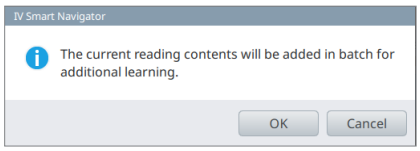
Make sure that you execute the learning of the master text in order to display matching rates.



4 Press [Batch Addition].



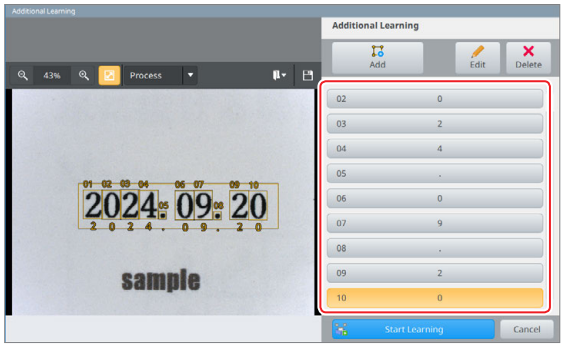
5 Press [OK] in the confirmation screen.



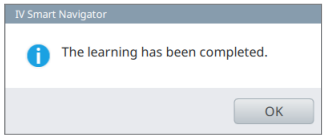
6 Confirm that the list of characters to be added are displayed, and press [Start Learning].

You can also use [Add] or [Edit] to add or edit characters to be read one by one.

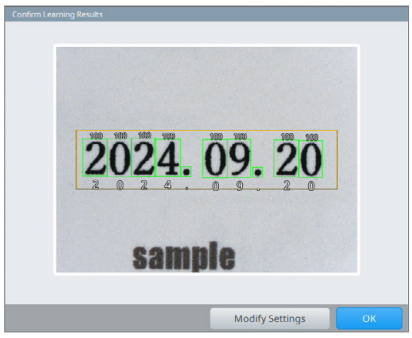
“Character Learning (Additional Learning)” (page 4-41)



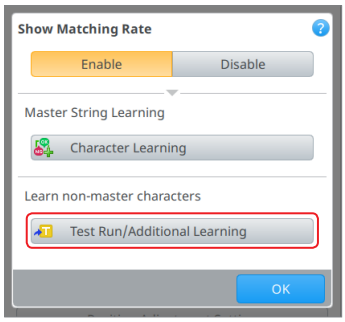
7 Press [OK].



8 Check the learning results and press [OK].



9 Press [Test Run/Additional Learning] to execute the learning of the string (of characters not included in the master string) for which to display matching rates.

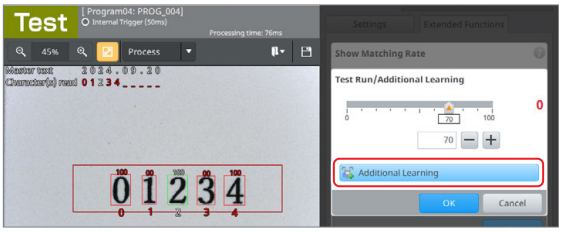


10 Capture the target that contains the string for which to display matching rates.

In the following cases, input an external trigger:
- When [External Trigger] is set in Trigger Options
- When [Internal Trigger Control/AI Trigger Control] is set to [Enable]

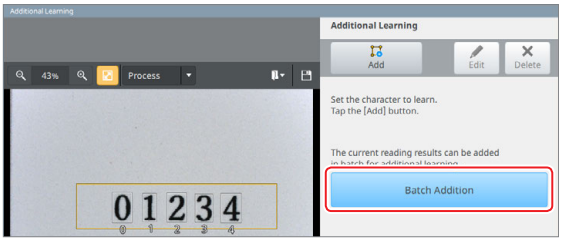
If a trigger cannot be input, press [Trigger ON] to take an image of the target by temporarily using the internal trigger.

11 Confirm that the string is recognized correctly, and press [Additional Learning].

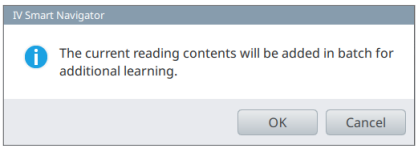


Reference If you use a format different from that of master text, judgment may result in NG.
We have not executed the learning of the string at this time, so judgment result OK/NG does not affect the learning result.

12 Press [Batch Addition].

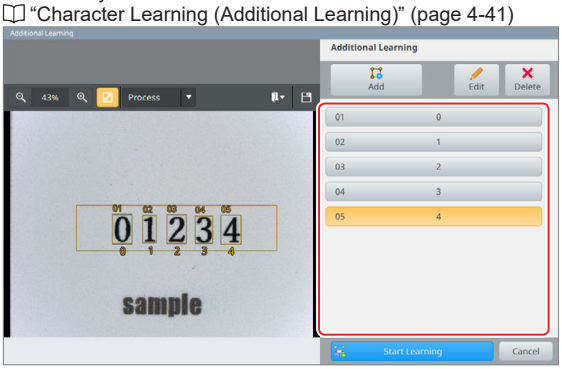


13 Press [OK] in the confirmation screen.

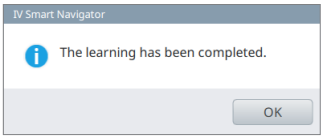


14 Confirm that the list of characters to be added are displayed, and press [Start Learning].

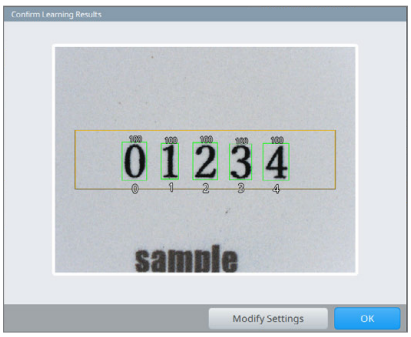
You can also use [Add] or [Edit] to add or edit characters to be read one by one.
“Character Learning (Additional Learning)” (page 4-41)



15 Press [OK].

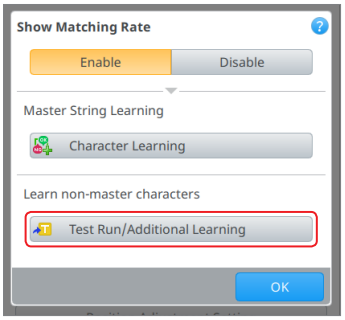


16 Check the learning results and press [OK].



17 Repeat steps 9 to 16 for the learning of all good samples of characters for which to display matching rates.

18 Press [Test Run/Additional Learning].

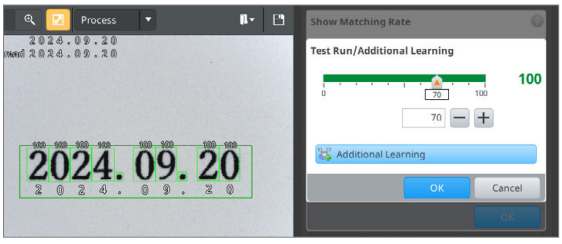


19 Take an “OK” image and a “NG” image.

In the following cases, input an external trigger:
- When [External Trigger] is set in Trigger Options
- When [Internal Trigger Control/AI Trigger Control] is set to [Enable]

If a trigger cannot be input, press [Trigger ON] to take an image of the target by temporarily using the internal trigger.

20 Adjust the threshold for anomaly detection by checking the matching rate. When setting is completed, press [OK].



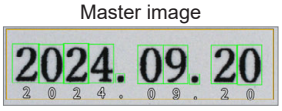
21 Press [OK].

Reference You can view the learned images and letters in [Learning Content List].
“Learning content list / List of learned characters” (page 4-43)

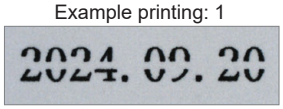
Line Detection Tool

This tool determines whether there is a bleaching line across printed letters.
You can use this function to check printer conditions such as clogging of the nozzle.
An image without a bleaching line will have a matching rate of 100, and an image that has a bleaching line will have a lower matching rate.

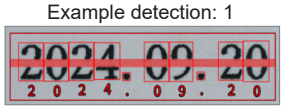
Master image



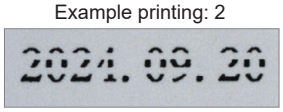
Example printing: 1



Example detection: 1



Example printing: 2



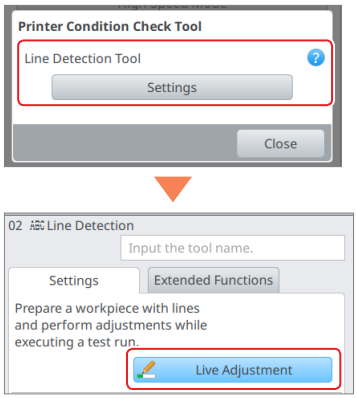
Example detection: 2



Reference If you set the Line Detection Tool, [Line Detection] is added in the tool list.



1 Press [Settings] of the Line Detection Tool, and then press [Live Adjustment].

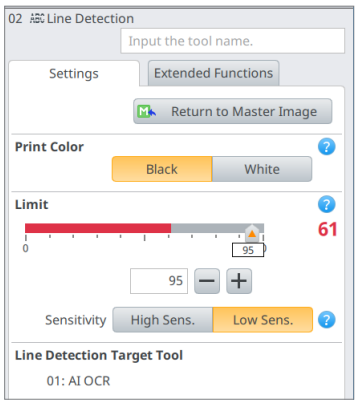


2 Capture the subject that has a bleaching line.

In the following cases, input an external trigger:
- When [External Trigger] is set in Trigger Options
- When [Internal Trigger Control/AI Trigger Control] is set to [Enable]

If a trigger cannot be input, press [Trigger ON] to take an image of the target by temporarily using the internal trigger.

3 Configure the Line Detection Tool.

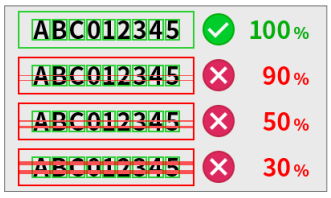


Print Color

Select the color (black or white) of the characters to be judged.

Limit

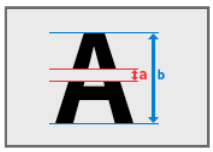
Set the pass/fail threshold of the matching rate for the Line Detection Tool.
The matching rate varies depending on the thickness of the bleaching line (the total thickness of the bleaching lines if there are more than one) and the sensitivity.



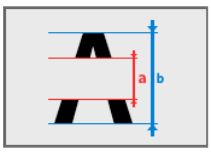
Sensitivity

Select a sensitivity of the Line Detection Tool (High/Low Sensitivity). This parameter indicates the sensitivity for determining the matching rate when a bleaching line is detected.
When a bleaching line is detected, the higher sensitivity lowers the matching rate more often.

Point **The matching rate falls to 0 when the ratio between the detected line thickness (a) (total thickness of all lines, if more than one) and the master image character height (b) reaches one of the following values:**



High Sensitivity
10% thickness of the height of the master text

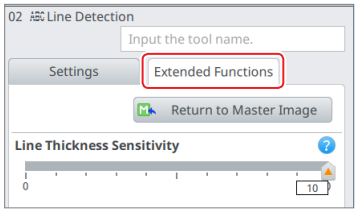


Low Sensitivity
50% thickness of the height of the master text

Tools for which Line Detection is applicable

Displays the names of the tools for which Line Detection is applicable.

4 Configure [Extended Functions] as necessary.



Line Thickness Sensitivity

Raising the sensitivity makes the detection of thin lines easier.

Color Area/Area tool

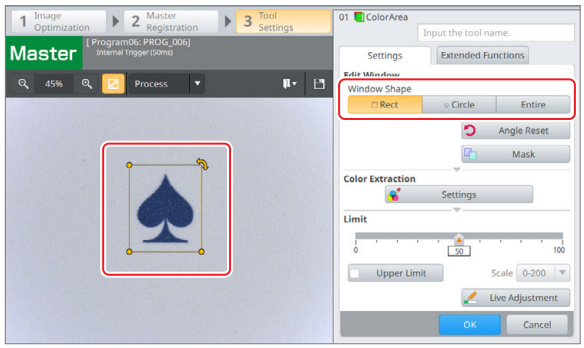
Setting the Color Area/Area tool

1 Add the [ColorArea] tool (color type) or [Area] tool (monochrome type).

“Adding a Tool” (page 4-21)

2 Select [Window Shape] and set the position, size, and angle according to the target.

When [Entire] is selected, the tool window will be hidden.



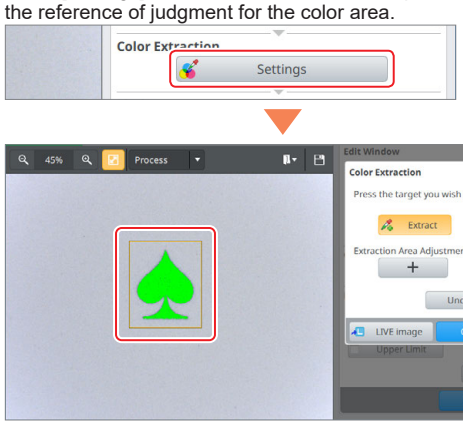
3 Configure the following settings as needed.

“Mask Settings” (page 4-22)

4 Set the area to extract from the target.

For color type

Press [Settings] for color extraction and then press the color to be the reference of judgment for the color area.



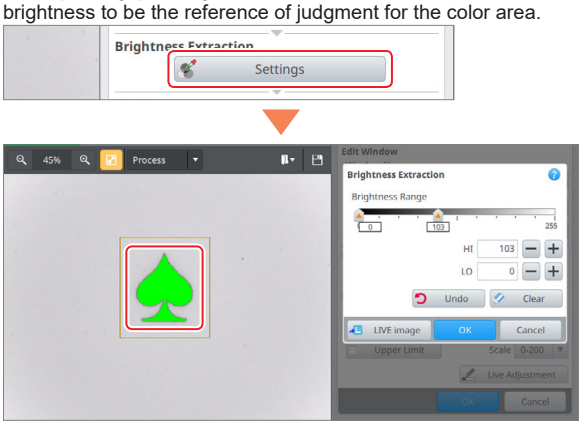
The pressed color will be extracted.

- If the areas of color that have not been extracted are pressed repeatedly, the extraction range can be adjusted.
- Press [Exclude] to specify the color to exclude from the extracted color.
- Press the [+]/[-] of the extraction area adjustment, and the range of color to be extracted can be expanded/reduced.
- Press [Undo] to cancel the previous operation (UNDO).
- To re-extract the color, press [Clear] and then press the color to be the reference of judgment again.
- By pressing [LIVE image], the range of color to be extracted can be set based on the file image saved in the Live image/Running image history/PC of the target.
  “Adjusting in the Live Image” (page 4-49)

When setting is completed, press [OK].

For monochrome type

Press [Settings] for brightness extraction and then press the brightness to be the reference of judgment for the color area.

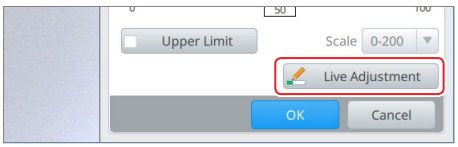


The pressed brightness will be extracted.

- If the areas of brightness that have not been extracted are pressed repeatedly, the extraction range can be expanded.
- Adjust the slider, and the range of the brightness to be extracted can be expanded/reduced.
- Pressing [+]/[-] can set the upper and the lower limit of brightness in a range within 0 to 255 with the extracted brightness as a reference.
- Press [Undo] to cancel the previous operation (UNDO).
- To re-extract the brightness, press [Clear] and then press the color to be the reference of judgment again.
- By pressing [LIVE image], the range of brightness to be extracted can be set based on the Live Image of the target.

When setting is completed, press [OK].

5 Press [Live Adjustment].



6 Take an “OK” image and a “NG” image.

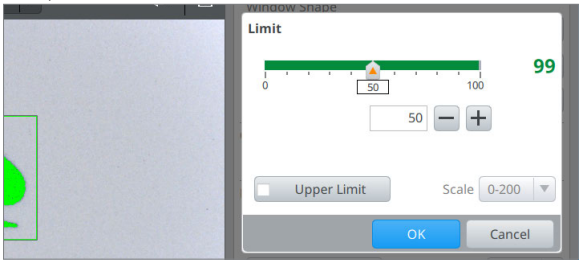
In the following cases, input an external trigger:

- When [External Trigger] is set in Trigger Options
- When [Internal Trigger Control/AI Trigger Control] is set to [Enable]

If a trigger cannot be input, press [Trigger ON] to take an image of the target by temporarily using the internal trigger.

7 Adjust the threshold for anomaly detection by checking the matching rate. When setting is completed, press [OK].

<Setting example>
If the matching rate of an “OK” image is higher than 90 and if the matching rate of a “NG” image is lower than 40, set the threshold to 65, the value intermediate between 40 and 90.



Reference

- A target is detected as OK if the matching rate is greater than the threshold, and detected as NG if the matching rate is lower than the threshold.
- The matching rate is 100 when an area matches perfectly. This becomes smaller with a narrower area and larger with a wider area. If the matching rate exceeds the upper limit of the threshold range, the matching rate will display as the upper limit of the threshold range.

8 Configure the following settings as needed.

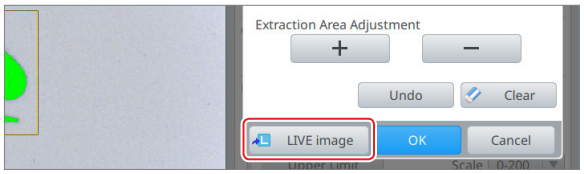
“Upper Limit” (page 4-50)
“Advanced Color Extraction/Advanced Brightness Extraction” (page 4-51)
“Fixed Reference Area” (page 4-51)
“Position Adjustment Setting” (page 4-23)
“Tool Name Setting” (page 4-23)

9 Press [OK].

Adjusting in the Live Image

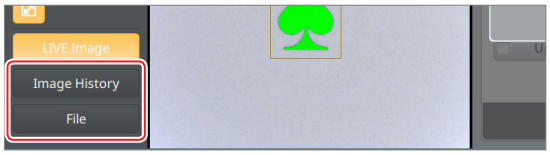
The color range to be extracted can be selected from the Live image of the target.
The range of color to be extracted can be based on the image in the image history or from an image in a saved file.

1 Press [LIVE image].



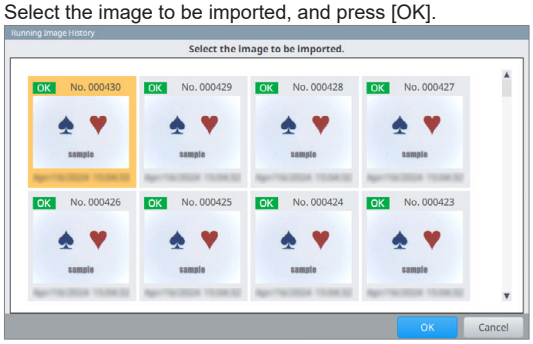
The Master image (top) and Live image (bottom) are displayed.

2 When adjusting with an image other than the Live image, press [Image History] or [File].



When importing from the running image history

Select the image to be imported, and press [OK].



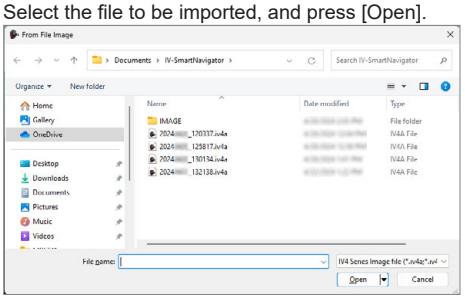
Check the image and press [OK].



The imported image will be displayed on the bottom side of the screen.

When an image is loaded from a file

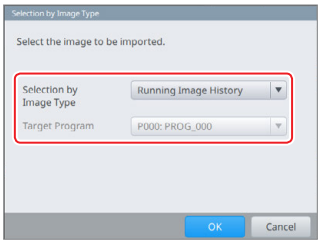
Select the file to be imported, and press [Open].



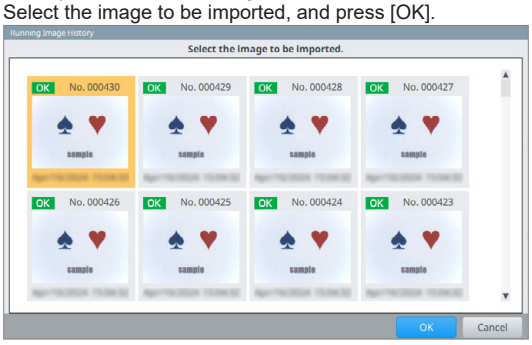
When selecting a batch backup file (*.iv4a) or individual program backup file (*.iv4a), select the image type from the following, and press [OK].

- Running Image History
- Master Image
- Learned Image History

Select the target program when the Learned Image History is selected.



Displays a list of saved images.
Select the image to be imported, and press [OK].

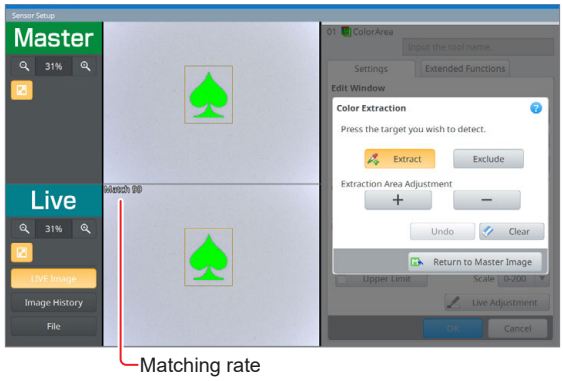


Check the image and press [OK].



The imported image will be displayed on the bottom side of the screen.

3 Adjust the color extraction area by checking the matching rate.



By selecting the [Extract] or [Exclude] button and pressing on an image (Master/Live/Log), the color extraction area can be adjusted.

- Press [Extract], and if the areas of color that have not been extracted are pressed repeatedly, the extraction range can be expanded.
- Press [Exclude] to specify the color to exclude from the extracted color.
- Press [+]/[-], and the range of color to be extracted can be expanded/reduced.
- To re-extract the color, press [Clear] and then press the color to be the reference of judgment again.

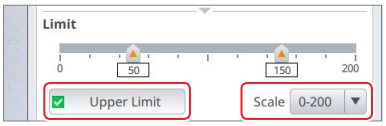
4 After setting is completed, press [Return to Master Image].

Upper Limit

Enables an upper limit on the threshold.
Enable when OK/NG judgment is desired for a situation when the target area is larger than the area extracted from the master image.

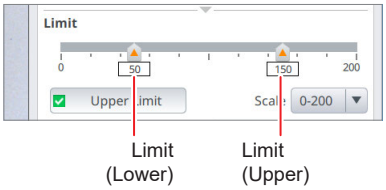
1 Switch the check box to ON for [Upper Limit].

Select the scale for the threshold according to the range of matching rates requires for judgment.



OFF (default)		Sets the upper and the lower limit of a threshold in a range within 0 to 100.
ON	0-200 (default value)	Sets the upper and the lower limit of a threshold in a range within 0 to 200.
	0-999	Sets the upper and the lower limit of the threshold in a range within 0 to 999. The slider movement unit is 1.

2 Adjust the threshold for anomaly detection by checking the matching rate.

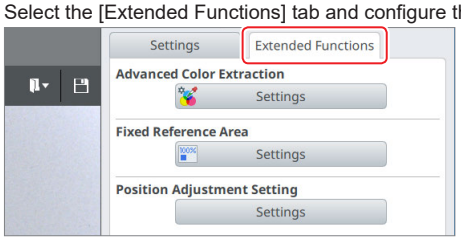


Reference

- A target is detected as OK if the matching rate is greater than the threshold, and detected as NG if the matching rate is lower than the threshold.
- The matching rate is 100 when an area matches perfectly. This becomes smaller with a narrower area and larger with a wider area. If the matching rate exceeds the upper limit of the threshold range, the matching rate will display as the upper limit of the threshold range.

Extended Functions for the Color Area/Area Tool

Select the [Extended Functions] tab and configure the settings.

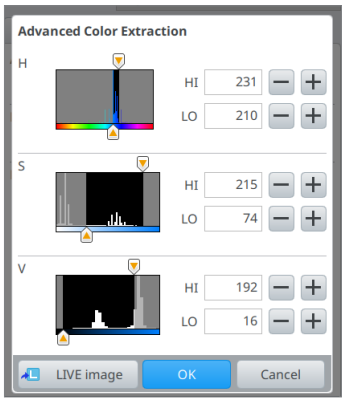


Advanced Color Extraction/Advanced Brightness Extraction

For color type

Specifies a color to be extracted using HSV (H: Hue, S: Saturation, V: Brightness).

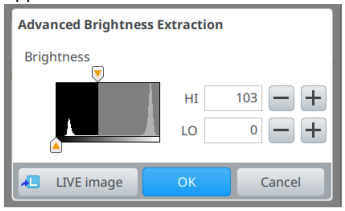
H	Set the upper limit and lower limit for the range of 0 to 359. • **Lower limit ≤ Upper limit** The extraction range of a color is from the lower limit to the upper limit. • **Lower limit > Upper limit** The extraction range of a color is from 0 to the upper limit, and from the lower limit to 359.
S V	Set the upper limit and lower limit for the range of 0 to 255. The extraction range of a color is from the lower limit to the upper limit.



- You can adjust the value by slider while confirming the color histogram. The values within the range specified by the sliders will be used as the brightness.
- The vertical axis indicates the extracted pixel.
- Among the pixels of each color to be extracted, the maximum one becomes the maximum value of the vertical axis.
- By pressing [LIVE image], the range of the extracted color can be set based on the Live Image of the target.

For monochrome type

Sets the upper and the lower limit of the brightness to be extracted in a range within 0 to 255.
The extraction range of the brightness is from the lower limit to the upper limit.



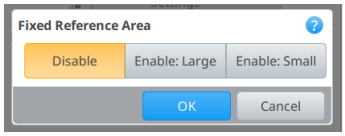
- Adjust the value by slider while confirming the monochrome histogram.
- The values within the range specified by the sliders will be used as the brightness.
- The vertical axis indicates the extracted pixel.
- Among the extracted pixels of each brightness, the one that has the most pixels becomes the maximum value of vertical axis.
- By pressing [LIVE image], the range of brightness to be extracted can be set based on the Live Image of the target.

Fixed Reference Area

Select the condition for which the matching rate of the Color Area/Area is 100%.

Reference

- Select [Enable] if the master image does not contain the color/brightness to be used for judgment.
- "Color Prohibition/Brightness Prohibition Tool" (page 4-56) is helpful for judging target protrusions and misalignments.



Position Adjustment Setting

You can select the Position Adjustment/High-Speed Position Adjustment tool to be applied.
"Position Adjustment Setting" (page 4-23)

Position Adjustment Tool

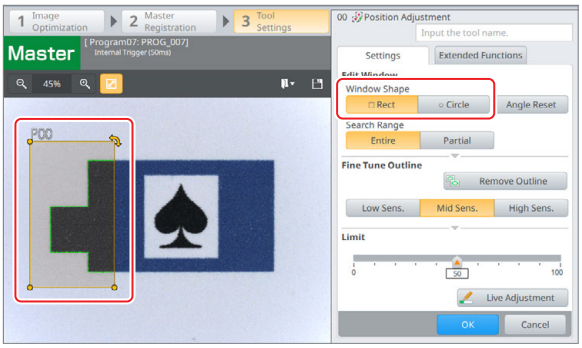
Setting of the Position Adjustment Tool

1 Add the [Position Adjustment] tool.

“Adding a Tool” (page 4-21)

2 Select [Window Shape] and set the position, size, and angle according to the target.

When [Entire] is selected, the tool window will be hidden.



Point **Set the position and size of the position adjustment tool to capture as much of a part that is common amongst all targets as possible.**
“Stabilizing the Position Adjustment” (page 6-21)

3 Configure the following settings as needed.

“Search Range Settings” (page 4-22)
“Settings for Disabling Outlines” (page 4-52)
“Setting a Sensitivity” (page 4-52)
“Rotation Range” (page 4-53)
“Search Algorithm” (page 4-53)
“Tool Name Setting” (page 4-23)

4 Press [Live Adjustment].

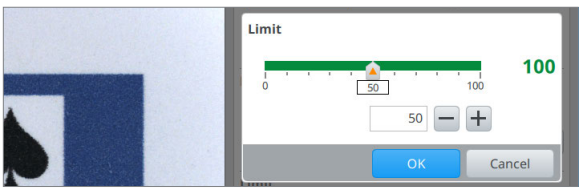


5 Captures an image of the target.

In the following cases, input an external trigger:
- When [External Trigger] is set in Trigger Options
- When [Internal Trigger Control/AI Trigger Control] is set to [Enable]

If a trigger cannot be input, press [Trigger ON] to take an image of the target by temporarily using the internal trigger.

6 Adjust the threshold to judge whether or not the position adjustment succeeds by checking the matching rate. When setting is completed, press [OK].



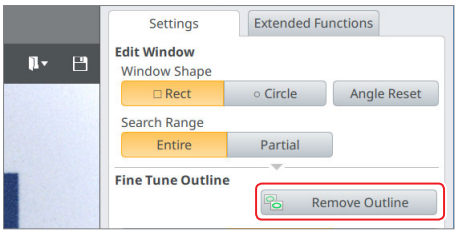
Reference
- If there are many variations of the target shape that the position adjustment tool has been set to, set the threshold to a lower matching rate.
- A target is detected as OK if the matching rate is greater than the threshold, and detected as NG if the matching rate is lower than the threshold.

7 Press [OK].

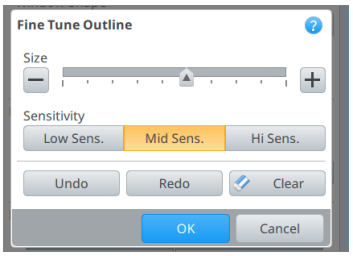
Settings for Disabling Outlines

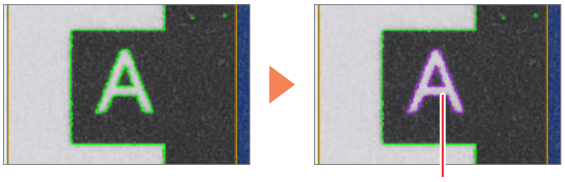
Judges by disabling an unnecessary outline which interrupts the stabilized detection. The disabled outlines can be specified by tracing the extracted outline.

1 Press [Remove Outline].



2 Drag the cursor to specify the unnecessary outline.





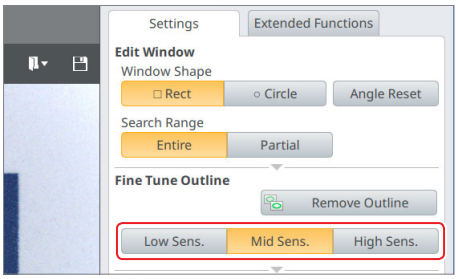
The outline that the outline extraction has disabled (purple)

Reference
- The size of the cursor when specifying the unnecessary outlines can be changed in [Size].
- The [Undo] button can be used up to 20 times.

3 When setting is completed, press [OK].

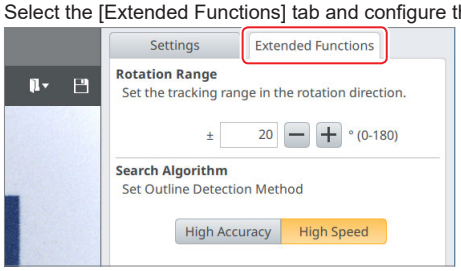
Setting a Sensitivity

The outline extraction sensitivity can be selected according to the target quality.



Extended Functions for the Position Adjustment Tool

Select the [Extended Functions] tab and configure the settings.



Rotation Range

Sets the range of rotation to adjust the position for the target. The status result of the position adjustment is NG and position is not adjusted if the angle of rotation of the target exceeds its rotation range.

- If the rotation range is set wide, the acceptable range of variation in the angles at which a target can be placed is wider.
- If the rotation range is set narrow, the processing time can be shortened.

Search Algorithm

The algorithm used to search for the Position Adjustment tool can be adjusted depending on the inspection requirements.

Point

- **Select [High Accuracy] when detection is not stable because of a small difference in the matching rate of an "OK" and "NG" image.**
- **Select [High Accuracy] when detection is not stable because of the influence of an unnecessary outline other than the target, such as the background.**
- **Select [High Speed] to shorten the processing time.**

High-Speed Position Adjustment (Hi-Sp.Adj) Tool

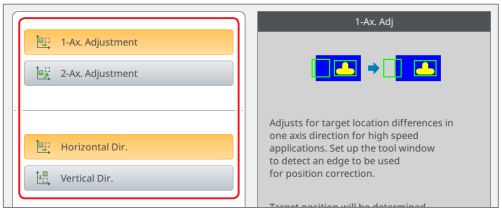
Setting the High-Speed Position Adjustment Tool

1-Axis Adjustment

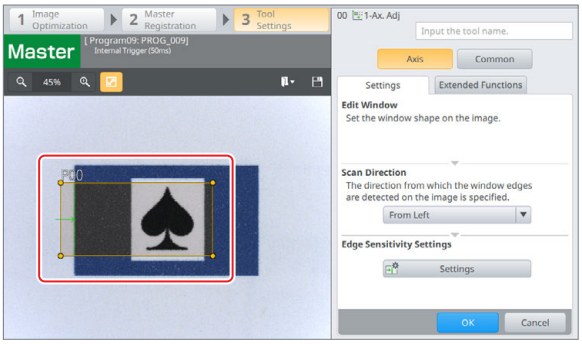
1 **Add the [Hi-Sp.Adj] tool.**

“Adding a Tool” (page 4-21)

2 **Select [1-Ax. Adjustment], press [Horizontal Dir.] or [Vertical Dir.], and then press [OK].**



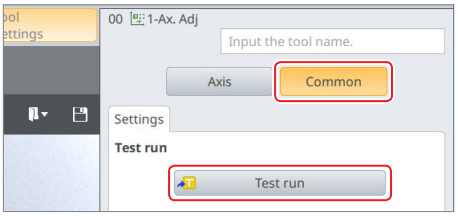
3 **Select the detection direction, and then set the position and size of the tool window according to a target.**



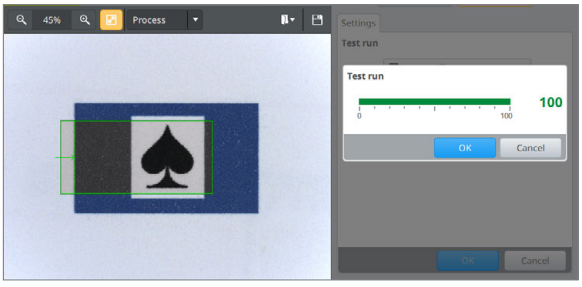
4 **Configure the following settings as needed.**

“Scan Direction” (page 4-55)
“Edge Sensitivity Settings” (page 4-55)
“Edge Detection” (page 4-55)
“Tool Name Setting” (page 4-23)

5 **Press [Common], and then press [Test run].**



6 **After position correction is performed, check that the edges have been detected, and then press [OK].**



7 **Press [OK].**

2-Axis Adjustment

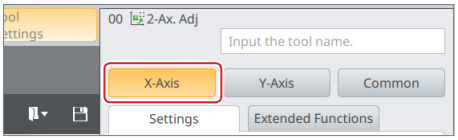
1 **Add the [Hi-Sp.Adj] tool.**

“Adding a Tool” (page 4-21)

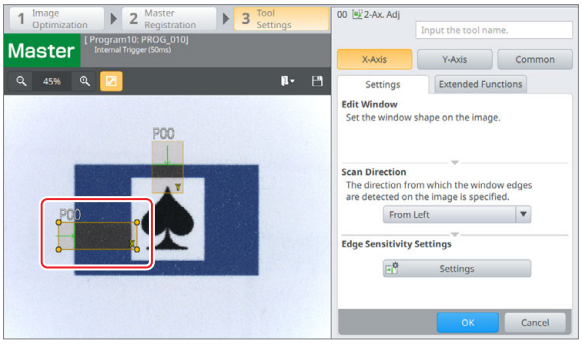
2 **Select the [2-Ax. Adj] button, and press [OK].**



3 **Press [X-Axis].**



4 **Select the detection direction, and set the position and size of the tool window according to a target.**

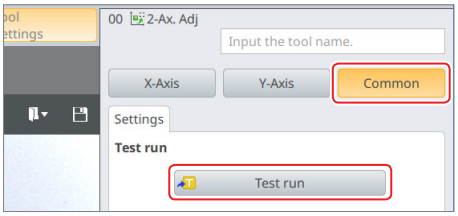


5 **Configure the following settings as needed.**

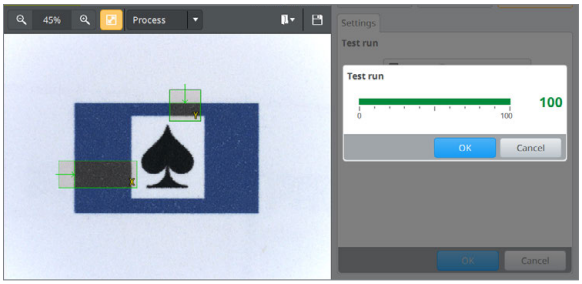
“Scan Direction” (page 4-55)
“Edge Sensitivity Settings” (page 4-55)
“Edge Detection” (page 4-55)
“Tool Name Setting” (page 4-23)

6 **Press [Y-Axis], and perform steps 3 to 5 for the Y axis with the same settings as the X-axis.**

7 **Press [Common], and then press [Test run].**



8 **After position correction is performed, check that the edges have been detected, and then press [OK].**



9 **Press [OK].**

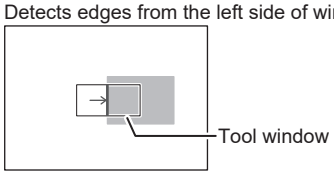
Scan Direction

Selects the direction for which the tool detects the target edge.



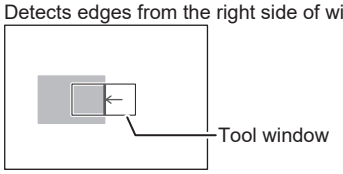
❍ **From Left (default)**

Detects edges from the left side of window to the right side.



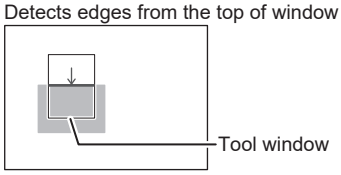
❍ **From Right**

Detects edges from the right side of window to the left side.



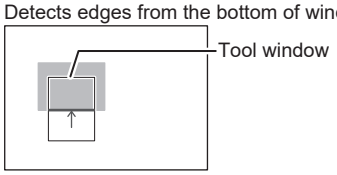
❍ **From Top**

Detects edges from the top of window to the bottom.



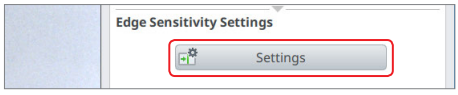
❍ **From Bottom**

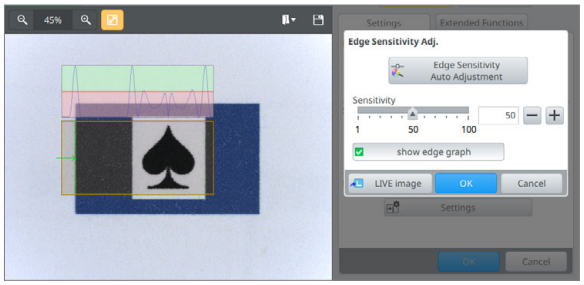
Detects edges from the bottom of window to the top.



Edge Sensitivity Settings

Adjusts the sensitivity for detecting edges.
For [2-Ax. Adj], select an axis to set, and then press [Settings].





When the edge sensitivity is adjusted automatically

Press [Edge Sensitivity Auto Adjustment].
The edge sensitivity will be adjusted automatically according to the target.

When the edge sensitivity is adjusted manually

Adjust the threshold value for edge sensitivity by checking the edge graph.

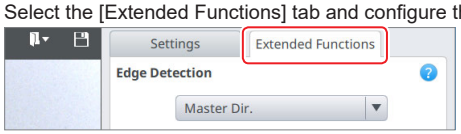
- The edge sensitivity limit can also be adjusted by pressing the red line on the edge graph.
- Press [LIVE image] to adjust threshold value for edge intensity using the target Live image.

❍ **Threshold for edge sensitivity**

“Threshold for Edge Sensitivity” (page 4-66)

Extended Functions for the High-Speed Position Adjustment Tool

Select the [Extended Functions] tab and configure the settings.



Edge Detection

Selects the bright/dark direction that detects a target edge.

Reference — The contents of the extended functions that can be set in [1-Ax. Adj], [2-Ax. Adj (Axis:X)], and [2-Ax. Adj (Axis:Y)] are the same.

❍ **Master Dir.**

Detects edges in the same bright/dark direction as the master image.

❍ **Both**

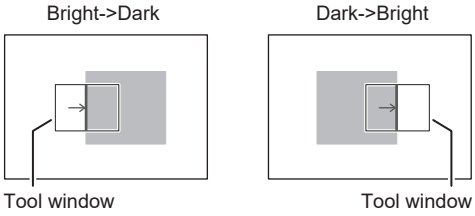
Detects both bright->dark and dark->bright edges.

❍ **Bright->Dark**

Detects edges that change from bright to dark.

❍ **Dark->Bright**

Detects edges that change from dark to bright.



Color Prohibition/Brightness Prohibition Tool

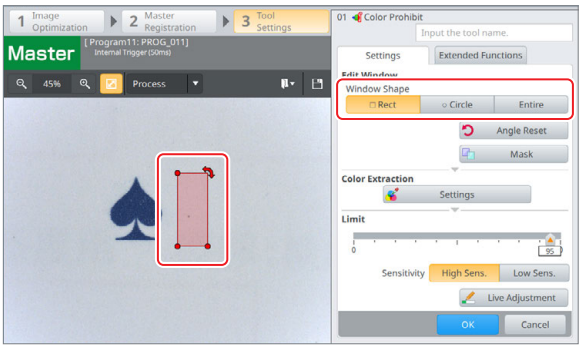
Setting the Color Prohibition/Brightness Prohibition Tool

1 Adds the [Color Prohibit/Brightness Prohibit] tool.

“Adding a Tool” (page 4-21)

2 Select the tool [Window Shape], and then set the position, size, and angle according to the desired target.

When [Entire] is selected, the tool window will be hidden.

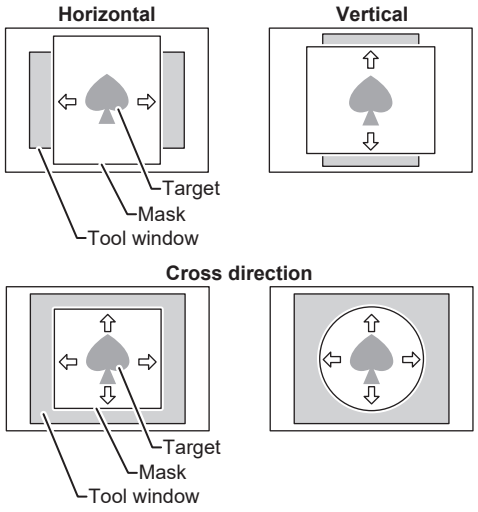


3 Configure the following settings as needed.

“Mask Settings” (page 4-22)

Point

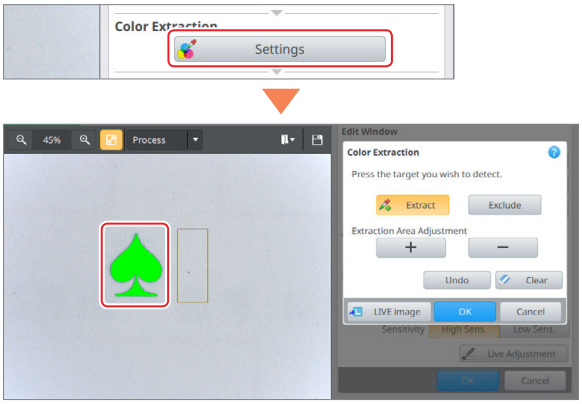
Using the tool in conjunction with mask settings enables misalignments and protrusions in various directions to be detected.



4 Extract the color/brightness to be judged from the target.

For color type

Press [Settings] for color extraction and then press the color to be the basis for judgment for color prohibition.



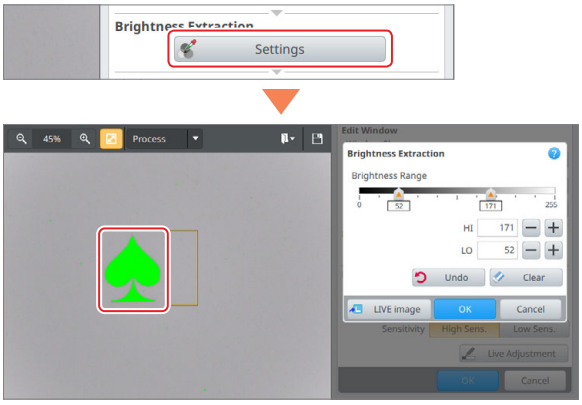
The pressed color will be extracted.

- If the areas of color that have not been extracted are pressed repeatedly, the extraction range can be adjusted.
- Press the [Exclude] button to specify the color to exclude from the extracted color.
- Press the [+]/[-] of the extraction area adjustment, and the range of color to be extracted can be expanded/reduced.
- To re-extract the color, press [Clear] and then press the color to be the reference of judgment again.
- By pressing [LIVE image], the range of the extracted color can be set using the Live Image of the target.

When setting is completed, press [OK].

For monochrome type

Press [Settings] for brightness extraction and then press the brightness to be the basis for judgment for brightness prohibition.



The pressed brightness will be extracted.

- If the areas of brightness that have not been extracted are pressed repeatedly, the extraction range can be expanded.
- Adjust the slider, and the range of the brightness to be extracted can be expanded/reduced.
- To re-extract the brightness, press [Clear] and then press the brightness to be the reference of judgment again.
- By pressing [LIVE image], the range of brightness to be extracted can be set using the Live Image of the target.

When setting is completed, press [OK].

5 Press [Live Adjustment].

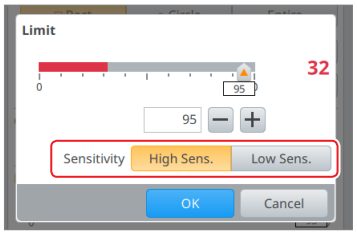


6 Take an “OK” image and a “NG” image.

In the following cases, input an external trigger:
- When [External Trigger] is set in Trigger Options
- When [Internal Trigger Control/AI Trigger Control] is set to [Enable]

If a trigger cannot be input, press [Trigger ON] to take an image of the target by temporarily using the internal trigger.

7 Select a sensitivity for the matching rate.



High Sensitivity (default)

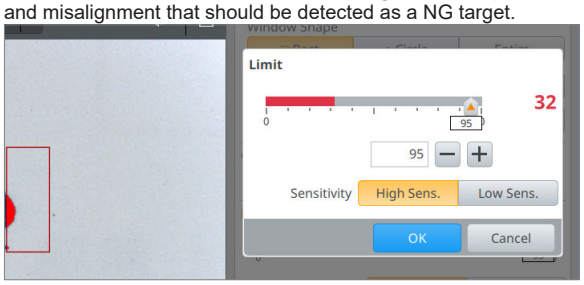
If "1/600th of the total sensor view" area in the tool window protrudes, the matching rate is 0%. The sensitivity to detect the protrusion increases.
Select this setting when you do not want to allow protrusions or deviations.

Low Sensitivity

If "1/10th of the total sensor view" area in the tool window protrudes, the matching rate is 0%.
This setting enables protrusions and deviations to be judged when they are allowed. Additionally, this setting makes judgment resistant to individual target differences and ambient light interference.

8 Adjust the threshold for anomaly detection by checking the matching rate. When setting is completed, press [OK].

<Setting example>
Set the detection threshold for the matching rate of the protrusion and misalignment that should be detected as a NG target.



Reference A target is detected as OK if the matching rate is greater than the threshold, and detected as NG if the matching rate is lower than the threshold.

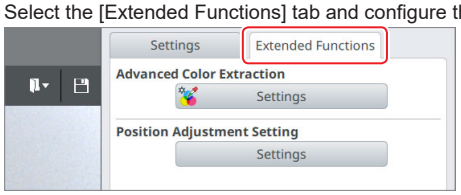
9 Configure the following settings as needed.

“Advanced Color Extraction/Advanced Brightness Extraction” (page 4-57)
“Position Adjustment Setting” (page 4-23)
“Tool Name Setting” (page 4-23)

10 Press [OK].

Advanced Settings for the Color Prohibition/ Brightness Prohibition Tool

Select the [Extended Functions] tab and configure the settings.

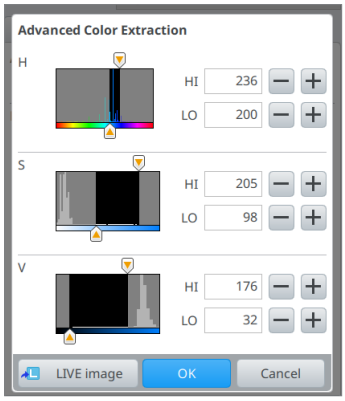


Advanced Color Extraction/Advanced Brightness Extraction

For color type

Specifies a color to be extracted using HSV (H: Hue, S: Saturation, V: Brightness).

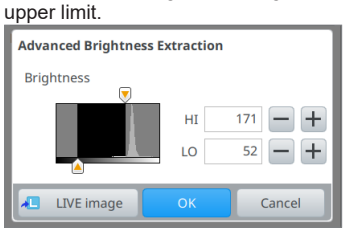
H	Set the upper limit and lower limit for the range of 0 to 359. • **Lower limit ≤ Upper limit** The extraction range of a color is from the lower limit to the upper limit. • **Lower limit > Upper limit** The extraction range of a color is from 0 to the upper limit, and from the lower limit to 359.
S V	Set the upper limit and lower limit for the range of 0 to 255. The extraction range of a color is from the lower limit to the upper limit.



- You can adjust the value by slider while confirming the color histogram. The values within the range specified by the sliders will be used as the brightness.
- The vertical axis indicates the extracted pixel.
- Among the pixels of each color to be extracted, the maximum one becomes the maximum value of the vertical axis.
- By pressing [LIVE image], the range of the extracted color can be set based on the Live Image of the target.

For monochrome type

Sets the upper and the lower limit of the brightness to be extracted in a range within 0 to 255.
The extraction range of the brightness is from the lower limit to the upper limit.



- Adjust the value by slider while confirming the monochrome histogram.
- The values within the range specified by the sliders will be used as the brightness.
- The vertical axis indicates the extracted pixel.
- Among the extracted pixels of each brightness, the one that has the most pixels becomes the maximum value of vertical axis.
- By pressing [LIVE image], the range of brightness to be extracted can be set based on the Live Image of the target.

Position Adjustment Setting

You can select the Position Adjustment/High-Speed Position Adjustment tool to be applied.
“Position Adjustment Setting” (page 4-23)

Color/Brightness Averaging Tool

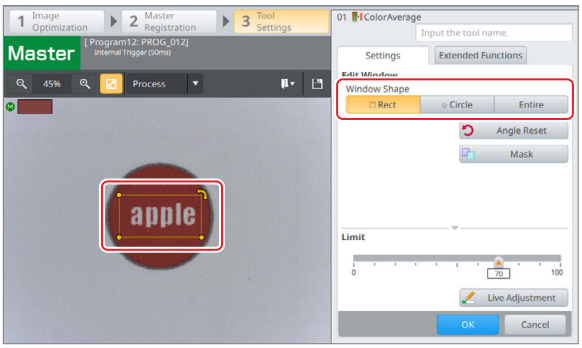
Setting the Color/Brightness Averaging Tool

1 Add the [ColorAverage] tool (color type) or [Brightness Avg] tool (monochrome type).

“Adding a Tool” (page 4-21)

2 Select [Window Shape] and set the position, size, and angle according to the target.

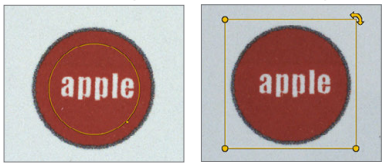
When [Entire] is selected, the tool window will be hidden.



Point

- **The average color or average brightness value is automatically extracted from inside the window.**
- **Only set the window size to the color or brightness area that you want to judge. If the background is included, the average color or brightness average that includes the background color will be registered. Therefore, the matching rate difference between an “OK” image and a “NG” image that you want to judge will decrease.**

Good example Bad example



3 Configure the following settings as needed.

“Mask Settings” (page 4-22)

4 Press [Live Adjustment].



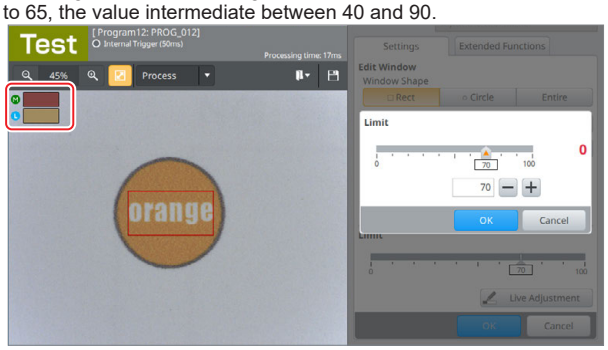
5 Take an “OK” image and a “NG” image.

In the following cases, input an external trigger:
- When [External Trigger] is set in Trigger Options
- When [Internal Trigger Control/AI Trigger Control] is set to [Enable]

If a trigger cannot be input, press [Trigger ON] to take an image of the target by temporarily using the internal trigger.

6 Adjust the threshold for anomaly detection by checking the matching rate. When setting is completed, press [OK].

<Setting example>
If the matching rate of an “OK” image is higher than 90 and if the matching rate of a “NG” image is lower than 40, set the threshold to 65, the value intermediate between 40 and 90.



Reference

- The following icons are displayed on the upper-left of the screen:
  : Average color/brightness of the master image.
  : Average color/brightness of the Live image.
- 100 indicates that the color and brightness is completely matched. The matching rate decreases as the color or brightness of the target differs. For the color average tool, the smallest matching rate for H/S/V calculated individually will be the matching rate for the tool.
- A target is detected as OK if the matching rate is greater than the threshold, and detected as NG if the matching rate is lower than the threshold.

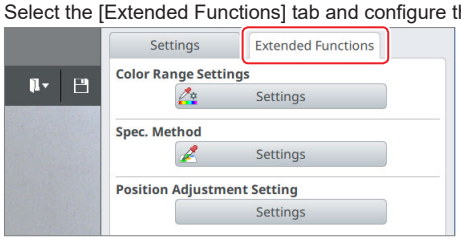
7 Configure the following settings as needed.

“Color Range Settings/Brightness Range Settings” (page 4-59)
“Specify Method” (page 4-61)
“Position Adjustment Setting” (page 4-23)
“Tool Name Setting” (page 4-23)

8 Press [OK].

Extended Functions for the Color/Brightness Averaging Tool

Select the [Extended Functions] tab and configure the settings.

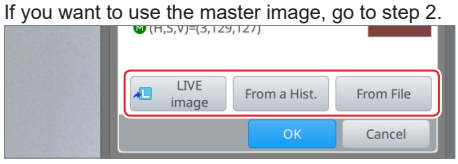


Color Range Settings/Brightness Range Settings

Specifies the judgment sensitivity for the color/brightness extracted from the master image.

1 Select an image for which you want to adjust the color/brightness area.

If you want to use the master image, go to step 2.



To use the Live image

Press [LIVE image].
The color area can be set based on the Live image of the target.

When importing from the image history

Press [From a Hist.] to select the image that is desired to be used.
“When importing from the running image history” (page 4-49)

When importing an image from a saved file

Press [From File] to select the file desired to be imported.
“When an image is loaded from a file” (page 4-49)

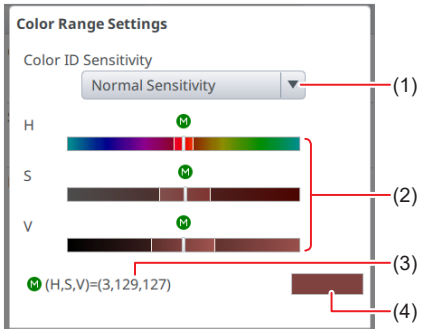
2 Select the color/brightness judgment sensitivity.

Point

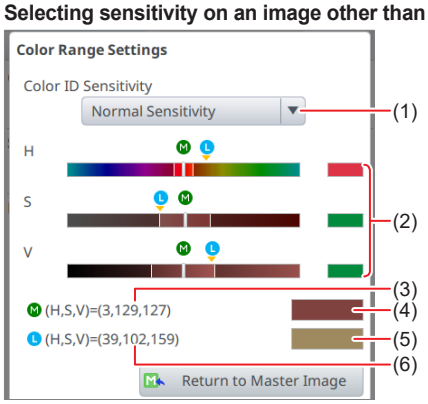
Re-registering the master image or registering an external master image automatically updates the area in conjunction with the average color/brightness for the updated master image. If [Manual] is selected, it is automatically updated while retaining the specified area.

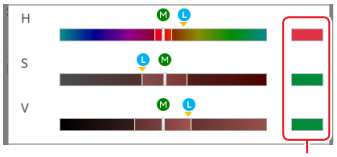
For color type

❍ **Selecting sensitivity on the master image**



❍ **Selecting sensitivity on an image other than the master image**

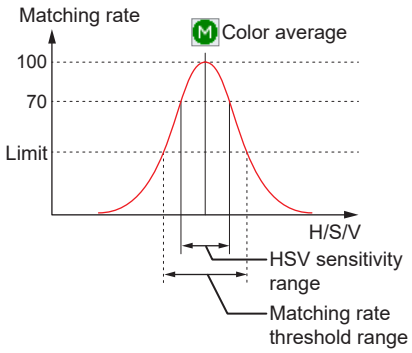


No.	Description
(1)	Selects the color judgment sensitivity ([High Sensitivity]/[Normal] (default)/[Low Sensitivity]/[Manual]). • Selecting [High Sensitivity]/[Normal]/[Low Sensitivity] automatically sets the judgment area. (The average color (HSV) value is the center of the master image window.) • To narrow the range of colors for non-defective workpieces, select [High Sensitivity]. This enables small color differences to be differentiated. • To widen the range of colors for non-defective workpieces, select [Low Sensitivity]. This setting makes judgment resistant to individual OK color differences and light interference.
(2)	• The following items are displayed on the bar graph (H/S/V). • (M): Average color value of the master image. • (L): Average color value of the Live image. • (L): Average color value of the image file or history image. • Solid line (color judgment sensitivity area) • Dotted line (threshold area of the color average tool) • For an image other than a master image, the total status result for each sensitivity is displayed on the right side of the bar graph (H/S/V). When all status results are OK, the total status result for the tool will be OK.  Status result (Green: OK; red: NG) Reference Bar graph scale • H: Automatically adjusts the average color value of the master image to be centered on the bar. • S/V: Left end is 0 and right end is 255.
(3)	Displays the average HSV value of the master image.
(4)	Displays the average color of the master image.
(5)	Displays the average HSV value of the imported image.
(6)	Displays the average color of the imported image.

Reference

Relationship between the color judgment sensitivity and matching rate

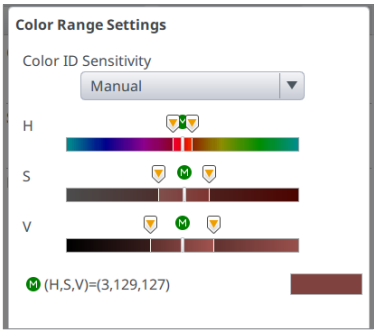
- When the average color of the target matches the average color of the master image, the matching rate is 100. The matching rate decreases as the difference between the average color of the target and master image increases. The sensitivity area is automatically adjusted so that the matching rate becomes 70.



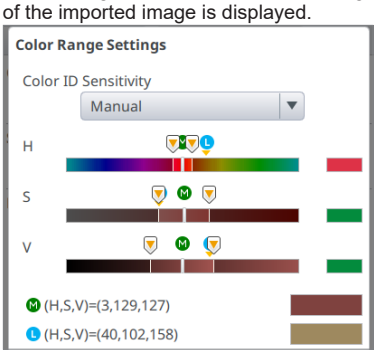
- The color average tool individually calculates the matching rate of H (hue)/S (saturation)/V (brightness) for the target.
- The smallest matching rate for H/S/V calculated individually will be the matching rate for the color average tool.

❍When [Manual] is selected

The OK range can be adjusted to the desired values.

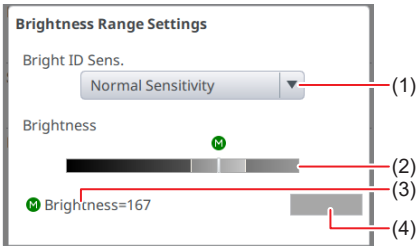


For an image other than the master image, the average color value of the imported image is displayed.

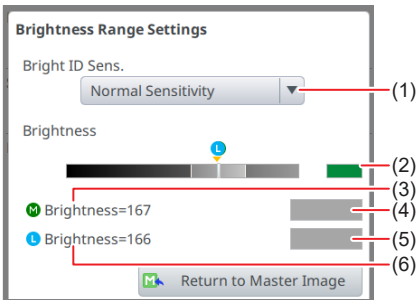


For monochrome type

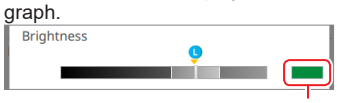
❍Selecting sensitivity on the master image



❍Selecting sensitivity on an image other than the master image

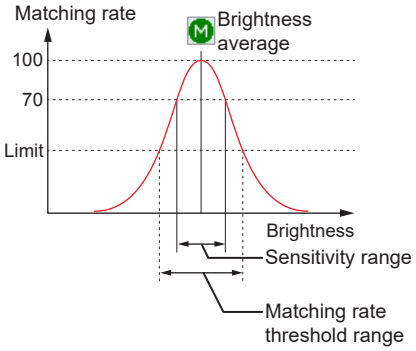


No.	Description
(1)	Selects the brightness judgment sensitivity ([High Sensitivity] / [Normal] (default)/[Low Sensitivity]/[Manual]). • Selecting [High Sensitivity]/[Normal]/[Low Sensitivity] automatically sets the judgment area. (The average brightness value is the center of the master image window.) • To narrow the range of OK brightness, select [High Sensitivity]. This enables small brightness differences to be differentiated. • To widen the range of OK brightness, select [Low Sensitivity]. This setting makes judgment resistant to individual brightness differences and light interference.

No.	Description
(2)	• The following items are displayed on the bar graph. • (Average brightness value of the master image) • (Average brightness value of the Live image) • (Average brightness value of the image file or history image) • Solid line (brightness judgment sensitivity area) • Dotted line (threshold area of the brightness average tool) • For an image other than a master image, the total status result for the tool is displayed on the right side of the bar graph.  Status result (Green: OK; red: NG) Reference The bar graph scale is from 0 on the left to 255 on the right.
(3)	Displays the average brightness value of the master image.
(4)	Displays the average brightness of the master image.
(5)	Displays the average brightness value of the imported image.
(6)	Displays the average brightness of the imported image.

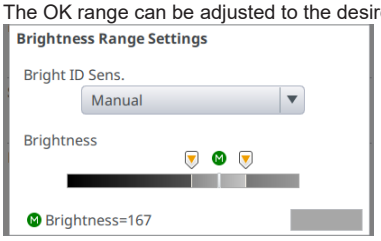
Reference Relationship between the brightness judgment sensitivity and matching rate

• When the average brightness of the target matches the average color of the master image, the matching rate is 100. The matching rate decreases as the difference between the average brightness of the target and master image increases. The sensitivity area is automatically adjusted so that the matching rate becomes 70.

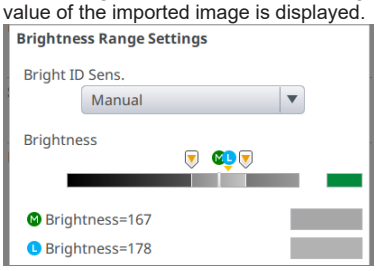


❍When [Manual] is selected

The OK range can be adjusted to the desired values.



For an image other than the master image, the average brightness value of the imported image is displayed.



3 When setting is completed, press [OK].

Specify Method

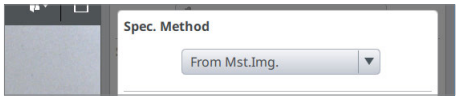
Select how to specify the master color/brightness.

Point

When updating the master color/brightness registered for the master image registration, select [From Mst.Img.].

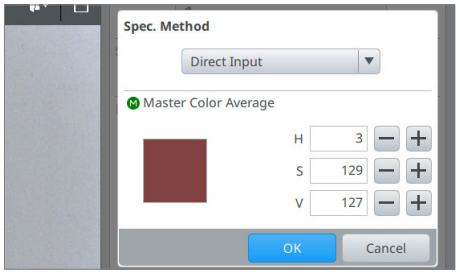
From Mst.Img. (default)

The average color/brightness value in the window specified with the master image is set as the master color/brightness.
If the master image is updated, the master color is automatically updated.



Direct Input

Input the HSV value/brightness to specify the master color/brightness.
Even if the master image is updated, the master color is not automatically updated.



Position Adjustment Setting

You can select the Position Adjustment/High-Speed Position Adjustment tool to be applied.
“Position Adjustment Setting” (page 4-23)

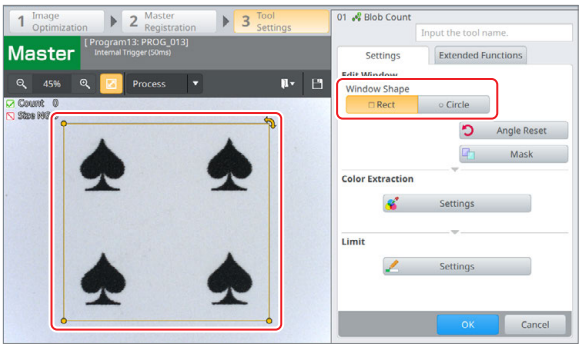
Blob Count Tool

Setting the Blob Count tool

1 Add the [Blob Count] tool.

“Adding a Tool” (page 4-21)

2 Select the tool [Window Shape], and then set the position, size, and angle according to the desired target.



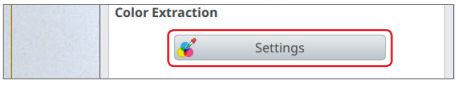
3 Configure the following settings as needed.

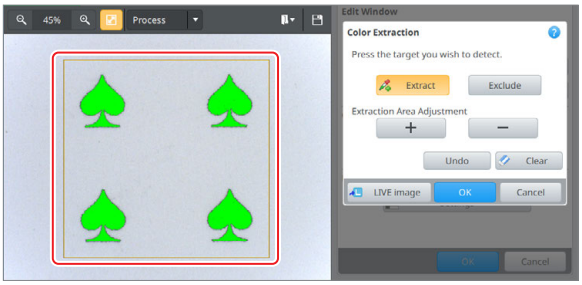
“Mask Settings” (page 4-22)

4 Set the color/brightness from the target to be extracted.

For color type

Press [Settings] for color extraction, and then press the color of the target to be counted.





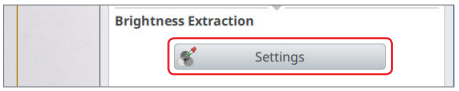
The pressed color will be extracted.

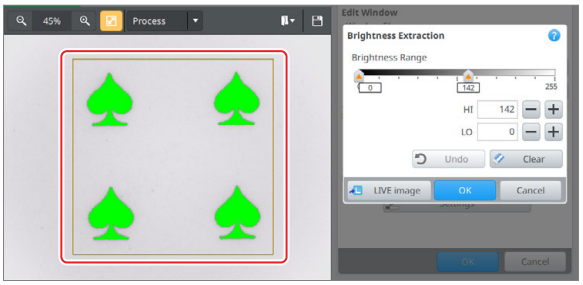
- If the areas of color that have not been extracted are pressed repeatedly, the extraction range can be adjusted.
- Press the [Exclude] button to specify the color to exclude from the extracted color.
- Press the [+]/[-] of the extraction area adjustment, and the range of color to be extracted can be expanded/reduced.
- To re-extract the color, press [Clear] and then press the color to be the reference of judgment again.
- By pressing [LIVE image], the range of the extracted color can be set using the Live Image of the target.

When setting is completed, press [OK].

For monochrome type

Press [Settings] for brightness extraction, and then press the brightness of the target to be counted.



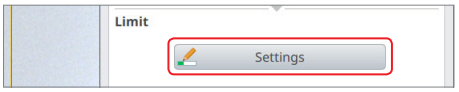


The pressed brightness will be extracted.

- If the areas of brightness that have not been extracted are pressed repeatedly, the extraction range can be expanded.
- Adjust the slider, and the range of the brightness to be extracted can be expanded/reduced.
- To re-extract the brightness, press [Clear] and then press the brightness to be the reference of judgment again.
- By pressing [LIVE image], the range of brightness to be extracted can be set using the Live Image of the target.

When setting is completed, press [OK].

5 Press [Settings] for [Limit].



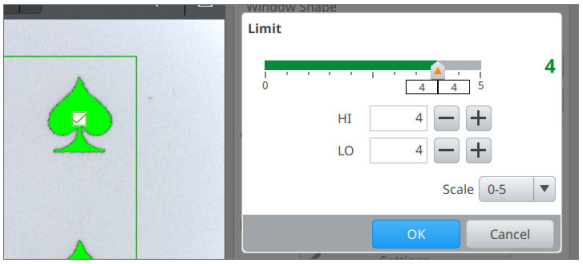
6 Take an “OK” image and a “NG” image.

In the following cases, input an external trigger:

- When [External Trigger] is set in Trigger Options
- When [Internal Trigger Control/AI Trigger Control] is set to [Enable]

If a trigger cannot be input, press [Trigger ON] to take an image of the target by temporarily using the internal trigger.

7 Adjust the threshold for anomaly detection by checking the count. When setting is completed, press [OK].



Reference The target is judged OK when the count is within a threshold range, and NG when it is outside the range.

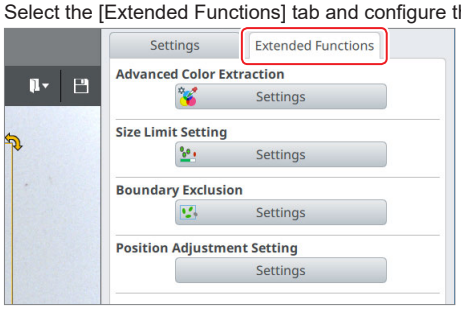
8 Configure the following settings as needed.

“Advanced Color Extraction/Advanced Brightness Extraction” (page 4-63)
“Size Limit Setting” (page 4-63)
“Boundary Exclusion” (page 4-63)
“Position Adjustment Setting” (page 4-23)
“Tool Name Setting” (page 4-23)

9 Press [OK].

Extended Functions for the Blob Count Tool

Select the [Extended Functions] tab and configure the settings.

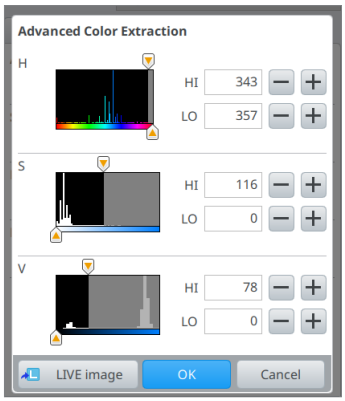


Advanced Color Extraction/Advanced Brightness Extraction

For color type

Specifies a color to be extracted using HSV (H: Hue, S: Saturation, V: Brightness).

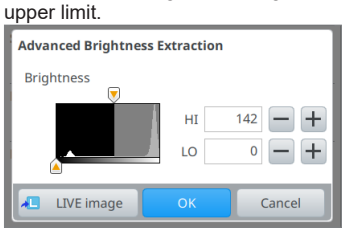
H	Set the upper limit and lower limit for the range of 0 to 359. • **Lower limit ≤ Upper limit** The extraction range of a color is from the lower limit to the upper limit. • **Lower limit > Upper limit** The extraction range of a color is from 0 to the upper limit, and from the lower limit to 359.
S V	Set the upper limit and lower limit for the range of 0 to 255. The extraction range of a color is from the lower limit to the upper limit.



- You can adjust the value by slider while confirming the color histogram. The values within the range specified by the sliders will be used as the brightness.
- The vertical axis indicates the extracted pixel.
- Among the pixels of each color to be extracted, the maximum one becomes the maximum value of the vertical axis.
- By pressing [LIVE image], the range of the extracted color can be set based on the Live Image of the target.

For monochrome type

Sets the upper and the lower limit of the brightness to be extracted in a range within 0 to 255.
The extraction range of the brightness is from the lower limit to the upper limit.



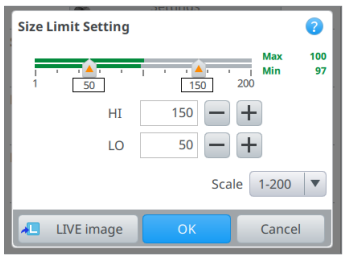
- Adjust the value by slider while confirming the monochrome histogram.
- The values within the range specified by the sliders will be used as the brightness.
- The vertical axis indicates the extracted pixel.
- Among the extracted pixels of each brightness, the one that has the most pixels becomes the maximum value of vertical axis.
- By pressing [LIVE image], the range of brightness to be extracted can be set based on the Live Image of the target.

Size Limit Setting

Sets the range of a blob size (area) to be counted.
Adjust the threshold for the size by checking the matching rate.

Point **The maximum size (area) extracted as a blob in the master image is set as the matching rate of 100. The target is counted when the matching rate is within a threshold range, and "Size NG" when it is outside the range.**

Reference Press [LIVE image] as needed, and take an “OK” image and an “NG” image.
- The image which the sensor is currently imaging will be displayed.
- If [Trigger Options] is set to [External] or [Internal Trigger Control/AI Trigger Control] is set to [Enable], input an external trigger.
- If the external trigger cannot be input, press [Trigger ON] to take an image of the target by temporarily using the internal trigger.



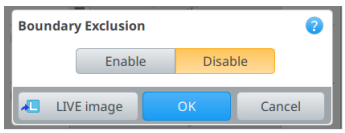
❍ Scale

Select [1-200] or [1-999] according to the range of the matching rate necessary for judgment.

Boundary Exclusion

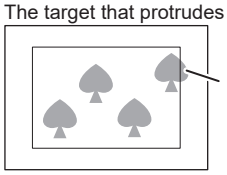
Sets whether to count or exclude the target that protrudes from the window.

Reference Press [LIVE image] as needed, and take an “OK” image and an “NG” image.
- The image which the sensor is currently imaging will be displayed.
- If [Trigger Options] is set to [External Trigger] or [Internal Trigger Control/AI Trigger Control] is set to [Enable], input an external trigger.
- If the external trigger cannot be input, press [Trigger ON] to take an image of the target by temporarily using the internal trigger.



❍ Enable

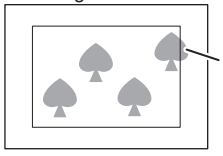
The target that protrudes from the window is not counted.



Count: 3

❍ Disable

The target is counted when its size within the window is within the size range.



Count: 4

Position Adjustment Setting

You can select the Position Adjustment/High-Speed Position Adjustment tool to be applied.
“Position Adjustment Setting” (page 4-23)

Edge Tool

Setting the Edge tool

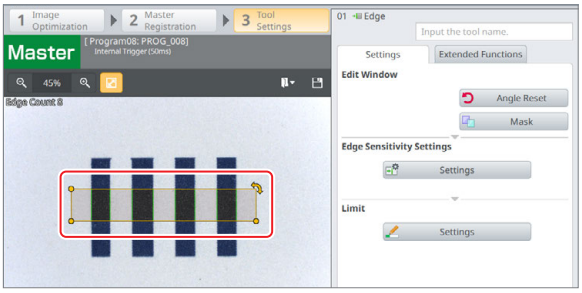
1 Add the [Edge] tool.

“Adding a Tool” (page 4-21)

2 Select [Horizontal Dir.] or [Vertical Dir.], and then press [OK].



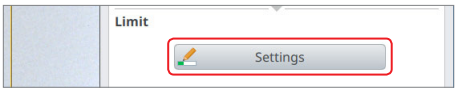
3 Set the position, size, and angle of tool window according to the target.



4 Configure the following settings as needed.

“Mask Settings” (page 4-22)
“Edge Sensitivity Settings” (page 4-64)
“Edge Detection” (page 4-65)
“Fine Edge Mode” (page 4-65)
“Position Adjustment Setting” (page 4-23)
“Tool Name Setting” (page 4-23)

5 Press [Settings] for [Limit].



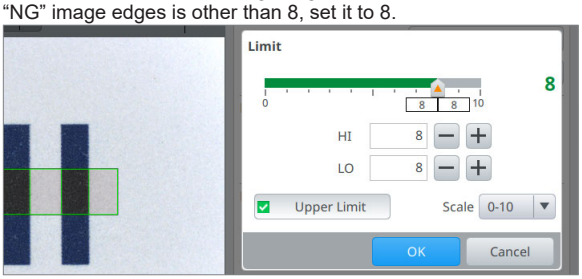
6 Take an “OK” image and a “NG” image.

In the following cases, input an external trigger:
- When [External Trigger] is set in Trigger Options
- When [Internal Trigger Control/AI Trigger Control] is set to [Enable]

If a trigger cannot be input, press [Trigger ON] to take an image of the target by temporarily using the internal trigger.

7 Adjust the threshold for anomaly detection by checking the number of edges. When setting is completed, press [OK].

<Setting example>
If the number of an “OK” image edges is 8, and if the number of a “NG” image edges is other than 8, set it to 8.



Upper Limit

Enables an upper limit on the threshold. (Default: ON)
Set if OK/NG judgment is desired for a target that has a number of target edges larger than the number of edges of the master image.

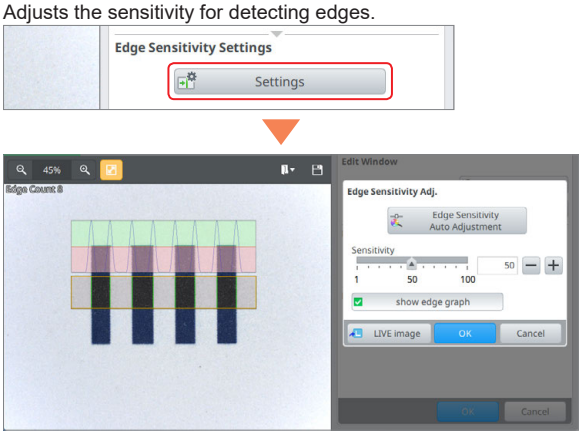
Scale

When the upper limit of the threshold is ON, select the threshold scale according to the range of the matching rate required for judgment.
The default value is automatically adjusted according to the number of edges of the registered master image.

8 Press [OK].

Edge Sensitivity Settings

Adjusts the sensitivity for detecting edges.



When the edge sensitivity is adjusted automatically

Press [Edge Sensitivity Auto Adjustment].
The edge sensitivity will be adjusted automatically according to the target.

When the edge sensitivity is adjusted manually

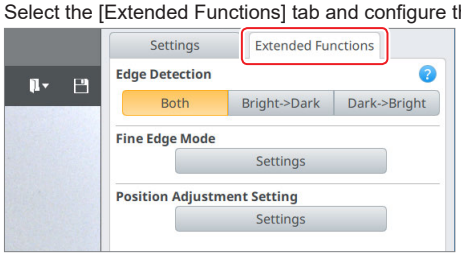
Adjust the threshold value for edge sensitivity by checking the edge graph.
- The edge sensitivity limit can also be adjusted by pressing the red line on the edge graph.
- Press [LIVE image] to adjust threshold value for edge intensity using the target Live image.

Threshold for edge sensitivity

“Threshold for Edge Sensitivity” (page 4-66)

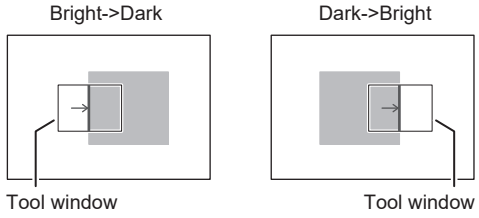
Extended Functions for the Edge Tool

Select the [Extended Functions] tab and configure the settings.



Edge Detection

Selects the bright/dark direction that detects a target edge.



❍ **Both**

Detects both bright->dark and dark->bright edges.

❍ **Bright->Dark**

Detects edges that change from bright to dark.

❍ **Dark->Bright**

Detects edges that change from dark to bright.

Reference

For [Horizontal Dir.], the edges are detected from the left to the right side of the tool window; for [Vertical Dir.], the edges are detected from the top to the bottom.

Fine Edge Mode

Select [ON] when edges can not be differentiated because the space between the edges is too narrow.

Position Adjustment Setting

You can select the Position Adjustment/High-Speed Position Adjustment tool to be applied.

“Position Adjustment Setting” (page 4-23)

Width Tool

Setting the Width Tool

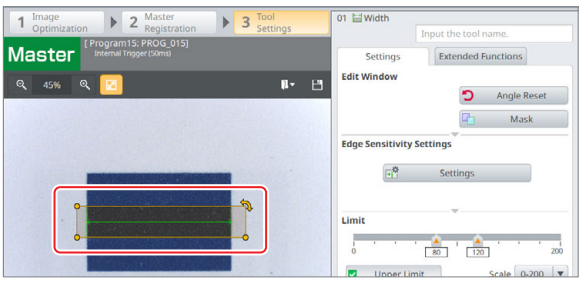
1 Add the [Width] tool.

“Adding a Tool” (page 4-21)

2 Press [Horizontal Dir.] or [Vertical Dir.], and press [OK].



3 Set the position, size, and angle of tool window according to the target.



4 Configure the following settings as needed.

“Mask Settings” (page 4-22)
“Edge Sensitivity Settings” (page 4-66)
“Width Extraction Method” (page 4-67)
“Scaling Setting” (page 4-67)
“Position Adjustment Setting” (page 4-23)
“Tool Name Setting” (page 4-23)

5 Press [Live Adjustment].

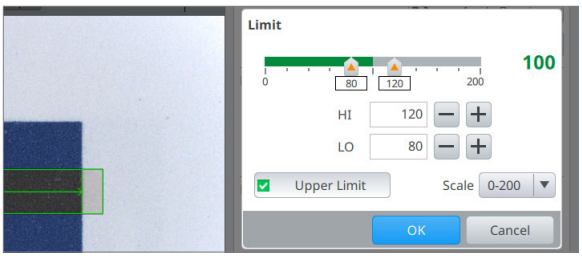


6 Take an “OK” image and a “NG” image.

In the following cases, input an external trigger:
- When [External Trigger] is set in Trigger Options
- When [Internal Trigger Control/AI Trigger Control] is set to [Enable]

If a trigger cannot be input, press [Trigger ON] to take an image of the target by temporarily using the internal trigger.

7 Adjust the threshold for anomaly detection by checking the matching rate. When setting is completed, press [OK].



Reference The target is judged OK when the matching rate is within a threshold range, and NG when it is outside the range.

Upper Limit

Enables an upper limit on the threshold. (Default: ON)
Enable when OK/NG judgment is desired for a situation when the target width is longer than the width extracted from the master image.

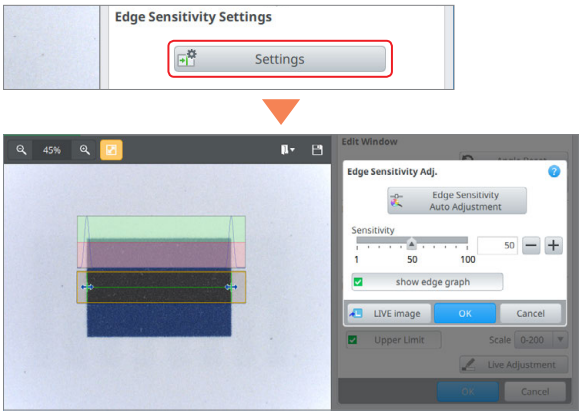
Scale

When the upper limit of the threshold is ON, select the threshold scale according to the range of the matching rate required for judgment.

8 Press [OK].

Edge Sensitivity Settings

Adjust the sensitivity that detects the edge that will become the standard of reference for width extraction.



When the edge sensitivity is adjusted automatically

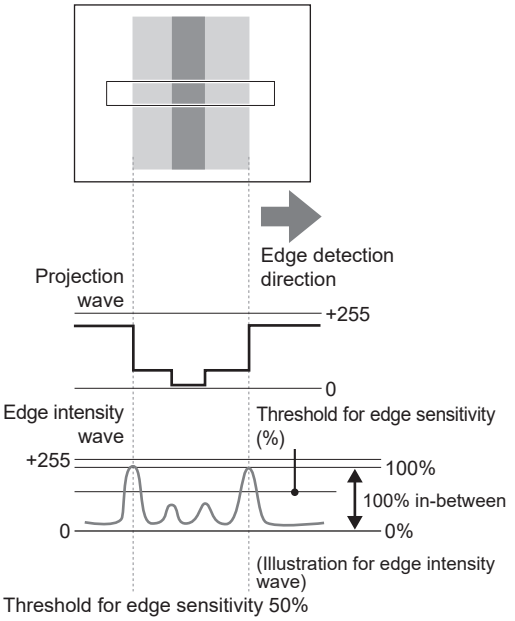
Press [Edge Sensitivity Auto Adjustment].
The edge sensitivity will be adjusted automatically according to the target.

When the edge sensitivity is adjusted manually

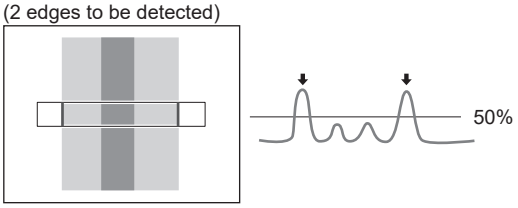
Adjust the threshold value for edge sensitivity by checking the edge graph.
- The edge sensitivity limit can also be adjusted by pressing the red line on the edge graph.
- Press [LIVE image] to adjust threshold value for edge intensity using the target Live image.

Threshold for Edge Sensitivity

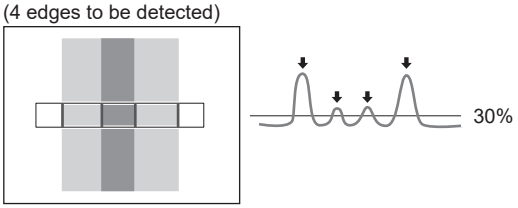
The edge intensity threshold indicates the ratio of edge recognition taking the edge intensity maximum value (where the contrasting density is greatest) as 100%.



Threshold for edge sensitivity 50%
(2 edges to be detected)

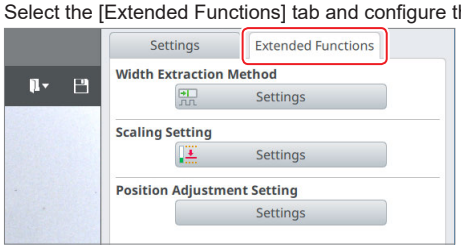


Threshold for edge sensitivity 30%
(4 edges to be detected)



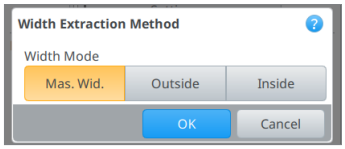
Extended functions for the width tool

Select the [Extended Functions] tab and configure the settings.



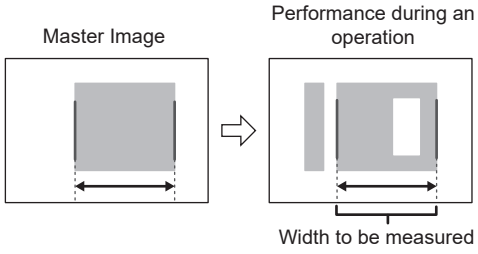
Width Extraction Method

Select the method used to extract the target width.



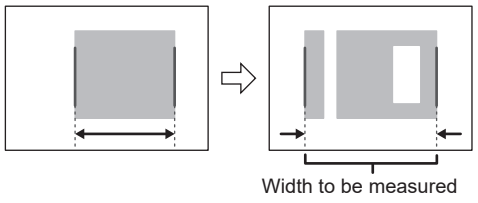
❍ **Mas. Wid.**

Extracts the width similar to the one registered in the master image.



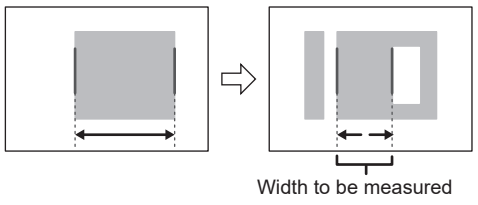
❍ **Outside**

Extracts the outer-most width of the tool window.



❍ **Inside**

Searches and extracts the width from the center of tool window towards outside.

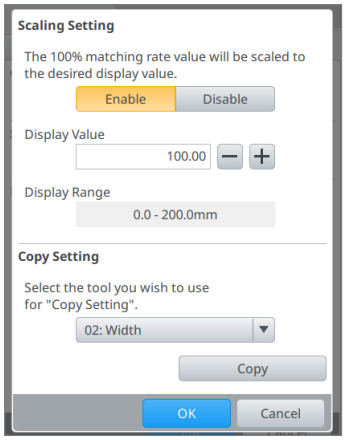


Scaling Setting

Sets scaling.
Set when length is being used for anomaly detection instead of the matching rate.

Point

- **If scaling is [Enable], the display range and the setting scale (x2 or x10) of the threshold adjustment will be automatically adjusted.**
- **If scaling is [Enable], the threshold can be adjusted by 0.1 mm.**



Display Value

Inputs the display value in relation to the matching rate of 100 after scaling.
The value of matching rate 100 is scaled by the display value.
A matching rate of 100 indicates that the width is completely matched. The matching rate becomes smaller with a narrower width and larger with a wider width.

- Setting range: 0.05 to 9999 (maximum input digits: 4).
- Default value: 100.00

Point

The scaling display value can be adjusted by 0.05mm.

Copy Setting

Copies the set scaling settings.
Executing copying refreshes [Display Range] to the value after scaling.

Point

If the scaling value of the source tool is changed, copy the scaling settings again.

Position Adjustment Setting

You can select the Position Adjustment/High-Speed Position Adjustment tool to be applied.
“Position Adjustment Setting” (page 4-23)

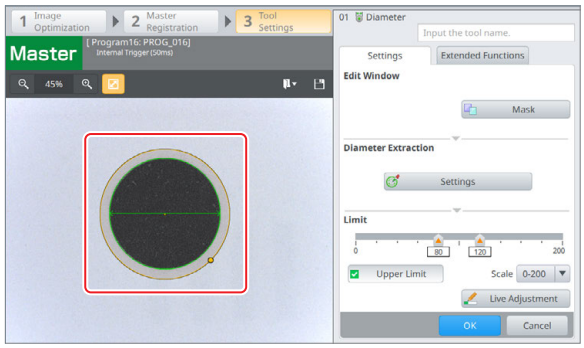
Diameter Tool

Setting the Diameter Tool

1 Add the [Diameter] tool.

“Adding a Tool” (page 4-21)

2 Set the position and size of the tool window according to a target.



Reference The sensor detects circles from the center of tool window towards outside.

3 Configure the following settings as needed.

“Mask Settings” (page 4-22)
“Diameter Extraction” (page 4-68)
“Advanced Diameter Extraction” (page 4-69)
“Scaling Setting” (page 4-69)
“Position Adjustment Setting” (page 4-23)
“Tool Name Setting” (page 4-23)

4 Press [Live Adjustment].

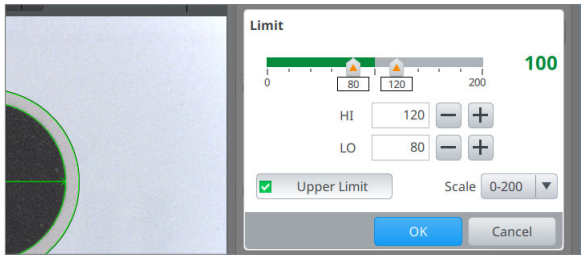


5 Take an “OK” image and a “NG” image.

In the following cases, input an external trigger:
- When [External Trigger] is set in Trigger Options
- When [Internal Trigger Control/AI Trigger Control] is set to [Enable]

If a trigger cannot be input, press [Trigger ON] to take an image of the target by temporarily using the internal trigger.

6 Adjust the threshold for anomaly detection by checking the matching rate. When setting is completed, press [OK].



Reference The target is judged OK when the matching rate is within a threshold range, and NG when it is outside the range.

Upper Limit

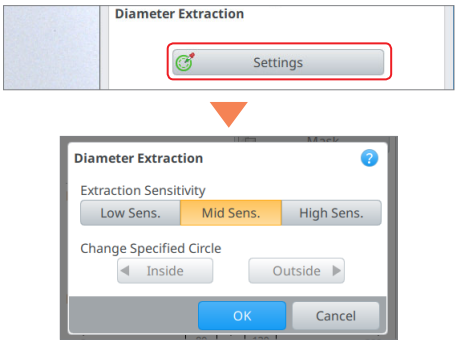
Enables an upper limit on the threshold. (Default: ON)
Set if the OK/NG judgment is desired when a target diameter is longer than the OK diameter.

Scale

When the upper limit of the threshold is ON, select the threshold scale according to the range of the matching rate required for judgment.

7 Press [OK].

Diameter Extraction



Extraction Sensitivity

Selects the sensitivity for diameter extraction according to the target.

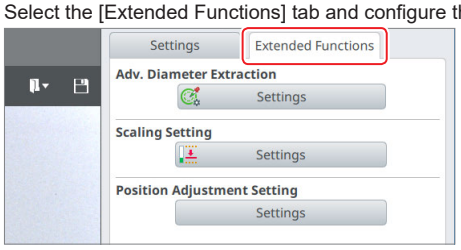
Change Specified Circle

Selects the circle to extract the diameter when there are multiple circles of the extracted diameter.

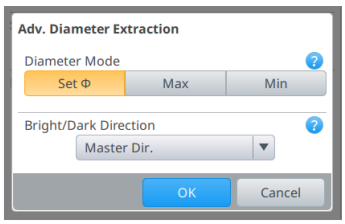
Reference The circle used for diameter extraction is displayed in green color.
You can also press the yellow candidate circle to select the circle for diameter extraction.

Extended Functions for the Diameter Tool

Select the [Extended Functions] tab and configure the settings.



Advanced Diameter Extraction

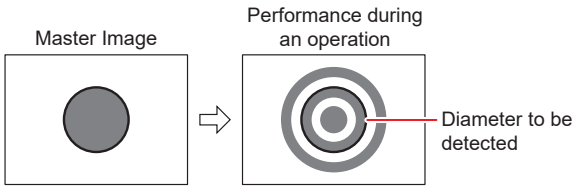


Diameter Mode

Select the method used to extract the target diameter.

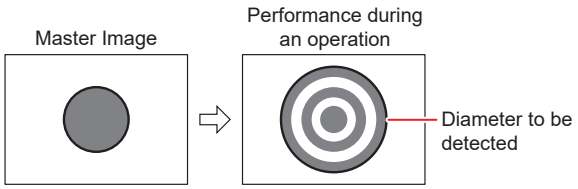
❍ Set Φ

Extracts the circle whose diameter is similar to the circle specified inside the tool window.



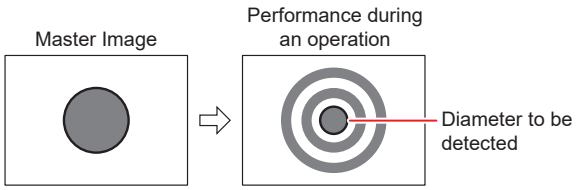
❍ Max

Extracts the largest circle inside the tool window.



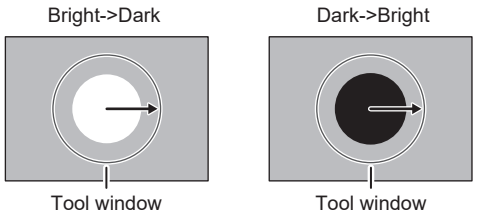
❍ Min

Extracts the smallest circle inside the tool window.



Bright/Dark Direction

Selects the direction for which the tool detects the target edge.



❍ Master Dir.

Detects edges in the same bright/dark direction as the master image.

❍ Both

Detects both bright->dark and dark->bright edges.

❍ Bright->Dark

Detects edges that change from bright to dark.

❍ Dark->Bright

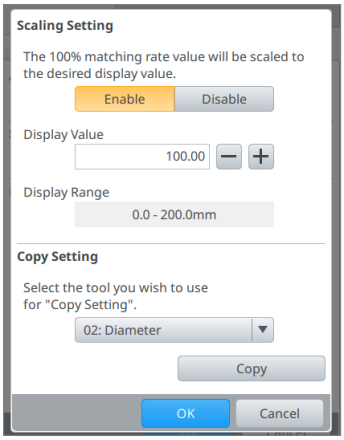
Detects edges that change from dark to bright.

Scaling Setting

Sets scaling.
Set when length is being used for anomaly detection instead of the matching rate.

Point

- **If scaling is [Enable], the display range and the setting scale (x2 or x10) of the threshold adjustment will be automatically adjusted.**
- **If scaling is [Enable], the threshold can be adjusted by 0.1 mm.**



Display Value

Inputs the display value in relation to the matching rate of 100 after scaling.
The value of matching rate 100 is scaled by the display value.

Point

The scaling display value can be adjusted by 0.05mm.

Copy Setting

Copies the set scaling settings.
Executing copying refreshes [Display Range] to the value after scaling.

Point

If the scaling value of the source tool is changed, copy the scaling settings again.

Position Adjustment Setting

You can select the Position Adjustment/High-Speed Position Adjustment tool to be applied.
“Position Adjustment Setting” (page 4-23)

Pitch tool

Setting the Pitch Tool

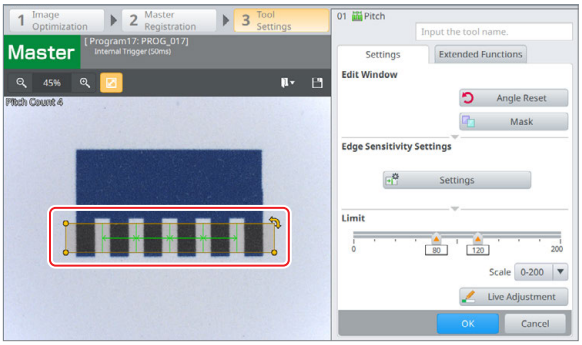
1 Add the [Pitch] tool.

“Adding a Tool” (page 4-21)
Displays the Pitch tool direction selection screen.

2 Select [Horizontal Dir.] or [Vertical Dir.], and then press [OK].



3 Set the position, size, and angle of tool window according to the target.



4 Configure the following settings as needed.

“Mask Settings” (page 4-22)
“Edge Sensitivity Settings” (page 4-70)
“Bright/Dark Mode” (page 4-71)
“Measurement Mode” (page 4-71)
“Narrow Pitch Mode” (page 4-71)
“Scaling” (page 4-71)
“Position Adjustment Setting” (page 4-23)
“Tool Name Setting” (page 4-23)

5 Press [Live Adjustment].



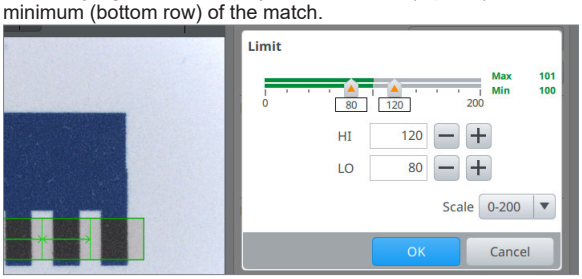
6 Take an “OK” image and a “NG” image.

In the following cases, input an external trigger:
- When [External Trigger] is set in Trigger Options
- When [Internal Trigger Control/AI Trigger Control] is set to [Enable]

If a trigger cannot be input, press [Trigger ON] to take an image of the target by temporarily using the internal trigger.

7 Adjust the threshold for anomaly detection by checking the matching rate. When setting is completed, press [OK].

The limit judgment bar displays the maximum (top row) and minimum (bottom row) of the match.



Point

A matching rate of 100 indicates that the average value of all pitches is completely matched to the master image. The value which deviates the most from the average value among all pitches becomes the matching rate. When the number of pitches is different from the number for the master image, the matching rate is 0.

Reference

- The target is judged OK when the matching rate is within a threshold range, and NG when it is outside the range.
- "Current number of pitches/number of registered pitches in master image" is displayed in the upper-left of the screen.



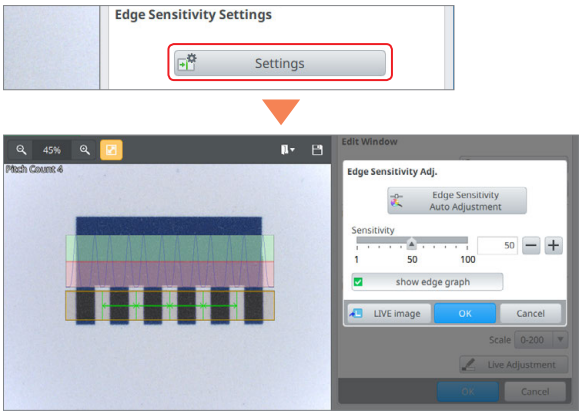
Scale

Select the scale for the threshold according to the range of matching rates requires for judgment.

8 Press [OK].

Edge Sensitivity Settings

Adjusts the sensitivity for detecting edges.



When the edge sensitivity is adjusted automatically

Press [Edge Sensitivity Auto Adjustment].
The edge sensitivity will be adjusted automatically according to the target.

When the edge sensitivity is adjusted manually

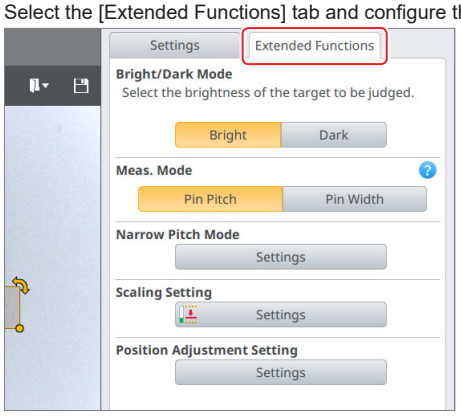
Adjust the threshold value for edge sensitivity by checking the edge graph.
- The edge sensitivity limit can also be adjusted by pressing the red line on the edge graph.
- Press [LIVE image] to adjust threshold value for edge intensity using the target Live image.

Threshold for edge sensitivity

“Threshold for Edge Sensitivity” (page 4-66)

Extended Functions for the Pitch Tool

Select the [Extended Functions] tab and configure the settings.

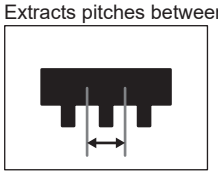


Bright/Dark Mode

Select the method to extract the target pitch.

❍ **Bright**

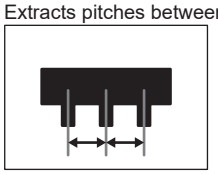
Extracts pitches between bright regions.



Number of pitches 1

❍ **Dark**

Extracts pitches between dark regions.

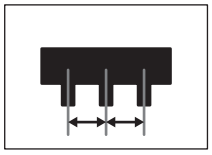


Number of pitches 2

Measurement Mode

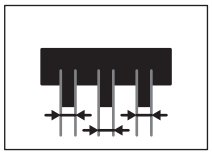
Select the measuring method for the pitch extracted from a target.

❍ **Example of [Pin Pitch]**



Number of pitches 2

❍ **Example of [Pin Width]**



Number of pitches 3

Narrow Pitch Mode

Set to [Enable] when the pitch width is narrow.

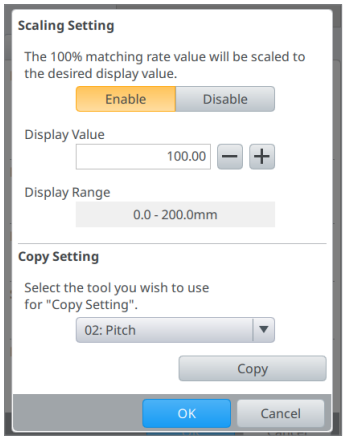
Scaling

Sets scaling.

Set when length is being used for anomaly detection instead of the matching rate.

Point

- **If scaling is [Enable], the display range and the setting scale (x2 or x10) of the threshold adjustment will be automatically adjusted.**
- **If scaling is [Enable], the threshold can be adjusted by 0.1 mm.**



Display Value

Inputs the display value in relation to the matching rate of 100 after scaling.

The value of matching rate 100 is scaled by the display value.

A matching rate of 100 indicates that the average value of all pitches is completely matched to the master image. The value which deviates the most from the average value among all pitches becomes the matching rate. When the number of pitches is different from the number for the master image, the matching rate is 0.

Point

The scaling display value can be adjusted by 0.05mm.

Copy Setting

Copies the set scaling settings.

Executing copying refreshes [Display Range] to the value after scaling.

Point

If the scaling value of the source tool is changed, copy the scaling settings again.

Position Adjustment Setting

You can select the Position Adjustment/High-Speed Position Adjustment tool to be applied.

“Position Adjustment Setting” (page 4-23)

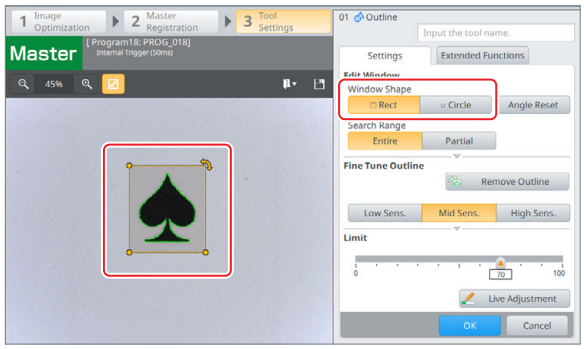
Outline Tool

Setting the Outline Tool

1 Add the [Outline] tool.

“Adding a Tool” (page 4-21)

2 Select [Window Shape] and set the position, size, and angle according to the target.



3 Configure the following settings as needed.

“Search Range Settings” (page 4-22)
“Settings for Disabling Outlines” (page 4-72)
“Setting a Sensitivity” (page 4-72)
“Rotation Range” (page 4-73)
“Search Algorithm” (page 4-73)
“Position Adjustment Setting” (page 4-23)
“Tool Name Setting” (page 4-23)

4 Press [Live Adjustment].



The sensor changes to the test operation.

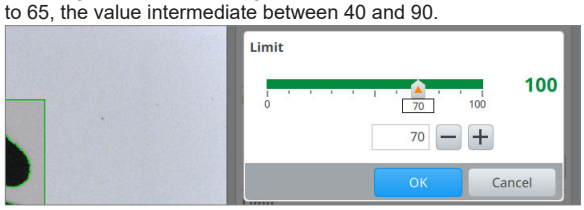
5 Take an “OK” image and a “NG” image.

In the following cases, input an external trigger:
- When [External Trigger] is set in Trigger Options
- When [Internal Trigger Control/AI Trigger Control] is set to [Enable]

If a trigger cannot be input, press [Trigger ON] to take an image of the target by temporarily using the internal trigger.

6 Adjust the threshold for anomaly detection by checking the matching rate. When setting is completed, press [OK].

<Setting example>
If the matching rate of an “OK” image is higher than 90 and if the matching rate of a “NG” image is lower than 40, set the threshold to 65, the value intermediate between 40 and 90.



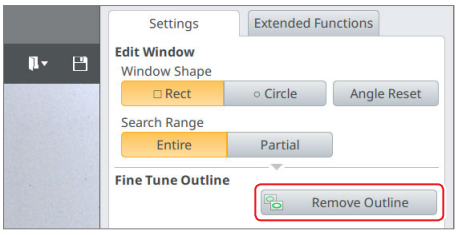
Reference
- A target is detected as OK if the matching rate is greater than the threshold, and detected as NG if the matching rate is lower than the threshold.
- A matching rate of 100 indicates that an outline is completely matched. The matching rate decreases with differences between the outline of the target and the master image.

7 Press [OK].

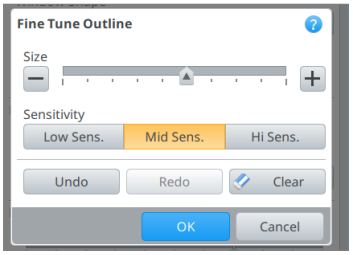
Settings for Disabling Outlines

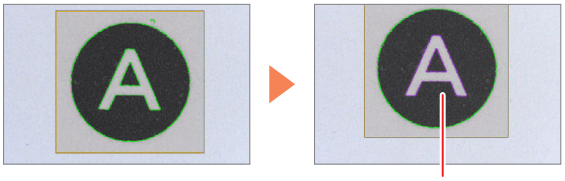
Judges by disabling an unnecessary outline which interrupts the stabilized detection. The disabled outlines can be specified by tracing the extracted outline.

1 Press [Remove Outline].



2 Drag the cursor to specify the unnecessary outline.





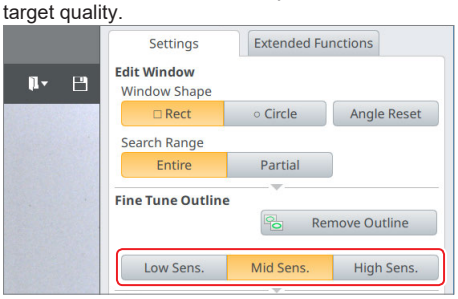
The outline that the outline extraction has disabled (purple)

Reference
- The size of the cursor when specifying the unnecessary outlines can be changed in [Size].
- The [Undo] button can be used up to 20 times.

3 When setting is completed, press [OK].

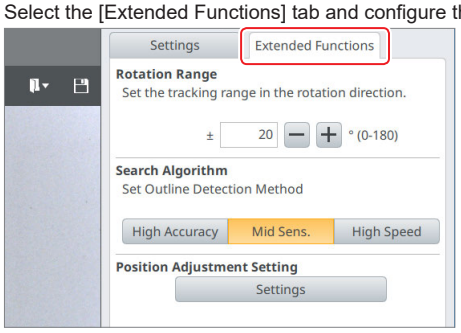
Setting a Sensitivity

The outline extraction sensitivity can be selected according to the target quality.



Extended Functions for the Outline Tool

Select the [Extended Functions] tab and configure the settings.



Rotation Range

Sets the range of rotation to search for the outline of the target. The system judges NG if an angle of the target exceeds its rotation range even if the target is the same shape.

- If the rotation range is set wide, the acceptable range of variation in the angles at which a target can be placed is wider.
- If the rotation range is set narrow, the processing time can be shortened.
- The direction of the target can be judged by limiting the rotation range.

Search Algorithm

The detection mode of the Outline tool can be changed depending on the inspection requirements.

Point

- **Select [High Accuracy] when detection is not stable because of a small difference in the matching rate of an "OK" and "NG" image.**
- **Select [Mid Sens.] when detection is not stable because of the influence of an unnecessary outline other than the target such as the background.**
- **Select [High Speed] to shorten the processing time.**

Position Adjustment Setting

You can select the Position Adjustment/High-Speed Position Adjustment tool to be applied.

"Position Adjustment Setting" (page 4-23)

EdgePixels tool

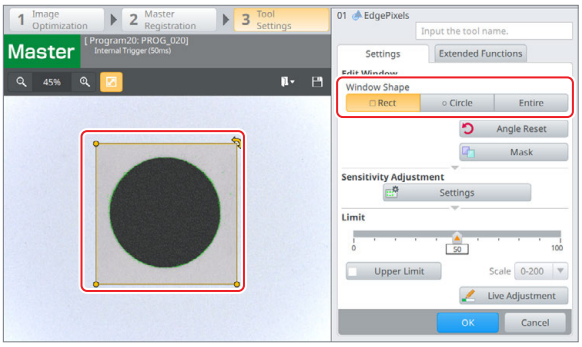
Setting the EdgePixels Tool

1 Add the [EdgePixels] tool.

“Adding a Tool” (page 4-21)

2 Select [Window Shape] and set the position, size, and angle according to the target.

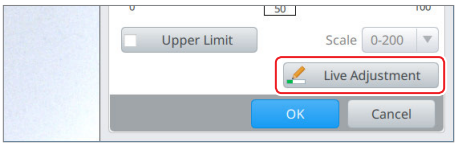
When [Entire] is selected, the tool window will be hidden.



3 Configure the following settings as needed.

“Mask Settings” (page 4-22)
“Edge Sensitivity Adjustment” (page 4-74)
“Upper Limit” (page 4-74)
“Fixed Reference Area” (page 4-75)
“Position Adjustment Setting” (page 4-23)
“Tool Name Setting” (page 4-23)

4 Press [Live Adjustment].



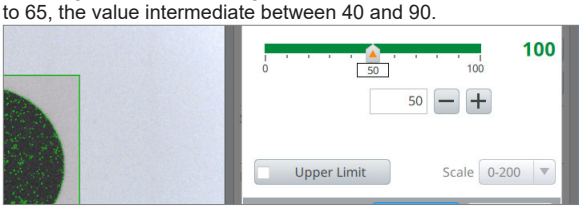
5 Take an “OK” image and a “NG” image.

In the following cases, input an external trigger:
- When [External Trigger] is set in Trigger Options
- When [Internal Trigger Control/AI Trigger Control] is set to [Enable]

If a trigger cannot be input, press [Trigger ON] to take an image of the target by temporarily using the internal trigger.

6 Adjust the threshold for anomaly detection by checking the matching rate. When setting is completed, press [OK].

<Setting example>
If the matching rate of an “OK” image is higher than 90 and if the matching rate of a “NG” image is lower than 40, set the threshold to 65, the value intermediate between 40 and 90.

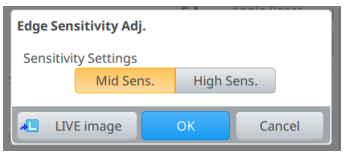


Reference A target is detected as OK if the matching rate is greater than the threshold, and detected as NG if the matching rate is lower than the threshold.

7 Press [OK].

Edge Sensitivity Adjustment

Sets the extraction sensitivity for the edge pixels tool according to the target.



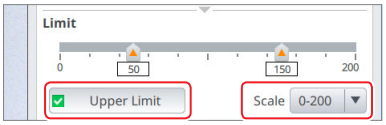
Reference When [LIVE image] is pressed, the extraction sensitivity of the edge pixels can be adjusted from the target Live image.

Upper Limit

Enables an upper limit on the threshold.
Enable when OK/NG judgment is desired for a situation when the target edge pixels are larger than the edge pixels extracted from the master image.

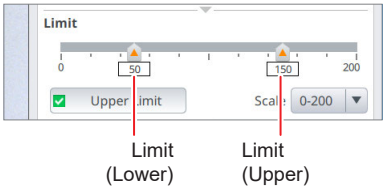
1 Switch the check box to ON for [Upper Limit].

Select the scale for the threshold according to the range of matching rates requires for judgment.



OFF (default)		Sets the upper and the lower limit of a threshold in a range within 0 to 100.
ON	0-200 (default value)	Sets the upper and the lower limit of a threshold in a range within 0 to 200.
	0-999	Sets the upper and the lower limit of the threshold in a range within 0 to 999. The slider movement unit is 1.

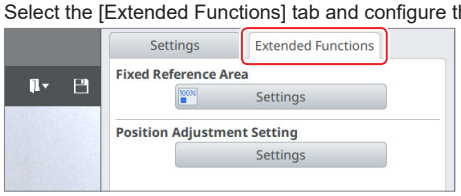
2 Adjust the threshold for anomaly detection by checking the matching rate.



Reference A target is detected as OK if the matching rate is greater than the threshold, and detected as NG if the matching rate is lower than the threshold.

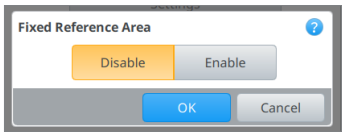
Extended Functions for the Edge Pixels Tool

Select the [Extended Functions] tab and configure the settings.



Fixed Reference Area

Select a condition which the matching rate of the EdgePixels tool is 100%.

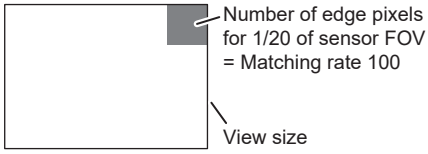


❍ **Disable**

Matches the pixels of the edge extracted from the master image as the criteria of a rate of 100%.

❍ **Enable**

Matches 1/20th of the pixels of the total sensor view as the criteria of a rate of 100%.



Reference Select [Enable] if the master image does not contain the edge pixels to be judged.

Position Adjustment Setting

You can select the Position Adjustment/High-Speed Position Adjustment tool to be applied.

“Position Adjustment Setting” (page 4-23)

3. Part Registration (Sorting Mode)

Setting the Judgment Method for the Target

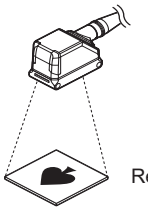
Sorting mode enables multiple part varieties (up to eight) to be registered. Imaged parts will be judged and matched to a registered type. Up to nine tools can be set in one program at the same time for judgement (up to eight detection tools and a position adjustment tool).

Workflow for Setting and Running Sorting Mode

In Sorting mode, the image registered with master registration is Part 0. The detection tool is set on the master image (Part 0). Register images for Part 1 to Part 7 in [Part Image Registration]. Detection tools are automatically registered with the optimal parameters on multiple part type images. Multiple detection tools can also be used in combination to identify part types.
While the device is running, it judges whether a captured image of the object matches any of the part types and identifies the part type.

Sensor Setup

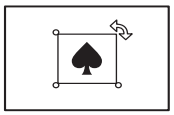
2. Master Registration



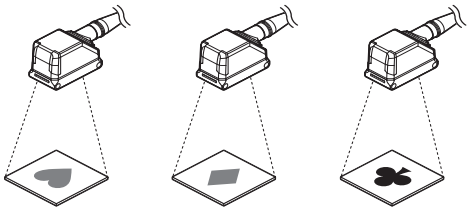
Registered as Part 0 (Master 00)

3. Part Registration

Tool Settings



Part Image Registration

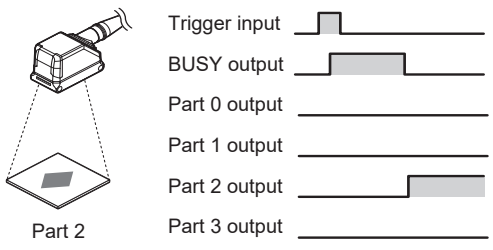


Part 1 (Master 01) | Part 2 (Master 02) | Part 3 (Master 03)

4. Output Settings

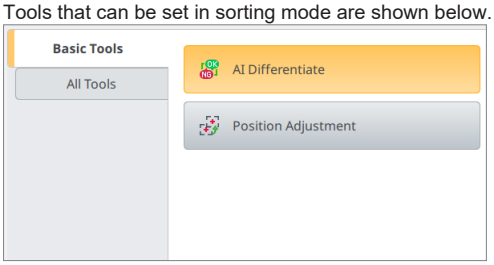
OUT1: Part 0: (Master 00)
OUT2: Part 1: (Master 01)
OUT3: Part 2: (Master 02)
OUT4: Part 3: (Master 03)

RUN



List of Tools for Sorting Mode

Tools that can be set in sorting mode are shown below.



Point

- **The method for setting each tool in sorting mode (add/edit/copy/delete) is the same as standard mode. Follow the procedure in the reference to set up the tool.**
- **Up to eight detection tools can be set.**
- **You can only set one Position Adjustment/High-Speed Position Adjustment tool.**

Basic Tools

"AI Differentiate" (page 4-26)
"Position Adjustment Tool" (page 4-52)

All Tools

Position Adjustment

"Position Adjustment Tool" (page 4-52)
"High-Speed Position Adjustment (Hi-Sp.Adj) Tool" (page 4-54)

Learn

"AI Differentiate" (page 4-26)

Color

"Color/Brightness Averaging Tool" (page 4-58)

Width

"Width Tool" (page 4-66)
"Diameter Tool" (page 4-68)

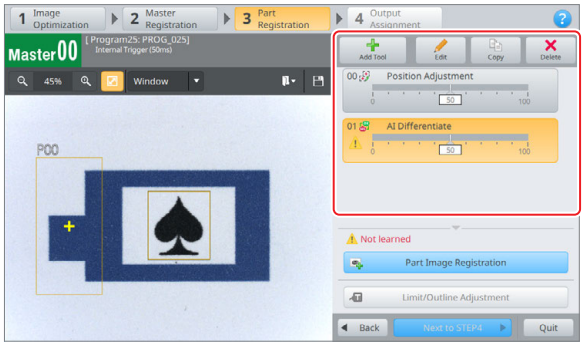
Shape

"Outline Tool" (page 4-72)

Part Registration

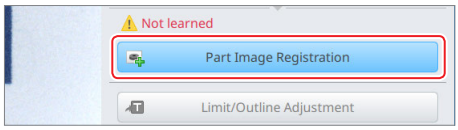
Tool Settings/Part Image Registration

1 Add a detection tool to be used in sorting mode.

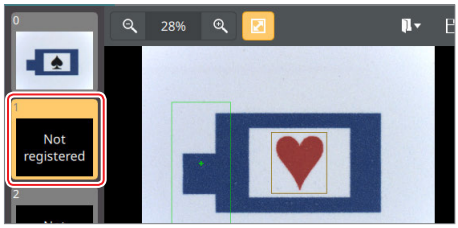


“List of Tools for Sorting Mode” (page 4-76)

2 Press [Part Image Registration].



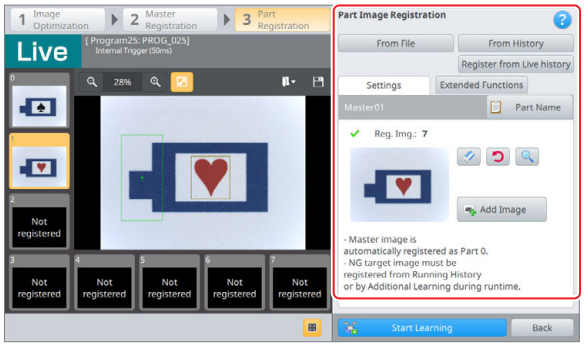
3 Select a part for [Not registered].



Point

- **For Part 0 a master image is automatically registered. When changing the image of Part 0 register another master image again.**
- **To start learning, at least two parts (including Part 0) must be registered.**

4 Register an image as the target to judge the part type.



	Deletes all registered images. The image registered at Part 0 cannot be deleted because it is linked to the master image.
	Deletes the last registered image so that it can be redone.
	The registered image can be expanded and checked. When registering multiple images, they can be checked or deleted with the move buttons.

- **Registration of Taken Image**
  “Registration of Taken Image” (page 4-78)
- **Registration of image saved in a file**
  “Registration of image saved in a file” (page 4-78)
- **Registration of Image from the Image History**
  “Registration of Image from the Image History” (page 4-79)
- **Registration of Image from the Live Image History**
  “Registration of Image from the Live Image History” (page 4-79)

5 When the AI Differentiate is set, repeat step 4 when registering multiple images for the part type.

Point

By capturing multiple images of different judgment criteria, the judgment stability will be improved automatically.
“Learning Multiple Images for Stability” (page 6-20)

6 Set [Part Name] if necessary.



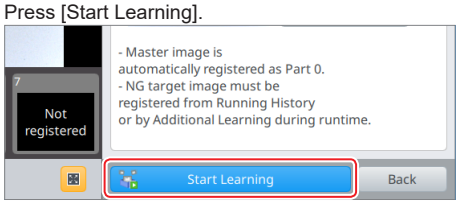
7 Add Part2 to 7 as needed.

Repeat steps 3 to 6 to register up to seven parts.

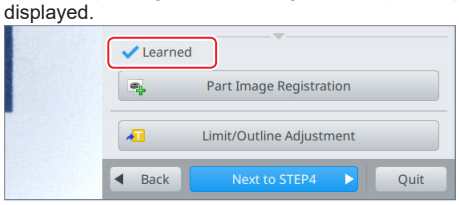
8 Press [Start Learning] or [OK].

- **When the AI Differentiate is set**

Press [Start Learning].



When learning is completed, press [OK].
When the part registration settings are completed, [Learned] will be displayed.



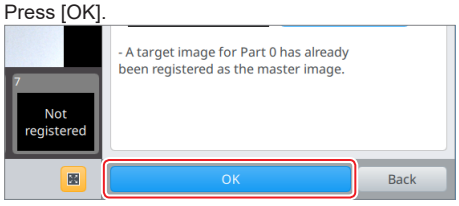
Reference

The following statuses for the AI Differentiate are displayed:

- **None**
  The AI Differentiate is not set.
- **Not learned**
  The learning for the target to judge the part type has not been completed.
- **Learned**
  The target to judge the part type has been learned.
- **Relearning required**
  Relearning is needed because of a setting change.

- **When the AI Differentiate is not set**

Press [OK].

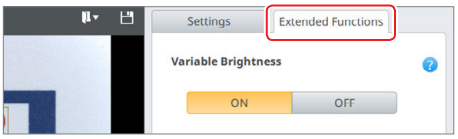


9 Perform [Limit/Outline Adjustment].

“Limit/Outline Adjustment” (page 4-80)

Registration of Taken Image

1 When changing the [Variable Brightness] setting, select the [Extended Functions] tab.



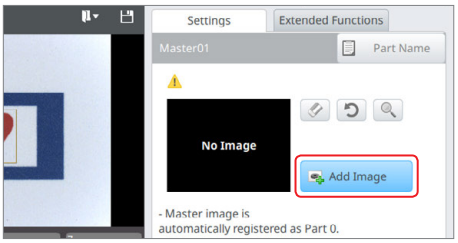
Reference

Variable brightness can be ON in the following cases.
- During internal trigger
- When pressing [T] with external trigger set to image by using the internal trigger.

2 Image a target to be registered.

If [Trigger Options] is set to [External] or [Internal Trigger Control/ AI Trigger Control] is set to [Enable], input an external trigger.
If an external trigger cannot be input, press [T] to take an image of the target by temporarily using the internal trigger.

3 Press [Add Image].

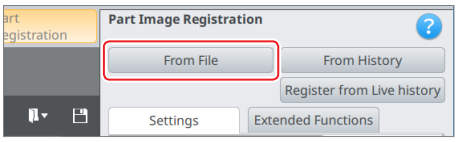


4 To register another image, press [Yes].

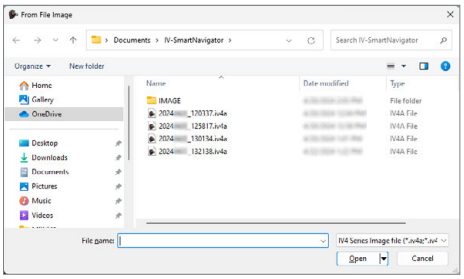
The captured image will be displayed.

Registration of image saved in a file

1 Press [From File].



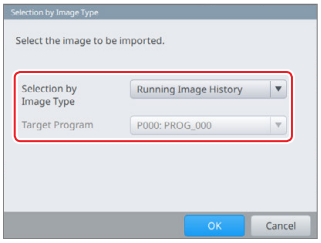
2 Select the file to be imported, and press [Open].



3 If a batch backup file (*.iv4a) or individual program backup file (*.iv4a) is selected, select the image type to be imported from the following.

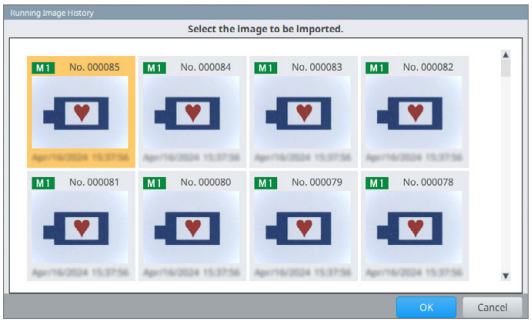
- Running Image History
- Master Image
- Learned Image History

Select the target program when the Learned Image History is selected.

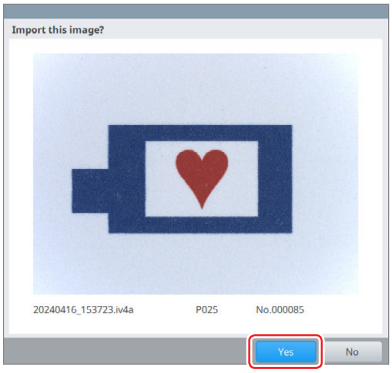


Displays a list of images.

4 Select the image to be registered, and press [OK].



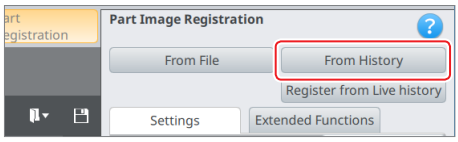
5 Press [Yes].



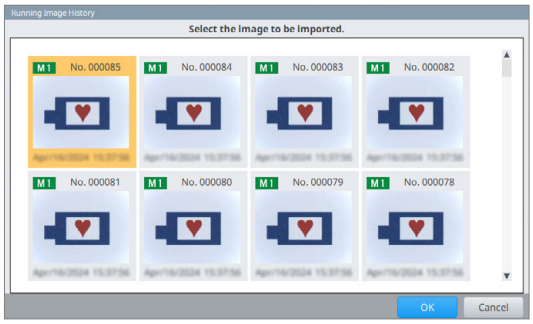
The registered image will be displayed.

Registration of Image from the Image History

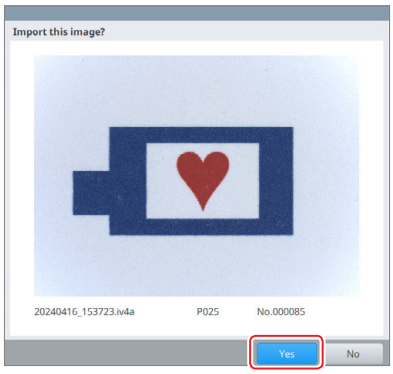
1 Press [From History].



2 Select the image to be registered, and press [OK].



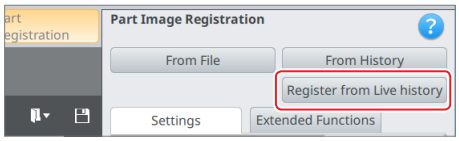
3 Press [Yes].



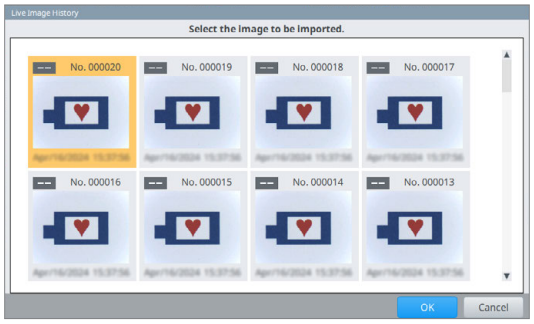
The registered image will be displayed.

Registration of Image from the Live Image History

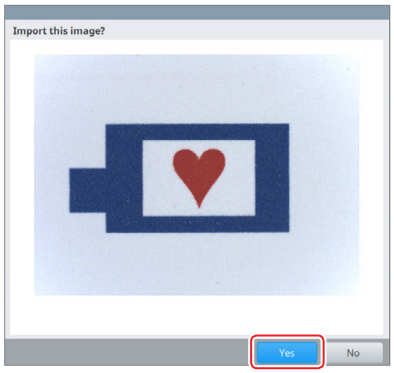
1 Press [Register from Live history].



2 Select the image to be registered, and press [OK].



3 Press [Yes].



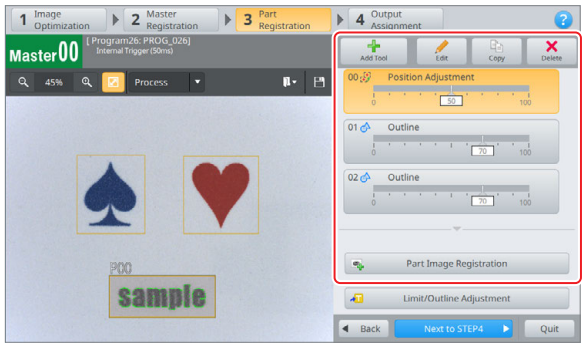
The registered image will be displayed.

Limit/Outline Adjustment

The threshold for each part type registered in the detection tool can be adjusted. Additionally, the outline for each part type registered in the outline tool can also be adjusted. The threshold for the position adjustment/high-speed adjustment tool cannot be adjusted.

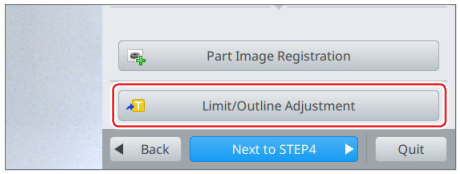
Limit Adjustment

1 Configure the tool settings and register part images.

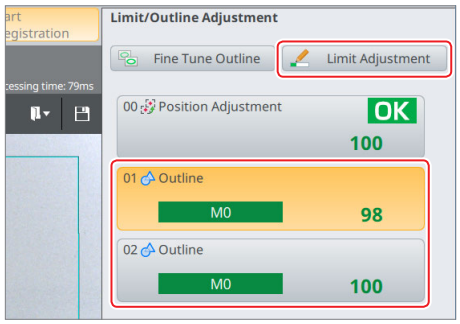


“Tool Settings/Part Image Registration” (page 4-77)

2 Press [Limit/Outline Adjustment].

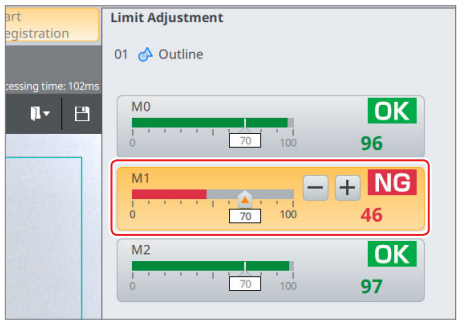


3 Select the detection tool and then press [Limit Adjust].



The sensor changes to the test operation.

4 Select the part type for which the threshold is to be adjusted.



M0 to M7 displayed on the screen represents Part 0 to Part 7.

5 Image the part type target to be the reference of judgment.

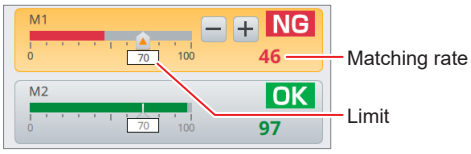
If [Trigger Options] is set to [External] or [Internal Trigger Control with IN1 Input] is set to [Enable], input the external trigger.
If the external trigger cannot be input, press [Trigger ON] to take an image of the target by temporarily using the internal trigger.

6 Adjust the threshold by checking the matching rate.

The optimal threshold can be set for each part type (M0 to M7).

Outline Tool/Color/Brightness Average Tool

<Setting example>
If the matching rate of the same part type is higher than 90 and if the matching rate of a different part type is lower than 40, set the threshold to 65, which is a value in between 40 and 90.



Reference

- A target is detected as OK if the matching rate is greater than the threshold, and detected as NG if the matching rate is lower than the threshold.
- A matching rate of 100 indicates that the target is completely matched to the master image. The matching rate decreases with differences between the outline of the target and the master image.

Width Tool

Sets the range of the width to judge as the same part.
“Width Tool” (page 4-66)

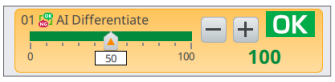
Diameter tool

Sets the range of the diameter to judge as the same part.
“Diameter Tool” (page 4-68)

AI Differentiate

Point

For the AI Differentiate, threshold adjustment is not needed since the target match is automatically adjusted by learning.
Use threshold adjustment if additional learning cannot be made or when it is determined to be needed after additional learning.
Additional learning also enables “NG” images to be registered and learned.
“Auto Adjustment by the Additional Learning” (page 6-2)



The matching rate of either part type appears. The part type is not displayed. Adjust the threshold so that all part types are “OK” and part type images that are not registered are “NG”.

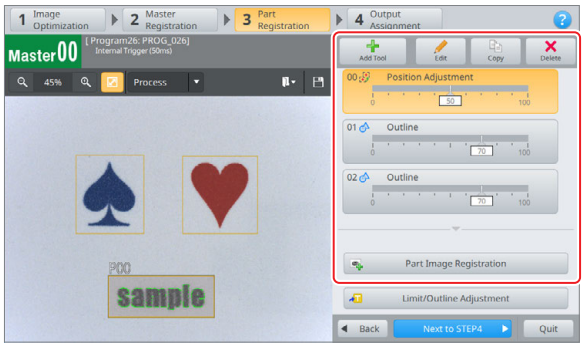
7 Press [OK].

The system returns to the [Limit/Outline Adjustment] screen.

8 Press [OK].

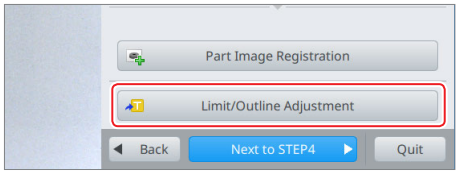
Fine Tune Outline

1 **Configure the tool settings and register part images.**

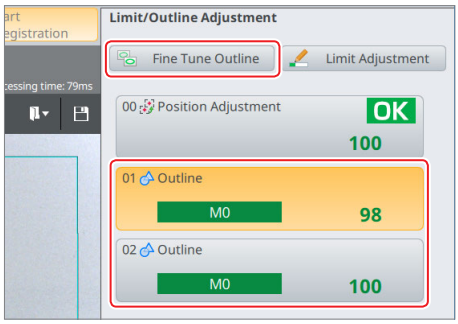


"Tool Settings/Part Image Registration" (page 4-77)

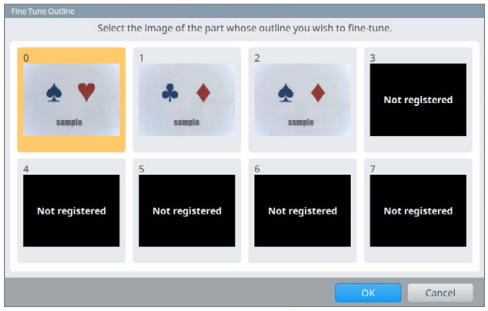
2 **Press [Limit/Outline Adjustment].**



3 **Select the outline tool and then press [Fine Tune Outline].**

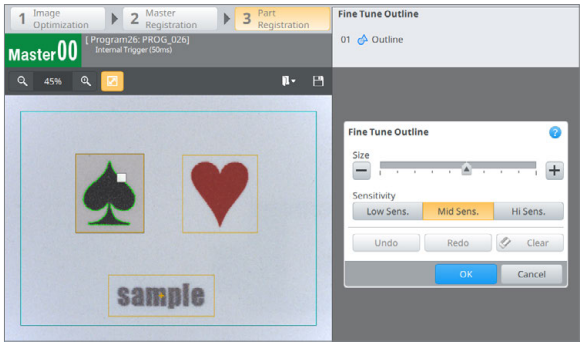


4 **Select the part type image for which the outline is to be adjusted, and press [OK].**



0 to 7 displayed on the screen represents Part 0 to Part 7.

5 **Adjust outline removal and sensitivity.**



"Settings for Disabling Outlines" (page 4-72)
"Setting a Sensitivity" (page 4-72)

6 **Press [OK].**

The system returns to the [Limit/Outline Adjustment] screen.

7 **Press [OK].**

3. Tool Settings (AI Through Count Mode)

Setting Count Targets

AI Through Count mode is a mode that counts the number of registered targets that have passed through the set count line.

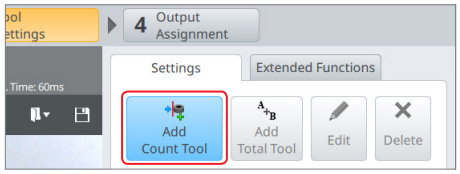
Tool Settings

Setting the AI Through Count Tool

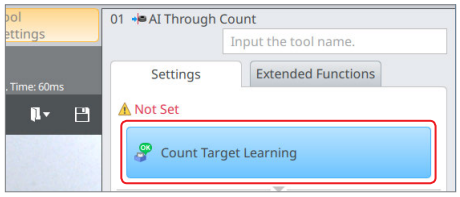
Point

- For the Count Value and the Today's total count, the displayable upper limit values are 9,999,999.
- The number of tools that can be set varies depending on "Operation Mode" (page 4-10).
  - High Speed/Standard: You can set up to two count tools.
  - High Accuracy: You can set up to six count tools.

1 Press [Add Count Tool].



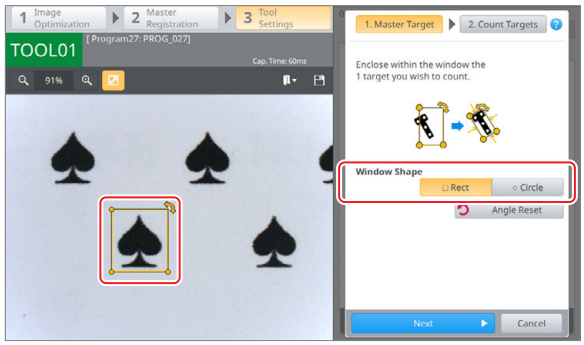
2 Press [Count Target Learning].



3 Select [Window Shape] and set the position, size, and angle according to the target.

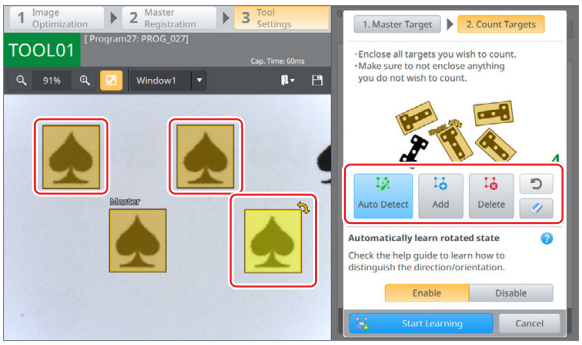
Point

- Select one target to become the detection reference and then set the window.
- Detection stability improves when the window closely matches the perimeter of the target.



4 Press [Next].

5 Completely enclose the target that you want to count.



- **Auto Detect**

  [Master] automatically detects targets that have the same shape as the displayed target.
  If all targets are not enclosed in one automatic detection cycle, press [Auto Detect] repeatedly.

  Point

  When the orientation of the target is aligned at ±10 degrees or less, KEYENCE recommends that you set [Automatically learn rotated state] to [Disable] and then press [Auto Detect].

- **Add**

  Adds a window to enclose the target.

- **Delete**

  Deletes the selected window.

- 

  Undoes the previous operation.

- 

  Deletes all windows.

- **Automatically learn rotated state**

  ❍ **Enable**

  Select this option when you want a target to be judged as OK even if it has been rotated.

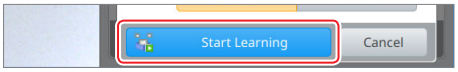
  ❍ **Disable**

  Select this option when you want the orientation of the target to be taken into account.

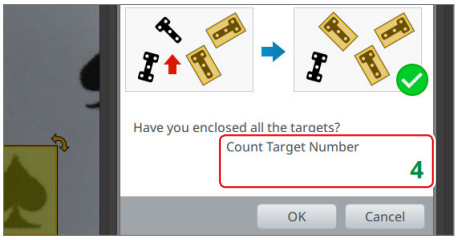
  Point

  - For advice on settings for judging the orientation, check the guide (?) in the upper right corner of the screen.
  - When [Disable] is selected, the window rotation angle is limited to ±10 degrees. If the rotation range of the target is known to be less than ±10 degrees, select [Disable].

6 Press [Start Learning].



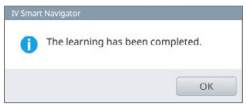
7 Check [Count Target Number] and press [OK].



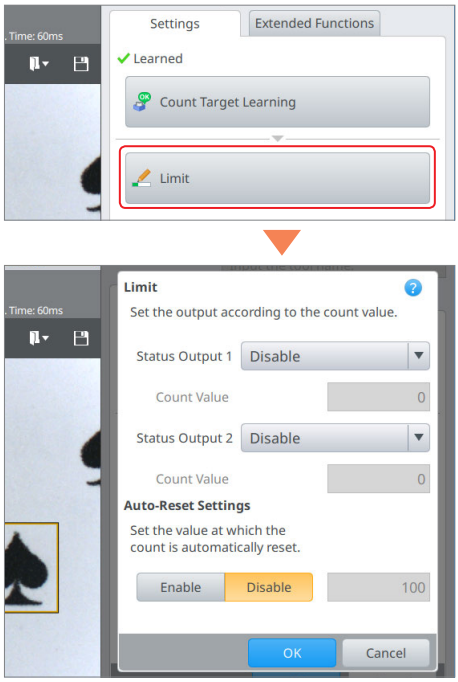
Point

- Enclose all targets that you want to count within the window.
- Make sure to not enclose any targets that you do not want to count within the window.

8 After learning has been completed, press [OK].



9 Press [Limit] and set the threshold for operation and test runs. When setting is completed, press [OK].



Status Output Settings

This function outputs a status when a set condition is met.
Two (Status Output 1/Status Output 2) can be set per tool.

Reference Assignment to output lines is performed in “Step 4: Output Assignment.”

❍ **ON when ≥ Set value**

Output when the count value is greater than or equal to the set value.

❍ **ON when = Set value**

Output when the count value is the same as the set value.

Auto-Reset Settings

Set the value at which the count is automatically reset.
“Count value and status output by status output and auto-reset settings” (page 4-84)

Reference When [Auto-Reset Settings] is set to 10, the count value returns to 0 when 1 is added from a count value of 9.

10 Configure the following settings as needed.

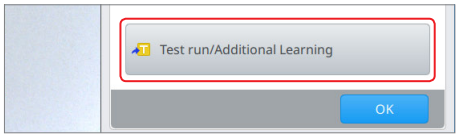
“Learning Image” (page 4-85)
“Tool Name Setting” (page 4-23)

11 To add a total tool, repeat steps 1 to 10 to add a count tool. Then add a total tool.

“Total Tool Settings” (page 4-86)

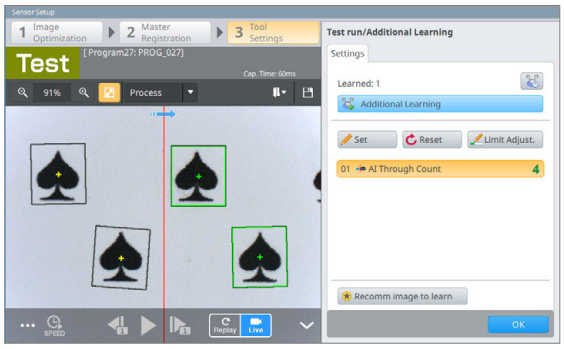
12 Press [OK].

13 Press [Test run/Additional Learning].



14 Take an “OK” image and a “NG” image.

15 Check the AI Through Count state. When you have finished checking, press [OK].



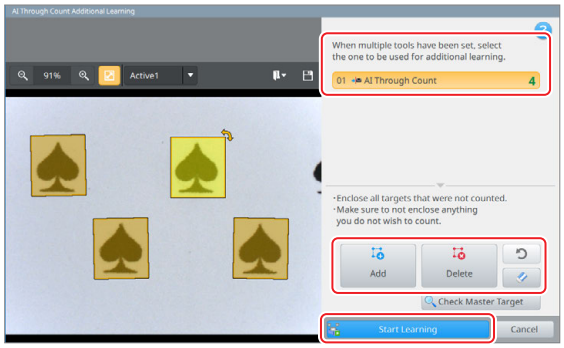


You can check the learned image history.
“Confirming Learned Image History” (page 6-8)

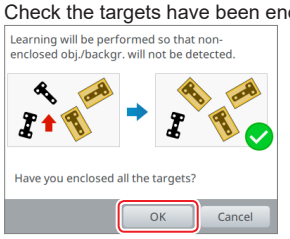
Additional Learning

Additional learning can be performed with the displayed image.
- When multiple AI Count tools have been set, select the one to be used for additional learning.
- [Add] and [Delete] will leave only the target to be counted enclosed.

Once you have configured the settings, press [Start Learning].



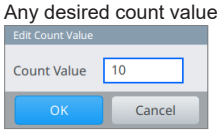
Check the targets have been enclosed, and then press [OK].



After learning has been completed, press [OK].

Set

Any desired count value can be set.



Reset

Resets the count value.

Limit Adjustment

“Status Output Settings” (page 4-83)
“Auto-Reset Settings” (page 4-83)

Recomm image to learn

“Additional Learning by Recommended Image” (page 4-85)

16 Configure the following settings as needed.

“Search Range Settings” (page 4-87)
“Conveyor End Settings” (page 4-87)

Count value and status output by status output and auto-reset settings

Auto-Reset Settings: Enabled
Reset Value: 10

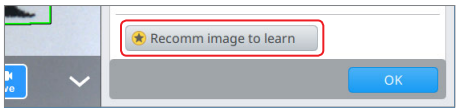
Status output settings		Previous count value (Display value)	Quantity counted at one time	Current count value (Display value)	Output status
ON when = Set value	Count value= 8	7	1	8	Latching output
ON when = Set value	Count value= 8	7	2	9	One-Shot output
ON when = Set value	Count value= 9	7	2	9	Latching output
ON when = Set value	Count value= 9	7	3	0	One-Shot output
ON when = Set value	Count value= 10	7	3	0	One-Shot output
ON when = Set value	Count value= 10	7	4	1	One-Shot output
ON when = Set value	Count value= 11	7	3	0	Does not output
ON when = Set value	Count value= 11	7	4	1	Does not output

Auto-Reset Settings: Enabled
Reset Value: 10

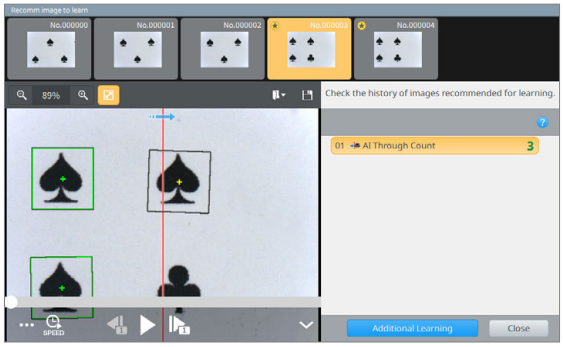
Status output settings		Previous count value (Display value)	Quantity counted at one time	Current count value (Display value)	Output status
ON when ≥ Set value	Count value ≥ 8	7	1	8	Latching output
ON when ≥ Set value	Count value ≥ 8	7	2	9	Latching output
ON when ≥ Set value	Count value ≥ 8	7	3	0	One-Shot output
ON when ≥ Set value	Count value ≥ 9	7	2	9	Latching output
ON when ≥ Set value	Count value ≥ 9	7	3	0	One-Shot output
ON when ≥ Set value	Count value ≥ 10	7	3	0	One-Shot output
ON when ≥ Set value	Count value ≥ 10	7	4	1	One-Shot output
ON when ≥ Set value	Count value ≥ 11	7	3	0	Does not output
ON when ≥ Set value	Count value ≥ 11	7	4	1	Does not output

Additional Learning by Recommended Image

1 **Press [Recomm image to learn].**



2 **Select the image to perform additional learning, and press [Go to Additional Learning Screen].**

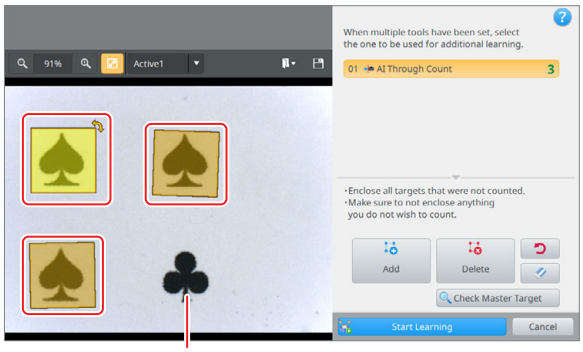


Point

Recommended images to learn are loaded as IV4 Series video files (*.iv4m). You can adjust the display position and perform additional learning with the image in any position.

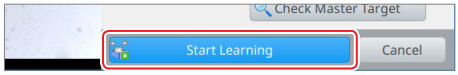


3 **Completely enclose the target that you want to count.**

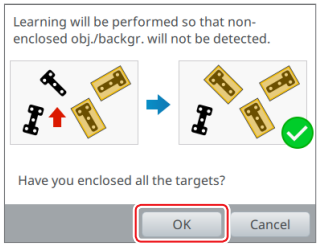


Targets that are not counted are not enclosed

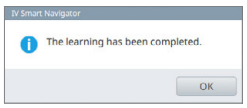
4 **Press [Start Learning].**



5 **Check the targets have been enclosed, and then press [OK].**



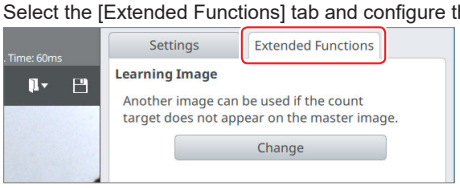
6 **After learning has been completed, press [OK].**



7 **Press [Close].**

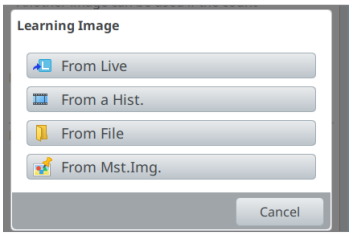
Extended Functions for the AI Through Count Tool

Select the [Extended Functions] tab and configure the settings.



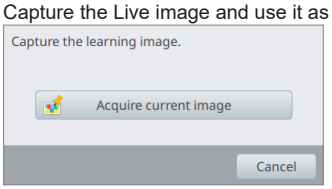
Learning Image

Another image can be used if the count target does not appear on the master image.



From Live

Capture the Live image and use it as the learning image.



From a Hist.

Selects an image from the running image history to be used as the learning image.

“When importing from the running image history” (page 4-49)

From File

Selects an image saved in a file to be used as the learning image.

“When an image is loaded from a file” (page 4-49)

From Mst.Img.

Uses a master image as the learning image.

Total Tool Settings

Set the tool that totals the count results of the AI Through Count tool.

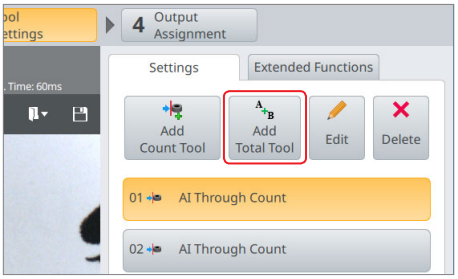
Point

The number of tools that can be set varies depending on “Operation Mode” (page 4-10).
- **High Speed/Standard: You can set one total tool.**
- **High Accuracy: You can set up to two total tools.**

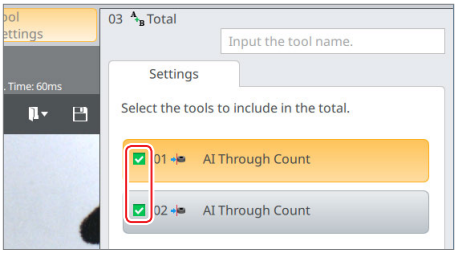
1 Set multiple instances of [AI Through Count].

“Setting the AI Through Count Tool” (page 4-82)

2 Press [Add Total Tool].



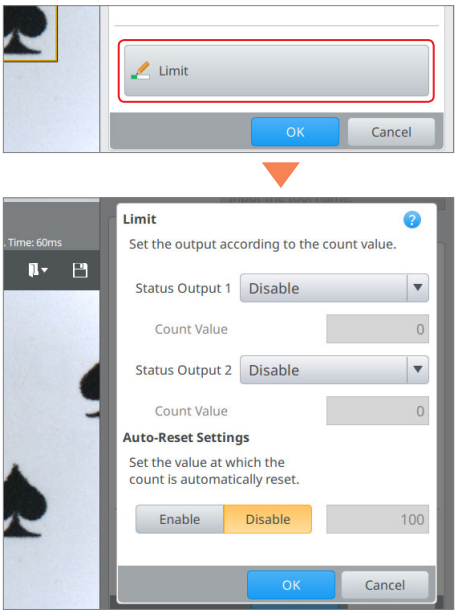
3 Select the target tool to total the count result.



4 Press [Limit] and set the threshold for operation and test runs. When setting is completed, press [OK].

Point

The status conditions of the count tools included in the total are disabled in the total tool.



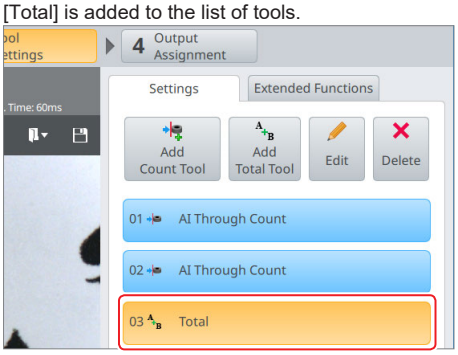
“Status Output Settings” (page 4-83)
“Auto-Reset Settings” (page 4-83)

5 Configure the following settings as needed.

“Tool Name Setting” (page 4-23)

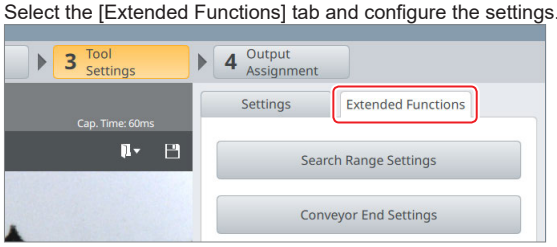
6 Press [OK].

[Total] is added to the list of tools.



Extended Functions for Tool Settings (AI Through Count Mode)

Select the [Extended Functions] tab and configure the settings.

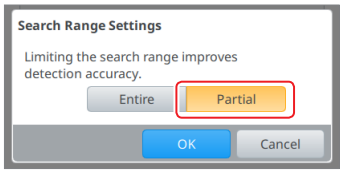


Search Range Settings

Specify an area in which to search for a target.
Limiting the search range improves detection accuracy.

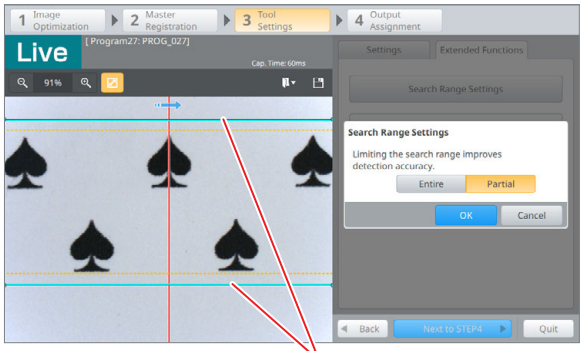
Point **If the search range is changed, the AI Through Count tool will need to be relearned.**

1 Press [Partial].



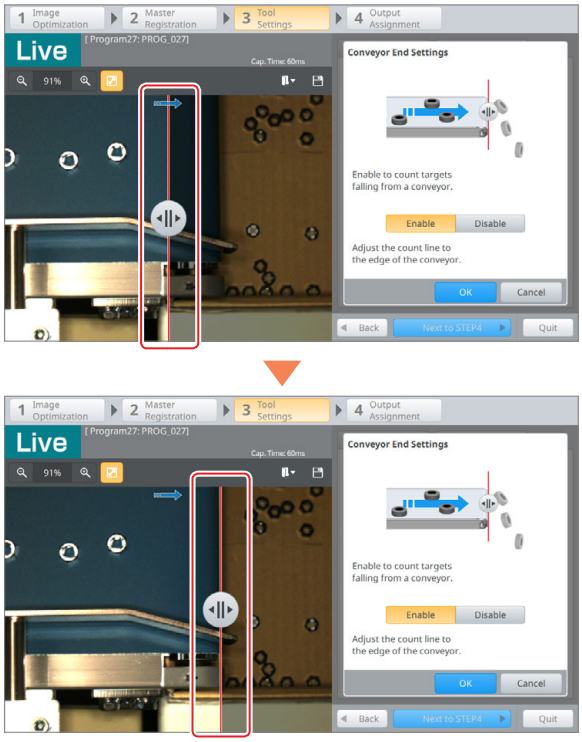
2 Set the search region.

- When the target movement direction is [Left to Right] or [Right to Left], you can change the search range up or down.
- When the target movement direction is [Top to Bottom] or [Bottom to Top], the left and right sides of the search range can be changed.



Conveyor End Settings

When counting targets that fall from a conveyor, set the count line to match the edge of the conveyor.

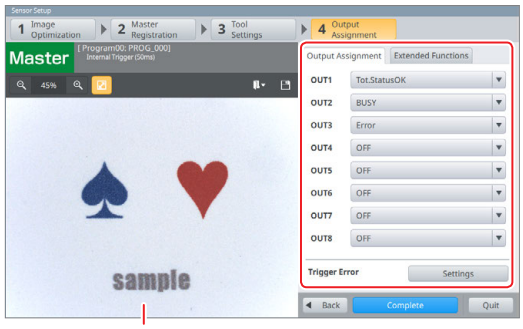


4. Output Assignment

Setting Details of Outputting to Output Line

Sets the output items to be assigned to the output line.
“Chapter 11 Controlling with the Input/Output Line” (page 11-1)

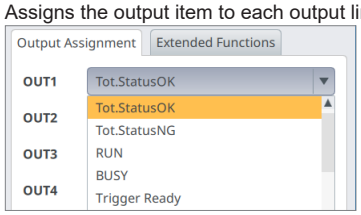
Setting the Output Assignment



Master Image

Output Assignment

Assigns the output item to each output line.



“Setting Range of the Output Assignment” (page 4-88)

Trigger Error

Selects whether to enable/disable the output when a trigger error occurs.
“Trigger Error” (page 4-90)

Extended Functions (Standard Mode)

Configures the total status conditions and logic settings.
“Total Status Conditions” (page 4-90)
“Logic Settings” (page 4-91)

Extended Functions (AI Through Count Mode)

Configures the logic settings.
“Logic Settings” (page 4-91)

Setting Range of the Output Assignment

Standard Mode

Setting range	Description
OFF	Do not output. Output will be constantly OFF.
Total Status OK	When the total status result is OK, the output turns ON. The total status condition can be selected from the following: • All Tools OK • Any Tool OK • Logic 1 to 8
Total Status NG	When the total status result is NG, the output turns ON.
RUN	When the sensor is running and no system error has occurred, the output turns ON.
BUSY	The output turns ON in the following cases. • Judgment process in progress (capture process/ image process) • Switching programs • Registering the external master image • Data transferring to an SD card (in the case of settings enabled)
Trigger Ready	Output turns on when the trigger can be accepted.
Strobe	Output turns on when the total status result is refreshed.
Transfer file	Output turns on during the transfer of the result file.
Error	The output turns ON when the following errors occur. • System error • Startup memory readout error • Program switching error • External master registration error • SD card access error The following errors are output when settings are [Enable]. • Trigger Error • FTP error • SD card transfer error • Trigger Input Time Error • Strobe Error • SNTP Sync Error • Tact Warning (when AI Trigger is Enabled) • AI Trigger Output Error (when AI Trigger is Enabled) • AI Trigger Buffer Errors (when AI Trigger is Enabled) • AI Trigger Capture Speed Warning (when AI Trigger is Enabled)
SD card error	The output turns ON when the following errors occur. • SD card access error • SD card transfer error (when settings are [Enable])
Insufficient SD capacity	Output turns on when the SD card does not have sufficient capacity.
AI Trigger Output	One-shot output when the AI trigger turns on. The one-shot output time can be set in [Sensor Advanced] > [I/O Settings] > [Output Settings] > [AI Trigger Output].
Tool 00: Position Adjustment	When the status result of the position adjustment is OK, the output function turns ON.
Tool 01 to 64	When the status results of the detection tool and position adjustment tool are OK, the output function turns ON. Status results can be output by each tool.
Master 00 to 07	• When master image settings are enabled and the status results for all tools, except the position adjustment tool, are OK with the selected master image set, the output function turns ON. • If the status result for multiple master numbers is OK, the supported output functions turn ON.
Logic 1 to 8	When the status result of the specified logic is OK, the output turns ON.

Sorting Mode

Setting range	Description
OFF	Do not output. Output will be constantly OFF.
Part 0 to 7	When the status result for a specified part type is OK, the output function turns ON. Status results can be output by each part type.
Total Status NG	When the status result for all part types is NG, the output turns ON.
RUN	When the sensor is running and no system error has occurred, the output turns ON.
BUSY	The output turns ON in the following cases. • Judgment process in progress (capture process/image process) • Switching programs • Data transferring to an SD card (in the case of settings enabled)
Trigger Ready	Output turns on when the trigger can be accepted.
Strobe	Output turns on when the total status result is refreshed.
Transfer file	Output turns on during the transfer of the result file.
Error	The output turns ON when the following errors occur. • System error • Startup memory readout error • Program switching error • External master registration error • SD card access error The following errors are output when settings are [Enable]. • Trigger Error • FTP error • SD card transfer error • Trigger Input Time Error • Strobe Error • SNTP Sync Error • Tact Warning (when AI Trigger is Enabled) • AI Trigger Output Error (when AI Trigger is Enabled) • AI Trigger Buffer Errors (when AI Trigger is Enabled) • AI Trigger Capture Speed Warning (when AI Trigger is Enabled)
SD card error	The output turns ON when the following errors occur. • SD card access error • SD card transfer error (when settings are [Enable])
Insufficient SD capacity	Output turns on when the SD card does not have sufficient capacity.
AI Trigger Output	One-shot output when the AI trigger turns on. The one-shot output time can be set in [Sensor Advanced] > [I/O Settings] > [Output Settings] > [AI Trigger Output].

AI Through Count Mode

Setting range	Description
OFF	Do not output. Output will be constantly OFF.
RUN	When the sensor is running and no system error has occurred, the output turns ON.
BUSY	The output turns ON in the following cases. • Switching programs
Error	The output turns ON when the following errors occur. • System error • Startup memory readout error • Program switching error • External master registration error • SD card access error The following errors are output when settings are [Enable]. • FTP error • SD card transfer error
Tool 01 to 08: Count Up	One-shot output when the tool counts up. The one-shot output time and minimum off time can be set in [Sensor Advanced] > [I/O Settings] > [Output Settings] > [Count Output].
Tool 01 to 08: Status Output 1	Status output turns on when a set condition is met.
Tool 01 to 08: Status Output 2	Status output turns on when a set condition is met.
Logic 1 to 8	When the status result of the specified logic is OK, the output turns ON.

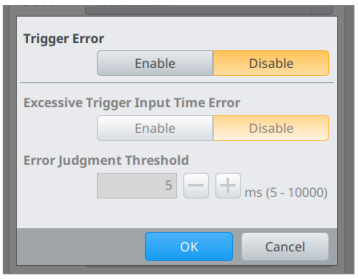
Output Assignment Default Values

Ultra-compact model	Built-in amplifier model	Standard Mode	Sorting Mode	AI Through Count Mode
OUT1		Total Status OK (N.O.)	Part 0: MASTER00 (N.O.)	Tool 01 Count Up (N.O.)
OUT2		BUSY (N.O.)		
OUT3		Error (N.C.)		
OUT4	I/O1	OFF		
OUT5	I/O2			
OUT6	I/O3			
OUT7	-			
OUT8	-			
Trigger Error		Disable		

Reference
- The output settings which determine N.O./N.C. can be changed.
  “Output Settings” (page 7-15)
- The input cable assignment can be changed.
  “Input Settings” (page 7-13)

Trigger Error

Configure the trigger error and excessive trigger input time error settings.



Trigger Error

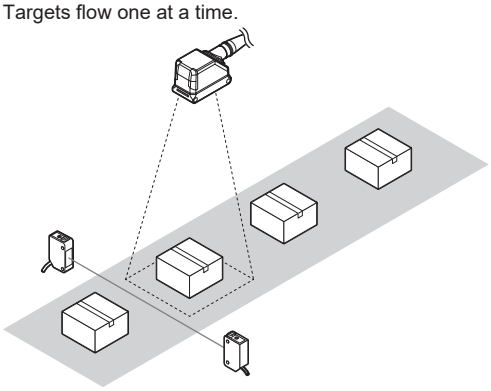
Selects whether to enable/disable the output when a trigger error occurs.

Excessive Trigger Input Time Error

This item can be set when [Trigger Options] is set to [External Trigger].
When [Enable] is selected, you can set [Error Judgment Threshold].
When the trigger input time exceeds the set time, [Trigger Input Time Error] is notified and the error output turns on.

❍ Normal

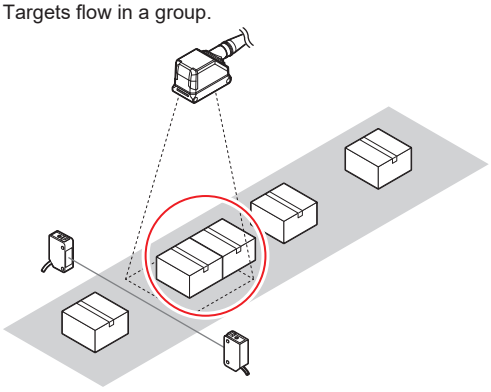
Targets flow one at a time.



Example
The time for the sensor for the trigger to turn on when one target flows is set to 2000 ms.

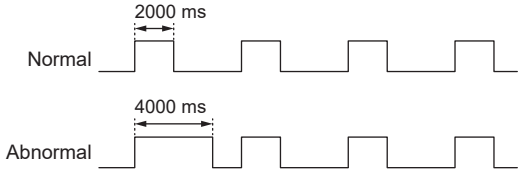
❍ Abnormal

Targets flow in a group.



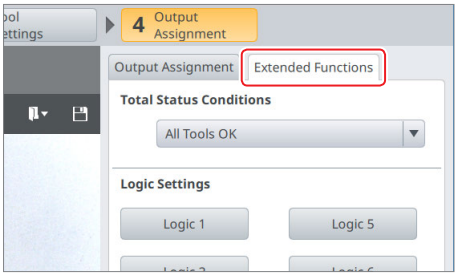
Example
Since two targets flow together, the time for the sensor for the trigger to turn on is 4000 ms.
In this case, set [Error Judgment Threshold] to 3000 ms.

Trigger input



Extended Functions for the Output Assignment

Select the [Extended Functions] tab and configure the settings.



Total Status Conditions

Selects a condition for the total status result.
The total status result is determined according to the selected condition.

All Tools OK

When the status results of all of the detection tools are OK, the total status output turns ON.

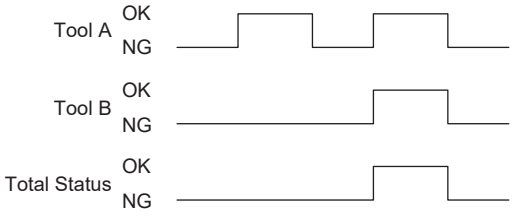


Image of total status output when the total status condition is [All Tools OK]

Any Tool OK

When the status results of any of the detection tools are OK, the total status output turns ON.

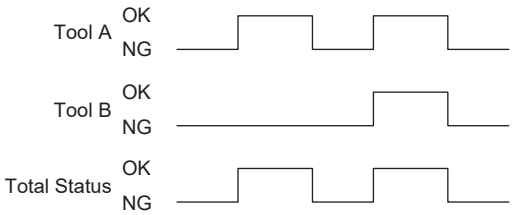


Image of total status output when the total status condition is [Any Tool OK]

Point

For [Any Tools OK], the status result of the position adjustment is not included in the total status conditions.

Logic 1 to 8

When the status result for the set logic is OK, the total status output turns ON.

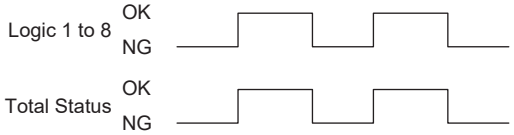


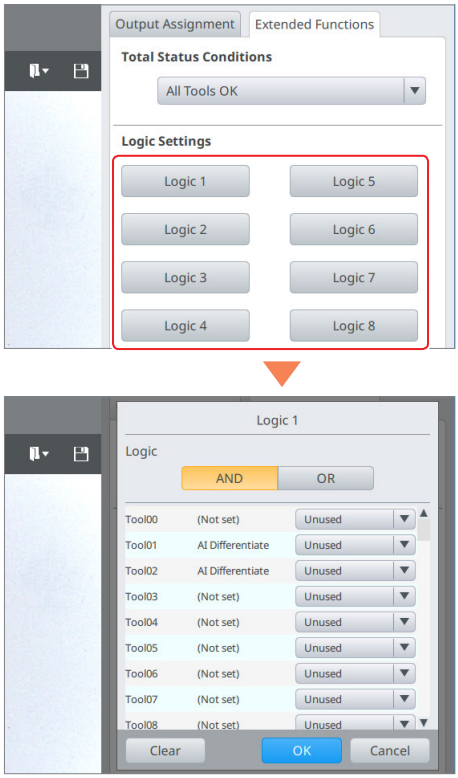
Image of total status output when the total status condition is [Logic 1 to 8]

Point

- **When the position adjustment fails, the status result of each tool is NG.**
- **If the Learning/Area/Edge Pixel/Width/Diameter/Edge/Pitch/OCR/Blob Count tool window protrudes from the imaging area when position adjustment succeeds, the tool cannot be judged and the status result is NG.**

Logic Settings

A logical operation can be performed using the status results of selected detection tools and can be applied to an output.
Logic 1 to 8 can be defined.



Logic

Select the operation method for the logic.

AND

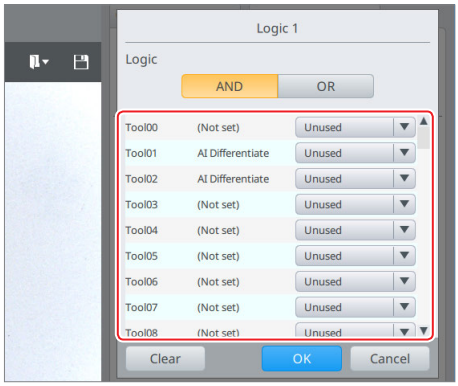
The logic output is the logical product (AND) of the status results of all of the selected detection tools.

OR

The logic output is the logical sum (OR) of the status results of all of the selected detection tools.

Items to be integrated into the logic

The status result of the logic is calculated from OK/NG of all of the items which [Used] or [Used (Inverse)] has been set.



❍ Used

When the status results are OK, the status output for items in the logic turns on.

❍ Used (Inverse)

When the status results are NG, the status output for items in the logic turns on.

Reference To use a logic which has been set to another logic, use the logic number which is greater than the logic number which has been set.
For example, use either of Logic 2 to Logic 8 in case of using Logic 1 to another logic.

Logic : AND

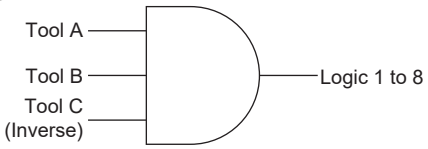


Image of logic output when the Logic is [AND]

Tool A	Tool B	Tool C	Logic
OK	OK	OK	NG
NG	OK	OK	NG
OK	NG	OK	NG
NG	NG	OK	NG
OK	OK	NG	OK
NG	OK	NG	NG
OK	NG	NG	NG
NG	NG	NG	NG

Logic : OR

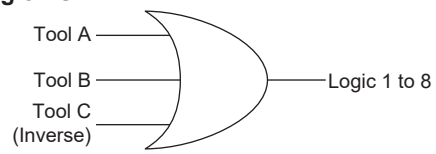


Image of logic output when the Logic is [OR]

Tool A	Tool B	Tool C	Logic
OK	OK	OK	OK
NG	OK	OK	OK
OK	NG	OK	OK
NG	NG	OK	NG
OK	OK	NG	OK
NG	OK	NG	OK
OK	NG	NG	OK
NG	NG	NG	OK

Point **When the program number has been changed or the sensor is put into [RUN] from [Sensor Settings Menu] after the power is turned ON, a judgment is not performed until a trigger has been input. Until the trigger is input, the judgment result of each tool is OFF.**

MEMO

5

Running

This chapter explains the procedures for starting operation and the names and functions of each section displayed on the operation screen.
The chapter also explains useful functions when confirming operation status.

Starting an Operation 5-2
Names and Functions of the Screen in [Run] / [Program] 5-3
List of NG Sensor Occurrences 5-11
NG Hold Function 5-13
Running Image History 5-14

Starting an Operation

Start operation according to the program created with Sensor Setup.

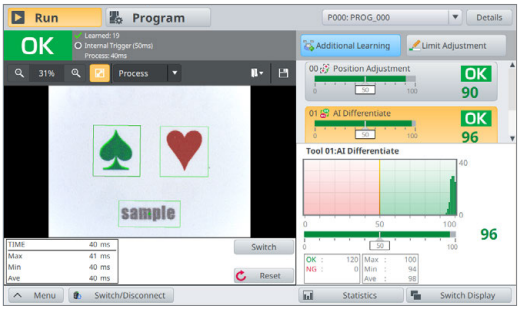
Reference The sensor can be independently operated.

Turning on the power and starting operation

1 Turn on the power for the sensor and start IV Smart Navigator. Alternatively, turn on the power for the sensor and the control panel/display expansion unit.

2 Confirm that the main screen in [Run] opens.

❍ **Example: [Standard Mode] (including the AI Differentiate) program**



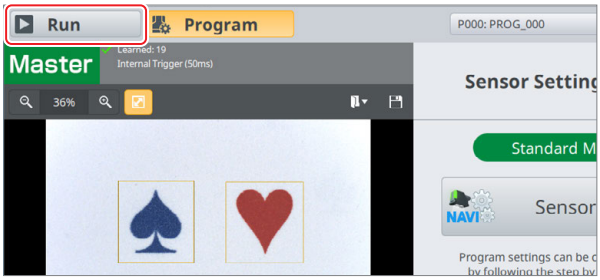
Point **If the image or status result does not update, refer to 🕮 “Troubleshooting” (page A-7).**

Exiting the sensor settings and starting operation

1 Exit sensor settings.

🕮 “Exiting Sensor Setup” (page 4-5)

2 Press [Run].



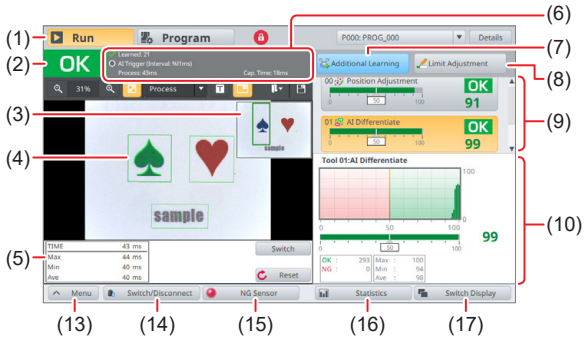
The run screen opens and the operation starts.

Point **If the image or status result does not update, refer to 🕮 “Troubleshooting” (page A-7).**

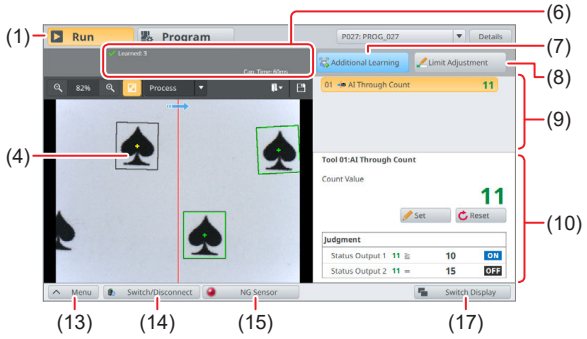
Names and Functions of the Screen in [Run] / [Program]

Main Screen in [Run] / [Program]

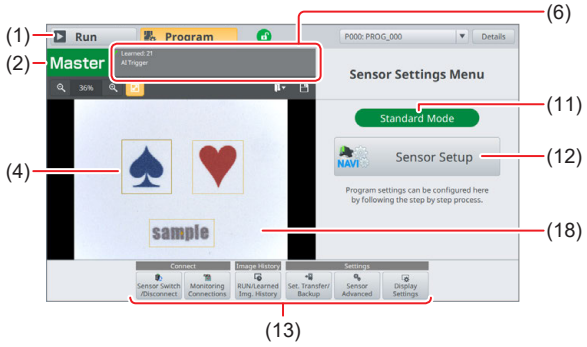
Main screen in [Run] (Standard Mode/Sorting Mode)



Main screen in [Run] (AI Through Count Mode)



Main screen in [Program]



(1) Settings button



(a) [Run]/[Program]
Switches the main screen between [Run] and [Program].

(b) Security
This icon is displayed when security is set.
A password is required to operate the screen.
“Security” (page 7-11)

(c) Program information
Displays the current program number and program name.
Programs can be switched from the drop-down menu.
“Displaying the [Program Details] screen” (page 7-7)

(d) Details
Displays the Program Details screen.
“Displaying the [Program Details] screen” (page 7-7)

(2) Total status result/by image type

Main screen in [Run] (standard mode)
Indicates the total status result.

OK — Total status result OK

NG — Total status result NG

NG HOLD — The [NG Hold] function is set to [Enable] and the total status is NG.
Holds the image when judged as NG.

Reference — OK/NG can be changed to user-defined characters such as PASS/FAIL.
PASS FAIL
“Judgment Notation” (page 7-30)

Main screen in [Run] (Sorting mode)
Displays a part (master) that is the target to be judged.

M0 — When the master name has not been set:
When the results of position adjustment are OK, the part numbers (M0 to M7) for which the part type discrimination is OK will be displayed.

00 SPADE — When the master name has been set:
When the results of position adjustment are OK, the part (master) number (00 to 07) for which the part type discrimination is OK (upper) and its part (master) name (lower) will be displayed.

NG — Displayed when the position adjustment results or part type discrimination results are all NGs.

NG HOLD — Displayed when the position adjustment result or part type discrimination result is NG while the [NG Hold] function is set to [Enable].
Holds the image when judged as NG.

Main screen in [Run] (AI Through Count Mode)
The screen is hidden.

Main screen in [Program]
Displays the image type (Master).

(3) AI trigger LIVE image display
“AI Trigger LIVE Image Display” (page 5-9)

(4) Tool window
Displays the selected tool window region with a green frame when the status result is OK, and displays with a red frame when the status result is NG.
The tool window selected can be changed by pressing a different tool region.
“Selecting the Display Method of the Tool Window” (page 5-6)

(5) Statistical information display

Displays statistical information of status results.
“Statistical/Tool Information Display” (page 5-7)

(6) Program information

Displays the information set in the program.



(a) Learned
(AI Differentiate/AI Identify/AI Count/AI OCR)
Displays the number of learned images and number of not reflected images.
“Confirming Learned Image History” (page 6-8)

(b) Trigger type (trigger interval/trigger delay)
The content that is displayed differs depending on the Trigger Options.
- Internal trigger: Displays the trigger interval in brackets.
- External trigger: Displays the trigger delay time in brackets.
- AI trigger: Displays the trigger interval in brackets.

(c) Processing time
Displays the time between receiving a trigger (external or internal) and when the status result is output.If “Output Settings” (page 7-15) is [One-Shot], the ON-delay time is not included.
“Shortening the Processing Time” (page 6-24)

(d) Remaining time/Retry count/Switching
Displays the remaining time for the judgment waiting time or remaining retry count when [Program Auto-Switching] is set to [Enable].
[Switching] appears during switching delay after the switching destination program is set.

(e) Capture Time
Displays the actual interval at which the image is currently being captured.
Displayed when the following settings are configured:
- AI Trigger
- For internal/external triggers:
  Select [2-image Buffer]/[10-image Buffer] in [Preliminary Capture].

“Setting Trigger Options” (page 4-8)

(7) [Additional Learning] button (AI Differentiate/AI Identify/AI Count/AI OCR)

Performs the additional learning of images displayed on the screen.
“Additional Learning by Taken Image” (page 6-3)

(8) [Limit Adjustment] button (Standard Mode/AI Through Count Mode)

Manually adjusts the tool threshold.
“Adjusting Thresholds for Judgment” (page 6-15)

(9) Status gauge

Displays the status gauge per set tool.
“Statistical/Tool Information Display” (page 5-7)

(10) Tool information

Displays the information for the selected tool.
“Statistical/Tool Information Display” (page 5-7)

(11) Mode

Displays the program mode (Standard Mode/Sorting Mode/AI Through Count Mode).

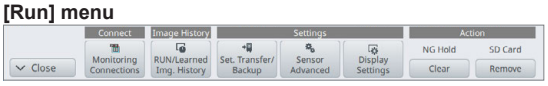
(12) [Sensor Setup] button

Displays the Sensor Setup screen.
“Starting Sensor Setup” (page 4-4)

(13) Operation menu

PC

[Run] menu



[Program] menu



Control panel

[Run] menu

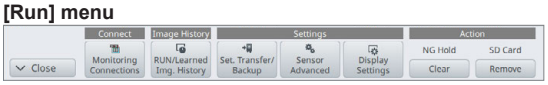


[Program] menu



Display expansion unit

[Run] menu



[Program] menu



❍ **Monitoring Connections**
“Multiple Sensors Monitoring” (page 3-12)

❍ **Sensor Switch/Disconnect**
“Switching the Sensor to be Connected” (page 3-10)
“Disconnecting from the sensor” (page 3-10)

❍ **RUN/Learned Img. History**
“Running Image History” (page 5-14)

❍ **Settings Transfer/Backup**
“Settings Transfer/Backup” (page 7-9)

❍ **Sensor Advanced**
“Sensor Advanced Settings” (page 7-10)

❍ **Display Settings**
“Judgment Notation” (page 7-30)

❍ **Panel Settings**
“Panel Settings” (page 7-25)

❍ **Action**
“NG Hold Function” (page 5-13)
“Removing the SD card” (page 8-9)

(14) Switch/Disconnect

“Switching the Sensor to be Connected” (page 3-10)
“Disconnecting from the sensor” (page 3-10)

(15) NG Sensor

“List of NG Sensor Occurrences” (page 5-11)

(16) Statistics

“Statistical/Tool Information Display” (page 5-7)

(17) Switch Display

Switches the display screen.
“Changing the Screen During Operation” (page 5-10)

(18) Master image display

Displays the master image registered to the currently selected program. If no master image is registered, [No Master Image] will be displayed.

Point

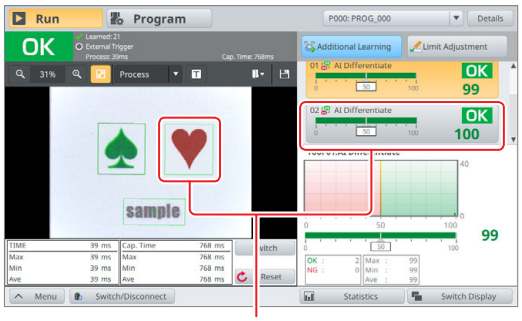
Search area and tool window will be hidden when you select [OFF] for the display methods for the tools (Page 5-6).

Selecting the Tool Window

The method for selecting the tool window is as follows.

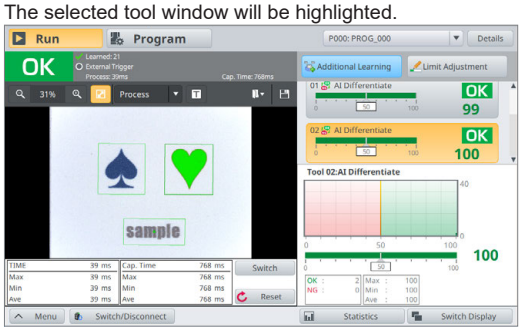
- Press to select the status gauge of the tool window.
- Press to select the tool window displayed on the image of the sensor.

1 Press the tool window displayed on the status gauge or image of the sensor.



Press either one

The selected tool window will be highlighted.



Selecting the Display Method of the Tool Window

You can select the display method for the tool window in accordance with your usage.



OFF

All the tool windows and search ranges become hidden.

Window: Standard Mode/Sorting Mode

❍ Selected tool window

- Displays the frame of the tool window with a thick line. If a mask region is set, the region where the tool window and mask region are combined will be displayed.
- Displays the frame of the search range in light blue.

❍ Non-selected tool window

- Displays the frame of the tool window with a thin line.
- The search range and the mask region will not be displayed.

❍ Common

When the results of position adjustment or status results are OK, the tool will be displayed in green. If one of the status results is NG, the tool will be displayed in red.
Displays the brightness correction window in blue.

Window: AI Through Count Mode

Displays the tool window in green on the target to be counted.

Process: Standard Mode/Sorting Mode

Compared to when the [Window] is selected, the following conditions are different. Other details are the same.

❍ Selected tool window

AI Differentiate	Displays the region with a high matching rate between the target and learned OK workpiece in green, and the region with a high matching rate between the target and learned NG workpiece in red. The higher the matching rate of the region, the darker the green/red display becomes. • If matching rate between the target and learned OK workpiece (or NG workpiece) is low, it may not be displayed. • The display range/density is rough indication. It should be treated as reference information.
AI Identify	This is the same behavior as when [Window] is selected.
AI Count	• When Missing Part Detection is disabled: This is the same behavior as when [Window] is selected. • When Missing Part Detection is enabled: Displays the numbers of the places detected in the count target as white (OK) or red (NG).
AI OCR	Displays the recognized text and date on a green (OK) or red (NG) window. Additionally, the master text/date and character(s) read are displayed on the top left of the screen. If [Show Matching Rate] is enabled, the matching rate is displayed in green (OK) or red (NG) text on the the recognized text.
Line Detection	• The detected line is displayed in red. • Displays the recognized text and date on a green (OK) or red (NG) window. • The master text/date and character(s) read for tools for which Line Detection is applicable are displayed on the top left of the screen.
Outline/ edge pixels/width/ diameter/ edge/pitch/ position adjustment	Displays the recognized outline/edge in green (OK) or red (NG). Inside of the tool window is displayed in monochrome, and outside the tool window in color if the sensor is the color type.
Color area/area/ color prohibition/ brightness prohibition	Displays the extracted region as green (OK) or red (NG).
ColorAverage	Displays the master color (M) and target color (L) on the top left of the screen.
Brightness Avg	Displays the master brightness (M) and target brightness (L) on the top left of the screen.
Blob Count	The following symbols are displayed on the counted blobs: Count number is OK Count number is NG Size NG

❍ Selected position adjustment tool

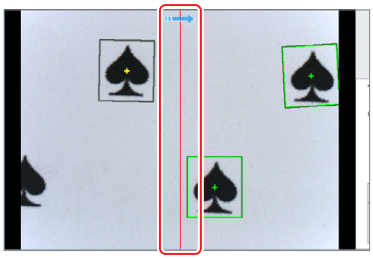
Indicates the recognized outline with a series of points in green (OK) or red (NG).

❍ If brightness correction has been set

The inside of the tool window is displayed with the corrected brightness when selected.
(For tools subject to brightness correction only)

Process: AI Through Count Mode

- Displays the tool window in black on the target to be counted. Displays the tool window that performed the count in green.
- A red line and an arrow indicating the line's direction of travel appear in the center of the screen.

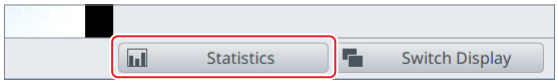


Statistical/Tool Information Display

Statistics/tool information can be displayed to check the contents.
In [AI Through Count Mode], the [Statistics] button is not displayed.

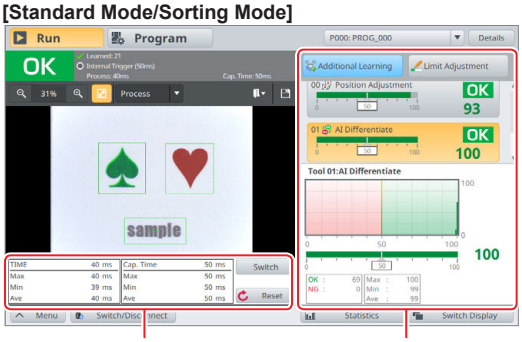
1 Press [Statistics] at the bottom right of the screen to display the statistical/tool information.

The information is shown or hidden each time you press on the button.
When using [AI Trigger], each press of the button toggles between [Statistical/Tool Info] → [AI Trigger Info] → (Hidden).



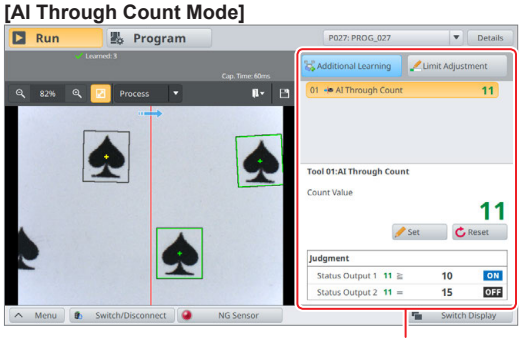
2 Check the statistical/tool information.

[Standard Mode/Sorting Mode]



Statistical Information　　Tool Information

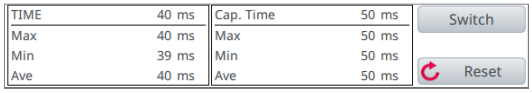
[AI Through Count Mode]



Tool Information

Statistical Information (Standard Mode/Sorting Mode)

❍ Processing time/Capture time

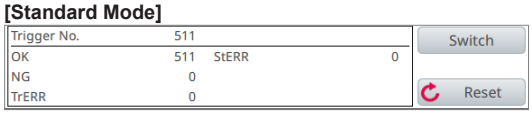


Processing time/ Capture time	Processing/capture time of the latest judgment process
Max	Maximum processing time/capture time
Min	Minimum processing time/capture time
Ave	Average processing time/capture time

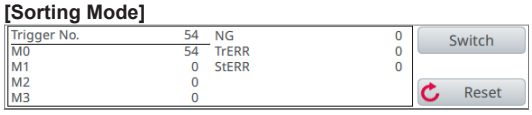
Reference
[Cap. Time] is displayed when the following settings are configured:
- AI Trigger
- For internal/external triggers:
  Select [2-image Buffer]/[10-image Buffer] in [Preliminary Capture].

❍ Trigger No.

[Standard Mode]



[Sorting Mode]



Trigger No.	Total number of triggers issued (This number does not include the number of trigger errors)
OK	[Standard Mode] Number of triggers issued with the total status OK.
Part	[Sorting Mode] Number of triggers issued by part
NG	• [Standard Mode] Number of triggers issued with the total status NG. • [Sorting Mode] Number of triggers issued with the part status all NG.
TrERR	Number of triggers issued as error triggers.
StERR	Number of strobe errors
BufERR	Number of buffer errors (Displayed when AI trigger used)

❍ OUT

Displays the information related to the outputs assigned to an output line in “Setting the Output Assignment” (page 4-88) of [Sensor Setup].
- The ON/OFF state of the output is not tracked.
- For the error output, during normal operation: OFF, at the error occurrence: ON
- [Standard Mode]
  Displays the state of each tool (judgment OK: ON, judgment NG: OFF).
- [Sorting Mode]
  Displays each part type matching state (suitable (OK): ON not suitable (NG): OFF).

❍ [Switch] button

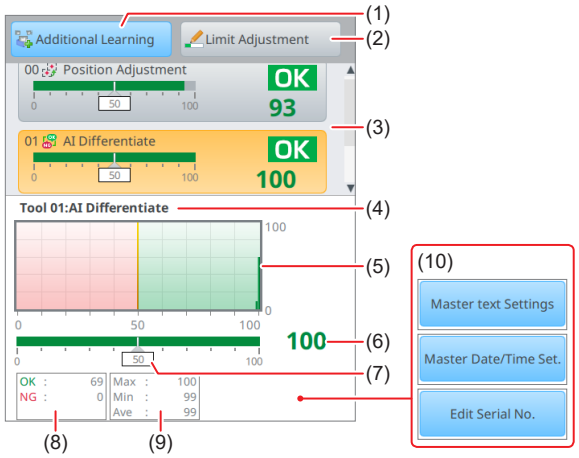
Toggles the display content between [Processing time/Capture time] → [Trigger No.] → [OUT] each time you press the button.

❍ [Reset] button

Resets the histogram, processing time, and number of triggers.
Pressing the [Reset] button does not reset [OUT].

Reference
The processing time, number of triggers, histogram, judgment record, matching information are reset under the following conditions.
- When [Reset] is pressed.
- When the power of the sensor is turned OFF.
- When a tool is added/deleted/copied.
- When the upper limit of the color area/area/edge pixel/width/diameter/edge/pitch tool is enabled/disabled or when the setting scale is changed.
- When changing the scaling settings for the width/diameter/pitch tool.
- When the program is switched.
- When the sensor is initialized.

Tool Information: Standard Mode/Sorting Mode



Reference For the method to reset the histogram, judgment record, and matching rate information, refer to "[Reset] button" (page 5-7).

(1) [Additional Learning] button

"Auto Adjustment by the Additional Learning" (page 6-2)

(2) [Limit Adjustment] button (standard mode only)

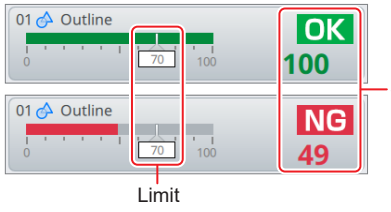
"Adjusting Thresholds for Judgment" (page 6-15)

(3) Status gauge

Displays the status results of the tool window set in the program. For details of the status result, refer to "Displaying and outputting the status result" (page A-4).

❍ Standard Mode

Displays the status results (OK/NG), a line indicating the threshold, and the matching rate.



Pitch tool	Displays both maximum and minimum values of the distances between all the pitches and the number of pitches. Among all of the distances between pitches, the one which deviates the most from the average value is displayed to show the matching rate.
Hi-Sp.Adj	The threshold is not displayed.
Width/ diameter/ pitch tool	Displays the scaling unit if the scaling function is used.
AI OCR	• **When [Show Matching Rate] is disabled** The threshold is not displayed. When the characters/date is completely matching, the matching rate is indicated with 100. If either the text or date does not match, 0 is displayed. • **When [Show Matching Rate] is enabled** The threshold is displayed.

❍ Sorting Mode

- Tools other than position adjustment tool
  Displays the tool name, status results, and the matching rate. The name of the part type (master) will be displayed when the part type discrimination is OK, whereas NG will be displayed when the part type discrimination is NG.
- Position adjustment tool
  It is the same as standard mode.



(4) Tool Name

Displays the name of the selected tool.

(5) Histogram

Displays the histogram (frequency distribution) of the selected tool. With the threshold being a border, the range for OK is displayed in green and for NG is displayed in red.

- The upper limit of the histogram is 999999. The values display stops updating when the upper limit is reached.
- Pitch tool displays the histogram (frequency distribution) of the selected pitches.

❍ Horizontal axis

Displays the distribution of the matching rate. The display of the range is fixed. It cannot be specified arbitrarily.

❍ Vertical axis

Adjusts automatically according to the maximum number. It cannot be specified arbitrarily.

Point **When in sorting mode, the histogram is only be displayed for the [Position Adjustment] tool and [AI Differentiate].**
When using the [Outline], [Color Average], [Brightness Average], [Width], or [Diameter] tool, the message, "Not available in Sorting Mode." will appear.

(6) Matching rate of the latest judgment process

Displays the matching rate of the latest judgment process.

(7) Limit

Displays the threshold of the selected tool with a vertical line (orange).

Reference The threshold is not displayed for [High-Speed Position Adjustment] and [AI OCR] (when [Show Matching Rate] is disabled).

(8) Judgment Record

Displays the judgment process counts for OK or NG.
The upper limit is 999999. The values display stops updating when the upper limit is reached.

Reference If the judgment threshold is changed, the histogram will update according to the result judged based on the changed threshold. However, the judgment record retains the counts judged based on the previous threshold. Therefore, the judgment conditions on the histogram may be different from the displayed judgment record counts.

(9) Matching rate information

Displays the information related to the matching rate.

Max	Displays the maximum value of the matching rate.
Min	Displays the minimum value of the matching rate.
Ave	Displays the average value of the matching rate.

Reference Both maximum (Max) and minimum (Min) values of all the pitches are displayed in the Pitch tool.

(10) Edit button

This button is displayed when AI OCR is set.

❍ Master text settings

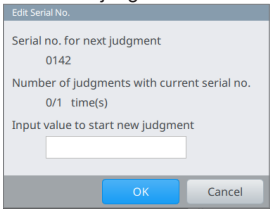
This button is displayed when [Select OCR Mode] is set to [String]. You can stop operation and edit the master text.

❍ Master Date/Time settings

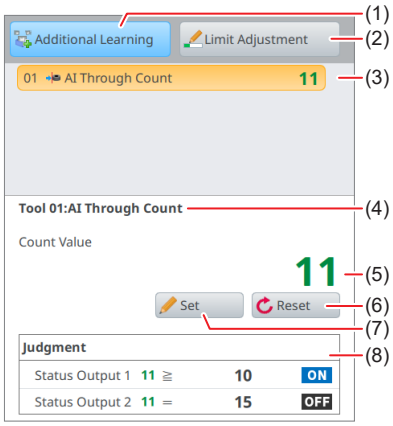
This button is displayed when [Select OCR Mode] is set to [Date/Time].
You can stop operation and edit the master date and time.

❍ Edit Serial No.

This message is displayed when [Custom] is selected for [Select OCR Mode] and [Serial No.] is included in [Status conditions]. You can set the value (serial number value that will be the judgment value at the next trigger) at which operation is stopped and a new judgment is started.



Tool Information: AI Through Count Mode

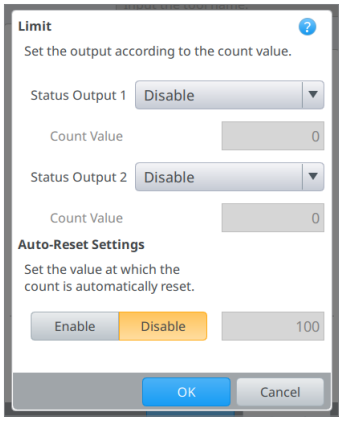


(1) [Additional Learning] button

“Auto Adjustment by the Additional Learning” (page 6-2)

(2) [Limit Adjustment] button

Sets the threshold for operation.



“Status Output Settings” (page 4-83)
“Auto-Reset Settings” (page 4-83)

(3) Status gauge

Displays the count value of the tool window set in the program.

(4) Tool Name

Displays the name of the selected tool.

(5) Count Value

Displays the count value of the selected tool.

(6) [Reset] button

Resets the count value.

(7) [Set] button

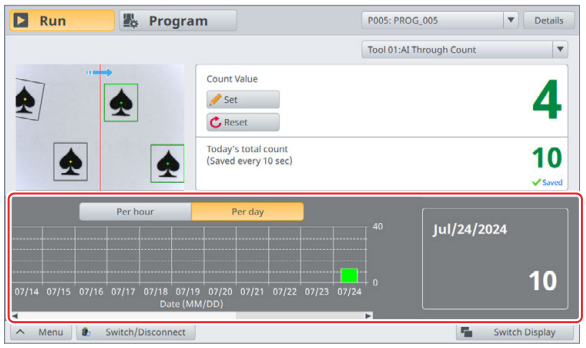
Any desired count value can be set.

(8) Judgment

If status output is set for [Limit], the setting and output status (ON/OFF) are displayed.

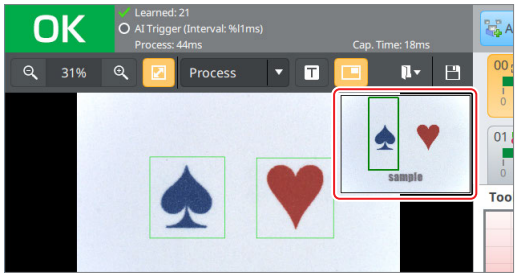
Tool Information: AI Through Count Mode (per hour/day)

You can view information of [Per Hour] and [Per Day] by switching screens by [Switch Display].



AI Trigger LIVE Image Display

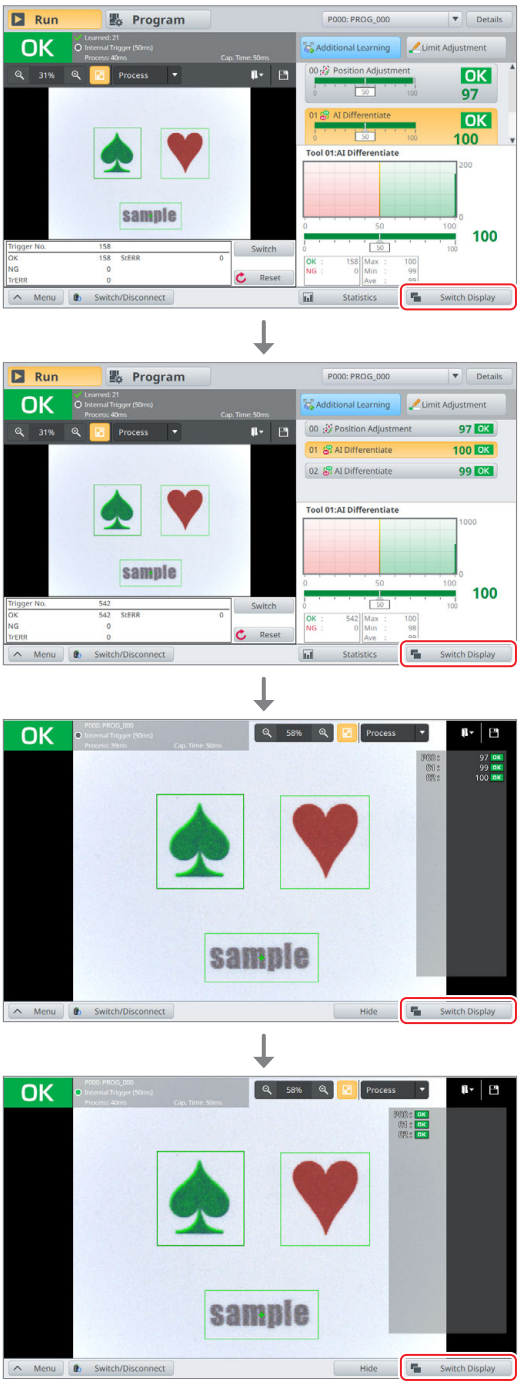
This button is only displayed when an AI trigger is set.
The display can be toggled on and off using the buttons on the toolbar.
The AI trigger window frame is displayed in green (judgment ON) and gray (judgment OFF).



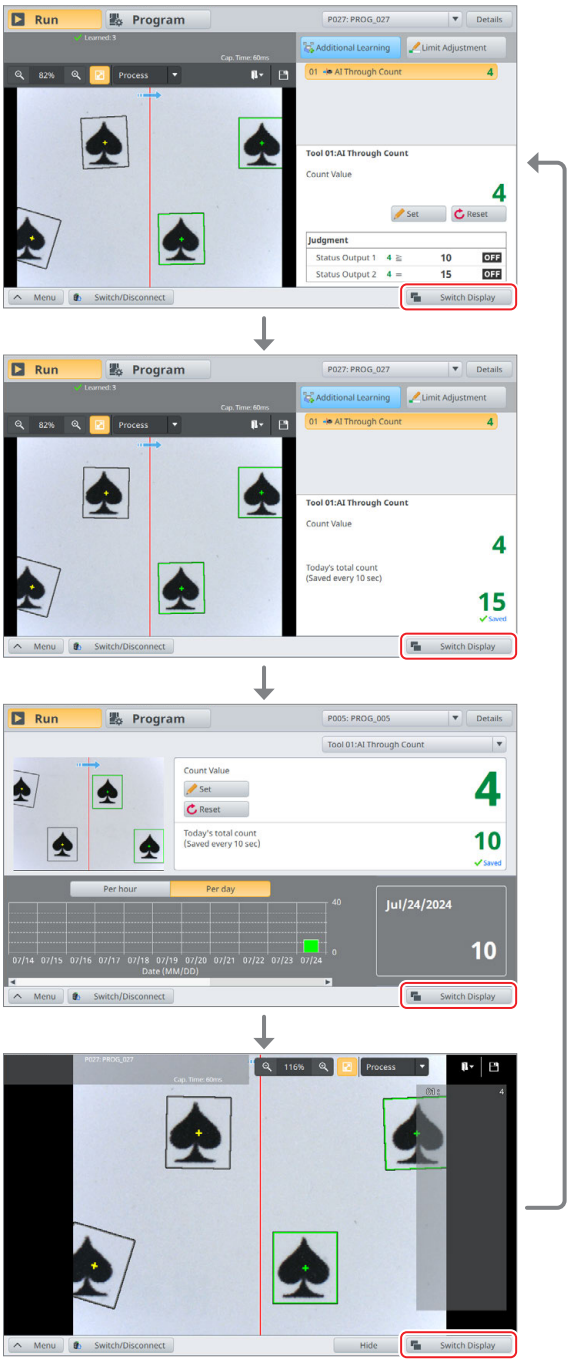
Changing the Screen During Operation

You can change the display screen by pressing [Switch Display].

Standard mode / Sorting mode

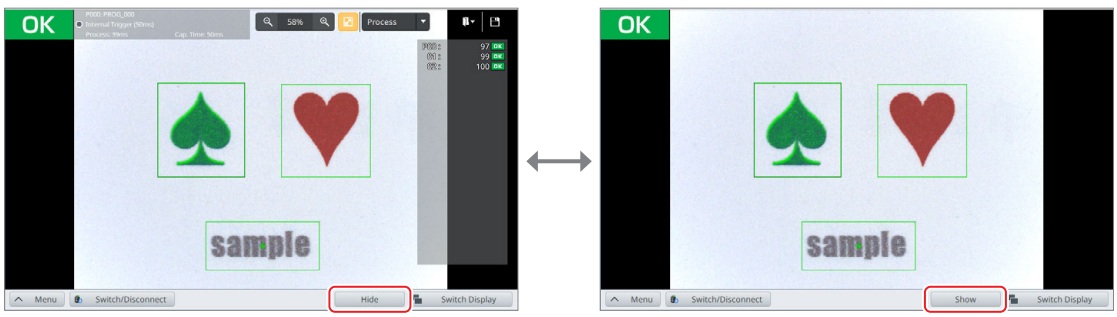


AI Through Count Mode



Reference [Today's total count] displays the cumulative values counted by the AI Through Count tool from the time the power was turned on until the present. The count is saved every 10 seconds.

Reference When statistics/tool information is hidden, press [Hide] to display only the target.

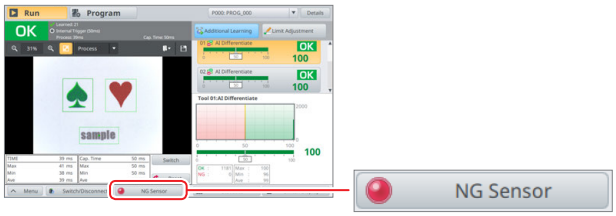


List of NG Sensor Occurrences

(Confirming the NG Occurrence Status of the Sensor Connected in a List)

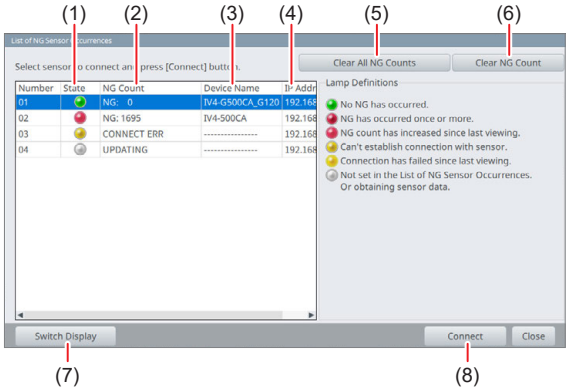
Overview of the List of NG Sensor Occurrences

The [NG Sensor] button blinks (red) when NG occurs on a sensor connected to the PC while in RUN mode.
Pressing [NG Sensor] enables you to check the NG occurrence status in a list.



Point

- **Only the sensors which have been registered as targets for NG sensor monitoring are displayed in the list.**
- **[List of NG Sensor Occurrences] can only be displayed during [Run].**
- **The IV4 Series, IV3 Series, IV2 Series and IV Series can be mixed and confirmed on the list.**



(1) Status

Displays the status of the sensors registered on the [List of NG Sensor Occurrences].

Green (ON)	No NG has occurred.
Red (ON)	NG has occurred once or more.
Red (Blink)	The number of NG occurrences has increased after displaying the latest [List of NG Sensor Occurrences].
Yellow (lighting) Yellow (blinking)	The sensor is not connected due to a connection error. Check the connection with the sensor. Blinks when confirming the [List of NG Sensor Occurrences] for the first time. Lights up when the status has been confirmed.
Gray	The sensor has not been registered, or the information of the sensor is being acquired.

(2) NG Count

Displays the status of the sensors registered on the [List of NG Sensor Occurrences].
The status of the sensor is displayed with characters.

NG: (counts)	The NG count is displayed as a value from 0 to 99999. The NG count is the accumulated value after turning the power on. The maximum number of NGs that can be displayed is 99999. After 99999 NGs have occurred, the number will not increase.
SYS ERR (No.)	An error number will be displayed when an important or fatal error occurs with the sensor. If multiple errors occur, the lowest error number will be displayed.
CONNECTION ERROR	ERROR The sensor is not connected.
UPDATING	The information from the sensor is being acquired. For example, UPDATED is displayed when the information from the sensor has not yet been acquired after startup.

Reference

To reset the NG count, perform one of the operations below:

- Press [Clear All NG Counts]/[Clear NG Count]
- Turn the power off.
- Initialize the sensor.

(3) Device Name

Displays the device name assigned to the sensor.

(4) IP Address

Displays the IP address set for the sensor.

(5) [Clear All NG Counts] button

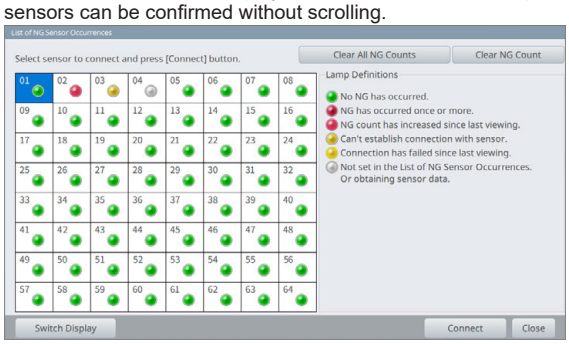
Clears the NG occurrence status of all the sensors registered on the [List of NG Sensor Occurrences].

(6) [Clear NG Count] button

Clears the NG occurrence status of the selected sensor.

(7) [Switch Display] button

Switches the sensor list display. NG occurrence status of up to 64 sensors can be confirmed without scrolling.



(8) [Connect] button

Connects the sensor currently selected and displays an image.
If the sensor on which NG occurred is selected, it can change to that sensor.

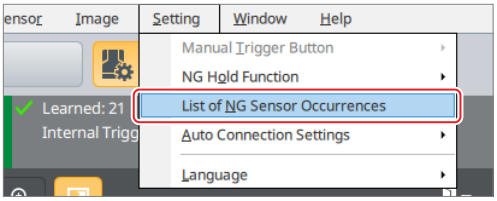
Setting [List of NG Sensor Occurrences]

1 Display the main screen in [Program].

2 Perform the following.

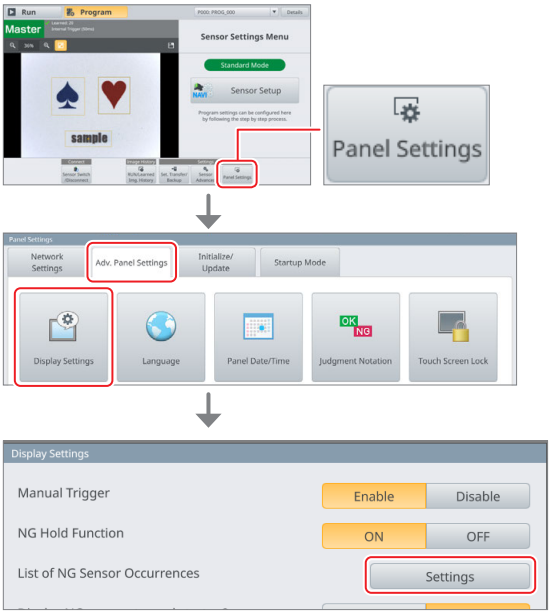
❍ **For a PC**

Select [Setting] → [List of NG Sensor Occurrences] from the menu bar.



❍ **For a control panel/display expansion unit**

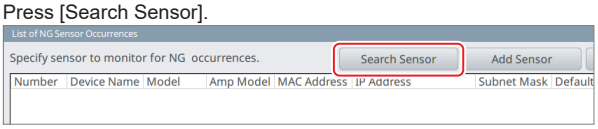
Select [Panel Settings] → [Adv. Panel Settings] tab → [Display Settings] → [List of NG Sensor Occurrences].



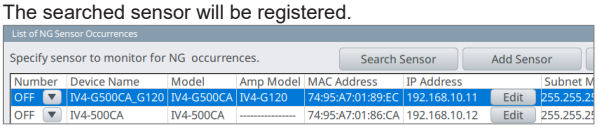
3 Register the sensor.

● **When searching for a sensor and registering it**

Press [Search Sensor].

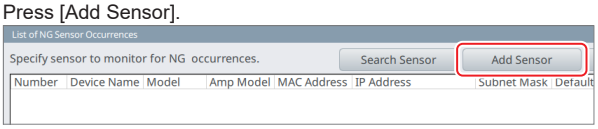


The searched sensor will be registered.



● **When registering by specifying the IP Address of the sensor**

Press [Add Sensor].



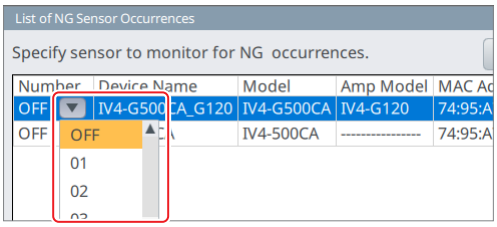
Enter the IP address of a sensor and press [OK].



The sensor of the specified IP address will be registered.

Reference The number displayed on the [List of NG Sensor Occurrences] is automatically assigned.

4 Select the number which is displayed on the List of NG Sensor Occurrences from the drop-down menu of [Number].



Reference
- Numbers will be displayed on [List of NG Sensor Occurrences] in the selected order.
- If the sensor was registered by specifying the IP address, the number is automatically assigned. Change the number as needed.

5 Repeat step 3 and step 4 and register the sensors for which the NG status will be monitored.

Point
- **Up to 64 sensors can be registered on [List of NG Sensor Occurrences].**
- **To initialize [List of NG Sensor Occurrences], press [Clear].**

6 Press [OK].

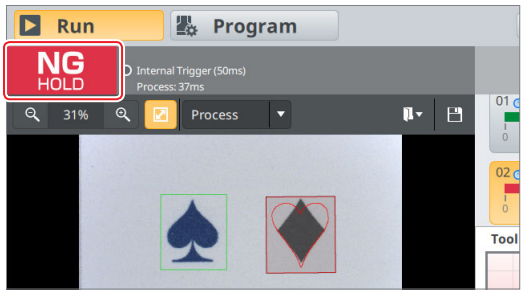
The system returns to the main screen in [Program].

NG Hold Function

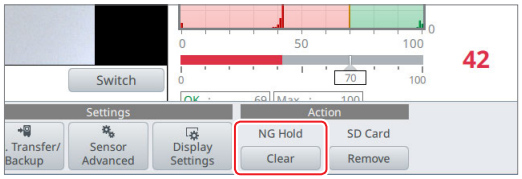
(Holding the Image of the Sensor on which NG Occurred)

Overview of the NG Hold function

The image of the sensor on which NG occurred during Run mode is held and [NG HOLD] is displayed on the screen.



To release the held image, display [Menu] and then press [Clear] under [NG Hold].



Point

- **If another NG occurs during holding of an NG image, the NG image will be updated.**
- **The NG hold status will be released with one of the operations below.**
  - **When the run screen is changed to the [Sensor Setup Menu] screen.**
  - **When external master image registration is performed.**
  - **When the status output is reset with an error clear external input.**
  - **When [Clear] for [NG Hold] is pressed.**
  - **When a program is changed.**
- **The operation Information will be updated during NG hold.**

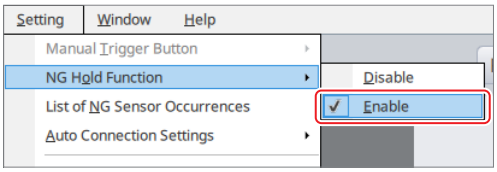
Reference

When multiple monitor devices (IV4-CP70/IV4/DU10/ IV Smart Navigator) are connected, executing [Clear] of [NG Hold] from a monitor device clears [NG Hold] for other monitor devices as well.

Setting the NG Hold function

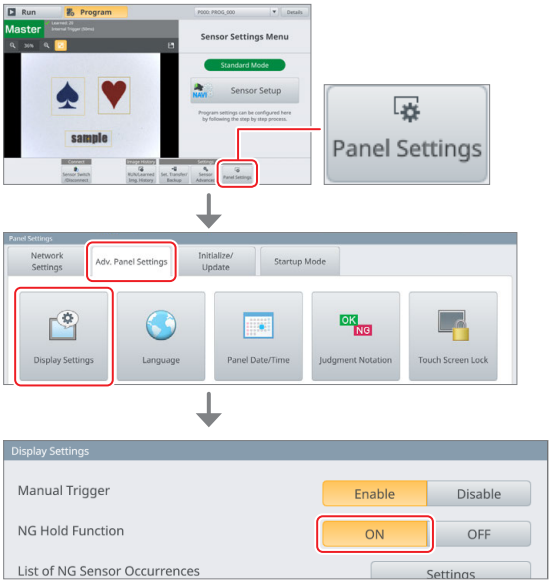
For a PC

Select [Setting] → [NG Hold Function] → [Enable] from the menu bar.



For a control panel/display expansion unit

Select [Panel Settings] → [Adv. Panel Settings] tab → [Display Settings] → [NG Hold Function] → [ON].



5 Running

Running Image History
(Checking the Images Captured During Operation)

The sensor has built-in memory for saving images used for judgment. The newest image is automatically saved as [Running Image History] in accordance with [Logging Settings].
“Setting the Logging Conditions (Save Conditions)” (page 5-18)

When [Running Image History] is displayed, the images saved in the sensor can be read to check the reasons and trends that caused the NG to occur.
Up to 100 images can be saved.

Important

Since the [Running Image History] memory is "volatile memory", all saved images are erased when the power is turned off.
To save the images, perform “Backing Up Running Image History in a Batch” (page 5-17).

Reference

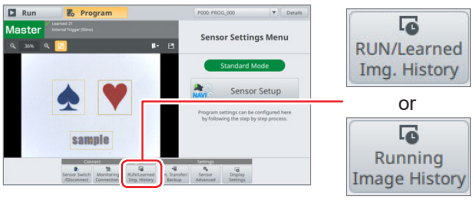
When multiple monitor devices (IV4-CP70/IV4-DU10/IV Smart Navigator) are connected, displaying [Running Image History] on a monitor device prevents other monitor devices from displaying it.

Displaying Running Image History

Displaying from the main screen in [Program]

1 Display the main screen in [Program].

2 Press [RUN/Learned Img. History] or [Running Image History].

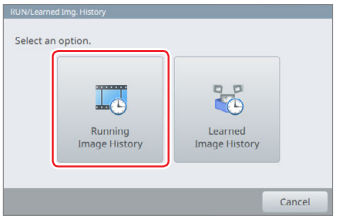


Reference

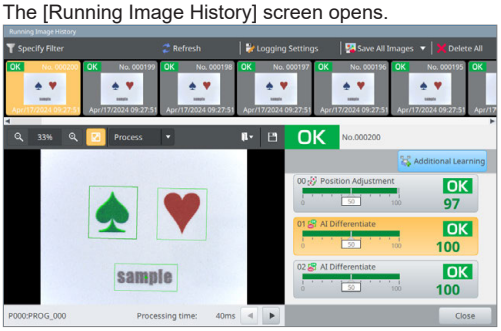
[RUN/Learned Img. History] is displayed in the following cases:
- Standard mode: When AI Differentiate/AI Identify/AI Count/AI OCR is set.
- Sorting mode: When AI Differentiate is set.
- In AI Through Count mode.
- When AI trigger is set.

In cases other than the above, [Running Image History] is displayed.

3 If you pressed [RUN/Learned Img. History], select [Running Image History].



The [Running Image History] screen opens.



Displaying from the Main Screen in [Run]

1 Display the main screen in [Run].

2 Press [RUN/Learned Img. History] or [Running Image History].

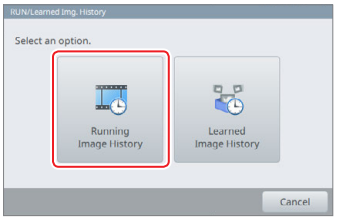


Reference

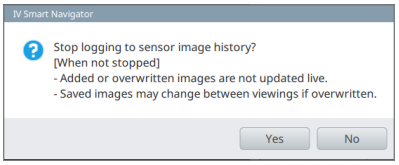
[RUN/Learned Img. History] is displayed in the following cases:
- Standard mode: When AI Differentiate/AI Identify/AI Count/AI OCR is set.
- Sorting mode: When AI Differentiate is set.
- In AI Through Count mode.
- When AI trigger is set.

In cases other than the above, [Running Image History] is displayed.

3 If you pressed [RUN/Learned Img. History], select [Running Image History].



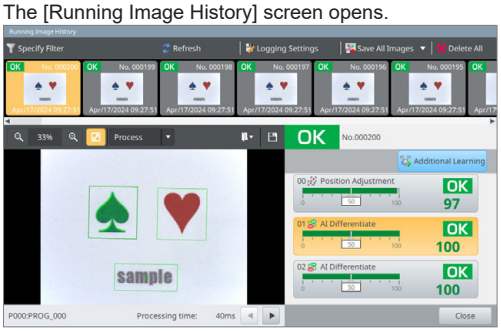
4 Select whether or not to stop logging while running (image-updating of the image history).



Point

When operation is not paused
- **The added or overwritten history image will not be updated automatically. To update, close [Refresh] and then display it again.**
- **When an image in the history is erased by overwriting and the sensor is updated while displaying the image, the image may not be displayed again.**

The [Running Image History] screen opens.



Checking Running Image History

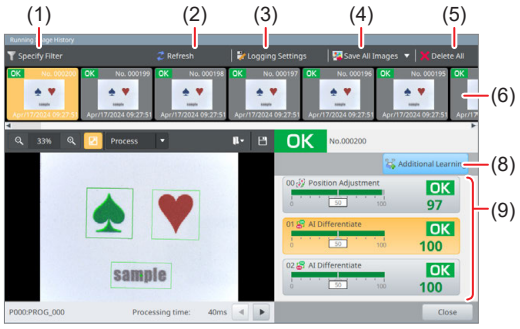
1 Display [Running Image History].

“Displaying Running Image History” (page 5-14)

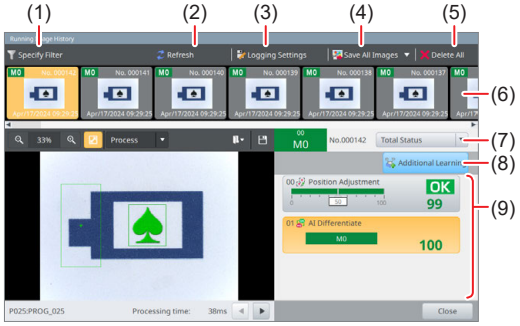
2 Check the [Running Image History] screen.

Reference For a control panel/display expansion unit, (4) is [Batch Backup].

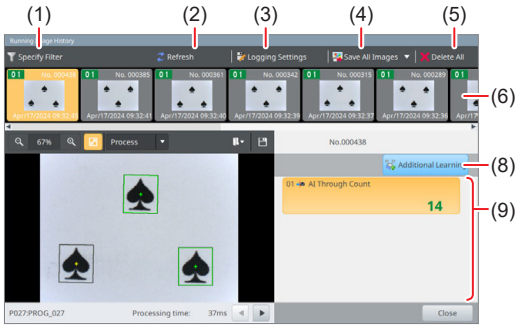
❍ **Standard Mode**



❍ **Sorting Mode**



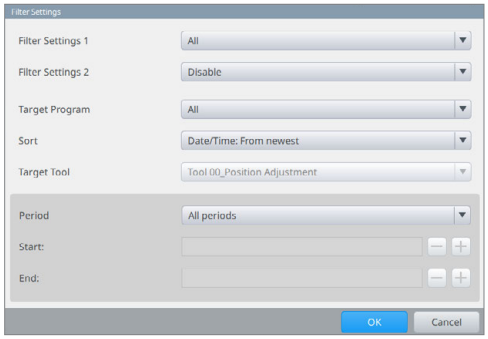
❍ **AI Through Count Mode**



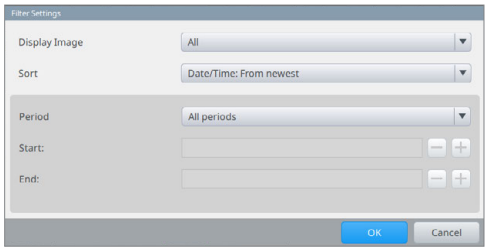
(1) [Specify Filter] button

Set the conditions for the images to be displayed on the [Running Image History] screen.

❍ **Standard mode / Sorting mode**



❍ **AI Through Count Mode**



Filter Settings 1 (Standard Mode/Sorting Mode)

Select the type of image to be displayed.

- All
- OK Only
- NG Only
- NG/near threshold OK
- Near threshold OK

Filter Settings 2 (Standard Mode/Sorting Mode)

Select the type of image to be displayed.

- Disable
- Before & After NG Images
- Fixed Interval Images
- Before & After NG Images/Fixed Interval Images

Target Program (Standard Mode/Sorting Mode)

Select the program to display the image.

Display Image (AI Through Count Mode)

Select the tool number to display the image.

- **All**
- **[Tool 01] to [Tool 08]**
  Displays only the images that have the selected number.

Sort

Selects the order of images to be displayed on the [Running Image History] screen from the following.

- Match: From highest (Standard Mode/Sorting Mode only)
- Match: From lowest (Standard Mode/Sorting Mode only)
- Date/Time: From newest
- Date/Time: From oldest

Target Tool

Displays only the images containing the selected tools on the [Running Image History] screen.

Period

Specifies the images to be displayed on the [Running Image History] screen by time period.

- **All periods**
- **Manual**
  Specifies the time period for [Start] and [End], and displays images saved during the specified period.
  Press the area you want to change and use the [+]/[-] buttons to change it.

(2) [Refresh] button

Displayed if "No" is selected in the logging stop dialog when the image history to be displayed from the [RUN] main screen. Clears the image history displayed on the IV Smart Navigator, and then acquires and displays the latest image history from the sensor.

(3) [Logging Settings] button

“Setting the Logging Conditions (Save Conditions)” (page 5-18)

(4) [Save All Images] button (PC)/[Batch Backup] button (control panel/display expansion unit)

Saves the running image history to individual files (*.bmp and *.iv4p) or a batch backup file (*.iv4a).

“Saving Running Image History Individually (PC Only)” (page 5-16)
“Backing Up Running Image History in a Batch” (page 5-17)

Point

When making batch backup from the image history view, you can select [Settings] or [Setting + Image History] as the backup target.

(5) [Delete All] button

Clears the history images saved in the sensor.

(6) Thumbnail images

Displays the total status result (standard mode), the part number (sorting mode), tool number (AI through count mode), trigger count, saved date and time, and thumbnail images.

Reference

For details about the number of triggers, refer to “Statistical/Tool Information Display” (page 5-7).

(7) Part type selection button (sorting mode only)

Displays the matching rate and status result for images registered in the selected part type judged as masters for each tool.

(8) [Additional Learning] button

Performs the additional learning with the selected history image.

“Additional Learning from the Running Image History” (page 6-6)

Reference

[Additional Learning] is displayed in the following cases:

- Standard mode:When AI Differentiate/AI Identify/ AI Count/AI OCR is set.
- Sorting mode:When AI Differentiate is set.
- When AI Through Count mode is set.
- When AI trigger is set.

(9) Tool list

Displays the tool list set in the program of the images.

Reference

An image displayed with red below requires processing with a setting different than the current program.

- Program number
- Program name
- Trigger No.
- Processing time

Saving Running Image History Individually (PC Only)

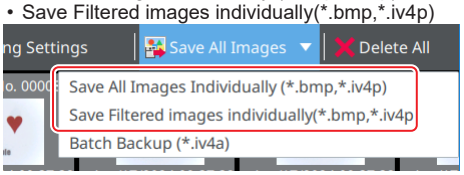
Saves image histories saved in the sensor to individual files (*.bmp and *.iv4p).

1 Display the running image history screen.

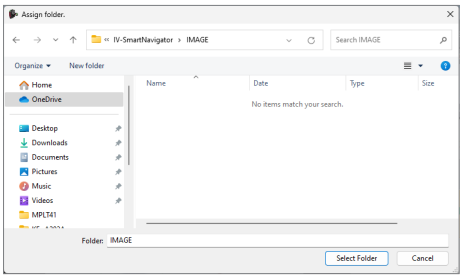
“Displaying Running Image History” (page 5-14)

2 Press [Save All Images] and select the saving method from the following.

- Save All Images Individually (*.bmp,*.iv4p)
- Save Filtered images individually(*.bmp,*.iv4p)



3 Specify the desired save destination and press [OK].



The save completion message opens.

Reference

This process saves all files at the same time. To save a file individually, save it with the [Save] button on the image tool bar.

“Operation of the Image Tool Bar” (page 3-14)

4 Press [OK].

Returns to the [Running Image History] screen.

Backing Up Running Image History in a Batch

Saves all the images saved in the sensor to a batch backup file (*.iv4a).

Point **The [Filter Settings] option is disabled.**

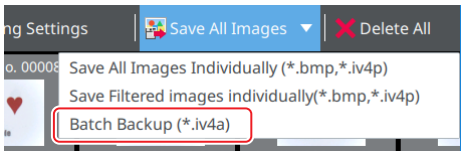
1 Display the running image history screen.

“Displaying Running Image History” (page 5-14)

2 Perform the following.

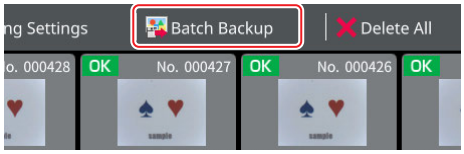
- **PC**

  Press [Save All Images] and select [Batch Backup (*.iv4a)].

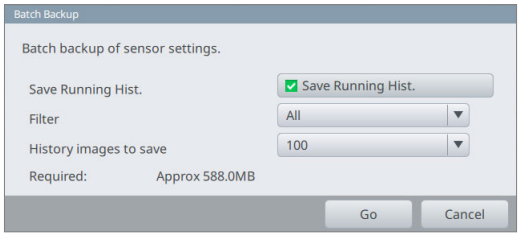


- **Control panel/Display expansion unit**

  Press [Batch Backup].



3 Configure the Batch Backup settings.



- **Save Running Hist.**

  Leave it on.

- **Filter**

  Select [All] or [NG Only].

Point **In AI Through Count Mode, image history is not saved by selecting [NG Only].**
To save image history, select [All].

- **History images to save**

  The maximum number of the image histories to be saved is 100.
  It can be selected from 20/50/100.

- **Required**

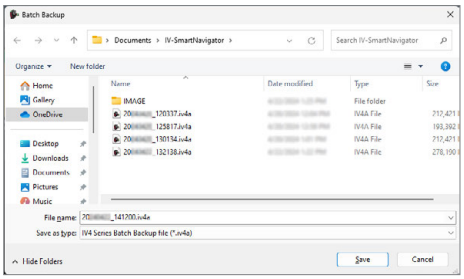
  Displays the expected size of the backup file.

4 Press [Go].

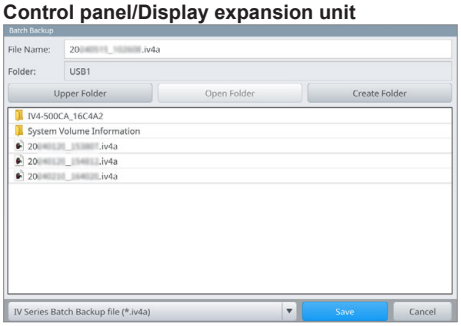
Point **When the running image history has been saved while in [Run], the images saved object may be updated and deleted during the batch backup. A deleted image is not saved. Because of this, saving while in [Program] is recommended.**

5 Set the save destination and file name, and press [Save].

PC



Control panel/Display expansion unit



The backup completion message opens.

6 Press [OK].

Setting the Logging Conditions (Save Conditions)

Set the logging conditions (save conditions) for the image history.

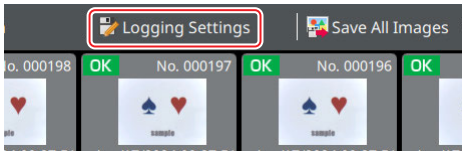
Point **[Logging Settings] can only be set when [Running Image History] is displayed from the main screen in [Program].**

1 Display the main screen in [Program].

2 Display the running image history screen.

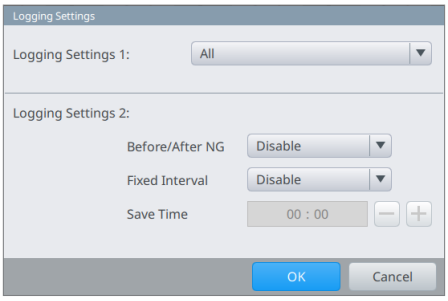
“Displaying Running Image History” (page 5-14)

3 Press [Logging Settings].



4 Set the logging conditions.

Standard mode / Sorting mode



❍ Logging Settings 1

- **All**
  Saves all the images to the image history regardless of the status result.
- **OK Only**
  Only saves images where the status result is OK to the image history.
- **NG Only (default value)**
  Only saves images where the status result is NG to the image history.
- **OFF**
  Images are not saved.
- **NG/near threshold OK**
  Saves the following images.
  - Among the images whose judgment results are OK, those images for which the matching rates of the AI Differentiate, AI Identify, or AI OCR (when [Show Matching Rate] is enabled) are closer to the threshold
  - Images whose status results are NG

Reference If saving OK images where the matching rates are close to the threshold, the images that should be judged as NG which have been mistakenly judged as OK can be searched.

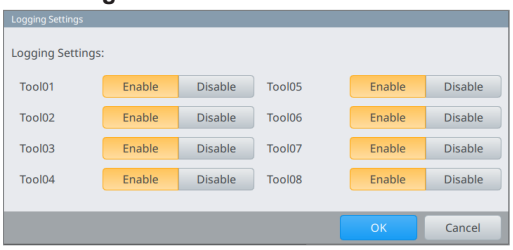
❍ Logging Settings 2

- **Before/After NG**
  Saves the specified number of before and after images based on the image determined to be total status NG.
  (Disable/1/5/10)

  Reference When [5 images] is set, the following 11 images will be saved:
  - Images whose status results are NG: 1 image
  - Images just before NG judgment: 5 images
  - Images immediately after NG judgment: 5 images

- **Fixed Interval**
  Saves one image currently being judged at each specified interval or at a specified time.
  (Disable/Every minute/Every 5 minutes/Every 10 minutes/Every 30 minutes/Every 60 minutes/At a specified time)
  Even if an image is judged not to match [Logging Settings 1], it will be saved in image history.

AI Through Count Mode



❍ Logging Settings

The image is saved when counting with the counting tool for the tool number for which [Enable] is selected.

5 Press [OK].

6

Adjusting

This chapter explains the adjustment method to make full use of the judgment capacity of this unit.

Auto Adjustment by the Additional Learning.....6-2
Adjusting Thresholds for Judgment.....6-15
Stabilizing the Judgment 6-16
Shortening the Processing Time 6-24

Auto Adjustment by the Additional Learning

Additional Learning

The additional learning function enables a user to stabilize the following judgment processing:
- AI Differentiate, AI Trigger (Standard Mode, Sorting Mode)
- AI Identify, AI Count, AI OCR (Standard Mode)
- Count Tool (AI Through Count Mode)

By imaging a target where the detection is not stable or by using images from the history to learn, judgment can be adjusted automatically. By performing the additional learning of multiple images, the stability is improved automatically.

Reference A target whose judgment is not stable is the target where the capture status is different from the registration status of the learning settings.
Target misalignment (shape, surface condition, dirt, setting position) and the change of ambient light or background can influence the judgment status.

Method for the additional learning

Using the capture image while in operation

“Additional Learning by Taken Image” (page 6-3)

Using the image history

“Additional Learning from the Running Image History” (page 6-6)

Using the learned image history

By using the learned image history and changing the status results of the tool, judgment processing is adjusted automatically.
In addition, delete images that are needed for learning mode.

“Additional Learning from the Learned Image History” (page 6-9)

Using a saved image

Use a batch backup file (*.iv4a), individual program backup file (*.iv4a) or image capture file (*.iv4p) for adjustment.

“Additional Learning from File” (page 6-10)

What should be done in the following case

Condition	Remedy	Reference
When additional learning is performed but the wrong status result (OK/NG, or Part Type) is applied.	Modify the learned image to the correct status result in the [Learned Image History] screen, and additional learning.	6-9
When you want to check or delete the learned image.	Check or delete the image in the [Learned Image History] screen.	6-7
When you want to look automatically for an image whose detection is not stable.	Perform additional learning of the “Image to be Learned” in the [Additional Learning] screen.	6-6
• When additional learning is mistakenly performed on two copies of the same image and one of them is OK and the other is NG. • When additional learning is performed on two copies of the same image, each as a different part, or both as a different part.	Delete the unneeded image in the [Learned image history] screen.	6-7
When an inspection is not stable even though additional learning has been repeatedly performed.	• Take large images of the part where the difference in an OK/NG image or part type image is clear. • Set the tool window only for the part where the difference in an OK/NG or part type is clear. For images where the difference in an OK/NG or part type image is small in the tool window, the detection may not be stable. • When a positional deviation of the target occurs, adjust the settings of the position adjustment. In addition, set the search algorithm to the high accuracy. • Perform the additional learning using multiple images where the judgments are not stable. • Check if there are any images with non-reflection.	6-16 6-20
When changing the settings of the program, such as modifying, adding, or deleting tool windows, or re-doing the learning operation by changing the settings for OK/NG target learning or part type image registration.	The additional learning will be cleared. Perform additional learning as needed. The registered image remains in [Learned Image History], however, it will be in the state that is not reflected in the learning process (not reflected).	6-9
When the sensor recognizes the background (no target) as OK. But the status should be NG.	Perform additional learning of an image where the background is captured. Register the status result as NG (standard mode only).	6-3 6-6 6-10
When the sensor should judge the background (no target) as OK.	Perform additional learning of an image where the background is captured. Register the status result as OK (standard mode only).	
There are multiple “targets the sensor should judge as OK” and “targets the sensor should judge as NG”.	Perform additional learning for all of the targets. Register the status results as OK or NG per tool window (standard mode only).	

Additional Learning by Taken Image

Standard mode / Sorting mode

1 **Display the main screen in [Run].**

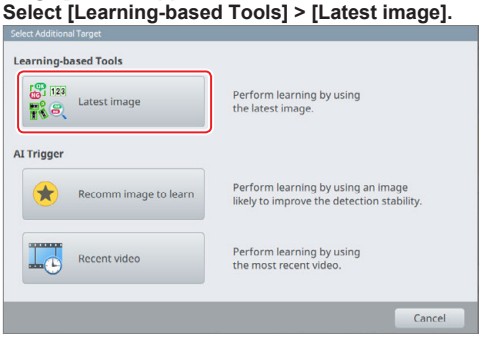
2 **Capture an image where the target is the object desired for additional learning.**

3 **Press [Additional Learning].**

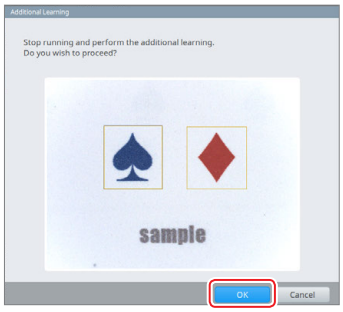


Point

When using [AI Trigger], the [Select Additional Target] screen appears.
Select [Learning-based Tools] > [Latest image].



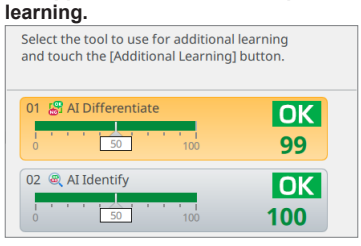
4 **Press [OK].**



The operation will stop.

Point

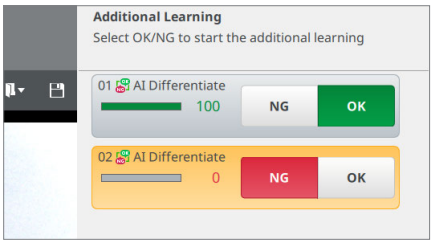
- **When using two or more types of tools that can perform additional learning, a screen for selecting the tool to perform additional learning will appear. Select the tool to perform additional learning.**



- **When the number of images registered for additional learning has exceeded the upper limit, a confirmation screen appears after operation stops.**
  “Operation When the Registered Number Reaches the Upper Limit” (page 6-14)

5 **Confirm the selection state of the status result. Change the status result as needed, then press [Start Learning].**

Standard mode (for a AI Differentiate)



Point

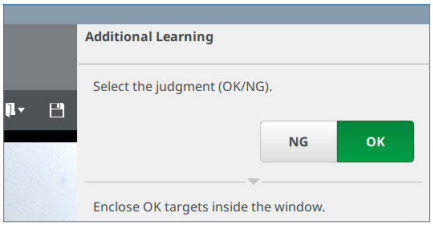
When multiple tool windows are set, confirm/ change all status results for the tool windows.

Standard mode (for AI Identify)

Select the judgment (OK/NG), enclose the target with the tool window, and press [Start Learning].

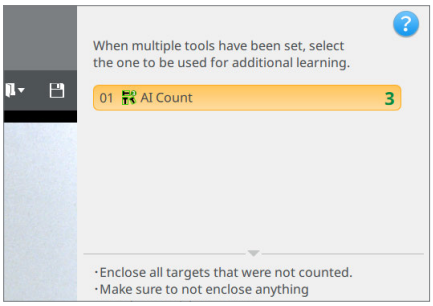
Reference

When learning as NG, the search region is subject to learning as NG. Therefore, no matter where the tool window position is set, it is recognized as NG.



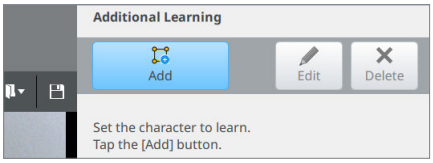
Standard mode (for AI Count)

Select the tool to perform additional learning, leave only the target to be counted enclosed using [Add] and [Delete], and then press [Start Learning].
For details about steps, refer to “Additional Learning” (page 4-31).

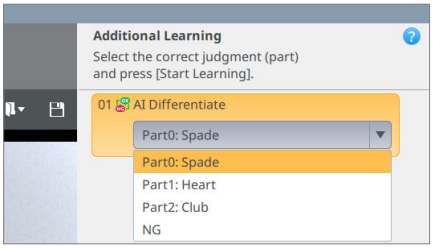


Standard mode (for AI OCR)

Press [Add] and set the character to learn.
For details about steps, refer to “Character Learning (Additional Learning)” (page 4-41).



Sorting mode (for a AI Differentiate)



6 **Press [OK].**

Learning will be performed.

7 **After learning has been completed, press [OK].**

Point

- **When a similar learned image is found, the [Check Registered Images] screen opens.**
  “Checking Similar Images and Additional Learning (AI Differentiate/AI Trigger Only)” (page 6-14)
- **You can edit and/or delete images where additional learning of the wrong status result is performed in the [Learned Image History] screen.**
  “Additional Learning from the Learned Image History” (page 6-9)

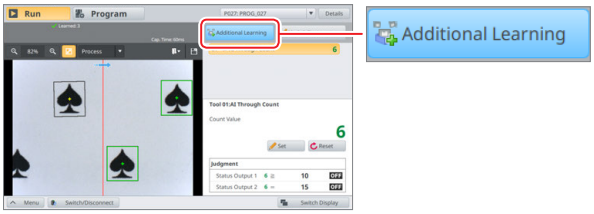
The system returns to the operation screen.

AI Through Count Mode

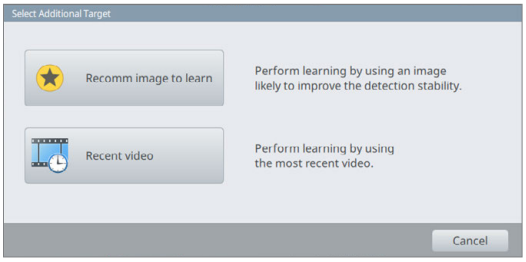
1 **Display the main screen in [Run].**

2 **Capture an image where the target is the object desired for additional learning.**

3 **Press [Additional Learning].**



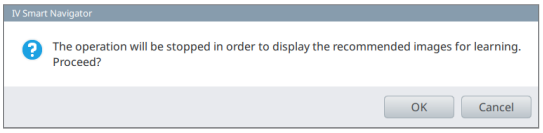
4 **Press [Recomm image to learn] or [Recent video].**



5 **Perform the following.**

- **Recomm image to learn**

  Press [OK].

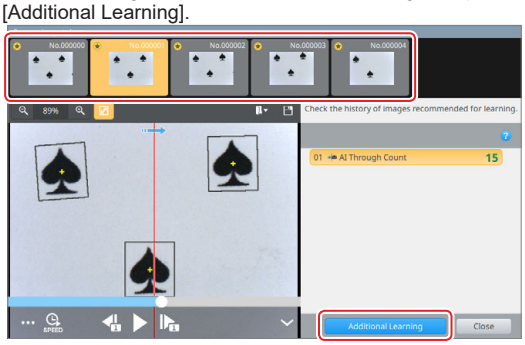


The operation will stop.

Point

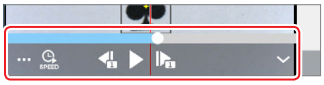
When the number of images registered for additional learning has exceeded the upper limit, a confirmation screen appears after operation stops.
“Operation When the Registered Number Reaches the Upper Limit” (page 6-14)

Select the image to perform additional learning, and press [Additional Learning].



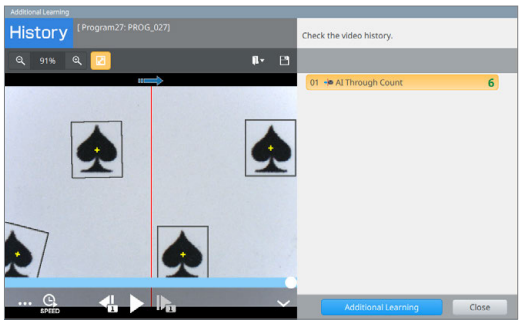
Point

Recommended images to learn are loaded as IV4 Series video files (*.iv4m). You can adjust the display position and perform additional learning with the image in any position.



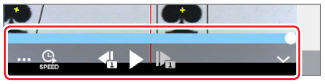
Recent video

Check the video, and then press [Additional Learning].



Point

Videos are loaded as IV4 Series video files (*.iv4m). You can adjust the display position and perform additional learning with the image in any position.



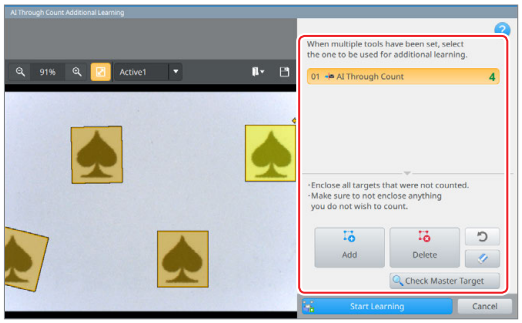
Press [OK].



The operation will stop.

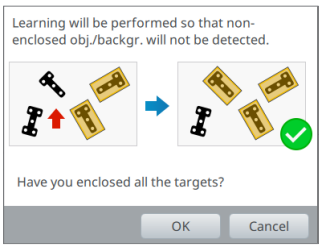
6 Configure the settings for additional learning.

- If multiple tools are set, select the tool to perform additional learning.
- When multiple tools are set, check that the window is correctly enclosed by all tools.
- If there are targets that have not been counted, press [Add] to enclose them.
- If a target to be excluded from the count is enclosed, select the applicable window and press [Delete].
- Press [Check Master Target] to check the image used when learning the master target to be counted in [Step 3. Tool Settings] under [Sensor Setup].



7 Press [Start Learning].

8 Check the settings and press [OK].



9 Press [OK].

10 Press [Close].

Additional Learning from the Running Image History

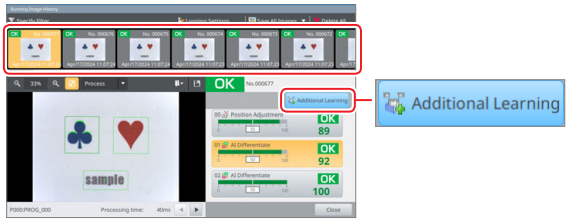
1 **Display the [Running Image History] screen.**

“Displaying Running Image History” (page 5-14)

2 **Select the image to perform additional learning, and press [Additional Learning].**

Point

When the number of images registered for additional learning has exceeded the upper limit, a confirmation screen appears after operation stops.
“Operation When the Registered Number Reaches the Upper Limit” (page 6-14)



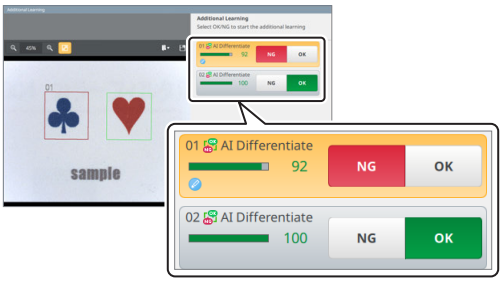
Reference

The confirmation screen for stopping operation during Run mode will be displayed. Press [OK], stop operation, and then perform additional learning again.

The [Additional Learning] screen opens.

3 **Confirm the selection state of the status result. Change the status result as needed, then press [Start Learning].**

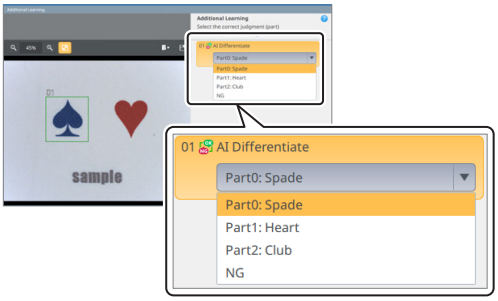
Standard Mode



Point

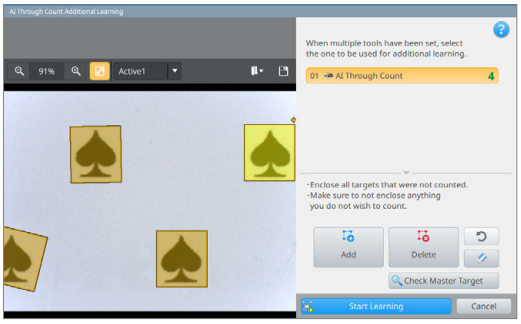
When multiple tool windows are set, confirm/ change all status results for the tool windows.

Sorting Mode



AI Through Count Mode

- If multiple tools are set, select the tool to perform additional learning.
- When multiple AI Count tools are set, check that the window is correctly enclosed by all tools.
- If there are targets that have not been counted, press [Add] to enclose them.
- If a target to be excluded from the count is enclosed, select the applicable window and press [Delete].
- By pressing [Check Master Target], the master image can be checked.



4 **Press [OK].**

Learning will be performed.

5 **After learning has been completed, press [OK].**

Point

- **When a similar learned image is found, the [Check Registered Images] screen opens.**
“Checking Similar Images and Additional Learning (AI Differentiate/AI Trigger Only)” (page 6-14)
- **You can edit and/or delete images where additional learning of the wrong status result is performed in the [Learned Image History] screen.**
“Additional Learning from the Learned Image History” (page 6-9)

The system returns to the [Running Image History] screen.

Displaying the [Learned Image History] screen

The [Learned image history] screen is the screen that can confirm/edit images registered in the OK/NG target learning, part image registration, or additional learning.

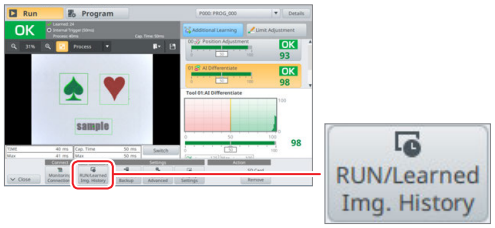
Point

The [Learned image history] screen can be displayed when using a program in the learn tool.

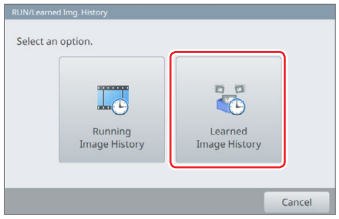
Displaying from the Main Screen in [Run]

1 **Display the main screen in [Run].**

2 **Display the menu, and then press [RUN/Learned Img. History].**



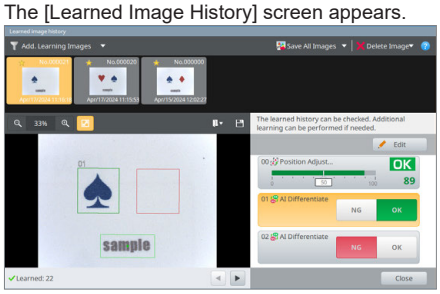
3 **Press [Learned Image History].**



The confirmation screen opens.

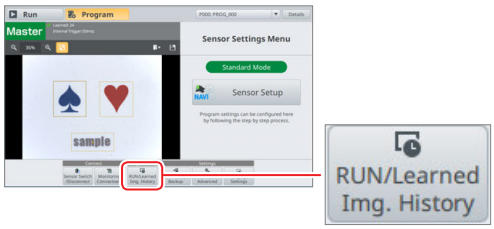
4 **Press [OK].**

The [Learned Image History] screen appears.

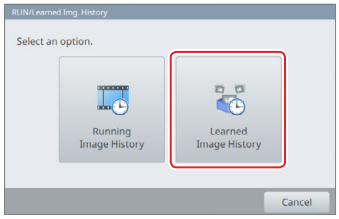


Displaying from the main screen in [Program]

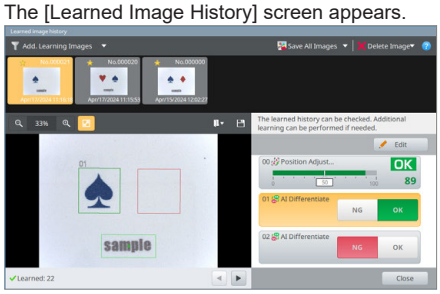
1 **Press [RUN/Learned Img. History] on the [Sensor Settings Menu] screen.**



2 **Press [Learned Image History].**



The [Learned Image History] screen appears.

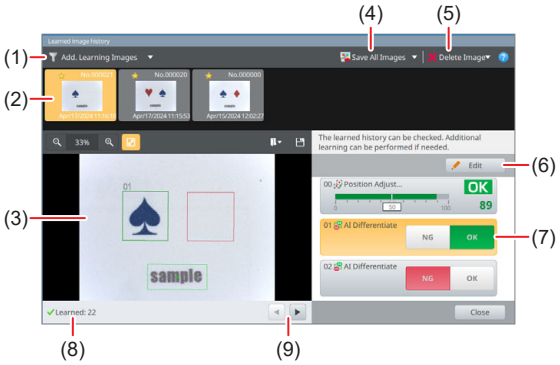


Point

When an image where an error occurs is included in the learned image history, a confirmation dialog opens.
“(2) Thumbnail images” (page 6-8)

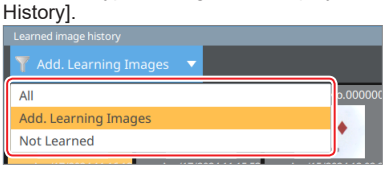
Confirming Learned Image History

Confirm the learned image history in the program.



(1) Image Type

Select the type of image to be displayed on [Learned Image History].



(2) Thumbnail images

Displays the image status, image number, and learned date and time.



Type	Description
	The original image acquired when registering OK/NG target or a part type.
	The image acquired when [Variable Brightness] is [ON]. Images where the brightness is different are saved. • **Standard Mode** 8 OK images, 8 NG images • **Sorting Mode** 6 images per part are saved.
	Images with high learning effect. *1 Since the influence on judgment is large, the judgment capacity of the sensor may change when editing or deleting to perform additional learning.
	An image on which an error has occurred. • **Position Adjustment Error** There is a tool window protruded out of the view range as the result of the position adjustment. Additional learning cannot be performed for this image.

*1 This symbol is displayed on the Learned Image History of AI Differentiate and AI Trigger. The symbol is not displayed on the Learned Image History of AI Identify, AI Count, AI OCR, and AI Through Count.

(3) History image

Displays the image saved in the sensor.

(4) [Save All Images] (PC only)

Saves all the images saved in the program to individual files (*.bmp and *.iv4p) or a batch backup file (*.iv4a).

“Saving Running Image History Individually (PC Only)” (page 5-16)
“Backing Up Running Image History in a Batch” (page 5-17)

Point

- **To back up the images in a batch from the View screen, the save target will be [Settings/Running Image History].**
- **This button is not displayed on a control panel or display expansion unit.**

(5) [Delete Image]

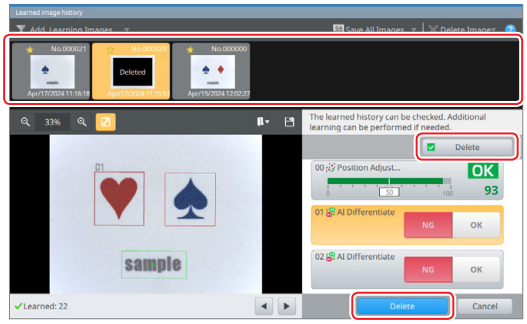
Deletes the image for which additional learning was performed.

Point

When deleting images from the learned image history, learning will be executed automatically using the remaining images to adjust the judgment process.

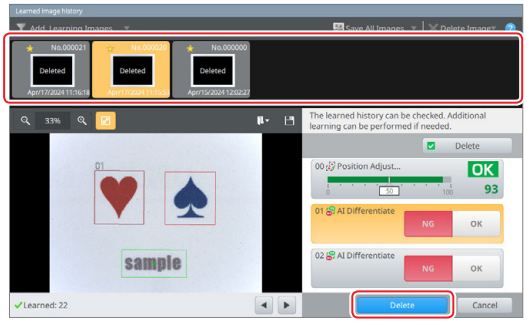
Select and Delete Images

Select a thumbnail image to be deleted, and then select the [Delete] check box.
After setting all targets for deletion, press [Delete] to delete the selected images.



Delete all selections

Deletes images for all additional learned images.
You can also delete images individually.



(6) [Edit] button

Selects this when editing the status result (OK/NG, or Part) of the selected image to redo learning.

“Additional Learning from the Learned Image History” (page 6-9)

(7) Tool list

Displays the tool list and the registered status results (OK/NG or Part Type) for the selected thumbnail image.

(8) Learned

Display the number of learned images and number of not reflected images.

(9) Select Image button

Moves thumbnail image selection.

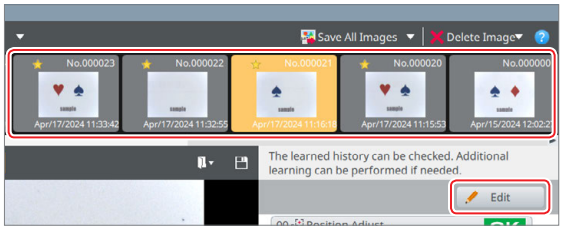
Additional Learning from the Learned Image History

Point **The status result of the images registered as the OK/NG target learning or part image registration cannot be edited.**

1 Display the [Learned Image History] screen.

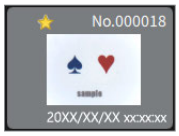
“Displaying the [Learned Image History] screen” (page 6-7)

2 Select an image on which to edit the status result and press [Edit].



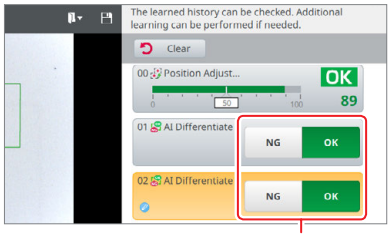
3 Confirm the selection state of the status result of the tool. Change the status result as needed.

Image reflected in the learning



Confirm the selection state of the status result of the AI Differentiate. Change the status result as needed.

Standard Mode



Change status result (OK/NG or Part)

Point **The part type discrimination results are shown in sorting mode.**

Image for which check is required



One or more images were ignored because learning was performed again after registering additional learning images. If necessary, perform [Edit] or [Delete Image] in the [Learned Image History] screen.

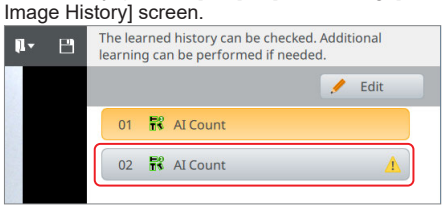
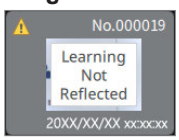
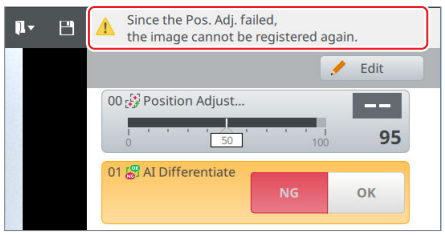


Image not reflected to the learning (with errors)



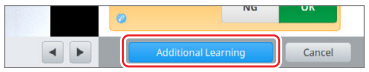
❍ Position Adjustment Error



There is a tool window protruded out of the view range as the result of the position adjustment. Additional learning cannot be performed for this image. Check the position adjustment, or delete the image in the [Learned Image History] screen.

4 When learning multiple images in a batch, change the selected image, and repeat step 3.

5 Press [Additional Learning].



The confirmation screen opens.

6 Press [OK].

Learning will be performed.

7 After learning has been completed, press [OK].

The system returns to the [Learned Image History] screen.

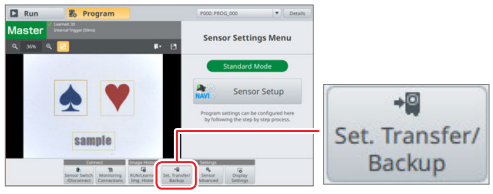
Point **You can delete images where additional learning of the wrong status result is performed in the [Learned Image History] screen.**
“(5) [Delete Image]” (page 6-8)

Additional Learning from File

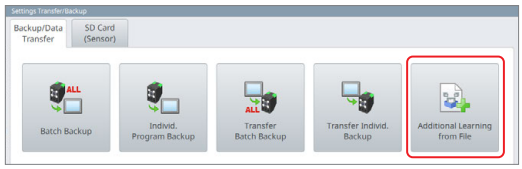
Point Additional learning from files is available for [Standard Mode] and [Sorting Mode].

1 Display the main screen in [Run] or [Program].

2 Press [Set. Transfer/Backup].

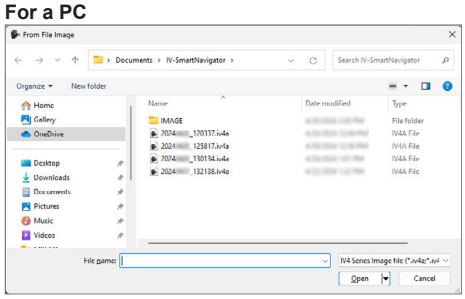


3 Press [Additional Learning from File].

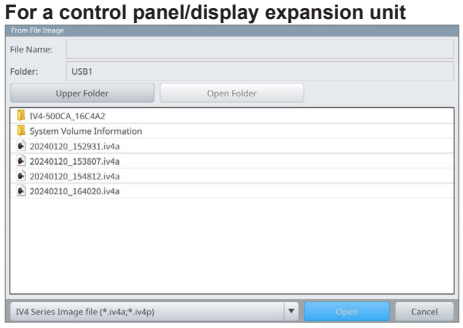


4 Select the batch backup file (*.iv4a), individual program backup file (*.iv4a) or image capture file (*.iv4p), and press [Open].

- For a PC



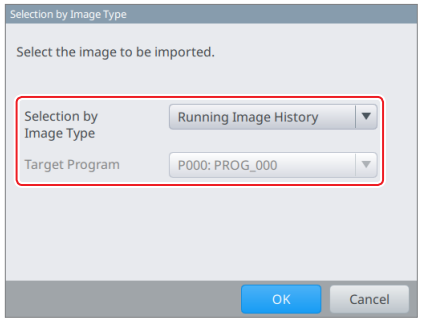
- For a control panel/display expansion unit



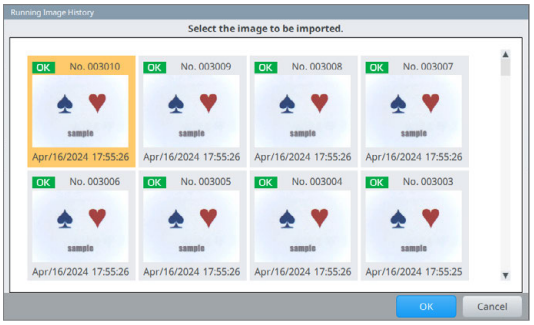
5 If a batch backup file (*.iv4a) or individual program backup file (*.iv4a) is selected, select the image type to be imported from the following.

- Running Image History
- Master Image
- Learned Image History

Select the target program when the Learned Image History is selected.



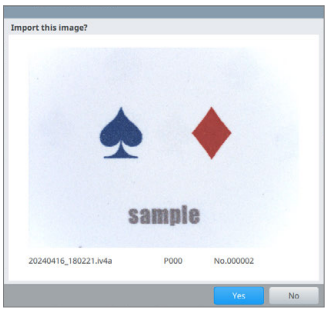
6 Select the image to be used for additional learning, and press [OK].



The confirmation screen for stopping operation during Run mode will be displayed. Press [OK], and stop operation.

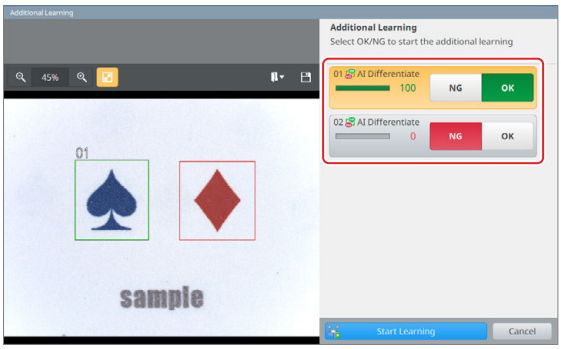
Point **When the number of images registered for additional learning has exceeded the upper limit, a confirmation screen appears after operation stops.**
“Operation When the Registered Number Reaches the Upper Limit” (page 6-14)

7 Check the image and press [Yes].



8 Confirm the selection state of the status result (OK/NG, or Part Type). Change the status result as needed, then press [Start Learning].

Check the part judgment results in sorting mode.



9 Press [OK].

Learning will be performed.

10 After learning has been completed, press [OK].

Point

- **When a similar learned image is found, the [Check Registered Images] screen opens.**
“Checking Similar Images and Additional Learning (AI Differentiate/AI Trigger Only)” (page 6-14)
- **You can edit and/or delete images where additional learning of the wrong status result is performed in the [Learned Image History] screen.**
“Additional Learning from the Learned Image History” (page 6-9)

The system returns to the main screen in [Program].

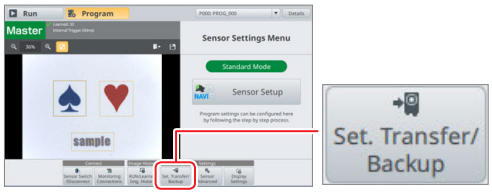
Additional Learning from Images in SD Card

The SD card data transfer function allows you to use an image transferred to the SD card for additional learning.

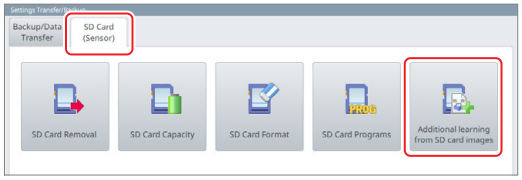
Point **Additional learning from images in the SD card is available for [Standard Mode] and [Sorting Mode].**

1 Display the main screen in [Program].

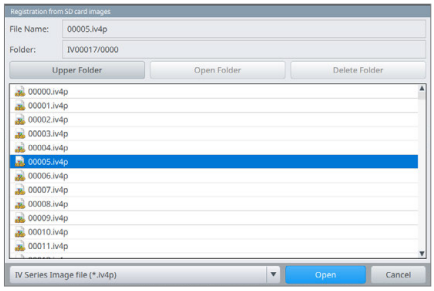
2 Press [Set. Transfer/Backup].



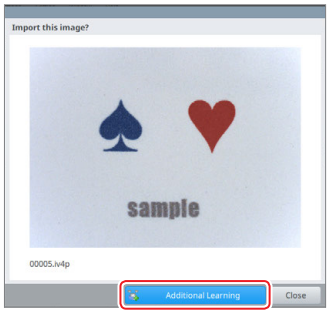
3 Select the [SD Card (Sensor)] tab and press [Additional Learning from Image in SD Card].



4 Select an image file (*.iv4p) in a desired folder and press [Open].

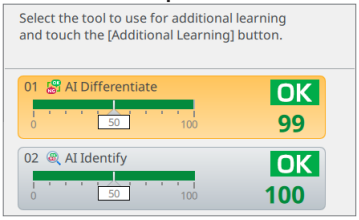


5 Press [Additional Learning].



Point

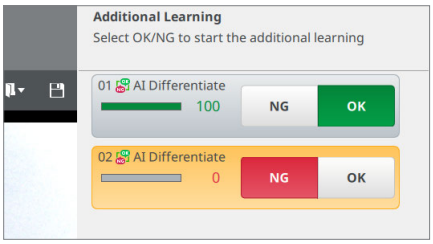
- **When using two or more types of tools that can perform additional learning, a screen for selecting the tool to perform additional learning will appear. Select the tool to perform additional learning.**



- **When the number of images registered for additional learning has exceeded the upper limit, a confirmation screen appears after operation stops.**
  “Operation When the Registered Number Reaches the Upper Limit” (page 6-14)

6 Confirm the selection state of the status result. Change the status result as needed, then press [Start Learning].

Standard mode (for a AI Differentiate)

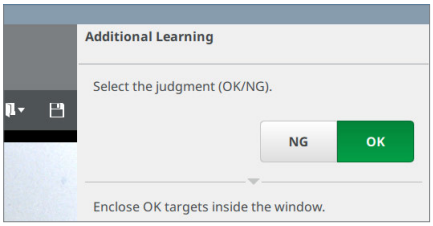


Point **When multiple tool windows are set, confirm/change all status results for the tool windows.**

Standard mode (for AI Identify)

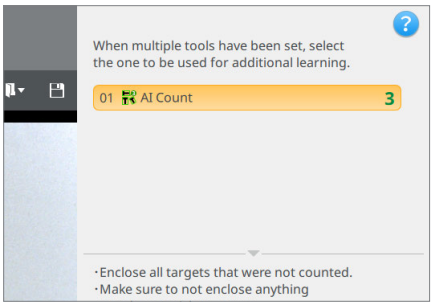
Select the judgment (OK/NG), enclose the target with the tool window, and press [Start Learning].

Reference When learning as NG, the search region is subject to learning as NG. Therefore, no matter where the tool window position is set, it is recognized as NG.



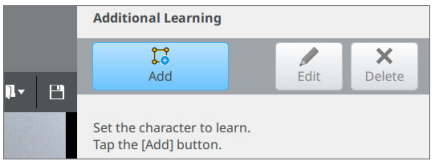
Standard mode (for AI Count)

Select the tool to perform additional learning, leave only the target to be counted enclosed using [Add] and [Delete], and then press [Start Learning].
For details about steps, refer to “Additional Learning” (page 4-31).

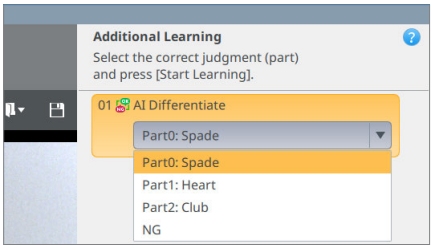


Standard mode (for AI OCR)

Press [Add] and set the character to learn.
For details about steps, refer to “Character Learning (Additional Learning)” (page 4-41).



Sorting mode (for a AI Differentiate)



7 **Press [OK].**

Learning will be performed.

8 **After learning has been completed, press [OK].**

Point

- **When a similar learned image is found, the [Check Registered Images] screen opens.**
  “Checking Similar Images and Additional Learning (AI Differentiate/AI Trigger Only)” (page 6-14)
- **You can edit and/or delete images where additional learning of the wrong status result is performed in the [Learned Image History] screen.**
  “Additional Learning from the Learned Image History” (page 6-9)

Delete Images from the SD Card

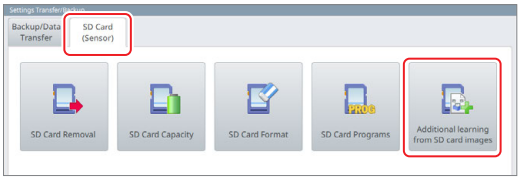
Delete an entire folder of images from the SD card.

1 **Display the main screen in [Program].**

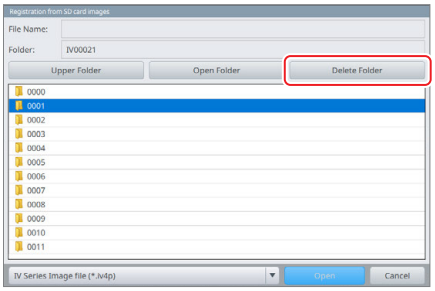
2 **Press [Set. Transfer/Backup].**



3 **Select the [SD Card (Sensor)] tab and press [Additional learning from SD card images].**



4 **Select a folder you want to delete and press [Delete Folder].**



5 **Press [OK].**

6 **After deleting the folder, press [OK].**

Maximum Number of Images that can be Learned

The number of images that can be learned are shown below.
If exceeding this limit, delete unnecessary learning images, etc.

❍ **Maximum number of images that can be registered in one program**
200

❍ **Total number of images in Program No. 0 to 31**
Approx. 1000

❍ **Program No. 32 to 127**
Up to 200 images can be registered for each program.

In addition, the number of images that can be learned in one program varies from tool to tool.

Mode	Tool	No. of images that can be learned[*1]
Standard Mode Sorting Mode	AI Trigger	100
	AI Differentiate[*2]	100[*7]
Standard Mode	AI Identify[*3]	200 (max. 50 per tool)
	AI Count[*4]	65 (max. 50 when one tool is set)
	AI OCR[*5]	200
AI Through Count Mode	Count Tool[*6]	• High Speed/Standard: 51 (max. 50 when one tool is set) • High Accuracy: 55 (max. 50 when one tool is set)

*1 The maximum total number of images that can be learned with the set tool is 200.
- **Example of number of images that can be registered**
  AI Trigger: 50 images + AI Differentiate: 50 images + Learning Count: 50 images = 150 images < 200 images
  The total number of images registered by each tool is less than 200, so learned images can be registered.
- **Example of number of images that cannot be registered**
  AI trigger: 100 images + AI Differentiate: 60 images + Learning count: 50 images = 210 images > 200 images
  Learned images cannot be registered because the total number of images registered by each tool exceeds 200.

*2 Even if multiple [AI Differentiate] are set in the same program, common learning images are used.
Example
If two [AI Differentiate] are set, the number of images that can be learned with [AI Differentiate] in that program is limited to 100 images.

*3 If multiple [AI Identify] tools are set in the same program, individual learned images are registered.
Example
When three [AI Identify] tools are set, up to 50 images can be registered for each, for a maximum of 150 images that can be learned.

*4 The maximum number of additional learning images is 49 and the maximum number of learning images is 16 (up to 16 [AI Count] tools can be set per program, and one learning image can be set for each tool), for a total of 65 possible learning images.
If one [AI Count] tool is set, there will be one learning image and 49 additional learning images, for a total of 50 images that can be learned.

*5 Even if multiple [AI OCR] tools are set in the same program, common learning images are used.
Example
If two [AI OCR] tools are set, the number of images that can be learned with [AI OCR] tools in that program is limited to 200 images.

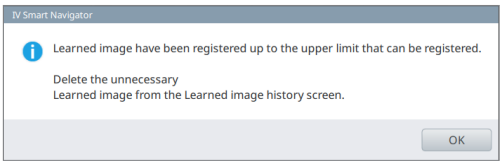
Maximum number of additional images/number of learning characters	200 images/200 characters
Number of additional windows per additional learning	32
Character types that can be registered in the user dictionary	Up to 200

*6 The maximum number of images for additional learning is 49, regardless of [Operation Mode].
As the number of tools that can be set varies depending on [Operation Mode], the number of images that can be learned in a single program varies.
- **High Speed/Standard**
  As up to two [Count Tools] can be set, two learning images and 49 additional learning images for a total of 51 images that can be learned.
- **High Accuracy**
  As up to six [Count Tools] can be set, six learning images and 49 additional learning images for a total of 55 images that can be learned.

*7 When the variable brightness is turned off, the number of learned images will be less than 100.

Operation When the Registered Number Reaches the Upper Limit

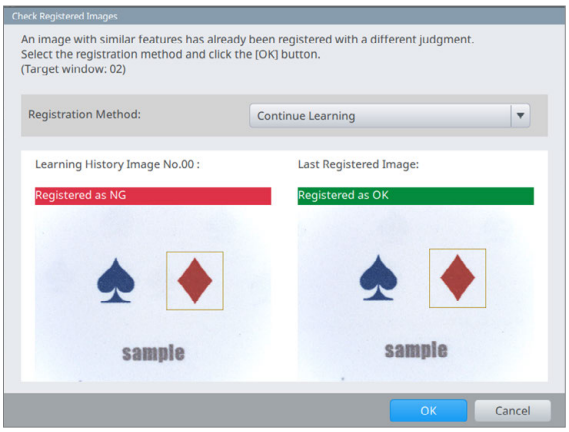
If additional learning is performed once the upper limit of images has been reached, a confirmation screen will be displayed. Confirm the images recommended to be deleted, and delete them.



Checking Similar Images and Additional Learning (AI Differentiate/AI Trigger Only)

When images have similar features to images already registered with a different status through additional learning, the [Check Registered Images] screen will appear. Confirm the status result for each image.

1 The [Check Registered Images] screen appears.



2 Select the registration method.

Standard Mode

❍ Continue Learning with Both OK

Performs the additional learning regarding both status results of [Registered Image (OK Image)] and [Last Registered Image] as OK.

❍ Continue Learning with Both NG

Performs the additional learning regarding both status results of [Registered Image (OK Image)] and [Last Registered Image] as NG.

❍ Continue Learning

Performs the additional learning without changing the status results of [Registered Image (OK Image)] and [Last Registered Image].

Sorting Mode

❍ Continue Learning with Both M - (Part Number)

Performs the additional learning regarding both status results of [Registered Image (OK Image)] and [Last Registered Image] as a specified part number.

❍ Continue Learning

Performs the additional learning without changing the status results of [Registered Image (OK Image)] and [Last Registered Image].

3 Press [OK].

Learning will be performed.

Point **When performing learning on a similar image with a different status result, stability of the judgment process can be decreased.**

Adjusting Thresholds for Judgment

Below is the method for manually adjusting the threshold while in operation.

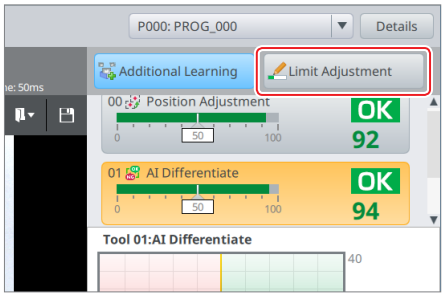
Point

- **This method is for [Standard Mode] and [AI Through Count Mode].**
- **For the AI Differentiate, threshold adjustment is not needed since the target match is automatically adjusted by learning. Use threshold adjustment if additional learning cannot be made or when it is determined to be needed after additional learning.**
  “Auto Adjustment by the Additional Learning” (page 6-2)

Reference Threshold adjustment can be started using the [Limit Adjustment] button in the [Tool Settings] of Sensor Setup as well.

1 Display the main screen in [Run].

2 Press [Limit Adjustment].

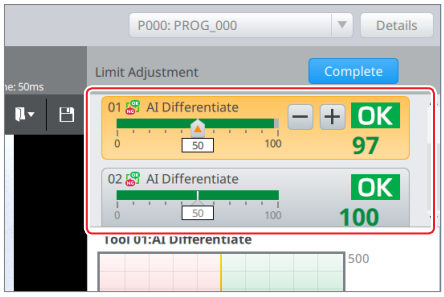


3 Press [Yes].

Point

Operation is not suspended. Changing the threshold reflects the value in the status output from the trigger immediately after the change. To not reflect the value in the status output, adjust the threshold on the settings screen for each tool’s sensor settings.

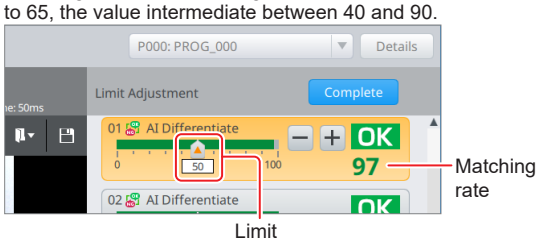
4 Select the tool for which the threshold is to be adjusted.



5 Capture an “OK” or “NG” image to be the reference of judgment.

6 Adjust the threshold by checking the matching rate.

<Setting example>
If the matching rate of an “OK” image is higher than 90 and if the matching rate of a “NG” image is lower than 40, set the threshold to 65, the value intermediate between 40 and 90.



Point

- **When the AI Differentiate tool is set, the limit adjustment of the position adjustment cannot be performed from the run screen. Change it from the settings screen.**
- **The threshold value after being adjusted cannot be backed up using the backup function for expansion programs (P032 to P127).**

7 After the adjustment is completed, press [Complete].

The system returns to the main screen in [Run].

Stabilizing the Judgment

This section explains how to adjust the device when the judgment is not stable.
To stabilize judgment, it is necessary to take a clear image of the target and adjust the detection tool such that it functions in a stable manner.

Point **If judgment is adjusted to stabilize the inspection, the processing time may become longer, depending on the settings changed. Adjust the judgment process while balancing the required processing time.**

- Stabilizing the Judgment Process by Taking a Clear Image of the Target(page 6-16)
  - Make the target large in the field of view
  - Achieving adequate image brightness
  - Achieve good focus
  - Reduce the image blur
  - Reduce the shininess of the glossy or metal surface
  - Adjust the color tint (for color type only)
  - Reduce the effect of lighting variation
- Stabilizing the AI Differentiate(page 6-19)
- Stabilizing by Correcting for Misaligned Target Position(page 6-20)
- Stabilizing the Position Adjustment(page 6-21)
- Stabilizing the High-Speed Position Adjustment(page 6-21)
- Stabilizing the Outline Tool(page 6-22)
- Stabilizing the Color Area/Area/Color Average/Brightness Average/Color Prohibition/Brightness Prohibition Tool(page 6-22)
- Stabilizing the EdgePixels tool(page 6-22)
- Stabilizing the Width/Edge/Pitch tool(page 6-23)
- Stabilizing the Diameter Tool(page 6-23)
- Stabilizing the AI OCR Tool(page 6-23)
- Stabilizing the Blob Count tool(page 6-23)

Stabilizing the Judgment Process by Taking a Clear Image of the Target

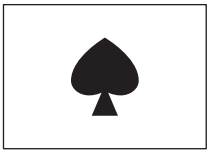
Adjust the imaging conditions so that the sensor can take images with which the detection tools can clearly recognize differences between an “OK” and “NG” image.

Make the target large in the field of view

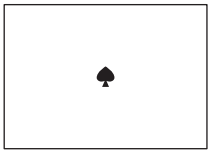
The judgment stabilizes by taking a large image of the target within the field of view.

Adjusting the installed distance (WD)

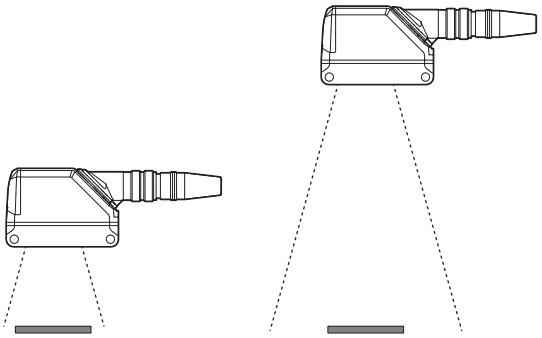
Install the sensor close to the target.
Install the sensor at the appropriate distance from the target upon checking the field of view and the installed distance of the sensor.
“Checking the field of view and installed distance” (page 2-2)



Adequate



Inadequate



Using the digital zoom function

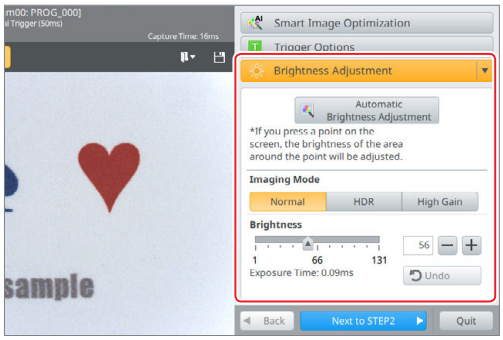
The target can be imaged larger using the digital zoom function.
“Zoom” (page 4-12)

Achieving Adequate Image Brightness

If the image is too dark, the judgment process becomes unstable due to poor contrast. Also, if the image is too bright, the judgment process may become unstable. Perform Smart Image Optimization and select the best optimized image. When the best image cannot be acquired for Smart Image Optimization adjust it using brightness adjustment.
“Smart Image Optimization” (page 4-6)
“Brightness Adjustment” (page 4-11)

When Performing Fine Brightness Adjustment

Finer adjustment of the brightness can be made in Advanced Brightness Adjustment.
“Brightness Adjustment” (page 4-11)



Adjusting automatically by pressing the target

If you press the image of the target, the brightness around the pressed position will be adjusted to be optimal automatically. Used when the adjustment results of the [Automatic Brightness Adjustment] button are too bright or dark due to the influence of brightness other than the target.

Imaging Mode

When [High Gain] is selected, the brightness amplification factor increases and the screen becomes brighter.

Brightness

Setting a higher value gives a longer exposure time, resulting in a brighter screen.

If the brightness cannot be properly adjusted due to uneven brightness

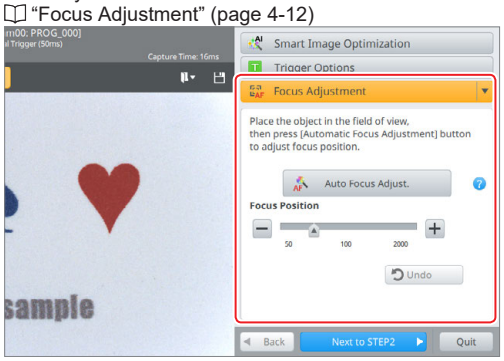
Refer to “Reducing the Shininess of a Glossy or Metal Surface” (page 6-18).

Achieving Good Focus

Adjusting the focus is required to clearly capture the target. Since focus can be adjusted automatically using Smart Image Optimization individual adjustments are not needed. However, when performing fine adjustment etc., the finer adjustment can be made using "Focus Adjustment".
“Focus Adjustment” (page 4-12)

When Performing Fine Focus Adjustment

The focusing position may not be adjusted correctly if the image is too dark or too bright.
Adjust to an applicable brightness with “Brightness Adjustment” (page 4-11) and then perform auto focus adjustment.
If the focus still cannot be properly adjusted, adjust the focus manually.
“Focus Adjustment” (page 4-12)



Adjust the focusing position.

Reducing the Image Blur

If the image is blurred while imaging a moving target, the image blurring can be corrected and the exposure time (shutter time) can be shortened by using the AI Lighting unit and adjusting the imaging mode/brightness.

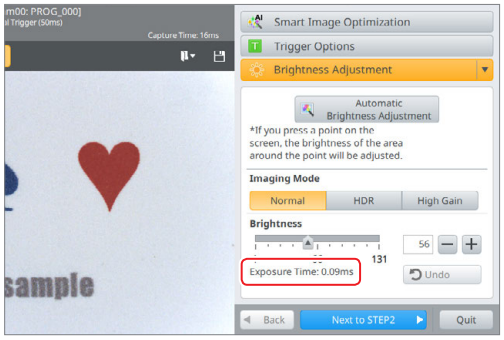
Point **Unmounting a polarizing filter can increase the brightness of the image. By unmounting the filter, image blurring can be reduced as the exposure time can be shortened.**

Using the AI Lighting Unit

Using the AI Lighting unit increases the light intensity so that the exposure time can be shortened and the image blurring can be reduced.
“Mounting the AI Lighting unit” (page 2-6)

Adjusting the Imaging Mode and Brightness

Adjust the imaging mode and brightness, and shorten the exposure time.
Adjust the exposure time with the advanced brightness adjustment.
“Brightness Adjustment” (page 4-11)



Imaging Mode

- By selecting [High Gain], the brightness gain becomes higher. The screen becomes brighter so that the exposure time can be shortened and the image blurring can be reduced. Image noise may increase.
- The exposure time may be shortened if [HDR] is selected.

Brightness

When the value is reduced, the exposure time becomes shorter, resulting in a less blurry image.

Reducing the Shininess of a Glossy or Metal Surface

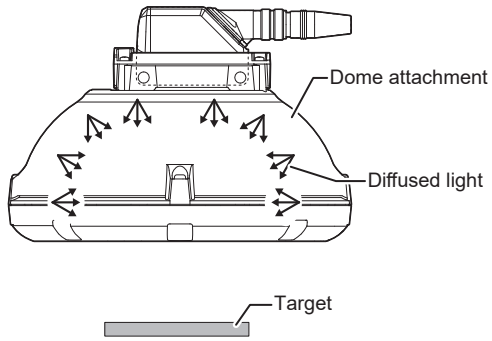
Glossy and/or metal surfaces may reflect the built-in light back into the camera. Since mirror reflection has a highlight intensity, the amount of light received will be saturated and the surface will shine. This section explains how to reduce the glare.

Using Multiple Imaging

By performing multiple imaging for a target and combining the images of shine-free areas, a clean image with less shine can be created.
The multiple imaging can be performed with only the built-in light of the sensor. However, by using the AI Lighting unit, light can be emitted at a certain angle to the target, resulting in a cleaner image with less shine. Perform Smart Image Optimization and select the optimized image for the multiple imaging. The settings can be done manually from the lighting advanced settings.
“Lighting” (page 4-11)
“Brightness Adjustment” (page 4-11)
“Mounting the AI Lighting unit” (page 2-6)

Using the Dome Attachment

Use the dome attachment.
By emitting the target with uniform diffuse light from the entire circumference, bright/dark difference is reduced and glare is prevented.
This is effective for any shapes of targets.
“Mounting the dome attachment” (page 2-12)



Using the Polarizing Filter

Use the polarizing filter. The optical characteristics of the polarizing filter attachment cut off the mirror reflection and reduce the glare on the target’s surface.
“Using the polarizing filter/magnifying lens attachment” (page 2-10)

Using HDR

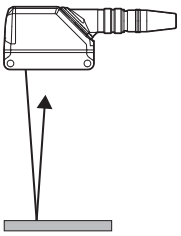
Selecting HDR in imaging mode can reduce the shininess.
The HDR (High Dynamic Range) function prevents light saturation in the area with glare by imaging the target with a wider dynamic range.
“Brightness Adjustment” (page 4-11)

Installing the sensor at an angle

The built-in lighting will not reflected back into the camera, so the glare on the target’s surface can be reduced.
This is effective for flat-surface targets.

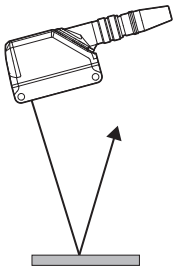
❍When the sensor is installed in front of the target

The mirror reflection of the built-in light reflects into the camera and causes the surface to have glare.



❍When the sensor is installed at an angle from the target

The mirror reflection of the built-in light does not reflect into the camera so no surface glare occurs.



Adjusting the color tint (for color type only)

Adjust the white balance if the color tint of the color type image is different from that of the target.
“White Balance (for color type only)” (page 7-23)

Reducing the effect of illumination variation

If detection is not stable due to the ambient light from the surroundings where the sensor is installed, the effect of the illumination variation can be reduced using the following method.

❍Using the AI Lighting Unit

The lighting intensity of this device will be increased, making it less influenced from changes in surrounding lighting.

❍Use the brightness correction function.

“Mounting the AI Lighting unit” (page 2-6)
“Brightness Adjustment” (page 4-11)

If detection cannot be stabilized with the methods above, use shielding around the sensor to prevent influence from the ambient light.
“Lighting” (page 4-11)

Stabilizing the AI Differentiate

Optimizing the Size of the Tool Window

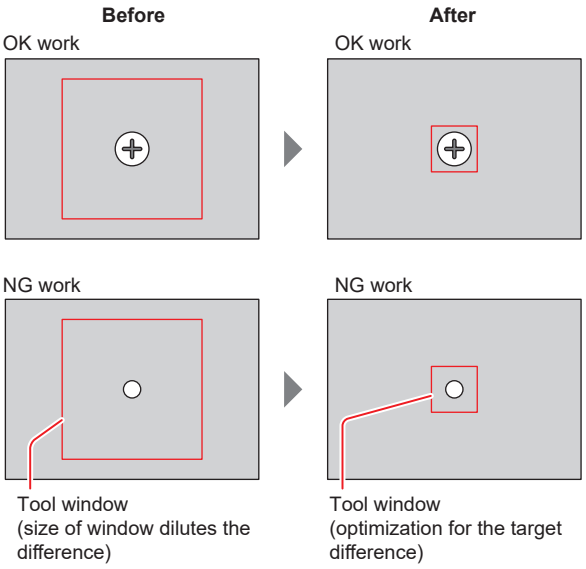
To enhance the learning effect, the tool window should be set according to the size of the image where the difference in an "OK" and "NG" or part image is clear. When the difference between an “OK” and “NG” target in the tool window is small, judgment may not be stable since the differences cannot be recognized. When the misalignment of the position of the target is large, set a position adjustment tool.

The following is the explanation with an example of standard mode.

Setting according to the image target difference to be judged

Usage example: Detection of the presence of a part

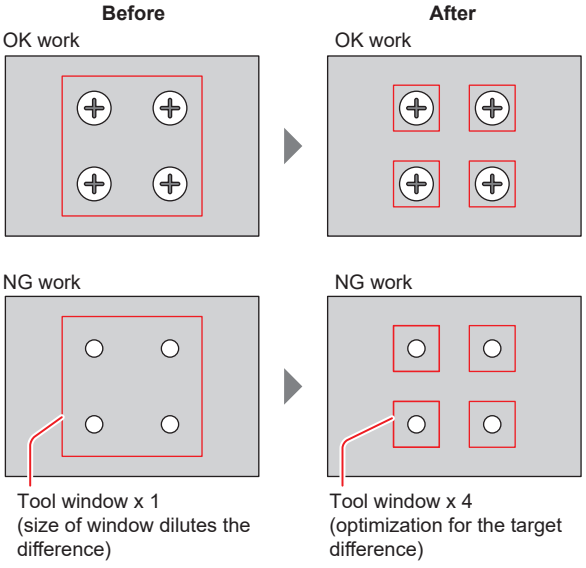
- Before..... Setting a tool window that is much larger than the target.
- After..... Setting a tool window that fits to the size of the target.



Setting by dividing into multiple tool windows

Usage example: Detection of the presence of four targets (less than 3 is NG).

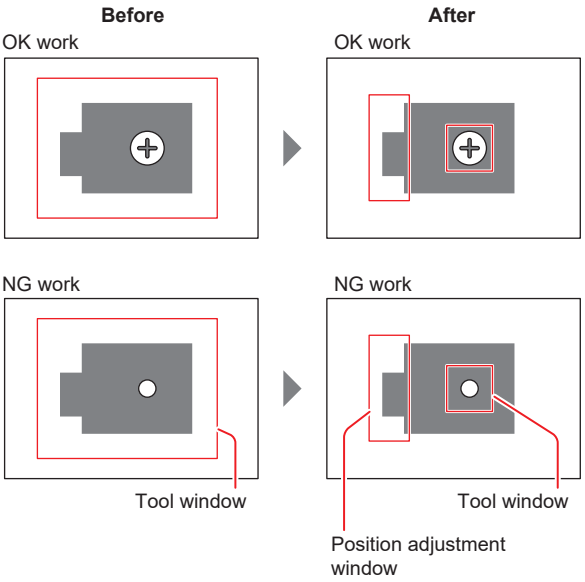
- Before..... Setting one tool window for the four targets in a batch.
- After..... Setting four tool windows, one for each target.



Setting the position adjustment tool

Usage example: Detection of the presence of targets whose positions are misaligned.

- Before..... Setting one large tool window
- After..... Setting the position adjustment tool and tool window optimized for the targets



“Stabilizing by Correcting for Misaligned Target Position” (page 6-20)
“Stabilizing the Position Adjustment” (page 6-21)

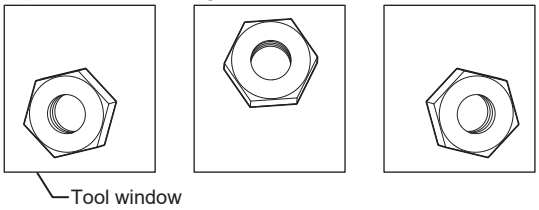
Learning Multiple Images for Stability

Target misalignment (shape, surface condition, dirt, setting position) or changes of ambient light or background may influence the inspection. In these cases, registering to learn multiple images that are different in capture status will automatically improve judgment stability.
The methods of registering to learn multiple images are “Learning OK/NG targets” or “Part Image Registration”, and “Additional Learning”.
“Learning OK/NG Targets” (page 4-26)
“Part Image Registration” (page 4-76)
“Auto Adjustment by the Additional Learning” (page 6-2)

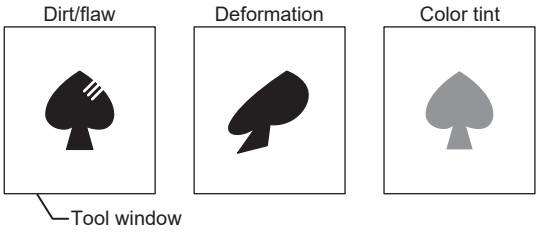
The following indicates examples of images that are different in capture status. Perform learning to register multiple images as OK or NG.

Example 1: Registering multiple images with position misalignment

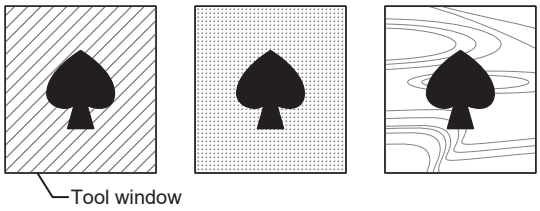
The capture status (what is seen) changes due to target misalignment. If it is the case, multiple images with different capture statuses are registered.



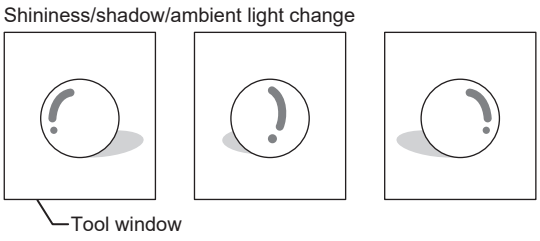
Example 2: Registering multiple images for changes of the target



Example 3: Registering multiple images for changes of the background



Example 4: Registering multiple images for changes of the ambient light



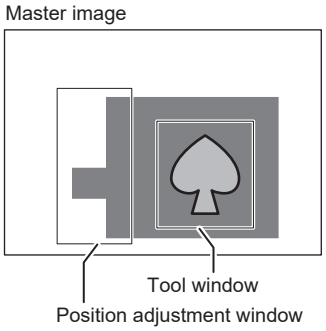
Reference

By turning ON [Variable Brightness] to perform the OK/NG target learning, the influence from the ambient light becomes small.
“Registration of Taken Image” (page 4-28)

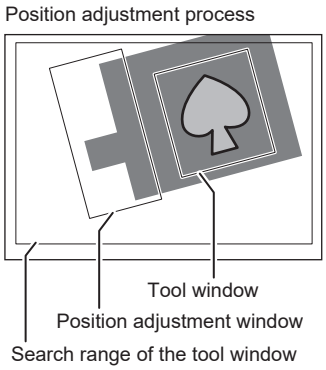
Stabilizing by Correcting for Misaligned Target Position

If there is variation (misalignment) in the positioning of the target, the target to be judged may also be removed from the tool window and cannot be judged correctly.
Detection can be stabilized by using the position adjusting function.
“Position Adjustment Tool” (page 4-52)

Tool settings

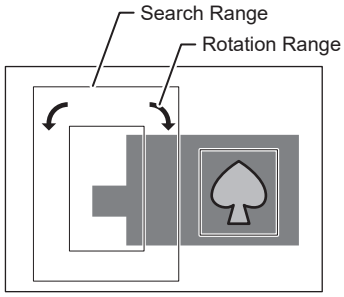


Processing during an operation



Stabilizing the Position Adjustment

If the target tilts and the position adjustment becomes unstable



Rotation Range

- Broaden the rotation range if the tilt of the target exceeds the rotation range (default value: ± 20°).
  “Rotation Range” (page 4-53)
- To stabilize the position adjustment, the tool window will search with the range ± a few degrees wider than the set value of the rotation range. (The tool window will search ± a few degrees even if the rotation range is set to 0°.)

Search Range

Broaden the search range if the variation in the position of the target exceeds the region to be searched.
“Search Range Settings” (page 4-22)

If the position adjustment becomes unstable due to the effect of the unwanted outlines

- The outline disabling function can disable unwanted outlines.
  “Settings for Disabling Outlines” (page 4-52)
- Set the extraction sensitivity to [Low Sensitivity].
  “Setting a Sensitivity” (page 4-52)

If the outline of the reference target cannot be detected

- If the contrast of the target is low, the outline may not be extracted. Set the extraction sensitivity to [High Sensitivity].
  “Setting a Sensitivity” (page 4-52)
  If the process remains unstable even after setting the extraction sensitivity to [High Sensitivity], it may be necessary to adjust the exposure condition for the target.
  “Stabilizing the Judgment Process by Taking a Clear Image of the Target” (page 6-16)
- For the color type, the outline extraction may become stable by using the color filter.
  “Filter (Color Type Only)” (page 4-12)

When the window position after the position adjustment is misaligned and not stable

Set the search algorithm to [High Accuracy] when the detection is not stable because the position of the tool window after the position adjustment does not match the target position.
“Search Algorithm” (page 4-53)

Stabilizing the High-Speed Position Adjustment

If the detection becomes unstable due to the effect of unwanted edges other than the target

- Raise the threshold for edge sensitivity so that unwanted edges are not extracted.
  “Edge Sensitivity Settings” (page 4-55)
- Change to an image with no unwanted edges by making the target background plain, etc.

If the edge of a target cannot be detected

- Set the window size as the same as the size of the target.
  If the judgment direction is horizontal (X axis in case of 2-Axis Adjustment), set the height of the tool window the same as the height of the target.
- Decrease the threshold for edge sensitivity.
  If the edge cannot be detected even after decreasing the threshold for edge sensitivity, it may be necessary to adjust the exposure for the target. Adjust the exposure so that shade on the target does not appear.
  “Edge Sensitivity Settings” (page 4-55)

Stabilizing the Outline Tool

If the outline cannot be detected when the target goes out of position

Adjust the search region. Broaden the search area if the variation in the position of the target exceeds the area to be searched.
“Search Range Settings” (page 4-22)

If the detection becomes unstable due to the effect of unwanted outlines other than the target

- The outline disabling function can disable unwanted outlines.
  “Settings for Disabling Outlines” (page 4-72)
- Set the extraction sensitivity to [Low Sensitivity].
  “Setting a Sensitivity” (page 4-72)
- Set the search area so that non-target areas containing unwanted outlines are not searched.
  “Search Range Settings” (page 4-22)
- Set the search algorithm to [High Accuracy].
  “Search Algorithm” (page 4-73)
- Make an image with no unwanted outlines by making the target background plain, etc.

If the target tilts and the outline cannot be detected

Adjust the rotation range. Broaden the rotation range if the tilt of the target exceeds the rotation range (default value: ± 20°).
“Rotation Range” (page 4-73)

If the matching rate difference between an “OK” and “NG” image is small

Adjust the search algorithm.
If there is no difference between the matching rate for an “OK” and “NG” image, select [Normal] or [High Accuracy]. [High Accuracy] improves judgment accuracy more than [Normal]. However, the processing time becomes longer.
“Search Algorithm” (page 4-73)

If the outline of the target cannot be detected

- If the contrast of the target is low, the outline may not be extracted. Set the extraction sensitivity to [High Sensitivity].
  “Setting a Sensitivity” (page 4-72)
  If the process remains unstable even after setting the extraction sensitivity to [High Sensitivity], it may be necessary to adjust the exposure condition for the target.
  “Stabilizing the Judgment Process by Taking a Clear Image of the Target” (page 6-16)
- For the color type, the outline extraction may become stable by using the color filter.
  “Filter (Color Type Only)” (page 4-12)

Stabilizing the Color Area/Area/Color Average/Brightness Average/Color Prohibition/Brightness Prohibition Tool

If the color you wish to judge cannot be extracted

- Press and extract the color or the brightness to be the reference for judgment.
- If the areas of color or brightness that have not been extracted are pressed repeatedly, the extraction range can be added.
- Adjust the extraction range with the extraction range zoom in/zoom out ([+]/[-] buttons). Press [+] to expand the color or brightness range currently being extracted. Press [-] to reduce the range.
- For the Color Area/Color Average/ Color Prohibition tool, isolate the desired color for inspection using the [Exclude], and then press the unnecessary color extracted to exclude it.
  “Color Area/Area tool” (page 4-48)
  “Color/Brightness Averaging Tool” (page 4-58)
  “Color Prohibition/Brightness Prohibition Tool” (page 4-56)
- Set the [Fixed Reference Area] to [Enable: Large/Small].
  “Fixed Reference Area” (page 4-51)
- If color difference detection does not stabilize when using the color average tool, adjust [Color ID Sensitivity] and [Limit]. Use the Live image (capture the target) for adjustment. The sensitivity and threshold can be adjusted while comparing the difference between the master color and target color on the Live image.
  “Color Range Settings/Brightness Range Settings” (page 4-59)

If the area search becomes unstable due to unwanted colors being extracted

- For the Color Area/Color Average/Color Prohibition tool, select the [Exclude] button, and then press the color that was unnecessarily extracted to exclude it.
  “Color Area/Area tool” (page 4-48)
  “Color/Brightness Averaging Tool” (page 4-58)
  “Color Prohibition/Brightness Prohibition Tool” (page 4-56)
- Adjust with the mask function. The region in which unwanted colors are extracted can be disabled.
  “Mask Settings” (page 4-22)
- For the color/brightness average tool, adjust the position and size of the window. Set so that the region with unwanted colors is not included in the window.
  “Color/Brightness Averaging Tool” (page 4-58)

Stabilizing the EdgePixels tool

If the target edge pixels cannot be extracted

- If the contrast of the target is low, the edge pixels may not be extracted.
  Set the edge extraction sensitivity to [Hi Sens].
  If the process remains unstable even after setting the edge extraction sensitivity to [Hi Sens], it may be necessary to adjust the exposure for the target.
  “Edge Sensitivity Adjustment” (page 4-74)
- When the number of the target’s edge pixels is low, capture a bigger target and increase the pixels of the edge to be extracted.

If it becomes unstable due to unwanted edge pixels being extracted

Adjust with the mask function. Mask the region in which unwanted edge pixels have been extracted.
“Mask Settings” (page 4-22)

Stabilizing the Width/Edge/Pitch tool

If the detection becomes unstable due to the effect of unwanted edges other than the target

- Adjust with the mask function. Mask the region in which unwanted edges have been extracted.
  “Mask Settings” (page 4-22)
- Raise the threshold for edge sensitivity so that unwanted edges are not extracted.
  “Edge Sensitivity Settings” (page 4-64)
  “Edge Sensitivity Settings” (page 4-66)
  “Edge Sensitivity Settings” (page 4-70)
- Change to an image with no unwanted edges by making the target background plain, etc.

If the edge of a target cannot be detected

- Align the rotation angle of tool window with the edge angle.
- Do not protrude from the tool window the side of the target that is not in the judgment direction of the tool window.
  If the judgment direction is horizontal, change the height of the tool window to be shorter than the height of the target.
- Decrease the threshold for edge sensitivity.
  If the edge cannot be detected even after decreasing the threshold for edge sensitivity, it may be necessary to adjust the exposure for the target. Adjust the exposure so that shade on the target does not appear.
  “Edge Sensitivity Settings” (page 4-64)
  “Edge Sensitivity Settings” (page 4-66)
  “Edge Sensitivity Settings” (page 4-70)

Stabilizing the Diameter Tool

If the detection becomes unstable due to the effect of unwanted circles other than the target

- Adjust with the mask function.
  “Mask Settings” (page 4-22)
- Set the edge sensitivity to low so that the unwanted circles will not be detected.
  “Diameter Extraction” (page 4-68)
- Choose an image with no unwanted edges by making the target background plain, etc.

If the target circle cannot be detected

- Set the detection direction for the diameter to detect both bright and dark directions.
  “Bright/Dark Mode” (page 4-71)
- Set the edge sensitivity to [Hi Sens].
  If the diameter can not be detected even after setting the edge sensitivity to [Hi Sens], it may be necessary to adjust the exposure for the target. Adjust the exposure so that shade on the target does not appear.
  “Diameter Extraction” (page 4-68)

Stabilizing the AI OCR Tool

When the text or date on the object cannot be read

- If the text or date on the object are not clear, reading may fail. Adjust the target image capture conditions and clearly display the text or date.
  “Stabilizing the Judgment Process by Taking a Clear Image of the Target” (page 6-16)
- Set high-speed mode to [Disable].
  “High-Speed Mode” (page 4-44)

When unwanted text or date are read

Adjust with the mask function.
Mask the region that contains the unwanted text or date.
“Mask Settings” (page 4-22)

Stabilizing the Blob Count tool

When color (brightness) blobs to be counted cannot be extracted

- Press and extract the color or the brightness to be the reference for judgment.
- If the areas of color or brightness that have not been extracted are pressed repeatedly, the extraction range can be added.
- Adjust the extraction range with the extraction range zoom in/zoom out ([+]/[-]). Press [+] to expand the color or brightness range currently being extracted. Press [-] to reduce the range.

“Advanced Color Extraction/Advanced Brightness Extraction” (page 4-63)

If the area search becomes unstable due to unwanted colors being extracted

Select [Exclude], and then press the color that was unnecessarily extracted to exclude it.
“Advanced Color Extraction/Advanced Brightness Extraction” (page 4-63)

When counting targets that are clearly different in size from one to be counted

Set the range of a size for counting.
By adjusting the range, objects with different sizes from the target to be counted can be excluded from the target for counting.
“Size Limit Setting” (page 4-63)

Shortening the Processing Time

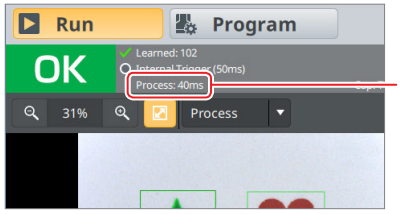
This section explains how to adjust the device to shorten the processing time.
To shorten the processing time, perform adjustments to shorten the processing times of the imaging process and the detection tools.

Point

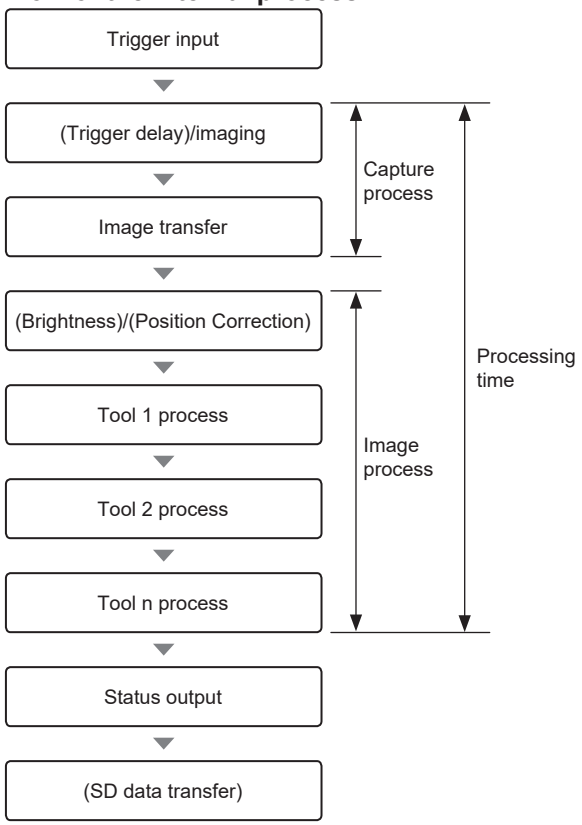
If the processing time is shortened, the stability of judgment may decrease. The processing time should therefore be adjusted while maintaining balance with the stability of the judgment process.

For the Processing Time

The processing time is the period of time from when an external or internal trigger is received until the status result is finalized.
The processing time is displayed on the run screen or the test screen.



Flow of the internal process



Methods to shorten the processing time are as follows.
- Shortening the imaging processing time.
- Shortening the processing time of each tool.
- Do not use position/brightness adjustment.
- Do not use a field network.

Shortening the Imaging Processing Time

Exposure time

The processing time can be shortened by shortening the exposure time.
(Adjust the exposure time with “Brightness Adjustment” (page 4-11).)
A longer exposure time makes the processing time longer, as it takes longer to take the image.
By adjusting the [Brightness] slider of the brightness adjustment, the exposure time can be shortened.

Point

The exposure time can be also shortened using the following method.
- **Using the AI Lighting Unit**
- **Remove the polarizing filter or dome attachment.**

High-Speed Capture

The time required for image capture can be shortened by setting [High-Speed Capture].
For details, refer to “High-Speed Capture” (page 4-13).

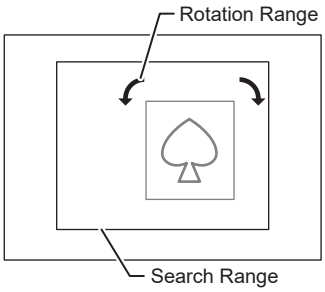
Selecting a Tool

- The processing time will be shorter for the below tools than the outline tool. If the following tools can judge this, set the tools again:
  Color Area/Area/Width/Diameter/Edge/Pitch/
  Edge Pixels/Color Prohibit
- The processing time will be shorter for the High-Speed Position Adjustment tool than the normal position adjustment tool. If the High-Speed Position Adjustment tool can be used, select the High-Speed Position Adjustment tool.

Shortening the processing time of each tool

Outline

The processing time can be shortened by adjusting the settings for the search range, rotation range, and search algorithm.



Search Range

The time for searching for a target in the field of view can be shortened by reducing the search range and setting the search region from [Entire] (default value) to [Partial].
Make sure that the range of the positions for the target does not exceed the search region.
“Search Range Settings” (page 4-22)

Rotation Range

The search time for a target that is rotated in relation to the master image can be shortened by reducing the rotation range. (default value: ± 20°)
Make sure that the range of installation angles for the target does not exceed the rotation range.
“Rotation Range” (page 4-73)

Search Algorithm

Select [High Speed]. This will decrease judgment accuracy, but the processing time will be shorter.
“Search Algorithm” (page 4-73)

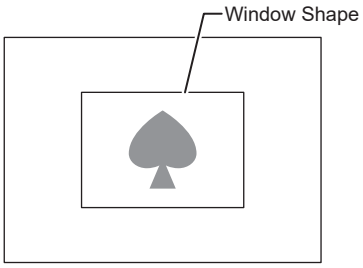
Producing an image with less unwanted outlines

The processing time becomes longer for images with multiple unwanted outlines other than the target outlines.

- Make an image with no unwanted outlines by making the target background plain, etc.
- Set the search area so that non-target images containing unwanted outlines are not searched.
  “Search Range Settings” (page 4-22)

Color Area/Area/Width/Diameter/Edge/Pitch/ Edge Pixel/Color Prohibit/Brightness Prohibit/ Blob Count

The processing time can be shortened by adjusting the window shape settings.



Window Shape

If the current window shape is [Entire], change and reduce the window size by modifying the window shape setting to [□ Rect] or [○ Circle].
The processing time can be shortened by reducing the size of the window.
“Color Area/Area tool” (page 4-48)
“Width Tool” (page 4-66)
“Diameter Tool” (page 4-68)
“Edge Tool” (page 4-64)
“Pitch tool” (page 4-70)
“EdgePixels tool” (page 4-74)
“Color Prohibition/Brightness Prohibition Tool” (page 4-56)
“Blob Count Tool” (page 4-62)

Window orientation

For the Width/Edge/Pitch tool, do not rotate the tool window (secure the orientation horizontally or vertically) to reduce processing time.

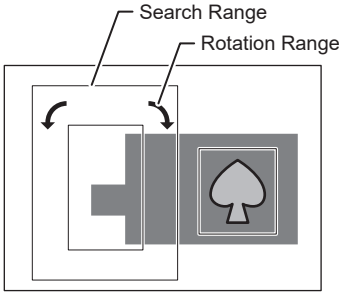
AI OCR Tool

If you are using the AI OCR tool, you can shorten the processing time by clearly displaying the object text and date.

- Make an image with no unwanted background information by making the target background plain, etc.
- Adjust the target image capture conditions and clearly display the text or date.
- Set [High-Speed Mode] to [Enable].

Position Adjustment

When position adjustment is performed, the processing time can be shortened by adjusting the search range settings or rotation range settings.



Search Range

The time for searching for a target in the field of view can be shortened by reducing the search range and setting the search region from [Entire] (default value) to [Partial].
Note that when the search region is reduced in size, the range of target positions that the position adjustment tool can correct for becomes narrower.
“Search Range Settings” (page 4-22)

Rotation Range

The search time for a target that is rotated in relation to the master image can be shortened by reducing the rotation range. (default value: ± 20°)
Note that the range of target angles that the position adjustment function can correct for becomes narrower when reducing the rotation range.
“Rotation Range” (page 4-53)

Search Algorithm

Select [High Speed]. This will decrease the positioning accuracy, but the processing time will be shorter.
“Search Algorithm” (page 4-53)

Producing an image with less unwanted outlines

The processing time becomes longer for images with multiple unwanted outlines other than the target outlines.

- Make an image with no unwanted outlines by making the target background plain, etc.
- Set the search area so that non-target images containing unwanted outlines are not searched.
  “Search Range Settings” (page 4-22)

Using High-Speed Position Adjustment tool

Compared with the normal position adjustment tool, the High-Speed Position Adjustment tool has a faster processing time.

7

Various Functions

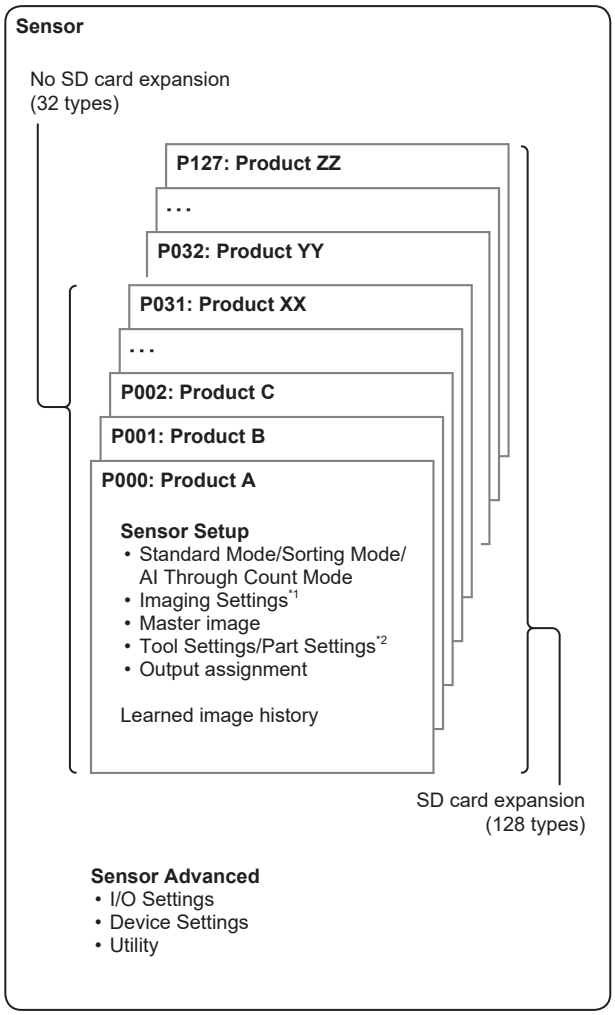
In this section, the program function, [I/O Settings] screen, [Sensor Advanced] screen, and menu bar operation method are explained.

Changeover for a Target (Program Functions).....7-2
Settings Transfer/Backup 7-9
Sensor Advanced Settings 7-10
Panel Settings 7-25
Display Settings.....7-30
Operating the Device from the Menu Bar (PC Only) 7-31
Converting IV4P/IV3P data to BMP data.....7-34
Web Monitor 7-35

Changeover for a Target (Program Functions)

Overview of the Program Functions

The sensor can save the judgment conditions set in Sensor Setup as program files. Up to 32 programs can be saved in the sensor, representing 32 types of target (32 products).
Additionally, if 🕮 "SD Card Programs" (page 8-10) for the SD card is set to [Enable], up to 128 programs can be saved, representing 128 types of targets (128 products).
By reading the judgment condition which has been saved according to each product, target changeover can be done easily.



*1 Includes the focusing position.
*2 Includes the threshold of each tool/detection window.

Reference The [SD Card Programs] function creates 96 setting types (P. 032 to P. 127) on the SD card.

Operations that can be performed with the program functions

- Saves 128 types (128 products) of judgment conditions (programs).
  🕮 "Chapter 4 Sensor Setup" (page 4-1)
- Reads and operates the saved program.
  🕮 "Using the Program Functions (Changing Over)" (page 7-4)
- Selects the reading method of the program.
  🕮 "Program Switching Method" (page 7-13)
- Imports programs from a batch backup file.
  🕮 "Importing a Program" (page 7-8)
- Appends any name, such as the manufactured product name, to the judgment conditions (programs).
  🕮 "Editing a Program Name" (page 7-8)
- Copies and uses the judgment conditions (programs) for another program number.
  🕮 "Copying a Program" (page 7-7)
- Returns the judgment conditions (programs) to the status before setting.
  🕮 "Initializing a Program" (page 7-8)

Preparing the Program Functions

Registers the judgment condition for each product to the program before running.

Preparation Flow

(1) Prepare the SD card

If there will be changeover with between 33 to 128 different types of programs, set [SD Card Programs] to [Enable].
🕮 "SD Card Programs" (page 8-10)
This setting is not required if there are 32 or fewer changeover types.

(2) Select the program number

Select a program number to register a judgment condition from P000 to P031.
Select a program number from P000 to P127 if SD Card Programs is enabled.

(3) Set the judgment conditions in Sensor Setup

Set the judgment conditions for the product in Sensor Setup.

(4) Select a program switch method

Select the method to switch the program.
- Switch from an external input line
- Selecting the program from the main screen in [Run].
- Displaying the Program Details screen and selecting the program.
- Switch from a field network
- Switch using IoT communications.
- Switch automatically using the program auto-switching settings

Reference The following functions can be used to prepare programs for changeover.
- Imports programs from a batch backup file.
  🕮 "Importing a Program" (page 7-8)
- The product name can be registered to the program.
  🕮 "Editing a Program Name" (page 7-8)
- To register a similar product, the program can be copied, and then the settings can be edited.
  🕮 "Copying a Program" (page 7-7)
- Initializes and returns the judgment condition registered in the program to the status before setting.
  🕮 "Initializing a Program" (page 7-8)

Preparing the SD Card

To use the program function to changeover between 33 and 128 types of targets, insert an SD card into this device and set [SD Card Programs] to [Enable].

- Supported SD card: CA-MSD32G

1 Insert the SD card into SD card slot on the sensor amplifier (ultra-compact model) or sensor (built-in amplifier model).

"Inserting the SD Card" (page 8-9)

2 Set [SD Card Programs] to [Enable].

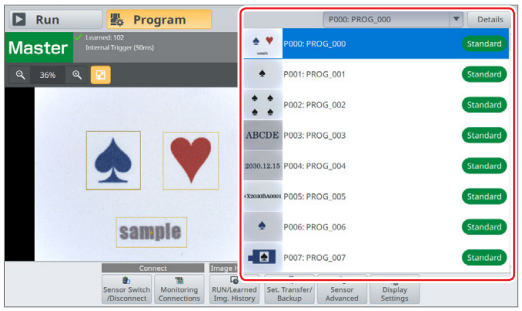
"SD Card Programs" (page 8-10)

Transfer program settings information is created on the SD card.

Preparation procedures

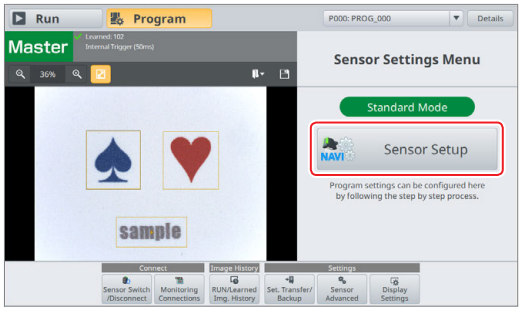
1 Display the main screen in [Program].

2 Select a program number to register the judgment conditions for a product.



Reference The program can also be selected from the [Details] button.
"Displaying the [Program Details] screen" (page 7-7)

3 Set the judgment conditions in [Sensor Setup].

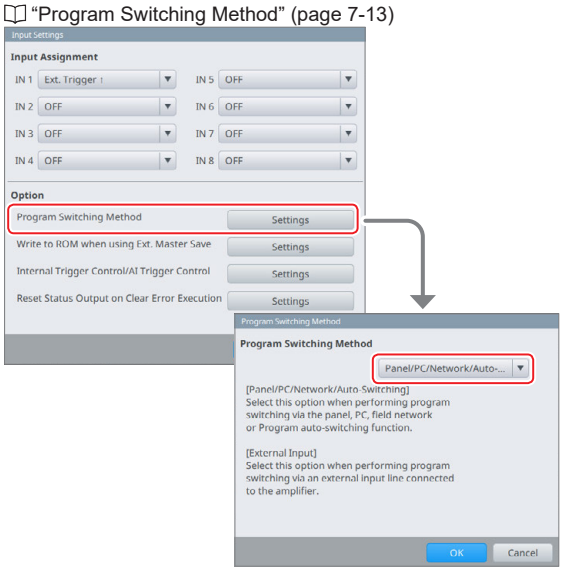


"Chapter 4 Sensor Setup" (page 4-1)

4 Repeat steps 2 and 3 to register programs for the number of products that are to be changed over.

5 Sets the method for switching the program.

"Program Switching Method" (page 7-13)



- **Panel/PC/Network/Auto-Switching (Default)**

The program number can be switched from the control panel, display expansion unit, PC, field network, DL, nonprocedural command, IoT communications, or program auto-switching.

- **External Input**

Use this setting to switch program numbers from external input (by inputting signals from the PLC to the input line of the sensor).

6 If [Program Switching Method] is set to [External Input], set "Input Assignment" (page 7-13).

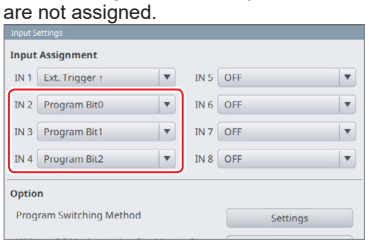
The bits that are required to be set will differ depending on the number of programs to be registered.

Product numbers to be registered (Program numbers)	bit to be assigned to the input line
2	bit0
3 to 4	bit0/bit1
5 to 8	bit0/bit1/bit2
9 to 16	bit0/bit1/bit2/bit3
17 to 32	bit0/bit1/bit2/bit3/bit4
33 to 64	bit0/bit1/bit2/bit3/bit4/bit5
65 to 128	bit0/bit1/bit2/bit3/bit4/bit5/bit6

Point
- **Setting [SD Card Programs] to [Enable] allows 33 or more programs (maximum of 128) to be set.**
- **To switch programs for the built-in amplifier type by external input, up to 32 programs can be set.**

Reference **Setup example**

When 7 programs are to be registered, bit0, bit1, and bit2 are assigned to arbitrary IN terminals. bit3 to bit6 are not assigned.



Using the Program Functions (Changing Over)

Precautions when [SD Card Programs] is set to [Enable]

Important

- Do not remove the SD card while the device is being activated. Additionally, do not perform the procedure to remove the SD card (Page 8-9).
- Do not use SD cards other than ones specified by KEYENCE.
- If you perform any of the following operations, a program switch error will occur:
  - Switching to a program saved on the SD card while the device is running when an SD Card is not recognized.
  - When operation stops because the SD card is not recognized while running a program on the SD card.
  - After the power is turned off with a program in the SD card selected, as the SD card is not recognized by the sensor during startup.
  - Switching to a program on the SD card when [SD Card Programs] is set to [Disable].
- Resolving a program switch error:
  - Stop operation. When the error is canceled, the settings screen opens.
- A program switch error in RUN mode can be assigned to an external output line and output to an external device. It can also be obtained using a field network PLC. Program switch error at startup cannot be output.
- To back up the sensor settings or copy settings to different sensors, use "Batch Backup" (page 8-3). The settings cannot be correctly saved by only copying data on the SD card.
- Precautions when using the transfer program settings in combination with the function to transfer data to the SD card:
  - Export data on the SD card when the device is not running.
  - After inserting the SD card, the data transfer function will automatically be restored when operation starts or the power is turned on.

How to clear a program switching error

Clear the error messages from the control panel, display expansion unit, or PC. The error will be canceled and the settings screen will appear. Clear error input is disabled. Thereafter, perform the following operations:

- When using the advanced program, re-read the SD card on which the correct advanced program is saved.
- When not using [SD Card Programs], set the [SD Card Programs] to [Disable].

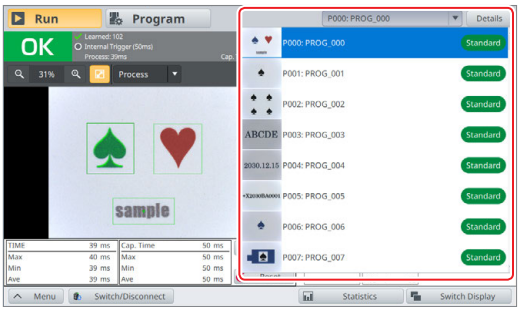
When [Program Switching Method] is set to [Panel/PC/Network/Auto-Switching]

Main screen in [Run]

1 Start run mode.

"Starting an Operation" (page 5-2)

2 Select the program number to which the product to be judged is registered.

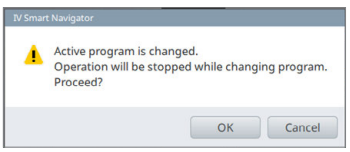


The confirmation screen opens.

Reference

The program number can also be selected while confirming the master image by pressing [Details] (Page 7-7).

3 Start run mode with the new program number by pressing [OK].



[Program Details] screen

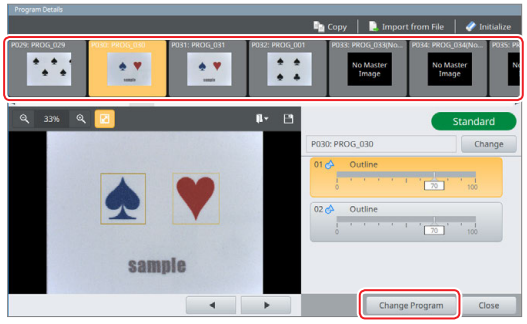
1 Start run mode.

"Starting an Operation" (page 5-2)

2 Displays the Program Details screen.

"Displaying the [Program Details] screen" (page 7-7)

3 Select the program to which the product to be judged is registered, and press [Change Program].



4 Start run mode with the new program number by pressing [OK].

To switch a program from a field network

For details about steps, refer to "Connecting to a Field Network" (page 9-12).

When switching from IoT communications

For details about procedure, refer to the following.

"OPC UA Server Function" (page 9-118)

"MQTT Client Function" (page 9-136)

When Setting the [Program Switching Method] to [External Input].

1 Start run mode.

“Starting an Operation” (page 5-2)

2 Select the program number to which the product to be judged is registered using the input lines.

- Change the status of the input lines IN2 to IN8 on which bit0 to bit6 are assigned to in the input assignment (Page 7-13) to change the program number (for the ultra-compact model: IN2 to IN8, for the built-in amplifier type: IN2 to N3 and I/O1 to I/O3). Once the program has been changed, save the settings. Start RUN mode with the new program number.
  For details, refer to the following.
  “Assignment of program numbers using bit0 to bit4 (when [SD Card Programs] is set to [Disable])” (page 7-5)
  “Assignment of program numbers using bit0 to bit6 (when [SD Card Programs] is set to [Enable])” (page 7-6)
- The ON/OFF state of the input lines corresponding to the sensor polarity is as follows.

Polarity	ON	OFF
NPN	The state shorted with 0 V line	Open
PNP	The state that voltage is applied	Open

Reference For details of the controlling method and the timing chart, refer to “Changing Over” (page 11-10).

Assignment of program numbers using bit0 to bit4 (when [SD Card Programs] is set to [Disable])

Program number	bit4 (MSB)	bit3	bit2	bit1	bit0 (LSB)
P000	OFF	OFF	OFF	OFF	OFF
P001	OFF	OFF	OFF	OFF	ON
P002	OFF	OFF	OFF	ON	OFF
P003	OFF	OFF	OFF	ON	ON
P004	OFF	OFF	ON	OFF	OFF
P005	OFF	OFF	ON	OFF	ON
P006	OFF	OFF	ON	ON	OFF
P007	OFF	OFF	ON	ON	ON
P008	OFF	ON	OFF	OFF	OFF
P009	OFF	ON	OFF	OFF	ON
P010	OFF	ON	OFF	ON	OFF
P011	OFF	ON	OFF	ON	ON
P012	OFF	ON	ON	OFF	OFF
P013	OFF	ON	ON	OFF	ON
P014	OFF	ON	ON	ON	OFF
P015	OFF	ON	ON	ON	ON

Program number	bit4 (MSB)	bit3	bit2	bit1	bit0 (LSB)
P016	ON	OFF	OFF	OFF	OFF
P017	ON	OFF	OFF	OFF	ON
P018	ON	OFF	OFF	ON	OFF
P019	ON	OFF	OFF	ON	ON
P020	ON	OFF	ON	OFF	OFF
P021	ON	OFF	ON	OFF	ON
P022	ON	OFF	ON	ON	OFF
P023	ON	OFF	ON	ON	ON
P024	ON	ON	OFF	OFF	OFF
P025	ON	ON	OFF	OFF	ON
P026	ON	ON	OFF	ON	OFF
P027	ON	ON	OFF	ON	ON
P028	ON	ON	ON	OFF	OFF
P029	ON	ON	ON	OFF	ON
P030	ON	ON	ON	ON	OFF
P031	ON	ON	ON	ON	ON

Point **For the program switching by external input of the built-in amplifier type, up to 32 programs can be set. When it is required to switch 33 programs or more, change programs from a field network, IoT communications, control panel, display expansion unit, or PC.**

Assignment of program numbers using bit0 to bit6 (when [SD Card Programs] is set to [Enable])

Program number	bit6 (MSB)	bit5	bit4	bit3	bit2	bit1	bit0 (LSB)
P000	OFF	OFF	OFF	OFF	OFF	OFF	OFF
P001	OFF	OFF	OFF	OFF	OFF	OFF	ON
P002	OFF	OFF	OFF	OFF	OFF	ON	OFF
P003	OFF	OFF	OFF	OFF	OFF	ON	ON
P004	OFF	OFF	OFF	OFF	ON	OFF	OFF
P005	OFF	OFF	OFF	OFF	ON	OFF	ON
P006	OFF	OFF	OFF	OFF	ON	ON	OFF
P007	OFF	OFF	OFF	OFF	ON	ON	ON
P008	OFF	OFF	OFF	ON	OFF	OFF	OFF
P009	OFF	OFF	OFF	ON	OFF	OFF	ON
P010	OFF	OFF	OFF	ON	OFF	ON	OFF
P011	OFF	OFF	OFF	ON	OFF	ON	ON
P012	OFF	OFF	OFF	ON	ON	OFF	OFF
P013	OFF	OFF	OFF	ON	ON	OFF	ON
P014	OFF	OFF	OFF	ON	ON	ON	OFF
P015	OFF	OFF	OFF	ON	ON	ON	ON
P016	OFF	OFF	ON	OFF	OFF	OFF	OFF
P017	OFF	OFF	ON	OFF	OFF	OFF	ON
P018	OFF	OFF	ON	OFF	OFF	ON	OFF
P019	OFF	OFF	ON	OFF	OFF	ON	ON
P020	OFF	OFF	ON	OFF	ON	OFF	OFF
P021	OFF	OFF	ON	OFF	ON	OFF	ON
P022	OFF	OFF	ON	OFF	ON	ON	OFF
P023	OFF	OFF	ON	OFF	ON	ON	ON
P024	OFF	OFF	ON	ON	OFF	OFF	OFF
P025	OFF	OFF	ON	ON	OFF	OFF	ON
P026	OFF	OFF	ON	ON	OFF	ON	OFF
P027	OFF	OFF	ON	ON	OFF	ON	ON
P028	OFF	OFF	ON	ON	ON	OFF	OFF
P029	OFF	OFF	ON	ON	ON	OFF	ON
P030	OFF	OFF	ON	ON	ON	ON	OFF
P031	OFF	OFF	ON	ON	ON	ON	ON
P032	OFF	ON	OFF	OFF	OFF	OFF	OFF
P033	OFF	ON	OFF	OFF	OFF	OFF	ON
P034	OFF	ON	OFF	OFF	OFF	ON	OFF
P035	OFF	ON	OFF	OFF	OFF	ON	ON
P036	OFF	ON	OFF	OFF	ON	OFF	OFF
P037	OFF	ON	OFF	OFF	ON	OFF	ON
P038	OFF	ON	OFF	OFF	ON	ON	OFF
P039	OFF	ON	OFF	OFF	ON	ON	ON
P040	OFF	ON	OFF	ON	OFF	OFF	OFF
P041	OFF	ON	OFF	ON	OFF	OFF	ON
P042	OFF	ON	OFF	ON	OFF	ON	OFF
P043	OFF	ON	OFF	ON	OFF	ON	ON
P044	OFF	ON	OFF	ON	ON	OFF	OFF
P045	OFF	ON	OFF	ON	ON	OFF	ON
P046	OFF	ON	OFF	ON	ON	ON	OFF
P047	OFF	ON	OFF	ON	ON	ON	ON
P048	OFF	ON	ON	OFF	OFF	OFF	OFF
P049	OFF	ON	ON	OFF	OFF	OFF	ON
P050	OFF	ON	ON	OFF	OFF	ON	OFF
P051	OFF	ON	ON	OFF	OFF	ON	ON
P052	OFF	ON	ON	OFF	ON	OFF	OFF
P053	OFF	ON	ON	OFF	ON	OFF	ON
P054	OFF	ON	ON	OFF	ON	ON	OFF
P055	OFF	ON	ON	OFF	ON	ON	ON
P056	OFF	ON	ON	ON	OFF	OFF	OFF
P057	OFF	ON	ON	ON	OFF	OFF	ON
P058	OFF	ON	ON	ON	OFF	ON	OFF
P059	OFF	ON	ON	ON	OFF	ON	ON
P060	OFF	ON	ON	ON	ON	OFF	OFF
P061	OFF	ON	ON	ON	ON	OFF	ON
P062	OFF	ON	ON	ON	ON	ON	OFF
P063	OFF	ON	ON	ON	ON	ON	ON

Program number	bit6 (MSB)	bit5	bit4	bit3	bit2	bit1	bit0 (LSB)
P064	ON	OFF	OFF	OFF	OFF	OFF	OFF
P065	ON	OFF	OFF	OFF	OFF	OFF	ON
P066	ON	OFF	OFF	OFF	OFF	ON	OFF
P067	ON	OFF	OFF	OFF	OFF	ON	ON
P068	ON	OFF	OFF	OFF	ON	OFF	OFF
P069	ON	OFF	OFF	OFF	ON	OFF	ON
P070	ON	OFF	OFF	OFF	ON	ON	OFF
P071	ON	OFF	OFF	OFF	ON	ON	ON
P072	ON	OFF	OFF	ON	OFF	OFF	OFF
P073	ON	OFF	OFF	ON	OFF	OFF	ON
P074	ON	OFF	OFF	ON	OFF	ON	OFF
P075	ON	OFF	OFF	ON	OFF	ON	ON
P076	ON	OFF	OFF	ON	ON	OFF	OFF
P077	ON	OFF	OFF	ON	ON	OFF	ON
P078	ON	OFF	OFF	ON	ON	ON	OFF
P079	ON	OFF	OFF	ON	ON	ON	ON
P080	ON	OFF	ON	OFF	OFF	OFF	OFF
P081	ON	OFF	ON	OFF	OFF	OFF	ON
P082	ON	OFF	ON	OFF	OFF	ON	OFF
P083	ON	OFF	ON	OFF	OFF	ON	ON
P084	ON	OFF	ON	OFF	ON	OFF	OFF
P085	ON	OFF	ON	OFF	ON	OFF	ON
P086	ON	OFF	ON	OFF	ON	ON	OFF
P087	ON	OFF	ON	OFF	ON	ON	ON
P088	ON	OFF	ON	ON	OFF	OFF	OFF
P089	ON	OFF	ON	ON	OFF	OFF	ON
P090	ON	OFF	ON	ON	OFF	ON	OFF
P091	ON	OFF	ON	ON	OFF	ON	ON
P092	ON	OFF	ON	ON	ON	OFF	OFF
P093	ON	OFF	ON	ON	ON	OFF	ON
P094	ON	OFF	ON	ON	ON	ON	OFF
P095	ON	OFF	ON	ON	ON	ON	ON
P096	ON	ON	OFF	OFF	OFF	OFF	OFF
P097	ON	ON	OFF	OFF	OFF	OFF	ON
P098	ON	ON	OFF	OFF	OFF	ON	OFF
P099	ON	ON	OFF	OFF	OFF	ON	ON
P100	ON	ON	OFF	OFF	ON	OFF	OFF
P101	ON	ON	OFF	OFF	ON	OFF	ON
P102	ON	ON	OFF	OFF	ON	ON	OFF
P103	ON	ON	OFF	OFF	ON	ON	ON
P104	ON	ON	OFF	ON	OFF	OFF	OFF
P105	ON	ON	OFF	ON	OFF	OFF	ON
P106	ON	ON	OFF	ON	OFF	ON	OFF
P107	ON	ON	OFF	ON	OFF	ON	ON
P108	ON	ON	OFF	ON	ON	OFF	OFF
P109	ON	ON	OFF	ON	ON	OFF	ON
P110	ON	ON	OFF	ON	ON	ON	OFF
P111	ON	ON	OFF	ON	ON	ON	ON
P112	ON	ON	ON	OFF	OFF	OFF	OFF
P113	ON	ON	ON	OFF	OFF	OFF	ON
P114	ON	ON	ON	OFF	OFF	ON	OFF
P115	ON	ON	ON	OFF	OFF	ON	ON
P116	ON	ON	ON	OFF	ON	OFF	OFF
P117	ON	ON	ON	OFF	ON	OFF	ON
P118	ON	ON	ON	OFF	ON	ON	OFF
P119	ON	ON	ON	OFF	ON	ON	ON
P120	ON	ON	ON	ON	OFF	OFF	OFF
P121	ON	ON	ON	ON	OFF	OFF	ON
P122	ON	ON	ON	ON	OFF	ON	OFF
P123	ON	ON	ON	ON	OFF	ON	ON
P124	ON	ON	ON	ON	ON	OFF	OFF
P125	ON	ON	ON	ON	ON	OFF	ON
P126	ON	ON	ON	ON	ON	ON	OFF
P127	ON	ON	ON	ON	ON	ON	ON

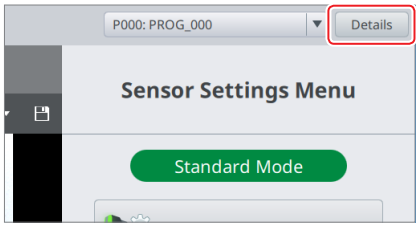
Displaying the [Program Details] screen

This section explains the Program Details screen displayed when [Details] is pressed on the main screen.

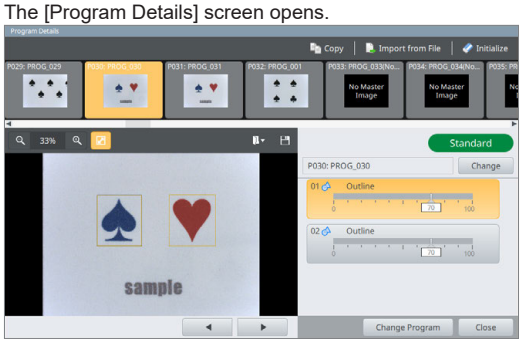
Point **When the Program Details screen is opened by pressing [Details] on the main screen in [Run], only [Change Program] can be pressed.**

1 Display the main screen in [Run] or [Program].

2 Press [Details].



The [Program Details] screen opens.



3 Configure the program settings.

“Copying a Program” (page 7-7)
“Importing a Program” (page 7-8)
“Initializing a Program” (page 7-8)
“Editing a Program Name” (page 7-8)

4 Press [Close].

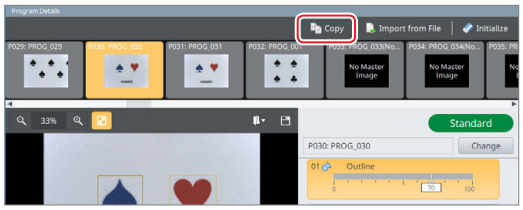
Copying a Program

Copies a set program to another program number. Re-uses the set items and creates a new program.

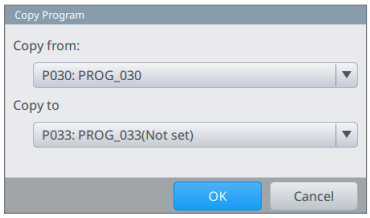
1 Display the [Program Details] screen.

“Displaying the [Program Details] screen” (page 7-7)

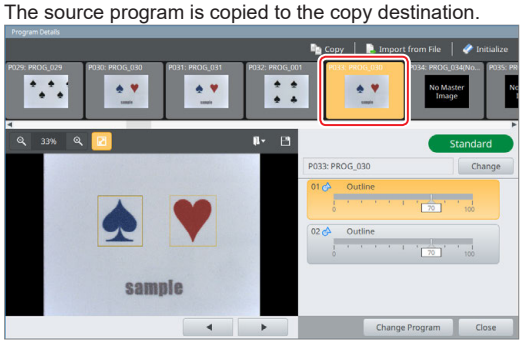
2 Select the program to be copied and press [Copy].



3 Select the program number to which the source program will be copied and press [OK].



The source program is copied to the copy destination.



Importing a Program

Imports one program from an individual program backup file (*.iv4a) or a batch backup file (*.iv4a). Re-uses the imported program settings to create a new program.

“Batch Backup” (page 8-3)
“Individ. Program Backup” (page 8-4)

Point

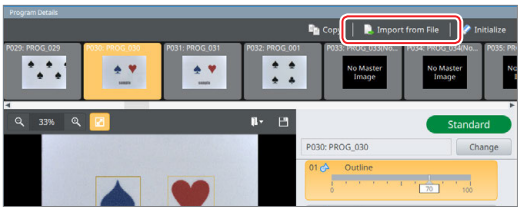
- **Programs cannot be imported from SD cards inserted in sensor amplifiers (ultra-compact models) and sensors (built-in amplifier models).**
- **Programs can be imported from the SD card inserted in the control panel and display expansion unit.**

1 Display the main screen in [Program].

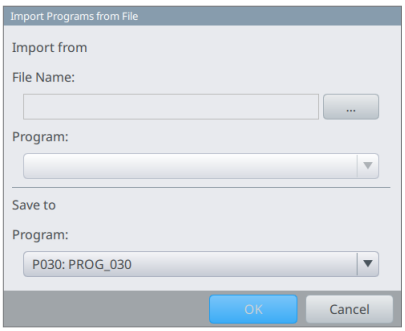
2 Display the [Program Details] screen.

“Displaying the [Program Details] screen” (page 7-7)

3 Press [Import from File].



4 Configure the following settings.



Import from

File name

Select a batch backup file (*.iv4a) or an individual program backup file (*.iv4a).

Program

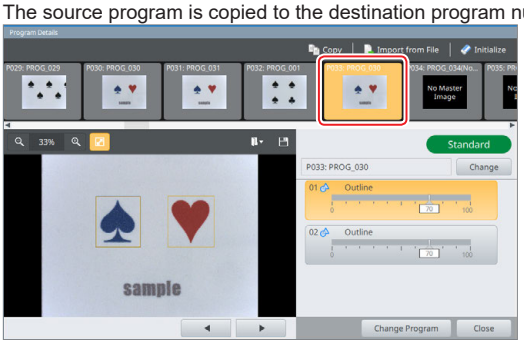
Selects the number of the program to be imported.

Save to

Selects the number of the destination program.

5 Press [OK].

The source program is copied to the destination program number.



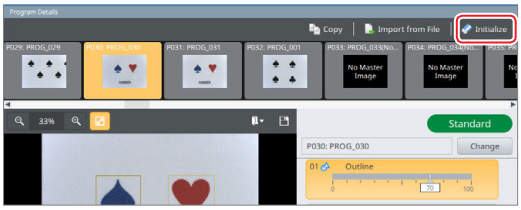
Initializing a Program

Initializes settings in the program and resets the program to the default.

1 Display the [Program Details] screen.

“Displaying the [Program Details] screen” (page 7-7)

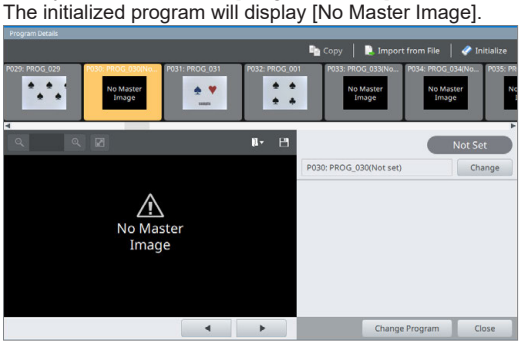
2 Select the program to be initialized and press [Initialize].



The confirmation screen opens.

3 Press [OK].

The system returns to the [Program Details] screen.
The initialized program will display [No Master Image].



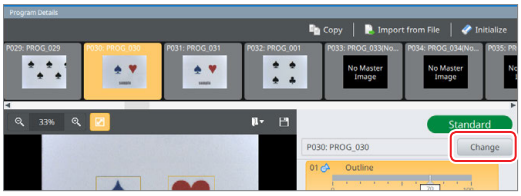
Editing a Program Name

Edits the program name.

1 Display the [Program Details] screen.

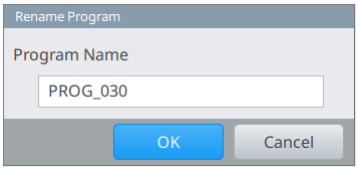
“Displaying the [Program Details] screen” (page 7-7)

2 Select the program to change the program name and press [Change].



The [Rename Program] screen opens.

3 Enter the user-defined program name and press [OK].

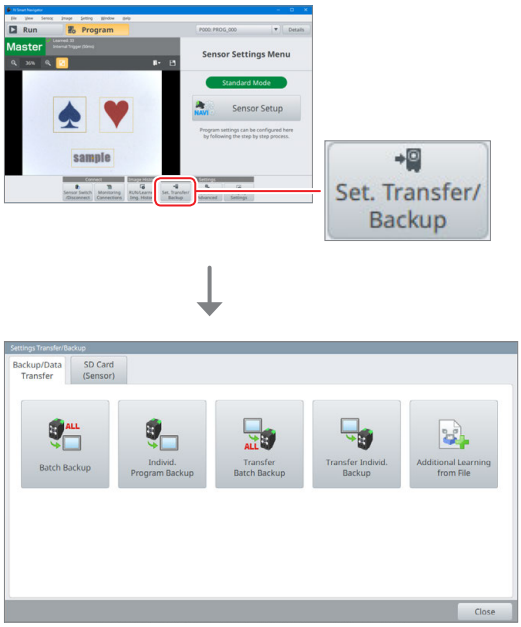


You can enter up to 16 alphanumeric characters.

Point

If the display language is changed, the device name might be replaced and displayed as hyphens (-).

Settings Transfer/Backup



[Backup/Data Transfer] tab

Batch Backup

Saves the settings data or image history saved in the sensor to the PC.
For a control panel and display expansion unit, the settings are saved to a USB memory stick or SD card.
“Batch Backup” (page 8-3)

Individ. Program Backup

Save the setting data saved in the sensor into the PC for each individual program. The image history can also be saved.
For a control panel and display expansion unit, the settings are saved to a USB memory stick or SD card.
“Individ. Program Backup” (page 8-4)

Transfer Batch Backup

Transfers all settings data saved in the PC to the sensor.
For a control panel and display expansion unit, data saved to a USB memory stick or SD card is transferred.
“Transfer Batch Backup” (page 8-5)

Transfer Individual Backup

Transfers each individual program settings data saved in the PC to the sensor.
“Transfer Individ. Backup” (page 8-6)

Additional Learning from File

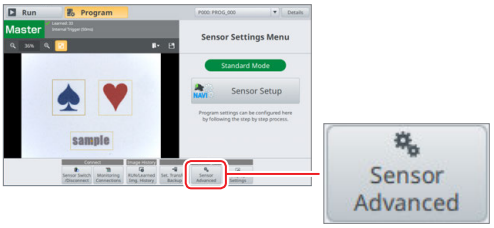
“Additional Learning from File” (page 6-10)

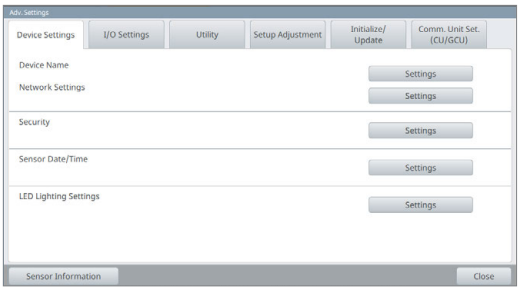
[SD Card] tab

Sets up SD cards inserted into sensor amplifiers (ultra-compact models) and sensors (built-in amplifier models).
“Setting up the SD Card” (page 8-8)

Sensor Advanced Settings

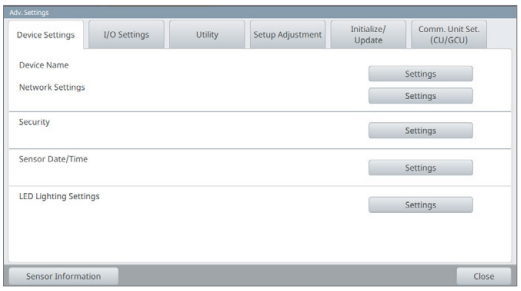
Point **The advanced settings of the sensor can only be changed when [Sensor Advanced] is pressed in the main screen in [Program].**





“Device Settings” (page 7-10)
“I/O Settings” (page 7-13)
“Utility” (page 7-17)
“Setup Adjustment” (page 7-23)
“Initialize/Update” (page 7-24)
“Comm. Unit Set. (CU/GCU)” (page 7-24)

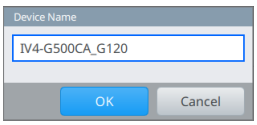
Device Settings



“Device Name” (page 7-10)
“Network Settings” (page 7-10)
“Security” (page 7-11)
“Sensor Date/Time” (page 7-12)
“LED Lighting Settings” (page 7-12)
“Sensor Information” (page 7-12)

Device Name

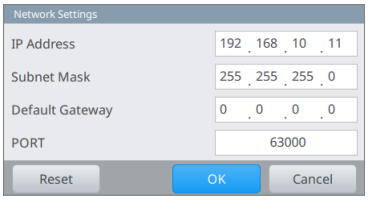
The sensor can be arbitrarily named and controlled.
To change the sensor name, input any desired name.



Point **If the display language is changed, the device name might be replaced and displayed as hyphens (-).**

Network Settings

Changes the network settings for the connected sensor.



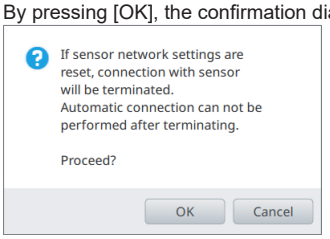
IP Address/Subnet Mask/Default Gateway/PORT

Displays the address for each network and port number.
Set the desired address and port number, and press [OK].

[Reset] button

By pressing [Reset], resets the IP Address / Subnet Mask / Default Gateway.
[Not Set] will be displayed after the reset.

By pressing [OK], the confirmation dialog appears.



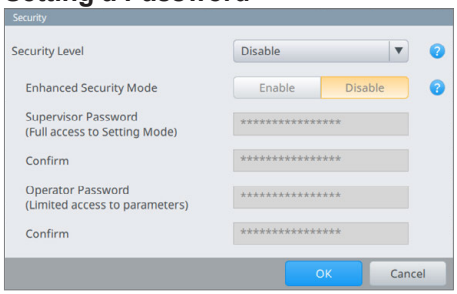
By pressing [OK], the network settings will reset and the system returns to the Activation Menu screen.
The connection to the sensor will be disconnected and reconnected. If reconnection is successful, the main screen of [Program] will be displayed. If reconnection fails, the [Activation Menu] screen opens.

Reference The settings can also be initialized using the IP reset switch of the sensor.
“Initializing the network settings” (page A-25)

Security

Sets a password on the sensor to prevent incorrect operation. Two levels of security authorizations (supervisor password and operator password) can be set.

Setting a Password



Security Level

Select a target for enabling a password.

❍ **Disable**

Disables all passwords.

❍ **Supervisor**

Enables a supervisor password. The settings can be changed in the settings mode using the supervisor password.

❍ **Supervisor/Operator**

Enables both the supervisor password and operator password. Although the threshold changing and statistics reset and others in operation are available when the operator password is used, the settings cannot be changed in the settings mode.

Enhanced Security Mode

With [Enable] selected, a password must meet the following requirements.

- At least 8 characters
- Use of an upper-case, lower-case, and number

Entering a Password

- Input a password into the [Supervisor Password] and the [Confirm] fields.
- Input a password into the [Operator Password] and the [Confirm] fields.
- Up to 16 characters can be set.
- Default: None (blank)

Reference

- The password will always be displayed as "********", regardless of the characters entered.
- After setting a password and displaying the run screen, the security becomes enabled.
- To disable the security, select [Disable] for [Security Level].

Enable the security

Display the main screen in [Run].

is displayed on the screen.



In the main screen in [Run], the following operation can be locked, and it can be unlocked using passwords according to their authorizations.

❍ **Operation that can be unlocked using an operator password**

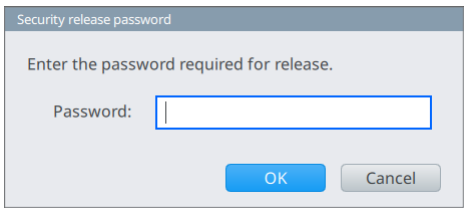
- Manual Trigger
- Image Additional Learning
- Limit Adjustment
- Reset Statistics
- Clear NG Hold
- Stop logging when opening running history display
- Display the learning history

❍ **Operation that can be unlocked using a supervisor password**

- Operation that can be unlocked using an operator password
- Transition to the main screen in [Program]
- Clearing NG Count on the list of NG occurrences
- Connection with the sensor where the security is enabled
- Transfer Program Settings

Unlock the security

Input the password when the [Security release password] screen appears.



is displayed on the screen.



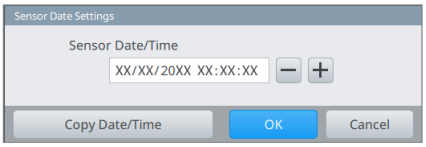
If security is disabled, operation will be locked again by pressing or after 60 seconds passes without performing any operations.

If the security is unlocked and the sensor is returned to the main screen in [Program], the password lock will be disabled until the sensor returns to the main screen in [Run].

Sensor Date/Time

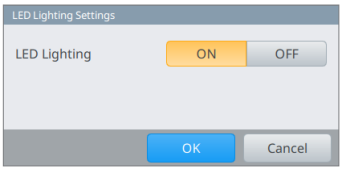
Confirms or changes the time set in the sensor.
When pressing [Copy Date/Time], the following date and time can be copied:

- When using a PC: Date and time of the PC
- When using a control panel: Date and time of the control panel
- When a display expansion unit is used: Date and time of the display expansion unit



LED Lighting Settings

Set whether to turn the sensor LEDs on or off.



Built-in amplifier model LEDs

Sensor

Status indicator light, OUT, TRIG, STATUS, LINK/ACT, SD

Ultra-compact model LEDs

Sensor head

Status indicator light

Sensor amplifier

PWR/ERR, OUT, TRIG, STATUS, LINK/ACT, SD

Communication unit (IV4-CU1/GCU1) LEDs

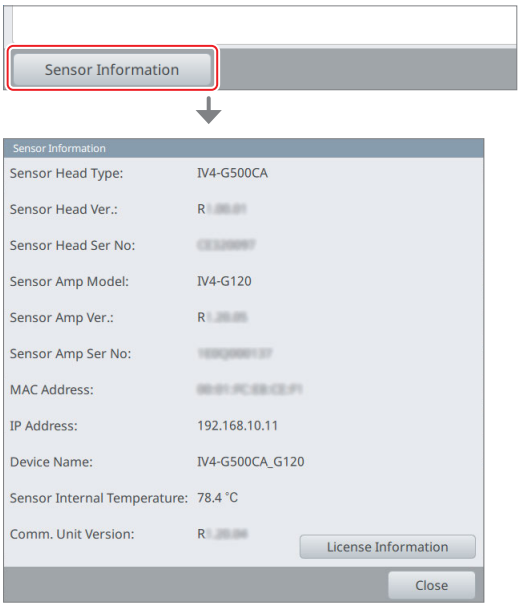
PWR/US1, RUN/BF, ERR/SF, L/A IN, L/A OUT, L/A 1, and L/A 2

Reference

- This setting does not apply to the "internal lighting LED on the sensor" and the "lighting LED on the AI lighting unit". If you want to turn the lighting LED off, configure the settings for [Sensor Setup] > [Step 1 Image Optimization] > [Extended Functions] > [Lighting].
  “Lighting” (page 4-11)
- These settings do not apply to the LEDs of the control panel, display expansion unit, and communication unit DL series.

Sensor Information

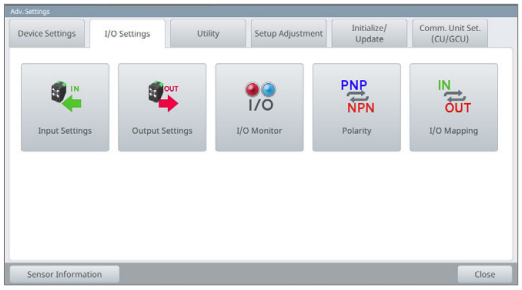
Displays the information set in the sensor.



Reference

About [Sensor Internal Temperature]
For built-in amplifier models, the temperature of the board inside the sensor is displayed.
For ultra-compact models, the temperature of the board inside the sensor amplifier is displayed.
This temperature is a guideline for checking whether the case temperature rating may meet the specifications described in the applicable specifications (the "sensor internal temperature" displayed in the software should be less than 85°C).

I/O Settings

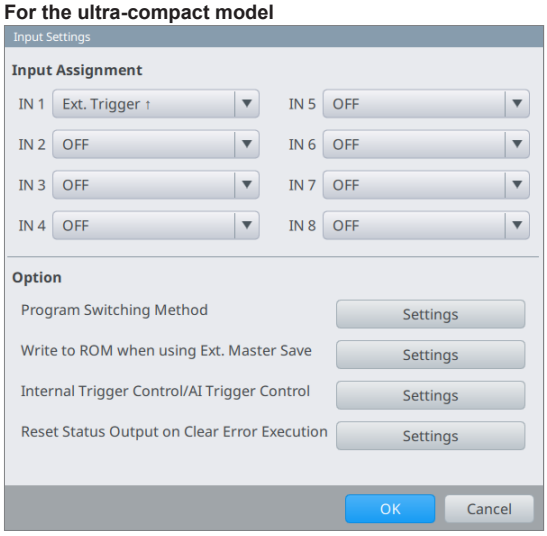


"Input Settings" (page 7-13)
"Output Settings" (page 7-15)
"I/O Monitor" (page 7-16)
"Polarity" (page 7-16)
"I/O Mapping (Built-In Amplifier Type)" (page 7-16)

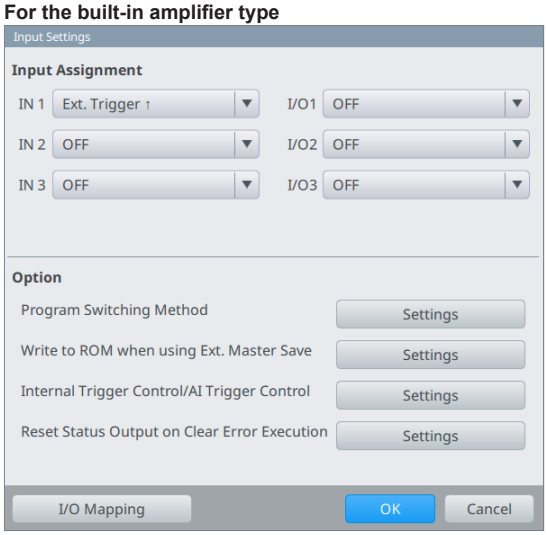
Input Settings

Set the input settings for the sensor.

For the ultra-compact model



For the built-in amplifier type



Input Assignment

IN1

Sets the detection timing of the trigger input for IN1 input line.

❍ Ext. Trigger ↑ (Default)

Sets the sensor so that the trigger input is received with the rising edge of the external trigger.

❍ Ext. Trigger ↓

Sets the sensor so that the trigger input is received with the falling edge of the external trigger.

IN2 to IN8 (for the ultra-compact model)

Sets the roles for input lines IN2 to IN8.

❍ OFF (default)

Disregards the input.

❍ Program bit0 to bit6

Specifies the number for switching programs.
"Changeover for a Target (Program Functions)" (page 7-2)

❍ Clear Error

Used to clear error outputs.
"Clearing Errors" (page 11-12)

❍ Ext. Master Save

Registers a new master image using the external input.
"Registering the Master Image" (page 11-11)

❍ SD Card Save Stop

Stop data transfer to the SD card and access to the expansion programs. The SD card indicator light turns off.
"Behavior When the Sensor Power is Turned On or Off" (page 11-14)

❍ OCR Serial No. Count Up

Counts up the current value of the serial number in the AI OCR Tool (custom).

❍ Reset Count

Resets the count value.
The contents that can be reset are as follows:
- Standard Mode: Current value of the serial number in the AI OCR Tool (custom)
- AI Through Count: Count value

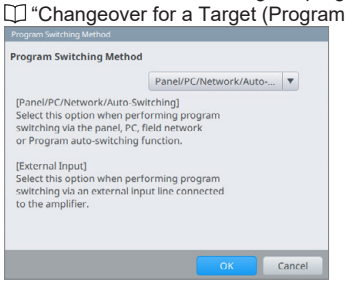
IN2 to IN3, I/O1 to I/O3 (for the built-in amplifier type)

Sets the roles for input lines IN2 to IN3 or I/O1 to I/O3.
The detailed setting methods are the same as those of the ultra-compact model input lines IN2 to IN8.
When I/O1 to I/O3 are set to OUT (output) in the I/O mapping settings, the input lines cannot be set.

Option

Program Switching Method

Sets the method for switching the program number.
"Changeover for a Target (Program Functions)" (page 7-2)



❍ Panel/PC/Network/Auto-Switching (Default)

The program number can be switched from the control panel, display expansion unit, PC, field network, DL, nonprocedural command, IoT communications, or program auto-switching.

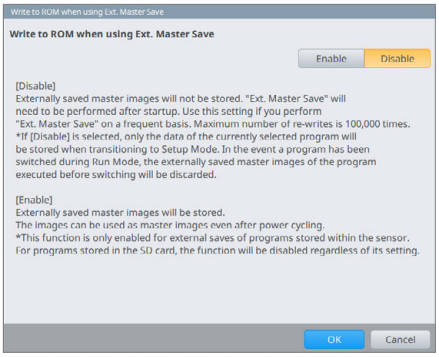
❍ External Input

The program number can be switched using external input.

Point

If [External Input] is set, one of the program Bit0 to Bit6 must be assigned to one of IN2 to IN8 in [Input Assignment].
"Input Assignment" (page 7-13)

Write to ROM when using Ext. Master Save



❍ Enable

Writes data to the ROM of the sensor when master image registration is performed using the external input or field network.
“Registering the Master Image” (page 11-11)

❍ Disable (default)

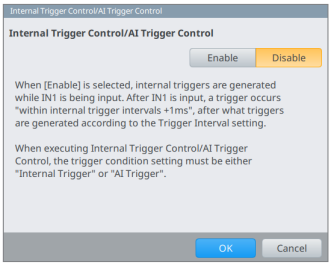
Writes only the master images of active programs selected in the settings mode to the ROM of the sensor. The other data will not be written.

Point

The target programs that write to ROM are P000 to P031.

Internal Trigger Control/AI Trigger Control

The following triggers are subject to control:
- Standard Mode/Sorting Mode: Internal Trigger, AI Trigger
- AI Through Count Mode: Trigger Operation



❍ Enable

As input to IN1 is turned on, or the field network cyclic communication trigger request is turned on, the target trigger is issued at intervals determined according to the setting, and the image is captured.
“Trigger Options” (page 4-7)

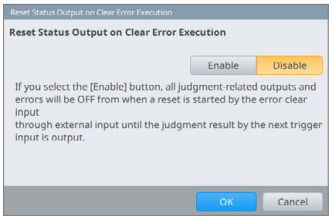
❍ Disable (default)

Does not control the target trigger with input to IN1.

Point

- **[Internal Trigger Control/AI Trigger Control] is a setting common to all programs. It cannot be set for each program.**
- **If [Trigger Options] is set to [External], IN1 input will be accepted as an external trigger.**

Reset Status Output on Clear Error Execution



❍ Enable

Resets status output when clear error is input. Judgment-related outputs and errors will be turned off until the judgment result by the next trigger input is output.
If a PC, control panel, or display expansion unit is connected, the image used for judgment will be reset and the [Waiting for trigger] screen will appear.

❍ Disable (default)

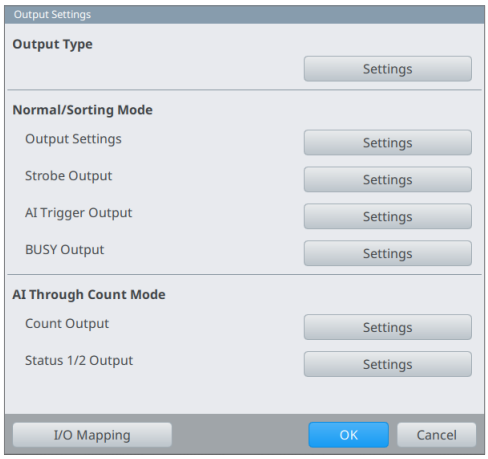
Does not reset status output when clear error is input.

Point

Judgment output cannot be reset with this function via the field network.
To do a reset via the field network, use [Status result/Buffer clear request].
“Chapter 9 Connecting to a Network” (page 9-1)

Output Settings

Set the Output Settings of the sensor.



Output Type

OUT1 to OUT8 (for the ultra-compact model)

Specifies the output format of the output line with [N.O] or [N.C].

OUT1 to OUT3, I/O1 to I/O3 (for the built-in amplifier type)

Specifies the output format of the output line with [N.O] or [N.C].
When I/O1 to I/O3 are set to IN (input) in the I/O Mapping settings, the output lines cannot be set.

Normal/Sorting Mode

Output Settings

❍ [Latching] (default)

Outputs the result simultaneously with the judgment condition of the sensor.

❍ [One-Shot]

Outputs the result as a one-shot. The one-shot time and ON delay time for the one-shot output can be set.

- **One-Shot ON Time**
  Specifies the length of time for which the one-shot will be active within 10 to 1000 ms.
  (Default value: 100 ms)
- **ON-Delay Time**
  Specifies the delay before the one-shot turns on within 0 to 5000 ms.
  (Default value: 100 ms)

Strobe Output

❍ One-Shot ON Time

Specifies the length of time for which the one-shot will be active within 1 to 50ms.
(Default value: 1ms)

❍ Strobe Error

Sets whether to output an error when overlapping strobe one-shots are output.

AI Trigger Output

❍ One-Shot ON Time

Specifies the length of time for which the one-shot will be active within 1 to 50ms.
(Default value: 1ms)

❍ AI Trigger Output Error

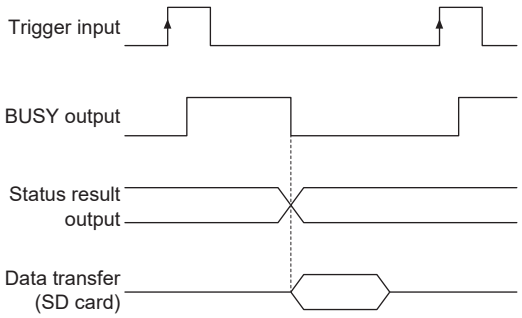
Sets whether to output an error when overlapping AI trigger one-shots are output.

BUSY Output

Sets the Busy output length.

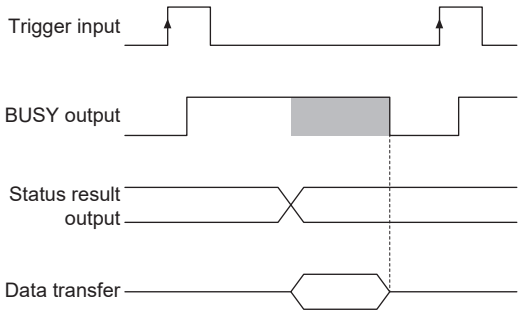
❍ Until Judgment is Complete (default)

The BUSY output turns on when the trigger is input and turns off when the judgment results are updated.



❍ Until Data Transfer is Complete

The BUSY output turns on when the trigger is input and turns off when data transfer is complete, after the judgment results are updated. This setting prevents trigger input while data is being transferred when using the function to transfer data to the FTP server, SFTP server, or micro SD card.



AI Through Count Mode

Count Output

Sets the one-shot and delay times for outputting judgment with count up.

❍ One-Shot ON Time

Sets the one-shot output time during count up from between 1 to 50 ms.
(Default value: 1ms)

❍ Minimum OFF Time

Sets the minimum off time for one-shot output from between 1 to 50 ms.
(Default value: 1ms)

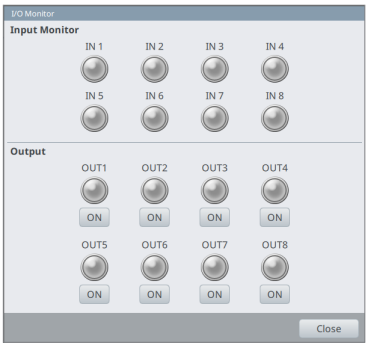
Status 1/2 Output

Sets the minimum output time for [Status Output 1] and [Status Output 2] in AI through count mode from between 1 and 10 ms.

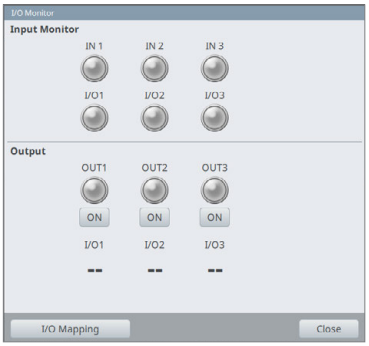
I/O Monitor

Used for confirming the proper operation and wiring of the I/O lines.

For the ultra-compact model



For the built-in amplifier type



Input Monitor

Displays the input status of external input in real time. Whether or not the ON/OFF output from the external input is being correctly input can be confirmed.

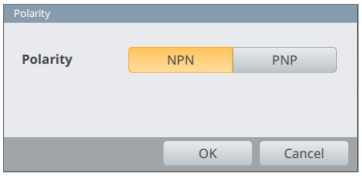
Output Monitor

Press [ON] to turn ON each OUT output. Press [OFF] to turn them OFF.
Confirm that the output destination is correctly receiving the output.

Polarity

Sets the sensor polarity.

Reference If the polarity is switched, the confirmation dialog opens.



“Cables” (page 2-21)

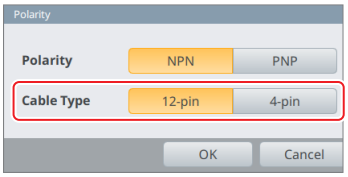
❍ NPN

- Output circuit: Photo MOS relay
- Input circuit: Non-voltage input

❍ PNP

- Output circuit: Photo MOS relay
- Input circuit: Voltage input

Select [12 pin] or [4 pin] for the cable type in the case of the built-in amplifier type.



❍ 12pin

Select this to use a power I/O cable (OP-88654/88655/88656).

❍ 4pin

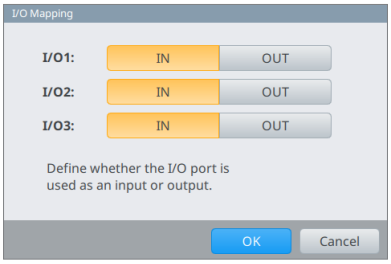
Select this to use a conversion connector for the power I/O cable (OP-88631/88632).

I/O Mapping (Built-In Amplifier Type)

Sets whether to use IN or OUT for ports where input and output can be switched (I/O ports).

Point **When changing IN/OUT, the input settings, output settings, and I/O monitor settings will be affected. Check each setting again after it is changed.**

Reference If the I/O port settings are switched, the confirmation screen opens.



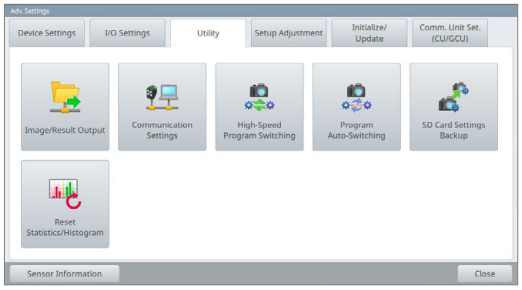
❍ IN

The corresponding I/O port can be used as an input (IN) port.

❍ OUT

The corresponding I/O port can be used as an output (OUT) port.

Utility



- “Image/Result Output” (page 7-17)
- “Communication Settings” (page 7-17)
- “High-Speed Program Switching” (page 7-19)
- “Program Auto-Switching” (page 7-20)
- “SD Card Settings Backup” (page 7-22)
- “Reset Statistics/Histogram” (page 7-22)

Image/Result Output

Sets the SD card data transfer function or FTP/SFTP client function settings for the sensor.

- “Transferring Judgment Results or Judged Images to the SD Card” (page 8-11)
- “Saving Judgment Results and Judged Images to an FTP/SFTP server” (page 9-2)

Communication Settings



- “FieldNet/Comm. Unit (DL)” (page 7-17)
- “Nonprocedural Communication Settings” (page 7-17)
- “SNTP Settings” (page 7-17)
- “MK/FP Comm Settings” (page 7-19)
- “DNS Settings” (page 7-19)
- “IoT Communication Settings” (page 7-19)
- “Web Monitor” (page 7-35)

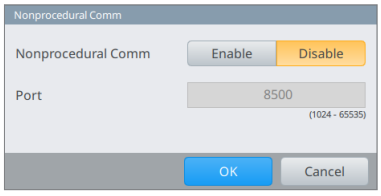
FieldNet/Comm. Unit (DL)

Sets the field network settings for the sensor and the settings for when the system is connected to the (DL series) communication unit.

“Connecting to a Field Network” (page 9-12)

Nonprocedural Communication Settings

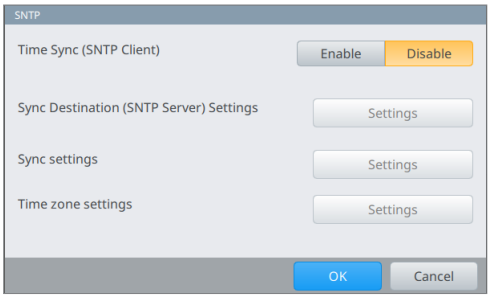
Enables or disables and sets the port number for nonprotocol communications.



“TCP/IP Non-procedural Communication Specifications and Functions” (page 9-146)

SNTP Settings

Accesses an SNTP server on the network to automatically adjust the time on the sensor amplifier’s internal clock.
This reduces the effort required to periodically check the time.



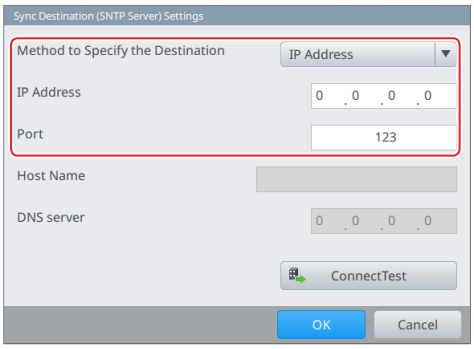
Time Sync (SNTP Client)

Enables or disables time synchronization.

Sync Destination (SNTP Server) Settings

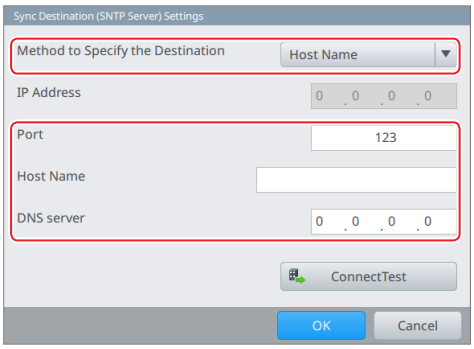
Point **After configuring the settings, press [ConnectTest] to test the connection with the connection destination.
If "Successfully connected." is displayed, setting is completed.**

❍When specifying the synchronization destination by IP address



- **Method to Specify the Destination**
  Select [IP Address].
- **IP Address**
  Sets the IP address for the synchronization destination (SNTP server).
- **Port**
  Sets the port number for the synchronization destination (SNTP server).

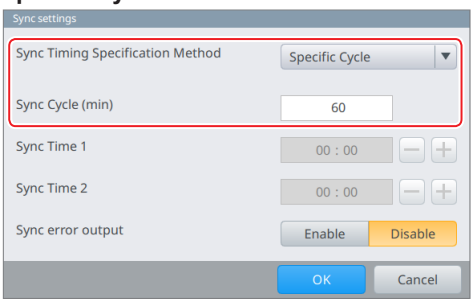
❍When specifying the synchronization destination by host name



- **Method to Specify the Destination**
  Select [Host Name].
- **Host Name**
  Sets the host name for the synchronization destination (SNTP server).

Sync settings

When specifying the synchronization destination by specific cycle



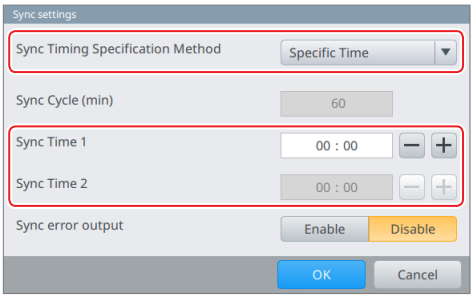
❍ **Sync Timing Specification Method**

Select [Specific Cycle].

❍ **Synchronization cycle (minutes)**

Sets the synchronization cycle in minutes. Sets the range within 1 to 1440 minutes.
(Default value: 60 minutes)

When specifying the synchronization destination by time



❍ **Sync Timing Specification Method**

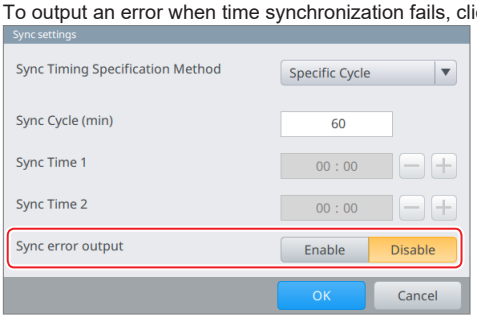
Select the number of times to perform synchronization in a day from [Specific Time] or [Add. Specific Time].

❍ **Sync Time 1/Sync Time 2**

Set the time (hours:minutes) for synchronization.

Sync error output

To output an error when time synchronization fails, click [Enable].



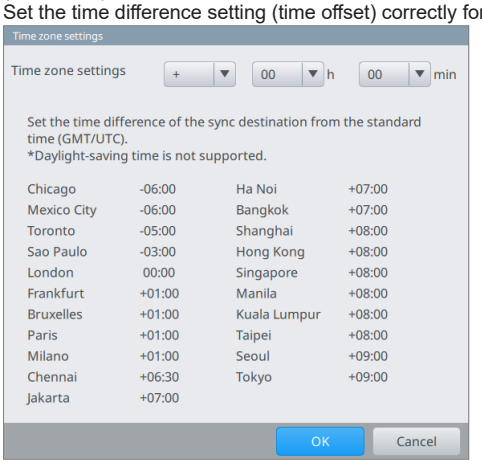
Point

When this option is set to [Enable], the following occurs if time synchronization fails.

- **An error message opens.**
- **The error output function turns ON.**
- **The error output can be turned off by the clearing error input.**

Time zone settings

Sets the time difference of the sync destination from standard time (GMT/UTC).
Set the time difference setting (time offset) correctly for your region.



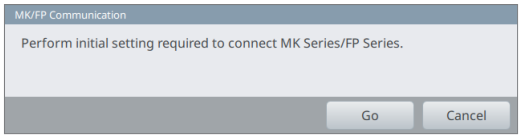
Reference

- GMT: Greenwich Mean Time
- UTC: Coordinated Universal Time
- If Daylight Saving Time (DST) is to be supported, set the time offset to account for DST.

MK/FP Comm Settings

To facilitate easy connection (linkage) with the MK and FP Series, the necessary settings for connection can be configured at the same time.

❍ For a PC

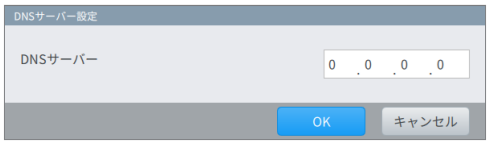


❍ Control panel and display expansion unit



DNS Settings

Sets the IP address for the DNS server.



IoT Communication Settings

Make settings for communication via the IoT protocol (OPC UA, MQTT).

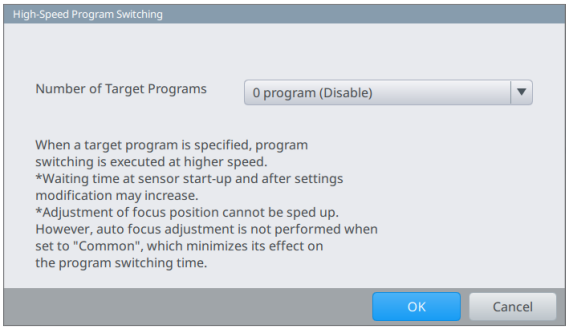
“OPC UA Server Function” (page 9-118)
“MQTT Client Function” (page 9-136)

High-Speed Program Switching

Selects the programs to be used for high-speed program switching. By holding the setting contents of the target program, switching between the targets can be performed at high speed.

Reference

- The approximate time to switch to the target program is about 100 ms (the time for focus adjustment is not included).
- By setting high-speed program switching, additional processing time will be required when the sensor starts and when settings are changed (it may take several tens of seconds).



0 Program (Disable)	High-speed program switching disabled
2 programs (P000 - P001)	High-speed switching enabled, only for two programs of P000 to P001
4 programs (P000 - P003)	High-speed switching enabled, only for four programs of P000 to P003
8 programs (P000 - P007)	High-speed switching enabled, only for eight programs of P000 to P007

A progress bar will be displayed while preparing high-speed program switching.

Program Auto-Switching

Program Auto-Switching

If multiple programs are used to perform a single examination, examinations can be performed continuously without controlling the program switching with a PLC etc.

“Importing the Status Output (When Program Auto-Switching is "Enable")” (page 11-8)

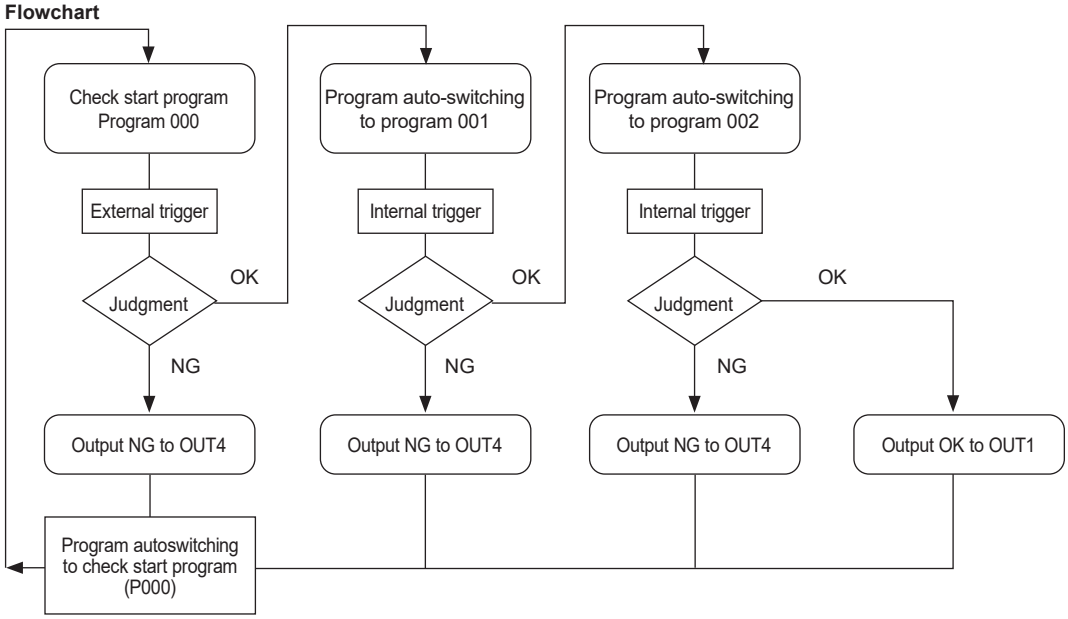
Reference Programs for which [AI Trigger] is selected as the trigger type and programs of [AI Through Count Mode] cannot use [Program Auto-Switching].

The following flow can be set easily.

Setup example

- Output the total status OK to OUT1 when all judgments in programs 000 to 002 are OK.
- Output the total status NG to OUT4 when any of judgments in programs 000 to 002 are NG.
- Return to the program 000 after determining the judgment.

Flowchart



Each program setting (for the ultra-compact model)

		P000	P001	P002
Trigger		External	Internal	Internal
Destination program	Total Status OK	P001	P002	P000
	Total Status NG	P000 *1	P000	P000
Output assignment	OUT1	OFF	OFF	Total Status OK
	OUT4 *2	Total Status NG	Total Status NG	Total Status NG

*1 Do not select [None] but select [P000]. When selecting [None], the judgment is not reset.
*2 The output of built-in amplifier type is limited to OUT3, thus set the desired output number.

Point **By assigning the total status OK to OUT1 for P002 only, you can prevent the total status OK from being output for the program in the middle of the process.**

Setting procedures

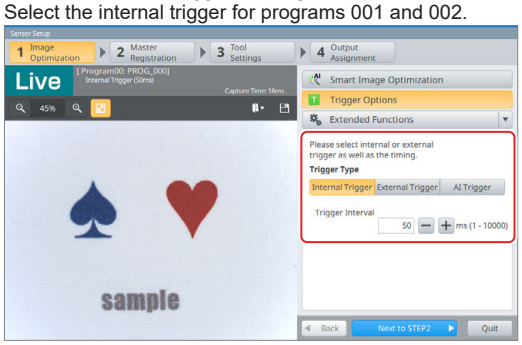
This section explains the settings using program 000 as an example.

Point

- **When [None] is selected for the switching destination, the current operation screen and judgment conditions are retained. When the same program number is selected for the switching destination, switching to the same program is processed and the operation screen and status are reset. If resetting the status in the start point program, select the same program.**
- **The life-span for the operation of the focusing function (program switch count) is 100,000 times. If the focusing position does not need to be changed in each program, set [Auto Focus Adj Pos] to [Common] to extend its duration.**
  “Auto Focus Adj Pos” (page 7-23)

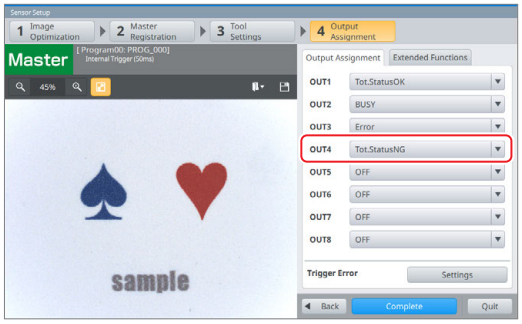
1 Set the trigger options.

Select the external trigger for program 000.
Select the internal trigger for programs 001 and 002.



“Trigger Options” (page 4-7)

2 Select the [Output Assignment] tab, and select [Total Status NG] for OUT4.



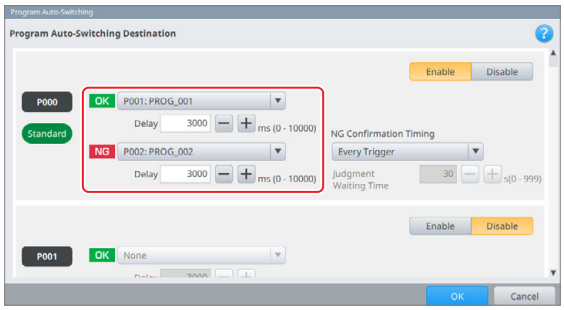
“4. Output Assignment” (page 4-88)

3 Select [Sensor Advanced] > [Utility] > [Program Auto-Switching] and then press [Enable].



4 Select the program switching destination at the total status OK and program switching destination at the total status NG.

Standard Mode

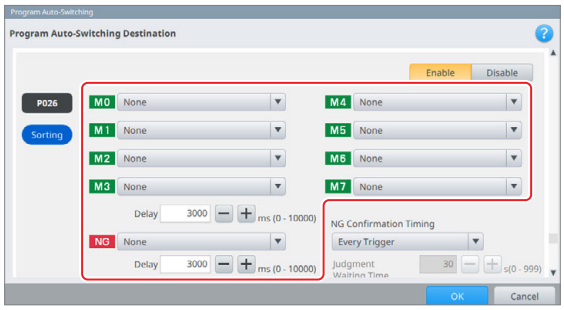


❍ **OK**
Selects the switching destination program when the total status is OK.

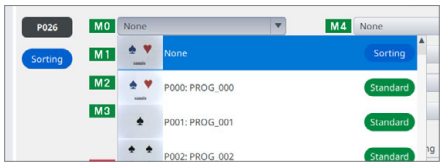
❍ **NG**
Selects the switching destination program when the total status is NG.

❍ **Delay**
Sets the delay time (default: 3000 ms) for switching.

Sorting Mode



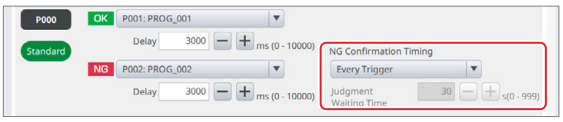
❍ **M0 to M7 (Part Judgment)**
Selects the switching destination program by part when the part status is OK.



❍ **NG**
Selects the switching destination program when the total status is NG.

❍ **Delay**
Sets the delay time (default: 3000 ms) for switching.

5 Set the NG confirmation timing.



❍ **Every trigger (default)**
Determines the target as the total status NG when NG occurs for every trigger.

❍ **After Judgment Waiting Time (at internal trigger only)**
When the total status NG occurs after the judgment waiting time has passed, the program switching operation at the total status NG is executed.
Even if the total status NG occurs during the judgment waiting time, the program switching operation at the total status NG is not executed.

❍ **After Retry Count (at external trigger only)**
When the total status NG counts reach the retry count + 1, the program switching operation at the total status NG is executed.
If the total status NG counts are within the retry count, the program switching operation at the total status NG is not executed.

Reference The methods to use [NG Confirmation Timing] properly are as follows:

- **Every Trigger**
  Determines the status for each trigger. Automatically switches to the program set in the switching destination according to the status result.
  This is mainly used for automatic machines and inline status without human intervention.
- **After Judgment Waiting Time (at internal trigger only)**
  Even if the judgment process results in the total status NG, the total status result is not determined during the time set in [Judgment Waiting Time].
  When the total status is OK, the program switching operation at the total status OK is executed at that point.
  When the total status is OK, the program switching operation at the total status OK is executed at that point. This is mainly used to check the work of assembly processes that require human intervention etc. The amount of time to complete a task can be set, using [Judgment Waiting Time].
- **After Retry Count (at external trigger only)**
  Even if the judgment process results in the total status NG, the total status result is not determined up to the count set in [Retry Count]. The program switching operation at the total status NG is not executed. When the total status is OK, the program switching operation at the total status OK is executed at that point.
  When the total status is OK, the program switching operation at the total status OK is executed at that point. This is mainly used to check the work of assembly processes that require human intervention etc. The number of times where the operator retries can be set, using [Retry Count].

6 Set P001 and P002 with the same procedures according to each program setting.

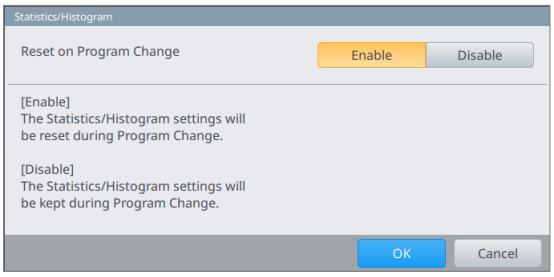
Point
- **To use program auto-switching, select [Panel/PC/Network/Auto-Switching] as the program switching method.**
  “Program Switching Method” (page 7-13)
- **Statistical information and histograms are retained or reset according to the [Reset Statistics/Histogram] setting during program changeover.**
- **To use program auto-switching, change to the start point program before starting operation.**
- **The program number switched by program auto-switching will not be saved in the internal sensor ROM.**
- **The life-span for the operation of the focusing function (program switch count) is 100,000 times. If the focusing position does not need to be changed in each program, set [Auto Focus Adj Pos] to [Common] to extend its duration.**
  “Auto Focus Adj Pos” (page 7-23)

SD Card Settings Backup

“Automatically Back Up/Restore the Settings on the SD Card” (page 8-19)

Reset Statistics/Histogram

Sets whether to reset the statistics/histogram settings during program changeover.



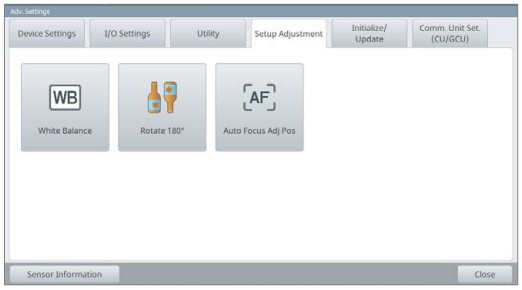
Point **If [Disable] is selected, statistics and histograms are retained for each program.**

Example
After switching from "Program 0" to "Program 1" and then back to "Program 0" again, the statistics and histogram results of the previous "Program 0" are retained.

Web Monitor Settings

“Web Monitor” (page 7-35)

Setup Adjustment

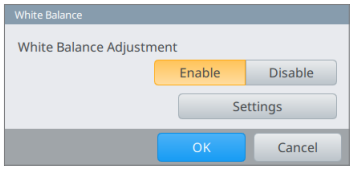


White Balance (for color type only)

Adjusts the white balance (color tint) of the built-in camera of the sensor.

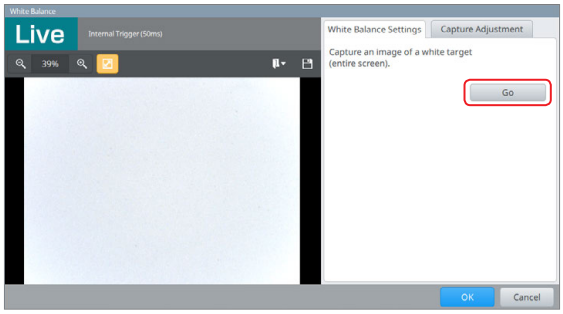
Point **The white balance is adjusted by default. When using the AI Lighting unit or polarizing filter, perform white balance adjustment with the attachment mounted.**

1 Select [Enable] for [White Balance Adjustment] and press [Settings].



2 Image a white-colored target and press [Go].

Point **If the displayed taken image is not suitable for adjusting the white balance, press the [Capture Adjustment] tab to adjust the taken image.**
If the white balance setting has been set to [Enable], the image will be displayed with the white balance adjustment applied.
The following adjustments can be made:
“Brightness Adjustment” (page 4-11)
“Lighting” (page 4-11)
“Lighting Mode” (page 4-11)
“Focus Adjustment” (page 4-12)



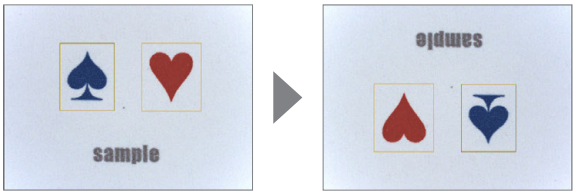
When adjustment is completed, the message, "White balance adjustment has been completed." appears.

3 Press [OK].

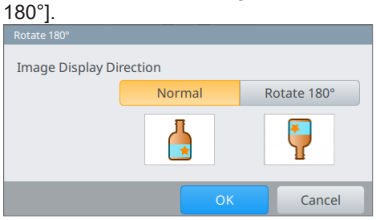
Point **If the settings are changed, a message prompting the re-registration of the program appears.**

Rotate 180°

Due to the installation restrictions of the sensor or the target, the image may be rotated.
Using [Rotate 180°] enables the image to be rotated 180°.



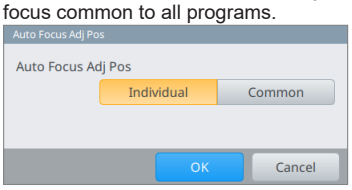
Check the state of the image and then select [Normal] or [Rotate 180°].



Point **If the settings are changed, a message prompting the re-registration of the program appears.**

Auto Focus Adj Pos

Sets whether or not to make the adjustment position for the auto focus common to all programs.



Individual

Sets the focus adjustment position in each program. Select this when the focus position is different for each target registered in each program. Re-adjusts the focusing position when the program is switched. Switching programs takes longer with this option due to the time needed to adjust the focusing position.

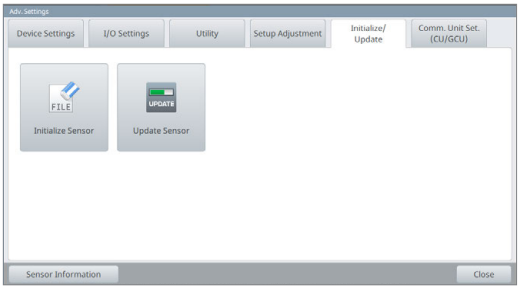
Common

Sets the focus adjustment position common to all programs. Select this when the focus position of the target registered in each program is the same. The program can be quickly switched because re-adjustment of the focusing position will not be performed when the program is switched.

NOTICE	**The life-span for the operation of the focusing function (program switch count) is 100,000 times. If the focusing position does not need to be changed in each program, set [Auto Focus Adj Pos] to [Common] to extend its duration.**

Point **If the settings are changed, a message prompting the re-registration of the program appears.**

Initialize/Update



Initialize Sensor

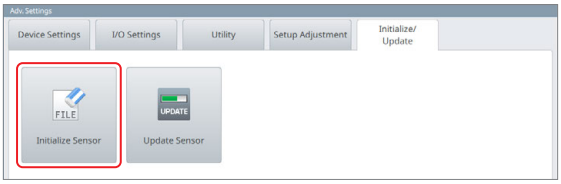
Initializes the information set in the sensor and sets it to the factory default.

Point

- **If there are any changes in the field network protocols due to sensor initialization, restart to apply the settings.**
- **If 🕮 "Setting Up SD Card Settings Backup" (page 8-19) is [Enable], the backup files on the SD card will also be initialized. To use an SD card that has not yet been initialized to restore different sensor settings, remove the SD card before initialization.**

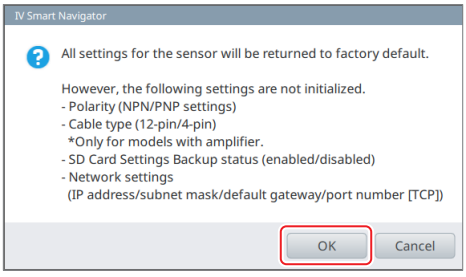
Reference To initialize the registered programs individually, refer to 🕮 "Initializing a Program" (page 7-8).

1 Press [Initialize Sensor].



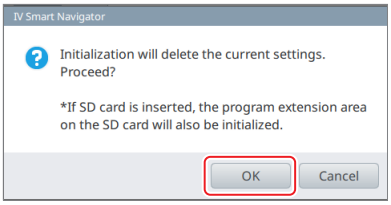
The confirmation screen opens.

2 Press [OK].

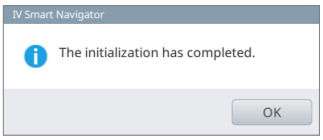


The confirmation screen opens.

3 Press [OK].



4 After initialization has been completed, press [OK].



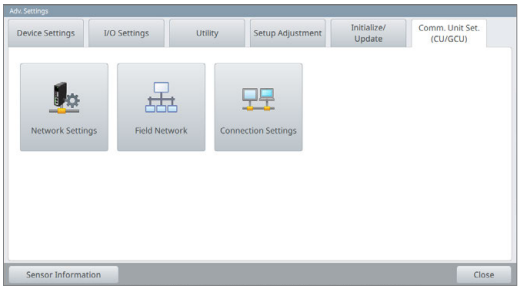
The system returns to the [Adv. Settings] screen.

Update Sensor

Updates the operation software of the sensor.
For details, refer to KEYENCE homepage.
URL: www.keyence.com/glb

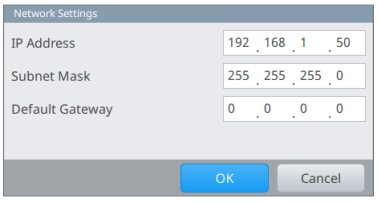
Point **To update the communication unit (IV4-CU1/GCU1), connect the unit to the sensor amplifier. When the sensor is updated with the communication unit (IV4-CU1/GCU1) connected to the sensor amplifier, the communication unit is also updated.**

Comm. Unit Set. (CU/GCU)



Network Settings

Change the network settings for the connected communication unit (IV4-CU1/GCU1).
Set the desired address and press [OK].



Field Network

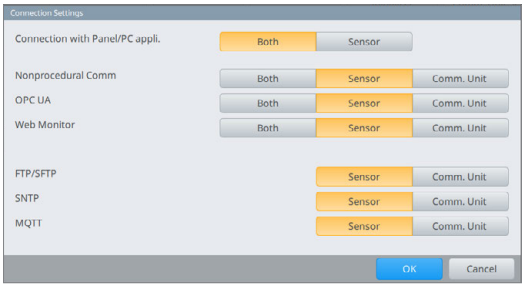
Adjust the settings of the field network for the communication unit (IV4-CU1/GCU1).
🕮 "Connecting to a Field Network" (page 9-12)

Connection Settings

Adjust the connection settings when using the communication unit (IV4-CU1/GCU1).

Point

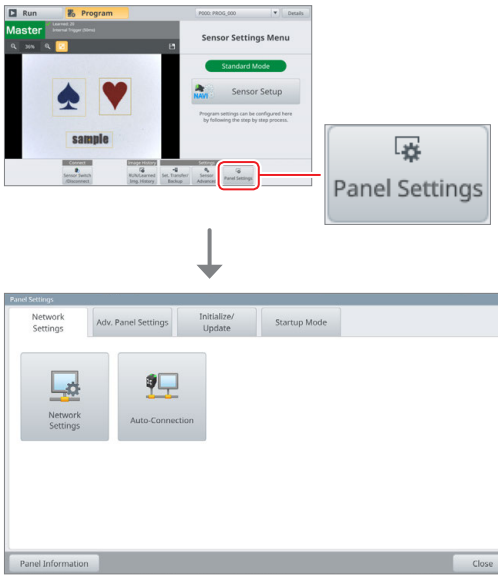
- **If the connection settings have been changed, restart the unit to apply the settings.**
- **When [EtherCAT] is selected for the protocol of field work of the communication unit (IV4-CU1/GCU1), the items are grayed out. All items are set to [Sensor].**



Panel Settings

(Control panel/Display expansion unit)

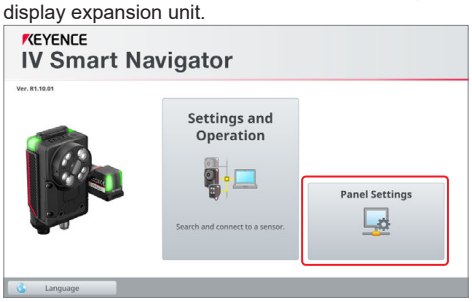
This section explains the [Panel Settings] screen that is displayed by pressing [Panel Settings] on a control panel or display expansion unit.



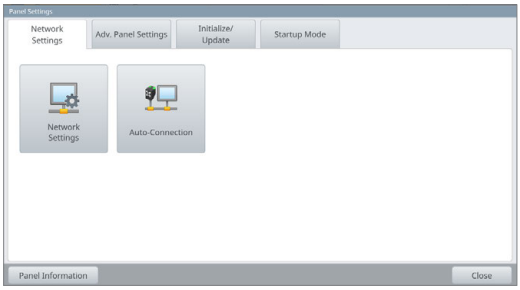
"Network Settings" (page 7-25)
"Advance Panel Settings" (page 7-26)
"Initialize/Update" (page 7-28)
"Startup Mode" (page 7-29)

Reference

The [Panel Settings] screen can also be displayed from the connection menu screen on a control panel or display expansion unit.

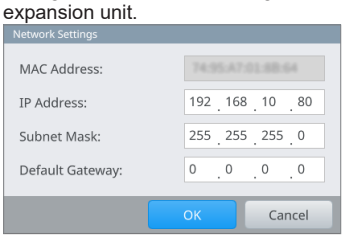


Network Settings



Network Settings

Configures the network settings for a control panel/display expansion unit.



- **MAC Address**

  Displays the MAC address. The MAC address cannot be changed.

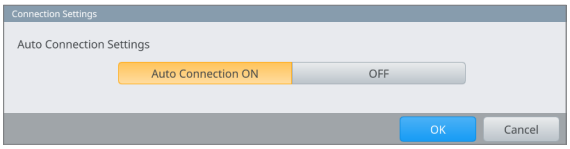
- **IP Address/Subnet Mask/Default Gateway**

  Pressing the address fields displays the edit screen.
  Set the desired address and press [OK].

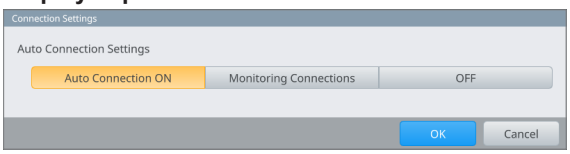
Connection Settings

Select the method to connect to the sensor when the control panel/display expansion unit starts.

- **Control panel**

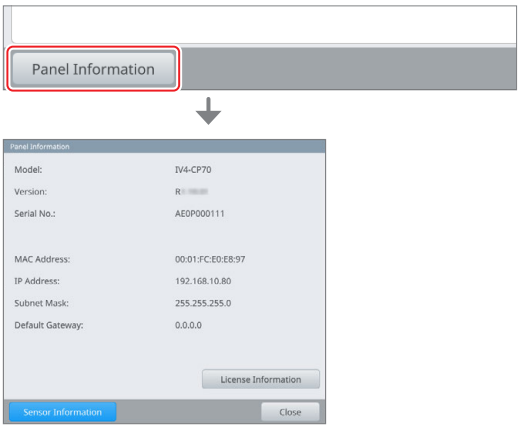


- **Display expansion unit**



Panel Information

Displays the information set on the control panel/display expansion unit.



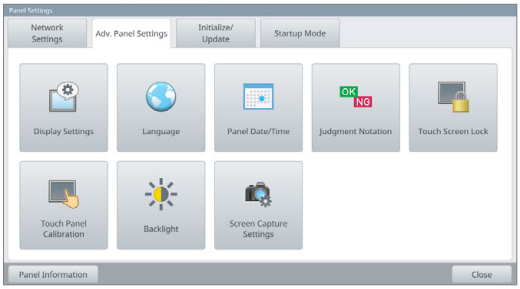
License Information

You can check the license information.

Sensor Information

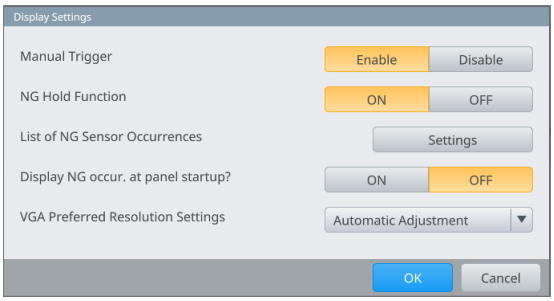
You can check “Sensor Information” (page 7-12).

Advance Panel Settings



“Display Settings” (page 7-26)
“Language” (page 7-27)
“Panel Date/Time” (page 7-27)
“Judgment Notation” (page 7-27)
“Touch Screen Lock” (page 7-27)
“Touch Panel Calibration (Control Panel Only)” (page 7-27)
“Backlight (Control Panel Only)” (page 7-28)
“Screen Capture Settings” (page 7-28)

Display Settings



Manual Trigger

When trigger options is set to external trigger, or [Internal Trigger Control/AI Trigger Control] is set to [Enable], set to show or hide the [Trigger] button displayed on the run screen.

“Names and Functions of the Screen in [Run] / [Program]” (page 5-3)

Reference The [Trigger] button displayed in the settings screen cannot be set to hidden.

NG Hold Function

Set to enable/disable the NG hold function.

“NG Hold Function” (page 5-13)

List of NG Sensor Occurrences

Adjust settings for the List of NG Sensor Occurrences.

“List of NG Sensor Occurrences” (page 5-11)

Display NG occur. at panel startup?

Adjust the settings of whether to display the "List of NG Sensor Occurrences" ON/OFF when starting up the control panel.

“Setting [List of NG Sensor Occurrences]” (page 5-12)

VGA Preferred Resolution Settings (Display Expansion Unit Only)

Sets the resolution for outputting images from the display expansion unit in VGA.
You can select from the following ranges:

- Automatic Adjustment
- 1366 × 768 60 Hz RB
- 1280 × 800 60 Hz RB
- 1280 × 720 60 Hz
- 1024 × 768 60 Hz

Reference When outputting via HDMI, [Automatic Adjustment] is selected.

Language

Select the language to be displayed on the control panel or display expansion unit.
Select the language, and then press [OK]. The control panel/ display expansion unit will restart.
After the restart, the display language will be switched to the selected language and the RUN screen opens.

Display of characters in device and program names

Details about the display of the characters in device and program names when changing the display language are as follows:

- Characters which cannot be displayed with the language after the change are replaced and displayed as hyphens (-).
- If the device or program name has not been changed after you changed a language, those names can be displayed as they were in the previous language once you change back to the previous language.
- If the device or program name has been changed after the language change, the name will remain replaced by hyphens (-) and the former information will be erased when the language is changed back to the previous language.

“Device Name” (page 7-10)
“Editing a Program Name” (page 7-8)

Panel Date/Time

Confirm or change the time set on the control panel or display expansion unit.

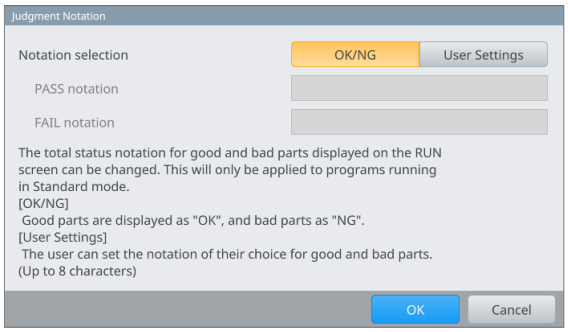
Reference

- This setting is adjusted by default.
- The date and time information are used for saving files into the USB memory.



Judgment Notation

Sets the notation (OK/NG) of the total status results on the run screen.

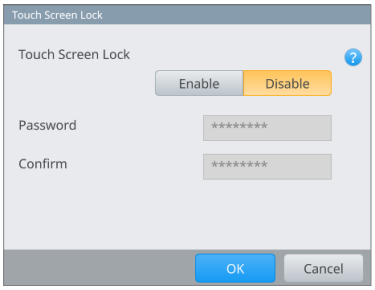


“Judgment Notation” (page 7-30)

Touch Screen Lock

Sets a password on the control panel or display expansion unit to prevent misoperation during operation.
Up to 8 characters can be set for the password.

- Displaying the RUN screen will enable the touch screen lock.
- When the touch screen is locked, operations other than tool selection will be locked.
- To disable the touch screen lock, press any button other than the tool buttons and input the password.



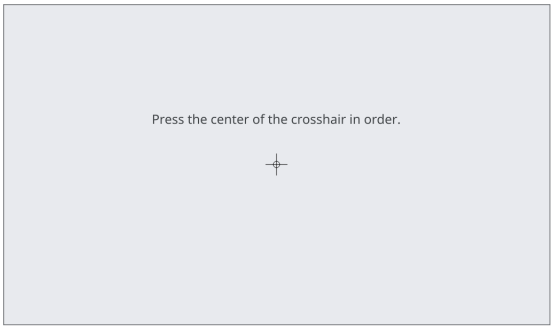
Efficiently using [Touch Screen Lock] and [Security]

- [Touch Screen Lock] locks operation of the control panel and display expansion unit to prevent misoperation of the control panel and display expansion unit, and the connected sensor.
- [Security] locks the sensor settings. It does not lock the operations of the control panel or display expansion unit.
- To lock editing of the sensor settings when using multiple control panels/display expansion units or a PC, use [Security]. This function cannot prevent misoperation from a control panel/ display expansion unit or a PC for which [Touch Screen Lock] is not set.

“Security” (page 7-11)

Touch Panel Calibration (Control Panel Only)

Adjusts the position of the screen operated when touched on the touch screen.
Follow the instructions displayed on the control panel and press the centers of the cross mark in order.

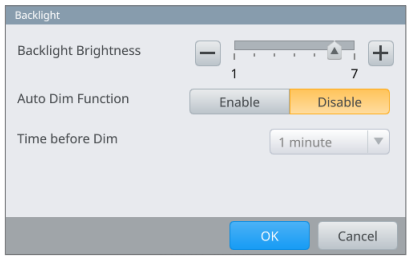


Reference

The touch position of the touch screen is adjusted at the factory.

Backlight (Control Panel Only)

Configures the control panel backlight.



Backlight Brightness

Adjusts the brightness of the backlight.
The brightness can be adjusted between level 1 to 7 (default : 6).

Auto Dim Function

Selects the [Enable]/[Disable] for the Auto Off function.

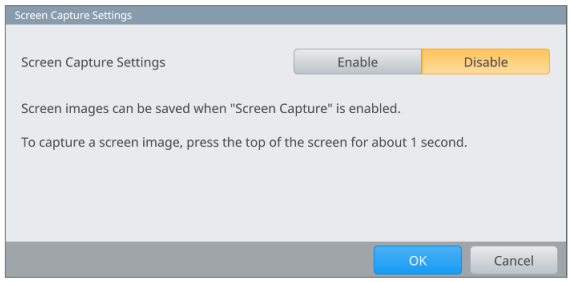
Time before Dim

This is available when the [Enable] is selected for the Auto Off function. Sets the time until the control panel is dimmed. After 30 minutes of the monitor being dimmed, the monitor screen will turn off.
Options: 30 seconds/ 1 minute (default value)/ 5 minutes/ 10 minutes/ 30 minutes

Reference The monitor exists from dim mode when the touch panel is operated or when an error occurs

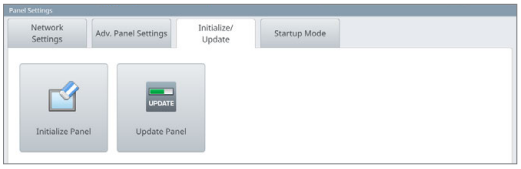
Screen Capture Settings

Sets screen capture for Control panel / Display expansion unit. When [Enable] is selected, hold down the upper side of the screen for about 1 second and the screen will be captured into a USB memory or a microSD card.



Point **Connect a USB memory or a microSD card to the Control panel / Display expansion unit before capturing a screenshot.**

Initialize/Update



Initialize Panel

Initializes the information set on the control panel/display expansion unit.

Update Panel

Updates the operation software for the control panel/display expansion unit.
For details, refer to KEYENCE homepage.
URL: www.keyence.com/glb

Startup Mode

Switch the control panel/display expansion unit to the selected mode.



IV-M30 Mode

You can connect to IV-series sensors.

IV2-CP50 Mode

You can connect to IV2-series sensors.

IV3-CP50 Mode

You can connect to IV3-series sensors.

IV4-CP70 Mode

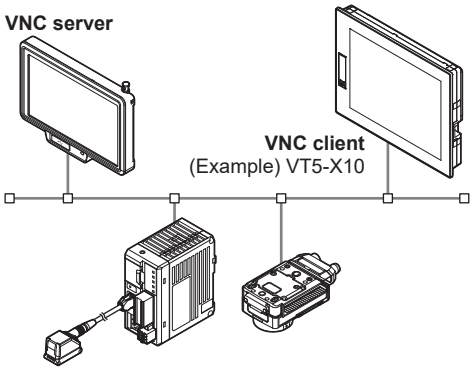
You can connect it to IV4 and IV3 series sensors.

VNC Mode

This only appears in IV4-CP70 mode.
Switch the control panel/display expansion unit to VNC mode.

❍ VNC Mode

The control panel and display expansion unit can operate as a Virtual Network Computing (VNC) server, enabling remote panel operation from VNC client devices.

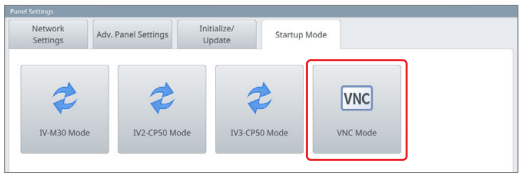


Point

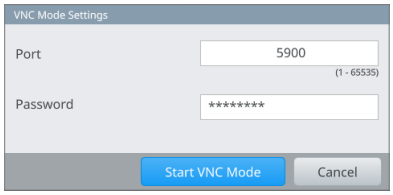
- **This mode is supported only for the IV4 and IV3 series (displayed only in IV4-CP70 mode).**
- **Up to two VNC client devices can be connected to one VNC server (control panel/display expansion unit) at the same time. If two VNC client devices are connected at the same time, their respective operations are linked. (For example, if one VNC client transitions to the operation screen, the other VNC client will also transition to the operation screen.)**
- **Output resolution is 1024 x 600 (fixed) when operating in VNC mode.**
- **The following VNC clients have been tested.**
  - **UltraVNC Viewer (Ver. 1.4.3.6)**
  - **Keyence touch panel VT5-X10 (Ver. 6.01)**

Switching to VNC mode

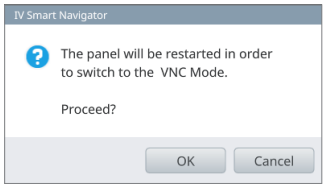
1 Press [VNC Mode].



2 Fill out [Port] and [Password], and then press [Start VNC Mode].



3 Press [OK].



After restart, the following screen is displayed.

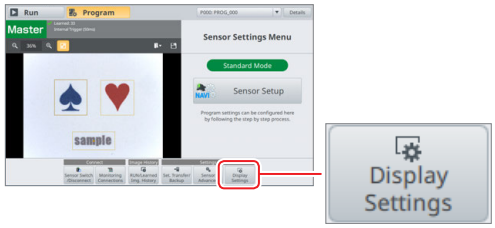


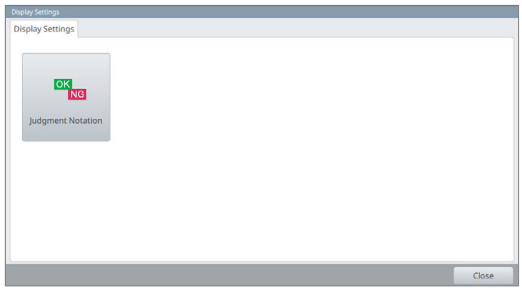
Reference

- In VNC mode, text is English regardless of the language selected.
- Press [Stop VNC mode] to return to IV4-CP70 mode.

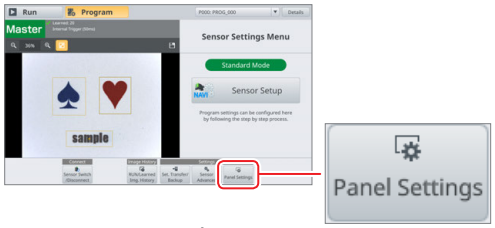
Display Settings
(PC Only)

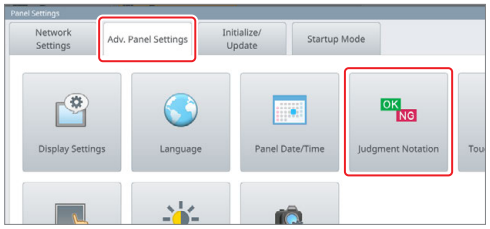
This section explains the [Display Settings] screen displayed when [Display Settings] is pressed.





Reference For a control panel/display expansion unit, follow the below procedure to set [Judgment Notation]:
[Panel Settings] > [Adv. Panel Settings] > [Judgment Notation]

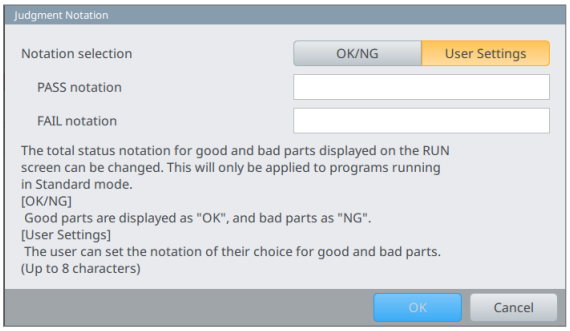




Judgment Notation

Sets the notation (OK/NG) of the total status results on the run screen.
Selecting [User Settings] enables you to set arbitrary notations to [PASS notation] and [FAIL notation].

Point
- **Only the characters for the total status results on the run screen can be changed. This setting will not be applied to other screens or output information.**
- **This setting will not be applied in sorting and AI through count modes.**



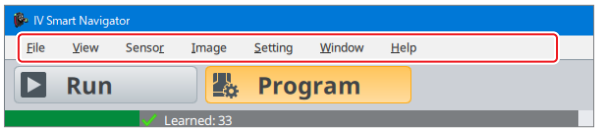
Notation selection

❍ OK/NG
[OK] is displayed if the total status result is good and [NG] if it is bad.

❍ User Settings
Any desired character string can be set.
(Up to 8 one-byte alphanumeric characters)
Input any character string into [PASS notation] and [FAIL notation].

Operating the Device from the Menu Bar (PC Only)

This section explains the menu bar that appears when operating IV Smart Navigator on a computer.



[File] Menu

Batch Backup

Backs up the data saved in the sensor to the PC in a batch.
“Batch Backup” (page 8-3)

Individual Program Backup

Backs up the setting data saved in the sensor into the PC individually for each program.
“Individ. Program Backup” (page 8-4)

Transfer Batch Backup

Transfers the setting data (batch backup file) saved in the PC to the sensor.
“Transfer Batch Backup” (page 8-5)

Transfer Individ. Backup

Transfers the settings data saved in the PC to the sensor for each individual program.
“Transfer Individ. Backup” (page 8-6)

SD Card

Check Capacity

Checks the SD card capacity.
“SD Card Capacity” (page 8-10)

Remove

Removes the SD card.
“Removing the SD card” (page 8-9)

Export

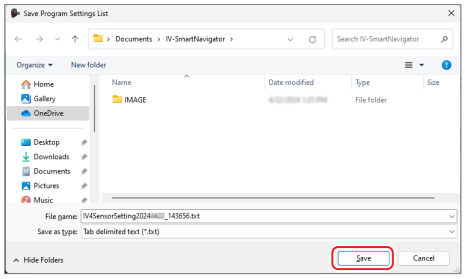
Save Program Settings List

Outputs the information set as sensor in the Tab delimited text.

1 **Display the main screen in [Program].**

2 **Select [File] → [Export] → [Save Program Settings List] from the menu bar.**

3 **Press [Save].**



Reference Change the save destination of the file and file name as needed.

The save completion message opens.

4 **Press [OK].**

The system returns to the main screen in [Program].

Reference The example for displaying the saved Program settings list file with Microsoft Excel is below.

	A	B
1	[Model Information]	
2	Sensor Head Model	IV4-G500CA
3	Sensor Amp Model	IV4-G120
4		
5	[Program]	
6	Current Program	
7		
8	[Running Image History]	
9	Logging Settings 1	All
10	Logging Settings 2	Before/After NG
11	Logging Settings 2	Fixed Interval

Save Statistics/Histogram Data (Standard Mode / Sorting Mode) and Count Log Data Output (AI Through Count mode)

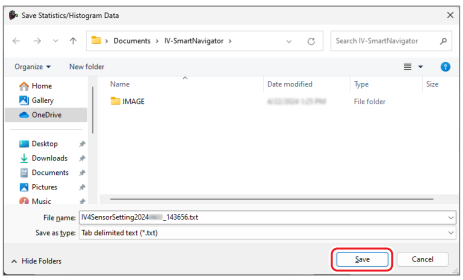
The following are output delimited by tabs.

- Standard Mode / Sorting Mode: Statistical information and histogram information
- AI Through Count Mode: Count log data

1 From the menu bar, select [File] → [Export] → [Save Statistics/Histogram Data] (Standard Mode / Sorting Mode) or [Count Log Data Output] (AI Through Count Mode).

The Save dialog box appears.

2 Press [Save].



Reference Change the save destination of the file and file name as needed.

The save completion message opens.

3 Press [OK].

The system returns to the main screen in [Run] or [Program].

Reference

- The example for displaying the saved Statistics/ histogram data file with Microsoft Excel is below.

	A	B	C
1	Statistical Information	TIME	Max
2	Statistical Information	TIME	
3	Statistical Information	Cap. Time	Max
4	Statistical Information	Cap. Time	
5	Statistical Information	Trigger	Trigger N
6	Statistical Information	Trigger	
7			
8	Histogram	Tool00: Position Adjustment	Limit
9	Histogram	Tool00: Position Adjustment	

- Shown below is an example of displaying the saved Count Log Data Output file with Microsoft Excel.

	A	B	C	D	E
1	<Per day>				
2	Count Log		Date	Jun/25/2024	Jun/26/2024
3	Count Log	Tool01: AI Through Count	count	0	
4					
5	<Per hour>				
6	Count Log		Time	07/22/2024 18:00	07/22/2024
7	Count Log	Tool01: AI Through Count	count	0	
8					

Additional Learning from File

“Additional Learning from File” (page 6-10)

Exiting IV Smart Navigator

Exit IV Smart Navigator.

[View] Menu

Statistical Information

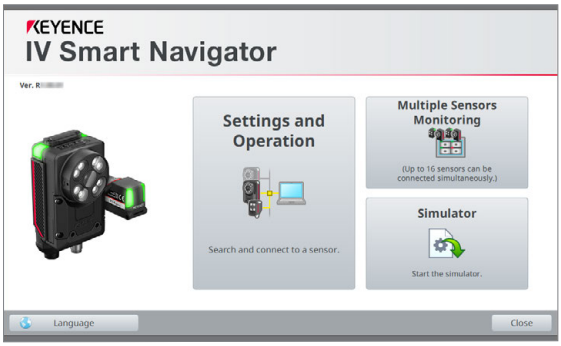
Controls whether to display or hide the statistical information.

“Statistical/Tool Information Display” (page 5-7)

[Sensor] menu

Disconnect

Disconnects the connection between the sensor and PC, and displays the connection menu screen.



Reset Statistics

Resets the statistical information and histograms.

1 Display the main screen in [Run].

2 Select [Sensor] → [Reset Statistics] from the menu bar.

The confirmation screen opens.

3 Press [Yes].

The statistical information and histograms will be reset.

Initialize Sensor

Initializes the information set in the sensor and sets it to the factory default.

“Initialize Sensor” (page 7-24)

Update Sensor

Updates the operation software of the sensor.
For details, refer to KEYENCE homepage.
URL: www.keyence.com/glb

[Image] Menu

Zoom

Reduces, enlarges, or window fits the image displayed on the IV Smart Navigator.
The image can be reduced to a minimum size of 25% or enlarged to a maximum size of 500%.

Display Tools

Switches the display method for the tools.
“Selecting the Display Method of the Tool Window” (page 5-6)

Manual Trigger

Issues a trigger one time for each selection of [Image] → [Manual Trigger] from the menu bar. This button is used when an external trigger cannot be input.
Enabled when [External Trigger] is selected or [Internal Trigger Control/AI Trigger Control] is set to [Enable].

Capture

Save Image

Saves a bmp format file of the captured image and an iv4p format file which can be used for master image registration or additional learning at the same time.
A screen capture of the IV Smart Navigator screen will also be saved at the same time.

Show Saved Image File Location

Opens the save destination folder for the captured image.

Change saved image file location

Opens the reference screen for the folder and changes the save destination for the captured image.

[Setting] Menu

Manual Trigger Button

When [External Trigger] is selected or [Internal Trigger Control/AI Trigger Control] is set to [Enable], use this setting to show/hide the [Manual Trigger] button.

Point **When an internal trigger is set, the Manual trigger button will not be displayed.**

NG Hold Function

Switch to enable/disable NG Hold function.
“NG Hold Function” (page 5-13)

List of NG Sensor Occurrences

Displays the list screen of NG Sensor Occurrences.
“List of NG Sensor Occurrences” (page 5-11)

Auto Connection Settings

Select the method to connect to the sensor when IV Smart Navigator starts.

Language

Switches the display language of IV Smart Navigator.

[Window] Menu

Program Details

Displays the [Program Details] screen.
“Displaying the [Program Details] screen” (page 7-7)

RUN/Learned Img. History

Displays the [Run/Learned Img. History] screen.
“Displaying Running Image History” (page 5-14)
“Displaying the [Learned Image History] screen” (page 6-7)

Settings Transfer/Backup

Displays the [Settings Transfer/Backup] screen.
“Settings Transfer/Backup” (page 8-3)
“Setting up the SD Card” (page 8-8)

Sensor Advanced

Displays the [Sensor Advanced] screen.
“Sensor Advanced Settings” (page 7-10)

Display Settings

Displays the [Display Settings] screen.
“Display Settings” (page 7-30)

[Help] Menu

About

Displays the version information of IV Smart Navigator.

Converting IV4P/IV3P data to BMP data

IVP Smart Converter is software for transferring images saved using the methods below from the IV4P or IV3P format to the BMP format:
- Individually saved image history
- FTP/SFTP client function
- SD card data transfer function

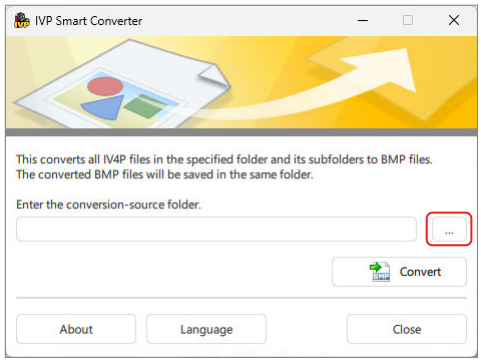
When IV Smart Navigator is installed on the PC, IVP Smart Converter is installed at the same time.

Converting IV4P/IV3P data to BMP data

1 Double-click [IVP Smart Converter] on the desktop.

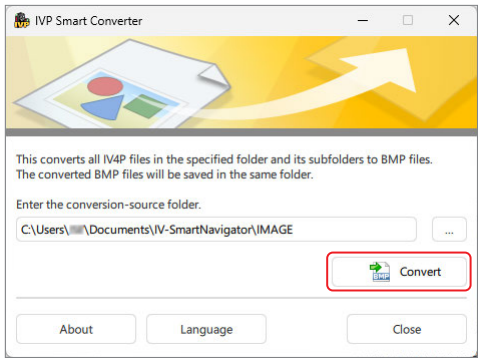


2 By pressing [...], specify the folder where the IV4P or IV3P data to be converted is stored.



All of the IV4P data that is stored in the specified folder and its subfolders are the conversion targets.

3 Press [Convert] to execute BMP conversion.



BMP data is saved in the conversion source folder.

Reference The BMP data is saved in the same folder as the pre-converted IV4P or IV3P data.

Point
- **If there are BMP files with the same names, they will be over written.**
- **Up to 100,000 files of IV4P/IV3P data can be converted at a time.**

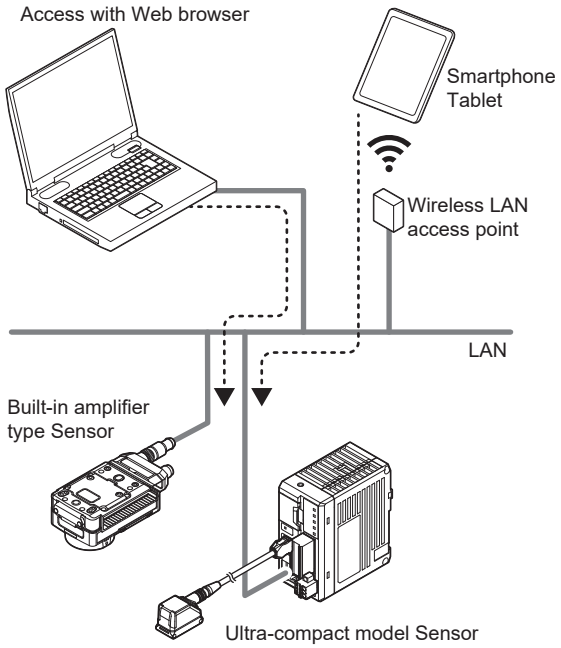
Web Monitor

Overview of the Web monitor function

Use a Web browser (Google Chrome or a similar browser) on a device such as a computer connected to the network to check the image capture and operation history of the sensor.

Point

The web monitor function has multiple interfaces.
- **Web Appli: Display image capture and operation history and switch program numbers.**
- **Web Monitor: Display image capture and operation history.**
- **Web Image: Display image capture only.**



Required environment

Supported Web browsers	• Google Chrome 120 or later • Microsoft Edge 120 or later • Safari 17 or later
Max. no. of simultaneous connections	2 units*
Languages	English

* When connecting 3 or more units at the same time, the screen update cycle will be slower.

Connection method

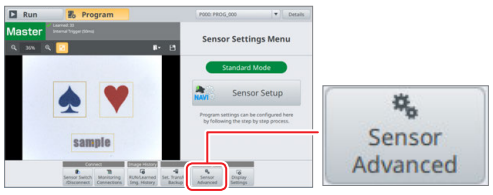
Point

The TLS supported version in HTTPS is TLS1.2/TLS1.3.

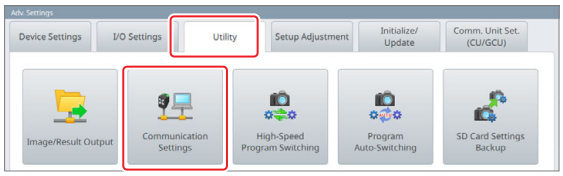
1 Configure the network settings for the sensor.

Set the IP address, subnet mask, and default gateway for the sensor. Use [Network Connection] for the PC and sensor connections.
“Network Settings” (page 7-10)
“Operation for Initial Startup of the IV Smart Navigator” (page 3-6)

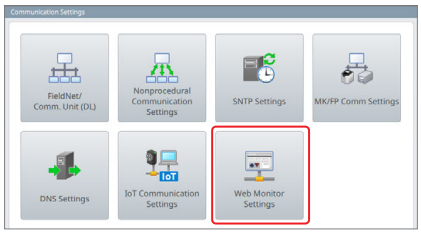
2 Press [Sensor Advanced] in the main screen in [Program].



3 Select the [Utility] tab and select [Communication Settings].



4 Select [Web monitor Settings].



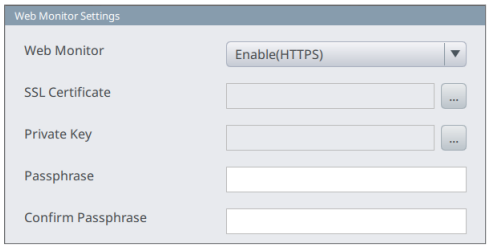
5 Configure the following settings and press [OK].

HTTP



❍ **Web Monitor**
Select [Enable(HTTP)].

HTTPS



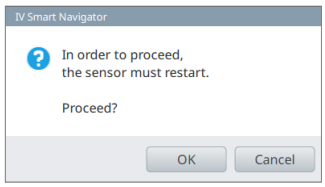
❍ **Web Monitor**
Select [Enable(HTTPS)].

❍ **SSL Certificate**
Select the SSL certificate file (PEM format file only, 10K bytes or less).

❍ **Private Key**
Select the private key file (PEM format file only, 10K bytes or less)

❍ **Passphrase/Confirm passphrase**
Input a password (0 to 80 characters,only ASCII characters; excluding control characters).

6 Press [OK] in the confirmation screen.



The sensor restarts and the run screen opens.

7 Start the Web browser.

8 Input the following URL into the address bar.

HTTP

❍ **Web Appli**
http://(IP_address_of_sensor_amplifier)/iv4-wa.html

❍ **Web Monitor**
http://(IP_address_of_sensor_amplifier)/iv4-wm.html

❍ **Web Image:**
http://(IP_address_of_sensor_amplifier)/iv4-wm-i.html

If the IP address for the sensor amplifier is 192.168.10.10:
http://192.168.10.10/iv4-wm.html

HTTPS

❍ **Web Appli**
https://(IP_address_of_sensor_amplifier)/iv4-wa.html

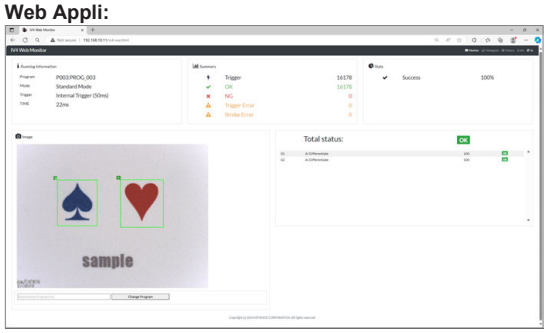
❍ **Web Monitor**
https://(IP_address_of_sensor_amplifier)/iv4-wm.html

❍ **Web Image:**
https://(IP_address_of_sensor_amplifier)/iv4-wm-i.html

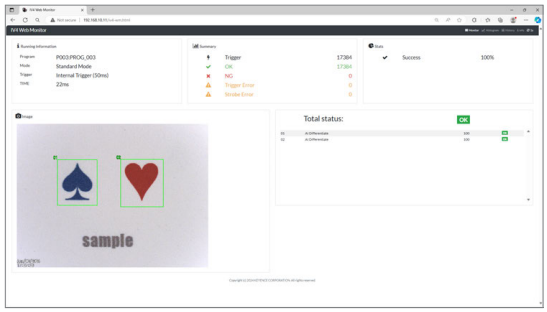
If the IP address for the sensor amplifier is 192.168.10.10:
https://192.168.10.10/iv4-wm.html

If connection is successful, the [IV4 Web Monitor] screen appears.

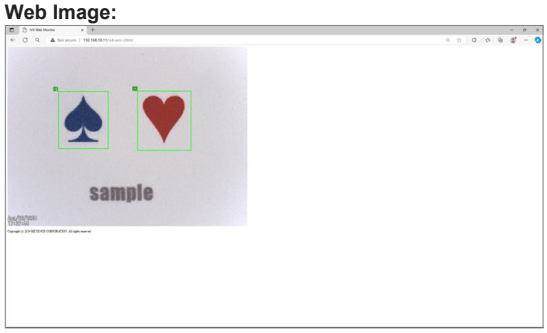
Web Appli:



Web Monitor:

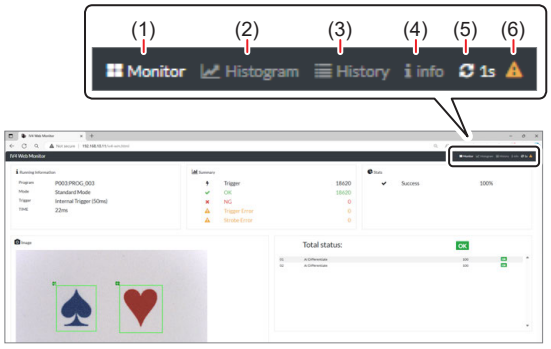


Web Image:



Monitoring screen

Select a screen to monitor information from the sensor.



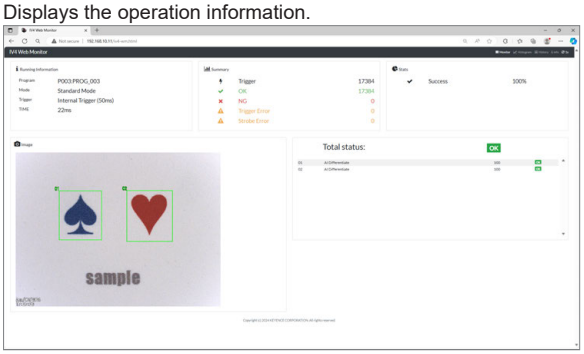
Reference
- For details of the displayed information, see “Names and Functions of the Screen in [Run] / [Program]” (page 5-3)
- To reset statistical information, use the IV4-CP70, IV4-DU10 or IV Smart Navigator.
- Responsive Web design is supported. The screen changes in accordance with the displayed device. Select the screen to be displayed on the menu button.



Menu button

(1) Monitor

Displays the operation information.

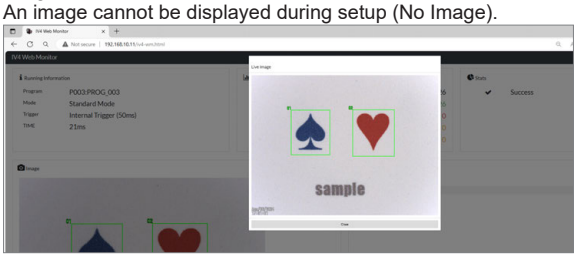


Running Information

Displays the program number, mode, trigger type, and processing time.

Image

Displays the image and the tool window frame. The processing screen cannot be displayed. Press the image to enlarge the Live image.
An image cannot be displayed during setup (No Image).



Summary

Displays the number of triggers, judgment count for OK and NG, and number of trigger errors.

Stats

When standard mode, displays the OK judgment retio for the statistical information.
When sorting mode, displays the part judgment retio for the statistical information.

Total status

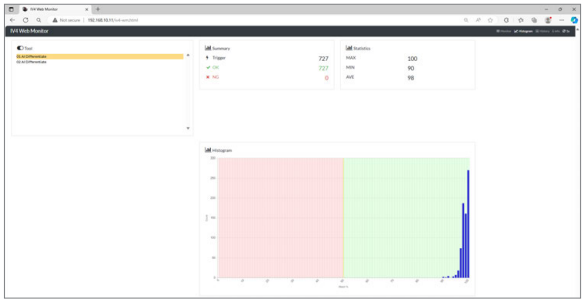
Displays the total status result and the status results of each tool.

(2) Histogram

Check the status results of each tool.

Reference

- For details of the displayed information, see “Selecting the Display Method of the Tool Window” (page 5-6).
- To reset statistical information, use the IV4-CP70, IV4-DU10 or IV Smart Navigator.
- When using sorting mode, histogram of outline, color/brightness average, width, diameter tool are not displayed.



Tool

Selects the tool to be checked.

Summary

Displays the number of triggers, judgment count for OK and NG.

Statistics

Displays the information (MAX, MIN, AVE) for the matching rate.

Histogram

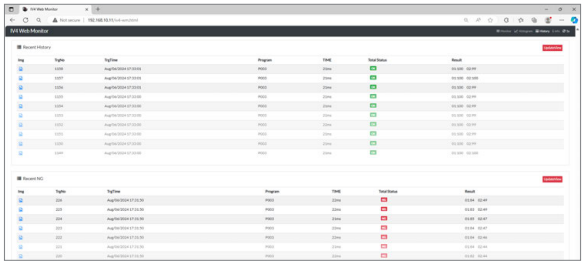
Displays the histogram of the selected tool.

(3) History

Check the operation result history.
Use the [UpdateView] button to refresh the display.

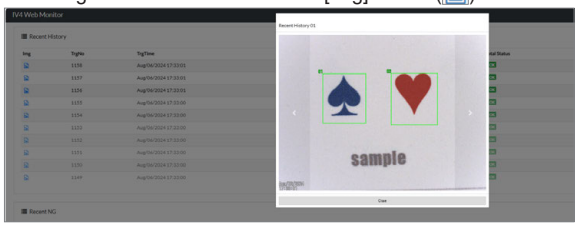
Point

Automatic update will not be performed regardless of the update frequency setting.
Use the [UpdateView] button to refresh the display.



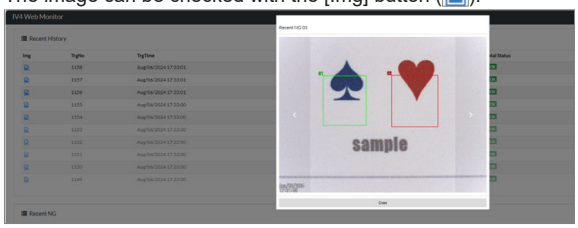
Recent History

Displays up to 10 latest status result histories.
The image can be checked with the [Img] button ( ).



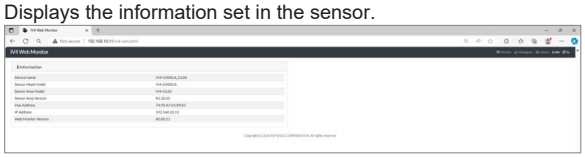
Recent NG

Displays up to 10 histories of the latest status results that were NG.
The image can be checked with the [Img] button ( ).



(4) info

Displays the information set in the sensor.



(5) Update frequency

Sets the frequency to refresh the displayed information.

1s	Automatically updates the information once a second.
5s	Automatically updates the information once every five seconds.
	Stops updates. It is only available on the Web Monitor.

The frequency is fixed for 2 seconds on the Web Image.

(6) Communication timeout

Displayed when a communication timeout occurs.
Check the connection with the sensor amplifier.

MEMO

8

Saving Settings and Images, SD Card

This section explains how to save the sensor setup or image files, and how to set the USB memory stick and SD card.

Saving Settings and Images, SD Card 8-2
Settings Transfer/Backup 8-3
Setting up the SD Card.....8-8
Transferring Judgment Results or Judged Images to the SD Card.....8-11
Automatically Back Up/Restore the Settings on the SD Card 8-19

Saving Settings and Images, SD Card

This device can use external media (USB memory and SD cards).
An SD card can be used by inserting it into the sensor for the built-in amplifier type, and into the sensor amplifier for the ultra-compact model.

Point

- **When using a USB memory stick, use the USB connection connector on the control panel/display expansion unit.**
- **The USB memory can be removed at any time, except while a progress bar or a dialog indicating that a saving process is in progress is being displayed.**
- **Supported USB memory format: FAT (FAT16)/FAT32**

Available function

Functions available on the PC, control panel, and display expansion unit

What can be performed	Function	PC	Control panel Display expansion unit USB memory stick/ Micro SD card	Reference
Save sensor settings	Batch Backup	√	√	8-3
	Individual Program Backup	√	√	8-4
Save Running Hist.	Batch Backup	√	√	8-3
	Individual Program Backup	√	√	8-4
Exporting backed up settings for all programs in a batch to the sensor	Transfer Batch Backup	√	√	8-5
Exporting individual programs from backed up settings to the sensor	Transfer Individual Backup	√	√	8-6
Saving screens and captured images	Screen Capture Function	√	√	3-14
Using saved images to set up the device	Additional Learning	√	√	6-10
	Master Registration	√	√	4-16
	Color Extraction / Color Range Settings (Color Area Tool / Blob Count Tool / Color Average tool)	√	√	4-48 4-58 4-62
Updating operating software	Update Sensor	√	√	7-24
	Update Panel (Control panel/Display expansion unit)	×	√	7-28

Micro SD card (sensor models with built-in amplifiers and sensor amplifier for the ultra-compact model)

What can be performed	Function	Reference
Transferring images and judgment results to an SD card	Data Transfer (SD card)	8-11
Increasing the number of programs to be changed over (Expanding the number of programs to 128)	Transfer Program Function	8-10
Automatically backing up sensor settings	Automatically back up/restore the settings on the SD card	8-19
Use the settings automatically backed up for restoration		

Settings Transfer/Backup

Backs up the data saved in the sensor and sends the setting data.

Backup

Batch Backup

Backs up the data saved in the sensor in a batch.
When multiple sensors are to be used, the settings can be copied based on the batch backup data.

Point

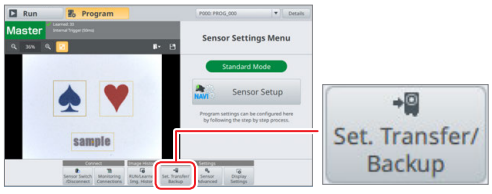
- **It is recommended to perform a batch backup of the data saved in the sensor in case of malfunction of the product.**
- **The saving time increases when this is performed in [Run]. Execution while in the [Program] mode is recommended.**
- **If [SD Card Access] is set to [Enable], the program data saved on the SD card is also backed up.**

Reference

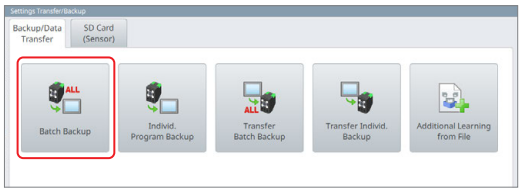
When multiple monitor devices (IV4-CP70/IV4-DU10/IV Smart Navigator) are connected and one monitor device is running a backup process by [Batch Backup], other monitor devices cannot perform backup until the backup process finishes.

1 Display the main screen in [Run] or [Program].

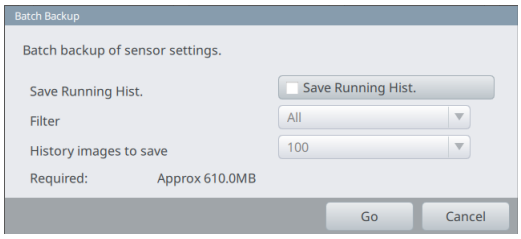
2 Press [Set. Transfer/Backup].



3 Press [Batch Backup].



4 Configure the Batch Backup settings.



- **Save Running Hist.**

To back up all the images of the image history in addition to the sensor settings (sensor settings of all programs (Sensor Setup) and advanced settings), select the [Save Running Hist.] check box.

- **Filter**

This setting can be set when [Save Running Hist.] is ON.
[All] or [NG Only] can be selected for the running image history to be saved.

Point

In AI Through Count Mode, image history is not saved by selecting [NG Only].
To save image history, select [All].

- **History images to save**

The maximum number of the image histories to be saved is 100. It can be selected from 20/50/100.

- **Required**

Displays the expected size of the backup file.

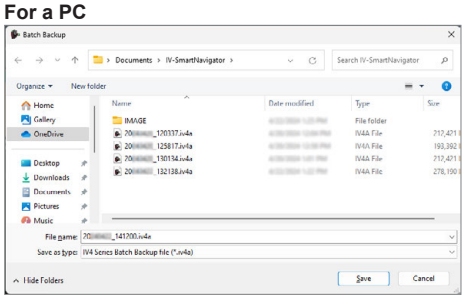
5 Press [Go].

Point

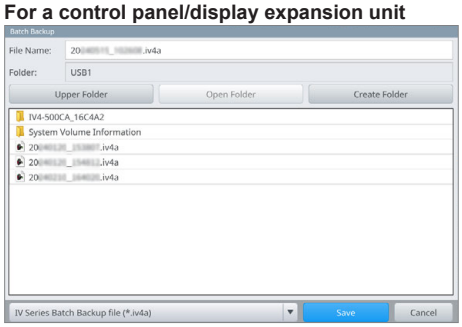
When the running image history has been saved while in [Run], the images saved object may be updated and deleted during the batch backup. A deleted image is not saved. Because of this, saving while in [Program] is recommended.

6 Set the save destination and file name, and press [Save].

For a PC



For a control panel/display expansion unit



The backup completion message opens.

7 Press [OK].

Individ. Program Backup

Backs up the setting data saved in the sensor individually for each program.

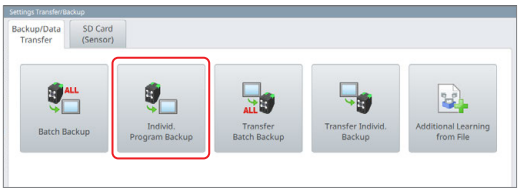
> **Point** **The saving time increases when this is performed in [Run]. Execution while in the [Program] mode is recommended.**

1 Display the main screen in [Run] or [Program].

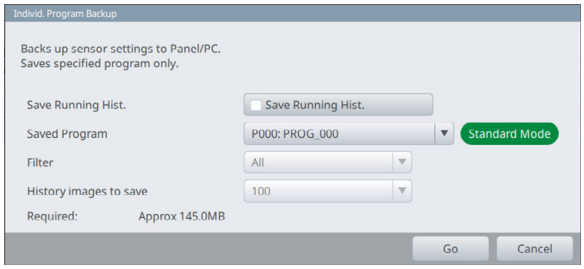
2 Press [Set. Transfer/Backup].



3 Press [Individ. Program Backup] button.



4 Set the individual program backup settings.



- **Save Running Hist.**
  To back up all the images of the running image history in addition to the program settings, place a check mark ON to the [Save Running Hist.] check box.
- **Saved Program**
  Select a program to back up.
- **Filter**
  This setting can be set when [Save Running Hist.] is ON.
  [All] or [NG Only] can be selected for the running image history to be saved.

> **Point** **In AI Through Count Mode, image history is not saved by selecting [NG Only].**
> **To save image history, select [All].**

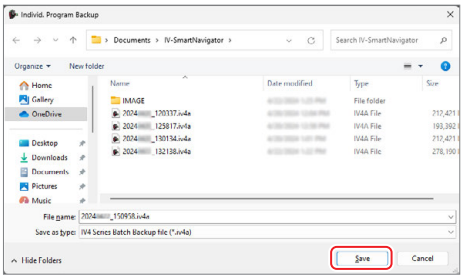
- **History images to save**
  It can be selected from 20/50/100.
- **Required**
  Displays the expected size of the backup file.

5 Press [Go].

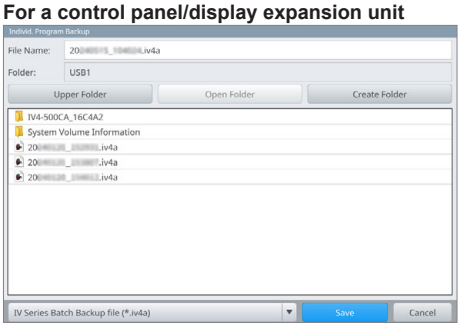
> **Point** **When the running image history has been saved while in [Run], the images saved object may be updated and deleted during the batch backup. A deleted image is not saved. Because of this, saving while in [Program] is recommended.**

6 Set the save destination and file name, and press [Save].

- **For a PC**



- **For a control panel/display expansion unit**



The backup completion message opens.

7 Press [OK].

Settings Transfer

Point

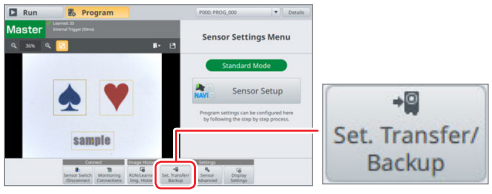
- **Operation cannot be cancelled during transmission of the settings data.**
- **It is recommended to back up the data saved in the sensor in a batch before transferring settings.**
  “Batch Backup” (page 8-3)
- **The image data in the image history will not be transferred.**
- **The settings file of a different model of the sensor head cannot be transferred.**
- **When the following functions are enabled, the setting data cannot be transferred to the sensor while the device is in [RUN] mode.**
  - **FTP/SFTP client function**
  - **SNTP client function**
  - **Field network/Communication unit (DL)**
- **In the case of a built-in amplifier model, the settings file of a sensor with a different power supply method cannot be transferred. For instance, a settings file saved from a PoE Power Class 4 sensor cannot be transferred to a sensor with PoE Power Class 6 or a power I/O cable (24 V DC).**

Transfer Batch Backup

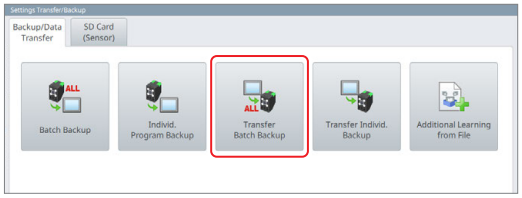
Transfer the saved setting data (batch backup file) to the sensor.
“Batch Backup” (page 8-3)
“Individ. Program Backup” (page 8-4)

1 Display the main screen in [Run] or [Program].

2 Press [Set. Transfer/Backup].



3 Press [Transfer Batch Backup].



The confirmation screen opens.

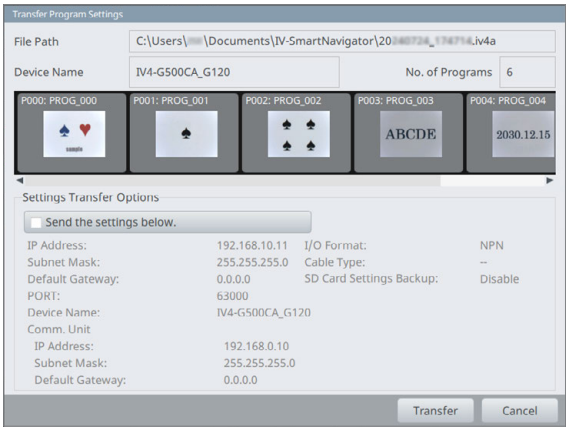
4 Press [Yes].

The screen to select the batch backup file opens.

5 Select a batch backup file to be transferred (*.iv4a), and press [Open].

The [Transfer Program Settings] screen opens.

6 Confirm the information of the setting file to be transferred and press [Transfer].



After the transfer of files has completed, the transfer completion message opens.

Point

- **If you would like to transfer the I/O polarity (NPN/PNP) and the network settings, check the [Send the settings below.] check box ON for [Setting Transfer Options].**
- **The setting for [Setting Transfer Options] is reset to OFF after the setting data is transferred or when the setting is canceled.**
- **When the protocol setting has been changed, connection is terminated and the sensor restarts.**

7 Press [OK].

Reference

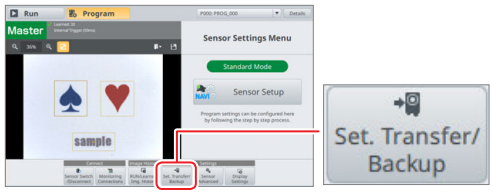
When a file was transferred while the [Send the settings below.] check box of [Setting Transfer Options] is checked ON, the connection with the sensor is terminated and the system returns to the Activation Menu screen.

Transfer Individ. Backup

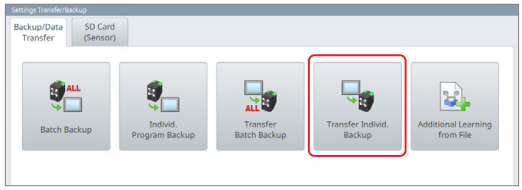
Transfer the saved program (individual backup file) to the sensor.
“Batch Backup” (page 8-3)
“Individ. Program Backup” (page 8-4)

1 Display the main screen in [Run] or [Program].

2 Press [Set. Transfer/Backup].

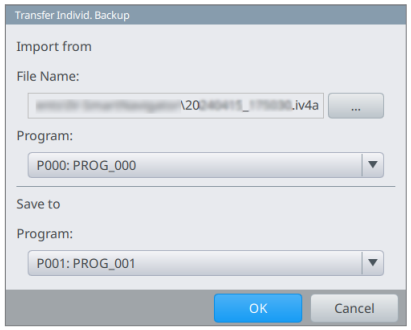


3 Press [Transfer Individ. Backup].



The confirmation screen opens.

4 Press [Yes].



● Import from

❍ File name

Select a batch backup file (*.iv4a) or an individual program backup file (*.iv4a) including the individual program to transfer.

❍ Program

Selects the number of the program to be imported.

● Save to

Selects the number of the destination program.

5 Press [OK].

Point **When the destination program is already set, the confirmation screen appears. Press [OK].**

The source program is transferred to the destination program. When the transfer is completed, a confirmation screen to switch to the transferred program will appear.

6 Press [Yes] or [No].

- Yes .....Switches to the transfer destination program.
- No.....The program remains as it was before the transfer.

Folder Composition and File Naming Rules

Batch Backup

Batch saves all the settings in the sensor.
All the images in the image history can also be saved along with the settings.

Storage folder	**PC**	A user-defined folder can be specified. (Default) C:\Users\(Login user name)\Documents\IV-SmartNavigator
	Control panel **Display expansion unit**	A user-defined folder can be specified.
File name		YYYYMMDD_hhmmss *1, 2
Extension		iv4a

“Batch Backup” (page 8-3)

Individual Program Backup

Save the settings inside the sensor by individual program.
All the images in the image history can also be saved along with the settings.

Storage folder	**PC**	A user-defined folder can be specified. (Default) C:\Users\(Login user name)\Documents\IV-SmartNavigator
	Control panel **Display expansion unit**	A user-defined folder can be specified.
File name		YYYYMMDD_hhmmss *1, 2
Extension		iv4a

“Individ. Program Backup” (page 8-4)

Save (save images)

Captured .bmp image files, files with the format specifically for the IV4 Series, and screen capture files for the IV Smart Navigator are simultaneously saved.

Storage folder	**PC**	A user-defined folder can be specified. (Default) C:\Users\(Login user name)\Documents\IV-SmartNavigator\IMAGE
	Control panel **Display expansion unit**	**Captured images (unprocessed captured images (bmp/iv4p))** \(Device name of the sensor)_(Last 24 bit of the MAC address)\IMAGE **Captured images (unprocessed screen shots (bmp))** \(Device name of the sensor)_(Last 24 bit of the MAC address)\SCREEN
File name		YYYYMMDD_hhmmss *1, 3 YYYYMMDD_hhmmss_screen *1, 4
Extension		iv4p, bmp

“Operation of the Image Tool Bar” (page 3-14)

Screen Capture

Capture a screenshot of run screen and setting screen in Control panel / Display expansion unit, and save it into a USB memory or microSD card as an image file (BMP).

Storage folder	**PC**	–
	Control panel **Display expansion unit**	\(Device name of the sensor)_(Last 24 bit of the MAC address)\SCREEN
File name		YYYYMMDD_hhmmss *1
Extension		bmp

“Screen Capture Settings” (page 7-28)

*1 YYYY: Year, MM: Month, DD: Day, hh: Hour, mm: Minute, ss: Second
*2 Using a PC, you can change the file name to any desired name and save it.
*3 Taken image file. Saved in .bmp and .iv4p formats.
*4 Screen capture file of the IV Smart Navigator. Saved in bmp format.

▶ Important **A folder name or file name may be distorted if it includes a character that cannot be displayed correctly with the current display language.**
(when IV4-CP70/IV4-DU10 is used)

Setting up the SD Card

About SD cards

Insert an SD card into the sensor amplifier (ultra-compact model) and sensor (built-in amplifier model) to configure various settings such as transferring data and expanding the number of programs.

- Usable SD card: CA-MSD32G
- Supported format: FAT32

NOTICE	**• Use a KEYENCE recommended product.** **• Close the SD card slot cover while the device is in use.** **• When removing the SD card, always perform the [Remove SD Card] procedure before removing the card.** **• Do not remove the SD card while accessing the SD card. Also do not turn off the system power while the SD card is being accessed. Otherwise, all or part of the setting data may be lost or the memory may be damaged.**

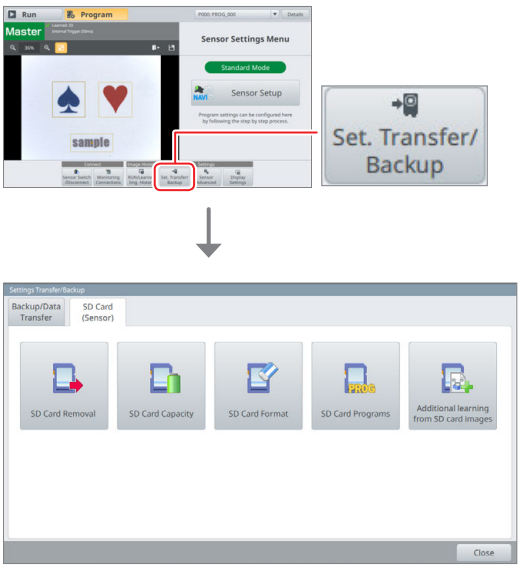
Point

When formatting the SD card on the PC, configure the settings below. If the format is different, the SD card may not be recognized.

- **File system: FAT32**
- **Allocation unit size: 32 kB**

Setting up the SD Card

Press [Set. Transfer/Backup] and select the [SD Card (Sensor)] tab.



“Inserting/Removing the SD Card” (page 8-9)
“SD Card Capacity” (page 8-10)
“SD Card Format” (page 8-10)
“SD Card Programs” (page 8-10)
“Additional learning from SD card images” (page 8-10)

Inserting/Removing the SD Card

Inserting the SD Card

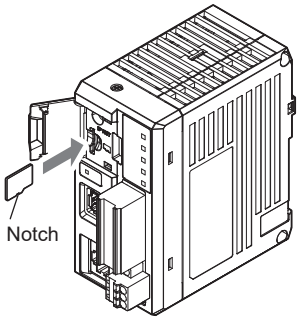
Ultra-compact model

1 Open the SD card slot cover on the sensor amplifier.

2 Insert a micro SD card.

Point

Make sure the notch on the SD card is facing downwards and insert it until you hear a clicking sound. The SD card indicator light turns on (green).



3 Close the cover.

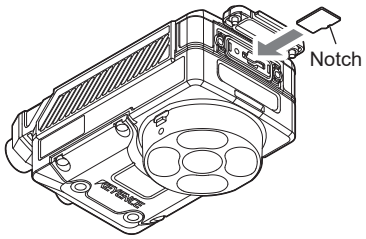
Built-in amplifier type

1 Open the SD card slot cover on the sensor.

2 Insert a micro SD card.

Point

- Make sure the notch on the SD card is on the right side and insert it until you hear a clicking sound.
- The built-in amplifier type cannot detect whether the cover is open or closed. When the SD card is set, the operation indicator light and the SD card indicator light in the slot part will light up (green).



3 Close the cover, and fix the sensor with two fall prevention screws.

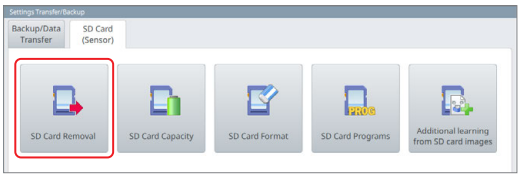
- Tightening torque: 0.15 to 0.20 N·m

Removing the SD card

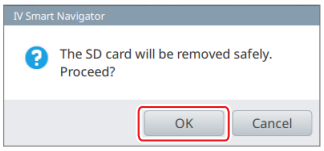
Point

- Always perform [SD Card Removal] before removing the SD card. This may corrupt data or settings that are being written to the card. Alternatively, the IV Smart Navigator may restart.
- To re-recognize an SD card after performing [SD Card Removal], remove the SD card from the SD card slot, reinsert the card, and then close the cover.

1 Press [SD Card Removal].



2 Press [OK] in the confirmation screen.



3 Press [OK].

4 Check that the SD card indicator light has turned off and open the cover.

5 Press the SD card inward to release and remove the card.

Point

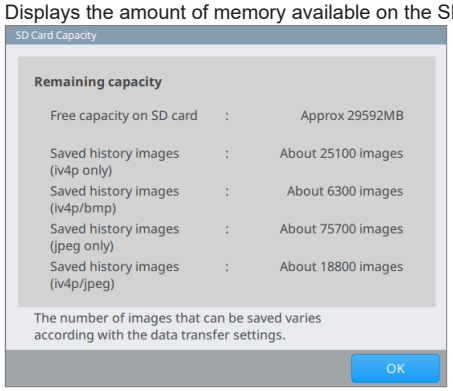
When the lock is disengaged, it will make a clicking sound and the SD card can now be removed.

6 Close the cover.

- Built-in amplifier type: tightening torque: 0.15 to 0.20 N·m

SD Card Capacity

Displays the amount of memory available on the SD card.



SD Card Format

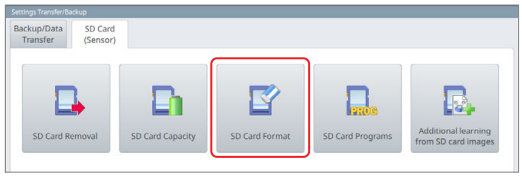
The SD card will be formatted with the following settings:

- File system: FAT32
- Allocation unit size: 32 kB

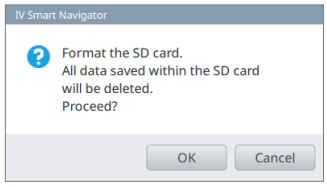
Point

If [SD Card Programs] (Page 8-10) is set to [Enable] and [SD Card Format] is performed, the transfer program settings will be disabled.

1 Press [SD Card Format].



2 Press [OK].



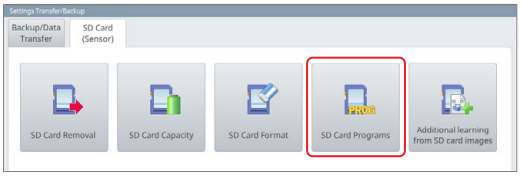
3 Once formatting is complete, press [OK].

4 Press [OK].

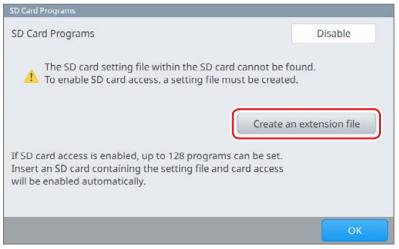
SD Card Programs

Expands the number of available programs on the sensor to a maximum of 128.

1 Press [SD card programs].



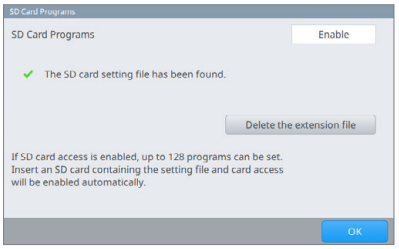
2 Press [Create an extension file].



3 Press [OK] in the confirmation screen.

Once the transfer program settings file is created, the file information screen opens.

4 Press [OK].



Point

- **If the expansion file is found on the SD card, [SD Card Access] is automatically enabled.**
- **To set [SD Card Access] to [Disable], remove the SD card or press [Delete the extension file].**
- **Expansion files created on a different sensor head model or a different power source type cannot be recognized.**

5 Press [OK].

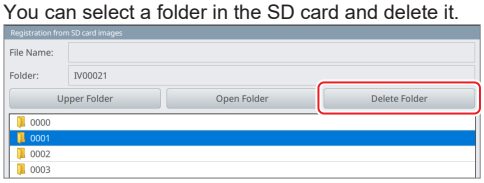
Additional learning from SD card images

Perform additional learning from images in SD card.

“Additional Learning from Images in SD Card” (page 6-11)

Reference

You can select a folder in the SD card and delete it.



Transferring Judgment Results or Judged Images to the SD Card

Overview of the SD Card Data Transfer Function

Automatically transfers the image data and status result information saved in the sensor memory to an SD card.

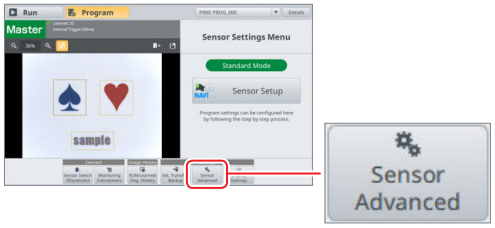
Point **In AI Through Count Mode, only [Operation info output] is supported.**

Setting up the SD Card Data Transfer Function

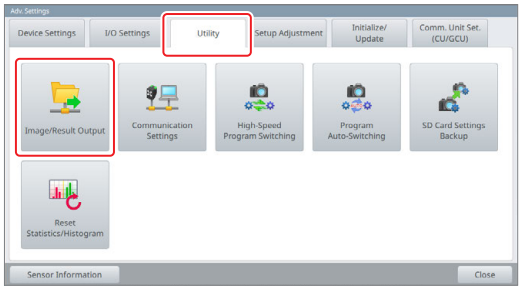
1 Insert the SD card into the sensor amplifier.

“Inserting the SD Card” (page 8-9)

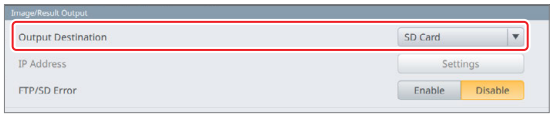
2 Press [Sensor Advanced] in the main screen in [Program].



3 Select the [Utility] tab and select [Image/Result Output].



4 Select [SD Card] from [Output Destination].



Point

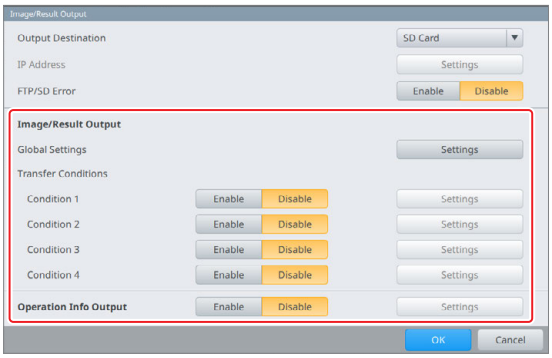
- **For [Output Destination], you can select any of [FTP], [SFTP], or [SD Card]. You cannot transfer data to the all ones at the same time.**
- **When you change the setting for [Output Destination], the [Index Upper Limit] settings are initialized.**

5 Configure the [FTP/SD Error].



“SD card transfer error” (page 8-12)

6 Configure the SD card data transfer settings.



- **Image/Result Output**
  “Global Settings” (page 8-12)
  “Transfer Conditions” (page 8-13)
- **Operation info output**
  “Operation information output” (page 8-18)

7 Press [OK].

8 Start the run mode.

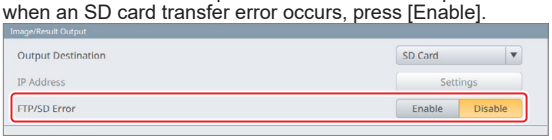
Once the target is judged, the specified data file is automatically transferred to the SD card.

Point

- **When the transfer condition is set to [All], adjust the processing time so that all the images can be transferred.**
- **Setting “BUSY Output” (page 7-15) to [Until Data Transfer is Complete] and controlling the trigger with the BUSY output prevents data from being lost while being transferred.**
- **When the transfer could not be done on time, the data is saved in the internal buffer. The internal buffer can save up to 20 images.**
- **Image data is transferred in the sequence that the images have been saved to the internal buffer.**
- **When the remaining capacity of the internal buffer is insufficient, the image data transfer fails. Transfer failures can be output using “SD card transfer error” (page 8-12).**
- **When the transfer condition is set to [All], confirm that there is sufficient storage on the SD card.**

SD card transfer error

To turn ON the error output and SD card error output function for when an SD card transfer error occurs, press [Enable].



Point

The behavior when file transfer fails is as follows:

- **An error message opens.**
  - **SD card access error**
  - **SD card transfer error (transfer failed)**
  - **SD card transfer error (insufficient data buffer)**
- **The error output and SD card error output function turns ON.**
  - **SD card access error output is always enabled.**
  - **To output an SD card transfer error (transfer failed/insufficient data buffer), set this setting to [Enable].**
- **To import SD card errors individually, use SD card error output.**
- **The sensor indicator light blinks (red).**
- **If an error occurs while the device is running, the error condition will continue until the error is cleared.**

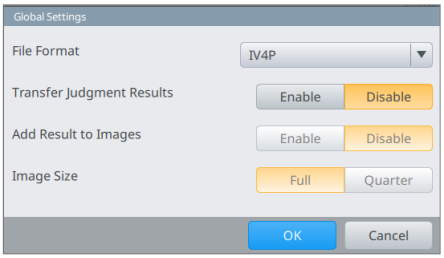
“Clearing Errors” (page 11-12)

Global Settings

1 Press [Settings] of the Global Settings.



2 Configure the settings.



File Format

Selects the file saving format for image data.
(IV4P, IV4P/BMP, JPEG, IV4P/JPEG)

❍ **IV4P**

Transfers the image data in a format that can be opened by IV Smart Navigator. Operation results can be confirmed in the simulator function by using the transferred image data.
Moreover, the image data can be converted to BMP by using the IV4P-Converter.

❍ **BMP**

Transfers the image data as the format which can be opened by other applications.

❍ **JPEG**

Transfers the image data as the format which can be opened by other applications.
The file size of these images is smaller than a BMP image. However, the image quality will slightly decrease.

Transfer Judgment Results

To transfer judgment results in a text file simultaneously with the image data, select [Enable].
Judgement results are transferred as a tab delimited text.

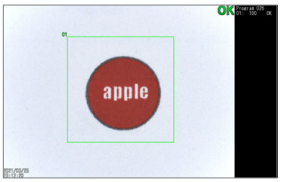
Reference The example for displaying the saved results file with Microsoft Excel is as follows.

	A	B	C
1	Time and Date	2019/2/28	16:04:45
2	Program No.	0	
3	Trigger No.	1	
4	TIME[ms]	144	
5	Total Status	OK	
6	Position Adjustment	OK	87
7	Tool01:Learning	OK	100
8	Tool02:Learning	OK	100

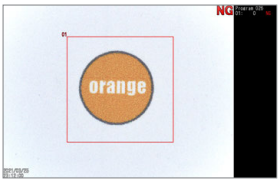
Add Result to Images

Press [Enable] to add the tool window (frame), total status results (standard mode: OK/NG, sorting mode: master number), program number, matching rate for each tool and status result, and capture date information to the image data to be transferred to the SD card. The setting can be made only when BMP or JPEG are included in the file format.

❍ **Example of the image to be transferred (standard mode)**

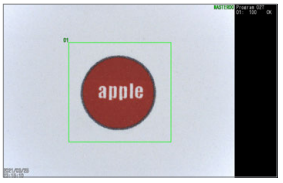


Total Status OK

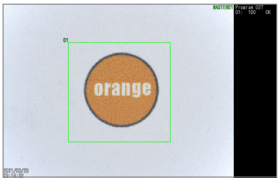


Total Status NG

❍ **Example of the image to be transferred (sorting mode)**



Part Type Discrimination MASTER00



Part Type Discrimination MASTER01

Reference The judgment notation settings (Page 7-30) are not applied.

❍ **Conditions when judgment information is not added**

If all of the following conditions are met, no judgment information will be added even if [Add Result to Images] is set to [Enable]:

- The following settings are configured in [Sensor Setup] > [Step 1 Image Optimization] > [Extended Functions].
  - [OFF] is selected for [Zoom] > [Digital Zoom]
  - [1/64x] is selected for [High-Speed Capture] > [Imaging Area]
  - [ON] is selected for [High-Speed Capture] > [High-Speed Filter]
- [Half] is selected for [Sensor Advanced] > [Utility] > [Image/Result Output] > [Global Settings] > [Image Size]

Image Size

Selects the saving size for image data.

“Approximate image size to save” (page 9-10)

3 Press [OK].

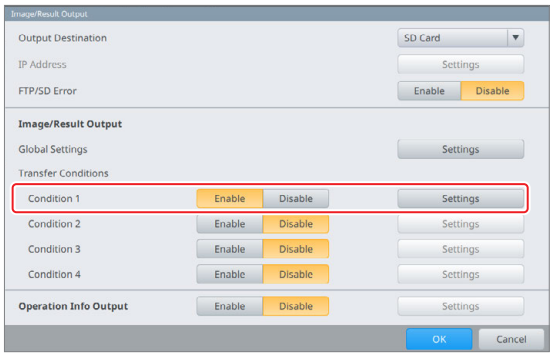
Transfer Conditions

Up to 4 transfer conditions can be set. The setting contents of each transfer condition are the same.

Point **Each transfer condition operates independently. Therefore, if judgment is duplicated, the file may be overwritten.**

1 Press [Enable] for Conditions 1 to 4 to be enabled.

2 Press [Settings] for the enabled condition.

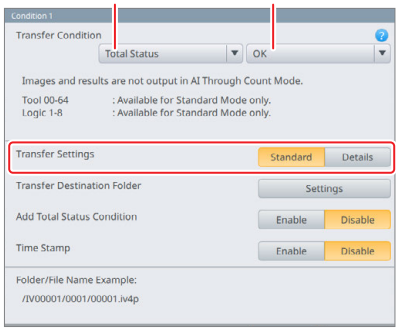


3 Configure the settings.

The setting items differ depending on the setting (Standard/Details) for [Transfer Setting].

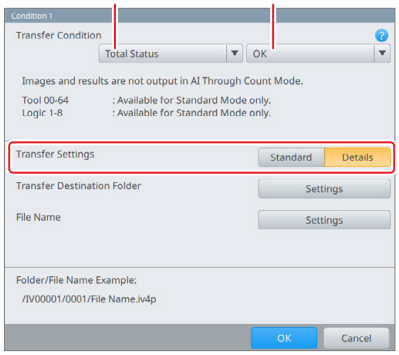
Standard

Transfer Condition 1 Transfer Condition 2



Details

Transfer Condition 1 Transfer Condition 2



“Transfer Condition 1 (Target Image)” (page 8-13)
“Transfer Condition 2 (Judgment Result)” (page 8-14)
“Transfer Destination Folder” (page 8-14)
“Add Total Status Condition” (page 8-15)
“Time Stamp” (page 8-15)
“File Name (Details)” (page 8-16)

4 Press [OK].

Transfer Condition 1 (Target Image)

All

Transfers all images that are captured. If this option is selected, the status conditions cannot be selected.

Judgment Complete

Transfers all the images that are judged. If this option is selected, the status conditions cannot be selected.

Total Status

Transfers only the images that match the status results, targeting images to which the total status has been processed.

Tool 00 to 64 (Standard Mode Only)

Transfers only the images that match the status results, targeting images to which judgment has been processed using a selected tool.
This option is enabled for standard mode only.

Master 00/Part 0 to Master07/Part 7

❍ **Master 00 to Master 07 (standard mode)**
Transfers images that match the status results of detection tools set for the selected master image when multiple master image settings are enabled.

❍ **Part 0 to Part 7 (sorting mode)**
Transfers images that match the status results, targeting images to which judgment has been processed based on a selected part type master image.

Logic 1 to 8 (Standard Mode Only)

Transfers only the images that match the status results, targeting images to which judgment has been processed using a selected logic.
This option is enabled for standard mode only.

Transfer Condition 2 (Judgment Result)

OK

Transfers images whose status results selected in the transfer condition 1 are OK.

❍ Standard Mode

When multiple master image settings are disabled
- Total status/tool/logic: Transferred when the result is OK
- Master 00: Transferred when the status of all tools is OK
- Master 01-07: Not transferred.

When master image settings are enabled
- Total status/tool/logic: Transferred when the result is OK
- Master 00-07: Transferred when the status of all tools set for the selected master image is OK

❍ Sorting Mode

- Total status: Transferred when matching any part type
- Tool/logic: Not transferred.
- Part 0-7: Transferred when matching the selected part type

NG

Transfers images whose status results selected in the transfer condition 1 are NG.

❍ Standard Mode

When multiple master image settings are disabled
- Total status/tool/logic: Transferred when the result is NG
- Master 00: Transferred when the status of any tool is NG
- Master 01-07: Not transferred.

When master image settings are enabled
- Total status/tool/logic: Transferred when the result is NG
- Master 00-07: Transferred when the status for any tool set for the selected master image is NG

❍ Sorting Mode

- Total status: Transferred when not matching any part type
- Tool/logic: Not transferred.
- Part 0-7: Transferred when not matching the selected part type

NG/near threshold OK

The following images will be transferred:
- Among the images for which the judgment results selected with the transfer condition 1 are OK, those images whose matching rates of AI Differentiate, AI Identify, or AI OCR (when [Show Matching Rate] is enabled) are closer to the threshold*
- The images whose status results selected in the transfer condition 1 are NG

*Except when "Logic 1 to 8" is selected in the transfer condition 1.

Reference If saving OK images where the matching rates are close to the threshold, the images that should be judged as NG which have been mistakenly judged as OK can be searched.

near threshold OK

The following images will be transferred:
- Among the images for which the judgment results selected with the transfer condition 1 are OK, those images whose matching rates of AI Differentiate, AI Identify, or AI OCR (when [Show Matching Rate] is enabled) are closer to the threshold*

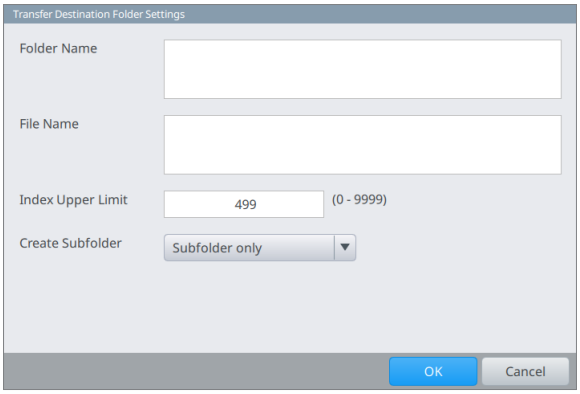
*Except when "Logic 1 to 8" is selected in the transfer condition 1.

Reference If saving OK images where the matching rates are close to the threshold, the images that should be judged as NG which have been mistakenly judged as OK can be searched.

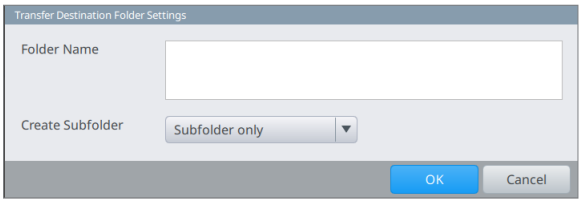
Transfer Destination Folder

Sets the transfer destination folder and file name of an image to be transferred to the SD card.

❍ Standard



❍ Details



Reference For detailed specifications of the transfer destination folder and file name, refer to the following:
- “Details of the transfer destination folder” (page 8-17)
- “Details of the file name” (page 8-17)

Folder Name

Specifies the transfer destination folder of the SD card.
(Default: Not set (blank))
Up to 128 characters can be set for the desired folder name.
- Input is not necessary if the image data is to be transferred to the root folder.
- To specify a subfolder, separate the name with a forward slash (/).
- If the specified folder does not exist, a new folder will be created.

Set a transfer destination folder name.

Point
- **A forward slash (/), period (.) and space ( ) cannot be used as the first or last letter of the folder name.**
- **“/” (one-byte slash) cannot be used multiple times in a row.**

File Name (Standard)

Sets the file name of the transfer files.
(Default: Not set (blank))
Up to 64 characters can be set for the file name.

Point
- **If there is a file with the same name at the transfer destination, that file will be overwritten. When you transfer image data from multiple IV4 Series devices, specify different transfer destinations so that the image data is not overwritten accidentally.**
- **If the transfer destination folder is read only or is open, the image data transfer will fail.**

Index Upper Limit

Sets the upper limit of the number of image data that can be transferred to the transfer destination folder to a number between 0 and 9999.
(Default value: 499)
When the file index quantity has reached the index upper limit, the following occurs.
- When [Create Subfolder] is set to any setting other than [No Sorting with Folders], a folder of the next sequence number is created in the same subfolder (4-digit number). The file index value returns to [0].
- When [Create Subfolder] is set to [No Sorting with Folders], the file index quantity returns to “0”. If there is a file with the same name, that file will be overwritten.

Reference When you change the setting for [Output Destination], the settings are initialized.

Create Subfolder

Select this setting to create a subfolder and sort files.

❍ **No Sorting with Folders**

A subfolder, program number folder, and YYMMDD folder will not be created.

❍ **Subfolder only (default value)**

Only a subfolder will be created.
A program number folder and YYMMDD folder will not be created.

❍ **Program**

A program number folder/subfolder will be created.

❍ **Date**

A YYMMDD folder/subfolder will be created.

❍ **Program/Date**

A program number folder/YYMMDD folder/subfolder will be created.

❍ **Date/Program**

A YYMMDD folder/program number folder/subfolder will be created.

Point

- **The default for subfolders is “IV00001”.**
- **The upper limit is “IV99999”. When the upper limit has been reached, the count continues by returning to “IV00000”.**
- **The subfolder name cannot be initialized.**
- **The upper limit of the count number of folders in the subfolder is “9999”. When the number exceeds the upper limit, the transfer stops.**

Add Total Status Condition

When this is enabled, the program number, total status result (standard mode: OK/NG), or part type discrimination result (sorting mode: M00 to M07/NG) is assigned to the image file name to be transferred to the SD card.

Example: In standard mode: filename_001_OK.iv4p
filename_001_NG.iv4p
In sorting mode: filename_002_M00.iv4p
filename_002_M01.iv4p

Time Stamp

When this is enabled, the date and time are assigned to the image file name to be transferred to the SD card. The time stamp is provided in the format "YYYYMMDD_hhmmss".

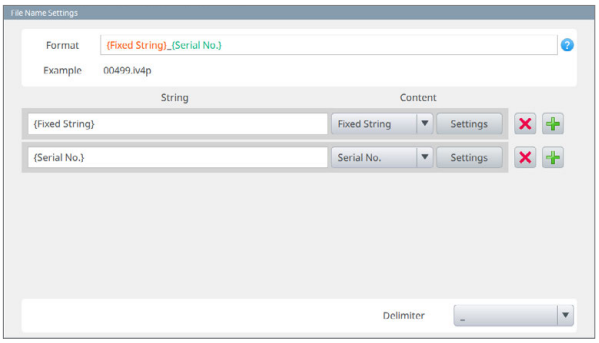
- YYYYMMDD: Date (year, month, and day)
- hhmmss: Time (hour, minute, and second)

Example: Filename_20240106_141510.iv4p

File Name (Details)

Sets the file name of the transfer files.

- Use ✕ or ✚ to delete or add a string for the format.
- You can select a delimiter: none, '-', ',', '_' or (space).



Point

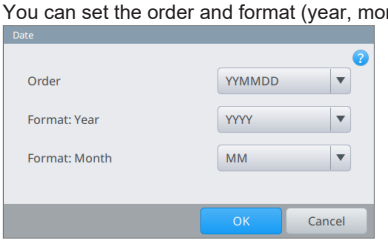
- **The maximum length of the file name is 96 bytes (including delimiters). The characters exceeding 96 bytes will be excluded from the file name.**
- **For [Serial No.], only one setting is available.**
- **Without [Serial No.], [Date], or [Time] set, the file name may not become unique, causing the file to be overwritten.**

Fixed String

Set a desired string for the file name.

Date

Set the date for the format of file name.
You can set the order and format (year, month).



Time

Set the time for the format of file name.
You can set the format (HHMMSS or HHMM).

Device Name

Set the device name for the format of file name.

Serial No.

Set the serial number (index upper limit) for the format of file name.
"Index Upper Limit" (page 8-14)

Point

Only one [Serial No.] can be added for one condition.

Program number

Set the program number for the format of file name.

Total Status

Set the total status result (OK/NG) for the format of file name.

Point

In the Sorting mode, if the part judgment result is between M00 and M07, the file name is shown with "OK".

Master/Part Number

Set the Master/Part Number for the format of file name.

Point

<For Standard Mode>
With [Multi-Master Image] set to [Enable], the smallest number is assigned among the numbers of master images whose tool judgment results are All Tools OK.
With [Multi-Master Image] set to [Disable], "00" is always assigned.

Tool 00 to 64

Set the tool number for the format of file name according to the output of judgment result of the tool number.

❍ **Status result**
OK, NG, - - (No judgment)

❍ **Match/Count Value**
The matching rate or count value of the tool

❍ **Character(s) read**
Characters that were read (AI OCR only)

Point

- **With [Status result] selected, if no tool is registered for the Target Tool No., "--" is added to the file name.**
- **With [Match/Count Value] selected, if no tool is registered for the Target Tool No., "000" is added to the file name.**
- **Nothing is added to the file name in the case where [Character(s) read] is selected, no tool is registered for the Target Tool No., or a tool other than AI OCR is registered.**

Nonprocedural (ITW) 1 to 8

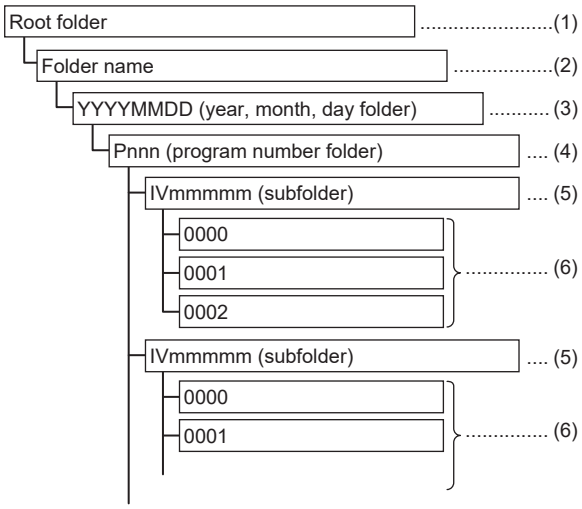
Set for the format of file name the string specified by the ITW command of the TCP/IP nonprocedural communications.

Point

You can check the currently set string by reading it using the ITR command.
The string is not displayed on the setting screen.

"Reading of nonprocedural ITW of FTP/SD file name (Details)" (page 9-160)
"Change of nonprocedural ITW of FTP/SD file name (Details)" (page 9-160)

Details of the transfer destination folder



(1) Root folder
This is the root folder for the SD card.
If [Folder Name] is not set and [Create Subfolder] is set to [No Sorting with Folders], files will be transferred to the root folder.

(2) Folder Name
A folder specified in [File Name] (Page 8-14) will be created.
If [Create Subfolder] is set to [No Sorting with Folders], files will be transferred to this folder. If no folder has been set, a folder will not be created.

(3) YYMMDD folder
If [Create Subfolder] is set to [Date], [Program/Date], or [Date/Program], a YYMMDD folder is created and files can be sorted.

(4) Program number folder
If [Create Subfolder] is set to [Program], [Program/Date], or [Date/Program], a program number folder is created and files can be sorted.
nnn: 000 to 127

(5) Subfolder
If [Create Subfolder] is set to a value other than [No Sorting with Folders], this folder will be created.
Files will be transferred to sequentially numbered folders (6) created directly under this folder.
mmmmm is a sequential number created every time the sensor is restarted or the SD card settings are changed.
Default value: IV00001

(6) Sequentially numbered folder
If [Create Subfolder] is set to a value other than [No Sorting with Folders], this folder will be created. The sequential numbers are "0000" to "9999".
When the number of transferred files reaches the index upper limit (Page 8-14), a new folder with the next sequential number will be created.

Reference
- You can create any YYMMDD folder and program number folder. You can also select any hierarchical order.
- You cannot transfer files to program number folders.

Details of the file name

File name

❍ **When [Transfer Settings] is set to [Standard]**
aaaa_bbbbb_ccc_ddd_YYYYMMDD_hhmmss.eee

❍ **When [Transfer Settings] is set to [Details]**
(Format set in [File name]).eee

aaaa
Set file name (Page 8-14). If this setting is blank, a name will not be appended.

bbbbb
The serial number every time a file is transferred. This number has a fixed 5 digits when zero suppression is not used.
The default value is 00000.
If the index upper limit (Page 8-14) is reached, the number will return to "00000".

ccc
The program number. This number has a fixed 3 digits when zero suppression is not used.

ddd
- In standard mode: The total status result (OK or NG).
- In sorting mode: Part type discrimination result M00 to M07 or NG.
  "Add Total Status Condition" (page 8-15).

YYYYMMDD
Year, month, and day of capturing. "Time Stamp" (page 8-15)

hhmmss
Hour, minute, and second of capturing.

eee
The following extensions:
- bmp: Image file (no compression)
- jpeg: Image file (compressed)
- iv4p: File format especially for the IV4 Series
- txt: A text file with the status result

Reference
- The settings to overwrite files with the same name in the same folder every time a file is transferred are as follows:
  - **When [Transfer Settings] is set to [Standard]**
    The file names will become "00000.eee".
    - File Name: Blank
    - Index Upper Limit: 0
    - Create Subfolder: No Sorting with Folders
    - Add Total Status Condition: Disable
    - Time Stamp: Disable
  - **When [Transfer Settings] is set to [Details]**
    The file name will become "(Format set in [File name]).eee".
    - Set the [Fixed String].
- The settings to save only the most recent desired number of files (e.g., 100) are as follows:
  - Index Upper Limit: 99
  - Create Subfolder: No Sorting with Folders
  - Add Total Status Condition: Disable
  - Time Stamp: Disable

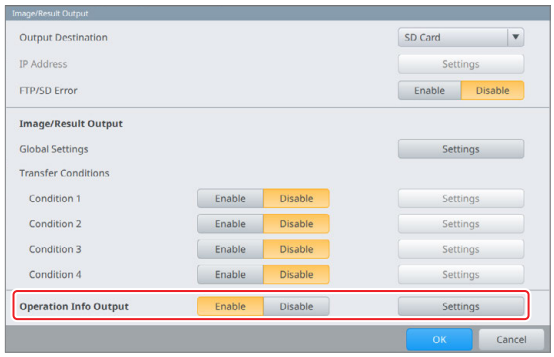
Approximate image size to save

"Approximate image size to save" (page 9-10)

Operation information output

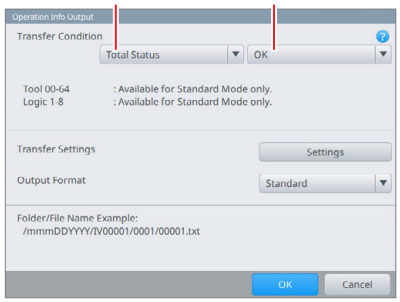
Use this function to add operation results with a line break in one file.
This function creates and outputs a file different from a text file that is output by [Transfer Judgment Results].

1 Select [Enable] for [Operation Information Output] and press [Settings].



2 Configure the settings.

Transfer Condition 1 Transfer Condition 2



Transfer Condition 1

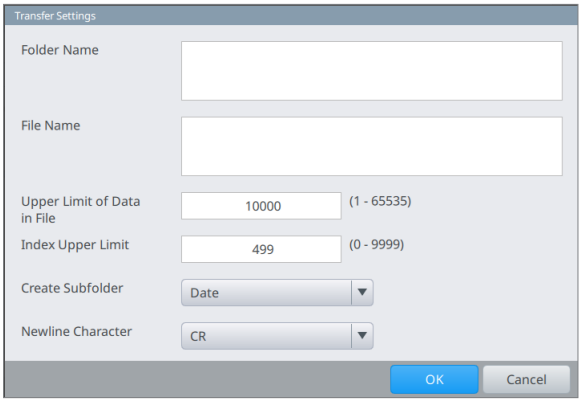
“Transfer Condition 1 (Target Image)” (page 8-13)

Transfer Condition 2

“Transfer Condition 2 (Judgment Result)” (page 8-14)

Transfer settings

Set the transfer destination folder and file name for operation information to be transferred to the SD card.



Reference For detailed specifications of the transfer destination folder and file name, refer to the following:
“Details of the transfer destination folder” (page 8-17)
“Details of the file name” (page 8-17)

❍ **Folder Name**

“Folder Name” (page 8-14)

❍ **File Name**

“File Name (Standard)” (page 8-14)

❍ **Upper limit of data in a file**

Set the upper limit of the number of data that can be stored in the transfer destination file to a value between 1 and 65535.
(Default value: 10000)

❍ **Index Upper Limit**

“Index Upper Limit” (page 8-14)

❍ **Create Subfolder**

Select this setting to create a subfolder and sort files.
(Default value: Date)
“Create Subfolder” (page 8-15)

❍ **Linefeed code**

Select a linefeed code (CR, LF, CR+LF) for the operation Information in the file.

Output format

Select an output format of operation information.
The format conforms to “Status result output formats” (page 9-161) of the TCP/IP nonprocedural communication.
The “RT” at the beginning is not output.

- Standard
- Standard (master number)
- Details
- Details (master number)

Point

Each format conforms to the following.

- **Standard: The format when “00” is specified with the OF command**
- **Standard (master number): The format when “02” is specified by the OF command**
- **Details: The format when “01” is specified by the OF command**
- **Details (master number): The format when “03” is specified by the OF command**

For details on the format, refer to the following.
“Standard format” (page 9-161)
“Detailed format” (page 9-162)

3 Press [OK].

Reference The following shows an example of the result file of operation information output (format: Standard) displayed in Microsoft Excel.

	A
1	00001,OK,01,OK,0000099,02,OK,0000099
2	00002,OK,01,OK,0000099,02,OK,0000099
3	00003,OK,01,OK,0000099,02,OK,0000099
4	00004,NG,01,NG,0000000,02,NG,0000001
5	00005,OK,01,OK,0000099,02,OK,0000099

Automatically Back Up/Restore the Settings on the SD Card

Overview of the SD Card Settings Backup

Backs up the settings of the unit to an SD card inserted in the sensor amplifier (ultra-compact model) or the sensor (built-in amplifier model). Additionally, the settings automatically backed up on the SD card can be used to restore the settings.

Usage examples:
- Restoring settings when the sensor is replaced
- Copying the same settings to multiple sensors (P000 to P031)

Point

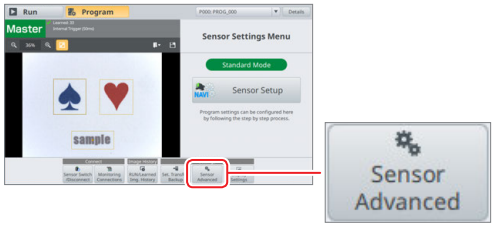
- **Backup when settings are updated and restoration when a sensor is replaced is performed automatically. Operation from IV4-CP70 or IV4-DU10 is not necessary.**
- **Settings can be backed up and restored (manually) using a USB memory stick or SD card inserted in IV4-CP70 or IV4-DU10.**
- **To copy the settings of a sensor for which SD Card Programs is enabled to multiple sensors, back up and transfer the settings using a USB memory stick or a SD card inserted in IV4-CP70 or IV4-DU10 or using the IV Smart Navigator. For SD card settings backup, P032 to P127 settings cannot be copied.**
  “Backup” (page 8-3)
  “Settings Transfer” (page 8-5)

Setting Up SD Card Settings Backup

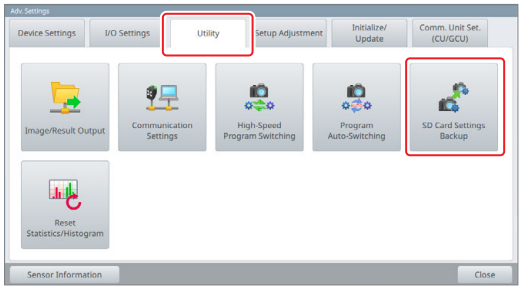
1 Insert the SD card into the sensor amplifier.

“Inserting the SD Card” (page 8-9)

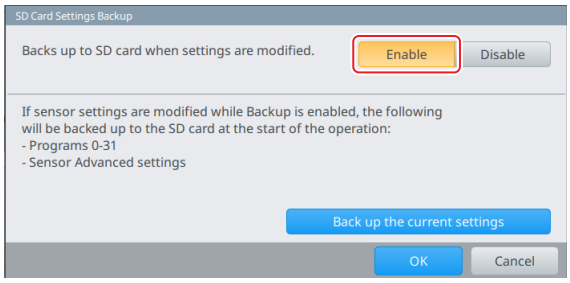
2 Press [Sensor Advanced] in the main screen in [Program].



3 Select the [Utility] tab, and then select [SD Card Settings Backup].



4 Set [Backs up to SD card when settings are modified.] to [Enable].



5 If the settings have yet to be backed up on the SD card, press [Back up the current settings].

Press [OK] when a backup completion dialog box appears.

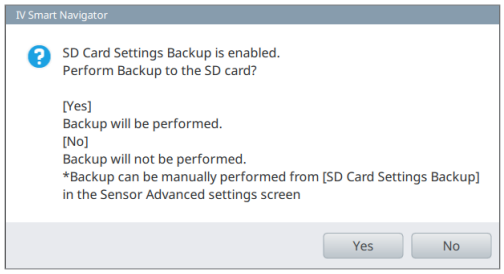
6 Press [OK].

Checking Backups When Changing Sensor Settings

1 After changing sensor settings, go to the run screen.

A dialog box appears confirming backup.

2 Press [Yes].



Press [OK] when a backup completion dialog box appears.

Point

- **If the SD card settings backup setting is set to [Enable] and “Initialize Sensor” (page 7-24) is also performed, the backup files on the SD card will also be initialized. To use an SD card that has not yet been initialized to restore different sensor settings, remove the SD card before initialization.**
- **If the SD card settings backup is set to [Enable] and the sensor settings are changed with one of the following methods, a backup confirmation dialog box will appear:**
  - **Settings are changed with Sensor Setup.**
  - **Additional learning is performed.**
  - **Program name change, initialization, copying, or import from file is performed on the program details screen.**
  - **Settings data is transferred.**
  - **Learning images are deleted and additional learning is performed on the learning history screen or additional learning is performed from a file.**
  - **Additional learning is performed on the image history screen.**
  - **External Master Save is performed.**
  - **Limit adjustment is performed during operation.**
  - **Change settings is performed via the field network.**

Restoring Settings from the SD Card

Settings can be restored for the following types of sensors:
- Sensors with the factory default settings
- Sensors that have been initialized

Point

The following conditions must be satisfied to restore settings:
- **The model of the sensor from which the settings are backed up and the model of the sensor to which the settings are restored are the same.**
- **The power source type of the sensor from which the settings are backed up and the power source type of the sensor to which the settings are restored are the same.**
- **The version of the sensor from which the settings are backed up and the version of the sensor to which the settings are restored are compatible.**
  Example
  - **If the version of the backed up sensor is "R1.00.**", the settings can be restored to a sensor with the version "R1.00.**". Settings cannot be restored to sensors with the version "R1.20.**".**
  - **If the version of the backed up sensor is "R1.20.**", the settings can be restored to a sensor with the version "R1.20.**". Settings cannot be restored to sensors with the version "R1.00.**".**

1 Turn off the power to the sensor for which the settings are going to be restored.

2 Insert the SD card with the backed up settings into the sensor.

For an ultra-compact model sensor amplifier, close the SD card cover.

3 Turn on the power to the sensor.

The backed up settings will be automatically restored.
While the settings are being restored, the [OUT] indicator light turns orange.

4 Once the settings are restored, the sensor will start.

Once the settings are restored, the control panel and the sensor can be connected.

Point

If restoring settings to multiple sensors, the IP address will conflict. Restore the settings with the sensor disconnected from the network and then initialize the sensor network settings.

9

Connecting to a Network

This chapter explains the procedures to connect this device to a network.

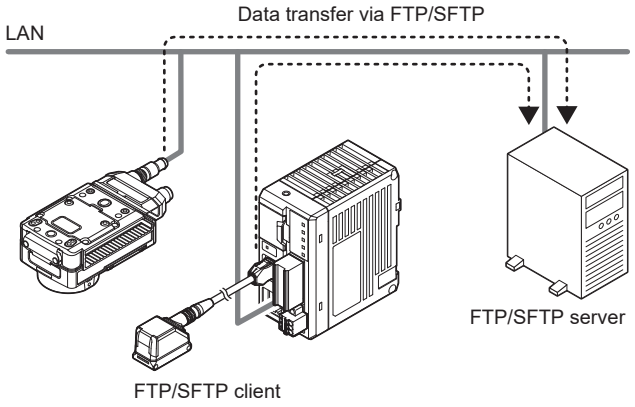
Saving Judgment Results and Judged Images to an FTP/SFTP server ...9-2
Connecting to a Field Network ...9-12
EtherNet/IP Communication Specifications and Functions ...9-16
PROFINET communication specifications and functions ...9-54
EtherCAT Communication Specifications and Functions ...9-88
OPC UA Server Function ...9-118
MQTT Client Function ...9-136
TCP/IP Non-procedural Communication Specifications and Functions...9-146

Saving Judgment Results and Judged Images to an FTP/SFTP server

Overview of the FTP/SFTP Data Transfer Function

Automatically transfers the image data and status result information saved in the sensor memory to an FTP/SFTP server.

Point **In AI Through Count Mode, only [Operation info output] is supported.**



Required environment

Hardware

FTP/SFTP server
(A PC/NAS/PLC or the like that runs FTP/SFTP server software)

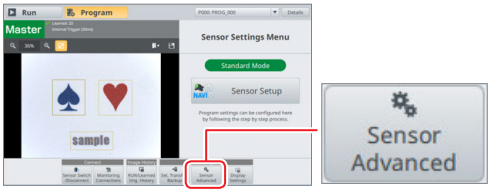
Setting up the FTP/SFTP data transfer function

1 Configure the network settings for the sensor.

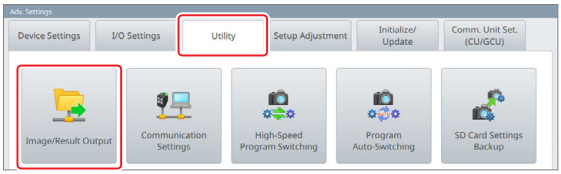
Set the IP address, subnet mask, and default gateway for the sensor.

“Network Settings” (page 7-10)

2 Press [Sensor Advanced] in the main screen in [Program].



3 Select the [Utility] tab and select [Image/Result Output].



4 Select [FTP] or [SFTP] from [Output Destination].



Point

- **For [Output Destination], you can select [FTP], [SFTP], or [SD Card]. You cannot transfer data to multiple locations at the same time.**
- **When you change the setting for [Output Destination], the [Index Upper Limit] settings are initialized.**

5 Configure the connection destination.



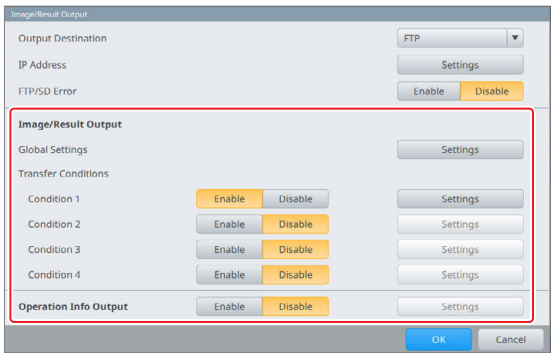
“Setting the Connection Destination” (page 9-3)

6 Configure the [FTP/SD Error].



“FTP Error” (page 9-4)

7 Configure the FTP/SFTP data transfer settings.



Image/Result Output

"Global Settings" (page 9-4)
"Setting the Transfer Conditions" (page 9-5)

Operation Info output

"Operation information output" (page 8-18)

Point

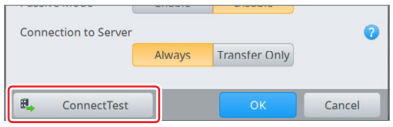
To use the operation information output via FTP/SFTP, the FTP/SFTP server must support the APPE command.
To check whether the server supports the command, refer to the instruction manual of the server. Or contact the manufacturer of the server.

"Setting the Connection Destination" (page 9-3)
"Global Settings" (page 9-4)
"Setting the Transfer Conditions" (page 9-5)

8 Press [Settings] of the Network Connection.



9 Press [ConnectTest] to test the connection with the connection destination.



10 Check the results and press [OK].

- If "Successfully connected." is displayed, setting is completed.
- The folder "IV4_Series_FTP_Test" is created in the folder specified for [Folder Name] on the FTP/SFTP server and the file "IV4_Series_FTP_Test.txt" is transferred.

Reference

When the test is executed, the connection with the FTP/SFTP server, the ability to create folders at the transfer destination, and the ability to create data files are tested. The data file will be created in the root folder when all the transfer conditions are disabled, or in the folder on the condition of a smaller number when any of the conditions is enabled.

Point

If data is not transferred correctly, refer to "Remedy when data transfer via FTP/SFTP is unavailable" (page A-24).

11 Press [OK].

12 Press [Close].

The system returns to the main screen in [Program].

13 Start the run mode.

Once the target is judged, the specified data file is automatically transferred to the FTP/SFTP server.

Point

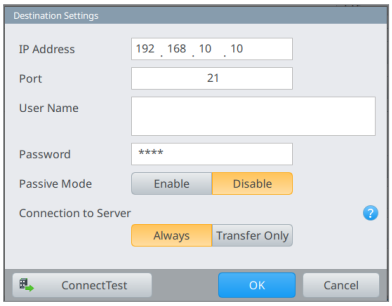
- **When the transfer condition is set to [All] or [Judgment Complete], adjust the processing time so that all the images can be transferred.**
- **When the transfer could not be done on time, the data is saved in the internal buffer. The internal buffer can save up to 20 images.**
- **Image data is transferred in the sequence that the images have been saved to the internal buffer.**
- **When the remaining capacity of the internal buffer is insufficient, the image data transfer fails.**
- **When the transfer condition is set to [All] or [Judgment Complete], confirm that there is sufficient storage on the FTP/SFTP server.**

Setting the Connection Destination

Point

You only need to configure these settings if the transfer destination is set to [FTP] or [SFTP].

Set the network address of the FTP/SFTP server.



IP Address

Displays the IP address of the FTP/SFTP server.
Set a user-defined address.

Port

Displays the port number.
(Default: 21 for FTP, 22 for SFTP)
Normally, there is no need to change.

User Name

Input the user name (max.: 48 characters) to log in to the FTP/SFTP server.
(Default: Not set (blank))

Password

Input the password (max.: 16 characters) to log in to the FTP/SFTP server.
(Default: Not set (blank))

Passive Mode

To use the passive mode for FTP, select [Enable]. Note that the passive mode cannot be used for SFTP.

Connection to Server

Select the method to connect to the server.

FTP Error

To turn ON the error output when a file transfer failed, press [Enable].



Point

When this item is set to [Enable], the following occurs if a file transfer fails.

- **The following error messages are displayed in response to the causes of failure.**
  - **FTP Connection Error**
  - **FTP Transfer Error (Transfer Failed)**
  - **FTP Transfer Error (Insufficient Data Buffer)**

  “Remedy when data transfer via FTP/SFTP is unavailable” (page A-24)
- **The error output function turns ON.**
- **The indicator light of the sensor blinks in red.**
- **If “FTP Transfer Error” has occurred while the sensor is running, the error condition will continue until the error is cleared.**

  “Clearing Errors” (page 11-12)

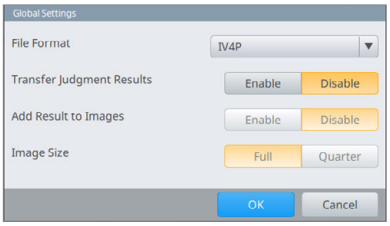
Global Settings

1 Press [Settings] of the Global Settings.



The Global Settings screen appears.

2 Configure the Global Settings.



File Format

Selects the file saving format for image data.
(IV4P, IV4P/BMP, JPEG, IV4P/JPEG)

❍ **IV4P**

Transfers the image data in a format that can be opened by IV Smart Navigator. Operation results can be confirmed in the simulator function by using the transferred image data.
Moreover, the image data can be converted to BMP format by using IV Smart-Converter.

❍ **BMP**

Transfers the image data as the format which can be opened by other applications.

❍ **JPEG**

Transfers the image data as the format which can be opened by other applications.
The file size of these images is smaller than a BMP image. However, the image quality will slightly decrease.

Transfer Judgment Results

To transfer judgment results in a text file simultaneously with the image data, select [Enable].
Judgement results are transferred as a tab delimited text.

Reference

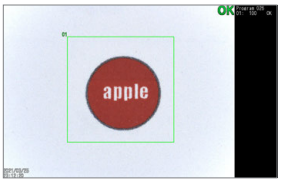
The example for displaying the saved results file with Microsoft Excel is as follows.

	A	B	C
1	Time and Date	2019/2/28	16:04:45
2	Program No.	0	
3	Trigger No.	1	
4	TIME[ms]	144	
5	Total Status	OK	
6	Position Adjustment	OK	87
7	Tool01:Learning	OK	100
8	Tool02:Learning	OK	100

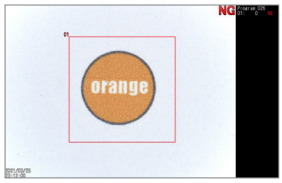
Add Result to Images

Press [Enable] to add the tool window (frame), total status results (standard mode: OK/NG, sorting mode: master number/NG), program number, matching rate for each tool and status result, and capture date information to the image data to be transferred.
The setting can be made only when BMP or JPEG are included in the file format.

❍ **Example of the image to be transferred (standard mode)**

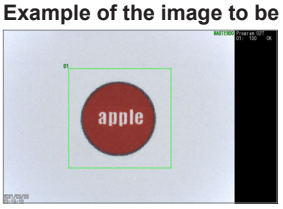


Total Status OK

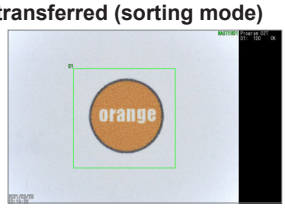


Overall judgment NG

❍ **Example of the image to be transferred (sorting mode)**



Part Type Discrimination MASTER00



Part Type Discrimination MASTER01

Point

When the number of image pixels is 40 x 30, no judgment information is added to the image and only the image is transferred even if [Add Result to Images] is set to [Enable].

Reference

The judgment notation settings (Page 7-30) are not applied.

Image Size

Selects the saving size for image data.

“Approximate image size to save” (page 9-10)

3 Press [OK].

The system returns to the [Image/Result Output] screen.

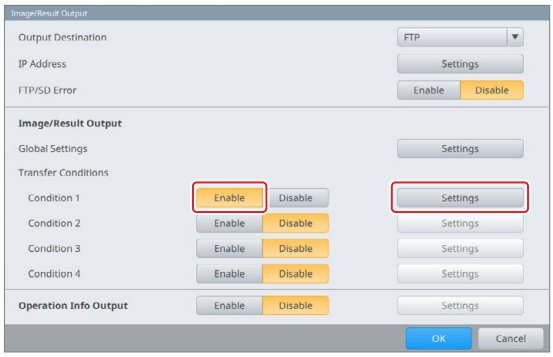
Setting the Transfer Conditions

Up to 4 transfer conditions can be set. The setting contents of each transfer condition are the same.

Point **Each transfer condition operates independently. Therefore, if judgment is duplicated, the file may be overwritten.**

1 Press [Enable] for Conditions 1 to 4 to be enabled.

2 Press [Settings] for the enabled condition.



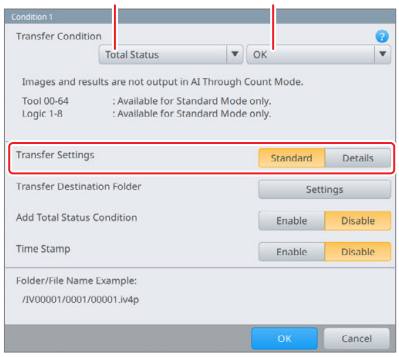
The Transfer Condition screen opens.

3 Configure the settings.

The setting items differ depending on the setting (Standard/Details) for [Transfer Setting].

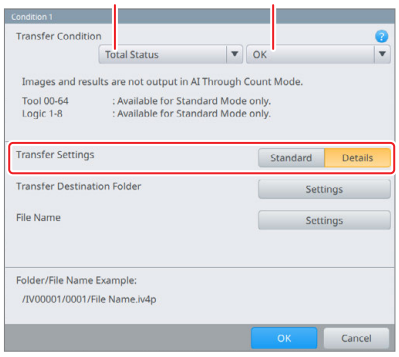
Standard

Transfer Condition 1 Transfer Condition 2



Details

Transfer Condition 1 Transfer Condition 2



“Transfer Condition 1 (Target Image)” (page 9-5)
“Transfer Condition 2 (Judgment Result)” (page 9-6)
“Transfer Destination Folder” (page 9-6)
“Add Total Status Condition” (page 9-7)
“Time Stamp” (page 9-7)
“File Name (Details)” (page 9-8)

4 Press [OK].

Transfer Condition 1 (Target Image)

All

Transfers all images including images that have not been judged. If this option is selected, [Transfer Condition 2] cannot be selected.

Judgment Complete

Transfer all images whose total status has been determined regardless of their judgment.
If this option is selected, [Transfer Condition 2] cannot be selected.

Total Status

Transfers only the images that match the status results, targeting images to which the total status has been processed.

Tool 00 to 64 (Standard Mode Only)

Transfers only the images that match the status results, targeting images to which judgment has been processed using a selected tool.
This option is enabled for standard mode only.

Master 00/Part 0 to Master07/Part 7

Master 00 to Master 07 (standard mode)

Transfers images that match the status results of detection tools set for the selected master image when multiple master image settings are enabled.

Part 0 to Part 7 (sorting mode)

Transfers images that match the status results, targeting images to which judgment has been processed based on a selected part type master image.

Logic 1 to 8 (Standard Mode Only)

Transfers only the images that match the status results, targeting images to which judgment has been processed using a selected logic.
This option is enabled for standard mode only.

Transfer Condition 2 (Judgment Result)

OK

Transfers images whose status results selected in the transfer condition 1 are OK.

❍ Standard Mode

When multiple master image settings are disabled
- Total status/tool/logic: Transferred when the result is OK
- Master 00: Transferred when the status of all tools is OK
- Master 01-07: Not transferred.

When master image settings are enabled
- Total status/tool/logic: Transferred when the result is OK
- Master 00-07: Transferred when the status of all tools set for the selected master image is OK

❍ Sorting Mode

- Total status: Transferred when matching any part type
- Tool/logic: Not transferred.
- Part 0-7: Transferred when matching the selected part type

NG

Transfers images whose status results selected in the transfer condition 1 are NG.

❍ Standard Mode

When multiple master image settings are disabled
- Total status/tool/logic: Transferred when the result is NG
- Master 00: Transferred when the status of any tool is NG
- Master 01-07: Not transferred.

When master image settings are enabled
- Total status/tool/logic: Transferred when the result is NG
- Master 00-07: Transferred when the status for any tool set for the selected master image is NG

❍ Sorting Mode

- Total status: Transferred when not matching any part type
- Tool/logic: Not transferred.
- Part 0-7: Transferred when not matching the selected part type

NG/near threshold OK

The following images will be transferred:
- Among the images for which the judgment results selected with the transfer condition 1 are OK, those images whose matching rates of AI Differentiate, AI Identify, or AI OCR (when [Show Matching Rate] is enabled) are closer to the threshold*
- The images whose status results selected in the transfer condition 1 are NG

*Except when "Logic 1 to 8" is selected in the transfer condition 1.

Reference If saving OK images where the matching rates are close to the threshold, the images that should be judged as NG which have been mistakenly judged as OK can be searched.

near threshold OK

The following images will be transferred:
- Among the images for which the judgment results selected with the transfer condition 1 are OK, those images whose matching rates of AI Differentiate, AI Identify, or AI OCR (when [Show Matching Rate] is enabled) are closer to the threshold*

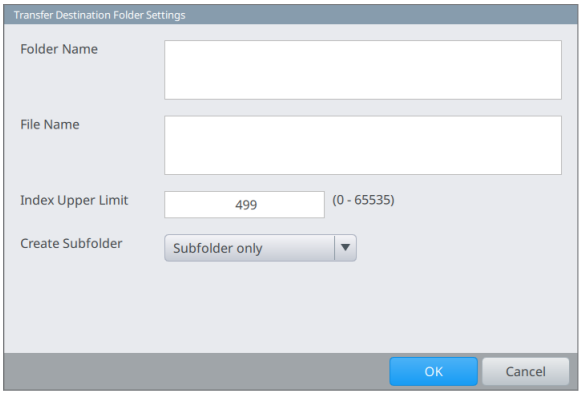
*Except when "Logic 1 to 8" is selected in the transfer condition 1.

Reference If saving OK images where the matching rates are close to the threshold, the images that should be judged as NG which have been mistakenly judged as OK can be searched.

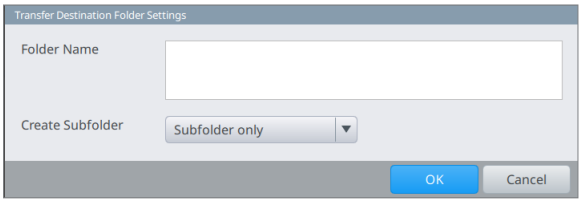
Transfer Destination Folder

Sets the transfer destination folder and file name of an image to be transferred to the FTP/SFTP server.

❍ Standard



❍ Details



Reference For detailed specifications of the transfer destination folder and file name, refer to the following:
"Details of the transfer destination folder" (page 9-9)
"Details of the file name" (page 9-9)

Folder Name

Specify the transfer destination folder of the FTP/SFTP server.
(Default: Not set (blank))
Up to 128 characters can be set for the desired folder name.
- Input is not necessary if the image data is to be transferred to the root folder.
- To specify a subfolder, separate the name with a forward slash (/).
- If the specified folder does not exist, a new folder will be created.

Set a user-defined transfer destination folder name.

Point
- **A forward slash (/), period (.) and space ( ) cannot be used as the first or last letter of the folder name.**
- **"/" (one-byte slash) cannot be used multiple times in a row.**

File Name (Standard)

Sets the file name of the transfer files.
(Default: Not set (blank))
Up to 64 characters can be set for the desired file name.

Point
- **If there is a file with the same name at the transfer destination, that file will be overwritten. When you transfer image data from multiple IV4 Series devices, specify different transfer destinations so that the image data is not overwritten accidentally.**
- **If the transfer destination folder is read only or is open, the image data transfer will fail.**

Index Upper Limit

Sets the upper limit of the number of image data that can be transferred to the transfer destination folder to a number between 0 and 65535.
(Default value: 499)
When the file index quantity has reached the index upper limit, the following occurs.
- When [Create Subfolder] is set to any setting other than [No Sorting with Folders], a folder of the next sequence number is created in the same subfolder (4-digit number). The file index value returns to [0].
- When [Create Subfolder] is set to [No Sorting with Folders], the file index quantity returns to "0". If there is a file with the same name, that file will be overwritten.

Reference When you change the setting for [Output Destination], the settings are initialized.

Create Subfolder

Select this setting to create a subfolder and sort files.

❍ **No Sorting with Folders**

A subfolder, program number folder, and YYMMDD folder will not be created.

❍ **Subfolder only (default value)**

Only a subfolder will be created.
A program number folder and YYMMDD folder will not be created.

❍ **Program**

A program number folder/subfolder will be created.

❍ **Date**

A YYMMDD folder/subfolder will be created.

❍ **Program/Date**

A program number folder/YYMMDD folder/subfolder will be created.

❍ **Date/Program**

A YYMMDD folder/program number folder/subfolder will be created.

Point

- **The default for subfolders is “IV00001”.**
- **The upper limit is “IV99999”. When the upper limit has been reached, the count continues by returning to “IV00000”.**
- **The subfolder name cannot be initialized.**
- **The upper limit of the count number of folders in the subfolder is “9999”. When the number exceeds the upper limit, the transfer stops.**

Add Total Status Condition

When this is enabled, the program number, total status result (standard mode: OK/NG), or part type discrimination result (sorting mode: M00 to M07/NG) is assigned to the image file name to be transferred to the FTP/SFTP server.

Example:	In standard mode:	filename_001_OK.iv4p
		filename_001_NG.iv4p
		filename_001_--.iv4p *
	In sorting mode:	filename_002_M00.iv4p
		filename_002_M01.iv4p

* When the program auto-switching is set to [Enable] and the NG image is transferred during retry or judgment waiting time. The status info on the image will be "NG".

Time Stamp

When this is enabled, the date and time are assigned to the image file name to be transferred to the FTP/SFTP server.
The time stamp is provided in the format "YYYYMMDD_hhmmss".

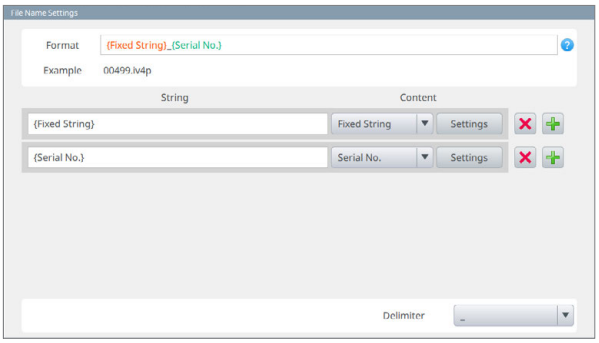
- YYYYMMDD: Date (year, month, and day)
- hhmmss: Time (hour, minute, and second)

Example: Filename_20210106_141510.iv4p

File Name (Details)

Sets the file name of the transfer files.

- Use ✕ or ✚ to delete or add a string for the format.
- You can select a delimiter: none, '-', ',', '_' or (space).



Point

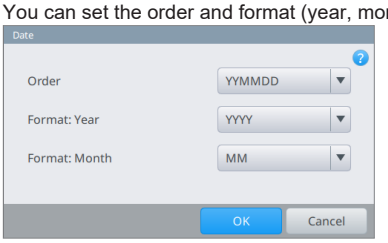
- **The maximum length of the file name is 96 bytes (including delimiters). The characters exceeding 96 bytes will be excluded from the file name.**
- **For [Serial No.], only one setting is available.**
- **Without [Serial No.], [Date], and [Time] set, the file name may not become unique, causing the file to be overwritten.**

Fixed String

Set a desired string for the file name.

Date

Set the date for the format of file name.
You can set the order and format (year, month).



Time

Set the time for the format of file name.
You can set the format (HHMMSS or HHMM).

Device Name

Set the device name for the format of file name.

Serial No.

Set the serial number (index upper limit) for the format of file name.
"Index Upper Limit" (page 9-6)

Point

Only one [Serial No.] can be added for one condition.

Program number

Set the program number for the format of file name.

Total Status

Set the total status result (OK/NG) for the format of file name.

Point

In the Sorting mode, if the part judgment result is between M00 and M07, the file name is shown with "OK".

Master/Part Number

Set the Master/Part Number for the format of file name.

Point

<For Standard Mode>
With [Multi-Master Image] is set to [Enable], the smallest number is assigned among the numbers of master images whose tool judgment results are All Tools OK.
With [Multi-Master Image] set to [Disable], "00" is always assigned.

Tool 00 to 64

Set the tool number for the format of file name according to the output of judgment result of the tool number.

❍ **Status result**
OK, NG, - - (No judgment)

❍ **Match/Count Value**
The matching rate or count value of the tool

❍ **Character(s) read**
Characters that were read (AI OCR only)

Point

- **With [Status result] selected, if no tool is registered for the Target Tool No., "--" is added to the file name.**
- **With [Match/Count Value] selected, if no tool is registered for the Target Tool No., "000" is added to the file name.**
- **Nothing is added to the file name when [Character(s) read] is selected, no tool is registered for the Target Tool No., or a tool other than AI OCR is registered.**

Nonprocedural (ITW) 1 to 8

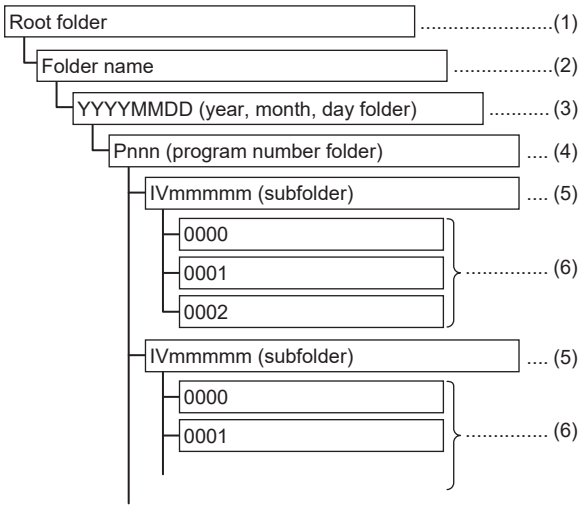
Set for the format of file name the string specified by the ITW command of the TCP/IP non-procedural communications.

Point

You can check the currently set string by reading it using the ITR command.
The string is not displayed on the setting screen.

"Reading of nonprocedural ITW of FTP/SD file name (Details)" (page 9-160)
"Change of nonprocedural ITW of FTP/SD file name (Details)" (page 9-160)

Details of the transfer destination folder



(1) Root folder
This is the root folder for the FTP/SFTP server.
If [Folder Name] is not set and [Create Subfolder] is set to [No Sorting with Folders], files will be transferred to the root folder.

(2) Folder Name
A folder specified in [File Name] (Page 9-6) will be created.
If [Create Subfolder] is set to [No Sorting with Folders], files will be transferred to this folder. If no folder has been set, a folder will not be created.

(3) YYMMDD folder
If [Create Subfolder] is set to [Date], [Program/Date], or [Date/Program], a YYMMDD folder is created and files can be sorted.

(4) Program number folder
If [Create Subfolder] is set to [Program], [Program/Date], or [Date/Program], a program number folder is created and files can be sorted.
nnn: 000 to 127

(5) Subfolder
If [Create Subfolder] is set to a value other than [No Sorting with Folders], this folder will be created.
Files will be transferred to sequentially numbered folders (6) created directly under this folder.
mmmmm is a sequential number created every time the sensor is restarted or the SD card settings are changed.
Default value: IV00001

(6) Sequentially numbered folder
If [Create Subfolder] is set to a value other than [No Sorting with Folders], this folder will be created. The sequential numbers are "0000" to "9999".
When the number of transferred files reaches the index upper limit (Page 9-6), a new folder with the next sequential number will be created.

Reference
- You can create any YYMMDD folder and program number folder. You can also select any hierarchical order.
- You cannot transfer files to program number folders.

Details of the file name

File name

❍ **When [Transfer Settings] is set to [Standard]**
aaaa_bbbbb_ccc_ddd_YYYYMMDD_hhmmss.eee

❍ **When [Transfer Settings] is set to [Details]**
(Format set in [File name]).eee

aaaa
Set file name (Page 9-6). If this setting is blank, a name will not be appended.

bbbbb
The serial number every time a file is transferred. This number has a fixed 5 digits when zero suppression is not used.
The default value is 00000.
If the index upper limit (Page 9-6) is reached, the number will return to "00000".

ccc
The program number. This number has a fixed 3 digits when zero suppression is not used.

ddd
- In standard mode: The total status result (OK or NG).
- In sorting mode: Part type discrimination result M00 to M07 or NG.
  "Add Total Status Condition" (page 9-7).

YYYYMMDD
Year, month, and day of capturing.
"Time Stamp" (page 9-7)

hhmmss
Hour, minute, and second of capturing.

eee
The following extensions:
- bmp: Image file (no compression)
- jpeg: Image file (compressed)
- iv4p: File format especially for the IV4 Series
- txt: A text file with the status result

Reference
- The settings to overwrite files with the same name in the same folder every time a file is transferred are as follows:
  - **When [Transfer Settings] is set to [Standard]**
    The file names will become "00000.eee".
    - File Name: Blank
    - Index Upper Limit: 0
    - Create Subfolder: No Sorting with Folders
    - Add Total Status Condition: Disable
    - Time Stamp: Disable
  - **When [Transfer Settings] is set to [Details]**
    The file name will become "(Format set in [File name]).eee".
    - Set the [Fixed String].
- The settings to save only the most recent desired number of files (e.g., 100) are as follows:
  - Index Upper Limit: 99
  - Create Subfolder: No Sorting with Folders
  - Add Total Status Condition: Disable
  - Time Stamp: Disable

Approximate image size to save

❍ Imaging Area 1x

High-Speed Filter	Add Result to Images	Image Size	Total Number of Tools	Number of Image Pixels	Approximate image size to save (kb)		
					IV4P	BMP	JPEG
ON	Enable	Full	33 tools or less	760 x 480	301	1069	46
			34 to 65 tools	880 x 480		1238	66
		Quarter	16 tools or less	440 x 240		309	18
			17 to 32 tools	560 x 240		394	28
			33 to 48 tools	680 x 240		478	38
			49 to 64 tools	800 x 240		563	47
			65 Tools	920 x 240		647	56
	Disable	Full	-	640 x 480		900	40
		Quarter		320 x 240		225	14
OFF	Enable	Full	33 tools or less	1520 x 960	1201	4275	170
			34 to 65 tools	1760 x 960		4950	225
		Quarter	33 tools or less	760 x 480		1069	49
			34 to 65 tools	880 x 480		1238	69
	Disable	Full	-	1280 x 960		3600	154
		Quarter		640 x 480		900	44

❍ Imaging Area 1/4x

High-Speed Filter	Add Result to Images	Image Size	Total Number of Tools	Number of Image Pixels	Approximate image size to save (kb)		
					IV4P	BMP	JPEG
ON	Enable	Full	16 tools or less	440 x 240	76	309	19
			17 to 32 tools	560 x 240		394	29
		Quarter	7 tools or less	280 x 120		98	9
			8 to 14 tools	400 x 120		141	13
			15 to 21 tools	520 x 120		183	18
			22 to 28 tools	640 x 120		225	23
			29 to 35 tools	760 x 120		267	25
	Disable	Full	-	320 x 240		225	15
		Quarter		160 x 120		56	6
OFF	Enable	Full	33 tools or less	760 x 480	301	1069	62
		Quarter	16 tools or less	440 x 240		309	21
			17 to 32 tools	560 x 240		394	31
	Disable	Full	-	640 x 480		900	57
		Quarter		320 x 240		225	18

❍ **Imaging Area 1/16x**

High-Speed Filter	Add Result to Images	Image Size	Total Number of Tools	Number of Image Pixels	Approximate image size to save (kb)		
					IV4P	BMP	JPEG
ON	Enable	Full	7 tools or less	280 x 120	20	99	8
			8 to 14 tools	400 x 120		141	12
			15 to 21 tools	520 x 120		183	16
		Quarter	3 tools or less	200 x 60		35	5
			4 to 6 tools	320 x 60		56	7
			7 to 9 tools	440 x 60		77	8
			10 to 12 tools	560 x 60		99	11
			13 to 15 tools	680 x 60		120	12
			16 to 18 tools	800 x 60		141	13
	Disable	Full	-	160 x 120		56	5
		Quarter		80 x 60		14	2
OFF	Enable	Full	16 tools or less	440 x 240	76	309	21
		Quarter	7 tools or less	280 x 120		99	9
			8 to 14 tools	400 x 120		141	13
			15 to 21 tools	520 x 120		183	17
	Disable	Full	-	320 x 240		225	17
		Quarter		160 x 120		56	6

❍ **Imaging Area 1/64x**

High-Speed Filter	Add Result to Images	Image Size	Total Number of Tools	Number of Image Pixels	Approximate image size to save (kb)		
					IV4P	BMP	JPEG
ON	Enable	Full	3 tools or less	200 x 60	6	35	5
			4 to 6 tools	320 x 60		56	6
			7 to 9 tools	440 x 60		77	8
		Quarter	-	40 x 30		4	1
	Disable	Full	-	80 x 60		14	2
		Quarter		40 x 30		4	1
OFF	Enable	Full	7 tools or less	280 x 120	20	99	8
			8 to 14 tools	400 x 120		141	12
		Quarter	3 tools or less	200 x 60		35	5
			4 to 6 tools	320 x 60		56	7
			7 to 9 tools	440 x 60		77	8
	Disable	Full	-	160 x 120		56	5
		Quarter		80 x 60		14	2

Connecting to a Field Network

Field Network

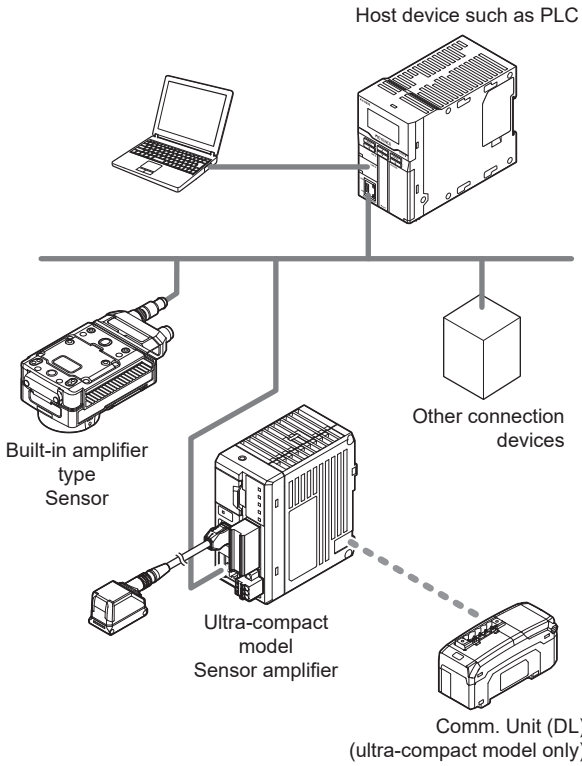
Communicates with a PLC via a field network and the status result, etc., can be input to the PLC as communication data.
You can select the following communications protocol:

- EtherNet/IP™
- PROFINET (Conformance Class B)
- TCP/IP non-procedural communications
- Comm. Unit (DL)

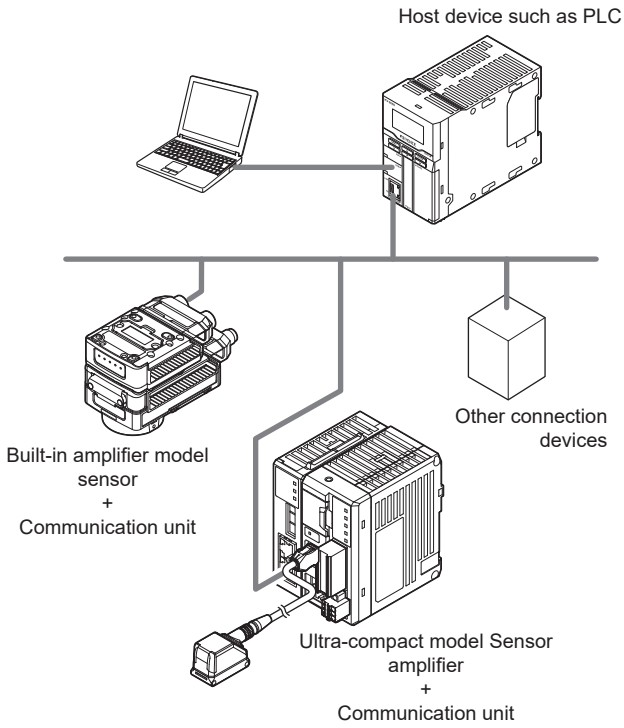
  When using a communication unit (IV4-CU1/IV4-GCU1), the following can be selected:
  - PROFINET (Conformance Class C)
  - EtherCAT

Point **When the protocol setting has been changed, connection is terminated and the sensor restarts.**

When using the field network installed in the sensor and communication unit DL

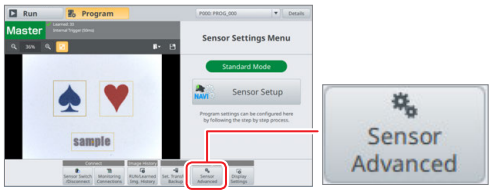


When using communication unit IV4-CU1/IV4-GCU1

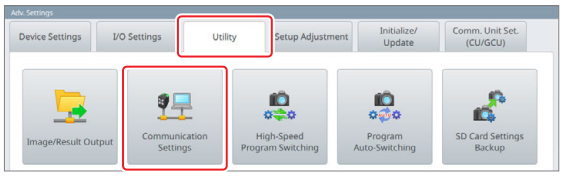


Field Network Setup (when using the communication function installed in the sensor)

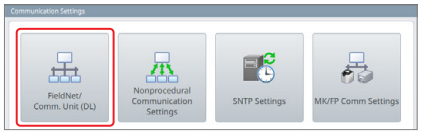
1 **Press [Sensor Advanced] in the main screen in [Program].**



2 **Select the [Utility] tab and select [Communication Settings].**



3 **Select [FieldNet/Comm. Unit (DL)].**



- **EtherNet/IP(TM)**

  “Built-in amplifier type: Operation of the indicator light of the sensor” (page 1-15)

- **PROFINET**

  “Built-in amplifier type: Operation of the indicator light of the sensor” (page 1-15)

- **Comm. Unit (DL)**

  ❍ **Byte Swap**

  You can change the order of storing the characters read by AI OCR and the FTP/SFTP transfer file names into PLC data memory (2 byte) in unit of bytes. Set the order according to the PLC specifications.

  - **Disable (default value)**
    First byte → Last byte (Example for the string “AB”: 0x4142)
  - **Enable**
    Last byte → First byte (Example for the string “AB”: 0x4241)

  ❍ **Comm. Unit (DL) Valid Tools**

  Select the maximum number of tools available when using the communication unit (DL).

  - **7 Tools (default)**
    Select this setting to communicate with the tool 01 to 06 and position adjustment tool.
  - **14 Tools**
    Select this setting to communicate with the tool 01 to 13 and position adjustment tool.

Point

- **No more than 13 tools can be used on the DL series.**
- **When using a DL series other than DL-RS1A to communicate the standard mode master number and sorting mode total status part type, select [14 Tools].**
- **For details of the communication unit (DL) function, refer to the DL Series User’s Manual.**

4 **Press [OK].**

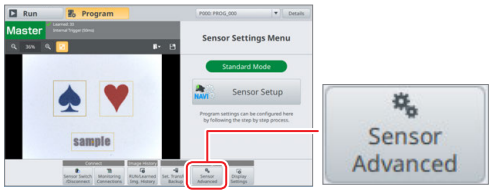
The confirmation screen opens.

5 **Press [OK].**

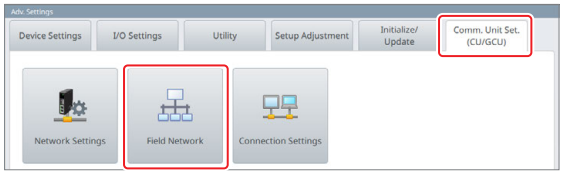
The sensor restarts and the run screen opens.

Setting of communication unit (IV4-CU1/IV4-GCU1)

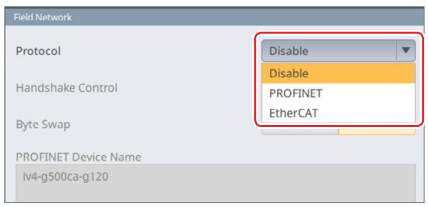
1 **Press [Sensor Advanced] in the main screen in [Program].**



2 **Select the [Comm. Unit Set. (CU/GCU)] tab, and press [Field Network].**



3 **Select the protocol and configure the settings.**



- **PROFINET**

  “Setting of communication unit (IV4-CU1/IV4-GCU1)” (page 9-56)

- **EtherCAT**

  “EtherCAT Communication” (page 9-90)

4 **When setting is completed, press [OK].**

5 **Press [OK].**

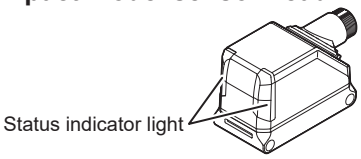
The sensor and communication unit restart.

Indicator Light Operation

This section describes the operation of the indicator lights when the field network function is used.
Other than the operations described here, operation is the same as in normal use.

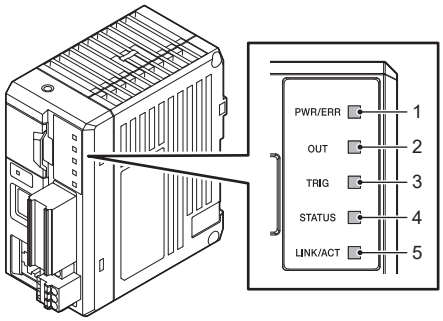
- “Name and function of each part of the ultra-compact model sensor head” (page 1-13)
- “Operation of the indicator light: Ultra-compact model sensor amplifier” (page 1-14)
- “Built-in amplifier type: Operation of the indicator light of the sensor” (page 1-15)

Ultra-compact model sensor head



Green and red are blinking alternately.	Flash LED has been requested by the PROFINET communication I/O controller. Alternatively, a request has been made for the sensor LED to blink.

Ultra-compact Model Sensor Amplifier



1 PWR/ERR

Orange (Blink)	Flash LED has been requested by the PROFINET communication I/O controller. Alternatively, a request has been made for the sensor LED to blink. The LED blinks 3 times a second.

2 OUT
Indicates the comprehensive result.

Orange (Blink)	• Flash LED has been requested by the PROFINET communication I/O controller. Alternatively, a request has been made for the sensor LED to blink. The LED blinks 3 times a second. • Settings are being restored from the micro SD card. Blinks once a second.

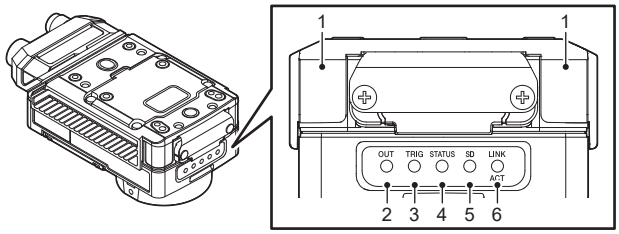
3 TRIG

Orange (Blink)	Flash LED has been requested by the PROFINET communication I/O controller. Alternatively, a request has been made for the sensor LED to blink. The LED blinks 3 times a second.

4 STATUS
Same as in normal use.

5 LINK/ACT
Same as in normal use.

Built-in amplifier type sensor



1 Status indicators

Green and red are blinking alternately.	Flash LED has been requested by the PROFINET communication I/O controller. Alternatively, a request has been made for the sensor LED to blink.

2 OUT
Indicates the comprehensive result.

Orange (Blink)	• Flash LED has been requested by the PROFINET communication I/O controller. Alternatively, a request has been made for the sensor LED to blink. Blinks 3 times a second. • Settings are being restored from the micro SD card. Blinks once a second.

3 TRIG

Orange (Blink)	Flash LED has been requested by the PROFINET communication I/O controller. Alternatively, a request has been made for the sensor LED to blink. Blinks 3 times a second.

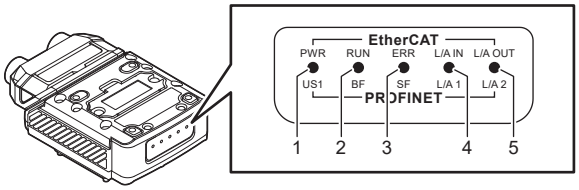
4 STATUS
Same as in normal use.

5 SD
Same as in normal use.

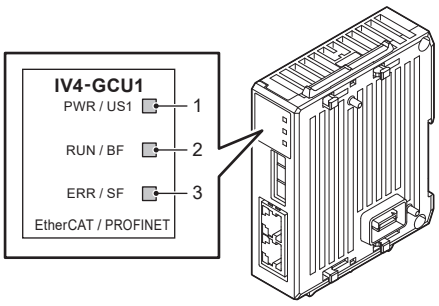
6 LINK/ACT
Same as in normal use.

Communication unit

IV4-CU1



IV4-GCU1



1 PWR/US1

Green (ON)	Power is supplied normally.
OFF	Power is not supplied.

2 RUN/BF

Green (ON)		[Protocol: EtherCAT] In the Operation state.
Green (Blink)	Turned on 0.2 second / Turned off 1 second	[Protocol: EtherCAT] In the Safe-Operational state.
	Turned on 0.2 second / Turned off 0.2 second	[Protocol: EtherCAT] In the Pre-Operational state.
Green (Blinking 3 times)	Turned on 0.5 second / Turned off 0.5 second	[Protocol: PROFINET] "LED Blinking" is requested.
Red (ON)		[Protocol: PROFINET] No communication is established with the master.
OFF		[Protocol: Disabled/ PROFINET] Normal startup is in progress.
		[Protocol: EtherCAT] In the Init state.

3 ERR/SF

Red (ON)		[Protocol: Disabled/ PROFINET] • The communication unit has detected an IP address duplication. • A system error has occurred in the unit.
Red (Blink)	Turned on 0.2 second / Turned off 0.2 second	[Protocol: EtherCAT] An error has occurred.
OFF		[Protocol: Disabled/ PROFINET] Normal startup is in progress.
		[Protocol: EtherCAT] An error has not occurred.

4 L/A IN, L/A OUT, L/A 1, L/A 2 (only IV4-CU1)

Green (ON)	Normally linked.
Green (Blink)	Normally linked, and the data transmission is in progress.
OFF	• Power is not supplied. • Sensor is not normally linked.

EtherNet/IP Communication Specifications and Functions

What is EtherNet/IP?

EtherNet/IP is an open industrial networking standard developed and maintained by the ODVA (Open DeviceNet Vendor Association, Inc.). All supported devices can use the communication network regardless of the vendor.
EtherNet/IP communication enables the network to be shared and used with standard Ethernet.

IV4 Series Support

The IV4 Series supports cyclic communication (implicit communication) with an EtherNet/IP communications adapter device.

List of supported PLCs

Check the instruction manual of each PLC for details of the setting methods.

KEYENCE PLC

PLC model	EtherNet/IP communication unit	CPU unit firmware version	Software used	Version of the software used
KV-8000	Built-in port	Ver. 1.0 or later	KV STUDIO	Ver. 10.0 or later
	KV-XLE02			
	KV-EP21V			
KV-7500	Built-in port	Ver. 1.0 or later		Ver. 8.0 or later
	KV-XLE02	Ver. 2.2 or later		Ver. 9.2 or later
	KV-EP21V	Ver. 1.0 or later		Ver. 8.0 or later
KV-7300	KV-XLE02	Ver. 2.2 or later		Ver. 9.2 or later
	KV-EP21V	Ver. 1.0 or later		Ver. 8.0 or later
KV-5500	Built-in port	Ver. 2.0 or later		Ver. 6.0 or later
	KV-EP21V			
KV-5000	KV-EP21V			
KV-3000	KV-EP21V			
KV-NC32T	KV-NC1EP	Ver. 2.0 or later		Ver. 7.1 or later
KV-N24**				
KV-N40**				
KV-N60**				

For the EDS file when using the KEYENCE KV Series, download the [IV4 Series] KV STUDIO communication unit setup file (the EZ1 file) and register it in KV STUDIO.

Rockwell Automation PLC

PLC model	EtherNet/IP communication unit	Firmware version	Software used	Version of the software used
1756 ControlLogix	1756-ENBT 1756-EN2T	Ver.13	Studio 5000	Ver.32.03.00
1769 CompactLogix	Built-in port	Ver.13		

The below file can be downloaded from the KEYENCE website.
• EDS files and tag files (it is also included in the folder in which IV Smart Navigator (IV-H1SN) has been installed).

EtherNet/IP communication specifications in the IV4 Series

Cyclic Communication (Implicit messages)	Number of connections	16

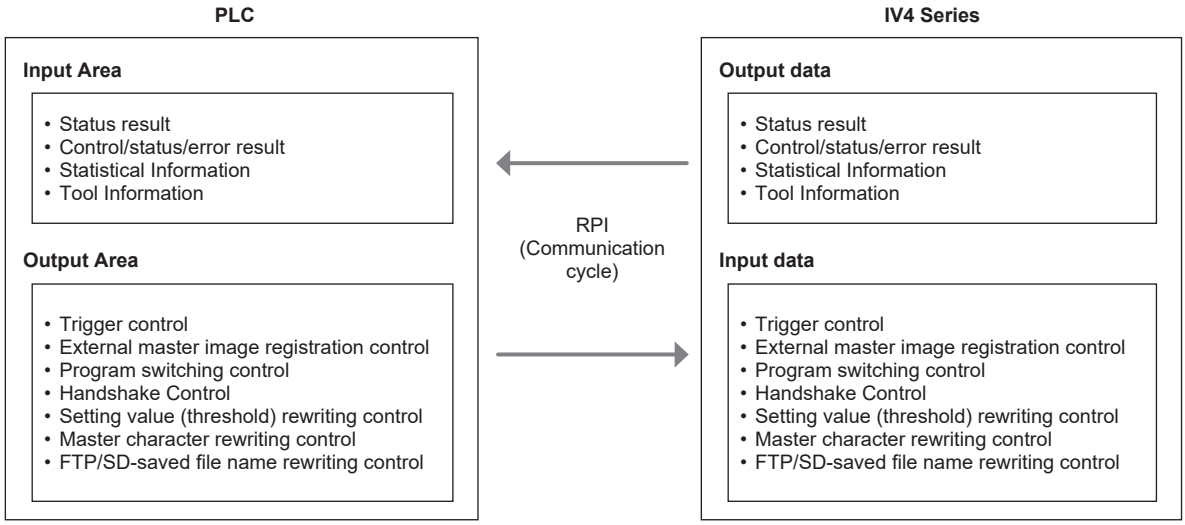
Available function

Function	Description
Trigger input	Executes a trigger input for the sensor.
Change Program	Executes a program switch for the sensor.
Ext. Master Save	Executes an external master registration for the sensor.
Threshold rewriting	Rewrites the threshold that is used as the reference for tool judgment.
Master text/master date rewriting	Rewrites the master text/master date that is used as the reference for AI OCR judgment.
Rewrite FTP/SD-saved file name	Rewrites the name of the image file to transfer to the FTP server or SD card.
Warning clear input	Executes a warning clear.
Read status	Allows you to check the unit status (Imaging, RUN, BUSY, Error, etc.).
Read overall status result	Reads the overall status result.
Read processing time	Reads the processing time of the judgment.
Read each tool's status result	Reads each tool's status result and matching rate.
Read statistical information	Reads out the number of triggers issued and the number of trigger errors.
Master text/master date rewriting (batch)	Rewrites the master text/master date that is used as the reference for AI OCR judgment in a batch.
Rewrite FTP/SD-saved file name (batch)	Rewrites the name of the image file to transfer to the FTP server or SD card in a batch.
All program statistics reset request	Resets the statistics for all programs.
OCR serial no. count up input request	Counts up the serial number in the AI OCR tool (custom).
Reset count input request	• Resets the serial number in the AI OCR tool (custom). • Resets the count value of the AI Through Count tool (AI Through Count Mode).
Count up when result file transfer is completed	Counts up the number of times each FTP transfer and SD card transfer per trigger is completed. The transfer complete timing can be checked.
Overwriting the serial number (number or English alphabet) for next OCR judgment	Overwrites the serial number for the next judgment when setting the serial number in custom mode of the AI OCR tool.
Overwriting the count value	Overwrites the count value of the AI Through Count tool (AI Through Count mode).

Cyclic Communication

What is cyclic communication?

This function enables cyclic (i.e. in fixed intervals) data communications with EtherNet/IP devices.

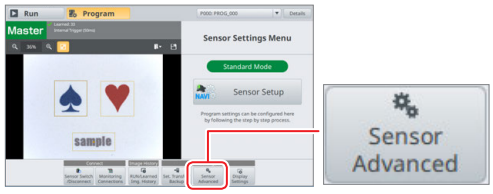


Point

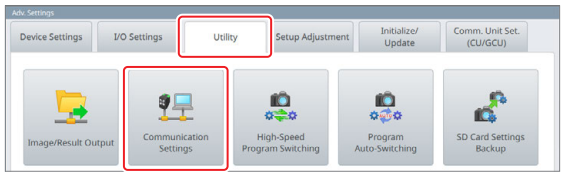
- **Communication settings for cyclic communication, such as the RPI (communication cycle) and the data size, will be configured on the PLC side.**
- **In a network with many connected devices (including the EtherNet/IP devices), a network delay and/or packet loss may occur when there is a heavy load on the network. Conduct a thorough verification before the operation.**

Setting the IV4 Series

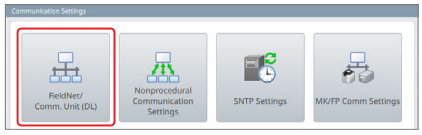
1 Press [Sensor Advanced] in the main screen in [Program].



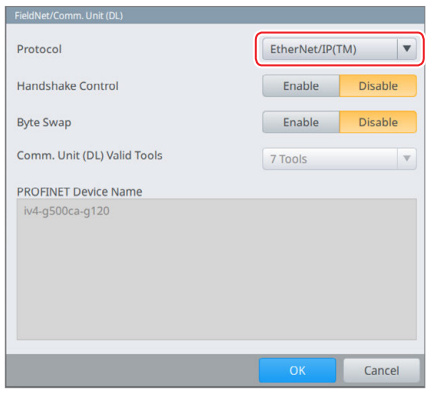
2 Select the [Utility] tab and select [Communication Settings].



3 Select [FieldNet/Comm. Unit (DL)].



4 Select [EtherNet/IP(TM)] for the [Protocol].



Handshake Control

❍ Disable (default value)

Select if the trigger interval is greater than the communication cycle (RPI).
A status result can be obtained in real time.
Normally select [Disable].

❍ Enable

Select if the trigger interval is less than the communication cycle (RPI) and the number of triggers is 10 or less.
If the status result is not picked up due to the trigger interval being faster than the communication cycle, the status result can be saved up to ten times in the buffer.

Point

When the data handshake control is set as [Enable], the status result will not be updated until [Result acquisition complete notice] (“Address2, Bit0” of Output Assembly) is input.
“Operating procedure of the cyclic communication” (page 9-43)

Byte Swap

You can change the order of storing the characters read by AI OCR and the FTP/SFTP transfer file names into PLC data memory (2 byte) in unit of bytes.

- Disable: First byte to Last byte
- Enable: Last byte to First byte

Point

Set byte swap in accordance with the specifications of each PLC. For details, see the instruction manual for the PLC. When connecting to the KEYENCE KV Series, select [Enable].

5 When setting is completed, press [OK].

The system returns to the [Adv. Settings] screen.

6 Press [OK].

PLC settings

You can set the following settings for the PLC:

- **Set the connection to be used for cyclic communication.**
- **Set the device to be used for cyclic communication.**

For details of the setting process, refer to the instruction manual of each PLC.

During EtherNet/IP cyclic communication, a connection is opened from the PLC to the IV4 Series. The following shows the list of connections that are available in the IV4 Series.

No	Application type	Connection name	I/O	Assembly Instance	Size (Byte)	RPI (ms)
1	Exclusive Owner (Data transmission + control)	Monitor Data/Ext. Input Monitor data/external input	IV → PLC	64H (100)	2 to 1400	4 to 10000
			PLC → IV	6EH (110)	2 to 104	
2		x4 Details Mon. Data/Ext. Input 4x details monitor data/external input	IV → PLC	65H (101)	2 to 1400	
			PLC → IV	6EH (110)	2 to 104	
3		x8 Details Mon. Data/Ext. Input 8x details monitor data/external input	IV → PLC	66H (102)	2 to 1400	
			PLC → IV	6EH (110)	2 to 104	
4		Simple Monitor Data/Ext. Input Simple monitor data/external input	IV → PLC	67H (103)	2 to 1400	
			PLC → IV	6EH (110)	2 to 104	
5	Input Only (Data transmission only)	Monitor Data Monitor data	IV → PLC	64H (100)	2 to 1400	
			PLC → IV	FEH (254)	0	
6		x4 Details Monitor Data 4x details monitor data	IV → PLC	65H (101)	2 to 1400	
			PLC → IV	FEH (254)	0	
7		x8 Details Monitor Data 8x details monitor data	IV → PLC	66H (102)	2 to 1400	
			PLC → IV	FEH (254)	0	
8		Simple Monitor Data Simple monitor data	IV → PLC	67H (103)	2 to 1400	
			PLC → IV	FEH (254)	0	

❍ Exclusive Owner

- IV4 → PLC: Data transmission
- PLC → IV4: Control input

In addition to data transmission from the IV4 Series to the PLC, the IV4 Series is used when the PLC controls the IV4 by inputting triggers, etc.
It is not possible to open "Exclusive Owner" connections for a single IV4 Series unit from multiple PLCs.

❍ Input Only

- IV4 → PLC: Data transmission

Used when transmitting data only from the IV4 Series.
Connections can be open for a single IV4 Series unit from multiple PLCs. (max.: 16)
If connections will be opened simultaneously from multiple PLCs, set the connection type to “Multicast” and match the RPI and the size.

Reference

- The trigger timings of each connection are controlled by the cyclic communications; and both the point-to-point and Multicast connection types are supported.
- If you wish to open “Exclusive Owner” and “Input Only” connections simultaneously, set the connection type to “Multicast” and match the RPI and the size.
- 4x detailed monitor data/8x detailed monitor data is a mode in which the maximum number of characters that can be read out is greater than that of monitor data when using AI OCR.
  For details about differences in the information that can be read out, refer to “AI OCR: 4x detailed data/8x detailed data” (page 9-34).
- Simple monitor data can read out 64 tools' worth of matches of less than 500 bytes. This is useful when there is a limit to the size of data that can be read, such as in the case of Rockwell PLCs.

Setting the KEYENCE KV Series

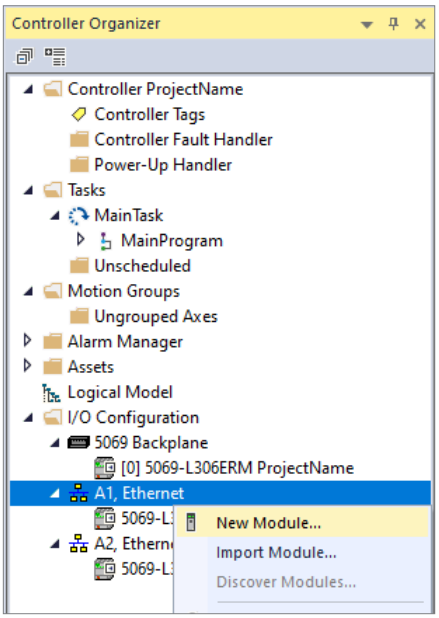
Documentation on connecting the KV Series and IV4 Series is available.
Please download it from the KEYENCE website.

Rockwell Automation ControlLogix series settings

The below file can be downloaded from the KEYENCE website.

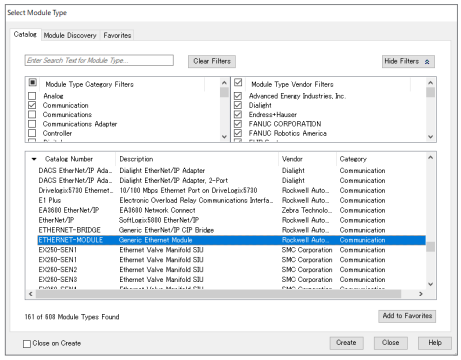
- EDS file
  (It is also included in the folder in which IV Smart Navigator (IV-H1SN) has been installed.)

1 Select the EtherNet/IP communication unit to be connected with the IV4 Series in the I/O configuration of Studio 5000, and then right-click to select [New Module].



The [Select Module Type] screen will open.

2 Apply a filter with Communications, and then select EtherNET-MODULE (Generic Ethernet Module) and click [OK].



The [New Module] screen will open.

3 Modify the settings as necessary.

Name (Device name)

You can assign a desired name.

Comm Format

Enter the desired format.
Programming will be easier with a format that supports a 2-byte (INT) alignment.

- Setting the Comm Format option to [Input Data] will enable you to establish cyclic communication with multiple PLCs using the “Input only” connection. To set the Comm Format to [Input Data], perform the following settings on each PLC.
  Example: Monitor Data/Ext. Input

Items	Setting contents
Comm Format	Input Data-INT
Input (Assembly Instance)	100
Input (Size)	Input Assembly size of the IV4 Series The default value of the EDS file is 197 (394 bytes).
Output (Assembly Instance)	110
Output (Size)	Output Assembly size for the IV4 Series The default value of the EDS file is 6 (12 bytes).

- If communications with multiple PLCs will be established using the “Input Only” connection, set the connection type to “Multicast”.

IP Address

Enter the IP address of the IV4 Series.

Input (Assembly Instance)

Enter “100”.

Input (Size)

Enter the Input Assembly size of the IV4 Series.

Output (Assembly Instance)

Enter “110”.

Output (Size)

Enter the Output Assembly size for the IV4 Series.

Configuration (Assembly Instance)

Enter “1”.

Configuration (Size)

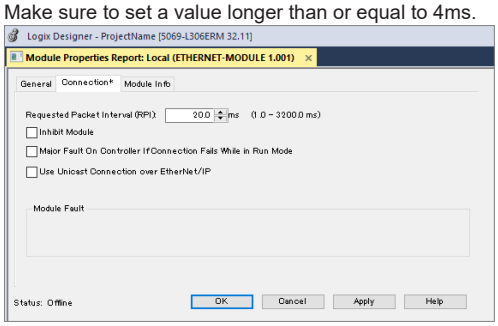
Enter “0”.

Reference

- For details of the Input Assembly and Output Assembly sizes for the IV4 Series, refer to “PLC settings” (page 9-19).
- When entering tool information for Tools 17 to 21, change the Input Assembly data size to 500 bytes.
- The upper limit for Input (Size) is 500 bytes. To enter tool information for tools 22 to 64, use the connection [Simple Monitor Data].

4 Set the RPI (communication cycle) for cyclic communication.

Make sure to set a value longer than or equal to 4ms.



5 Download the settings to the PLC.

The EtherNet/IP communication will be enabled when you switch to online after downloading the settings.

Data allocation in the cyclic communication

Input Assembly (IV4 Series → PLC)

Input Assembly are devices that write responses from the IV4 Series to the PLC.
For details of each parameter, refer to “Input Assembly parameter details” (page 9-26).

Default mode

Standard mode / Sorting mode

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0	Setting value change response	SD card saving stop response	Status result/ Buffer clear response	Statistics reset response	Warning clear response	Program switching response	Master registration response	Trigger response
1	Setting value change failed	SD card saving stop failed	Reserved by system	Reset count input response	OCR serial no. count up input response	Program switch failed	Master registration failed	Trigger failed
2	SD card identification status	Trigger Ready	Ready	RUN	Imaging status	BUSY	Result update complete	Result available
3	Error	Warning	Buffer overrun	Insufficient SD card capacity	Reserved by system			Sorting mode information
4	Reserved by system	Overall judgment NG	LOGIC4	LOGIC3	LOGIC2	LOGIC1	Position Adjustment	Total Status OK
5	Reserved by system				LOGIC8	LOGIC7	LOGIC6	LOGIC5
6	Tool 8	Tool 7	Tool 6	Tool 5	Tool 4	Tool 3	Tool 2	Tool 1
7	Tool 16	Tool 15	Tool 14	Tool 13	Tool 12	Tool 11	Tool 10	Tool 9
8 - 9	Error No. (Unsigned 16-bit integer)							
10 - 11	Warning No. (Unsigned 16-bit integer)							
12 - 13	Number of remaining buffers (Unsigned 16-bit integer)							
14 - 15	Checksum (Unsigned 16-bit integer)							
16 - 17	Current program No. (Unsigned 16-bit integer)							
18 - 19	Program No. during judgment (Unsigned 16-bit integer)							
20 - 21	Result No. (Unsigned 16-bit integer)							
22 - 23	Processing time (Unsigned 16-bit integer)							
24 - 25	Processing time MAX (16-bit unsigned integer)							
26 - 27	Processing time MIN (Unsigned 16-bit integer)							
28 - 29	Processing time AVE (Unsigned 16-bit integer)							
30 - 31	Reserved by system							
32 - 35	Number of triggers (Unsigned 32-bit integer)							
36 - 39	Number of OKs (standard mode)/number of sorts (sorting mode) (Unsigned 32-bit integer)							
40 - 43	Number of NGs (Unsigned 32-bit integer)							
44 - 47	Number of trigger errors (Unsigned 32-bit integer)							
48 - 51	Number of completed result output transfers (Unsigned 32-bit integer)							
52 - 53	Position correction score (Unsigned 16-bit integer)							
54 - 55	Position correction score MAX (Unsigned 16-bit integer)							
56 - 57	Position correction score MIN (Unsigned 16-bit integer)							
58 - 59	Position correction score Lower threshold (Unsigned 16-bit integer)							
60 - 71	Reserved by system							
72 - 73	Tool 1 information matching rate, etc.							
74 - 75								
76 - 77								
78 - 79								
80 - 81								
82 - 83								
84 - 85								
86 - 87								
88 - 89								
90 - 91								
92 - 391	Tool 2 to 16 (Same as Tool 1) The start address of tool number “n” is 72 + (n - 1) x 20							
392 - 393	Master number/total status product type							
394	Tool 24	Tool 23	Tool 22	Tool 21	Tool 20	Tool 19	Tool 18	Tool 17
395	Tool 32	Tool 31	Tool 30	Tool 29	Tool 28	Tool 27	Tool 26	Tool 25
396	Tool 40	Tool 39	Tool 38	Tool 37	Tool 36	Tool 35	Tool 34	Tool 33
397	Tool 48	Tool 47	Tool 46	Tool 45	Tool 44	Tool 43	Tool 42	Tool 41
398	Tool 56	Tool 55	Tool 54	Tool 53	Tool 52	Tool 51	Tool 50	Tool 49

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
399	Tool 64	Tool 63	Tool 62	Tool 61	Tool 60	Tool 59	Tool 58	Tool 57
400 - 1359	Tool 17 to 64 (Same as Tool 1; assigned in groups of 20 bytes) The start address of tool number “m” is 400+(m-17) x 20							
1360 - 1399	Reserved by system							

❍ **In the case of sorting mode**

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
392 - 393	In sorting mode: total status product type (unsigned 16-bit integer)							
394 - 395	Sorting mode: Tool 1 status product type (unsigned 16-bit integer)							
396 - 397	Sorting mode: Tool 2 status product type (unsigned 16-bit integer)							
398 - 399	Sorting mode: Tool 3 status product type (unsigned 16-bit integer)							

Reference When using standard mode and setting multiple position adjustment tools, the information of each position adjustment tool starting with the second one is assigned to a tool from Tool 1 to Tool 64.

● AI Through Count Mode

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0	Setting value change response	SD card saving stop response	Reserved by system		Warning clear response	Program switching response	Reserved by system	Trigger response
1	Setting value change failed	SD card saving stop failed	Reserved by system	Reset count input response	Reserved by system	Program switch failed	Reserved by system	
2	SD card identification status	Trigger Ready	Ready	RUN	Imaging status	BUSY	Reserved by system	
3	Error	Warning	Reserved by system	SD card Insufficient capacity	Reserved by system	AI Through Count mode run state	Reserved by system	
4	Reserved by system		LOGIC4	LOGIC3	LOGIC2	LOGIC1	Reserved by system	
5	Reserved by system				LOGIC8	LOGIC7	LOGIC6	LOGIC5
6	Output 1 for Tool 8	Output 1 for Tool 7	Output 1 for Tool 6	Output 1 for Tool 5	Output 1 for Tool 4	Output 1 for Tool 3	Output 1 for Tool 2	Output 1 for Tool 1
7	Output 2 for Tool 8	Output 2 for Tool 7	Output 2 for Tool 6	Output 2 for Tool 5	Output 2 for Tool 4	Output 2 for Tool 3	Output 2 for Tool 2	Output 2 for Tool 1
8 - 9	Error No. (Unsigned 16-bit integer)							
10 - 11	Warning No. (Unsigned 16-bit integer)							
12 - 13	Reserved by system							
14 - 15	Checksum (Unsigned 16-bit integer)							
16 - 17	Current program No. (Unsigned 16-bit integer)							
18 - 19	Program No. during judgment (Unsigned 16-bit integer)							
20 - 71	Reserved by system							
72 - 73	Tool 1 count value last two bytes (Unsigned 16-bit integer)							
74 - 75	Tool 1 count value first two bytes (Unsigned 16-bit integer)							
76 - 77	Tool 1 Output 1 threshold value last two bytes (Unsigned 16-bit integer)							
78 - 79	Tool 1 Output 1 threshold value first two bytes (Unsigned 16-bit integer)							
80 - 81	Tool 1 Output 2 threshold value last two bytes (Unsigned 16-bit integer)							
82 - 83	Tool 1 Output 2 threshold value first two bytes (Unsigned 16-bit integer)							
84 - 85	Tool 1 Today’s total count value last two bytes (Unsigned 16-bit integer)							
86 - 87	Tool 1 Today’s total count value first two bytes (Unsigned 16-bit integer)							
88 - 91	Reserved by system							
92 - 231	Tool 2 to 8 (Same as Tool 1; assigned in groups of 20 bytes) The start address of tool number “n” is 72 + (n-1) x 20							
232 - 1399	Reserved by system							

Simple Monitor Data

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0	Setting value change response	SD card saving stop response	Status result/ Buffer clear response	Statistics reset response	Warning clear response	Program switching response	Master registration response	Trigger response
1	Setting value change failed	SD card saving stop failed	Reserved by system	Reset count input response	OCR serial no. count up input response	Program switch failed	Master registration failed	Trigger failed
2	SD card identification status	Trigger Ready	Ready	RUN	Imaging status	BUSY	Result update complete	Result available
3	Error	Warning	Buffer overrun	SD card Insufficient capacity	Reserved by system	AI Through Count mode run state	Reserved by system	Sorting mode information
4	Reserved by system	Overall judgment NG	LOGIC4	LOGIC3	LOGIC2	LOGIC1	Position Adjustment	Total Status OK
5	Reserved by system				LOGIC8	LOGIC7	LOGIC6	LOGIC5
6 - 7	Reserved by system							
8 - 9	Error No. (Unsigned 16-bit integer)							
10 - 11	Warning No. (Unsigned 16-bit integer)							
12 - 13	Number of remaining buffers (Unsigned 16-bit integer)							
14 - 15	Checksum (Unsigned 16-bit integer)							
16 - 17	Current program No. (Unsigned 16-bit integer)							
18 - 19	Program No. during judgment (Unsigned 16-bit integer)							
20 - 21	Result No. (Unsigned 16-bit integer)							
22 - 23	Processing time (Unsigned 16-bit integer)							
24 - 25	Processing time MAX (16-bit unsigned integer)							
26 - 27	Processing time MIN (Unsigned 16-bit integer)							
28 - 29	Processing time AVE (Unsigned 16-bit integer)							
30 - 31	Reserved by system							
32 - 35	Number of triggers (Unsigned 32-bit integer)							
36 - 39	Number of OKs (standard mode)/number of sorts (sorting mode) (Unsigned 32-bit integer)							
40 - 43	Number of NGs (Unsigned 32-bit integer)							
44 - 47	Number of trigger errors (Unsigned 32-bit integer)							
48 - 51	Number of completed result output transfers (Unsigned 32-bit integer)							
52 - 55	Reserved by system							
56 - 57	Master number (standard mode)/total status product type (sorting mode)							
58	Tool 8	Tool 7	Tool 6	Tool 5	Tool 4	Tool 3	Tool 2	Tool 1
59	Tool 16	Tool 15	Tool 14	Tool 13	Tool 12	Tool 11	Tool 10	Tool 9
60	Tool 24	Tool 23	Tool 22	Tool 21	Tool 20	Tool 19	Tool 18	Tool 17
61	Tool 32	Tool 31	Tool 30	Tool 29	Tool 28	Tool 27	Tool 26	Tool 25
62	Tool 40	Tool 39	Tool 38	Tool 37	Tool 36	Tool 35	Tool 34	Tool 33
63	Tool 48	Tool 47	Tool 46	Tool 45	Tool 44	Tool 43	Tool 42	Tool 41
64	Tool 56	Tool 55	Tool 54	Tool 53	Tool 52	Tool 51	Tool 50	Tool 49
65	Tool 64	Tool 63	Tool 62	Tool 61	Tool 60	Tool 59	Tool 58	Tool 57
66 - 89	Reserved by system							
90 - 91	Reserved by system							
92 - 93	Position correction score (Unsigned 16-bit integer)							
94 - 95	Tool 1 matching rate (Unsigned 16-bit integer)							
96 - 97	Tool 2 matching rate (Unsigned 16-bit integer)							
98 - 219	...							
220 - 221	Tool 64 matching rate (Unsigned 16-bit integer)							
222 - 601	Reserved by system							
602 - 1399	Reserved by system							

❍ In the case of sorting mode

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
56 - 57	In sorting mode: total status product type (unsigned 16-bit integer)							
60 - 61	Sorting mode: Tool 1 status product type (unsigned 16-bit integer)							
62 - 63	Sorting mode: Tool 2 status product type (unsigned 16-bit integer)							
64 - 65	Sorting mode: Tool 3 status product type (unsigned 16-bit integer)							

4x details monitor mode

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0 - 71	(Same as default mode)							
72 - 73	Tool 1 information matching rate, etc.							
74 - 75								
76 - 77								
78 - 79								
80 - 81								
82 - 83								
84 - 85								
86 - 87								
88 - 89								
90 - 151								
152 - 391	Tool 2 to 4 (Same as Tool 1; assigned in groups of 80 bytes) The start address of tool number “n” is 72 + (n - 1) x 80							
392 - 393	Master number (standard mode)/total status product type (sorting mode)							
394	Tool 24	Tool 23	Tool 22	Tool 21	Tool 20	Tool 19	Tool 18	Tool 17
395	Tool 32	Tool 31	Tool 30	Tool 29	Tool 28	Tool 27	Tool 26	Tool 25
396	Tool 40	Tool 39	Tool 38	Tool 37	Tool 36	Tool 35	Tool 34	Tool 33
397	Tool 48	Tool 47	Tool 46	Tool 45	Tool 44	Tool 43	Tool 42	Tool 41
398	Tool 56	Tool 55	Tool 54	Tool 53	Tool 52	Tool 51	Tool 50	Tool 49
399	Tool 64	Tool 63	Tool 62	Tool 61	Tool 60	Tool 59	Tool 58	Tool 57
400 - 1359	Tool 5 to 16 (Same as Tool 1; assigned in groups of 80 bytes) The start address of tool number “n” is 400 + (n - 5) x 80							
1360 - 1399	Reserved by system							

8x details monitor mode

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0 - 71	(Same as default mode)							
72 - 73	Tool 1 information matching rate, etc.							
74 - 75								
76 - 77								
78 - 79								
80 - 81								
82 - 83								
84 - 85								
86 - 87								
88 - 89								
90 - 231								
232 - 391	Tool 2 (Same as Tool 1)							
392 - 393	Master number (standard mode)/total status product type (sorting mode)							
394	Tool 24	Tool 23	Tool 22	Tool 21	Tool 20	Tool 19	Tool 18	Tool 17
395	Tool 32	Tool 31	Tool 30	Tool 29	Tool 28	Tool 27	Tool 26	Tool 25
396	Tool 40	Tool 39	Tool 38	Tool 37	Tool 36	Tool 35	Tool 34	Tool 33
397	Tool 48	Tool 47	Tool 46	Tool 45	Tool 44	Tool 43	Tool 42	Tool 41
398	Tool 56	Tool 55	Tool 54	Tool 53	Tool 52	Tool 51	Tool 50	Tool 49
399	Tool 64	Tool 63	Tool 62	Tool 61	Tool 60	Tool 59	Tool 58	Tool 57
400 - 1359	Tool 3 to 8 (Same as Tool 1; assigned in groups of 160 bytes) The start address of tool number “n” is 400 + (n - 3) x 160							
1360 - 1399	Reserved by system							

Input Assembly parameter details

Input Assembly Address 0: Control Result 1 (response)

Address	Bit	Items	Description	Data content
0	0	Trigger response	Response from External Trigger, Internal Trigger Control/AI Trigger Control	0: OFF, 1: ON
	1	Master image registration response	Response to master image registration	0: OFF, 1: ON
	2	Program switching response	Response to the program switching request	0: OFF, 1: ON
	3	Warning clear response	Response to the warning clear	0: OFF, 1: ON
	4	Statistics reset response	Response to the statistics reset request	0: OFF, 1: ON
	5	Status result/Buffer clear response	Response to status result/buffer clear request	0: OFF, 1: ON
	6	SD card saving stop response	Response to the SD card saving stop request	0: OFF, 1: ON
	7	Setting value change response	Response to the setting value change request	0: OFF, 1: ON

Input Assembly Address 1: Control Result 2 (response)/Control error result

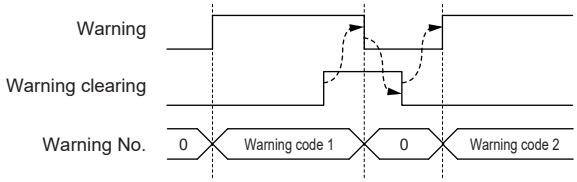
Address	Bit	Items	Description	Data content
1	0	Trigger failed	The trigger request failed	0: -, 1: Failed
	1	Master image registration failed	Registration of the master image failed	0: -, 1: Failed
	2	Program switching failed	Switching programs failed	0: -, 1: Failed
	3	OCR serial no. count up input response	Response to the count up input request. Target: AI OCR (standard mode)	0: OFF, 1: ON
	4	Reset count input response	Response to the reset count input request. Target: • AI OCR (standard mode) • Count Tool (AI Through Count Mode)	0: OFF, 1: ON
	5	Reserved by system	----	---
	6	SD card saving stop failed	Failed to stop the SD card saving (Failure cause: SD card save stop request turned on during Sensor Setup)	0: -, 1: Failed
	7	Setting value change failed	Failed to change the setting value	0: -, 1: Failed

Input Assembly Address 2 to 3: Handshake control/status/error result

Address	Bit	Items	Description	Data content
2	0	Result available	This bit is output when the status result can be acquired.	0 : - 1: Available
	1	Result update complete	This bit switches the ON/OFF statuses when the status result is updated.	0 : 1
	2	BUSY	This bit is output when the unit is unable to accept new trigger inputs, such as while performing imaging, processing a judgment, registering an external master image, switching programs, etc.	0 : - 1: Busy state
	3	Imaging	This bit is output while the unit is performing imaging operation.	0 : - 1: Imaging
	4	RUN	This bit is output when the unit is “RUN” and no system errors have occurred.	0 : - 1: Normal operating status
	5	Ready	This bit is output when the start-up sequence of this unit completes after power-on.	0: Start-up not completed 1: Start-up completed
	6	Trigger Ready	This is output when the trigger can be received.	0: Trigger cannot be received 1: Trigger can be received
	7	SD card identification status	This bit is output when the SD card is recognized.	0 : - 1: SD card recognized
3	0	Sorting mode information	This bit is output when the unit is in [RUN] status and Sorting mode.	0 : - 1 : In [RUN] status in Sorting mode
	1	Reserved by system	----	---
	2	AI Through Count mode run state	This bit is output in AI Through Count mode while running	0 : - 1: Run state in AI Through Count mode
	3	Reserved by system	----	---
	4	Insufficient SD card capacity	This bit is output when the free space on the SD card is 100 MB or less.	0: No insufficient free space error has occurred. 1: An insufficient free space (100 MB or less) error has occurred.
	5	Buffer overrun status	If handshake control is [Enabled], this bit is output when an overrun of the status result has occurred.	0: No buffer overrun has occurred. 1: The buffer is in overrun status.
	6	Warning status	This bit outputs the warning status of the unit.	0: The unit is not in warning status. 1: The unit is in warning status.
	7	Error status	This bit outputs the error status of the unit.	0: The unit is not in error status. 1: The unit is in error status.

Reference

- By monitoring whether the unit is in “Imaging” status, you can determine whether the target object or the unit can be moved before completion of the image processing.
- “BUSY” and “Imaging” statuses may be skipped in some cyclic frequency settings. It is therefore necessary to take the imaging condition into consideration when setting the cyclic frequency.
- Warning status can be cleared with a warning clear request.
- When two or more warnings are issued, all subsequent warnings after the first warning will be saved in the history. If you clear the warnings, the warning code of the highest priority warning will be displayed.



- Error statuses cannot be cleared from the EtherNet/IP communication. The error code of the highest priority error will be displayed.
- The buffer overrun status can be cleared using a warning clear.

Input Assembly Address 4 to 7 and 394 to 399: Status result

Address	Bit	Items	Description	Data content
4	0	Total Status OK	Total status OK result	0 : NG 1 : OK
	1	Position Adjustment	Position adjustment result	0 : NG 1 : OK
	2	Logic 1	Result of Logic 1	0 : NG 1 : OK
	3	Logic 2	Result of Logic 2	0 : NG 1 : OK
	4	Logic 3	Result of Logic 3	0 : NG 1 : OK
	5	Logic 4	Result of Logic 4	0 : NG 1 : OK
	6	Overall judgment NG	Total status NG result	0 : OK 1 : NG
	7	Reserved by system	----	---
5	0	Logic 5	Result of Logic 5	0 : NG 1 : OK
	1	Logic 6	Result of Logic 6	0 : NG 1 : OK
	2	Logic 7	Result of Logic 7	0 : NG 1 : OK
	3	Logic 8	Result of Logic 8	0 : NG 1 : OK
	4 to 7	Reserved by system	----	---
6	0 to 7	Tools 1 to 8	Assigns to Bit 0 to Bit 7 the results of Tools 1 to 8 and displays these results.	0: NG, 1: OK
7	0 to 7	Tools 9 to 16	Assigns to Bit 0 to Bit 7 the results of Tools 9 to 16 and displays these results.	0: NG, 1: OK
394	0 to 7	Tools 17 to 24	Assigns to Bit 0 to Bit 7 the results of Tools 17 to 24 and displays these results.	0: NG, 1: OK
395	0 to 7	Tools 25 to 32	Assigns to Bit 0 to Bit 7 the results of Tools 25 to 32 and displays these results.	0: NG, 1: OK
396	0 to 7	Tools 33 to 40	Assigns to Bit 0 to Bit 7 the results of Tools 33 to 40 and displays these results.	0: NG, 1: OK
397	0 to 7	Tools 41 to 48	Assigns to Bit 0 to Bit 7 the results of Tools 41 to 48 and displays these results.	0: NG, 1: OK
398	0 to 7	Tools 49 to 56	Assigns to Bit 0 to Bit 7 the results of Tools 49 to 56 and displays these results.	0: NG, 1: OK
399	0 to 7	Tool 57 to 64	Assigns to Bit 0 to Bit 7 the results of Tools 57 to 64 and displays these results.	0: NG, 1: OK

Reference
- If the position correction/logic/tool is not set, the data content will be “0”.
- If the status result of the tool is either “trigger standby” (no judgment) or “judgment not possible”, the data content will be OFF (0).

In sorting mode, Address 394 to 399 have the following functions:

Address	Data type*	Items	Description	Data content
394 to 395	WORD	Tool 1 status product type	Stores the product type determined by Tool 1 when the Tool 1 status result is OK (1).	0: M0 or NG 1 to 7: M1 to M7
396 to 397	WORD	Tool 2 status product type	Stores the product type determined by Tool 2 when the Tool 2 status result is OK (1).	0: M0 or NG 1 to 7: M1 to M7
398 to 399	WORD	Tool 3 status product type	Stores the product type determined by Tool 3 when the Tool 3 status result is OK (1).	0: M0 or NG 1 to 7: M1 to M7

* WORD: Unsigned 16-bit integer

Point
- Check against each tool’s status result. If the product type cannot be determined (the result is NG), the value becomes 0.
- The product types determined by Tools 4 to 8 in sorting mode cannot be displayed.

Input Assembly Address 8 to 23: Error/status/status result information

Address	Data type*	Items	Description	Data content
8 to 9	UINT	Error code	Displays the currently occurring error code.	0 to 128
10 to 11	UINT	Warning code	Displays the currently occurring warning code.	0 to 128
12 to 13	UINT	Number of remaining buffers	Displays the number of status results that can be buffered, if handshake control is [Enabled].	0 to 10
14 to 15	UINT	Checksum	Displays the current sensor setting status using an arbitrary 5-digit integer.	0 to 65535
16 to 17	UINT	Current program No.	Displays the current program No.	0 to 127
18 to 19	UINT	Program No. during judgment	Displays the program No. of the latest judgment process.	0 to 127
20 to 21	UINT	Result No.	Displays the judgment process counts.	0 to 32767
22 to 23	UINT	Processing time	Displays the processing time of the latest judgment process.	0 to 10000

* UINT: Unsigned 16-bit integer
UDINT: Unsigned 32-bit integer

Reference
- The unit of processing time is msec.
- Error and warning codes can be found on the Error Number Search site on the KEYENCE website.
  www.keyence.com/iv4_trouble_support
- If two or more errors are occurring at the same time, the error code of the highest priority error will be displayed.
- The first occurred warning code will be displayed.
- A checksum can be used to monitor whether the sensor settings have been modified by a third party.
- The checksum can check whether program is switched.
- The checksum will remain unchanged even if you change the IP address, subnet mask, default gateway or port number of the IV4 Series.
- For the number of remaining buffers, refer to “Reading out the status result (handshake control: [Enable]; Preliminary capture: [Disable])” (page 9-46).
- The upper limit value of the result No. is 32767. If the maximum value is exceeded, it will go back to 0 and start counting up again.
- The result No. will also count the judgment process counts that were skipped due to the cyclic frequency setting.

Input Assembly Address 24 to 51: Statistics information

Address	Data type*	Items	Description	Data content
24 to 25	UINT	Processing time MAX	Displays the maximum processing time value.	0 to 10000
26 to 27	UINT	Processing time MIN	Displays the minimum processing time value.	0 to 10000
28 to 29	UINT	Processing time AVE	Displays the average processing time value.	0 to 10000
30 to 31	---	Reserved by system	----	---
32 to 35	UDINT	Trigger No.	Displays the total number of triggers issued.	0-1000000000
36 to 39	UDINT	OK count (standard mode) Total sort count (sorting mode)	Displays the total number of issued triggers whose total status result was “OK” or with which the product type was determined.	0-1000000000
40 to 43	UDINT	Number of NGs (standard mode/sorting mode)	Displays the total number of issued triggers whose total status result was “NG” or with which the product type was not determined.	0-1000000000
44 to 47	UDINT	Number of trigger errors	Number of triggers issued as error triggers.	0-1000000000
48 to 51	UDINT	Number of completed result output transfers	Counts up for each completed transfer of images and judgment results (text files) to FTP/SFTP/SD card. (If multiple transfer conditions are used, the count up is performed upon completion of the transfer of all files matching the conditions.)	0-1000000000

* UINT: Unsigned 16-bit integer
UDINT: Unsigned 32-bit integer

Reference
- The unit of processing time is msec.
- If the number of triggers or the number of times of the completion of result output transfer exceeds the upper limit, the counting up starts from 0 again.
- The number of OK triggers, the number of NG triggers, and the number of trigger errors stop counting up at the upper limit.
- A reset will occur in the following conditions:
  - When [Statistics reset] is input
  - When a tool is added/deleted/copied
  - When the sensor is switched OFF
  - When the program is switched
  - When a correction for the sensor is started
  - When the sensor is initialized

Input Assembly Address 52 to 71: Position correction information

Address	Data type*	Items	Description	Data content
52 to 53	UINT	Position adjustment tool matching rate	Stores the matching rate of the position adjustment tool.	0 to 100
54 to 55	UINT	Position adjustment tool matching rate MAX	Stores the maximum matching rate value of the position adjustment tool.	0 to 100
56 to 57	UINT	Position adjustment tool matching rate MIN	Stores the minimum matching rate value of the position adjustment tool.	0 to 100
58 to 59	UINT	Position adjustment tool threshold	Stores the threshold value of the position adjustment tool.	0 to 100
60 to 71	---	Reserved by system	----	---

* UINT: Unsigned 16-bit integer
UDINT: Unsigned 32-bit integer

Reference Maximum and minimum matching rate values of the position adjustment tool will be reset in the same manner as the statistics information.
If the position adjustment tool is not set, the data content will be “0”.

Input Assembly Address 72 to 391 and 400 to 1359: Tool Information

Monitor data The information of tools 1 to 64 will be assigned for each 20-byte Address.
4x details monitor data The information of tools 1 to 16 will be assigned for each 80-byte Address.
8x details monitor data The information of tools 1 to 8 will be assigned for each 160-byte Address.

Position Adjustment/Hi-Sp.Adj/AI Differentiate/AI Identify/Total/Color Prohibit/Brightness Prohibit/Outline/Area/Color Area/Edge Pixel/Edge

Address			Data type*	Items	Description	Data content
Monitor data	4x details	8x details				
72 to 73			UINT	Tool 1 matching rate	---	0 to 9999 (default: 0)
74 to 75				Tool 1 matching rate MAX	---	
76 to 77				Tool 1 matching rate MIN	---	
78 to 79				Tool 1 lower threshold	---	
80 to 81				Tool 1 upper threshold	---	0 to 9999 (default: 65535)
82 to 91	82 to 151	82 to 231	---	Reserved by system	----	---

The information of tools 2, 3, ... 64 will be assigned for each 20-byte Address of Input Assembly.
* UINT: Unsigned 16-bit integer

Reference
- Maximum and minimum matching rate values of the tool will be reset in the same manner as the statistics information.
- If the tool is not set, the data content will be “0”.
- If the upper threshold value of the tool is not set, the data content of the tool’s upper limit value will be “65535”.
- The information for tools (other than the learning tool) in sorting mode outputs the information of the tool that was determined as the master image registered to the judged product type. If the status of sorting is NG, the information of product type M0 is output. However, MAX, MIN, and the thresholds are invalid values.

Width/Diameter

Address			Data type*	Items	Description	Data content
Monitor data	4x details	8x details				
72 to 73			UINT	Tool 1 matching rate*1	---	0 to 9999 (default: 0)
74 to 75				Tool 1 matching rate MAX*1	---	
76 to 77				Tool 1 matching rate MIN*1	---	
78 to 79				Tool 1 lower threshold	---	
80 to 81				Tool 1 upper threshold	---	0 to 9999 (default: 65535)
82 to 83				Tool 1 Scaling decimal point position	Stores the decimal point position for matching rate when scaling is enabled.	0: No decimal point 1: 1 digit after decimal point 2: 2 digits after decimal point
84 to 91	84 to 151	84 to 231	---	Reserved by system	----	---

*1 Outputs the value after scaling when scaling is enabled.

The information of tools 2, 3, ... 64 will be assigned for each 20-byte Address of Input Assembly.
* UINT: Unsigned 16-bit integer

Reference
- Maximum and minimum matching rate values of the tool will be reset in the same manner as the statistics information.
- If the tool is not set, the data content will be “0”.
- If the upper threshold value of the tool is not set, the data content of the tool’s upper limit value will be “65535”.
- The decimal point position when the scaling is enabled is applied to the data results of matching rate, matching rate MAX, matching rate MIN, lower threshold, upper threshold, pitch present value MAX, pitch present value MIN.
(Example): When the “Tool 1 matching rate” is 505 and “Tool 1 decimal point position” is 1, the matching rate of Tool 1 is “50.5”.
- The information for tools (other than the learning tool) in sorting mode outputs the information of the tool that was determined as the master image registered to the judged product type. If the status of sorting is NG, the information of product type M0 is output. However, MAX, MIN, and the thresholds are invalid values.

Pitch

Address			Data type*	Items	Description	Data content
Monitor data	4x details	8x details				
	72 to 73		UINT	Tool 1 matching rate*1	---	0 to 9999 (default: 0)
	74 to 75			Tool 1 matching rate MAX*1	---	
	76 to 77			Tool 1 matching rate MIN*1	---	
	78 to 79			Tool 1 lower threshold	---	
	80 to 81			Tool 1 upper threshold	---	0 to 9999 (default: 65535)
	82 to 83			Tool 1 Scaling decimal point position	Stores the decimal point position for matching rate when scaling is enabled.	0: No decimal point 1: 1 digit after decimal point 2: 2 digits after decimal point
	84 to 85			Tool 1 Pitch present value MAX	Maximum value of all pitches	0 to 9999 (default: 0)
	86 to 87			Tool 1 Pitch present value MIN	Minimum value of all pitches	
	88 to 89			Tool 1 Number of pitches	---	
90 to 91	90 to 151	90 to 231	---	Reserved by system	----	---

*1 Outputs the value after scaling when scaling is enabled.

The information of tools 2, 3, ... 64 will be assigned for each 20-byte Address of Input Assembly.
* UINT: Unsigned 16-bit integer

Reference

- Maximum and minimum matching rate values of the tool will be reset in the same manner as the statistics information.
- If the tool is not set, the data content will be “0”.
- If the upper threshold value of the tool is not set, the data content of the tool’s upper limit value will be “65535”.
- The decimal point position when the scaling is enabled is applied to the data results of matching rate, matching rate MAX, matching rate MIN, lower threshold, upper threshold, pitch present value MAX, pitch present value MIN.
  (Example): When the “Tool 1 matching rate” is 505 and “Tool 1 decimal point position” is 1, the matching rate of Tool 1 is “50.5”.
- The information for tools (other than the learning tool) in sorting mode outputs the information of the tool that was determined as the master image registered to the judged product type. If the status of sorting is NG, the information of product type M0 is output. However, MAX, MIN, and the thresholds are invalid values.

ColorAverage

Address			Data type*	Items	Description	Data content
Monitor data	4x details	8x details				
	72 to 73		UINT	Tool 1 matching rate	---	0 to 9999 (default: 0)
	74 to 75			Tool 1 matching rate MAX	---	
	76 to 77			Tool 1 matching rate MIN	---	
	78 to 79			Tool 1 lower threshold	---	
	80 to 81			Reserved by system	---	---
	82 to 83			Reserved by system	----	---
	84 to 85			Tool 1 H (hue)	---	0 to 359 (default: 0)
	86 to 87			Tool 1 S (saturation)	---	0 to 255 (default: 0)
	88 to 89			Tool 1 V (brightness)	---	0 to 255 (default: 0)
90 to 91	90 to 151	90 to 231	---	Reserved by system	----	---

The information of tools 2, 3, ... 64 will be assigned for each 20-byte Address of Input Assembly.
* UINT: Unsigned 16-bit integer

Reference

- Maximum and minimum matching rate values of the tool will be reset in the same manner as the statistics information.
- If the tool is not set, the data content will be “0”.
- The information for tools (other than the learning tool) in sorting mode outputs the information of the tool that was determined as the master image registered to the judged product type. If the status of sorting is NG, the information of product type M0 is output. However, MAX, MIN, and the thresholds are invalid values.

Blob Count

Address			Data type*	Items	Description	Data content
Monitor data	4x details	8x details				
72 to 73			UINT	Tool 1 Quantity	---	0 to 200 (default: 0)
74 to 75				Tool 1 Quantity MAX	---	0 to 200 (default: 0)
76 to 77				Tool 1 Quantity MIN	---	0 to 200 (default: 0)
78 to 79				Tool 1 lower threshold	---	0 to 9999 (default: 0)
80 to 91	80 to 151	80 to 231	---	Reserved by system	----	----

The information of tools 2, 3, ... 64 will be assigned for each 20-byte Address of Input Assembly.
* UINT: Unsigned 16-bit integer

Reference
- The maximum and minimum numbers of the tools will be reset in the same manner as the statistics information.
- If the tool is not set, the data content will be “0”.

AI Count

Address			Data type	Items	Description	Data content
Monitor data	4x details	8x details				
72 - 73			UINT	Tool 1 Quantity	---	0 to 9999 (default: 0)
74 - 75				Tool 1 Quantity MAX	---	
76 - 77				Tool 1 Quantity MIN	---	
78 - 79				Tool 1 lower threshold	---	
80 - 81				Tool 1 upper threshold	---	0 to 9999 (default: 65535)
82 - 83				Tool 1 Missing window No. 1	• When Missing Part Detection is enabled: Missing window numbers are saved sequentially in the ascending order. • When Missing Part Detection is disabled: Fixed to 0.	0 to 201 (default: 0)
84 - 85				Tool 1 Missing window No. 2		
86 - 87				Tool 1 Missing window No. 3		
88 - 89				Tool 1 Missing window No. 4		
90 - 91	90 - 151	90 - 231	---	Reserved by system	---	---

The maximum and minimum numbers of the tools will be reset in the same manner as the statistics information.

AI OCR: Monitor data

Address Monitor data	Data type*	Items	Description	Data content
72 to 73	UINT	Tool 1 matching rate	---	• When Show Matching Rate is disabled: 0: NG, 100: OK • When Show Matching Rate is enabled: 0 to 100
74 to 75		Tool 1 lower threshold	---	0 to 9999 (default: 0)
76 to 91	---	Tool 1 text read	Stores text read (up to 16 letters) by Tool 1. If it contains characters with more than two bytes, the total is 16 bytes. If the total is less than 16 bytes, the remaining devices are NULL.	UTF-8

The information of tools 2, 3, ... 64 will be assigned for each 20-byte Address of Input Assembly.
* UINT: Unsigned 16-bit integer

❍ Example of tool 1 text read

Trigger Count	Text read	Address															
		76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91
1st	ABCDEF	A (0x41)	B (0x42)	C (0x43)	D (0x44)	E (0x45)	F (0x46)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)
2nd	ABF	A (0x41)	B (0x42)	F (0x46)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)
3rd	ABCDEFGHIJKLMNOP	A (0x41)	B (0x42)	C (0x43)	D (0x44)	E (0x45)	F (0x46)	G (0x47)	H (0x48)	I (0x49)	J (0x4A)	K (0x4B)	L (0x4C)	M (0x4D)	N (0x4E)	O (0x4F)	P (0x50)
4th	2019.3.28	2 (0x32)	0 (0x30)	1 (0x31)	9 (0x39)	. (0x2E)	3 (0x33)	. (0x2E)	2 (0x32)	8 (0x38)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)
5th	---- (No text read)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)

Point

- All addresses (72 to 91) are simultaneously updated at each trigger. The previous data is discarded.
- Correctly set byte swap in accordance with the PLC specifications.
  “Setting the IV4 Series” (page 9-18)
- If outputting the data type of STRING, use 15 or fewer characters of the read text. As NULL cannot be stored for the 16th letter, the text may not be output correctly.
- If the tool is not set, the data content will be “0”.

● AI OCR: 4x detailed data/8x detailed data

Address		Data type*	Items	Description	Data content
4x details	8x details				
72 to 73		UINT	Tool 1 matching rate	-	• When Show Matching Rate is disabled: 0: NG, 100: OK • When Show Matching Rate is enabled: 0 to 100
74 to 75			Tool 1 lower threshold	-	0 to 9999 (default: 0)
76 to 77			Tool 1 Current serial No. Last (number)	If serial numbers are used in the number setting in AI OCR (custom), the current value of the serial number is divided into the last 2-bytes and first 2-bytes, and stored.	0 to 999999
78 to 79			Tool 1 Current serial No. First (number)		
80 to 85		---	Tool 1 Current serial No. (ASCII text)	If serial numbers are used in the uppercase letters setting in AI OCR (custom), the current value of the serial number is stored.	ASCII
86 to 87		---	Reserved by system	----	---
88 to 89		UINT	Tool 1 Number of letters to be read	Stores the text currently being read.	0-32
90 to 91			Tool 1 Number of bytes to be read	Stores the total size of the letters currently being read.	• 4x details monitor data: 0 to 60 • 8x details monitor data: 0 to 96
92 to 151	92 to 187	---	Tool 1 text read	Stores text read (up to 32 letters) by Tool 1. If it contains characters with more than two bytes, there is a limit to the total size of characters that can be read in each connection. • **4x details monitor data** Total characters are less than 60 bytes. If the total is less than 60 bytes, the remaining devices are NULL. • **8x details monitor data** Total characters are 96 bytes or less. If the total is less than 96 bytes, the remaining devices are NULL.	UTF-8
---	188 to 231	---	Reserved by system	----	---

The information of tools 2, 3, ... 64 will be assigned for each 20-byte Address of Input Assembly.
* UINT: Unsigned 16-bit integer

■ Input Assembly Address 392: Master number/total status product type

The Bits at Address 392 of the Input Assembly have the following functions:

Address	Data Type*	Items	Description	Data content
392 to 393	UINT	When in standard mode with multiple master registration enabled: Master number	Stores the master number (00 to 07) from the total status result obtained from the results of each tool when “total status result is OK” is OK (1).	0: 00 or NG 1 to 7: 01 to 07
		In sorting mode: Total status product type	Stores the product type (M0 to M7) from the total status result obtained from the results of each tool when “total status result is OK” is OK (1).	0: M0 or NG 1 to 7: M1 to M7

* UINT: Unsigned 16-bit integer

Point

- **Check that “total status result is NG” is OK (1), and then check the master number or product type. If the master number or product type cannot be determined (the result is NG), the value becomes 0.**
- **When obtaining the master number, set [Total status condition] as shown below. Failing to do so will prevent you from obtaining correct master numbers.**
  - **Total status condition: Logic n (n = 1 to 8)**
  - **Logic n setting**
    Logic: OR
    Set master number (Master00 to Master07): Use
    “4. Output Assignment” (page 4-88)
- **If there are multiple master numbers whose status is OK, the lowest master number is output.**

Output Assembly (PLC → IV4 Series)

For details of each parameter, refer to “Output Assembly parameter details” (page 9-36).

Standard mode / Sorting mode

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0	Setting value change request	SD saving stop request	Status result/ Buffer clear request	Statistics reset request	Warning clear request	Program switching request	Master registration request	Trigger request
1	Reserved by system			Reset count input request	OCR serial no. count up input request	All program statistics reset request	Reserved by system	
2	Reserved by system							Result acquisition complete notification
3	Reserved by system							
4 - 5	Program number							
6 - 7	Upper/lower limit setting No. Master text setting No. (AI OCR) FTP/SD-saved setting No. (FTP client / SD card saving function) Serial setting no. for next judgment (AI OCR)							
8 - 103	Upper/lower limit Master text/number of letters (AI OCR) FTP/SD saving settings (FTP client / SD card saving function) Serial no. setting value for next judgment (AI OCR)							

Reference When using standard mode and setting multiple position adjustment tools, the information of each position adjustment tool starting with the second one is assigned to a tool from Tool 1 to Tool 64.

AI Through Count Mode

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0	Setting value change request	SD saving stop request	Reserved by system		Warning clear request	Program switching request	Reserved by system	Trigger request
1	Reserved by system			Reset count input request	Reserved by system			
2 - 3	Reserved by system							
4 - 5	Program number							
6 - 7	Count value change setting number							
8 - 103	Count setting value							

Output Assembly parameter details

Output Assembly Address 0 to 1: Control request

Address	Bit	Items	Description	Data content
0	0	Trigger request	Requests the external trigger.	0: OFF 1: ON
	1	Master image registration request	Requests a master image registration.	0: OFF 1: ON
	2	Program switching request	Requests program switching.	0: OFF 1: ON
	3	Warning clear request	Requests a warning clear.	0: OFF 1: ON
	4	Statistics reset request	Requests a statistics reset.	0: OFF 1: ON
	5	Status result/Buffer clear request	Resets the currently held judgment result.	0: OFF 1: ON
	6	SD card saving stop request	Requests to stop the saving of data to the SD card. Execute this request before turning off the sensor.	0: OFF 1: ON
	7	Setting value change request	Requests a setting value change.	0: OFF 1: ON
1	0 to 1	Reserved by system	----	---
	2	All program statistics reset request	Resets the statistics information for all programs.	0: OFF 1: ON
	3	OCR serial no. count up input request	Requests a count up of the serial number for AI OCR (custom). (Functions when OCR serial number count up input is enabled.)	0: OFF 1: ON
	4	Reset count input request	Resets the total count in AI Through Count mode and the serial number in AI OCR (custom). AI OCR (Custom): Batch resets tools with the reset input setting enabled.	0: OFF 1: ON
	5 to 7	Reserved by system	----	---

Reference

- The following will occur when a status result/buffer clear is requested:
  - If handshake control is [Enable]
    - The current status result will be cleared.
    - The status result in the buffer will be cleared.
    - The result available bit will become OFF (0).
    - The number of remaining buffers will become “10”.
  - If the handshake control is [Disable]
    - The current status result will be cleared.
    - The result available bit will become OFF (0).
- If you are switching programs using EtherNet/IP communication, set the [Switching method] option to [Panel/PC/Network/Automatic Switching].
  “Program Switching Method” (page 7-13)
- Buffer overrun and warning statuses will not be cleared even if you execute a status result/buffer clear request.
- If the external master registration will be executed frequently using EtherNet/IP communication, set the [Write to ROM when using Ext. Master Save] option to [No] in order to protect the non-volatile memory within the sensor.
  “Write to ROM when using Ext. Master Save” (page 7-14)
- If the FTP/SD-saved file name will be rewritten frequently using EtherNet/IP, set the [Non-volatile memory writing flag] bit to OFF (0) in order to protect the non-volatile memory within the sensor.
  “Changing the FTP/SD-saved file name (change 4 characters at a time)” (page 9-51)

Output Assembly Address 2 to 3: Handshake control

Address	Bit	Items	Description	Data content
2	0	Result acquisition complete notification	Permits the updating of the status result.	0: OFF 1: ON
	1 to 7	Reserved by system	----	----
3	0 to 7	Reserved by system	----	---

Reference

A result acquisition completion notice is used when handshake control is [Enabled].
Updating of the status result will be permitted when you request a result acquisition completion notice.
“Reading out the status result (handshake control: [Enable]; Preliminary capture: [Disable])” (page 9-46)

Output Assembly Address 4 to 5: Program No.

Address	Data type*	Items	Description	Data content
4 to 5	UINT	Program number	Stores the program No. when program switching is requested.	0 to 127

* UINT: Unsigned 16-bit integer

Output Assembly Address 6 to 11: Threshold (for a tool other than AI OCR (when [Show Matching Rate] is disabled) and Hi-Sp.Adj tool)

Address	Data type*	Items	Description	Data content
6 to 7	WORD	Upper/lower limit setting No.	Stores the tool and direction of the threshold value to be changed.	0 to 129
8 to 11	DWORD	Upper/lower limit	Stores the threshold value for when a threshold value change is requested.	0 to 99999

* WORD: Unsigned 16-bit integer
DWORD: Unsigned 32-bit integer

Reference

The setting value setting number rules are shown below.

0: Position correction lower threshold
1: Reserved by system
2: Tool 1 lower threshold 3: Tool 1 upper threshold
4: Tool 2 lower threshold 5: Tool 2 upper threshold
6: Tool 3 lower threshold 7: Tool 3 upper threshold
.
.
32: Tool 16 lower threshold 33: Tool 16 upper threshold
.
.
128: Tool 64 lower threshold 129: Tool 64 upper threshold

To change the threshold of a tool which is using scaling function, input the value which is 10 times of the threshold in [Threshold].
Example) 9999 → 99990 99.9 → 999

NOTICE

Cutoff processing is done for a number of 4 or more digits.
Example) 99995 → 99990

Output Assembly Address 6 to 103: Master text (for AI OCR)

Address	Data type*	Items	Description	Data content

6 to 7	WORD	Master text setting No.	Stores the destination for a master text change.
			• Method 1: Batch change (supports up to 32 characters)
			• Method 2: Change four characters at a time (supports up to 16 characters)
				• Method 1: Batch change
				  • String mode (string identification): 1501 to 1564
				  • Date/time mode: 1601 to 1664
				• Method 2: Change four characters at a time
				  • String mode (string identification): 201 to 456
				  • String mode (when only judging the number of letters): 501 to 628
				  • Date/time mode: 701 to 956

8 to 103	---	Master text	Stores the master text/number of letters after a change.	• Master text when the text/date reading settings are set (Batch change: UTF-8, change 4 characters at a time: ASCII) • Minimum and maximum number of letters when judging only the number of letters: 0 to 32 (DWORD*)

* WORD: Unsigned 16-bit integer
DWORD: Unsigned 32-bit integer

Method 1: To change the master text (string mode (string identification)/date/time) in a batch

- Specify [Master text setting No.] and write the text in the applicable address number in the table below.
- Append NULL (0x00) to the end of all text that you want to change. If you overwrite using all [Master text] addresses, NULL (0x00) does not need to be appended.
- When the master text is changed, it is not saved in non-volatile memory.
- The below example is for 1-byte characters (ASCII compatible area). When using 3-byte characters, also use Address 39 and after (for 3-byte characters x 32 characters, use up to Address 103).

Address	Stored data			
	Tool 1	Tool 2	· · ·	Tool 64*1
6 to 7 (WORD)	1501	1502	· · ·	1564
8	1st letter	1st letter	· · ·	1st letter
9	2nd letter	2nd letter	· · ·	2nd letter
. . .	. . .	. . .	. . .	. . .
38	31st letter	31st letter	· · ·	31st letter
39	32nd letter	32nd letter	· · ·	32nd letter

Address	Stored data			
	Tool 1	Tool 2	· · ·	Tool 64*1
6 to 7 (WORD)	1601	1602	· · ·	1664
8	1st letter	1st letter	· · ·	1st letter
9	2nd letter	2nd letter	· · ·	2nd letter
. . .	. . .	. . .	. . .	. . .
38	31st letter	31st letter	· · ·	31st letter
39	32nd letter	32nd letter	· · ·	32nd letter

*1 The number of AI OCR tools that can be set in one program are 16. However, when used with other detection tools, an AI OCR tool can be configured as the 64th tool, so the setting number is available up to tool 64.

Point

- **Correctly set byte swap in accordance with the PLC specifications.**
- **This will fail if it is AI OCR (custom mode).**

Method 2: To change the master text/date (change 4 characters at a time)

- Specify [Master text setting No.] and write the text in the applicable address number in the table below.
- Change the file name in groups of four letters. Also append NULL (0x00) to the end of the text that you want to change. Overwrite the text from the beginning of the text until NULL (0x00) at the end in groups of four letters. Not appending NULL (0x00) will not allow you to correctly change the master text/date. If you overwrite all 16 letters, NULL (0x00) does not need to be appended.
- Change of the 17th character and beyond is not supported. Use method 1 to change the 17th character and beyond.
- When the master text/date is changed, it is not saved in non-volatile memory.
- For details of how to change the master text, see “Changing the master text (change 4 characters at a time)” (page 9-50).

Address	Stored data								
	Tool 1				Tool 2		···	Tool 64*	
6 to 7 (WORD)	201	202	203	204	205	···	···	···	456
8	1st letter	5th letter	9th letter	13th letter	1st letter	···	···	···	13th letter
9	2nd letter	6th letter	10th letter	14th letter	2nd letter	···	···	···	14th letter
10	3rd letter	7th letter	11th letter	15th letter	3rd letter	···	···	···	15th letter
11	4th letter	8th letter	12th letter	16th letter	4th letter	···	···	···	16th letter

Address	Stored data								
	Tool 1				Tool 2		···	Tool 64*	
6 to 7 (WORD)	701	702	703	704	705	···	···	···	956
8	1st letter	5th letter	9th letter	13th letter	1st letter	···	···	···	13th letter
9	2nd letter	6th letter	10th letter	14th letter	2nd letter	···	···	···	14th letter
10	3rd letter	7th letter	11th letter	15th letter	3rd letter	···	···	···	15th letter
11	4th letter	8th letter	12th letter	16th letter	4th letter	···	···	···	16th letter

To set the number of letters when judging only the number of letters

Address	Stored data								
	Tool 1		Tool 2		Tool 3		···	Tool 64*	
6 to 7 (WORD)	501	502	503	504	505	···	···	627	628
8 to 11 (DWORD)	Minimum number of letters	Maximum number of letters	Minimum number of letters	Maximum number of letters	Minimum number of letters	···	···	Minimum number of letters	Maximum number of letters

* The number of AI OCR tools that can be set in one program are 16. However, when used with other detection tools, an AI OCR tool can be configured as the 64th tool, so the setting number is available up to tool 64.

Point

- **Correctly set [Byte Swap] in accordance with the PLC specifications.**
  “Setting the IV4 Series” (page 9-18)
- **This will fail if it is AI OCR (custom mode).**

Output Assembly Address 6 to 71: Batch Change FTP/SD Save File Name (FTP Client/SD Card Saving Function)

Address	Data type*	Items	Description	Data content
6 to 7	WORD	Batch changing FTP/SD-saved file name setting number	Stores the setting number to change the FTP/SD-saved file name in a batch.	• Does not save to non-volatile memory (Deleted when the power is turned off) • Transfer condition 1: 1031 • Transfer condition 2: 1032 • Transfer condition 3: 1033 • Transfer condition 4: 1034 • Save to nonvolatile memory • Transfer condition 1: 1041 • Transfer condition 2: 1042 • Transfer condition 3: 1043 • Transfer condition 4: 1044
8 to 71	---	FTP/SD-saved file name	Stores the file name after it is changed.	File name character (ASCII) The following characters can be used: 0-9, a-z, A-Z, ' '[space], '(', ')', '+', '-', '=', '_', '.', '', '!', '#', '$', '%', '&', '@'

* WORD: Unsigned 16-bit integer

To batch change the FTP/SD-saved file name

- Specify [Batch change FTP/SD-saved file name setting number] and write the string in the applicable address in the table below after the change.
- Append NULL (0x00) to the end of all text that you want to change. If you overwrite using all [FTP/SD-saved file name] addresses, NULL (0x00) does not need to be appended.

❍ Does not save to non-volatile memory (deleted when the power is turned off)

Address	Stored data			
	Transfer Condition 1	Transfer Condition 2	Transfer Condition 3	Transfer condition 4
6 to 7 (WORD)	1031	1032	1033	1034
8	1st letter	1st letter	1st letter	1st letter
9	2nd letter	2nd letter	2nd letter	2nd letter
. . .	. . .	. . .	. . .	. . .
70	63rd letter	63rd letter	63rd letter	63rd letter
71	64th letter	64th letter	64th letter	64th letter

❍ Save to nonvolatile memory

Address	Stored data			
	Transfer Condition 1	Transfer Condition 2	Transfer Condition 3	Transfer condition 4
6 to 7 (WORD)	1041	1042	1043	1044
8	1st letter	1st letter	1st letter	1st letter
9	2nd letter	2nd letter	2nd letter	2nd letter
. . .	. . .	. . .	. . .	. . .
70	63rd letter	63rd letter	63rd letter	63rd letter
71	64th letter	64th letter	64th letter	64th letter

Output Assembly Address 6 to 11: FTP/SD Save File Name (Change 4 Characters at a Time) (FTP Client/SD Card Saving Function)

Address	Data type*	Items	Description	Data content
6 to 7	WORD	FTP/SD-saved setting No.	• Stores the transfer condition number for the file name to change and the setting number specifying whether to write to non-volatile memory. • Stores the setting number specifying the character position in the file name to change. The 64-character file name is subdivided so the setting number can be specified in groups of four letters.	• File name transfer condition number and specifying whether to write to non-volatile memory: 1001 • File name character position specification: 1011 to 1026
8 to 11	---	FTP/SD saving settings	When [FTP/SD-saved setting No.] is 1001 Bit 0: Transfer condition 1 Bit 1: Transfer condition 2 Bit 2: Transfer condition 3 Bit 3: Transfer condition 4 Bits 4 to 7: Reserved by system Bit 8: Write to non-volatile memory Bits 9 to 31: Reserved by system When [FTP/SD-saved setting No.] is 1011 to 1026 Stores the file name after it is changed. Change the file name in groups of four letters.	When [FTP/SD-saved setting No.] is 1001 0: OFF, 1: ON When [FTP/SD-saved setting No.] is 1011 to 1026 File name character (ASCII) The following characters can be used: 0-9, a-z, A-Z, ' '[space], '(', ')', '+', '-', '=', '_', '.', '"', '!', '#', '$', '%', '&', '@'

* WORD: Unsigned 16-bit integer

To change the FTP/SD-saved file name (change 4 characters at a time)

- Write 1001 to [FTP/SD-saved setting No.: Addresses 6 to 7] and specify the transfer condition for changing the file name.
- Use [FTP/SD saving settings: Addresses 8 to 11] to set to ON (1) the bit of the transfer condition number to change. If multiple bits are set to ON (1), the condition with the smallest number is specified. If all the bits are set to OFF (0), transfer condition 1 is specified. Set the non-volatile memory writing flag bit to OFF (0) when not writing and to ON (1) when writing.

Address	Stored data
6 to 7 (WORD)	1001

Address	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
8	Reserved by system				Transfer condition 4	Transfer Condition 3	Transfer Condition 2	Transfer Condition 1
9	Reserved by system							Non-volatile memory writing flag
10	Reserved by system							
11	Reserved by system							

- Write to [FTP/SD-saved setting No.: Addresses 6 to 7] the setting number corresponding to the character position in the file name to change.
- Write to [FTP/SD saving settings: Addresses 8 to 11] the character string after the change.
- Change the file name in groups of four letters. Add a NULL (0x00) after the character string to change to. Overwrite the text from the beginning of the text until NULL (0x00) at the end in groups of four letters. If NULL (0x00) is not added, it will not be possible to change to the correct file name. If you overwrite all 64 letters, NULL (0x00) does not need to be appended.
- For details of how to change the master text, see “Changing the FTP/SD-saved file name (change 4 characters at a time)” (page 9-51).

Address	Stored data						
6 to 7 (WORD)	1011	1012	1013	1014	· · ·	1025	1026
8	1st letter	5th letter	9th letter	13th letter	· · ·	57th letter	61st letter
9	2nd letter	6th letter	10th letter	14th letter	· · ·	58th letter	62nd letter
10	3rd letter	7th letter	11th letter	15th letter	· · ·	59th letter	63rd letter
11	4th letter	8th letter	12th letter	16th letter	· · ·	60th letter	64th letter

Output Assembly Address 6 to 11: Change Serial Number for Next OCR Judgment (Numerical Value)

When the serial number is changed, it is not saved in non-volatile memory.

Address	Data type*	Items	Description	Data content
6 to 7	WORD	Change the serial setting number (numerical value) for next OCR judgment	Stores the setting number for changing the serial number for the next judgment of the AI OCR tool (custom mode).	Tool 1: 1701 onwards Tool 64*2: 1764
8 to 11	DWORD	Serial no. for next OCR judgment	Stores the serial number for when a serial number change is requested.	0 to 999999

*1 WORD: Unsigned 16-bit integer
DWORD: Unsigned 32-bit integer
*2 The number of AI OCR tools that can be set in one program are 16. However, when used with other detection tools, an AI OCR tool can be configured as the 64th tool, so the setting number is available up to tool 64.

Output Assembly Address 6 to 13: Change Serial Number for Next OCR Judgment (Letter)

When the serial number is changed, it is not saved in non-volatile memory.

Address	Data type*	Items	Description	Data content
6 to 7	WORD	Change the serial setting number (letter) for next OCR judgment	Stores the setting number for changing the serial number for the next judgment of the AI OCR tool (custom mode).	Tool 1: 1801 onwards Tool 64*2: 1864
8 to 11	ASCII	Serial no. for next OCR judgment	Stores the serial number after it is changed.	A to ZZZZZZ

*1 WORD: Unsigned 16-bit integer
*2 The number of AI OCR tools that can be set in one program are 16. However, when used with other detection tools, an AI OCR tool can be configured as the 64th tool, so the setting number is available up to tool 64.

Changing the Serial Number (Letter) for the Next Judgment of the AI OCR Tool (Custom Mode)

Address	Stored data			
	Tool 1	Tool 2	· · ·	Tool 64
6 to 7 (WORD)	1801	1802	· · ·	1864
8	1st letter	1st letter	· · ·	1st letter
9	2nd letter	2nd letter	· · ·	2nd letter
10	3rd letter	3rd letter	· · ·	3rd letter
11	4th letter	4th letter	· · ·	4th letter
12	5th letter	5th letter	· · ·	5th letter
13	6th letter	6th letter	· · ·	6th letter

Output Assembly Address 6 to 11: Change the Count Value in AI Through Count Mode

When the serial number is changed, it is not saved in non-volatile memory.

Address	Data type*	Items	Description	Data content
6 to 7	WORD	Change count value in AI Through Count mode Setting number	Stores the setting number for changing the count value in AI Through Count mode.	Tool 1: 1901 to Tool 8: 1908
8 to 11	DWORD	Count Value	Stores the count value for when a count value change is requested.	0 to 9999999

* WORD: Unsigned 16-bit integer
DWORD: Unsigned 32-bit integer

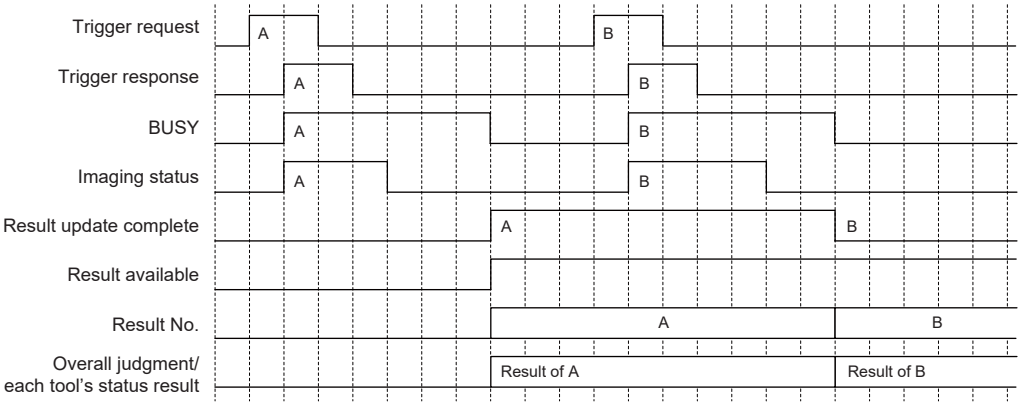
Operating procedure of the cyclic communication

This section explains the method for communicating from the PLC to the IV4 Series using cyclic communication.
It also introduces reference programs. When making use of the reference programs, give thought to items such as error processing during programming.

Reading out the status result (handshake control: [Disable]; Preliminary capture: [Disable])

The operation procedure when the data handshake control is set to [Disable] is shown below.

When a trigger is successful



(1) Run [Trigger request]. (0 → 1) Trigger request is retained until trigger response is set to ON

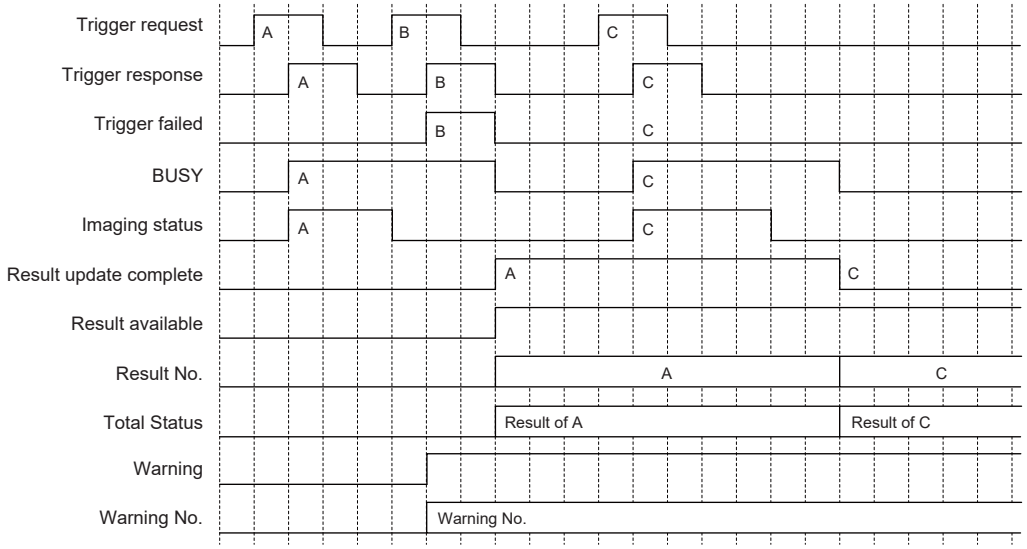
(2) If the trigger is valid, [Trigger response] will change from 0 to 1.

(3) Once the judgment process ends, the [Result update complete] Bit will switch and [Overall judgment]/[Each tool's status result] will be updated. The read text will be updated for AI OCR.

Point **Do not cancel (1 → 0) [Trigger request] before [Trigger response] changes from 0 to 1. The trigger may not be able to be requested correctly.**

Reference
- [Result update complete] will switch (toggle) to "1" if its value was "0" after the previous judgment update or switch to "0" if its value was "1".
- [Result available] will switch from 0 to 1 at the timing when the first judgment process has been confirmed; and the new value will be retained thereafter.
- [Result available] will be reset in the following conditions:
  - If handshake control is set to [Disabled]
    - When the program is switched
    - When the unit's status is switched from "Setting" to "RUN"
    - When a buffer clear request is issued
  - If handshake control is set to [Enabled]
    - When a buffer clear request is issued
- [Result No.] will be counted up each time the status result is updated. The upper limit value is 32767. If the maximum value is exceeded, it will go back to 0 and start counting up again.
- [Result No.] will also count the judgment process counts that were skipped due to the cyclic frequency setting.
- [Busy] and [Imaging] may be skipped in some cyclic frequency settings. It is therefore necessary to take the imaging condition into consideration when setting the cyclic frequency.

When a trigger is unsuccessful



(1) Run [Trigger request]. (0 → 1) Trigger request is retained until trigger response is set to ON

(2) If the trigger is valid, [Trigger response] will change from 0 to 1.

(3) When the judgment process ends, the [Result update complete] bit will be switched and the [Overall judgment] will be updated.

(4) If you wish to output trigger errors, set the trigger error option to [Enabled]. If a trigger has been input while the trigger error option is set to [Enabled] and the unit is in “BUSY” status, [Trigger failed] will change from 0 to 1 ignoring the trigger input. No judgment process will be performed for trigger B.

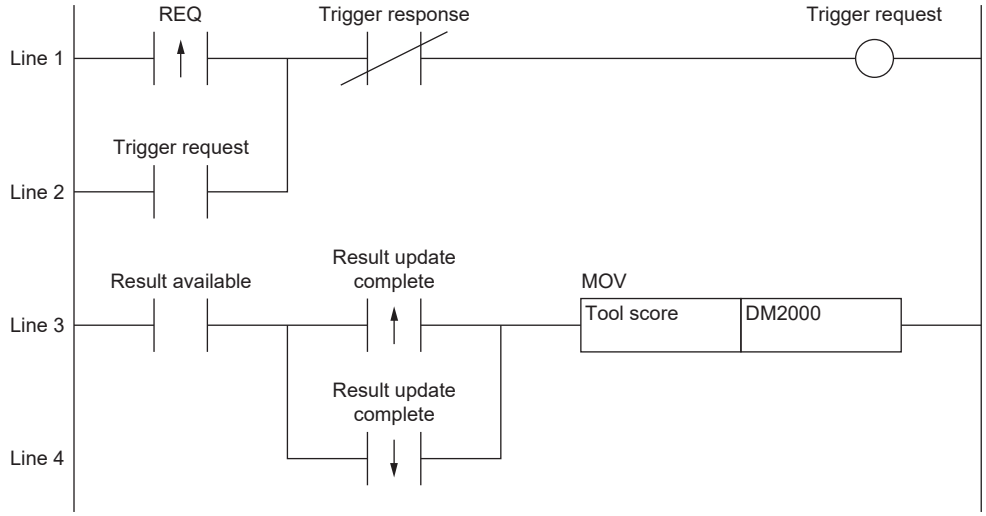
(5) If the trigger input is unsuccessful, [Warning] will switch from “0” to “1” and [Warning No.] will be updated to “65”.

Point **Do not cancel (1 → 0) [Trigger request] before [Trigger response] changes from 0 to 1. The trigger may not be able to be requested correctly.**

Reference
- [Result update complete] will switch to “1” if its value was “0” after the previous judgment update (or from “0” to “1” if the previous value was “1”).
- [Result available] will switch from 0 to 1 at the timing when the first judgment process has been confirmed; and the new value will be retained thereafter.
- [Result No.] will be counted up each time the status result is updated. The upper limit value is 32767. If the maximum value is exceeded, it will go back to 0 and start counting up again.
- [Result No.] will also count the judgment process counts that were skipped due to the cyclic frequency setting.
- [Busy] and [Imaging] may be skipped in some cyclic frequency settings. It is therefore necessary to take the imaging condition into consideration when setting the cyclic frequency.
- [Number of trigger errors] will be counted up at the timing when the [Result updated] BIT is switched.

Reference programs

KEYENCE KV Series



❍ **Description of the reference program**

- **Line 1/Line 2**
  Sets “REQ” to ON and executes a trigger request.
  “Trigger response” ON will set “Trigger request” to OFF (“Trigger request” is retained until “Trigger response” is set to ON).
- **Line 3/Line 4**
  “Result available” ON + Rising or falling of “Result update complete” will copy the data that have been written to the tool score to DM2000.

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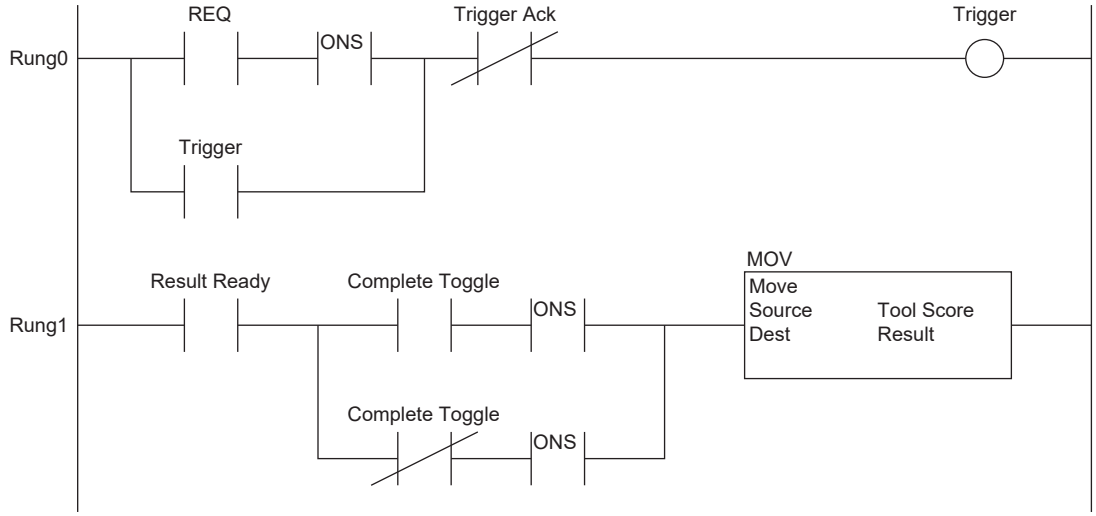


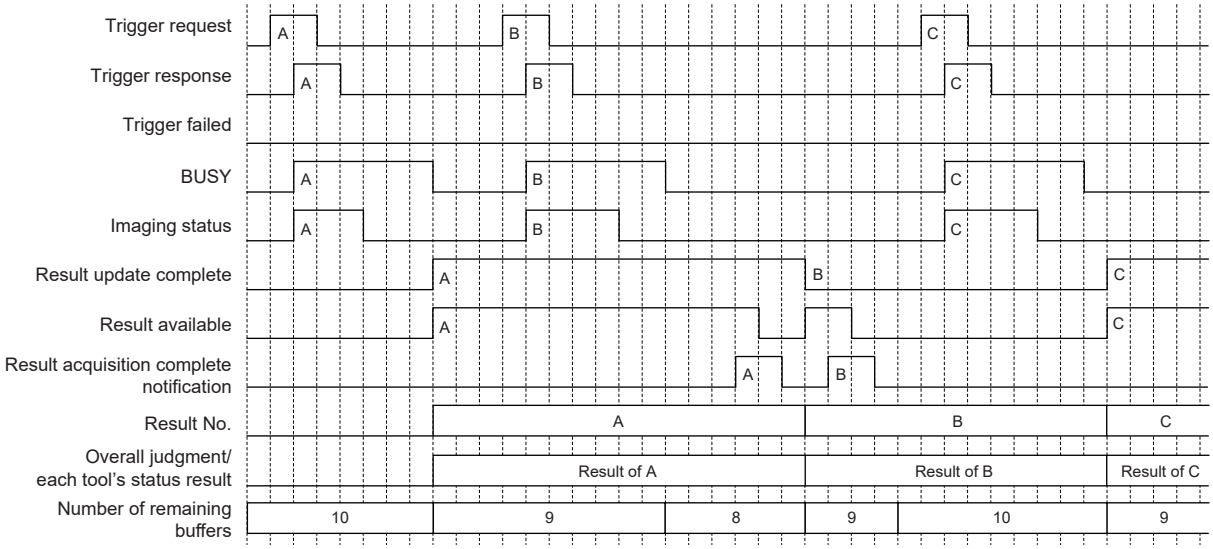
❍ **Description of the reference program**

- **Rung0**
  Sets “REQ” to ON and executes “Trigger”.
  “Trigger Ack” ON will set “Trigger” to OFF (“Trigger” will be retained until “Trigger Ack” becomes ON).
- **Rung1**
  “Result Ready” ON + Rising or falling of “Complete Toggle” will copy the data that have been written to “Tool Score” to “Result”.

Point **To ensure synchronicity between Input Data and Output Data, use the CPS instruction at the beginning of the ladder.**

Reading out the status result (handshake control: [Enable]; Preliminary capture: [Disable])

The following describes the operating procedure when the data handshake control is set to [Enabled].
You can acquire all status results without fail by setting the data handshake control to [Enabled].



(1) Run [Trigger request]. (0 → 1) Trigger request is retained until trigger response is set to ON

(2) If the trigger is valid, [Trigger response] will change from 0 to 1.

(3) Once the judgment process ends, the [Result update complete] Bit will switch, [Result available] will switch from 0 to 1, and [Overall judgment]/[Each tool's status result] will be updated. The read text will be updated for AI OCR.

(4) [Number of remaining buffers] will be reduced by 1 when the status result is updated.

(5) Executes [Result acquisition complete notice] (1 → 0) and [Result available] is held until 1 becomes 0.

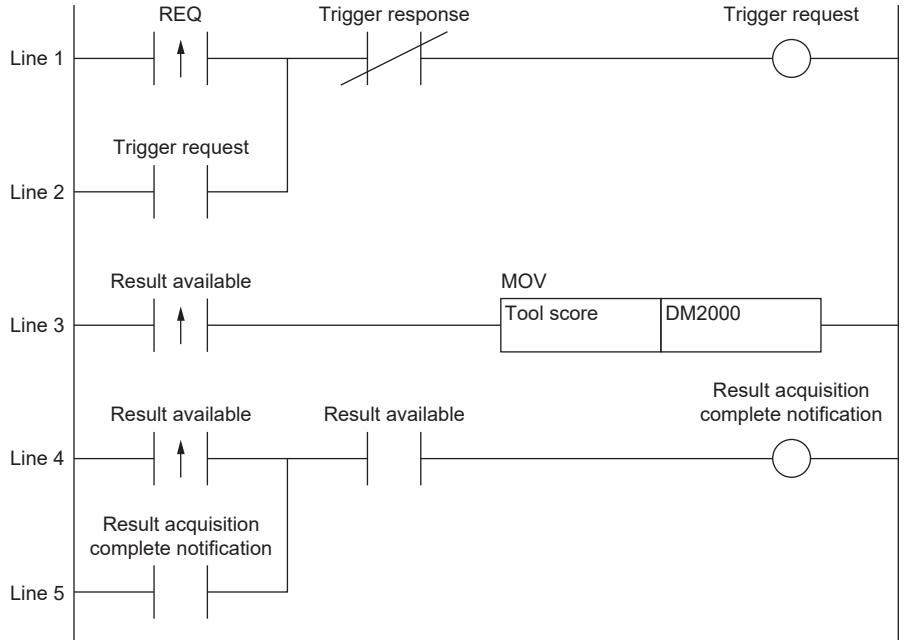
(6) Turns [Result acquisition complete notice] off (1 → 0). [Number of remaining buffers] will be incremented by 1.

Point **Do not cancel (1 → 0) [Trigger request] before [Trigger response] changes from 0 to 1. The trigger may not be able to be requested correctly.**

Reference
- [Result update complete] will switch (toggle) to "1" if its value was "0" after the previous judgment update or switch to "0" if its value was "1".
- [Result No.] will be counted up each time the status result is updated. The upper limit value is 32767. If the maximum value is exceeded, it will go back to 0 and start counting up again.
- [Result No.] will also count the judgment process counts that were skipped due to the cyclic frequency setting.
- [Busy] and [Imaging] may be skipped in some cyclic frequency settings. It is therefore necessary to take the imaging condition into consideration when setting the cyclic frequency.
- [Number of trigger errors] will be counted up at the timing when the [Result updated] BIT is switched.
- If handshake control has been set to [Enabled], the status result will not be updated until [Result acquisition complete notice] is set ON/OFF (0 → 1 → 0), even if the next trigger has been input and a judgment process has been executed.
- If a new trigger is input when [Number of remaining buffers] is "0", [Buffer overrun] will switch from "0" to "1". The status result from the new trigger will be ignored.
- [Buffer overrun] can be cleared using [Warning clear].

Reference programs

KEYENCE KV Series



❍ **Description of the reference program**

- **Line 1/Line 2**
  Sets “REQ” to ON and executes a trigger request.
  “Trigger response” ON will set “Trigger request” to OFF (“Trigger request” is retained until “Trigger response” is set to ON).
- **Line 3**
  The result available bit becomes ON to copy the data written in the tool score to DM2000.
- **Line 4/Line 5**
  “Result available” ON will execute a result acquisition completion notice.
  “Result available” OFF will set “Result acquisition completion notice” to OFF (“Result acquisition completion notice” will be retained until “Result available” becomes OFF).

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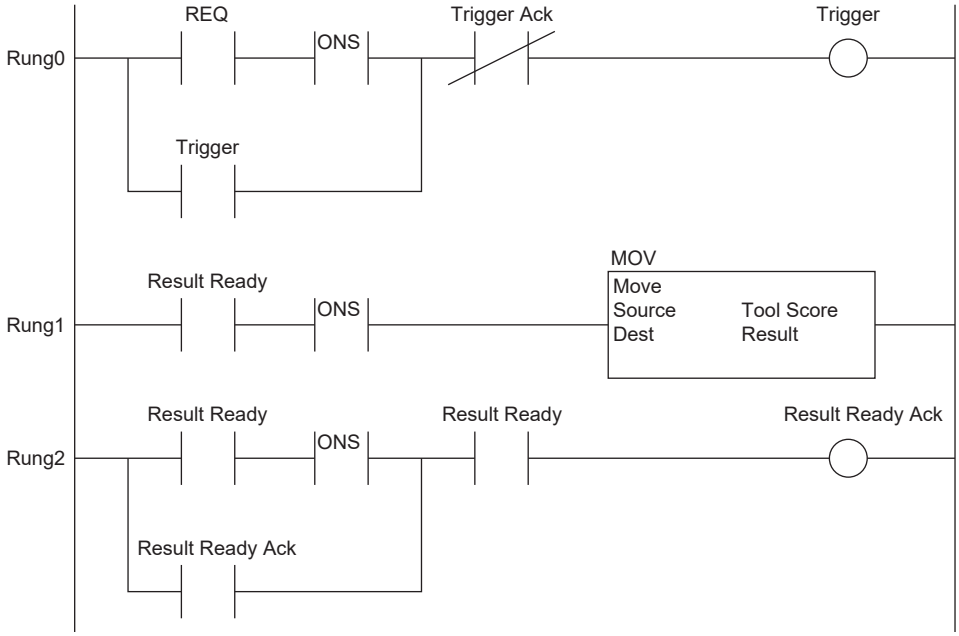
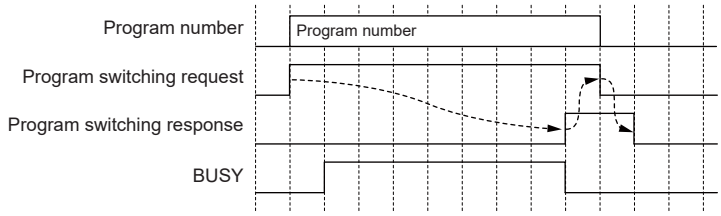


❍ **Description of the reference program**

- **Rung0**
  Sets “REQ” to ON and executes “Trigger”.
  “Trigger Ack” ON will set “Trigger” to OFF (“Trigger” will be retained until “Trigger Ack” becomes ON).
- **Rung1**
  “Result Ready” ON will copy the data written in “Tool Score” to “Result”.
- **Rung2**
  “Result Ready” ON will execute “Result Ready Ack”.
  “Result Ready” OFF will set “Result Ready Ack” to OFF (“Result Ready Ack” will be retained until “Result Ready” becomes OFF).

Point **To ensure synchronicity between Input Data and Output Data, use the CPS instruction at the beginning of the ladder.**

Switching the programs



(1) Write the program No. to be set to [Program No.].

(2) Execute [Program switching request], maintaining the state (0 → 1) until [Program switching response] is received.

(3) When the program switch is complete, [Program switching response] (0 → 1) is received.

(4) Once [Program switching response] is received, clear [Program switching request] (1 → 0). When [Program switching request] is cleared, [Program switching response] is cleared.

Point

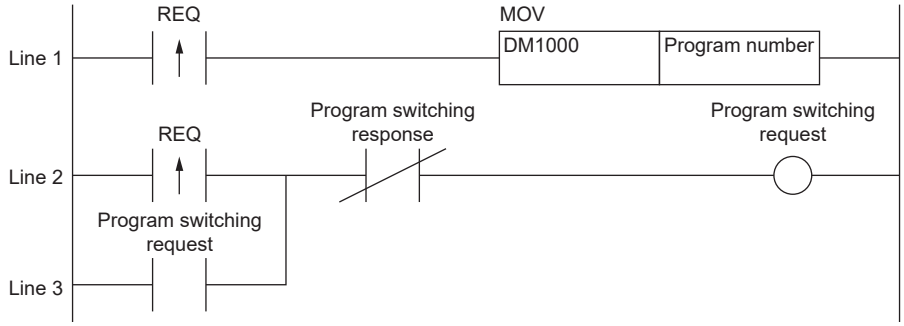
- **Do not cancel (1 → 0) [Program switching request] before [Program switching response] changes from 0 to 1. The program may not be able to switch correctly.**
- **When [Program switching request] was canceled (1 → 0) before [Program switching response] changes from 0 to 1, execute (0 → 1) [Program switching request] and cancel (1 → 0) it again.**

Reference

- [BUSY] will change from 0 to 1 while the program switching is in progress.
- If the program switching fails, [Program switching failed] will change from "0" to "1".
- If the program switching is unsuccessful, [Warning] will switch from "0" to "1" and [Warning No.] will be updated to "64".
- You cannot switch programs using EtherNet/IP communication while the unit is in [Setting] status.
- If you are switching programs using EtherNet/IP communication, set the [Switching method] option to [Panel/PC/Network/Automatic Switching].
  "Program Switching Method" (page 7-13)
- The program No. switched to from EtherNet/IP communication will be deleted when the power is turned off.

Reference programs

KEYENCE KV Series



Description of the reference program

- **Line 1**
  This line sets "REQ" to ON and copies the DM1000 data, which contains the program No. to be set, to the program No.
- **Line 2/Line 3**
  Sets "REQ" to ON and executes a program switching request.
  "Program switching response" ON to will set "Program switching request" to OFF ("Program switching request" will be retained until "Program switching response" becomes ON).

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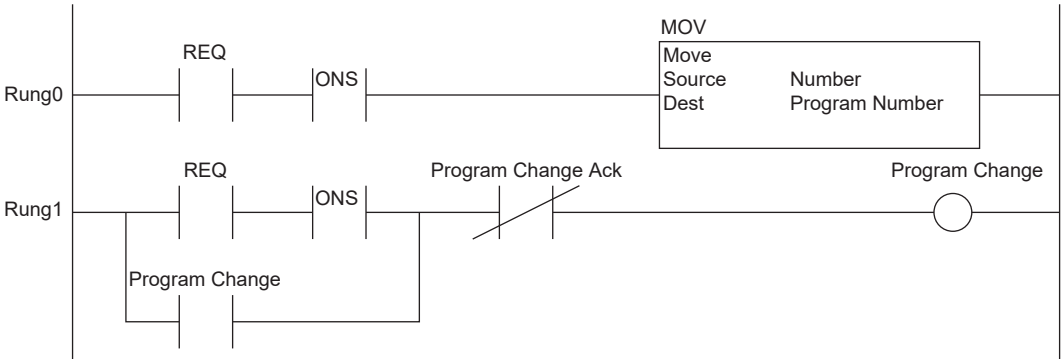
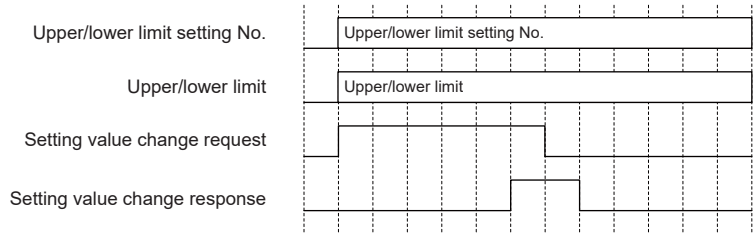


Description of the reference program

- **Rung0**
  This line sets "REQ" to ON and copies the Number data, which contains the program No. to be set, to the program No.
- **Rung1**
  Sets "REQ" to ON and executes "Program Change".
  "Program Change Ack" ON will set "Program Change" to OFF ("Program Change" will be retained until "Program Change Ack" becomes ON).

Changing the tool adjustment threshold



(1) Write the tool number and threshold type of the threshold to be changed to [Upper/lower limit setting No.].

(2) Write the threshold to be changed to [Upper/lower limit].

(3) Execute [Setting value change request]. (0→1)

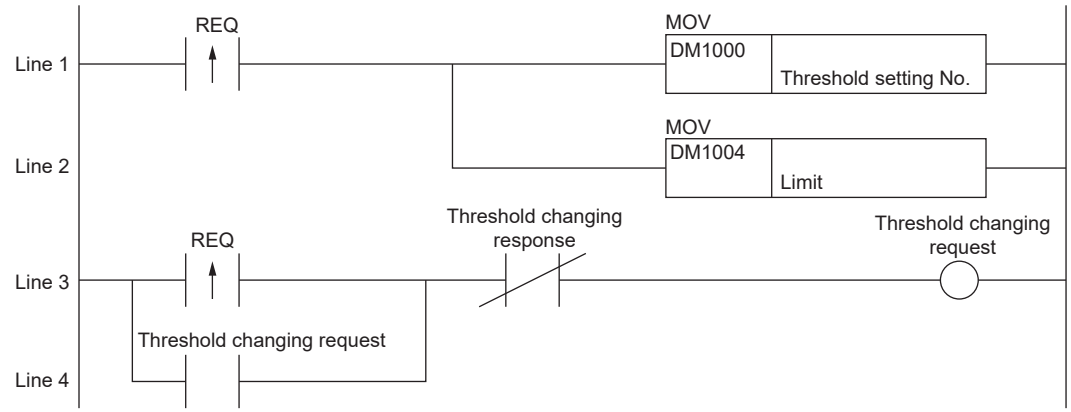
(4) You can check the input status in [Setting value change response].

Reference

- If the setting value change fails, [Setting value change failed] will switch from “0” to “1”.
- If the setting value change fails, [Warning] will switch from “0” to “1” and [Warning No.] will be updated to 60.
- Thresholds cannot be changed for the following tools.
  - In standard mode or sorting mode, the position adjustment tool, which corrects the position of the learning tool
  - In sorting mode, tools other than the learning tool
  - In the AI Through Count Mode, AI Through Count Tool whose judgment result is [Disable] and Total Tool

Reference programs

KEYENCE KV Series



❍ Description of the reference program

- **Line 1**
  This line sets “REQ” to ON and copies the DM1000 data, which contains the threshold setting No. to be set, to the threshold setting No.
- **Line 2**
  This line sets “REQ” to ON and copies the DM1004 data, which contains the threshold to be set, to the threshold.
- **Line 3/Line 4**
  Sets “REQ” to ON and executes a threshold changing request.
  “Threshold changing response” ON will set “Threshold changing request” to OFF. (“Threshold changing request” will be retained until “Threshold changing response” becomes ON.)

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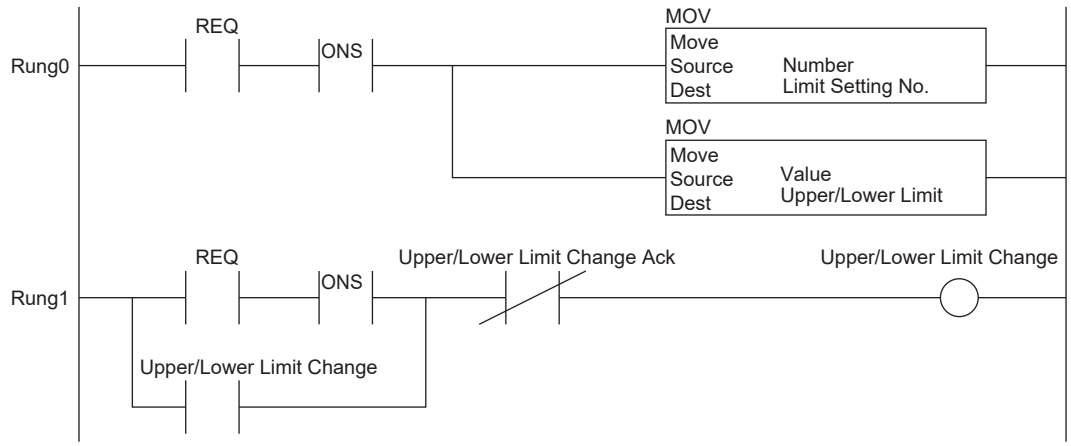
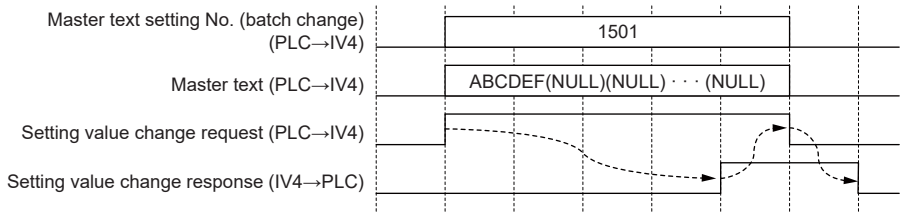


❍ Description of the reference program

- **Rung0**
  This line sets “REQ” to ON and copies the Number data, which contains the Limit Setting No. to be set, to the Limit Setting No. This line also copies the Value data, which contains the Upper/Lower Limit to be set, to the Upper/Lower Limit.
- **Rung1**
  Sets “REQ” to ON and executes “Upper/Lower Limit Change”.
  “Upper/Lower Limit Change Ack” ON will set “Upper/Lower Limit Change” to OFF.
  (“Upper/Lower Limit Change” will be retained until “Upper/Lower Limit Change Ack” becomes ON.)

Changing the master text (batch change)

This section shows the master text for Tool 1 (AI OCR: String mode) changing in batch to [ABCDEF] as an example.



(1) Overwrite [Master text setting No.: Address 6 to 7] with 1501 (AI OCR tool string mode string identification with Tool 1).

(2) Overwrite [Master text: Address 8] with A (0x41), [Master text: Address 9] with B (0x42), [Master text: Address 10] with C (0x43), [Master text: Address 11] with D (0x44), [Master text: Address 12] with E (0x45), [Master text: Address 13] with F (0x46), and [Master text: Address 14] onwards with NULL (0x00).

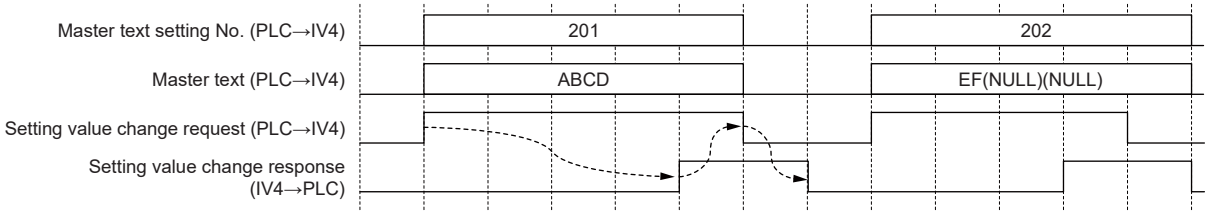
(3) Execute [Setting value change request] (0→1). The request is retained until [Setting value change response] can be confirmed.

(4) Once the change is complete, [Setting value change response] changes from 0 to 1.

(5) Setting [Setting value change request] to 0 sets [Setting value change response] to 0.

Changing the master text (change 4 characters at a time)

This section shows the master text for Tool 1 changing to [ABCDEF] as an example. The text is overwritten twice in groups of four letters.



(1) Overwrite [Master text setting No.: Address 6 to 7] with 201 (master text (first to fourth letter) when the read text settings are set with Tool 1).

(2) Overwrite [Master text: Address 8] with A (0x41), [Master text: Address 9] with B (0x42), [Master text: Address 10] with C (0x43), and [Master text: Address 11] with D (0x44).

(3) Execute [Setting value change request] (0→1). The request is retained until [Setting value change response] can be confirmed.

(4) Once the change is complete, [Setting value change response] changes from 0 to 1.

(5) Setting [Setting value change request] to 0 sets [Setting value change response] to 0.

(6) Overwrite [Master text setting No.: Address 6 to 7] with 202 (master text (fifth to eighth letter) when the read text settings are set with Tool 1).

(7) Overwrite [Master text: Address 8] with E (0x45), [Master text: Address 9] with F (0x46), [Master text: Address 10] with NULL (0x00), and [Master text: Address 11] with NULL (0x00).

(8) Execute [Setting value change request] (0→1). The request is retained until [Setting value change response] can be confirmed.

(9) Once the change is complete, [Setting value change response] changes from 0 to 1.

(10) Setting [Setting value change request] to 0 sets [Setting value change response] to 0.

Point

- **Append the NULL character to the end of the text.**
  If you change "ABCDEFG" to "1234" and did not write NULL, the text is changed to "1234EFG".

Example of a failure	Master text/date							
	1st	2nd	3rd	4th	5th	6th	7th	8th
Master text/date before change	A	B	C	D	E	F	G	NULL
Text to be written	1	2	3	4	None			
Master text/date after change	1	2	3	4	E	F	G	

Example of a success	Master text/date							
	1st	2nd	3rd	4th	5th	6th	7th	8th
Master text/date before change	A	B	C	D	E	F	G	NULL
Text to be written	1	2	3	4	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)
Master text/date after change	1	2	3	4				

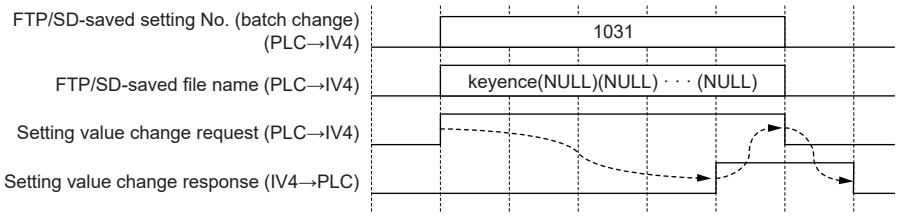
- **Arbitrary text can be changed in groups of four letters.**
  To change "2019.4.5" to "2019.4.6", you can change only 202 for [Setting value setting No.: Address 6 to 7] (master text (fifth to eighth letter) when the read text settings are set with Tool 1).

	Master text/date							
	1st	2nd	3rd	4th	5th	6th	7th	8th
Master text/date before change	2	0	1	9	.	4	.	5
Text to be written	None				.	4	.	6
Master text/date after change	2	0	1	9	.	4	.	6

- **Changes in groups of four letters are applied immediately. Do not execute a trigger until all text changes are complete.**

Changing the FTP/SD-saved file name (batch change)

This section shows an example in which the transfer condition 1 file name is changed to “keyence”.
No data is written to non-volatile memory. (The setting number is different when writing to non-volatile memory.)



(1) Write 1031 to [Batch change FTP/SD save file name: Addresses 6 to 7].

(2) Overwrite [FTP/SD save file name: Address 8] with k (0x6B), [FTP/SD save file name: Address 9] with e (0x65), [FTP/SD save file name: Address 10] with y (0x79), [FTP/SD save file name: Address 11] with e (0x65), [FTP/SD save file name: Address 12] with n (0x6E), [FTP/SD save file name: Address 13] with c (0x63), [FTP/SD save file name: Address 14] with e (0x65), and [FTP/SD save file name: Address 15] onwards with NULL (0x00).

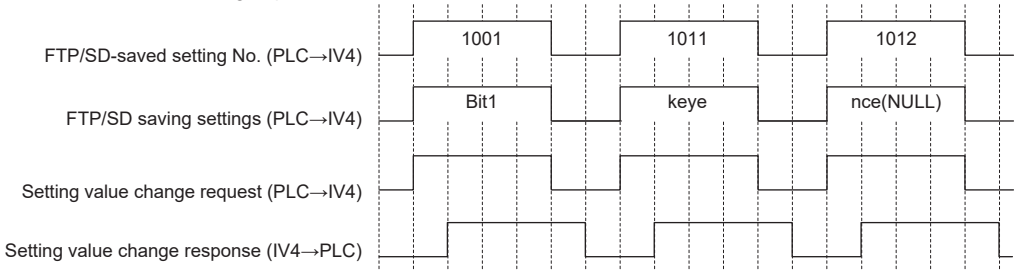
(3) Execute [Setting value change request] (0→1). The request is retained until [Setting value change response] can be confirmed.

(4) Once the change is complete, [Setting value change response] changes from 0 to 1.

(5) Setting [Setting value change request] to 0 sets [Setting value change response] to 0.

Changing the FTP/SD-saved file name (change 4 characters at a time)

This section shows an example in which the transfer condition 2 file name is changed to “keyence”. No data is written to non-volatile memory.
The text is overwritten twice in groups of four letters.



(1) Write 1001 to [FTP/SD-saved setting No.: Addresses 6 to 7] to enable the specification of the transfer condition number.

(2) Set [FTP/SD saving settings: Address 8 Bit 1] to ON (1). (Specify Transfer Condition 2)
Set [FTP/SD saving settings: Address 9 Bit 0] to OFF (0). (No writing to non-volatile memory)

(3) Execute [Setting value change request: Address 0 Bit 7] (0→1). The request is retained until [Setting value change response] can be confirmed.

(4) Once the transfer condition number specification is complete, [Setting value change response] changes from 0 to 1.

(5) Setting [Setting value change request: Address 0 Bit 7] to 0 sets [Setting value change response] to 0.

(6) Overwrite [FTP/SD-saved setting No.: Addresses 6 to 7] with 1011 (first to fourth letter of the FTP/SD-saved file name).

(7) Overwrite [FTP/SD saving settings: Address 8] with k (0x6B), [FTP/SD saving settings: Address 9] with e (0x65), [FTP/SD saving settings: Address 10] with y (0x79), and [FTP/SD saving settings: Address 11] with e (0x65).

(8) Execute [Setting value change request: Address 0 Bit 7] (0→1). The request is retained until [Setting value change response] can be confirmed.

(9) Once the transfer condition number specification is complete, [Setting value change response] changes from 0 to 1.

(10) Setting [Setting value change request: Address 0 Bit 7] to 0 sets [Setting value change response] to 0.

(11) Overwrite [FTP/SD-saved setting No.: Addresses 6 to 7] with 1012 (fifth to eighth letter of the FTP/SD-saved file name).

(12) Overwrite [FTP/SD saving settings: Address 8] with n (0x6E), [FTP/SD saving settings: Address 9] with c (0x63), [FTP/SD saving settings: Address 10] with e (0x65), and [FTP/SD saving settings: Address 11] with NULL (0x00).

(13) Execute [Setting value change request: Address 0 Bit 7] (0→1). The request is retained until [Setting value change response] can be confirmed.

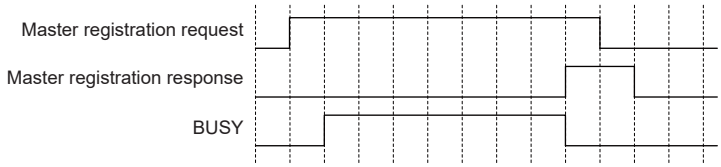
(14) Once the transfer condition number specification is complete, [Setting value change response] changes from 0 to 1.

(15) Setting [Setting value change request: Address 0 Bit 7] to 0 sets [Setting value change response] to 0.

Point

- **Append the NULL character to the end of the text.**
  If you change “ABCDEF” to “1234” and did not write NULL, the text is changed to “1234EF”.
- **Arbitrary text can be changed in groups of four letters.**
  To change “ABCDEF” to “ABCDGH”, you can change only 1012 for [FTP/SD-saved setting No.: Addresses 6 to 7] (the fifth to eighth letters of the FTP file name).
- **Changes in groups of four letters are applied immediately. Do not execute a trigger until all text changes are complete.**
- **If multiple transfer condition numbers are specified, the condition with the smallest number is used.**
- **If data is not written to non-volatile memory, the set transfer condition number and file name will be deleted when the power is turned off.**

Registering a master image externally



(1) Execute [Master registration request]. (0→1)

(2) You can check the input status in [Master registration response].

Reference

- [BUSY] will change from 0 to 1 while the master image registration is in progress.
- If the master image registration is unsuccessful, [Master registration failed] will change from 0 to 1.
- If the master image registration is unsuccessful, [Warning] will switch from “0” to “1” and [Warning No.] will be updated according to the failure details.
- You cannot register a master image from the EtherNet/IP communication while the unit is in [Setting] status.
- If you wish to write the master registration data to the sensor ROM, set the [Write to ROM when using Ext. Master Save] option to [Yes].
  “Write to ROM when using Ext. Master Save” (page 7-14)
- External Master Image registration cannot be used when AI-based tools are used. (AI tool/AI Identify/AI Count/AI Trigger), Sorting Mode, and AI Through Count Mode.

MEMO

PROFINET communication specifications and functions

What is PROFINET?

PROFINET is an open communication standard defined by PROFIBUS & PROFINET International (PI), and any vendor can communicate with any compatible device. Sensors of IV4 Series conform to Conformance Class B.
Conformance Class C is applicable when using a communication unit (IV4-CU1/IV4-GCU1).

List of supported PLCs

Siemens PLC

PLC model	PROFINET communication unit	Firmware version	Software used	Version of the software used
S7 300 series Example: CPU315-2 PN/DP	- (Built-in to the unit)	V3.2.6	TIA Portal	15.1
S7 1200 series Example: CPU1212C	- (Built-in to the unit)	V4.2	TIA Portal	15.1
S7 1500 series Example: CPU1516-3 PN/DP	- (Built-in to the unit)	V2.06.0	TIA Portal	15.1

When using STEP 7, use V5.6.
The GSDML file can be downloaded from the KEYENCE website.

IV4 Series PROFINET Communication Specifications

Data I/O communication	Communication size	to 1400 byte

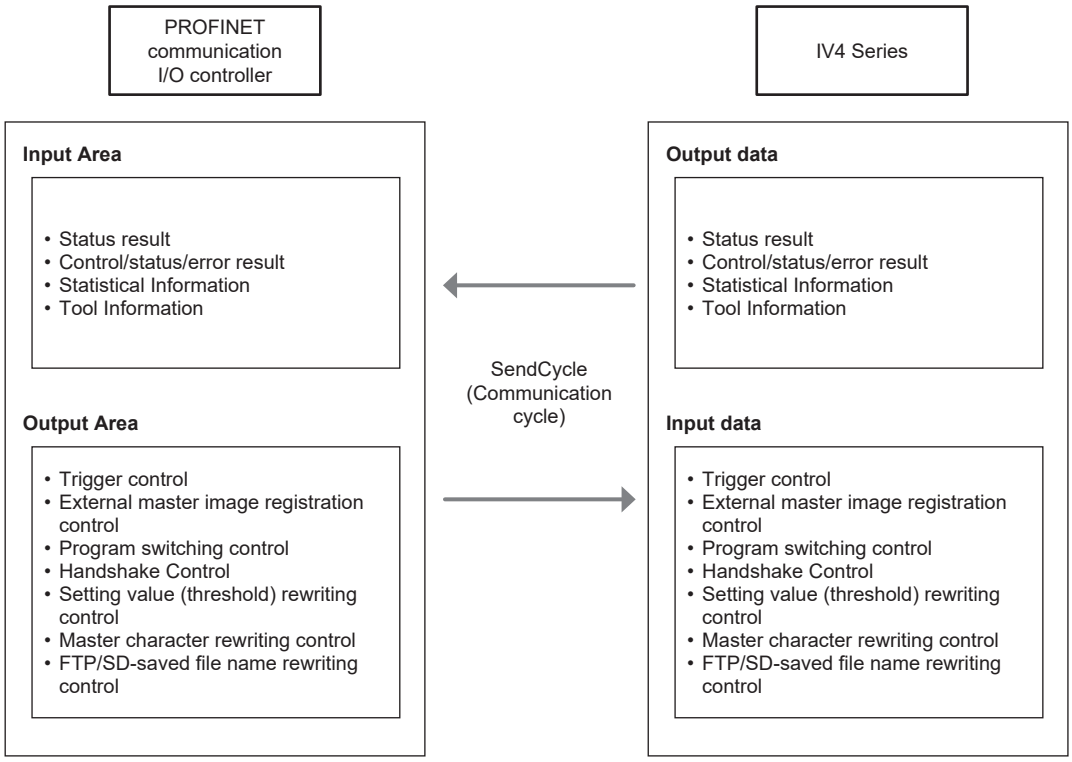
Functions Available with IV4 Series

The functions that can be used to control the IV4 Series via PROFINET communication are listed below.

Function	Description
Trigger input	Executes a trigger input for the sensor.
Change Program	Executes a program switch for the sensor.
Ext. Master Save	Executes an external master registration for the sensor.
Threshold rewriting	Rewrites the threshold that is used as the reference for tool judgment.
Master text/master date rewriting	Rewrites the master text/master date that is used as the reference for AI OCR judgment.
Rewrite FTP/SD-saved file name	Rewrites the name of the image file to transfer to the FTP server or SD card.
Warning clear input	Executes a warning clear.
Read status	Allows you to check the unit status (Imaging, RUN, BUSY, Error, etc.).
Read overall status result	Reads the overall status result.
Read processing time	Reads the processing time of the judgment.
Read each tool's status result	Reads each tool's status result and matching rate.
Read statistical information	Reads out the number of triggers issued and the number of trigger errors.
Master text/master date rewriting (batch)	Rewrites the master text/master date that is used as the reference for AI OCR judgment in a batch.
Rewrite FTP/SD-saved file name (batch)	Rewrites the name of the image file to transfer to the FTP server or SD card in a batch.
All program statistics reset request	Resets the statistics for all programs.
OCR serial no. count up input request	Counts up the serial number in the AI OCR tool (custom).
Reset count input request	• Resets the serial number in the AI OCR tool (custom). • Resets the count value of the AI Through Count tool (AI Through Count Mode).
Count up when result file transfer is completed	Counts up the number of times each FTP transfer and SD card transfer per trigger is completed. The transfer complete timing can be checked.
Overwriting the serial number for next OCR judgment (number or English alphabet)	Overwrites the serial number for the next judgment when setting the serial number in custom mode of the AI OCR tool.
Overwriting the count value	Overwrites the count value of the AI Through Count tool (AI Through Count mode).

Overview of the data I/O communication

Data I/O communication is high-speed communication in which data is sent and received periodically at intervals of several milliseconds to several tens of milliseconds.

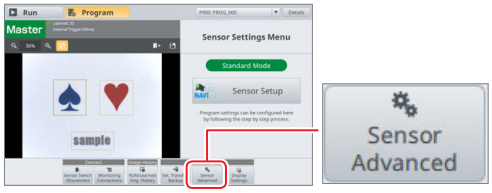


Point

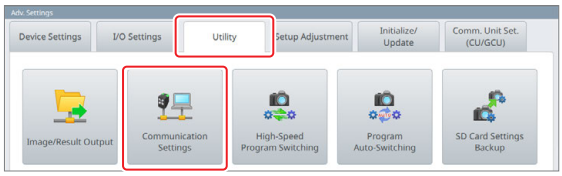
- **Communication settings for data I/O communication, such as SendCycle (communication cycle) and the data size, will be configured on the PLC side.**
- **In a network with many connected devices (including PROFINET devices), a network delay and/or packet loss may occur when there is a heavy load on the network. Conduct a thorough verification before the operation.**

Setting the IV4 Series (when using the communication function installed in the sensor)

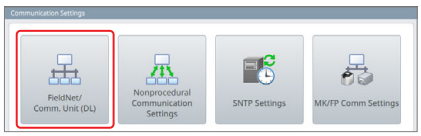
1 Press [Sensor Advanced] in the main screen in [Program].



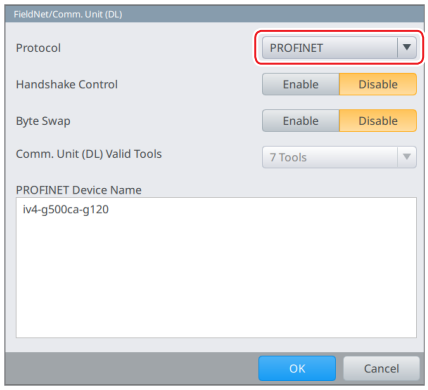
2 Select the [Utility] tab and select [Communication Settings].



3 Select [FieldNet/Comm. Unit (DL)].



4 Select [PROFINET] in [Protocol] for the field network.



Handshake Control

❍ Disable (default value)

Select if the trigger interval is greater than the communication cycle (RPI). A status result can be obtained in real time. In most situations, select [Disable].

❍ Enable

Select if the trigger interval is less than the communication cycle (RPI) and the number of triggers is 10 or less. If the status result is not picked up due to the trigger interval being faster than the communication cycle, the status result can be saved up to ten times in the buffer.

Point

If data handshake control has been set to [Enable], the status result will not be updated until [Result acquisition complete notice] (“Address2 Bit0” of Command Control) is input.
“Operating procedure of the data I/O communication” (page 9-78)

Byte swap

To enable byte swap for the data region, select [Enable].

Point

You can change the order of storing the characters read by AI OCR and the FTP/SFTP transfer file names into PLC data memory (2 byte) in unit of bytes.

- **Disable: First byte → Last byte (Example for the string "AB": 0x4142)**
- **Enable: Last byte → First byte (Example for the string "AB": 0x4241)**

Set byte swap in accordance with the specifications of each PLC. For details, see the instruction manual for the PLC.

PROFINET Device Name

Set the PROFINET device name as necessary.
Default value: The same as the IV4 Device Name

Point

- **Device naming rules for when PROFINET communication is used**
  - **Do not use characters other than "a-z", "0-9", "-", and ".".**
  - **"-" (Half-width hyphen) cannot be used at the beginning and end of the name.**
  - **"." (dot) cannot be used at the beginning of the name.**
  - **Two or more consecutive "." (dots) cannot be used.**
  - **IP addresses cannot be used.**
  - **"y port-x (x: 0-999)" cannot be used.**
  - **"n.n.n.n (n: 0-999)" cannot be used.**
  - **A string that begins with "xn-" cannot be used for PROFINET of a sensor.**
  - **A string that begins with "xn-" can be used for PROFINET of a communication unit (IV4-CU1/IV4-GCU1).**
- **The sensor will be restarted if the device name or network setting is modified while the PROFINET function is in use.**
- **Up to 240 characters can be used to set the PROFINET device name.**

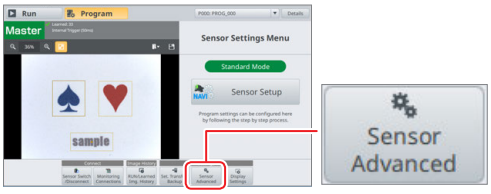
5 **When setting is completed, press [OK].**

The system returns to the Advanced Sensor Settings screen.

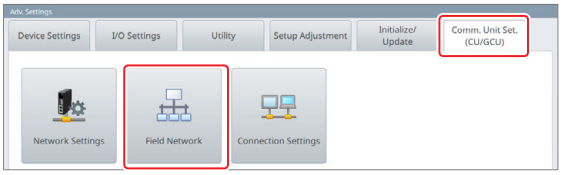
6 **Press [OK].**

Setting of communication unit (IV4-CU1/IV4-GCU1)

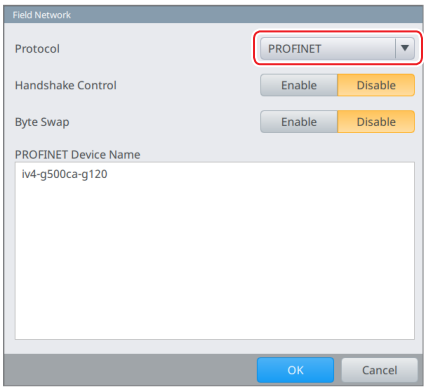
1 **Press [Sensor Advanced] in the main screen in [Program].**



2 **Select the [Comm. Unit Set. (CU/GCU)] tab, and press [Field Network].**



3 **Select [PROFINET] in [Protocol].**



Handshake Control

"Handshake Control" (page 9-55)

Byte Swap

"Byte swap" (page 9-56)

PROFINET Device Name

"PROFINET Device Name" (page 9-56)

4 **When setting is completed, press [OK].**

5 **Press [OK].**

The sensor and communication unit restart.

PLC settings

You can set the following settings for the PLC:

- **Establish a real-time communication for setting up the data I/O communication.**
- **Set the I/O device to be used for the data I/O communication.**

For details of the setting process, refer to the instruction manual of each PLC.

Data allocations in the data I/O communication

PROFINET communication for the IV4 Series is defined using the following modules:
- Command Control Module
- Command Status Bits Module
- Device Result Bits Module
- Device Status Words Module
- Device Statistics Module
- Position Adjust Result Module
- Tool Result Module

Reference When using standard mode and setting multiple position adjustment tools, the information of each position adjustment tool starting with the second one is assigned to a tool from Tool 1 to Tool 64.

Control Modules (PLC → IV4 Series)

Control Modules are modules that write instructions from the PLC to the IV4 Series.
For details of each parameter, refer to “Control Modules parameter details” (page 9-63).

Command Control

Slot No.: 1
Module size: 104 bytes

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0	Setting change request	SD saving stop request	Status result/ Buffer clear request	Statistics reset request	Warning clear request	Program switching request	Master registration request	Trigger request
1	Reserved by system			Reset count input request	OCR serial no. count up input request	All program statistics reset request	Reserved by system	
2	Reserved by system							Result acquisition complete notification
3	Reserved by system							
4 - 5	Program number							
6 - 7	Upper/lower limit setting No. (tools other than the AI OCR tool) Master text setting No. (AI OCR tool) Serial setting no. for next judgment (AI OCR tool) FTP/SD-saved setting No. (FTP client / SD card saving function) Count value change setting number (AI Through Count Mode)							
8 - 103	Upper/lower limit (tools other than the AI OCR tool) Master text/number of letters (AI OCR tool) Serial no. setting value for next judgment (AI OCR tool) FTP/SD saving settings (FTP client / SD card saving function) Count setting value (AI Through Count Mode)							

Status Modules (IV4 Series → PLC)

Status Modules are modules that write responses from the IV4 Series to the PLC.
For details of each parameter, refer to “Status Modules parameter details” (page 9-70).

Command Status Bits

Slot No.: 2
Module size: 4 bytes

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0	Setting value change response	SD card saving stop response	Status result/ Buffer clear response	Statistics reset response	Warning clear response	Program switching response	Master registration response	Trigger response
1	Setting value change failed	SD card saving stop failed	Reserved by system	Reset count input response	OCR serial no. count up input response	Program switch failed	Master registration failed	Trigger failed
2	SD card identification status	Trigger Ready	Ready	RUN	Imaging status	BUSY	Result update complete	Result available
3	Error	Warning	Buffer overrun	SD card Insufficient capacity	Reserved by system	AI Through Count mode run state	Reserved by system	Sorting mode information

Device Result Bits

Slot No.: 3
Module size: 4 bytes

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0	Reserved by system	Overall judgment NG	LOGIC4	LOGIC3	LOGIC2	LOGIC1	Position Adjustment	Total Status OK
1	Reserved by system				LOGIC8	LOGIC7	LOGIC6	LOGIC5
2	Tool 8	Tool 7	Tool 6	Tool 5	Tool 4	Tool 3	Tool 2	Tool 1
3	Tool 16	Tool 15	Tool 14	Tool 13	Tool 12	Tool 11	Tool 10	Tool 9

Device Status Words

Slot No.: 4
Module size: 16 bytes

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0 - 1	Error number (unsigned 16-bit data)							
2 - 3	Warning No. (unsigned 16-bit data)							
4 - 5	Number of remaining buffers (unsigned 16-bit data)							
6 - 7	Checksum (unsigned 16-bit data)							
8 - 9	Current program No. (unsigned 16-bit data)							
10 - 11	Program No. during judgment (unsigned 16-bit data)							
12 - 13	Result number (unsigned 16-bit data)							
14 - 15	Processing time (unsigned 16-bit data)							

Device Statistics

Slot No.: 5
Module size: 28 bytes

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0 - 1	Max. processing time (unsigned 16-bit data)							
2 - 3	Min. processing time (unsigned 16-bit data)							
4 - 5	Ave. processing time (unsigned 16-bit data)							
6 - 7	Reserved by system							
8 - 11	Number of triggers (unsigned 32-bit data)							
12 - 15	Number of OKs (standard mode)/number of sorts (sorting mode) (unsigned 32-bit data)							
16 - 19	Number of NGs (unsigned 32-bit data)							
20 - 23	Number of trigger errors (unsigned 32-bit data)							
24 - 27	Number of completed result output transfers (unsigned 32-bit data)							

Tool Result Modules (IV4 Series→ PLC)

Tool Result Modules are modules that write responses from the IV4 Series to the PLC.
For details of each parameter, refer to “Tool Result Modules parameter details” (page 9-74).

Position Adjust Result

Slot No.: 6
Module size: 20 bytes

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0 - 1	Position correction score (unsigned 16-bit data)							
2 - 3	Position correction score MAX (unsigned 16-bit data)							
4 - 5	Position correction score MIN (unsigned 16-bit data)							
6 - 7	Position correction score Lower threshold (unsigned 16-bit data)							
8 - 19	Reserved by system							

Tool Result

Slot No.: 7 to 70
Module size: 20 bytes

Position Adjustment/Hi-Sp.Adj/Learn/AI Identify/Total/Color Prohibit/Brightness Prohibit/Outline/Area/Color Area/Edge Pixel/Edge/Line Detection

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0 - 1	Tool matching rate							
2 - 3	Tool matching rate MAX							
4 - 5	Tool matching rate MIN							
6 - 7	Tool lower threshold							
8 - 9	Tool upper threshold							
10 - 19	Reserved by system							

Width/diameter

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0 - 1	Tool matching rate							
2 - 3	Tool matching rate MAX							
4 - 5	Tool matching rate MIN							
6 - 7	Tool lower threshold							
8 - 9	Tool upper threshold							
10 - 11	Tool scaling decimal point position							
12 - 19	Reserved by system							

Pitch

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0 - 1	Tool matching rate							
2 - 3	Tool matching rate MAX							
4 - 5	Tool matching rate MIN							
6 - 7	Tool lower threshold							
8 - 9	Tool upper threshold							
10 - 11	Tool scaling decimal point position							
12 - 13	Tool pitch present value MAX							
14 - 15	Tool pitch present value MIN							
16 - 17	Tool number of pitches							
18 - 19	Reserved by system							

Color/brightness average

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0 - 1	Tool matching rate							
2 - 3	Tool matching rate MAX							
4 - 5	Tool matching rate MIN							
6 - 7	Tool lower threshold							
8 - 9	Tool upper threshold							
10 - 11	Reserved by system							
12 - 13	Tool H (hue)*							
14 - 15	Tool S (saturation)*							
16 - 17	Tool V (brightness)							
18 - 19	Reserved by system							

Note: In the case of brightness average, H and S are always 0.

Blob Count

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0 - 1	Tool quantity							
2 - 3	Tool quantity MAX							
4 - 5	Tool quantity MIN							
6 - 7	Tool lower threshold							
8 - 9	Tool upper threshold							
10 - 19	Reserved by system							

AI Count

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0 - 1	Tool quantity							
2 - 3	Tool quantity MAX							
4 - 5	Tool quantity MIN							
6 - 7	Tool lower threshold							
8 - 9	Tool upper threshold							
10 - 11	Tool Missing window No. 1*							
12 - 13	Tool Missing window No. 2*							
14 - 15	Tool Missing window No. 3*							
16 - 17	Tool Missing window No. 4*							
18 - 19	Reserved by system							

* When Missing Part Detection is enabled: Missing window numbers are saved sequentially in the ascending order.

AI OCR

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0 - 1	Tool matching rate							
2 - 3	Tool lower threshold							
4 - 19	Tool text read							

AI Through Count Mode

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0-1	Lower 2 bytes of count value							
2-3	Upper 2 bytes of count value							
4-5	Lower 2 bytes of the threshold of output 1							
6-7	Upper 2 bytes of the threshold of output 1							
8-9	Lower 2 bytes of the threshold of output 2							
10-11	Upper 2 bytes of the threshold of output 2							
12-13	Lower 2 bytes of today's total count							
14-15	Upper 2 bytes of today's total count							
16-19	Reserved by system							

Extended Modules (IV4 Series → PLC)

Extended modules are modules that write responses from the IV4 to the PLC.
For details of each parameter, refer to “Extended Modules parameter details” (page 9-77).

Device Result Bits

Slot No.: 71
Module size: 8 bytes
Standard Mode

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0 to 1	Master number (unsigned 16-bit data)							
2	Tool 24	Tool 23	Tool 22	Tool 21	Tool 20	Tool 19	Tool 18	Tool 17
3	Tool 32	Tool 31	Tool 30	Tool 29	Tool 28	Tool 27	Tool 26	Tool 25
4	Tool 40	Tool 39	Tool 38	Tool 37	Tool 36	Tool 35	Tool 34	Tool 33
5	Tool 48	Tool 47	Tool 46	Tool 45	Tool 44	Tool 43	Tool 42	Tool 41
6	Tool 56	Tool 55	Tool 54	Tool 53	Tool 52	Tool 51	Tool 50	Tool 49
7	Tool 64	Tool 63	Tool 62	Tool 61	Tool 60	Tool 59	Tool 58	Tool 57

Sorting Mode

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0 to 1	Total status product type (unsigned 16-bit data)							
2 to 3	Tool 1 status product type (unsigned 16-bit data)							
4 to 5	Tool 2 status product type (unsigned 16-bit data)							
6 to 7	Tool 3 status product type (unsigned 16-bit data)							

Four Times More Detailed Tool Results (IV4 Series → PLC)

Four Times More Detailed Tool Results are modules that write responses from the IV4 Series to the PLC.
For details of each parameter, refer to “Four Times More Detailed Tool Results 0 to 79: Tool Results 4x Details” (page 9-76).

Four Times More Detailed Tool Results

Slot No.: 7-1 to 7-16
Module size: 80 bytes

Other than the AI OCR tool

After the tool result, 60 bytes of an area reserved by the system is added.

AI OCR Tool

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0 - 1	Tool matching rate							
2 - 3	Tool lower threshold							
4 - 5	Tool current serial No. Last (number)							
6 - 7	Tool current serial No. First (number)							
8 - 13	Tool current serial No. (ASCII text)							
14 - 15	Reserved by system							
16 - 17	Tool number of letters to be read							
18 - 19	Tool number of bytes to be read							
20 - 79	Tool text read							

Eight Times More Detailed Tool Results (IV4 Series → PLC)

Eight Times More Detailed Tool Results are modules that write responses from the IV4 Series to the PLC.
For details of each parameter, refer to “Eight Times More Detailed Tool Results 0 to 159: Tool Results 8x Details” (page 9-76).

Eight Times More Detailed Tool Results

Slot No.: 7-1 to 7-8
Module size: 160 bytes

Other than the AI OCR tool

After the tool result, 140 bytes of an area reserved by the system is added.

AI OCR Tool

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0 - 1	Tool matching rate							
2 - 3	Tool lower threshold							
4 - 5	Tool current serial No. Last (number)							
6 - 7	Tool current serial No. First (number)							
8 - 13	Tool current serial No. (ASCII text)							
14 - 15	Reserved by system							
16 - 17	Tool number of letters to be read							
18 - 19	Tool number of bytes to be read							
20 - 115	Tool text read							
116-159	Reserved by system							

Control Modules parameter details

Command Control Address 0 to 1: Control request

Address	Bit	Items	Description	Data content	AI Through Count Mode
0	0	Trigger request	Requests external trigger/internal trigger control	0: OFF, 1: ON	✓
	1	Master image registration request	Requests master image registration	0: OFF, 1: ON	-
	2	Program switching request	Requests program switching	0: OFF, 1: ON	✓
	3	Warning clear request	Requests warning clear	0: OFF, 1: ON	✓
	4	Statistics reset request	Requests statistics reset	0: OFF, 1: ON	-
	5	Status result/Buffer clear request	Requests status result/buffer clear	0: OFF, 1: ON	-
	6	SD card saving stop request	Requests SD card saving stop	0: OFF, 1: ON	✓
	7	Setting value change request	Requests setting value change	0: OFF, 1: ON	✓
1	0 to 1	Reserved by system	----	---	---
	2	All program statistics reset request	Requests all program statistics information reset	---	---
	3	OCR serial no. count up input request	Requests a count up of the serial number for AI OCR (custom) (Functions when OCR serial number count up input is enabled.)	---	---
	4	Reset count input request	Requests reset input of the total count in AI Through Count mode and the serial number in AI OCR (custom). (AI OCR (Custom): Batch resets tools with the reset input setting enabled.)	---	✓
	5 to 7	Reserved by system	----	---	---

Reference

- The following will occur when a buffer clear is requested:
  - If handshake control is [Enabled]
    - The current status result and the status result in the buffer will be cleared.
    - The result available bit will become OFF (0).
    - The number of remaining buffers will become “10”.
  - If the handshake control is [Disabled]
    - The current status result will be cleared.
    - The result available bit will become OFF (0).
- If you are switching programs using PROFINET communication, set the [Switching method] option to [Panel/PC/Network/Automatic Switching].
  “Program Switching Method” (page 7-13)
- Buffer overrun and warning statuses will not be cleared even if you execute a buffer clear request.
- To request a trigger, set the [Trigger Type] option to [External Trigger].

Command Control Address 2 to 3: Handshake control

Address	Bit	Items	Description	Data content	AI Through Count Mode
2	0	Result acquisition complete notification	Permits the updating of the status result.	0: OFF, 1: ON	---
	1 to 7	Reserved by system	----	---	---
3	0 to 7	Reserved by system	----	---	---

Reference

A result acquisition completion notice is used when handshake control is [Enabled].
For details, refer to “Reading out the status result (handshake control: [Enable]; Preliminary capture: [Disable])” (page 9-80).

Command Control Address 4 to 5: Program No.

Address	Data type*	Items	Description	Data content	AI Through Count Mode
4 to 5	WORD	Program number	The program number when program switching is requested.	0 to 127	✓

* WORD: Unsigned 16-bit integer

Command Control Address 6 to 11: Threshold (for a tool other than AI OCR (when [Show Matching Rate] is disabled) and high-speed position adjustment tool)

Address	Data type*	Items	Description	Data content	AI Through Count Mode
6 to 7	WORD	Upper/lower limit setting No.	Destination of the threshold value to be changed.	0 to 129	✓
8 to 11	DWORD	Upper/lower limit	The threshold value for when a threshold value change is requested.	0 to 99999	✓

* WORD: Unsigned 16-bit integer
DWORD: Unsigned 32-bit integer

Reference

The setting value setting number rules are shown below.

0: Position correction lower threshold
1: Reserved by system
2: Tool 1 lower threshold 3: Tool 1 upper threshold
4: Tool 2 lower threshold 5: Tool 2 upper threshold
6: Tool 3 lower threshold 7: Tool 3 upper threshold
.
.
32: Tool 16 lower threshold 33: Tool 16 upper threshold
.
.
128: Tool 64 lower threshold 129: Tool 64 upper threshold

To change the threshold of a tool which is using scaling function, input the value which is 10 times of the threshold in [Threshold].
Example) 9999 → 99990 99.9 → 999

NOTICE

Cutoff processing is done for a number of 4 or more digits.
Example) 99995 → 99990

Command Control Address 6 to 103: Master text (for AI OCR)

Address	Data type*	Items	Description	Data content	AI Through Count Mode
6 to 7	WORD	Master text setting No.	The destination for a master text change • Method 1: Batch change (Supports up to 32 characters) • Method 2: Change four characters at a time (Supports up to 16 characters)	• Method 1: Batch change • String mode (string identification): 1501 to 1564 • Date/time mode: 1601 to 1664 • Method 2: Change four characters at a time • String mode (string identification): 201 to 456 • String mode (when only judging the number of letters): 501 to 628 • Date/time mode: 701 to 956	-
8 to 103	---	Master text	The master text/number of letters after a change.	• Master text when the text/date reading settings are set (Batch change: UTF-8, change 4 characters at a time: ASCII) • Minimum and maximum number of letters when judging only the number of letters: 0 to 32 (DWORD*)	-

* WORD: Unsigned 16-bit integer
DWORD: Unsigned 32-bit integer

Method 1: To change the master text (string mode (string identification)/date/time) in a batch

- Specify [Master text setting No.] and write the text in the applicable address number in the table below.
- Append NULL (0x00) to the end of all text that you want to change. If you overwrite using all [Master text] addresses, NULL (0x00) does not need to be appended.
- When the master text is changed, it is not saved in non-volatile memory.
- The below example is for 1-byte characters (ASCII compatible area).
  When using 3-byte characters, also use Address 39 and after (for 3-byte characters x 32 characters, use up to Address 103).

Address	Stored data			
	Tool 1	Tool 2	· · ·	Tool 64*1
6 to 7 (WORD)	1501	1502	· · ·	1564
8	1st letter	1st letter	· · ·	1st letter
9	2nd letter	2nd letter	· · ·	2nd letter
. . .	. . .	. . .	. . .	. . .
38	31st letter	31st letter	· · ·	31st letter
39	32nd letter	32nd letter	· · ·	32nd letter

Address	Stored data			
	Tool 1	Tool 2	· · ·	Tool 64*1
6 to 7 (WORD)	1601	1602	· · ·	1664
8	1st letter	1st letter	· · ·	1st letter
9	2nd letter	2nd letter	· · ·	2nd letter
. . .	. . .	. . .	. . .	. . .
38	31st letter	31st letter	· · ·	31st letter
39	32nd letter	32nd letter	· · ·	32nd letter

*1 The number of AI OCR tools that can be set in one program are 16. However, when used with other detection tools, an AI OCR tool can be configured as the 64th tool, so the setting number is available up to tool 64.

Point

- **Correctly set byte swap in accordance with the PLC specifications.**
- **This will fail if it is AI OCR (custom mode).**

Method 2: To change the master text/date (change 4 characters at a time)

- Specify [Master text setting No.] and write the text in the applicable address number in the table below.
- Change the file name in groups of four letters. Also append NULL (0x00) to the end of the text that you want to change. Overwrite the text from the beginning of the text until NULL (0x00) at the end in groups of four letters. Not appending NULL (0x00) will not allow you to correctly change the master text/date. If you overwrite all 16 letters, NULL (0x00) does not need to be appended.
- Change of the 17th character and beyond is not supported. Use method 1 to change the 17th character and beyond.
- For details of how to change the master text, see “Changing the master text (change 4 characters at a time)” (page 9-84).

Address	Stored data								
	Tool 1				Tool 2	· · ·	· · ·	Tool 64*	
6 to 7 (WORD)	201	202	203	204	205	· · ·	· · ·	· · ·	456
8	1st letter	5th letter	9th letter	13th letter	1st letter	· · ·	· · ·	· · ·	13th letter
9	2nd letter	6th letter	10th letter	14th letter	2nd letter	· · ·	· · ·	· · ·	14th letter
10	3rd letter	7th letter	11th letter	15th letter	3rd letter	· · ·	· · ·	· · ·	15th letter
11	4th letter	8th letter	12th letter	16th letter	4th letter	· · ·	· · ·	· · ·	16th letter

Address	Stored data								
	Tool 1				Tool 2	· · ·	· · ·	Tool 64*	
6 to 7 (WORD)	701	702	703	704	705	· · ·	· · ·	· · ·	956
8	1st letter	5th letter	9th letter	13th letter	1st letter	· · ·	· · ·	· · ·	13th letter
9	2nd letter	6th letter	10th letter	14th letter	2nd letter	· · ·	· · ·	· · ·	14th letter
10	3rd letter	7th letter	11th letter	15th letter	3rd letter	· · ·	· · ·	· · ·	15th letter
11	4th letter	8th letter	12th letter	16th letter	4th letter	· · ·	· · ·	· · ·	16th letter

To set the number of letters when judging only the number of letters

Address	Stored data								
	Tool 1		Tool 2		Tool 3	· · ·	· · ·	Tool 64*	
6 to 7 (WORD)	501	502	503	504	505	· · ·	· · ·	627	628
8 to 11 (DWORD)	Minimum number of letters	Maximum number of letters	Minimum number of letters	Maximum number of letters	Minimum number of letters	· · ·	· · ·	Minimum number of letters	Maximum number of letters

* The number of AI OCR tools that can be set in one program are 16. However, when used with other detection tools, an AI OCR tool can be configured as the 64th tool, so the setting number is available up to tool 64.

Point

- **Correctly set [Byte Swap] in accordance with the PLC specifications.**
  “Setting the IV4 Series (when using the communication function installed in the sensor)” (page 9-55)
- **This will fail if it is AI OCR (custom mode).**

Command Control Address 6 to 11: Change Serial Number for Next OCR Judgment (Numerical Value)

When the serial number is changed, it is not saved in non-volatile memory.

Address	Data Type*1	Items	Description	Data content	AI Through Count Mode
6 to 7	WORD	Change the serial setting number (numerical value) for next OCR judgment	The setting number for changing the serial number for the next judgment of the AI OCR tool (custom mode)	Tool 1: 1701 onwards Tool 64*2: 1764	-
8 to 11	DWORD	Serial no. for next OCR judgment	The serial number for when a serial number change is requested	0 to 999999	-

*1 WORD: Unsigned 16-bit integer
DWORD: Unsigned 32-bit integer
*2 The number of AI OCR tools that can be set in one program are 16. However, when used with other detection tools, an AI OCR tool can be configured as the 64th tool, so the setting number is available up to tool 64.

Command Control Address 6 to 13: Change Serial Number for Next OCR Judgment (Letter)

When the serial number is changed, it is not saved in non-volatile memory.

Address	Data Type*1	Items	Description	Data content	AI Through Count Mode
6 to 7	WORD	Change the serial setting number (letter) for next OCR judgment	The setting number for changing the serial number for the next judgment of the AI OCR tool (custom mode)	Tool 1: 1801 onwards Tool 64*2: 1864	-
8 to 13	ASCII	Serial no. for next OCR judgment	The serial number after it is changed	A to ZZZZZZ	-

*1 WORD: Unsigned 16-bit integer
*2 The number of AI OCR tools that can be set in one program are 16. However, when used with other detection tools, an AI OCR tool can be configured as the 64th tool, so the setting number is available up to tool 64.

Changing the Serial Number (Letter) for the Next Judgment of the AI OCR Tool (Custom Mode)

Address	Stored data			
	Tool 1	Tool 2	· · ·	Tool 64
6 to 7 (WORD)	1801	1802	· · ·	1864
8	1st letter	1st letter	· · ·	1st letter
9	2nd letter	2nd letter	· · ·	2nd letter
10	3rd letter	3rd letter	· · ·	3rd letter
11	4th letter	4th letter	· · ·	4th letter
12	5th letter	5th letter	· · ·	5th letter
13	6th letter	6th letter	· · ·	6th letter

Command Control Address 6 to 71: Batch Change FTP/SD Save File Name (FTP Client/SD Card Saving Function)

Address	Data type*	Items	Description	Data content	AI Through Count Mode
6 to 7	WORD	Batch changing FTP/SD-saved file name setting number	The setting number to change the FTP/SD-saved file name in a batch	• Does not save to non-volatile memory (Deleted when the power is turned off) • Transfer condition 1: 1031 • Transfer condition 2: 1032 • Transfer condition 3: 1033 • Transfer condition 4: 1034 • Save to nonvolatile memory • Transfer condition 1: 1041 • Transfer condition 2: 1042 • Transfer condition 3: 1043 • Transfer condition 4: 1044	-
8 to 71	---	FTP/SD-saved file name	The file name after it is changed	File name character (ASCII) The following characters can be used: 0-9, a-z, A-Z, ' '[space], '(', ')', '+', '-', '=', '_', '.', '', '!', '#', '$', '%', '&', '@'	-

* WORD: Unsigned 16-bit integer

To batch change the FTP/SD-saved file name

- Specify [Batch change FTP/SD-saved file name setting number] and write the string in the applicable address in the table below after the change.
- Append NULL (0x00) to the end of all text that you want to change. If you overwrite using all [FTP/SD-saved file name] addresses, NULL (0x00) does not need to be appended.

❍ Does not save to non-volatile memory (deleted when the power is turned off)

Address	Stored data			
	Transfer Condition 1	Transfer Condition 2	Transfer Condition 3	Transfer condition 4
6 to 7 (WORD)	1031	1032	1033	1034
8	1st letter	1st letter	1st letter	1st letter
9	2nd letter	2nd letter	2nd letter	2nd letter
. . .	. . .	. . .	. . .	. . .
70	63rd letter	63rd letter	63rd letter	63rd letter
71	64th letter	64th letter	64th letter	64th letter

❍ Save to nonvolatile memory

Address	Stored data			
	Transfer Condition 1	Transfer Condition 2	Transfer Condition 3	Transfer condition 4
6 to 7 (WORD)	1041	1042	1043	1044
8	1st letter	1st letter	1st letter	1st letter
9	2nd letter	2nd letter	2nd letter	2nd letter
. . .	. . .	. . .	. . .	. . .
70	63rd letter	63rd letter	63rd letter	63rd letter
71	64th letter	64th letter	64th letter	64th letter

Command Control Address 6 to 11: FTP/SD Save File Name (Change 4 Characters at a Time) (FTP Client/SD Card Saving Function)

Address	Data type*	Items	Description	Data content	AI Through Count Mode
6 to 7	WORD	FTP/SD-saved setting No.	• The transfer condition number for the file name to change and the setting number specifying whether to write to non-volatile memory • The setting number specifying the character position in the file name to change. (The 64-character file name is subdivided so the setting number can be specified in groups of four letters.)	• File name transfer condition number and specifying whether to write to non-volatile memory: 1001 • File name character position specification: 1011 to 1026	✓
8 to 11	---	FTP/SD saving settings	When [FTP/SD-saved setting No.] is 1001 Bit 0: Transfer condition 1 Bit 1: Transfer condition 2 Bit 2: Transfer condition 3 Bit 3: Transfer condition 4 Bits 4 to 7: Reserved by system Bit 8: Write to non-volatile memory Bits 9 to 31: Reserved by system When [FTP/SD-saved setting No.] is 1011 to 1026 The file name after it is changed. (Changes the file name in groups of four letters)	When [FTP/SD-saved setting No.] is 1001 0: OFF 1: ON When [FTP/SD-saved setting No.] is 1011 to 1026 File name character (ASCII) The following characters can be used: 0-9, a-z, A-Z, ' '[space], '(', ')', '+', '-', '=', '_', '.', '', '!', '#', '$', '%', '&', '@'	✓

* WORD: Unsigned 16-bit integer

To change the FTP/SD-saved file name

- Write 1001 to [FTP/SD-saved setting No.: Addresses 6 to 7] and specify the transfer condition for changing the file name.
- Use [FTP/SD saving settings: Addresses 8 to 11] to set to ON (1) the bit of the transfer condition number to change. If multiple bits are set to ON (1), the condition with the smallest number is specified. If all the bits are set to OFF (0), transfer condition 1 is specified. Set the non-volatile memory writing flag bit to OFF (0) when not writing and to ON (1) when writing.

Address	Stored data
6 to 7 (WORD)	1001

Address	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
8	Reserved by system				Transfer condition 4	Transfer Condition 3	Transfer Condition 2	Transfer Condition 1
9	Reserved by system							Non-volatile memory writing flag
10	Reserved by system							
11	Reserved by system							

- Write to [FTP/SD-saved setting No.: Addresses 6 to 7] the setting number corresponding to the character position in the file name to change.
- Write to [FTP/SD saving settings: Addresses 8 to 11] the character string after the change.
- Change the file name in groups of four letters. Add a NULL (0x00) after the character string to change to. Overwrite the file name in groups of four letters from the starting letter to the ending NULL (0x00). If NULL (0x00) is not added, it will not be possible to change to the correct file name. When overwriting all 64 characters, there is no need to add NULL (0x00).
- For details on how to make this change, refer to “Changing the FTP/SD-saved file name (batch change)” (page 9-85).

Address	Stored data						
6 to 7 (WORD)	1011	1012	1013	1014	· · ·	1025	1026
8	1st letter	5th letter	9th letter	13th letter	· · ·	57th letter	61st letter
9	2nd letter	6th letter	10th letter	14th letter	· · ·	58th letter	62nd letter
10	3rd letter	7th letter	11th letter	15th letter	· · ·	59th letter	63rd letter
11	4th letter	8th letter	12th letter	16th letter	· · ·	60th letter	64th letter

Command Control Address 6 to 11: Change Count Value in AI Through Count Mode

Address	Data type*	Items	Description	Data content	AI Through Count Mode
6 to 7	WORD	Change count value in AI Through Count mode Setting number	The setting number for changing the count value in AI Through Count mode	Tool 1: 1901 to Tool 8: 1908	-
8 to 11	DWORD	Count Value	The count value for when a count value change is requested	0 to 9999999	-

* WORD: Unsigned 16-bit integer
DWORD: Unsigned 32-bit integer

Status Modules parameter details

Command Status Bits Address 0: Control Result 1 (response)

Address	Bit	Items	Description	Data content	AI Through Count Mode
0	0	Trigger response	Response from External Trigger, Internal Trigger Control/AI Trigger Control	0: OFF, 1: ON	✓
	1	Master image registration response	Response to master image registration	0: OFF, 1: ON	-
	2	Program switching response	Response to program switching	0: OFF, 1: ON	✓
	3	Warning clear response	Response to the warning clear	0: OFF, 1: ON	✓
	4	Statistics reset response	Response to the statistics reset request	0: OFF, 1: ON	-
	5	Status result/Buffer clear response	Response to status result/buffer clear request	0: OFF, 1: ON	-
	6	SD card saving stop response	Response to the SD card saving stop request	0: OFF, 1: ON	✓
	7	Setting value change response	Response to the setting value change request	0: OFF, 1: ON	✓

Command Status Bits Address 1: Control Result 2 (response)/Control error result

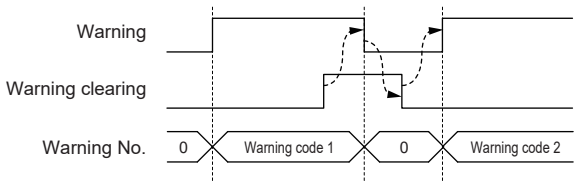
Address	Bit	Items	Description	Data content	AI Through Count Mode
1	0	Trigger failed	The trigger request failed	0: -, 1: Failed	-
	1	Master image registration failed	Registration of the master image failed	0: -, 1: Failed	-
	2	Program switching failed	Switching programs failed	0: -, 1: Failed	✓
	3	OCR Serial Number Count-up Input response	Response to the count up input request. Target: AI OCR (standard mode)	0: OFF, 1: ON	-
	4	Reset count input response	Response to the reset count input request. Target: • AI OCR (standard mode) • Count Tool (AI Through Count Mode)	0: OFF, 1: ON	✓
	5	Reserved by system	----	---	-
	6	SD card saving stop failed	Failed to stop the SD card saving (Failure cause: SD card save stop request turned on during Sensor Setup)	0: -, 1: Failed	✓
	7	Setting value change failed	Failed to change the setting value	0: -, 1: Failed	✓

Command Status Bits Address 2 to 3: Handshake control/status/error result

Address	Bit	Items	Description	Data content	AI Through Count Mode
2	0	Result available	This bit is output when the status result can be acquired.	0 : - 1: Available	-
	1	Result update complete	This bit switches the ON/OFF statuses when the status result is updated.	0 ↔ 1	-
	2	BUSY	This bit is output when the unit is unable to accept new trigger inputs, such as while performing imaging, processing a judgment, registering an external master image, switching programs, etc.	0 : - 1: Busy state	✓
	3	Imaging	This bit is output while the unit is performing imaging operation.	0 : - 1: Imaging	✓
	4	RUN	This bit is output when the unit is “RUN” and no system errors have occurred.	0 : - 1: Normal operating status	✓
	5	Ready	This bit is output when the start-up sequence of this unit completes after power-on.	0: Start-up not completed 1: Start-up completed	✓
	6	Trigger Ready	This is output when the trigger can be received.	0: Trigger cannot be received 1: Trigger can be received	✓
	7	SD card identification status	This bit is output when the SD card is recognized.	0 : - 1: SD card recognized	✓
3	0	Sorting mode information	This bit is output when the unit is in [RUN] status and Sorting mode.	0 : - 1 : In [RUN] status in Sorting mode	-
	1	Reserved by system	----	---	-
	2	AI Through Count mode run state	This bit is output in AI Through Count mode while running	0 : - 1: Run state in AI Through Count mode	✓
	3	Reserved by system	----	---	-
	4	Insufficient SD card capacity	This bit is output when the free space on the SD card is 100 MB or less.	0: No insufficient free space error has occurred. 1: An insufficient free space (100 MB or less) error has occurred.	✓
	5	Buffer overrun status	If handshake control is [Enabled], this bit is output when an overrun of the status result has occurred.	0: No buffer overrun has occurred. 1: The buffer is in overrun status.	-
	6	Warning status	This bit outputs the warning status of the unit.	0: The unit is not in warning status. 1: The unit is in warning status.	✓
	7	Error status	This bit outputs the error status of the unit.	0: The unit is not in error status. 1: The unit is in error status.	✓

Reference

- By monitoring whether the unit is in “Imaging” status, you can determine whether the target object or the unit can be moved before completion of the image processing.
- “BUSY” and “Imaging” statuses may be skipped due to the data I/O cycle settings. It is therefore necessary to take the imaging condition into consideration when setting the cyclic communication frequency.
- Warning statuses can be cleared from the PROFINET communication. For the warning details, refer to the warning code. The first occurred warning code will be displayed.
- When two or more warnings are issued, all subsequent warnings after the first warning will be saved in the history. If you clear the warnings, the warning code of the highest priority warning will be displayed.



- Error statuses cannot be cleared from the PROFINET communication. For the error details, refer to the error code. The error code of the highest priority error will be displayed.
- The buffer overrun status can be cleared using a warning clear.

Device Results Bits Address 0 to 3: Status result

Address	Bit	Items	Description	Data content	AI Through Count Mode
0	0	Total Status OK	Total status OK result	0: NG, 1: OK	-
	1	Position Adjustment	Position adjustment result	0: NG, 1: OK	-
	2	Logic 1	Result of Logic 1	0: NG, 1: OK	✓
	3	Logic 2	Result of Logic 2	0: NG, 1: OK	✓
	4	Logic 3	Result of Logic 3	0: NG, 1: OK	✓
	5	Logic 4	Result of Logic 4	0: NG, 1: OK	✓
	6	Overall judgment NG	Total status NG result	0 : OK, 1: NG	-
	7	Reserved by system	----	---	-
1	0	Logic 5	Result of Logic 5	0: NG, 1: OK	✓
	1	Logic 6	Result of Logic 6	0: NG, 1: OK	✓
	2	Logic 7	Result of Logic 7	0: NG, 1: OK	✓
	3	Logic 8	Result of Logic 8	0: NG, 1: OK	✓
	4	Reserved by system	----	---	-
	5	Reserved by system	----	---	-
	6	Reserved by system	----	---	-
	7	Reserved by system	----	---	-
2	0	Tool 1	Displays the result of Tool 1. Stores Output 1 of Tool 1 in AI Through Count mode.	0: NG, 1: OK	✓
	1	Tool 2	Displays the result of Tool 2. Stores Output 1 of Tool 2 in AI Through Count mode.	0: NG, 1: OK	✓
	2	Tool 3	Displays the result of Tool 3. Stores Output 1 of Tool 3 in AI Through Count mode.	0: NG, 1: OK	✓
	3	Tool 4	Displays the result of Tool 4. Stores Output 1 of Tool 4 in AI Through Count mode.	0: NG, 1: OK	✓
	4	Tool 5	Displays the result of Tool 5. Stores Output 1 of Tool 5 in AI Through Count mode.	0: NG, 1: OK	✓
	5	Tool 6	Displays the result of Tool 6. Stores Output 1 of Tool 6 in AI Through Count mode.	0: NG, 1: OK	✓
	6	Tool 7	Displays the result of Tool 7. Stores Output 1 of Tool 7 in AI Through Count mode.	0: NG, 1: OK	✓
	7	Tool 8	Displays the result of Tool 8. Stores Output 1 of Tool 8 in AI Through Count mode.	0: NG, 1: OK	✓
3	0	Tool 9	Displays the result of Tool 9. Stores Output 2 of Tool 1 in AI Through Count mode.	0: NG, 1: OK	✓
	1	Tool 10	Displays the result of Tool 10. Stores Output 2 of Tool 2 in AI Through Count mode.	0: NG, 1: OK	✓
	2	Tool 11	Displays the result of Tool 11. Stores Output 2 of Tool 3 in AI Through Count mode.	0: NG, 1: OK	✓
	3	Tool 12	Displays the result of Tool 12. Stores Output 2 of Tool 4 in AI Through Count mode.	0: NG, 1: OK	✓
	4	Tool 13	Displays the result of Tool 13. Stores Output 2 of Tool 5 in AI Through Count mode.	0: NG, 1: OK	✓
	5	Tool 14	Displays the result of Tool 14. Stores Output 2 of Tool 6 in AI Through Count mode.	0: NG, 1: OK	✓
	6	Tool 15	Displays the result of Tool 15. Stores Output 2 of Tool 7 in AI Through Count mode.	0: NG, 1: OK	✓
	7	Tool 16	Displays the result of Tool 16. Stores Output 2 of Tool 8 in AI Through Count mode.	0: NG, 1: OK	✓

Reference

- If the position correction/logic/tool is not set, the data content will be “0”.
- If the status result of the tool is either “trigger standby” (no judgment) or “judgment not possible”, the data content will be OFF (0).

Device Status Words Address 0 to 15: Error/status/status result information

Address	Data Type*	Items	Description	Data content	AI Through Count Mode
0 to 1	WORD	Error code	Displays the currently occurring error code.	0 to 128	✓
2 to 3	WORD	Warning code	Displays the currently occurring warning code.	0 to 128	✓
4 to 5	WORD	Number of remaining buffers	Displays the number of status results that can be buffered, if handshake control is [Enabled].	0 to 10	-
6 to 7	WORD	Checksum	Displays the current sensor setting status using an arbitrary 5-digit integer.	0 to 65535	✓
8 to 9	WORD	Current program No.	Displays the current program No.	0 to 127	✓
10 to 11	WORD	Program No. during judgment	Displays the program No. of the latest judgment process.	0 to 127	✓
12 to 13	WORD	Result No.	Displays the judgment process counts.	0 to 32767	✓
14 to 15	WORD	Processing time	Displays the processing time of the latest judgment process.	0 to 10000	✓

* WORD: Unsigned 16-bit integer
DWORD: Unsigned 32-bit integer

Reference
- The unit of processing time is msec.
- Error and warning codes can be found on the Error Number Search site on the KEYENCE website.
  www.keyence.com/iv4_trouble_support
- If two or more errors are occurring at the same time, the error code of the highest priority error will be displayed.
- The first occurred warning code will be displayed.
- A checksum can be used to monitor whether the sensor settings have been modified by a third party.
- The checksum can check whether program is switched.
- The checksum will remain unchanged even if you change the IP address, subnet mask, default gateway or port number of the IV4 Series.
- For the number of remaining buffers, refer to “Reading out the status result (handshake control: [Enable]; Preliminary capture: [Disable])” (page 9-80).
- The upper limit value of the result No. is 32767. If the maximum value is exceeded, it will go back to 0 and start counting up again.
- The result No. will also count the judgment process counts that were skipped due to the data I/O cycle settings.

Device Statistics Address 0 to 27 (Statistics information)

Address	Data Type*	Items	Description	Data content	AI Through Count Mode
0 to 1	WORD	Processing time MAX	Displays the maximum processing time value.	0 to 10000	✓
2 to 3	WORD	Processing time MIN	Displays the minimum processing time value.	0 to 10000	✓
4 to 5	WORD	Processing time AVE	Displays the average processing time value.	0 to 10000	✓
6 to 7	---	Reserved by system	----	---	-
8 to 11	DWORD	Trigger No.	Displays the total number of triggers issued.	0-1000000000	-
12 to 15	DWORD	OK count (standard mode) Total sort count (sorting mode)	Displays the total number of issued triggers whose total status result was “OK” or with which the product type was determined.	0-1000000000	-
16 to 19	DWORD	Number of NGs (standard mode/sorting mode)	Displays the total number of issued triggers whose total status result was “NG” or with which the product type was not determined.	0-1000000000	-
20 to 23	DWORD	Number of trigger errors	Number of triggers issued as error triggers.	0-1000000000	-
24 to 27	DWORD	Number of completed result output transfers	Counts up for each completed transfer of images and judgment results (text files) to FTP/SFTP/SD card. (If multiple transfer conditions are used, the count up is performed upon completion of the transfer of all files matching the conditions.)	0-1000000000	-

* WORD: Unsigned 16-bit integer
DWORD: Unsigned 32-bit integer

Reference
- The unit of processing time is msec.
- If the number of triggers or the number of times of the completion of result output transfer exceeds the upper limit, the counting up starts from 0 again.
- The number of OK triggers, the number of NG triggers, and the number of trigger errors stop counting up at the upper limit.
- A reset will occur in the following conditions:
  - When [Statistics reset] is input
  - When a tool is added/deleted/copied
  - When the sensor is switched OFF
  - When the program is switched
  - When a correction for the sensor is started
  - When the sensor is initialized

Tool Result Modules parameter details

Position Adjust Result Address 0 to 19 (Position correction information)

The Bits at Address 0 to 19 of the Position Adjust Result (slot No.: 6) have the following functions:

Address	Data Type*	Items	Description	Data content	AI Through Count Mode
0 to 1	WORD	Position adjustment tool matching rate	Stores the matching rate of the position adjustment tool.	0 to 100	-
2 to 3	WORD	Position adjustment tool matching rate MAX	Stores the maximum matching rate value of the position adjustment tool.	0 to 100	-
4 to 5	WORD	Position adjustment tool matching rate MIN	Stores the minimum matching rate value of the position adjustment tool.	0 to 100	-
6 to 7	WORD	Position adjustment tool threshold	Stores the threshold value of the position adjustment tool.	0 to 100	-
8 to 19	---	Reserved by system	----	---	-

* WORD: Unsigned 16-bit integer
DWORD: Unsigned 32-bit integer

Reference Maximum and minimum matching rate values of the position adjustment tool will be reset in the same manner as the statistics information.

Tool Result Address 0 to 19 (Tool information: AI OCR, when in a mode other than AI Through Count mode)

The Bits at Address 0 to 19 of the Tool Result (slot No.: 7 to 70) have the below functions.

Address	Data Type*	Items	Description	Data content
0 to 1	WORD	Tool matching rate	Stores the tool matching rate.	0 to 9999
2 to 3	WORD	Tool matching rate MAX	Stores the maximum tool matching rate value.	0 to 9999
4 to 5	WORD	Tool matching rate MIN	Stores the minimum tool matching rate value.	0 to 9999
6 to 7	WORD	Tool lower threshold	Stores the tool lower threshold value.	0 to 9999
8 to 9	WORD	Tool upper threshold	Stores the tool upper threshold value.	0 to 9999
10 to 11	WORD	Tool decimal point position	Stores the decimal point position for matching rate when scaling is enabled with the Width/Diameter/Pitch tool.	0: No decimal point 1: 1 digit after decimal point 2: 2 digits after decimal point 3: 3 digits after decimal point
12 to 13	WORD	Tool Pitch present value MAX Color average H (hue)	Maximum value of all pitches	0 to 9999
			Color Average tool H (hue)	0 to 359
14 to 15	WORD	Tool Pitch present value MIN Color average S (saturation)	Minimum value of all pitches	0 to 9999
			Color Average tool S (saturation)	0 to 255
16 to 17	WORD	Tool Number of pitches Color average V (brightness) Brightness average brightness	Number of pitches	0 to 9999
			Color Average tool V (brightness)	0 to 255
			Brightness Average tool brightness	0 to 255
18 to 19	---	Reserved by system	----	---

* WORD: Unsigned 16-bit integer
DWORD: Unsigned 32-bit integer

The information of tools 1, 2, ... 64 will be assigned for each slot number (7 to 70).

Reference
- Maximum and minimum matching rate values of the tool will be reset in the same manner as the statistics information.
- If the upper threshold value of the tool is not set, the data content of the tool's upper limit value will be "65535".
- The decimal point position when the scaling is enabled is applied to the data results of matching rate, matching rate MAX, matching rate MIN, lower threshold, upper threshold, pitch present value MAX, pitch present value MIN.
  (Example): When the "Tool 1 matching rate" is 505 and "Tool 1 decimal point position" is 1, the matching rate of Tool 1 is "50.5".
- The information for tools (other than the learning tool) in sorting mode outputs the information of the tool that was determined as the master image registered to the judged product type. If the status of sorting is NG, the information of product type M0 is output. However, MAX, MIN, and the thresholds are invalid values.

Tool Result Address 0 to 19 (Tool information: AI OCR)

The Bits at Address 0 to 19 of the Tool Result (slot No.: 7 to 70) have the below functions.

Address	Data type*1	Items	Description	Data content*2
0 to 1	WORD	Tool matching rate	Stores the tool matching rate.	• When Show Matching Rate is disabled: 0: NG, 100: OK • When Show Matching Rate is enabled: 0 to 100
2 to 3	WORD	Tool lower threshold	Stores the tool lower threshold value.	0 to 100
4 to 19	---	Tool text read	Stores text read (up to 16 letters) by the tool. If the number of letters is less than 16, the remaining devices are stored as NULL.	UTF-8

*1: WORD: Unsigned 16-bit integer
*2: When the tool is not set, 0 is stored in all devices (20 bytes).

Example of tool 1 text read

Trigger Count	Text read	Address															
		4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1st	ABCDEF	A (0x41)	B (0x42)	C (0x43)	D (0x44)	E (0x45)	F (0x46)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)
2nd	ABF	A (0x41)	B (0x42)	F (0x46)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)
3rd	ABCDEFGHIJKLMNOP	A (0x41)	B (0x42)	C (0x43)	D (0x44)	E (0x45)	F (0x46)	G (0x47)	H (0x48)	I (0x49)	J (0x4A)	K (0x4B)	L (0x4C)	M (0x4D)	N (0x4E)	O (0x4F)	P (0x50)
4th	2019.3.28	2 (0x32)	0 (0x30)	1 (0x31)	9 (0x39)	. (0x2E)	3 (0x33)	. (0x2E)	2 (0x32)	8 (0x38)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)
5th	---- (No text read)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)

Point

- **All addresses (0 to 19) are simultaneously updated at each trigger. The previous data is discarded.**
- **Data with no read text is stored as NULL (0x00).**
- **Read text is output as UTF-8.**
- **Correctly set byte swap in accordance with the PLC specifications.**
  “Setting the IV4 Series” (page 9-18)
- **If outputting the data type of STRING, use 15 or fewer characters of the read text. As NULL cannot be stored for the 16th letter, the text may not be output correctly.**

Tool Result Address 0 to 19 (Tool information: AI Through Count tool (AI Through Count mode))

The Bits at Address 0 to 19 of the Tool Result (slot No.: 7 to 70) have the following functions:

Address	Data Type*	Items	Description	Data content
0 to 1	WORD	Count Value Last 2 bytes	The tool's count value is divided into the last two bytes and first two bytes and stored.	0 to 65535: Last only 0 to 9999999: First and last connection
2 to 3	WORD	Count Value First 2 bytes		
4 to 5	WORD	Output 1 threshold value Last two bytes	The tool's Output 1 threshold value is divided into the last two bytes and first two bytes and stored.	0 to 65535: Last only 0 to 9999999: First and last connection
6 to 7	WORD	Output 1 threshold value First two bytes		
8 to 9	WORD	Output 2 threshold value Last two bytes	The tool's Output 2 threshold value is divided into the last two bytes and first two bytes and stored.	0 to 65535: Last only 0 to 9999999: First and last connection
10 to 11	WORD	Output 2 threshold value First two bytes		
12 to 13	WORD	Today's total count Last 2 bytes	The tool's count value is divided into the last two bytes and first two bytes and stored.	0 to 65535: Last only 0 to 9999999: First and last connection
14 to 15	WORD	Today's total count First 2 bytes		
16 to 17	WORD	Reserved	---	---
18 to 19	WORD	Reserved	---	---

*WORD: Unsigned 16-bit integer

Four Times More Detailed Tool Results 0 to 79: Tool Results 4x Details

The Bits at Address 0 to 79 of the Four Times More Detailed Tool Results (slot No.: 7-1 to 7-16) have the below functions.

AI OCR

Address	Data Type*	Items	Description	Data content
0 to 1	WORD	Tool matching rate	Stores the tool matching rate.	• When Show Matching Rate is disabled: 0: NG, 100: OK • When Show Matching Rate is enabled: 0 to 100
2 to 3	WORD	Tool lower threshold	Stores the tool lower threshold value.	0 to 100
4 to 5	WORD	Tool current serial No. Last (number)	Stores the current value (last two bytes) of the serial number in the AI OCR Tool (custom) only when the serial number is set as a numerical value.	0 to 65535: Last only 0 to 999999: First and last connection
6 to 7	WORD	Tool current serial No. First (number)	Stores the current value (first two bytes) of the serial number in the AI OCR Tool (custom) only when the serial number is set as a numerical value.	
8 to 13	---	Tool current serial No. (ASCII text)	Stores the current value of the serial number in the AI OCR Tool (custom) only when the serial number is set as ASCII code.	ASCII
14 to 15	---	Reserved by system	----	---
16 to 17	WORD	Tool number of letters to be read	Stores the number of characters read. Stores all characters read, even if the number of characters is greater than 60 bytes.	0 to 32
18 to 19	WORD	Tool number of bytes to be read	Stores the number of bytes of characters read. The upper limit is 60 bytes.	0 to 60
20 to 79	---	Tool text read	Stores the read string (up to 60 bytes in UTF-8; for 1-byte characters (ASCII compatible area), up to 32 characters, which is the maximum number of characters the AI OCR tool can read).	UTF-8

*WORD: Unsigned 16-bit integer

Eight Times More Detailed Tool Results 0 to 159: Tool Results 8x Details

The Bits at Address 0 to 159 of the Eight Times More Detailed Tool Results (slot No.: 7-1 to 7-8) have the below functions.

AI OCR

Address	Data Type*	Items	Description	Data content
0 to 1	WORD	Tool matching rate	Stores the tool matching rate.	• When Show Matching Rate is disabled: 0: NG, 100: OK • When Show Matching Rate is enabled: 0 to 100
2 to 3	WORD	Tool lower threshold	Stores the tool lower threshold value.	0 to 100
4 to 5	WORD	Tool current serial No. Last (number)	Stores the current value (last two bytes) of the serial number in the AI OCR Tool (custom) only when the serial number is set as a numerical value.	0 to 65535: Last only 0 to 999999: First and last connection
6 to 7	WORD	Tool current serial No. First (number)	Stores the current value (first two bytes) of the serial number in the AI OCR Tool (custom) only when the serial number is set as a numerical value.	
8 to 13	---	Tool current serial No. (ASCII text)	Stores the current value of the serial number in the AI OCR Tool (custom) only when the serial number is set as ASCII code.	ASCII
14 to 15	---	Reserved by system	----	---
16 to 17	WORD	Tool number of letters to be read	Stores the number of characters read.	0 to 32
18 to 19	WORD	Tool number of bytes to be read	Stores the number of bytes of characters read.	0 to 60
20 to 115	---	Tool text read	Stores read strings.	UTF-8
116 to 159	---	Reserved	---	---

*WORD: Unsigned 16-bit integer

Extended Modules parameter details

Device Results Bits Address 0 to 7: status result (Tools 17 to 64), master number/total status product type

Standard Mode

Address	Data type	Items	Description	Data content
0 to 1	WORD	Master number	When multiple master registration is set to [Enable]: Stores the master number (00 to 07) from the total status result obtained from the results of each tool when “total status result is OK” is OK (1).	0: 00 or NG 1 to 7: 01 to 07
2	BOOL	Tool 17 to 24	Assigns to Bit 0 to Bit 7 the results of Tools 17 to 24 and stores these results.	0 : NG 1 : OK
3	BOOL	Tool 25 to 32	Assigns to Bit 0 to Bit 7 the results of Tools 25 to 32 and stores these results.	0 : NG 1 : OK
4	BOOL	Tool 33 to 40	Assigns to Bit 0 to Bit 7 the results of Tools 33 to 40 and stores these results.	0 : NG 1 : OK
5	BOOL	Tool 41 to 48	Assigns to Bit 0 to Bit 7 the results of Tools 41 to 48 and stores these results.	0 : NG 1 : OK
6	BOOL	Tool 49 to 56	Assigns to Bit 0 to Bit 7 the results of Tools 49 to 56 and stores these results.	0 : NG 1 : OK
7	BOOL	Tool 57 to 64	Assigns to Bit 0 to Bit 7 the results of Tools 57 to 64 and stores these results.	0 : NG 1 : OK

Point

- **Check that “total status result is NG” is OK (1), and then check the master number. If the master number cannot be determined (the result is NG), the value becomes 0.**
- **When obtaining the master number, set [Total status condition] as shown below. Failing to do so will prevent you from obtaining correct master numbers.**
  - **Total status condition: Logic n (n = 1 to 8)**
  - **Logic n setting**
    Logic: OR
    Set master number (Master00 to Master07): Use
    “4. Output Assignment” (page 4-88)
- **If there are multiple master numbers whose status is OK, the lowest master number is output.**

Sorting Mode

Address	Data type	Items	Description	Data content
0 to 1	WORD	Total status product type	Stores the product type (M0 to M7) from the total status result obtained from the results of each tool when “total status result is OK” is OK (1).	0: M0 or NG 1 to 7: M1 to M7
2 to 3	WORD	Tool 1 status product type	Stores the product type (M0 to M7) determined by Tool 1 when the Tool 1 status result is OK (1).	0: M0 or NG 1 to 7: M1 to M7
4 to 5	WORD	Tool 2 status product type	Stores the product type (M0 to M7) determined by Tool 2 when the Tool 2 status result is OK (1).	0: M0 or NG 1 to 7: M1 to M7
6 to 7	WORD	Tool 3 status product type	Stores the product type (M0 to M7) determined by Tool 3 when the Tool 3 status result is OK (1).	0: M0 or NG 1 to 7: M1 to M7

Point

- **Check that “total status result is NG” is OK (1) or that each tool’s status result is OK, and then check the product type. If the product type cannot be determined (the result is NG), the value becomes 0.**
- **The product types determined by Tools 4 to 8 in sorting mode cannot be displayed.**

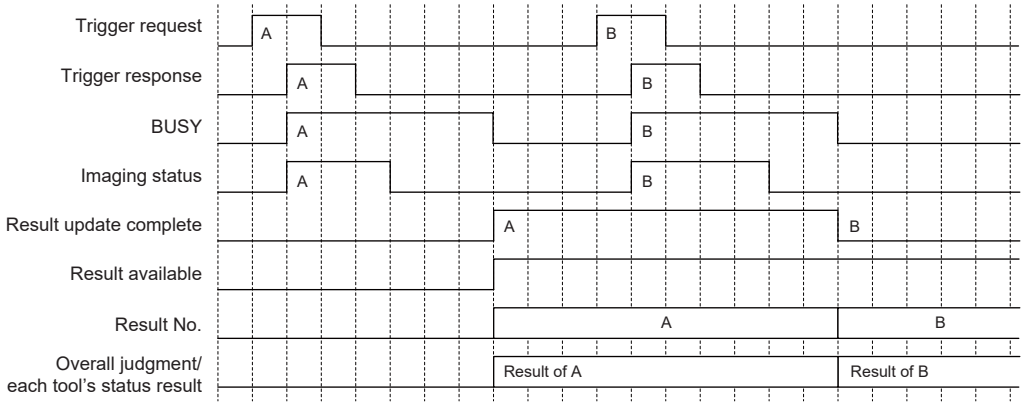
Operating procedure of the data I/O communication

This section explains the method for communicating from the PLC to the IV4 Series using cyclic communication.
It also introduces reference programs. When making use of the reference programs, give thought to items such as error processing during programming.

Reading out the status result (handshake control: [Disable]; Preliminary capture: [Disable])

The operation procedure when the data handshake control is set to [Disable] is shown below.

When a trigger is successful



(1) Run [Trigger request]. (0 → 1) Trigger request is retained until trigger response is set to ON

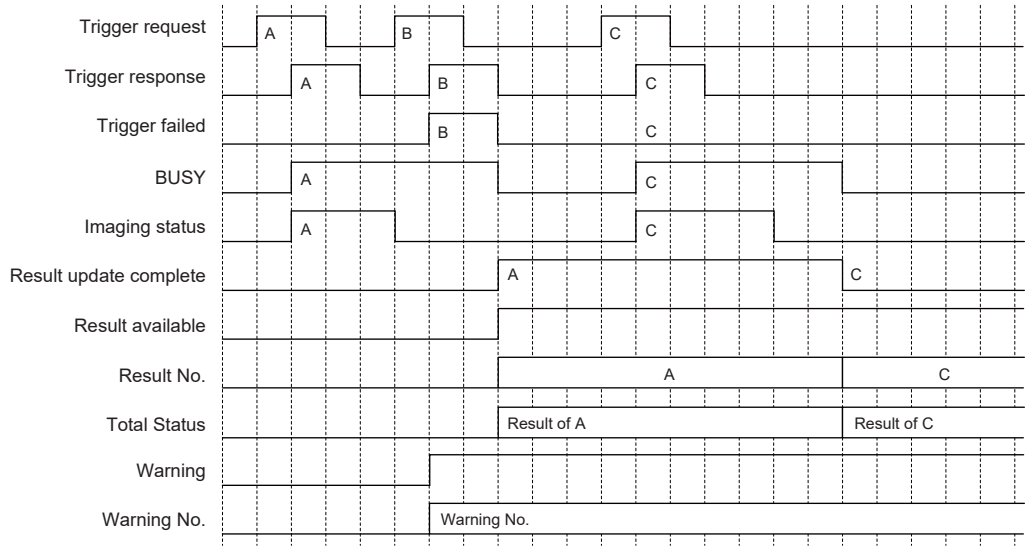
(2) If the trigger is valid, [Trigger response] will change from 0 to 1.

(3) Once the judgment process ends, the [Result update complete] Bit will switch and [Overall judgment]/[Each tool's status result] will be updated. The read text will be updated for AI OCR.

Point **Do not cancel (1 → 0) [Trigger request] before [Trigger response] changes from 0 to 1. The trigger may not be able to be requested correctly.**

Reference
- [Result update complete] will switch (toggle) to "1" if its value was "0" after the previous judgment update or switch to "0" if its value was "1".
- [Result available] will switch from 0 to 1 at the timing when the first judgment process has been confirmed; and the new value will be retained thereafter.
- [Result available] will be reset in the following conditions:
  - If handshake control is set to [Disabled]
    - When the program is switched
    - When the unit's status is switched from "Setting" to "RUN"
    - When a buffer clear request is issued
  - If handshake control is set to [Enabled]
    - When a buffer clear request is issued
- [Result No.] will be counted up each time the status result is updated. The upper limit value is 32767. If the maximum value is exceeded, it will go back to 0 and start counting up again.
- [Result No.] will also count the judgment process counts that were skipped due to the data I/O cycle settings.
- [BUSY] and [Imaging] may be skipped due to the data I/O cycle settings. It is therefore necessary to take image optimization into consideration when setting the data I/O cycle settings.

When a trigger is unsuccessful



(1) Run [Trigger request]. (0 → 1) Trigger request is retained until trigger response is set to ON

(2) If the trigger is valid, [Trigger response] will change from 0 to 1.

(3) When the judgment process ends, the [Result update complete] bit will be switched and the [Overall judgment] will be updated.

(4) If you wish to output trigger errors, set the trigger error option to [Enabled].
If a trigger has been input while the trigger error option is set to [Enabled] and the unit is in "BUSY" status, [Trigger failed] will change from 0 to 1 ignoring the trigger input. No judgment process will be performed for trigger B.

(5) If the trigger input is unsuccessful, [Warning] will switch from "0" to "1" and [Warning No.] will be updated to "65".

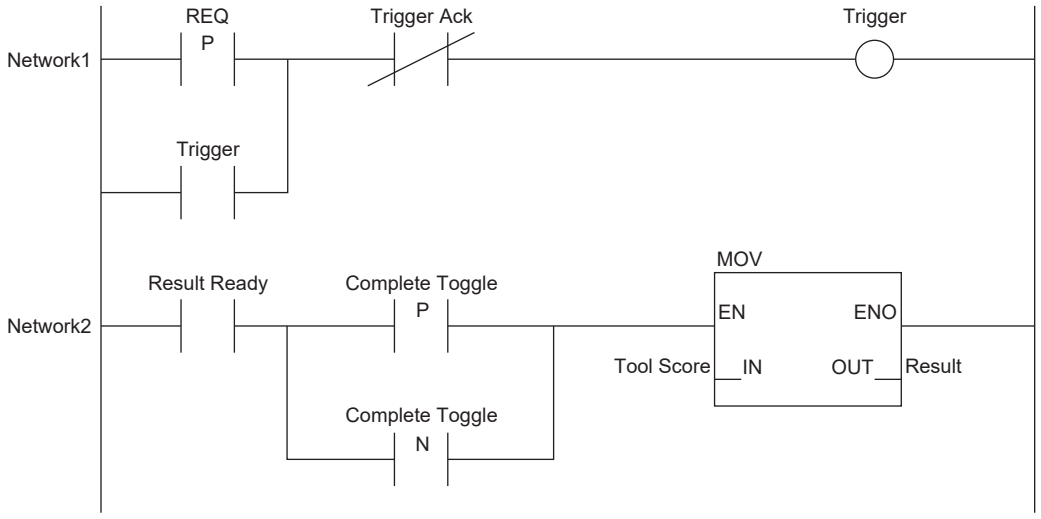
Point **Do not cancel (1 → 0) [Trigger request] before [Trigger response] changes from 0 to 1. The trigger may not be able to be requested correctly.**

Reference

- [Result update complete] will switch to "1" if its value was "0" after the previous judgment update (or from "0" to "1" if the previous value was "1").
- [Result available] will switch from 0 to 1 at the timing when the first judgment process has been confirmed; and the new value will be retained thereafter.
- [Result No.] will be counted up each time the status result is updated. The upper limit value is 32767. If the maximum value is exceeded, it will go back to 0 and start counting up again.
- [Result No.] will also count the judgment process counts that were skipped due to the data I/O cycle settings.
- [BUSY] and [Imaging] may be skipped due to the data I/O cycle settings. It is therefore necessary to take image optimization into consideration when setting the data I/O cycle settings.
- [Number of trigger errors] will be counted up at the timing when the [Result updated] BIT is switched.

Reference programs

Siemens PLC

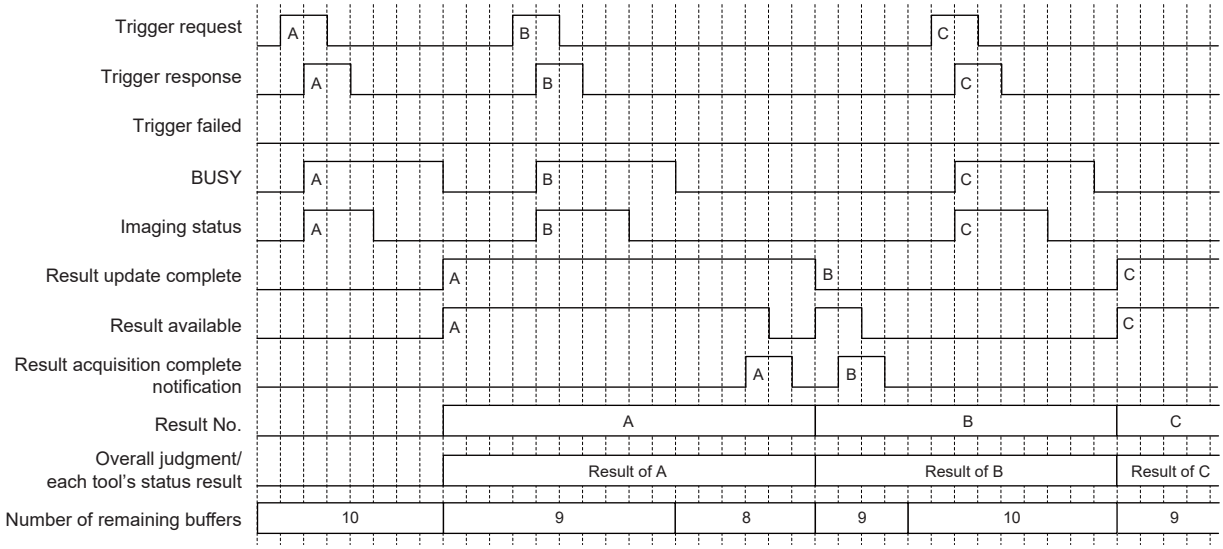


❍ Description of the reference program

- **Network1**
  Sets "REQ" to ON and executes "Trigger".
  "Trigger Ack" ON will set "Trigger" to OFF ("Trigger" will be retained until "Trigger Ack" becomes ON).
- **Network2**
  "Result Ready" ON + Rising or falling of "Complete Toggle" will copy the data that have been written to "Tool Score" to "Result".

Reading out the status result (handshake control: [Enable]; Preliminary capture: [Disable])

The following describes the operating procedure when the data handshake control is set to [Enabled].
You can acquire all status results without fail by setting the data handshake control to [Enabled].



(1) Run [Trigger request]. (0 → 1) Trigger request is retained until trigger response is set to ON

(2) If the trigger is valid, [Trigger response] will change from 0 to 1.

(3) Once the judgment process ends, the [Result update complete] Bit will switch, [Result available] will switch from 0 to 1, and [Overall judgment]/[Each tool's status result] will be updated. The read text will be updated for AI OCR.

(4) [Number of remaining buffers] will be reduced by 1 when the status result is updated.

(5) Executes [Result acquisition complete notice] (0 → 1) and [Result available] is held until 1 becomes 0.

(6) Turns [Result acquisition complete notice] off (1 → 0). [Number of remaining buffers] will be incremented by 1.

Point

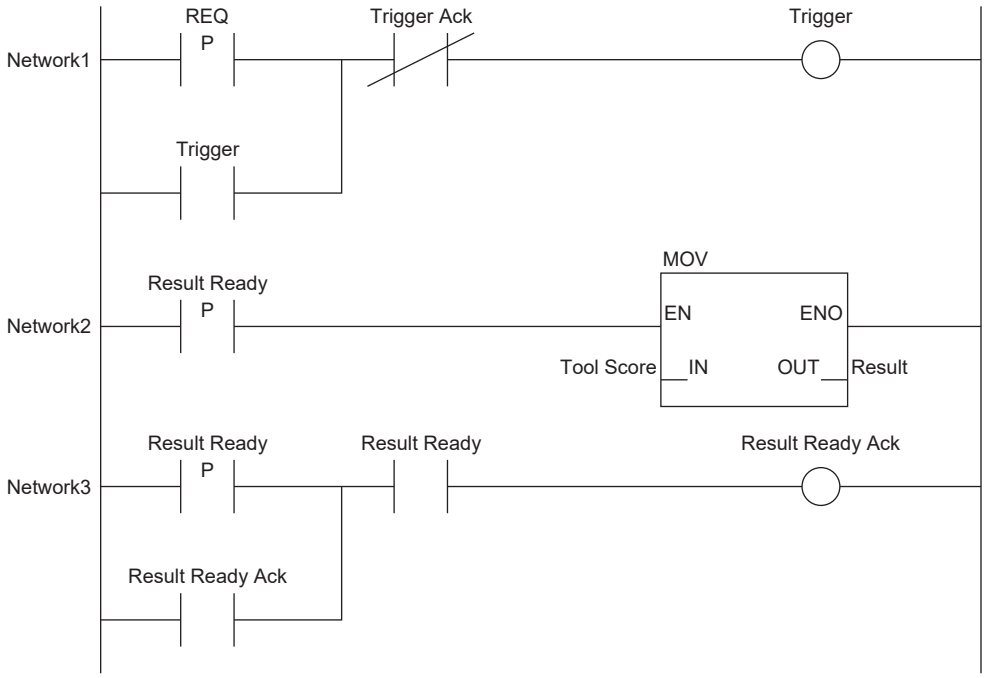
Do not cancel (1 → 0) [Trigger request] before [Trigger response] changes from 0 to 1. The trigger may not be able to be requested correctly.

Reference

- [Result update complete] will switch (toggle) to "1" if its value was "0" after the previous judgment update or switch to "0" if its value was "1".
- [Result No.] will be counted up each time the status result is updated. The upper limit value is 32767. If the maximum value is exceeded, it will go back to 0 and start counting up again.
- [Result No.] will also count the judgment process counts that were skipped due to the data I/O cycle settings.
- [BUSY] and [Imaging] may be skipped due to the data I/O cycle settings. It is therefore necessary to take image optimization into consideration when setting the data I/O cycle settings.
- [Number of trigger errors] will be counted up at the timing when the [Result updated] BIT is switched.
- If handshake control has been set to [Enabled], the status result will not be updated until [Result acquisition complete notice] is set ON/OFF (0 → 1 → 0), even if the next trigger has been input and a judgment process has been executed.
- If a new trigger is input when [Number of remaining buffers] is "0", [Buffer overrun] will switch from "0" to "1". The status result from the new trigger will be ignored.
- [Buffer overrun] can be cleared using [Warning clear].

Reference programs

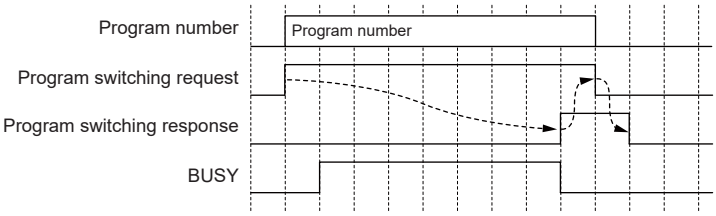
Siemens PLC



❍ Description of the reference program

- **Network1**
  Sets “REQ” to ON and executes “Trigger”.
  “Trigger Ack” ON will set “Trigger” to OFF (“Trigger” will be retained until “Trigger Ack” becomes ON).
- **Network2**
  “Result Ready” ON will copy the data written in “Tool Score” to “Result”.
- **Network3**
  “Result Ready” ON will execute “Result Ready Ack”.
  “Result Ready” OFF will set “Result Ready Ack” to OFF (“Result Ready Ack” will be retained until “Result Ready” becomes OFF).

Switching the programs



(1) Write the program No. to be set to [Program No.].

(2) Execute [Program switching request], maintaining the state (0 → 1) until [Program switching response] is received.

(3) When the program switch is complete, [Program switching response] (0 → 1) is received.

(4) Once [Program switching response] is received, clear [Program switching request] (1 → 0). When [Program switching request] is cleared, [Program switching response] is cleared.

Point

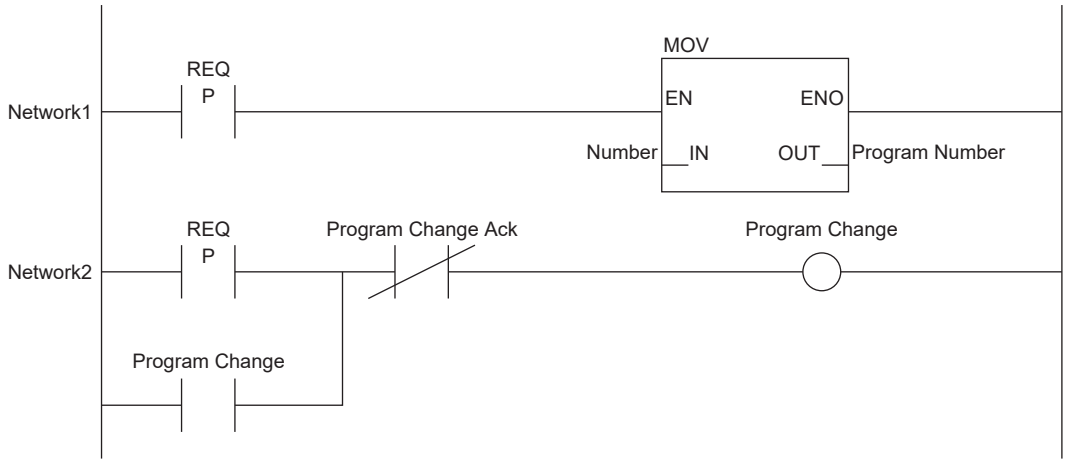
- **Do not cancel (1 → 0) [Program switching request] before [Program switching response] changes from 0 to 1. The program may not be able to switch correctly.**
- **When [Program switching request] was canceled (1 → 0) before [Program switching response] changes from 0 to 1, execute (0 → 1) [Program switching request] and cancel (1 → 0) it again.**

Reference

- [BUSY] will change from 0 to 1 while the program switching is in progress.
- If the program switching fails, [Program switching failed] will change from “0” to “1”.
- If the program switching is unsuccessful, [Warning] will switch from “0” to “1” and [Warning No.] will be updated to “64”.
- You cannot switch programs using PROFINET communication while the unit is in [Setting] status.
- If you are switching programs using PROFINET communication, set the [Switching method] option to [Panel/PC/Network/Automatic Switching].
  “Program Switching Method” (page 7-13)
- The program No. switched to from PROFINET communication will be deleted when the power is turned off.

Reference programs

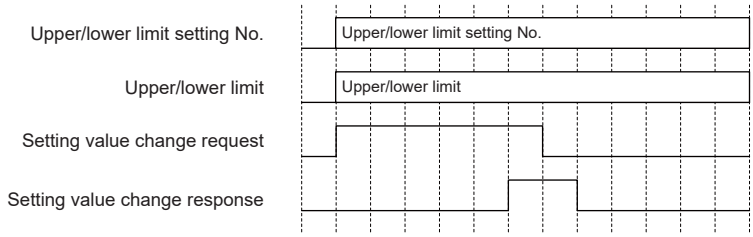
Siemens PLC



❍ Description of the reference program

- **Network1**
  This line sets “REQ” to ON and copies the Number data, which contains the program No. to be set, to the program No.
- **Network2**
  Sets “REQ” to ON and executes “Program Change”.
  “Program Change Ack” ON will set “Program Change” to OFF (“Program Change” will be retained until “Program Change Ack” becomes ON).

Changing the tool adjustment threshold



(1) Write the tool number and threshold type of the threshold to be changed to [Upper/lower limit setting No.].

(2) Write the threshold to be changed to [Upper/lower limit].

(3) Execute [Setting value change request]. (0→1)

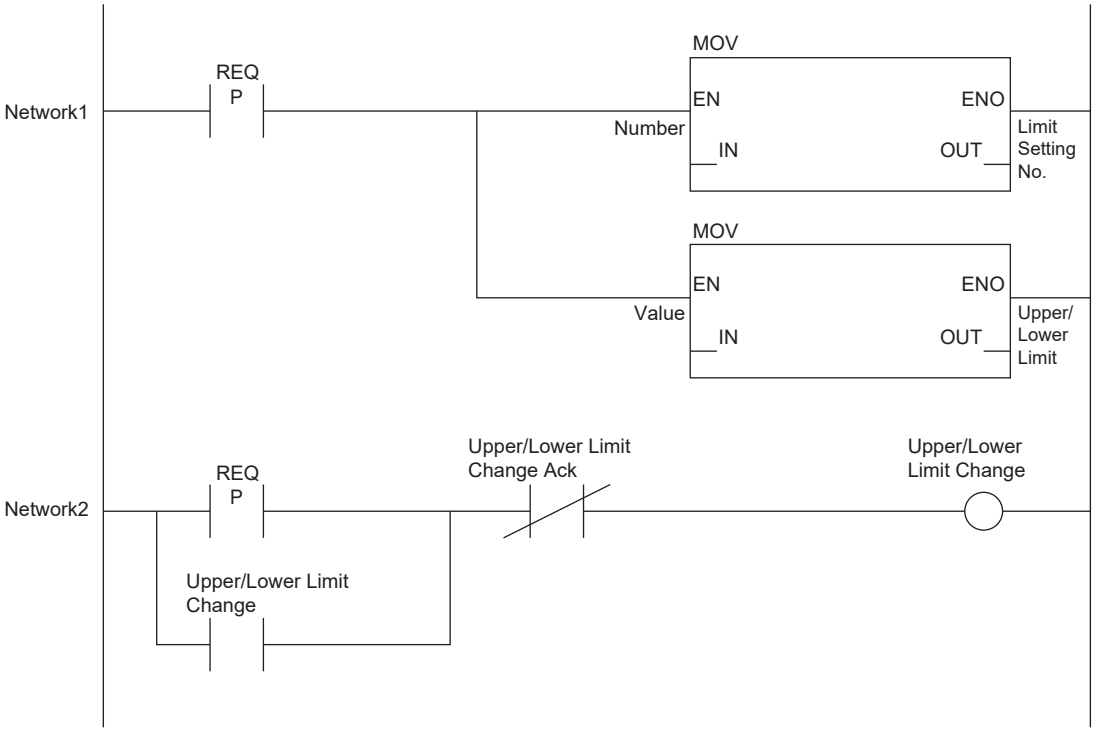
(4) You can check the input status in [Setting value change response].

Reference

- If the setting value change fails, [Setting value change failed] will switch from “0” to “1”.
- If the setting value change fails, [Warning] will switch from “0” to “1” and [Warning No.] will be updated to 60.
- Thresholds cannot be changed for the following tools.
  - In standard mode or sorting mode, the position adjustment tool, which corrects the position of the learning tool
  - In sorting mode, tools other than the learning tool
  - In the AI Through Count Mode, AI Through Count Tool whose judgment result is [Disable] and Total Tool

Reference programs

Siemens PLC

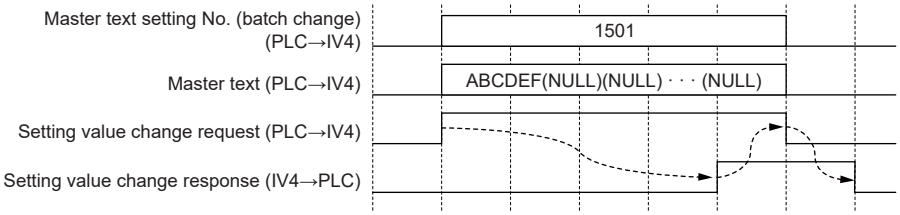


❍ **Description of the reference program**

- **Network1**
  This line sets “REQ” to ON and copies the Number data, which contains the Limit Setting No. to be set, to the Limit Setting No. This line also copies the Value data, which contains the Upper/Lower Limit to be set, to the Upper/Lower Limit.
- **Network2**
  Sets “REQ” to ON and executes “Upper/Lower Limit Change”.
  “Upper/Lower Limit Change Ack” ON will set “Upper/Lower Limit Change” to OFF.
  (“Upper/Lower Limit Change” will be retained until “Upper/Lower Limit Change Ack” becomes ON.)

Changing the master text (batch change)

This section shows the master text for Tool 1 (AI OCR: String mode) changing in batch to [ABCDEF] as an example.



(1) Overwrite [Master text setting No.: Address 6 to 7] with 1501 (AI OCR tool string mode string identification with Tool 1).

(2) Overwrite [Master text: Address 8] with A (0x41), [Master text: Address 9] with B (0x42), [Master text: Address 10] with C (0x43), [Master text: Address 11] with D (0x44), [Master text: Address 12] with E (0x45), [Master text: Address 13] with F (0x46), and [Master text: Address 14] onwards with NULL (0x00).

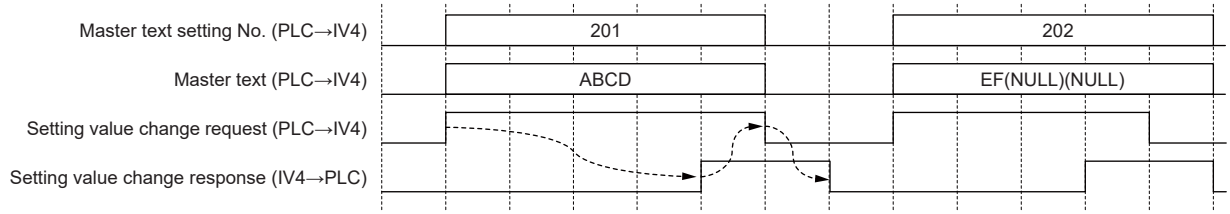
(3) Execute [Setting value change request] (0→1). The request is retained until [Setting value change response] can be confirmed.

(4) Once the change is complete, [Setting value change response] changes from 0 to 1.

(5) Setting [Setting value change request] to 0 sets [Setting value change response] to 0.

Changing the master text (change 4 characters at a time)

This section shows the master text for Tool 1 changing to [ABCDEF] as an example. The text is overwritten twice in groups of four letters.



(1) Overwrite [Master text setting No.: Address 6 to 7] with 201 (master text (first to fourth letter) when the read text settings are set with Tool 1).

(2) Overwrite [Master text: Address 8] with A (0x41), [Master text: Address 9] with B (0x42), [Master text: Address 10] with C (0x43), and [Master text: Address 11] with D (0x44).

(3) Execute [Setting value change request] (0→1). The request is retained until [Setting value change response] can be confirmed.

(4) Once the change is complete, [Setting value change response] changes from 0 to 1.

(5) Setting [Setting value change request] to 0 sets [Setting value change response] to 0.

(6) Overwrite [Master text setting No.: Address 6 to 7] with 202 (master text (fifth to eighth letter) when the read text settings are set with Tool 1).

(7) Overwrite [Master text: Address 8] with E (0x45), [Master text: Address 9] with F (0x46), [Master text: Address 10] with NULL (0x00), and [Master text: Address 11] with NULL (0x00).

(8) Execute [Setting value change request] (0→1). The request is retained until [Setting value change response] can be confirmed.

(9) Once the change is complete, [Setting value change response] changes from 0 to 1.

(10) Setting [Setting value change request] to 0 sets [Setting value change response] to 0.

Point

- **Append the NULL character to the end of the text.**
  If you change "ABCDEFG" to "1234" and did not write NULL, the text is changed to "1234EFG".

Example of a failure	Master text/date							
	1st	2nd	3rd	4th	5th	6th	7th	8th
Master text/date before change	A	B	C	D	E	F	G	NULL
Text to be written	1	2	3	4	None			
Master text/date after change	1	2	3	4	E	F	G	

Example of a success	Master text/date							
	1st	2nd	3rd	4th	5th	6th	7th	8th
Master text/date before change	A	B	C	D	E	F	G	NULL
Text to be written	1	2	3	4	NULL (0x00)	NULL (0x00)	NULL (0x00)	NULL (0x00)
Master text/date after change	1	2	3	4				

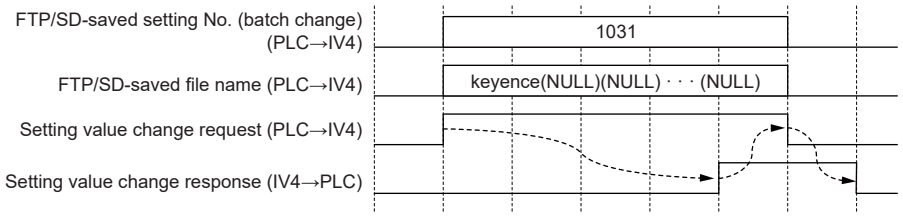
- **Arbitrary text can be changed in groups of four letters.**
  To change "2019.4.5" to "2019.4.6", you can change only 202 for [Setting value setting No.: Address 6 to 7] (master text (fifth to eighth letter) when the read text settings are set with Tool 1).

	Master text/date							
	1st	2nd	3rd	4th	5th	6th	7th	8th
Master text/date before change	2	0	1	9	.	4	.	5
Text to be written	None				.	4	.	6
Master text/date after change	2	0	1	9	.	4	.	6

- **Changes in groups of four letters are applied immediately. Do not execute a trigger until all text changes are complete.**

Changing the FTP/SD-saved file name (batch change)

This section shows an example in which the transfer condition 1 file name is changed to “keyence”.
No data is written to non-volatile memory. (The setting number is different when writing to non-volatile memory.)



(1) Write 1031 to [Batch change FTP/SD save file name: Addresses 6 to 7].

(2) Overwrite [FTP/SD save file name: Address 8] with k (0x6B), [FTP/SD save file name: Address 9] with e (0x65), [FTP/SD save file name: Address 10] with y (0x79), [FTP/SD save file name: Address 11] with e (0x65), [FTP/SD save file name: Address 12] with n (0x6E), [FTP/SD save file name: Address 13] with c (0x63), [FTP/SD save file name: Address 14] with e (0x65), and [FTP/SD save file name: Address 15] onwards with NULL (0x00).

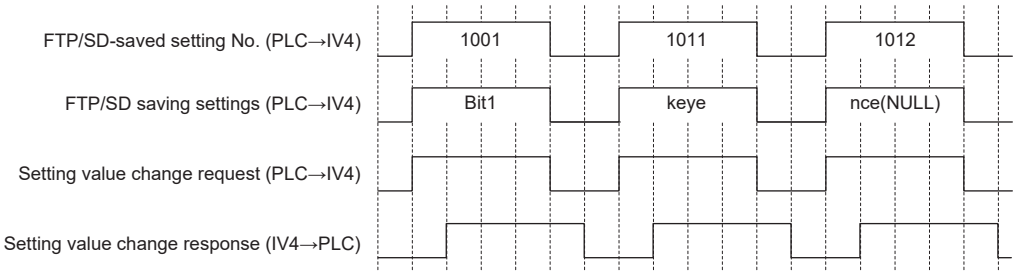
(3) Execute [Setting value change request] (0→1). The request is retained until [Setting value change response] can be confirmed.

(4) Once the change is complete, [Setting value change response] changes from 0 to 1.

(5) Setting [Setting value change request] to 0 sets [Setting value change response] to 0.

Changing the FTP/SD-saved file name (change 4 characters at a time)

This section shows an example in which the transfer condition 2 file name is changed to “keyence”. No data is written to non-volatile memory.
The text is overwritten twice in groups of four letters.



(1) Write 1001 to [FTP/SD-saved setting No.: Addresses 6 to 7] to enable the specification of the transfer condition number.

(2) Set [FTP/SD saving settings: Address 8 Bit 1] to ON (1). (Specify Transfer Condition 2)
Set [FTP/SD saving settings: Address 9 Bit 0] to OFF (0). (No writing to non-volatile memory)

(3) Execute [Setting value change request: Address 0 Bit 7 (0→1). The request is retained until [Setting value change response] can be confirmed.

(4) Once the transfer condition number specification is complete, [Setting value change response] changes from 0 to 1.

(5) Setting [Setting value change request: Address 0 Bit 7] to 0 sets [Setting value change response] to 0.

(6) Overwrite [FTP/SD-saved setting No.: Addresses 6 to 7] with 1011 (first to fourth letter of the FTP/SD-saved file name).

(7) Overwrite [FTP/SD saving settings: Address 8] with k (0x6B), [FTP/SD saving settings: Address 9] with e (0x65), [FTP/SD saving settings: Address 10] with y (0x79), and [FTP/SD saving settings: Address 11] with e (0x65).

(8) Execute [Setting value change request: Address 0 Bit 7] (0→1). The request is retained until [Setting value change response] can be confirmed.

(9) Once the transfer condition number specification is complete, [Setting value change response] changes from 0 to 1.

(10) Setting [Setting value change request: Address 0 Bit 7] to 0 sets [Setting value change response] to 0.

(11) Overwrite [FTP/SD-saved setting No.: Addresses 6 to 7] with 1012 (fifth to eighth letter of the FTP/SD-saved file name).

(12) Overwrite [FTP/SD saving settings: Address 8] with n (0x6E), [FTP/SD saving settings: Address 9] with c (0x63), [FTP/SD saving settings: Address 10] with e (0x65), and [FTP/SD saving settings: Address 11] with NULL (0x00).

(13) Execute [Setting value change request: Address 0 Bit 7 (0→1). The request is retained until [Setting value change response] can be confirmed.

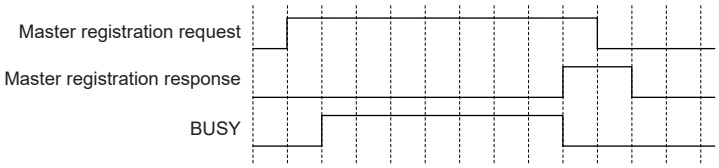
(14) Once the transfer condition number specification is complete, [Setting value change response] changes from 0 to 1.

(15) Setting [Setting value change request: Address 0 Bit 7] to 0 sets [Setting value change response] to 0.

Point

- **Append the NULL character to the end of the text.**
  If you change “ABCDEF” to “1234” and did not write NULL, the text is changed to “1234EF”.
- **Arbitrary text can be changed in groups of four letters.**
  To change “ABCDEF” to “ABCDGH”, you can change only 1012 for [FTP/SD-saved setting No.: Addresses 6 to 7] (the fifth to eighth letters of the FTP file name).
- **Changes in groups of four letters are applied immediately. Do not execute a trigger until all text changes are complete.**
- **If multiple transfer condition numbers are specified, the condition with the smallest number is used.**
- **If data is not written to non-volatile memory, the set transfer condition number and file name will be deleted when the power is turned off.**

Registering a master image externally



(1) Execute [Master registration request]. (0→1)

(2) You can check the input status in [Master registration response].

Reference

- [BUSY] will change from 0 to 1 while the master image registration is in progress.
- If the master image registration is unsuccessful, [Master registration failed] will change from 0 to 1.
- If the master image registration is unsuccessful, [Warning] will switch from “0” to “1” and [Warning No.] will be updated according to the failure details.
- You cannot register a master image from the PROFINET communication while the unit is in [Setting] status.
- If you wish to write the master registration data to the sensor ROM, set the [Write to ROM when using Ext. Master Save] option to [Yes].
  “Write to ROM when using Ext. Master Save” (page 7-14)
- Master images cannot be registered externally when learning-based tools (AI tool/AI Identify/AI Count/AI Trigger) are in use or in sorting mode.
- External master image registration cannot be used when using AI-based tools. (AI tool/AI Identify/AI Count/AI Trigger), Sorting Mode, and AI Through Count Mode.

MEMO

EtherCAT Communication Specifications and Functions

What is EtherCAT?

EtherCAT is an Ethernet-based real-time fieldbus proposed and developed by Beckhoff in Germany.
Since it is based on Ethernet, generic Ethernet cables can be used when building a network. EtherCAT® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

IV4 Series Support

The IV4 Series can operate as a slave device for EtherCAT communications by connecting the communication unit IV4-CU1 (for built-in amplifier models) or IV4-GCU1 (for ultra-compact models) to the sensor. Process data objects (PDOs) and Mailbox communications are supported.

List of Supported Master Devices

Check the instruction manual of each device for details of the setting methods.

BECKHOFF PC/PLC

PLC model	EtherCAT communication unit	Firmware version	Software used	Version of the software used
C6920-0050	- (Built-in to the unit)	Microsoft Windows Version 6.1	TwinCAT3	v3.1
CX5120		Microsoft Windows 10 IoT EnterPrise 2016		

OMRON PLC

PLC model	EtherCAT communication unit	Firmware version	Software used	Version of the software used
NJ101-9000	- (Built-in to the unit)	Ver1.10	SYSMAC STUDIO	Ver1.20.1

INOVANCE PLC

PLC model	EtherCAT communication unit	Firmware version	Software used	Version of the software used
INOVANCE AM401	- (Built-in to the unit)	3.5.11.11	InoProShop	V1.8.0.0
INOVANCE AC702		3.5.11.51		

EtherCAT Communication Specifications for IV4-CU1/ IV4-GCU1

Supported protocol	CoE

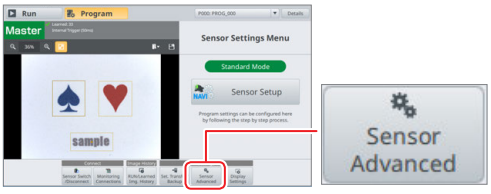
Available function

Function	Description
Trigger input	Executes a trigger input for the sensor.
Change Program	Executes a program switch for the sensor.
Ext. Master Save	Executes an external master registration for the sensor.
Threshold rewriting	Rewrites the threshold that is used as the reference for tool judgment.
Master text/master date rewriting	Rewrites the master text/master date that is used as the reference for AI OCR judgment.
Rewrite FTP/SD-saved file name	Rewrites the name of the image file to transfer to the FTP server or SD card.
Warning clear input	Executes a warning clear.
Read status	Allows you to check the unit status (Imaging, RUN, BUSY, Error, etc.).
Read overall status result	Reads the overall status result.
Read processing time	Reads the processing time of the judgment.
Read each tool's status result	Reads each tool's status result and matching rate.
Read statistical information	Reads out the number of triggers issued and the number of trigger errors.
Master text/master date rewriting (batch)	Rewrites the master text/master date that is used as the reference for AI OCR judgment in a batch.
Rewrite FTP/SD-saved file name (batch)	Rewrites the name of the image file to transfer to the FTP server or SD card in a batch.
All program statistics reset request	Resets the statistics for all programs.
OCR serial no. count up input request	Counts up the serial number in the AI OCR tool (custom).
Reset count input request	• Resets the serial number in the AI OCR tool (custom). • Resets the count value of the AI Through Count tool (AI Through Count Mode).
Count up when result file transfer is completed	Counts up the number of times each FTP transfer and SD card transfer per trigger is completed. The transfer complete timing can be checked.
Overwrite serial no. for next OCR judgment (Numbers/Letters)	Overwrites the serial number for the next judgment when setting the serial number in custom mode of the AI OCR tool.
Overwrite the count value	Overwrites the count value of the AI Through Count tool (AI Through Count mode).

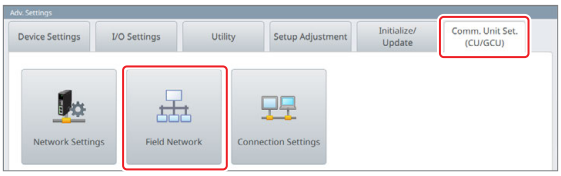
EtherCAT Communication

Setting the IV4 Series

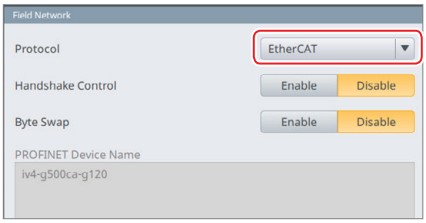
1 Press [Sensor Advanced] in the main screen in [Program].



2 Select the [Comm. Unit Set. (CU/GCU)] tab and press [Field Network].



3 Select [EtherCAT] for [Protocol].



Handshake Control

❍ **Disable (default value)**

Select if the trigger interval is greater than the communication cycle. A status result can be obtained in real time. In most situations, select [Disable].

❍ **Enable**

Select if the trigger interval is less than the communication cycle and the number of triggers is 10 or less. If the status result is not picked up due to the trigger interval being faster than the communication cycle, the status result can be saved up to ten times in the buffer.

> **Point**
> **If data handshake control has been set to [Enable], the status result will not be updated until [Result acquisition complete notice] (Index 0x1600: 11 of Command Control) is input.**
> **“Operating procedure of the data I/O communication” (page 9-78)**

Byte Swap

To enable byte swap for the data region, select [Enable].

> **Point**
> **You can change the order of storing the characters read by AI OCR and the FTP/SFTP transfer file names into PLC data memory (2 byte) in unit of bytes.**
> - **Disable: First byte → Last byte (Example for the string “AB”: 0x4142)**
> - **Enable: Last byte → First byte (Example for the string “AB”: 0x4241)**
>
> **Set byte swap in accordance with the specifications of each PLC. For details, see the instruction manual for the PLC.**

4 When setting is completed, press [OK].

The system returns to the Advanced Sensor Settings screen.

5 Press [OK].

Setting the EtherCAT Master

Workflow to Establish EtherCAT Communications

This section describes how to set up the EtherCAT master to use the IV4-CU1/IV4-GCU1 in an EtherCAT system.

> **Point**
> **This manual describes only the functions and settings of the EtherCAT master that are necessary to communicate with the communication unit. For details, see the manual of the EtherCAT master or configuration software used.**

1 Install the ESI file in the configuration software.

The functions of the IV4-CU1/IV4-GCU1 in an EtherCAT system are defined by the ESI file.
If you are configuring the IV4-CU1/IV4-GCU1 for the first time with the configuration software, please install the ESI file in the configuration software.

2 Add IV4-CU1/IV4-GCU1 to the EtherCAT system.

Add IV4-CU1/IV4-GCU1 to the EtherCAT system with the configuration software.
In general, there are two ways to add the IV4-CU1/IV4-GCU1: Manually or automatically by scanning the network after connecting the IV4-CU1/IV4-GCU1 to the EtherCAT system.

3 Assign the module to be used to a slot.

Assign modules for process data objects (PDOs) required for the application with the configuration software.

> **Reference**
> By not assigning unused process data objects as targets for cyclic communication, the amount of data to be communicated can be reduced and the processing load can be decreased. With this product, process data object assignments can be changed according to the data to be communicated over EtherCAT and the number of connected sensors.

4 Assign objects to the input and output of the application program.

Assign process data objects to the inputs and outputs of the application program.
To use the Mailbox communication function, create a communication program.

Definition of each item

Items	Value	Definition
Data type	BIT	Boolean value
	INT	2-byte signed integer
	UINT	2-byte unsigned integer
	UDINT	4-byte unsigned integer
	STR	String
Attribute	R	Can be read
	RW	Can be read/written
PDO assignment	⊙	PDO assigned from the beginning (ESI file registration)
	√	PDO can be assigned
	-	PDO cannot be assigned

MEMO

Process Data Object (PDO) Communication

Overview of process data object (PDO) communication

This function enables the IV4-CU1/IV4-GCU1 to communicate data cyclically (i.e. at a constant frequency) with the EtherCAT master.
Process data object (PDO) communication uses 2 to 3 of Sync Manager.
Some of the data placed in the object dictionary is assigned to process data objects for communication.
The following are the two types of process data objects:

- RxPDO to send data from the master to the slave (IV4-CU1/IV4-GCU1)
- TxPDO to send data from the slave (IV4-CU1/IV4-GCU1) to the master

Process data object (PDO) communication map: RxPDO

Command Control

Sync Manager2 (RxPDO from master to device)
Indicates a map of data to be sent from the master to a device using process data object communication.

Process data object map (PDO List)		Process data object content (PDO Content)							AI Through Count Mode
Index (HEX)	Sub Index (HEX)	Name	Description	Data type	Data size (BIT)	Attribute	Source Index (HEX)	PDO assignment	
0x1600	01	Trigger request	Request for External Trigger/Internal Trigger Control/AI Trigger Control	BIT	1	RW	7000:01	⊙	√
	02	Master registration request	Requests master image registration	BIT	1	RW	7000:02	⊙	-
	03	Program switching request	Requests change program	BIT	1	RW	7000:03	⊙	√
	04	Warning clear request	Requests warning clear	BIT	1	RW	7000:04	⊙	√
	05	Statistics reset request	Requests statistics reset	BIT	1	RW	7000:05	⊙	-
	06	Status result/ Buffer clear request	Requests status result/buffer clear	BIT	1	RW	7000:06	⊙	-
	07	SD card Saving stop request	Requests SD card saving stop	BIT	1	RW	7000:07	⊙	√
	08	Setting change request	Requests setting value change	BIT	1	RW	7000:08	⊙	√
	09 to 0A	Reserved by system	-	BIT	1	RW	7000: 09 to 0A	⊙	-
	0B	All program statistics reset request	Requests all program statistics information reset	BIT	1	RW	7000:0B	⊙	-
	0C	OCR serial no. count up input request	Requests a count up of the serial number for AI OCR (custom) (Functions when OCR serial number count up input is enabled.)	BIT	1	RW	7000:0C	⊙	-
	0D	Reset count input request	Requests reset input of the total count in AI Through Count mode and the serial number in AI OCR (custom). (AI OCR (Custom): Batch resets tools with the reset input setting enabled.)	BIT	1	RW	7000:0D	⊙	√
	0E to 10	Reserved by system	-	BIT	1	RW	7000: 0E to 10	⊙	-
	11	Result acquisition complete notification	Permits the updating of the status result.	BIT	1	RW	7000:11	⊙	-
	12 to 18	Reserved by system	-	BIT	1	RW	7000: 12 to 18	⊙	-
	19	Reserved by system	-	BYTE	8	RW	7000:19	⊙	-
	1A	Program number	The destination program number when change program is requested.	UINT	16	RW	7000:1A	⊙	√
	1B	Setting number	• Upper/lower limit setting No. (tools other than the AI OCR and High-Speed Position Adjustment tools) • Master text setting No. (AI OCR tool) • Serial setting no. for next judgment (AI OCR tool) • FTP/SD-saved setting No. (FTP client / SD card saving function) • Change count value setting number (AI Through Count mode)	UINT	16	RW	7000:1B	⊙	√

Process data object map (PDO List)		Process data object content (PDO Content)							AI Through Count Mode
Index (HEX)	Sub Index (HEX)	Name	Description	Data type	Data size (BIT)	Attribute	Source Index (HEX)	PDO assignment	
0x1600	1C	Setting value 1	• Upper/lower limit values (tools other than the AI OCR and High-Speed Position Adjustment tools) • Master text/number of letters (AI OCR tool) • Serial no. setting value for next judgment (AI OCR tool) • FTP/SD saving settings (FTP client / SD card saving function) • Change count value setting number (AI Through Count mode)	UDINT	32	RW	7000:1C	⊙	√
	1D	Setting value 2		UDINT	32	RW	7000:1D	⊙	√
	. . .	. . .		. . .	. . .	. . .	. . .	. . .	√
	33	Setting value 24		UDINT	32	RW	7000:33	⊙	√

Command Control Index1600: 1B - 1F: Upper/lower limit setting No. (tools other than the AI OCR tool (when Show Matching Rate is disabled) and High-Speed Position Adjustment tool)

Index (HEX)	Sub Index (HEX)	Name	Description	Data content	AI Through Count Mode
0x1600	1B	Upper/lower limit Setting number	Destination of the threshold value to be changed.	0 to 129	√
	1C to 1F	Upper/lower limit	The threshold value for when a threshold value change is requested.	0 to 99999	√

Reference

The setting value setting number rules are shown below.

0: Position correction lower threshold
1: Reserved by system
2: Tool 1 lower threshold 3: Tool 1 upper threshold
4: Tool 2 lower threshold 5: Tool 2 upper threshold
6: Tool 3 lower threshold 7: Tool 3 upper threshold
.
.
32: Tool 16 lower threshold 33: Tool 16 upper threshold
.
.
128: Tool 64 lower threshold 129: Tool 64 upper threshold

To change the threshold of a tool which is using scaling function, input the value which is 10 times of the threshold in [Threshold].
Example) 9999 → 99990 99.9 → 999

NOTICE

Cutoff processing is done for a number of 4 or more digits.
Example) 99995 → 99990

Command Control Index1600: 1B - 33: Master text setting No. (AI OCR tool)

Index (HEX)	Sub Index (HEX)	Name	Description	Data content	AI Through Count Mode
0x1600	1B	Master text setting No.	Stores the destination for a master text change. • Method 1: Batch change (supports up to 32 characters) • Method 2: Change four characters at a time (Supports up to 16 characters)	• Method 1: Batch change • String mode (string identification): 1501 to 1564 • Date/time mode: 1601 to 1664 • Method 2: Change four characters at a time • String mode (string identification): 201 to 456 • String mode (when only judging the number of letters): 501 to 628 • Date/time mode: 701 to 956	-
	1C to 33	Master text	Stores the master text/number of letters after a change.	• Master text when the text/date reading settings are set (Batch change: UTF-8, change 4 characters at a time: ASCII) • Minimum and maximum number of letters when judging only the number of letters: 0 to 32 (UDINT)	-

Method 1: To change the master text (string mode (string identification)/date/time) in a batch

- Specify [Master text setting No.] and write the text in the applicable sub index in the table below.
- Append NULL (0x00) to the end of all text that you want to change. If you overwrite using all [Master text] sub indexes, NULL (0x00) does not need to be appended.
- When the master text is changed, it is not saved in non-volatile memory.

The below example is for 1-byte characters (ASCII compatible area).
When using 3-byte characters, also use Sub Index 0x24 and after (for 3-byte characters x 32 characters, use up to Sub Index 0x33).

❍ **For string mode (string identification)**

Index (HEX)	Sub Index (HEX)	Stored data			
		Tool 1	Tool 2	· · ·	Tool 64*1
0x1600	1B	1501	1502	· · ·	1564
	1C	1st to 4th character	1st to 4th character	· · ·	1st to 4th character
	1D	5th to 8th character	5th to 8th character	· · ·	5th to 8th character
	⋮	⋮	⋮	⋮	⋮
	22	25th to 28th character	25th to 28th character	· · ·	25th to 28th character
	23	29th to 32nd character	29th to 32nd character	· · ·	29th to 32nd character

❍ **For date/time mode**

Index (HEX)	Sub Index (HEX)	Stored data			
		Tool 1	Tool 2	· · ·	Tool 64*1
0x1600	1B	1601	1602	· · ·	1664
	1C	1st to 4th character	1st to 4th character	· · ·	1st to 4th character
	1D	5th to 8th character	5th to 8th character	· · ·	5th to 8th character
	⋮	⋮	⋮	⋮	⋮
	22	25th to 28th character	25th to 28th character	· · ·	25th to 28th character
	23	29th to 32nd character	29th to 32nd character	· · ·	29th to 32nd character

*1 The number of AI OCR tools that can be set in one program are 16. However, when used with other detection tools, an AI OCR tool can be configured as the 64th tool, so the setting number is available up to tool 64.

Point

- **Correctly set byte swap in accordance with the PLC specifications.**
- **This will fail if it is AI OCR (custom mode).**

Method 2: To change the master text/date (change 4 characters at a time)

- Specify [Master text setting No.] and write the text in the applicable sub index in the table below.
- Change the file name in groups of four letters. Also append NULL (0x00) to the end of the text that you want to change. Overwrite the text from the beginning of the text until NULL (0x00) at the end in groups of four letters. Not appending NULL (0x00) will not allow you to correctly change the master text/date. If you overwrite all 16 letters, NULL (0x00) does not need to be appended.
- When the master text/date is changed, it is not saved in non-volatile memory.
- For details of how to change the master text, see “Changing the master text (change 4 characters at a time)” (page 9-84).

❍ For string mode (string identification)

Index (HEX)	Sub Index (HEX)	Stored data								
		Tool 1				Tool 2		···	Tool 16	
0x1600	1B	201	202	203	204	205	···	···	···	264
	1C	1st to 4th character	5th to 8th character	9th to 12th character	13th to 16th character	1st to 4th character	···	···	···	13th to 16th character

❍ For date/time mode

Index (HEX)	Sub Index (HEX)	Stored data								
		Tool 1				Tool 2		···	Tool 16	
0x1600	1B	701	702	703	704	705	···	···	···	764
	1C	1st to 4th character	5th to 8th character	9th to 12th character	13th to 16th character	1st to 4th character	···	···	···	13th to 16th character

❍ To set the number of letters when judging only the number of letters

Index (HEX)	Sub Index (HEX)	Stored data								
		Tool 1		Tool 2		Tool 3		···	Tool 16	
0x1600	1B	501	502	503	504	505	···	···	531	532
	1C	Min char.	Max char.	Min char.	Max char.	Min char.	···	···	Min char.	Max char.

Point

- **Correctly set [Byte Swap] in accordance with the PLC specifications.**
  “Setting the IV4 Series” (page 9-18)
- **This will fail if it is AI OCR (custom mode).**

Command Control Index1600: 1B - 2B: Batch change FTP/SD save file name (FTP client/SD card saving function)

Index (HEX)	Sub Index (HEX)	Name	Description	Data content	AI Through Count Mode
0x1600	1B	Batch changing FTP/SD-saved file name setting number	Stores the setting number to change the FTP/SD-saved file name in a batch.	• Does not save to non-volatile memory (Deleted when the power is turned off) • Transfer condition 1: 1031 • Transfer condition 2: 1032 • Transfer condition 3: 1033 • Transfer condition 4: 1034 • Saves to non-volatile memory (Kept even when the power is turned off) • Transfer condition 1: 1041 • Transfer condition 2: 1042 • Transfer condition 3: 1043 • Transfer condition 4: 1044	-
	1C - 2B	FTP/SD-saved file name	Stores the file name after it is changed.	File name character (ASCII) The following characters are available: 0-9, a-z, A-Z, ' '[space], '(', ')', '+', '-', '=', '_', '.' , '"', '!' , '#', '$', '%', '&', '@'	-

To batch change the FTP/SD-saved file name

- Specify [Batch change FTP/SD-saved file name setting number] and write the string in the applicable sub index in the table below after the change.
- Append NULL (0x00) to the end of all text that you want to change. If you overwrite using all [FTP/SD-saved file name] sub indexes, NULL (0x00) does not need to be appended.

❍ **Does not save to non-volatile memory (deleted when the power is turned off)**

Index (HEX)	Sub Index (HEX)	Stored data			
		Transfer Condition 1	Transfer Condition 2	Transfer Condition 3	Transfer Condition 4
0x1600	1B	1031	1032	1033	1034
	1C	1st to 4th character	1st to 4th character	1st to 4th character	1st to 4th character
	1D	5th to 8th character	5th to 8th character	5th to 8th character	5th to 8th character
	⋮	⋮	⋮	⋮	⋮
	2A	57th to 60th character	57th to 60th character	57th to 60th character	57th to 60th character
	2B	61st to 64th character	61st to 64th character	61st to 64th character	61st to 64th character

❍ **Save to nonvolatile memory**

Index (HEX)	Sub Index (HEX)	Stored data			
		Transfer Condition 1	Transfer Condition 2	Transfer Condition 3	Transfer Condition 4
0x1600	1B	1041	1042	1043	1044
	1C	1st to 4th character	1st to 4th character	1st to 4th character	1st to 4th character
	1D	5th to 8th character	5th to 8th character	5th to 8th character	5th to 8th character
	⋮	⋮	⋮	⋮	⋮
	2A	57th to 60th character	57th to 60th character	57th to 60th character	57th to 60th character
	2B	61st to 64th character	61st to 64th character	61st to 64th character	61st to 64th character

Command Control Index1600: 1B - 1C: Serial no. for next OCR judgment change (number)

When the serial number is changed, it is not saved in non-volatile memory.

Index (HEX)	Sub Index (HEX)	Name	Description	Data content	AI Through Count Mode
0x1600	1B	Change the serial setting number for next OCR judgment	Stores the setting number for changing the serial number for the next judgment of the AI OCR tool (custom mode).	Tool 1: 1701 onwards Tool 64*1: 1764	-
	1C	Serial no. for next OCR judgment	Stores the serial number for when a serial number change is requested.	0 to 999999	-

*1 The number of AI OCR tools that can be set in one program are 16. However, when used with other detection tools, an AI OCR tool can be configured as the 64th tool, so the setting number is available up to tool 64.

Command Control Index1600: 1B - 1D: Serial no. for next OCR judgment change (letter)

When the serial number is changed, it is not saved in non-volatile memory.

Index (HEX)	Sub Index (HEX)	Name	Description	Data content	AI Through Count Mode
0x1600	1B	Change the serial setting number for next OCR judgment	Stores the setting number for changing the serial number for the next judgment of the AI OCR tool (custom mode).	Tool 1: 1801 onwards Tool 64*1: 1864	-
	1C to 1D	Serial no. for next OCR judgment	Stores the serial number for when a serial number change is requested.	A to ZZZZZZ	-

*1 The number of AI OCR tools that can be set in one program are 16. However, when used with other detection tools, an AI OCR tool can be configured as the 64th tool, so the setting number is available up to tool 64.

Changing the Serial Number (Letter) for the Next Judgment of the AI OCR Tool (Custom Mode)

Index (HEX)	Sub Index (HEX)	Stored data			
		Tool 1	Tool 2	· · ·	Tool 64
0x1600	1B	1801	1802	· · ·	1864
	1C	1st to 4th character	1st to 4th character	· · ·	1st to 4th character
	1D	5th to 6th character	5th to 6th character	· · ·	5th to 6th character

Process data object (PDO) communication map: TxPDO

Sync Manager3 (RxPDO from device to master)

Indicates a map of data to be sent from a device to the master using process data object communication.
There are three main types of indexes that read out the results of each tool.

<Tool Results Monitor Data>
<Tool Results 4x Detailed Data>
<Tool Results 8x Detailed Data>

4x detailed data/8x detailed data is an index in which the maximum number of characters that can be read out is greater than that of monitor data when using AI OCR. Since these indexes are exclusive, select one of them to use.
For details about differences in the information that can be read out, see “AI OCR: 4x detailed data/8x detailed data” (page 9-34).

Command Status Bits

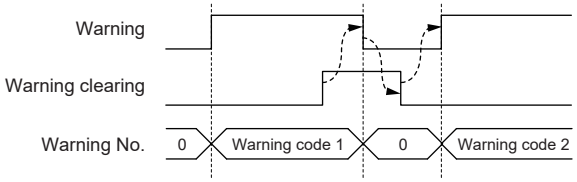
Process data object map (PDO List)		Process data object content (PDO Content)									AI Through Count Mode
Index (HEX)	Sub Index (HEX)	Items	Description	Data content	Data type	Data size (BIT)	Attribute	Source Index (HEX)	Source Sub Index (HEX)	PDO assignment	
0x1A00	01	Trigger response	Response from External Trigger, Internal Trigger Control/AI Trigger Control	0: OFF 1: ON	BIT	1	R	6000	01	⊙	√
	02	Master registration response	Response to master image registration	0: OFF 1: ON					02		-
	03	Program switching response	Response to program switching	0: OFF 1: ON					03		√
	04	Warning clear response	Response to the warning clear	0: OFF 1: ON					04		√
	05	Statistics reset response	Response to the statistics reset request	0: OFF 1: ON					05		-
	06	Status result/ Buffer clear response	Response to status result/buffer clear request	0: OFF 1: ON					06		-
	07	SD saving stop response	Response to the SD card saving stop request	0: OFF 1: ON					07		√
	08	Setting change response	Response to the setting value change request	0: OFF 1: ON					08		√
	09	Trigger failed	The trigger request failed	0: - 1: Failed					09		-
	0A	Master registration failed	Registration of the master image failed	0: - 1: Failed					0A		-
	0B	Program switch failed	Switching programs failed	0: - 1: Failed					0B		√
	0C	OCR serial no. count up input response	Response to the count up input request. Target: AI OCR (Standard Mode)	0: OFF 1: ON					0C		-
	0D	Reset count input response	Response to the reset count input request. Target: • AI OCR (Standard Mode) • Count Tool (AI Through Count Mode)	0: OFF 1: ON					0D		√
	0E	Reserved by system			-	-	-	-	0E	-	-

Process data object map (PDO List)		Process data object content (PDO Content)									AI Through Count Mode
Index (HEX)	Sub Index (HEX)	Items	Description	Data content	Data type	Data size (BIT)	Attribute	Source Index (HEX)	Source Sub Index (HEX)	PDO assignment	
0x1A00	0F	SD card saving stop failed	Failed to stop the SD card saving (Failure cause: SD card save stop request turned on during Sensor Setup)	0: - 1: Failed	BIT	1	R	6000	0F	⊙	√
	10	Setting change failed	Failed to change the setting value	0: - 1: Failed					10		√
	11	Result available	This bit is output when the status result can be acquired.	0: - 1: Available					11		-
	12	Result update complete	This bit switches the ON/OFF statuses when the status result is updated.	0 : 1					12		-
	13	BUSY	This bit is output when the unit is unable to accept new trigger inputs, such as while performing imaging, processing a judgment, registering an external master image, switching programs, etc.	0: - 1: Busy state					13		√
	14	Imaging	This bit is output while the unit is performing imaging operation.	0: - 1: Imaging					14		√
	15	RUN	This bit is output when the unit is “RUN” and no system errors have occurred.	0: - 1: Normal operating status					15		√
	16	Ready	This bit is output when the start-up sequence of this unit completes after power-on.	0: Start-up not completed 1: Start-up completed					16		√
	17	Trigger Ready	This is output when the trigger can be received.	0: Trigger cannot be received 1: Trigger can be received					17		√
	18	SD card identification status	This bit is output when the SD card is recognized.	0: - 1: SD card recognized					18		√
	19	Sorting mode operation	This bit is output in Sorting mode while running	0: - 1: In [RUN] status in Sorting mode					19		-
	1A	Reserved by system			-	-	-	-	1A	-	-
	1B	AI Through Count mode run state	This bit is output in AI Through Count mode while running	0: - 1: Run state in AI Through Count mode	BIT	1	R	6000	1B	⊙	√
	1C	Reserved by system			-	-	-	-	1C	-	-
	1D	SD card insufficient capacity	This bit is output when the free space on the SD card is 100 MB or less.	0: No insufficient free space error has occurred. 1: Insufficient free space (100 MB or less).	BIT	1	R	6000	1D	⊙	√

Process data object map (PDO List)		Process data object content (PDO Content)									AI Through Count Mode
Index (HEX)	Sub Index (HEX)	Items	Description	Data content	Data type	Data size (BIT)	Attribute	Source Index (HEX)	Source Sub Index (HEX)	PDO assignment	
0x1A00	1E	Buffer overrun	If handshake control is [Enabled], this bit is output when an overrun of the status result has occurred.	0: No buffer overrun has occurred. 1: The buffer is in overrun status.	BIT	1	R	6000	1E	⊙	-
	1F	Warning	This bit outputs the warning status of the unit.	0: The unit is not in warning status. 1: The unit is in warning status.					1F		√
	20	Error	This bit outputs the error status of the unit.	0: The unit is not in error status. 1: The unit is in error status.					20		√

Reference

- By monitoring whether the unit is in “Imaging” status, you can determine whether the target object or the unit can be moved before completion of the image processing.
- “BUSY” and “Imaging” statuses may be skipped in some cyclic frequency settings. It is therefore necessary to take the imaging condition into consideration when setting the cyclic frequency.
- Warning status can be cleared with a warning clear request.
- When two or more warnings are issued, all subsequent warnings after the first warning will be saved in the history. If you clear the warnings, the warning code of the highest priority warning will be displayed.



- The error status cannot be cleared. The error code of the highest priority error will be displayed.
- The buffer overrun status can be cleared using a warning clear.

Device Result Bits

Process data object map (PDO List)		Process data object content (PDO Content)									AI Through Count Mode
Index (HEX)	Sub Index (HEX)	Items	Description	Data content	Data type	Data size (BIT)	Attribute	Source Index (HEX)	Source Sub Index (HEX)	PDO can be assigned	
0x1A01	01	Total Status OK	Total status OK result	0: NG 1: OK	BIT	1	R	6001	01	⊙	-
	02	Total Status NG	Total status NG result	0: OK 1: NG					02		-
	03 to 04	Reserved by system	-	-	-	-	-	-	03 to 04	-	-
	05	Position Adjustment	Position adjustment result	0: NG 1: OK	BIT	1	R	6001	05	⊙	-
	06 to 08	Reserved by system	-	-	-	-	-	-	06 to 08	-	-
	09	LOGIC1	Result of Logic 1	0: NG 1: OK	BIT	1	R	6001	09	⊙	√
	0A	LOGIC2	Result of Logic 2						0A		√
	0B	LOGIC3	Result of Logic 3						0B		√
	0C	LOGIC4	Result of Logic 4						0C		√
	0D	LOGIC5	Result of Logic 5						0D		√
	0E	LOGIC6	Result of Logic 6						0E		√
	0F	LOGIC7	Result of Logic 7						0F		√
	10	LOGIC8	Result of Logic 8						10		√

- If the position correction/logic/tool is not set, the data content will be OFF (0).
- If the status result of the tool is either “trigger standby” (no judgment) or “judgment not possible”, the data content will be OFF (0).

Tool Result: Judgment result (Tool 1 to 16), master number/overall judgment variety, Tool Extended Result: Judgment result (Tool 17 to 64)

Process data object map (PDO List)		Process data object content (PDO Content)									AI Through Count Mode
Index (HEX)	Sub Index (HEX)	Items	Description	Data content	Data type	Data size (BIT)	Attribute	Source Index (HEX)	Source Sub Index (HEX)	PDO can be assigned	
0x1A02	01	Master number [Standard Mode]*1	When multiple master registration is “Enabled”: Stores the master number (00 to 07) from the total status result obtained from the results of each tool when “total status result is OK” is OK (1).	0: 00 or NG 1 to 7: 01 to 07	UINT	16	R	6002	01	⊙	-
		Total status product types [Sorting Mode]*1	Stores the product type (M0 to M7) from the total status result obtained from the results of each tool when “total status result is OK” is OK (1).	0: M0 or NG 1 to 7: M1 to M7							
	02	Tool 1	Displays the result of Tool 1. Stores Output 1 of Tool 1 in AI Through Count mode.	0: NG 1: OK	BIT	1	R		02		√
	03	Tool 2	Displays the result of Tool 2. Stores Output 1 of Tool 2 in AI Through Count mode.						03		
	04	Tool 3	Displays the result of Tool 3. Stores Output 1 of Tool 3 in AI Through Count mode.						04		
	05	Tool 4	Displays the result of Tool 4. Stores Output 1 of Tool 4 in AI Through Count mode.						05		
	06	Tool 5	Displays the result of Tool 5. Stores Output 1 of Tool 5 in AI Through Count mode.	0: NG 1: OK	BIT	1	R	6002	06	⊙	√
	07	Tool 6	Displays the result of Tool 6. Stores Output 1 of Tool 6 in AI Through Count mode.						07		
	08	Tool 7	Displays the result of Tool 7. Stores Output 1 of Tool 7 in AI Through Count mode.						08		
	09	Tool 8	Displays the result of Tool 8. Stores Output 1 of Tool 8 in AI Through Count mode.						09		
	0A	Tool 9	Displays the result of Tool 9. Stores Output 2 of Tool 1 in AI Through Count mode.						0A		
	0B	Tool 10	Displays the result of Tool 10. Stores Output 2 of Tool 2 in AI Through Count mode.						0B		
	0C	Tool 11	Displays the result of Tool 11. Stores Output 2 of Tool 3 in AI Through Count mode.						0C		

Process data object map (PDO List)		Process data object content (PDO Content)									AI Through Count Mode
Index (HEX)	Sub Index (HEX)	Items	Description	Data content	Data type	Data size (BIT)	Attribute	Source Index (HEX)	Source Sub Index (HEX)	PDO can be assigned	
0x1A02	0D	Tool 12	Displays the result of Tool 12. Stores Output 2 of Tool 4 in AI Through Count mode.	0: NG 1: OK	BIT	1	R	6002	0D	⊙	√
	0E	Tool 13	Displays the result of Tool 13. Stores Output 2 of Tool 5 in AI Through Count mode.						0E		
	0F	Tool 14	Displays the result of Tool 14. Stores Output 2 of Tool 6 in AI Through Count mode.						0F		
	10	Tool 15	Displays the result of Tool 15. Stores Output 2 of Tool 7 in AI Through Count mode.						10		
	11	Tool 16	Displays the result of Tool 16. Stores Output 2 of Tool 8 in AI Through Count mode.						11		
0x1A03(*3)	01	Tool 17	Stores the judgment result of Tool 17.* 2	0: NG 1: OK	BIT	1	R	6002	12	⊙	-
	⋮	⋮	⋮		⋮	⋮	⋮		⋮		⋮
	30	Tool 64	Stores the judgment result of Tool 64.* 2		BIT	1	R		41		-

*1 • Check that “total status result is NG” is OK (1), and then check the master number or product type. If the master number or product type cannot be determined (the result is NG), the value becomes 0.
• When obtaining the master number, set [Total status condition] as shown below. Failing to do so will prevent you from obtaining correct master numbers.
  • Total status condition: Logic n (n = 1 to 8)
  • Logic n setting
  Logic: OR
  Set master number (Master00 to Master07): Use
  “4. Output Assignment” (page 4-88)
• If there are multiple master numbers whose status is OK, the lowest master number is output.

*2 • If the position correction/logic/tool is not set, the data content will be OFF (0).
• If the status result of the tool is either “trigger standby” (no judgment) or “judgment not possible”, the data content will be OFF (0).

*3 Cannot be used simultaneously with Index 0x1A04.

Classify Result: Sorting mode judgment part

Process data object map (PDO List)		Process data object content (PDO Content)									AI Through Count Mode
Index (HEX)	Sub Index (HEX)	Items	Description	Data content	Data type	Data size (BIT)	Attribute	Source Index (HEX)	Source Sub Index (HEX)	PDO can be assigned	
0x1A04	01	Sorting Mode Tool 1 status product type	Stores the product type determined by Tool 1 when the Tool 1 status result is OK (1).	0: M0 or NG 1 to 7: M1 to M7	UINT	16	R	6003	01	⊙	-
	02	Sorting Mode Tool 2 status product type	Stores the product type determined by Tool 2 when the Tool 2 status result is OK (1).		UINT	16	R		02		-
	03	Sorting Mode Tool 3 status product type	Stores the product type determined by Tool 3 when the Tool 3 status result is OK (1).		UINT	16	R		03		-

Point

- **Check against each tool’s status result. If the product type cannot be determined (the result is NG), the value becomes 0.**
- **The product types determined by Tools 4 to 8 in sorting mode cannot be displayed.**
- **Cannot be used simultaneously with Index 0x1A03.**

Device Status Words: Error/status/status result information

Process data object map (PDO List)		Process data object content (PDO Content)									AI Through Count Mode
Index (HEX)	Sub Index (HEX)	Items	Description	Data content	Data type	Data size (BIT)	Attribute	Source Index (HEX)	Source Sub Index (HEX)	PDO can be assigned	
0x1A05	01	Error code	Displays the currently occurring error code. If two or more errors are occurring at the same time, the error code of the highest priority error will be displayed.	0 - 128	UINT	16	R	6004	01	⊙	√
	02	Warning Code	Displays the currently occurring warning code. The first occurred warning code will be displayed when multiple warnings have occurred.	0 - 128	UINT	16	R		02		√
	03	Number of remaining buffers	Displays the number of status results that can be buffered, if handshake control is [Enabled].	0 - 10	UINT	16	R		03		-
	04	Checksum	Displays the current sensor setting status using an arbitrary 5-digit integer. A checksum can be used to monitor whether the sensor settings have been modified or the program has been changed by a third party.	0 - 65535	UINT	16	R		04		√
	05	Current program No.	Displays the current program No.	0 - 127	UINT	16	R		05		√
	06	Program No. during judgment	Displays the program No. of the latest judgment process.	0 to 127	UINT	16	R		06		√
	07	Result No.	Displays the judgment process counts. If the maximum value is exceeded, it will go back to 0 and start counting up again.	0 to 32767	UINT	16	R		07		√
	08	Processing time	Displays the processing time (msec) of the latest judgment process.	0 to 10000	UINT	16	R		08		√

Reference

- Error and warning codes can be found on the Error Number Search site on the KEYENCE website. www.keyence.com/iv4_trouble_support
- The checksum will remain unchanged even if you change the IP address, subnet mask, default gateway or port number of the IV4 Series.
- For the number of remaining buffers, refer to “Reading out the status result (handshake control: [Enable]; Preliminary capture: [Disable])” (page 9-46).
- The result No. will also count the judgment process counts that were skipped due to the cyclic frequency setting.

Device Statistics: Statistical information

Process data object map (PDO List)		Process data object content (PDO Content)									AI Through Count Mode
Index (HEX)	Sub Index (HEX)	Items	Description	Data content	Data type	Data size (BIT)	Attribute	Source Index (HEX)	Source Sub Index (HEX)	PDO can be assigned	
0x1A06	01	Processing time MAX	Displays the maximum processing time (msec).	0 to 10000	UINT	16	R	6005	01	⊙	√
	02	Processing time MIN	Displays the minimum processing time (msec).	0 to 10000	UINT	16	R		02		√
	03	Processing time AVE	Displays the average processing time (msec).	0 to 10000	UINT	16	R		03		√
	04	Reserved by system			UINT	16	R		04		-
	05	Trigger Count	Displays the total number of triggers issued.	0 to 1000000000	UDINT	32	R		05		-
	06	OK count (Standard Mode) Sorting count (Sorting Mode)	Displays the total number of issued triggers whose total status result was “OK” or with which the product type was determined.	0 to 1000000000	UDINT	32	R		06		-
	07	NG count [Standard Mode/ Sorting Mode]	Displays the total number of issued triggers whose total status result was “NG” or with which the product type was not determined.	0 to 1000000000	UDINT	32	R		07		-
	08	Trigger error count	Displays the number of triggers issued as error triggers.	0 to 1000000000	UDINT	32	R		08		-
	09	Number of completed result output transfers	Counts up for each completed transfer of images and judgment results (text files) to FTP/ SFTP/SD card. (If multiple transfer conditions are used, the count up is performed upon completion of the transfer of all files matching the conditions.)	0 to 1000000000	UDINT	32	R		09		-

Reference

- If the maximum number of triggers/completed result output transfers is exceeded, it will go back to 0 and start counting up again.
- Updates of the numerical value for the number of OK triggers, NG triggers, and trigger errors will stop at the upper limit.
- A reset will occur in the following conditions:
  - When [Statistics reset] is input
  - When a tool is added/deleted/copied
  - When the sensor is switched OFF
  - When the program is switched
  - When a correction for the sensor is started
  - When the sensor is initialized

Position Adjust Score

Process data object map (PDO List)		Process data object content (PDO Content)									AI Through Count Mode
Index (HEX)	Sub Index (HEX)	Items	Description	Data content	Data type	Data size (BIT)	Attribute	Source Index (HEX)	Source Sub Index (HEX)	PDO can be assigned	
0x1A07	01	Position adjustment tool matching rate	Stores the matching rate of the position adjustment tool.	0 to 100	UINT	16	R	6006	01	⊙	-

Position Adjust detailed result

Process data object map (PDO List)		Process data object content (PDO Content)									AI Through Count Mode
Index (HEX)	Sub Index (HEX)	Items	Description	Data content	Data type	Data size (BIT)	Attribute	Source Index (HEX)	Source Sub Index (HEX)	PDO can be assigned	
0x1A08	01	Position adjustment tool Matching rate MAX	Stores the maximum matching rate value of the position adjustment tool.	0 - 100	UINT	16	R	6006	02	⊙	-
	02	Position adjustment tool Matching rate MIN	Stores the minimum matching rate value of the position adjustment tool.	0 - 100	UINT	16	R		03		-
	03	Position adjustment tool Limit	Stores the threshold value of the position adjustment tool.	0 - 100	UINT	16	R		04		
	04 to 09	Reserved by system							05 to 0A		-

Reference Maximum and minimum matching rate values of the position adjustment tool will be reset in the same manner as the statistics information.

Tool Results Monitor Data

Tool N Score (N=1 to 8)

Process data object map (PDO List)		Process data object content (PDO Content)									AI Through Count Mode
Index (HEX)	Sub Index (HEX)	Items	Description	Data content	Data type	Data size (BIT)	Attribute	Source Index (HEX)	Source Sub Index (HEX)	PDO can be assigned	
0x1A09	01	Tool 1 Matching rate/ Quantity	[Standard Mode] Stores the matching rate and quantity for each tool. [AI Through Count Mode] Stores the count value (last 2 bytes) for each tool.	[Standard Mode] 0 - 9999 Blob count: 0 to 200 AI count: 0 to 999 [AI Through Count Mode] 0 - 65535*	UINT	16	R	6007	01h	⊙	√
0x1A0B	01	Tool 2 Matching rate/ Quantity			UINT	16	R		0Bh		√
0x1A0D	01	Tool 3 Matching rate/ Quantity			UINT	16	R		15h		√
0x1A0F	01	Tool 4 Matching rate/ Quantity			UINT	16	R		1Fh		√
0x1A11	01	Tool 5 Matching rate/ Quantity			UINT	16	R		29h		√
0x1A13	01	Tool 6 Matching rate/ Quantity			UINT	16	R		33h		√
0x1A15	01	Tool 7 Matching rate/ Quantity			UINT	16	R		3Dh		√
0x1A17	01	Tool 8 Matching rate/ Quantity			UINT	16	R		47h		√

*When reading out to 99999999, the first 2 bytes of the Tool N detailed result are also read out.

Tool N detailed result (N=1 to 8)

Process data object map (PDO List)		Process data object content (PDO Content)									AI Through Count Mode
Index (HEX)	Sub Index (HEX)	Items	Description	Data content	Data type	Data size (BIT)	Attribute	Source Index (HEX)	Source Sub Index*1 (HEX)	PDO can be assigned	
Tool 1: 0x1A0A Tool 2: 0x1A0C Tool 3: 0x1A0E Tool 4: 0x1A10 Tool 5: 0x1A12 Tool 6: 0x1A14 Tool 7: 0x1A16 Tool 8: 0x1A18	01	Tool N Status result information (default)*2			UINT	16	R	6007	02h+(M-1)×Ah	√	√
	02				UINT	16	R		03h+(M-1)×Ah		√
	03				UINT	16	R		04h+(M-1)×Ah		√
	04				UINT	16	R		05h+(M-1)×Ah		√
	05				UINT	16	R		06h+(M-1)×Ah		√
	06				UINT	16	R		07h+(M-1)×Ah		√
	07				UINT	16	R		08h+(M-1)×Ah		√
	08				UINT	16	R		09h+(M-1)×Ah		√
	09				UINT	16	R		0Ah+(M-1)×Ah		√

*1 For details on how the sub index formula is calculated, refer to “How to Calculate Sub Indexes for Tool N” (page 9-111).
*2 The status result information for each type of tool is as follows.

Position Adjustment/Hi-Sp.Adj/Learn/AI Identify/Total/Color Prohibit/Brightness Prohibit/Outline/Area/ Color Area/Edge Pixel/Edge/Missed Line Detection

Sub Index (HEX)	Items	Description	Data content
01	Tool matching rate MAX	-	0 to 9999 (default: 0)
02	Tool matching rate MIN	-	
03	Tool lower threshold	-	
04	Tool upper threshold	-	0 to 9999 (default: 65535)
05 to 09	Reserved by system		

Width/diameter/pitch

Sub Index (HEX)	Items	Description	Data content
01	Tool matching rate MAX	-	0 to 9999 (default: 0)
02	Tool matching rate MIN	-	
03	Tool lower threshold	-	
04	Tool upper threshold	-	0 to 9999 (default: 65535)
05	Tool 1 scaling decimal point position	Stores the decimal point position for matching rate when scaling is enabled. It is applied to the data results of matching rate, matching rate MAX, matching rate MIN, lower threshold, upper threshold, pitch present value MAX, pitch present value MIN.	0: No decimal point 1: 1 digit after decimal point 2: 2 digits after decimal point 3: 3 digits after decimal point
06	Tool 1 pitch present value MAX	Maximum value of all pitches	0 to 9999 (default: 0)
07	Tool 1 pitch present value MIN	Minimum value of all pitches	
08	Tool 1 Number of pitches	-	
09	Reserved by system		

AI Count

Sub Index (HEX)	Items	Description	Data content
01	Tool quantity MAX	-	0 to 9999 (default: 0)
02	Tool quantity MIN	-	
03	Tool lower threshold	-	
04	Tool upper threshold	-	0 to 9999 (default: 65535)
05	Missing Window No. 1	• When Missing Part Detection is enabled Stores the missing window numbers in order of the smallest number. • When Missing Part Detection is disabled Fixed to 0	0 to 201 (default: 0)
06	Missing Window No. 2		
07	Missing Window No. 3		
08	Missing Window No. 4		
09	Reserved by system		

*Maximum and minimum tool quantities will be reset in the same manner as the statistics information.

AI OCR

Sub Index (HEX)	Items	Description	Data content
01	Tool lower threshold	-	0 to 9999 (default: 0)
02 to 09	Tool text read	Stores text read (up to 16 letters). If it contains characters with more than two bytes, the total is 16 bytes. If the total is less than 16 bytes, the remaining devices are NULL.	UTF-8

Blob Count

Sub Index (HEX)	Items	Description	Data content
01	Tool quantity MAX	-	0 to 200 (default: 0)
02	Tool quantity MIN	-	0 to 200 (default: 0)
03	Tool lower threshold	-	0 to 9999 (default: 0)
04	Tool upper threshold	-	0 to 9999 (default: 65535)
05 to 09	Reserved by system		

Color/brightness average

Sub Index (HEX)	Items	Description	Data content
01	Tool matching rate MAX	-	0 to 9999 (default: 0)
02	Tool matching rate MIN	-	
03	Tool lower threshold	-	
04	Tool upper threshold	-	0 to 9999 (default: 65535)
05	Reserved by system	-	
06	Tool H (hue)*	-	0 to 359 (default: 0)
07	Tool S (saturation)*	-	0 to 255 (default: 0)
08	Tool V (brightness)	-	0 to 255 (default: 0)
09	Reserved by system		

AI Through Count

Sub Index (HEX)	Items	Description	Data content
01	Count value first 2 bytes	Stores the first 2 bytes of the count value for the tool. The last 2 bytes of the Tool N Score are also read out.	0 to 99999999: First and last connection
02	Output 1 threshold value Last 2 bytes	The tool's Output 1 threshold value is divided into the last and first two bytes and stored.	0 to 65535: Last only 0 to 99999999: First and last connection
03	Output 1 threshold value First 2 bytes		
04	Output 2 threshold value Last 2 bytes	The tool's Output 2 threshold value is divided into the last and first two bytes and stored.	0 to 65535: Last only 0 to 99999999: First and last connection
05	Output 2 threshold value First 2 bytes		
06	Today's total count Last 2 bytes	The tool's today total count value is divided into the last and first two bytes and stored.	0 to 65535: Last only 0 to 99999999: First and last connection
07	Today's total count First 2 bytes		
08 to 09	Reserved by system		

Reference

- The MAX and MIN matching rate values of the tool will be reset in the same manner as the statistics information.
- If the upper threshold value of the tool is not set, the data content of the tool's upper limit value will be "65535".
- The information for tools (other than the learning tool) in sorting mode outputs the information of the tool that was determined as the master image registered to the judged product type. If the status of sorting is NG, the information of product type M0 is output. However, MAX, MIN, and the thresholds are invalid values.

In the case of Tool 9 to 64

Tool N Score (N=9 to 64)
Tool N detailed result (N=9 to 64)

Process data object map (PDO List)		Process data object content (PDO Content)									AI Through Count Mode
Index (HEX)	Sub Index*1 (HEX)	Items	Description	Data content	Data type	Data size (BIT)	Attribute	Source Index (HEX)	Source Sub Index*1 (HEX)	PDO can be assigned	
Tool 9 to 16 0x1A19 Tool 17 to 32 0x1A1A Tool 33 to 48 0x1A1B Tool 49 to 64 0x1A1C	01h + (M-1) x Ah	Tool N Matching rate/ Quantity	Stores the matching rate and quantity for Tool N.	0 to 9999 Blob count: 0 to 200 AI count: 0 to 999	UINT	16	R	Tool 9 to 16: 0x6007 Tool 17 to 32: 0x6008 Tool 33 to 48: 0x6009 Tool 49 to 64: 0x600A	01h + (M-1) x Ah	√	-
	02h + (M-1) x Ah	Tool N status result information (default)*2			UINT	16	R		02h + (M-1) x Ah		-
	03h + (M-1) x Ah				UINT	16	R		03h + (M-1) x Ah		-
	04h + (M-1) x Ah				UINT	16	R		04h + (M-1) x Ah		-
	05h + (M-1) x Ah				UINT	16	R		05h + (M-1) x Ah		-
	06h + (M-1) x Ah				UINT	16	R		06h + (M-1) x Ah		-
	07h + (M-1) x Ah				UINT	16	R		07h + (M-1) x Ah		-
	08h + (M-1)×Ah				UINT	16	R		08h + (M-1) x Ah		-
	09h + (M-1) x Ah				UINT	16	R		09h + (M-1) x Ah		-
	0Ah + (M-1) x Ah				UINT	16	R		0Ah + (M-1) x Ah		-

*1 For details on how the sub index formula is calculated, refer to "How to Calculate Sub Indexes for Tool N" (page 9-111).
*2 This is the same as the sub index for the Tool N detailed result (N=1 to 8).

Tool Results 4x Detailed Data

Tool N 4x detailed result1 (N=1 to 16)

AI OCR*

Process data object map (PDO List)		Process data object content (PDO Content)									AI Through Count Mode
Index (HEX)	Sub Index*1 (HEX)	Items	Description	Data content	Data type	Data size (BIT)	Attribute	Source Index (HEX)	Source Sub Index*1 (HEX)	PDO can be assigned	
Tool 1 to 4 0x1A31 Tool 5 to 8 0x1A32 Tool 9 to 12 0x1A33 Tool 13 to 16 0x1A34	01h + (L-1) x 28h	Tool N Matching rate	-	0 to 9999 (Default value: 0)	UINT	16	R	6010	01h + (L-1) x 28h	√	-
	02h + (L-1) x 28h	Tool N Lower Limit	-	0 to 9999 (Default value: 0)	UINT	16	R		02h + (L-1) x 28h		-
	03h + (L-1) x 28h	Tool N Current serial No. Last (number)	If serial numbers are used in the number setting for the AI OCR tool (custom), the current value of the serial number is divided into the last 2-bytes and first 2-bytes, and stored.	0-999999	UINT	16	R		03h + (L-1) x 28h		-
	04h + (L-1) x 28h	Tool N Current serial No. First (number)			UINT	16	R		04h + (L-1) x 28h		-
	05h + (L-1) x 28h	Tool N Current serial No. (ASCII text)	If serial numbers are used in the uppercase letters setting for the AI OCR tool (custom), the current value of the serial number is stored.	ASCII	UINT	16	R		05h + (L-1) x 28h		-
	06h + (L-1) x 28h				UINT	16	R		06h + (L-1) x 28h		-
	07h + (L-1) x 28h				UINT	16	R		07h + (L-1) x 28h		-
	08h + (L-1) x 28h	Reserved by system			UINT	16	R		08h + (L-1) x 28h		-
	09h + (L-1) x 28h	Tool N Number of letters to be read	Stores the text currently being read.	0 to 32	UINT	16	R		09h + (L-1) x 28h		-
	0Ah + (L-1) x 28h	Tool N Number of bytes to be read	Stores the total size (bytes) of the letters currently being read.	0 to 60	UINT	16	R		0Ah + (L-1) x 28h		-
	0Bh + (L-1) x 28h to 28h + (L-1) x 28h	Tool N Text read	Stores text read (up to 32 letters). If it contains text with more than two bytes, the total text that can be read out is 60 bytes. If the total is less than 60 bytes, the remaining devices are NULL.	UTF-8	UINT	16	R		0Bh + (L-1) x 28h to 28h + (L-1) x 28h		-

*1 For details on how the sub index formula is calculated, refer to “How to Calculate Sub Indexes for Tool N” (page 9-111).

Tool Results 8x Detailed Data

Tool N 8x detailed result (N=1 to 8)

Process data object map (PDO List)		Process data object content (PDO Content)									AI Through Count Mode
Index (HEX)	Sub Index (HEX)	Items	Description	Data content	Data type	Data size (BIT)	Attribute	Source Index (HEX)	Source Sub Index*1 (HEX)	PDO can be assigned	
Tool 1 to 2 0x1A41 Tool 3 to 4 0x1A42 Tool 5 to 6 0x1A43 Tool 7 to 8 0x1A44	01h + (K-1) x 50h	Tool N Matching rate	-	0 to 9999 (Default value: 0)	UINT	16	R	6020	01h + (K-1) x 50h	√	-
	02h + (K-1) x 50h	Tool N Lower Limit	-	0 to 9999 (Default value: 0)	UINT	16	R		02h + (K-1) x 50h		-
	03h + (K-1) x 50h	Tool N Current serial No. Last (number)	If serial numbers are used in the number setting for the AI OCR tool (custom), the current value of the serial number is divided into the last 2-bytes and first 2-bytes, and stored.	0-999999	UINT	16	R		03h + (K-1) x 50h		-
	04h + (K-1) x 50h	Tool N Current serial No. First (number)			UINT	16	R		04h + (K-1) x 50h		-
	05h + (K-1) x 50h	Tool N Current serial No. (ASCII text)	If serial numbers are used in the uppercase letters setting for the AI OCR tool (custom), the current value of the serial number is stored.	ASCII	UINT	16	R		05h + (K-1) x 50h		-
	06h + (K-1) x 50h				UINT	16	R		06h + (K-1) x 50h		-
	07h + (K-1) x 50h				UINT	16	R		07h + (K-1) x 50h		-
	08h + (K-1) x 50h	Reserved by system			UINT	16	R		08h + (K-1) x 50h		-
	09h + (K-1) x 50h	Tool N Number of letters to be read	Tool N Number of letters to be read	0 to 32	UINT	16	R		09h + (K-1) x 50h		-
	0Ah + (K-1) x 50h	Tool N Number of bytes to be read	Tool N Number of bytes to be read	0 to 96	UINT	16	R		0Ah + (K-1) x 50h		-
	0Bh + (K-1) x 50h to 3Ah + (K-1) x 50h	Tool N Text read	Stores text read (up to 32 letters). Total characters are 96 bytes or less. If the total is less than 96 bytes, the remaining devices are NULL.	UTF-8	UINT	16	R		0Bh + (K-1) x 50h to 3Ah + (K-1) x 50h		-
	3Bh + (K-1) x 50h to 50h + (K-1) x 50h	Reserved by system			UINT	16	R		3Bh + (K-1) x 50h to 50h + (K-1) x 50h		-

*1 For details on how the sub index formula is calculated, refer to “How to Calculate Sub Indexes for Tool N” (page 9-111).

How to Calculate Sub Indexes for Tool N

This section describes how to calculate sub indexes for Tool N.
As an example, the case of sub index (HEX) of the matching rate and quantity of Tool 9 and Tool 16 in Index:0x1A19 of the monitor data will be used.

Process data object map (PDO List)		Process data object content (PDO Content)
Index (HEX)	Sub Index (HEX)	Items
Tool 9 to 16 0x1A19	01h+(M-1)×Ah	Tool N Matching rate/Quantity

The formula from the above table is 01h+(M-1)×Ah.

In the case of Tool 9

Variable M is M = 9 from [Correspondence table for Tool N and Variables M, L, and K].
Substitute M for 9 and calculate as follows.

01h+(M-1)×Ah
=01h+(9-1)×Ah
=01h+8×Ah
=01h+50h
=51h

As the M-1 part is defined as a decimal number, Ah is also converted to a decimal number and calculated, and then converted back to a hexadecimal number.
Ah→10(DEC)
8×10(DEC)=80(DEC)
80(DEC)→50h

In the case of Tool 9, the value of sub index (HEX) is 51h.

In the case of Tool 16

Variable M is M = 16 from [Correspondence table for Tool N and Variables M, L, and K].
Substitute M for 16 and calculate as follows.

01h+(M-1)×Ah
=01h+(16-1)×Ah
=01h+15×Ah
=01h+96h
=97h

As the M-1 part is defined as a decimal number, Ah is also converted to a decimal number and calculated, and then converted back to a hexadecimal number.
Ah→10(DEC)
15×10(DEC)=150(DEC)
150(DEC)→96h

In the case of Tool 16, the value of sub index (HEX) is 97h.

Correspondence table for Tool N and Variables M, L, and K

All values in the table are decimal.

Tool N	Monitor Data	4x Detailed Data	8x Detailed Data
	M	L	K
1	1	1	1
2	2	2	2
3	3	3	1
4	4	4	2
5	5	1	1
6	6	2	2
7	7	3	1
8	8	4	2
9	9	1	-
10	10	2	-
11	11	3	-
12	12	4	-
13	13	1	-
14	14	2	-
15	15	3	-
16	16	4	-
17	1	-	-
18	2	-	-
19	3	-	-
20	4	-	-
21	5	-	-
22	6	-	-
23	7	-	-
24	8	-	-
25	9	-	-
26	10	-	-
27	11	-	-
28	12	-	-
29	13	-	-
30	14	-	-
31	15	-	-
32	16	-	-

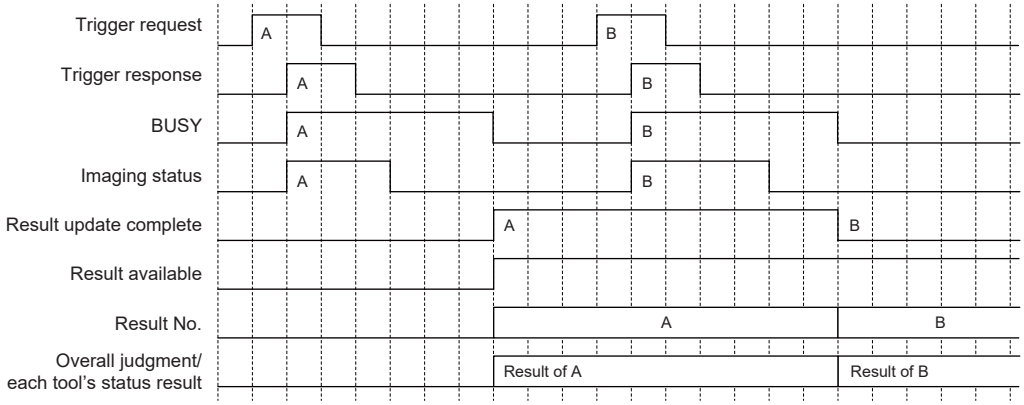
Tool N	Monitor Data	4x Detailed Data	8x Detailed Data
	M	L	K
33	1	-	-
34	2	-	-
35	3	-	-
36	4	-	-
37	5	-	-
38	6	-	-
39	7	-	-
40	8	-	-
41	9	-	-
42	10	-	-
43	11	-	-
44	12	-	-
45	13	-	-
46	14	-	-
47	15	-	-
48	16	-	-
49	1	-	-
50	2	-	-
51	3	-	-
52	4	-	-
53	5	-	-
54	6	-	-
55	7	-	-
56	8	-	-
57	9	-	-
58	10	-	-
59	11	-	-
60	12	-	-
61	13	-	-
62	14	-	-
63	15	-	-
64	16	-	-

Operating Procedure of Process Data Object Communication

This section explains the method for communicating from the PLC to the IV4 Series using cyclic communication.
• Reading out the status result (handshake control: [Disable]; Preliminary capture: [Disable])

When a trigger is successful

The operation procedure when the data handshake control is set to [Disable] is shown below.



(1) Run [Trigger request]. (0 → 1) Trigger request is retained until trigger response is set to ON

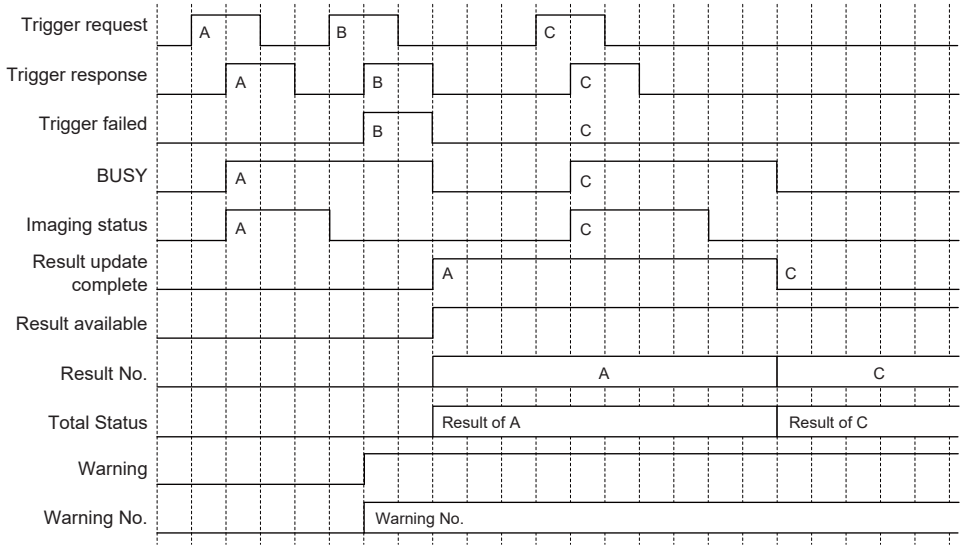
(2) If the trigger is valid, [Trigger response] will change from 0 to 1.

(3) Once the judgment process ends, the [Result update complete] Bit will switch and [Overall judgment]/[Each tool's status result] will be updated. The read text will be updated for AI OCR.

Point **Do not cancel (1 → 0) [Trigger request] before [Trigger response] changes from 0 to 1. The trigger may not be able to be requested correctly.**

Reference
- [Result update complete] will switch (toggle) to "1" if its value was "0" after the previous judgment update or switch to "0" if its value was "1".
- [Result available] will switch from 0 to 1 at the timing when the first judgment process has been confirmed; and the new value will be retained thereafter.
- [Result available] will be reset in the following conditions:
  - If handshake control is set to [Disabled]
    - When the program is switched
    - When the unit's status is switched from "Setting" to "RUN"
    - When a buffer clear request is issued
  - If handshake control is set to [Enabled]
    - When a buffer clear request is issued
- [Result No.] will be counted up each time the status result is updated. The upper limit value is 32767. If the maximum value is exceeded, it will go back to 0 and start counting up again.
- [Result No.] will also count the judgment process counts that were skipped due to the PDO cycle settings.
- [BUSY] and [Imaging] may be skipped due to the PDO cycle settings. It is therefore necessary to take image optimization into consideration when setting the PDO cycle settings.

When a trigger is unsuccessful



(1) Run [Trigger request]. (0 → 1) Trigger request is retained until trigger response is set to ON

(2) If the trigger is valid, [Trigger response] will change from 0 to 1.

(3) When the judgment process ends, the [Result update complete] bit will be switched and the [Overall judgment] will be updated.

(4) If you wish to output trigger errors, set the trigger error option to [Enabled].
If a trigger has been input while the trigger error option is set to [Enabled] and the unit is in "BUSY" status, [Trigger failed] will change from 0 to 1 ignoring the trigger input. No judgment process will be performed for trigger B.

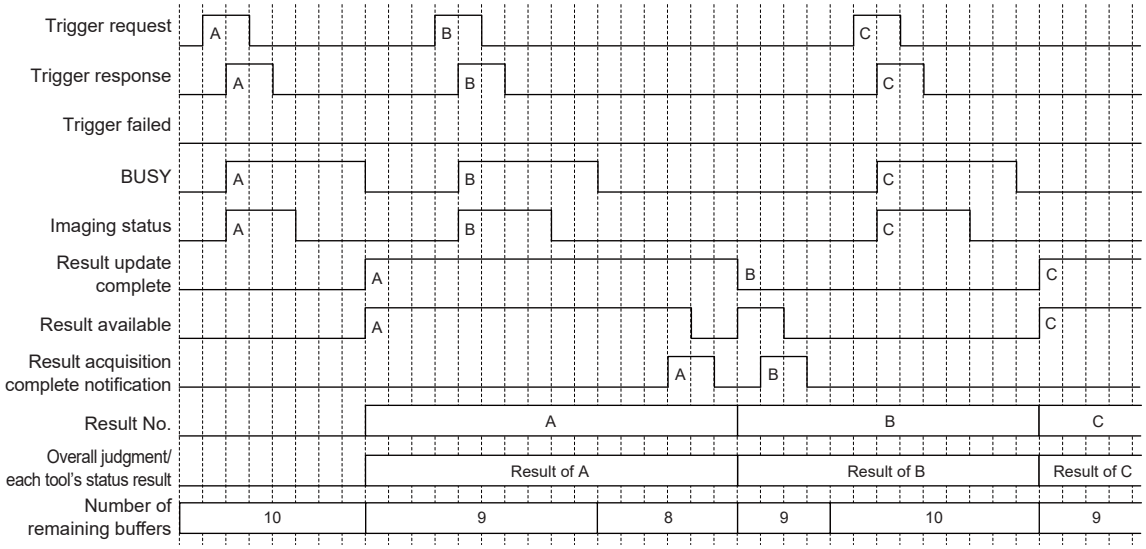
(5) If the trigger input is unsuccessful, [Warning] will switch from "0" to "1" and [Warning No.] will be updated to "65".

Point **Do not cancel (1 → 0) [Trigger request] before [Trigger response] changes from 0 to 1. The trigger may not be able to be requested correctly.**

Reference
- [Result update complete] will switch to "1" if its value was "0" after the previous judgment update (or from "0" to "1" if the previous value was "1").
- [Result available] will switch from 0 to 1 at the timing when the first judgment process has been confirmed; and the new value will be retained thereafter.
- [Result No.] will be counted up each time the status result is updated. The upper limit value is 32767. If the maximum value is exceeded, it will go back to 0 and start counting up again.
- [Result No.] will also count the judgment process counts that were skipped due to the PDO cycle settings.
- [BUSY] and [Imaging] may be skipped due to the PDO cycle settings. It is therefore necessary to take image optimization into consideration when setting the PDO cycle settings.
- [Number of trigger errors] will be counted up at the timing when the [Result updated] BIT is switched.

Reading out the status result (handshake control: [Enable]; Preliminary capture: [Disable])

The following describes the operating procedure when the data handshake control is set to [Enabled].
You can acquire all status results without fail by setting the data handshake control to [Enabled].



(1) Run [Trigger request]. (0 → 1) Trigger request is retained until trigger response is set to ON

(2) If the trigger is valid, [Trigger response] will change from 0 to 1.

(3) Once the judgment process ends, the [Result update complete] Bit will switch, [Result available] will switch from 0 to 1, and [Overall judgment]/[Each tool's status result] will be updated. The read text will be updated for AI OCR.

(4) [Number of remaining buffers] will be reduced by 1 when the status result is updated.

(5) Executes [Result acquisition complete notice] (0 → 1) and [Result available] is held until 1 becomes 0.

(6) Turns [Result acquisition complete notice] off (1 → 0). [Number of remaining buffers] will be incremented by 1.

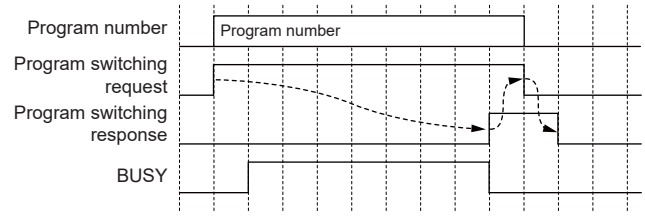
Point

Do not cancel (1 → 0) [Trigger request] before [Trigger response] changes from 0 to 1. The trigger may not be able to be requested correctly.

Reference

- [Result update complete] will switch (toggle) to "1" if its value was "0" after the previous judgment update or switch to "0" if its value was "1".
- [Result No.] will be counted up each time the status result is updated. The upper limit value is 32767. If the maximum value is exceeded, it will go back to 0 and start counting up again.
- [Result No.] will also count the judgment process counts that were skipped due to the PDO cycle settings.
- [BUSY] and [Imaging] may be skipped due to the PDO cycle settings. It is therefore necessary to take image optimization into consideration when setting the PDO cycle settings.
- [Number of trigger errors] will be counted up at the timing when the [Result updated] BIT is switched.
- If handshake control has been set to [Enabled], the status result will not be updated until [Result acquisition complete notice] is set ON/OFF (0 → 1 → 0), even if the next trigger has been input and a judgment process has been executed.
- If a new trigger is input when [Number of remaining buffers] is "0", [Buffer overrun] will switch from "0" to "1". The status result from the new trigger will be ignored.
- [Buffer overrun] can be cleared using [Warning clear].

Switching the programs



(1) Write the program No. to be set to [Program No.].

(2) Execute [Program switching request], maintaining the state (0 → 1) until [Program switching response] is received.

(3) When the program switch is complete, [Program switching response] (0 → 1) is received.

(4) Once [Program switching response] is received, clear [Program switching request] (1 → 0). When [Program switching request] is cleared, [Program switching response] is cleared.

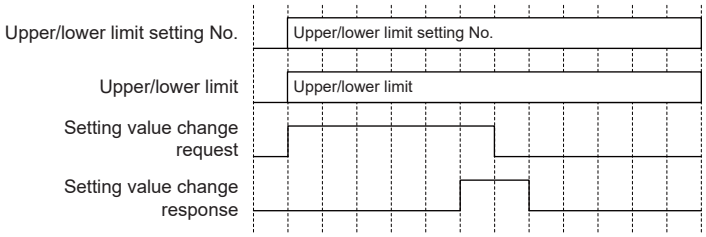
Point

- **Do not cancel (1 → 0) [Program switching request] before [Program switching response] changes from 0 to 1. The program may not be able to switch correctly.**
- **When [Program switching request] was canceled (1 → 0) before [Program switching response] changes from 0 to 1, execute (0 → 1) [Program switching request] and cancel (1 → 0) it again.**

Reference

- [BUSY] will change from 0 to 1 while the program switching is in progress.
- If the program switching fails, [Program switching failed] will change from “0” to “1”.
- If the program switching is unsuccessful, [Warning] will switch from “0” to “1” and [Warning No.] will be updated to “64”.
- You cannot switch programs using PROFINET communication while the unit is in [Setting] status.
- If running change program with field network communication, set [Switching method] to [Panel/PC/Network/Auto-Switching].
  “Program Switching Method” (page 7-13)
- The program number switched to using field network communication will be deleted when the power is turned off. At the next start-up, the device starts with the program operated by the control panel, display expansion unit, or computer software.

Changing the tool adjustment threshold



(1) Write the tool number and threshold type of the threshold to be changed to [Upper/lower limit setting No.].

(2) Write the threshold to be changed to [Upper/lower limit].

(3) Execute [Setting value change request]. (0→1)

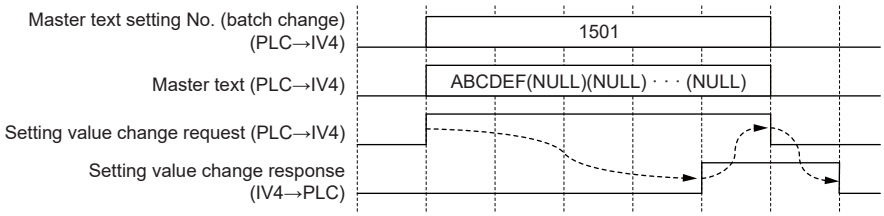
(4) You can check the input status in [Setting value change response].

Reference

- If the setting value change fails, [Setting value change failed] will switch from “0” to “1”.
- If the setting value change fails, [Warning] will switch from “0” to “1” and [Warning No.] will be updated to 60.
- Thresholds cannot be changed for the following tools.
  - In standard mode or sorting mode, the position adjustment tool, which corrects the position of the learning tool
  - In sorting mode, tools other than the learning tool
  - In AI through count mode, the AI through count and total tools with status output set to [Disable]

Changing the master text (batch change)

This section shows the master text for Tool 1 (AI OCR: String mode) changing in batch to [ABCDEF] as an example.



(1) Overwrite [Master text setting No.: Index 0x1600:1B] with 1501 (AI OCR tool string mode string identification with Tool 1).

(2) A (0x41), B (0x42), C (0x43), D (0x44) in [Master text: Index 0x1600:1C],
E (0x45), F (0x46), NULL (0x00), NULL (0x00) in [Master text: Index 0x1600:1D]
Write NULL (0x00) after [Master text: Index 0x1600:1E].

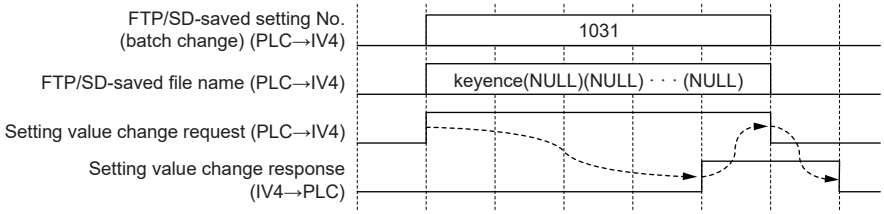
(3) Execute [Setting value change request] (0→1). The request is retained until [Setting value change response] can be confirmed.

(4) Once the change is complete, [Setting value change response] changes from 0 to 1.

(5) Setting [Setting value change request] to 0 sets [Setting value change response] to 0.

Changing the FTP/SD-saved file name (batch change)

This section shows an example in which the transfer condition 1 file name is changed to “keyence”.
No data is written to non-volatile memory. (The setting number is different when writing to non-volatile memory.)



(1) Write 1031 to [Batch change FTP/SD save file name: Index 0x1600:1B].

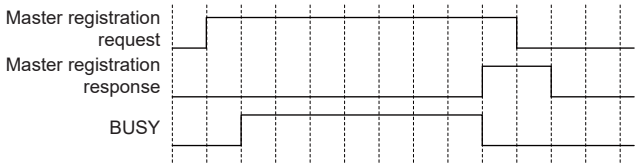
(2) k (0x6B), e (0x65), y (0x79), e (0x65) in [FTP/SD-saved file name: Index 0x1600:1C],
n (0x6E), c (0x63), e (0x65), NULL (0x00) in [FTP/SD-saved file name: Index 0x1600:1D],
Write NULL (0x00) after [FTP/SD-saved file name: Index 0x1600:1E].

(3) Execute [Setting value change request] (0→1). The request is retained until [Setting value change response] can be confirmed.

(4) Once the change is complete, [Setting value change response] changes from 0 to 1.

(5) Setting [Setting value change request] to 0 sets [Setting value change response] to 0.

Registering a master image externally



(1) Execute [Master registration request]. (0→1)

(2) You can check the input status in [Master registration response].

Reference

- [BUSY] will change from 0 to 1 while the master image registration is in progress.
- If the master image registration is unsuccessful, [Master registration failed] will change from 0 to 1.
- If the master image registration is unsuccessful, [Warning] will switch from “0” to “1” and [Warning No.] will be updated according to the failure details.
- You cannot register a master image using field network communication while the unit is in [Setting] status.
- If you wish to write the master registration data to the sensor ROM, set the [Write to ROM when using Ext. Master Save] option to [Yes].
  “Write to ROM when using Ext. Master Save” (page 7-14)
- External Master Image registration cannot be used when using AI-based tools. (AI differentiate tool, AI identify, AI count, AI trigger) are in use or sorting mode or AI through count mode are set.

Mailbox communication

Overview of mailbox communication

This function enables the IV4-CU1/IV4-GCU1 to communicate data acyclically (i.e. non-periodically) with the EtherCAT master device. The mailbox communication function enables communication of all data placed in the object dictionary using 0 and 1 in the Sync Manager.

Point **Mailbox communication is available only when Command Control is not assigned to process data object communication.**

Object Dictionary

The status of the IV4 Series connected to IV4-CU1/IV4-GCU1, for example, is placed in the object dictionary for each group as an object.
Addresses for objects are specified by a 16-bit index expressed as a 4-digit hexadecimal number.
An overview of the object dictionary specified by CANopen over EtherCAT (CoE) is shown below.

Index (HEX)	Object	Description
0000 to 0FFF	Data Type Area*	(Not used by this device. This is the system area.)
1000 to 1FFF	Communication Profile Area	This is the setting area for identification information, EtherCAT communication function settings, process data assignment, and so on.
1600 to 17FF	RxPDO Mapping	This is the receive data area for PDO communication.
1A00 to 1BFF	TxPDO Mapping	This is the send data area for PDO communication.
6000 to 6FFF	Input Area	This is the input process data area.
7000 to 7FFF	Output Area	This is the output process data area.

Communication Profile Area

This area stores information for communication such as device information of this device (IV4-CU1/IV4-GCU1) in the EtherCAT system.

Index (Hex)	Sub Index (Hex)	Function name	Description	Data type	Data size (Byte)	Attribute	PDO	Data content
0x1000	-	Device Type	Indicates the device type of this device.	UDINT	4	RO	-	5001
0x1008	-	Device Name	Indicates the model of this device.	STR	8	RO	-	Communication unit for ultra-compact models: IV4-GCU1 Communication unit for built-in amplifier models: IV4-CU1/
0x1009	-	Hardware Version	Indicates the hardware version of this device.	STR	8	RO	-	V1.00
0x100A	-	Software Version	Indicates the software version of this device.	STR	8	RO	-	V1.00
0x1018	01	Vendor ID	This is the vendor ID.	UDINT	4	RO	-	0x00000541
	02	Product code	This is the product code.	UDINT	4	RO	-	Communication unit for ultra-compact models: 4600 Communication unit for built-in amplifier models: 4601
	03	Revision number	This is the revision number.	UDINT	4	RO	-	0x00000001
	04	Serial number	This is the serial number.	UDINT	4	RO	-	CIP serial number

OPC UA Server Function

What is OPC UA?

OPC UA, one of the network communication protocols, is a platform-independent, service-oriented architecture, which is integrated into a framework that can extend all functionalities in the OPC Classic specifications.
This architecture features high interconnectivity between devices, enabling connections between various levels of layers ranging from field devices to servers on the cloud.
OPC UA is safe and reliable, and increasingly used for industrial equipment.

Safety Precautions on Security

Do not use a server with a vulnerability.

- To restrict access to settings for OPC UA, enable the security function and appropriately set the user level.
- Enable the security function of OPC UA, such as encryption and signature. For the initial setting, the [None] for the security policies is enabled for the initial connection to be made easier. For operation with the security function enabled, disable [None].
- Formulate policies concerning the user name and password management for operation.
- Appropriately perform certificate management, such as update, expiration, and deletion. When trusting a certificate, thoroughly check the certificate information and make sure that the correct certificate is registered.
- Prevent the private key from being compromised.
- Do not reuse applications or user certificates.
- Apply any software updates related to vulnerability.

Design and maintenance for network configuration for security

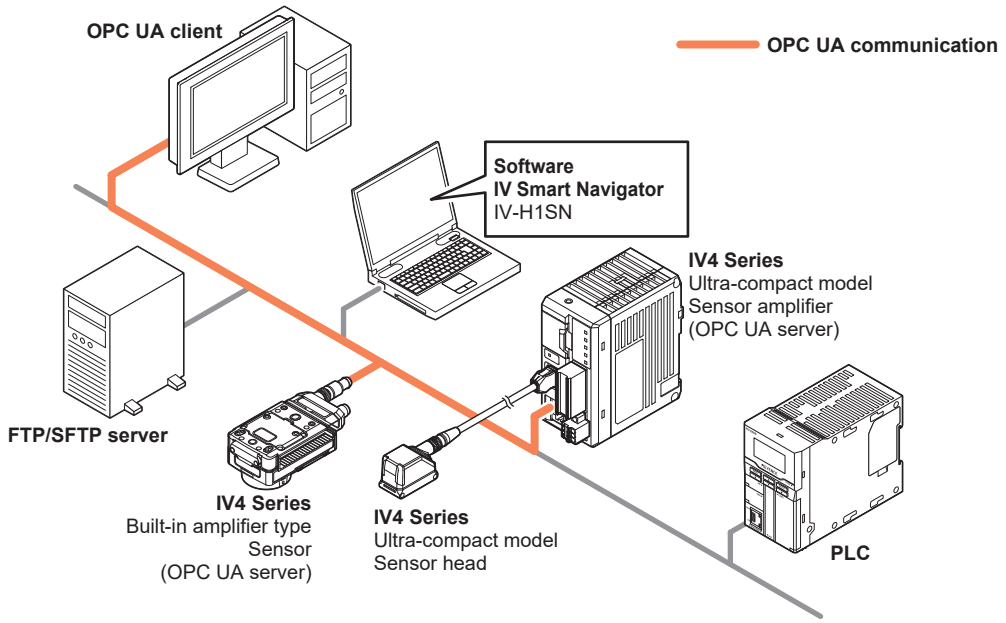
- Manage the system so that eavesdropping and DoS attacks are unlikely to occur.
- If there is a risk of unauthorized access from external devices via the network, the user should take measures.

OPC UA Server Function

The OPC UA server function makes IV4 function as an OPC UA server.

Supported versions

IV4 Sensor	R1.30.** or later
IV Smart Navigator/IV4-CP70/IV4-DU10	R1.30.** or later



Specifications of OPC UA Server Functions for IV4

Items		Description
Connection port to use		Built-in amplifier model/ultra-compact model/communication unit (IV4-CU1/GCU1) Built-in Ethernet port
Supported functions		OPC UA server function
Transport/data encoding method		UA TCP binary
URL (end point URL) specification method		opc.tcp://[IP address] : [port No.] Example: opc.tcp://192.168.10.10:4840
Maximum number of sessions (clients)		5
Number of monitor items		2,000
Supported sampling cycle		50 to 10,000 ms
OPC UA security mode and policy		• Signature and encryption are required: SingAndEncrypt • Signature is required: Sign • Neither signature nor encryption is required: None
Algorithm of signature and encryption		Basic128Rsa15 / Basic256 / Basic256Sha256 / Aes128Sha256RsaOaep / Aes256Sha256RsaPss
Application authentication	Certificate authentication method	• Authentication by trusted certificates • Authentication by CA-signed trusted certificates
User authentication	User authentication method	• User name/password • Anonymous
Certificate supported standard		X.509 compliant

Overview of OPC UA Server Functions for IV4

The following shows the typical reading and control functions of the OPC UA server in the IV4 Series.
For details about the other functions, refer to “Node Functions” (page 9-131).

Function	Content
Trigger input	Executes a trigger input for the sensor.
Change Program	Executes a program switch for the sensor.
Read status	Allows you to check the unit status (Imaging, RUN, BUSY, Error, etc.).
Read overall status result	Reads the overall status result.
Read processing time	Reads the processing time of the judgment.
Read each tool’s status result	Reads each tool’s status result and matching rate.
Read statistical information	Reads out the number of triggers issued and the number of trigger errors.
Statistical Information reset	Resets the statistics information for programs that are running.

List of supported clients

For details of the setting method, refer to the instruction manual of each client.

OPCUA client		Version
SIEMENS	TIA Portal	V19
BECKHOFF	TwinCAT3	v3.1.4024.10
Ignition	Standard Edition	Version 8.1.43
HighByte	Intelligence-Hub	3.4.5
UaExpert	UaExpert	v1.7.1.540

The following client cannot be connected.

OPCUA client		Version
Kepware	KEPServerEX	6-6.16.217.0

How to Configure IV4

To use the OPC UA server functions, you need to fix the IP address.

Point **If no IP address is set, set it before configuring the OPC UA server.**

Setting the IP address for IV4

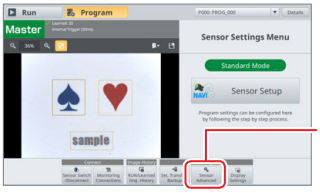
1 Configure the network settings for the sensor.

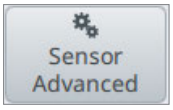
Set the IP address, subnet mask, and default gateway for the sensor.

“Network Settings” (page 7-10)

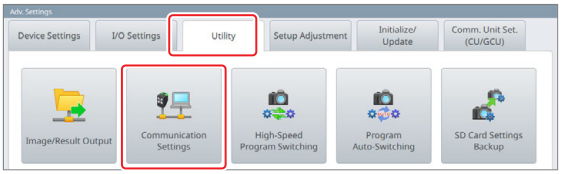
Setting the OPC UA server functions

1 Press [Sensor Advanced] in the main screen in [Program].

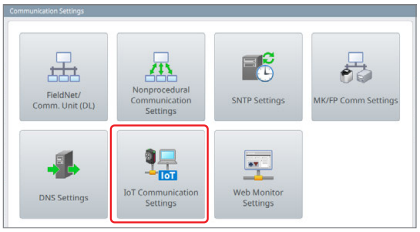




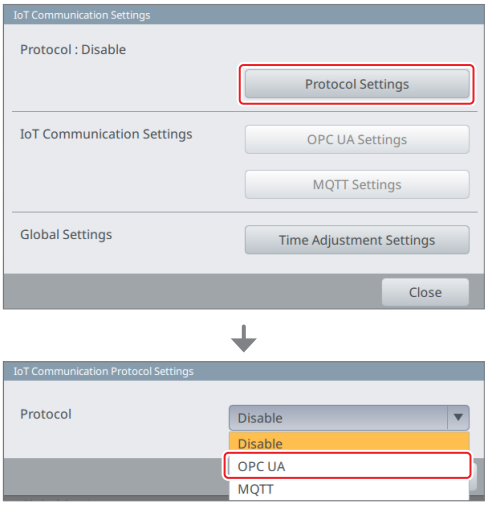
2 Select the [Utility] tab and select [Communication Settings].



3 Select [IoT Communication Settings].

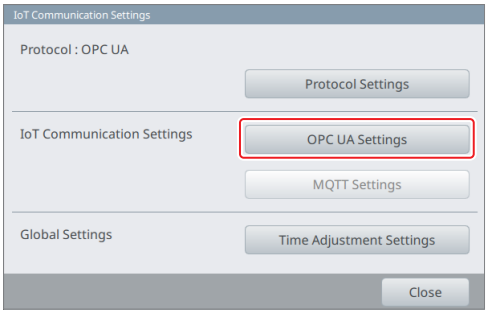


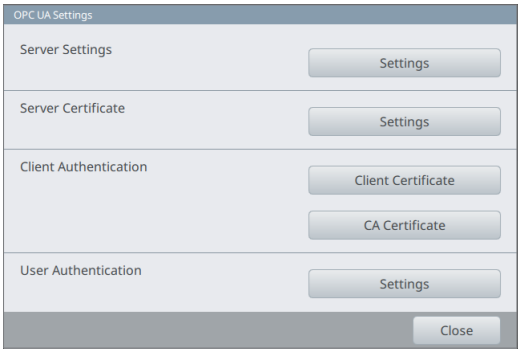
4 Press [Protocol Setting] and select [OPC UA].



Point **When checking communication without security settings, the following are unnecessary: [OPC UA Settings] in step 5 and [Global Settings] in step 6.**

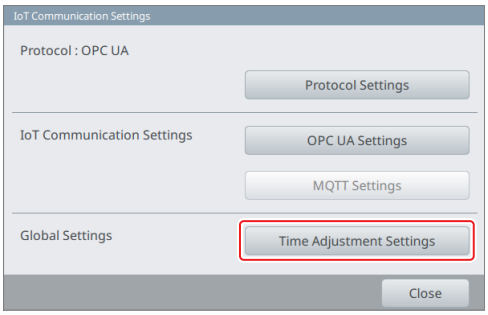
5 Press [OPC UA Setting] for [IoT Communication Setting] to set the OPC UA server functions.





“Sever settings” (page 9-121)
“Server Certificate” (page 9-121)
“Client Certificate” (page 9-122)
“CA Certificate” (page 9-125)
“User Authentication” (page 9-129)

6 Press [Time Adjustment Settings] of [Global Settings] to set the time zone.



“Time Adjustment Setting” (page 9-129)

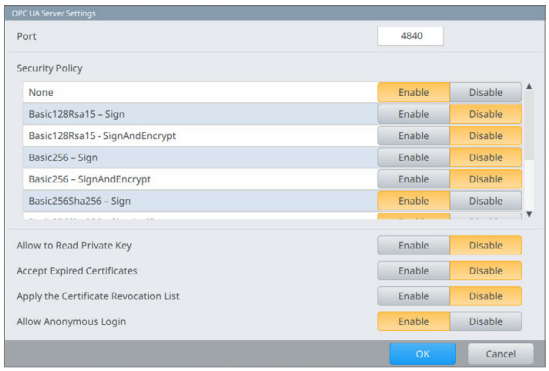
7 Press [Close].

The system returns to the main screen in [Program].

8 Start to run the system.

Sever settings

Set the security functions for connection from OPC UA clients.



Port

Displays the port number. (Default value: 4840)
Normally, there is no need to change.

Security policies

Set [Enable] for the security policies to be applied for messages that are exchanged via the OPC UA communication.

- None (Default value: Enable)
- Basic128Rsa15-Sign (Default value: Disable)
- Basic128Rsa15-SignAndEncrypt (Default value: Disable)
- Basic256-Sign (Default value: Disable)
- Basic256-SignAndEncrypt (Default value: Disable)
- Basic256Sha256-Sign (Default value: Enable)
- Basic256Sha256-SignAndEncrypt (Default value: Enable)
- Aes128Sha256RsaOaep-Sign (Default value: Enable)
- Aes128Sha256RsaOaep-SignAndEncrypt (Default value: Enable)
- Aes256Sha256RsaPss-Sign (Default value: Enable)
- Aes256Sha256RsaPss-SignAndEncrypt (Default value: Enable)

Allow to Read Private Key

Select whether to allow the private key to be read that is stored in the storage.

- Enable: Allow the private key to be read.
- Disable (default): Reject the private key to be read.

Accept Expired Certificates

Select whether to allow connection in response to a request for connection using the client certificate included in the [Trust] folder even if the certificate is expired.

- Enable: Allow connection by trusting the certificate.
- Disable (default): Reject connection by not trusting the certificate.

Apply the Certificate Revocation List

When a certificate revocation list is registered, select whether to reject connecting the client certificate included in the certificate revocation list.

- Enable: Reject the request for connection by the client certificate included in the certificate revocation list.
- Disable (default): No authentication is performed using the certificate revocation list.
  With a client certificate included in the [Trust] folder, connection is allowed in response to a connection request even from a client included in the certificate revocation list.

Allowing Anonymous Login

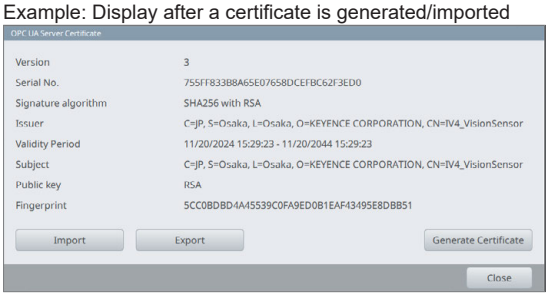
Select whether to allow login by an anonymous client.

- Enable (default): Allow anonymous login.
- Disable: Reject anonymous login.

Server Certificate

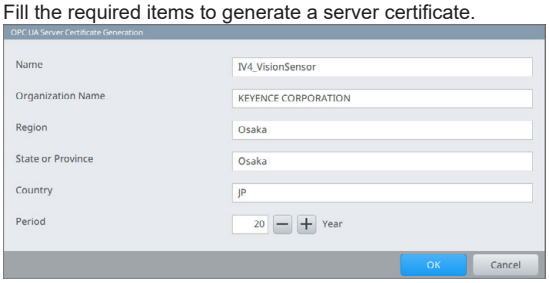
The server certificate is used to prove the identity of the OPC UA server. To make a connection, register the server certificate with the OPC UA client.
This section describes the authentication and management of the server certificate.

Example: Display after a certificate is generated/imported



Generating a certificate

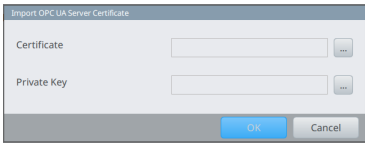
Fill the required items to generate a server certificate.



Items	Description
Name *1	Enter the name of the organization that manages the server. (Default: KEYENCE CORPORATION)
Organization Name *1	Enter the division or department of the organization that manages the server. (Default: blank)
Region *1	Enter the municipality where the organization managing the server is located. (Default: Osaka)
State or Province *1	Enter the prefecture where the organization managing the server is located. (Default: Osaka)
Country *2	Enter the country where the organization managing the server is located. (Default: JP)
Period	Enter the validity period of the server certificate. (Default value: 20)

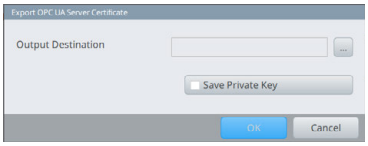
*1 The following characters are available (up to 64 characters): 0 to 9, a to z, A to Z, single-byte space [ ], hyphen [-], dot [.], underscore [_], comma [,], slash [/], parenthesis [(], closing parenthesis [)], and at mark [@]
*2 Enter a country identifier (two single-byte letters).

Importing the server certificate



Exporting the server certificate

When providing an OPC UA client with a server certificate, export the server certificate registered with the IV4.



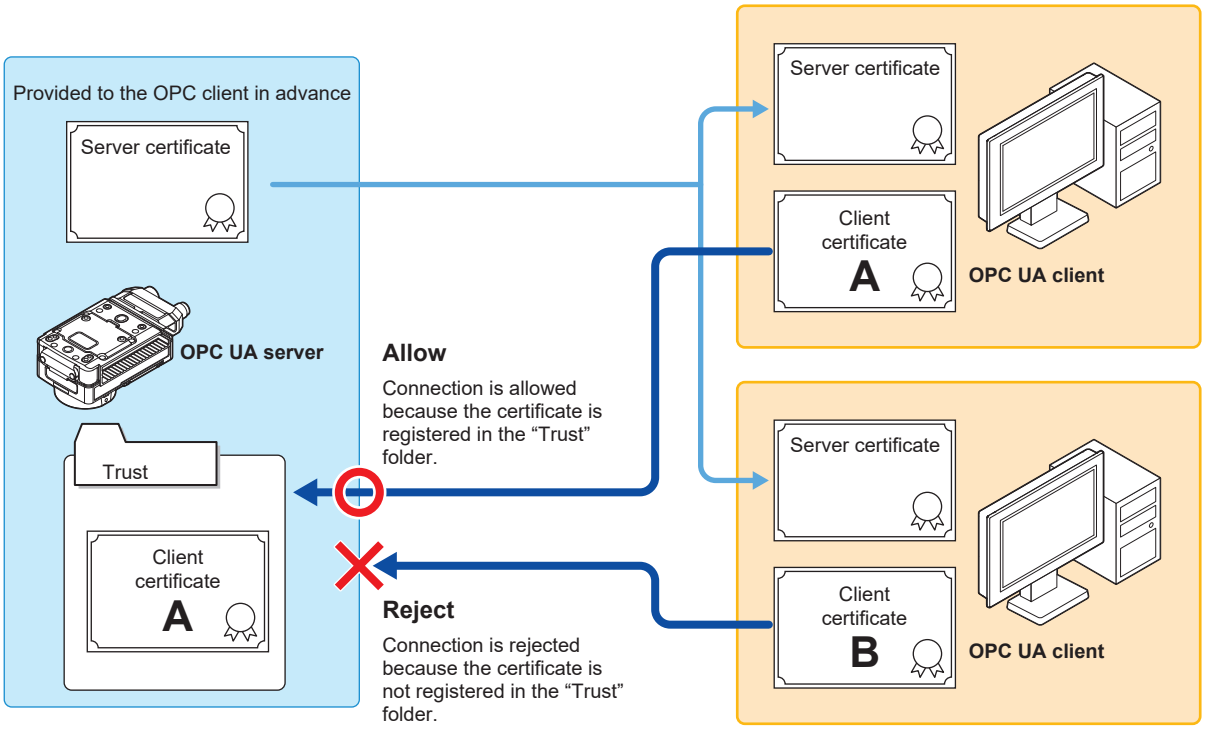
Point **To select [Save also the private key], set [Allow the private key to be read] to [Enable].**

Client Certificate

The client certificate is used to prove the identity of the OPC UA client. To make a connection when the security function is set, register the client certificate with the OPC UA server.
This section describes the authentication of a self-signed client certificate and the management of client certificate.

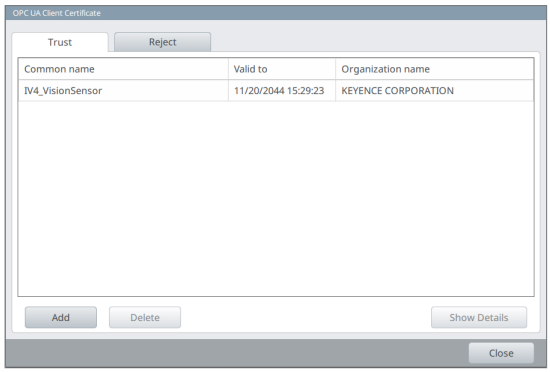
Authentication of Client Certificate

When a client certificate is sent by an OPC UA client together with a request for connection, check the client certificate against one in the [Trust] folder, and allow connection if the client certificate is registered in the [Trust] folder.



Client certificate: [Trust] list

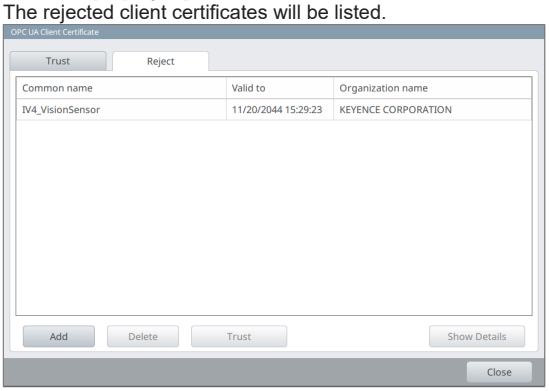
To display the list, select [Client Authentication] > [Client Certificate] > [Trust] tab.
The trusted client certificates will be listed.



Reference Press [Display Details] to show the details of the selected client certificate.

Client certificate: [Reject] list

To display the list, select [Client Authentication] > [Client Certificate] > [Reject] tab.
The rejected client certificates will be listed.



Reference Press [Display Details] to show the details of the selected client certificate.

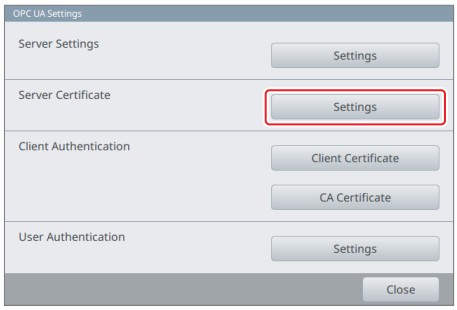
Example 1: Procedure for connecting an OPC UA client for the first time

The following shows an example of procedure for making a connection by trusting the client certificate that has been rejected when attempting to connect the OPC UA server.

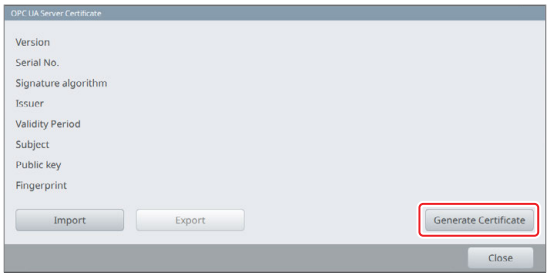
Point **The client certificate is used for self-signature in the connection procedure.**

1 Generate a server certificate for the IV4.

(1) Select [Settings] for the [Server Certificate].



(2) Press [Generate Certificate].



(3) Generate a server certificate.

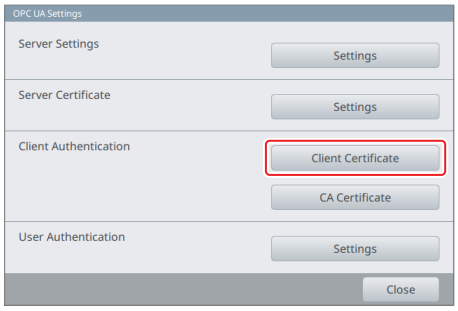
“Server Certificate” (page 9-121)

2 Attempt to connect from the client.

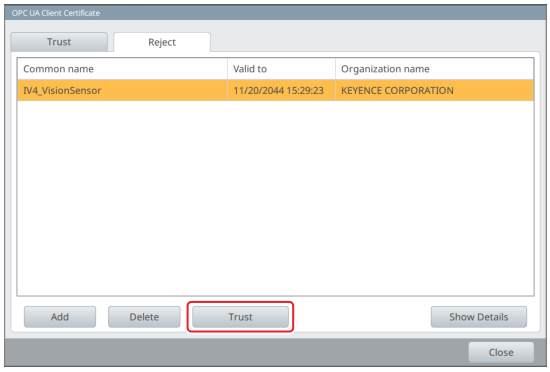
Register the server certificate for the IV4 with the client before making a connection. You can get the server certificate for the IV4 from [Export].
After completing the registration of the server certificate, connect to the OPC UA server of the IV4 from the client.
A connection to the server for the first time will fail because the client certificate is not trusted on the IV4 side. However, with the security policies set to [None], a connection will be successful at this point.

3 Make the server (IV4) trust the client.

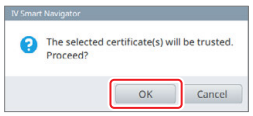
(1) Press [Client Authentication] > [Client Certificate].



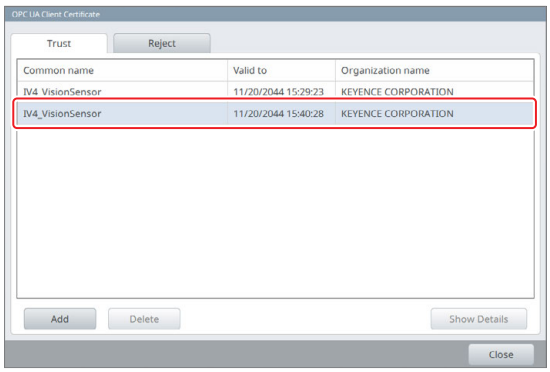
(2) Select the [Reject] tab. Select a client to be connected and press [Trust].



(3) Press [OK].



(4) Check that the selected client has moved to the [Trust], and close the screen.



4 Connect from the client to the server (IV4).

Connect again from the client to the OPC UA server (IV4).
The connection will be successful with correct settings.
If the connection failed, the server certificate may not have been correctly registered on the client side.

Example 2: Procedure for connecting an OPC UA client for the first time

This example shows a procedure for registering a client certificate in advance of making a connection.

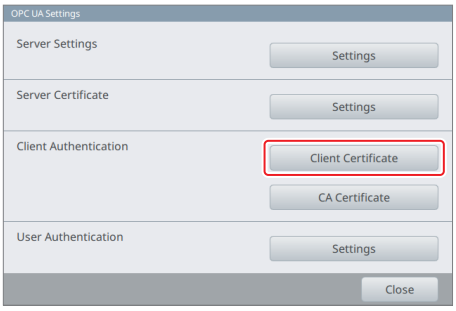
Point **The client certificate is used for self-signature in the connection procedure.**

1 Generate a server certificate for the IV4.

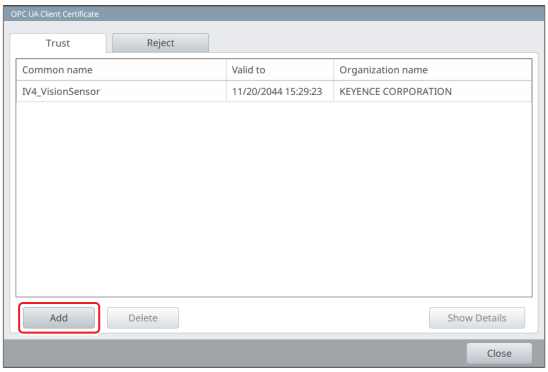
Generate a server certificate in the same procedure as “Example 1: Procedure for connecting an OPC UA client for the first time” (page 9-123).

2 Register a client certificate.

(1) Press [Client Authentication] > [Client Certificate].



(2) Select the [Trust] tab and press [Add].

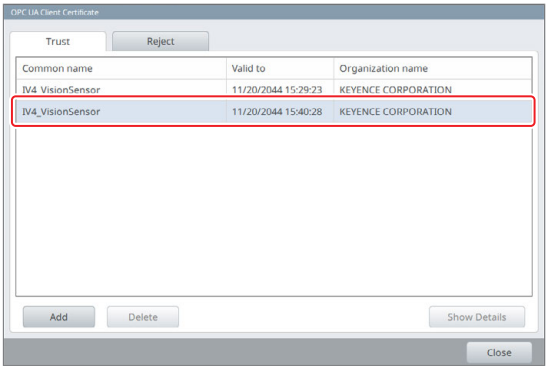


(3) Select a client certificate (*.der) to be registered and press [Open].

(4) Press [OK].



(5) Check that the selected client certificate has been registered, and close the screen.

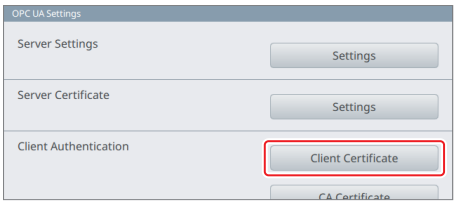


3 Connect from the client to the server (IV4).

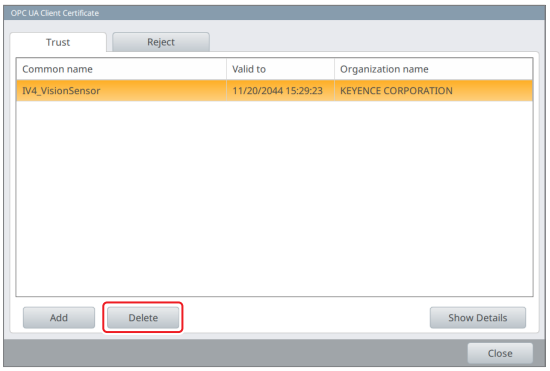
Register the server certificate for the IV4 with the client before making a connection. You can get the server certificate for the IV4 from [Export].
After completing the registration of the server certificate, connect to the OPC UA server (IV4) from the client.

Deleting a client certificate

1 Press [Client Authentication] > [Client Certificate].

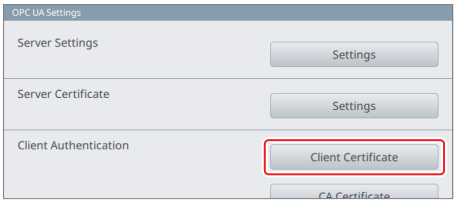


2 Select a certificate to be deleted and press [Delete].

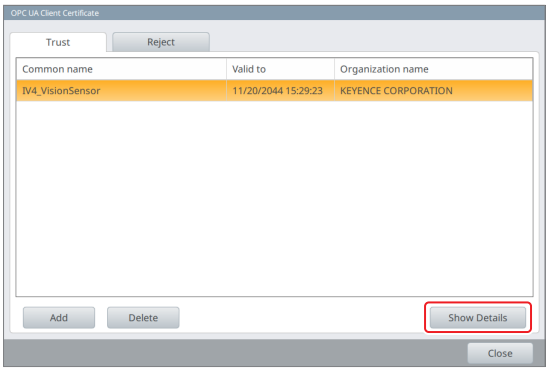


Displaying the details of a client certificate

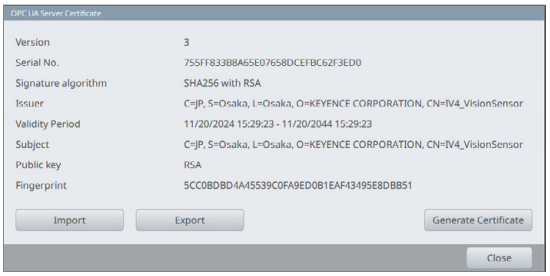
1 Press [Client Authentication] > [Client Certificate].



2 Select a certificate and press [Display Details].



The details of certificate will be displayed.



CA Certificate

The OPC UA server function supports a CA-signed client certificate in addition to a self-signed client certificate. The function ensures client reliability by using a client certificate proved by a third party in a case, for instance, where a connection is made via the OPC UA server and a global network.

CA

A CA (Certificate Authority) plays roles in issuing electronic certificates and revoking digital certificates or private keys that may have been compromised in response to requests for revocation.

CA Certificate

This is an electronic certificate issued by a CA. This certificate is required when creating, revoking, or using a certificate authenticated by a CA.

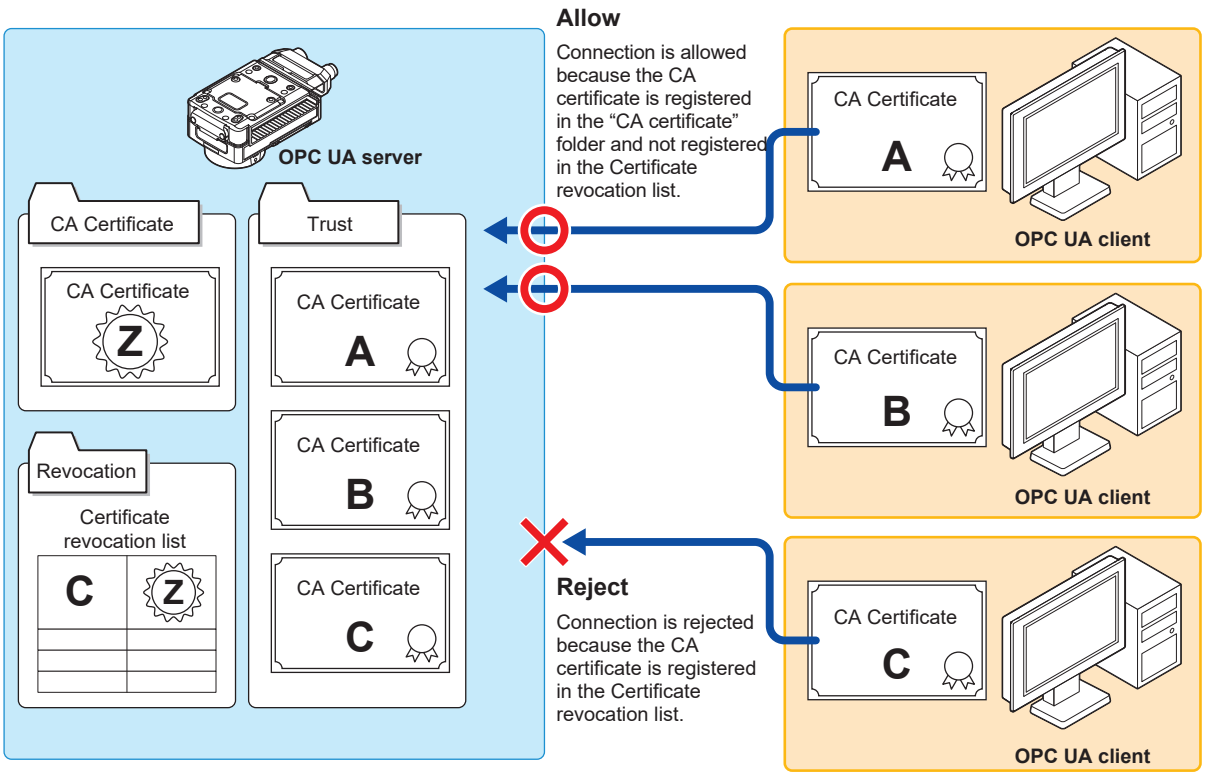
Certificate revocation list

The certificate revocation list is denoted as CRL (Certificate Revocation List). The CRL is a list of electronic certificates revoked by a CA. By checking the CRL, you can see whether or not the electronic certificate has been revoked.

Authenticating all clients authenticated by a specific CA

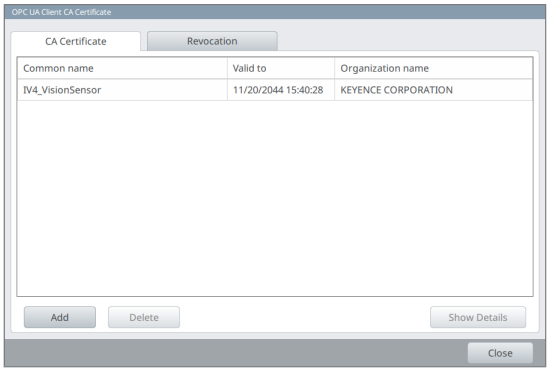
You can register a CA certificate indicating that the CA has been proved, by which you can allow equipment having a client certificate signed by the registered CA to be connected. This saves you from individually registering client certificates.
Connection is allowed when the following conditions are met by a client certificate sent by an OPC UA client together with a request for connection.

- A CA certificate is registered.
- The certificate is not included in the certificate revocation list in the [Revocation] folder.



CA certificate: [Trust] list

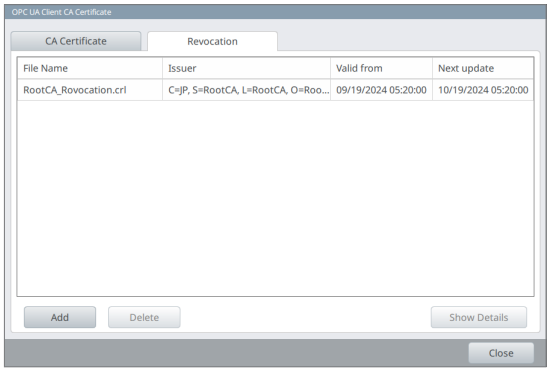
To display the list, select [Client Authentication] > [CA Certificate] > [CA Certificate] tab.
The added client certificates will be listed.



Reference Press [Display Details] to show the details of the selected CA certificate.

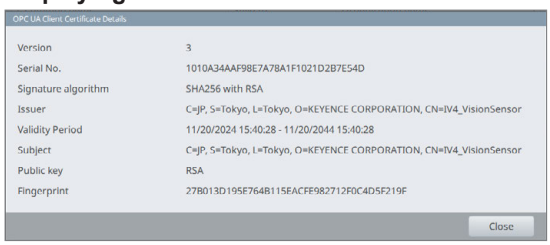
CA certificate: [Revocation] list

To display the list, select [Client Authentication] > [CA Certificate] > [Revocation] tab.
The revoked CA certificates will be listed.



Reference Press [Display Details] to show the details of the selected CA certificate.

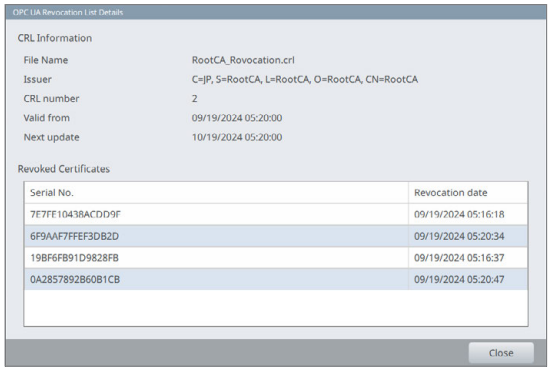
Displaying CA certificate details



Items	Description
Version	Version information of the certificate
Serial No.	Identification number of the certificate
Signature algorithm	Algorithm of a signature to be attached to the certificate
Issuer	Name of the certificate authority that issued the certificate Example: C=JP, S=Osaka, O=KEYENCE CORPORATION,CN=keyence.co.jp
Validity Period	Validity period of the certificate Example: 2021/11/23 11:19:43 to 2041/11/23 11:19:43
Subject	Owner of the public key For a self-signed certificate, the value is the same as the [Issuer]. Example: C=JP, S=Osaka, O=KEYENCE CORPORATION,CN=keyence.co.jp
Public key	The applicant's public key and its type
Thumb print	Check code to prevent the falsification of the certificate

Displaying the details of the CA (certificate authority) revocation list

Display the details of the selected certificate revocation list.



Items	Description
File Name	File name of the certificate revocation list
Issuer	Name of the certificate authority that issued the certificate Example: C=JP, S=Osaka, O=KEYENCE CORPORATION,CN=keyence.co.jp
CRL number	Number that indicates the order of issuing the certificate revocation list
Validity from	Start date and time of the validity period of the certificate revocation list
Next update	Next update date and time of the certificate revocation list
Serial No.	Serial number of the revoked certificate
Revocation date	Date and time when the certificate was revoked

Specifications of usable certificates

- Signature method: RSA
- Key bit length: 2048 to 4096 bits
- Hash type: SHA1,256,384,512

Reference Certificates in the ECDSA format cannot be used.

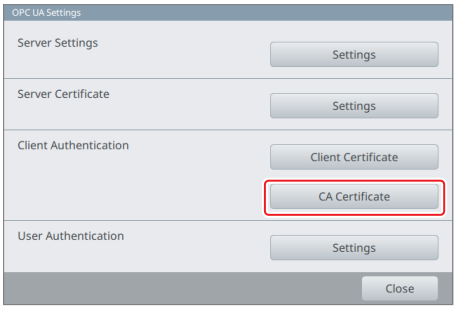
Registering a CA certificate

Register a CA certificate file (extension .der).

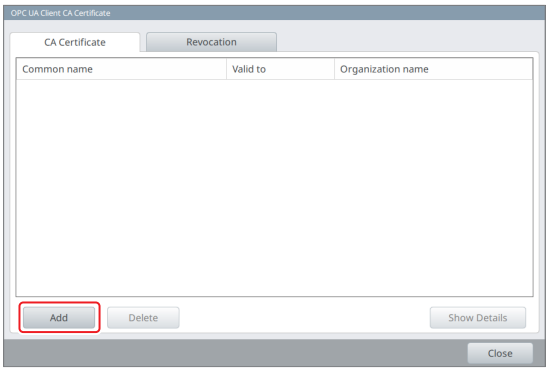
Point

- **Check carefully if the CA certificate you are attempting to register is trustworthy. If you mistakenly register in the [Trust] folder of [Client] a CA certificate signed by the CA that should not be connected, all clients singed by the CA will be able to be connected. This may result in leakage of confidential information on the server side or cause an unintended operation.**
- **If a signed-CA is an intermediate CA, register all CA certificates up to the root CA.**

1 Press [Client Authentication] > [CA Certificate].

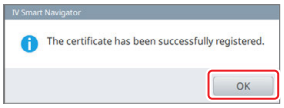


2 Select the [CA Certificate] tab and press [Add].

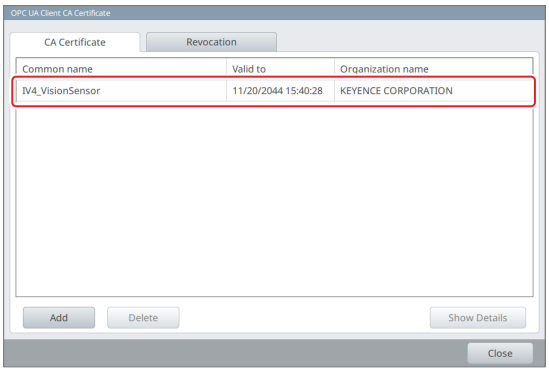


3 Select a CA certificate file (extension .der) to be added and press [Open].

4 Press [OK].



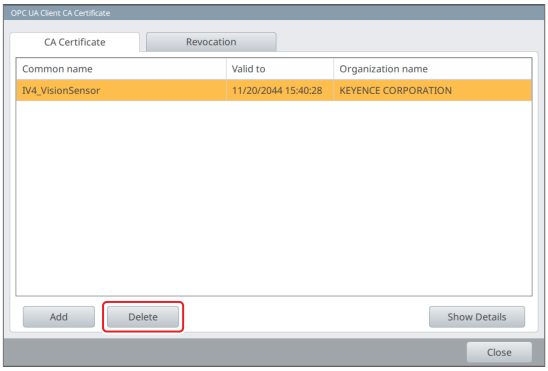
5 Check that the selected CA certificate has been registered, and close the screen.



Deleting a CA Certificate

1 **Press [Client Authentication] > [CA Certificate].**

2 **Select the [CA Certificate] tab. Select a CA certificate to be deleted and press [Delete].**



3 **Select a CA certificate file (extension .der) to be added and press [Open].**

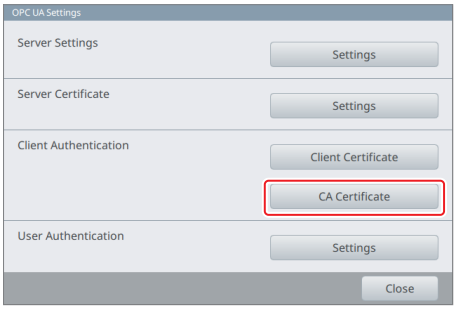
Registering a certificate revocation list

Register a certificate revocation list (extension .crl).

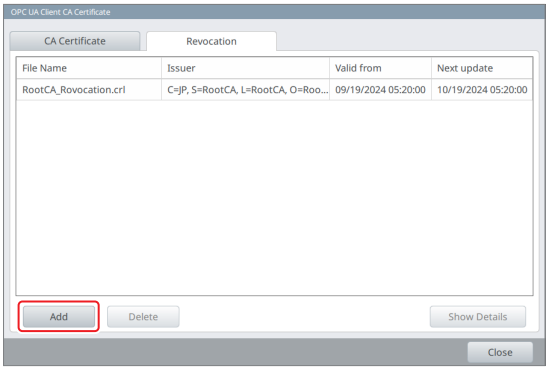
Point

- **No device can be connected that has a CA certificate registered in the certificate revocation list as well as an intermediate CA that is proved by the CA.**
- **No device can be connected that has a client certificate registered in the certificate revocation list.**
- **To make a connection, you must register the certificate revocation list in the Revocation folder.**
- **In the case of a certificate of an intermediate CA, you must register all certificate revocation lists up to those in the root CA in the Revocation folder to make a connection.**

1 **Press [Client Authentication] > [CA Certificate].**



2 **Select the [Revocation] tab and press [Add].**



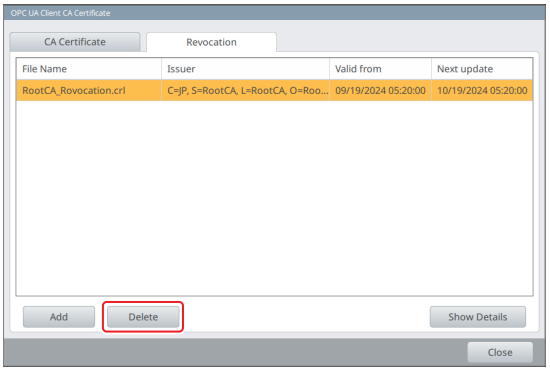
3 **Select a certificate revocation list (extension .crl) to be added and press [Open].**

A confirmation screen appears, and the certificate revocation list will be registered.

Deleting a certificate revocation list

1 **Press [Client Authentication] > [CA Certificate].**

2 **Select the [Revocation] tab. Select a certificate revocation list to be deleted and press [Delete].**

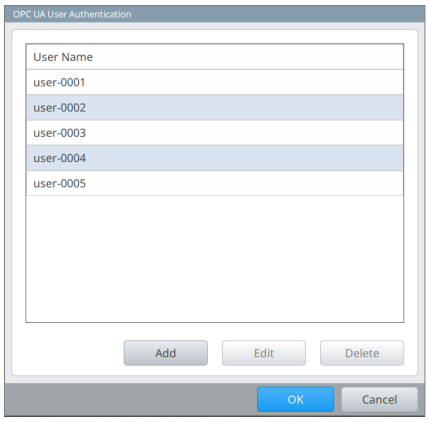


User Authentication

The OPC UA server function supports user authentication using the user name and password, which is combined with application authentication, ensuring security by two-step authentication.
For user authentication, perform the following operation.

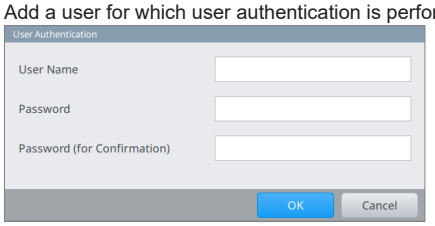
Point

- **Characters available for the user name and password are ASCII printable characters (including single-byte spaces).**
- **Up to 10 users can be registered.**
- **For the user name and password, the minimum character length is 1 and the maximum is 64.**



Add

Add a user for which user authentication is performed.



Edit

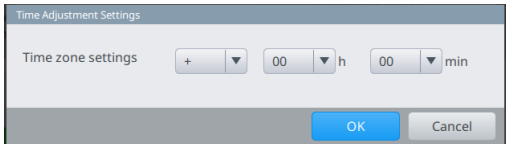
Change the user name and password of a registered user.

Delete

Delete a registered user.

Time Adjustment Setting

Sets the time difference of the sync destination from standard time (GMT/UTC).
Set the time difference setting (time offset) correctly for your region.



Reference

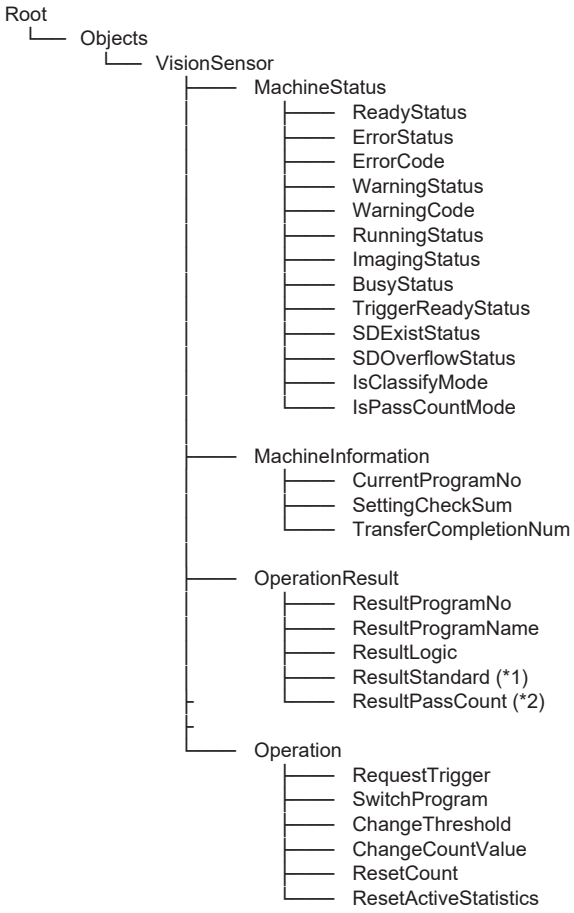
- GMT: Greenwich Mean Time
- UTC: Coordinated Universal Time
- If Daylight Saving Time (DST) is to be supported, set the time offset to account for DST.

Chicago	-06:00	Ha Noi	+07:00
Mexico City	-06:00	Bangkok	+07:00
Toronto	-05:00	Shanghai	+08:00
Sao Paulo	-03:00	Hong Kong	+08:00
London	00:00	Singapore	+08:00
Frankfurt	+01:00	Manila	+08:00
Bruxelles	+01:00	Kuala Lumpur	+08:00
Paris	+01:00	Taipei	+08:00
Milano	+01:00	Seoul	+09:00
Chennai	+06:30	Tokyo	+09:00
Jakarta	+07:00		

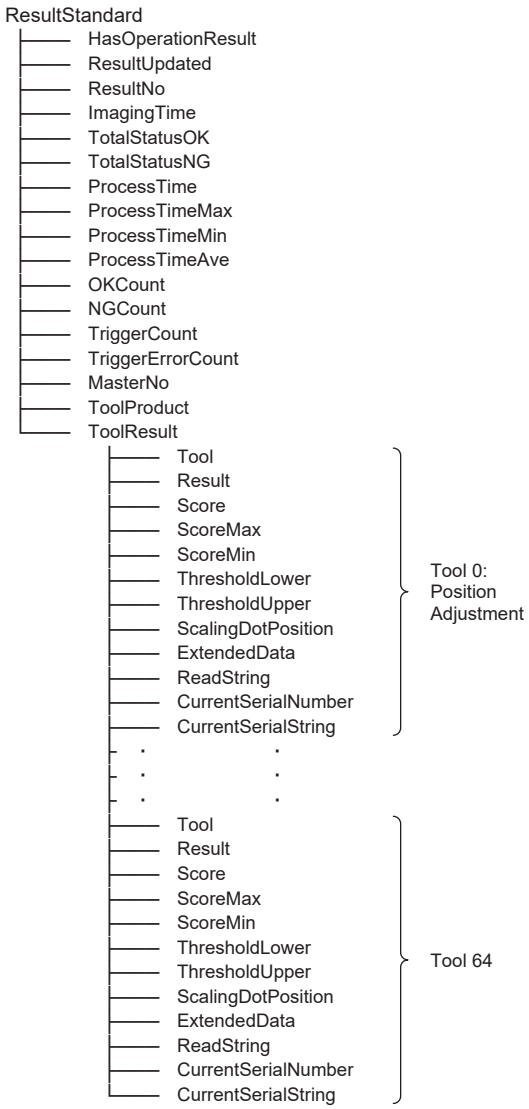
Node Structure

The following shows the node structure of the IV4 Series.

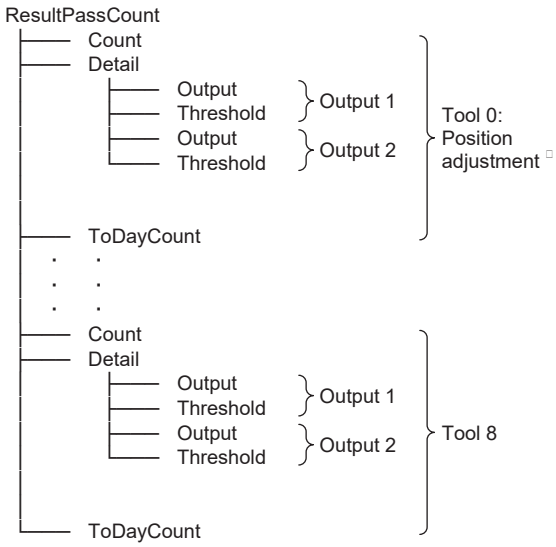
Node (Object) structure



***1: The data structure of ResultStandard is as follows.**



***2: The data structure of ResultPassCount is as follows.**



* The AI Through Count Mode is always set to 0 because no position adjustment tool exists.

Node Functions

Object

Name Space	Node ID	Belonging Object	Items	Overview	Supplemental
2	15001	Roots - Objects	VisionSensor	VisionSensor object (including the object mentioned below)	-
2	15002	VisionSensor	Operation	Object for controlling trigger input or other events	-

Variable

Name Space	Node ID	Belonging Object	Items	Type	Read/ Write	Overview	Supplemental remarks, range of values
2	16001	MachineStatus	ReadyStatus	Boolean	Read	Ready status	True: Start-up completed False: Start-up not completed (default)
2			ErrorStatus	Boolean	Read	Error status	True: An error has occurred. False: No error has occurred. (default)
2			ErrorCode	UInt16	Read	Error code	Displays the currently occurring error code. 0 to 128 (default: 0)
2			WarningStatus	Boolean	Read	Warning status	True: A warning has occurred. False: No warning has occurred. (default)
2			WarningCode	UInt16	Read	Warning Code	Displays the currently occurring warning code. 0 to 128 (default: 0)
2			RunningStatus	Boolean	Read	Running status	True: Normal running status (Running and no errors) False: - (default)
2			ImagingStatus	Boolean	Read	Imaging status	True: Imaging in progress False: - (default)
2			BusyStatus	Boolean	Read	Busy status	True: Busy status False: - (default)
2			TriggerReadyStatus	Boolean	Read	Trigger ready status	True: Trigger can be received False: No trigger can be received (default)
2			SDExistStatus	Boolean	Read	SD card identification status	True: SD card recognized False: SD card not recognized (default)
2			SDOverflowStatus	Boolean	Read	SD card insufficient capacity	True: Insufficient capacity (100 MB or less) False: Sufficient capacity (default)
2			IsClassifyMode	Boolean	Read	Sorting Mode	True: Running in the Sorting mode False: - (default)
2			IsPassCountMode	Boolean	Read	AI Through Count mode	True: Running in the AI Through Count mode False: - (default)
2	16002	MachineInformation	CurrentProgramNo	Byte	Read	Current program No.	0 to 127 (default: 0)
2			SettingCheckSum	UInt16	Read	Checksum	Displays the current sensor setting status using an arbitrary 5-digit integer. 0 to 65535 (default: 0)
2			TransferCompletionNum	UInt32	Read	Number of times of completed result output transfers	Counts up for each completed transfer of images and judgment results (text files) to FTP/SFTP/SD card. (If multiple transfer conditions are used, the count up is performed upon completion of the transfer of all files matching the conditions.) 0 to 1000000000 (default: 0)
2	16500	OperationResult DataType	ResultProgramNo	Byte	Read	Program No. during judgment	0 to 127 (default: 0)
2			ResultProgramName	String	Read	Program Name	Store the program name. (Default: blank) (Stores up to 16 letters. UTF-8)
2			ResultLogic	Boolean [8]	Read	Status result of Logic	Store the result of logic 1 to 8 since the array consists of 8 elements (fixed). True: OK False: NG (default)
2			ResultStandard	ResultStandard DataType	Read	Normal/Sorting Mode result	
2			ResultPassCount	ResultPassCount DataType [9]	Read	AI Through Count Mode result	The array consists of 9 elements (fixed). The result of the tool not set (including tool 0) is filled with the default values of the items of ResultPassCountDataType.

Data structure of ResultStandardDataType

Name Space	Structure	Items	Type	Read/ Write	Overview	Supplemental remarks, range of values
2	ResultStandard	HasOperationResult	Boolean	Read	Result available	True: Can be received False: Cannot be received (including the case of AI Through Count mode) (default)
2		ResultUpdated	Boolean	Read	Result update complete	True/False is switched when the status result is updated. (Default: False)
2		ResultNo	UInt16	Read	Result No.	0 to 32767 (default: 0)
2		ImagingTime	DateTime	Read	Imaging time	Imaging time * Displays the imaging time (UTC) when the result number is updated.
2		TotalStatusOK	Boolean	Read	Total Status OK	True: OK False: NG (default)
2		TotalStatusNG	Boolean	Read	Total Status NG	True: NG (default) False: OK
2		ProcessTime	UInt16	Read	Process time	0 to 10000 (default: 0)
2		ProcessTimeMax	UInt16	Read	Processing time MAX	0 to 10000 (default: 0)
2		ProcessTimeMin	UInt16	Read	Processing time MIN	0 to 10000 (default: 0)
2		ProcessTimeAve	UInt16	Read	Average process time	0 to 10000 (default: 0)
2		OKCount	UInt32	Read	**Standard Mode** Number of OKs **Sorting Mode** Total sort count	Displays the total number of issued triggers whose total status result was “OK” or with which the product type was determined. 0 to 1000000000 (default: 0)
2		NGCount	UInt32	Read	Number of NGs (Standard mode/Sorting mode)	Displays the total number of issued triggers whose total status result was “NG” or with which the product type was not determined. 0 to 1000000000 (default: 0)
2		TriggerCount	UInt32	Read	Trigger No.	0 to 1000000000 (default: 0)
2		TriggerErrorCount	UInt32	Read	Number of trigger errors	Number of triggers issued as error triggers. 0 to 1000000000 (default: 0)
2		MasterNo	UInt16	Read	Master number (Standard mode) Total status product types (Sorting Mode)	**Standard Mode** 0: 00 or NG (default) 1 to 7: 01 to 07 **Sorting Mode** 0: M0 or NG (default) 1 to 7: M1 to M7
2		ToolProduct	UInt16 [9]	Read	Tool status product type	**Sorting Mode** 9 elements (fixed) Stores the status product type from Tool 0 to Tool 8. 0: M0 or NG (default) 1 to 7: M1 to M7 The value 0 is always set for the result of the position adjustment tool and for tools not set. **Other than the Sorting Mode** 0 elements
2		ToolResult	ResultTool DataType [65]	Read	Tool result information	The array consists of 65 elements (fixed). **Normal/Sorting Mode** For tools not set, each item of ResultToolDataType is filled with the default value. **Other than the Normal/Sorting Mode** Each item of ResultToolDataType is filled with the default value.

Data structure of ResultToolDataType

Name Space	Structure	Items	Type	Read/ Write	Overview	Supplemental remarks, range of values
2	ToolResult	Tool	ToolType	Read	Tool type	0: No tool (default) 1: Position Adjustment 2: Hi-Sp.Adj 1-axis edge 3: Hi-Sp.Adj 2-axis edge 4: Outline 5: Edge 6: AI Identify 7: Learn 8: Brightness Prohibit 9: Color Area/Area 10: EdgePixels 11: Missing line detection 12: Totaling tool (Totaling tool of the AI Count tool) 13: Width 14: Diameter 15: Pitch 16: Color Average/Brightness Average 17: OCR 18: Blob Count 19: AI Count
2		Result	Boolean	Read	Status result of Tool	True: OK False: NG (default)
2		Score	UInt16	Read	Match	0 to 9999 (default: 0)
2		ScoreMax	UInt16	Read	Maximum match	0 to 9999 (default: 0)
2		ScoreMin	UInt16	Read	Minimum match	0 to 9999 (default: 0)
2		ThresholdLower	UInt16	Read	Lower Limit	0 to 9999 (default: 0)
2		ThresholdUpper	UInt16	Read	Upper Limit	0 to 9999 (default: 65535)
2		ScalingDotPosition	Byte	Read	Decimal point position	Stores the decimal point position for matching rate when scaling is enabled. 0: No decimal point (default) 1: 1 digit after decimal point 2: 2 digits after decimal point
2		ExtendedData	Int16 [10]	Read	Extended data	The array consists of 10 elements (fixed). *1
2		ReadString	String	Read	Read strings	Stores strings read with an OCR. (Default: blank) (Stores up to 32 letters. UTF-8)
2		CurrentSerialNumber	UInt32	Read	Current serial No.	If serial numbers are used in the number setting in OCR (custom), the current value of the serial number is stored. 0 to 999999 (default: 0)
2		CurrentSerialString	String	Read	Current serial No.	If serial numbers are used in the uppercase letters setting in OCR (custom), the current value of the serial number is stored. (Default: blank) (Stores up to 6 letters. ASCII)

*1 ExtendedData differs depending on the tool in use.

	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
Pitch	Pitch Present value MAX	Pitch Present value MIN	Number of pitches	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ColorAverage	Hue	Saturation	Brightness	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
Brightness Avg	Reserved	Reserved	Brightness	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
AI Count	AI Count Missing Window No. 1	AI Count Missing Window No. 2	AI Count Missing Window No. 3	AI Count Missing Window No. 4	AI Count Missing Window No. 5	AI Count Missing Window No. 6	AI Count Missing Window No. 7	AI Count Missing Window No. 8	AI Count Missing Window No. 9	AI Count Missing Window No. 10
OCR	Read Number of characters	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
Other tools	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved

Data structure of ResultPassCountDataType

Name Space	Structure	Items	Type	Read/ Write	Overview	Supplemental remarks, range of values
2	ResultPassCount	Count	UInt32	Read	Count Value	Count value 0 to 9999999 (Default: 0)
2		Detail	ResultPassCountDetail DataType [2]	Read	Details	The array consists of 2 elements (fixed). [0] Output 1 [1] Output 2
2		ToDayCount	UInt32	Read	Today's total count	Today's total count 0 to 9999999 (Default value: 0)

Data structure of ResultPassCountDetailDataType

Name Space	Structure	Items	Type	Read/ Write	Overview	Supplemental remarks, range of values
2	Detail	Output	Boolean	Read	Output	Output of the tool (Default: False)
2		Threshold	UInt32	Read	Output threshold	Output threshold of the tool 0 to 999999 (Default value: 4,294,967,295)

Method

Name Space	Node ID	Belonging Object	Items	Argument *1 <Value.Name>	Return Value *2 <Value.Name>	Overview	Supplemental
2	17001	Operation	Request Trigger	None	1. Succeeded/Failed <Succeeded>: Boolean 2. Error code <ErrorCode>: UInt16	Trigger request	Executes a trigger input for the sensor. To request a trigger, set the [Trigger Type] option to [External Trigger].
2	17002	Operation	Switch Program	A. Program No. (0 to 127) <ProgramNo>: Byte	1. Succeeded/Failed <Succeeded>: Boolean 2. Error code <ErrorCode>: UInt16	Change Program	Executes a program switch for the sensor. To change the programs, set the [Switching method] option to [Panel/PC/Network/Auto-Switching].
2	17003	Operation	Change Threshold	A. Tool No. (0 to 64) <ToolNo>: Byte B. Threshold change type (0: Lower limit, 1: Upper limit AI Through Count Mode: 0: Output 1, 1: Output 2) <ThresholdType>: ThresholdType C. Threshold <ThresholdValue>: UInt32	1. Succeeded/Failed <Succeeded>: Boolean 2. Error code <ErrorCode>: UInt16	Threshold change	Changes the threshold that is used as the reference for tool judgment. • A Supplemental 0: Position Adjustment 1: Tool 1 ···, 64: Tool 64 • C Supplemental *3
2	17004	Operation	Change CountValue	A. Tool No. (1 to 8) <ToolNo>: Byte B.Count value <CountValue>: UInt32	1. Succeeded/Failed <Succeeded>: Boolean 2. Error code <ErrorCode>: UInt16	Count value change	Changes the count value of AI Through Count to the set value. • A Supplemental 0: Position Adjustment 1: Tool 1, ···, 8: Tool 8 * If the specified tool number has not been set for the tool, Succeeded will be returned. • B Supplemental Count Value: 0 to 9999999
2	17005	Operation	ResetCount	None	1. Succeeded/Failed <Succeeded>: Boolean 2. Error code <ErrorCode>: UInt16	Reset Count	Resets the serial number of OCR and the count value of AI Through Count Mode. • If the input settings for [Reset Count] are disabled, the count will not be reset. • All tools are reset at a time.
2	17006	Operation	ResetActive Statistics	None	1. Succeeded/Failed <Succeeded>: Boolean 2. Error code <ErrorCode>: UInt16	Reset Statistics	Resets the statistics for the current program.

*1 Set the argument to inputArguments.
*2 Get the returned value from OutputArguments.
*3 The following shows the range of thresholds that can be specified for each tool type.

Mode	Tool type	Lower Limit	Upper Limit (When enabled)	When Scaling is enabled
Standard	Position Adjustment/Outline/Learn/AI Identify/AI OCR Brightness Prohibit/ColorAverage, Brightness Avg	0 to 100	-	-
	Area/ColorArea/EdgePixels/Edge Blob Count/AI Count	0 to upper limit	0 to upper limit	-
	Hi-Sp.Adj	-	-	-
	Width/Diameter/Pitch	0 to upper limit	0 to upper limit	0 to 999.9 for both upper and lower limits
Sorting	Position Adjustment/Learn	0 to 100	-	-
	ColorAverage, Brightness Avg/Width/Diameter/Outline Hi-Sp.Adj	-	-	-
AI Through Count	Count/Total	0 to 9999999	0 to 9999999	-
		Changes the threshold of Output 1	Changes the threshold of Output 2	-

MQTT Client Function

What is MQTT?

MQTT (Message Queuing Telemetry Transport), one of the network communication protocols, is a light messaging protocol with a small header, and thus is especially suitable for communication between IoT (Internet of Things) devices.

Publish/subscribe model

The publish/subscribe model, which is the core communication pattern of MQTT, is a mechanism for efficient messaging between clients. This model does not directly connect a message sender (publisher) with a receiver (subscriber) but makes them communicate via a broker.

Terminology

Terminology	Description
Broker (Broker)	An intermediary of messages. A broker receives a message from a client and delivers it to an appropriate client.
Client (Client)	A device or application that communicates with a broker. A client sends (Publish) and receives (Subscribe) messages.
Client ID (Client ID)	An ID to uniquely identify a client. A broker uses this ID to manage the session information of the client. A client ID must be unique. Clients having the same ID cannot be simultaneously connected.
Publish (Publish)	An operation that a client sends a message to a broker.
Subscribe (Subscribe)	An operation that a client makes settings to receive messages on a specific topic.
Topic (Topic)	The category or channel of a message. A client sends/receives messages on a specific topic.
QoS (Quality of Service)	The level that indicates the message delivery quality. There are three levels: 0 (Once at most), 1 (Once at least), and 2 (Exactly once)
Retained Message (Retained message)	A message saved by a broker, which can be immediately received by a new subscriber upon connection.
Will Message (Will message)	A message that the broker sends when the client is unexpectedly disconnected.
Session (Session)	Connected period between the client and broker. A session is transitory (clean session) or permanent (persistent session).
Clean Session (Clean Session)	With this setting selected, when a client connects to a broker, the system starts a new session without retaining the previous session information (subscription or undelivered messages). Even if the session is disconnected, a new session will start next time the client makes a connection.
Keep Alive (Keep Alive)	A signal that a client periodically sends to a broker. Use this setting to check that the connection is valid.

Safety Precautions on Security

Do not use a server with a vulnerability.

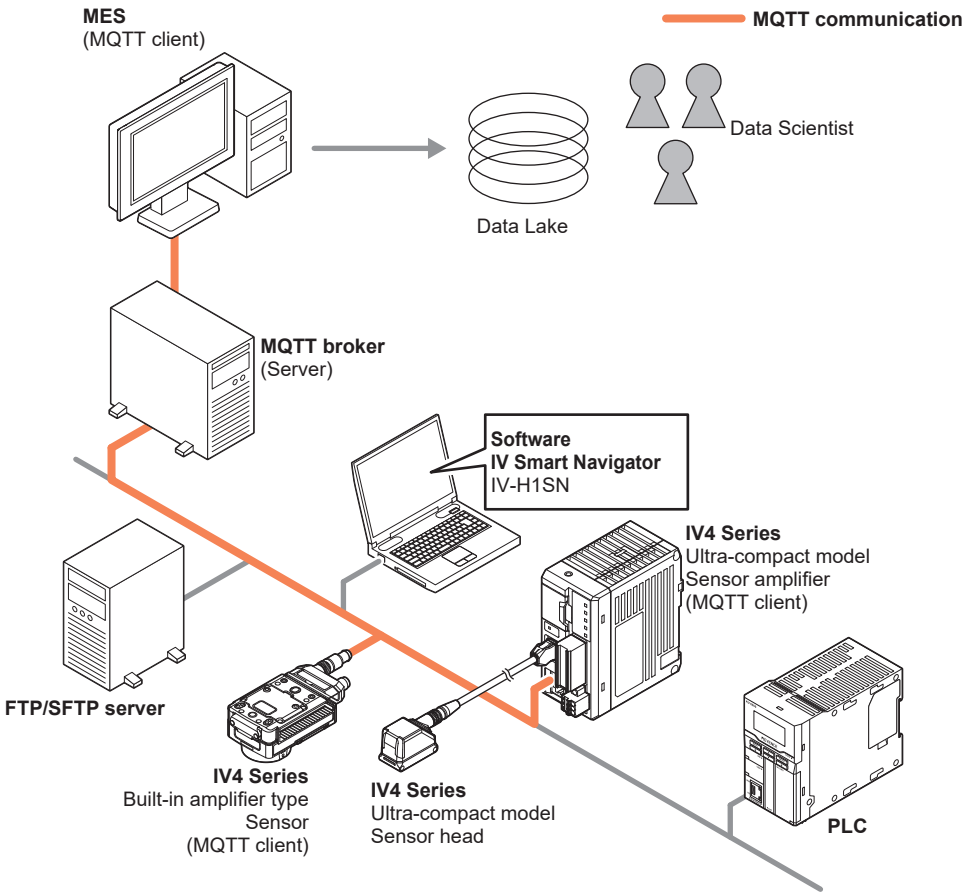
- To restrict access to the MQTT settings, enable the security function and appropriately set the user level.
- Enable the security function of MQTT.

MQTT client function

Make the IV4 operate as a MQTT client. With the MQTT function enabled, messages can be sent to/received from a broker.

Supported versions

IV4 Sensor	R1.30.** or later
IV Smart Navigator/IV4-CP70/IV4-DU10	R1.30.** or later



Specifications of MQTT Client Function of IV4

Items	Description
MQTT version	3.1.1
Connection port to use	Built-in amplifier model/ultra-compact model/Ethernet port with built-in communication unit IV4-CU1/GCU1
Clean Session (Clean Session)	Fixed (True)
TLS authentication	Supported (Default: Disabled)
Server authentication	You can install up to four files of the broker's server certificate, intermediate certificate, and root certificate.
Client authentication	You can install the certificate and private key of a client.
User authentication	You can set whether to use the user name and password. If used, the length of the user name can be from 8 to 128 characters, and the password can be from 0 to 256 characters.
Message delivery	A message in the Json format is delivered to a topic at a specific timing.

List of supported brokers

For details of the setting method, refer to the instruction manual of each broker.

Company name	Service name	Version
Eclipse Foundation	Mosquitto	2.0.20
HiveMQ GmbH	HIVEMQ	4.6.2
Inductive Automation	Ignition	8.1.43
EMQ Technologies Co., Ltd	EMQX	5.8.0

How to Configure IV4

To use the MQTT client function, you need to fix the IP address.

Point **If no IP address is set, set it before configuring the MQTT client.**

Setting the IP address for IV4

1 Configure the network settings for the sensor.

Set the IP address, subnet mask, and default gateway for the sensor.

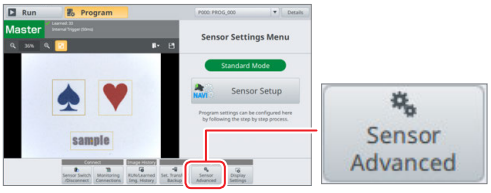
“Network Settings” (page 7-10)

Point **To use the MQTT client function with the communication unit (IV4-CU1/GCU1), configure the connection settings and set the IP address of the communication unit.**

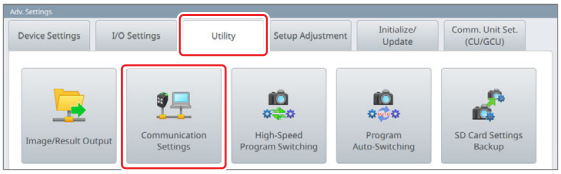
- **“Network Settings” (page 7-24)**
- **“Connection Settings” (page 7-24)**

Setting the MQTT client function

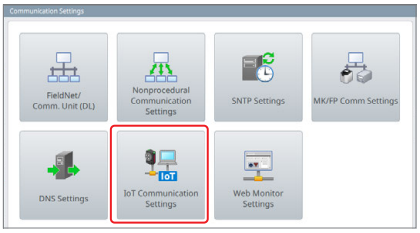
1 Press [Sensor Advanced] in the main screen in [Program].



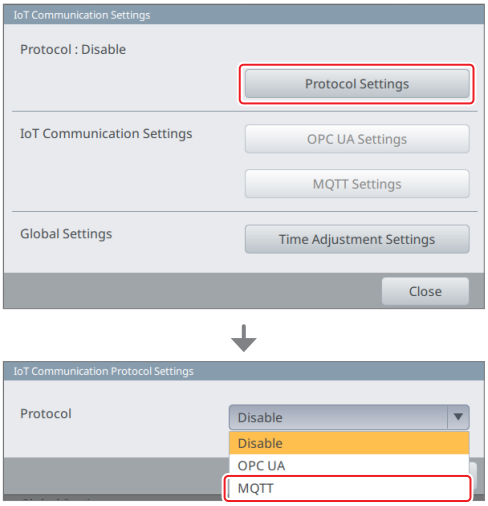
2 Select the [Utility] tab and select [Communication Settings].



3 Select [IoT Communication Settings].

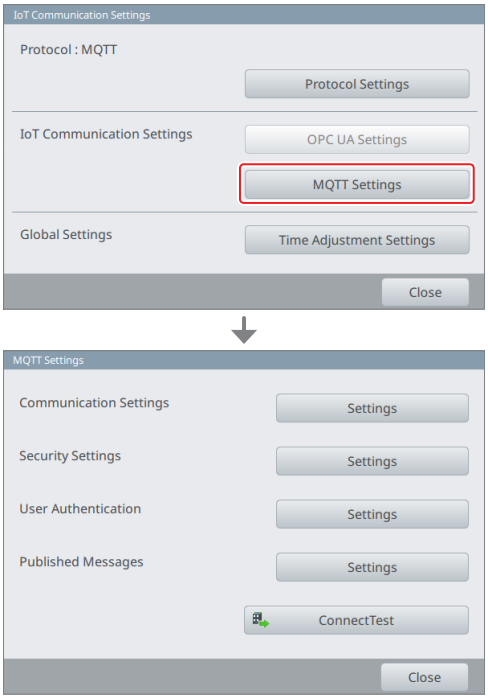


4 Press [Protocol Setting] and select [MQTT].



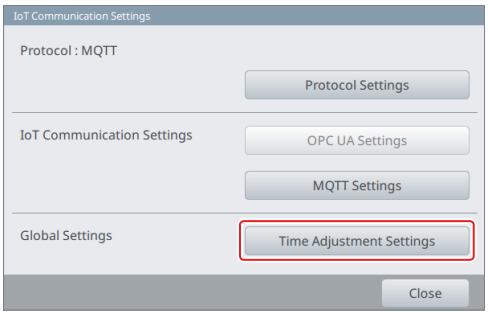
Point **When checking communication without security settings, the following are unnecessary: [MQTT Settings] in step 5 and [Global Settings] in step 6.**

5 Press [MQTT Settings] for [IoT Comm. Settings] to set the MQTT client functions.



“Communication Settings” (page 9-139)
“Security Settings” (page 9-139)
“User Authentication” (page 9-140)
“Published Message” (page 9-140)
“Connection Test” (page 9-141)

6 Press [Time Correction Settings] of [Global Settings] to set the time zone.



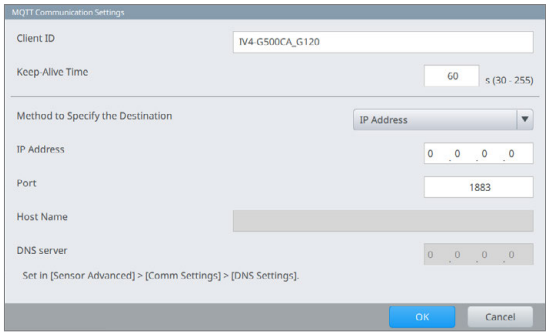
“Time Adjustment Setting” (page 9-129)

7 Press [Close].

The system returns to the main screen in [Program].

8 Start to run the system.

Communication Settings



Client ID

Up to 23 characters can be set.
Default value: (device name)
You can check the [Device Name] in “Device Settings” (page 7-10).

Keep-Alive Time

Set a value between 30 to 255 seconds.
(Default value: 60 seconds)

Method to Specify the Destination

Set a method of specifying a broker to be connected.
Select IP Address or Host Name.

IP Address

With the [IP Address] selected for the [Method to Specify the Destination], enter the IP address of the broker to be connected.

Port

Enter the port number of the broker to be connected. (Default value: 1883)

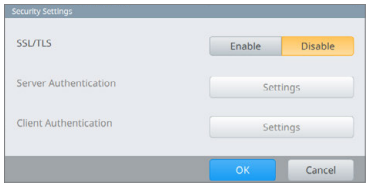
Host Name

With the [Host Name] selected for the [Method to Specify the Destination], enter the host name of the broker to be connected.
Up to 64 characters can be set.

DNS server

Shows the current DNS server setting.
To change the setting, refer to “DNS Settings” (page 7-19).

Security Settings

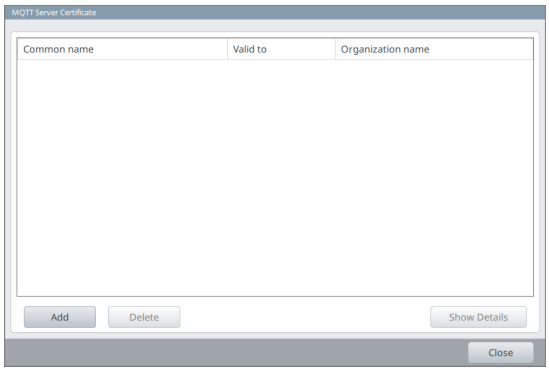


SSL/TLS

- Enable: SSL/TLS authentication is performed.
- Disable (default): No SSL/TLS authentication is performed.

Server authentication

You can view the list of certificates or add certificates of the broker to be connected.



Add

The server certificate is used to prove the identity of a broker.
You can install up to four files of the broker’s server certificate and CA certificate (intermediate certificate, root certificate).

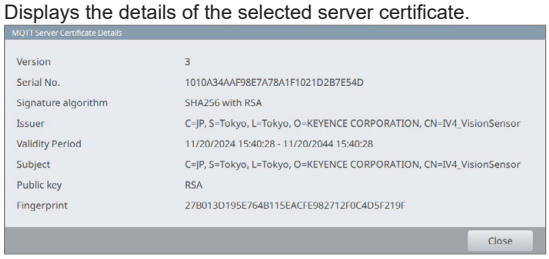
- Supported certificate format: der

Delete

You can delete an installed certificate.

Details display

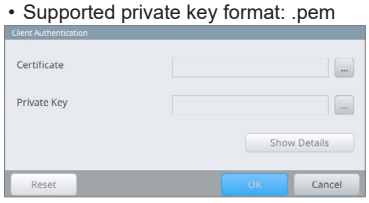
Displays the details of the selected server certificate.



Client authentication

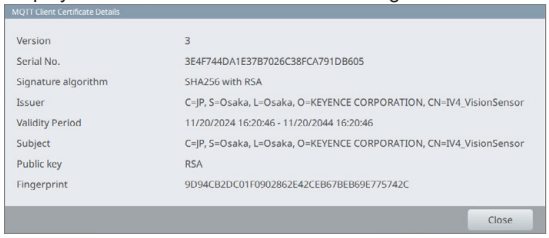
The client certificate is used to prove the identity of the MQTT client (IV4). To make a connection when the security settings are used, register the client certificate with the MQTT client (IV4) and the broker.

- Supported certificate format: .der
- Supported private key format: .pem



Details display

Display the details of the client certificate registered with the IV4.

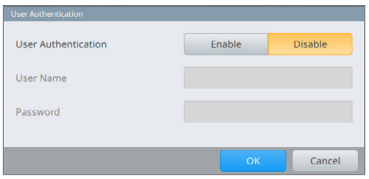


Reset

Reset the registered certificate and private key.
Press [Reset] and then press [OK] to reset them.

User Authentication

The IV4 supports user authentication using the user name and password, which is combined with SSL/TLS, ensuring security by two-step authentication.
The length of the user name can be from 8 to 128 characters, and the password can be from 0 to 256 characters.

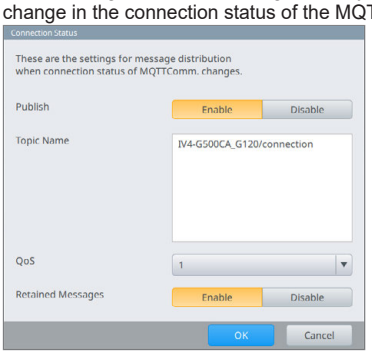


Published Message



Connection Status

The following shows the message delivery settings in the case of a change in the connection status of the MQTT communication.



Publish

- Enable (default): Delivers the message of [Connection Status].
- Disable: Not deliver the message of [Connection Status].

Topic Name

Enter the topic name of the message of [Connection Status]. Up to 160 characters can be entered.
- Up to 160 characters can be used.
- Available characters are as follows (all single-byte characters).
  0 to 9, a to z, A to Z, hyphen [-], dot [.],
  underscore [_], slash [/], and colon [:]

Default value: (client ID)/connection

QoS

Select a level of QoS. You can select from 0, 1, and 2.
(Default value: 1)

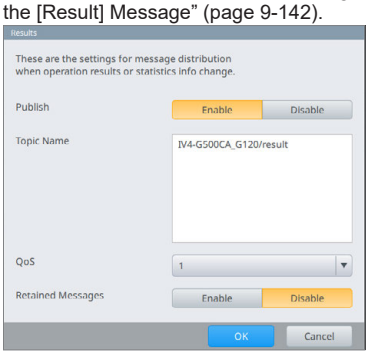
Retained Message

- Enable (default): Delivers the [Connection Status] as a retained message.
- Disable: The message of [Connection Status] is not retained in the broker.

Type	Delivery Timing	JSON Structure
Online message	When connection is established	{“ClientID”:XX, “State”:“Online”}
Offline message	When connection terminates	{“ClientID”:XX, “State”:“Offline”}
Will message	When connection unexpectedly terminates	{“ClientID”:XX, “State”:“Offline”}

Result

The following shows the settings for a message to be delivered when there is a change in the operation result or statistical Information of the sensor.
For details and structure of the message, refer to “Content of the [Result] Message” (page 9-142).



Publish

- Enable (default): Delivers the message of [Result].
- Disable: Not deliver the message of [Result].

Point

Messages related to the result are distributed at the following timing.
- **When a trigger is received during RUN in the Standard/Sorting Mode and the judgment result is updated**
- **When the count value is updated during RUN in the AI Through Count Mode**
- **When the statistical information is cleared by operation (communication, IN line, button operation) other than program change during RUN**

No message is distributed in the following cases.
- **In the setting status (including the test running of tools)**
- **When moving from the running status to setting status**
- **When the statistical information is cleared by program change**

Topic Name

Enter a topic name of the message of [Result]. Up to 160 characters can be entered.
- Up to 160 characters can be used.
- Available characters are as follows (all single-byte characters).
  0 to 9, a to z, A to Z, hyphen [-], dot [.],
  underscore [_], slash [/], and colon [:]

Default value: (client ID)/result

QoS

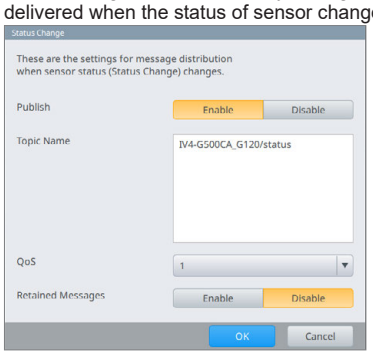
Select a level of QoS. You can select from 0, 1, and 2.
(Default value: 1)

Retained Message

- Enable (default): Delivers the [Result] as a retained message.
- Disable: The message of [Result] is not delivered as a retained message nor retained in the broker.

Status Change

The following shows the delivery settings for a message to be delivered when the status of sensor changes.



Publish

- Enable (default): Delivers the message of [Status Change].
- Disable: Not deliver the message of [Status Change].

Topic Name

Enter a topic name of the message of [Status Change]. Up to 160 characters can be entered.

- Up to 160 characters can be used.
- Available characters are as follows (all single-byte characters).
  0 to 9, a to z, A to Z, hyphen [-], dot [.], underscore [_], slash [/], and colon [:]

Default value: (client ID)/status

QoS

Select a level of QoS. You can select from 0, 1, and 2.
(Default value: 1)

Retained Message

- Enable (default): Delivers the [Status Change] as a retained message.
- Disable: The message of [Status Change] is not retained in the broker.

Delivery Timing	JSON Structure
When the warning No. has changed *1	{"ClientID":XX,"WarningCode":warning No.}
When the error No. has changed *2	{"ClientID":XX,"ErrorCode":error No.}
When the program number has changed	{"ClientID":XX,"Program No":changed program No.}

*1
- If multiple warnings have occurred, the warning having the greatest number will be distributed.
- When all warnings are resolved, 0 will be distributed. (Warnings can be cleared from the screen of IV4-CP70/IV4-DU10/PC software or by inputting error clear using the IN line. Warnings cannot be cleared by a warning clear request from the field network.)

*2
- If multiple errors have occurred, the error code having the greatest number will be distributed.
- When all errors are resolved, 0 will be distributed.

Connection Test

Press [ConnectTest] to test the connection with the connection destination.
When "Successfully connected." appears, the setting has been completed.

Message Receiving

The IV4 Series subscribes to the "'client ID'/action" topic and receives a request for operation such as trigger depending on the received JSON.

Request Type	Content	JSON Structure	Success/failure of request
Trigger	Requests external trigger/internal trigger control.	{"actiontype":"trigger"}	Receives the message of [Result].
Change Program	Requests program switching.	{"actiontype":"switch program", "program_no":program No. (0 to 127)}	Receives the message of [Status Change].
Threshold changing	Requests a change to the tool's threshold.	{"actiontype":"change threshold", "tool_no":tool No. (0 to 64), "type": Threshold change type (0: Lower limit, 1: Upper limit), "value": Threshold}	Check that the element in the message of [Result] has changed.
Count value change	Requests a change to the count value in AI Through Count mode.	{"actiontype":"change count", "tool_no":tool No. (1 to 8), "count_value":count value}	
Reset Count	Resets the total count in AI Through Count mode and the serial number in AI OCR (custom). AI OCR (Custom): Batch resets tools with the reset input setting enabled.	{"actiontype":"reset count"}	
Reset Statistics	Requests statistics reset	{"actiontype":"reset statistics"}	

Point

- **Two or more types of requests cannot be executed by one JSON. Only the operation request written first will be executed.**
- **QoS is fixed to "1".**

Content of the [Result] Message

The following shows the details of the message of [Result] to be delivered.

JSON Structure	Items	Content	Data content
ClientID	Client ID	Stores the ID string of the client ID.	Up to 23 characters
MachineStatus	-	-	-
├ ReadyStatus	Ready	The start-up of the unit has completed after power-on.	true: Start-up completed false: Start-up not completed (default)
├ ErrorStatus	Error status	Error status of the unit	true: An error has occurred. false: No error has occurred. (default)
├ ErrorCode	Error code	Error code that has occurred	0 to 128 (default: 0)
├ WarningStatus	Warning status	Warning status of the unit	true: A warning has occurred. false: No warning has occurred. (default)
├ WarningCode	Warning code	The current warning code	0 to 128 (default: 0)
├ RunningStatus	RUN	The unit is "RUN" and no system errors have occurred.	true: Normal running status (RUN and no errors) false: - (default)
├ ImagingStatus	Imaging	The unit is performing imaging operation.	true: Imaging in progress false: - (default)
├ BusyStatus	BUSY	The unit is unable to accept new trigger inputs, such as while performing imaging, processing a judgment, registering an external master image, switching programs, etc.	true: Imaging in progress false: - (default)
├ TriggerReadyStatus	Trigger Ready	The trigger can be received.	true: Trigger can be received false: No trigger can be received (default)
├ SDExistStatus	SD card identification status	The SD card is recognized.	true: SD card recognized false: SD card not recognized (default)
├ SDOverflowStatus	SD card insufficient capacity	The free space on the SD card is 100 MB or less.	true: Insufficient capacity (100 MB or less) false: Sufficient capacity (default)
├ IsClassifyMode	Sorting mode operation	The unit is in RUN status and Sorting mode.	true: Running in the Sorting mode without errors false: - (default)
└ IsPassCountMode	AI Through Count mode run	The unit is in RUN status and AI Through Count mode.	true: Running in the AI Through Count mode without errors false: - (default)
MachineInformation	-		-
├ CurrentProgramNo	Current program No.	Current Program	0 to 127 (default: 0)
├ SettingCheckSum	Checksum	Delivers the current sensor setting status using an arbitrary 5-digit integer.	0 to 65535 (default: 0)
└ TransferCompletionNum	Number of completed result output transfers	Counts up for each completed transfer of images and judgment results (text files) to FTP/SFTP/SD card. (If multiple transfer conditions are used, the count up is performed upon completion of the transfer of all files matching the conditions.)	0 to 1000000000 (default: 0)

JSON Structure	Items	Content	Data content
OperationResult	-		-
├ ResultProgramNo	Program No. during judgment	The program No. of the latest judgment process.	0 to 127 (default: 0)
├ ResultProgramName	Program No. during judgment	The program No. of the latest judgment process.	Up to 16 characters. UTF8. (Default: blank)
├ ResultLogic	-	-	-
│ └ ResultLogic1 to ResultLogic8	Result of Logic	Stores the result of Logic 1 to 8	The array consists of 8 elements (fixed). true: OK false: NG (default)
├ ResultStandard	Normal/Sorting Mode result	-	-
│ ├ HasOperationResult	Result available	The result can be received.	true: Can be received false: Cannot be received (including the case of AI Through Count mode) (default)
│ ├ ResultUpdated	Result update complete	The status, true/false, is switched when the status result is updated.	true <=> false
│ ├ ImagingTime	Imaging time	The imaging time (UTC) when the result number is updated. The time is corrected to the UTC time according to the IoT time zone settings.	yyyy-MM-ddTHH:mm:ss:SSSZ ("z" fixed is added. (UTC time))
│ ├ ResultNo	Result No.	Judgment process count	0 to 32767 (default: 0)
│ ├ TotalStatusOK	Total Status OK	Total Status OK	true: OK false: NG (default)
│ ├ TotalStatusNG	Total Status NG	Total Status NG	true: NG (default) false: OK
│ ├ ProcessTime	Process time	Processing time of the latest judgment process	0 to 10000 (default: 0)
│ ├ ProcessTimeMax	Processing time MAX	Maximum processing time	0 to 10000 (default: 0)
│ ├ ProcessTimeMin	Processing time MIN	Minimum processing time	0 to 10000 (default: 0)
│ ├ ProcessTimeAve	Processing time AVE	Average processing time	0 to 10000 (default: 0)
│ ├ OKCount	In standard mode: Number of OKs In sorting mode: Total sort count	The total number of issued triggers whose total status result was "OK" or with which the product type was determined	0 to 1000000000 (default: 0)
│ ├ NGCount	Number of NGs (standard mode/sorting mode)	The total number of issued triggers whose total status result was "NG" or with which the product type was not determined	0 to 1000000000 (default: 0)
│ ├ TriggerCount	Trigger No.	Total number of triggers issued	0 to 1000000000 (default: 0)
│ ├ TriggerErrorCount	Number of trigger errors	Number of triggers issued as error triggers.	0 to 1000000000 (default: 0)
│ ├ MasterNo	In standard mode with multiple master registration enabled: Master number	Stores the master number (00 to 07) from the total status result obtained from the results of each tool when "total status result is OK" is OK (1).	0: 00 or NG (default) 1 to 7: 01 to 07
	In sorting mode: Total status product type	Stores the product type (M0 to M7) from the total status result obtained from the results of each tool when "total status result is OK" is OK (1).	0: M0 or NG (default) 1 to 7: M1 to M7
│ ├ ToolProductNum	Number of tool status product types	Number of status product types in the Sorting Mode	Maximum registered tool number +1 (for Tool 00) *Other than the Sorting Mode: 0 (fixed) *For other than 0, the subsequent ToolProduct are not added to the JSON data.
│ ├ ToolProduct [Number of tool status product types]	In sorting mode: Status product type	-	JSON array data for the number of tool status product types
│ │ └ ProductType	Status product type	Tool n status product type	0: M0 or NG (default) 1 to 7: M1 to M7 *Not set Tool No. and Tool 00: 0 (fixed) *Other than the Sorting Mode: 0 fixed
│ ├ ToolResultNum	Number of tool results	Number of result elements in the Normal/Sorting Mode	Maximum registered tool number +1 (for Tool 0) *Other than the Normal/Sorting Mode: 0 *When the result is 0, the ToolResult is not added to the JSON data.
│ └ ToolResult [Number of tool results]	Tool result information	-	JSON array data for the number of tool results

JSON Structure	Items	Content	Data content
│ ├ Tool	Tool type	Type of Tool n	Tool name string • None (default) • Position_Adjustment: Position Adjustment Tool • One_Ax_Adjustment: High-Speed Position Adjustment (Hi-Sp.Adj) Tool (1 axis) • Two_Ax_Adjustment: High-Speed Position Adjustment (Hi-Sp.Adj) Tool (2 axes) • Outline: Outline Tool • Edge: Edge Tool • AI_Identify: AI Identify Tool • AI_Differentiate: AI Differentiate Tool • Color_Brightness_Prohibit: Color Prohibit/Brightness Prohibit Tool • Color_Brightness_Area: Color Area/Area tool • EdgePixels: EdgePixels Tool • OCR_Line_Defect: Missing Line Detection Tool • Total: Total Tool • Width: Width Tool • Diameter: Diameter Tool • Pitch: Pitch Tool • Color_Brightness_Average: Color/Brightness Averaging Tool • AI_OCR: AI OCR Tool • Color_Brightness_Blob_Count: Blob Count Tool • AI_Count: AI Differentiate Count Tool
│ ├ JudgeResult	Status result of Tool	Latest status result of Tool n	true: OK false: NG (default)
│ ├ Score	Match	Latest matching rate of Tool n	0 to 9999 (default: 0)
│ ├ ScoreMax	Maximum match	Maximum matching rate of tool n	0 to 9999 (default: 0)
│ ├ ScoreMin	Minimum match	Minimum matching rate of tool n	0 to 9999 (default: 0)
│ ├ ThresholdLower	Lower Limit	Lower limit of Tool n	0 to 9999 (default: 0) For Sorting, the lower limit of the status product type
│ ├ ThresholdUpper	Upper Limit	Upper limit of Tool n	0 - 9999 (The upper limit not set: 65535) For Sorting, the upper limit of the status product type
│ ├ ScalingDotPosition	Decimal point position	Decimal point position of the matching rate of Tool n (When Scaling is enabled)	0: No decimal point (default) 1: 1 digits after decimal point 2: 2 digits after decimal point
│ ├ ExtendedDataNum	Number of extended data	-	Fixed to 10
│ ├ ExtendedData [Number of extended data]	Extended data	-	JSON array data for the number of extended data
│ │ └ Data	Various data	*1	-
│ ├ ReadString	Read strings	Latest read strings of Tool n	Up to 32 characters. UTF8. (Default: blank)
│ ├ CurrentSerialNumber	Current serial No.	If serial numbers are used in the number setting in AI OCR (custom): Current serial No. of Tool n	0 to 999999 (default: 0)
│ └ CurrentSerialString	Current serial No.	If serial numbers are used in the uppercase letters setting in AI OCR (custom): Current serial number of Tool n	Stores up to 6 letters. ASCII (Default: blank)
├ ResultPassCountNum	Number of AI Through Count Mode results	Number of elements of AI Through Count Mode result	Maximum registered tool number *Other than the AI Through Count Mode: 0 *When the result is 0, the ResultPassCount is not added to the JSON data.
└ ResultPassCount [Number of AI Through Count Mode results]	AI Through Count Mode result		JSON array data for the number of AI Through Count Mode results
├ Count	Count Value	Count value of Tool n	0 to 9999999 (default: 0)
├ StatusOutput1	AI Through Count Mode Status Output 1 Settings	-	-
│ ├ Output1	Status Output 1 Output	Status Output 1 of Tool n	true: ON false: OFF (default)
│ └ Threshold1	Status Output 1 Threshold	Threshold of Status Output 1 of Tool n	0 to 9999999 (Output disabled: 4,294,967,295)
├ StatusOutput2	AI Through Count Mode Status Output 2 Settings	-	-
│ ├ Output2	Status Output 2 Output	Status Output 2 of Tool n	true: ON false: OFF (default)
│ └ Threshold2	Status Output 2 Threshold	Threshold of Status Output 2 of Tool n	0 to 9999999 (Output disabled: 4,294,967,295)
└ TodayCount	Today's total count	Today's total count value of Tool n	0 to 9999999 (default: 0)

*1 Data to be stored in ExtendedData[10]

	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
Pitch	Pitch Present value MAX	Pitch Present value MIN	Number of pitches	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
ColorAverage	Hue	Saturation	Brightness	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
Brightness Avg	Reserved	Reserved	Brightness	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
AI Count	AI Count Missing Window No. 1	AI Count Missing Window No. 2	AI Count Missing Window No. 3	AI Count Missing Window No. 4	AI Count Missing Window No. 5	AI Count Missing Window No. 6	AI Count Missing Window No. 7	AI Count Missing Window No. 8	AI Count Missing Window No. 9	AI Count Missing Window No. 10
OCR	Read Number of characters	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
Other tools	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved

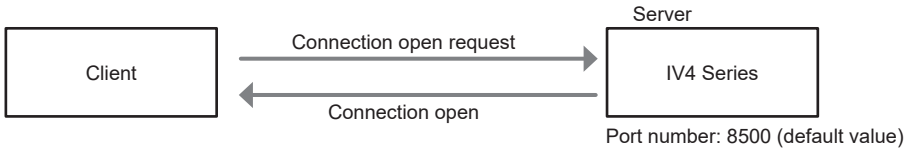
Data name	Parameter range
Pitch present value MAX	0 to 999 (default: 0)
Pitch present value MIN	0 to 999 (default: 0)
Number of pitches	0 to 999 (default: 0)
Hue	0 to 359 (default: 0)
Saturation	0 to 255 (default: 0)
Brightness	0 to 255 (default: 0)
Window number of missing AI Count	0 to 201 (default: 0)
Number of read characters	0 to 38 (default: 0)

TCP/IP Non-procedural Communication Specifications and Functions

TCP/IP no procedure communication is a function that transmits and receives data between Ethernet devices using the TCP/IP protocol. This makes it possible to communicate not only with PCs or PLCs but also with various devices that support Ethernet.
External devices such as PCs and PLCs use socket communication function to perform TCP/IP no procedure communication with the IV4 Series.

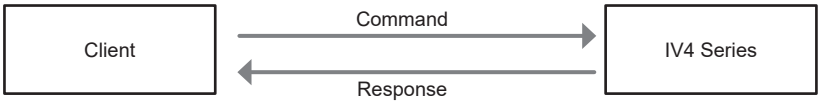
Establishing the connection

When communicating with TCP/IP, a connection must be established between the devices. A connection is established when the device on the server side performs passive open processing and is in a standby state and the device on the client side makes an open request (active open processing) to the server and is accepted. When a connection is established, a transmission path is created between the devices, making it possible to send and receive control information and data.



Overview of commands and responses

A request (command) is transmitted from a PLC, PC, or other such external device to the IV4 Series, and then the IV4 Series sends a response. The code format for both commands and responses is ASCII.



Command format

a	a	[	,	b	b	]	···	[	,	c	c	]	d

aa	Use the first 2 or 3 characters to specify the type of command on the basis of the control details.
bb, cc	Specify the parameters according to the command type. The number of parameters and the number of characters vary depending on the command. Use a comma (0x2C) to separate the parameters.
d	Specify [CR(0x0D)] as the delimiter.

Command example

D	R	,	0	3	,	1	C_R
0x44	0x52	0x2C	0x30	0x33	0x2C	0x31	0x0D

Response format

The response when the command was processed successfully.

a	a	[	,	b	b	]	···	[	,	c	c	]	d

aa	The same command as the one received is returned.
bb, cc	Parameters are appended according to the command type and returned. The number of parameters and the number of characters vary depending on the response. A comma (0x2C) is used as the parameter delimiter.
d	[CR(0x0D)] is appended as the delimiter.

Response example

P	R	,	0	6	4	C_R
0x50	0x52	0x2C	0x30	0x36	0x34	0x0D

Error response format

The response when the command was not processed successfully.

E	R	,	a	a	,	b	b	C_R

The first 2 characters of the response are set to [ER].

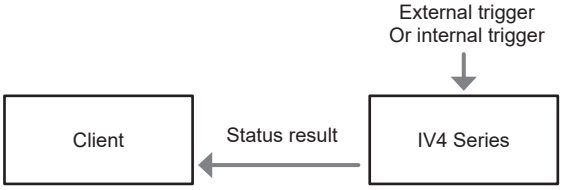
aa	The same command as the one received is returned in 18 characters or less.
bb	An error number corresponding to the error details is returned. Fixed to 2 characters. 02: No corresponding command exists. 03: The command cannot be executed under these settings or conditions. 22: The number of parameters or the range is incorrect.

Point

When creating a control program, confirm that this unit has received the response before transmitting the next command to this unit.

Automatic status result transmission

Judgment processing can be performed during internal triggers or input signals (external triggers) from an external device such as a PLC or photoelectric switch, and status results can be transmitted automatically. This eliminates the need to transmit the status result read command.



Point

- **Use the OE command (“Automatic status result transmission” (page 9-154)) in advance to enable the automatic transmission function.**
- **If the next status result is confirmed while the prior status result is being transmitted, the new data will be discarded. (The status result will not be transmitted.)**

IV4 Series TCP/IP no procedure communication specifications

Number of connections	2
Port*	8500 (default value) 1024 to 65535
Transmission code	ASCII
Data delimiter	CR (0x0D)

*Normally, there is no need to change this setting.
The port numbers assigned for PC/control panel/display expansion unit (default value: 63000) cannot be used.

IV4 Series TCP/IP no procedure communication function overview

Functions that can be used to control the IV4 Series via TCP/IP no procedure communication are listed below.

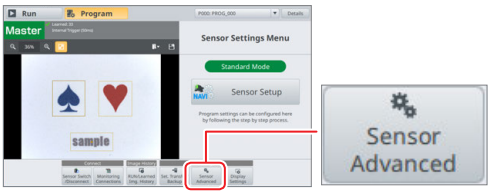
Function	Description
Trigger input	Executes a trigger input for the sensor.
Change Program	Executes a program switch for the sensor.
Read/overwrite program name	Reads/overwrites the current program name.
Ext. Master Save	Executes an external master registration for the sensor.
Read/overwrite setting value (judgment threshold)	Reads/overwrites the threshold that is used as the reference for tool judgment.
Read/overwrite master text/master date	Reads/overwrites the master text/master date that is used as the reference for AI OCR judgment.
Read/overwrite FTP/SD-saved file name	Reads/overwrites the name of the image file to transfer to the FTP server or SD card.
Warning clear input	Executes a warning clear.
Read status	Allows you to check the unit status (Imaging, RUN, BUSY, Error, etc.).
Read overall status result	Reads the overall status result.
Read processing time	Reads the processing time of the judgment.
Read each tool's status result	Reads each tool's status result and matching rate.
Read statistical information	Reads out the number of triggers issued and the number of trigger errors.
Statistical Information reset	Resets the statistics information of the running program or all programs.
Unit time reading	Reads out the sensor unit time.
Unit time changing	Overwrites the sensor unit time.
Count value reading	Reads out the count value of the count tool (AI Through Count mode).
Count value change	Overwrites the count value of the AI Through Count tool (AI Through Count mode).
Serial no. for next OCR judgment reading	Reads out the serial number for the next judgment when setting the serial number in custom mode of the AI OCR tool.
Serial no. for next OCR judgment change	Overwrites the serial number for the next judgment when setting the serial number in custom mode of the AI OCR tool.
Reset Count	• Resets the serial number for the next judgment when setting the serial number in custom mode of the AI OCR tool. • Resets the count value of the count tool (AI Through Count mode).
Count Up	Counts up the serial number for the next judgment when setting the serial number in custom mode of the AI OCR tool.
Number of completed result output transfers reading	Reads out the number of times the result output (transfer of images and judgment results) to the FTP server and microSD card has been completed.
Image data communication reading	Reads the latest image (24-bit bitmap format).
Image data SD card saving	Saves the latest image (24-bit bitmap format) to a microSD card.
Temperature reading (built-in amplifier model)	Reads out the internal temperature of sensors with built-in amplifiers and sensor amplifiers for ultra-compact models.

Point

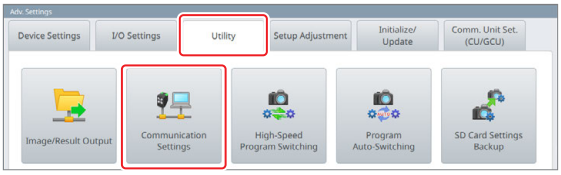
- **If you are switching programs using TCP/IP no procedure communication, set the [Switching method] option to [Panel/PC/Network/Automatic Switching].**
  "Program Switching Method" (page 7-13)
- **If the external master registration will be executed frequently using TCP/IP no procedure communication, set the [Write to ROM when using Ext. Master Save] option to [No] to protect the non-volatile memory in the sensor.**
  "Write to ROM when using Ext. Master Save" (page 7-14)
- **If the FTP/SD-saved file name will be rewritten frequently using TCP/IP no procedure communication, configure the settings to prevent writing to non-volatile memory (set the corresponding bit to 0) in order to protect the non-volatile memory within the sensor.**
  "FTP/SD-saved file name reading" (page 9-153)
- **When using standard mode and setting multiple position adjustment tools, the information of each position adjustment tool starting with the second one is assigned to a tool from Tool 1 to Tool 64.**

Setting the IV4 Series

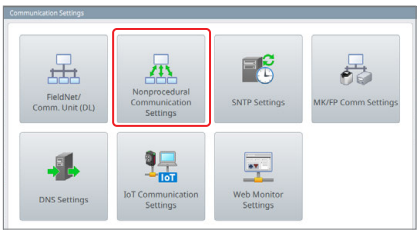
1 **Press [Sensor Advanced] in the main screen in [Program].**



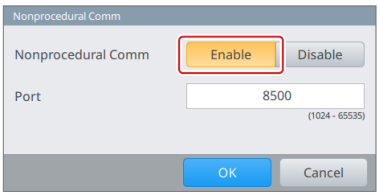
2 **Select the [Utility] tab and select [Communication Settings].**



3 **Select [Nonprocedural Communication Settings].**



4 **Select [Enable].**



Point

- **Port number is the port number for the TCP/IP no protocol communications function on the device. Specify it when opening a connection from an external device to the device.**
- **Normally, there is no need to change the port number.**
- **The port number assigned to the PC/control panel/display expansion unit (default: 63000) cannot be used.**

5 **When setting is completed, press [OK].**

The system returns to the [Adv. Settings] screen.

6 **Press [OK].**

List of Commands Supported by the IV4 Series

Control details	Command	Response	Reception possible with the unit in [Setting] status	Support for AI Through Count mode	Ref.
Trigger	T1 [CR]	T1 [CR]	×	×	9-150
Status result reading	RT [CR]	RT, tool result (standard) [CR] RT, tool result (detailed) [CR]	×	✓	9-150
Trigger + status result reading	T2 [CR]	RT, tool result (standard) [CR] RT, tool result (detailed) [CR]	×	×	9-150
Program number reading	PR [CR]	PR, nnn [CR]	✓	✓	9-150
Switching the program number	PW, nnn [CR]	PW [CR]	×	✓	9-150
Threshold reading	DR, nn, a [CR]	DR, nn, a, bbbbbbb [CR]	✓	✓	9-151
Program name reading	PNR[CR] PNR, a[CR]	PNR,nnnnnnn[CR] PNR,a,nnnnnnnn[CR]	✓	✓	9-151
Program name overwriting	PNW,nnnnnnnn[CR]	PNW[CR]	×	✓	9-151
Threshold changing	DW, nn, a, bbbb [CR]	DW, nn [CR]	×	✓	9-151
Master text/date reading	CR, nn [CR] CR,nn,a[CR]	CR, nn, ssss [CR] CR,nn,a,ssss[CR]	✓	×	9-152
Changing the master text/date	CW, nn, ssss [CR]	CW, nn [CR]	×	×	9-152
Master text reading	CNR, nn [CR]	CNR, nn, aa, bb [CR]	✓	×	9-152
Master text number changing	CNW, nn, aa, bb [CR]	CNW, nn [CR]	×	×	9-152
FTP/SD-saved file name reading	FNR,n,m[CR]	FNR,n,m,ssss[CR]	✓	✓	9-153
FTP/SD-saved file name changing	FNW,n,m,ssss[CR]	FNW,n,m[CR]	×	✓	9-153
Master Registration	MR [CR]	MR [CR]	×	×	9-153
Operating status reading	RM [CR]	RM, n [CR]	✓	✓	9-153
Sensor status reading	SR [CR]	SR,a,b,c,d,e,f,g[CR]	×	✓	9-153
Error number reading	RER [CR]	RER, nnn [CR]	×	✓	9-154
Warning number reading	WR [CR]	WR, nnn [CR]	×	✓	9-154
Warning clearing	WC [CR]	WC [CR]	×	✓	9-154
SD card free space reading	SDR [CR]	SDR, nnnnn[CR]	×	✓	9-154
SD Card Save Stop	SDS [CR]	SDS [CR]	×	✓	9-154
Automatic status result transmission	OE, n [CR]	OE [CR]	✓	✓	9-154
Status result output format changing	OF, nn [CR]	OF [CR]	✓	✓	9-155
Statistical information reading	STR [CR]	“Statistical information reading” (page 9-156)	×	✓	9-156
Reset Statistics	STC [CR] STC,a[CR]	STC [CR] STC,a[CR]	×	×	9-157
Version reading	VI [CR]	VI, nnn, vvv [CR]	✓	✓	9-157
Setting checksum reading	CSR [CR]	CSR, aaaaa [CR]	×	✓	9-157
Unit time reading	TR[CR]	TR,yy,mm,dd,hh,mm,ss[CR]	✓	✓	9-157
Unit time changing	TC,yy,mm,dd,hh,mm,ss[CR]	TC[CR]	✓	✓	9-157
Count value reading	PCR,nn[CR]	PCR,nn,bbbbbbb[CR]	✓	✓	9-158
Count value change	PCW,nn,bbbb[CR]	PCW,nn[CR]	×	✓	9-158
Serial no. for next OCR judgment reading	SNR,nn[CR]	SNR,nn,aa[CR]	✓	×	9-158
Serial no. for next OCR judgment change	SNW,nn,aaa[CR]	SNW,nn[CR]	×	×	9-158
Reset Count	CTR[CR]	CTR[CR]	×	✓	9-158
Count Up	CTU[CR]	CTU[CR]	×	×	9-158
Number of completed result output transfers reading	RFC[CR]	RFC,nnnnnnnnnn[CR]	×	×	9-159
Image data communication reading	BR,m[CR]	Br,nnnnnnnnnn,ddddddd,image data	×	✓	9-159
Image data SD card saving	BR,SD,m,folder name[CR]	BR,nnnnnnnnnn[CR]	×	✓	9-159
Temperature reading	TP[CR]	TP,pnn.n[CR]	✓	✓	9-159
Reading of nonprocedural ITW of FTP/SD file name (Details)	ITR,n,[CR]	ITR,n,ssss[CR]	✓	✓	9-160
Change of nonprocedural ITW of FTP/SD file name (Details)	ITW,n,ssss[CR]	ITW,n[CR]	×	✓	9-160

Trigger

❍ **Command**

T	1	C_R

0x31

❍ **Response**

T	1	C_R

❍ **Description**

Issues a trigger to start judgment processing.
The response is returned immediately. It does not wait until the judgment processing is finished.

Reading the status result

❍ **Command**

R	T	C_R

❍ **Response**

Standard format

R	T	,	Tool result (standard)	C_R

“Standard format” (page 9-161)

Detailed format

R	T	,	Tool result (detailed)	C_R

“Detailed format” (page 9-162)

❍ **Description**

Reads the confirmed status result when this command is received.
The standard and detailed read formats are available.
Use the OF command
(“Status result output format changing” (page 9-155)) to switch between standard and detailed format.

ER,RT,03[CR] is returned when:
- The judgment processing is not executed after the power is turned on/the program number is switched.
- “Automatic status result transmission (OE command)” is enabled.

Trigger + status result reading

❍ **Command**

T	2	C_R

❍ **Response**

Standard format

R	T	,	Tool result (standard)	C_R

“Standard format” (page 9-161)

Detailed format

R	T	,	Tool result (detailed)	C_R

“Detailed format” (page 9-162)

❍ **Description**

When this command is received, a trigger is issued to start judgment processing. When judgment processing is finished, the result is returned as a response.
The status result can be read in either standard or detailed format.
Use the OF command (“Status result output format changing” (page 9-155)) to switch between standard and detailed format.

ER, T2, 03 [CR] is returned when:
- “Automatic status result transmission (OE command)” is enabled.

Program number reading

❍ **Command**

P	R	C_R

❍ **Response**

P	R	,	n	n	n	C_R

❍ **Parameters**

nnn	Program number (000 to 127) Fixed to 3 characters

❍ **Description**

Reads the current program number.

❍ **Response example**

PR, 099 [CR]

Switching the program number

❍ **Command**

P	W	,	n	n	n	C_R

❍ **Response**

P	W	C_R

❍ **Parameters**

nnn	Program number (000 to 127) Up to 3 characters

❍ **Description**

Switches the program number.
After the program number is switched, the response is returned.

Point

- **Set the program’s [Switching method] option to [Panel/PC/Network/Automatic Switching].**
- **The program No. switched to from TCP/IP no procedure communication will be deleted when the power is turned off.**

❍ **Command examples**

Switching to P099 (PROG099)
PW, 099 [CR]

❍ **Response example (success)**

PW [CR]

❍ **Response example (failure)**

ER, PW, 03 [CR]
ER, PW, 22 [CR]

Program name reading

❍ **Command**

P	N	R	C_R

P	N	R	,	a	C_R

❍ **Response**

P	N	R	,	n	n	n	n	n	n	n	n	C_R

P	N	R	,	a	,	n	n	n	n	n	n	n	n	C_R

❍ **Parameters**

a	0: Fixed to 48 bytes 1: All characters (a can be omitted. If omitted, it is treated as 0.)
nnnnnnnn	Program name

❍ **Description**

Obtains the name of the program (UTF8) currently set.
When fixed to 48-bytes, the maximum number of letters for the program name to be read out is 16.
When fixed to 48-bytes, if the program name is less than 16 letters, a NULL character is placed at the end of the missing area.
For all letters, the reply data size is variable depending on the program name.

Program name overwriting

❍ **Command**

P	N	W	,	n	n	n	n	n	n	n	n	C_R

❍ **Response**

P	N	W	C_R

❍ **Parameters**

nnnnnnnn	Program name (max. 16 letters)

❍ **Description**

Changes the currently set program name (UTF8 1 to 3 byte characters).
If the program is a main unit program (0-31), it is saved in non-volatile memory. Extended programs (32-127) are not saved in non-volatile memory.
¥ / : * ? " < > | are forbidden characters. The name cannot be set if the name contains these characters.
(¥ is a backslash.)

Threshold reading

❍ **Command**

D	R	,	n	n	,	a	C_R

❍ **Response**

D	R	,	n	n	,	a	,	b	b	b	b	b	b	b	C_R

❍ **Parameters**

nn	00: Position adjustment tool 01 to 64: Tool number
a	0: Lower limit 1: Upper Limit In AI Through Count mode. 0: Output 1 (AI Through Count) 1: Output 2 (AI Through Count)
bbbbbbb	Limit Fixed to 7 characters 0000000 to 9999999

❍ **Description**

Reads the threshold of the specified tool.
When 00 is specified, the threshold of the position adjustment tool is read.
Reading is not possible in the following situation. (Error 03)
- In standard mode or sorting mode, the position adjustment tool, which corrects the position of the learning tool
- In sorting mode, tools other than the learning tool

❍ **Examples**

Response when the lower limit of Tool 1 is 80
DR, 01, 0, 0000080 [CR]

Response when the lower limit of Tool 3 is 23.25 mm
DR, 03, 0, 0023250 [CR]

Threshold changing

❍ **Command**

D	W	,	n	n	,	a	,	b	b	b	b	C_R

❍ **Response**

D	W	,	n	n	C_R

❍ **Parameters**

nn	00: Position adjustment tool 01 to 64: Tool number
a	0: Lower limit 1: Upper Limit In AI Through Count mode. 0: Output 1 (AI Through Count) 1: Output 2 (AI Through Count)
bbbb	Limit Up to 7 characters 0 to 9999999 Only 2 characters can be specified when this parameter is 2 characters long.

❍ **Description**

Changes the threshold of the specified tool.
If you specify 00, the threshold of the position adjustment tool will be changed.
After the threshold is changed, the response is returned.
If the number of threshold characters to transmit is a fixed length and the number of characters in the threshold changes, fill in the remaining characters with 0.
This cannot be changed in the following situation. (Error 03)
- In standard mode or sorting mode, the position adjustment tool, which corrects the position of the learning tool
- In sorting mode, tools other than the learning tool

❍ **Examples**

Change the lower limit of Tool 1 to 80.
DW, 01, 0, 80 [CR]

Fill a threshold made of 4 characters with 0.
DW, 01, 0, 0080 [CR]

Change the lower limit of Tool 2 to 23.25 mm.
DW, 02, 0, 0023250 [CR]

Master text/date reading

❍ **Command**

C	R	,	n	n	CR

C	R	,	n	n	,	a	CR

❍ **Response**

C	R	,	n	n	,	s	s	s	· ·	s	s	s	CR

C	R	,	n	n	,	a	,	s	s	s	· ·	s	s	s	CR

❍ **Parameters**

nn	Tool number (01 to 64)
a	0: Fixed to 96 bytes, 1: All characters (a can be omitted. If omitted, it is treated as 0)
sss..sss	Master text/date

❍ **Description**

This is an AI OCR tool command.
If there are less than 96 bytes when fixed to 96 bytes, the remaining characters are filled with SP (0x20).
If only the number of characters is judged, all characters will be SP (0x20).

❍ **Response example**

When the master text is 14 characters
CR, 01, 123456789ABCDE [SP] [SP] [CR]

Changing the master text/date

❍ **Command**

C	W	,	n	n	,	s	s	s	· ·	s	s	s	CR

❍ **Response**

C	W	,	n	n	CR

❍ **Parameters**

nn	Tool number (01 to 64)
sss..sss	Master text/date Up to 32 characters

❍ **Description**

This is an AI OCR tool command.
The master text/date can be up to 32 characters in length. The parameter represented by sss..sss can also be sent as all Null. (The master text becomes [Not Set].)
After the master text/date is changed, the response is returned.
Only 10 characters can be specified when this parameter is 10 characters long.
If the number of characters to transmit changes to a fixed length and the number of characters in the master text changes, fill the preceding characters with NULL (0x00).
This cannot be changed in the following situation. (Error 03)
- When judgment only for the number of characters is enabled
- When calendar synchronization is enabled
- When the AI OCR tool (custom) is set

❍ **Command examples**

CW, 01, 123456789 [CR]
CW, 01, 1234567[NULL][NULL]

Master text reading

❍ **Command**

C	N	R	,	n	n	CR

❍ **Response**

C	N	R	,	n	n	,	a	a	,	b	b	CR

❍ **Parameters**

nn	Tool number (01 to 64)
aa	Minimum number of characters (00 to 32) Fixed to 2 characters
bb	Maximum number of characters (00 to 32) Fixed to 2 characters

❍ **Description**

This is an AI OCR tool command.
It is used when judgment only for the number of characters is enabled.
Reading is not possible in the following situation. (Error 03)
- When judgment only for the number of characters is disabled

❍ **Response example**

CNR, 01, 06, 10 [CR]

Master text number changing

❍ **Command**

C	N	W	,	n	n	,	a	a	,	b	b	CR

❍ **Response**

C	N	W	,	n	n	CR

❍ **Parameters**

nn	Tool number (01 to 64)
aa	Minimum number of characters (01 to 32) 1 to 2 characters
bb	Maximum number of characters (01 to 32) 1 to 2 characters

❍ **Description**

This is an AI OCR tool command.
It is used when judgment only for the number of characters is enabled.
This cannot be changed in the following situation. (Error 03)
- When judgment only for the number of characters is disabled
- aa (the smallest number of characters) is larger than bb (the largest number of characters).

❍ **Command examples**

CNW, 01, 06, 10 [CR]

FTP/SD-saved file name reading

❍ **Command**

F	N	R	,	n	,	m	C_R

❍ **Response**

F	N	R	,	n	,	m	,	s	s	· ·	s	s	C_R

Point

- **When this unit starts, the file name is read from non-volatile memory to volatile memory.**
- **During operation, FTP/SD card transferring is performed with the file name saved in volatile memory.**
- **The correct file name cannot be checked if the end of this name is SP (0x20).**

❍ **Parameters**

n	Transfer condition number (1 to 4)
m	0: Read from volatile memory. 1: Read from non-volatile memory.
sss..sss	FTP/SD-saved file name Fixed to 64 characters

❍ **Description**

Checks the FTP/SD-saved file name of the specified transfer condition.
The file name is fixed to 64 characters. If it uses less characters, the remainder are filled with SP (0x20).

❍ **Response example**

When the FTP/SD-saved file name is 10 characters
FNR,1,0,123456789A[SP][SP]...[SP][CR]
54 characters

FTP/SD-saved file name changing

❍ **Command**

F	N	W	,	n	,	m	,	s	s	· ·	s	s	C_R

❍ **Response**

F	N	W	,	n	,	m	C_R

❍ **Parameters**

n	Transfer condition number (1 to 4)
m	0: Write to volatile memory. 1: Write to volatile and non-volatile memory.
sss..sss	FTP/SD-saved file name Up to 64 characters The following characters can be used: 0-9, a-z, A-Z, ' '[space], '(', ')', '+', '-', '=', '_', '.', '"', '!', '#', '$', '%', '&', '@'

❍ **Description**

Changes the FTP/SD-saved file name of the specified transfer condition.
Overwriting fails if a condition other than 1 to 4 is specified.
Only 10 characters can be specified when this parameter is 10 characters long.
If the number of characters to transmit changes to a fixed length and the number of characters in the file name changes, fill the preceding characters with NULL (0x00).

❍ **Command examples**

FNW, 1, 0, 123456789 [CR]
FNW, 1, 0, 1234567 [NULL] [NULL] [CR]

Master Registration

❍ **Command**

M	R	C_R

❍ **Response**

M	R	C_R

❍ **Description**

Registers the captured image as a master image.
When the master image registration is complete, a response is returned.

Point

- **Set the [Write to ROM when using Ext. Master Save] option when frequently using the Master Image Registration command.**
  "Write to ROM when using Ext. Master Save" (page 7-14)
- **Master images cannot be registered externally when AI tool, AI Identify, AI Count are in use or sorting mode or AI Through Count mode are set.**

Operating status reading

❍ **Command**

R	M	C_R

❍ **Response**

R	M	,	n	C_R

❍ **Parameters**

n	0: Program, 1: Run

❍ **Description**

You can check the operating status (Run or Program).

❍ **Response example**

RM, 1 [CR]

Sensor status reading

❍ **Command**

S	R	C_R

❍ **Response**

S	R	,	a	,	b	,	c	,	d	,	e	,	f	,	g	C_R

❍ **Parameters**

a	BUSY (0: OFF, 1: ON)
b	Trigger Ready (0: OFF, 1: ON)
c	Image capture (0: Stopped, 1: Imaging)
d	SD card (0: Not identified, 1: Identified)
e	Insufficient SD card capacity (0: None, 1: Insufficient free space [100 MB or less] on SD card error occurring)
f	Warning (0: None, 1: Warning occurring) You can use the WR command to check the details of the warning.
g	Error (0: None, 1: Error occurring) You can use the RER command to check the details of the error.

❍ **Description**

You can check the operating status of the sensor.

❍ **Response example**

SR, 1, 0, 1, 1, 0, 0 [CR]

Error number reading

❍ **Command**

R	E	R	C_R

❍ **Response**

R	E	R	,	n	n	n	C_R

❍ **Parameters**

nnn	Fixed to 3 characters 000: No error

Error and warning codes can be found on the Error Number Search site on the KEYENCE website.
www.keyence.com/iv4_trouble_support

❍ **Description**

Reads the error number.

❍ **Response example**

RER, 079 [CR]

Warning number reading

❍ **Command**

W	R	C_R

❍ **Response**

W	R	,	n	n	n	C_R

❍ **Parameters**

nnn	Fixed to 3 characters 000: No warning

Error and warning codes can be found on the Error Number Search site on the KEYENCE website.
www.keyence.com/iv4_trouble_support

❍ **Description**

Reads the warning number.

❍ **Response example**

WR, 065 [CR]

Warning clearing

❍ **Command**

W	C	C_R

❍ **Response**

W	C	C_R

❍ **Description**

Clears the warning.

SD card free space reading

❍ **Command**

S	D	R	C_R

❍ **Response**

S	D	R	,	n	n	n	n	n	C_R

❍ **Parameters**

nnn	Fixed to 5 characters Free space [MB] If no SD card has been loaded, 00000 is returned.

❍ **Description**

Reads the free space on the SD card.

SD Card Save Stop

❍ **Command**

S	D	S	C_R

❍ **Response**

S	D	S	C_R

❍ **Description**

Removes the SD card. After normal completion, the SD card can be safely removed from the sensor amplifier. Alternatively, the sensor amplifier can be turned off.
You can use the SR command (“Sensor status reading” (page 9-153)) to check the SD card identification status.

Automatic status result transmission

❍ **Command**

O	E	,	n	C_R

0x4F

❍ **Response**

O	E	C_R

❍ **Parameters**

n	0: Disable, 1: Enable

❍ **Description**

Selects whether to automatically transmit the status result.

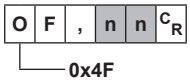
- When [Enable] is selected, the status result is automatically transmitted when the camera processes an inspection with an external trigger, internal trigger, and AI trigger. The status result can be obtained without requiring the RT command.
  “Automatic status result transmission” (page 9-146)
- When set to [Disable], read the status result using the RT command.
  This function is set to [Disable] when the power is turned on. To use the automatic transmission function, change this to [Enable] after the power is turned on. The change is retained until the power is turned off.

❍ **Command examples**

OE, 1 [CR]

Status result output format changing

❍ **Command**



❍ **Response**



❍ **Parameters**

nn	**00: Standard** Use 00 in the following situations. • In standard mode with multiple master registration set to [Disable] • Sorting Mode **02: Standard (master number)** Use 02 in the following situations. • In standard mode with multiple master registration set to [Enable] For details on the format, refer to 🕮 "Standard format" (page 9-161). **01: Detailed** Use 01 in the following situations. • In standard mode with multiple master registration set to [Disable] • Sorting Mode **03: Detailed (master number)** Use 03 in the following situations. In standard mode with multiple master registration set to [Enable] For details on the format, refer to 🕮 "Detailed format" (page 9-162). Fixed to 2 characters

❍ **Description**

Changes the format of the status result output.
The change is retained until the power is turned off.
The default value when the power is turned on is [00: Standard].

❍ **Command examples**

OF, 01 [CR]

Point

When specifying [02: Standard (master number)] or [03: Detailed (master number)], set [Total status condition] as shown below. Failing to do so will prevent you from obtaining correct master numbers.

- **Total status condition: Logic n (n = 1 to 8)**
- **Logic n setting**
  - **Logic: OR**
  - **Set master number (Master00 to Master07): Use**

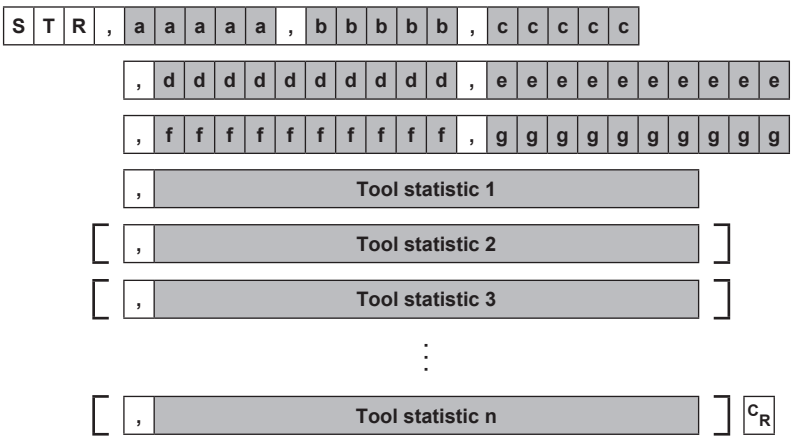
🕮 "4. Output Assignment" (page 4-88)

Statistical information reading

❍ **Command**



❍ **Response**



❍ **Parameters**

aaaaa	MAX processing time [ms], fixed to 5 characters, upper limit: 10000
bbbbb	MIN processing time [ms], fixed to 5 characters, upper limit: 10000
ccccc	AVE processing time [ms], fixed to 5 characters, upper limit: 10000
ddddddddd	Number of triggers, fixed to 10 characters, upper limit: 10^9 (Returns to 0 after reaching the upper limit.)
eeeeeeeee	OK count (standard mode) Total sort count (sorting mode) Fixed to 10 characters, upper limit: 10^9 (Stays at the upper limit after reaching it.)
fffffffff	Number of times of NG, fixed to 10 characters, upper limit: 10^9 (Stays at the upper limit after reaching it.)
ggggggggg	Number of times of trigger errors, fixed to 10 characters, upper limit: 10^9 (Stays at the upper limit after reaching it.)

❍ **Description**

Reads the confirmed statistical information when this command is received.
An error is returned when the number of triggers is 0. (ER,STR,03)

❍ **Tool statistics details**

Standard mode: The number of tools being used (n, up to 65) is output.
Sorting mode: The number of tools being used (n, up to 9) is output. However, the MAX and MIN of tools other than the position adjustment tool are disabled.
AI Through Count mode: The number of triggers, OK triggers, NG triggers, trigger errors, and tool statistics information are all always 0.



hh	00: Position adjustment tool 01 to 64: Tool number Fixed to 2 characters
iiiiiii	MAX matching rate, fixed to 7 characters
jjjjjjj	MIN matching rate, fixed to 7 characters

Reset Statistics

❍ **Command**

S	T	C	C_R

S	T	C	,	a	C_R

❍ **Response**

S	T	C	C_R

S	T	C	,	a	C_R

❍ **Parameters**

a	0: Resets the statistics of the running program. 1: Resets the statistics of all programs.

❍ **Description**

Resets the statistical information.

Version reading

❍ **Command**

V	I	C_R

0x49

❍ **Response**

V	I	,	n	n	··	n	n	,	v	v	··	v	v	C_R

❍ **Parameters**

nn ··· nn	Sensor head model, variable length
vv ··· vv	Sensor version, variable length

❍ **Response example**

VI,IV4-G500CA,R1.10.00[CR]

Setting checksum reading

❍ **Command**

C	S	R	C_R

❍ **Response**

C	S	R	,	a	a	a	a	a	C_R

❍ **Parameters**

aaaaa	00000 to 65535 Decimal, unsigned integer Fixed to 5 characters

❍ **Description**

Obtains the sensor setting status as a 5-digit integer. You can use this to check whether the sensor settings have been modified by a third party. This also allows you to check whether the program is switched.

In the following situations, the checksum will not be changed.

• When the network settings are changed (such as the IP address)

Unit time reading

❍ **Command**

T	R	C_R

❍ **Response**

T	R	,	y	y	,	m	m	,	d	d	,	h	h	,	m	m	,	s	s	C_R

❍ **Description**

Reads out the current time set in the sensor unit.

❍ **Parameters**

yy	Year (20yy)	00 to 99, up to 2 characters
mm	Month	01 to 12, up to 2 characters
dd	DD	01 to 31, up to 2 characters
hh	hh	00 to 23, up to 2 characters
mm	mm	00 to 59, up to 2 characters
ss	Seconds	00 to 59, up to 2 characters

Unit time changing

❍ **Command**

T	C	,	y	y	,	m	m	,	d	d	,	h	h	,	m	m	,	s	s	C_R

❍ **Response**

T	C	C_R

❍ **Parameters**

yy	Year (20yy)	00 to 99, up to 2 characters
mm	Month	01 to 12, up to 2 characters
dd	DD	01 to 31, up to 2 characters
hh	hh	00 to 23, up to 2 characters
mm	mm	00 to 59, up to 2 characters
ss	Seconds	00 to 59, up to 2 characters

Reference If a day (dd) that does not exist in the specified month (mm) is specified, an error is returned.

❍ **Description**

Changes the date and time information of the sensor.

Count value reading

❍ **Command**

P	C	R	,	n	n	C_R

❍ **Response**

P	C	R	,	n	n	,	b	b	b	b	b	b	b	C_R

❍ **Parameters**

nn	Tool number (01 to 08)
bbbbbbb	Count (fixed to 7 characters)

❍ **Description**

Reads out the number of counts in AI Through Count mode.
It will fail except in AI Through Count mode.

Count value change

❍ **Command**

P	C	W	,	n	n	,	b	b	b	b	C_R

❍ **Response**

P	C	W	,	n	n	C_R

❍ **Parameters**

nn	Tool number (01 to 08)
bbbb	Count (maximum 7 characters)

❍ **Description**

Writes the number of counts in AI Through Count mode.
It will fail except in AI Through Count mode.
In AI Through Count mode, if the parameters are within range, it will succeed even if the tool is not registered.

Serial no. for next OCR judgment reading

❍ **Command**

S	N	R	,	n	n	C_R

❍ **Response**

S	N	R	,	n	n	,	a	a	C_R

❍ **Parameters**

nn	Tool number (00 to 64)
aa	Current serial number (1-6 digits: Depends on the set value of the digit setting)

❍ **Description**

Reads out the serial number for the next judgment when setting the serial number in [Custom Mode] for the AI OCR tool. The number of digits read out depends on the value of the serial number digit setting.
Read out fails in the following cases:
- If the tool with the specified number is not an AI OCR tool
- If the mode is not custom mode
- If the serial number is not set

Serial no. for next OCR judgment change

❍ **Command**

S	N	W	,	n	n	,	a	a	a	C_R

❍ **Response**

S	N	W	,	n	n	C_R

❍ **Parameters**

nn	Tool number (00 to 64)
aa	Serial number setting value (1-6 digits: Depends on the set value of the digit setting)

❍ **Description**

Writes the serial number for the next judgment when setting the serial number in [Custom Mode] for the AI OCR tool.
Writing fails in the following cases:
- If the tool with the specified number is not an AI OCR tool
- If the mode is not custom mode
- If the serial number is not set
- If the written value is not within the upper and lower limits of the serial number setting value
- If the OCR serial number setting contains characters that cannot be used

Reset Count

❍ **Command**

C	T	R	C_R

❍ **Response**

C	T	R	C_R

❍ **Description**

- Resets the serial number for the next judgment when setting the serial number in [Custom Mode] for the AI OCR tool.
- Resets the count value of the AI Through Count tool in AI Through Count mode.

All tools are reset.

Reference The following cases also do not return an error:
- When the tool is not the AI OCR tool or the mode is not AI Through Count mode
- When the reset input setting is [Disable]

Count Up

❍ **Command**

C	T	U	C_R

❍ **Response**

C	T	U	C_R

❍ **Description**

Counts up the serial number for the next judgment when setting the serial number in [Custom Mode] for the AI OCR tool. If the count-up input of the AI OCR tool is disabled, the tools will not reset.
All tools are reset.

Reference The absence of an AI OCR tool or if count-up is disabled does not result in an error.

Number of completed result output transfers reading

❍ **Command**

R	F	C	C_R

❍ **Response**

R	F	C	,	n	n	n	n	n	n	n	n	n	n	C_R

❍ **Parameters**

nnnnnnnnnn	Number of transfers (fixed to 10 digits, upper limit 1000000000)

❍ **Description**

Reads out the number of count up times each FTP/SD transfer per trigger is fully completed.
- After one billion times, it returns to 1.
- Count up is not performed in the event of an FTP transfer error.

Example
When all four transfer conditions are enabled and for .txt, .ivp, and .jpeg file transfers
4 x 3 = 12 file transfers then counts up

Image data communication reading

❍ **Command**

B	R	,	m	C_R

❍ **Response**

B	R	,	n	n	n	n	n	n	n	n	n

,	d	d	d	d	d	d	d	,	Image data

❍ **Parameters**

m	Compression ratio 0: No compression 1: 1/2
nnnnnnnnnn	Total trigger number • Fixed length: 0 to DWORD_MAX-1 • AI Through Count mode: 999999999
ddddddd	Image data length Image data: Binary

❍ **Description**

- Binary data will be in 24-bit bitmap format (regardless of whether the image is color or monochrome).

An error is returned in the following cases:
- If reading of an image is attempted without the latest image

Image data SD card saving

❍ **Command**

B	R	,	S	D	,	m	,	File name with path	C_R

❍ **Response**

B	R	,	n	n	n	n	n	n	n	n	n	C_R

❍ **Parameters**

m	Compression ratio 0: No compression 1: 1/2
File name with path	File name when writing to memory card Specify up to 192 bytes with path Example: "/IV/test.bmp"
nnnnnnnnnn	Total trigger number • Fixed length: 0 to DWORD_MAX-1 • AI Through Count mode: 999999999

❍ **Description**

- Writes the latest image to the memory card in 24-bit bitmap format (regardless of whether the image is color or monochrome).
- If the specified folder does not exist, a new folder will be created.
- If the same folder name as the existing one is specified, it will be overwritten.
- Characters that can be entered are 0-9, a-z, A-Z, ' '[space], '(', ')', '+', '-', '=', '_', '.' , '/', '"', '!' , '#', '$', '%', '&', '@'

An error is returned in the following cases:
- If reading of an image is attempted without the latest image
- '/' does not exist at the beginning of folder name
- The folder name ends in '/'
- The directory part of the folder name (between '/') begins or ends with ' ' (space) or '.' (dot) is used at the beginning or end of a folder name
- Successive '/' characters are used in the folder name
- All filename parts after the last '/' in the folder name are ' ‘ [space]

Temperature reading

❍ **Command**

T	P	C_R

❍ **Response**

T	P	,	p	n	n	.	n	C_R

❍ **Parameters**

p	+ / -
n	Fixed digit of OO.O

❍ **Description**

Reads out the sensor internal temperature. Fixed to °C.
Temperatures above 99.9 will be displayed as 99.9.

Reading of nonprocedural ITW of FTP/SD file name (Details)

❍ **Command**

I	T	R	,	n	C_R

❍ **Response**

I	T	R	,	n	,	s	s	••	s	s	C_R

❍ **Parameters**

n	Nonprocedural (ITW) 1 to 8
ss..ss	Nonprocedural (ITW) 1 to 8 saved file name

❍ **Description**

Reads the nonprocedural (ITW) with the specified number.
If Nonprocedural (ITW) is not set, a blank string (64 space characters) is read.

Change of nonprocedural ITW of FTP/SD file name (Details)

❍ **Command**

I	T	W	,	n	,	s	s	••	s	s	C_R

❍ **Response**

I	T	W	,	n	C_R

❍ **Parameters**

n	Nonprocedural (ITW) 1 to 8
ss..ss	Nonprocedural (ITW) 1 to 8 saved file name

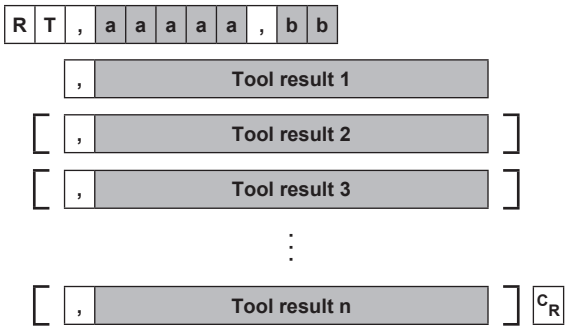
❍ **Description**

Overwrites the nonprocedural (ITW) with the specified number. (Character code: UTF8. Supported for 1 to 3-byte characters.)
Overwriting will fail if the specified n is other than a value between 1 and 8.
Overwriting will fail if the number of specified characters exceeds 64 bytes.
Data written by ITW command are always stored to the volatile memory. Because of this, the data will be deleted when the power turns off.

Status result output formats

Standard format

This is the format when the power is turned on or when 00 is specified with the OF command.



❍ **Parameters**

aaaaa	Result number, fixed to 5 characters 0 to 32767 The count is incremented each time the status result is updated. If the maximum value is exceeded, the count is returned to 0 and is incremented again. By comparing the result number, you can also confirm that no status results have been missed (that they have all been obtained).
bb	**When the output format is 00: standard** Use this parameter in the following situation. • In standard mode with multiple master registration disabled • Sorting Mode • AI Through Count Mode Total status result, fixed to 2 characters • OK: Total status is OK (standard mode). • 00 to 07: Product types M0 to M7 from the total status (sorting mode). • NG: Total status/total sorting status is NG • -- Unable to judge, AI Through Count Mode **When the output format is 02: standard (master number)** Use this parameter in the following situation. • In standard mode with multiple master registration enabled Master status result, fixed to 2 characters • 00 to 07 Master numbers 00 to 07 from the total status. If there are multiple master numbers whose status is OK, the lowest master number is output. • 99 Master status result is NG • -- Status not possible

❍ **Tool result details (Standard Mode/Sorting Mode)**

The number of tools being used (n, up to 65 in standard mode and up to 9 in sorting mode) is output.

c c , d d , e e e e e e e

cc	Tool number, fixed to 2 characters 00: Position adjustment tool 01 to 64 (standard mode)/01 to 08 (sorting mode): Tool number
dd	Status result, fixed to 2 characters • OK Status OK (standard mode) • NG Status/sorting status is NG • -- Status not possible • 00 to 07 Product types M0 to M7 determined by each tool (sorting mode)
eeeeeee	Matching rate, fixed to 7 characters Example of a matching rate of 80: 0000080 Example of a matching rate of 21.5 mm: 0021500 When the status result is "- -": 0000000 Number of BLOBs for the BLOB count tool. Example of 5 BLOBs: 0000005

Reference The matching rate (other than that of the learning tool) in sorting mode outputs the matching rate of the tool that was determined as the master image registered to the judged product type. If the status of sorting is NG, the matching rate of product type M0 is output.

Output example

Result number 1234, total status NG
Tool 1: Area tool, result OK, matching rate 80
Tool 2: Diameter tool, result NG, matching rate: 21.5 mm
RT, 01234, NG, 01, OK, 0000080, 02, NG, 0021500 [CR]

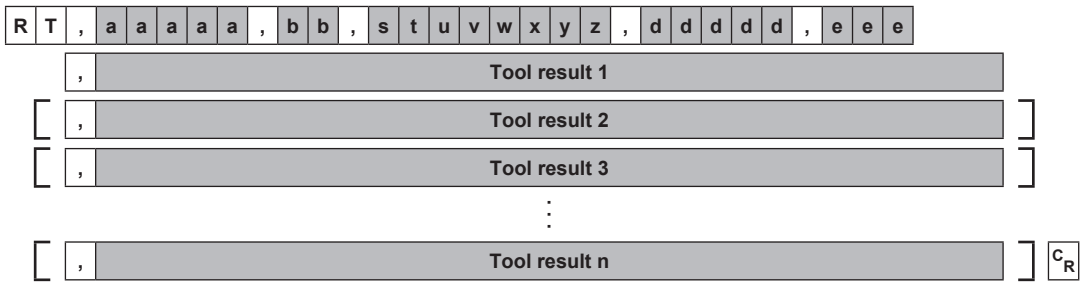
❍ **Tool result details (AI Through Count mode)**

c c , d d d d d d d , e e e e e e e

cc	Tool number, fixed to 2 characters
ddddddd	Count Value Values above 9999999 will be displayed as 9999999.
eeeeeee	Today's total count value Values above 9999999 will be displayed as 9999999.

Detailed format

This is the format when 01 is specified with the OF command.



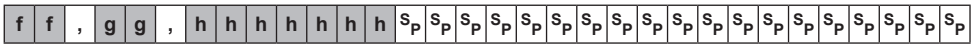
❍ Parameters

aaaaa	Result number, fixed to 5 characters 0 to 32767 The count is incremented each time the status result is updated. If the maximum value is exceeded, the count is returned to 0 and is incremented again. By comparing the result number, you can also confirm that no status results have been missed (that they have all been obtained).	
bb	**When the output format is 01: detailed** Use this parameter in the following situation. • In standard mode with multiple master registration disabled • Sorting Mode • AI Through Count Mode Total status result, fixed to 2 characters • OK: Total status is OK (standard mode). • 00 to 07: Product types M0 to M7 from the total status (sorting mode). • NG: Total status/total sorting status is NG • -- Unable to judge, AI Through Count Mode	**When the output format is 03: detailed (master number)** Use this parameter in the following situation. • In standard mode with multiple master registration enabled Master status result, fixed to 2 characters • 00 to 07 Master numbers 00 to 07 from the total status. If there are multiple master numbers whose status is OK, the lowest master number is output. • 99 Master status result is NG • -- Status not possible
stuvwxyz	Logic result, fixed to 8 characters s: logic 1, t: logic 2, u: logic 3, v: logic 4, w: logic 5, x: logic 6, y: logic 7, z: logic 8 0: OFF 1: ON	
ddddd	Processing time [ms], fixed to 5 characters	
eee	Program number, 000 to 127, fixed to 3 characters	

❍ Tool result details

The number of tools being used (n, up to 65 in standard mode, up to 9 in sorting mode, and up to 8 in AI Through Count mode) is output. The format varies depending on the type of target tool.

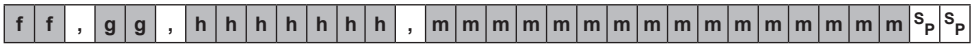
• Format for tools other than Pitch/AI OCR/Color Average/Brightness Average/AI Count Tool/AI Through Count Mode, fixed to 32 characters, SP (0x20) for unused areas



• Format of the pitch tool, fixed to 32 characters



• Format of AI OCR, fixed to 32 characters (fixed to 96 bytes), SP (0x20) for unused areas



• Format of the color average/brightness average tool, fixed to 32 characters, SP (0x20) for unused areas



• Format of AI Count Tool, fixed to 32 characters, SP (0x20) for unused areas



• Format of AI Through Count mode, fixed to 32 characters, SP (0x20) for unused areas



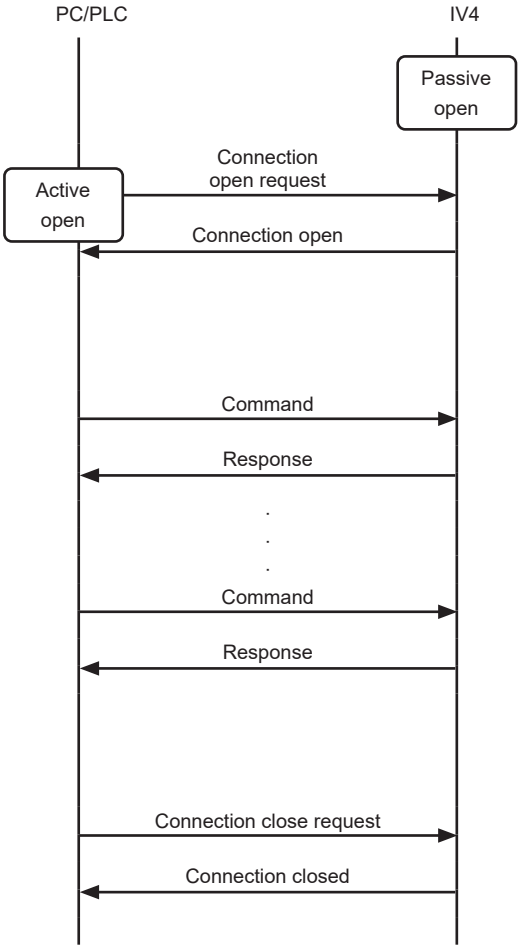
ff	Tool number, fixed to 2 characters • 00: Position adjustment tool • 01 to 64 (standard mode)/01 to 08 (sorting mode)/01 to 08 (AI Through Count mode): Tool number
gg	Status result, fixed to 2 characters • OKStatus OK (standard mode) • NGStatus/sorting status is NG • --Status not possible • 00 to 07Product types M0 to M7 determined by each tool (sorting mode)
hhhhhhh	Matching rate, fixed to 7 characters Example of a matching rate of 80: 0000080 Example of a matching rate of 21.5 mm: 0021500 When the status result is "- -": 0000000 Number of BLOBs for the BLOB count tool. Example of 5 BLOBs: 0000005 Reference The matching rate (other than that of the learning tool) in sorting mode outputs the matching rate of the tool that was determined as the master image registered to the judged product type. If the status of sorting is NG, the matching rate of product type M0 is output.
iiiiiii	MAX current pitch value, fixed to 7 characters Maximum value of all pitches
jjjjjjj	MIN current pitch value, fixed to 7 characters Minimum value of all pitches
kk	Number of pitches, fixed to 2 characters
mm ··· mm	AI OCR reading text, fixed to 96 bytes When the number of read characters is less than 96 bytes, SP (0x20) is entered for each missing character.
nnn	Color average tool H (hue), fixed to 3 characters, 000 to 359, fixed to 000 for the brightness average tool
ooo	Color average tool S (saturation), fixed to 3 characters, 000 to 255, fixed to 000 for the brightness average tool
ppp	Color average tool V (brightness)/brightness average tool brightness, fixed to 3 characters, 000 to 255
qqqqqqq	Count Value Values above 9999999 will be displayed as 9999999.
rrrrrrr	Today's total count value Values above 9999999 will be displayed as 9999999.
sss,ttt, uuu,vvv	• When Missing Part Detection is enabled Maximum of 4 missing window numbers are output. Numbers are entered from the sss position sequentially in the ascending order. When the number of missing windows is less than 4, this field is padded by 0. • When Missing Part Detection is disabled: Filled with 0.

ASCII Code Table (Reference)

Lower four bits \ Upper four bits	0	1	2	3	4	5	6	7
0	$^{N}_{U}$	$^{D}_{L}$	$^{S}_{P}$	0	@	P	`	p
1	$^{S}_{O}$	$^{D}C_{1}$	!	1	A	Q	a	q
2	$^{S}_{T}$	$^{D}C_{2}$	”	2	B	R	b	r
3	$^{E}_{T}$	$^{D}C_{3}$	#	3	C	S	c	s
4	$^{E}_{O}$	$^{D}C_{4}$	$	4	D	T	d	t
5	$^{E}_{N}$	$^{N}_{A}$	%	5	E	U	e	u
6	$^{A}_{C}$	$^{S}_{Y}$	&	6	F	V	f	v
7	$^{B}_{E}$	$^{E}_{T}$	’	7	G	W	g	w
8	$^{B}_{S}$	$^{C}_{A}$	(	8	H	X	h	x
9	$^{H}_{T}$	$^{E}_{M}$	)	9	I	Y	i	y
A	$^{L}_{F}$	$^{S}_{U}$	*	:	J	Z	j	z
B	$^{V}_{T}$	$^{E}_{S}$	+	;	K	[	k	{
C	$^{F}_{F}$	→	,	<	L	¥	l	|
D	$^{C}_{R}$	←	—	=	M	]	m	}
E	$^{S}_{O}$	↑	.	>	N	^	n	~
F	$^{S}_{I}$	↓	／	?	O	_	o	$^{D}_{E}$

Communication Methods

Communication flow



Opens a connection from the PC/PLC to port number 8500 (default value) of the IV4.

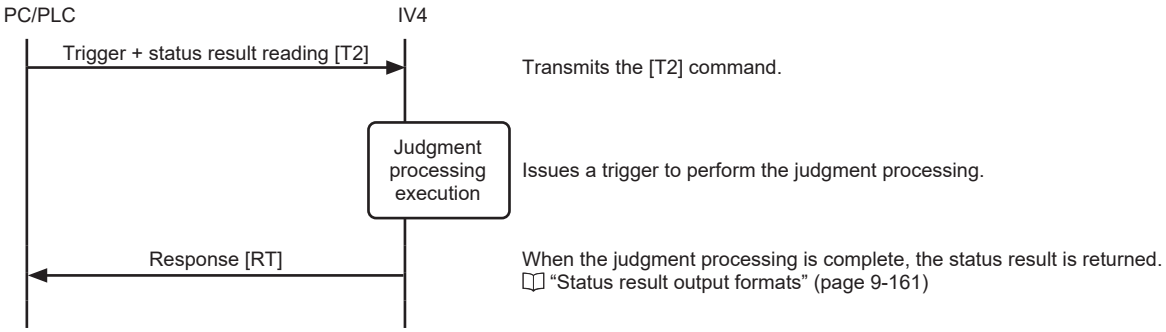
Transmits a command according to the control details and receives a response.

Point **When creating a control program, confirm that this unit has received the response before transmitting the next command to this unit.**

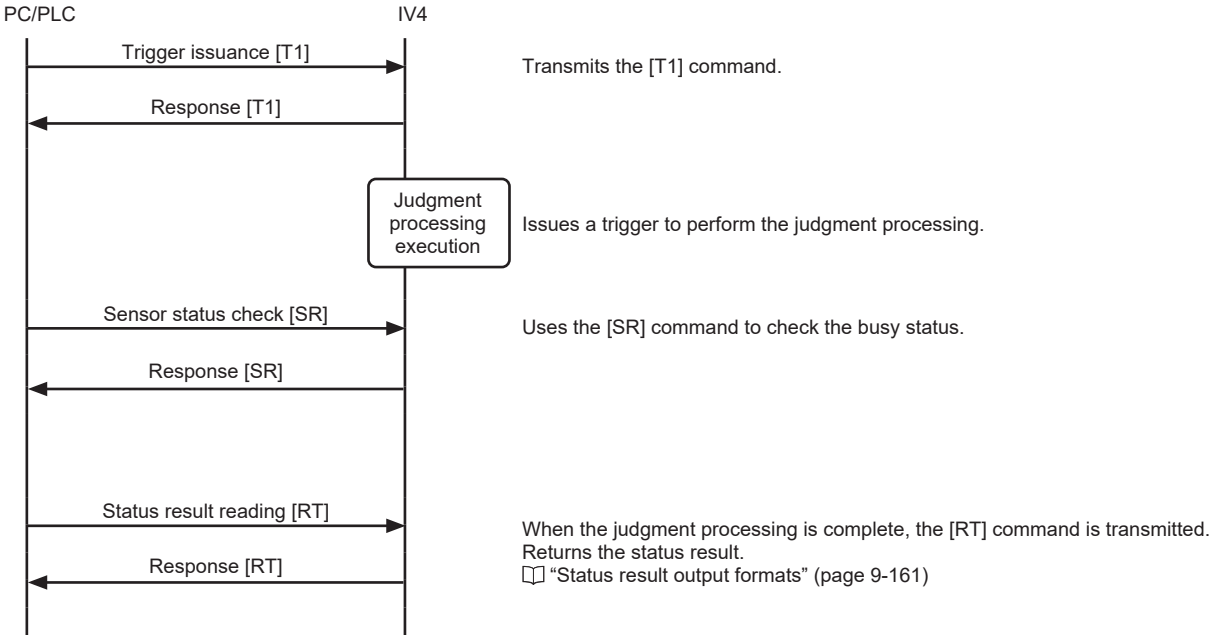
Closes and ends the connection.

Judgment processing communication methods

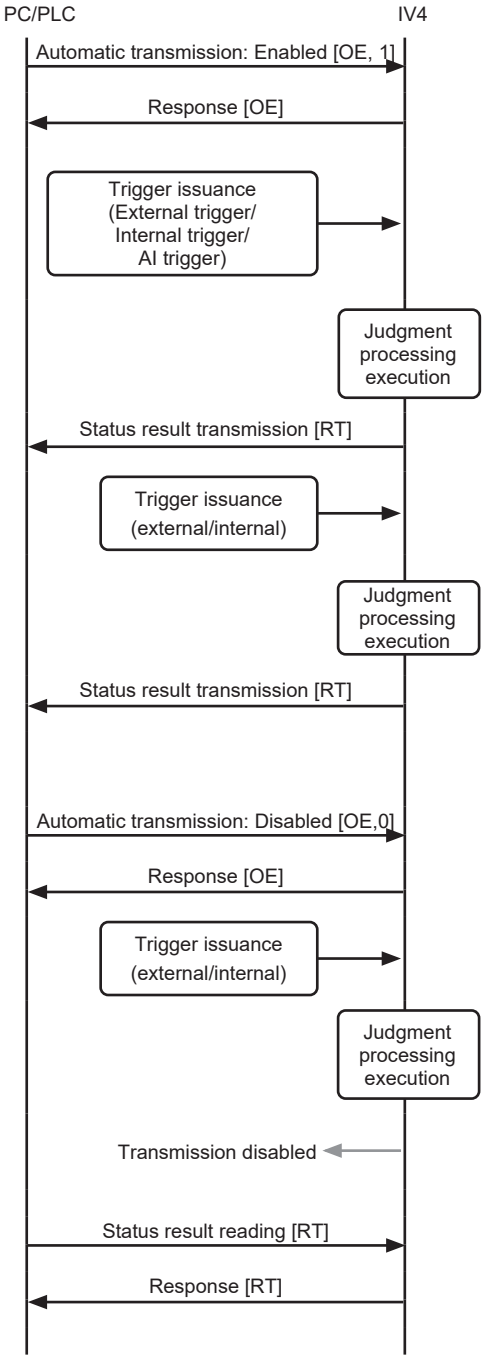
Use the [T2] command.



Use the [T1] command and [RT] command.



Use the automatic status result transmission.



Use the [OE] command to change the automatic transmission function to [Enable].

Point **This function is set to [Disable] when the power is turned on. Change this to [Enable] each time the power is turned on.**

Issues an external trigger, internal trigger, or AI trigger to perform the judgment processing.

When the judgment processing is complete, the status result is automatically transmitted.
“Status result output formats” (page 9-161)

Point **If the next status result is confirmed while the prior status result is being transmitted, the new data will be discarded. (The status result will not be transmitted.)**

When the automatic transmission function is set to [Disable], the status result will not be transmitted.

Reference The [RT] command can be used to obtain the status result.

10

Simulator (PC Only)

This chapter explains the functions and operations of the Simulator.

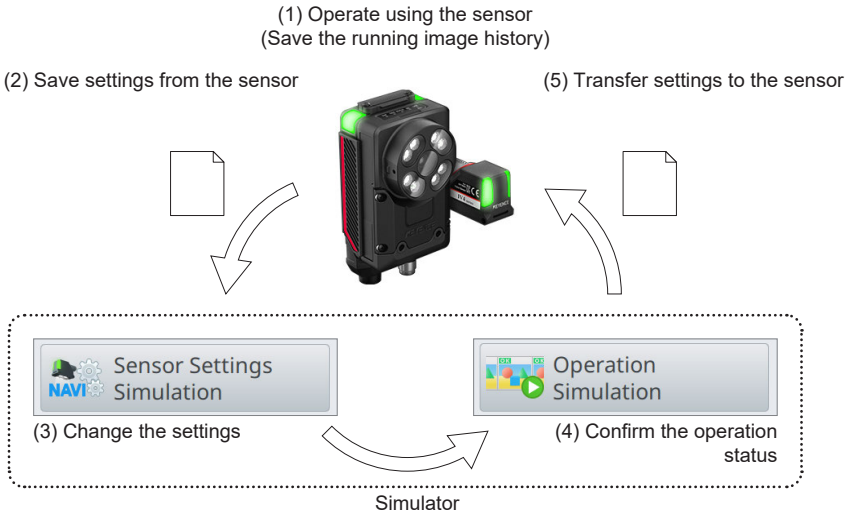
Simulator 10-2
Basic operation of simulator 10-3
Names and functions of the screen 10-4
Sensor Settings Simulation 10-5
Operation Simulation 10-8
Operating from the Menu Bar 10-10

Simulator

The Simulator can only be used on a PC with IV Smart Navigator installed.
The Simulator is a function for checking and changing the program settings without being connected to a sensor, using a batch or individual program backup file (*.iv4a), and for performing operation simulation based on history images.
It is also possible to transfer the data to the sensor and to perform operation again after changing the setting data with the Simulator.

Point

- **To check the AI Through Count Mode or AI Trigger using the simulator, use [Test Run] of [Sensor Settings Simulation].**
- **The IV Smart Navigator's simulator function supports the IV3 series (R1.30. ** or later). When performing operation simulation for the IV3 series, replace "iv4a" with "iv3a" for the settings file and "iv4p" with "iv3p" for the image file in the following descriptions.**



The three main operations which can be performed with the Simulator function are as follows.

Sensor Settings Simulation

With no sensor connected, various tools settings can be edited and saved.

Reference The screen to be displayed is the same as Sensor Setup. However, some functions that cannot be used by Simulator are hidden.

Operation Simulation

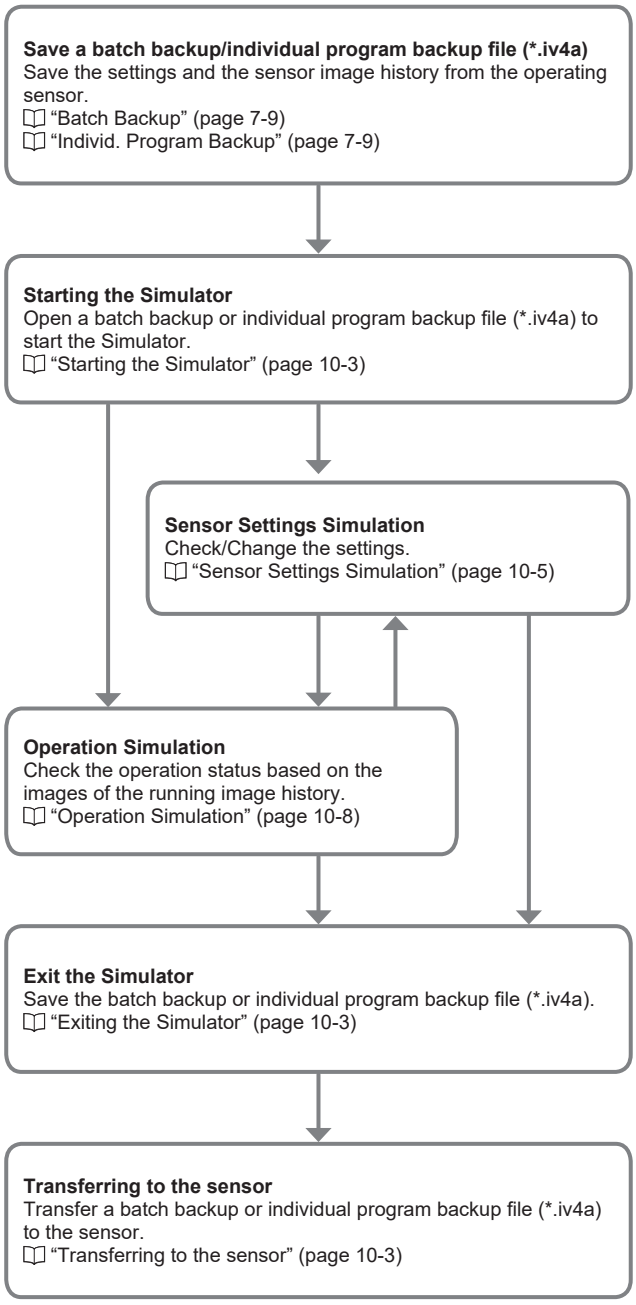
With no sensor connected, the operation results can be checked based on the program and the image history.
It is also possible to perform additional learning for AI Differentiate and adjust the settings by changing the various tools thresholds during simulation.

Confirming the image history

The image history saved in the batch backup or the individual program backup file (*.iv4a) can be checked. Moreover, additional learning of the AI Differentiate can be performed by using an image from the image history.

Basic operation of simulator

Operation flow of the simulator



Starting the Simulator

1 **Double-click the [IV Smart Navigator] icon on the desktop.**

2 **Press [Simulator].**

3 **Select a file and press [Open].**

Point **Files with the formats other than the “iv4a” or “iv3a” (R1.30 or later) format cannot be used.**

The main screen for the Simulator opens.

Exiting the Simulator

1 **The system returns to the main screen for the Simulator.**

If the [Sensor Settings Simulation] or [Operation Simulation] is activating, exit it.

2 **Select [File] → [Terminate Simulator] from the menu bar.**

When the program setting or image history has been changed, the confirmation dialog to save opens.

3 **Press [Yes].**

The Saving Method Selection dialog box appears.

4 **Press [Go].**

The Save dialog box appears.

5 **Set the file save destination and file name, and press [Save].**

The changed content is saved and the system returns to the Activation Menu screen.

Reference If you want to reduce the file size, delete the entire image history with the [RUN/Learned Img. History] on the main screen of the Simulator or the [Delete] button of [Operation Simulation] before saving the file. Only the settings are saved and the file size becomes smaller.

Transferring to the sensor

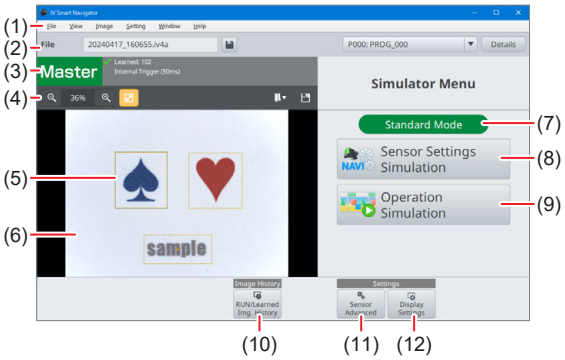
1 **Transfer the saved batch backup file or individual program backup file to the sensor.**

“Settings Transfer” (page 8-5)

Reference The batch backup or individual program backup file (*.iv4a or *.iv3a (R1.30 or later)) can also be transferred to the sensor using a control panel or display expansion unit.

Names and functions of the screen

Main Screen of the Simulator



(1) Menu bar

“Operating from the Menu Bar” (page 10-10)

(2) Settings button



No.	button	Function	Reference
(a)	File name	Displays the name of the displayed file.	-
(b)	Save	Saves the content set with the Simulator.	10-10
(c)	Select Program	Displays the program number and program name. Programs can be switched from the drop-down menu.	7-2
(d)	Details	Displays the Program Details screen.	7-7

(3) Status bar

Displays the image type (Master/Part), the number of learned images (Learn tool only) and trigger type.

(4) Image tool bar

“Operation of the Image Tool Bar” (page 3-14)

(5) Tool window

Displays the set region of the tool set in the program.
The tool window selected can be changed by pressing a different tool region.

“Selecting the Display Method of the Tool Window” (page 5-6)

(6) Master image display

Displays the master image registered to the currently selected program.

Reference

If the search range of the selected tool is being set to [Partial], the search range will be displayed with a light blue frame. If the position adjustment is set, the search range after position adjustment will be displayed.

(7) Mode

Displays the program mode (Standard Mode/Sorting Mode/AI Through Count Mode).

(8) [Sensor Settings Simulation]

“Sensor Settings Simulation” (page 10-5)

(9) [Operation Simulation]

“Operation Simulation” (page 10-8)

(10) [RUN/Learned Img. History]

“Running Image History” (page 5-14)

(11) [Sensor Advanced]

“Sensor Advanced Settings” (page 7-10)

(12) [Display Settings]

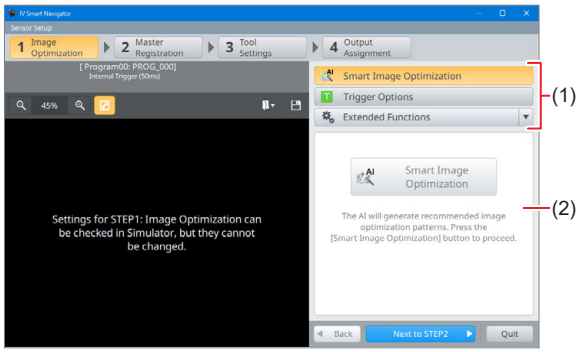
“Display Settings” (page 7-30)

Sensor Settings Simulation

1. Image Optimization

Confirm the Image Optimization settings used for taking an image of a target.

Point **In the Simulator Sensor Setup, the settings of the Image Optimization can only be confirmed. Image Optimization settings cannot be changed.**



(1) Settings button

Displays the settings to be set for Image Optimization.
“Smart Image Optimization” (page 4-6)
“Trigger Options” (page 4-7)
“Line Settings” (page 4-10)
“Extended Functions for Image Optimization” (page 4-11)

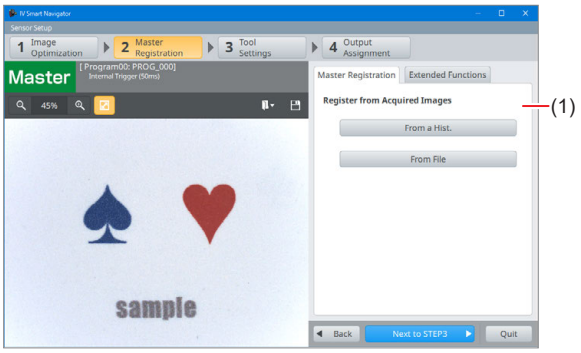
(2) Setting confirmation screen

Displays the settings of the menu selected with the Settings button.

2. Master Registration

Registers a master image used as the reference for judgment. Also, set Brightness Correction.

Point **In the Simulator Sensor Setup, the following images can be registered as master image.**
- **The running image history saved in the currently open IV4A file.**
- **The running image history or master image saved in an IV4A file different to the one currently open.**
- **Image capture file (*.iv4p)**



(1) Settings button

Displays the settings used in the Master Registration.
“Registering a Master Image from Image History” (page 4-15)
“Registering a Master Image from a File” (page 4-16)
“Extended Functions for the Master Image Registration” (page 4-17)

Registering the master image

Master Registration from a Running Image History

The image history saved in the batch backup or the individual program backup file (*.iv4a) is registered as a master image.

Point **To perform a master image registration from the image history in a sensor, the image to be registered as a master image in the running image history must be saved in advance.**
“Running Image History” (page 5-14)

For details about steps, refer to “Registering a Master Image from Image History” (page 4-15).

Master Registration Using the File Saved in the PC

Select a batch backup or an individual program backup file (*.iv4a) or an image capture file (*.iv4p) stored in the PC, and register it as the master image.

Point
- **Save the image to be registered as the master image into the PC in advance.**
- **The files which can be registered as a master image are batch backup, individual program backup files (*.iv4a), and image capture files (*.iv4p).**
“Folder Composition and File Naming Rules” (page 8-7)
- **Register images taken with a sensor with the same installation conditions and the same image-related settings (exposure conditions etc.). Otherwise correct judgment may not be possible.**

For details about steps, refer to “Registering a Master Image from a File” (page 4-16).

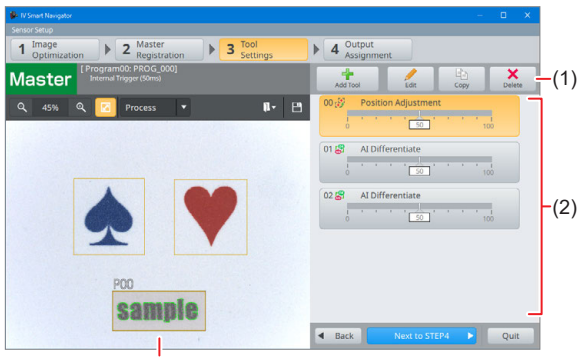
3: Tool Settings/Part Registration Settings

Tool Settings (Standard Mode)

Adds, edits, copies, or deletes the tool.
“3. Tool Settings (Standard Mode)” (page 4-20)

Point

In the Simulator, the following buttons will not be displayed.
- **[Live Adjustment] button for adjustment of the threshold of each tool**
- **The [LIVE image] button which displays the live image during tool setting.**



(1) Tool settings button

“Adding/Editing/Copying/Deleting a Tool” (page 4-21)

(2) Tool list

Select the tool to confirm/edit/delete the setting conditions of the detection windows.

(3) Master image

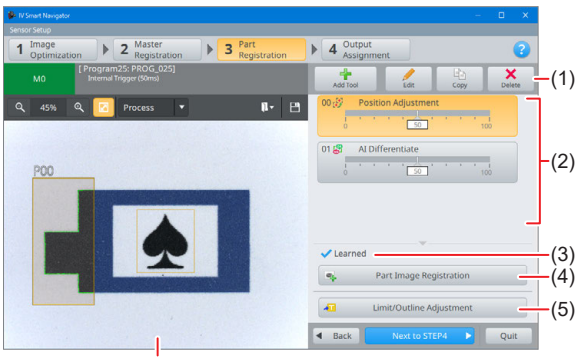
Displays the master image and tool window.
If a search range is set, a window which indicates the range (light blue) will be displayed.

Part Registration (Sorting Mode)

Adds, edits, copies, or deletes the tool.
In addition, registers an image to judge the part type to perform learning.
“3. Part Registration (Sorting Mode)” (page 4-76)

Point

In the Simulator Sensor Setup, the following buttons will not be displayed.
- **[Live Adjustment] button for [Limit Adjustment] of the position adjustment window**



(1) Tool settings button

“Adding/Editing/Copying/Deleting a Tool” (page 4-21)

(2) Tool list

Select the tool to confirm/edit/delete the setting conditions of the detection windows.

(3) Condition Display

Displays the condition of the learning settings.

Displayed	State
AI Differentiate Not Set	The tool window for the AI Differentiate is not set.
Not learned	The learning for the target to judge the part type has not been completed.
Learned	The target to judge the part type has been learned.
Relearning required	Relearning is needed because of a setting change.

(4) [Part Image Registration] button

“Tool Settings/Part Image Registration” (page 4-77)

(5) [Limit/Outline Adjustment] button

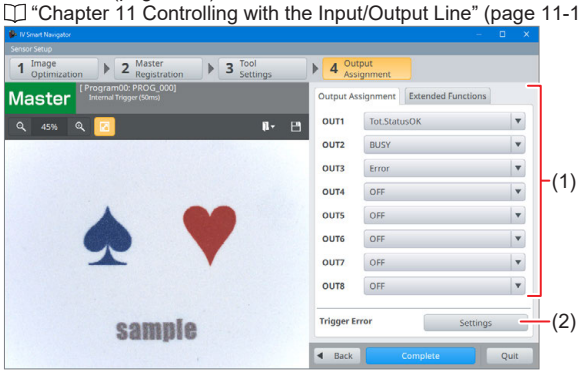
This button adjusts the threshold for detection tools with the exception of the position adjustment and Hi-Sp.Adj tools and adjusts the outline for the outline tool.
“Limit/Outline Adjustment” (page 4-80)

(6) Master image

Displays the master image and tool window.
If a search range is set, a window which indicates the range (light blue) will be displayed.

4. Output Assignment

Sets the output items to be assigned to the output line.
“Cables” (page 2-21)
“Chapter 11 Controlling with the Input/Output Line” (page 11-1)



(1) Output Assignment button

❍ [Output Assignment] tab

Assigns the output item to each output line.
“Setting the Output Assignment” (page 4-88)

❍ [Extended Functions] tab (Standard Mode)

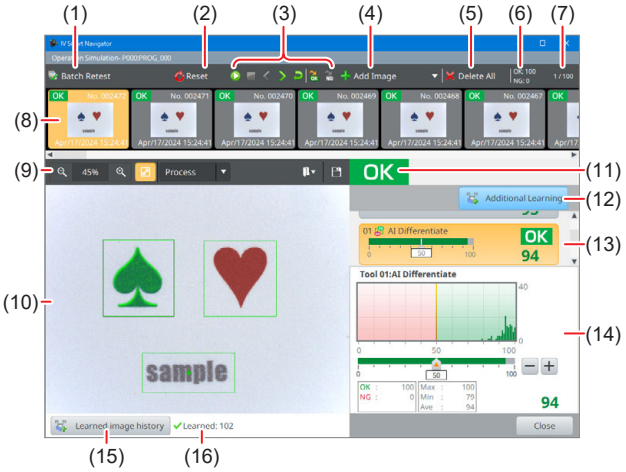
Configures the total status conditions and logic settings.
“Total Status Conditions” (page 4-90)
“Logic Settings” (page 4-91)

(2) [Enable]/[Disable] setting for the trigger error output

Selects whether to enable/disable the output when a trigger error occurs.
“Error Messages” (page A-9)

Operation Simulation

Main Screen of the Operation Simulation



(1) [Batch Retest] button

Performs batch operation simulation for all images.

(2) [Reset] button

Resets the result of batch operation simulation for every image. The status result will be [--].

(3) Operating button for operation simulation

(Play)	Start operation simulation one by one in order from the selected history image.
(Stop)	Stop the operation simulation being reproduced.
(Back)	Shift the history image selection one position to the left.
(Next)	Shift the history image selection one position to the right.
(Repeat)	When this button is ON, the operation simulation is repeated from the first history image after the operation simulation for the last history image ends. Repeat can be switched ON/OFF during reproduction.
(Next OK Image)	Transition to the next OK image after the selected history image.
(Next NG Image)	Transition to the next NG image after the selected history image.

Point

When (Next OK Image) / (Next NG Image) is executed after the settings for a threshold have been changed, the judgment result may be changed depending on the simulation result.

(4) [Add Image] button

Add an image to be used for the operation simulation from a batch backup or individual program backup file (*.iv4a), or an image file (*.iv4p).

Point

- **The image is added to the left (latest position) of the thumbnail image. You cannot add it at a user-defined position.**
- **When the number of images reaches 100, the oldest image will be the next image to be deleted.**

(5) [Delete All] button

Deletes all registered image.

(6) Number of OKs/NGs

Displays the number of images for which the judgment result from the operation simulation is OK or NG.

(7) Image number

Display the image No. of the images in the Simulator as "(Currently selected image No.)/(Total number of images)".

(8) Thumbnail image (image history)

The image used as the target for operation simulation.
Displays the number of triggers, the status result of the operation simulation, and the thumbnail image.

Reference

- For details about the number of triggers, refer to "Statistical/Tool Information Display" (page 5-7).
- In the initial status, the newest image is at the left edge. The history becomes older from left to right.

The selected image is displayed with an orange background. Operation Simulation is performed automatically for the selected image and the judgment result is displayed.

(9) Image tool bar

"Operation of the Image Tool Bar" (page 3-14)

(10) Magnified display screen

Magnifies the selected thumbnail image.

(11) Status result

Displays the judgment result for operation simulation for the selected thumbnail image.

(12) [Additional Learning] button (Learn tools only)

"Additional Learning from the Running Image History" (page 6-6)

(13) Status gauge

"Statistical/Tool Information Display" (page 5-7)
For details of the status result, refer to "Displaying and outputting the status result" (page A-4).

(14) Tool information

"Statistical/Tool Information Display" (page 5-7)

(15) [Learned Image History] button (Learn tools only)

"Displaying the [Learned Image History] screen" (page 6-7)

(16) Number of learned images (Learn tools only)

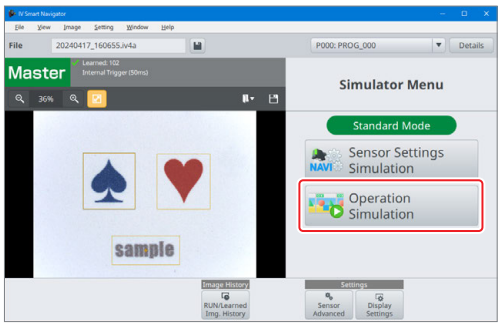
Displays the number of learned images and number of not reflected images.

Starting the operation simulation

1 Display the main screen for the Simulator.

“Starting the Simulator” (page 10-3)

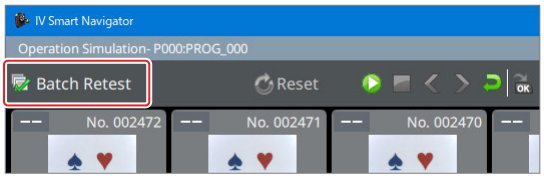
2 Press [Operation Simulation].



The message dialog opens.

3 Press [OK].

4 Perform the Operation Simulation by pressing [Batch Retest].



Point

Please perform “Batch Retest” when the setting for “Color Extraction”/”Brightness Extraction” or the setting of the threshold has been changed. If this is not done, pay attention to the following items.

- **The frequency distribution of the histogram is not displayed correctly (when the setting has been changed, the matching rate may change after retesting).**
- **The “Number of OKs/NGs” and the “Judgment record” are not updated.**

5 After the Operation Simulation is completed, press [Close] at the lower right on the screen.

The system returns to the main screen for the Simulator.

Reference

The test results will not be saved. If checking the test results again, perform Operation Simulation (Batch Retest) with the same settings and the same image history.

Operating from the Menu Bar

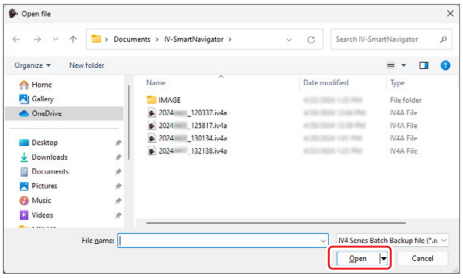
[File] Menu

Open file

Open the batch backup or the individual program backup file (*.iv4a) saved on the PC.

1 Select [File] → [Open file].

2 Select a file and press [Open].



Point **Files with the formats other than the iv4a format cannot be used.**

Save

Save the contents set in the Simulator to a PC as a batch backup or an individual program backup file (*.iv4a).

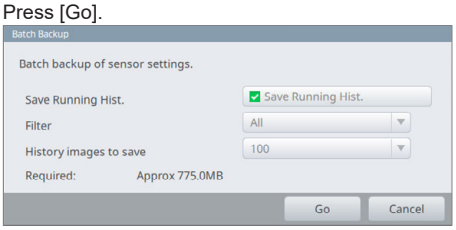
1 Select [File] → [Save].

2 Press [Batch Backup] or [Individ. Program Backup].

3 Perform the backup.

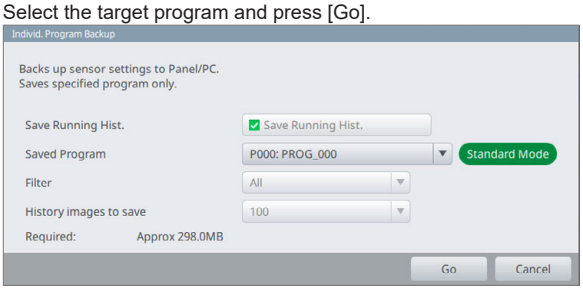
- **In the case of the batch backup**

Press [Go].



- **In the case of the individual program backup**

Select the target program and press [Go].



4 Specify the file save destination and file name, and press [Save].

5 Press [OK].

Export

- **Save Program Settings List**

Outputs the sensor information held in the IV2-Simulator as tab-delimited text.

“Save Program Settings List” (page 7-31)

Terminate Simulator

Terminates the Simulator and returns to the Activation Menu screen.

Exiting IV Smart Navigator

Exit IV Smart Navigator.

1 Select [File]→[Exit].

When the program setting or image history has been changed, the confirmation dialog to save opens.

2 Press [Yes].

The changed contents are saved in the batch backup or individual program backup file (*.iv4a), and the IV Smart Navigator exits.

[View] Menu

Operation Simulation Startup Message

Switches whether to show/hide the message when pressing [Operation Simulation].

[Image] Menu

Zoom

Reduces, enlarges, or window fits the image displayed on the Simulator.
The image can be reduced to a minimum size of 25% or enlarged to a maximum size of 500%.

Display Tools

Switches the display method for the tools.
“Selecting the Display Method of the Tool Window” (page 5-6)

Capture

Save Image

Saves the bmp format file of the image displayed in the Simulator and the iv4p format file which can be used for a master image registration or additional learning at the same time.
A screen capture of the IV Smart Navigator screen will also be saved at the same time.

Show Saved Image File Location

Opens the save destination folder for the captured image.

Change Saved Image File Location

Opens the reference screen for the folder and changes the save destination for the captured image.

[Setting] Menu

Language

Switches the display language of IV Smart Navigator.

Reference The displayed language can be switched on the Activation Menu screen of the IV Smart Navigator.

[Window] Menu

Program Details

Display the [Program Details] screen.
“Displaying the [Program Details] screen” (page 7-7)

Running Image History

Display the [Run/Learned Img. History] screen.
“Running Image History” (page 5-14)
“Displaying the [Learned Image History] screen” (page 6-7)

Reference The following buttons and menus will not be displayed in the [Running Image History] screen on the Simulator.
- [Refresh] button
- [Recomm image to learn] button
- [Batch Backup (*.iv4a)] menu

Sensor Advanced Settings

Displays the [Adv. Settings] screen.
“Sensor Advanced Settings” (page 7-10)

Reference In the [Adv. Settings] screen on the simulator, items that cannot be displayed and set are grayed out.

Display Settings

Displays the [Display Settings] screen.
“Display Settings” (page 7-30)

[Help] Menu

About

Displays the version information of IV Smart Navigator.

MEMO

11

Controlling with the Input/Output Line

This chapter explains how the input / output terminal controls each operation.

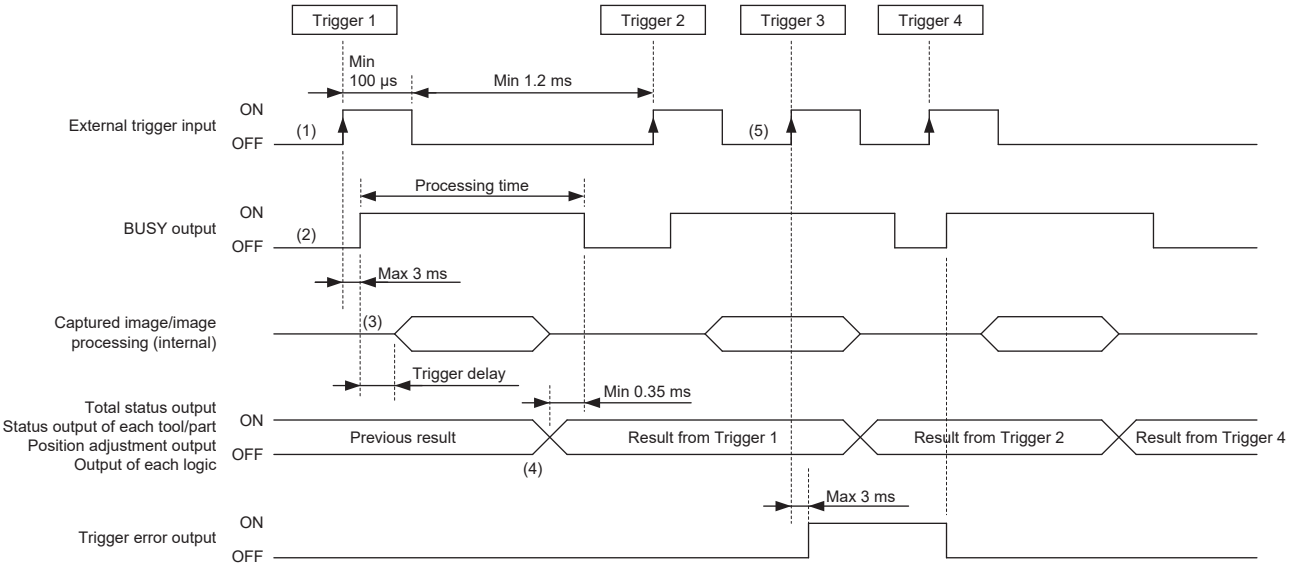
Controlling Timing of Judgment with Triggers 11-2
Importing the Status Output (When Program Auto-Switching is "Disable") 11-6
Importing the Status Output (When Program Auto-Switching is "Enable") 11-8
Changing Over 11-10
Registering the Master Image 11-11
Clearing Errors 11-12
Behavior When the Sensor Power is Turned On or Off 11-14
AI Trigger 11-16
AI Through Count Mode 11-18
Excessive Trigger Input Time Error 11-20
Input Response Time 11-21

Controlling Timing of Judgment with Triggers

For details about triggers, refer to “Setting Trigger Options” (page 4-8).

External Trigger

When the [Trigger Options] is set to [External], imaging and judgment are performed when inputting the external trigger.
To import the acceptance timing of the external trigger and status output, use the BUSY output.



(1) Position the target and input external trigger. Minimum input time where input is ON is 100 µs and OFF is 1.2 ms.

(2) BUSY output turns ON. Processing time differs depending on the settings.

(3) After the trigger delay time (Page 4-8) elapses, the target is imaged and the judgment process is performed.

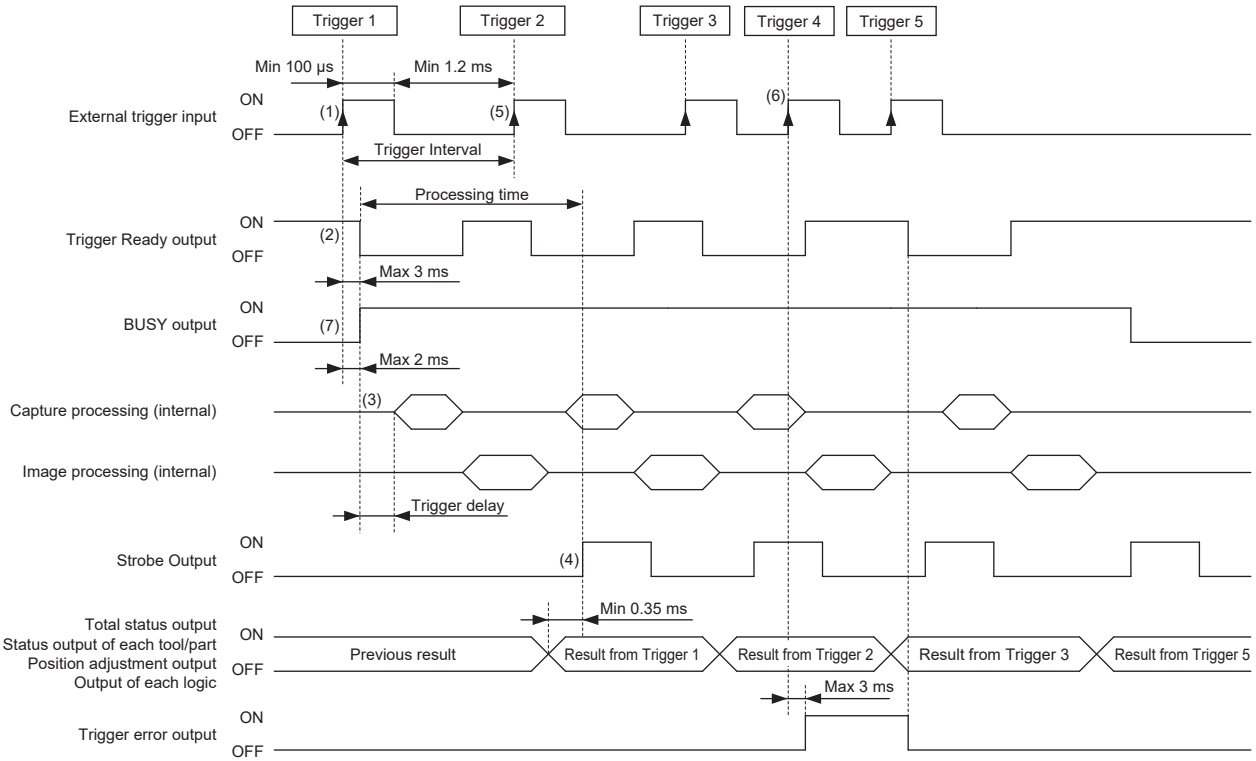
(4) After the judgment process is completed, the status output updates and the BUSY output is turned OFF.
If “BUSY Output” (page 7-15) is set to [Until Data Transfer is Complete], BUSY output is turned OFF after data is transferred to the SD card/ FTP/SFTP server. Confirm that the BUSY output is turned OFF, then import the status output.

(5) If the external trigger is input while BUSY is being output, the input is ignored and a trigger error occurs. Trigger 3 is not judged.
To output the trigger error, set trigger error in the Output Assignment (Page 4-88) under Sensor Setup to [Enable].

- Use external trigger input and BUSY output to control the timing.
- The ON status of each output is as follows.
  When “Output Settings” (page 7-15) are [N.O.]: Status with output ON.
  When “Output Settings” (page 7-15) are [N.C.]: Status with output OFF.
- The ON status of each input indicates the input line is shorted when the Polarity (Page 7-16) is NPN, and indicates that voltage is applied within the input line when the Polarity is PNP.
- The edge used for activating or deactivating timing can be set in the external trigger input settings.
  “Input Settings” (page 7-13)
- The trigger error output turns OFF when the next trigger is activated, when the error is cleared, when the program is switched, or when the system moves to the settings screen.
- When the output mode of status output (Page 7-15) is set to [Latching]. For [One-Shot], refer to “Changing the timing of status outputs” (page 11-7).

Controlling timing using ready output

This is a control method that performs imaging synchronized with ready output and captures the judgment output synchronized with the strobe output.
Select [ON (2-image Buffer)] for “Preliminary Capture” (page 4-13).
The external trigger can be input after the image capture process is complete, shortening the detection tact time. However, the number of required control lines will increase.



(1) Position the target and input external trigger. Minimum input time where input is ON is 100 µs and OFF is 1.2 ms.

(2) The ready output function turns OFF. Processing time differs depending on the settings.

(3) After the trigger delay time (Page 4-8) elapses, the target is imaged and the judgment process is performed.

(4) After the judgment process is completed, the status output updates and the strobe output is turned ON. Synchronize it with strobe output and then import the status output.
The strobe output one-shot time (Page 7-15) can be changed.

(5) After imaging processing completes, the ready output function turns ON. When ready output is turned on, an external trigger can be input.

(6) If an external trigger is input when ready output is turned off, the input is ignored and a trigger error occurs. Trigger 4 is not judged.
To output the trigger error, set trigger error in the Output Assignment (Page 4-88) under Sensor Setup to [Enable].

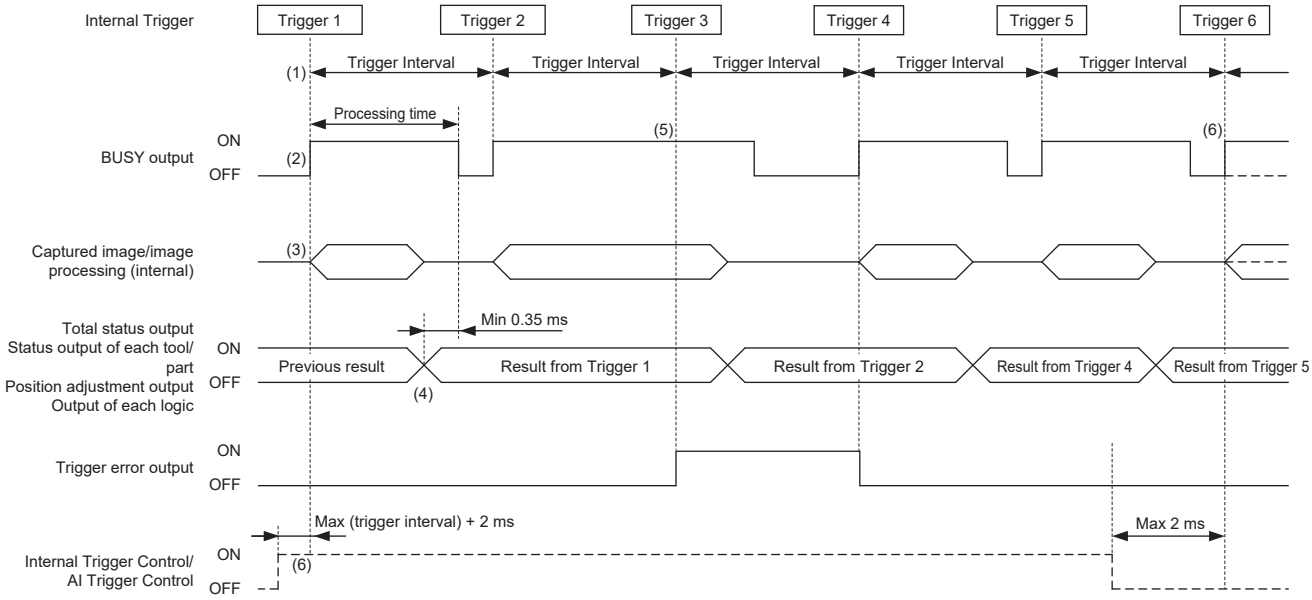
(7) BUSY output turns on during internal processing. If the trigger interval is shorter than the processing time, it is always on and cannot be used for importing status output.

- Use external trigger input, ready output, and strobe output to control the timing.
- The ON status of each output is as follows.
  When “Output Settings” (page 7-15) are set to [N.O.]: Status with NPN or PNP open collector output turned on.
  When “Output Settings” (page 7-15) are set to [N.C.]: Status with NPN or PNP open collector output turned off.
- The ON status of each input indicates the input line is shorted when the Polarity (Page 7-16) is NPN, and indicates that voltage is applied within the input line when the Polarity is PNP.
- The edge used for activating or deactivating timing can be set in the external trigger input settings.
  “Input Settings” (page 7-13)
- The trigger error output turns OFF when the next trigger is activated, when the error is cleared, when the program is switched, or when the system moves to the settings screen.
- The one-shot time for strobe output should be 1/2 of the imaging interval displayed on the run screen (50% duty ratio at the shortest cycle). If the one-shot time is long, strobe output may not be captured correctly due to overlap. To output a strobe output error, set [Strobe Error Output] to [Enable]. Strobe error output turns off when the next strobe output does not overlap, when the error is cleared, when the program is switched, or when the system moves to the settings screen.
- When the output mode of status output (Page 7-15) is set to [Latching]. For [One-Shot], refer to “Changing the timing of status outputs” (page 11-7).

Internal Trigger

When [Trigger Options] is set to [Internal], imaging and judgment are performed at the timing of the set trigger interval.
To import the status output, use the BUSY output.

Controlling timing using BUSY output



(1) Inputs an internal trigger at the set trigger interval.

(2) BUSY output turns ON when the internal trigger occurs. Processing time differs depending on the settings.

(3) The target is imaged and judged. No trigger delay settings.

(4) After the judgment process is completed, the status output updates and the BUSY output is turned OFF.
If “BUSY Output” (page 7-15) is set to [Until Data Transfer is Complete], BUSY output is turned OFF after data is transferred to the SD card/ FTP/SFTP server. Confirm that the BUSY output is turned OFF, then import the status output.

(5) If the internal trigger is input while BUSY is being output, the input is ignored and a trigger error occurs. Trigger 3 is not judged.
To output the trigger error, set trigger error in the Output Assignment (Page 4-88) under Sensor Setup to [Enable].

(6) If [Internal Trigger Control/AI Trigger Control] is set to [Enable] (dotted line), the internal trigger stops when IN1 input is OFF.
BUSY output does not turn ON for Trigger 6 (dotted line). Additionally, judgment processing is not performed (dotted line). If it is set to [Disable], the internal trigger is always on.

- The ON status of each output is as follows.
  When “Output Settings” (page 7-15) are [N.O.]: Status with output ON.
  When “Output Settings” (page 7-15) are [N.C.]: Status with output OFF.
- The trigger error output turns OFF when the next trigger is activated, when the error is cleared, when the program is switched, or when the system moves to the settings screen.
- When the output mode of status output (Page 7-15) is set to [Latching]. For [One-Shot], refer to “Changing the timing of status outputs” (page 11-7).
- When [Internal Trigger Control/AI Trigger Control] is set to [Enable], the minimum input ON time is 1 ms and the minimum input OFF time is 1.2 ms.
  The actual interval from IN1 input to an internal trigger output is within “set trigger interval + +2ms”.

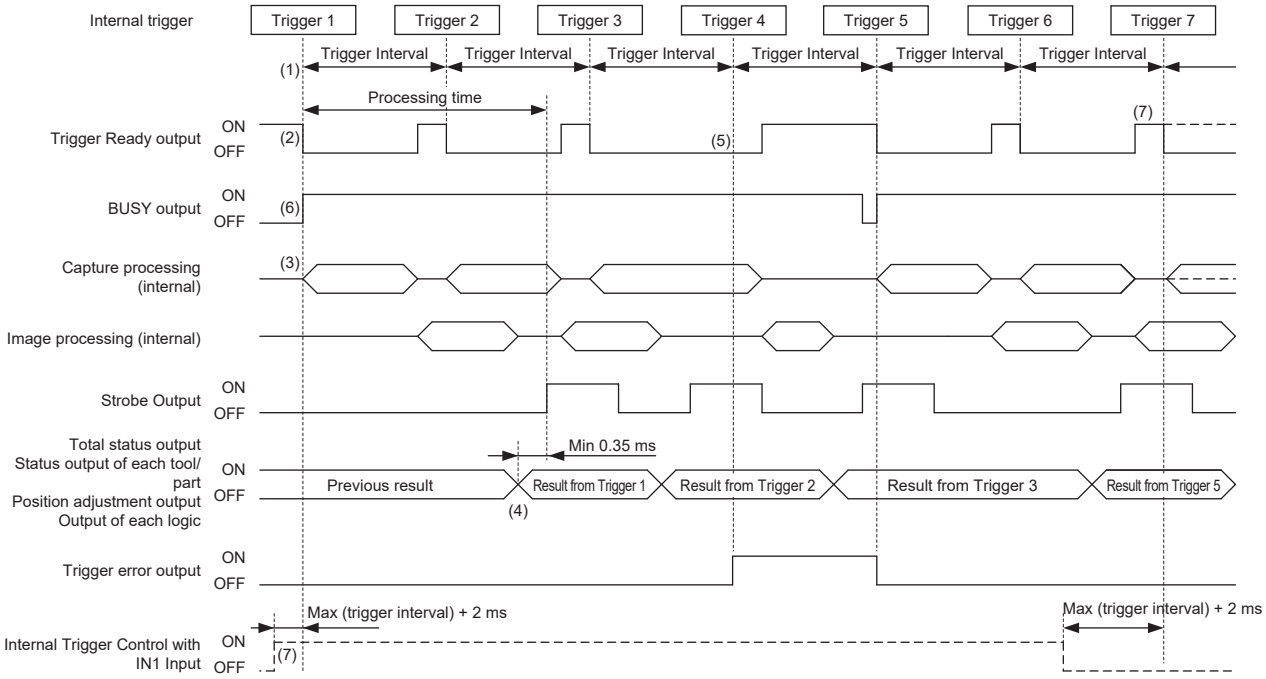
Point **Set the trigger interval longer than the processing time. If the trigger interval is shorter than the processing time, the internal trigger will be input during the processing time, so the trigger error will occur.**

Operating in the shortest cycle

To input the internal trigger in the shortest cycle and perform the judgment process, set the trigger interval to 1 ms.
Set the trigger error in the Output Assignment (Page 4-88) in Sensor Setup to [OFF] and disregard the trigger error.

Controlling timing using ready output

Since the internal trigger is issued after imaging processing is complete, the detection tact time can be shorter than with the method using a busy output.
Status output is imported synchronously with the strobe output.
Select [ON (2-image Buffer)] for “Preliminary Capture” (page 4-13).



(1) Inputs an internal trigger at the set trigger interval.

(2) Ready output turns OFF when the internal trigger occurs. Processing time differs depending on the settings.

(3) The target is imaged and judged. No trigger delay settings.

(4) After the judgment process is completed, the status output updates and the strobe output is turned ON. Synchronize it with strobe output and then import the status output.
The strobe output one-shot time (Page 7-15) can be changed.

(5) If the internal trigger is input when ready output is turned off, the input is ignored and a trigger error occurs. Trigger 4 is not judged.
To output the trigger error, set trigger error in the Output Assignment (Page 4-88) under Sensor Setup to [Enable].

(6) BUSY output turns on during internal processing. If the trigger interval is shorter than the processing time, it is always on and cannot be used for importing status output.

(7) If [Internal Trigger Control/AI Trigger Control] is set to [Enable] (dotted line), the internal trigger stops when IN1 input is OFF.
Ready output does not turn OFF for Trigger 7 (dotted line). Additionally, judgment processing is not performed (dotted line). If it is set to [Disable], the internal trigger is always on.

- The ON status of each output is as follows.
  When “Output Settings” (page 7-15) are set to [N.O.]: Status with NPN or PNP open collector output turned on.
  When “Output Settings” (page 7-15) are set to [N.C.]: Status with NPN or PNP open collector output turned off.
- The trigger error output turns OFF when the next trigger is activated, when the error is cleared, when the program is switched, or when the system moves to the settings screen.
- The one-shot time for strobe output should be 1/2 of the imaging interval displayed on the run screen (50% duty ratio at the shortest cycle). If the one-shot time is long, strobe output may not be captured correctly due to overlap. To output a strobe output error, set [Strobe Error Output] to [Enable]. Strobe error output turns off when the next strobe output does not overlap, when the error is cleared, when the program is switched, or when the system moves to the settings screen.
- When the output mode of status output (Page 7-15) is set to [Latching]. For [One-Shot], refer to “Changing the timing of status outputs” (page 11-7).

Point **Set the trigger interval to a value longer than the capture time displayed on the run screen. If the trigger interval is shorter than the capture time, the internal trigger will be input during the processing time, so the trigger error will occur.**

Operating in the shortest cycle

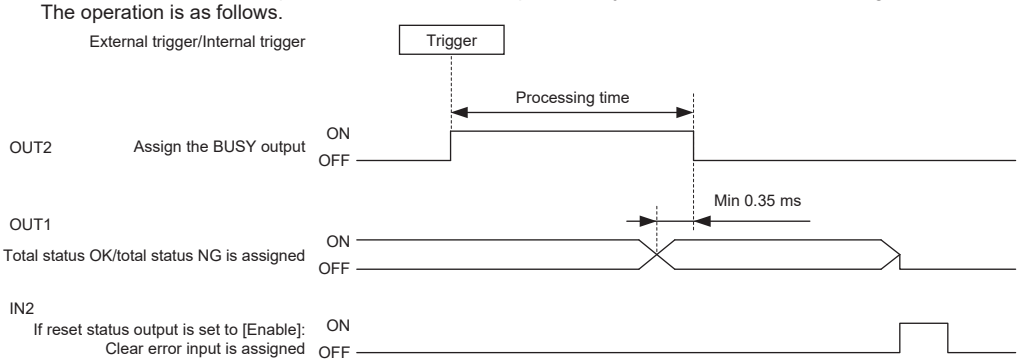
To input the internal trigger in the shortest cycle and perform the judgment process, set the trigger interval to 1 ms.
Set the trigger error in the Output Assignment (Page 4-88) in Sensor Setup to [OFF] and disregard the trigger error.

Importing the Status Output
(When Program Auto-Switching is "Disable")

Imports the status output assigned to output lines of the I/O terminal block and power I/O cable. For details about assigning to output lines, refer to 📖"4. Output Assignment" (page 4-88).
To use program auto-switching, refer to 📖 "Importing the Status Output (When Program Auto-Switching is "Enable")" (page 11-8).

Importing the total status OK/total status NG output (standard mode only)

Total status results of multiple detection tools and the position adjustment for the examined target can be checked.
The operation is as follows.



- This is an example operation when the output mode of status output (Page 7-15) is set to [Latching]. For [One-Shot], refer to 📖 "Changing the timing of status outputs" (page 11-7).
- The total status output turns ON when the total status results were OK. The total status NG output turns ON when the total status results were NG.

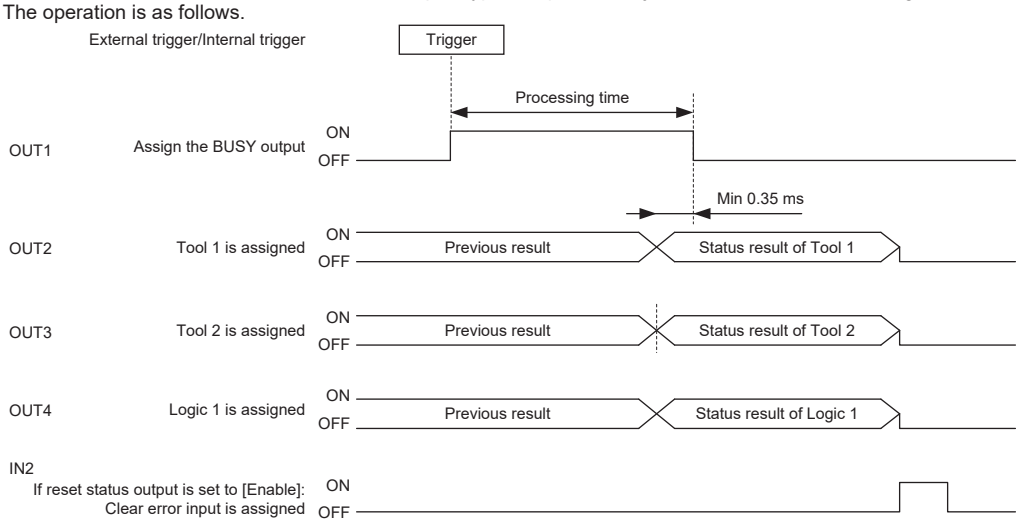
Reference

The total status conditions can be selected from [All Tools OK], [Any Tool OK] and [Logic 1] to [Logic 8].
- **[All Tools OK]**
  When all of the status results of the detection tools and the adjustment result of the position adjustment result were OK, the total status result is OK.
- **[Any Tool OK]**
  When any of the status results of the detection tools except that of the position adjustment was OK, the total status result is OK.
- **Logic**
  When the logical operation result of the set detection tools was OK, the total status result is OK.

- The status result will be kept until the next status result output. However, the output function turns OFF when the program number is switched or an external master image is registered.
- The ON status of each output is as follows.
  When "Output Settings" (page 7-15) are [N.O.]: Status with output ON.
  When "Output Settings" (page 7-15) are [N.C.]: Status with output OFF.
- When [Reset Status Output on Clear Error Execution] is set to [Yes], the status output can be reset with the clear error input.

Importing the individual status output of each detection tool/part type/logic

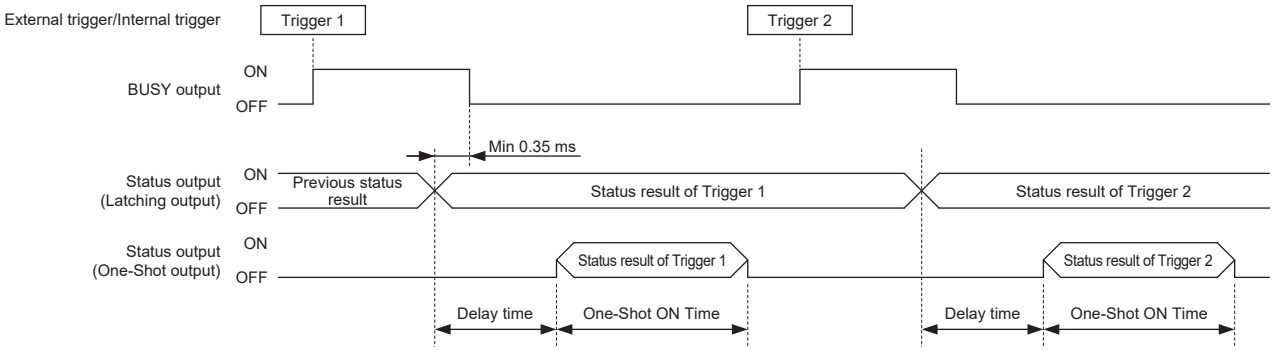
The individual status result of the detection tool/part type and position adjustment for the examined target can be checked.
The operation is as follows.



- This is an example operation when the output mode of status output (Page 7-15) is set to [Latching]. For [One-Shot], refer to 📖 "Changing the timing of status outputs" (page 11-7).
- This is an example when the status results of Tool 1, Tool 2, and Logic 1 are to be checked individually in standard mode.
- In Sorting Mode, Part0 to Part7 will be assigned. The logic cannot be set.
- The status output turns ON when the status result of each tool/logic, or part was OK. Turns OFF when the result was NG or --.
- The ON status of each output is as follows.
  When "Output Settings" (page 7-15) are [N.O.]: Status with output ON.
  When "Output Settings" (page 7-15) are [N.C.]: Status with output OFF.
- The status result will be kept until the next status result output. However, the output function turns OFF when the program number is switched or an external master image is registered.
- When [Reset Status Output on Clear Error Execution] is set to [Yes], the status output can be reset with the clear error input.

Changing the timing of status outputs

The timing of status outputs can be selected from [Latching] which links to judgment and [One-Shot] which outputs for a certain time. For details of how to configure the settings, refer to “Output Settings” (page 7-15).



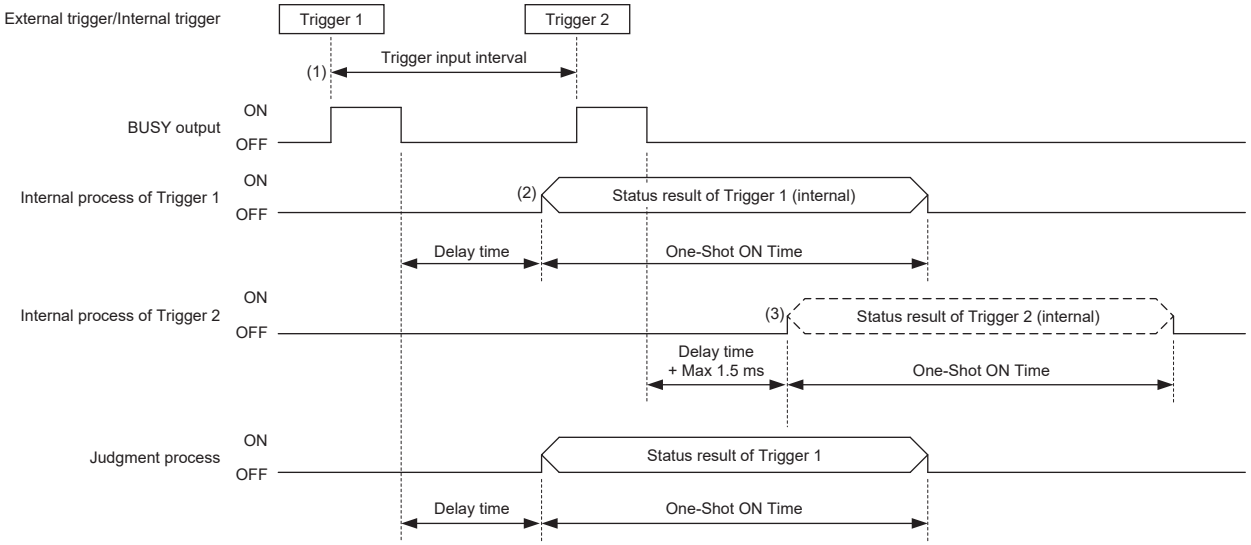
- In case of [Latching], updates the output by linking with judgment.
- In case of [One-Shot], outputs for a set amount of time after the set delay time is passed.
- When the program number is switched or the external master image is registered, the status output turns OFF.

Canceling One-Shot output

To use the One-Shot output function, the following condition needs to be met.

Trigger input interval (trigger interval) > Maximum value of processing time > One-Shot ON Time

If the above condition is not met, the One-Shot output that follows the current One-Shot output is canceled and will not be output.



(1) This is an example of what happens when the trigger input interval is shorter than the One-Shot ON Time.

(2) Since the previous One-Shot output has been completed, the status result of Trigger 1 can be output as a One-Shot normally.

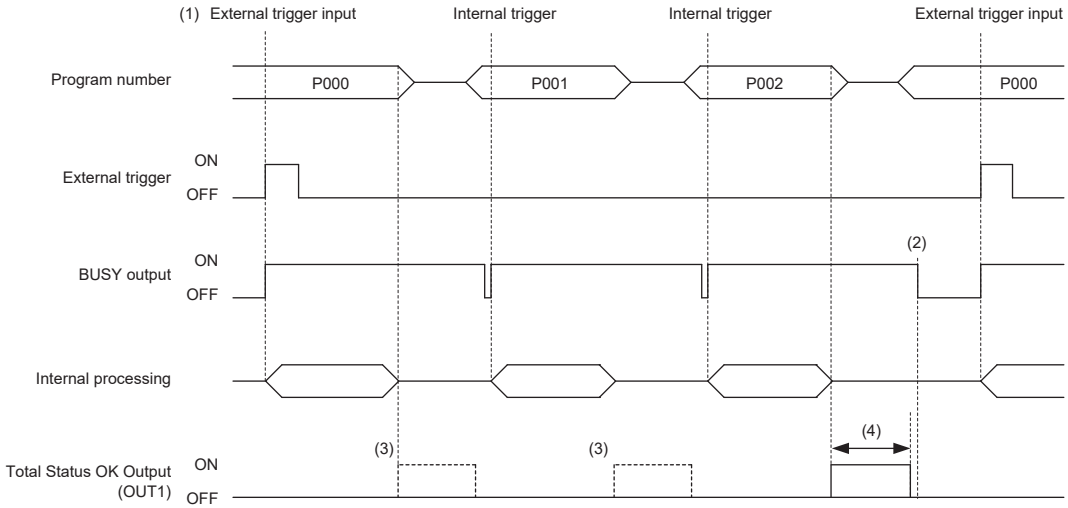
(3) When the status result of trigger 2 is output as a One-Shot, the One-Shot output of trigger 1 is being output. Therefore, the status output of trigger 2 is discarded and not output.

Importing the Status Output
(When Program Auto-Switching is "Enable")

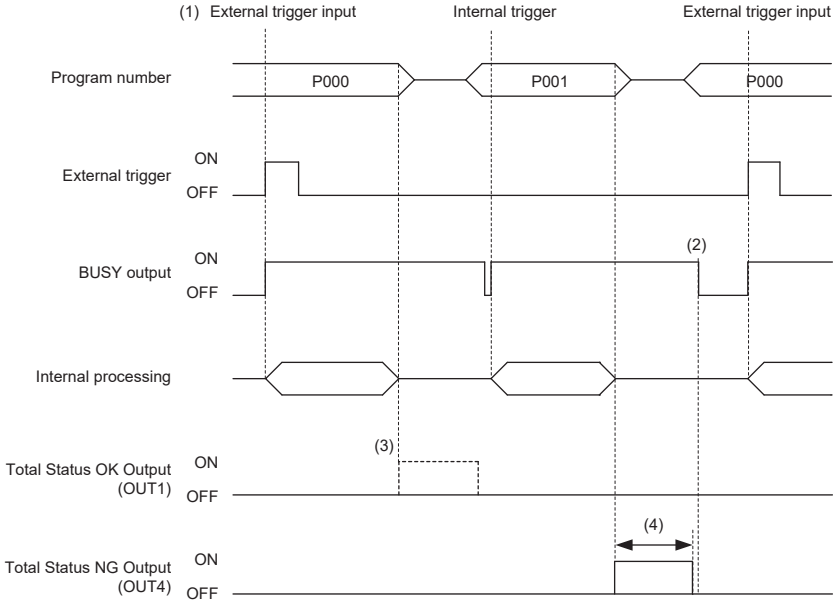
Program auto-switching is a function to change automatically to a pre-set program number according to the status result.
If multiple programs are used to perform a single examination, examinations can be performed continuously without controlling the program switching with a PLC etc. For details, refer to “Program Auto-Switching” (page 7-20).

The operation in the setup example of “Program Auto-Switching” (page 7-20) is as follows.

When all judgments are OK



When the judgment in the program 001 is NG



(1) When the start point program is set as an external trigger and the other programs as internal triggers, the programs other than the start point program will be processed for judgment. Thereafter, the programs will be automatically switched to each switching destination according to the judgment.

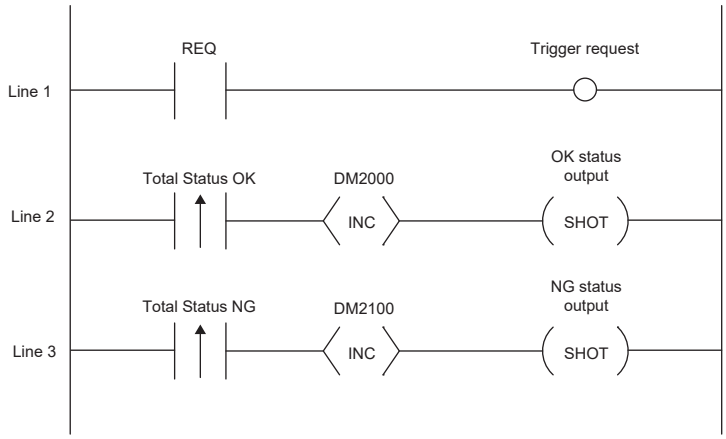
(2) The status output turns off before the BUSY output turns off. To acquire the total status result, obtain the rising of the total status OK and NG outputs.

(3) The external output of status results is set by "Output Assignment" for each program. At this point, select "OFF" for OUT1 of P000 and P001. For OUT1 of P002, select "Total Status OK". For OUT4 of P000 to P002, select "Total Status NG".

(4) Status output time = Program switching time + Delay time
The time from the determination of judgment to the execution of the program auto-switching can be changed by the delay settings.
If extending the status output ON time and checking the status result on the screen or others, set the required delay time.
“Program Auto-Switching” (page 7-20)

Reference ladder program

KEYENCE KV Series



❍ Line 1

Turn on REQ, and executes the trigger request.

❍ Line 2/Line 3

Acquire the status result at rising of the total status OK or total status NG. When program auto-switching is "Enable", the ON time of the total status output and total status NG output will be shorter. Therefore, ON time is adjusted using the one-shot circuit in the above reference ladder program. There is also a method to retain the output with a self-holding circuit. Create a ladder program according to the necessary controlling method.

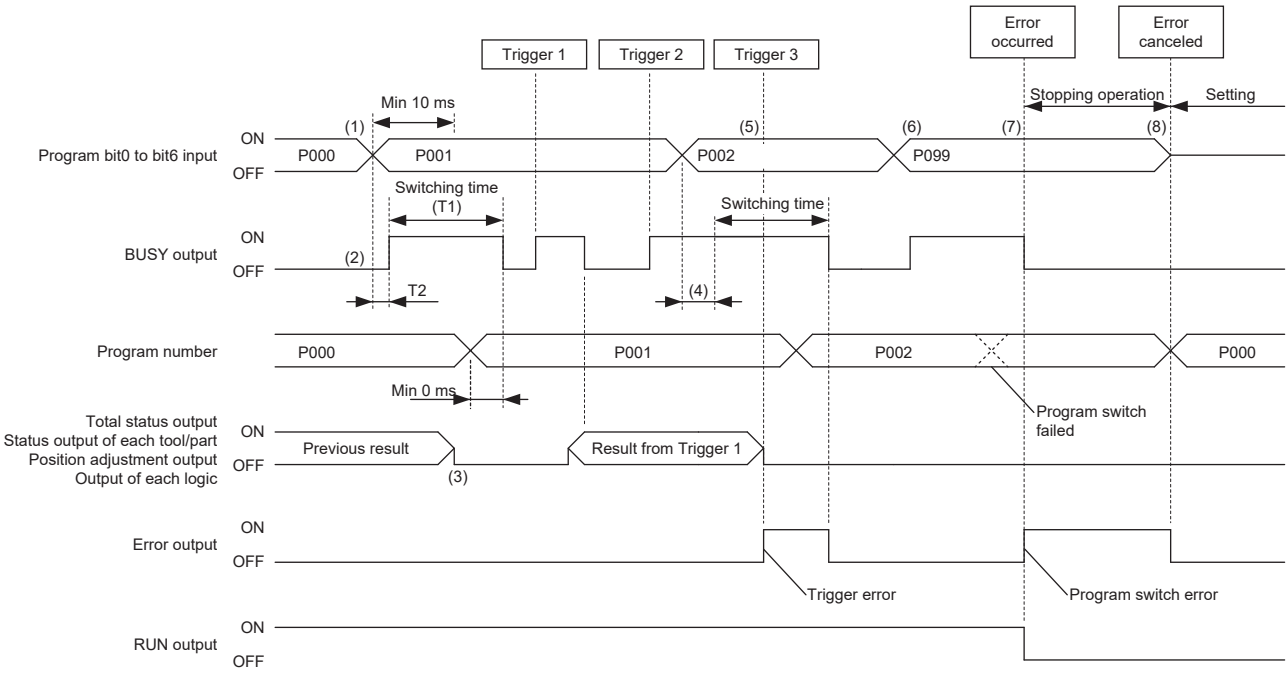
Additionally, the reference ladder above uses an increment instruction to count the number of OKs and NGs. Use it as needed.
In the reference ladder program above, the number of times OK and NG are recorded in DM2000 and DM2100.

Reference

- The reference ladder program assumes that the trigger option of the start point program is "External (Trigger)", and the trigger options of other programs are "Internal (Trigger)".
- The BUSY output cannot be used for importing the status output.

Changing Over

The program set in the sensor can easily by changed by referencing the previously-saved judgment condition (program) with the input lines. For details about program functions, refer to “Changeover for a Target (Program Functions)” (page 7-2).



(1) Switch the current program by inputting Program bit0 to bit6 and keeping the line active. Minimum input time is 10 ms.
“When Setting the [Program Switching Method] to [External Input].” (page 7-5)

(2) BUSY output turns ON while switching the programs. Switching time differs depending on the settings.

(3) The output status (Latching output and One-Shot output) turns OFF before the switching program is completed.

(4) If the program number is switched during a judgment process, the system cancels the judgment process (result of Trigger 2 is not output). The program switching process is delayed because the judgment must be canceled. Delay time depends on the settings.

(5) If a trigger occurs while switching programs (during the BUSY output), the trigger is ignored and a trigger error occurs. To output the trigger error set trigger error in the Output Assignment (Page 4-88) under Sensor Setup to [Enable]. In the case of a manual trigger, the trigger is processed after the program switching process has completed.

- For details about T1 and T2, refer to “Input Response Time” (page 11-21).
- Use this function during operation. Programs cannot be switched with the external input during setup.
- The trigger error output turns OFF when the next trigger is activated, when the error is cleared, when the program is switched, or when the system moves to the settings screen.
- If the switched program is set to [Internal], the time for inputting the trigger after switching the program fluctuates. A delay of one trigger interval may occur.
- Do not use with the external master registration input at the same time. The sequence for switching programs and the external master registration process will vary.
- The response of the image displayed on the IV Smart Navigator might be delayed until after switching programs (BUSY output OFF).

❍ Program switch error

If using the program expansion function for the SD card (Page 8-10), a program switch error occurs when the advanced program information cannot be read from the SD card.

(6) For example, bit0 to bit6 input changes and switches to P099 when the SD card is removed.

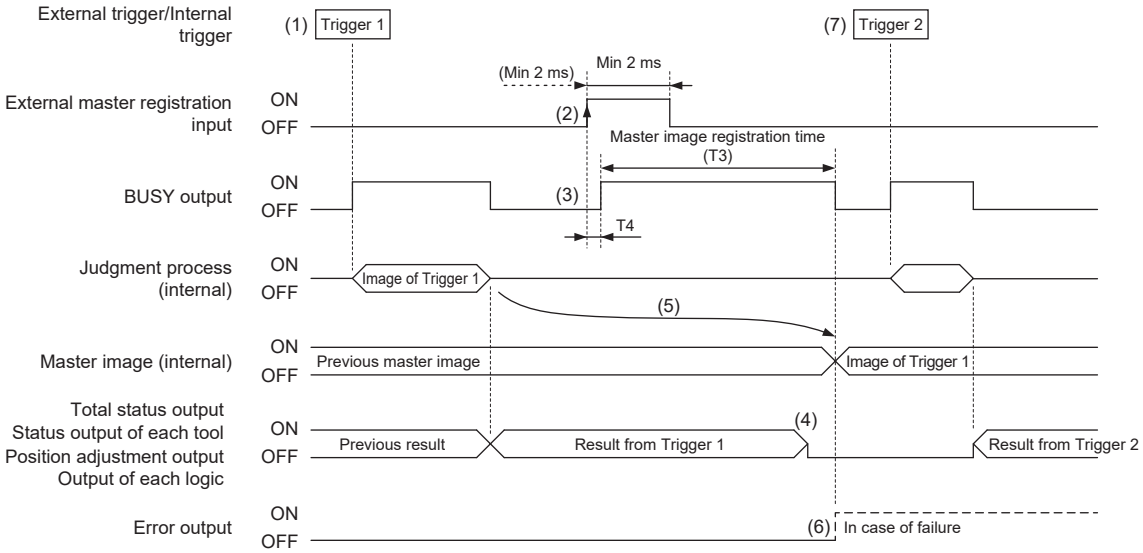
(7) A program switch error occurs. BUSY output turns OFF and error output turns ON. Run output turns OFF and operation stops. The previous program number will be retained but the device cannot run. Clear error input is disabled. The PWR/ERR indicator light on the sensor amplifier turns ON (red). The sensor head operation indicator light blinks (red).

(8) Connecting the control panel or IV Smart Navigator (IV-H1SN) and clearing the error messages cancels the errors and the device changes to the settings screen. Error output turns off. The program number changes to “P000”.

Reference For details about how to clear the program switch error, refer to “How to clear a program switching error” (page 7-4).

Registering the Master Image

The external master registration function can register the master image with using the input line.
For details, refer to “2. Master Image Registration” (page 4-14).



(1) Captures an image to be registered as a master image by the external trigger or internal trigger.

(2) If the BUSY output is turned off, the external master registration input will be input. Minimum ON/OFF input time is 2 ms.

(3) The BUSY output turns on and master registration starts. The master registration time depends on the settings.

(4) The status output (Latching output and One-Shot output) turns off before master image registration is completed.

(5) The image imaged in Trigger 1 will be registered as a master image.

(6) If the external master image registration fails, the error output turns on. Check that the external master image registration succeeds with the error output.
In case of failure, the image will not be updated from the previous master image.
The error output turns OFF when the external master image registration succeeds or by the clear error input.

(7) After master image registration is completed, the judgment process is performed with the new master image. Trigger 2 judges the target using the image of Trigger 1 as a master image.

- For details about T3 and T4, refer to “Input Response Time” (page 11-21).
- Use this function during operation. External master image registration cannot be performed during setup.
- If a trigger occurs while registering the master image (during BUSY output), the trigger is ignored and a trigger error occurs. The trigger error output turns OFF when the next trigger is activated, when the program is switched, or when the error is cleared. To output the trigger error set trigger error in the Output Assignment (Page 4-88) under Sensor Setup to [Enable].
- If the external master registration input is input during the imaging process (BUSY) by the trigger, the system cancels the judgment process (taken image will not be registered). After the process is canceled, the image taken before cancellation is registered as a master image. The master image registration process is delayed by the cancelling process. Delay time depends on the settings.
- Do not change over the programs at the same time that the external master registration input is being performed. The sequence of the external master registration and program switching process will vary.
- This function cannot be used when a learning-based tool (AI tool/AI Identify/AI Count/AI Trigger) is set or when it is in Sorting Mode or AI Through Count Mode.
- Registered as master image 0 when master image settings are set to [Enable]. Images cannot be registered as master images 1 to 7.

Saving a program (P000 to P031) on the internal sensor ROM

NOTICE

• If the external master image registration is to be performed frequently, set [Write to ROM when using Ext. Master Save] of the Input Settings to [Disable] to protect the nonvolatile memory of the internal sensor. For details of how to configure the settings, refer to “Input Settings” (page 7-13).

ROM writing settings	Master image is registered externally when power is turned OFF	Number of times that external master image registration can perform (duration)
Enable	The master image is not deleted. The image can be used as a master image after starting up the device next time.	100,000 times
Disable	The master image is deleted. External master image registration needs to be performed after starting up the device.	No limit

• If the setting for writing to ROM is set to [Disable], only the master images of active programs selected in the settings mode is written to ROM.
An image for external master registration will not be reflected to the backup file (iv4a) of the batch backup/individual program backup performed while running.
• If the setting is set to [Enable], do not turn OFF the power during the master registration time (T3). Otherwise, all or part of the setting data may be lost.

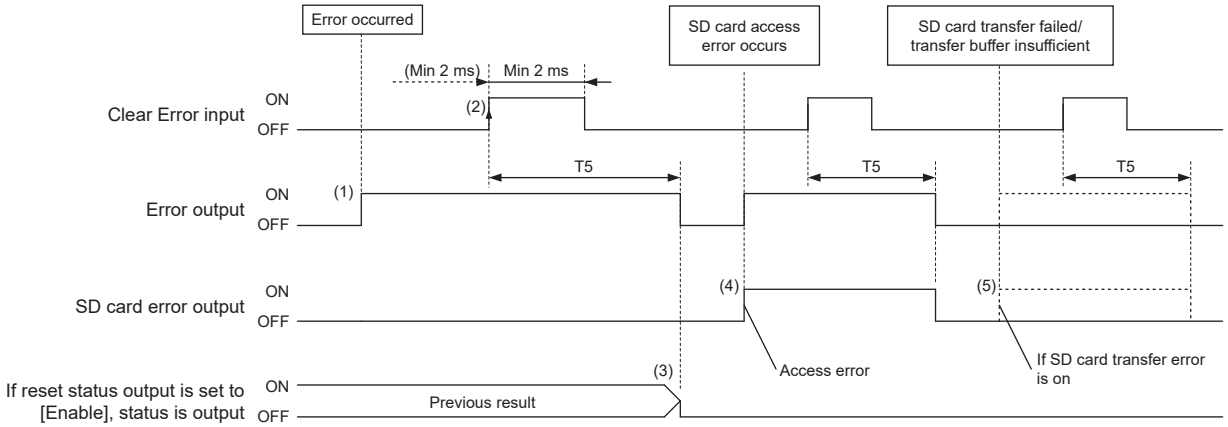
Saving a program (P032 to P127) on an SD card

NOTICE

The operation will be the same as the one when [Write to ROM when using Ext. Master Save] is set to [Disable] for the programs saved in the ROM in the sensor, regardless of the settings of [Write to ROM when using Ext. Master Save].

Clearing Errors

If an error occurs, the error that is output can be turned OFF using the clear error input.



(1) If an error occurred, the error output turns on.

(2) The error output can be turned off by the clear error input. Minimum ON/OFF input time is 2 ms.

(3) When [Reset Status Output on Clear Error Execution] is set to [Yes], the status output is reset.

(4) SD card access errors can be output to error output and SD card error output.

(5) If [SD card transfer error] for the SD card data transfer function is set to [Enable], errors can be output to error output and SD card error output.

• For details about T5, refer to “Input Response Time” (page 11-21).

Error types that can be output

Error type	Error output ON/OFF	Clear Error input	Reference
System error	Enable	Cannot be cleared	“Error Messages” (page A-9)
Startup memory readout error			
Running program switch error	Enable	Cannot be cleared	“Changeover for a Target (Program Functions)” (page 7-2) “Changing Over” (page 11-10) “SD Card Programs” (page 8-10)
Program switch error at startup	Disable	-	
External master registration error	Enable	Can be cleared	“Registering the Master Image” (page 11-11)
SD card access error			
Trigger error	OFF (default)/ ON	Can be cleared	“4. Output Assignment” (page 4-88) “Controlling Timing of Judgment with Triggers” (page 11-2)
FTP error			“FTP Error” (page 9-4)
SD card transfer error			“SD card transfer error” (page 8-12)

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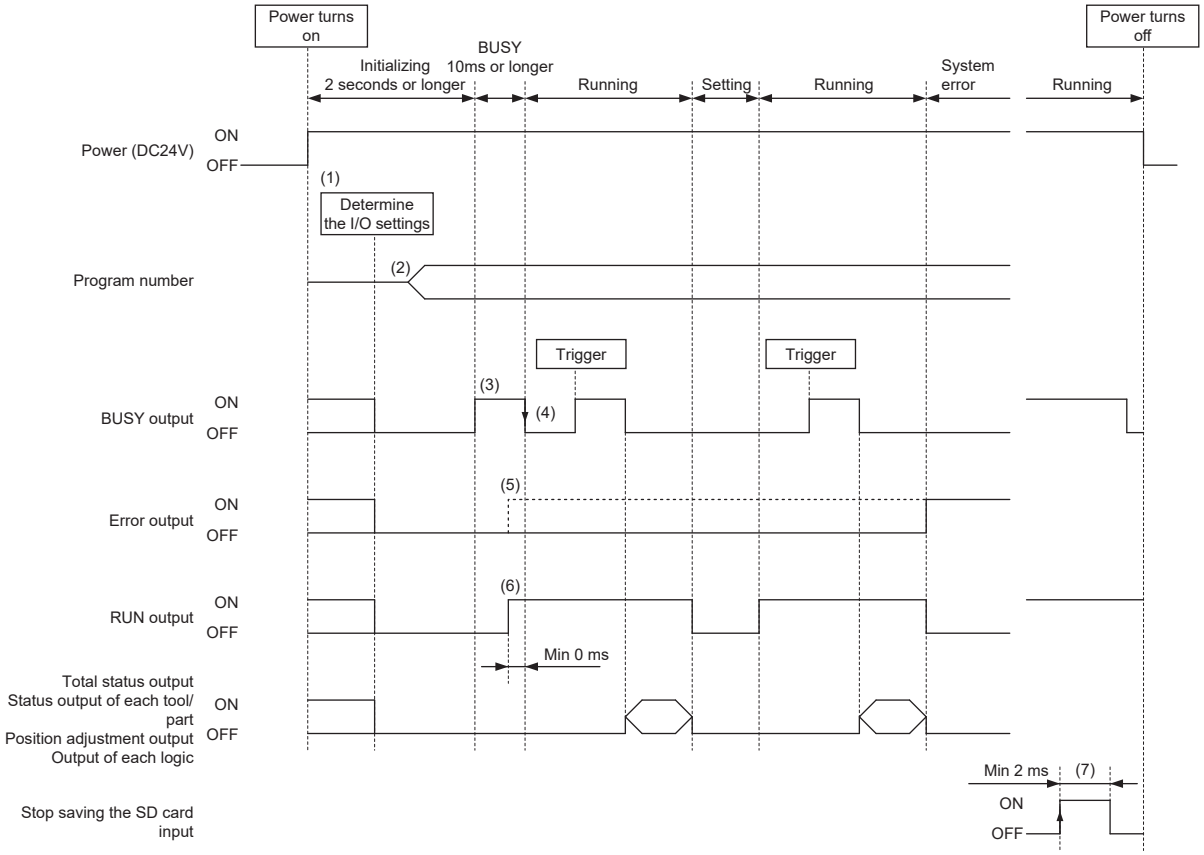
Behavior When the Sensor Power is Turned On or Off

The device behavior when the power is turned on or off is as follows. Check activation of the BUSY output when starting operation.



(1) After the power is turned on, the I/O Settings (NPN or PNP and N.O. or N.C.) will be determined.
“Operation for Initial Startup of the Sensor” (page 3-8)
“Polarity” (page 7-16)
“Output Settings” (page 7-15)

(2) The program number will be determined. If [Program Switching Method] (Page 7-13) is set to [External Input], the program number is determined according to the condition of the input lines.

(3) BUSY output turns ON.
- In case of N.O. output, the output turns from OFF to ON.
- In case of N.C. output, the output turns from OFF to OFF, so no changes occur.

(4) The BUSY output turns off and the system starts to operate.
- In case of N.O. output, the output turns from ON to OFF.
- In case of N.C. output, the output turns from OFF to ON.

By checking the activation of the BUSY output, operation in N.O./N.C. can be checked.

(5) If the startup error has occurred, the error output turns on during the BUSY status.

(6) The RUN output turns on when the sensor is running with no system error occurring.

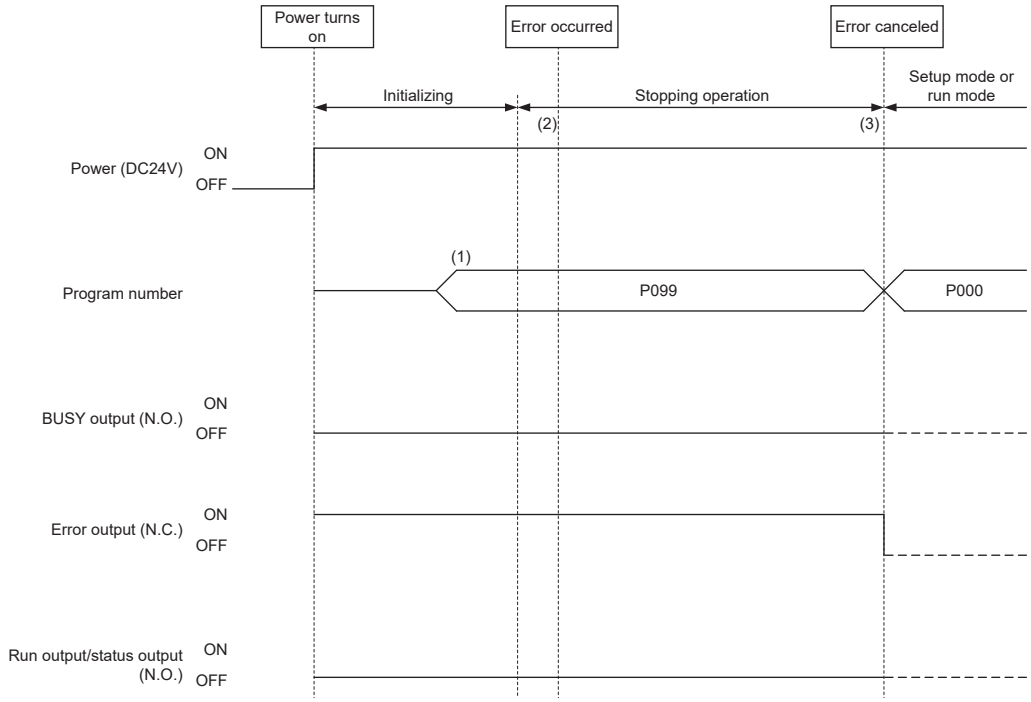
(7) To turn the power off when using data transfer to SD card.
- Set [BUSY Output Settings] to [Until Data Transfer is Complete].
- In the case of an external trigger, check that BUSY output from input of [Stop saving the SD card] has turned off and then turn the power off.
- In the case of an internal trigger, after input from [Stop saving the SD card], wait five seconds and then turn the power off.
- Once the current image has been transferred, stop transfer to the SD card. Images in the transfer buffer will be lost.
- [Stop saving the SD card] is only enabled when the device is running.

NOTICE	**Do not turn off the system power while the SD card is being accessed. Otherwise, all or part of the setting data may be lost or the memory may be damaged.**

- The ON status of each output is as follows.
  When “Output Settings” (page 7-15) are [N.O.]: Status with output ON.
  When “Output Settings” (page 7-15) are [N.C.]: Status with output OFF.
- The RUN output, BUSY output and error output will be output from the output line assigned in output assignment (Page 4-88) for program numbers determined after the power is turned on. If the outputs are not being assigned, it will not be output.

Program switch error when the power is turned on

Behavior in the case that a program switch error occurs when the power is turned on is as follows.



If using the program expansion function for the SD card (Page 8-10), a program switch error occurs when the advanced program information cannot be read from the SD card.

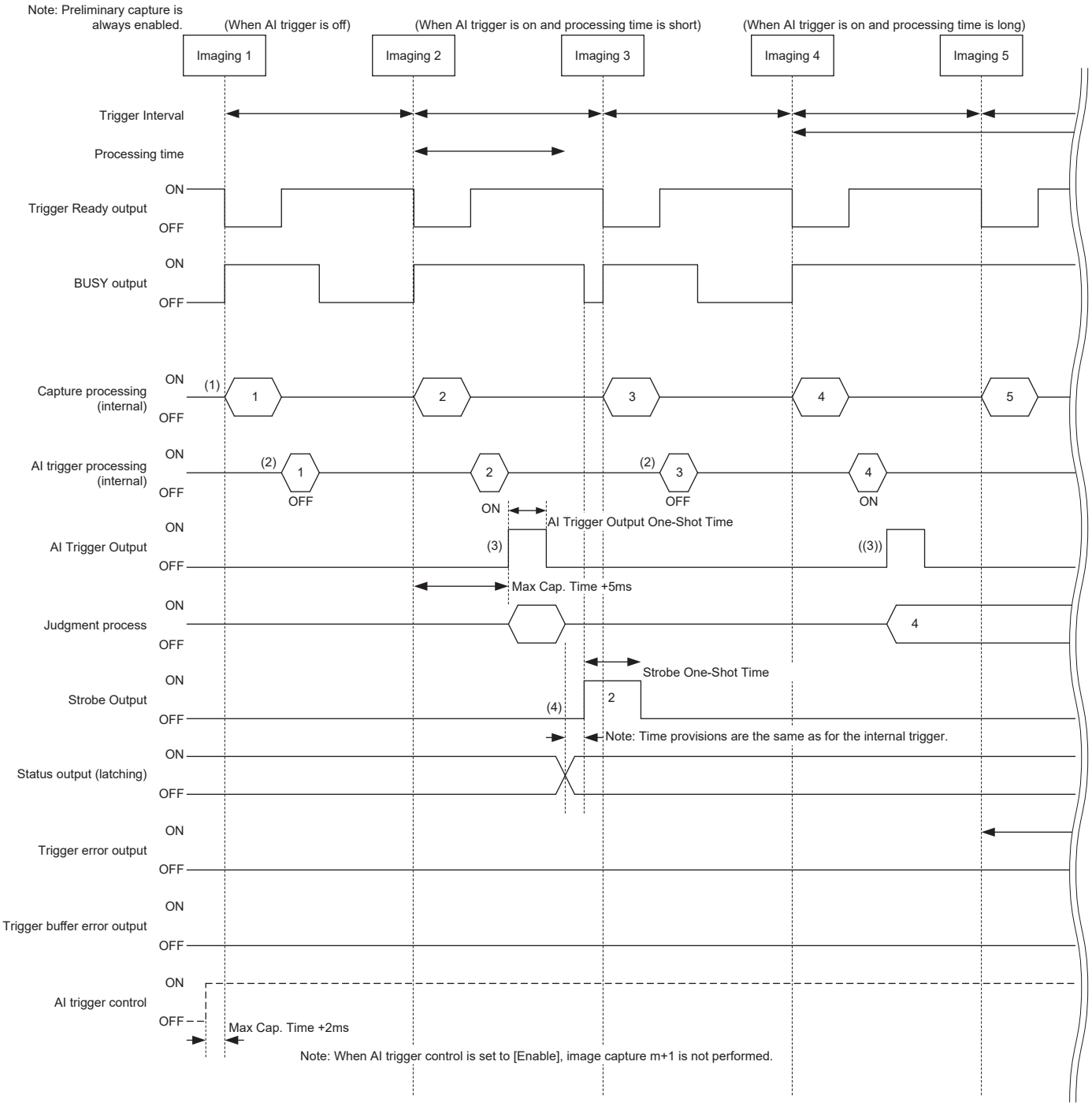
(1) For example, the power is turned on when the SD card is removed and P099 is selected.

(2) A program switch error occurs. The output (OUT1 to OUT8) does not operate and is OFF regardless of [NO] and [NC].

(3) You can connect the control panel or IV Smart Navigator (IV-H1SN) and clear the error message and error output.
If [Program Switching Method] is set to [External Input], the system will move to the settings screen. P000 is selected as the program number.
For [Panel/PC/Network/Auto-Switching], you can select to continue operating the device with P000 or change the system to the settings screen when you clear the error message.

- For details about how to clear the program switch error, refer to “How to clear a program switching error” (page 7-4).
- The ON status of each output is as follows.
  When “Output Settings” (page 7-15) are [N.O.]: Status with output ON.
  When “Output Settings” (page 7-15) are [N.C.]: Status with output OFF.

AI Trigger



(1) AI trigger captures images at fix intervals based on the set image optimization.

(2) AI trigger processing is performed for each image capture to detect trigger ON/OFF.
If the result of AI trigger processing is trigger OFF, the judgment processing by the detection tool is not performed.

(3) If the previous trigger is off and the AI trigger process is trigger ON, the AI trigger is output and judgment processing is performed.

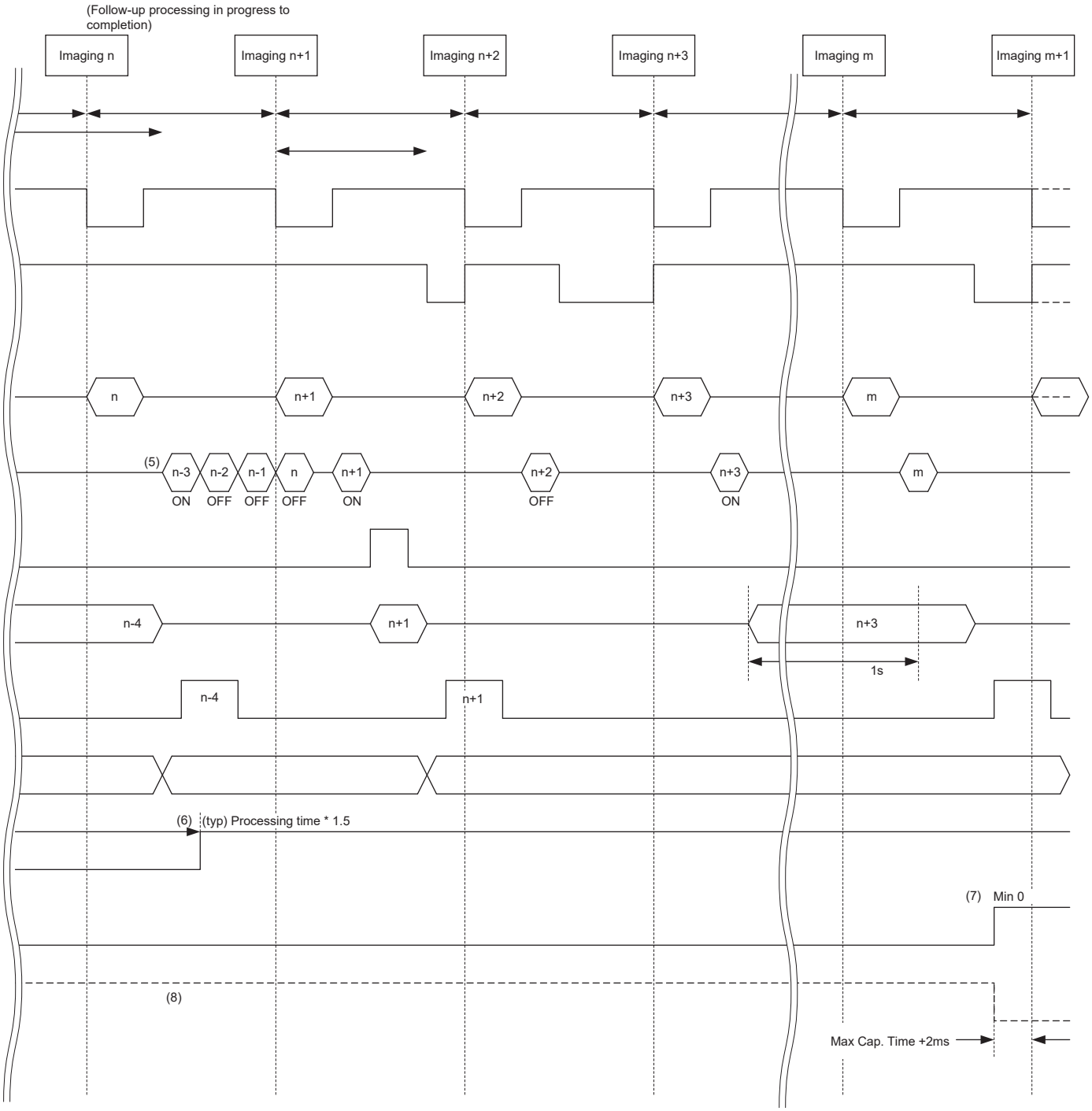
(4) After the judgment process is completed, the status output updates and the strobe output is turned ON. Confirm that the strobe output is turned on, and then import the status output.

(5) Images captured during the judgment process are processed by the AI trigger after the judgment process is completed (follow-up processing).

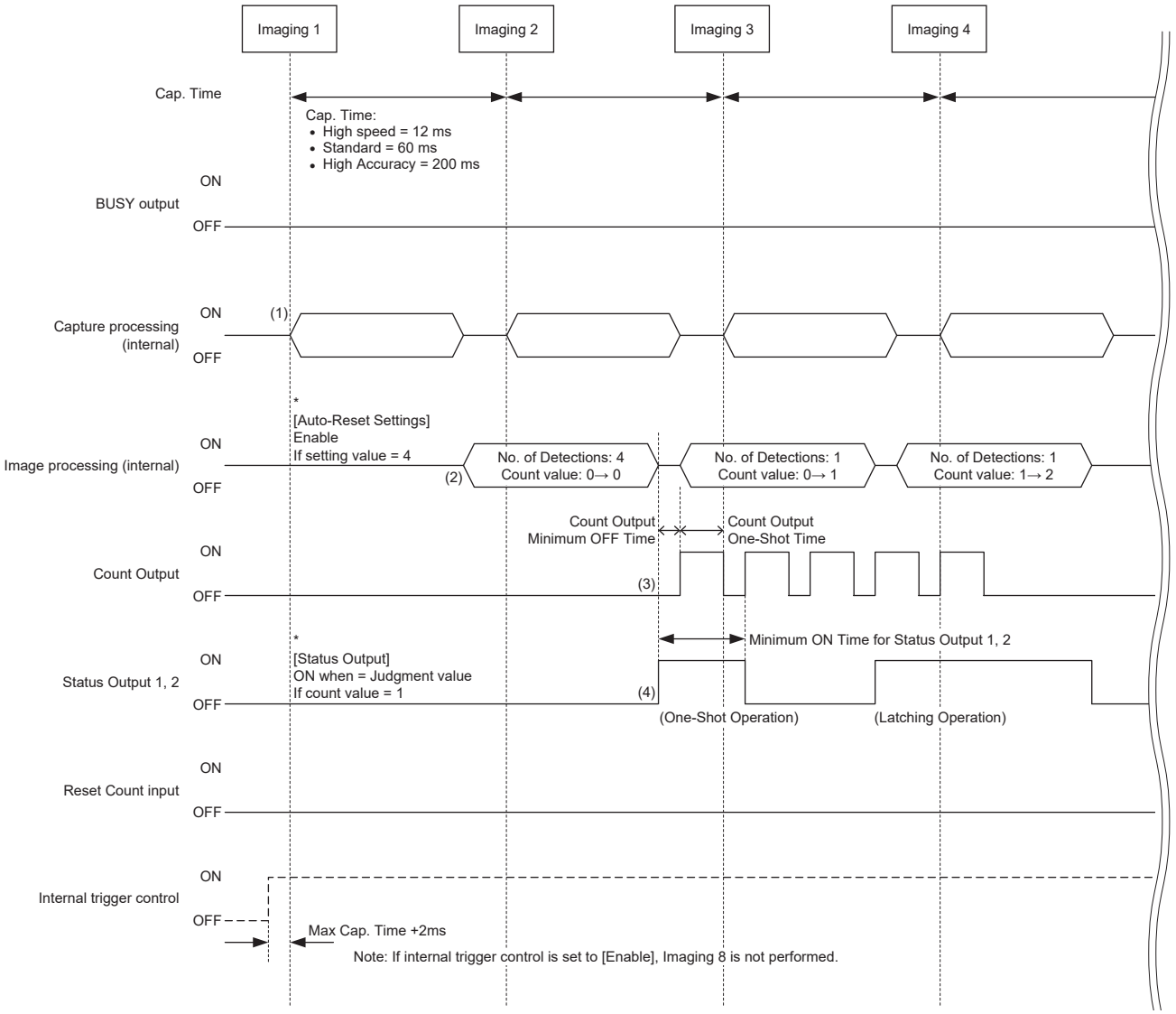
(6) If a trigger on is detected in the follow-up process, AI trigger output and judgment processing for the target image are not performed, and an AI trigger error occurs.
An AI trigger error will not be cleared even if the next normal AI trigger is established. Execute the clear error input.

(7) If the judgment process exceeds 1 s, the trigger buffer error output turns on. If trigger buffer error output is turned on, no trigger error will occur even if there is a trigger on in the follow-up process.

(8) If [Internal Trigger Control/AI Trigger Control] is set to [Enable] (dotted line), capture processing stops when IN1 input is off.
If it is set to [Disable], capture processing is always performed.


(Follow-up processing in progress to completion)
Imaging n
Imaging n+1
Imaging n+2
Imaging n+3
Imaging m
Imaging m+1
n
n+1
n+2
n+3
m
(5)
n-3
n-2
n-1
n
n+1
n+2
n+3
m
ON
OFF
OFF
OFF
ON
OFF
ON
n-4
n+1
n+3
1s
n-4
n+1
(6) (typ) Processing time * 1.5
(7) Min 0
(8)
Max Cap. Time +2ms

AI Through Count Mode



(1) Images are captured at a fixed interval based on the set operation mode.

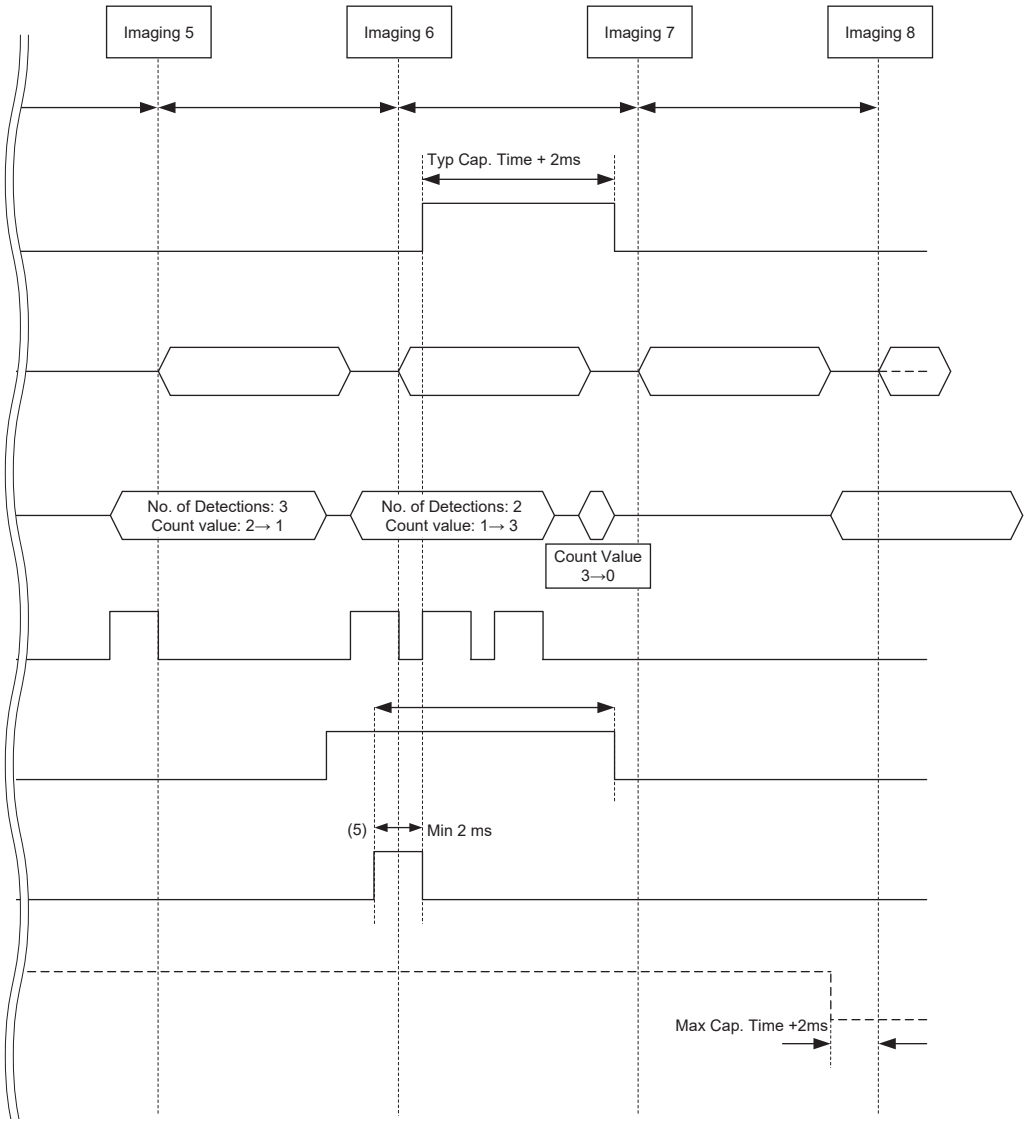
(2) The number of items passing through the line is counted each time the image is captured.

(3) One-shot output is performed for the counted items. One-shot ON time is specified by count-up output one-shot time and OFF time is specified by count-up output minimum OFF time.

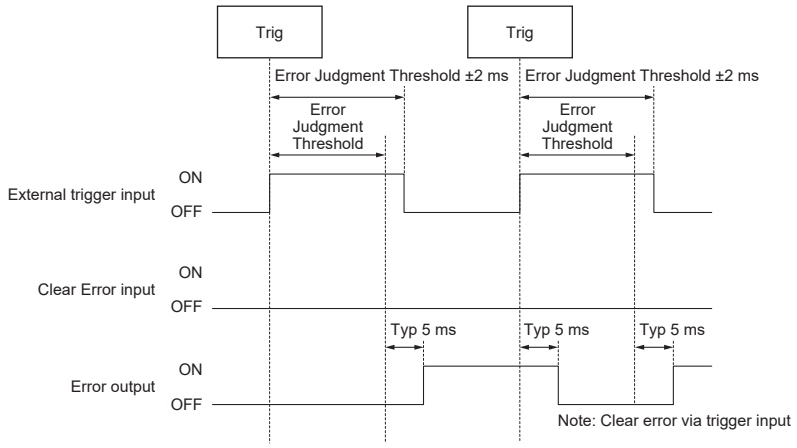
(4) One-shot output operation/latching output operation is performed when the set judgment output conditions are met.
For one-shot output and latching output operation, refer to the status conditions (Page 4-83) in AI Through Count Mode.

(5) Turning on the count reset input clears the remaining count of the count-up output and stops the output. The busy output turning off confirms that the count reset has completed.

(6) If [Internal Trigger Control/AI Trigger Control] is set to [Enable] (dotted line), the internal trigger stops when IN1 input is OFF. Imaging 8 is not performed. If it is set to [Disable], the internal trigger is always on.


Imaging 5
Imaging 6
Imaging 7
Imaging 8
Typ Cap. Time + 2ms
No. of Detections: 3
Count value: 2→ 1
No. of Detections: 2
Count value: 1→ 3
Count Value
3→0
(5)
Min 2 ms
Max Cap. Time +2ms

Excessive Trigger Input Time Error



(1) If the external trigger input exceeds the set time ±2 ms, an excessive trigger input time error is output.

• Use the clear error input after the trigger input turns off. Clear input during trigger ON may result in incorrect clear processing.

Input Response Time

Point **The following response times are the typical examples (typ.). The response times may differ depending on the settings or the image processing condition. Control by confirming "BUSY output" to prevent impact from different response times.**

Response time for the switch program input

- **When not using high-speed program switching**
  T1 (Switch program time) = A + B + C + E [ms] (typ.)
  T2 = 10 [ms] (typ.)
- **When using high-speed program switching**
  T1 (Switch program time) = A + C + 100 [ms] (typ.)
  T2 = 10 [ms] (typ.)

Response time for the external master registration input

T3 (Master registration time) = A + B + D + 400 [ms] (typ.)
T4 = 5 [ms] (typ.)

Response time for the error clear input

T5 = 5 [ms] (typ.)

Description for symbols

Symbols	Description	Time
A	Judgment process canceling time	**Standard mode / Sorting mode** Processing time (Max) + Trigger delay time **AI Through Count Mode** Processing time (Max) + Trigger delay time + 30 [ms] Added when a program switching input or external master registration input is input during the judgment process. The "Trigger delay time" is added only when [External Trigger] (Page 4-8) is selected for the trigger type.
B	Tool registration time	**Standard Mode/AI Through Count Mode** Tool registration time = Total of the "Registration time per tool x Number of set tools" **Sorting Mode** Tool registration time = (Learn tool registration time x Number of set tools) + ((Total of registration time for tools other than the learn tool x Number of set tools) x Number of registered part types) Registration time per tool • Learning*1 : 20 [ms] (typ.) • AI Identify : 1 [ms] (typ.) • AI Count : 1 [ms] (typ.) • AI Through Count : 1 [ms] (typ.) • Total : 1 [ms] (typ.) • AI OCR : 50 [ms] (typ.) • Line Detection : 1 [ms] (typ.) • Outline/Position Adjustment (High Speed) : 300 [ms] (typ.) • Position Adjustment (High Accuracy) : 350 [ms] • Color Area/Area/Color Prohibition/Brightness Prohibition : 35 [ms] (typ.) • Color Average/Brightness Average : 35 [ms] (typ.) • Blob count : 40 [ms] (typ.) • Diameter : 45 [ms] (typ.) • EdgePixels : 20 [ms] (typ.) • Width/Edge/Pitch/Hi-Sp.Adj (1 axis) : 1 [ms] (typ.) • Hi-Sp.Adj (2 axes) : 15 [ms] *1: Includes sorting mode.
C	Auto focus position adjustment time	240 [ms] (typ.) Added only when auto focus-type sensor is used and the "Auto Focus Adj Pos" (page 7-23) is set to [Individual].
D	Nonvolatile memory storage time	5000 [ms] (typ.)*2 3000 [ms] (typ.) • "Write to ROM when using Ext. Master Save" (page 7-14) is set to [Yes]. • A program (P000 to P031) saved on the internal sensor ROM is in use. *2: When multiple masters are used: 5000 + 500 x (Number of registered master images - 1) [ms] (typ.).
E	Program reading time	500 [ms] + master image (part) * 30 [ms] (typ.)

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12

Specifications

This chapter explains the specifications and dimensions of the sensor and software.

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Dimensions.....12-10

Specifications

Built-in amplifier model sensor

Model		IV4-400CA	IV4-400MA	IV4-500CA	IV4-500MA	IV4-600CA	IV4-600MA
Type		Narrow view type		Standard type		Wide view type	
Installed distance[*1]		400 mm or more		50 mm or more		50 mm or more	
Field of view (typical example)		Installed distance 400 mm: 58 (H)×44 (V) mm or more Installed distance 3000 mm: 464 (H)×348 (V) mm		Installed distance 50mm: 22 (H)×16 (V) mm or more Installed distance 3000mm: 1184 (H)×888 (V) mm		Installed distance 50mm: 51 (H)×38 (V) mm to Installed distance 3000mm: 2730 (H)×2044 (V) mm	
Image sensor		1/2.9inch color CMOS	1/2.9inch monochrome CMOS	1/2.9inch color CMOS	1/2.9inch monochrome CMOS	1/2.9inch color CMOS	1/2.9inch monochrome CMOS
	Pixel	1280 (H) x 960 (V)					
Focus Adjustment		Auto[*2]					
Exposure time[*3]		12 µs to 10 ms					
Light	Light source	White LED	Infrared LED	White LED	Infrared LED	White LED	Infrared LED
	Lighting method	Pulse/continuous lighting Switchable	Pulse lighting	Pulse/continuous lighting Switchable	Pulse lighting	Pulse/continuous lighting Switchable	Pulse lighting
Tool	Available mode	Standard Mode, Sorting Mode, AI Through Count Mode					
	Available Tool	Standard/Sorting mode: AI Differentiate, Outline, Color Area[*4], Area[*5], EdgePixels, Color Average[*4], Brightness Avg[*5], Width, Diameter, Edge, Pitch, Color prohibit, Brightness prohibit, Position adjustment, High-speed position adjustment (1-axis edge/2-axis edge), Blob count, AI Identify, AI Count, Total, AI OCR, AI Trigger AI Through Count Mode: Count, Total					
	Number of tools[*6]	65 Tools					
Switch settings (programs)		128 programs (with SD card)/32 programs (without SD card)					
Image History[*7]	Numbers	100 images					
	Condition	Logging Settings 1: OK only, NG only, None, NG and near threshold OK[*8]. All of these can be selected. Logging settings 2: Specified number of images before and after NG, Fixed interval, or Specified time can be selected.					
Image data transfer	Transfer Destination	microSD card/FTP server/SFTP server is selectable					
	Transfer format	Selectable between bmp, jpeg, iv4p, and txt, and file names can be modified					
	Transfer Condition	OK/NG/NG and near threshold OK[*8]/near threshold OK[*8]/All/Judgment Complete are selectable					
Analysis information[*9]	Display Method	List by tools (judgment results, matching rate, matching bar display)					
	Operation Information	OFF/Histogram/Processing time/Count/Output monitor is switchable Histogram: Histogram, matching rate (Max, Min, Ave), numbers of OKs, numbers of NGs Processing time: Processing time (latest, Max., Min., Ave.), Cap. Time (Latest value, MAX, MIN, AVE) Count: Trigger numbers, numbers of OKs, numbers of NGs, numbers of trigger errors, Output monitor: ON / OFF status for each output					
Other functions	Imaging function	Digital zoom (2×, 4×), HDR, High gain, Color filter[*4], White balance[*4], Brightness correction, AI capture, Preliminary capture, Trapezoidal shape correction, Mirror inversion correction Image capture range setting (1280 x 960, 640 x 480, 320 x 240, 160 x 120 with accelerator filter disabled; 640 x 480, 320 x 240, 160 x 120, 80 x 60 with accelerator filter enabled)					
	Tool functions	Additional Learning (Learning, AI Identify, AI OCR, AI Count, AI Trigger, AI Through Count Mode), Remove Outline, Mask function, Color extraction/Color exclusion[*4], Color histogram function[*4], Monochrome histogram function[*5], Scaling function					
	Utility	List of NG Sensor Occurrences, NG Hold Function, Test run, I/O monitor, Security settings (Two levels of passwords, Security enhancement mode), Simulator[*10], FTP image information addition, Multiple position adjustments, Multiple master image additions, High-Speed Program Switching, Program auto-switching, Automatic backup and restoration of settings, Change of thresholds while running, Excessive trigger input time detection, Reset Statistics/Histogram					
Indicator light		OUT, TRIG, STATUS, LINK/ACT, SD					
Input		Switchable between non-voltage input and voltage input For non-voltage input: ON voltage 2 V or lower, OFF current 0.1 mA or lower, ON current 2 mA (short circuit) For voltage input: Maximum input rating 30 V, ON voltage 18 V or higher, OFF current 0.15 mA or lower, ON current about 2 mA (for 24 V)					
	Number of inputs	6 ports, 3 ports are selectable as IN/OUT					
	Function	IN1: External trigger, IN2, IN3, I/O1 to I/O3: Enable by assigning optional functions Assignable functions: Program switching, Clear error, External master image registration, Stop saving for SD card, OCR Serial No. Count Up, Reset Count					
Output		Open collector output NPN/PNP is switchable, N.O./N.C. is switchable. Maximum rating 30 V 50 mA, remaining voltage 1.5 V or lower[*11]					
	Number of inputs	6 ports, 3 ports are selectable as IN/OUT					

Model		IV4-400CA	IV4-400MA	IV4-500CA	IV4-500MA	IV4-600CA	IV4-600MA
	Function	Enable by assigning the optional functions Assignable functions (Standard/Sorting Mode): Total Status (OK/NG), RUN, BUSY, Trigger Ready, Strobe, Position adjustment result, Judgment result of each tool, Logical operation result of each tool, Error, SD card error, Part discrimination result, Master status result, Insufficient SD capacity, Transfer results file, AI Trigger Output Assignable functions (AI Through Count Mode): Run, Busy, Error, Count up for each tool, Judgment result for each tool, Logic operation result for each tool					
Power/I/O	Connector	M12 12 pin A code Male connector					
	PoE	PoE power Class 4/6*12					
Ethernet	Standard	1000BASE-T/100BASE-TX					
	Connector	M12 8 pin X code Female connector					
Network function		FTP client/SFTP client/SNTP client, FTP client, SFTP client, SNTP client, OPC UA server, MQTT client					
Supported interface	Built-in Ethernet	EtherNet/IP™, PROFINET CC-B*13, TCP/IP non-procedure communication (No. of connections: 2)					
	Communication unit (IV4-CU1)	PROFINET CC-C *14, EtherCAT					
Expanded memory		microSD card (microSD/microSDHC)*15					
Power supply	Power voltage	24 V +25%, -20% (including ripple)*16					
	Current consumption	3.4 A or less (at 19.2 V), 2.7 A or less (at 24.0 V) (without AI Lighting, with communication unit, and including an output load of 120 mA) 3.3 A or less (at 19.2 V), 2.6 A or less (at 24.0 V) (without AI Lighting and communication units, and including an output load of 120 mA) 2.1 A or less (at 19.2 V), 1.8 A or less (at 24.0 V) (with AI Lighting and communication units, and including an output load of 120 mA)*17					
	Average power consumption	9.3 W (without AI Lighting unit) 12.8 W (with AI Lighting unit) 14.0 W or lower (with AI Lighting unit and communication unit)					
Environmental resistance	Operating ambient temperature	0 to +50°C (no freezing)*18					
	Operating ambient humidity	85% RH or less (No condensation)					
	Vibration resistance*19	Frequency: 10 to 500 Hz Power spectral density: 0.816 G^2/Hz X, Y, Z directions					
	Shock resistance*19	500 m/s^2 6 different directions in 3 times					
	Enclosure rating*20	IP67					
Material*21		Body: Aluminum diecast; Front cover: acrylic (hard coating); Rear plastic cover and plastic lid: PBT; Indicator cover: TPU; Power connector: PA, POM; Ethernet connector: Copper alloy + Ni plating; Nameplate: PC Water proof cap for the power connector: PC+ABS alloy; Water proof cap for the Ethernet connector: PC					
Weight		Approx. 370 g (without AI Lighting unit) Approx. 560 g (with AI Lighting unit)					

*1 When used over 3 m, KEYENCE recommends removing the polarizing filter.
*2 The focus position can be automatically adjusted at the time of installation. Disabled during operation. The focus position can be registered by program.
*3 The maximum exposure time is 500 ms only when the lighting is set to OFF.
*4 Color type only.
*5 Monochrome type only.
*6 Tools can be installed by programs. The number of tools for the detection tools and position adjustment tools combined. For the detection tools, up to 64 tools can be set. For the AI Count and AI OCR tools, up to 16 tools can be set. The number of detection tools in sorting mode is eight. The number of tools set in AI Through Count mode and in the High Speed/Standard mode is two AI Count tools and one Total tool, while the number of tools set in High Accuracy mode is six AI Count tools and two Total tools.
*7 Saves to the sensor's internal memory. The images saved in the sensor can be backed up to the USB memory stick or microSD card connected to the control panel (IV4-CP70) or display expansion unit (IV4-DU10), or to the PC using the PC software (IV-H1SN).
*8 Learn tool only.
*9 Can also be displayed on the control panel (IV4-CP70), display expansion unit (IV4-DU10), or the PC software (IV-H1SN).
*10 Usable on the PC software (IV-H1SN).
*11 Make sure to keep a total of each output with 120 mA or less. Residual voltage is specified at an output current of 20 mA or less. The output current is 2.0 V at 50 mA.
*12 For PoE power supply devices, IEEE802.3at power Class 4 or higher is recommended when using the AI Lighting unit, and IEEE802.3bt power Class 6 or higher is recommended when not using the AI Lighting unit. When using PoE, operation may be restricted due to power limitation.
*13 Conformance Class B, applicable protocol: LLDP and SNMP
*14 Conformance Class C, applicable protocol: LLDP, SNMP, and MRP
*15 Use only products recommended by KEYENCE.
*16 When using the OP-88656 (10 m), the power voltage is 24 V DC +25%/-10% (including ripple).
*17 The peak current is designed to be smaller if the AI Lighting unit is mounted. The peak current is greater if the AI Lighting unit is not mounted.
*18 If the operating ambient temperature exceeds 40°C that the case temperature does not exceed the rated 75°C by appropriate heat dissipation measures after installation as specified by KEYENCE. For details, refer to the instruction manual.
*19 Except for mounting the dome attachment for (IV3-D10).
*20 Except when the polarizing filter (OP-88640/OP-88641/OP-88644/OP-88645) is mounted.
*21 ESD-safe, IEC61340-5-1-compliant

External Light Unit

Model		IV4-L4C	IV4-L4M	IV4-L5C	IV4-L5M	IV4-L6C	IV4-L6M
Compatible sensor		IV4-400CA	IV4-400MA	IV4-500CA	IV4-500MA	IV4-600CA	IV4-600MA
Light	Light source	White LED	Infrared LED	White LED	Infrared LED	White LED	Infrared LED
Power supply		Power is supplied by the connected sensor					
Environmental resistance	Operating ambient temperature	0 to +50°C (No freezing)					
	Operating ambient humidity	85% RH or less (No condensation)					
	Enclosure rating	IP67*1					
Material *2		Case: Aluminum die-casting; Rear cover: Acrylic					
Weight		Approx. 195 g					

*1 Applicable only when mounted to a compatible sensor. Except when the polarizing filter (OP-88644/OP-88645/OP-88646/OP-88647) is mounted.
*2 ESD-safe, IEC61340-5-1-compliant

Ultra-compact Model Sensor Amplifier

Model		IV4-G120
Available mode		Standard Mode, Sorting Mode, AI Through Count Mode
Tool	Available Tool	Standard/Sorting mode: Learning, Outline, Color Area*1, Area*2, EdgePixels, Color Average*1, Brightness Avg*2, Width, Diameter, Edge, Pitch, Color prohibit, Brightness prohibit, Position adjustment, High-speed position adjustment (1-axis edge/2-axis edge), Blob count, AI Identify, AI Count, Total, AI OCR, AI Trigger AI Through Count Mode: Count, Total
	Number of tools *3	65 Tools
Switch settings (programs)		128 programs (with SD card)/32 programs (without SD card)
Image history *4	Numbers	100 images
	Condition	Logging Settings 1: OK only, NG only, None, NG and near threshold OK*5. All of these can be selected. Logging settings 2: Specified number of images before and after NG, Fixed interval, or Specified time can be selected.
Image data transfer	Transfer Destination	microSD card/FTP server/SFTP server is selectable
	Transfer format	Selectable between bmp, jpeg, iv4p, and txt, and file names can be modified
	Transfer Condition	OK/NG/NG and near threshold OK*5/near threshold OK*5/All/Judgment Complete are selectable
Analysis information *6	Display Method	List by tools (judgment results, matching rate, matching bar display)
	Operation Information	OFF/Histogram/Processing time/Count/Output monitor is switchable Histogram: Histogram, matching rate (Max, Min, Ave), numbers of OKs, numbers of NGs Processing time: Processing time (latest, Max., Min., Ave.), Cap. Time (Latest value, MAX, MIN, AVE) Count: Trigger numbers, numbers of OKs, numbers of NGs, numbers of trigger errors Output monitor: ON / OFF status for each output
Other functions	Imaging function	Digital zoom (2×, 1×), HDR, High gain, Color filter*1, White balance*4, Brightness correction, AI capture, Preliminary capture, Trapezoidal shape correction, Mirror inversion correction Image capture range setting (1280 x 960, 640 x 480, 320 x 240, 160 x 120 with accelerator filter disabled; 640 x 480, 320 x 240, 160 x 120, 80 x 60 with accelerator filter enabled)
	Tool functions	Additional Learning (Learning, AI Identify, AI OCR, AI Count, AI Trigger, AI Through Count Mode), Remove Outline, Mask function, Color extraction/Color exclusion*1, Color histogram function*1, Monochrome histogram function*2, Scaling function
	Utility	List of NG Sensor Occurrences, NG Hold Function, Test run, I/O monitor, Security settings (Two levels of passwords, Security enhancement mode), Simulator*7, FTP image information addition, Multiple position adjustments, Multiple master image additions, High Speed program switching, Program auto-switching, Automatic backup and restoration of settings, Change of thresholds while running, Excessive trigger input time detection, Reset Statistics/Histogram
Indicator light		PWR/ERR, OUT, TRIG, STATUS, LINK ACT, SD
Input		Switchable between non-voltage input and voltage input For non-voltage input: ON voltage 2 V or lower, OFF current 0.1 mA or lower, ON current about 2 mA (short circuit) For voltage input: Maximum input rating 30 V, ON voltage 18 V or higher, OFF current 0.15 mA or lower, ON current 2 mA (for 24 V)
	Number of inputs	8 (IN1 to IN8)
	Function	IN1: External trigger, IN2 to IN8: Enable by assigning the optional functions Assignable functions: Program switching, Clear error, External master image registration, Stop saving for SD card, OCR Serial No. Count Up, Reset Count
Output		Open collector output NPN/PNP is switchable, N.O./N.C. is switchable. Maximum rating 30 V 50 mA, remaining voltage 1.5 V or lower*8
	Number of inputs	8 (OUT1 to OUT8)
	Function	Enable by assigning the optional functions Assignable functions (Standard/Sorting Mode): Total Status (OK/NG), RUN, BUSY, Trigger Ready, Strobe, Position adjustment result, Judgment result of each tool, Logical operation result of each tool, Error, SD card error, Part discrimination result, Master status result, Insufficient SD capacity, Transfer results file, AI Trigger Output Assignable functions (AI Through Count Mode): Run, Busy, Error, Count up for each tool, Judgment result for each tool, Logic operation result for each tool
Ethernet	Standard	1000BASE-T/100BASE-TX
	Connector	RJ45 8pin connector
Network function		FTP client, SFTP client, SNTP client, OPC UA server, MQTT client

Model		IV4-G120
Supported interface	Built-in Ethernet	EtherNet/IP™, PROFINET CC-B[*9], TCP/IP non-procedure communication (No. of connections: 2)
	Communication unit (IV4-GCU1)	PROFINET CC-C [*10], EtherCAT
	Communication unit (DL series)	EtherCAT, CC-Link, DeviceNet, RS-232C[*11]
Expanded memory		microSD card (microSD/microSDHC)[*12]
Power supply	Power voltage	24 V +25%, -20% (including ripple)
	Current consumption	2.2 A or less (at 19.2 V), 1.7 A or less (at 24.0 V) (without AI Lighting and communication units, and including an output load of 120 mA) 3.9 A or less (at 19.2 V), 3.1 A or less (at 24.0 V) (with AI Lighting unit, without communication unit, and including an output load of 120 mA) 4.0 A or less (at 19.2 V), 3.2 A or less (at 24.0 V) (with AI Lighting and communication units, and including an output load of 120 mA)
	Average power consumption	9.5 W (sensor amplifier only, no output load) 10.6 W (sensor amplifier, communication unit, and no output load)
Environmental resistance	Operating ambient temperature	0 to +50°C (no freezing)[*13]
	Operating ambient humidity	85% RH or less (no condensation)
Material		Case: PC; Power connector: PA; I/O connector: LCP; Sensor head connector: Zinc + Ni plating/PA; Ethernet connector: Copper alloy + Au plating; Radiator plate on rear of the main unit: Aluminum; DIN rail tab on rear of the main unit: POM; Nameplate: PC
Weight		Approx. 290 g

*1 Color type only.
*2 Monochrome type only.
*3 Tools can be installed by programs. The number of tools for the detection tools and position adjustment tools combined. For the detection tools, up to 64 tools can be set. For the AI Count and AI OCR tools, up to 16 tools can be set. The number of detection tools in sorting mode is eight. The number of tools set in AI Through Count mode and in the High Speed/Standard mode is two AI Count tools and one Total tool, while the number of tools set in High Accuracy mode is six AI Count tools and two Total tools.
*4 Saves to the sensor amplifier's internal memory. The images saved in the sensor amplifier can be backed up to the USB memory stick or microSD card connected to the control panel (IV4-CP70) or display expansion unit (IV4-DU10), or to the PC using the PC software (IV-H1SN).
*5 Only AI Differentiate, AI Identify, and AI OCR (when [Show Matching Rate] is enabled)
*6 Can also be displayed on the control panel (IV4-CP70), display expansion unit (IV4-DU10), or the PC software (IV-H1SN).
*7 Usable on the PC software (IV-H1SN).
*8 Make sure to keep a total of each output with 160 mA or less. Residual voltage is specified at an output current of 20 mA or less. The output current is 2.0 V at 50 mA.
*9 Conformance Class B, applicable protocol: LLDP and SNMP
*10 Conformance Class C, applicable protocol: LLDP, SNMP, and MRP
*11 When a communication unit (DL Series) is connected.
*12 Use the KEYENCE recommended product.
*13 If the operating ambient temperature exceeds 40°C, confirm that the case temperature does not exceed the rated 65°C by appropriate heat dissipation measures after installation as specified by KEYENCE. Measure the case temperature at the metal on the back of the sensor amplifier.

Ultra-compact model sensor head

Model		IV4-G500CA+ OP-88909	IV4-G500MA+ OP-88909	IV4-G400CA	IV4-G400MA	IV4-G500CA	IV4-G500MA	IV4-G600CA	IV4-G600MA
Type		Ultra narrow view type		Long distance narrow view type		Standard type		Wide view type	
Installed distance		23 mm to 40 mm		400 mm or more		50 mm or more		50 mm or more	
Field of view (typical example)		Installed distance 23 mm: 9.8 (H) × 7.3 (V) mm or more Installed distance 40 mm: 15 (H)×11.2 (V) mm		Installed distance 400 mm: 58 (H) × 44 (V) mm or more Installed distance 3000 mm: 464 (H)×348 (V) mm		Installed distance 50 mm: 22 (H) × 16 (V) mm or more Installed distance 3000 mm: 1184 (H)×888 (V) mm		Installed distance 50 mm: 51 (H) × 38 (V) mm or more Installed distance 3000 mm: 2730 (H)×2044 (V) mm	
Image sensor		1/2.9inch color CMOS	1/2.9inch monochrome CMOS	1/2.9inch color CMOS	1/2.9inch monochrome CMOS	1/2.9inch color CMOS	1/2.9inch monochrome CMOS	1/2.9inch color CMOS	1/2.9inch monochrome CMOS
	Pixel	1280 (H) x 960 (V)							
Focus Adjustment		Auto*1							
Exposure time*3		12 µs to 9 ms	12 µs to 9 ms	12 µs to 9 ms	12 µs to 9 ms*2	12 µs to 9 ms	12 µs to 9 ms*2	12 µs to 9 ms	12 µs to 9 ms*2
Light	Light source	White LED	Infrared LED	White LED	Infrared LED	White LED	Infrared LED	White LED	Infrared LED
	Lighting method	Pulse lighting/ continuous lighting is switchable.	Pulse lighting	Pulse lighting/ continuous lighting is switchable.	Pulse lighting	Pulse lighting/ continuous lighting is switchable.	Pulse lighting	Pulse lighting/ continuous lighting is switchable.	Pulse lighting
Indicator light		2 (indicate the same status)							
Power supply	Average power consumption	2.5 W		2.5 W (without AI Lighting unit) 6.6 W (with AI Lighting unit)					
Environmental resistance	Operating ambient temperature	0 to +50°C (no freezing)*4							
	Operating ambient humidity	85% RH or less (no condensation)							
	Vibration resistance	Frequency: 10 to 500 Hz Power spectral density: 0.816 G^2/Hz X, Y, Z directions							
	Shock resistance	500 m/s^2 6 different directions in 3 times							
	Enclosure rating*5	-		IP67					
Material*6		Body: zinc diecast, front cover: acrylic, indicator cover: TPU							
Weight		Approx. 85g		Approx. 75 g (without the AI Lighting unit) Approx. 225 g (with the AI Lighting unit)					

*1 The focus position can be automatically adjusted at the time of installation. Disabled during operation. The focus position can be registered by program.
*2 When the AI Lighting unit is mounted, the maximum exposure time is 6.25 msec.
*3 The maximum exposure time is 500 ms only when the lighting is set to OFF.
*4 If the operating ambient temperature exceeds 40°C, confirm that the case temperature does not exceed the rated 65°C by appropriate heat dissipation measures after installation as specified by KEYENCE. Measure the case temperature at the side marked “IV4 Series”.
*5 Except when the polarizing filter (OP-88642/OP-88643/OP-88646/OP-88647) is mounted.
*6 ESD-safe, IEC61340-5-1-compliant

AI Lighting unit

Model		IV4-LG4C	IV4-LG4M	IV4-LG5C	IV4-LG5M	IV4-LG6C	IV4-LG6M
Compatible sensor		IV4-G400CA	IV4-G400MA	IV4-G500CA	IV4-G500MA	IV4-G600CA	IV4-G600MA
Light	Light source	White LED	Infrared LED	White LED	Infrared LED	White LED	Infrared LED
Power supply		Power is supplied by the connected amplifier					
Environmental resistance	Operating ambient temperature	0 to +50°C (No freezing)					
	Operating ambient humidity	85% RH or less (No condensation)					
	Enclosure rating	IP67*1					
Material *2		Unit case: Aluminum die-casting/PBT Sensor head connector: Zinc + Ni plating/PA Front cover: Acrylic Cable: PVC, Ni plating, TPEE					
Weight		Approx. 150 g					

*1 Applicable only when mounted to a compatible sensor. Except when the polarizing filter (OP-88644/OP-88645/OP-88646/OP-88647) is mounted.
*2 ESD-safe, IEC61340-5-1-compliant

Control panel

Model		IV4-CP70
Compatible sensor		IV4 Series, IV3 Series, IV2 Series, IV Series
Display		7" TFT color LCD 1024 x 600 (WSVGA)
Backlight	Method	White LED
	Duration	Approx. 50,000 hours (25 ˚C)
Interface	Touch panel	Analog resistive
	Ethernet*1	M12 8pin X-code connector (1000BASE-T/100BASE-TX)
	USB	A-type connector 1 port (for HS-compatible expanded memory/mouse connection)
Expanded memory		USB memory stick/microSD card (microSD/microSDHC)*2
Network function		VNC Server*3
Supported languages*4		Japanese/English/Simplified Chinese/Traditional Chinese/Korean/ German/Italian/French/Spanish/Portuguese/Czech/Hungarian/Polish/Thai
Power supply	Power voltage	24 V DC +25%/-20%
	Current consumption	0.9 A or less (at 19.2 V)
	Average power consumption	6.0 W
Environmental resistance	Operating ambient temperature	0 to +50°C (no freezing)*5
	Operating ambient humidity	85% RH or less (No condensation)
	Vibration resistance	10 to 500 Hz power spectral density 0.816 G^2/Hz X, Y, Z directions
	Drop impact resistance	1.3 m over the concrete (2 times each in the arbitrary direction)
	Enclosure rating	IP40
Material		Housing: PC; Power connector: Brass + Ni plating; Ethernet connector: Zinc alloy + Ni plating/LCP; USB connector cover: EPDM; Touch pen: POM
Weight		Unit: Approx. 540 g; with wall mounting adapter and stylus: Approx. 590 g

*1 This is dedicated for connection with the IV4 Series, IV3 Series, IV2 Series and IV Series.
*2 Use only products recommended by KEYENCE.
*3 When a VNC server is used, output to the LCD panel is not possible.
*4 When connected to the IV4 series. When the IV3 Series is connected, the languages supported in the startup mode being used (IV4-CP70 or IV3-CP50) are applicable. When the IV2 Series is connected, the languages supported by the IV2-CP50 are applicable. When the IV Series is connected, the languages supported by the IV-M30 are applicable.
*5 It is the value when it is attached in the vertical direction. If you use other installation methods, use it at 0 to +40°C (no freezing).

Display expansion unit

Model		IV4-DU10
Compatible sensor		IV4 Series, IV3 Series, IV2 Series, IV Series
Indicator light		PWR, SENSOR, LINK/ACT
Interface	Ethernet*1	RJ45 connector (1000BASE-T/100BASE-TX)
	USB	A-type connector 2 ports (for connection of HS-compatible mouse/other manufacturer's touch panel/expansion memory)
Video output*2	HDMI output	1 port (output resolution*3 1280 x 720, 1920 x 1080)
	VGA output (analog RGB output)	1 port (output resolution*3 1024 x 768, 1280 x 720, 1280 x 800, 1366 x 768)
Expanded memory		USB memory stick/microSD card (microSD/microSDHC)*4
Network function		VNC Server*2
Supported languages*5		Japanese/English/Simplified Chinese/Traditional Chinese/Korean/ German/Italian/French/Spanish/Portuguese/Czech/Hungarian/Polish/Thai
Power supply	Power voltage	24 V DC +25%/-20% Or use the dedicated AC adapter (OP-88766)
	Current consumption	1.2 A or less (at 19.2 V and maximum USB current)
	Average power consumption	5.4 W
Environmental resistance	Operating ambient temperature	0 to +50°C (no freezing)*6
	Operating ambient humidity	85% RH or less (no condensation)
	Vibration resistance	10 to 500 Hz power spectral density 0.816 G^2/Hz X, Y, Z directions
Setup		DIN mount/VESA mount (OP)/Flat (secured by screws)
Material		Housing: PC; Ethernet connector: SUS/PA; HDMI connector: S50C + tin plating, VGA connector: Iron + Ni plating/PBT; USB connector: Copper alloy + tin plating; micro SD slot: Copper alloy + Ni plating; Power terminal block, AC adapter connector: PBT; DIN rail tab on rear of the main unit: POM; DIN rail bracket on rear of the main unit: Aluminum; Nuts for fixing screws: Brass
Weight		Approx. 260 g

*1 This is dedicated for connection with the IV4 Series, IV3 Series, IV2 Series and IV Series.
*2 HDMI output/VGA output/VNC server function cannot be used simultaneously.
*3 When using a display with a resolution different from the listed resolution, "W1024 or higher and H600 or higher" is required.
*4 Use only products recommended by KEYENCE.
*5 When connected to the IV4 series. When the IV3 Series is connected, the languages supported in the startup mode being used (IV4-CP70 or IV3-CP50) are applicable. When the IV2 Series is connected, the languages supported by the IV2-CP50 are applicable. When the IV Series is connected, the languages supported by the IV-M30 are applicable.
*6 It is the value when it is attached in the vertical direction (DIN rail). If you use other installation methods, use it at 0 to +40°C (no freezing).

AC adapter for display expansion unit

Model		OP-88766
Rating	Rated input	100 - 240 V AC (50/60Hz)
	Rated output	24 V DC 2.7 A
Weight	Operating ambient temperature	0 - +40˚C
	Operating ambient humidity	20 - 80% RH (no condensation)
Environmental resistance		Approx. 260 g

Communication unit (IV4-CU1/GCU1)

Model		IV4-CU1	IV4-GCU1
Compatible sensor		IV4-400CA/IV4-500CA/IV4-600CA IV4-400MA/IV4-500MA/IV4-600MA	IV4-G120
Supported network		PROFINET, EtherCAT, TCP/IP nonprocedural communication, HTTP, HTTPS, SNTP client, FTP client, SFTP client, OPC UA server, MQTT client	
Ethernet specifications	Transmission speed	100 Mbps	
	Connector specification	M12 (D) 4-pin female	RJ45
	Number of connectors	2 ports	
Supported functions	EtherCAT	CoE	
	PROFINET	Conformance Class C	
Power supply		Power is supplied by the connected sensor	
Environmental resistance	Operating ambient temperature	0 to +50°C (No freezing)	
	Operating ambient humidity	85% RH or less (No condensation)	
	Vibration resistance	Frequency: 10 to 500 Hz Power spectral density: 0.816 G^2/Hz X, Y, Z directions	-
	Shock resistance	500 m/s^2, 6 different directions, 3 times for each	-
	Enclosure rating	IP67 *1	-
Material *2		Front case and rear cover: PBT Rear transparent lid: PES Rear case: Aluminum die-casting Ethernet connector: Copper alloy with Au plating Nameplate: PC Waterproof cap for Ethernet connector: PC	Unit case: PC Ethernet connector: Copper alloy with Au plating Unit rear DIN rail tab: POM Nameplate: PC
Weight		Approx. 220 g	Approx. 100 g

*1 Applicable only when mounted on a sensor.
*2 ESD-safe, IEC61340-5-1-compliant

PC software for IV4/IV3/IV2/IV series

Model		IV-H1SN	
Compatible sensor		IV4 Series, IV3 Series, IV2 Series, IV Series	
Recording software		For the IV4/IV3 Series: IV Smart Navigator	For the IV3 Series: IV3-Navigator For the IV2 Series: IV2-Navigator For the IV Series: IV-Navigator
System requirements	Interface	Equipped with the Ethernet (1000BASE-T) interface	
	OS	Windows 11 Home/Pro/Enterprise Windows 10 Home/Pro/Enterprise (Windows 10 64-bit version supported)	Windows 11 Home/Pro/Enterprise Windows 10 Home/Pro/Enterprise Windows 7 (SP1 or later) Home Premium/Professional/Ultimate; (Windows 10/Windows 7 32-bit and 64-bit versions supported)
	Supported languages*1	Japanese/English/Simplified Chinese/Traditional Chinese/Korean/ German/Italian/French/Spanish/Portuguese/Czech/Hungarian/Polish/Thai	
	Processor	Needs to be compliant with system requirements for OS. Recommended CPU*2: Intel® Core™ i5 processor or equivalent or higher	Needs to be compliant with system requirements for OS.
	Memory capacity	8GB or more	4 GB or more
	Required capacity for installation	4 GB or more	4 GB or more
	Monitor	Resolution: 1024 × 768 pixel or higher Display color: High Color (16-bit) or higher	
	Operating conditions*3	Microsoft Visual Studio C++2019 Distribution Package Update needs to be installed.	• .NET Framework 4.5.2 or above needs to be installed. • Microsoft Visual C++ 2017 Distribution Package Update or above needs to be installed.

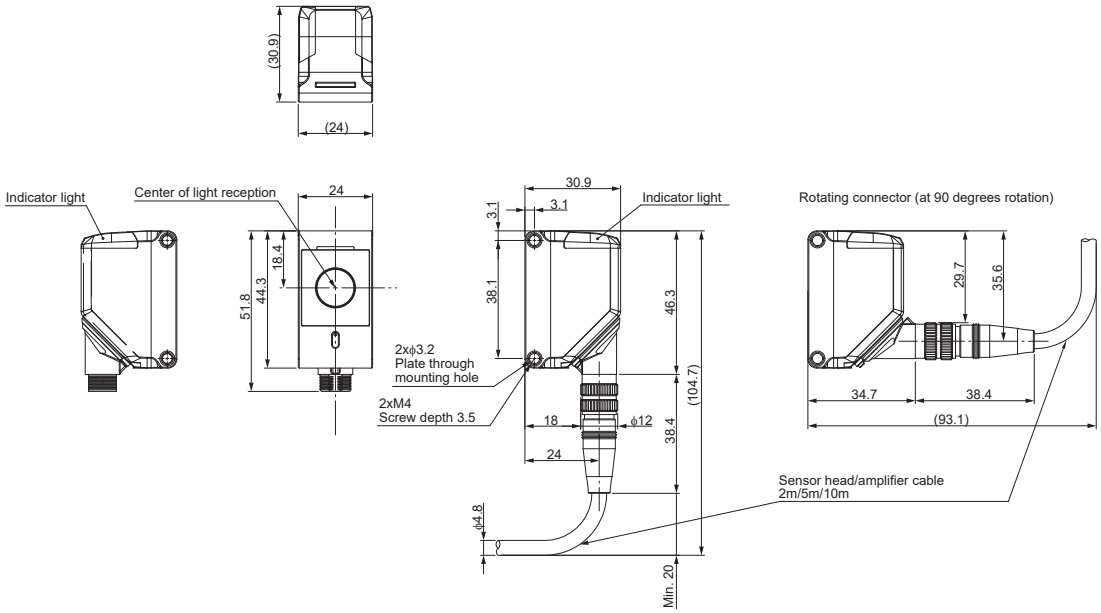
*1 Supported languages are those of the software being used (IV Smart Navigator or IV3-Navigator) when connected to the IV3 Series, those of IV2-Navigator when connected to the IV2 Series, or those of IV-Navigator when connected to the IV Series.
*2 When using the Simulator.
*3 If not installed, it will be installed automatically when IV-H1SN is installed.

Dimensions

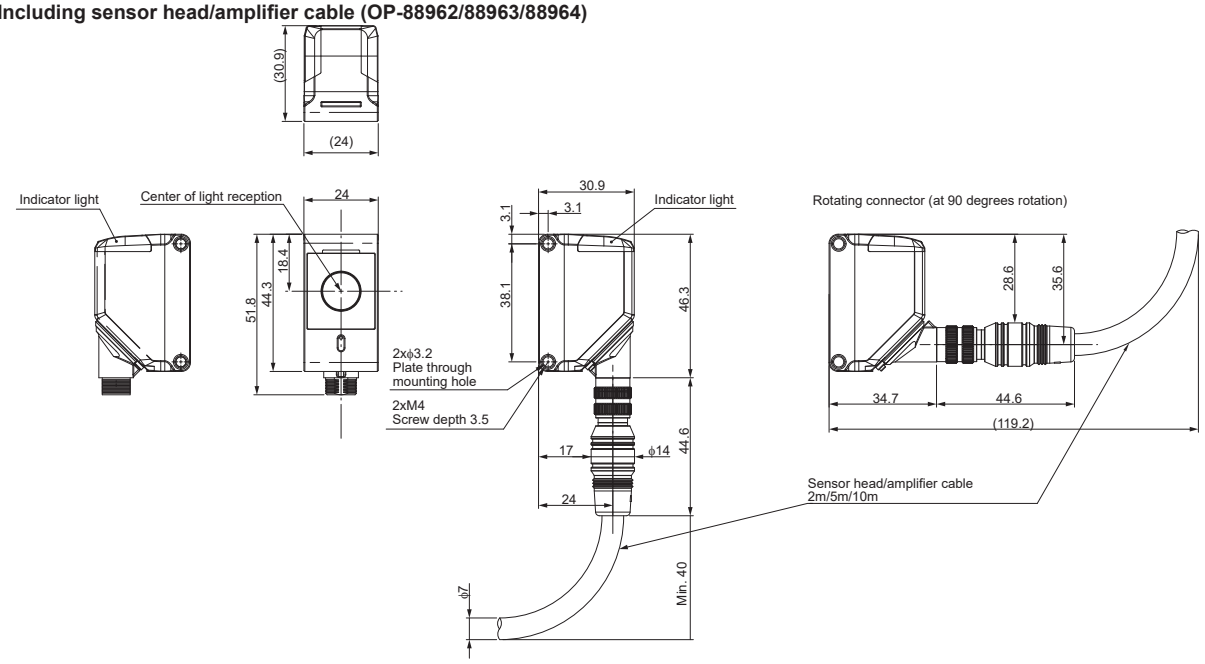
Ultra-compact model

Ultra-compact model sensor head (IV4-G400CA/G400MA/G500CA/G500MA/G600CA/G600MA)

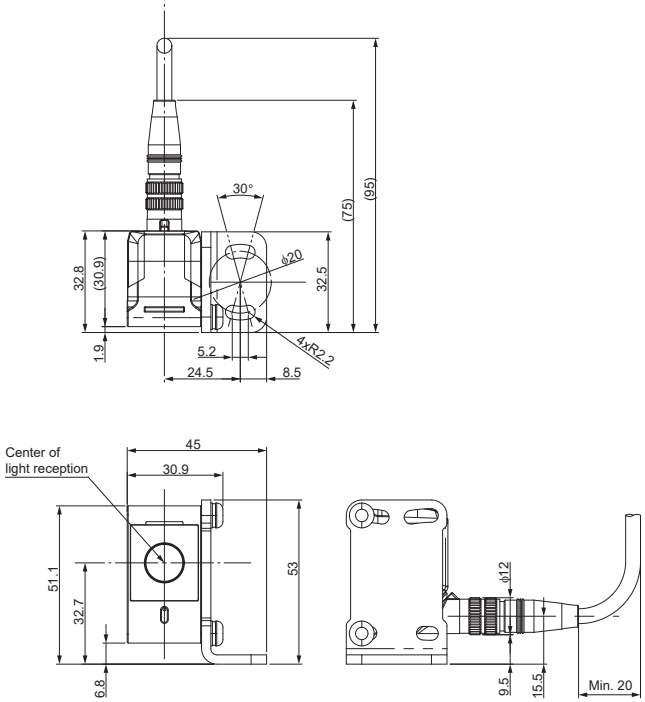
- **Including sensor head/amplifier cable (OP-88648/88649/88650)**



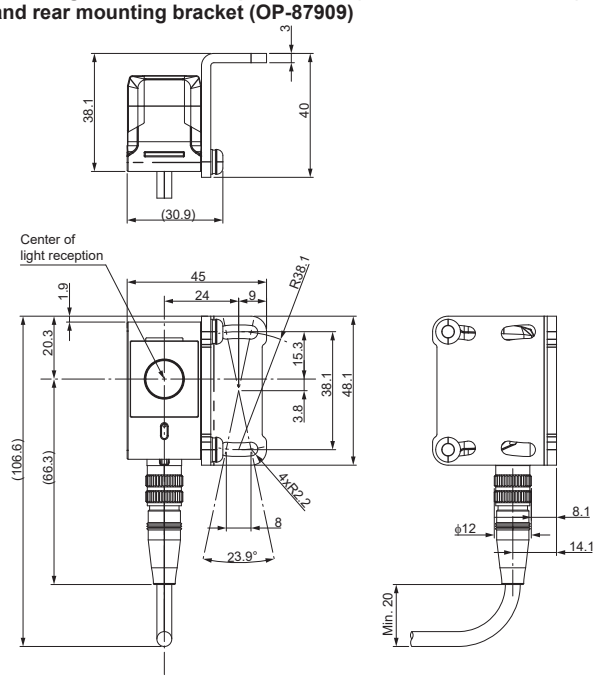
- **Including sensor head/amplifier cable (OP-88962/88963/88964)**



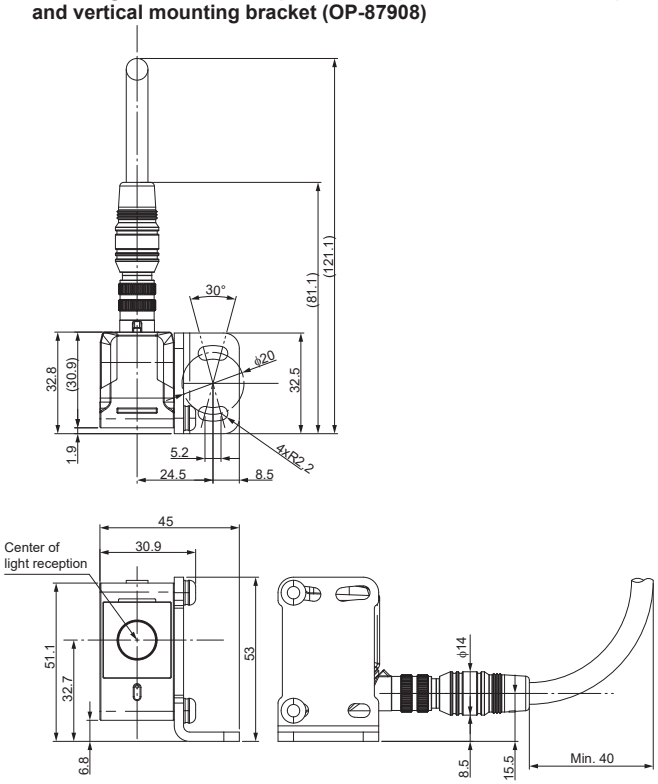
- **Including sensor head/amplifier cable (OP-88648/88649/88650) and vertical mounting bracket (OP-87908)**



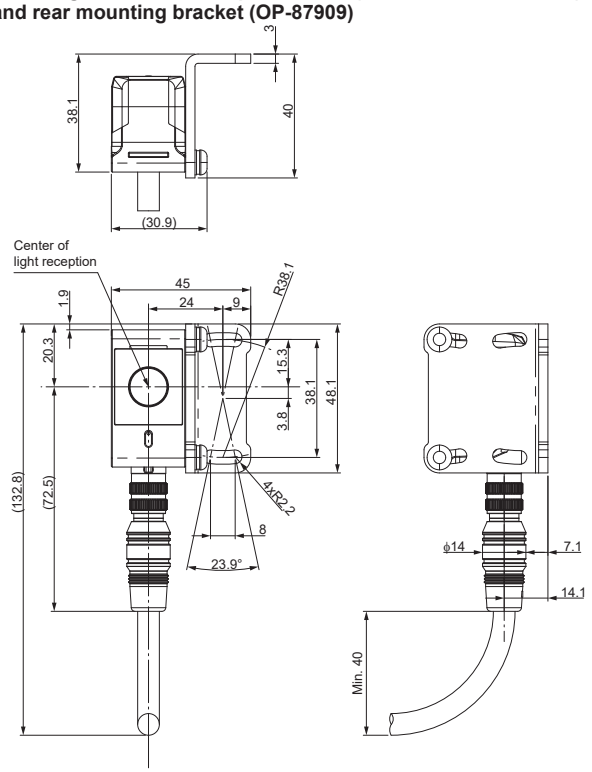
- **Including sensor head/amplifier cable (OP-88648/88649/88650) and rear mounting bracket (OP-87909)**



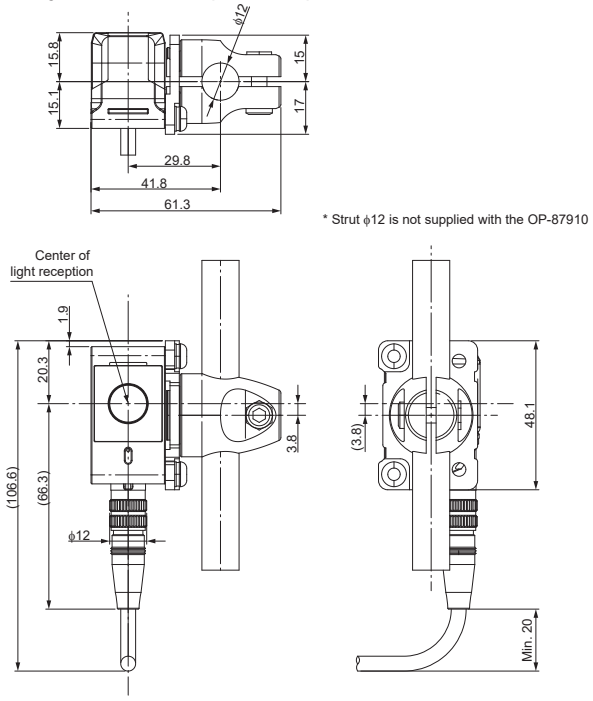
- **Including sensor head/amplifier cable (OP-88962/88963/88964) and vertical mounting bracket (OP-87908)**



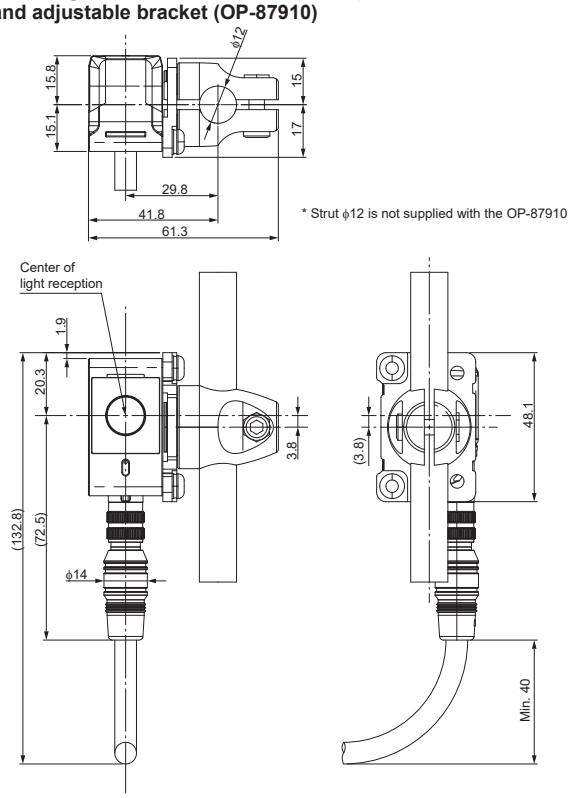
- **Including sensor head/amplifier cable (OP-88962/88963/88964) and rear mounting bracket (OP-87909)**



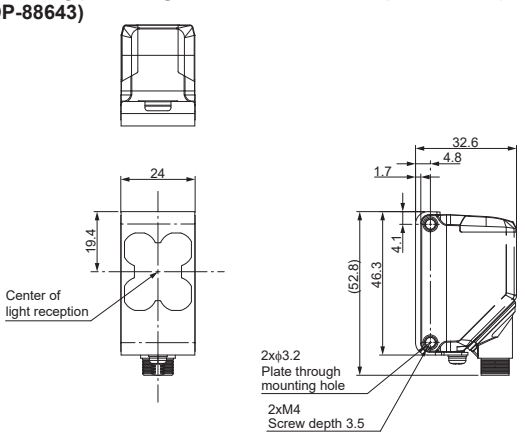
- **Including sensor head/amplifier cable (OP-88648/88649/88650) and adjustable bracket (OP-87910)**



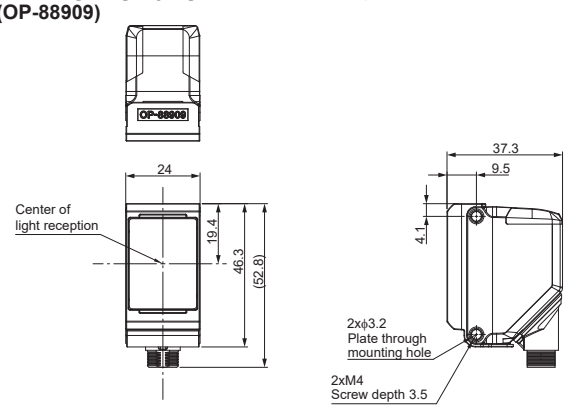
- **Including sensor head/amplifier cable (OP-88962/88963/88964) and adjustable bracket (OP-87910)**



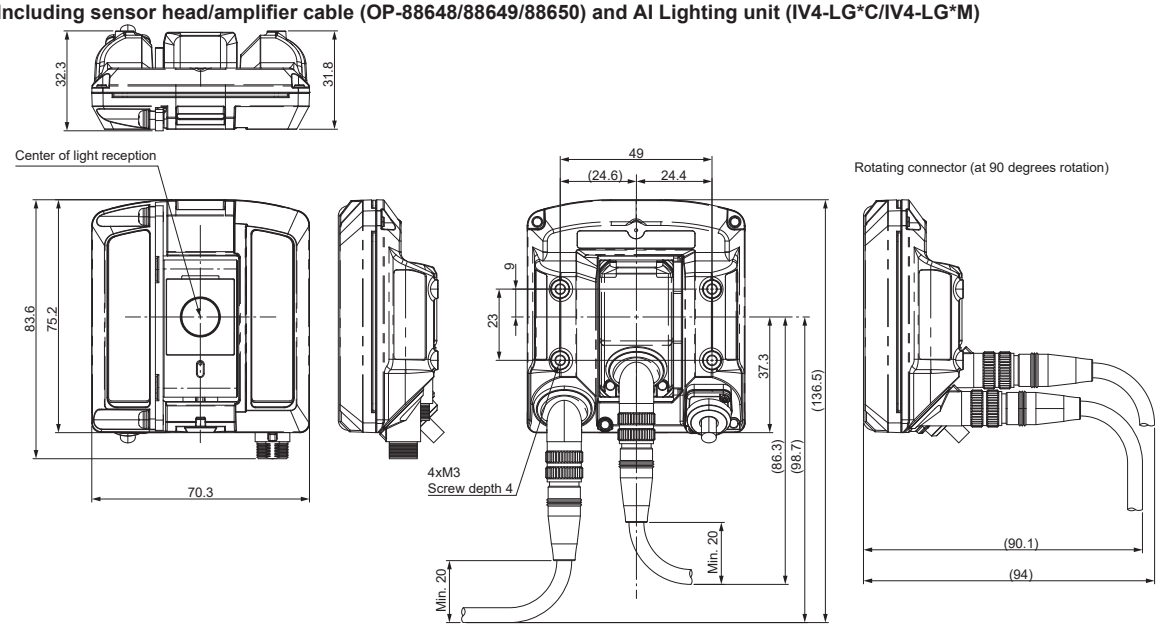
- **Including polarizing filter for the ultra-compact model (OP-88642/OP-88643)**



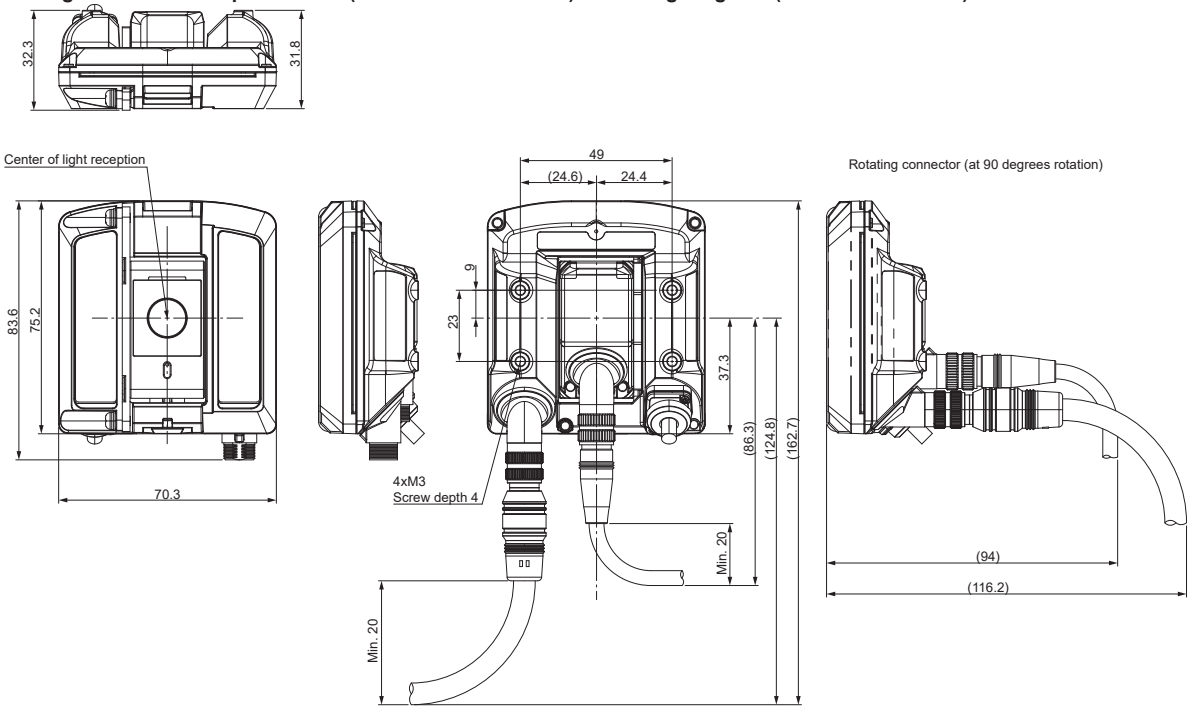
- **Including magnifying lens attachment (for the standard model) (OP-88909)**



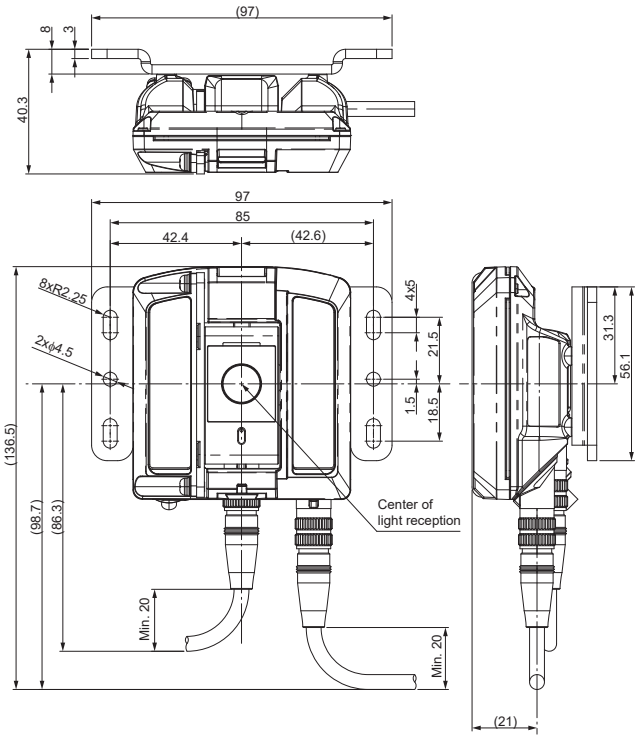
• **Including sensor head/amplifier cable (OP-88648/88649/88650) and AI Lighting unit (IV4-LG*C/IV4-LG*M)**



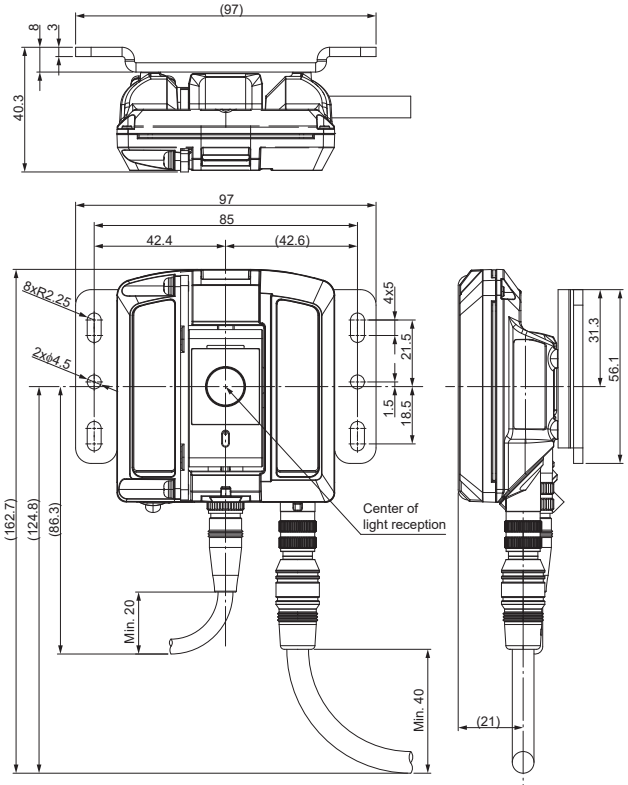
• **Including sensor head/amplifier cable (OP-88962/88963/88964) and AI Lighting unit (IV4-LG*C/IV4-LG*M)**



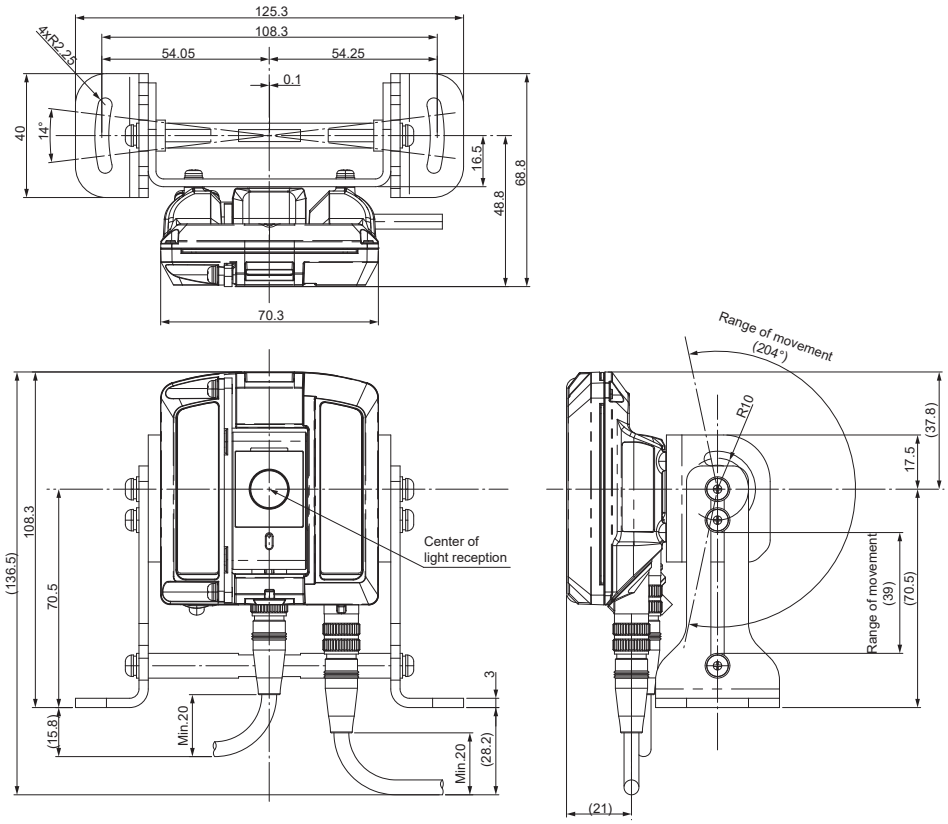
- **Including sensor head/amplifier cable (OP-88648/88649/88650), AI Lighting unit (IV4-LG*C/IV4-LG*M), and common mounting bracket (OP-88911)**



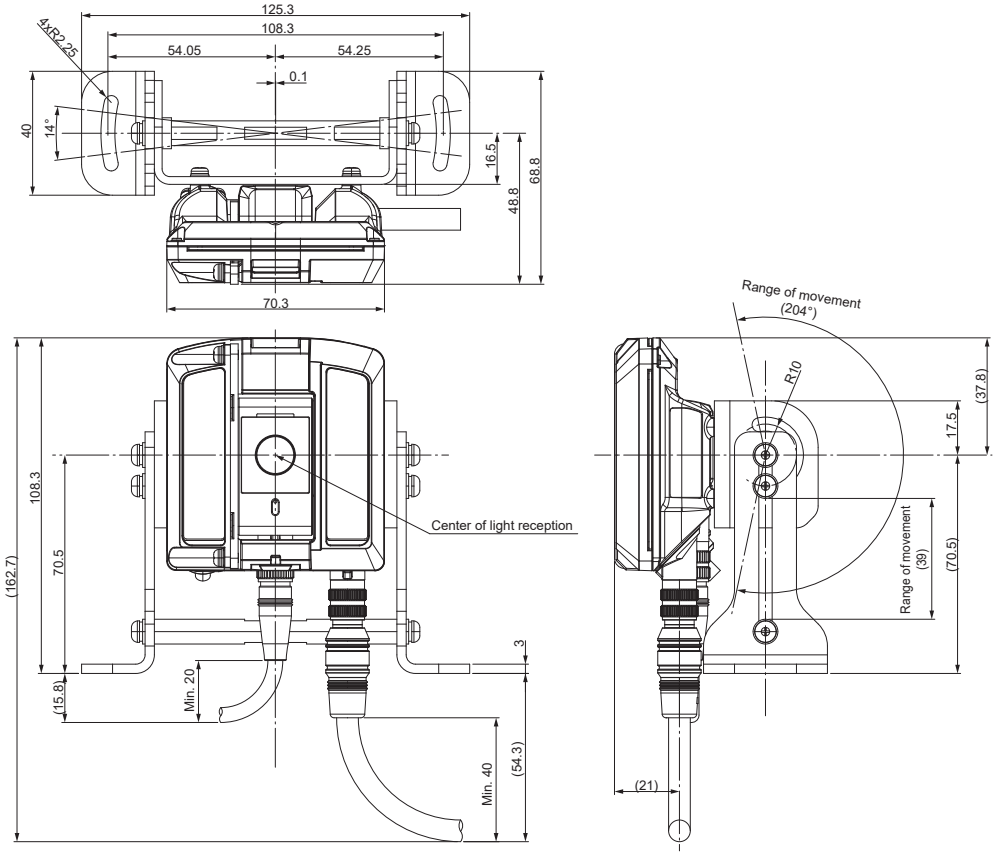
- **Including sensor head/amplifier cable (OP-88962/88963/88964), AI Lighting unit (IV4-LG*C/IV4-LG*M), and common mounting bracket (OP-88911)**



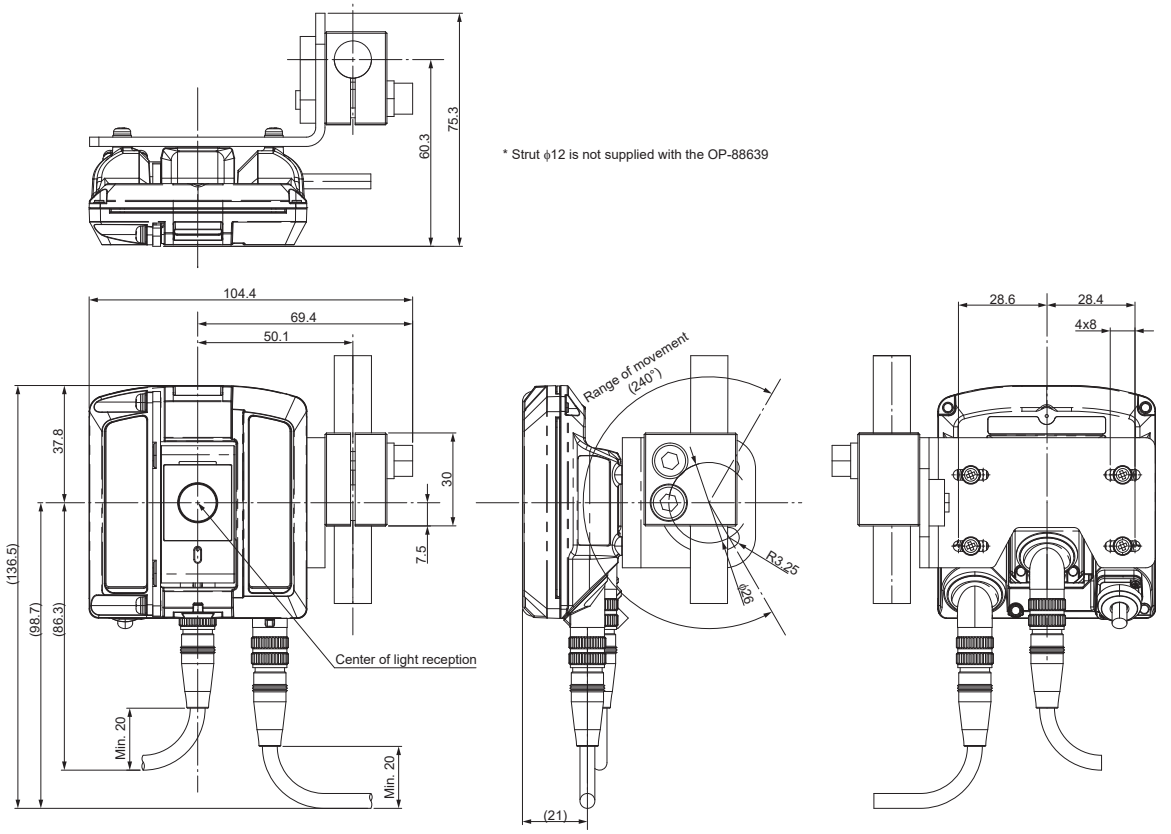
- **Including sensor head/amplifier cable (OP-88648/88649/88650), AI Lighting unit (IV4-LG*C/IV4-LG*M), and 2-axis adjustment mounting bracket (OP-88638)**



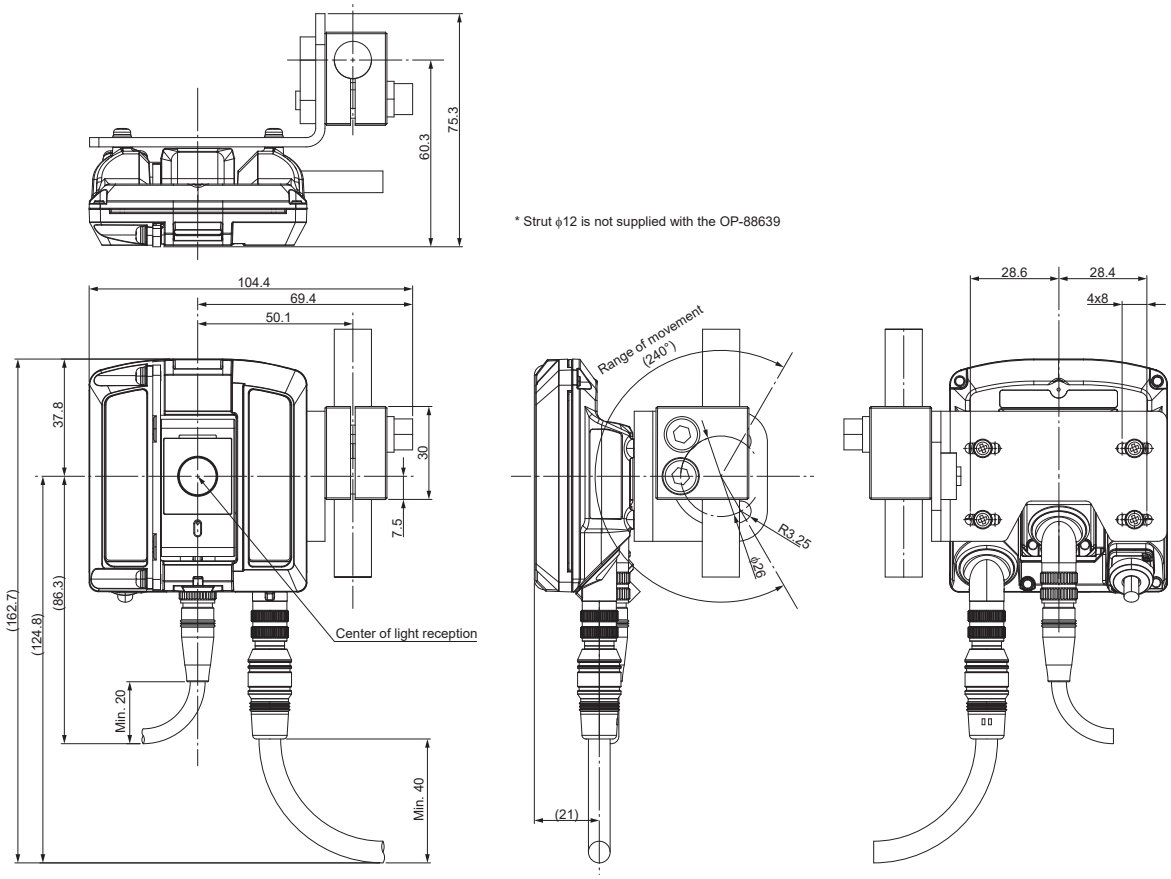
- **Including sensor head/amplifier cable (OP-88962/88963/88964), AI Lighting unit (IV4-LG*C/IV4-LG*M), and 2-axis adjustment mounting bracket (OP-88638)**



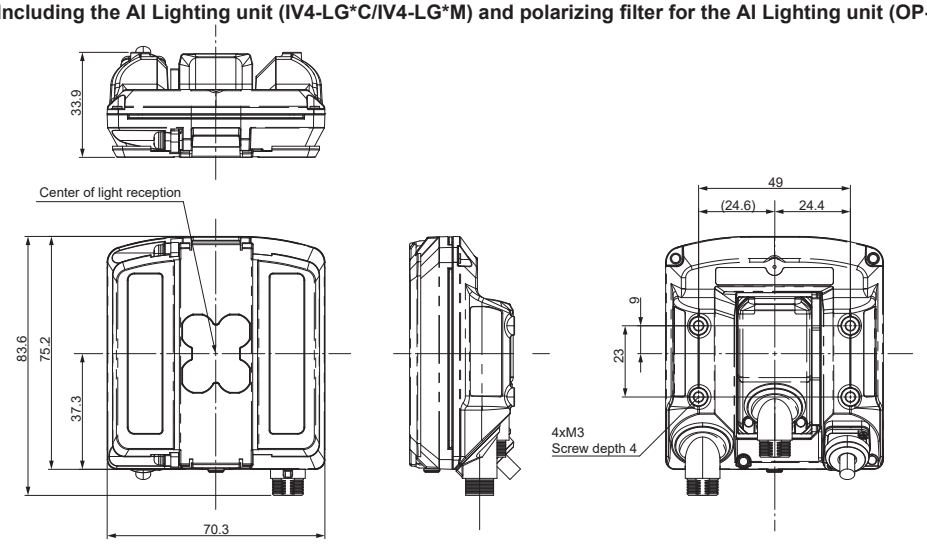
• **Including sensor head/amplifier cable (OP-88648/88649/88650), AI Lighting unit (IV4-LG*C/IV4-LG*M), and adjustable bracket (OP-88639)**



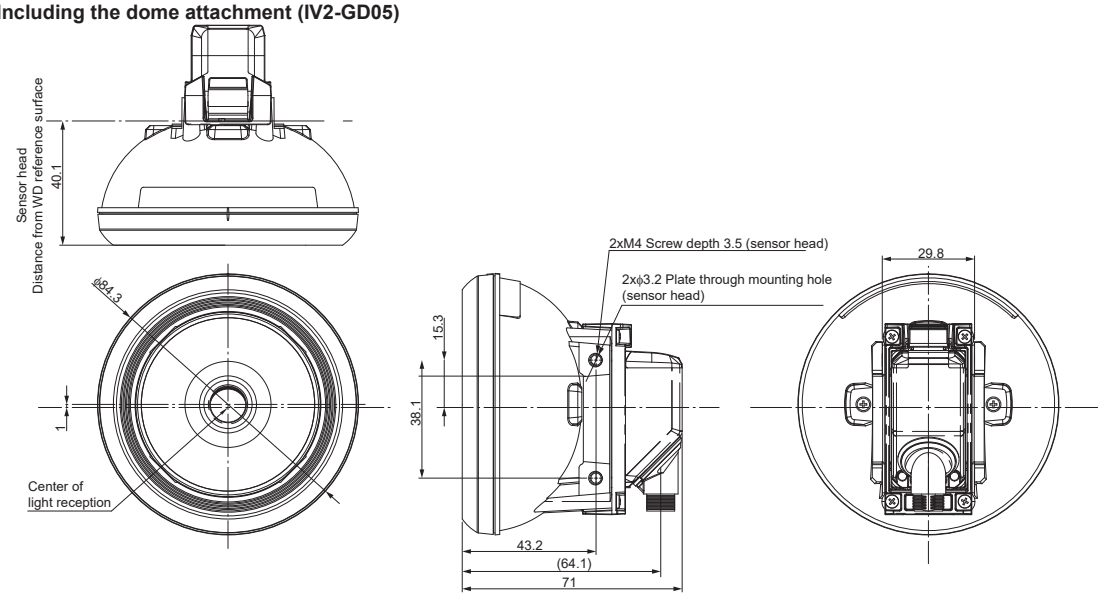
• **Including sensor head/amplifier cable (OP-88962/88963/88964), AI Lighting unit (IV4-LG*C/IV4-LG*M), and adjustable bracket (OP-88639)**



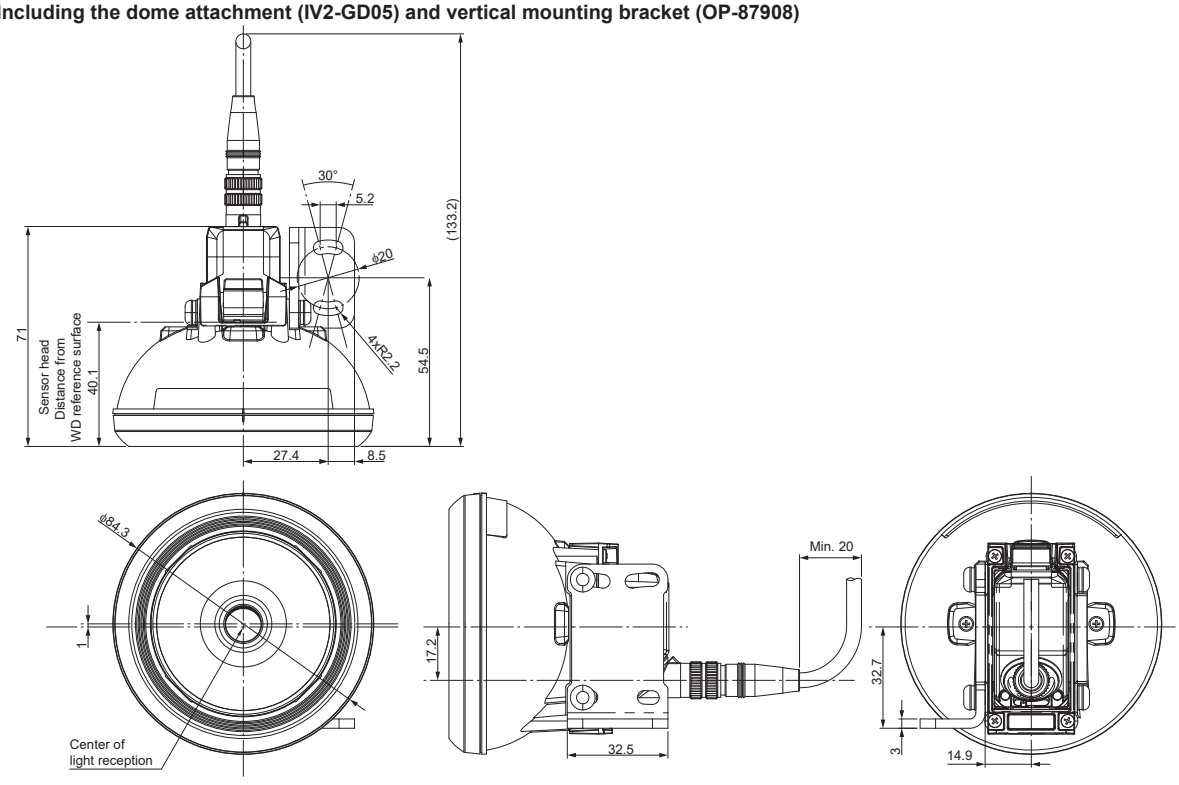
• **Including the AI Lighting unit (IV4-LG*C/IV4-LG*M) and polarizing filter for the AI Lighting unit (OP-88646/OP-88647)**



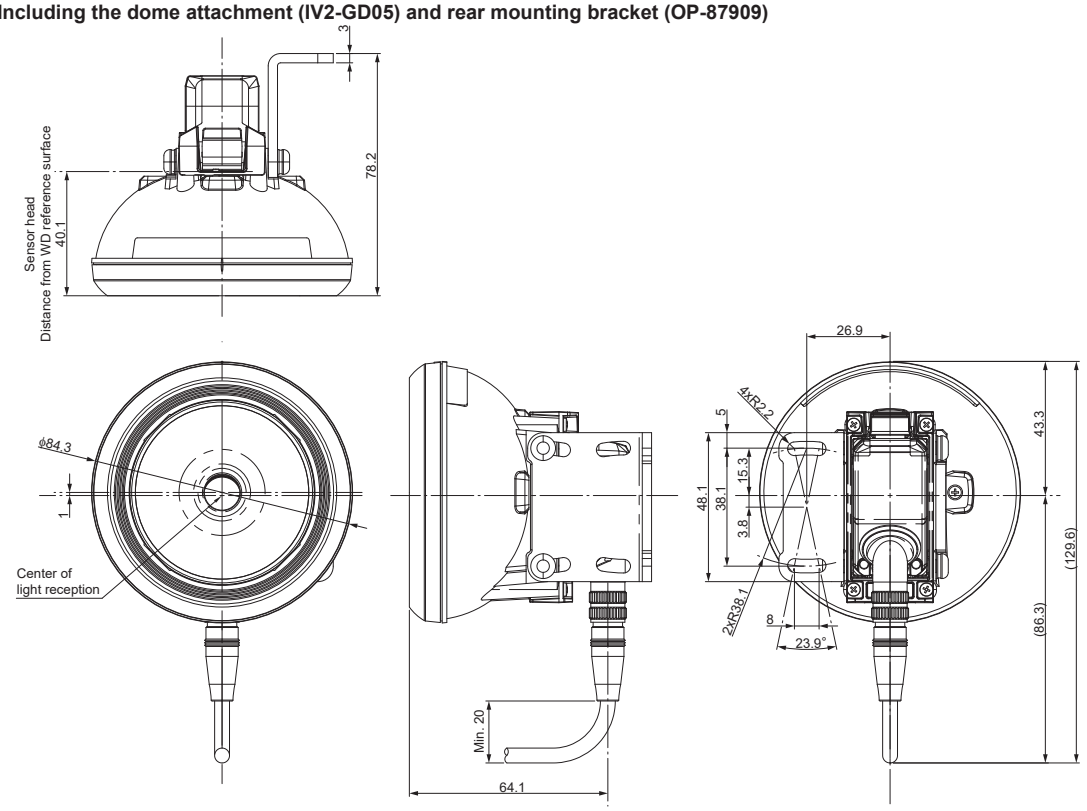
• **Including the dome attachment (IV2-GD05)**



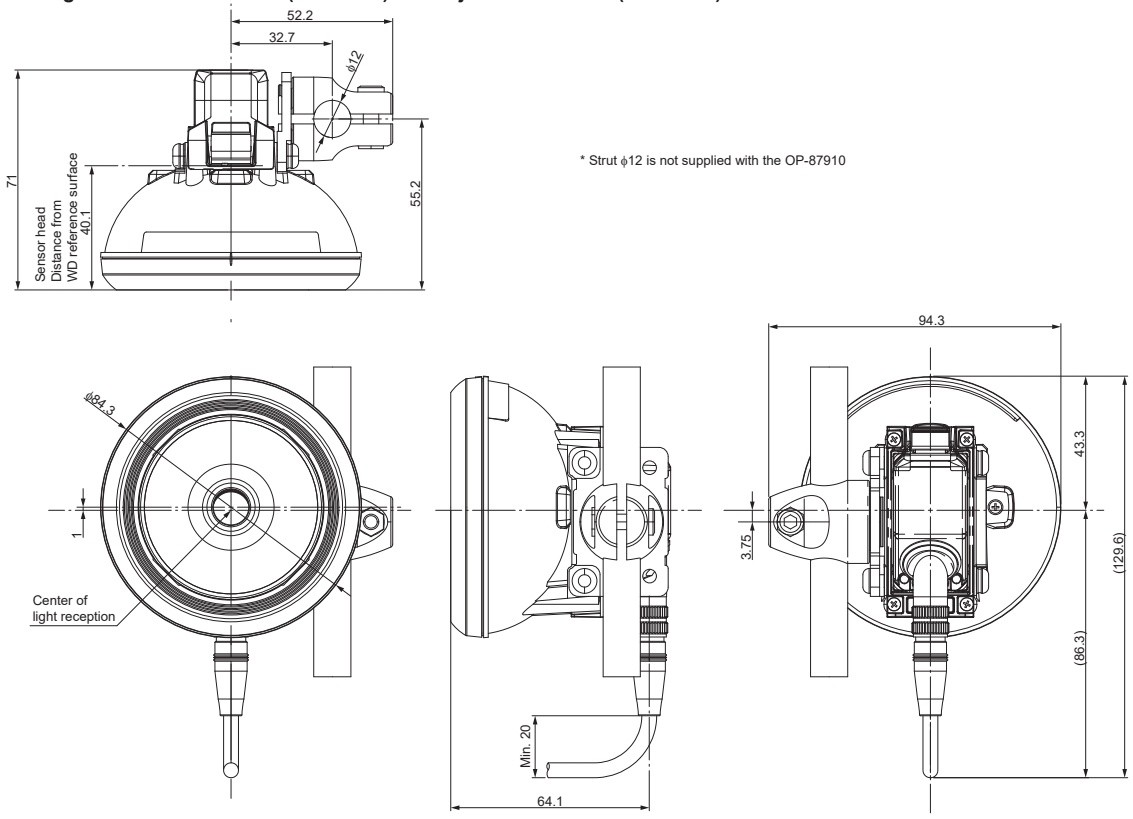
• **Including the dome attachment (IV2-GD05) and vertical mounting bracket (OP-87908)**



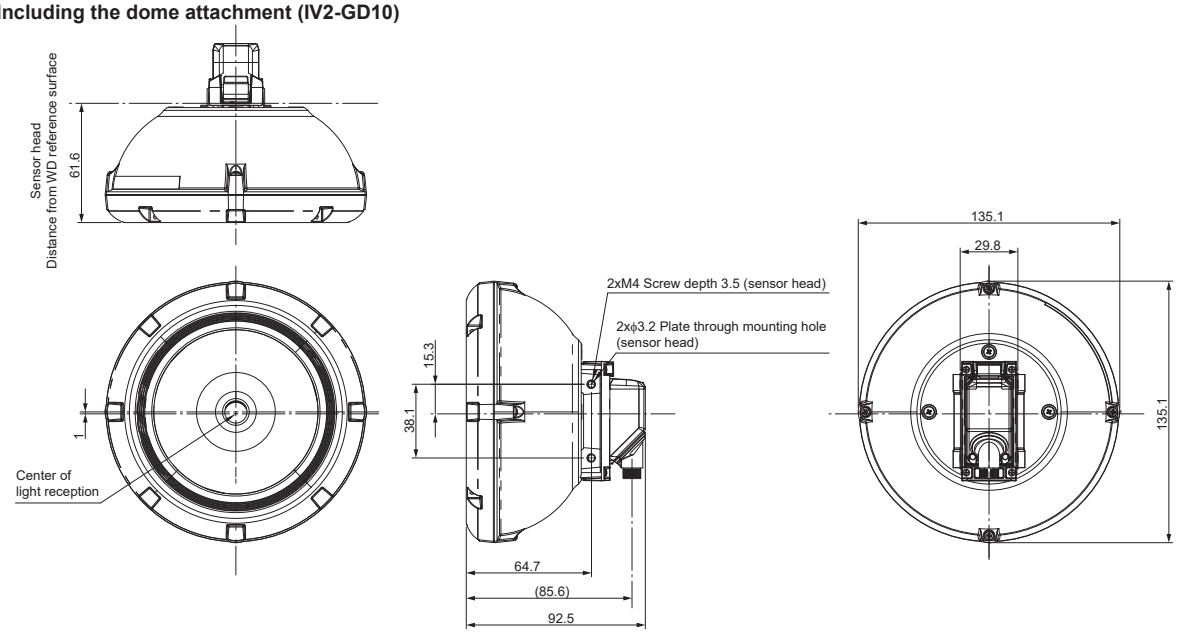
• **Including the dome attachment (IV2-GD05) and rear mounting bracket (OP-87909)**



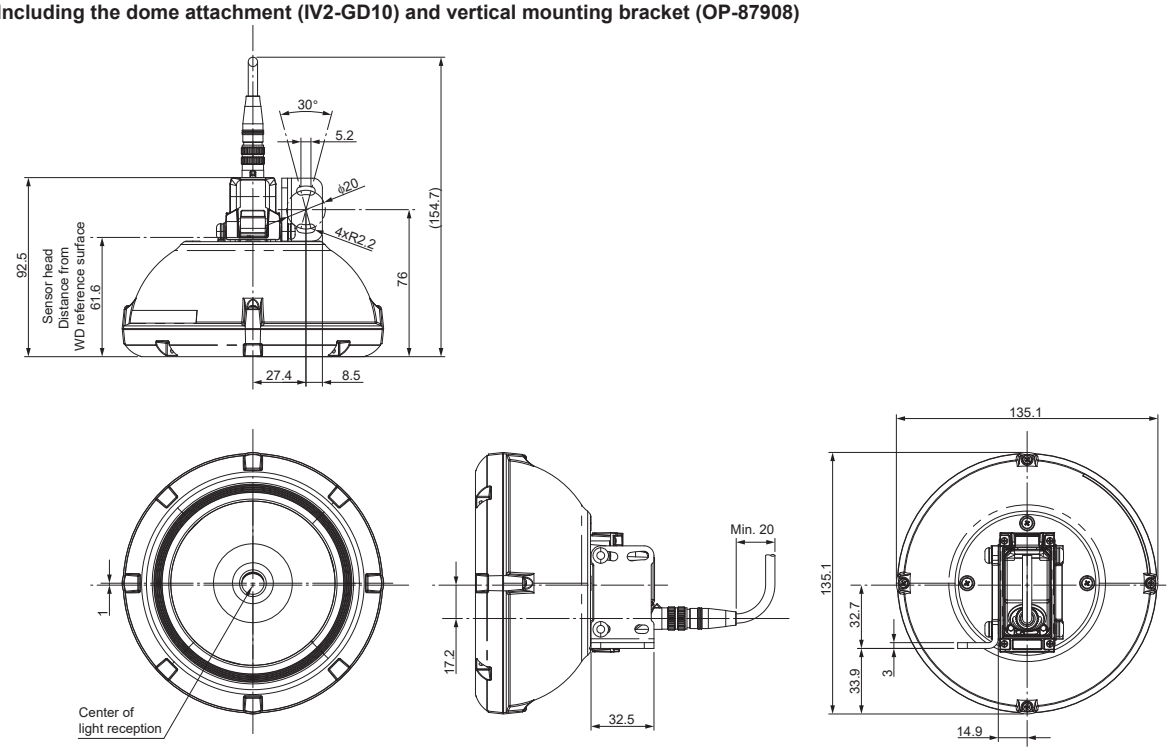
• **Including the dome attachment (IV2-GD05) and adjustable bracket (OP-87910)**



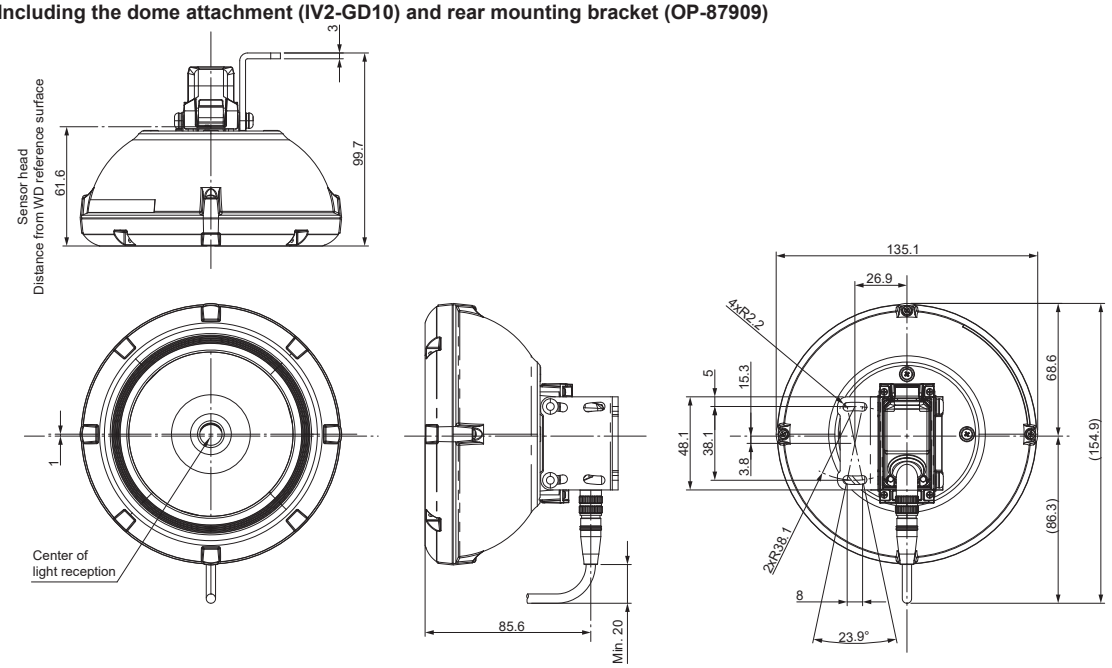
• **Including the dome attachment (IV2-GD10)**



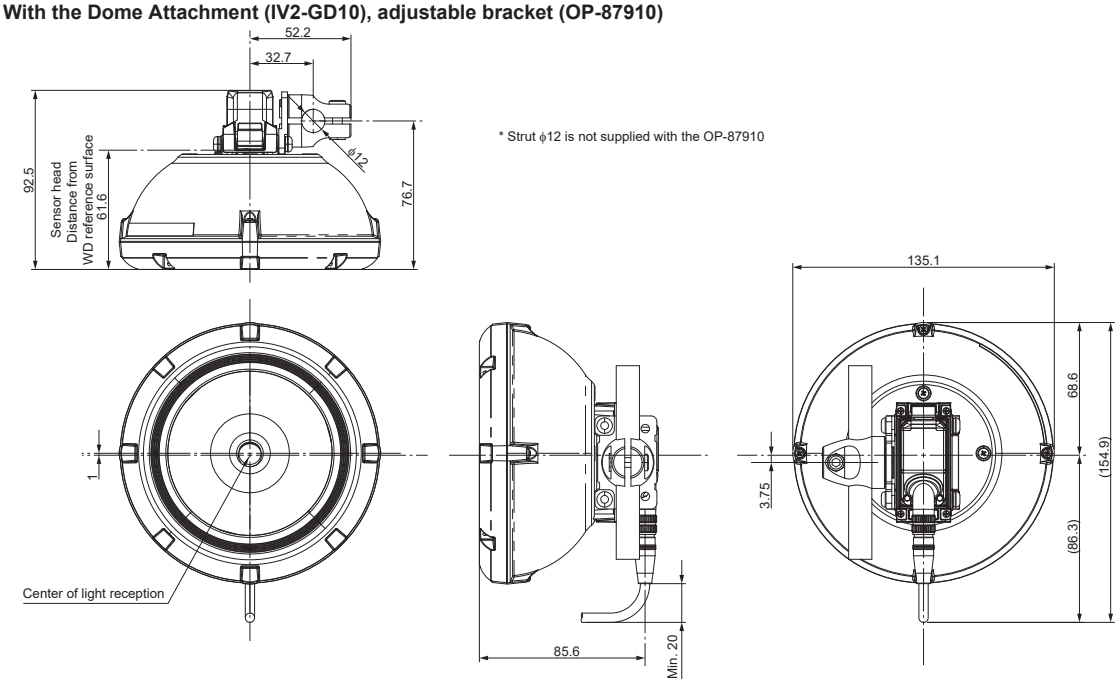
• **Including the dome attachment (IV2-GD10) and vertical mounting bracket (OP-87908)**



- **Including the dome attachment (IV2-GD10) and rear mounting bracket (OP-87909)**



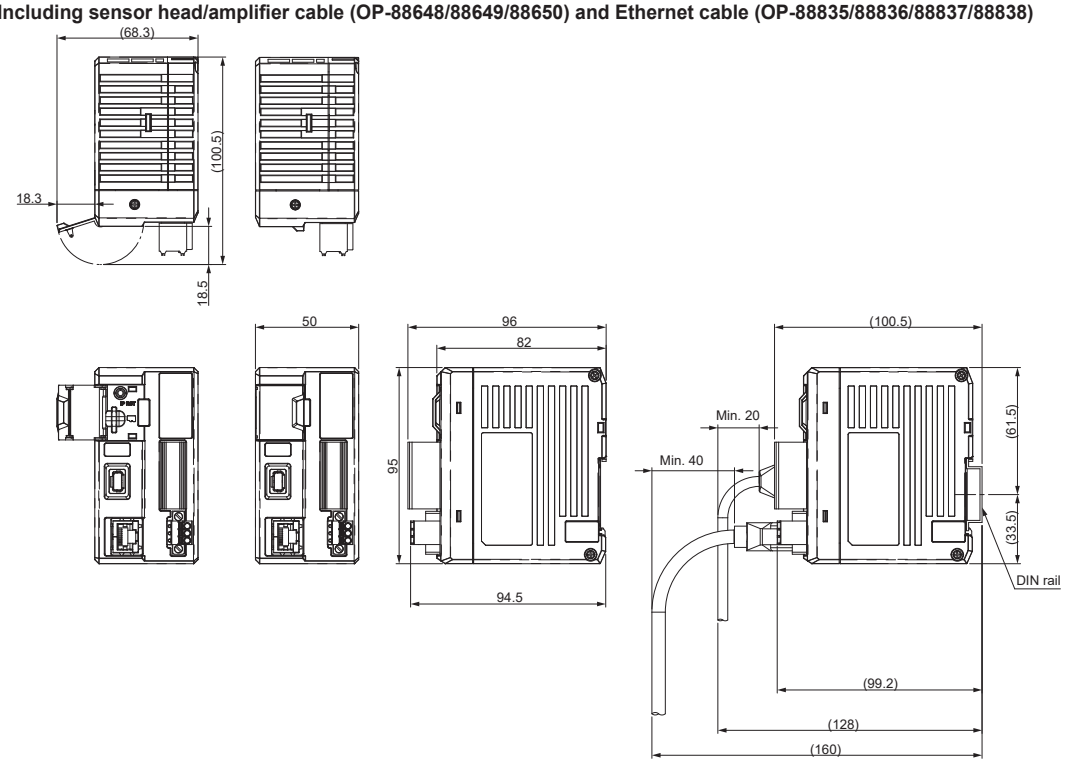
- **With the Dome Attachment (IV2-GD10), adjustable bracket (OP-87910)**



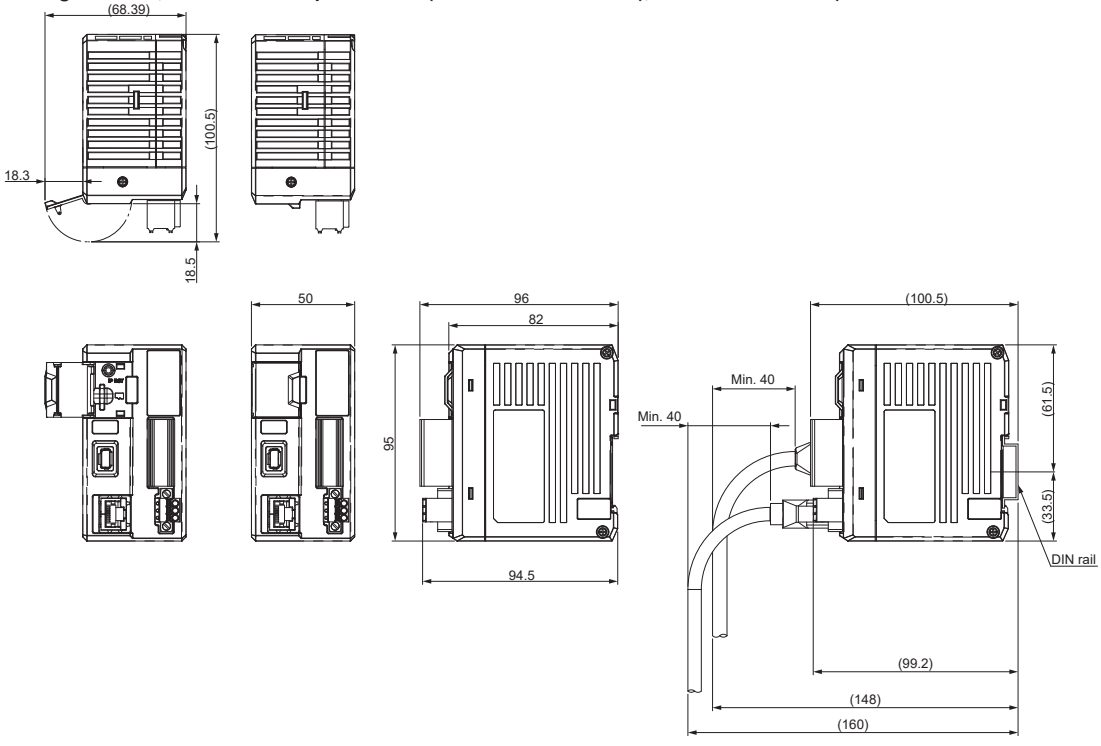
* Strut ϕ12 is not supplied with the OP-87910

Ultra-compact Model Sensor Amplifier (IV4-G120)

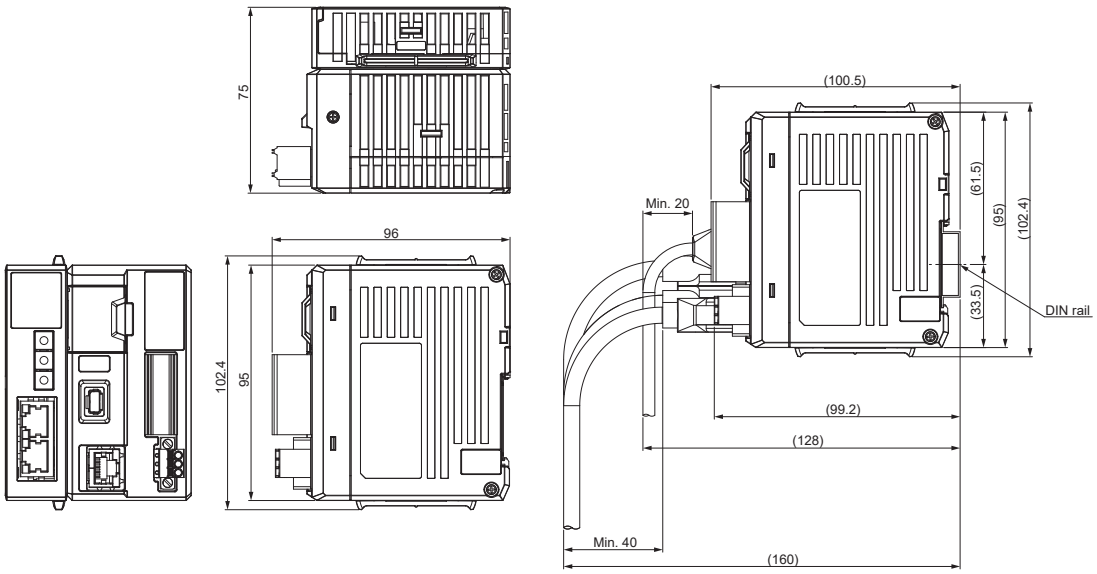
- **Including sensor head/amplifier cable (OP-88648/88649/88650) and Ethernet cable (OP-88835/88836/88837/88838)**



- **Including IV4-G120, sensor head/amplifier cable (OP-88962/88963/88964), and Ethernet cable (OP-88835/88836/88837/88838)**



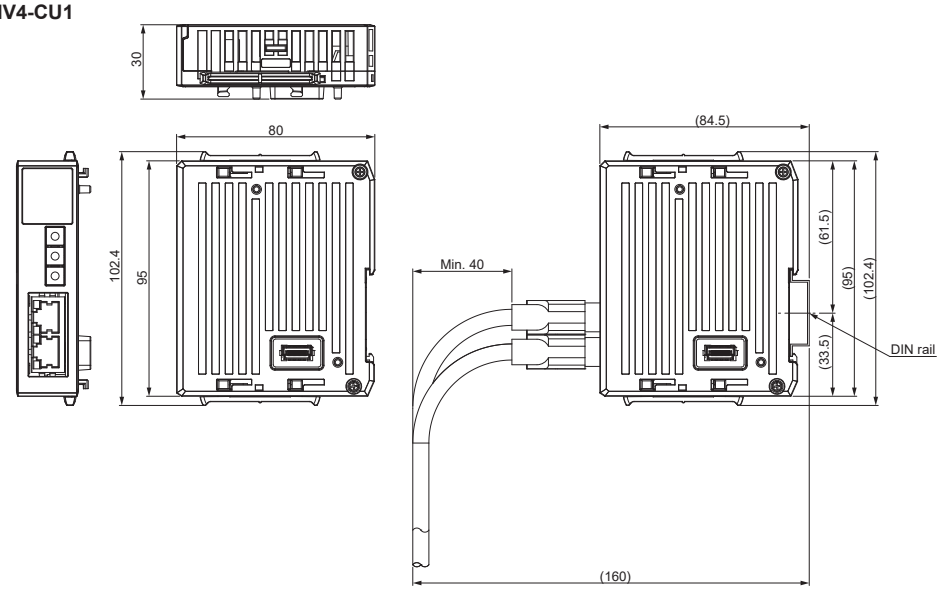
- **Including IV4-G120, sensor head/amplifier cable (OP-88962/88963/88964), and communication unit (IV4-GCU1)**



Options for the ultra-compact model

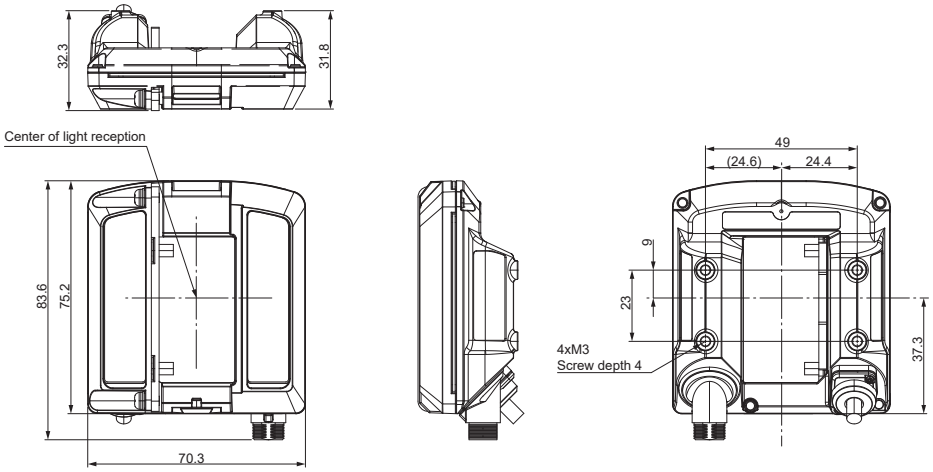
Communication unit

• **IV4-CU1**



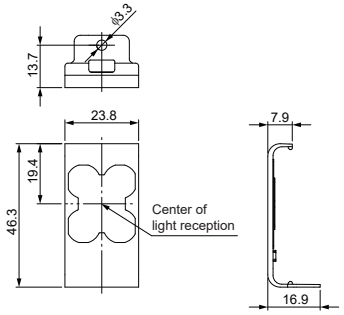
AI Lighting unit

• **IV4-LG4C/IV4-LG4M/IV4-LG5C/IV4-LG5M/IV4-LG6C/IV4-LG6M**

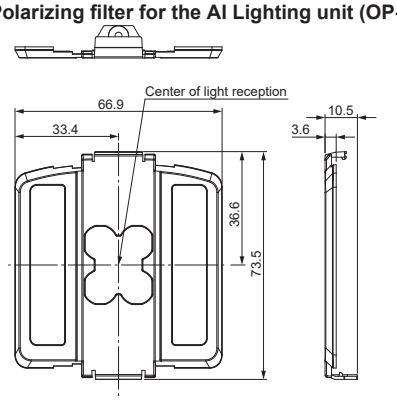


Polarizing filter

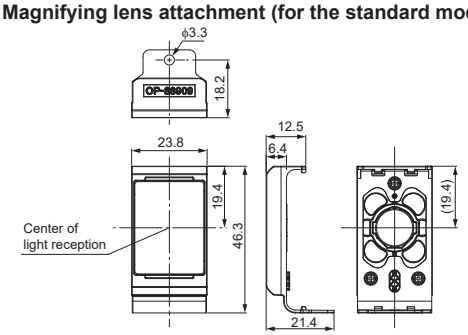
• **Polarizing filter (OP-88642/OP-88643)**



• **Polarizing filter for the AI Lighting unit (OP-88646/OP-88647)**

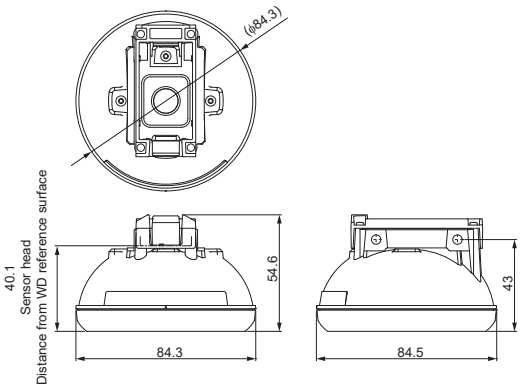


• **Magnifying lens attachment (for the standard model) (OP-88909)**

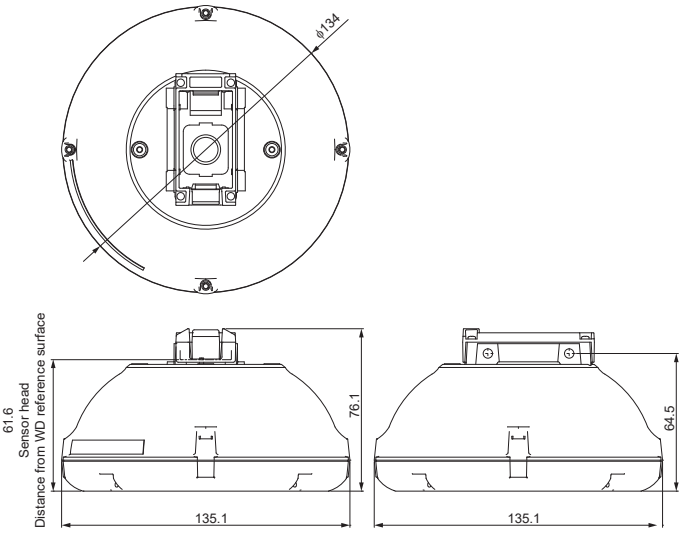


Dome attachment

• **IV2-GD05**

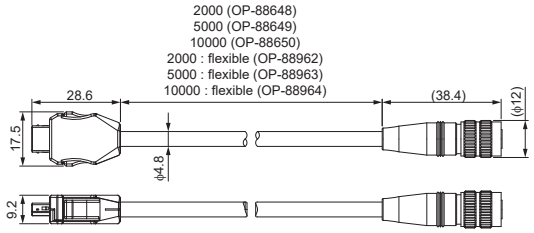


• **IV2-GD10**



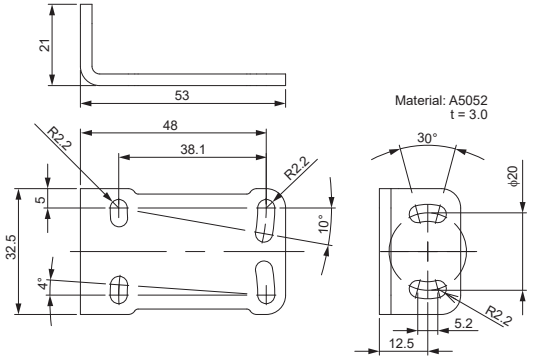
Sensor head/amplifier cable

- OP-88648 (2 m)
- OP-88649 (5 m)
- OP-88650 (10 m)
- OP-88962 (2 m: flexible)
- OP-88963 (5 m: flexible)
- OP-88964 (10 m: flexible)



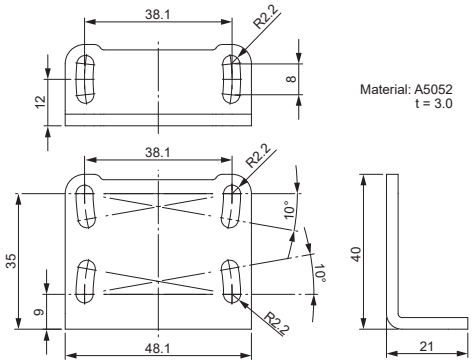
Vertical mounting bracket

- OP-87908



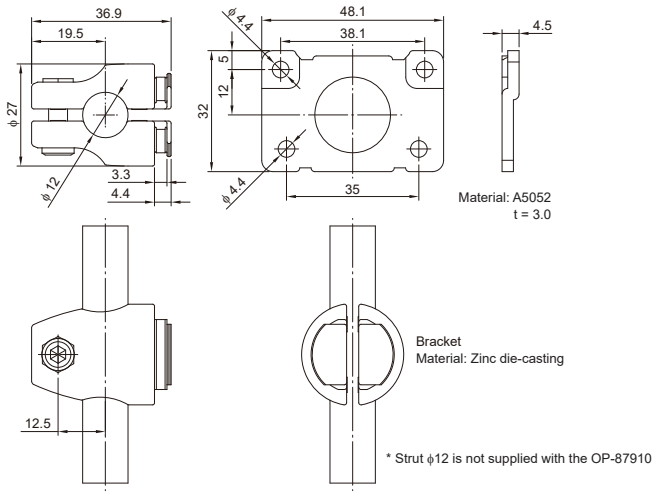
Rear mounting bracket

- OP-87909



Adjustable bracket

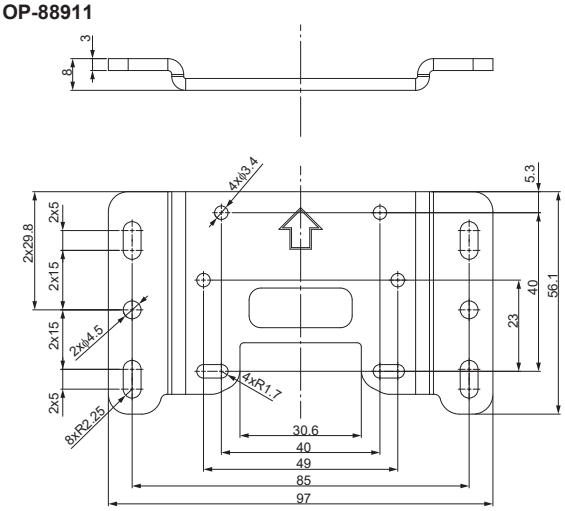
- OP-87910



* Strut φ12 is not supplied with the OP-87910

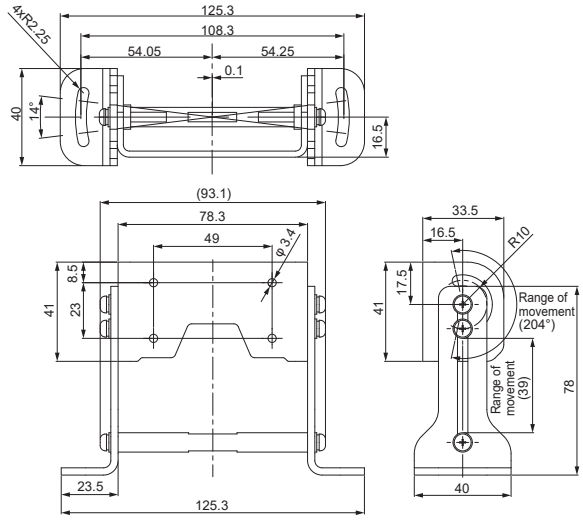
Common mounting bracket (common to built-in amplifier type)

- OP-88911



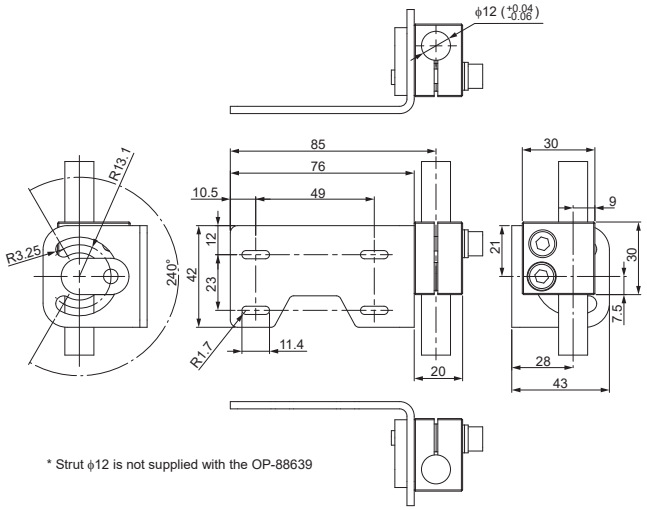
2-axis adjustment mounting bracket for the AI Lighting unit

- OP-88638



Adjustable bracket for the AI Lighting unit

- OP-88639

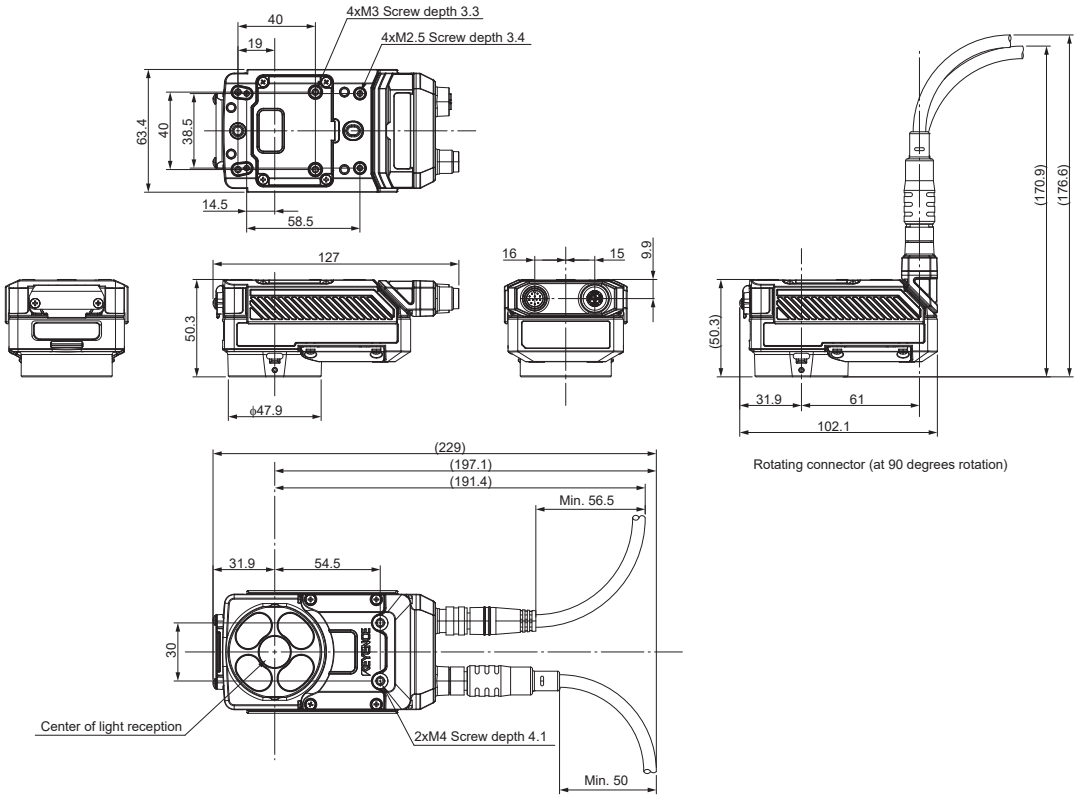


* Strut φ12 is not supplied with the OP-88639

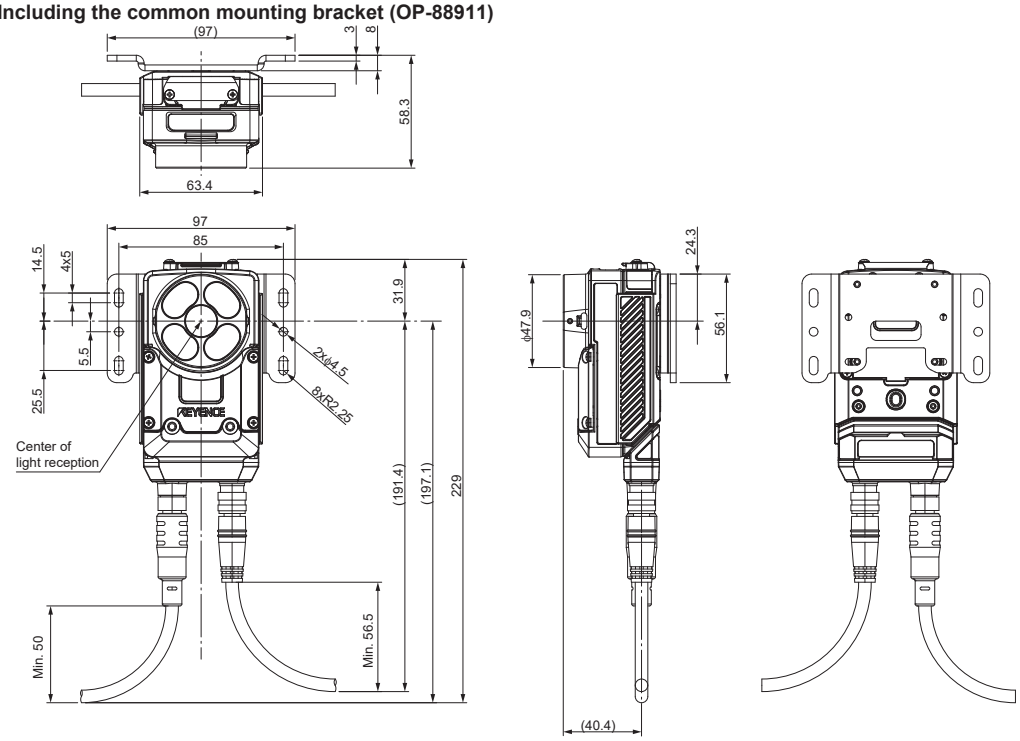
Built-in amplifier type

Built-in amplifier model sensor (IV4-400CA/400MA/500CA/500MA/600CA/600MA)

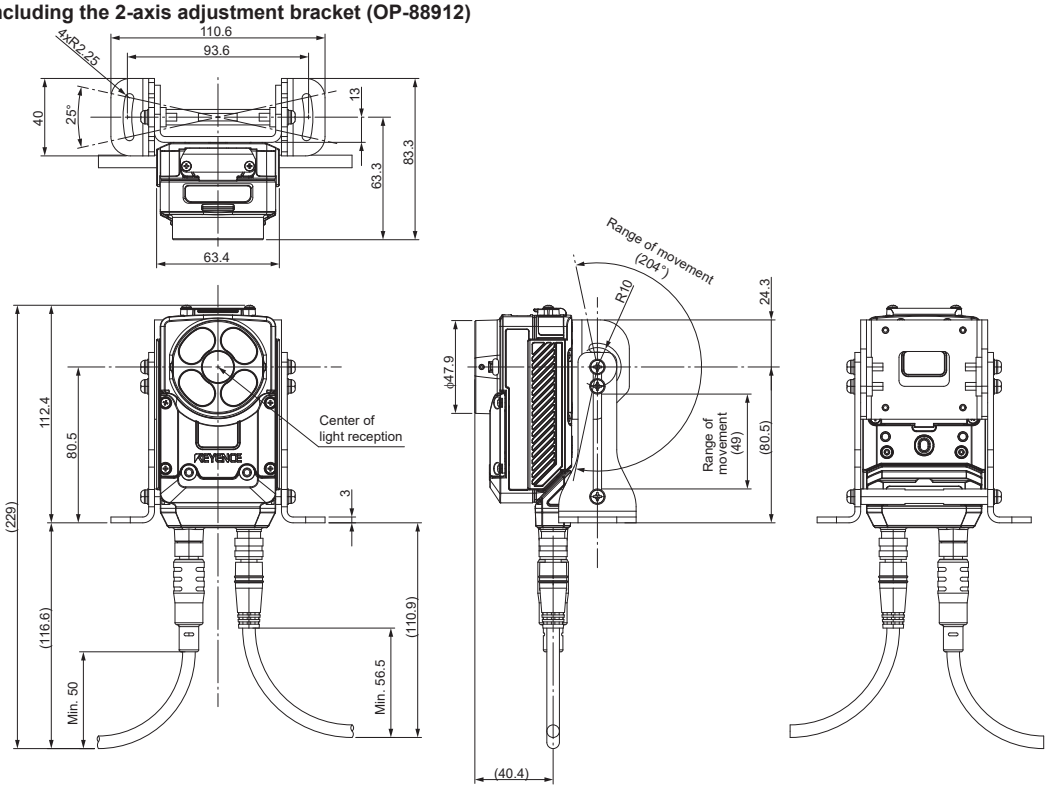
- **Sensor**



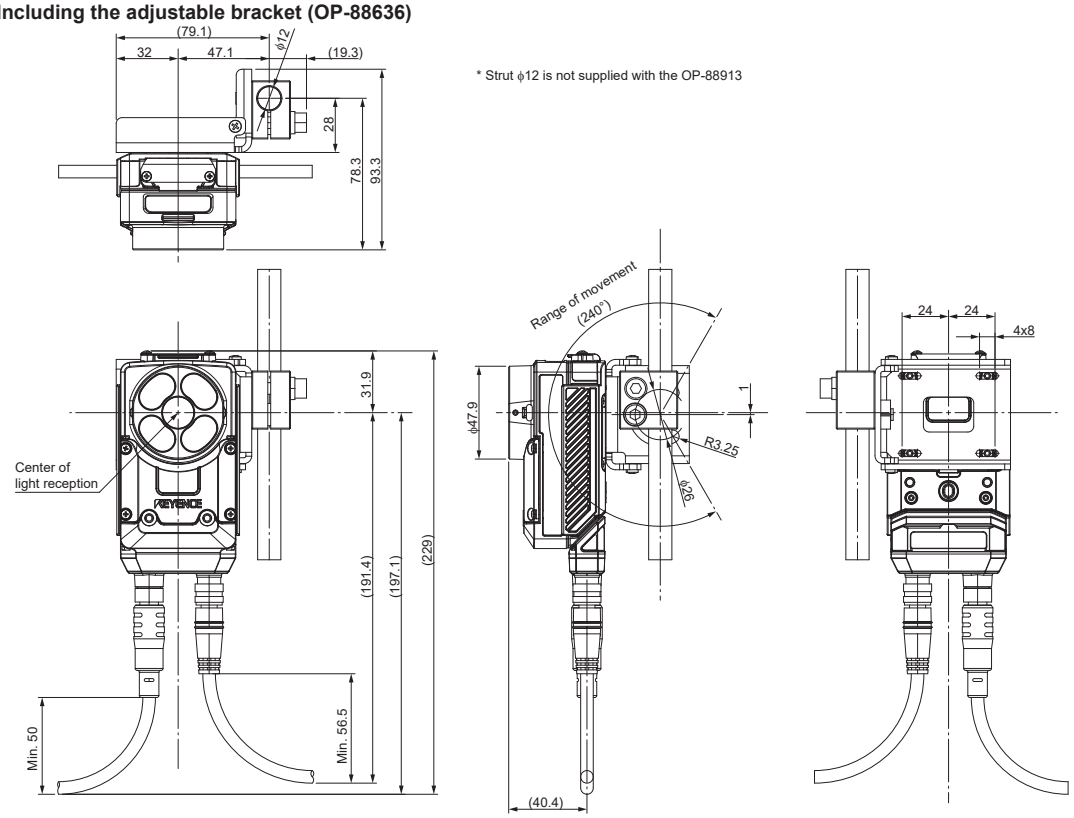
- **Including the common mounting bracket (OP-88911)**



• **Including the 2-axis adjustment bracket (OP-88912)**

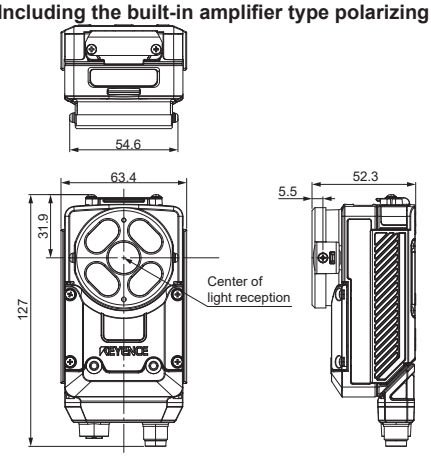


• **Including the adjustable bracket (OP-88636)**

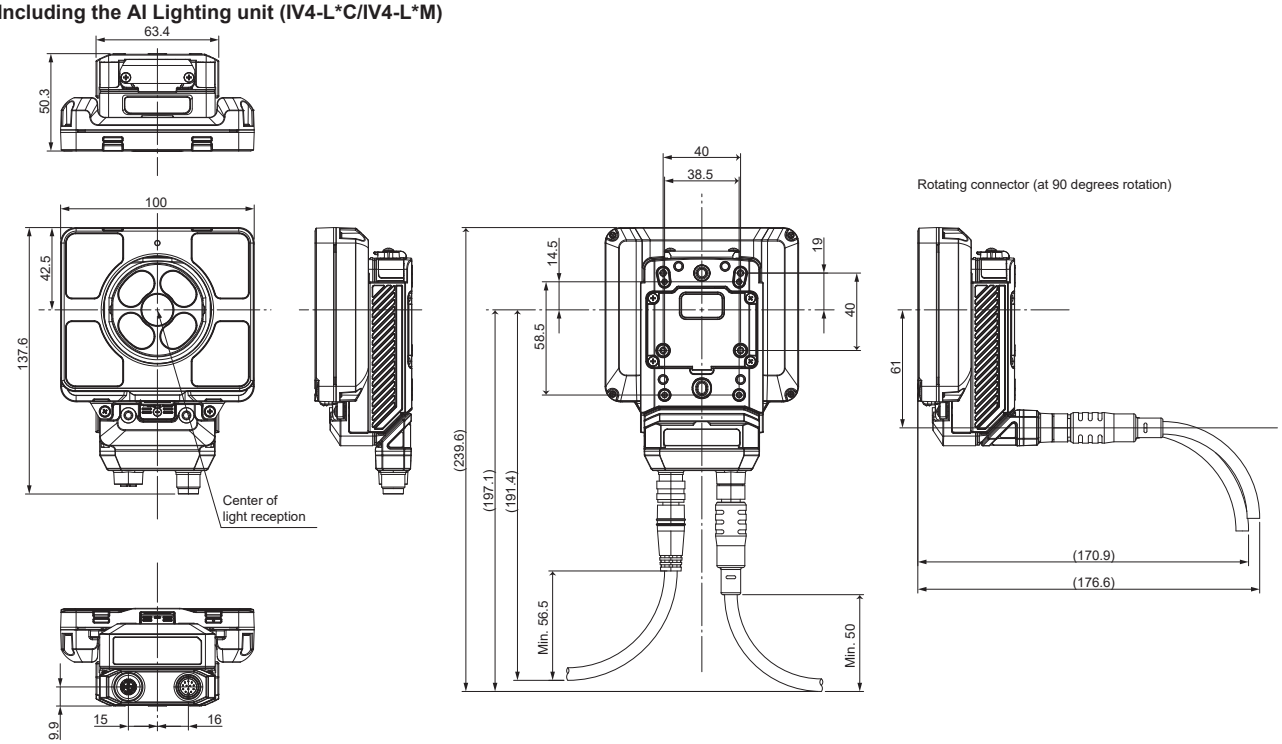


* Strut ϕ12 is not supplied with the OP-88913

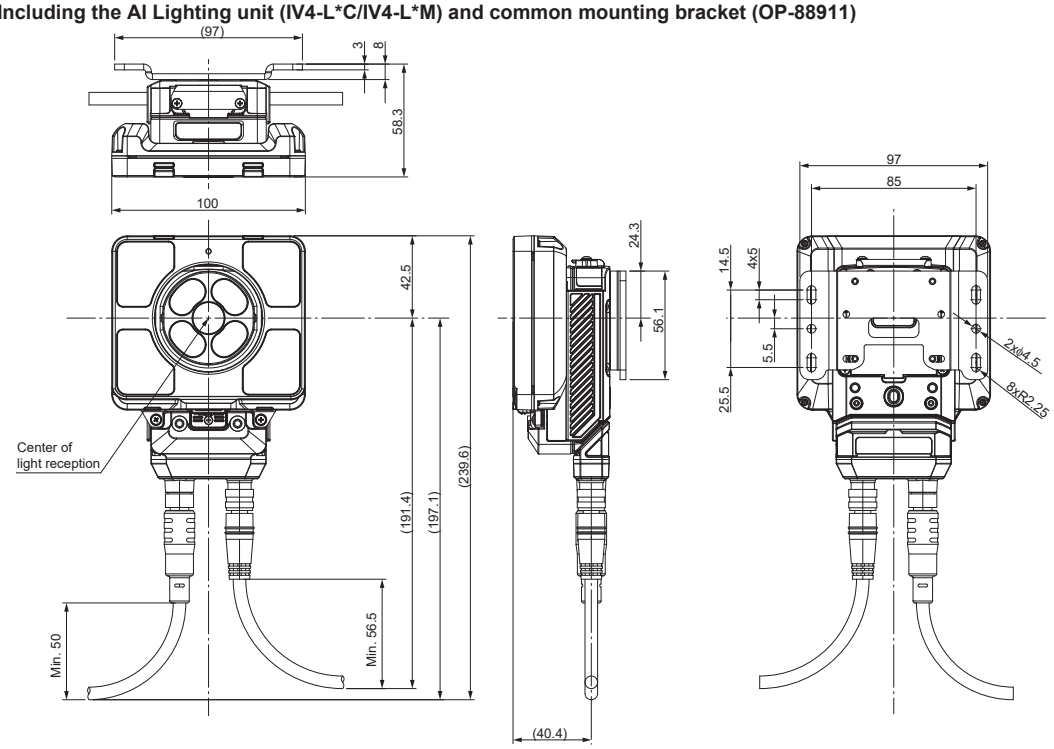
- **Including the built-in amplifier type polarizing filter (OP-88640/OP-88641)**



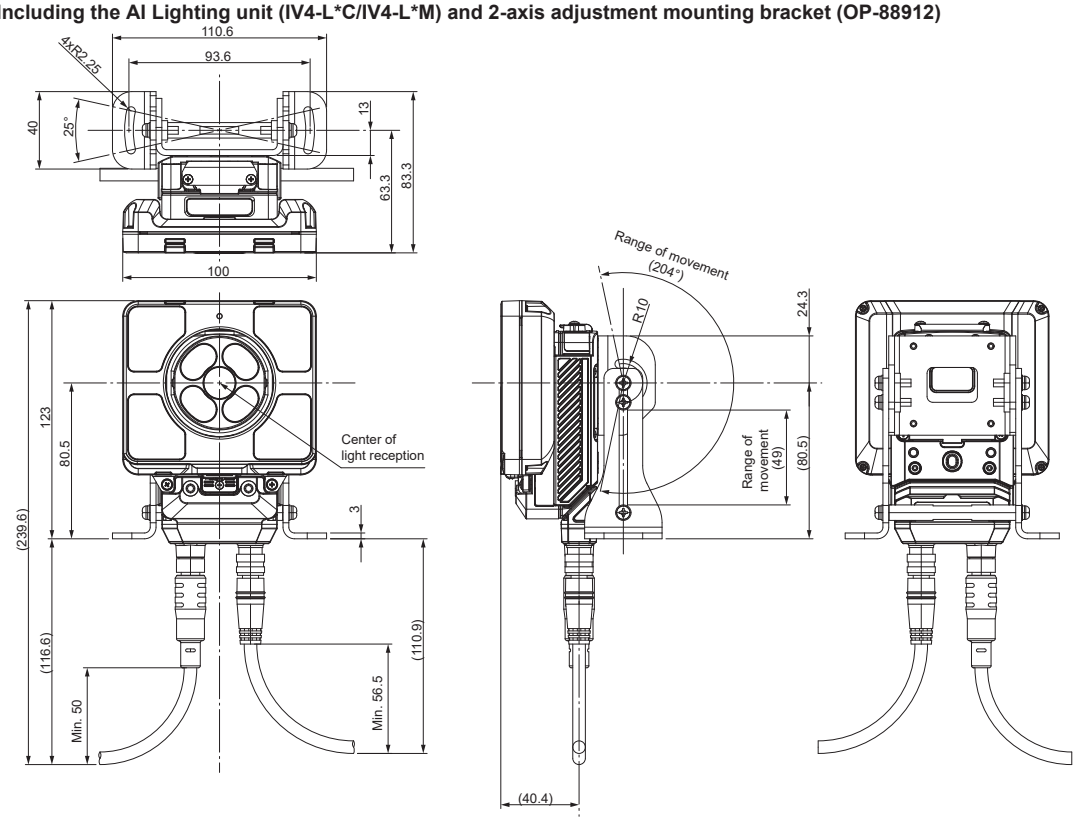
- **Including the AI Lighting unit (IV4-L*C/IV4-L*M)**



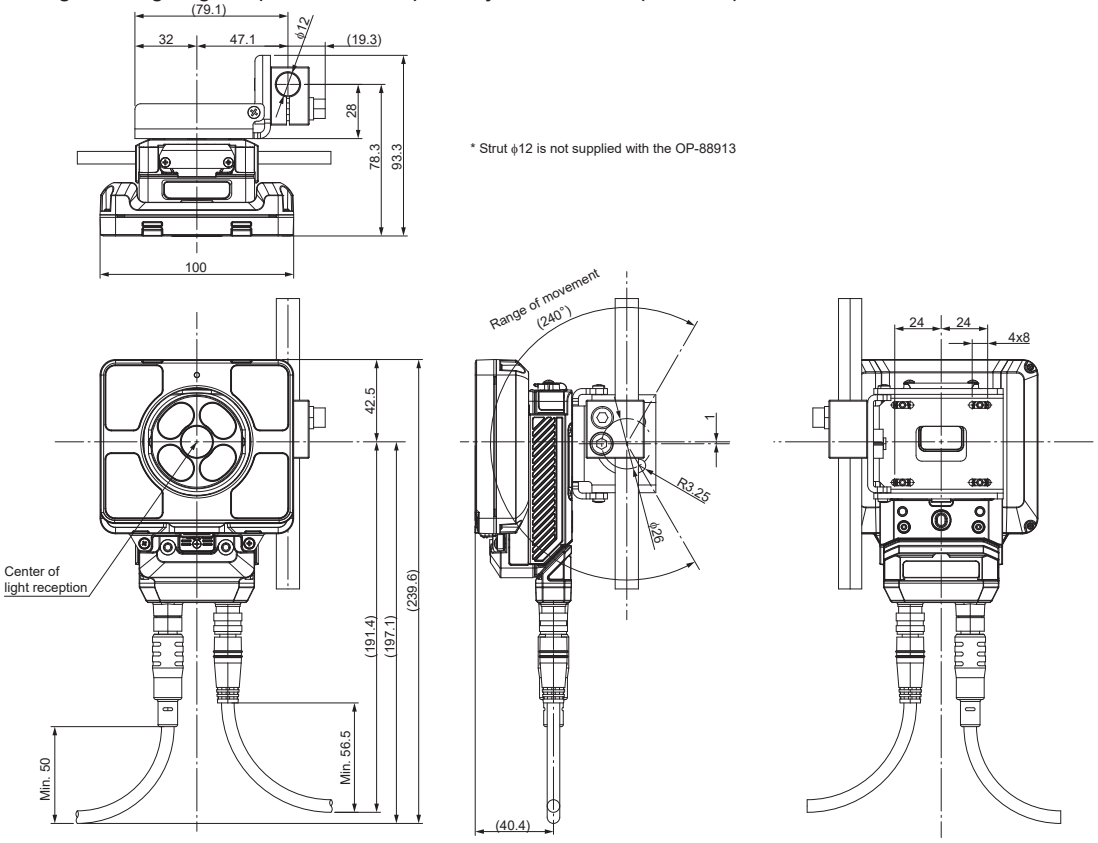
- **Including the AI Lighting unit (IV4-L*C/IV4-L*M) and common mounting bracket (OP-88911)**



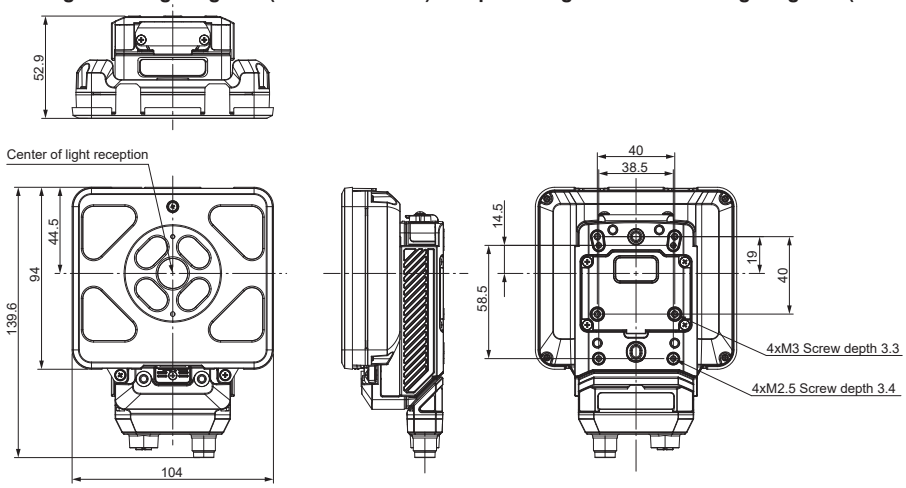
• **Including the AI Lighting unit (IV4-L*C/IV4-L*M) and 2-axis adjustment mounting bracket (OP-88912)**



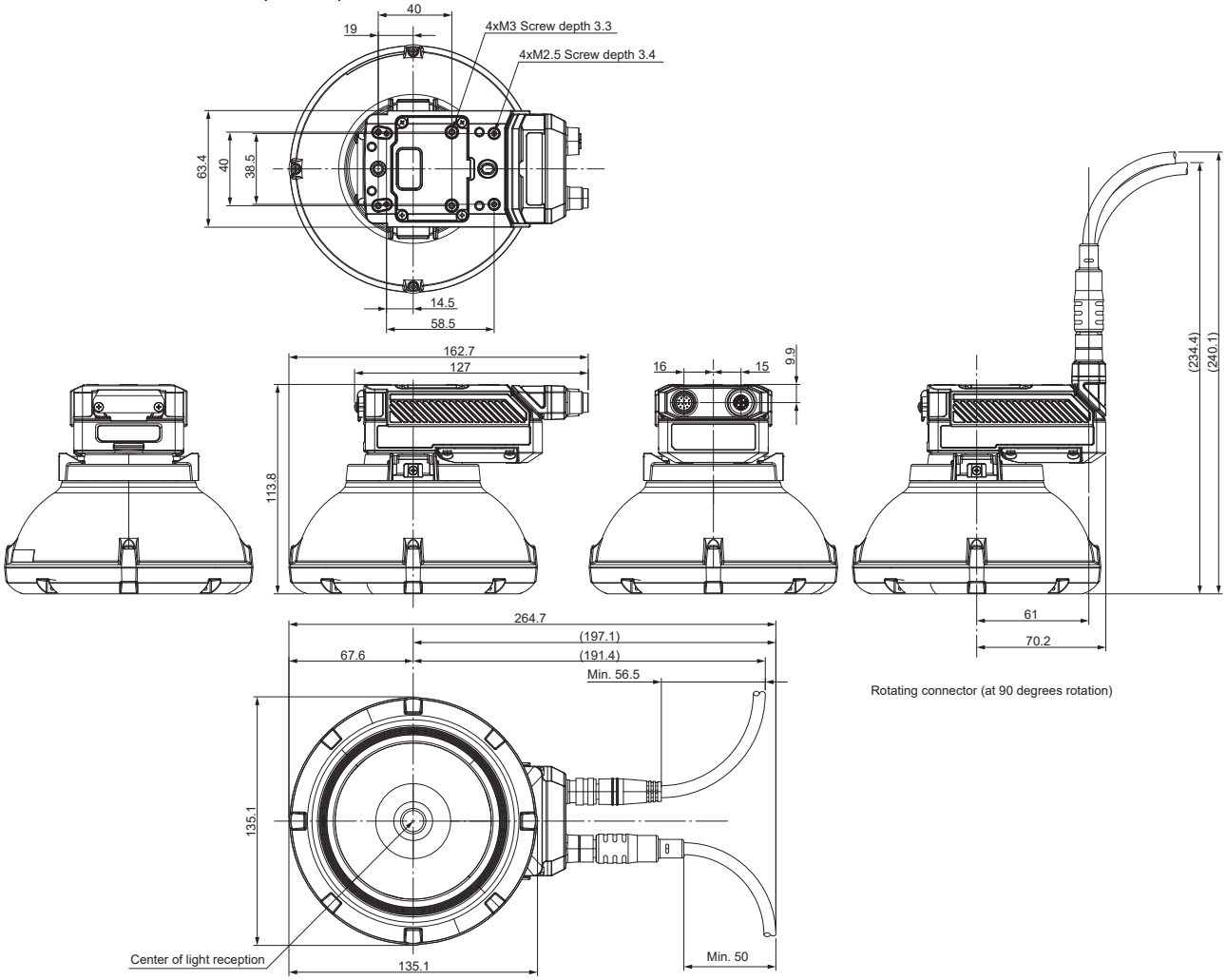
• **Including the AI Lighting unit (IV4-L*C/IV4-L*M) and adjustable bracket (OP-88913)**



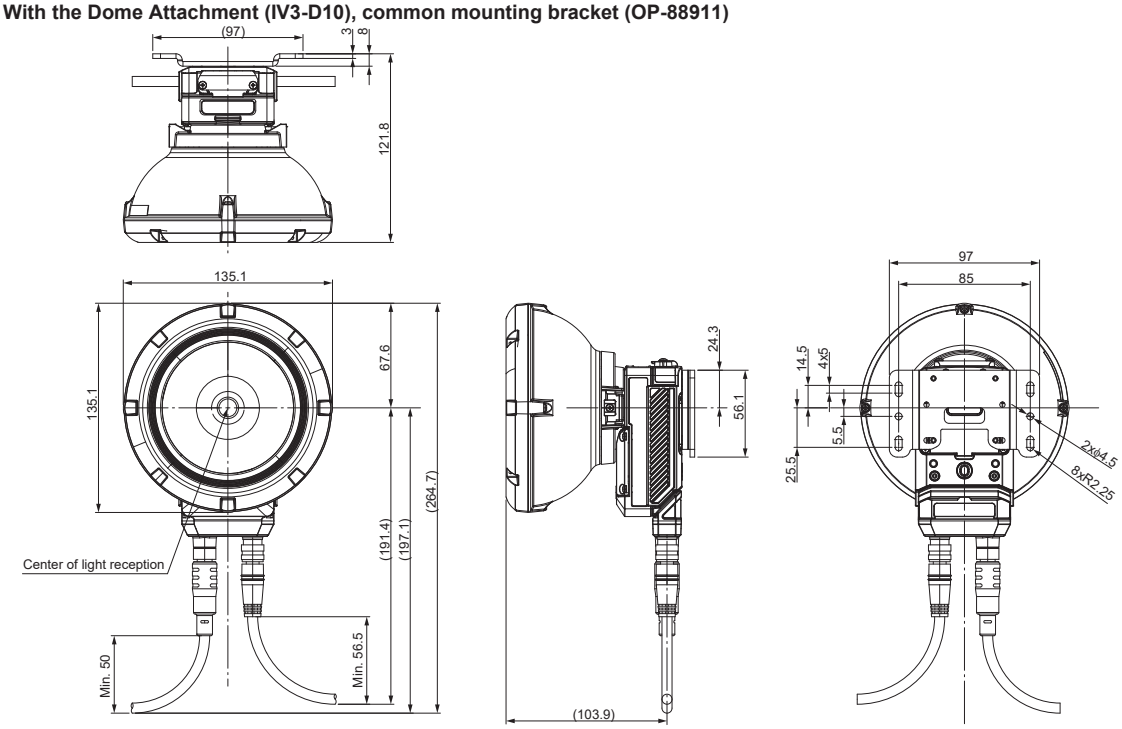
- **Including the AI Lighting unit (IV4-L*C/IV4-L*M) and polarizing filter for the AI Lighting unit (OP-88644/OP-88645)**



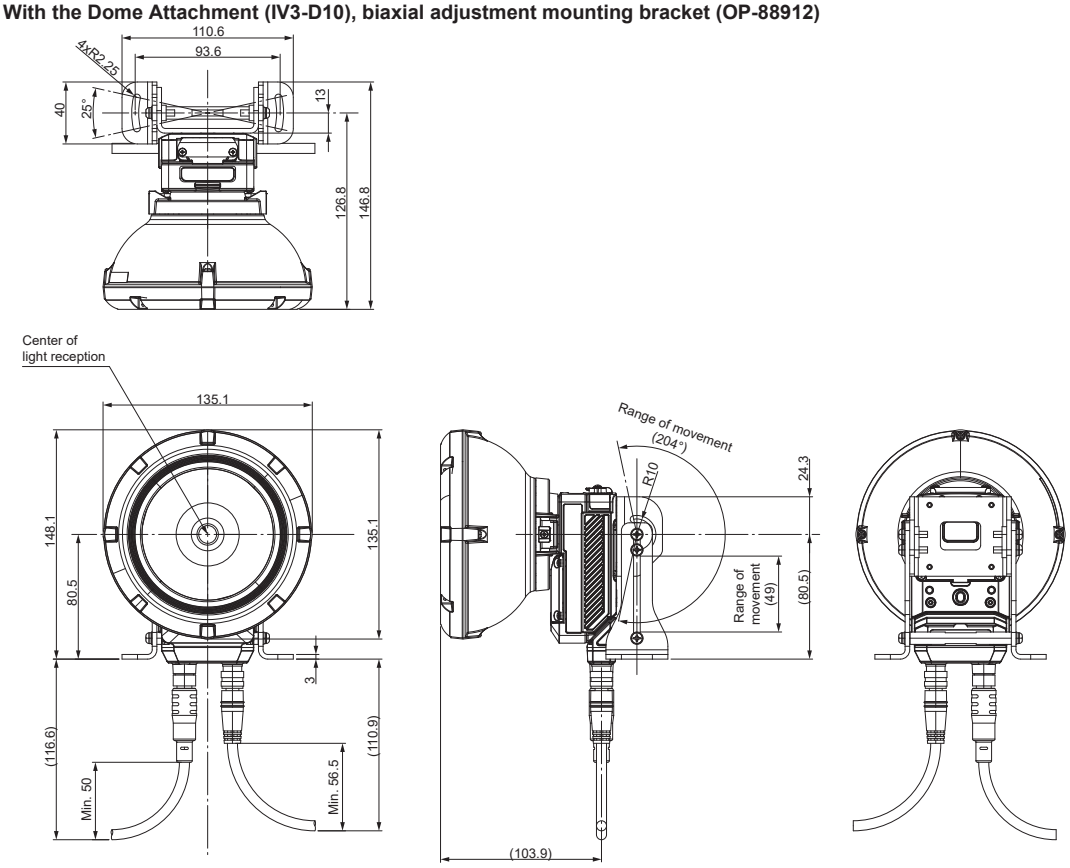
- **With the Dome Attachment (IV3-D10)**



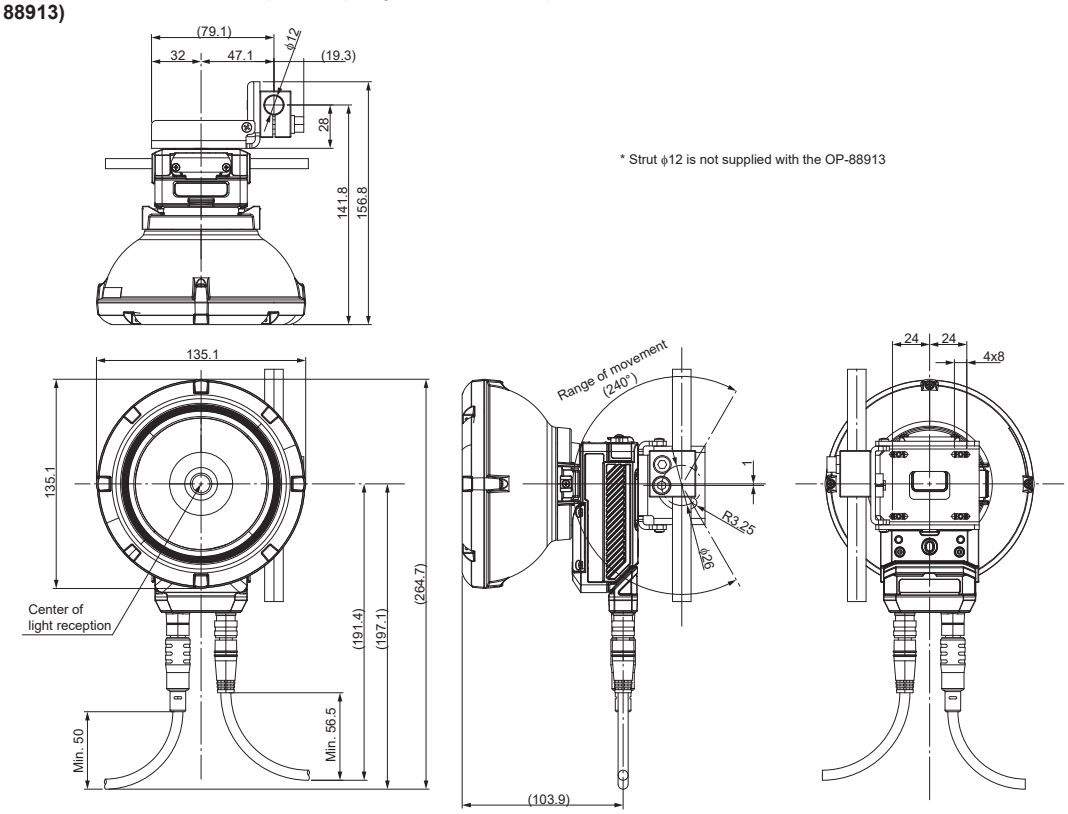
• **With the Dome Attachment (IV3-D10), common mounting bracket (OP-88911)**



• **With the Dome Attachment (IV3-D10), biaxial adjustment mounting bracket (OP-88912)**

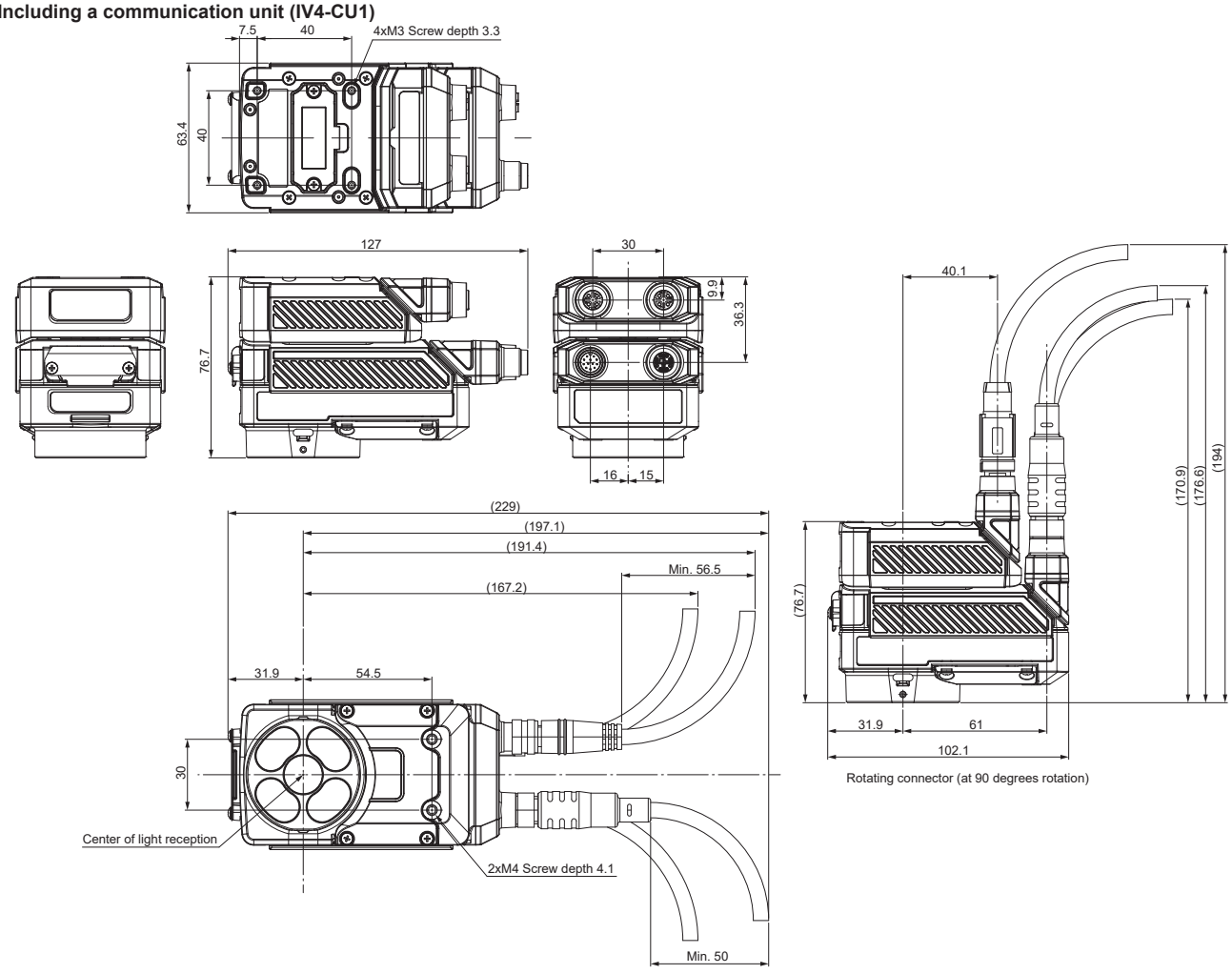


- **With the Dome Attachment (IV3-D10), adjustable bracket (OP-88913)**



* Strut ϕ12 is not supplied with the OP-88913

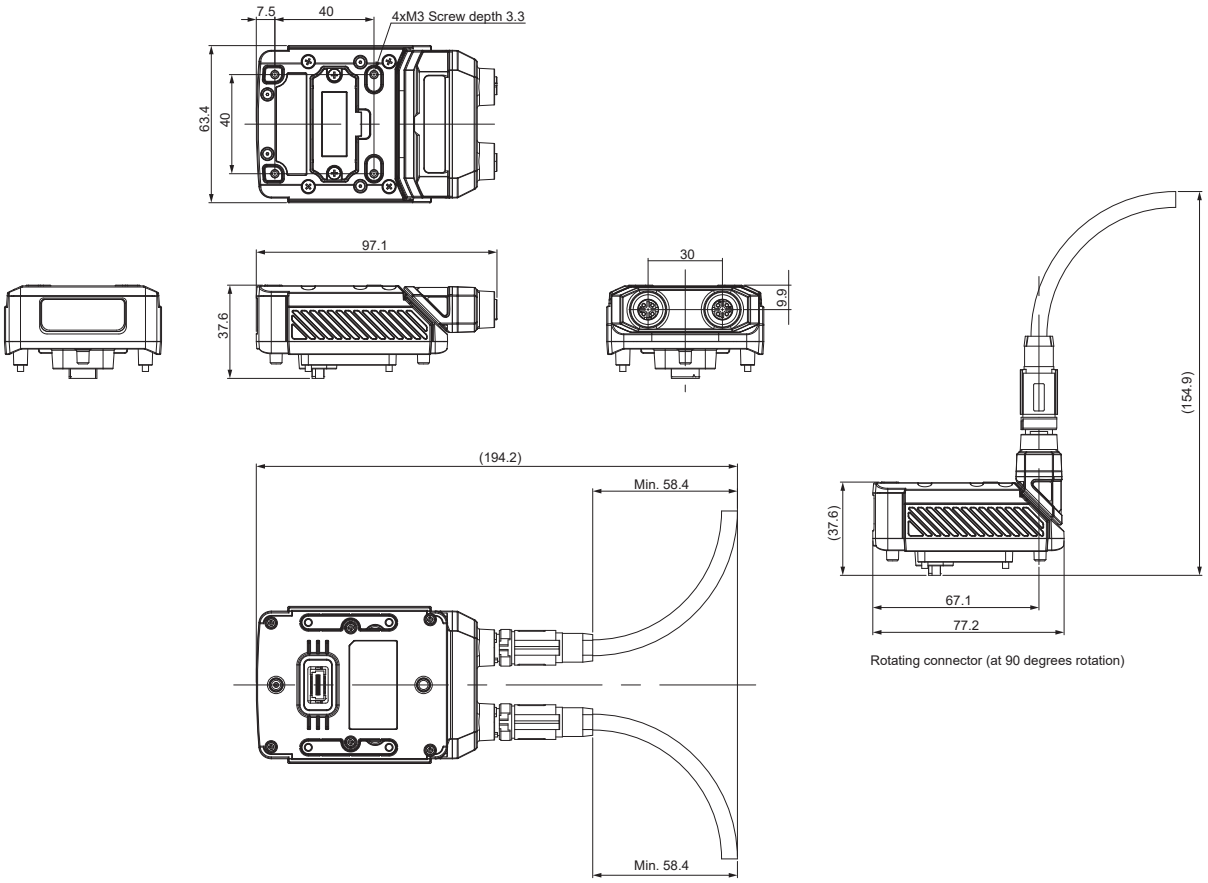
- **Including a communication unit (IV4-CU1)**



Options for the built-in amplifier type

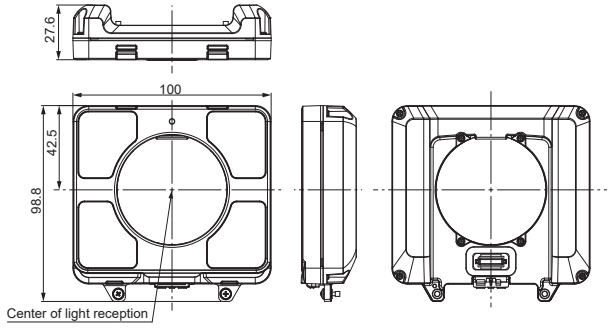
Communication unit

• **IV4-CU1**



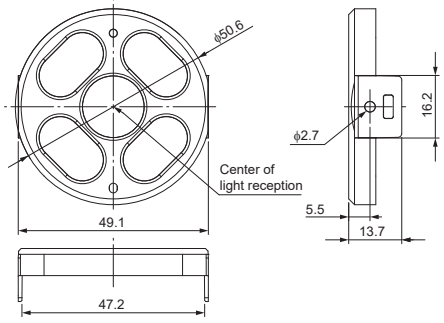
AI Lighting unit

• **IV4-L4C/IV4-L4M/IV4-L5C/IV4-L5M/IV4-L6C/IV4-L6M**

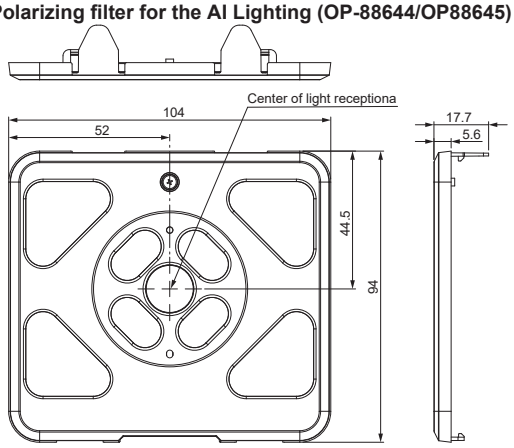


Polarizing filter

• **Polarizing filter (OP-88640/OP-88641)**

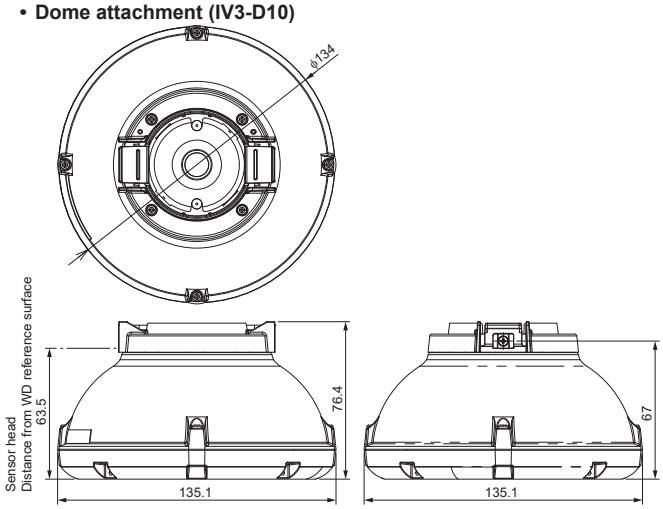


• **Polarizing filter for the AI Lighting (OP-88644/OP88645)**



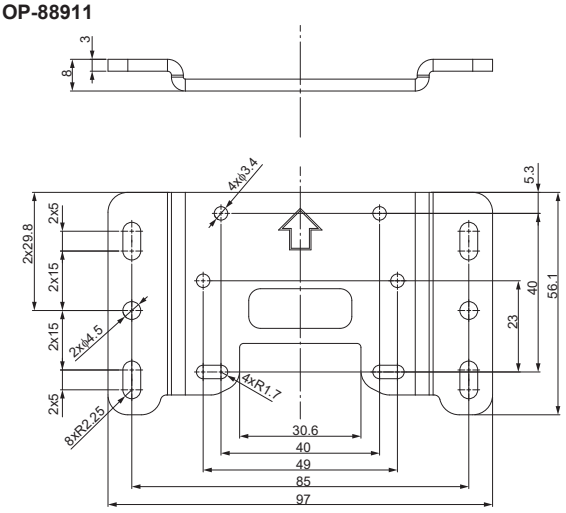
Dome attachment for the built-in amplifier model

• Dome attachment (IV3-D10)



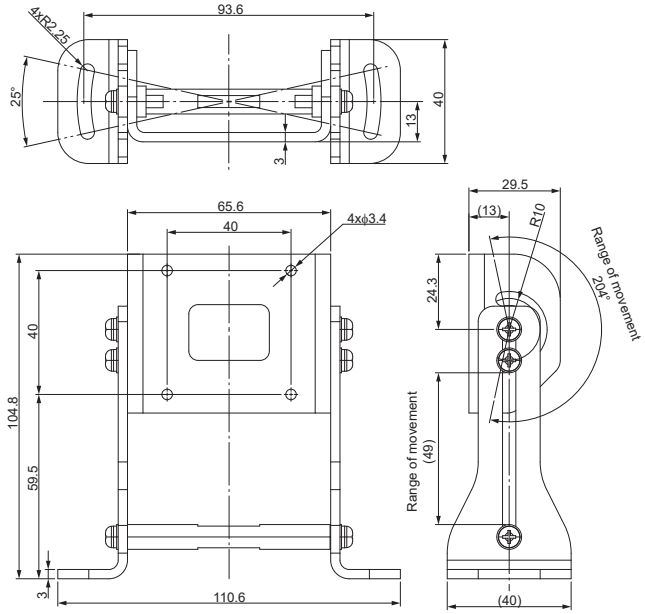
Common mounting bracket (common to all ultra-compact models)

• OP-88911



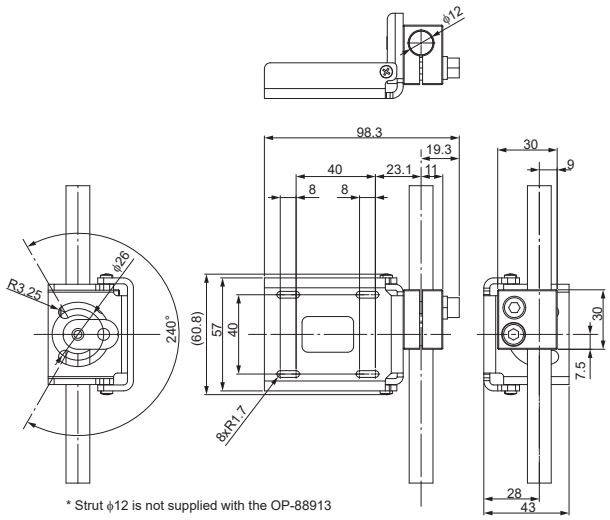
2-axis adjustment mounting bracket

• OP-88912



Adjustable bracket

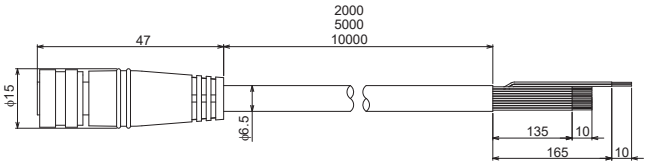
• OP-88913



* Strut ϕ12 is not supplied with the OP-88913

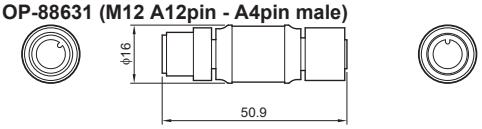
Power I/O cable

• OP-88654 (2m) • OP-88655 (5m) • OP-88656 (10m)

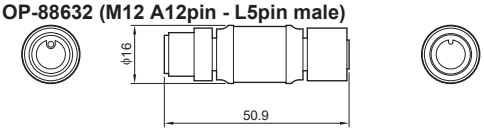


Conversion connector for power I/O cable

• OP-88631 (M12 A12pin - A4pin male)

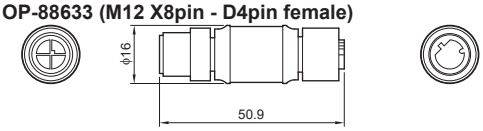


• OP-88632 (M12 A12pin - L5pin male)



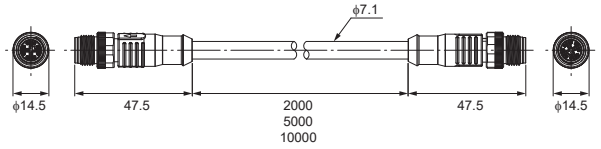
Conversion connector for the Ethernet cable

• OP-88633 (M12 X8pin - D4pin female)



Ethernet cable (M12 X8pin - M12 X8pin)

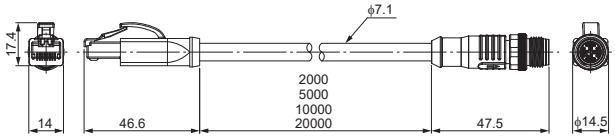
• OP-88831 (2 m) • OP-88832 (5 m) • OP-88833 (10 m)



Ethernet cable (M12 X8pin - RJ45)

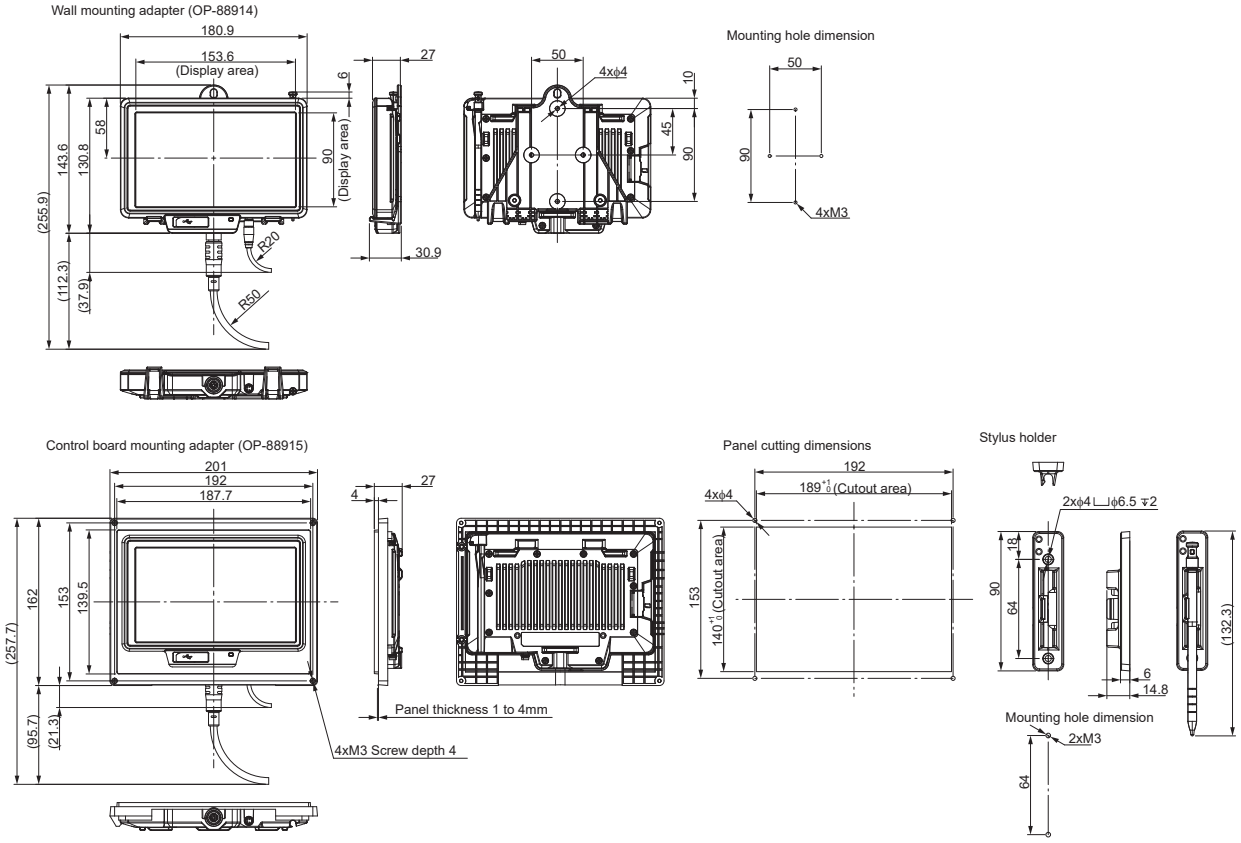
• OP-88835 (2 m) • OP-88836 (5 m)

• OP-88837 (10 m) • OP-88838 (20 m)



Control panel

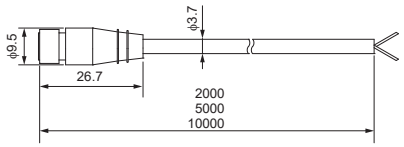
IV4-CP70



Control panel options

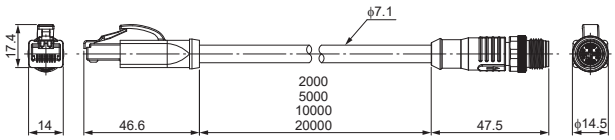
Panel/Monitor power cable (M8 4pin - strand wire)

- OP-87443 (2m)
- OP-87444 (5m)
- OP-87445 (10m)



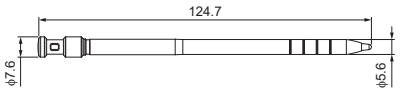
Ethernet cable (M12 X8pin - RJ45)

- OP-88835 (2 m)
- OP-88836 (5 m)
- OP-88837 (10 m)
- OP-88838 (20 m)



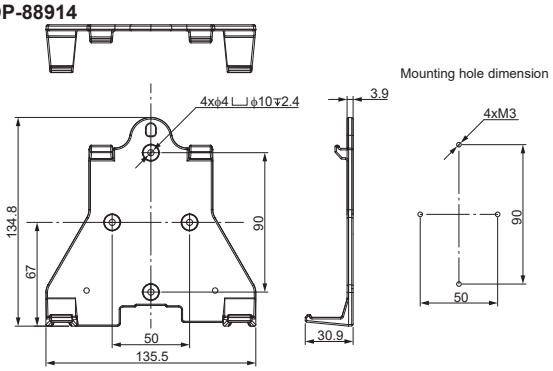
Stylus

- OP-88352



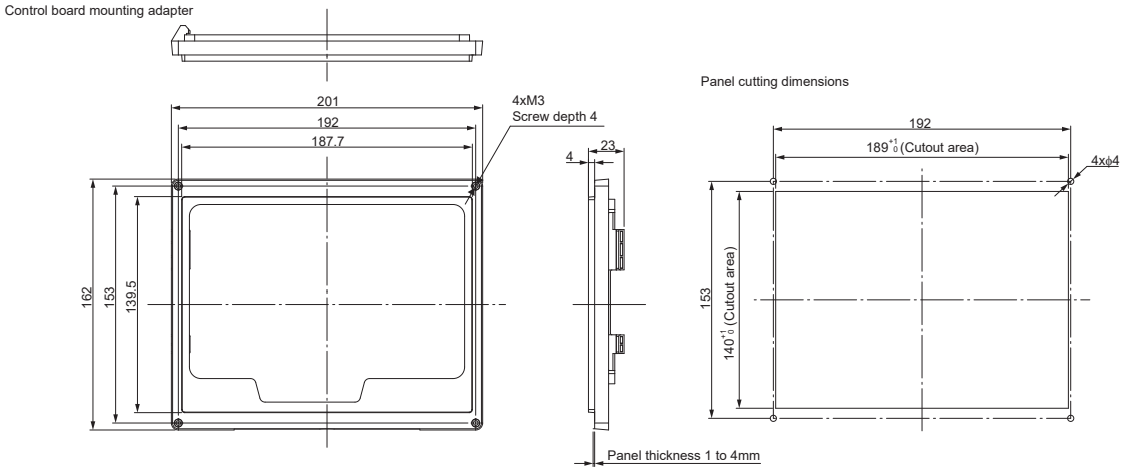
Wall mounting adapter

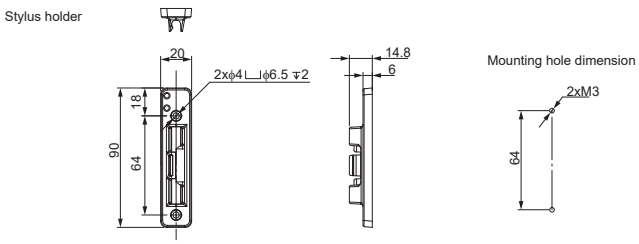
- OP-88914



Control board mounting bracket

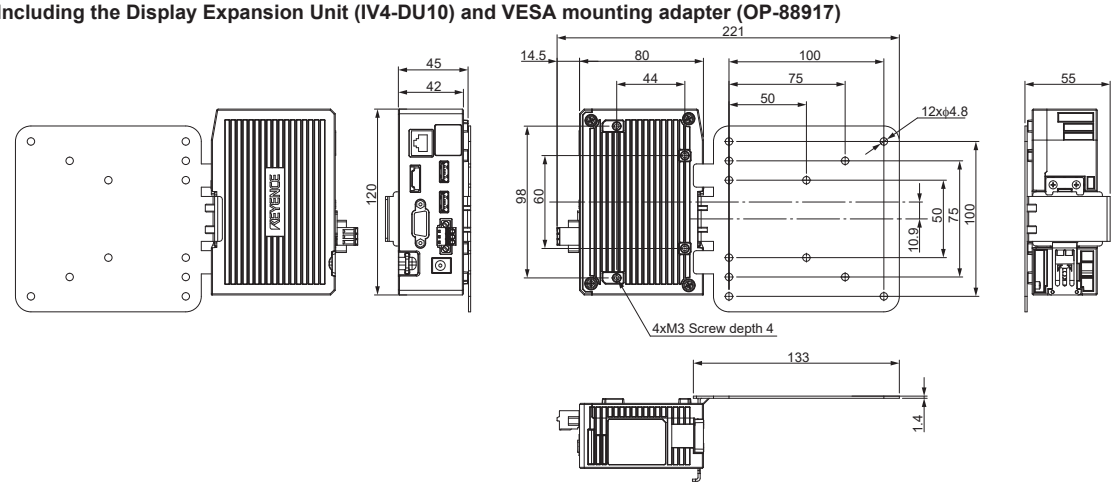
- OP-88915



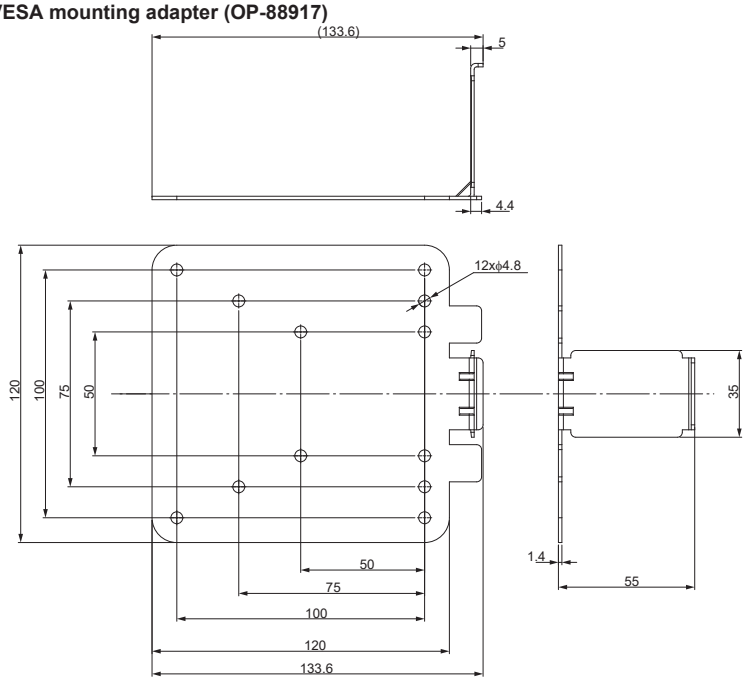


Display expansion unit

• **Including the Display Expansion Unit (IV4-DU10) and VESA mounting adapter (OP-88917)**



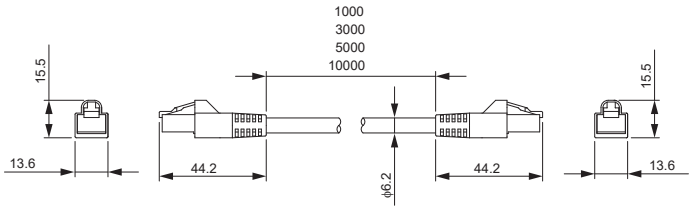
• **VESA mounting adapter (OP-88917)**



Communication cable

LAN cable

• **OP-87950 (1 m)** • **OP-87951 (3 m)** • **OP-87952 (5 m)** • **OP-87953 (10 m)**



MEMO

Appendices

Status Table A-2
Matching Rate of the Outline Tool and Position Adjustment Tool A-6
Troubleshooting A-7
Error Messages A-9
Remedy when data transfer to the SD card is unavailable A-17
Remedy when the Software cannot be Connected with the Sensor A-18
Initializing the Network Settings (IP Reset Switch) A-25
Functional differences when an IV3-Series sensor is connected A-26

Status Table

Status Table

Status			Screen type	Sensor (built-in amplifier)/ Sensor amplifier (ultra-compact model) indicator light				
				PWR/ERR (Ultra-compact model)	Status indicator light (built-in amplifier type) (ultra-compact model head part)	OUT	TRIG	
Starting up			-	Lighting (green)	Blink (green)	Blink (green)	OFF	
Running*2	Waiting for a trigger		RUN	Lighting (green)	*3	*3	OFF	
	Judgment processing						*5	
	Switching programs				*9	*9	OFF	
	Registering the external master image							
Setting	Limit Adjustment		TEST	Blink (green)	Blink (green)	OFF	*5	
	Trigger Options, Master Registration, etc.		LIVE					
	Capturing AI/Automatically adjusting the brightness						*13	
	Setup Adjustment						*14	
	I/O Monitor		-				OFF	
	Others							
Error	Trigger error	Running	RUN	Blink (red)	Blink (red)	Same as normal		
		Setting	LIVE					
	External master registration error		-					
	System error			Lighting (red)		OFF	OFF	
	Startup memory readout error							

✓/× indicates enable/disable of the input.
ON/OFF indicates the following status. The operation differs according to the output setting (N.O./N.C).
- When N.O. ON : Indicates ON for output.
  OFF : Indicates OFF for output.
- When N.C. ON : Indicates OFF for output.
  OFF : Indicates ON for output.

*1 Turns ON if the judgment is OK. Turns OFF if it is NG.
When the total status result is OK, the total status output turns ON.
When the total status result is NG, the total status NG output turns ON.
The total status conditions can be selected from [All Tools OK], [Any Tool OK] and [Logic 1] to [Logic 8].
“Total Status Conditions” (page 4-90)
When the position adjustment is NG, the status of each tool becomes NG.
*2 The sensor continues running even during the operation of the [Panel Settings]/[Run/Learned Img. History] screen in the run screen.
*3 Indicates the overall status result of the previous judgment process. OK: Lighting (green), NG: Lighting (red)
*4 Outputs the status result of the previous judgment process.
*5 Lights up (one-shot) according to the input of a trigger (external/internal/AI trigger).
*6 Disregards the input. A trigger error occurs.
*7 Stops the judgment process and switches over.
*8 Stops the judgment process and registers the previously taken image as a master image.
*9 Turns off the light before the process is completed. Until the light turns off, the previous status result will be displayed.
*10 After the current process is completed, a new input begins.
*11 Do not use. The processing order becomes indeterminate.
*12 Turns OFF before the process is completed. Outputs the previous status result until this turns OFF.
*13 The internal trigger is issued automatically and the image is updated. The Busy output operates.
*14 The internal trigger is issued automatically and the image is updated.
*15 While the I/O monitor function is used, only the operation of the I/O lines is confirmed. The assigned functions will not operate.
*16 The output turns OFF regardless of the output settings (N.O./N.C.) and the polarity (NPN/PNP) settings.

Reference Additionally, refer to “Chapter 11 Controlling with the Input/Output Line” (page 11-1).

<table>
<tr><th></th><th colspan="4">Input</th><th colspan="4">Output</th></tr>
<tr><th></th><th>External trigger</th><th>Switching programs</th><th>External master image registration</th><th>Clear Error</th><th>BUSY</th><th>Total Status / Total Status NG / Each Tool / Each Logic / Part Type / Pos. Adj.*1</th><th>RUN</th><th>Error</th></tr>
<tr><td></td><td>×</td><td>×</td><td>×</td><td>×</td><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td></tr>
<tr><td></td><td>✓</td><td>✓</td><td>✓</td><td rowspan="4">×</td><td>OFF</td><td rowspan="2">*4</td><td rowspan="4">ON</td><td rowspan="4">OFF</td></tr>
<tr><td></td><td rowspan="3">*6</td><td>*7</td><td>*8</td><td rowspan="3">ON</td></tr>
<tr><td></td><td>*10</td><td>*11</td><td>*12</td></tr>
<tr><td></td><td>*11</td><td>*10</td></tr>
<tr><td></td><td>✓</td><td rowspan="3">×</td><td rowspan="3">×</td><td rowspan="3">×</td><td>Same as while running</td><td rowspan="3">OFF</td><td rowspan="4">OFF</td><td rowspan="3">OFF</td></tr>
<tr><td></td><td rowspan="2">×</td><td>*13</td></tr>
<tr><td></td><td>OFF</td></tr>
<tr><td></td><td>*15</td><td>←</td><td>←</td><td>←</td><td>←</td><td>←</td><td>←</td></tr>
<tr><td></td><td>×</td><td>×</td><td>×</td><td>×</td><td>OFF</td><td>OFF</td><td>OFF</td></tr>
<tr><td></td><td colspan="3">Same as normal</td><td>✓</td><td colspan="3">Same as normal</td><td rowspan="2">ON</td></tr>
<tr><td></td><td rowspan="2">×</td><td rowspan="2">×</td><td rowspan="2">×</td><td rowspan="2">×</td><td>OFF</td><td>OFF</td><td rowspan="2">OFF</td></tr>
<tr><td></td><td>*16</td><td>*16</td><td>*16</td></tr>
</table>

A

Displaying and outputting the status result

Status	Status of the tool/part type			Total Status[*2]		
	Displayed		Output	Displayed	Total Status OK Output	Total Status NG Output
	Judgment	Matching rate[*1]				
Waiting for a trigger (Not judged)[*3]	--	---	OFF	--	OFF[*7]	OFF[*7]
Judge is OK	OK[*5]	0 to 100	ON	OK[*6]	ON[*7]	OFF[*7]
Judge is NG	NG	0 to 100	OFF	NG	OFF[*7]	ON[*7]
Unable to judge[*4]	--	---	OFF	NG	OFF[*7]	ON[*7]

*1 • When the setting scale is changed for the Color Area/Area tool, 0 to 200/0 to 999 can be selected.
• When the setting scale is changed for the Width/Diameter/Pitch tool, 0 to 100/0 to 999 can be selected.
• The matching rate of the Edge tool is the number of detected edges. The scales shown below can be selected.
0 to 2/0 to 5/0 to 10/0 to 20/0 to 50/0 to 128/0 to 256/0 to 320
• The matching rate of the Blob Count tool is the number of counts of detected blobs. The scales shown below can be selected.
0 to 5/0 to 10/0 to 20/0 to 50/0 to 100/0 to 200
• The matching rate when the scaling function is used with the Width/Diameter/Pitch tool is based on the scaling settings.
• The cut-off process (Page A-6) may be performed for the Outline tool and Position Adjustment tool.
• Matching rate of AI OCR
  • When [Show Matching Rate] is [Disable]
    Matching rate 100% is indicated when all characters of the text, date, or date and time match the characters of the master text or master date and time. Matching rate 0% is indicated when any character of the text, date, or date and time does not match the corresponding character of the master text or master date and time.
  • When [Show Matching Rate] is [Enable]
    When all characters of the text, date, or date and time match the characters of the master text or master date and time, the matching rate indicated by the tool is the lowest matching rate among those of the characters tested against good characters that have gone through character learning. Values indicated are in the range of 0 to 100. Matching rate 0% is indicated when there is a character in the text or the date and time that does not match the corresponding character of the master text or master date and time.

*2 The total status conditions can be selected from [All Tools OK], [Any Tool OK] and [Logic 1] to [Logic 8].
“Total Status Conditions” (page 4-90)

*3 In this status, there has been no trigger input after the power turned ON, after the program number has changed, after the master image registered, after the status output reset, or after a shift from the setting mode to the run mode.

*4 At the time of using the position adjustment/High-Speed Position Adjustment tool, when the judgment of each tool cannot be determined, the tool becomes “Unable to judge”. For details, refer to “Displaying and outputting the status result at the time of position adjustment” (page A-5).

*5 Displays the part type (master) number in sorting mode.

*6 Displays the part type (master) name and part type (master) in sorting mode.

*7 In standard mode only. The total status output cannot be selected in sorting mode.

Displaying and outputting the status result at the time of position adjustment

Position adjustment result	Window protrusion *1	Display/output	Status of the tool/part type			Total Status*2 (standard mode only)	Total Status NG (standard mode only)
			Pos. Adj./ Hi-Sp.Adj	Outline/AI Identify/ AI Count	Learning/Color Area/ Area/Width/ Diameter/ Edge/Pitch/ AI OCR/OCR/ EdgePixels/ Blob Count		
Succeeded	No	View judgment	OK	OK/NG	OK/NG	OK/NG*3	
		Status output	ON	ON/OFF	ON/OFF	*4	*5
		Show Matching Rate	0 to 100	0 to 100*6	0 to 100*6		
	Yes	View judgment	OK	OK/NG	--*7	OK/NG*3	
		Status output	ON	ON/OFF	OFF	*4	*5
		Show Matching Rate	0 to 100	0 to 100*8	----*7		
Failed		View judgment	NG	--	--	NG	
		Status output	OFF	OFF	OFF	OFF	ON
		Show Matching Rate	0 to 100	---	---		

*1 This is an operation for if the adjusted position of the tool window is protruded from the imaging area at the time that position adjustment succeeded.
For details, refer to “Matching rate at the time of protrusion” (page A-6).

*2 The total status conditions can be selected from [All Tools OK], [Any Tool OK] and [Logic 1] to [Logic 8].
“Total Status Conditions” (page 4-90)

*3 Displays the part (master) number, part (master) name, or NG in sorting mode.

*4 When the total status result is OK, the total status OK output turns ON. This cannot be selected in sorting mode.

*5 When the total status result is NG, the total status NG output turns ON. This cannot be selected in sorting mode.

*6 Setting scale can be changed.
The scales shown below are selectable.
- AI Count: 0 to 5/0 to 10/0 to 20/0 to 50/0 to 100/0 to 200/0 to 999
- Color Area/Area/Width/Diameter/Pitch/Edge Pixel: 0 to 100/0 to 200/0 to 999
- Edge: 0 to 2/0 to 5/0 to 10/0 to 20/0 to 50 / 0 to 128 / 0 to 256 / 0 to 320
- AI OCR (When [Show Matching Rate] is [Enable]: 0 to 100)
- Line Detection Tool of AI OCR: 0 to 100
- OCR (when shade contrast is [Enable]): 0 to 100 (when IV3 series is connected)
- Blob Count: 0 to 5/0 to 10/0 to 20/0 to 50/0 to 100/0 to 200

When the scaling function is used with the Width/Diameter/Pitch tool, the matching rate is based on the scaling settings.

*7 The judgment cannot be determined if the adjusted position of the tool window is protruded from the imaging area.

*8 For details on the target’s outline which is protruded from the search region, refer to “Matching rate at the time of protrusion” (page A-6).

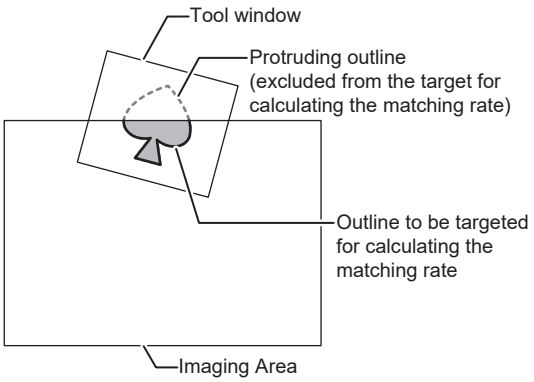
Matching Rate of the Outline Tool and Position Adjustment Tool

Matching rate at the time of protrusion

When the matching rate decreases in proportion to the protrusion amount

- With the [Search Range] of the Outline tool set to [Entire]
- With the [Search Range] of the Position Adjustment set to [Entire] and with the [Search Algorithm] set to [High Speed]

When the target outline protrudes from the imaging area, the protruding outline is excluded from the target in regards to calculating the matching rate.
The matching rate decreases in proportion to the protrusion amount.
If the target is being protruded from the imaging area, the matching rate will decrease depending on how much the target is protruded from the imaging area.



When searching for outline within a partial search area.

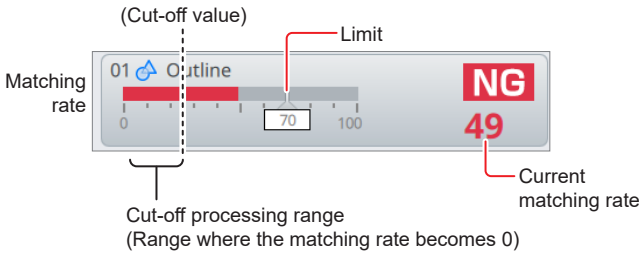
- With the [Search Range] of the Outline tool set to [Partial]
- With the [Search Range] of the Position Adjustment set to [Partial] and with the [Search Algorithm] set to [High Speed]
- With the [Search Algorithm] of the Position Adjustment set to [High Accuracy]

The sensor searches the outline of the target that is in the search range. The matching rate of the target being out of search range will be “0”.

Reference When the tool window after position adjustment is protruded from the imaging area, the judgment display of the Learning/Color Area/Area/ColorAverage/Brightness Average/Width/Diameter/Edge/Pitch/AI OCR/EdgePixels tool/Blob Count becomes "--" (Unable to judge) and the status output turns OFF.

Cut-off process of the matching rate

The cut-off process means the process where the outline detection process is ended when no outline exceeding a certain matching rate (cut-off value) below the threshold value is found.
A matching rate which has been cut off becomes 0. Because the cut-off value is linked to the threshold, the cutoff value is also changed when the threshold is changed.



A

Troubleshooting

Symptom	Check point	Remedy	Reference
The PWR/ERR indicator light of the sensor amplifier is on or blinking in red.	An error has occurred. Check the errors indicated by the lighting or blinking.	Refer to “Error Message”.	A-9
The status indicator light is blinking in red. (Built-in amplifier type)			
The power of the sensor does not turn on.	Is the power cable correctly connected?	Connect the power cable correctly.	2-21
	• Does the voltage or capacity of the power source meet the specification? • Has the voltage dropped due to the power cable conductor resistance?	• Use a power source of the correct rating. • Choose a power cable with consideration to a voltage drop.	12-2
The image does not display on the control panel or IV Smart Navigator. Or the image is abnormal.	Is the installed distance of the target correct?	Place a target at the correct installed distance. The installed distance depends on the sensor type.	2-2
	Is the sensor view correct?	Place the sensor in such a way that the sensor view matches the target size.	2-2
	Is the focus adjustment correct?	Adjust the focusing position (focus) of the sensor.	4-12
	Is the brightness adjustment correct?	Adjust the brightness of the sensor.	4-11
	Is the target or the sensor vibrating?	Implement anti-vibration measures etc.	-
	Is the multiple imaging set on a moving target?	Set the image optimization again.	
	Does ambient light affect the image?	Mount the AI Lighting unit.	2-6
		Use brightness correction.	4-17
		Implement a shield to prevent the incident of ambient light.	-
	Is the front cover dirty or damaged?	Clean the front cover. If it is damaged, contact your nearest KEYENCE office.	-
The image or the status result is not updated.	Is the system in the setting mode?	• Start run mode • Turn on the power of the sensor again.	5-2
	Is the trigger correctly input?	If a target is to be imaged using an external trigger, input the external trigger. When NPN is selected in the Polarity, the circuit becomes a non-voltage input circuit. When PNP is selected in the Polarity, the circuit becomes a voltage input circuit. Check the cables.	4-7
	All or part of the settings necessary for running have not been completed.	Complete the settings in Sensor Setup.	4-1
	The NG Hold function is used.	Set [NG Hold Function] to [Disable].	5-13
Image update is slow. (during operation/setting)	Is the network connected to the in-plant LAN?	The network may be affected by the traffic in the in-plant LAN. Configure a local network and confirm the network connection only for the IV4 Series.	-
The monitor cannot be operated using the touch panel.	Is the input screen for the unlock password displayed?	The touch screen lock of the control panel or the security of the sensor is enabled. Input the unlock password.	7-27
	The password is lost and cannot unlock.	Contact your nearest KEYENCE office.	-
	Is there any damage or cracks on the touch screen?		
The device cannot be operated with the IV Smart Navigator.	Is the input screen for the unlock password displayed?	Sensor security is enabled. Input the unlock password.	7-11
	The password is lost and cannot unlock.	Contact your nearest KEYENCE office.	-

Symptom	Check point	Remedy	Reference
The status result is not output.	Is the output line correctly connected?	Correctly connect to the external devices.	2-21
	Is the output setting correctly set?	Set the output line and output settings correctly in Sensor Setup.	4-88
	Is the system in the setting mode?	Start run mode	5-2
	Is the threshold correctly set?	Set the threshold correctly.	6-15
	Is the tool correctly set?	• Set the judgment tool correctly. • Set the position adjustment tool correctly.	4-20 4-76 4-82
	Is the Polarity correctly set?	Set NPN or PNP according to the circuits of the external devices.	7-16
	Are the N.O. and N.C. correctly set?	Set N.O. (normally open) or N.C. (normally closed) according to the circuits of the external devices.	7-15
An external trigger cannot be input.	Is Trigger Options set to [External Trigger]?	Select [External Trigger] in Trigger Options.	4-7
	Is the input line correctly connected?	Correctly connect to the external devices.	2-21
	Has the input setting been made correctly?	Adjust the input line and input settings correctly in [Input Assignment].	7-13
	Is the Polarity correctly set?	When NPN is selected in the Polarity, the circuit becomes a non-voltage input circuit. When PNP is selected in the Polarity, the circuit becomes a voltage input circuit. Check the cables.	7-16
The program number cannot be changed with the input line.	Has the switching method for the programs been correctly set?	Set the [Program Switching Method] to [External Input].	7-13
	Is the input line correctly connected?	Correctly connect to the external devices.	2-21
	Has the input setting been made correctly?	Adjust the input line and input settings correctly in [Input Assignment].	7-13
	Is the Polarity correctly set?	When NPN is selected in the Polarity, the circuit becomes a non-voltage input circuit. When PNP is selected in the Polarity, the circuit becomes a voltage input circuit. Check the cables.	7-16
	When using P032 to P127, is the SD card correctly inserted?	Insert the SD card correctly and close the cover.	8-9
	Is the program expansion function correctly set?	Set [SD Card Access] to [Enable].	8-10
• IV Smart Navigator cannot connect to the sensor. • The control panel and the sensor cannot be connected.	Check the cables and settings.	Refer to “Remedy when the Monitor cannot be Connected with the Sensor” (Page A-16).	A-18
Image data cannot be transferred via FTP/SFTP.	Check the cables and settings.	Refer to “Remedy when data transfer via FTP/SFTP is unavailable”	A-24
Image data cannot be transferred to the SD card.	Check if the settings are correct and if the SD card is correctly inserted.	Refer to “Remedy when data transfer to the SD card is unavailable”	A-17

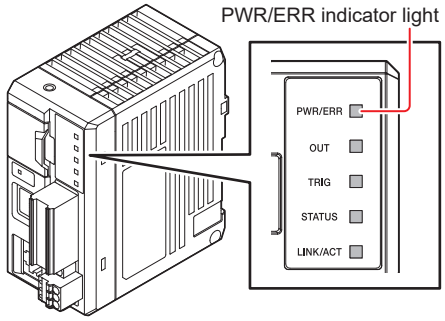
Error Messages

For error messages not listed in this manual, check the following error number search page:
www.keyence.com/iv4_trouble_support

Checking errors by observing the PWR/ERR indicator light and status indicator light

Ultra-compact model

For the ultra-compact model, the causes of and remedies for an error can be checked by observing the indicator light.



The indicator light on the sensor head blinks (red) when the light on the sensor amplifier is ON (red) or blinking (red).

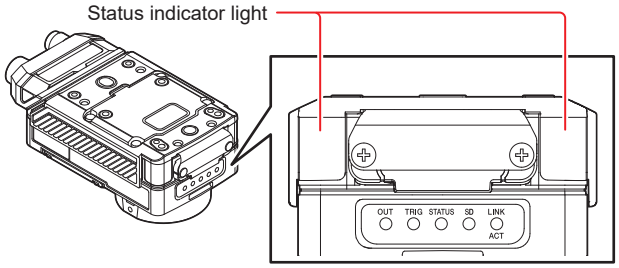
PWR/ERR indicator light status		Cause	Remedy
Green	ON	Operation is in progress.	-
	Blink	Setting in progress. Operation stopped.	-
		If the light turns off periodically, the power supply rating may be insufficient.	• Use a power source of the correct rating.
Red	ON	A system error occurred.	• Cycle the power of this device. • If the same error occurs, contact your nearest KEYENCE office.
		A startup memory read error occurred. • A data abnormality occurred due to noise or because the power switched OFF while writing was in progress.	• Initialize the settings. • If the same error occurs, contact your nearest KEYENCE office.
		An error occurred in switching the advanced program at the time of startup or during operation.	Refer to “Checking Error Messages on the IV Smart Navigator” (page A-14).
	Blink	A trigger error occurred. The judgment process is not performed. • If a target is to be imaged using an external trigger, the external trigger was input during a BUSY status. • If a target is to be imaged using an internal trigger, the trigger interval was shorter than the processing time.	• A trigger error can be fixed using one of the following procedures. • Next normal trigger input • Clear Error input • Switching the program number • Proceeding to the settings screen of the sensor • Set the trigger interval of the internal trigger to a value that is longer than the processing time (calculate the data transfer time when [BUSY Output] is set to [Until Data Transfer is Complete]). • An error will not occur if the trigger error is set to [Disable] described in 📖 “4. Output Assignment” (page 4-88) for [Sensor Setup].
		An error occurred in switching the advanced program during setup.	Refer to “Checking Error Messages on the IV Smart Navigator” (page A-14).
		An external master image registration error (with no registered master image) occurred. The master image is not updated. • The image to be registered as a master image was not imaged. • The work memory is insufficient.	• An external master image registration error can be fixed using one of the following procedures. • Successful in next external master image registration • Clear Error input • Switching the program number • Proceeding to the settings screen of the sensor • Taking an image to be registered as a master image and registering it as an external master image. • Deleting one or more detection tools.
		A buffer overrun has occurred.	• Execute result acquisition completion notification from an external device (e.g. PLC). • Disable handshake control for field networks (EtherNet/IP, Profinet).

PWR/ERR indicator light status		Cause	Remedy
Red	Blink	An external master image registration error (with registered master image) occurred. The following errors occurred even though the image was updated and registered as a master image. • For the new master image, the outline cannot be extracted with the outline tool. • For the new master image, the area cannot be extracted with the Color Area/Area tool. • For the new master image, the edge cannot be extracted with the Width/Diameter/Edge/Pitch/Edge Pixel tool. • When the learning tool (including sorting mode) is set, the external master image registration cannot be used.	• An external master image registration error can be fixed using one of the following procedures. • Successful in next external master image registration • Clear Error input • Switching the program number • Proceeding to the settings screen of the sensor • Checking that the image to be registered and the detection tools/position adjustment settings are applicable.
		An SD card error occurred. The following errors occurred. • Accessing the SD card has failed. • Transfer to the SD card failed.	Refer to “Remedy when data transfer to the SD card is unavailable” (page A-17).
		An FTP error occurred. The following errors occurred. • Connection with the FTP/SFTP server failed. • Tranfer to the transfer destination folder failed. • The transfer speed could not catch up to the sensor processing speed.	An FTP error can be fixed using one of the following procedures. • Press [OK] on the Error screen • Clear Error input • Resolve the causes of transfer failure.
OFF		Power is not supplied to this device.	• Connect the power cable correctly. • Use a power source of the correct rating.

Reference
Errors in a state that the PWR/ERR indicator light lights in red or blinks in red turn the error output ON.
“Cables” (page 2-21)
“4. Output Assignment” (page 4-88)

Built-in amplifier type

For the built-in amplifier type, the status indicator light blinks in red when an error occurs.



Status of the status indicator light		Cause	Remedy
Green	ON	The total status result and part type discrimination are OK.	-
	Blink	Under startup or setting in progress. Operation stopped.	-
		If the light turns off periodically, the power supply rating may be insufficient.	• Use a power source of the correct rating.
Red	ON	The total status result and part type discrimination are NG.	-
	Blink	An error has occurred. The Status indicator light on the build-in amplifier type blinking in red means the same as when the PWR/ERR indicator light of the ultra-compact model lights or blinks in red.	For the causes of and remedies for this error, refer to those of the PWR/ERR indicator light of the ultra-compact model. “Ultra-compact model” (page A-9)
OFF		Power is not supplied to this device.	• Connect the power cable correctly. • Use a power source of the correct rating.

Reference
Errors in the status indicator light blinks in red turn the error output ON.
“Cables” (page 2-21)
“4. Output Assignment” (page 4-88)

Checking Error Messages on the Control Panel

For error messages not listed in this manual, check the following error number search page:
www.keyence.com/iv4_trouble_support

Message	Cause	Remedy	Output/ Indicator
A system error occurred on the sensor. Turn on the power of the sensor again.	A system error occurred in the sensor. • It is possible that a fault occurred inside the sensor.	• Turn on the power of the sensor again. • Check the above error number search site. • If the same error occurs, contact your nearest KEYENCE office.	*1
Failed to read nonvolatile memory at sensor startup. Turn on the sensor power again or initialize the sensor. After this message is closed, the [Initialize] button will be displayed.	A memory read error occurred when the sensor started. • A data error occurred. • It is possible that the power was switched OFF during writing, or noise was picked up.	• Initialize the settings following the instructions on the screen. • Turn on the power of the sensor again. • Do not turn OFF the power while saving the settings. • If the same error occurs, contact your nearest KEYENCE office.	*1
Initialization is necessary because sensor program xx is corrupt. After this message is closed, the [Initialize] button for program xx will be displayed.	A memory read error occurred when the sensor started. • A data error occurred during the execution of program number xx. • It is possible that the power was switched OFF during writing, or noise was picked up.	• Initialize the settings following the instructions on the screen. • Turn on the power of the sensor again. • Do not turn OFF the power while saving the settings. • If the same error occurs, contact your nearest KEYENCE office.	*1

Trigger error	A trigger error occurred. Judgment processing has not been executed.
	• If a target is to be imaged using an external trigger, the external trigger was input during a BUSY status.
	• If a target is to be imaged using an internal trigger, the trigger interval was shorter than the processing time.
		• A trigger error can be fixed using one of the following procedures.
		  • Next normal trigger input
		  • Clear Error input
		  • Switching the program number
		  • Proceeding to the settings screen of the sensor
		• Do not input the external trigger during a BUSY status.
		• Set the trigger interval of the internal trigger to a value that is longer than the processing time.
		• An error will not occur if the trigger error is set to [Disable] described in “4. Output Assignment” (page 4-88) for [Sensor Setup].
			*2

Some tools cannot be judged correctly because of insufficient outline extraction amount as a result of “Ext. Master Save”. (Matching rate is 0.)
Check tool configuration.
	An external master image registration error (with registered master image) occurred. The following errors occurred even though the image was updated and registered as a master image.
	• For the new master image, the outline cannot be extracted with the outline tool.
	• For the new master image, the area cannot be extracted with the Color Area/Area tool.
	• For the new master image, the edge cannot be extracted with the Edge Pixel/Width/Diameter/Edge/Pitch tool.
	• The brightness correction cannot be performed correctly for the new master image.
	• When the learning tool (including sorting mode) is set, the external master image registration cannot be used.
		• An external master image registration error can be fixed using one of the following procedures.
		  • Successful in next external master image registration
		  • Clear Error input
		  • Switching the program number
		  • Proceeding to the settings screen of the sensor
		• Checking that the image to be registered and the detection tools/ position adjustment settings are applicable.
		• Adjusting the brightness of the image to be registered properly.
			*2

Some tools can not be judged correctly because area is 0 as a result of “Ext. Master Save”. (Matching rate is 0.) Check tool configuration.			
Some tools can not correctly judged because the edge extraction amount as a result of the “Ext. Master Save” is not sufficient. (Matching rate is 0.) Check tool configuration.			
Brightness adjustment area is not adjustable as a result of “Ext. Master Save”. Check configuration of brightness adjustment.			
External master registration failed because the learning tool is set to the program.			

A

Message	Cause	Remedy	Output/ Indicator
External master registration failed because the image has not been captured.	An external master image registration error (with no registered master image) occurred. The master image is not updated. • The image to be registered as a master image was not imaged. • The work memory is insufficient.	• An external master image registration error can be fixed using one of the following procedures. • Successful in next external master image registration • Clear Error input • Switching the program number • Proceeding to the settings screen of the sensor • Taking an image to be registered as a master image and registering it as an external master image. • Deleting one or more detection tools.	*2
External master registration failed due to insufficient work memory.			
Application error has occurred.	A system error occurred in the control panel. • It is possible that a fault occurred inside the control panel.	• Turn on the power of the control panel again. • If the same error occurs, contact your nearest KEYENCE office.	
Connecting to sensor…	Connection is not possible because there is no response from the sensor.	Refer to "Remedy when the Software cannot be Connected with the Sensor" (page A-18).	
Connecting to sensor (XXX.XXX.XXX.XXX)…	Connection is not possible because there is no response from the sensor with the specified IP address.		
Communication timeout to sensor occurred.	Connection is not possible because there is no response from the sensor.		
Data transfer to sensor fails.	Connection is not possible because data transmission to the sensor has failed.		
The connection with the sensor will be cut in order to connect with another panel or PC.	The connected sensor has been disconnected, because it was connected from another control panel or PC.	Reconnect to the sensor when it is ready to connect.	
Writing in file has failed.	File saving to the USB memory or SD card failed.	Replace the USB memory or SD card.	
Failed to access the file or folder.	Access to the USB memory or SD card failed.	• Format the USB memory or SD card. • Replace the USB memory or SD card.	
Free space is insufficient.	Saving is not possible because the amount of free space of the USB memory or SD card is insufficient.	Increase the amount of free space by deleting files or by formatting the USB memory or SD card.	
There is not enough space to perform individual program backup.	Saving is not possible because the amount of free space of the USB memory or SD card is insufficient.	Increase the amount of free space by deleting files or by formatting the USB memory or SD card.	
This file configuration data is for xxxx. This file is not readable.	The setting files for a different model of sensor cannot be read.	Read the setting files of a sensor of the same model.	
FTP Connection Error	Connection with the FTP/SFTP server failed.	Refer to "Remedy when data transfer via FTP/SFTP is unavailable" (page A-24).	*2
FTP Transfer Error (Transfer Failed)	Data transfer to the transfer destination folder failed.		
FTP Transfer Error (Insufficient Data Buffer)	Data which is larger than the remaining storage of the FTP/SFTP buffer has been created and the transfer failed.		
No server found.	Connection with the SFTP server failed.		
It does not match the server settings. Review those settings as well as other related settings. (Key exchange algorithm)			
It does not match the server settings. Review those settings as well as other related settings. (Host key algorithm)			
It does not match the server settings. Review those settings as well as other related settings. (Cryptographic algorithm)			
It does not match the server settings. Review those settings as well as other related settings. (MAC algorithm)			
The sensor head and sensor amplifier are not compatible with each other. Connect the correct sensor head and sensor amplifier.	A sensor head of the IV, IV2, or IV3 Series has been connected with the sensor amplifier of the IV4 Series.	Connect the IV4 Series sensor head.	

Message	Cause	Remedy	Output/ Indicator
The sensor head is not connected to the sensor amplifier.	The sensor head is not connected.	Connect the sensor head. Connect the sensor head to the sensor amplifier, and then turn the power on again. If not turned on, contact local service center.	
A connection cannot be established with number **. Check the following items. - The correct sensor IP address is specified. - Power supply for the sensor. - Network connection. - The network settings of the panel.	Connection with the sensor failed.	Check the following items. • Specify the correct IP address of the sensor. • Power supply for the sensor. • Network connection. • Network settings of the control panel	
The system will return to the sensor settings menu because the program file selected by external input cannot be found. * The program number will change to P000. To start operation, set a valid program number for the destination program or change the program switching method.	An error occurred in switching the advanced program (external input) at the time of startup.	Clear the error message. The error is cleared and the system moves to the setting screen. Thereafter, perform the following operations: • Make the system re-recognize the SD card that stores the correct advanced program. • Select between P000 and P031 by external input.	*3
The system will return to the sensor settings menu because the program file selected previously cannot be found. the program number will be switched to P000.	An error occurred in switching the advanced program (panel/PC/ communication) at the time of startup.	Clear the error message. The error is cleared and the system moves to the setup or run screen. Thereafter, perform the following operations: • Make the system re-recognize the SD card that stores the correct advanced program. • Select between P000 and P031. • When clearing the error message, operation can be selected to continue with P000 or move to the setting screen.	*3
The system will return to the sensor settings menu because the selected program file cannot be found. * The program number will change to P000. To start operation, set a valid program number for the destination program or change the program switching method.	An error occurred in switching the advanced program during operation.	Clear the error message. The error is cleared and the system moves to the setting screen. Thereafter, perform the following operations: • Make the system re-recognize the SD card that stores the correct advanced program. • Select between P000 and P031.	*1
As the previously selected program file cannot be found, the program number will be switched to P000.	A setup error of the advanced program occurred during setup.	Make the system re-recognize the SD card that stores the correct advanced program.	*2
Accessing the data in the SD card failed.	Failed to access data in the SD card.	Refer to 📖 “Remedy when data transfer to the SD card is unavailable” (page A-17).	*2
SD card transfer error (Transfer failure)	Data transfer to the transfer destination folder failed.		
SD card transfer error (Insufficient data buffer)	Data which is larger than the remaining storage of the transfer buffer has been created and the transfer failed.		

*1 Error output from the sensor: ON, PWR/ERR indicator light of the sensor: ON (red) Status indicator light: Blinking (red)
*2 Error output from the sensor: ON, PWR/ERR indicator light of the sensor: Blinking (red) Status indicator light: Blinking (red)
*3 Error output from the sensor: Does not operate, PWR/ERR indicator light of the sensor: ON (red) Status indicator light: Blinking (red)

Checking Error Messages on the IV Smart Navigator

For error messages not listed in this manual, check the following error number search page:
www.keyence.com/iv4_trouble_support

Message	Cause	Remedy	Output/ Indicator
A system error occurred on the sensor. Turn on the power of the sensor again.	A system error occurred in the sensor. • It is possible that a fault occurred inside the sensor.	• Turn on the power of the sensor again. • Check the above error number search site. • If the same error occurs, contact your nearest KEYENCE office.	*1
Failed to read nonvolatile memory at sensor startup. Turn on the sensor power again or initialize the sensor. After this message is closed, the [Initialize] button will be displayed.	A memory read error occurred when the sensor started. • A data error occurred. • It is possible that the power was switched OFF during writing, or noise was picked up.	• Initialize the settings following the instructions on the screen. • Turn on the power of the sensor again. • Do not turn OFF the power while saving the settings. • If the same error occurs, contact your nearest KEYENCE office.	*1
Initialization is necessary because sensor program xx is corrupt. After this message is closed, the [Initialize] button for program xx will be displayed.	A memory read error occurred when the sensor started. • A data error occurred during the execution of program number xx. • It is possible that the power was switched OFF during writing, or noise was picked up.	• Initialize the settings following the instructions on the screen. • Turn on the power of the sensor again. • Do not turn OFF the power while saving the settings. • If the same error occurs, contact your nearest KEYENCE office.	*1

Trigger error	A trigger error occurred. Judgment processing has not been executed.
	• If a target is to be imaged using an external trigger, the external trigger was input during a BUSY status.
	• If a target is to be imaged using an internal trigger, the trigger interval was shorter than the processing time.
		• A trigger error can be fixed using one of the following procedures.
		  • Next normal trigger input
		  • Clear Error input
		  • Switching the program number
		  • Proceeding to the settings screen of the sensor
		• Do not input the external trigger during a BUSY status.
		• Set the trigger interval of the internal trigger to a value that is longer than the processing time.
		• An error will not occur if the trigger error is set to [Disable] described in “4. Output Assignment” (page 4-88) for [Sensor Setup].
			*2

Some tools cannot be judged correctly because of insufficient outline extraction amount as a result of “Ext. Master Save”. (Matching rate is 0.)
Check tool configuration.
	An external master image registration error (with registered master image) occurred. The following errors occurred even though the image was updated and registered as a master image.
	• For the new master image, the outline cannot be extracted with the outline tool.
	• For the new master image, the area cannot be extracted with the Color Area/Area tool.
	• For the new master image, the edge cannot be extracted with the Width/ Diameter/Edge/Pitch/Edge Pixel tool.
	• The brightness correction cannot be performed correctly for the new master image.
	• When the learning tool (including sorting mode) is set, the external master image registration cannot be used.
		• An external master image registration error can be fixed using one of the following procedures.
		  • Successful in next external master image registration
		  • Clear Error input
		  • Switching the program number
		  • Proceeding to the settings screen of the sensor
		• Checking that the image to be registered and the detection tools/ position adjustment settings are applicable.
		• Adjusting the brightness of the image to be registered properly.
			*2

Some tools can not be judged correctly because area is 0 as a result of “Ext. Master Save”. (Matching rate is 0.) Check tool configuration.			
Some tools can not correctly judged because the edge extraction amount as a result of the “Ext. Master Save” is not sufficient. (Matching rate is 0.) Check tool configuration.			
Brightness adjustment area is not adjustable as a result of “Ext. Master Save”. Check configuration of brightness adjustment.			
External master registration failed because the learning tool is set to the program.			

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Message	Cause	Remedy	Output/ Indicator
External master registration failed because the image has not been captured.	An external master image registration error (with no registered master image) occurred. The master image is not updated. • The image to be registered as a master image was not imaged. • The work memory is insufficient.	• An external master image registration error can be fixed using one of the following procedures. • Successful in next external master image registration • Clear Error input • Switching the program number • Proceeding to the settings screen of the sensor • Taking an image to be registered as a master image and registering it as an external master image. • Deleting one or more detection tools.	*2
External master registration failed due to insufficient work memory.			
An application error occurred.	An application failure occurred.	• Reinstall the IV Smart Navigator (IV-H1SN). • Replace the PC. • If the same error occurs, contact your nearest KEYENCE office.	
Registry access has failed.	A failure of the registry information occurred.	• Restart the PC. • Reinstall the IV Smart Navigator (IV-H1SN).	
Network adapter not found	• Ethernet cable is not connected to the PC. • The network adapter is not correctly connected to the PC.	Refer to 📖 “Remedy when the Software cannot be Connected with the Sensor” (page A-18).	
Sensor cannot be found.	Searching the sensor failed.		
Data transfer to sensor has failed.	Connection is not possible because data transmission to the sensor has failed.		
Communication timeout to sensor has occurred.	Connection is not possible because there is no response from the sensor.		
Network connection to sensor can not be performed.	Connection is not possible because the IV-Navigator is not correctly connected with the sensor.		
The connection with the sensor will be cut in order to connect with another panel or PC.	The connected sensor has been disconnected, because it was connected from another control panel or PC.	Reconnect to the sensor when it is ready to connect.	
Writing in file has failed.	Saving the file to the specified save destination has failed.	• Specify the save destination correctly. • Confirm the access privileges of the save destination.	
Failed to access the file or folder.	Accessing to the specified file or folder failed.	• Confirm the access privileges of the save destination. • Change the attribute of the readonly folder.	
Free space is insufficient.	Saving is not possible because the amount of free space in the specified save destination is insufficient.	Delete a file to make an enough space for the save destination.	
FTP Connection Error	Connection with the FTP/SFTP server failed.	Refer to 📖 “Remedy when data transfer via FTP/SFTP is unavailable” (page A-24).	*2
FTP Transfer Error (Transfer Failed)	Data transfer to the transfer destination folder failed.		
FTP Transfer Error (Insufficient Data Buffer)	Data which is larger than the remaining storage of the FTP/SFTP buffer has been created and the transfer failed.		
No server found.	Connection with the SFTP server failed.		
It does not match the server settings. Review those settings as well as other related settings. (Key exchange algorithm)			
It does not match the server settings. Review those settings as well as other related settings. (Host key algorithm)			
It does not match the server settings. Review those settings as well as other related settings. (Cryptographic algorithm)	Connection with the SFTP server failed.	Refer to 📖 “Remedy when data transfer via FTP/SFTP is unavailable” (page A-24).	*2
It does not match the server settings. Review those settings as well as other related settings. (MAC algorithm)			

Message	Cause	Remedy	Output/ Indicator
The sensor head and sensor amplifier are not compatible with each other. Connect the correct sensor head and sensor amplifier.	A sensor head of the IV, IV2, or IV3 Series has been connected with the sensor amplifier of the IV4 Series.	Connect the IV4 Series sensor head.	
The sensor head is not connected to the sensor amplifier.	The sensor head is not connected.	Connect the sensor head. Connect the sensor head to the sensor amplifier, and then turn the power on again. If not turned on, contact local service center.	
A connection cannot be established with number **. Check the following items. - The correct sensor IP address is specified. - Power supply for the sensor. - Network connection. - PC network settings.	Connection with the sensor failed.	Check the following items. • Specify the correct IP address of the sensor. • Power supply for the sensor. • Network connection. • PC network settings.	
The system will return to the sensor settings menu because the program file selected by external input cannot be found. * The program number will change to P000. To start operation, set a valid program number for the destination program or change the program switching method.	An error occurred in switching the advanced program (external input) at the time of startup.	Clear the error message. The error is cleared and the system moves to the setting screen. Thereafter, perform the following operations: • Make the system re-recognize the SD card that stores the correct advanced program. • Select between P000 and P031 by external input.	*3
The system will return to the sensor setup menu because the program file selected previously cannot be found. * The program number will change to P000.	An error occurred in switching the advanced program (panel/PC/ communication) at the time of startup.	Clear the error message. The error is cleared and the system moves to the setup or run screen. Thereafter, perform the following operations: • Make the system re-recognize the SD card that stores the correct advanced program. • Select between P000 and P031. • When clearing the error message, operation can be selected to continue with P000 or move to the setting screen.	*3
The system will return to the sensor settings menu because the selected program file cannot be found. * The program number will change to P000. To start operation, set a valid program number for the destination program or change the program switching method.	An error occurred in switching the advanced program during operation.	Clear the error message. The error is cleared and the system moves to the setting screen. Thereafter, perform the following operations: • Make the system re-recognize the SD card that stores the correct advanced program. • Select between P000 and P031.	*1
As the previously selected program file cannot be found, the program number will be switched to P000.	A setup error of the advanced program occurred during setup.	Make the system re-recognize the SD card that stores the correct advanced program.	*2
Accessing the data in the SD card failed.	Failed to access data in the SD card.	Refer to “Remedy when data transfer to the SD card is unavailable” (page A-17).	*2
SD card transfer error (Transfer failure)	Data transfer to the transfer destination folder failed.		
SD card transfer error (Insufficient data buffer)	Data which is larger than the remaining storage of the transfer buffer has been created and the transfer failed.		

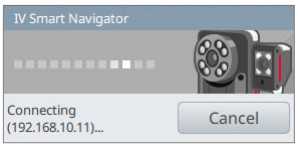
*1 Error output from the sensor: ON, PWR/ERR indicator light of the sensor: ON (red) Status indicator light: Blinking (red)
*2 Error output from the sensor: ON, PWR/ERR indicator light of the sensor: Blinking (red) Status indicator light: Blinking (red)
*3 Error output from the sensor: Does not operate, PWR/ERR indicator light of the sensor: ON (red) Status indicator light: Blinking (red)

Remedy when data transfer to the SD card is unavailable

Status	Remedy
Error (078) Failed to access data in the SD card.	• Do not remove the SD card while it is being accessed. • Format the SD card. • Replace the SD card. • There may be influence from noise.
Error (076) SD Card Transfer Error (Transfer Failed)	• Check whether the SD card is write-protected. • Check the amount of free space. • Remove the SD card from the SD card slot, re-insert it, and then close the cover. Check that the SD card indicator light is on.
Error (075) SD Card Transfer Error (Insufficient Transfer Buffer)	• Increase the trigger cycle of the sensor. “Trigger Options” (page 4-7) • Control the trigger using the busy output. In doing do, set the timing of busy output to “Until Data Transfer is Complete.” “BUSY Output” (page 7-15)

Remedy when the Software cannot be Connected with the Sensor

For a Control Panel and Display Expansion Unit

Status	Remedy
 Retries occur repeatedly because connection is not possible after the power is turned on.	• Supply power to the sensor and the network equipment. • Correctly connect with the sensor and the network equipment. • After a correct connection is established as a result of a retry, the run screen opens automatically. • Press [Connect] after a correct connection has established. • Press [Search Sensor] and search a sensor. “Searching for a Sensor to Connect to” (page 3-6) If the connection cannot be established, refer to “When the connection cannot be established by searching for the sensor” (page A-18). • Input the IP address of the sensor to be connected and press [Connect] to connect. “Specifying the Sensor to be Connected by IP Address” (page 3-7) If the connection cannot be established, refer to “When the connection cannot be established by specifying the sensor” (page A-18).
Error (381) Data transfer to sensor has failed. **Error (382)** Communication timeout to sensor has occurred. Connection became impossible after connection was established.	
Sensor cannot be found. The message “Sensor cannot be found.” is displayed with [Search Sensor] on the [Network Connection] screen.	**When the connection cannot be established by searching for the sensor** • Supply power to the sensor and the network equipment. • Correctly connect with the sensor and the network equipment. “Connecting the Sensor with the Control Panel” (page 2-30) • Confirm that the IP address of the control panel does not coincide with that of the sensor or another device. Also, correctly set the subnet mask and the default gateway. “Confirming/setting the IP address of the control panel” (page A-22) • Reset (initialize) the network setting for the sensor. “Confirming/Setting the IP address of the sensor” (page A-23) “Initializing the Network Settings (IP Reset Switch)” (page A-25) • The following conditions are required for a successful sensor search. • The subnet masks of the sensor and control panel are matched. • The sensor network setting is not set or the IP address is not duplicated. • For the control panel start mode, select [IV4-CP70 Mode]. When in [IV3-CP50/ IV2-CP50/IV-M30] mode, a sensor without an IP address cannot be found. “Startup Mode” (page 7-29)
Network connection to sensor can not be performed. Check the following items. • The correct IP address is specified for the sensor • Sensor power supply • Network connection • The panel network settings Connection is not possible to the sensor with the IP address specified on the [Network Connection] screen.	**When the connection cannot be established by specifying the sensor** • Supply power to the sensor and the network equipment. • Correctly connect with the sensor and the network equipment. “Connecting the Sensor with the Control Panel” (page 2-30) • Specify the correct IP address of the sensor. • If the sensor IP address has not been set, establish a connection using [Search Sensor]. “Searching for a Sensor to Connect to” (page 3-6) • Confirm that the IP address of the control panel does not coincide with that of the sensor or another device. Also, correctly set the subnet mask and the default gateway. “Confirming/setting the IP address of the control panel” (page A-22) Reset (initialize) the network setting for the sensor. “Confirming/Setting the IP address of the sensor” (page A-23) “Initializing the Network Settings (IP Reset Switch)” (page A-25)

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For IV Smart Navigator

Status	Remedy
Network adapter not found Check the following items. • Sensor power supply • Connection between the sensor and PC • Attachment of the network adapter Connection is not possible even by pressing [Connect] in the Activation Menu.	• Press [OK] and close the message. • Setup the network adapter correctly in the PC. • Supply power to the sensor and the network equipment. • Correctly connect with the sensor and the network equipment.
Network connection to sensor can not be performed. Check the following items. • The correct IP address is specified for the sensor • Sensor power supply • Network connection • PC network settings Connection is not possible even by pressing [Connect] in the Network connection screen.	• On the Network connection screen, select the correct network adapter. • Press [Search Sensor] and search a sensor. 📖 "Searching for a Sensor to Connect to" (page 3-6) If the connection cannot be established, refer to 📖 "When the connection cannot be established by searching for the sensor" (page A-18). • Input the IP address of the sensor to be connected and press [Connect] to connect. 📖 "Specifying the Sensor to be Connected by IP Address" (page 3-7) If the connection cannot be established, refer to 📖 "When the connection cannot be established by specifying the sensor" (page A-18).
Error (381) Data transfer to sensor has failed. **Error (382)** Communication timeout to sensor has occurred. Connection became impossible after connection was established.	• The PC firewall (Windows firewall or commercially-available security software) may be blocking IV Smart Navigator communications. Disable the firewall or allow IV Smart Navigator communications.
Sensor cannot be found. The sensor was not found using the [Search Sensor] button on the Network connection screen.	**When the connection cannot be established by searching for the sensor** • Supply power to the sensor and the network equipment. • Correctly connect with the sensor and the network equipment. • Confirm that the IP address of the PC does not coincide with that of the sensor or another device. Also, correctly set the subnet mask and the default gateway. 📖 "Confirming/Setting the IP address of the PC" (page A-22) • On the Network connection screen, select the correct network adapter. • The PC firewall (Windows firewall or commercially-available security software) may be blocking IV Smart Navigator communications. Disable the firewall or allow IV Smart Navigator communications. • Confirm that the IP address of the sensor does not coincide with that of the PC or another device. Also, reset (initialize) the network setting for the sensor. 📖 "Operation for Initial Startup of the IV Smart Navigator" (page 3-6) 📖 "Confirming/Setting the IP address of the sensor" (page A-23) 📖 "Initializing the Network Settings (IP Reset Switch)" (page A-25) • The following conditions are required for a successful sensor search. • The subnet masks of the sensor and PC are matched. • The sensor network setting is not set or the IP address is not duplicated.

Remedy when the Software cannot be Connected with the Sensor

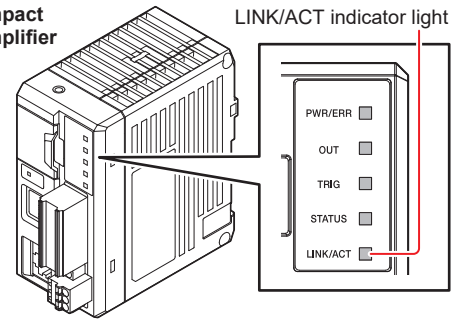
Status	Remedy
Network connection to sensor can not be performed. Check the following items. • The correct IP address is specified for the sensor • Sensor power supply • Network connection • PC network settings Connection is not possible even by inputting the IP address into the Network connection screen and pressing [Connect].	**When the connection cannot be established by specifying the sensor** • Supply power to the sensor and the network equipment. • Correctly connect with the sensor and the network equipment. • Specify the correct IP address of the sensor. • If the sensor IP address has not been set, establish a connection using the [Search Sensor] button. “Searching for a Sensor to Connect to” (page 3-6) • Confirm that the IP address of the PC does not coincide with that of the sensor or another device. Also, correctly set the subnet mask and the default gateway. “Confirming/Setting the IP address of the sensor” (page A-23) • On the Network connection screen, select the correct network adapter. • The PC firewall (Windows firewall or commercially-available security software) may be blocking IV Smart Navigator communications. Disable the firewall or allow IV Smart Navigator communications. • Confirm that the IP address of the sensor does not coincide with that of the PC or another device. Also, correctly set the subnet mask and the default gateway. Also, reset (initialize) the network setting for the sensor. “Operation for Initial Startup of the IV Smart Navigator” (page 3-6) “Confirming/Setting the IP address of the sensor” (page A-23) “Initializing the Network Settings (IP Reset Switch)” (page A-25)

Confirming the status by observing the indicator light of the sensor

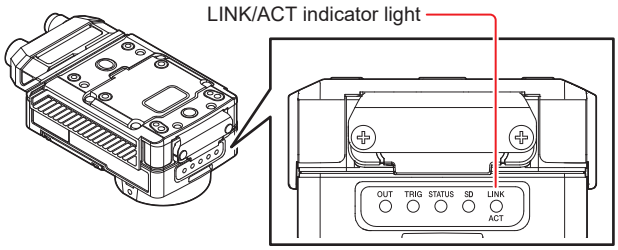
LINK/ACT (link/activity) indicator light

Displays the link status with the network.

Ultra-compact model amplifier



Built-in amplifier type

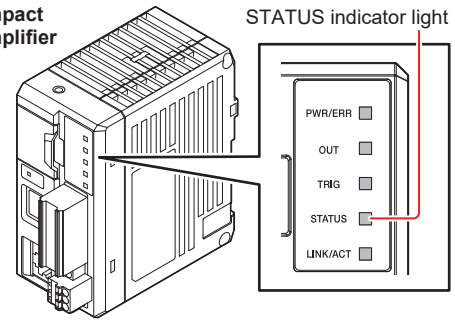


LINK/ACT indicator light status		Status	Remedy
Green	ON	The device is correctly linked to the control panel/PC or the Ethernet switch.	Link is normal. When connection with the control panel/IV Smart Navigator is not possible, check the STATUS indicator light.
	Blink	The device is correctly linked to the control panel/PC or the Ethernet switch. Data is being sent and received.	
OFF		The device is not correctly linked to the control panel/PC or the Ethernet switch. • Power is not supplied to this unit or the connection target. • The cable is not connected correctly.	• Supply power to the sensor. • Supply power to the control panel/PC or the Ethernet switch of the connection target. • Connect the cable correctly.

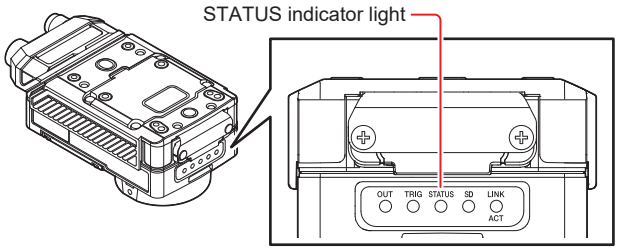
STATUS indicator light

Indicates the connection status with the control panel/IV Smart Navigator.
Confirm that the LINK/ACT indicator light is green (lighting) or green (blinking) and then check the STATUS indicator light.

Ultra-compact model amplifier



Built-in amplifier type



STATUS indicator light status		Status	Remedy
Green	ON	The device is correctly connected to the control panel/IV Smart Navigator. The connection with the control panel/IV Smart Navigator has been established by acquiring the IP address.	-
	Blink	No correct connection with the PC. The IP address of the sensor has been set but connection with the control panel/IV Smart Navigator has not been established.	“For IV Smart Navigator” (page A-19)
OFF		The device is not connected correctly to the control panel/PC. The IP address of the sensor has not been set.	“For IV Smart Navigator” (page A-19)

If the light is ON (red), the IP address coincides or a network loop is detected.

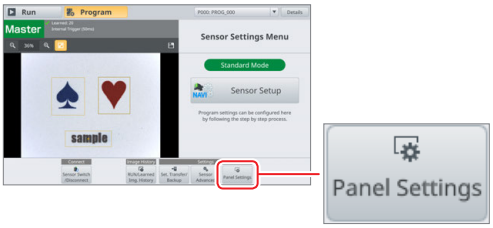
Reference
- The communication timeout time is 1 minute.
- During the timeout interval after an error has occurred, the screen may fail to refresh while the STATUS indicator light is on or may not accept an operation.
- During the timeout interval, devices other than the previously connected control panel/PC cannot be connected.

A

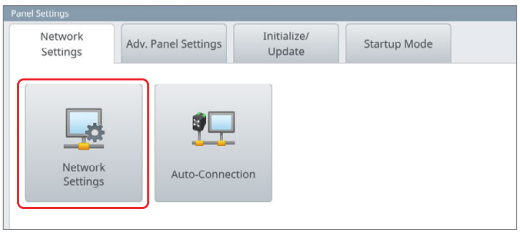
Other methods for confirmation

Confirming/setting the IP address of the control panel

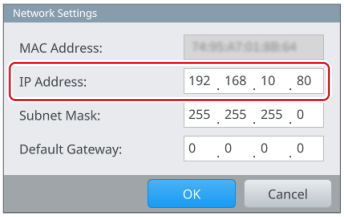
1 Press [Panel Settings].



2 Select the [Network Settings] tab and press [Network Settings].



3 Check the IP address of the control panel



When the settings for the sensor are to be changed, set an arbitrary IP address and press [OK].

4 When confirmation/setting is completed, press [OK].

- If the setting has not been changed, system returns to the [Panel Settings] screen.
- If the setting has been changed, the message “Monitor will be restarted.” is displayed.

5 Press [OK] if the setting has been changed.

The control panel will re-start.

If the device could be connected to the sensor

The run screen opens.

If the IV Smart Navigator cannot be connected with the sensor

The Sensor Connect screen opens. Set the connection method and connect to the sensor.

“Operation for Initial Startup of the IV Smart Navigator” (page 3-6)

Reference For detail on how to make connection after the control panel starts for the first time or after initialization of the control panel, refer to “Operating the Control Panel/ Display Expansion Unit for the First Time” (page 3-7).

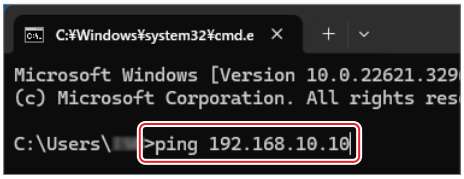
Confirming the existence of the sensor from the PC

Whether or not the sensor is correctly connected can be confirmed by sending a ping command from the PC to the sensor to be connected.

1 Select [Windows Tools] → [Command Prompt] from the Windows [Start] menu.

The Command Prompt screen opens.

2 Input “pingΔ(IP address of the sensor)” (Δ indicates a “space”) and press the [Enter] key.



3 Confirm the sent result of the ping command.

If correctly connected with a target sensor

The responded time from the sensor (input IP address) will be displayed, and [0% loss] will be displayed.

If not connected with a target sensor

A message which indicates failure in sending the ping command will be displayed, and [100% loss] will be displayed.

4 After the confirmation, close the Command Prompt screen.

Point

- **Note that when the ping command is executed to a device other than a sensor, the confirmation will succeed if there is a response to the ping command.**
- **Confirmation is not possible for a direct connection.**

Confirming/Setting the IP address of the PC

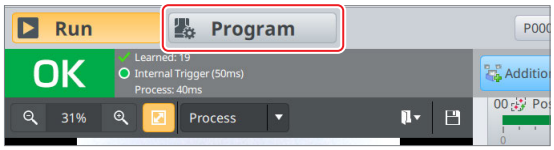
- For details of how to confirm/set the IP address of the PC, refer to “Changing the PC Settings (IP Address Settings)” (page 2-32).
- Confirm that the IP addresses of the PC/sensor/other network device do not coincide with each other. Also, confirm that the subnet mask and default gateway are correctly set.

A

Confirming/Setting the IP address of the sensor

Confirm the IP address of the sensor.

1 Press [Program].

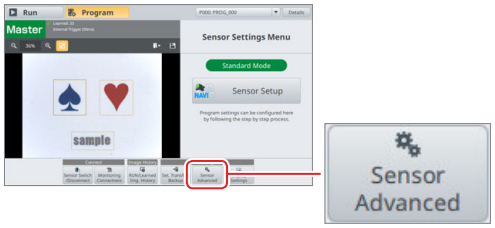


The confirmation screen opens.

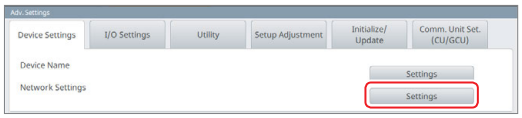
2 Press [OK].

The system switches to the main screen in [Program].

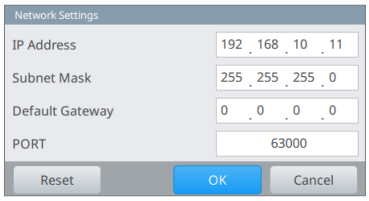
3 Press [Sensor Advanced].



4 Select the [Device Settings] tab and press [Settings] of [Network Settings].



5 Confirm the IP address of the sensor.



- When the IP address of the sensor is to be changed, set an arbitrary IP address and press [OK].
- Confirm that the IP addresses of the sensor/PC/other network device do not coincide with each other. Also, confirm that the subnet mask and default gateway are correctly set.
- When [Reset] is pressed, the setup values for the [IP Address], [Subnet Mask], and [Default Gateway] will be reset and [Not Set] will be displayed. [PORT] will be 63000.

6 Press [OK] and exit from the network settings.

7 Exit IV Smart Navigator.

8 Turn OFF the sensor power, and turn it ON again.

9 Start IV Smart Navigator, and connect IV Smart Navigator to the sensor.

If the device could be connected to the sensor

The run screen opens.

If the IV Smart Navigator cannot be connected with the sensor

The sensor setup menu screen opens. Set the connection method and connect to the sensor.

“Remedy when the Software cannot be Connected with the Sensor” (page A-18)

Checking the router settings

When a router is used, confirm that the following port is opened.

Sensor: 63000 (default value)

Reference

For the setting methods of the sensor port number, refer to the following.

“Network Settings” (page 7-10)

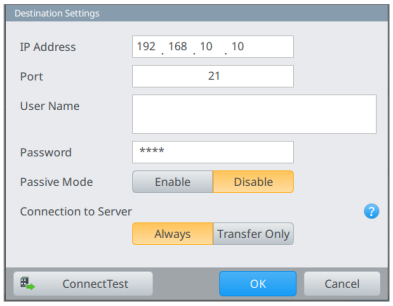
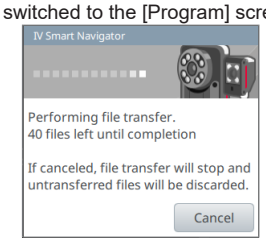
- The FTP/SFTP port number can be changed on the server. It is generally 20 and 21 for the FTP port, and 22 for the SFTP port.
- Confirm the firewall software on the PC whether the port is available or not.

Checking the firewall settings

- If the Windows Security Alert dialog box opens and the IV Smart Navigator is blocked by the Windows firewall, press [Allow access].
- Confirm that the application or port to be used are enabled in the firewall software of the PC. To allow the port number to be used, refer to “Checking the router settings” (page A-23).

A

Remedy when data transfer via FTP/SFTP is unavailable

Status	Remedy
Error (072) FTP Connection Error	• Confirm the IP address of the FTP/SFTP server and set it correctly. • Confirm the port number of the FTP/SFTP server and set it correctly. • Moreover, confirm the firewall software on the PC whether the port is available or not. • Confirm the user name for logging in to the FTP/SFTP server and set it correctly. • Confirm the password for logging in to the FTP/SFTP server and set it correctly.  “Setting the Connection Destination” (page 9-3)
Error (071) FTP Transfer Error (Transfer Failed)	• Check whether the FTP server has space available. • Authorization for accessing the transfer destination folder is not granted. Acquire the access authorization of the transfer destination folder and perform the operation again. • Confirm that there is no file with the same name as the transfer destination folder name which has been set. If a file with the same name exists, change the file name or change the transfer destination folder. “Transfer Destination Folder” (page 9-6) • When the PC was switched from the [Run] screen to the [Program] screen, the screen is switched to the [Program] screen after the transfer of data has finished.  Pressing [Cancel] during transfer will forcibly finish the transfer.
Error (070) FTP Transfer Error (Insufficient Data Buffer)	• Change the trigger cycle of the sensor. “Trigger Options” (page 4-7) • Confirm the stress status of the network.
Error (473) No server found.	• Confirm the IP address of the SFTP server and set it correctly. • Confirm the port number of the SFTP server and set it correctly. • Moreover, confirm the firewall software on the server whether the port is available or not. • Confirm the user name for logging in to the SFTP server and set it correctly. • Confirm the password for logging in to the SFTP server and set it correctly.
Error (474) It does not match the server settings. Review those settings as well as other related settings. (Key exchange algorithm)	Review the SFTP server setting of the key exchange algorithm (KexAlgorithms).
Error (475) It does not match the server settings. Review those settings as well as other related settings. (Host key algorithm)	Review the SFTP server setting of the host key algorithm (HostKeyAlgorithms).
Error (476) It does not match the server settings. Review those settings as well as other related settings. (Cryptographic algorithm)	Review the SFTP server setting of the cryptographic algorithm (Ciphers).
Error (477) It does not match the server settings. Review those settings as well as other related settings. (MAC algorithm)	Review the SFTP server settings of the MAC algorithm (Macs).

Initializing the Network Settings (IP Reset Switch)

The network settings such as the IP addresses of the sensor and the devices connected to the sensor such as a communication unit IV4-CU1/IV4-GCU1 ("communication unit", hereafter) can be initialized to the factory default by means of the IP reset switch of the sensor. In addition, a fixed IP address can be assigned.

Point

- **The IP reset switch is used when joining a sensor used in another network to a new network, or when trouble occurs during connection.**
- **Do not initialize the correctly connected sensor and communication unit. The connection will be interrupted.**

Settings after initialization

The factory default settings

The settings are initialized to the factory default. Normally, the initialization to the factory default will be performed.

Setting Items	Settings after initialization
Communication speed	Sensor: 1000/100 Mbps Automatically switched Communication unit: 100 Mbps *3
IP address setting method	UDP (User Datagram Protocol)
IP Address	0.0.0.0*1, *2
Subnet Mask	0.0.0.0*2
Default Gateway	0.0.0.0*2

*1 Do not assign an IP address except through the IV Smart Navigator.
*2 In the Network Settings screen, [Not Set] is displayed.
“Network Settings” (page 7-10)
*3 Fixed to 100 Mbps for the communication unit.

Fixed IP address

Assigns the fixed IP address to the sensor. This is used when the sensor amplifier or the communication unit cannot be searched because the factory default settings are blocked by firewalls, etc.

Setting Items	Settings after initialization
Communication speed	Sensor: 1000/100 Mbps Automatically switched Communication unit: 100 Mbps
IP Address	Sensor: 192.168.10.10 Communication unit: 192.168.1.50
Subnet Mask	255.255.255.0
Default Gateway	0.0.0.0

Point

- **Set an IP address of the PC to be connected (IV Smart Navigator) to the IP address of the same network. (e.g., 192.168.10.1)**
- **To assign an arbitrary IP address, perform initialization with the fixed IP address (192.168.10.10), connect the IV Smart Navigator, and then change it to a desired IP address.**

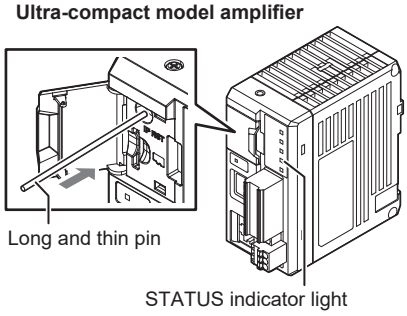
“Network Settings” (page 7-10)

- Do not connect multiple sensor amplifiers or communication units to the same network and initialize them at the same time. IP address overlapping will occur.
- Confirm that no device with IP address 192.168.10.10 is connected to the same network. IP address overlapping will occur.

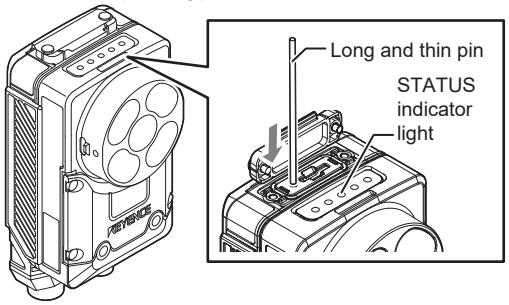
Initializing the network settings

1 Insert a long and thin pin (1 to 2 mm in diameter) and press the IP reset switch for about 3 seconds with the power on.

Ultra-compact model amplifier



Built-in amplifier type



The factory default settings

Press the switch for about 3 seconds. The STATUS indicator light will blink twice (orange) and then turn off. The settings are initialized to the factory default.

Fixed IP address

Press the switch for about 10 seconds. Continue to press and hold the switch even after the factory settings have been initialized after about 3 seconds. After about 10 seconds, the STATUS indicator light will blink twice in orange and then blink in green. A fixed IP address (192.168.10.10) is assigned to the sensor. (If a communication unit is connected, 192.168.1.50 is assigned to it.)

A

Functional differences when an IV3-Series sensor is connected

When IV Smart Navigator is connected to an IV3 Series sensor, some functions are adjusted to the IV3 Series.
The following are functional differences when an IV3 Series sensor is connected.

Operation from the Menu Bar

Relevant function	Difference	Ref.
[View] Menu	[AI Trigger] is not displayed.	7-31

Statistics displayed on the [Run] screen

Relevant function	Difference	Ref.
Statistical Information	[StERR] is not displayed.	5-7

[Sensor Setup] in the [Program] screen

Relevant function	Difference	Ref.
Select Mode	[AI Through Count Mode] is not displayed.	4-2
Step 1. Image Optimization	• [AI Trigger] is not displayed in [Trigger Options] • [Line Settings] is not displayed.	4-6
Step 1. Extended Functions for Image Optimization	• [Image Correction] and [Trapezoidal Shape Correction] are not displayed in [Mirror Inversion Correction]. • [High-Speed Capture] is not displayed.	4-13
Step 2. Master Registration	In [Standard Mode], the screen for registering the image adjusted in Step 1 as the master image is not displayed.	4-13
Step 3. Tool Settings	• The following tools are not displayed: AI Identify, AI Count, and AI OCR. • The OCR tool can be added.	4-20
	In the setting of [AI Differentiate], [Test Run/Additional Learning] and [Register from Live history] are not displayed.	4-26
Step 4. Output Assignment	• The following are not displayed in [Output Assignment]. Trigger Ready, Strobe, Transfer file, SD card error, Insufficient SD capacity, AI Trigger Output, Logic 5 to 8 • [I/O Mapping] can be configured. • [Trigger Error] can only be set to [Enable] or [Disable].	4-88
Step 4. Extended Functions for the Output Assignment	[Logic 5 to 8] is not displayed in [Total Status Conditions].	4-90

[Running Image History] screen

Relevant function	Difference	Ref.
Filter Settings	[Filter Settings 2] and [Target Program] are not displayed.	5-15
Logging Settings	[Logging Settings 2] is not displayed.	5-18

[Learned image history] screen

Relevant function	Difference	Ref.
Filter Settings	The image type (All / Additional learning image / Not learned) is not displayed in the upper left corner of the screen.	6-8
Save All Images	[Save Filtered images individually] is not displayed.	6-8
Thumbnail images	Date of learning is not displayed in the lower-right corner.	6-8

[Settings Transfer/Backup] screen

Relevant function	Difference	Ref.
[SD Card] tab	Slot cover open/close detection] is displayed.	7-9

[Sensor Advanced] screen

Relevant function	Difference	Ref.
Sensor Information	[Sensor Internal Temperature], [License Information], and [Comm. Unit Version:] are not displayed.	7-12
[Device Settings] tab	[LED Lighting Settings] is not displayed.	7-12
[I/O Settings] tab	In input setting, [Internal Trigger Control] is displayed instead of [Internal Trigger Control/ AI Trigger Control].	7-13
	The following are not displayed in [Output Settings]: • [Strobe Output] and [AI Trigger Output] of [Normal/Sorting Mode]. • [AI Through Count Mode]	7-15
[Utility] tab	[Nonprocedural Communication Settings], [SNMP Settings], [Reset Statistics/Histogram], and [MK/FP Comm Settings] are not displayed.	7-17
	When [Output Destination] is set to [FTP] or [SFTP] in [Image/Result Output], [Connection to Server] is not displayed in the setting of [IP Address].	9-2
	• In [Transfer Conditions] of [Image/Result Output], [Judgment Complete] is not displayed as transfer condition 1. • In [Transfer Conditions] of [Image/Result Output], [near threshold OK] is not displayed as transfer condition 2.	8-13 9-5
	[Nonprocedural command] is displayed in [Protocol] of [FieldNet/Comm. Unit (DL)].	9-13
[Comm. Unit Set. (CU/GCU)] tab	Buttons cannot be selected.	7-24

Revision history

Revision history	Edition number	Revision details
May 2024	2nd edition	• Screen capture function is added. • English / Simplified Chinese are added as supported languages.
August 2024	Revised 1st edition	• Supports communication units (IV4-CU1/GCU1). • Provides additional support for Korean, German, French, Italian, and Spanish. • The Missing Part Detection function is added to the AI Count tool. • The Show Matching Rate tool and Printer Check tool have been added to the AI OCR Tool. • Supports connection from IV4-CP70 (IV4-CP70 mode), IV4-DU10 (IV4-CP70 mode), and IV Smart Navigator to the IV3 series.
December 2024	2nd revision 1st edition	Supports the following functions: • [Mask] of [Search Range] of AI Identify and AI Count • Function for accessing the mirco SD card in the sensor from the IV4-CP70/IV4-DU10/PC software • FTP/SD file name setting function • Operation Information output function • IoT protocol • Security enhancement mode • Communication bypass function of the communication unit (IV4-CU1/GCU1) • Update function when the sensor is connected for the first time Supports the following languages: • Portuguese, Czech, Hungarian, Polish, Thai, and Chinese (Traditional)

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